Webinar

VERIFYING THE DIGITAL DESIGN FOR YOUR MILCOM RADIO DEVICES

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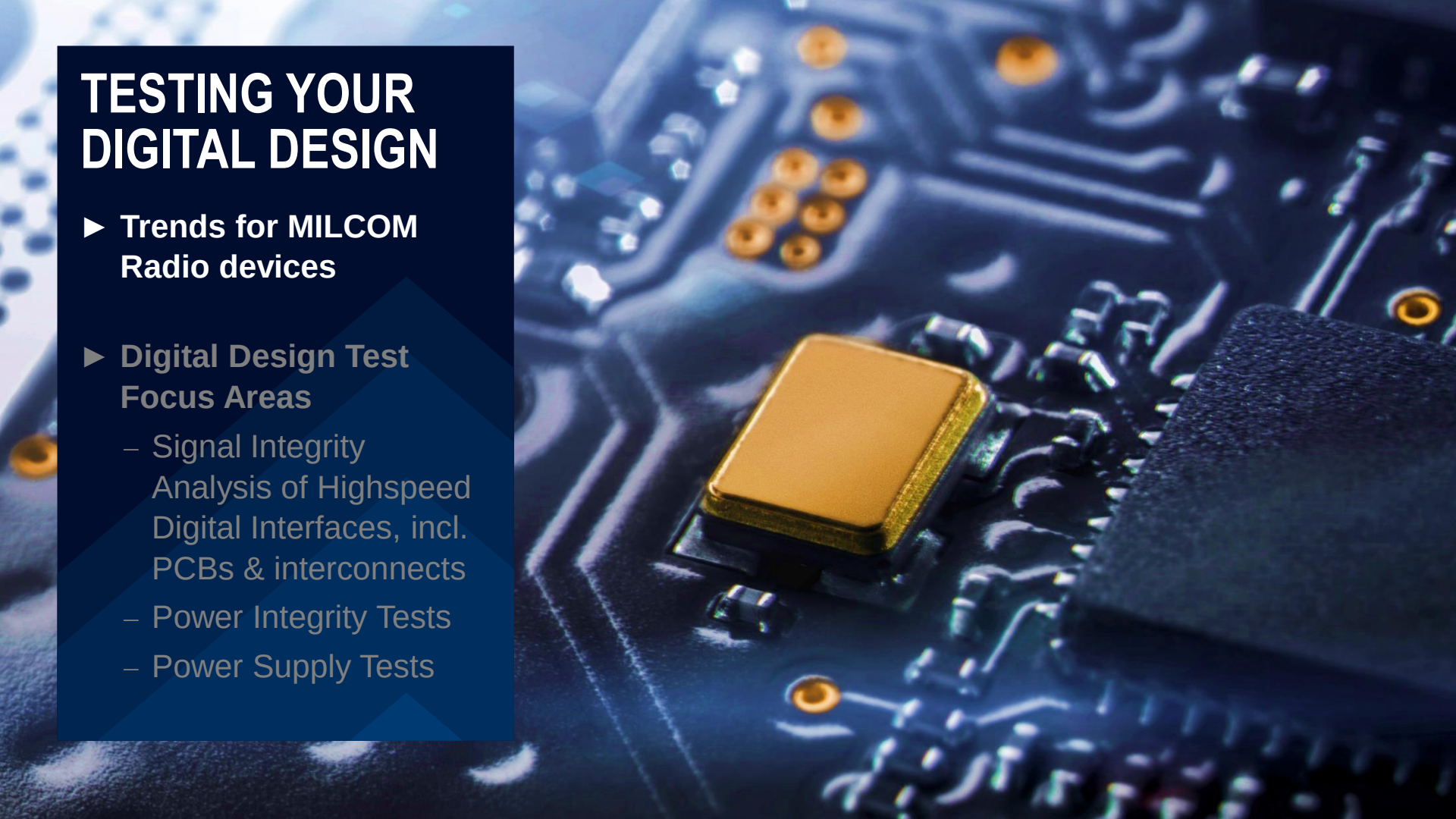
ROHDE&SCHWARZ

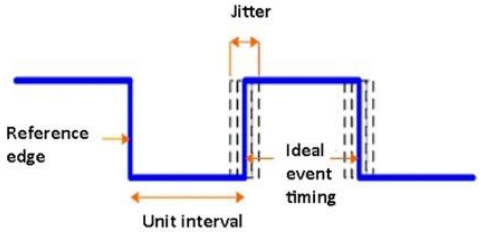
Make ideas real

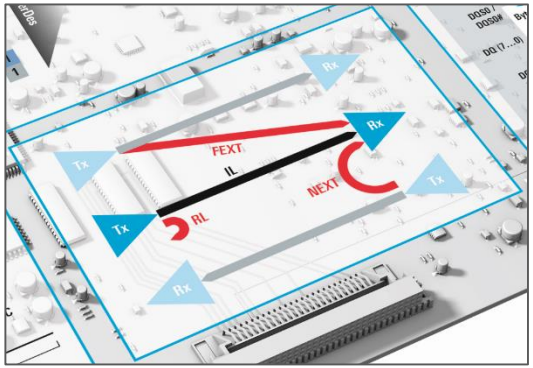
TESTING YOUR DIGITAL DESIGN

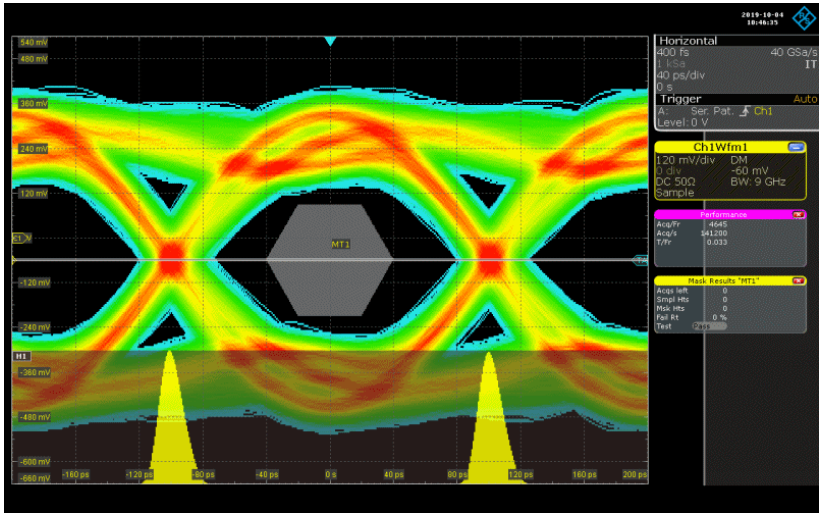
- **Trends for MILCOM Radio devices**
- **Digital Design Test Focus Areas**
  - Signal Integrity Analysis of Highspeed Digital Interfaces, incl. PCBs & interconnects
  - Power Integrity Tests
  - Power Supply Tests



WHY DIGITAL DESIGN?







WHAT IS MILCOM TEST ABOUT?

Testing Tactical Communications for and by armed forces
Testing Secure Communications: police, fire, homeland and private security

Mainly driven by V/UHF analogue radio maintenance testing.
Demand for Digital Comms waveform development and testing increasing
Testing new Software Design Radios digital designs and its components

Land mobile radios, Soldier radios vehicular and onboard radios
Pt-Pt and Pt-Multi Point Terrestrial communications for wideband datalinks
VSAT and SATCOM Terminals used by armed forces and homeland security

TECHNOLOGY TRENDS IN MILCOM TEST

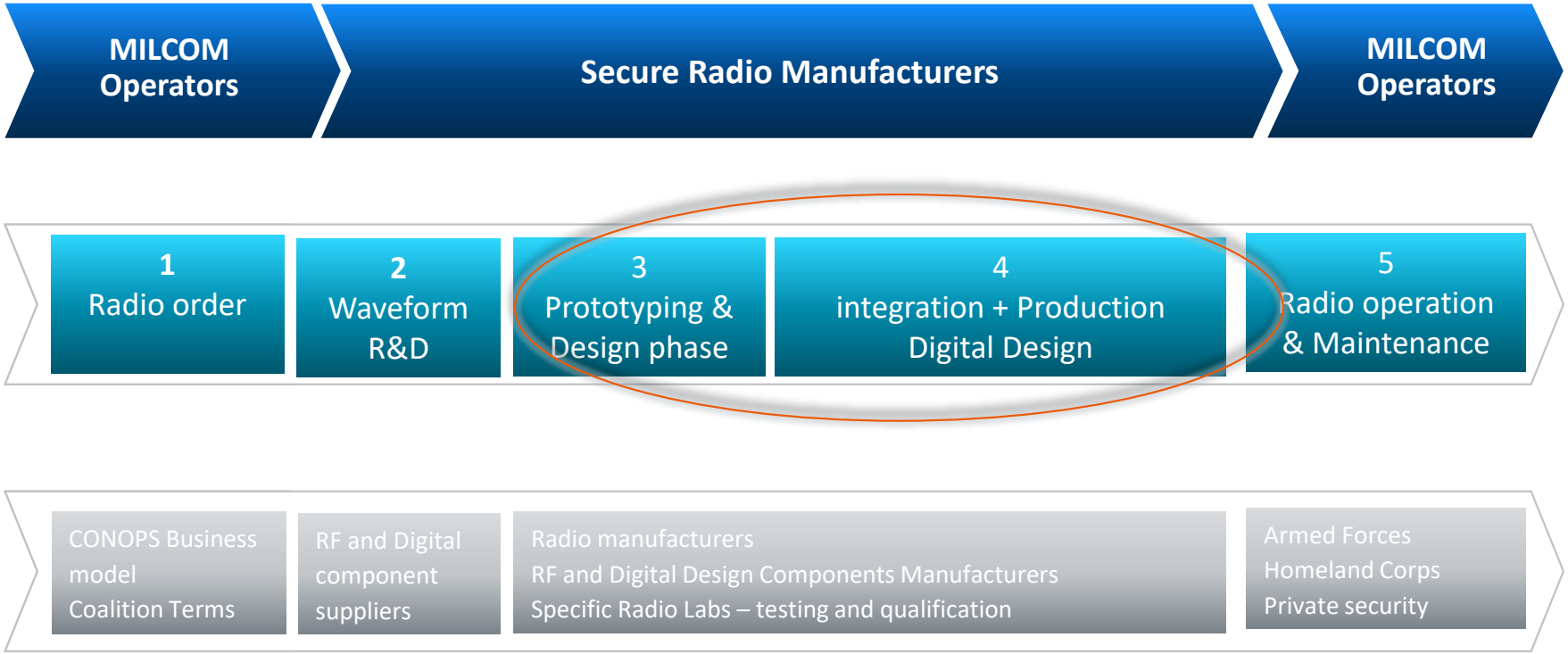
Evolution of already used technologies

- New multi-coalition secure waveforms: SCA-SDR, HDR-WF, ESSOR, JPEO-JTRS
- Next Generation Digital Tactical Radio frequency up to 8GHz and 100MHz BW
- Microwave Data Links up to 85 GHz with 500MHz - 5GHz BW
- OTA and commercial coexistence for Wi-Fi, Bluetooth and 4G
- Digital Design in reduced weight, size and power.

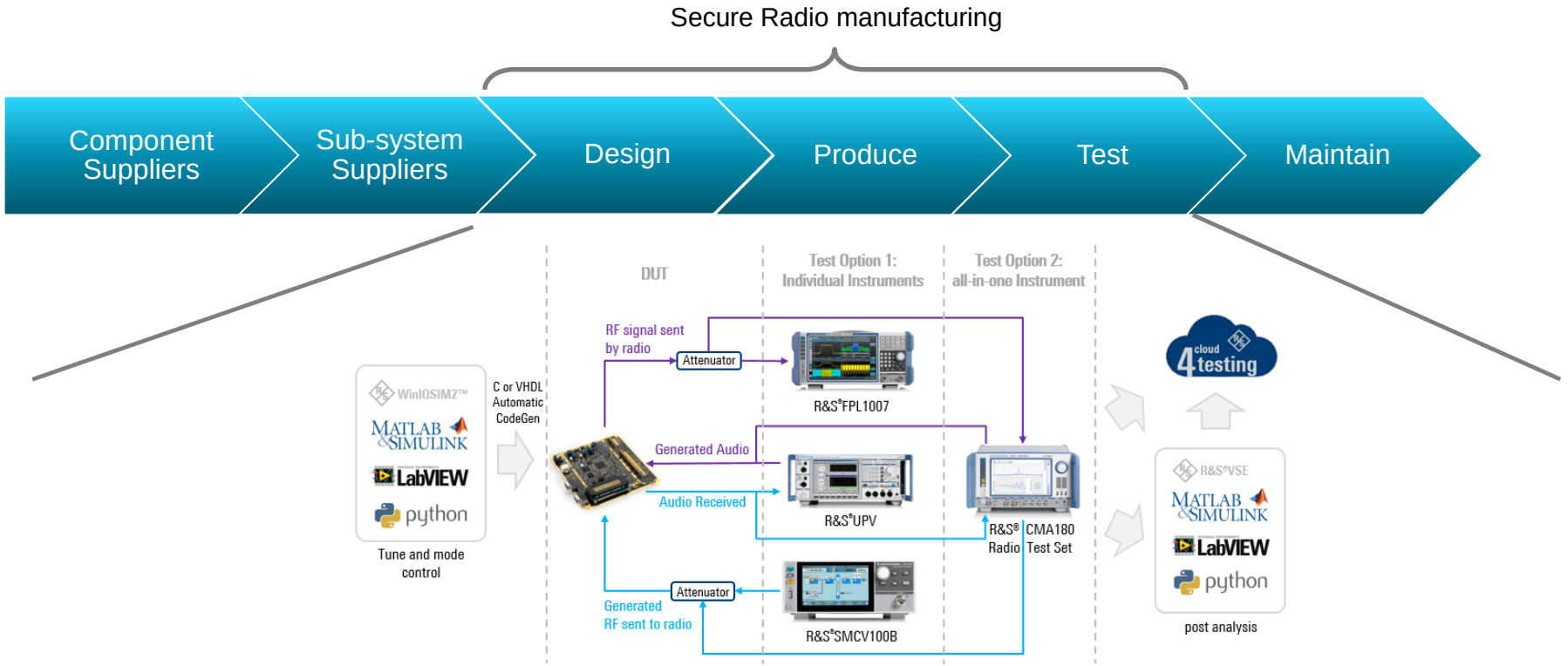
Emerging new technologies:

- Rapid deployable 5G Secure Networks
- Internet of Military Things, connecting all warfare assets
- Vehicular short range secure Wireless replacing system wires.
- Conformable light weight antennas, MIMO radios, and AESA antennas

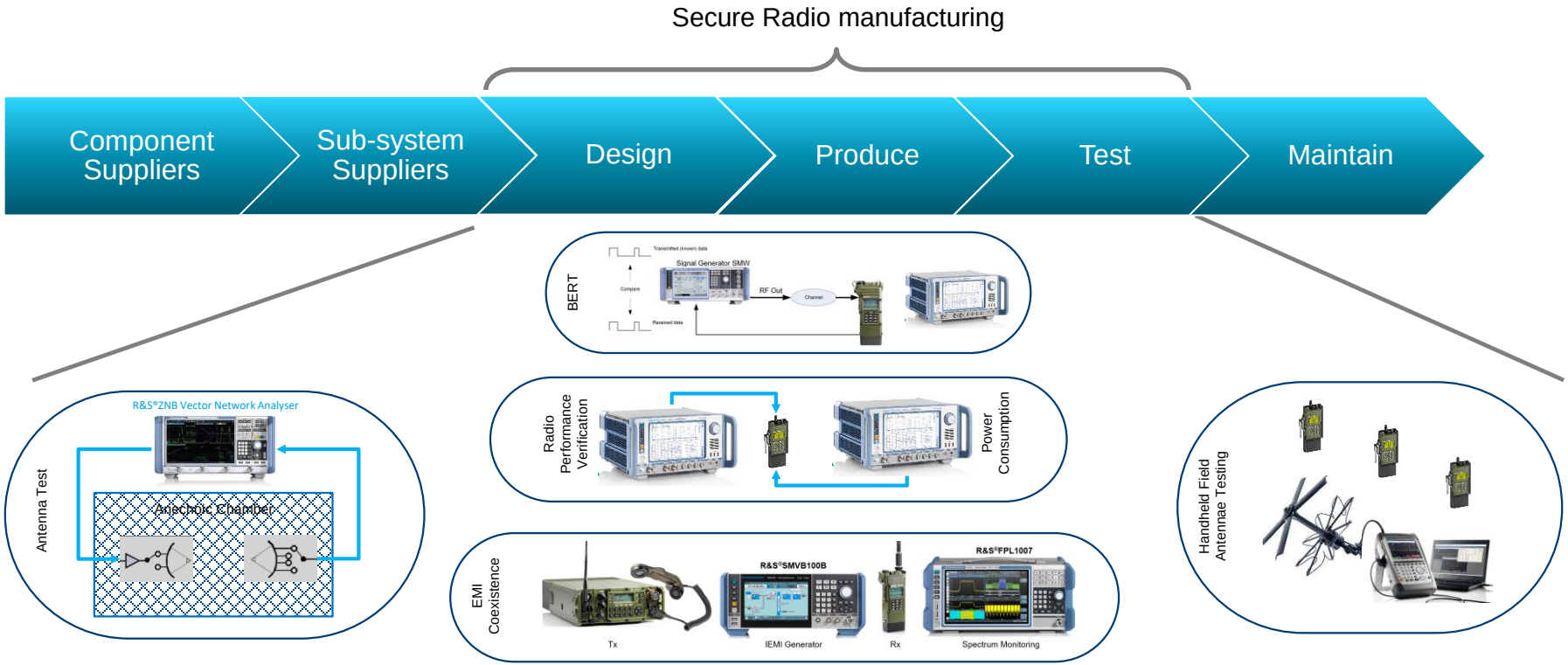
MILCOM VALUE CHAIN



MILCOM MANUFACTURING – RF

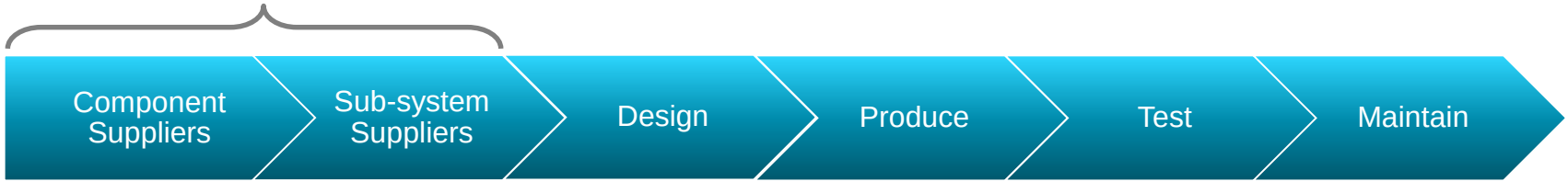


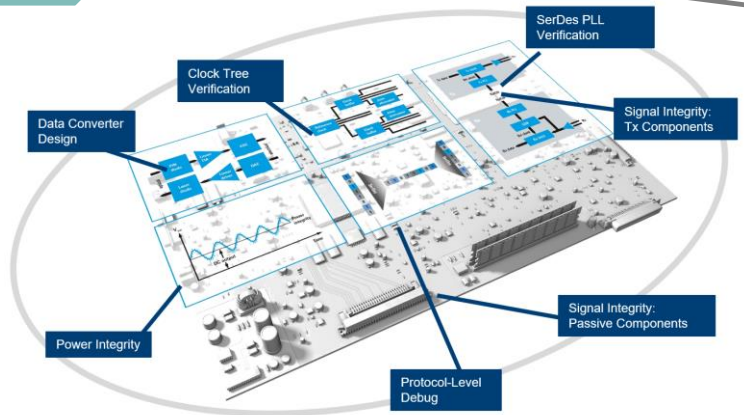
MILCOM MANUFACTURING – RF



MILCOM MANUFACTURING – DIGITAL DESIGN

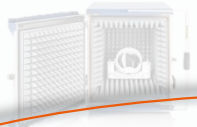
RF and Digital Design component manufacturing





Digital component suppliers
Mixed RF components suppliers
Digital Design engineers for debugging
Digital Design labs for test and verification

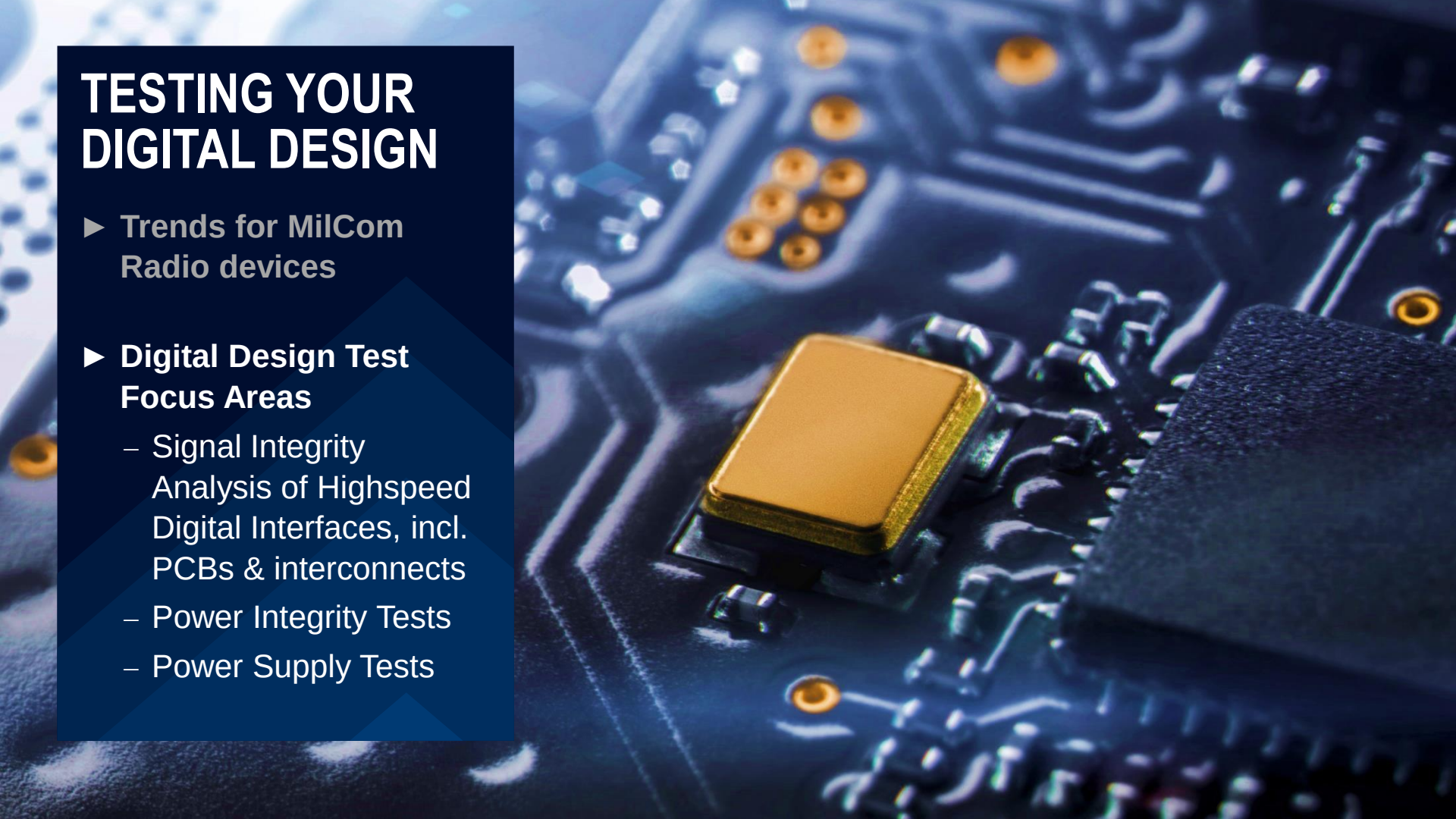
R&S MILCOM TESTING SOLUTIONS PORTFOLIO

	Signal Generators
	Signal und Spectrum Analyzers
	IQ Acquisition Recording and Replay
	Vector Network Analyzers
	Antenna Test OTA Chambers
	**Real Time Oscilloscopes**

	Power Sensors
	Switch Matrix
	Digital Radio Testers
	Analogue Radio Testers
	Broadband Power Amplifiers
	Automatic Test Sequencers and other Analysis Software

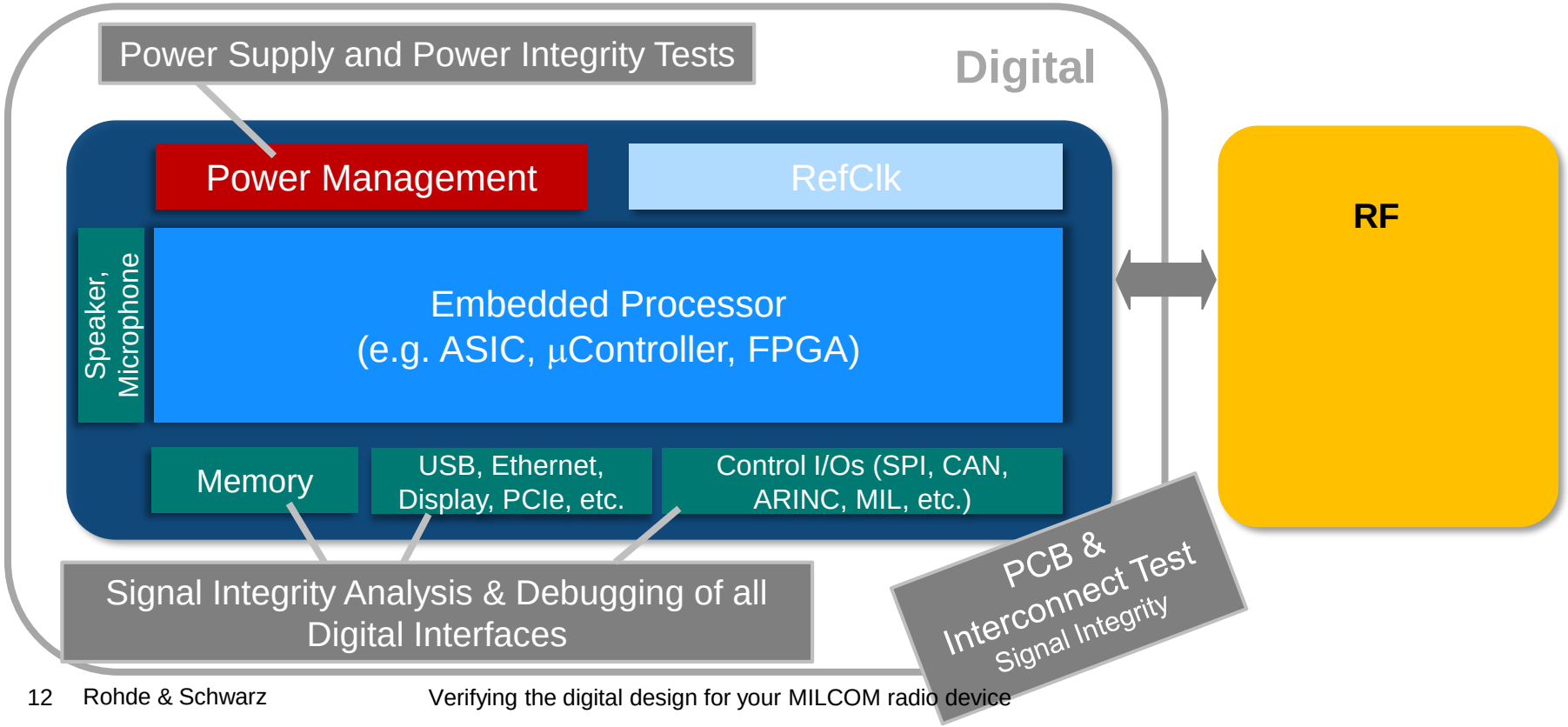
TESTING YOUR DIGITAL DESIGN

- Trends for MilCom Radio devices
- **Digital Design Test Focus Areas**
  - Signal Integrity Analysis of Highspeed Digital Interfaces, incl. PCBs & interconnects
  - Power Integrity Tests
  - Power Supply Tests

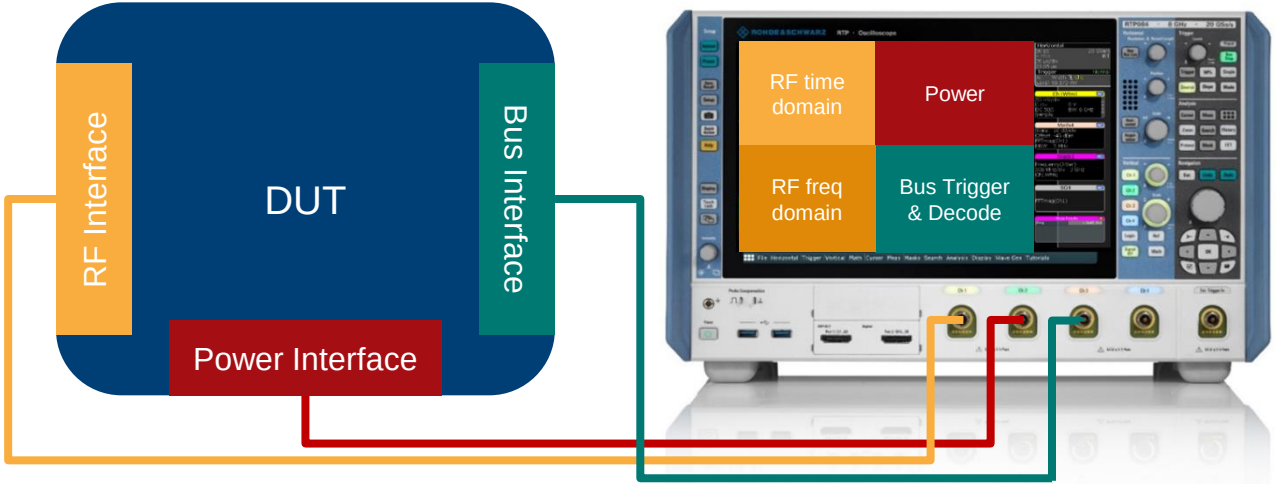


MILCOM RADIO DESIGNS

The Digital Part: Typical Test Areas for Every New Designs



MULTIDOMAIN ANALYSIS FOR SYSTEM-LEVEL DEBUGGING



System-level Debugging

- Combine multiple measurements from different DUT interfaces on the same screen
- Look for possible correlations to determine causes of signal anomalies

1. HIGH SPEED DIGITAL INTERFACES

Why fast and reliable signal integrity solutions including PCB and interconnect tests are so important for integration of Highspeed Digital Interfaces?

HIGHSPEED DIGITAL INTERFACES CHALLENGES

- Signal integrity challenges due to increasing data rates
- Interference issues due to increasing level of integration

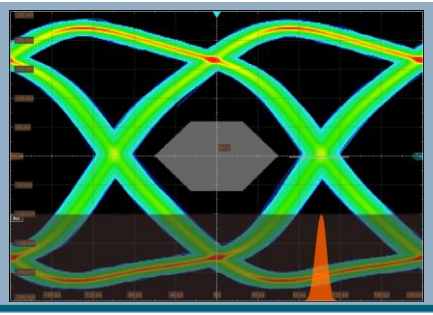
For optimal Signal Integrity analysis – T&M equipment needs to collect statistical data fast.

HIGH SPEED DIGITAL INTERFACES

Require Dedicated Tests for Verification & Debugging

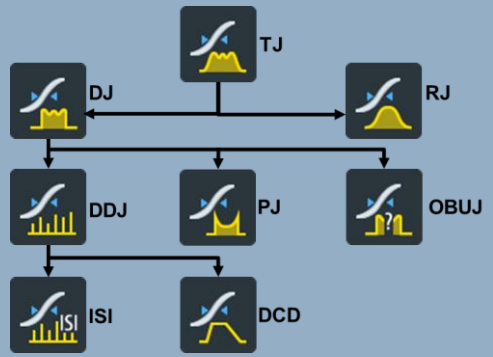
Eye Diagram

- Fast update rate for statistical confidence
- Continously operating Clock-Data-Recovery (CDR)
- Mask tests
- Deembedding function to compensate transmission loss



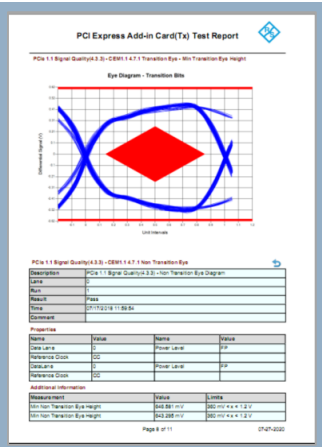
Jitter Analysis

- Break-down of jitter and noise into individual components for characterization & debugging



Automated Compliance Tests

- Verify compliance of the physical layer to interface standards and report results



R&S RTP HIGH-PERFORMANCE OSCILLOSCOPE

- 4-16 GHz bandwidth
- Dedicated hardware for real-time Signal-Integrity
- Most compact & silent for everyday use in the lab

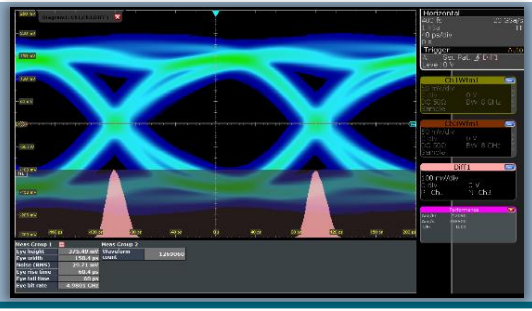
Providing Unique Signal Integrity Analysis Functions

R&S RTP HIGH-PERFORMANCE OSCILLOSCOPE

Providing Unique Signal Integrity Analysis Functions

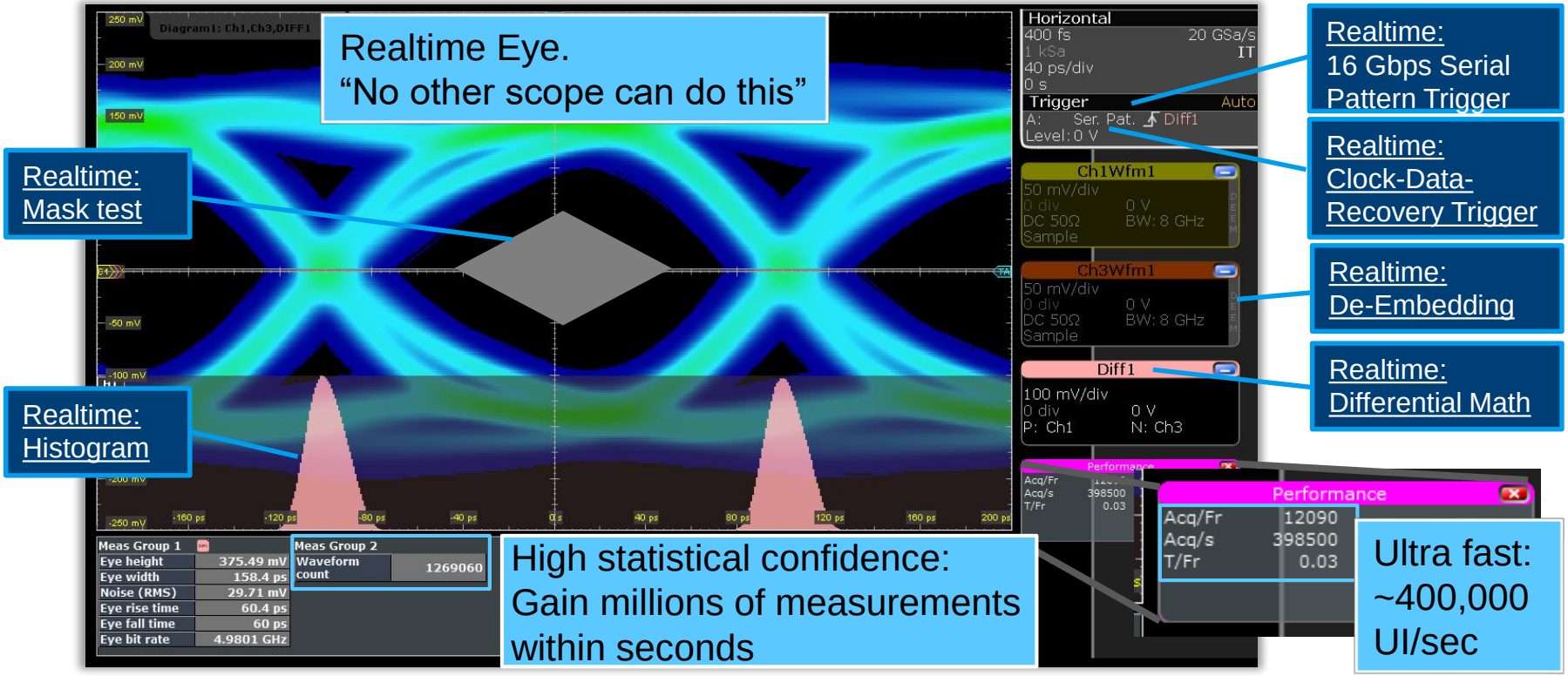
Fastest Eye Diagram Analysis

- CDR based triggering
- Real-time deembedding
- Real-time differential math
- Real-time analysis (histogram, mask)



R&S RTP HIGH PERFORMANCE OSCILLOSCOPES

Making It Fast – Realtime Analysis



R&S RTP HIGH-PERFORMANCE OSCILLOSCOPE

Providing Unique Signal Integrity Analysis Functions

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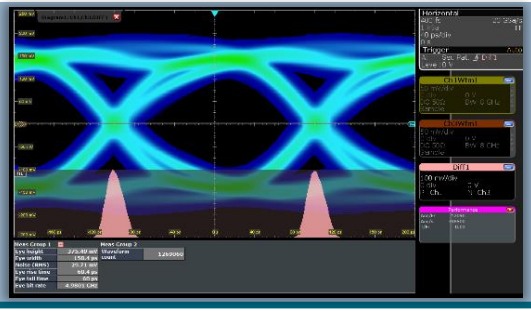
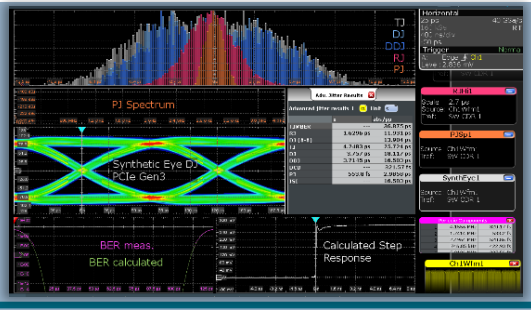


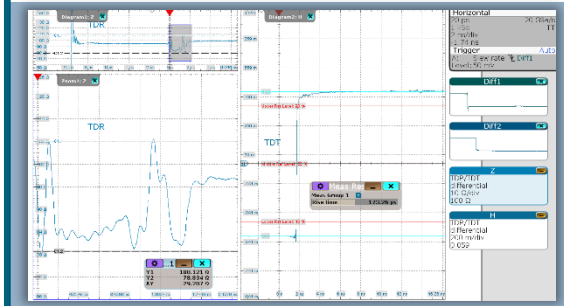
Most detailed Jitter Decomposition

- Histograms for all components
- Track and Spectrum views
- Eye diagram, BER bathtub
- Step/Frequency response



Most versatile TDR/TDT Analysis

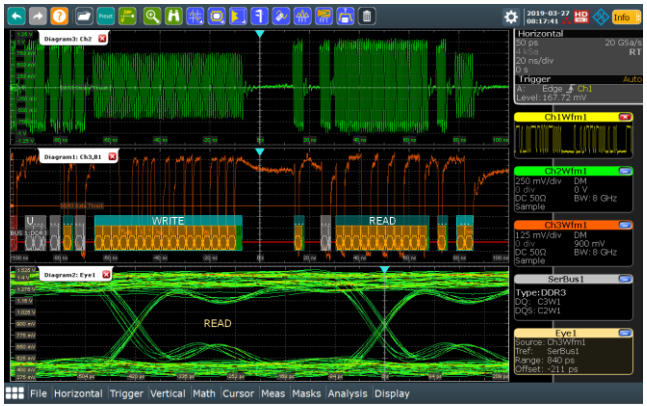
- 16 GHz differential Pulse Source
- TDR / TDT Analysis SW
- Guided calibration & measurement
- PacketMicro Probe



R&S RTP HIGH-PERFORMANCE OSCILLOSCOPE

DDR Debugging and Compliance

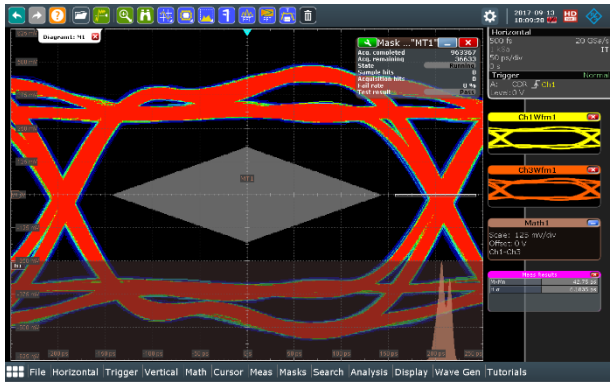
- Solutions for DDR3 and DDR4
- Powerful debugging capabilities
  - Read/Write Decoding
  - Data Eye – mask test, eye measurements
  - Combine with Realtime Deembedding
- Compliance test according JEDEC standards
  - DDR3/4, LPDDR3/4
- Interposer from partners such as Nexus Technologies or EyeKnowHow



R&S RTP HIGH-PERFORMANCE OSCILLOSCOPE

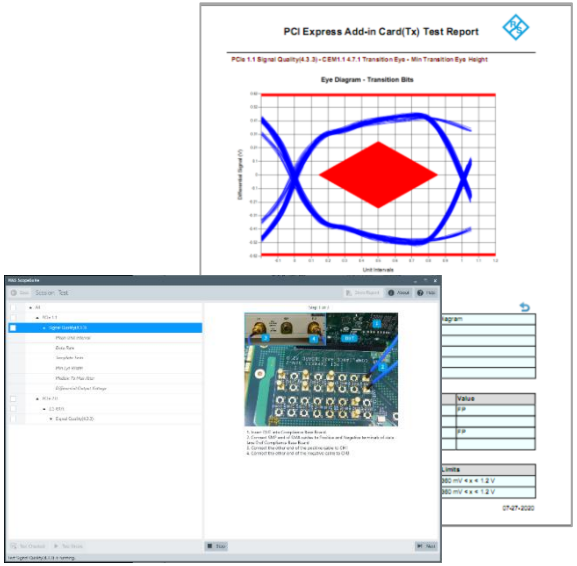
PCI Express Debugging and Compliance

- Solution for PCIe 1.1/2.0/3.0
  - Signal Integrity debugging (Serial pattern trigger / CDR)
  - Protocol triggering and decoding
  - Compliance testing with R&S ScopeSuite



Data eye and mask testing

Decoding of 5 Gbps PCIe 2.0



Automated Compliance testing

2. LOW SPEED DIGITAL INTERFACES

Why trigger and decoding solutions are so important for integration of Low-speed Digital Interfaces?

LOWSPEED DIGITAL INTERFACES CHALLENGES

- Protocol coding data complicate debugging
- Interference issues due to increasing level of integration

For optimal data debugging – T&M equipment needs protocol-specific triggering and data analysis.

LOW SPEED DIGITAL INTERFACES

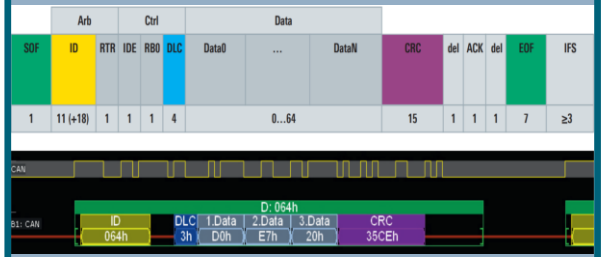
Require Dedicated Tools for Protocol-specific Debugging

Protocol Decoding

- Decoding of various control and programming protocol standards
- User definable decoding based on NRZ, 8B/10B or Manchester coding

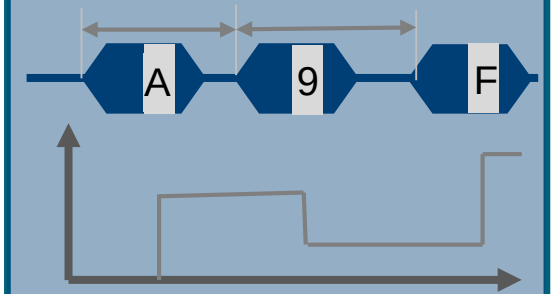
Protocol Triggering

- For debugging – trigger on Protocol events and errors



Bus Measurements

- Measurement of protocol timing
- Measurement and analysis of protocol data



R&S PROTOCOL TRIGGERING AND DECODING SOLUTIONS

- Dedicated protocol options
- Flexible decode option for certain coding schemes
- HW processing support for fast results

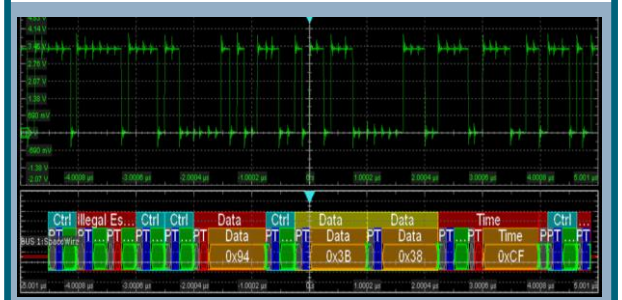
Providing Unique Protocol-Specific Analysis Functions

R&S OSCILLOSCOPE

Providing Unique Protocol-Specific Analysis Functions

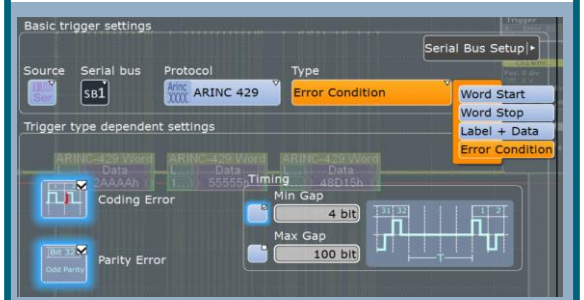
Gain protocol inside with decoding options

- Comprehensive portfolio of decoding options
- Time-correlation of waveform and protocol data
- View data in waveform or table
- Powerful search and navigation



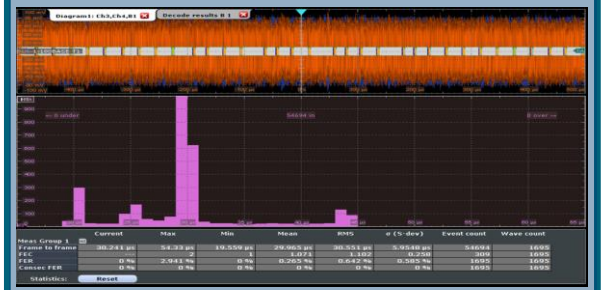
Powerful protocol-based trigger functions

- Reliable isolate protocol events (e.g. address or data) and errors with protocol specific trigger
- HW support



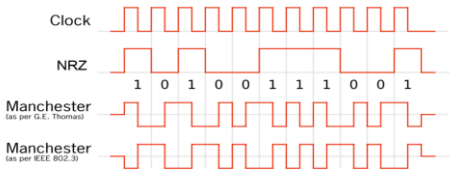
Analyze protocol data with bus measurement option

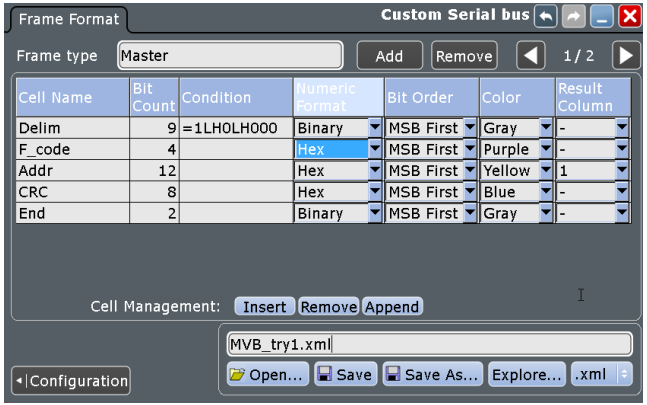
- supports I2C, SPI, UART, RS232, CAN, CAN-FD, LIN, Ethernet
- Display protocol data as waveform
- Measure frame spacing, frame error rate, or bus idle time, etc.

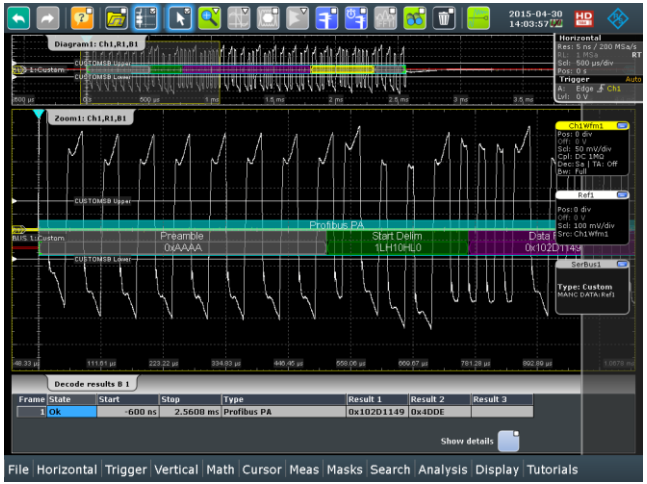


CUSTOM TRIGGERING AND DECODING
NRZ / MANCHESTER

- **Define your own proprietary protocol structure**
  - Bit encodings:
    - Manchester, Manchester II, NRZ clocked / unclocked
  - Frame format:
    - Define multiple different frame types
    - Define multiple cells within one frame
    - Define frame Ids and content conditions
    - Select color, bit order and result display column
- **Comprehensive functions:**
  - Protocol-based triggering
  - Search function
- **Option:** RTE/ RTO/ RTP-K50







3. POWER INTEGRITY

What are the right tools and analyzing functions for appropriate characterizing & debugging?

POWER INTEGRITY CHALLENGES

- Increasing number of power rails
- Lower margins due to lower supply voltages
- Interferences due to dense designs of mixed technologies

An optimal solution for characterizing and debugging DC power rails demands suitable probes & oscilloscopes.

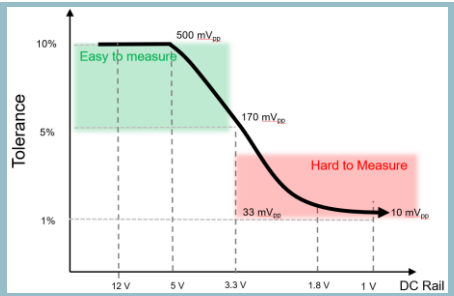
Providing Solutions for Power Integrity

POWER INTEGRITY

Requires Dedicated Tools for Verification & Debugging

The Right Scope

- Fast update rate
- Min. vertical scale: 1..2 mV/div in HW at full bandwidth
- Low noise
- Support of specialized probes also on high-performance class instruments

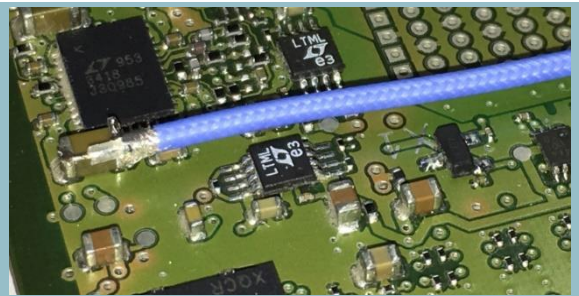


Specialized Probes

Power Integrity Probe

- Bandwidth >2 GHz
- Low noise with 1:1 attenuation
- Extended offset range
- Connectivity

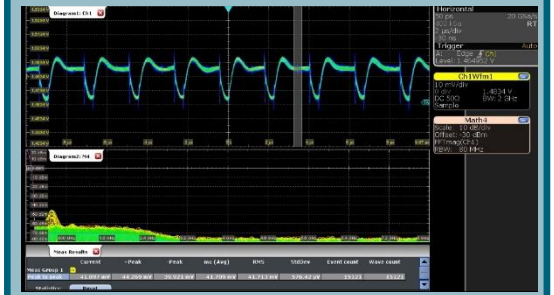
Current probes, etc.



Dedicated Analysis Functions

Typical measurements

- Ripple, Load step response
- Power-up/down, Sequencing
- Drift over temperature and input voltage
- EMI debugging / harmonic analysis

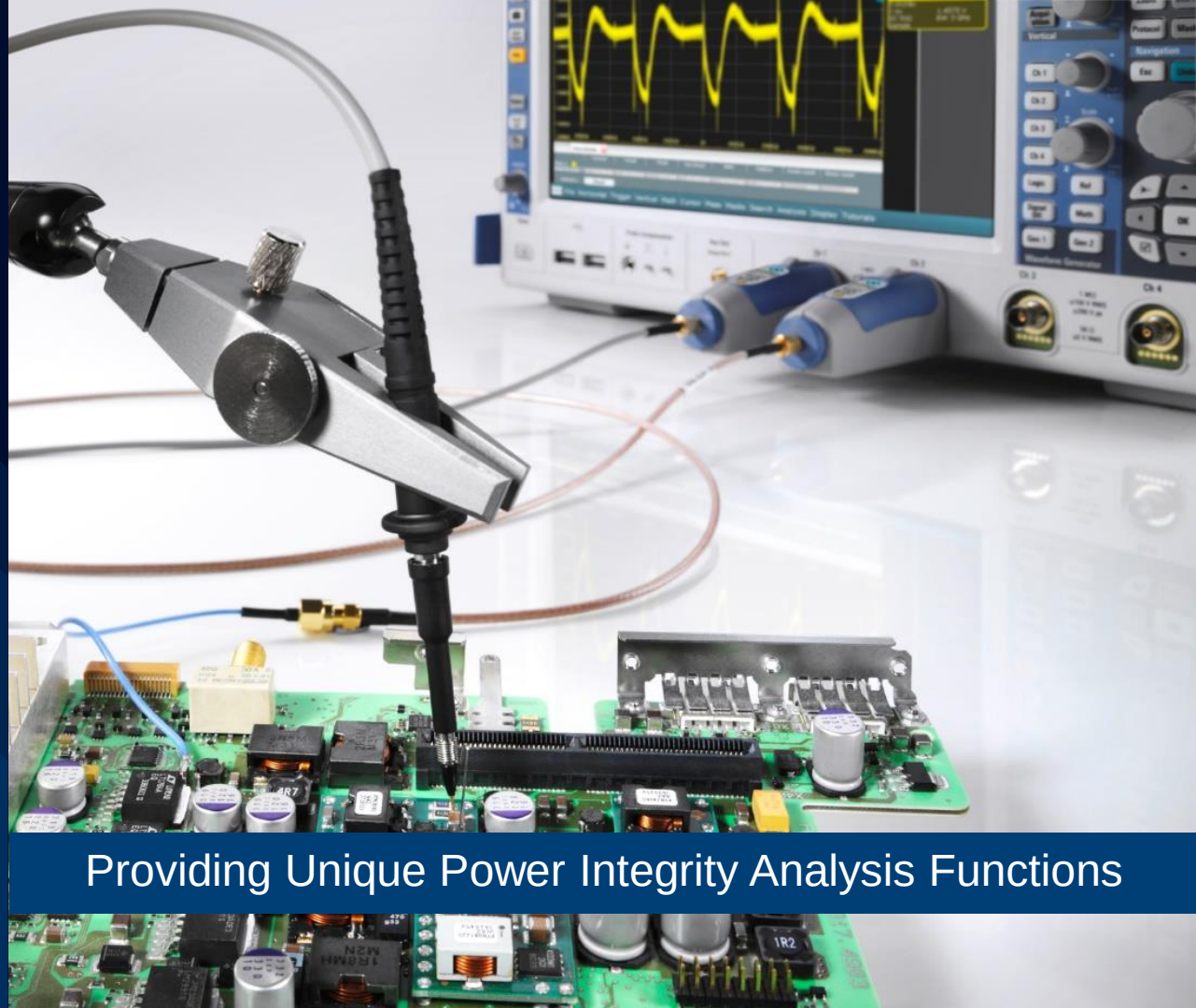


R&S POWER INTEGRITY SOLUTION

- Low Noise
- Fast FFT
- Fast Update Rate

- Low-Price Alternatives
  -RTM / RTA Oscilloscopes

- **Superior Power Rail Probes**



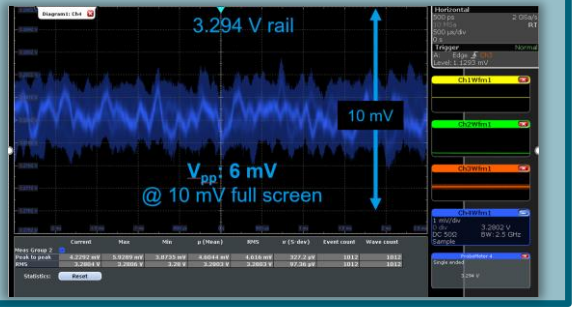
Providing Unique Power Integrity Analysis Functions

R&S RTO & RTP HIGH-PERFORMANCE OSCILLOSCOPE

Providing Unique Power Integrity Analysis Functions

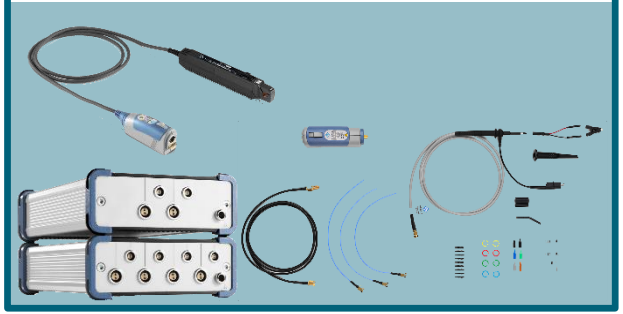
Fast Scopes: RTE, RTO, RTP

- Up to 1,000,000 wfms/s to find worst case tolerances quickly
- 1mV/div in HW, full bandwidth
- Lowest noise w/ 16 bit HD mode
- Most sensitive trigger to capture very small amplitude droops



Best Power Rail Probes

- RT-ZPR20/40 Power Rail Probes
  - 1:1, 2/4 GHz bandwidth
  - Highest offset: +/-60 V
  - Browser and solder-in tips
  - Unique R&S Probe Meter (high accuraccy DC voltmeter)
- Portfolio of current probes
- Multi-channel 18 bit power probes



Unique Analysis Functions in one instrument

- Fast and responsive FFT to detect interferer
- R&S ProbeMeter for precise DC measurements (0.05%)
- Fast measurements for statistics analysis

4. POWER SUPPLIES

What are the right tools and analyzing functions for appropriate characterizing & debugging?

POWER SUPPLY CHALLENGES

- Increasing number of converters and PMICs
- Tight timing requirements for power up and power down sequences
- Efficiency
- Higher frequency conversion
- Power saving modes

An optimal solution for characterizing and debugging power supplies requires suitable probes and oscilloscope performance.

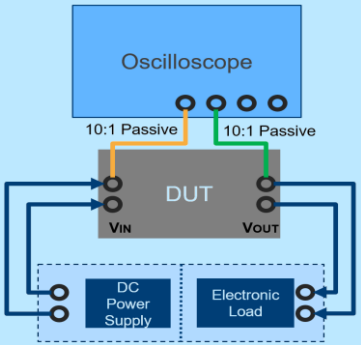
Providing Optimal Power Supply Debugging

POWER SUPPLIES

Requires Dedicated Tools for Verification & Debugging

The Right Scope

- Low noise
- High resolution
- High measurement dynamic
- Deep memory
- Typical bandwidth 350 MHz to 1 GHz



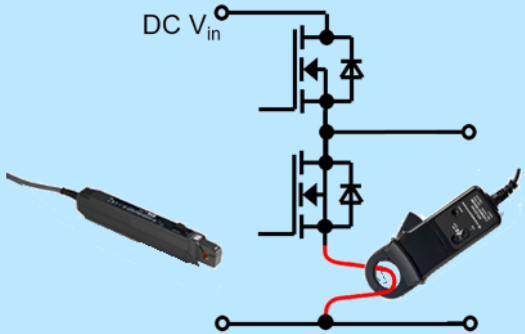
Specialized Probes

Current Probes:

- Bandwidth / sensitivity

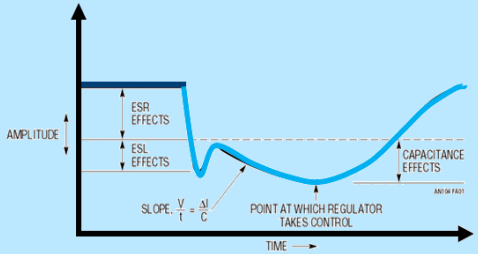
High voltage probes:

- High CMRR and linearity
- Build-in offset compensation
- Low noise, low zero error



Dedicated Analysis Functions

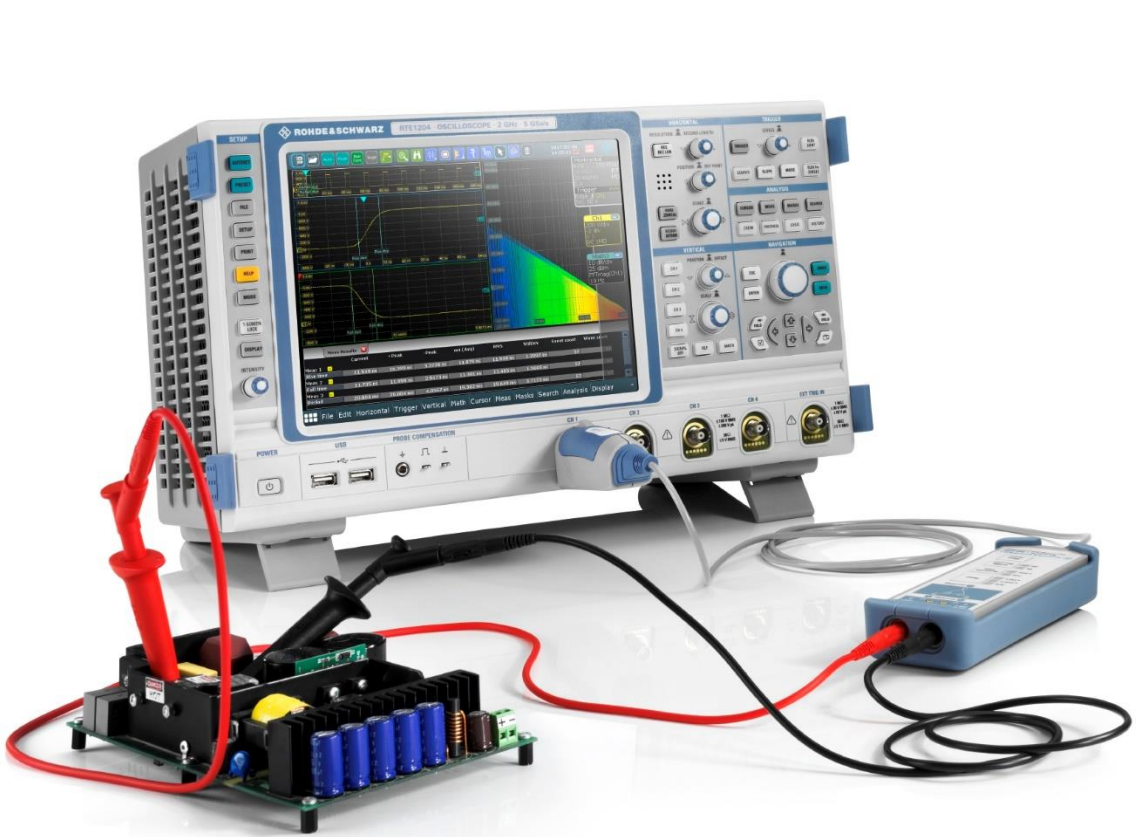
- Measurement and track, complex math functions
- User definable filters
- Frequency response analysis (Bode-Plot)
- FFT and harmonics analysis



R&S POWER SUPPLY SOLUTION

- Low Noise
- Up to 16 bit vertical resolution
- Large and segmented memory

- **Rich Probes Portfolio to address your needs**



Providing Unique Power Supply Analysis Functions

R&S OSCILLOSCOPE AND PROBES

Providing Unique Power Supply Test Functions

"The Power of 10"

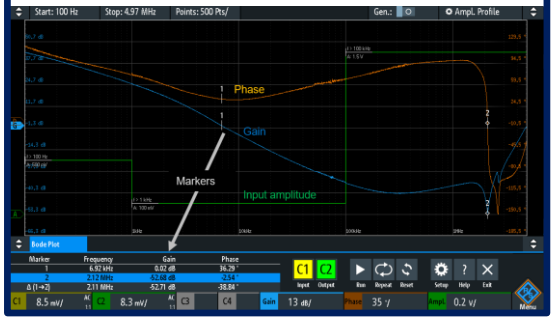
- RTB/ RTM/ RTA with:
  - 10 bit ADC (16 bit in HiRes)
  - up to 1 GSa segmented memory
  - 10" display
- RTE/ RTO with 16 bit HD mode
- RTH with isolated channels

Rich Probe Portfolio

- RT-ZHD diff. high voltage probes
  - Up to 200 MHz; up to 6000 V
  - Lowest noise
  - High linearity and small zero error
  - Unique up to 2000 V offset
- Portfolio of current probes
- Multi-channel 18 bit power probes

Unique Analysis Functions

- Bipolar PWM analysis
- Complex math
- User definable filters
- Frequency response analysis option
- Spectrum analyzer option



R&S T&M SOLUTIONS FOR POWER CONVERTER DESIGN

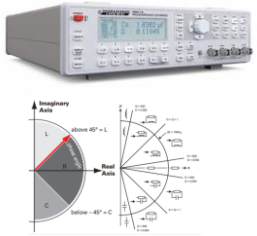
Addressing the whole product chain

Power Devices → Power Modules → Products → Systems

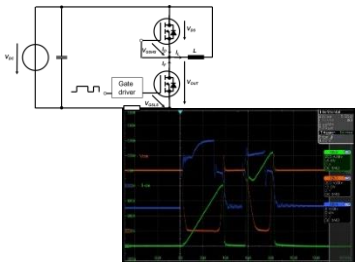
- Component Test / Validation
- Converter / Inverter Design
- Product / System Test
- Power MOSFET Dynamic Characterization
- EMI / Safety / General Compliance

Standard lab equipment: Power Supplies, Multimeter

Characterizing passives: R&S HM8118 LCR Bridge



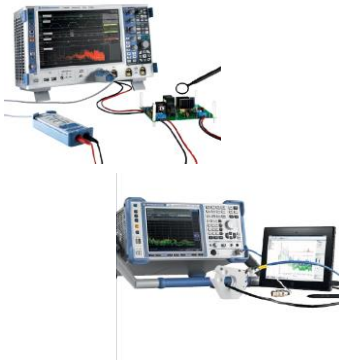
Double-pulse testing with R&S Oscilloscopes



Switching Analysis with R&S RT-ZHD HV-Diff Probes

Stability Analysis with Bode Plots

EMI Debug, Pre-compliance and Compliance

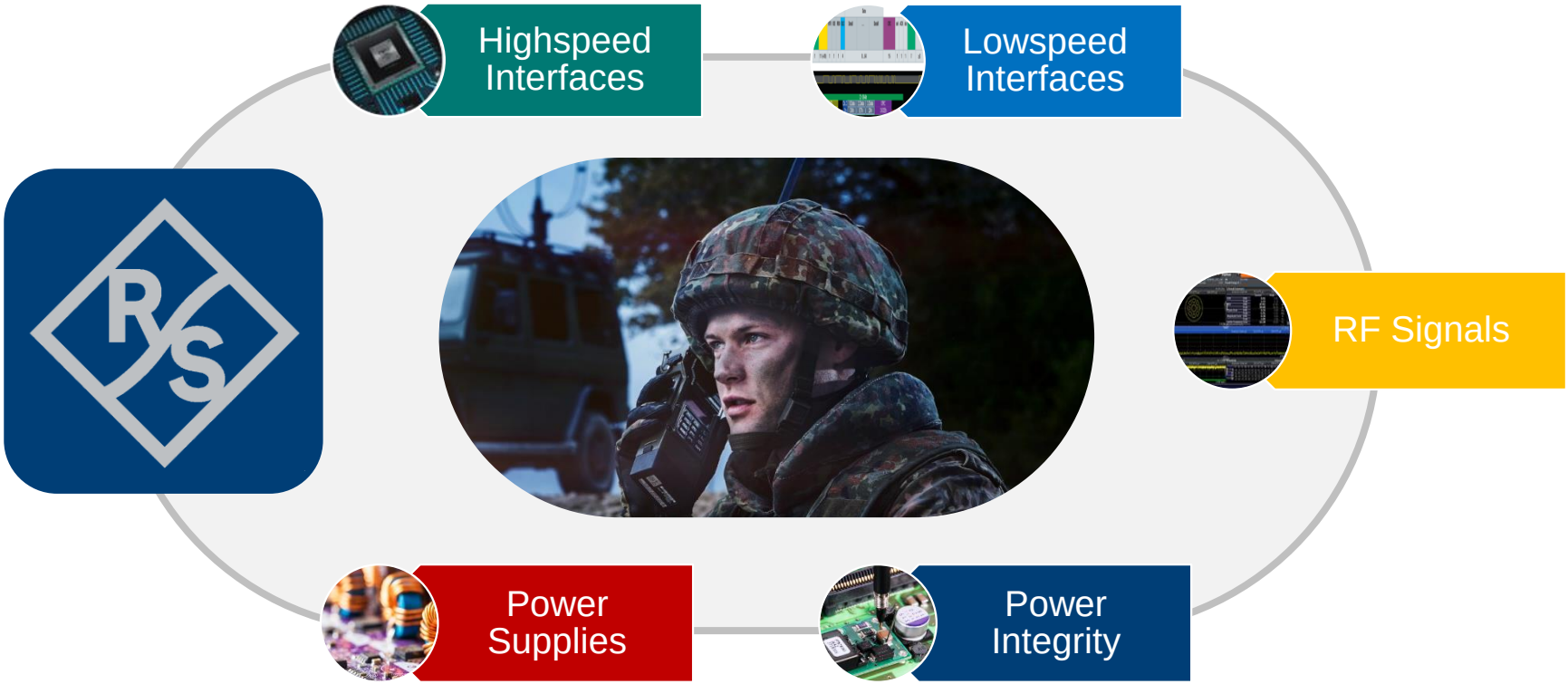


SUMMARY

R&S addresses T&M needs for RF, highspeed digital and power design.

VERIFY YOUR MILCOM RADIO DESIGNS AND COMPONENTS

R&S a reliable partner – providing overall T&M solutions



THANK YOU FOR YOUR ATTENTION!