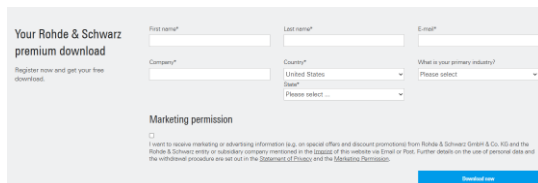


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- *Pocket Guides are multiple pages. Posters are 1 to 2 pages.*



The image shows a registration form for Rohde & Schwarz premium downloads. The form includes fields for 'First name*', 'Last name*', and 'E-mail*'. Below these are 'Company*', 'Country*' (with a dropdown menu showing 'United States'), and 'What is your primary industry?' (with a dropdown menu showing 'Please select...'). There is also a 'Marketing permission' section with a checkbox and a small disclaimer. A blue 'Download now' button is at the bottom right.

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Key Characteristics of Signal Generators and Modulation Methods.

[Power integrity: pocket guide](#)

Power Integrity is a key prerequisite for any digital and RF system design. This pocket guides shows, how to make accurate power rail measurements and how impedance measurements can help to detect typical root causes of Power Integrity issues.

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Request and/or download this pocket guide for important considerations for determining which technology best fits your application, its testing challenges, and certification tips.

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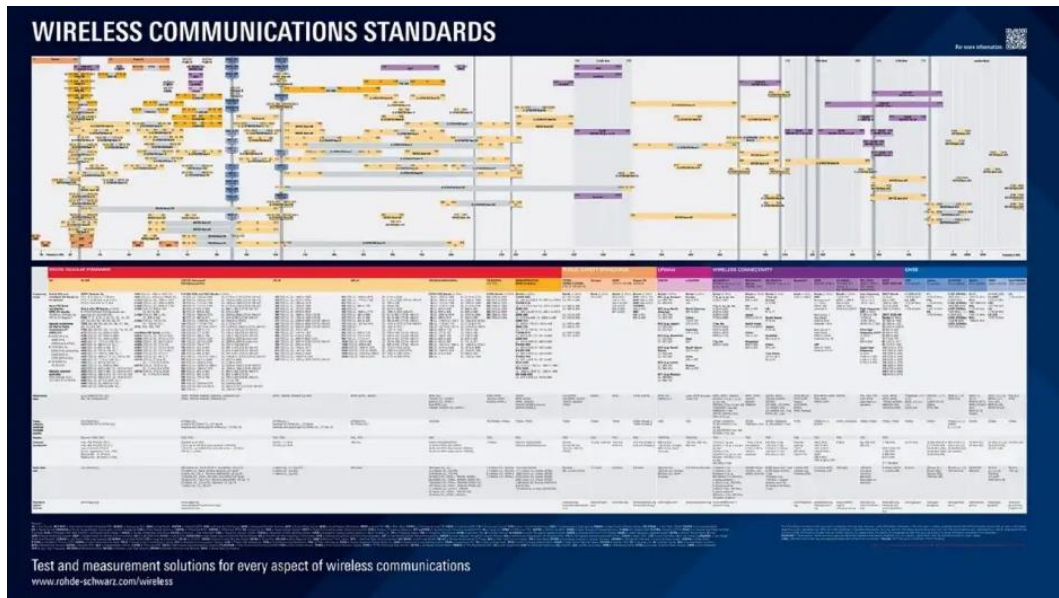
In RF design, the key specifications of active and passive components must be clearly understood to ensure that the system meets the requirements of the specific application. This guide gives an overview of important parameters and measurements for active and passive components.



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[Oscilloscope fundamentals](#)



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The HISTORY and FUTURE of Wi-Fi

Learn more about IEEE 802.11 testing: www.rohde-schwarz.com/80211

Multi-system transmitter methods

Test and measurement solutions from Rohde & Schwarz

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More ideas, real!

The History and Future of Wi-Fi

POWERING DEMANDING APPLICATIONS

ROHDE & SCHWARZ High resolution power & voltage and current source with 50W load capacity for test, making a high load for challenging applications & test coverage. 802.11ax (Wi-Fi 6) requires higher power & voltage.

Model	Power	Voltage	Current	Load Capacity
PSM 1000	1000W	100V	10A	50W
PSM 2000	2000W	100V	20A	50W
PSM 3000	3000W	100V	30A	50W
PSM 4000	4000W	100V	40A	50W
PSM 5000	5000W	100V	50A	50W

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Powering Demanding Applications

Power Integrity Fundamentals

A guide to verifying power rail tolerances

Caution! Measurements

Learn how to get the most accurate results from your measurements at any of the 100+ nodes. Your system is only as good as the tolerance measurement strategy.

Test equipment measurement challenges

Low bandwidth
The bandwidth of your test equipment is critical. A low bandwidth will result in a distorted signal, which can lead to incorrect measurements. To avoid this, you must ensure that the bandwidth of your test equipment is at least 10 times the bandwidth of the signal you are measuring.

High frequency
At high frequencies, parasitic inductance and capacitance become significant. These parasitics can lead to ringing and overshoot, which can be mistaken for real signal features. To avoid this, you must use test equipment with low parasitics and proper termination.

Impedance
The impedance of your test equipment is critical. A high impedance will result in a distorted signal, which can lead to incorrect measurements. To avoid this, you must use test equipment with a low impedance that matches the impedance of the signal you are measuring.

What to look for in an oscilloscope?

Bandwidth
The bandwidth of your oscilloscope is critical. It must be at least 5 times the bandwidth of the signal you are measuring. A higher bandwidth will result in a more accurate measurement.

Resolution
The resolution of your oscilloscope is critical. It must be at least 8 bits. A higher resolution will result in a more accurate measurement.

Sampling rate
The sampling rate of your oscilloscope is critical. It must be at least 2.5 times the highest frequency component of the signal you are measuring. A higher sampling rate will result in a more accurate measurement.

Triggering
The triggering of your oscilloscope is critical. It must be able to trigger on the signal you are measuring. A more advanced triggering will result in a more accurate measurement.

Power integrity analysis methods

Test Method	Key Parameters	Test Setup	Power Analysis
Transient Analysis	Transient Voltage Drop (TVD)	Load Regulation	Power Distribution Network (PDN) Impedance
Steady State Analysis	Load Regulation	Load Regulation	Power Distribution Network (PDN) Impedance
Dynamic Analysis	Dynamic Voltage Drop (DVD)	Dynamic Voltage Drop (DVD)	Power Distribution Network (PDN) Impedance
AC Analysis	AC Impedance	AC Impedance	Power Distribution Network (PDN) Impedance

Related to look for in a device?

- 1) All digital logic blocks
- 2) High speed
- 3) High resolution
- 4) High accuracy

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Power integrity fundamentals

CONNECTING ALMOST EVERYTHING WITH BLUETOOTH® LOW ENERGY

Channel plan (5.1)

Physical layer overview (5.1)

Mode	Frequency	Bandwidth	Symbol rate	Modulation
LE 1M	2.402 GHz	1 MHz	1.5 Msps	GFSK
LE 2M	2.402 GHz	2 MHz	3 Msps	GFSK
LE 2M+CS	2.402 GHz	2 MHz	3 Msps	GFSK + CS
LE 2M+CS+LFH	2.402 GHz	2 MHz	3 Msps	GFSK + CS + LFH

Packet formats

Power aware state

Interfering devices over time

Angle of arrival (5.1)

Angle of departure (5.1)

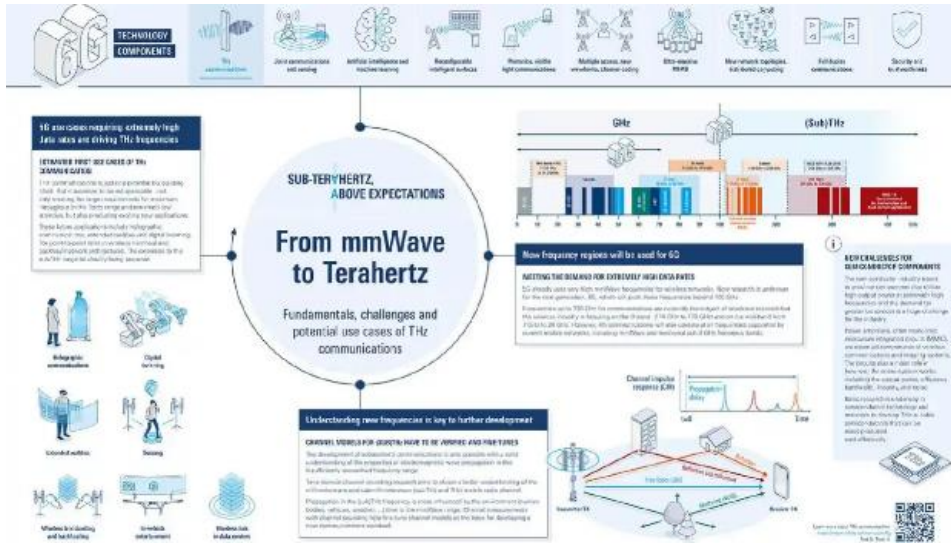
Power control mechanism (5.2)

Interference channels used for LE audio (5.2)

TEST SOLUTIONS FROM ROHDE & SCHWARZ – YOUR PARTNER IN TESTING BLUETOOTH® LOW ENERGY

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Connecting almost everything with Bluetooth® Low Energy



6G - from mmWave to Terahertz

Microwaves and beyond

Band	Frequency Range	Wavelength
1000 MHz	300 MHz - 3000 MHz	1 m - 100 cm
10 GHz	3 GHz - 30 GHz	10 cm - 10 mm
100 GHz	30 GHz - 300 GHz	10 mm - 1 mm
1 THz	300 GHz - 3 THz	1 mm - 0.1 mm

Mismatch reference and estimate of measurement uncertainty

Directivity and uncertainty

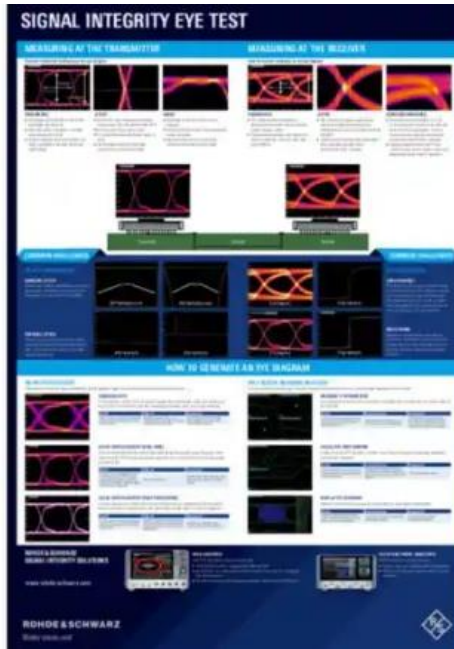
Correction factor for S/N

Signal level conversions

Waveguide standards

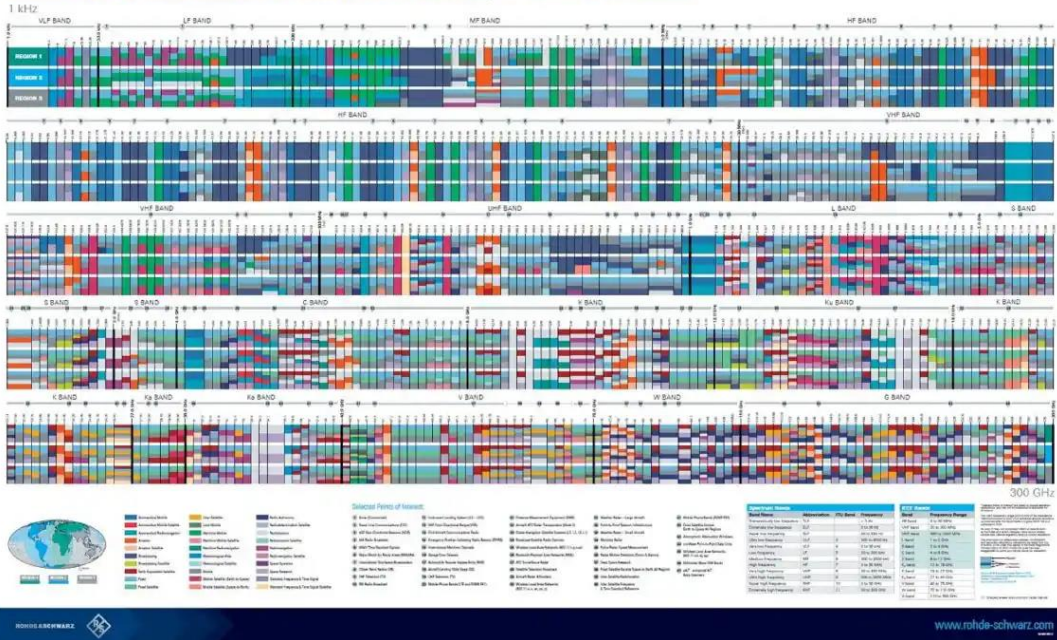
RF connector types

Microwaves and Beyond



Signal integrity eye test

WORLDWIDE SPECTRUM ALLOCATIONS Courtesy of Rohde & Schwarz



Worldwide Spectrum Allocations

5G brings PRIVATE NETWORKS to a new level

Applying 5G for private networks

The fast, flexible and low-latency capabilities of 5G networks enable business critical use cases such as manufacturing, warehouses, ports, mining, airports, etc. to provide an agile, flexible and scalable connectivity environment. 5G is able to address different requirements of high performing private networks and can ultimately facilitate technology trial implementations focus on critical use cases such as remote support for an airport using virtual reality (VR) to assist with maintenance related repairs and systems due to security concerns. The 5G core part of the mobile edge computing enables real time control of manufacturing and production processes by connecting 5G networks with manufacturing (IIoT) processes using Time Sensitive Networking (TSN) features for a hyperconnected environment. Devices and assets can be tracked and controlled and business management can be more efficient. 5G also can be used to decentralize private networks and also separate a single physical network into virtual slices, which supports the allocation of appropriate network resources to meet a specific usage.

How testing makes manufacturing smart

5G brings the possibility of faster and safer operation as well as new capabilities and efficiencies in industrial processes. It is also coming with increased complexity and performance demands for the network. Accurate and meaningful testing at every phase of the mobile network to prepare, deploy and operate private networks enables faster rollout, efficient use of network resources and avoidance of issues before they become critical.

Activity	1. ROLL-OUT PREPARATION	2. ACCEPTANCE	3. PERFORMANCE AND SERVICE LEVEL VERIFICATION	4. SHARED-BUILDING
Products	<ul style="list-style-type: none"> 5G LTE/5G NR test equipment 5G NR test equipment 5G NR test equipment 5G NR test equipment 	<ul style="list-style-type: none"> 5G NR test equipment 5G NR test equipment 5G NR test equipment 5G NR test equipment 	<ul style="list-style-type: none"> 5G NR test equipment 5G NR test equipment 5G NR test equipment 5G NR test equipment 	<ul style="list-style-type: none"> 5G NR test equipment 5G NR test equipment 5G NR test equipment 5G NR test equipment
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5G Private Networks

5G SITE TESTING

Ensure successful 5G site testing and troubleshooting

The emergence of 5G brings new challenges to the task of site testing such as new base station architecture, 5G connectivity requirements, higher frequency bands and the necessity to test parameters such as latency and download speed. Each new installation needs to be verified to ensure correct network performance and quality of service (QoS). However, with a well-defined test procedure and the correct test tools, a reliable and efficient process can be conducted. This primer provides a step-by-step guide to the required functional 5G site tests, groups them into different phases and lists the necessary test equipment.

Solutions to test the entire network lifecycle

Our mobile network testing portfolio addresses all phases of the network lifecycle from initial clearance and deployment to benchmarking, optimization and monitoring. We empower our customers to make 5G-centric decisions, to deliver better services with higher QoS and reduce time to market.

Activity	1. INITIAL CHECKS	2. ACCEPTANCE AND PERFORMANCE TESTING	3. PERFORMANCE AND SERVICE LEVEL VERIFICATION	4. SHARED-BUILDING
Products	<ul style="list-style-type: none"> 5G NR test equipment 5G NR test equipment 5G NR test equipment 5G NR test equipment 	<ul style="list-style-type: none"> 5G NR test equipment 5G NR test equipment 5G NR test equipment 5G NR test equipment 	<ul style="list-style-type: none"> 5G NR test equipment 5G NR test equipment 5G NR test equipment 5G NR test equipment 	<ul style="list-style-type: none"> 5G NR test equipment 5G NR test equipment 5G NR test equipment 5G NR test equipment
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5G site testing

POWER ELECTRONICS DESIGN AND TESTING

CONVERTER TYPES

Group	Sub	Conversion	Line	Full-Bridge Structure	Soft-Switching	Top-Switching	Top	Phase	Two-switch Cell	Half-Cell	Topology	Full-Bridge	Power MOSFET/IGBT	Number of Cells	Power	Efficiency	Typical Losses	Typical Speed
AC-DC	Rectifier	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode
	Inverter	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode
DC-DC	Buck	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode
	Boost	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode
DC-AC	Inverter	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode
	Rectifier	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode	Diode

MOST IMPORTANT MEASUREMENTS

REQUIREMENTS

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EXTERNAL INTERFERENCE HUNTING

With an increasing number of important communication systems based on cellular networks, the need for quick and precise troubleshooting in these networks also increases. In many cases external interference are responsible for service trouble. This infographic shows the process of identifying and eliminating one of these interference sources. In our case, an interference source is located and eliminated. In our case, an interference source is located and eliminated. In our case, an interference source is located and eliminated.

- ### 1 Identification (alarm notification)

In case of a broken connection, the network operation center of the operator of the mobile network receives an alarm message from the network and issues a trouble ticket to its operation team. The main cause checks for internal network problems caused by intermodulation, overloaded or broken parts or external interference.
- ### 2 Verification (operator)

After internal interference could be excluded, a network operator technician starts first measures to search for external interference. He measures with a field strength hand-held spectrum analyzer and directional antenna by walking around a base station pointing the antenna in different directions. Once suspicion for external interference is proven, next step is to call the regulatory authorities, which is now responsible to precisely locate and eliminate the interference.
- ### 3 Location and mitigation (regulatory body)

The regulatory authority sends a mobile monitoring station to that site, where radio interference was recorded. The operators verify the unwanted emission in the spectrum before they turn it on the center with the vehicle. On the last meters, operators use the portable receiver with hand-held antenna for finally locating the interference source.

Mobile station with field strength antenna

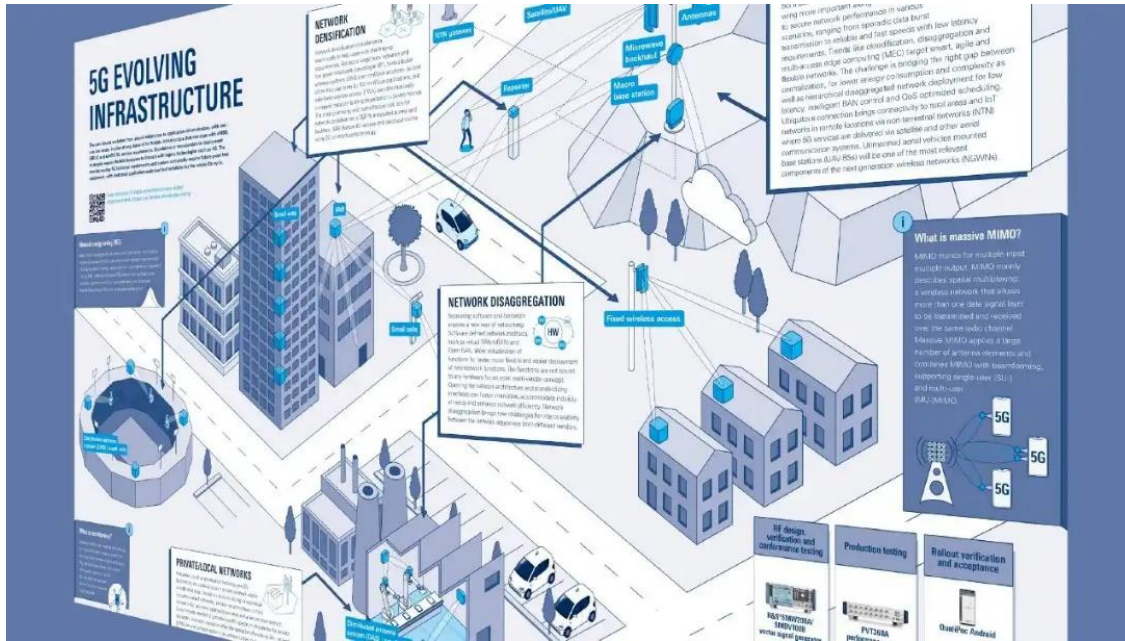
Directional antenna with directional antenna

Portable receiver with hand-held antenna

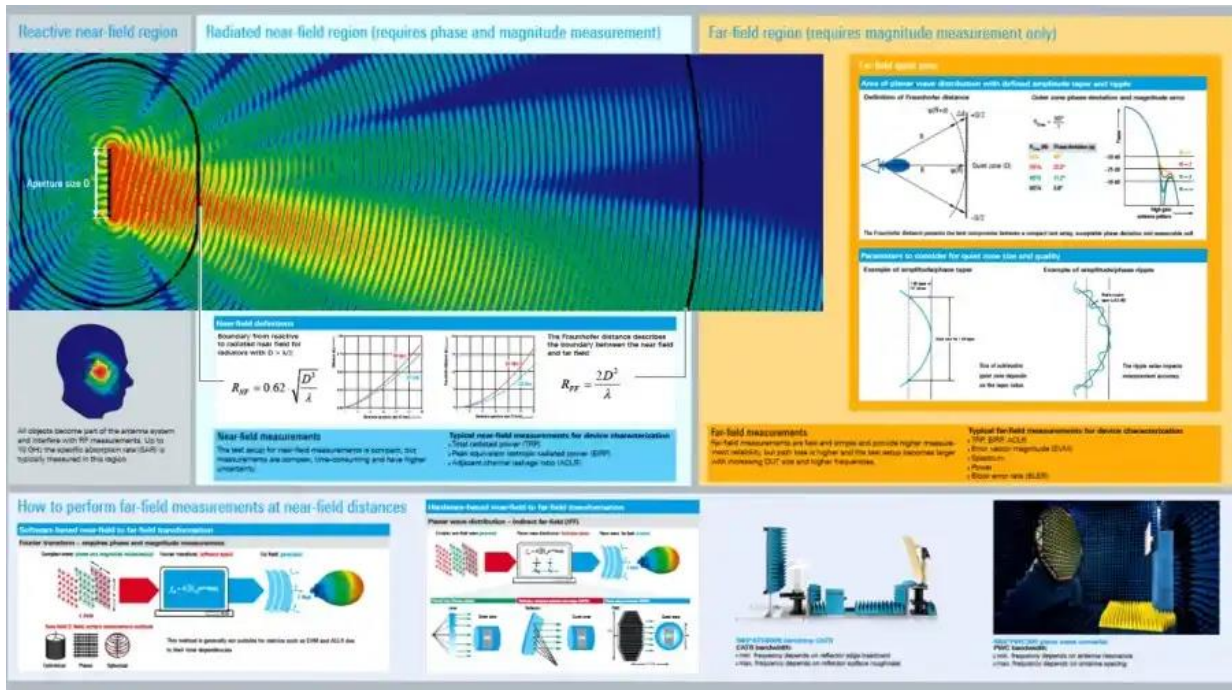
Mobile monitoring station with GPS antenna

Learn more about interference hunting
<http://www.rohde-schwarz.com/interference-hunting>

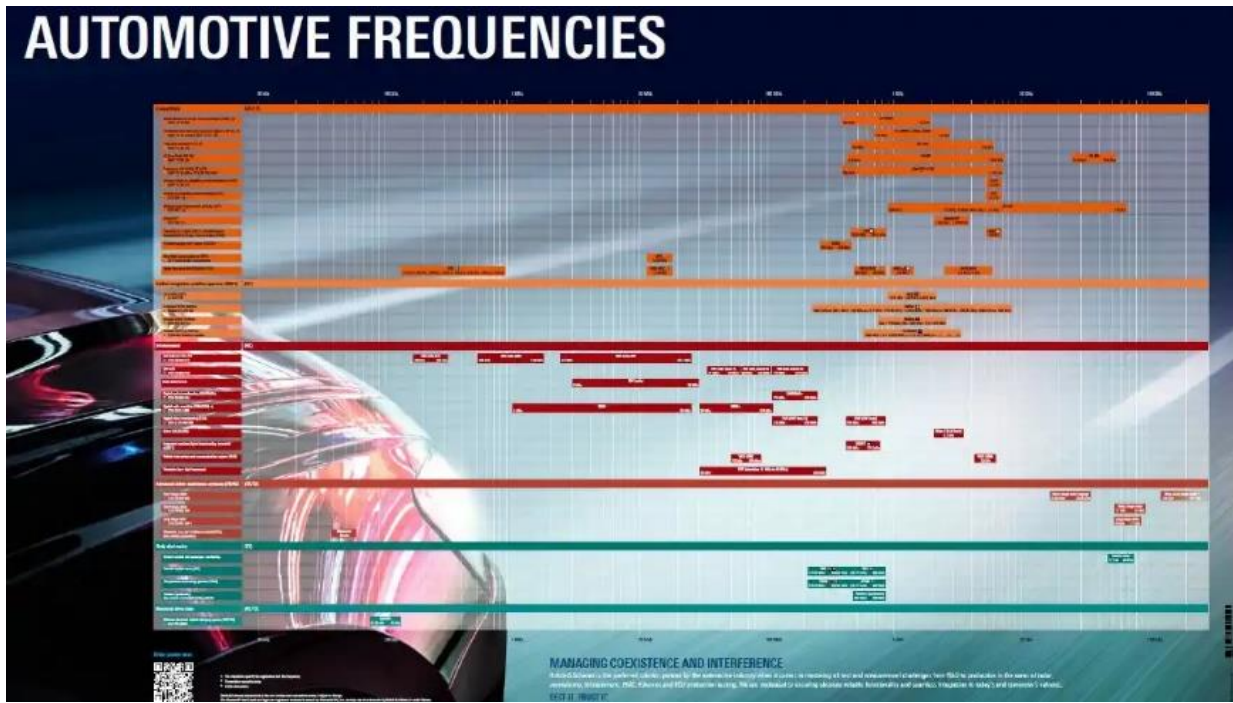
External Interference Hunting



5G infrastructure ecosystem



OTA testing



automotive radio frequencies

EMISSION TESTING IN LINE WITH MIL-STD-461

Advantages of FFT mode over stepped scans mode

Fast acquisition speed

Higher resolution

Real-time monitoring

Accurate peak detection

Low noise floor

Wide bandwidth

High dynamic range

Easy to use

Accurate for measuring the electrical field strength index with RE 302

EMI testing solutions from Rohde & Schwarz for AEC applications

Product	Application	Key Features
ESW	Automotive Emission	Wide bandwidth, high resolution
ESW	Automotive Emission	High dynamic range, real-time monitoring
ESW	Automotive Emission	Accurate peak detection, low noise floor
ESW	Automotive Emission	Easy to use, accurate for measuring

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Make sense test

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Emission testing in line with MIL-STD-461