EMC Test

ROHDE&SCHWARZ

Make ideas real

Agenda

- Introduction to Rohde & Schwarz
  Your reliable EMC Test solution partner
- Introduction Signal Generator/Analyzer
  SG and SA introduction
- Introduction to EMC Testing
  Market trends, Standards, Test systems
- Rohde & Schwarz EMC Test Solutions
  Key products and new releases

EMC Test

Introduction to Rohde & Schwarz

Your reliable partner for EMC Test solutions

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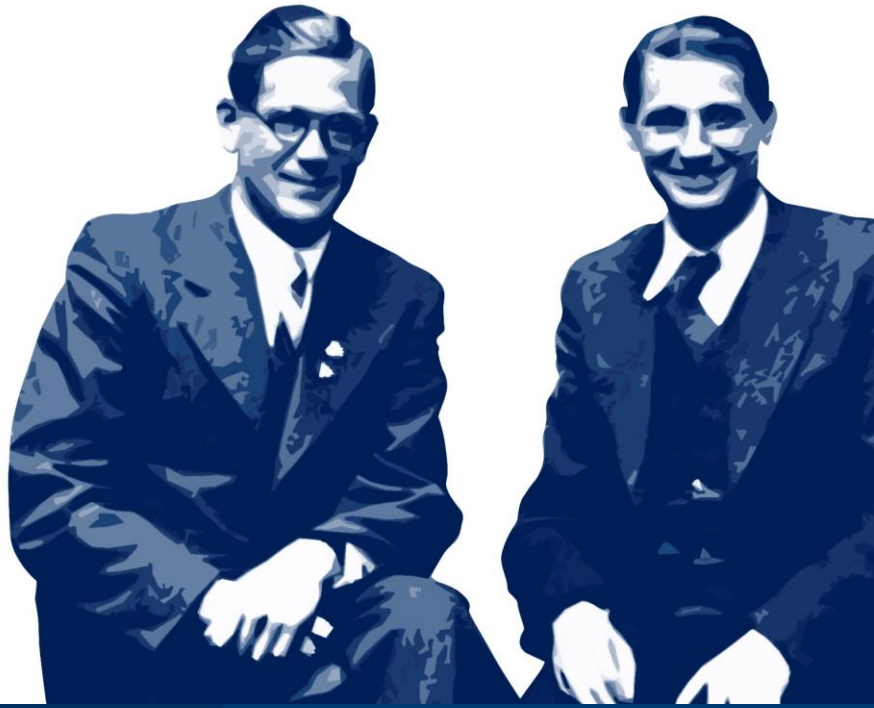
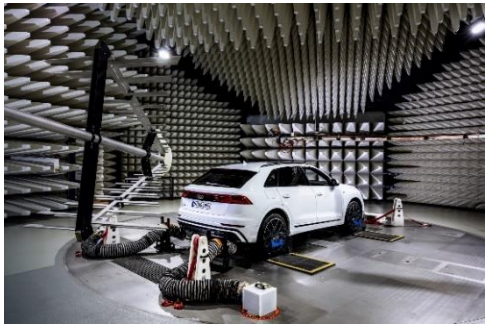
Rohde & Schwarz: Private and Family-Owned Since 1933

- **Founded more than 90 years ago** by university friends Dr. Lothar Rohde and Dr. Hermann Schwarz as "Physikalisch-technisches Entwicklungslabor" ("Physical and Engineering Development Lab")
- Still fully owned by the founding families
- **Independent** of financial and capital markets
- **Long term customer relationship** and support focus
- Since its founding, an **enabler and innovator of a safer and connected world**



Rohde & Schwarz as your reliable EMC Test solution partner

- **Core competency** of Rohde & Schwarz
- **In-house development** of test equipment (instruments) and software
- **Active participation** in standardization committees
- Commercial, industrial, automotive, military, aerospace and wireless applications
- Design, Production, Integration, Delivery, Acceptance, Training, Documentation, Support for full **turnkey systems & custom projects**



Rohde & Schwarz offers the complete portfolio for EMC test

EMI test receivers

EMC test software ELEKTRA, AdVISE

Broadband amplifiers

EMC test systems

EMC accessories

Signal and spectrum analyzers

Oscilloscopes

TEMPEST receiver

Service you can rely on

Onsite calibration
Onsite support and repair
Bridging Devices

Remote Support
ELEKTRA Software Update

Training
Project Management
and much more….

Signal Generator and Spectrum

Introduction SG/SA for Testing

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TYPES OF Signal Generator

- **Analog Signal Generator**
  - Continuous wave (CW) source
  - Basic analog modulation
    - Amplitude Modulation
    - Frequency Modulation
    - Phase Modulation
  - Pulse Modulation
  - Avionics (e.g. VOR, ILS, etc.)

- **Vector Signal Generator**
  - Can create any arbitrary type of digital or analog signal
    - Digital signals (Wi-Fi, LTE, GNSS, etc.)
    - Special signal types (e.g. MCCW)
    - Arbitrary waveform files
  - Impairments and fading

SIGNAL QUALITY

Analog signal generators excel at creating high-quality RF signals

– **Frequency**
- Range
- Accuracy
- Stability
- Setting time

– **Level**
- Range
- Accuracy
- Linearity
- Repeatability
- Setting time

– **Spectral purity**
- Phase noise
- Wideband noise
- Harmonics
- Spurious

R&S Portfolio
General Benefits

► High Compatibility between R&D, Production, & Benchtop Solutions

Same GUI

Same GPIB Commands

SMW

FSW

SGx

FPS

SMBV

FSV / FSVA

High Performance Instruments for **R&D**

Maximized Speed & Reduced Size for **Production**

Cost Effective Instruments for **Benchtop**

EMC Test

Introduction to EMC Testing & Standards

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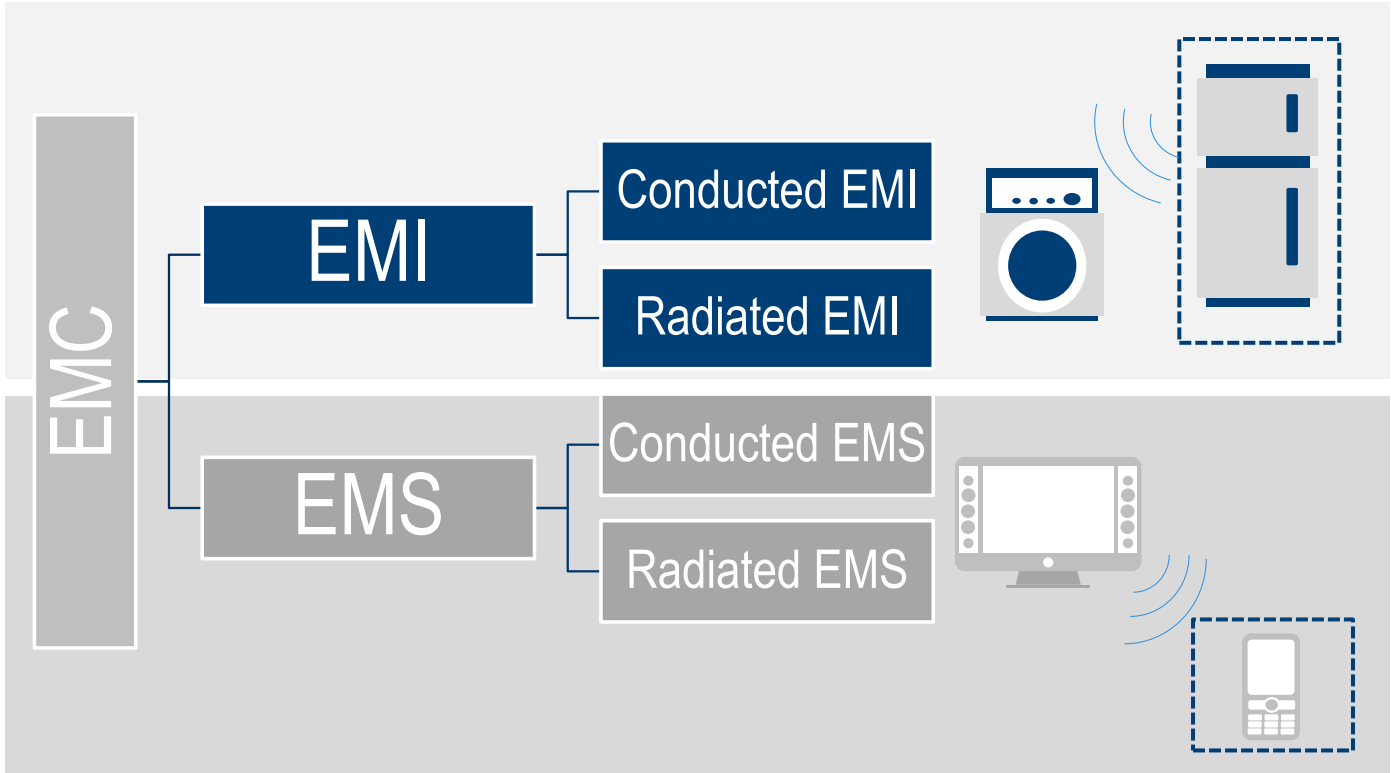
What is EMC?


EMC
EMI
Conducted EMI
Radiated EMI
EMS
Conducted EMS
Radiated EMS

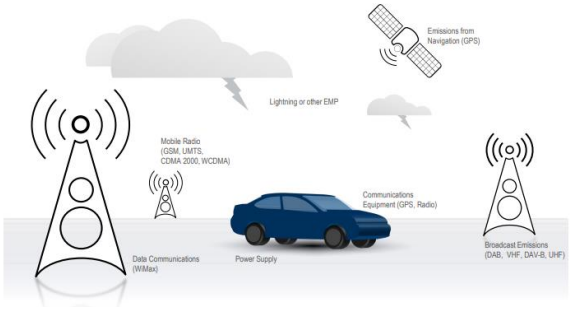
Definition

- Electromagnetic compatibility (EMC) is an important criteria of product safety and quality. **Every electrical device has to fulfill Electromagnetic compatibility (EMC) requirements by law.** It is mandatory in the product certification process.

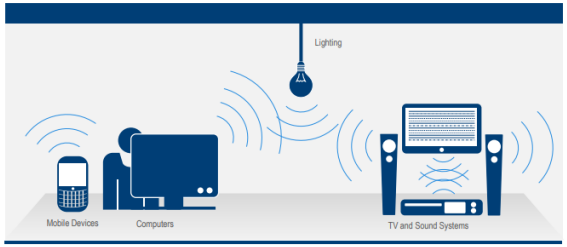
- The equipment under test “EUT” can have anomalies caused by **external impacts** (RF or electrical disturbances in close proximity to the “EUT”), **internal impacts** (emissions from components) or human interaction (i.e. ESD) and must be tested to avoid potential failures.

- Electromagnetic compatibility (EMC) is the **capability** of an electrical device or system **to operate** in its electromagnetic environment **without either**
  - **disturbing it** (i.e. producing emissions or interference = EMI) OR
  - **being disturbed by it** (i.e. susceptibility = immunity = EMS)
  - **EMC = EMI + EMS**

Outdoor Environment



Indoor Environment (Living Room)

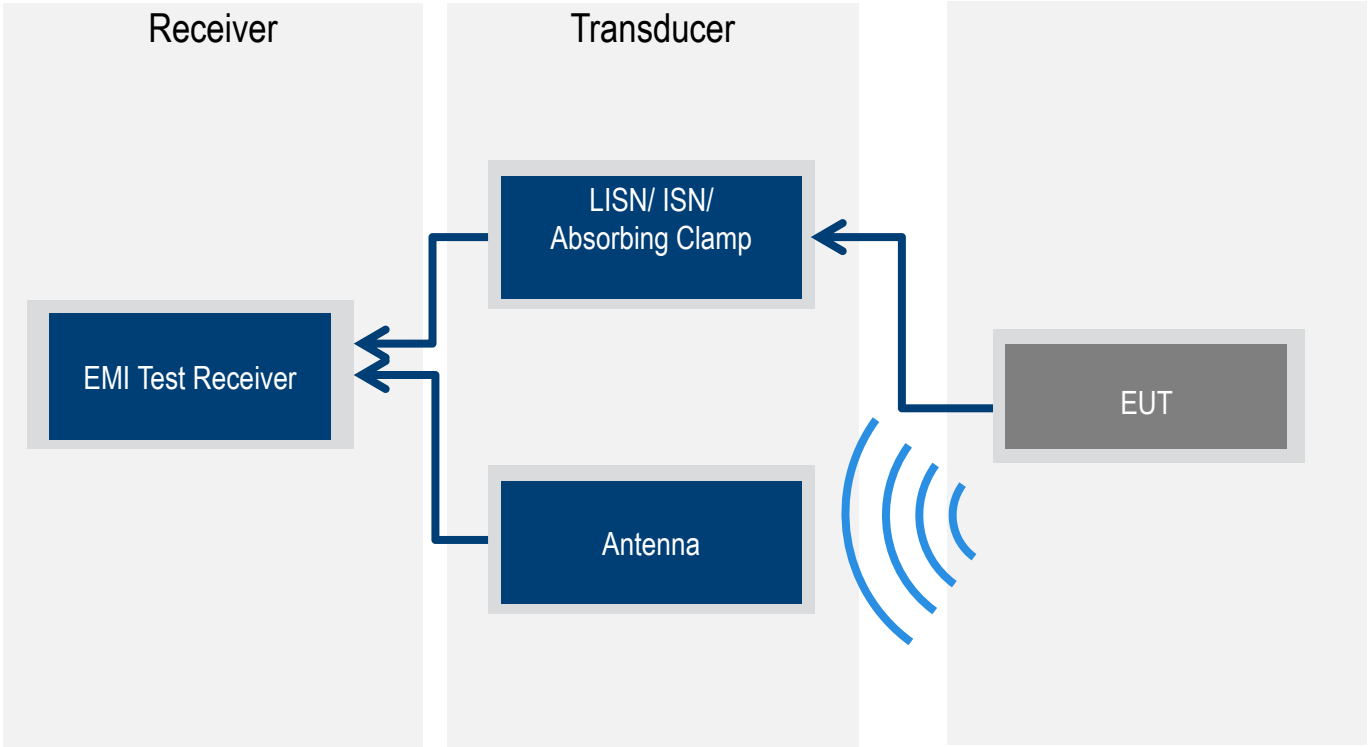


Common Mode of Coupling/Emission

EMI

Radiated EMI	Conducted EMI
Magnetic radiation	Voltage disturbance (via power line, telecom line, ect)
Electric radiation	Power disturbance

EMI / Emissions Test System (Typical)



Common Mode of Coupling/Emission

EMS

Radiated EMS	Conducted EMS
Electric radiation	Voltage/ current disturbance (from power line, telecom line, etc.)

EMI Environment

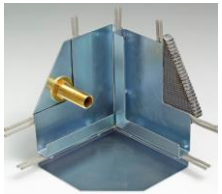
- Conducted
  - Shield room
    - Disturbance voltage, magnetic disturbance, disturbance power, discontinuous disturbance

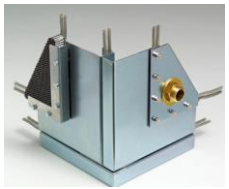
- Radiated
  - Open Area Test Site; Semi Anechoic Chamber; Fully Anechoic Chamber
    - Radiated disturbance

EMS Environment

- Conducted
  - Shield room - Immunity to conducted disturbances, induced by radio-frequency fields
    - CDN injection
    - Clamp injection
    - Direct injection
- Radiated
  - FAC – Radiated, radiofrequency, electromagnetic field immunity test

Shield Room – EMI and EMS



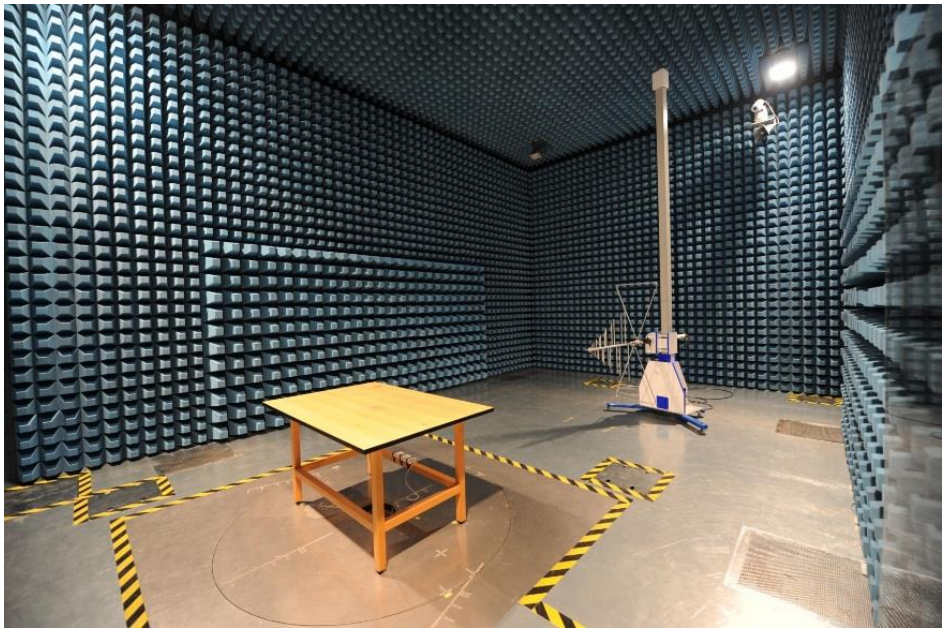


Signal line & Power line filter

RF Power Amplifier

power line transformer & LISN

Anechoic Chamber - EMI



3m compliance chamber

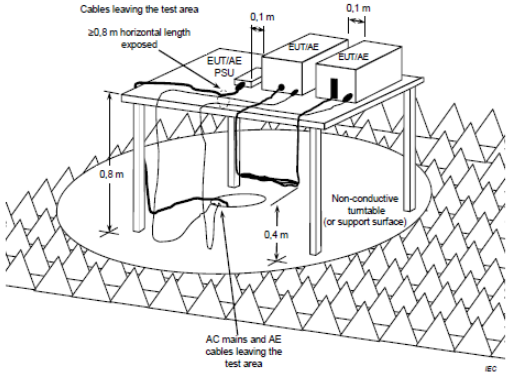
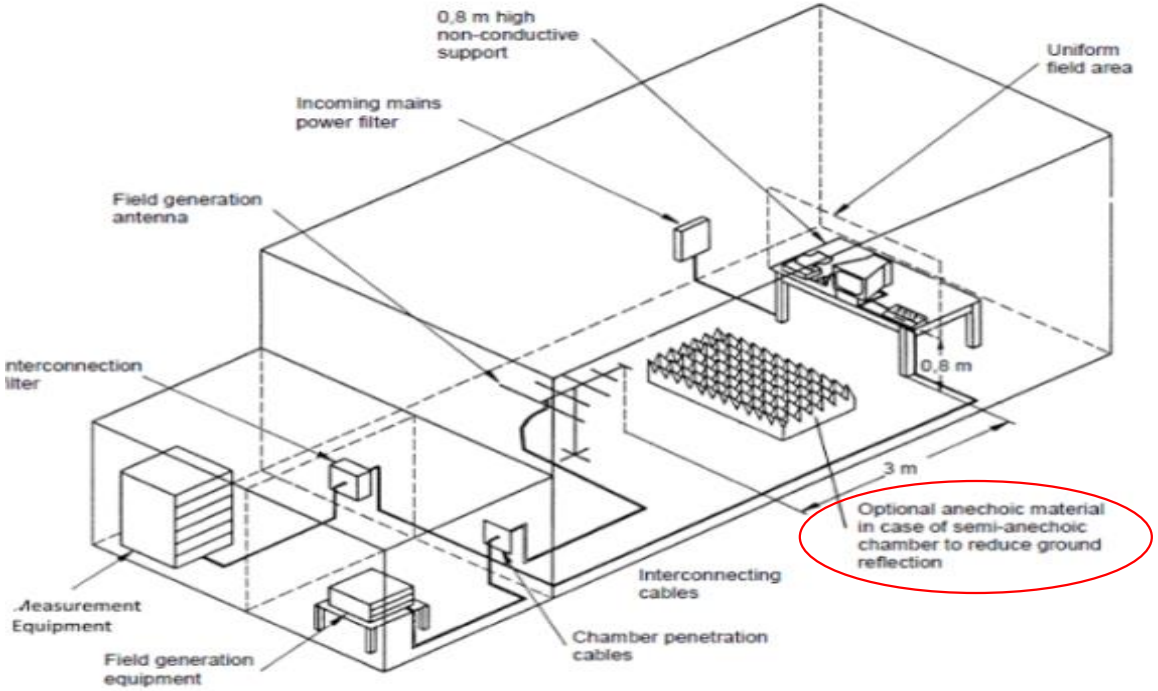


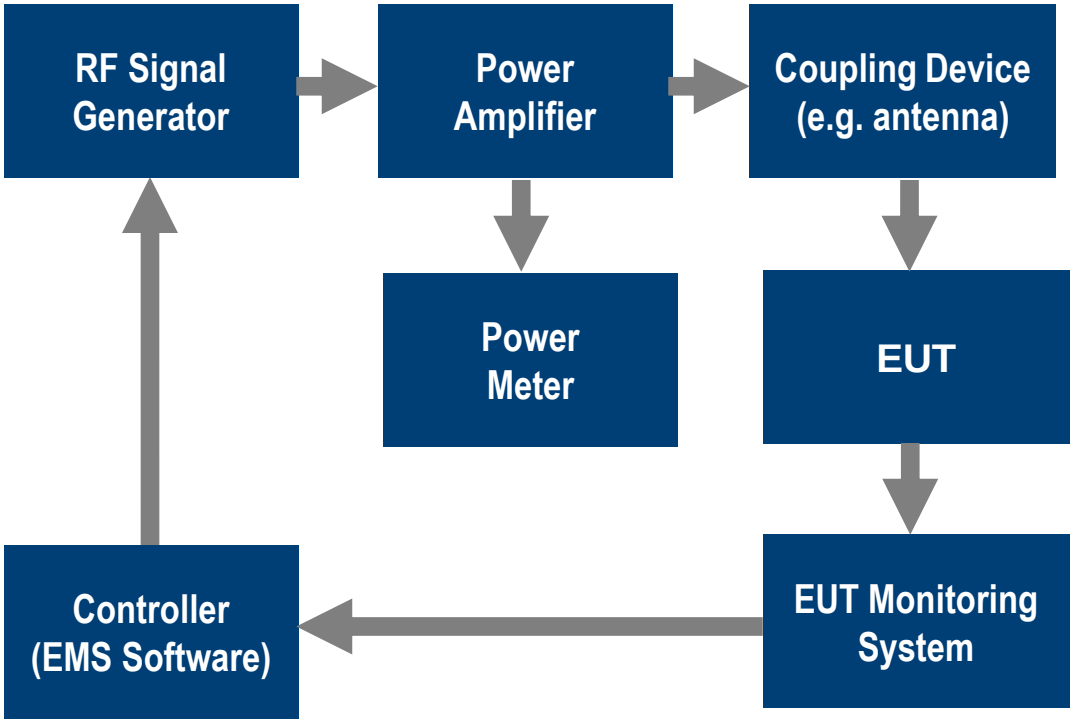
Figure D.11 – Example measurement arrangement for tabletop EUT (radiated emission measurement within a FAR)

National Physical Laboratory (UK)

Anechoic Chamber - EMS



EMS / Immunity Test System (Typical)



EMC Testing is all about Standards

- EMC and international standardization **critical for market access**
- Products with more **demanding requirements**
  - product safety, reliability, connectivity, time to market…
- Standardization cycles getting **shorter**
- **Complexity of test scenarios** increases
- **Limited test resources** call for faster test times and automation

Market & Technology Trends

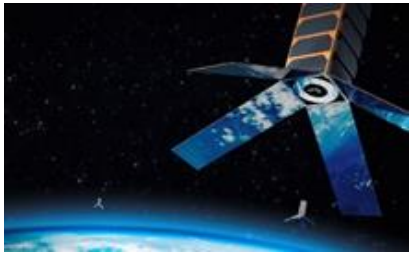
Industry, Components & Research

- Products with more **demanding requirements** safety, reliability, connectivity, time to market
- **Test labs expand globally** and operate 24/7
- **Coexistence test** for connected Medical/IoT equipment
- **Higher freq limits** for basic & ISM product standards incl. Reverb for IT/18Ghz

Automotive

- **Electric Vehicle**: HV 400-800VDC critical for EMC
- **Wide bandgap (SiC)** technologies cause EMI
- Field to lab **dynamic EMC**, ADAS and OTA test
- OTA testing of cellular and local connectivity (V2X, 5G, UWB...)
- **Reverb chambers** for large DUTs driven by OEMs
- **Transient test** mandatory for electric drive train

Aerospace & Defense



- **Space commercialization**
- **Real-Life EME**, Co-existence & Modulated test in higher freq
- New aircraft technology like eVTOL
- **Higher automation**
- **Expanding budgets** for military programs
- **TEMPEST** demand grows

Wireless Communication

- **RSE requirements** up to 200-325GHz
- **IoT/Vertical industry** become relevant to **regulatory testing** under scheme of radio equipment. (RED, FCC, etc)
- **New technology** (5G NR NTN, RedCap, 6G…), new **connectivity** (WiFi6E/WiFi7, UWB, BT5.2), new devices (Smart Home and IoT, VR/XR

EMC Test

Key Products / New Releases

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Advantages of Wideband testing

Commercial

- Direct QP measurement
- Higher speed
- Better insight for debugging

MIL

- Longer Measurement Time
- Probability of intercept
- Wide spectrogram for analysis

Automotive

- Greater insight for debugging
- Higher speed

Software Automation with R&S®ELEKTRA and R&S®AdVISE

Automatic EMC measurements with **ELEKTRA**

Intuitive. Interactive. Fast. Reliable.

Automatic visual inspection with **AdVISE**

Eliminate human error. Flexible. Optimal analysis

R&S®ELEKTRA Key Features & Supported Standards

Commercial	Automotive/MIL	Wireless
CISPR 11	CISPR 12	ETSI/FCC
CISPR 14	CISPR 25	
CISPR 15	ISO 11451	
CISPR 32	ISO 11452	
CISPR 35	MIL STD 461	
IEC 61000-4-3		
IEC 61000-4-6		

R&S®BBA300 Amplifier Series

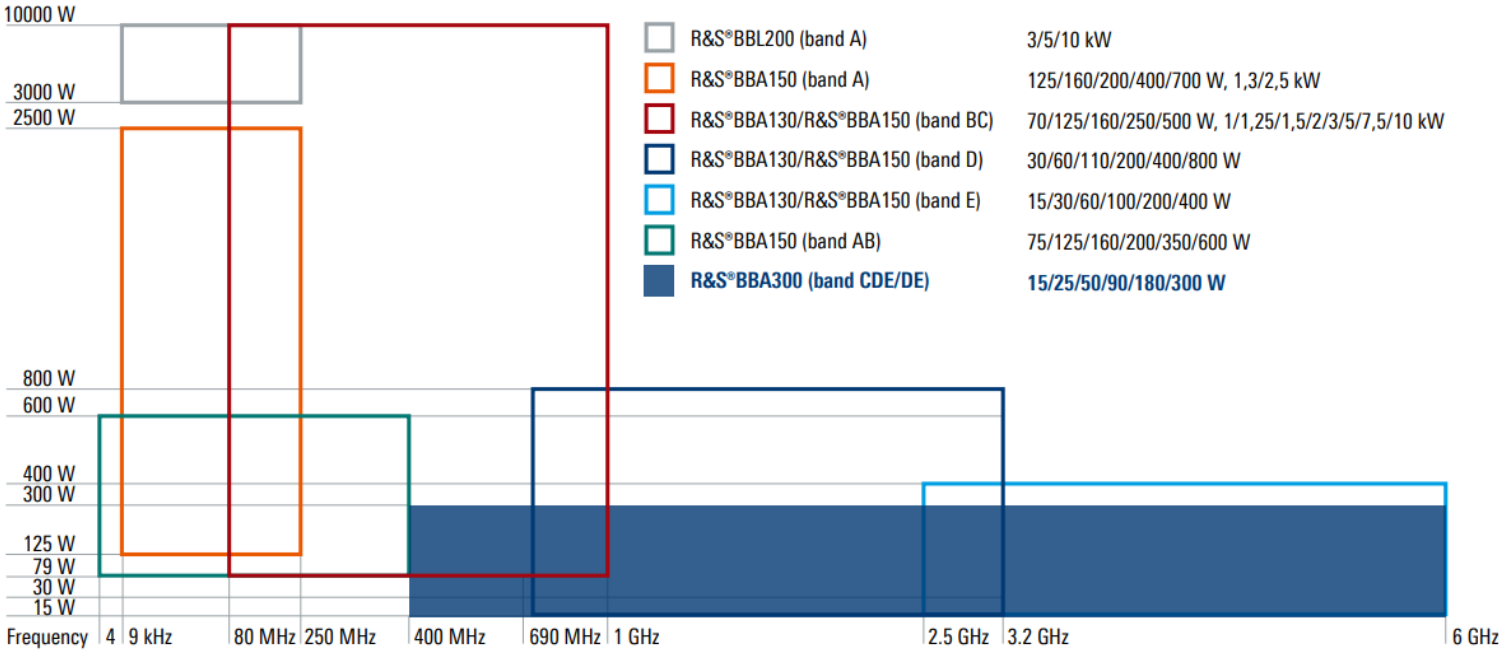
Linear RF output up to 300W

Ultrawide frequency band from 380Mhz to 6Ghz

Exceptional RF performance
- high linearity
- outstanding harmonic performance
- Excellent noise characteristics

Broadband Amplifier Portfolio

Rohde & Schwarz broadband amplifiers – model overview



Next generation oscilloscope for accelerated insight

R&S®MXO4 AT A GLANCE

MXO 4 Series Key Specifications	
Channels	4
Bandwidth	200, 350 & 500 MHz, 1 & 1.5* GHz
Max. Sample Rate	5 GSa/s
Record Length	400 Mpts / channel (option: 800 Mpts on 2 ch)
Vertical resolution	12 bit ADC, up to 18 bit
Acquisition rate	4.5 Mwfm/s
HW options	► MSO 16 ch ► 2 ch 100 MHz generator
Display	13.3“ Full HD
OS	Linux

*interleaved

THANK YOU!


DEMC
Demystifying Electromagnetic Compatibility
JAN 25-27 2022
-40% CO2 by 2030
3D
component and sys level development
antenna development
full vehicle testing
meet or beat human exposure
abstraction is key
hardware is more relevant to EMC than software
smartphone on wheels
focus on unshielded systems and higher voltage
OTA updates every 12 weeks
DAY 2
go for the perfect pair
EMC chamber
Load machine
look at the E-Motor from every side
ASK an EXPERT
extend the frequency range
identify problems early > talk together!
risk assessment upfront
intelligent prediction
it will be necessary to come together and combine these separated world's of expertise
we must come up with interfaces that integrate
Automotive E-Drive
blue box even inside!
2x
let's converge the software solutions
standard test person? (♂)
AC/DC cable knots
wireless snack charging
e.g. dongle server
e.g. large antenna in low building
e.g. mobile GHz-Rack
System design
water is even worse than fire
identical shield throughout
greatest EMI when NOT spinning
let's use more numerical tools
modern society requires RAPID electronic development
Dr. Johann Heyen
Electrification
Software defined product
New Business Model
Autonomous Driving
interdisciplinary work is in our DNA
flexible software
full automation?
special req.s
low cost?
standards
individual solutions!
self-supporting
easy to clean
Laboratory Investments
prefabricated
push the real-time button
protection of onboard receivers
tape the cable to the ground
measurement of electric and hybrid-el vehicles
speed
FFT
Reliability
Insights
coexistence
performance
TRENDS & CHALLENGES
flexible
upgradable
turn off the light
spinning wheels
i.e. large egg beater
New Editions
how to ensure a SAFE and RELIABLE connected world?
Michael Friederich
from manufacturing to installation
modular systems
long pyramids back in business
Dr. Daniel Feyerlein
Frankonia
What Country are you in?
SILENT
Lee Hill
(trying to have fun by himself in the studio)
ground the motor? shield the cable?
Being surprised means I learn something
reduce the length of the cable
Emission
Immunity
Purpose: Standardization
Product
General
Basic
CISPR since 1933
CISPR-Average Detector
Jens Medler
secrets behind testing criteria
emission detector
we investigate unknown signals
do you DARE to take the necessary risks and decisions?
complexity
INCREASED
testing
number of quality product assessments
cost of EMC failure
DAY 1
compliance
pre-compliance
pre-selection
debugging
trouble-shooting becomes critical
better power efficiency in less space
communication is in everything
spurious emission testing becomes a must
filter design by simulation and sanity check
Radiated testing below 30 MHz - R U ready?
large object testing
better safe than sorry
R.I.P. Project X
Quasi Peak
new methods
testing to the limits - and BEYOND!
DAY 3
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