

*Let's talk*

# **EMC & Regulatory test for wireless devices**

*All about test standards & R&S solutions*

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**ROHDE & SCHWARZ**

Make ideas real



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# Wireless technology is enabling a connected world

## Many tests are required for successful market access

### Regulatory Compliance Test

To grant market access under legal aspect

- CE RED
- FCC
- ...

### Telecom Industry Certification Test

To enable the high quality, reliability, and secure wireless communication

- GCF/CTIA Cellular
- SIG/Bluetooth
- FiRa/UWB
- WiFi Alliance/WiFi

### Cellular Network Operator Acceptance Test

To demonstrate interoperability for specific features

- AT&T
- VzW
- T-mobile
- CMCC



Wireless products become more complex than ever.



Wireless technology innovations are chasing higher frequency & bandwidth.



Wireless test scopes and methods are developed for 'next-level' of challenges.

# Wireless products need CE marking and/or FCC ID

## No regulatory compliance means no market access!

Testing according to regulatory standards is a mandatory step in the demonstration of compliance.



Test results are part of 'technical documentation':

- be prepared before placing product on the market
- be made available to surveillance authorities
- be kept for 10years from placed on the market

[Link](#)



Testing is performed by an FCC-recognized accredited testing laboratory.

[Link](#)



# CE

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# RED standards landscape developed by ETSI & Co.

## Tons of EN standards under 4 essential requirements

### Health & Safety Art 3.1a

“the protection of health and safety of persons and of domestic animals and the protection of property”

Directive 2014/35/EU  
CENELEC - EN 50360  
Specific Absorption Rate



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### EMC Art 3.1b

“an adequate level of electromagnetic compatibility as set out in Directive 2014/30/EU”

- EN 301 489-1 Common
- EN 301 489-17 WLAN
- EN 301 489-19 GNSS
- EN 301 489-33 UWB
- EN 301 489-50 Cellular BS
- EN 301 489-52 Cellular UE
- EN 301 489-?? ...



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### Radio Spectrum Art 3.2

“Radio equipment shall be so constructed that it both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference”

- EN 303 883-1/2 UWB
- EN 303 413 GNSS
- EN 300 328 WLAN2.4GHz
- EN 301 893 WLAN5GHz
- EN303 687 WLAN6GHz
- EN 301 908-1 Cellular Common
- EN 301 908-2 WCDMA UE
- EN 301 908-3 WCDMA BS
- EN 301 908-13 LTE UE
- EN 301 908-14 LTE BS
- EN 301 908-24 5G NR BS
- EN301 908-25 5G NR UE

### Specific topics Art 3.3

(g) radio equipment supports certain features ensuring access to emergency services;

Guideline 2019/320 (E112)



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# Specific Absorption Rate is the most important test for Health & Safety Art3.1a



## Health & Safety Art 3.1a

“the protection of health and safety of persons and of domestic animals and the protection of property”

Directive 2014/35/EU  
CENELEC - EN 50360  
Specific Absorption Rate



To demonstrate the extreme transmission power of EUT, network emulators are necessary for the test.



CMW500



CMX500

Network emulator for SAR testing



# RED standards for EMC Art3.1b

## Test cases focus on both emission and immunity

### EMC Art 3.1b

“an adequate level of electromagnetic compatibility a set out in Directive 2014/30/EU

- EN 301 489-1 Common
- EN 301 489-17 WLAN
- EN 301 489-19 GNSS
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- EN 301 489-?? ...



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Table A.1: Relationship between the present document and the essential requirements of Directive 2014/53/EU

Harmonised Standard ETSI EN 301 489-1					
No	Requirement			U/C	Requirement Conditionality
	Description	Essential requirements of Directive	Clause(s) of the present document		Condition
1	Emissions: Enclosure port	3.1b	8.2	C	Only applicable to ancillary equipment not incorporated in the radio equipment.
2	Emissions: DC power input/output ports	3.1b	8.3	C	Only where equipment has DC power input and/or output ports with a cable length greater than 3 m or from a vehicle power supply.
3	Emissions: AC mains power input/output ports	3.1b	8.4	C	Only where equipment has AC mains power input and/or output ports.
4	Emissions: Harmonic current emission (AC mains input port)	3.1b	8.5	C	Only where equipment has AC mains power input ports.
5	Emissions: Voltage fluctuations and flicker (AC mains input ports)	3.1b	8.6	C	Only where equipment has AC mains power input ports.
6	Emissions: Wired network ports	3.1b	8.7	C	Only where equipment has wired network ports.
7	Immunity: Radio frequency electromagnetic field (80 MHz to 6 000 MHz)	3.1b	9.2	U	
8	Immunity: Electrostatic discharge	3.1b	9.3	U	
9	Immunity: Fast transients common mode	3.1b	9.4	C	Applicable for equipment with AC mains power input ports.
10	Immunity: Fast transients common mode	3.1b	9.4	C	Applicable for equipment with DC power ports with cables longer than 3 m.
11	Immunity: Fast transients common mode	3.1b	9.4	C	Applicable for equipment with cable(s) longer than 3 m connected to signal, wired network, or control ports.
12	Immunity: Radio frequency common mode	3.1b	9.5	C	Applicable for equipment with AC mains power input ports.
13	Immunity: Radio frequency common mode	3.1b	9.5	C	Applicable for equipment with DC power ports with cables longer than 3 m.
14	Immunity: Radio frequency common mode	3.1b	9.5	C	Applicable for equipment with cable(s) longer than 3 m connected to signal, wired network, or control ports.
15	Immunity: Transients and surges in the vehicular environment	3.1b	9.6	C	Only where equipment is connected to vehicle power supply.
16	Immunity: Voltage dips and interruptions	3.1b	9.7	C	Only where equipment has AC mains power input ports.

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- Devices with AC/DC need all emission and Immunity test cases.
- Devices without power supply need immunity test only. Radio frequency electromagnetic field test, which require analog signal generator and power amplifier and antenna.
- The test method is in accordance with CENELEC EN 61000-4-3, clauses 6, 7 and 8.

[TS9982 EMS&TS9975 EMI systems](#)




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# RED standards for Radio Spectrum Art3.2

## Test cases for devices with unlicensed frequency bands

Radio Spectrum Art 3.2		Test case	EN 300 328	EN 301 893	EN 303 687		
<p>"Radio equipment shall be so constructed that it both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference"</p> <p>EN 300 328    WLAN2.4GHz            EN 301 893    WLAN5GHz            EN 303 687    WLAN6GHz</p> 		Carrier frequency accuracy		X	X		
		RF output power	X	X	X		
		Transmit power control (TPC)		X			
		Spectrum power density	X	X	X		
		Occupied channel bandwidth	X	X	X		
		Transmitter unwanted emissions	In out-of-band domain		within 5GHz bands	Within 6GHz bands	
			Spurious domain		Outside 5GHz bands	Outside 6GHz band	
				Duty cycle, TX sequence, TX gap	X		
				Dwell time, minimum frequency occupation, hopping sequence (only for frequency hopping DUTs)	X		
				Hopping frequency separation	X		
		Medium utilization (MU) factor	X				
		Adaptivity	X	X	X		
		Dynamic frequency selection (DFS)		X			
		Receiver spurious emissions	X	X	X		
		Receiver blocking	X		X		
		Receiver adjacent channel selectivity			X		



# RED standards for Radio Spectrum Art3.2

Test cases for cellular technologies are similar to 3GPP TS 38.521/GCF Conducted, OTA and Radiated Spurious Emission



## Radio Spectrum Art 3.2

“Radio equipment shall be so constructed that it both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference”

- EN 301 908-1 Cellular Common
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- EN 301 908-3 WCDMA BS
- EN 301 908-13 LTE UE
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- EN 301 908-24 5G NR BS
- EN301 908-25 5G NR UE

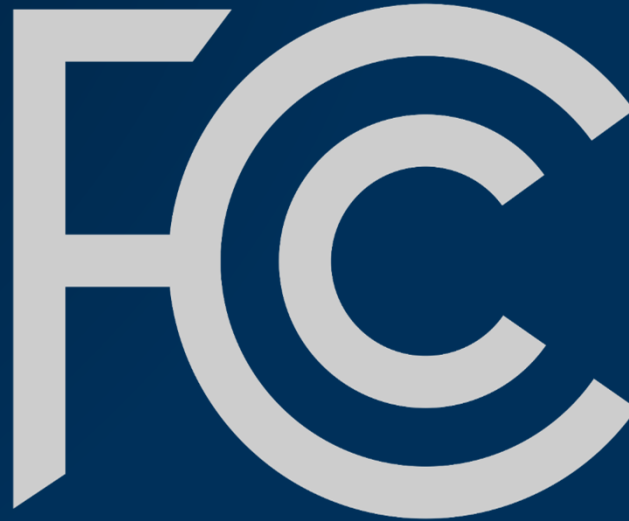


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Test case	EN 301 908-13	EN 301 908-25	EN 301 908-1
Transmitter maximum output power	X	X	
Transmitter minimum output power	X	X	
Transmitter spectrum emission mask	X	X	
Transmitter Adjacent Channel Leakage Power Ratio	X	X	
Transmitter spurious emissions	X	X	
Receiver Reference Sensitivity Level	X	X	
Receiver adjacent channel selectivity (ACS)	X	X	
Receiver blocking characteristics	X	X	
Receiver spurious response	X	X	
Receiver intermodulation characteristics	X	X	
Receiver spurious emissions	X	X	
Transmit OFF power		X	
Receiver Total Radiated Sensitivity (TRS)	X		
Total Radiated Power (TRP)	X		
Radiated emissions		X (5G NR FR2)	X

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# FCC test requirements are defined as Code of Federal Regulation ANSI standards define the test methods

CFR47  
[\[link\]](#)

Cellular FR1

Cellular FR2

Non  
Terrestrial  
Network  
\$25

NII-WiFi & Co  
Unlicensed bands  
\$15

Ultra Wide  
Band  
\$15/25

\$2/22/24/27/90

Conducted  
setup

IEEE STANDARDS ASSOCIATION IEEE  
American National Standard for  
Compliance Testing of Transmitters  
Used in Licensed Radio Services

IEEE SA  
STANDARDS  
ASSOCIATION  
American National Standard of  
Procedures for Compliance Testing  
of Unlicensed Wireless Devices

C63.10

Radiated  
setup

Human  
exposure

- IEC/IEEE 62209-1528 Measurement procedure for the assessment of specific absorption ... (of 4 MHz to 10 GHz)
- C63.19 American National Standard Methods of Measurement of Compatibility Between Wireless Communications Devices and Hearing Aids

# FCC defines test requirements under CFR47

## Many fragmented test solutions are required



Technology	Cellular	Satellite/NTN	Unlicensed bands WiFi	Ultra Wideband
CFR47	§2/22/24/27/...	§25	§15 (c/e)	§15 (f)
Conducted Test				
Radiated Test				
EMF Test/ Human exposure &Co.				

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**firo** | The Power to Be Precise



CMP200 for FiRa UWB



R&S®ATS1800M



R&S®TS8980



R&S® CMX500



R&S® TS-LBS

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# R&STW Seminar & Webinar website

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## ACTIVITIES

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全部 | 實體研討會 | 線上研討會 | 合作展會

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C-V2X

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日期 2023/08/22 - 2023/08/22  
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<https://www.rohde-schwarz.taipei/activity.php>



2023/08/17

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2023 MOXA Care Day

*Thank you for your participation!*