

Which instrument for which Application

The slide features a red header bar with the text "Séminaire Technique Gratuit". Below it, the location "Buc (78) – le mardi 2 juillet 2019" is listed. The main title "INVITATION" is written in large red letters on the left, with a white arrow pointing from it towards a hand holding a white marker. To the right of the hand is a red rectangular box containing the text "Théorie, pratique et mesure à destination du concepteur d'électronique". At the bottom right of the slide is a blue button labeled "Agenda".

Séminaire Technique Gratuit

Buc (78) – le mardi 2 juillet 2019

INVITATION

Théorie,
pratique et
mesure à
destination du
concepteur
d'électronique

[Agenda](#)

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Introduction of ElectroMagnetic Emission (EMI)

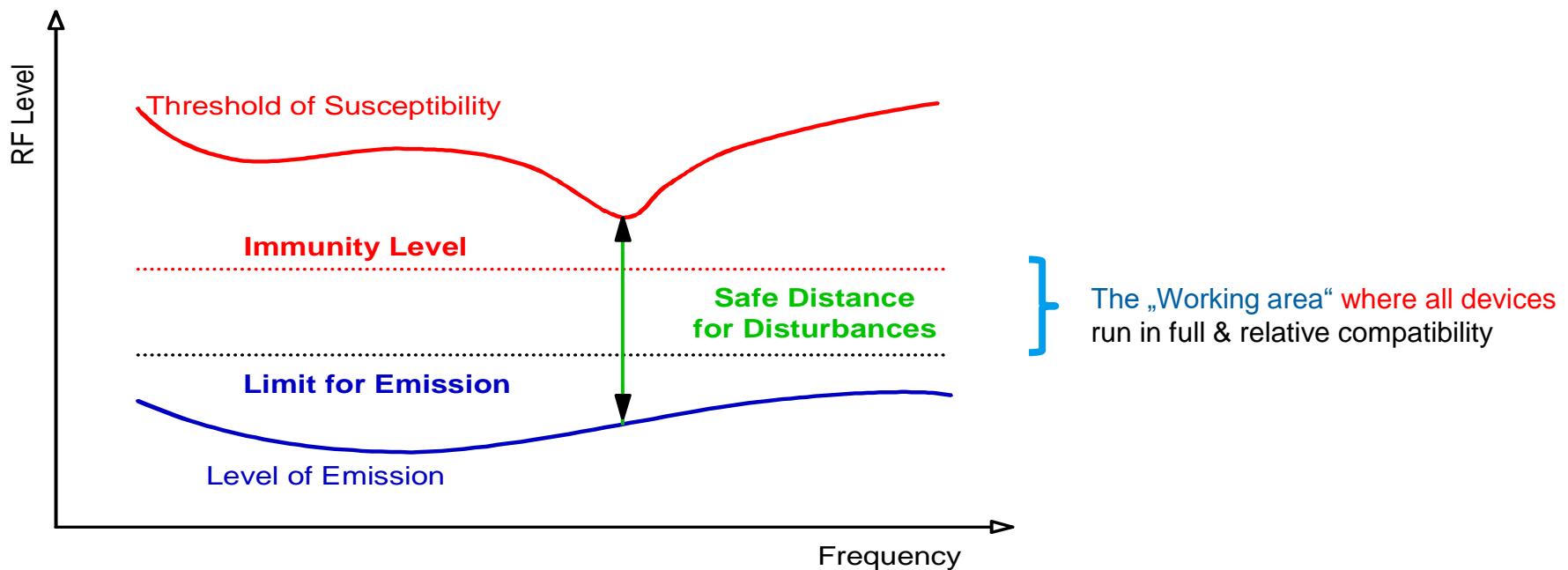


EMI measurement :

consist to measure un-intended emission of the DUT.

Results are compared to limits, defined by standards

Dut with wanted emission are defined as special cases



EMI Regulation & standards

For civil DUT :

- The major standard remains the CISPR16-1-1
- ❖ Giving standards per countries as FCC for the US... and standards per type of DUT as CISPR11 for industry // .14 for house and so on
- ❖ Civil EMI philosophy take care of the RF emissions repetition frequency (QPk)

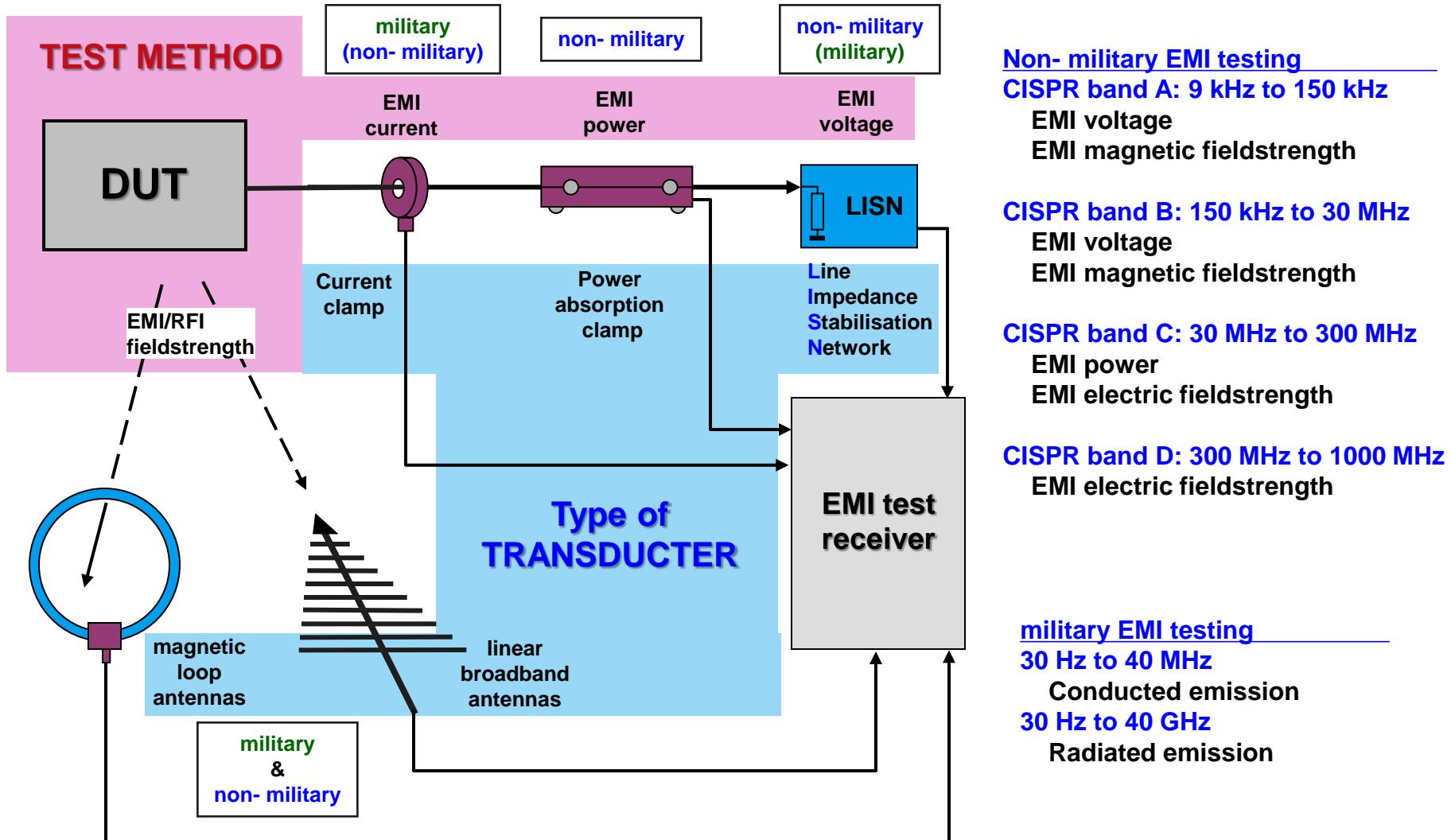
For Military DUT :

- a certain freedom was existing around major standard as MilSTD.
- ❖ Giving special coupled standard as DO & Mil standard (military airplane for ex.)
- ❖ Mil. EMI philosophy take care of RF emisions bandwith (NB/BB discrimination)

 **But the goal of standards is to make test verdict repetitive**

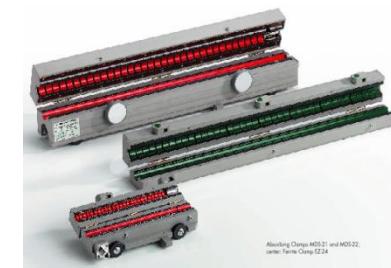
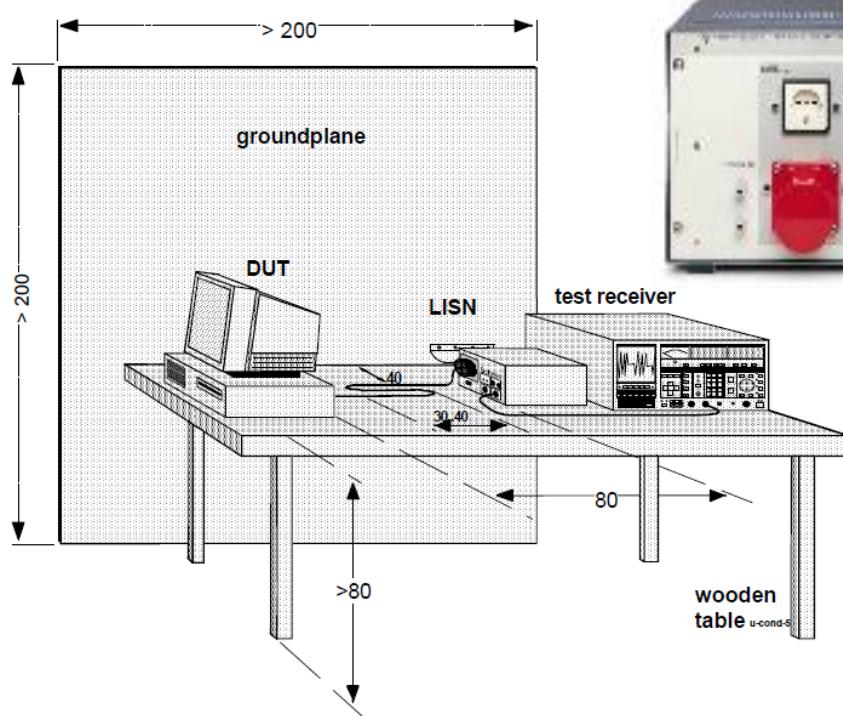
This is important to keep this “in mind „ when discussing **Certification**

Description of standard EMI test setup

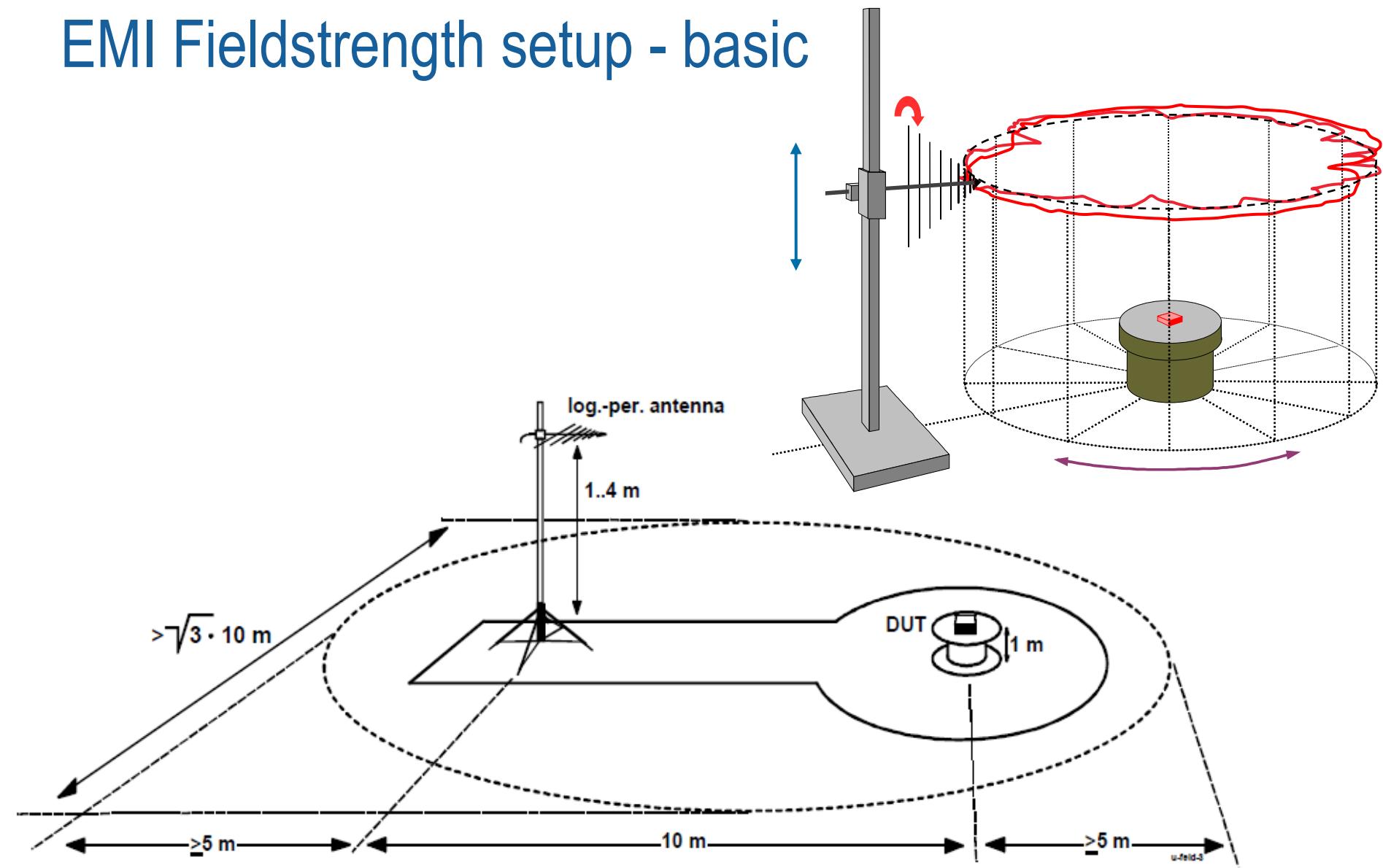


Standard EMI Voltage (as most used Setup)

- measurement of conducted EMI as a voltage referred to PE
- frequency range: (9kHz to)150 kHz to 30 MHz (CISPR band A + B)
- main equipment: test receiver, LISN, ground plane, (artificial hand)
- important for the receiver: pulse protection
- search on different lines

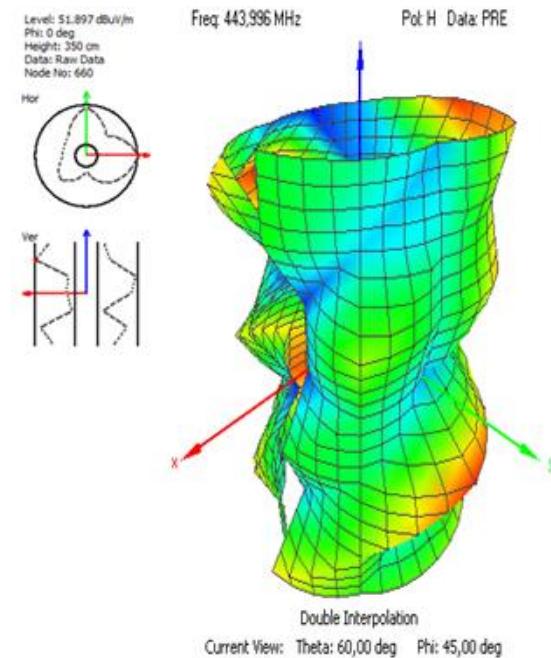


EMI Fieldstrength setup - basic



COMPANY RESTRICTED

EMI Fieldstrength (most in Semi-Anechoic Chamber)

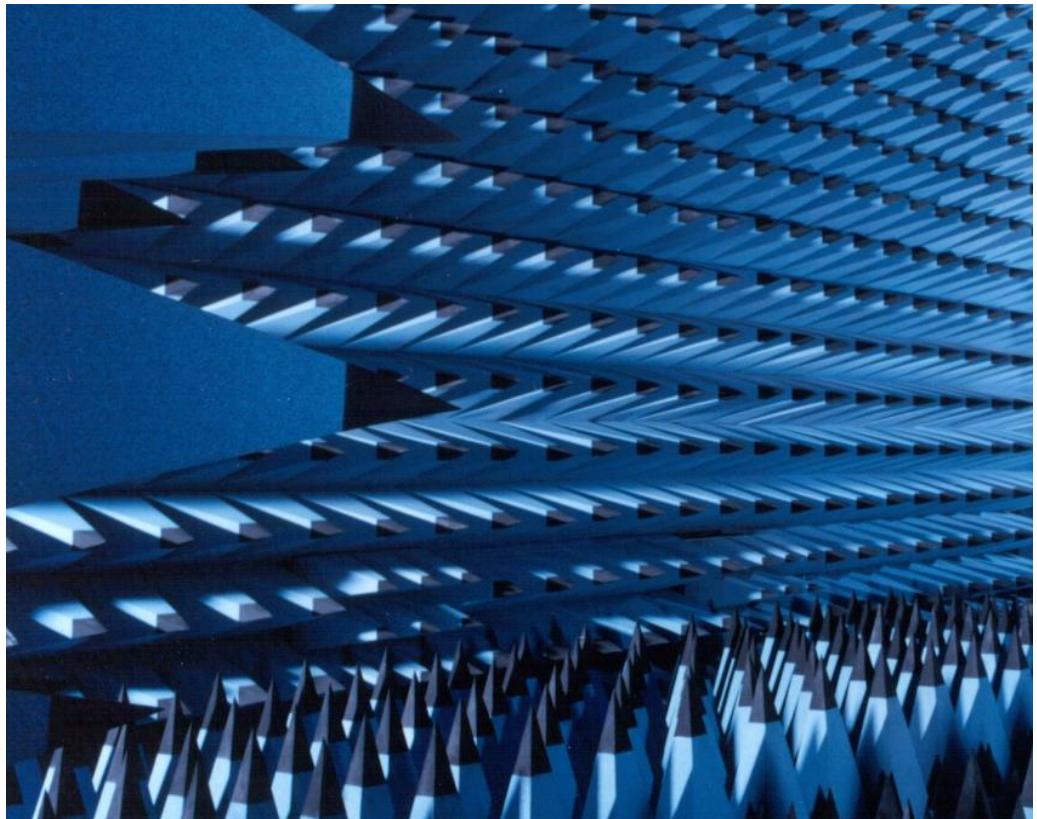


- frequency range: 30 MHz to 1000 MHz (CISPR band C+D) and above
- main equipment: test receiver, linear broadband antennas
- variation of antenna height, polarisation and DUT azimuth for max. result

So question :

When better to use a Receiver or a Spectrum ?

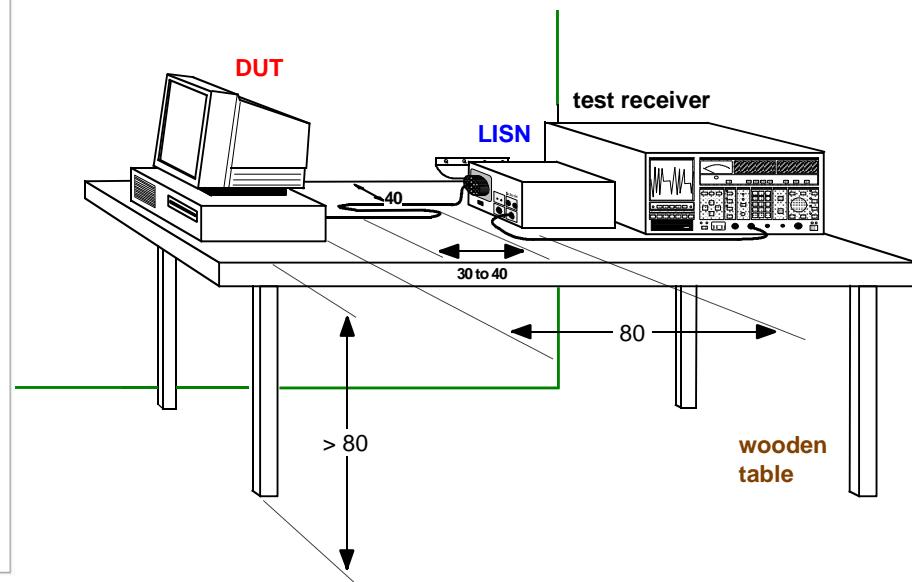
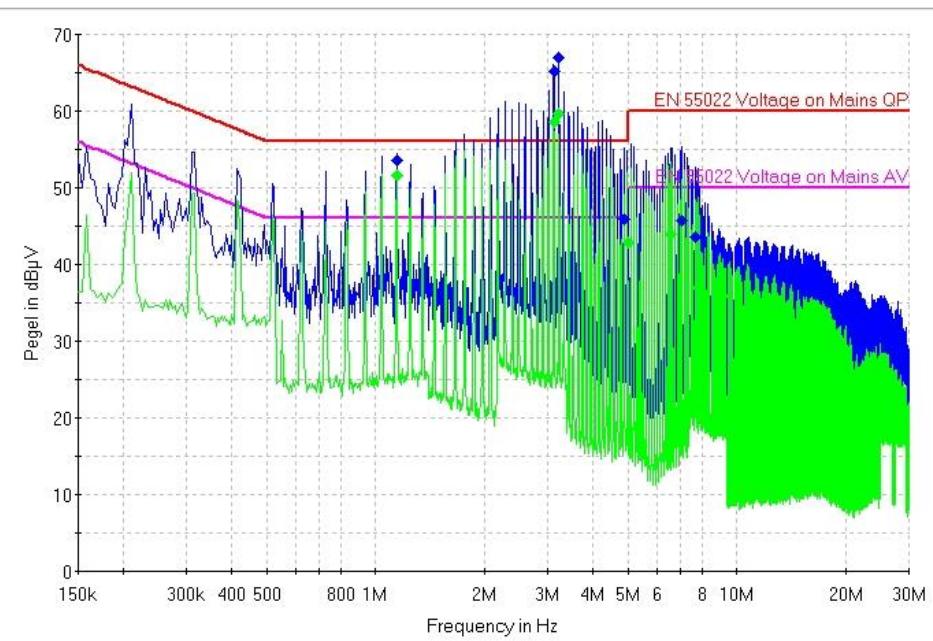
With or without TimeDomain scan ?



CONDUCTED TEST : we recommend receiver...

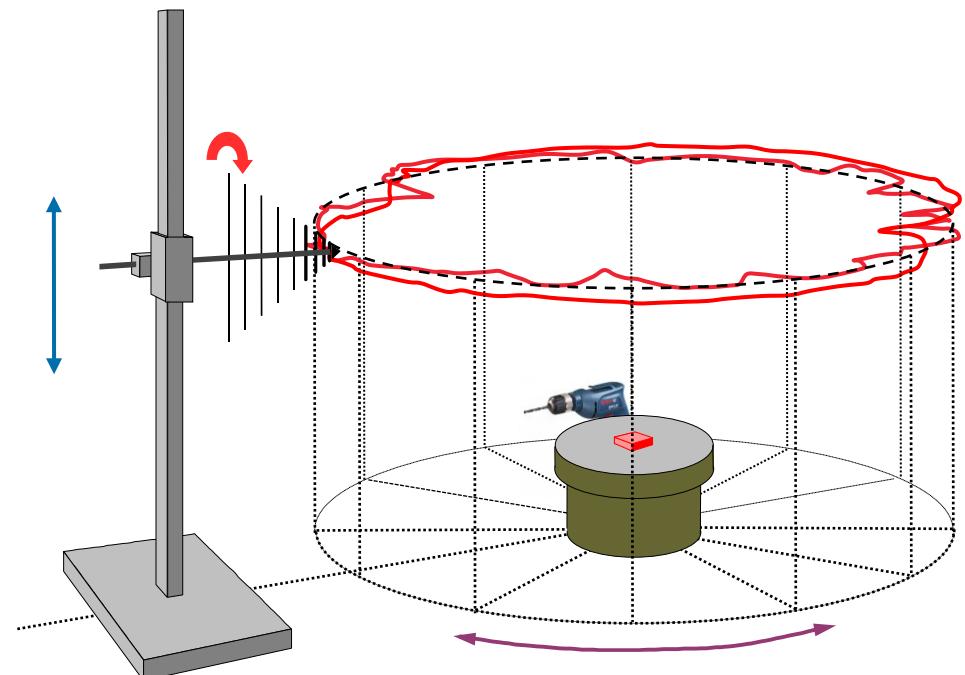
- | **Complex and high Signals** : we are in the hart of DUT...
 - | High Voltage NarrowBand Freq signals with mostly also BroadBand signals
 - | No attenuation between RF input instrument and DUT

- | **Preselector and Atten. autoranging** : the only way to measure...
 - | If not, then compression or saturation will affect results measurement



RADIATED TEST on none RF transmitting DUT

- | **Spectrum can be used (as receiver) for certification because...**
 - | Low RF signal on the input
 - | Big attenuation due to antenna factor and cables loss
- | **Preselector and Atten. autoranging :** not always mandatory
 - | What is important remains dynamic available on the detectors.



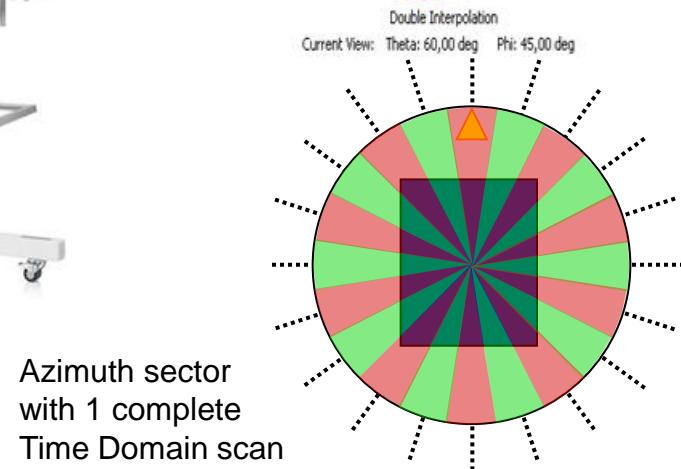
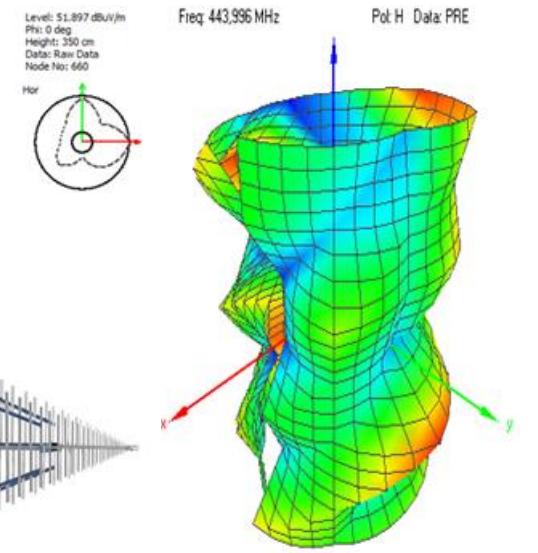
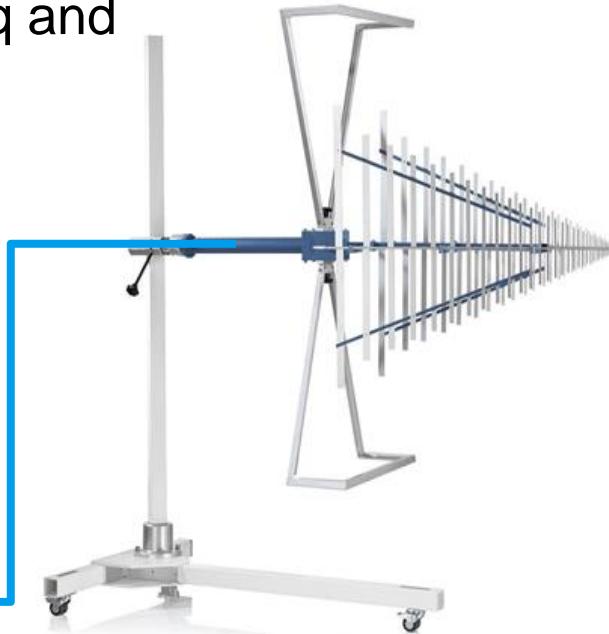
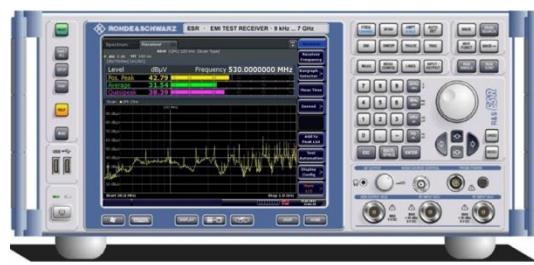
Expert RADIATED TEST with spatial DUT graphics

(Turn Table and Antenna Mast for Maxima search)

I For maxima search positionning

We suggest TD Scan meas. with more speed, more data per critical freq and better representation...

for less time...than before !



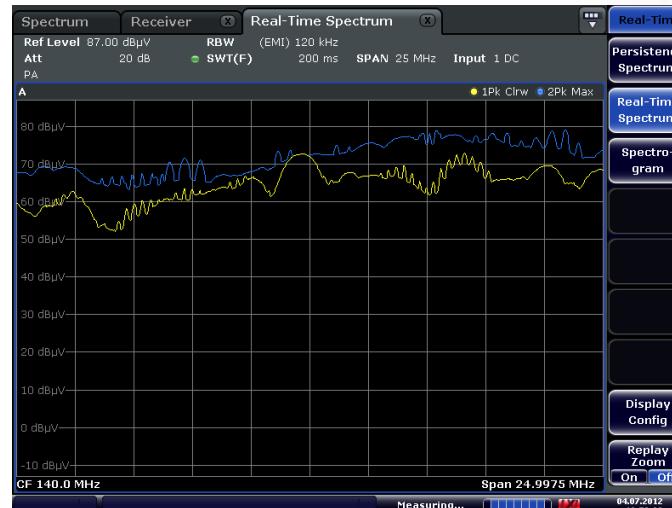
Expert RADIATED TEST with EMI analysis

(BB / NB on the easiest way)



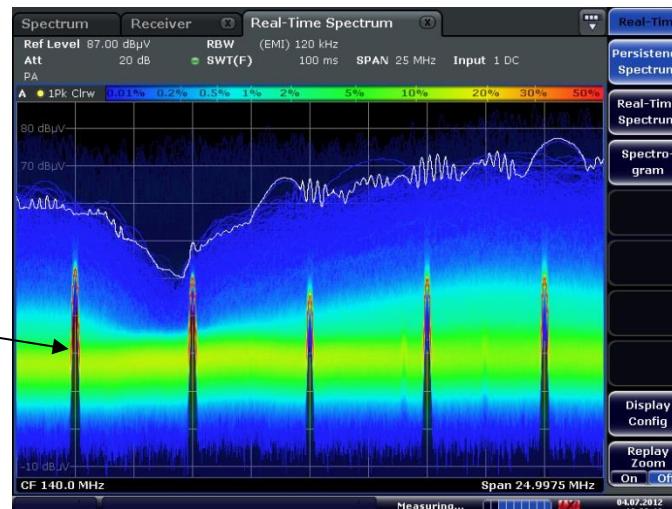
I Classic Spectrum

only showing max amplitude
which of course is the most
important, but...



I Persistance view remains

Valuable aid for signal
identification
(discriminate NB from BB signals
which can be mixed)

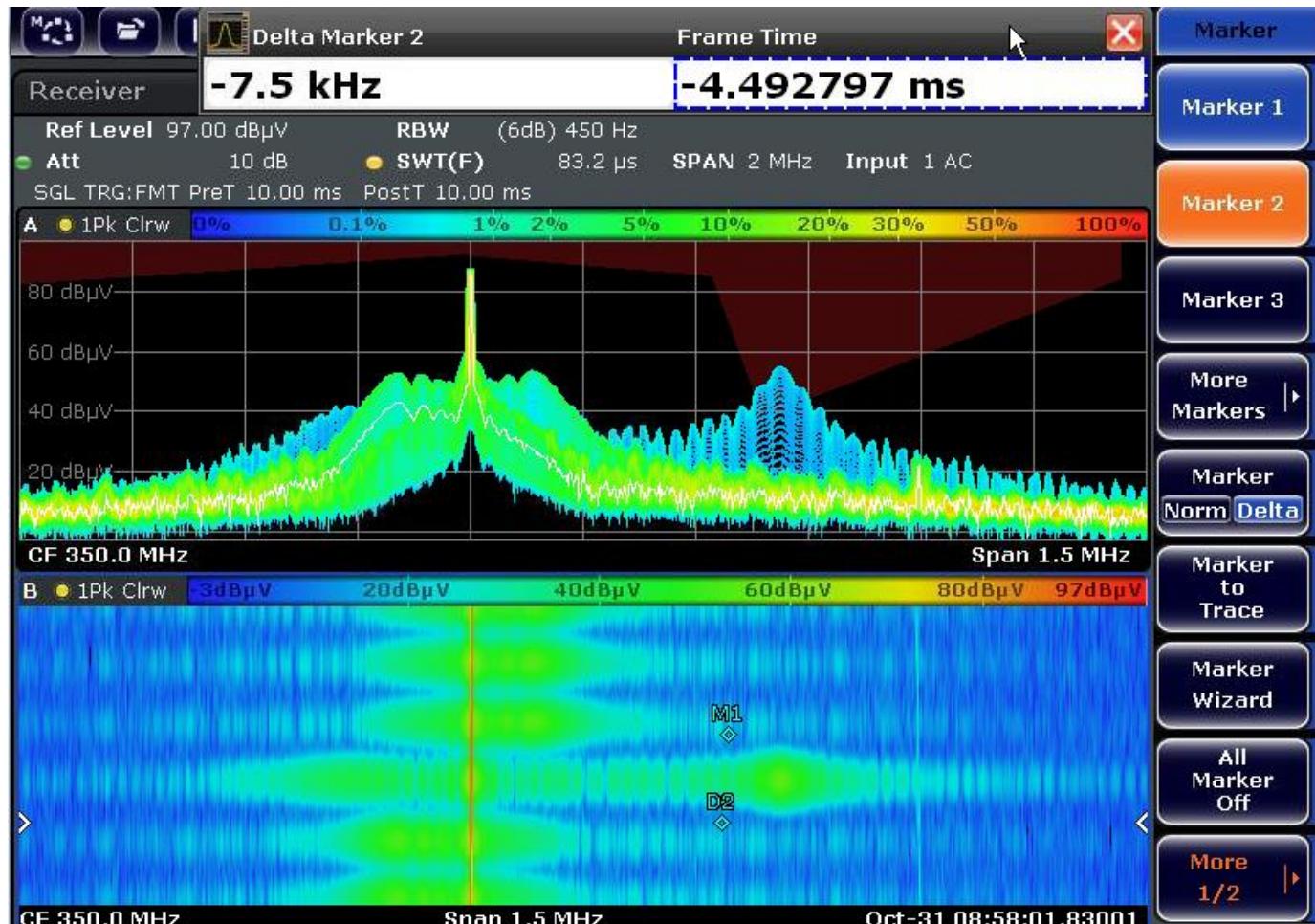


RADIATED TEST with EMI analysis (Frequency Trigger Mask)



I Limit lines

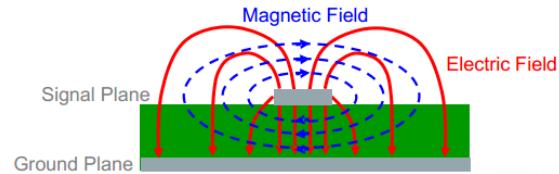
any shape mask can be edited as “Freq./ Amp” points



I Trig event

Store Events in spectrum which exceed the mask (TRG on violation of the frequency mask)

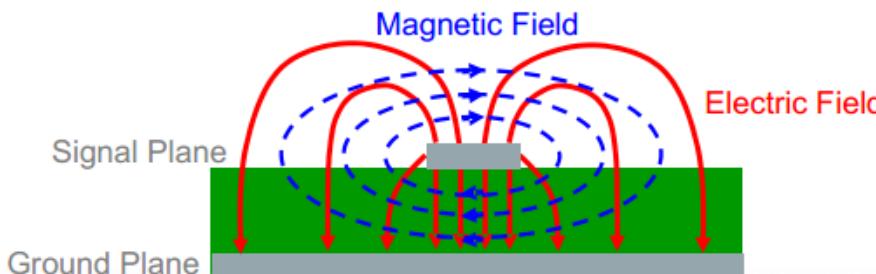
Now for Emi debugging



Introduction to EMI

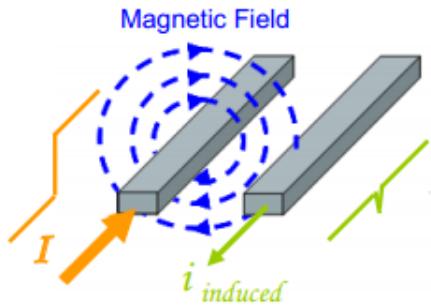
The impact of Electromagnetism

Even on a simple PCB circuit, Magnetic & Electric Field are generated as long as current passes through the conducting medium

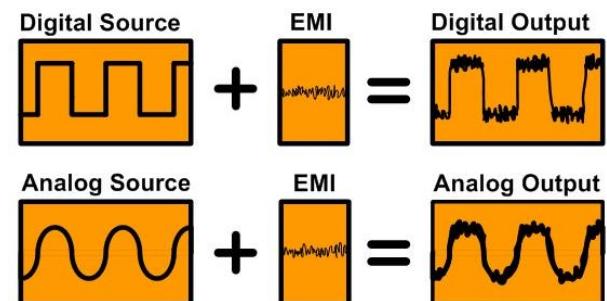
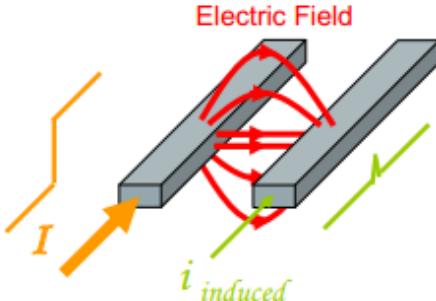


Both the E & H-field will penetrate adjacent conducting medium and induce noise on it

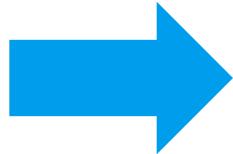
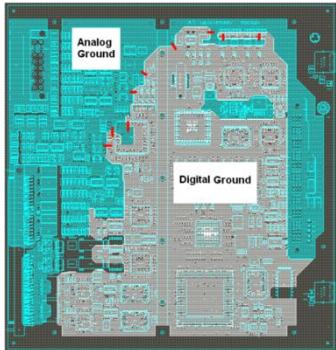
I Mutual Inductance



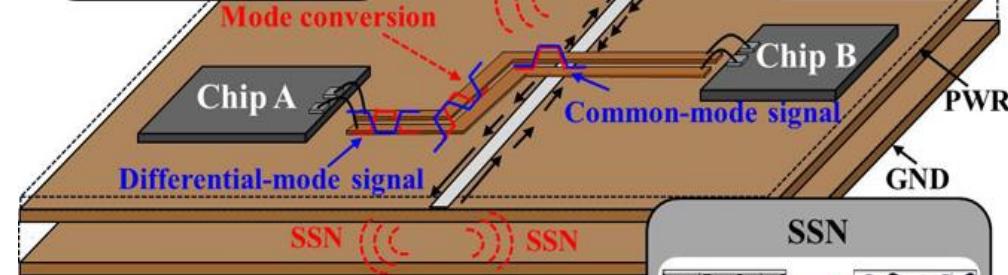
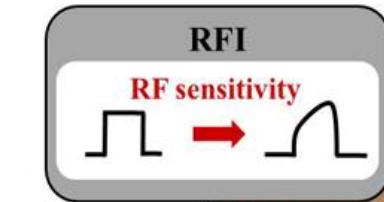
I Mutual Capacitance



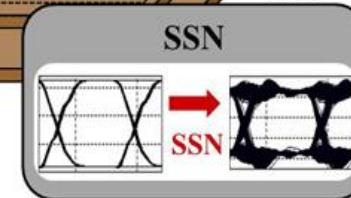
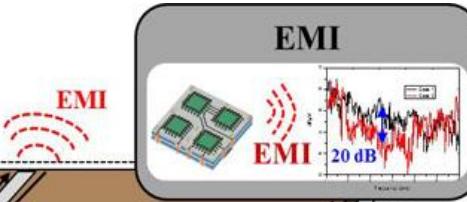
Top Common Causes of EMI Problems



Radio Frequency Interference



Electro-Magnetic Interference



Simultaneous Switching Noise



LCM

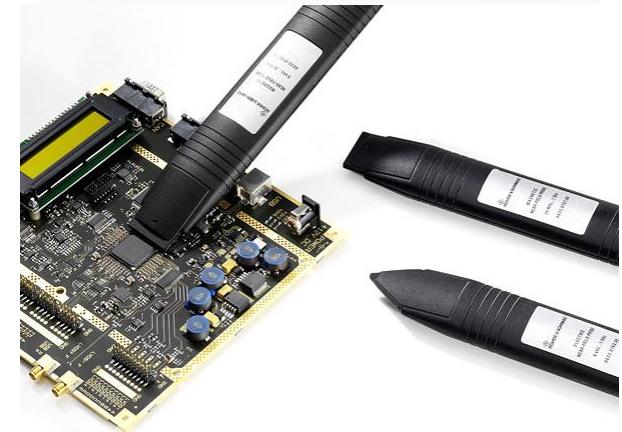


Power Supply

R&S Oscilloscope EMI Debugging Solution

EMI Debugging Set (Up to 4GHz)

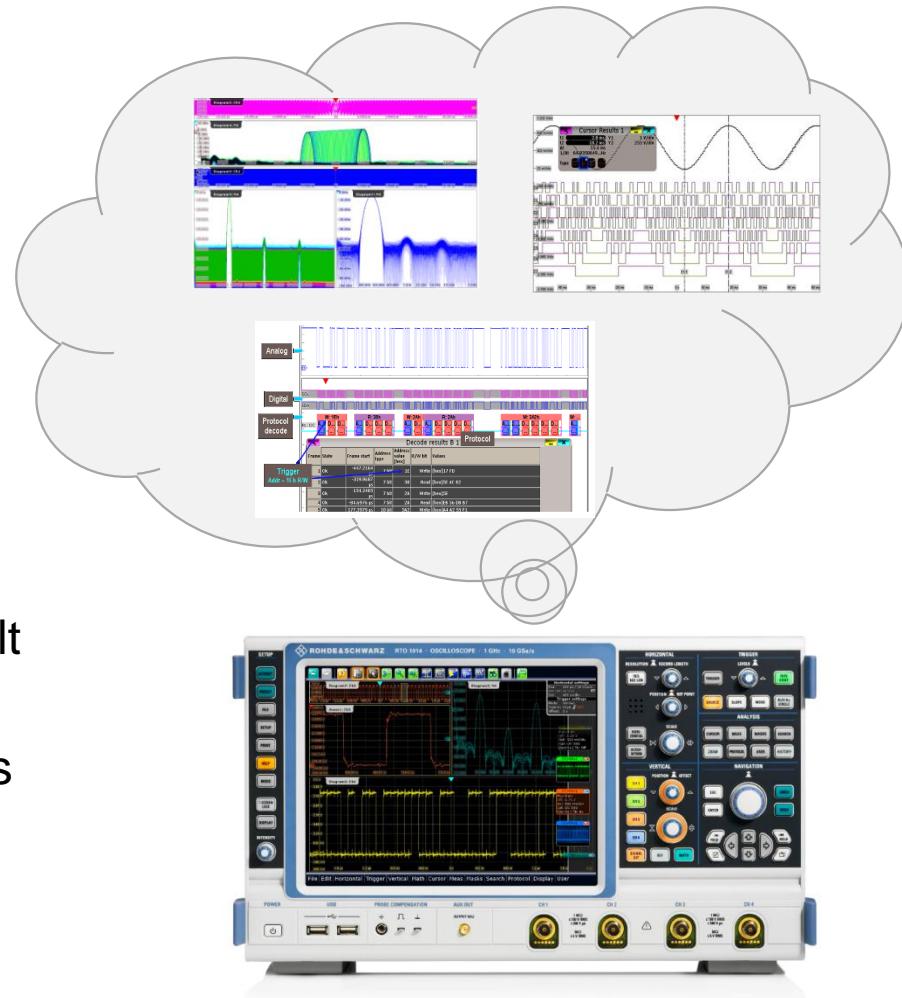
RTO	Oscilloscope
HZ14 9kHz – 1GHz	<ul style="list-style-type: none">•2x H-field probes•E-field probe with built-in preamplifier•Preamplifier for H-field probes•Test jig for H-field probes
HZ15 30MHz – 3GHz	<ul style="list-style-type: none">•3x H-field probes•2x E-field probes
HZ16 (For HZ15)	<ul style="list-style-type: none">•Preamplifier 20dB



EMI Debugging with R&S Oscilloscope

I Most Common Tool for Engineers

- Analog Signals, Digital Bus
- Parallel, Serial Bus Analysis & Decode
- Mix Signal Oscilloscope
- FFT Analysis
- Complex Trigger
- Time Correlated Events



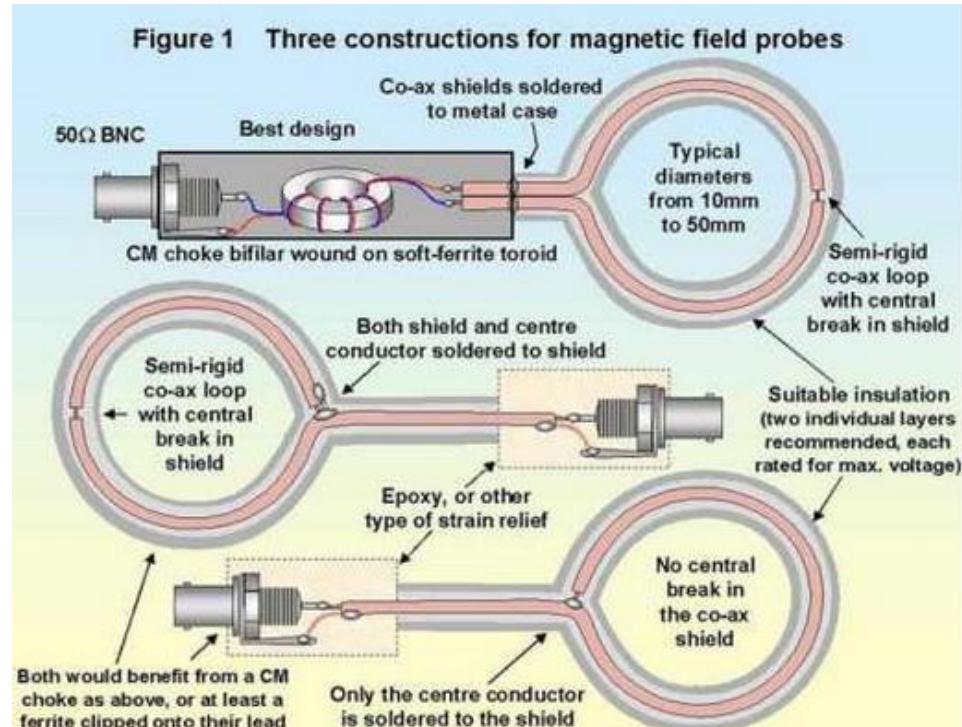
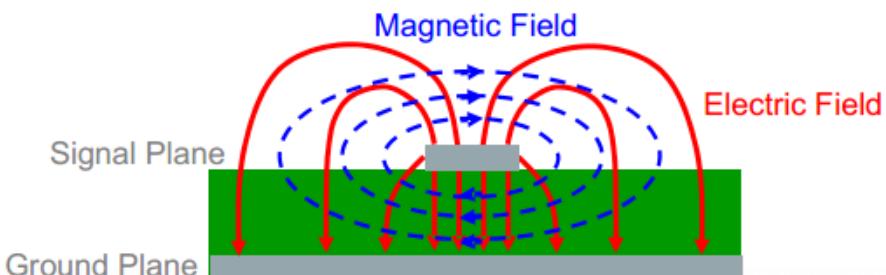
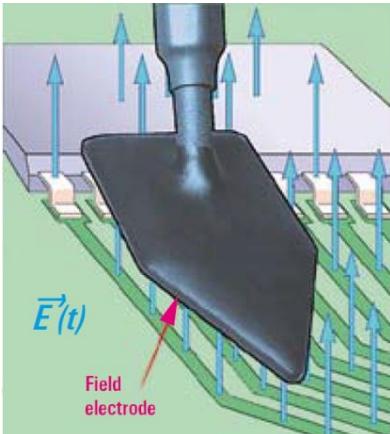
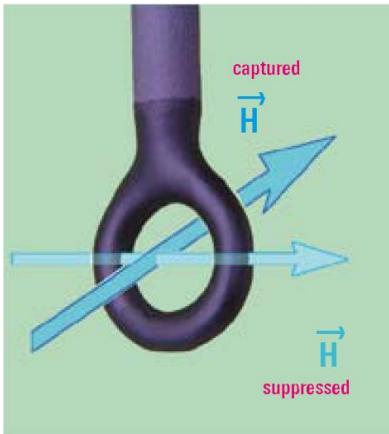
I Concerns

- Slow acquisition missed intermittent fault
- Limited Dynamic Range
- No correlation to Time Domain Captures
- Spectrum cannot be used for trigger
- Complicated settings
- EMI Filters, Detectors, and Averaging

EMI Debugging with R&S Oscilloscope

Selecting the right tools – Sniffer Probes

- Basically the probes are antenna that pickup the magnetic & electric field variation
- Depending on the position & orientation, it picks up different reading

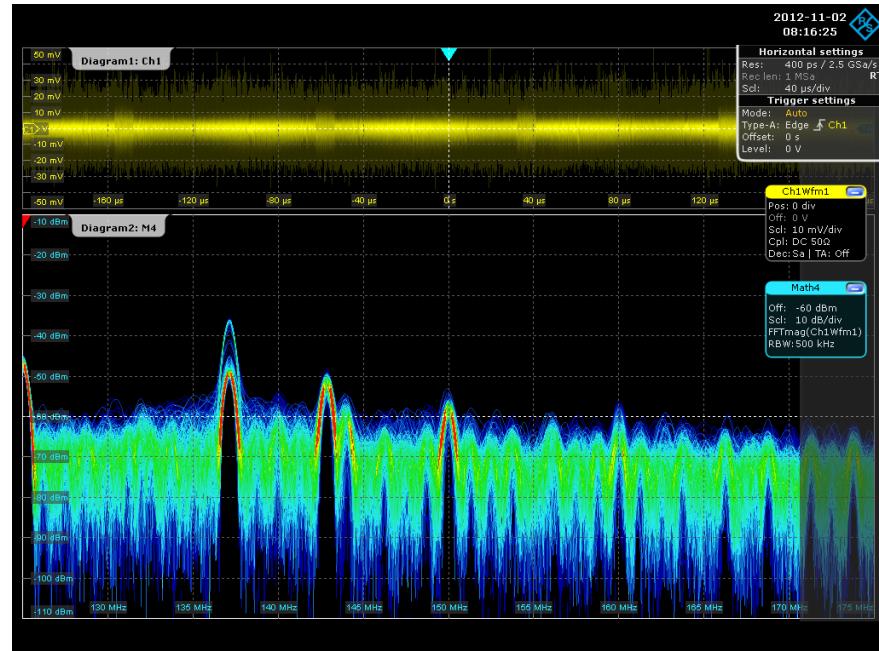
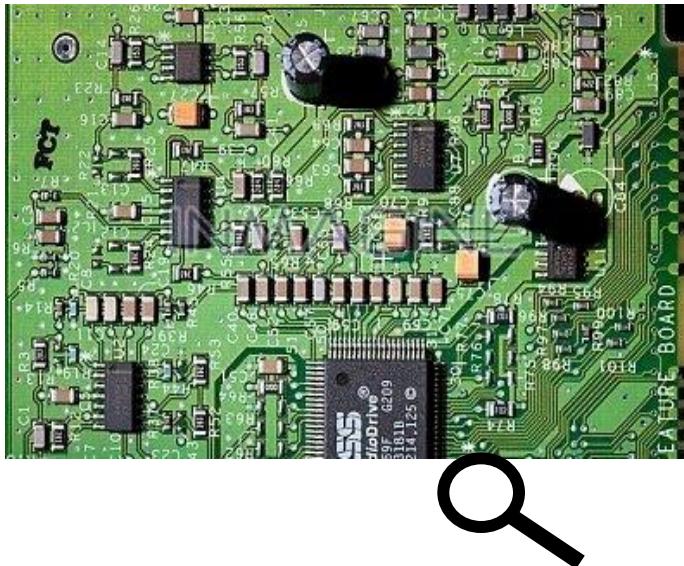


EMI Debugging with R&S Oscilloscope

Locate position of EMI faults

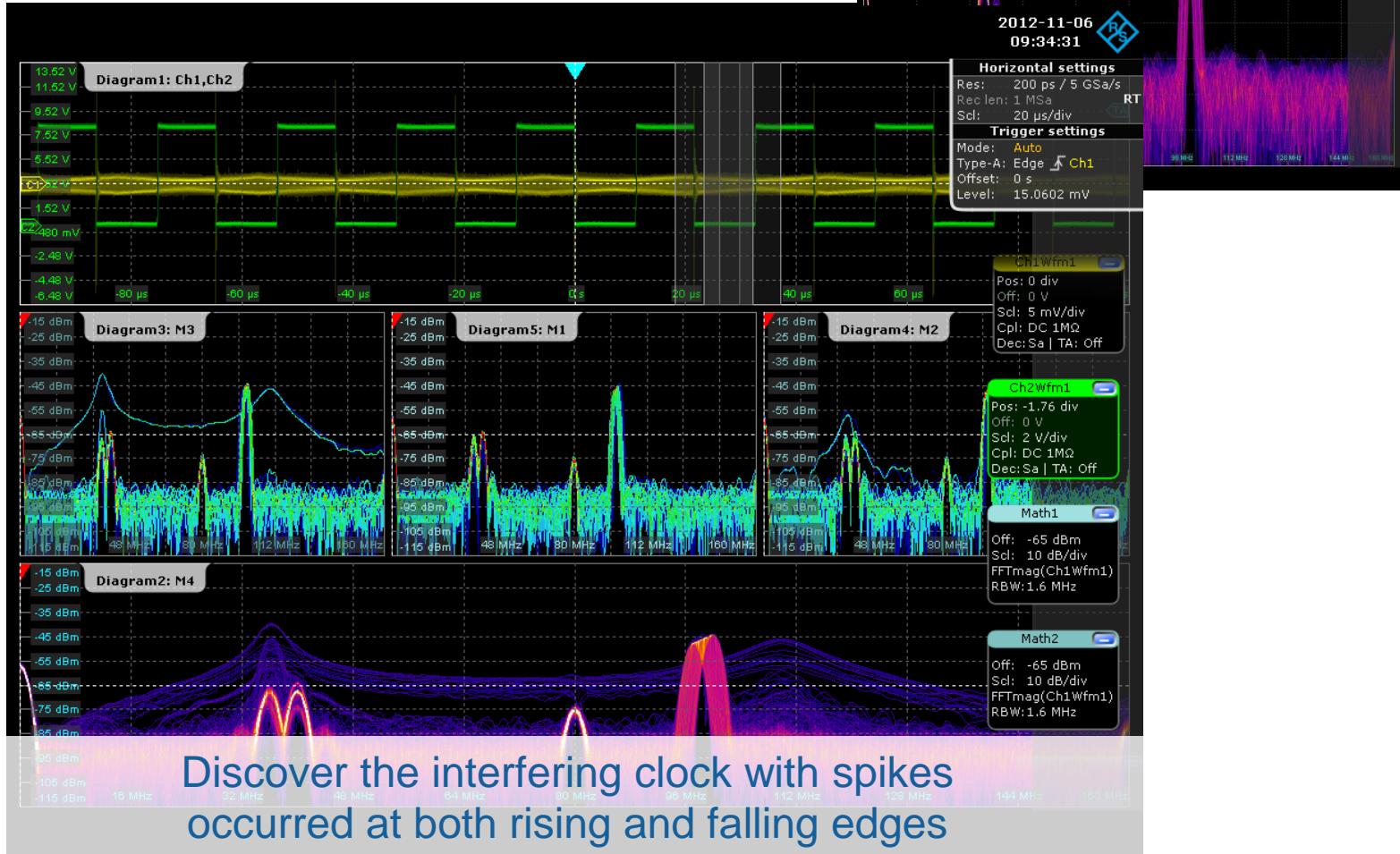
I) General Approach

- Wide Span scan – fundamental of interfering signals are usually lower than 1GHz, a span of <1GHz is sufficient as a start
- Identify abnormal spike or behavior and its location while moving the probe around
- Narrow down to smaller span and RBW, change to smaller probe for better analysis



EMI Practical Diagnosis example

Locating Broadband Noise Source

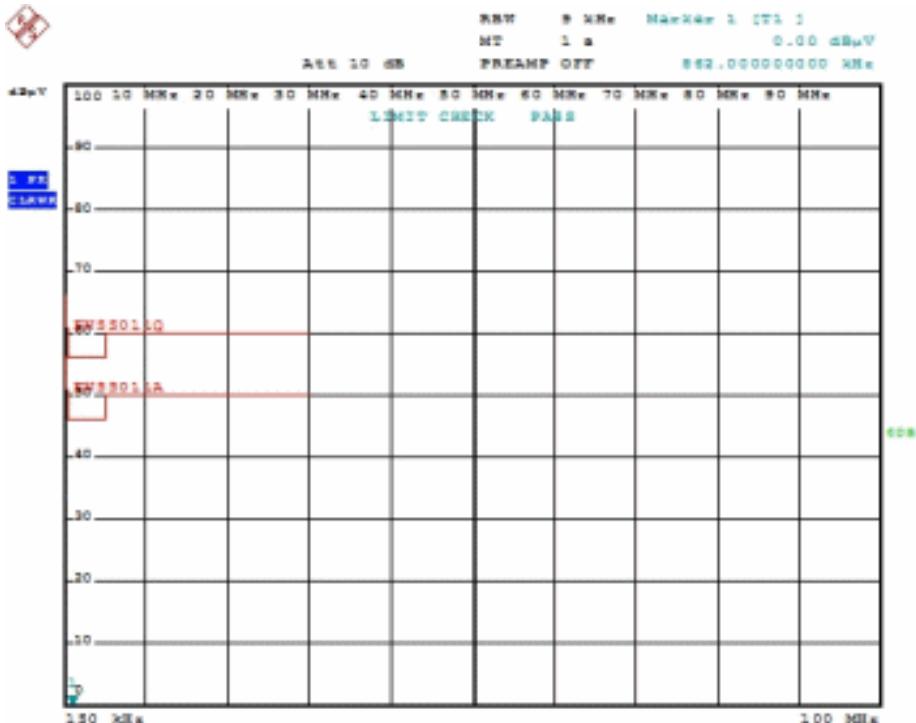


For EMI Debugging with R&S RTO scope

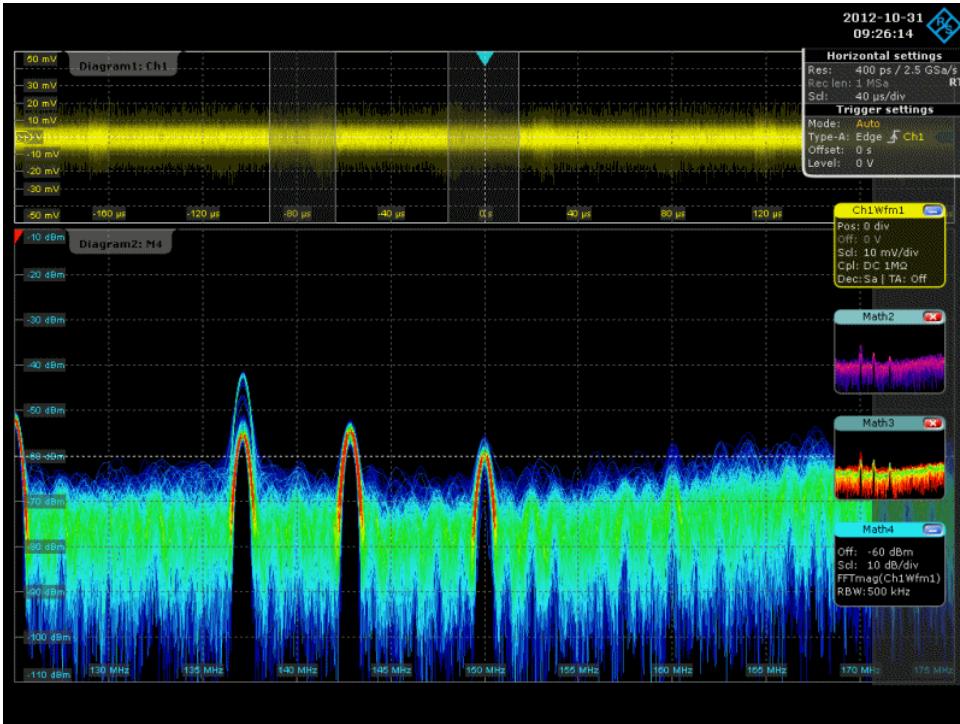


Important consideration #1

Acquisition speed



150 kHz ~ 30MHz is scan at 9 kHz at 1s
Measuring Time (Smallest is 100us)



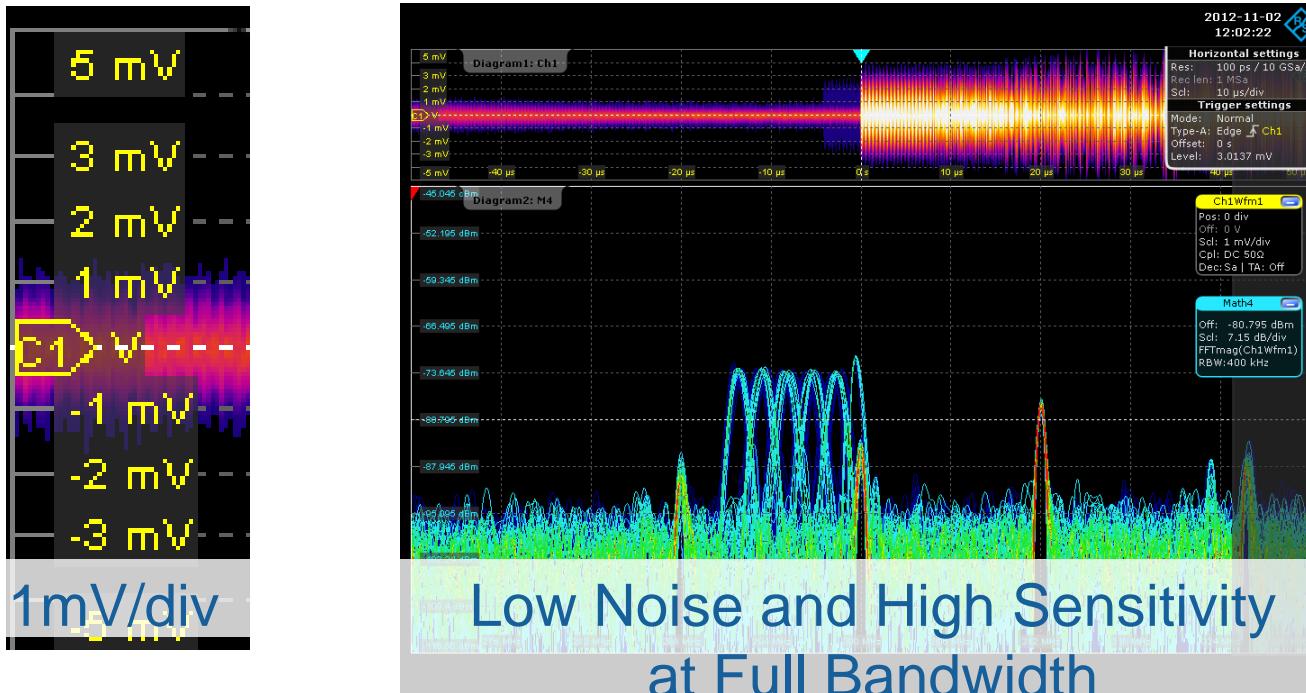
RTO Spectrum Analysis is live and
no sweep involve

EMI Debugging with R&S RTO

★ Important consideration #2

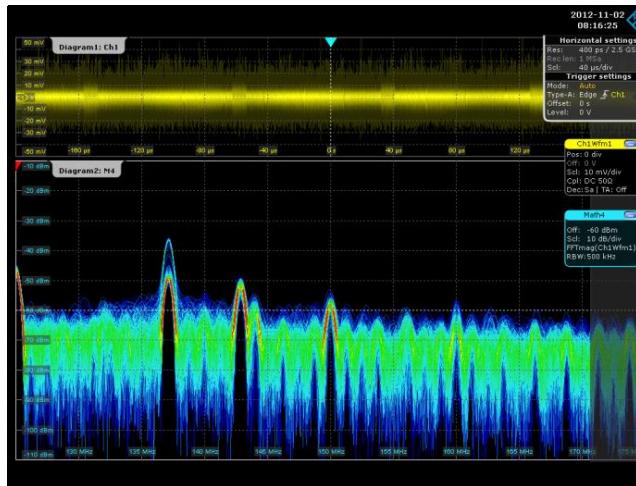
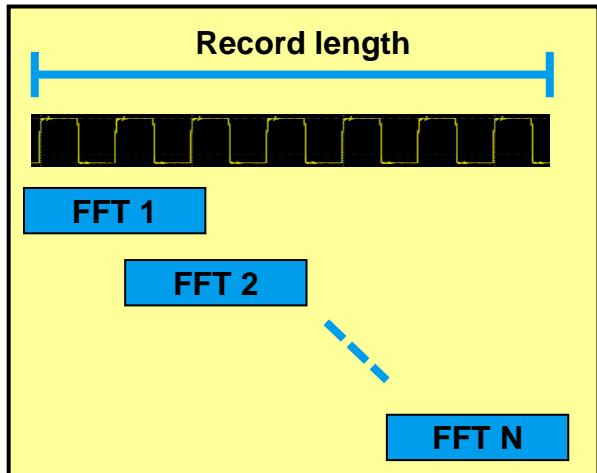
Ability to detect weak Signals

EMI tends to be weak, to detect such signals, oscilloscope need to be able to detect them without limiting the bandwidth

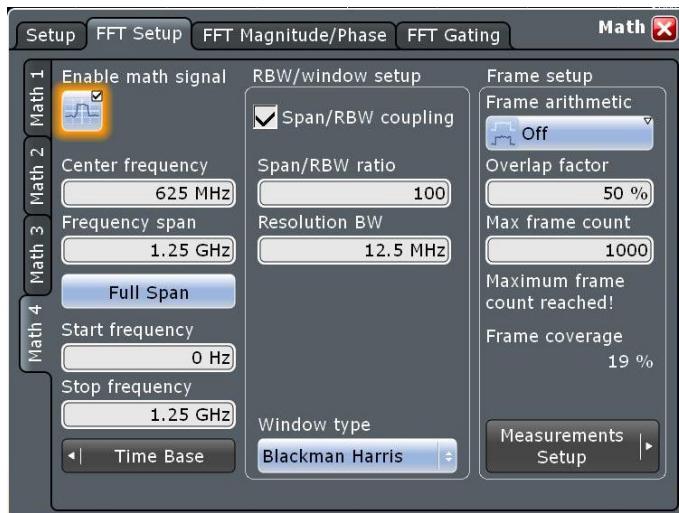


EMI Debugging with R&S RTO

★ Important consideration #3



Record length
=>
FFT Length
↓
~440 FFTs



- The time structure of the signal becomes visible (color coding) by overlapping FFT.
- High sensitivity for short emissions
- (Partly) decoupling of time domain setting parameters from frequency domain setting parameters

EMI Debugging with R&S RTO



and easiest locating Spike with FFT gating





**Thank you
for your attention**

