

AUT

CISPR UPDATE

NEW DEVELOPMENTS IN CISPR AUTOMOTIVE STANDARDS FOR EMISSION MEASUREMENTS

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ROHDE & SCHWARZ

Make ideas real



EMC STANDARDS FOR AUTOMOTIVE

EMC Standards for Vehicles and ESA (Electronic Sub Assemblies)

Vehicle Manufacturer	Global	USA	Europe	China	Japan
GS, MB, TL, GMW, B21, etc.	ISO, CISPR	SAE	UN ECE Regulation No. 10	GB	JASO

CISPR | International special committee on radio interference | Comité international spécial des perturbations radioélectriques

- ▶ **Technical committee within the International Electrotechnical Commission (IEC)**
- ▶ **Long history - CISPR had its first meeting in June 1934 in Paris**
- ▶ **Members of CISPR are 41 National Committees (25 participate/ 16 observer), EBU, ETSI, CIGRE, IARU, CRAF and both ITU-R and ITU-T**

WAS ESTABLISHED TO CONSIDER THE PROTECTION OF RADIO RECEPTION FROM INTERFERENCE



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AUTOMOTIVE EMI

- ▶ CISPR 12
 - Off-board protection
- ▶ CISPR 25
 - On-board protection
- ▶ CISPR 36
 - Off-board protection electric and hybrid electric vehicles



CISPR 12 – PROTECTION OF OFF-BOARD RECEIVERS

Developed by CISPR sub-committee D

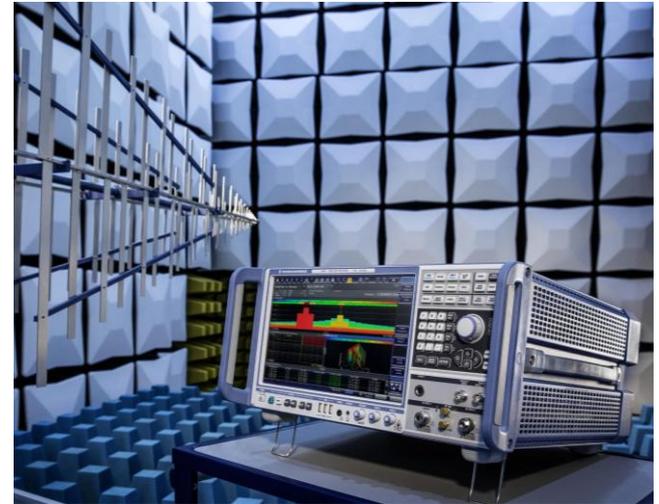
- ▶ **CISPR 12 Ed. 7** was published on **18 July 2025**
- ▶ Radiated emission **30 MHz to 1000 MHz**
- ▶ Protection distance 10 m
- ▶ Used for regulatory purposes
(referenced in legally binding UN ECE R10)
- ▶ Used for CE certification for devices
chainsaws, water pumps, snow blowers, air compressors, ...
- ▶ in Europe to be published as EN 55012:202x,
(date of withdrawal in EEA not defined yet)



CISPR 12 – PROTECTION OF OFF-BOARD RECEIVERS

► What's New in Edition 7?

- Vehicles, boats and **devices with** internal combustion engines **or traction batteries**
- Adds **electric vehicles** and **hybrid electric vehicles**
- The references to CISPR 16-1-1 will be updated to make **FFT-based receivers like R&S®ESW, ESR, EPL and ESU** applicable for EMI compliance measurements



CISPR 12 – PROTECTION OF OFF-BOARD RECEIVERS

Amendment 1:2010-06 to CISPR 16-1-1 (3rd Ed.)

► Blackbox approach



► FFT-based **measurement receiver** for compliance testing

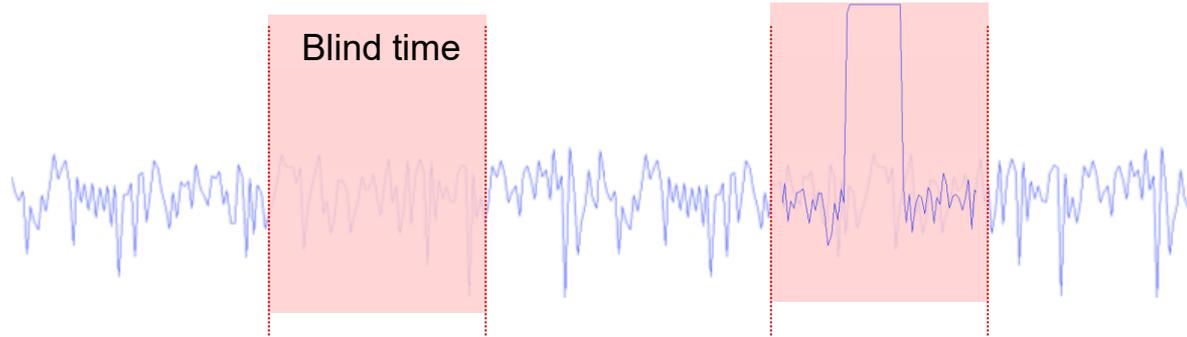


“instrument such as a tunable voltmeter, an EMI receiver, a spectrum analyzer or an FFT-based measuring instrument, with or without preselection, that meets the relevant parts of this standard”

CISPR 12 – PROTECTION OF OFF-BOARD RECEIVERS

Amendment 1:2010-06 to CISPR 16-1-1 (3rd Ed.)

- ▶ With traditional instruments there is a blind time between capturing the signal
- ▶ Information might be and will be overlooked

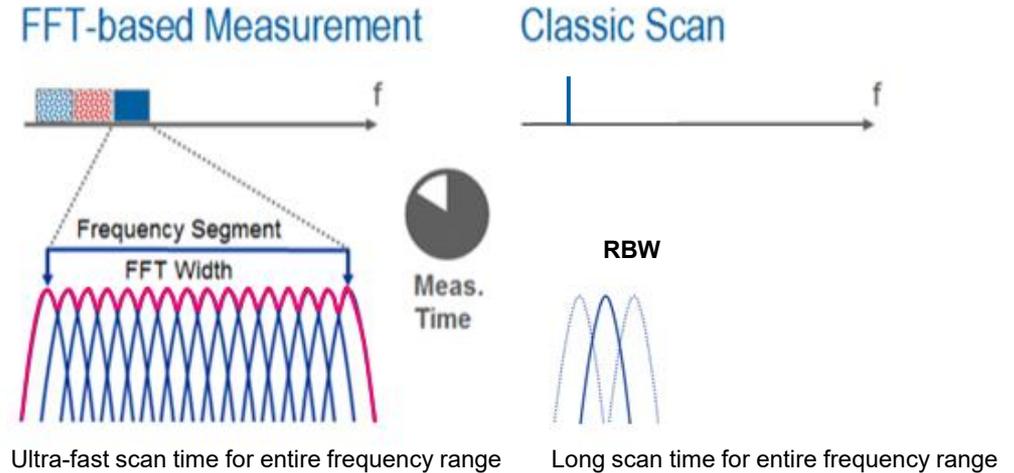


”for EMI measurements, FFT-based measuring instruments shall sample and evaluate the signal continuously during the measurement time”

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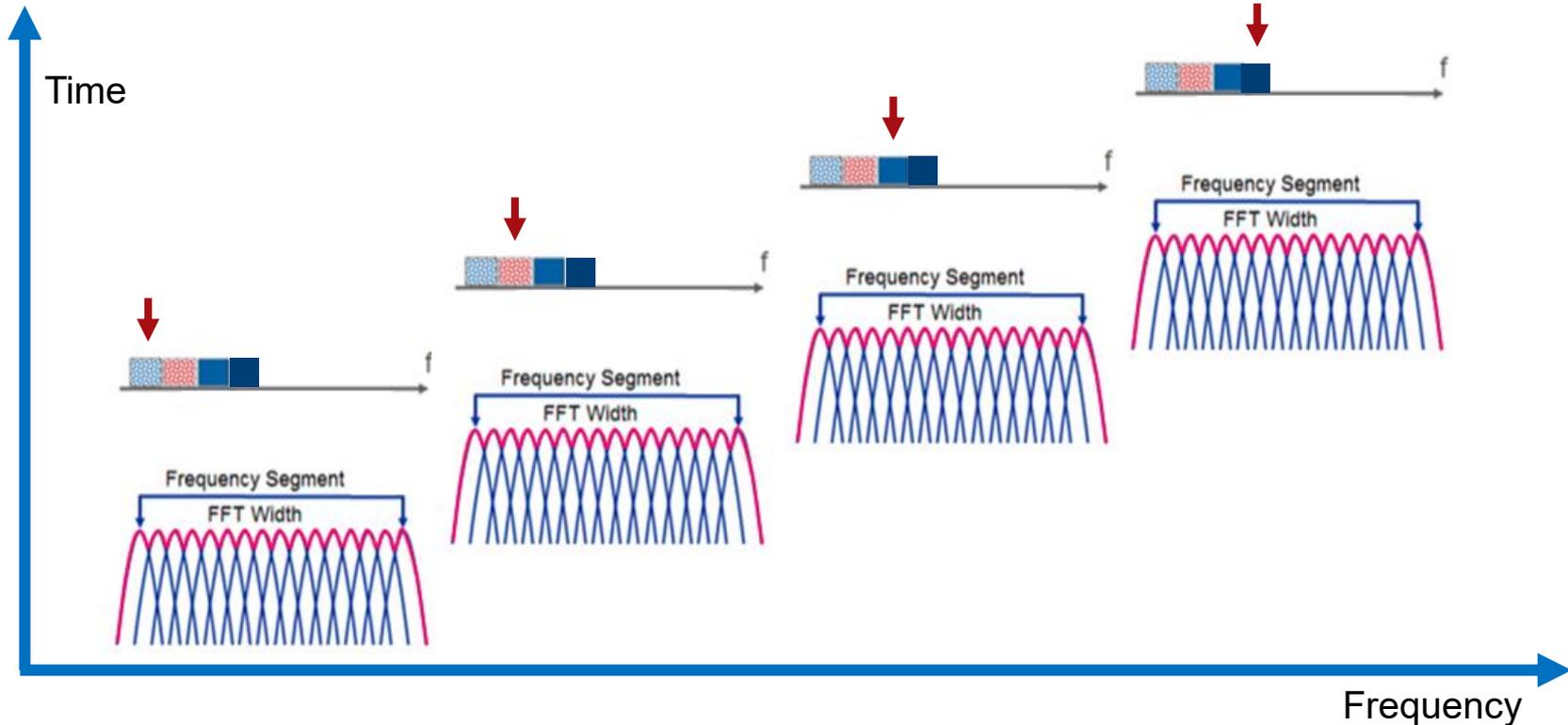
Motivation for FFT-based measurement instrumentation

- I **More Speed** – FFT-based receivers are measuring spectral segments much wider than the resolution bandwidth during the measurement time by parallel calculation at several frequencies
- I **More Reliable** – FFT allows application of longer measurement times, e.g. for measuring intermittent signals
- I **More Insight** – FFT offers enhanced measurement functions like the scan spectrogram



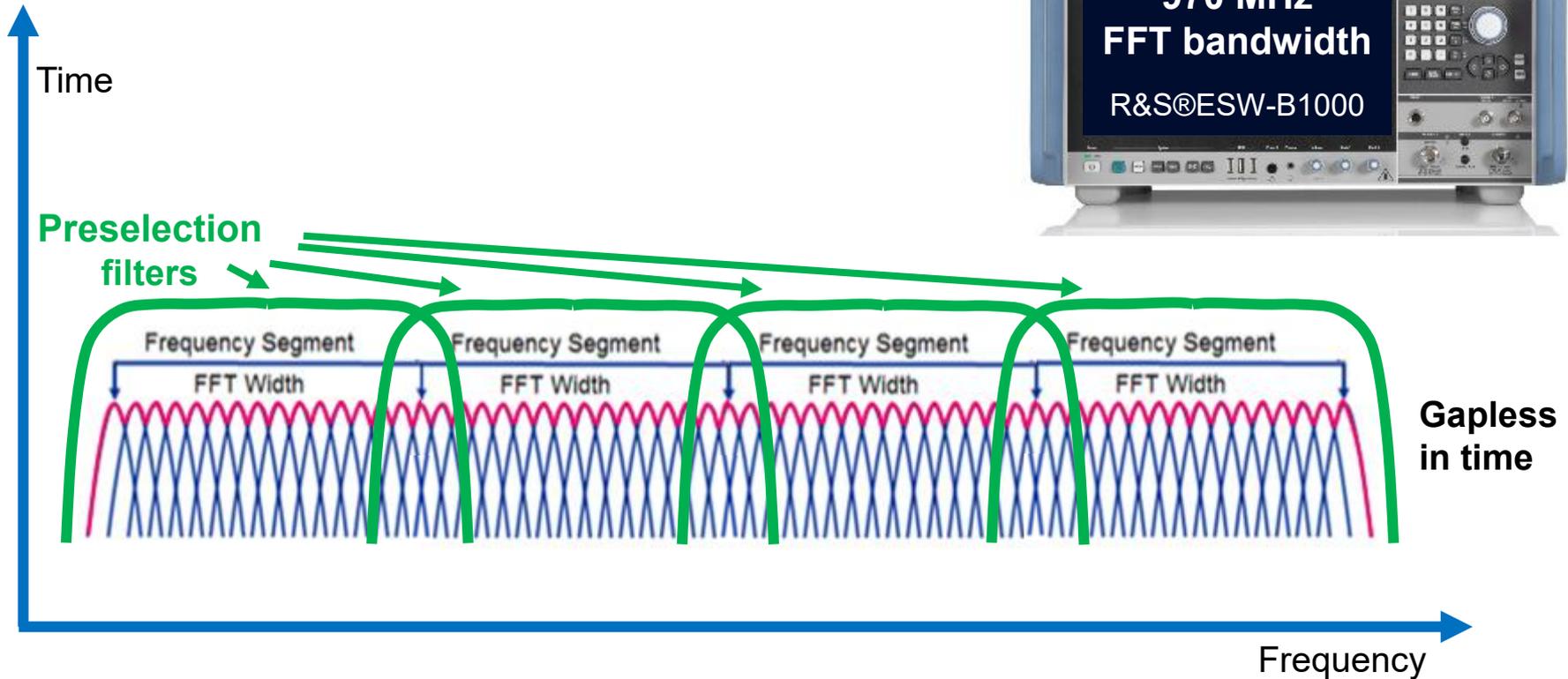
CISPR 12 – PROTECTION OF OFF-BOARD RECEIVERS

Consecutive measured FFT-Segments if Span > FFT Width



CISPR 12 – PROTECTION OF OFF-BOARD RECEIVERS

Parallel measured FFT-Segments



More Speed with Time-Domain Scan



Measurement Times	R&S ESW			B1000
	Stepped Scan	Auto TDS (Full compliant)	Fast TDS (PRF 10 Hz)	Speed TDS (PRF 5 Hz)
150 kHz – 30 MHz 9 kHz, Peak, 100 ms	12:35 min	0.11 s	0.11 s	0.11 s
150 kHz – 30 MHz 9 kHz, QP + CAV , 1 s	~ 3.8 h	2 s	2 s	2 s
30 MHz – 1000 MHz 120 kHz, Peak, 10 ms	4:15 min	0.38 s	0.38 s	0.018 s
30 MHz – 1000 MHz 120 kHz, QP + CAV , 1 s	~ 10 h	50 s	40 s	2 s

CISPR 12 – PROTECTION OF OFF-BOARD RECEIVERS



Scan spectrogram

Practical use

Open via Remote Key –
Vehicle wakes UP

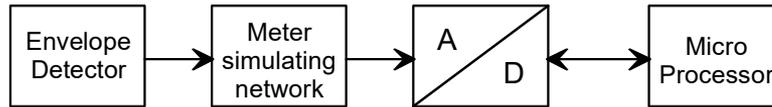
First you see Remote Key
communication ~433 MHz

Complete Vehicle/Board
Network is waking up
immediately afterwards,
Broadband Emission occur
over the hole Frequency
Band

CISPR 12 – PROTECTION OF OFF-BOARD RECEIVERS

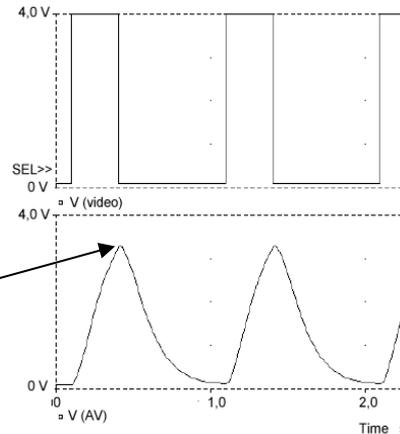
► What's New in Edition 7? (continued)

- The appropriate average detector is the **CISPR-AV detector** with meter time constant



For pulse-modulated signals with a PRF lower than the meter time constant, e.g. $f_p < 6$ Hz for Band A/B, the measurement result is not the average!

but the maximum of the output of the meter simulating network



Meter Time Constant

Band A/B = 160 ms

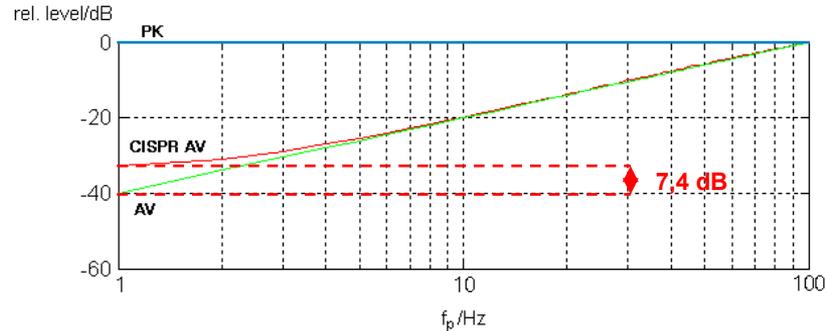
Band C/D/E = 100 ms

CISPR 12 – PROTECTION OF OFF-BOARD RECEIVERS

Example for pulse width = 10 ms, measurement time $T_{\text{meas}} > 10 / f_p$

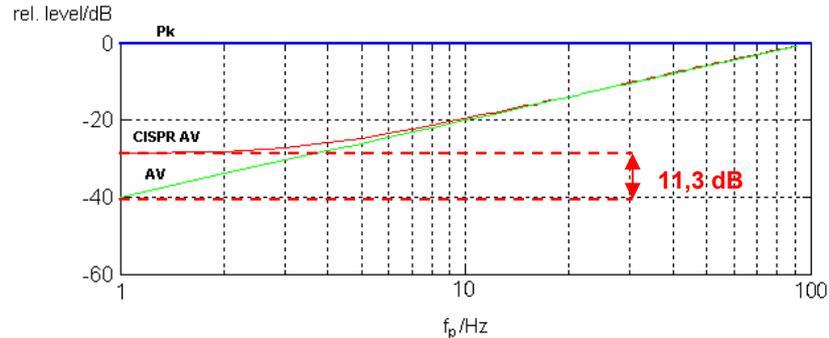
Band A/B:

$T_{\text{meter}} = 160 \text{ ms}$



Band C/D/E:

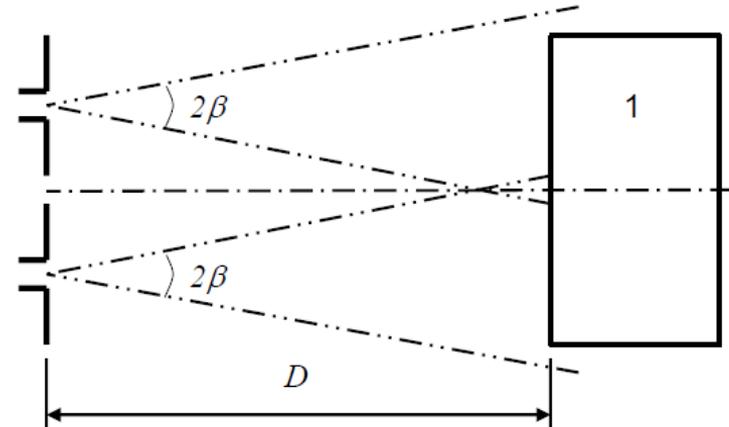
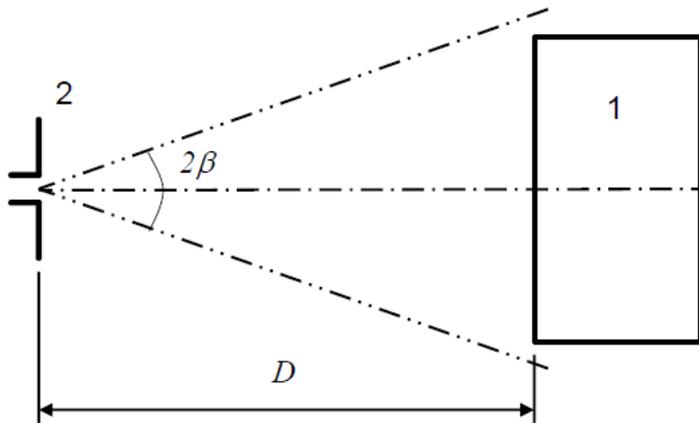
$T_{\text{meter}} = 100 \text{ ms}$



CISPR 12 – PROTECTION OF OFF-BOARD RECEIVERS

► What's New in Edition 7? (continued)

- Antenna position for vehicles, it is proposed to define the center position of the EUT as reference point if **3 dB antenna beam width** covers the entire EUT
- Otherwise, multiple antenna positions are necessary



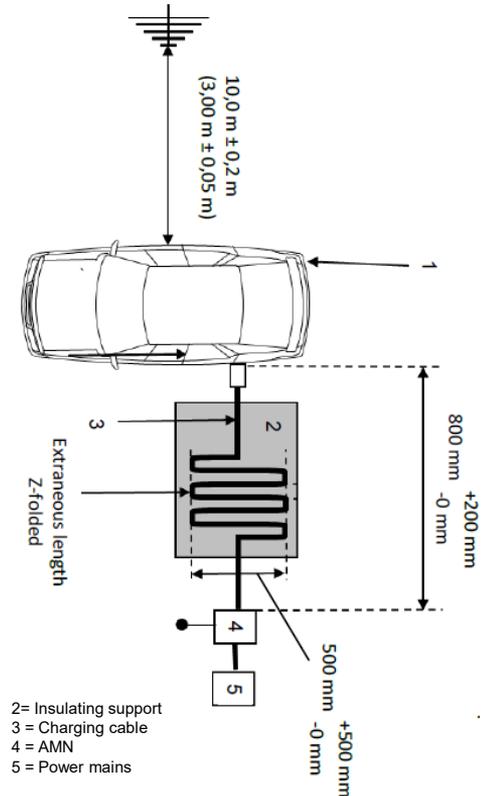
Source: CIS/D/498/CDV

CISPR 12 – PROTECTION OF OFF-BOARD RECEIVERS

► What's New in Edition 7? (continued)

■ Measurements in charging mode of **electric and hybrid electric vehicles** if the charger is part of the vehicle

- Conducted emission **not** in CISPR 12, (e.g. on-board chargers in IEC 61851-21-1)
- Radiated emission 30 MHz to 1000 MHz acc. to CISPR 12
- The measurements shall be performed in engine off mode and all other equipment shall be switched off
- AC Power mains lines through a **50 μ H//50 Ω AMN (R&S®ENV216/432/4200)**
- DC Power mains through a **5 μ H//50 Ω DC-charging-AN**



Source: CISPR 12:2025

CISPR 12 – PROTECTION OF OFF-BOARD RECEIVERS

► What's New in Edition 7? (continued)

- Measurements in “**engine running**” mode of **electric and hybrid electric vehicles**
 - Constant speed 40 km/h \pm 20 % driven on a dynamometer without load
 - or maximum if top speed of vehicle is less than 40 km/h
 - But revolution speed, e.g. 1000 rpm versus 3000 rpm may have an influence on the emission result
- New normative Annex F will be added on the consideration of **measurement instrumentation uncertainty (MIU)**, uncertainty budget (sample calculation) is given in informative Annex G



CISPR 12 – PROTECTION OF OFF-BOARD RECEIVERS

► What's New in Edition 7? (continued)

- **New Peak Limit proposal** for radiated disturbance - Separation into groups
- **Group 1:** Vehicles, boats and devices **with internal combustion engine in operation**
→ Peak limit 20 dB above Quasi-peak limit
- **Group 2:** Vehicles and boats **with electric propulsion motor in operation**
→ Peak limit 13 dB above Quasi-peak limit in **“engine running” mode**
→ Only Quasi-peak limit in **“charging” mode**
- **Group 3:** Vehicles with electric propulsion motor such as **E-transporters** (IEC 63281-1), **E-bikes** with pedal assistance (rated power ≤ 1000 W, with motor cut off when the cyclist stops pedaling or vehicle speed reaches 45 km/h) and **other vehicles designed to be used in pedestrian areas**
→ Only Quasi-peak limit in **“engine running” and “charging” mode**

CISPR 25

Automotive equipment
protection of on-board
receivers



CISPR 25 – PROTECTION OF ON-BOARD RECEIVERS

► Developed by CISPR sub-committee D

- 5th Edition was published on 16 December 2021
- Will be published in Europe on national level only, e.g. BS EN 55025 (UK), DIN EN 55025 (Germany)
- **EN 55025 is not listed in the Official Journal of the EU and has no legal status**

Therefore, the car component manufacturer has to apply the specific company standards of the car manufacturer, which are usually based on CISPR 25 or EN 55025 respectively



CISPR 25 – PROTECTION OF ON-BOARD RECEIVERS

► What's New in Edition 5?

- **Maximum frequency extended up to 6 GHz** for both component (ALSE method) and vehicle (voltage at internal antenna) testing, **this will add new bands:**
 - 4G: 2496 to 2690 MHz, 3300 to 3800 MHz and 5150 to 5925 MHz
 - WiFi: 5150 to 5350 MHz and 5470 to 5725 MHz
 - C2X (Car-to-X Communication): 5850 to 5925 MHz
- **Adds new GNSS band: BDS (BeiDou System)**
- **Deletion of Annex F on TEM cell method**
- **New Annexes will be added on the consideration of measurement instrumentation uncertainty (MIU), also uncertainty budget is given (sample calculation)**



CISPR 25 – PROTECTION OF ON-BOARD RECEIVERS

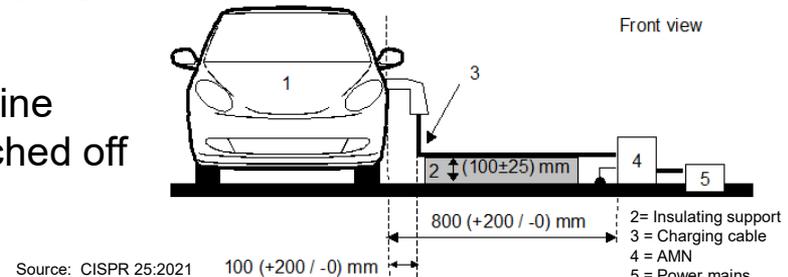
► What's New in Edition 5? (continued)

■ Revision of measurement methods in **charging mode** of electric and hybrid vehicles based on charging mode concept in IEC 61851-1 (Mode 1 to 4)

- Mode 1: AC power charging on **public power grid** (no communication)
- Mode 2: AC power charging on **wall box** (with communication)
- Mode 3: AC power charging on **charging station** (with communication)
- Mode 4: DC power charging on **charging station** (with communication)

■ Disturbance measurements in charging mode of electric and hybrid vehicles if the charger is part of the vehicle

- Vehicle test – Voltage at internal antenna
- The measurements are made without the engine running and all other equipment shall be switched off
- AMN/AN-HV same as for CISPR 12



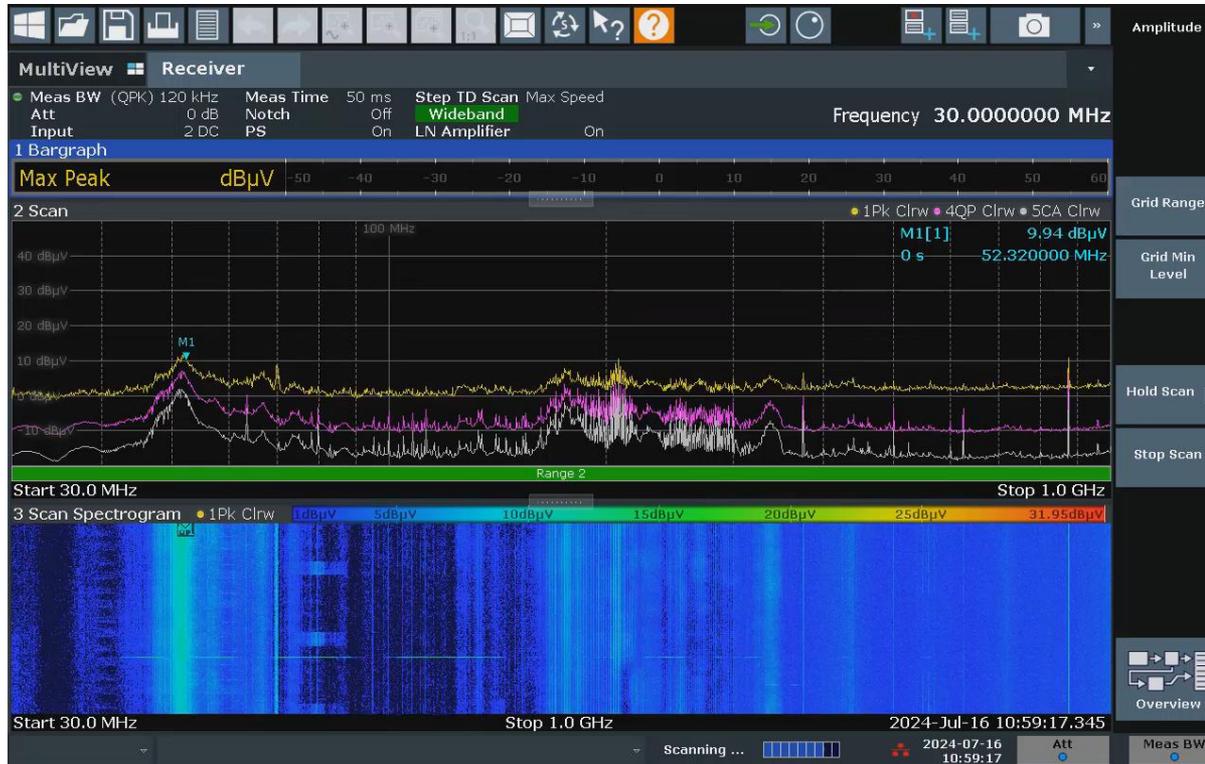
CISPR 25 – PROTECTION OF ON-BOARD RECEIVERS

► What's New in Edition 5? (continued)

- If using FFT-based instruments, the minimum measurement time should be 1 s
- Using the **minimum measurement time** as defined in Table 2 with a measuring receiver can result in enormous measurement result errors
- In a worst case the receiver will not capture the disturbance signal at all if the dwell time is shorter than the pulse repetition interval of the disturbance signal
- **Not suitable for measuring intermittent narrowband signals with CISPR-AV!**
Should be at least:
 - 160 ms in AM Band (<30 MHz)
 - 100 ms in Bands >30 MHz
 - ≥1 s recommended in all Bands

Service / Band	Frequency range MHz	Peak detection			Quasi-peak detection			Average detection		
		RBW at -6 dB	Max step size	Min mea- sure- ment time	RBW at -6 dB	Max step size	Min mea- sure- ment time	RBW at -6 dB	Max step size	Min mea- sure- ment time
Analogue broadcast services										
LW	0,15 to 0,30	9 kHz	5 kHz	50 ms	9 kHz	5 kHz	1 s	9 kHz	5 kHz	50 ms
MW	0,53 to 1,8									
SW	5,9 to -6,2									
FM	76 to 108	120 kHz	50 kHz	5 ms	120 kHz	50 kHz	1 s	120 kHz	50 kHz	5 ms
TV Band I	41 to 88									
TV Band III	174 to 230									
TV Band IV	470 to 944									
Digital broadcast services										
DAB III	167 to 245	1 MHz	500 kHz	50 ms	Does not apply	1 MHz	500 kHz	50 ms		
TV Band III	174 to 230									
DTTV	470 to 770									
DAB L Band	1 447 to 1 494									
SDARS	2 320 to 2 345									
Mobile services										
CB	26 to 28	9 kHz	5 kHz	50 ms	9 kHz	5 kHz	1 s	9 kHz	5 kHz	50 ms

CISPR 25 – PROTECTION OF ON-BOARD RECEIVERS



Scan spectrogram

Practical use

Honking

Honking 3 times shortly successively

CISPR 36

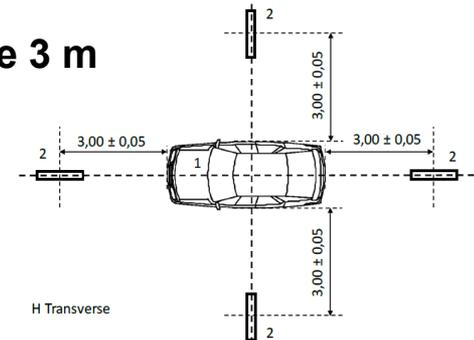
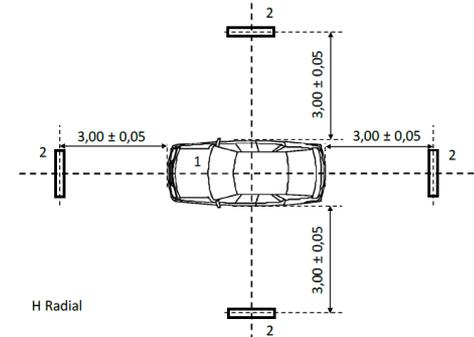
Automotive equipment
protection of off-board
receivers



CISPR 36 – PROTECTION OF OFF-BOARD RECEIVERS

► Developed by CISPR sub-committee D

- 1st Edition was published 22 July 2020
- **Electric and hybrid electric road vehicles**
- Quasi-peak limits for radiated emission (magnetic field) 150 kHz to 30 MHz, similar to CISPR 11 Class B Group 2 but more stringent above 4 MHz
- Measurement with 60 cm Loop Antenna like R&S®HFH2-Z2E in Radial (X) and Transverse (Y) direction at four positions, centre of loop at fixed height of 1,30 m, measurement distance 3 m
- Measurements with **electric engine running only**, constant speed 40 km/h \pm 20 % driven on dynamometer without load
- New normative Annex A on MIU, sample calculation in informative Annex B



Source: CISPR 36:2020

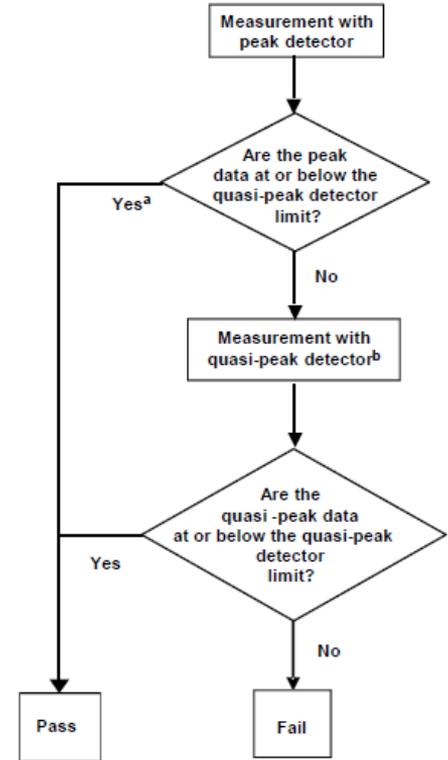
CISPR 36 – PROTECTION OF OFF-BOARD RECEIVERS

► Amendment 1 to CISPR 36 Edition 1

- ▮ The Amendment was **published on 17 May 2023**

► What's New in Amendment 1?

- ▮ Usage of term REES (rechargeable energy storage system) with voltages above 60 V, e.g. HV batteries
- ▮ Adds peak detector for prescan
 - ▮ Receiver: Minimum measurement time = 50 ms
 - ▮ Spectrum analyzer: Minimum sweep time = 10 s/MHz
 - ▮ **Can lead to a simplified and quicker conformance process if peak value is below Quasi-peak limit**



Source: CIS/D/483/CDV

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