

Safety Market Surveillance

Comparison of radiated electromagnetic emission in different normal driving conditions

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Topics

- Scope of testing
- Laboratory and test articles
- Test result of regulated modalities
- Test results of other normal driving conditions
- Conclusions

Scope of testing

2 vehicles of category M₁ have been tested regarding electromagnetic emission (UNECE Regulation 10) as part of the Vehicle Safety Market Surveillance activities as per Regulation (EC) 2018/858.

- Broadband radiated emission other than charging modes
 - Regulated modalities (40 km/h)
 - Other normal driving conditions upto 120 km/h
- Narrowband radiated emission – engine off

Test articles

Vehicle 1

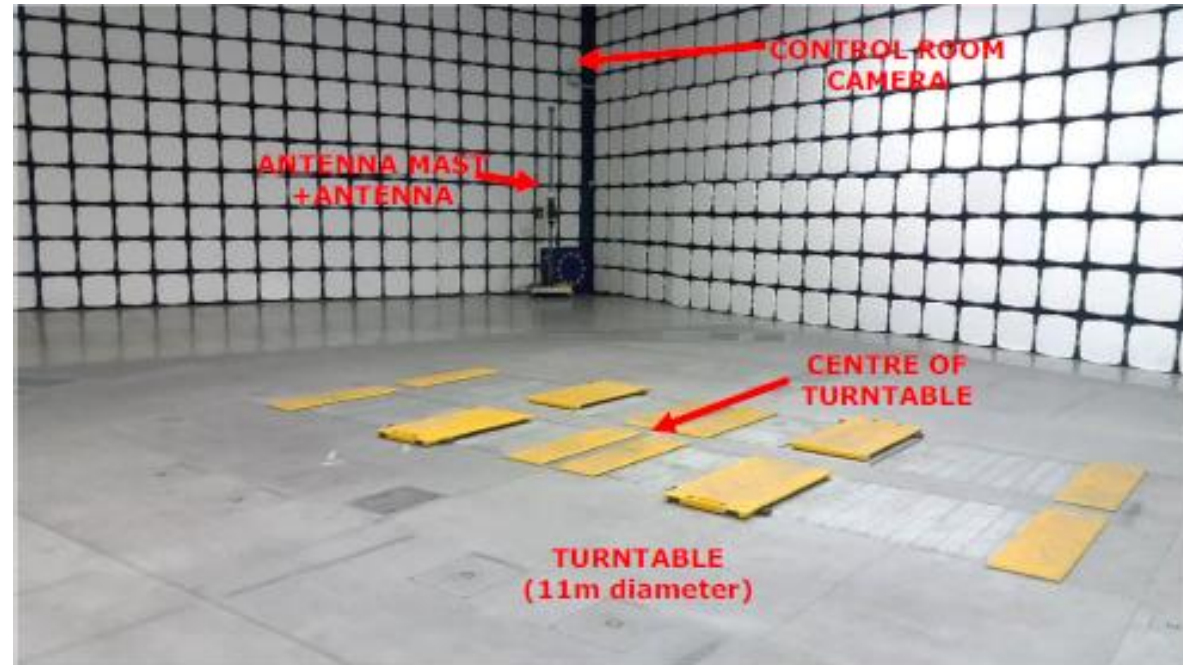
Parameter	Value
Model year	2020
Engine	Asynchronous rear and front electric engine : 300 kW
Battery size	80 kWh
Charging power	16A single-phase, 16A two-phases; Direct Current: 200A, Type 2; Combo 2 (CCS), 110kW

Vehicle 2

Parameter	Value
Model year	2020
Engine	Dual motor: rear (88kW) and front (65kW)
Battery size	75 kWh
Charging power	On-board 3-phase 48 A (AC), 250 kW (DC) with Supercharger V3

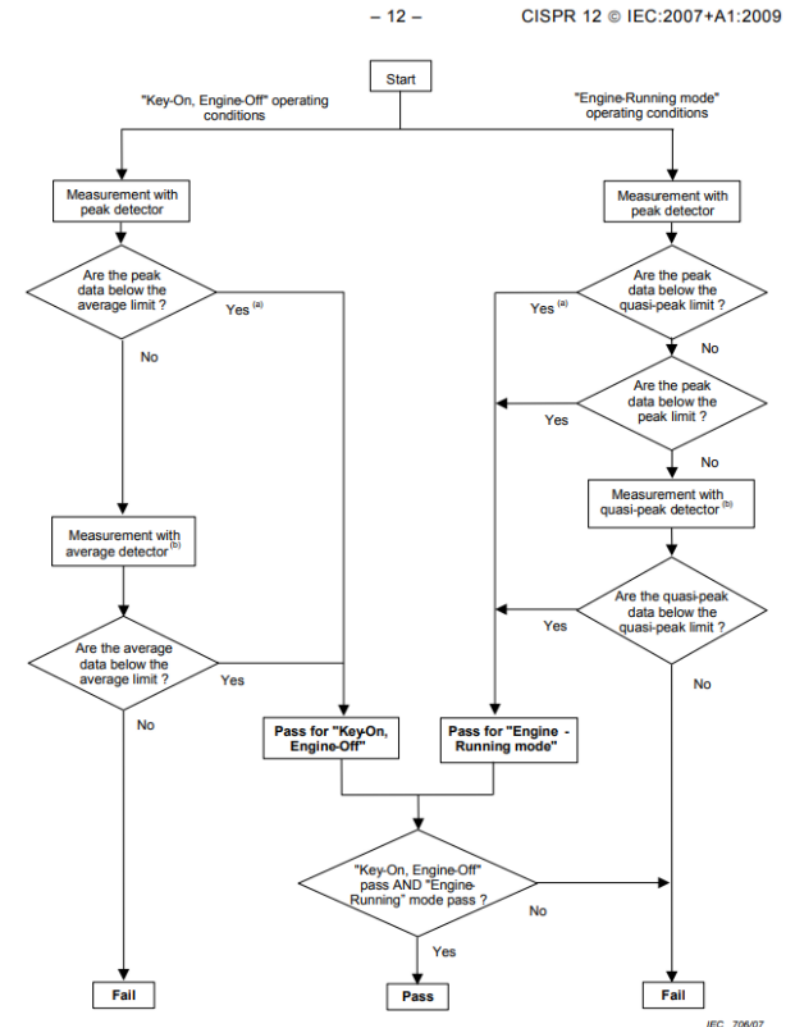
Laboratory: JRC Vela 9

- Semi anechoic chamber with dimension 21m x 15.6m x 8m
- Chassis dynamo by AVL
- Antenna: Schwarzbeck MESS VULB 9162 (placement at 10 m)
- Signal receiver: Rohde&Schwarz ESR 7



Test conditions

- Narrowband radiated emission: ANNEX 5 + CISPR 12: Key-on engine off
- Regulated broadband radiated emission: ANNEX 4 + CISPR 12
 - Driving at 40 km/h constant speed
- Other modalities:
 - constant driving: 40, 60 60, 100 and 120 km/h
 - 0-40-0 km/h acceleration in 10 s and highest regenerative braking power
 - 0-120-0 km/h acceleration in 30 s highest regenerative braking power
 - Stepped driving 40, 60 60, 100 and 120 km/h and highest braking
 - Random driving profile upto 120 km/h



Other normal conditions of use: Rational



Front engine works at 40 km/h



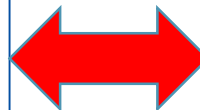
Both engines works at higher speed and during acceleration



Both engines recuperates energy during deceleration

UN ECE Regulation R10 (v5)

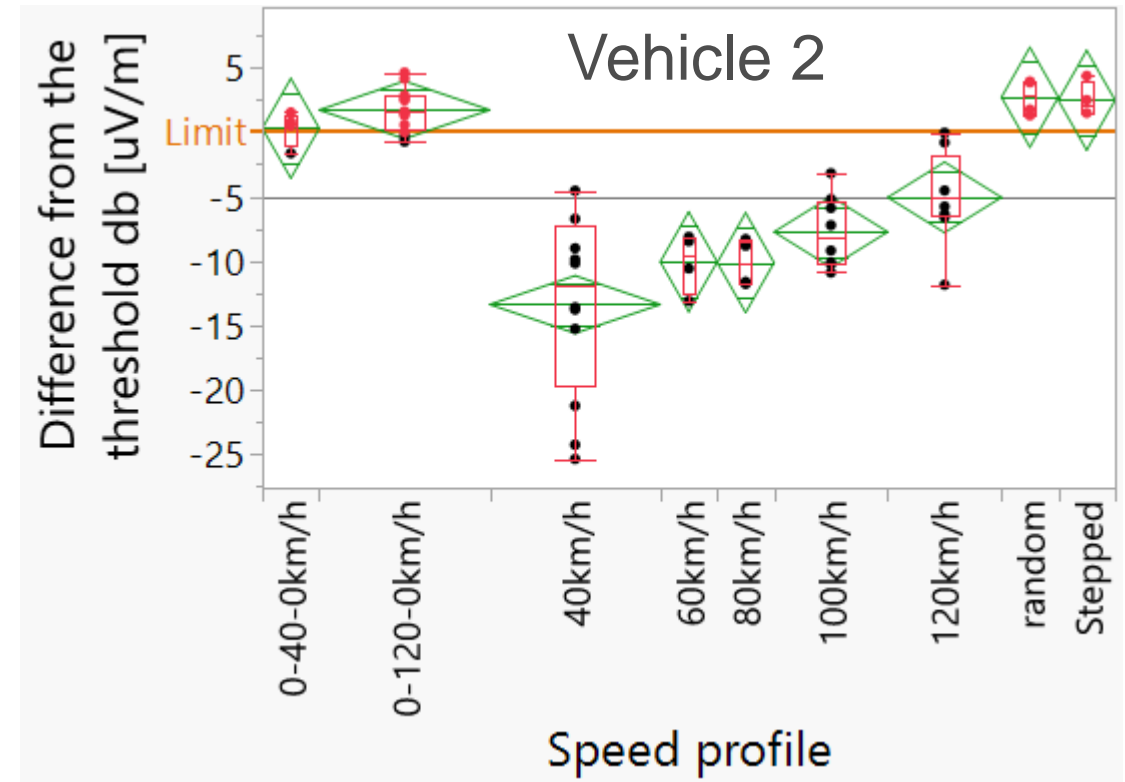
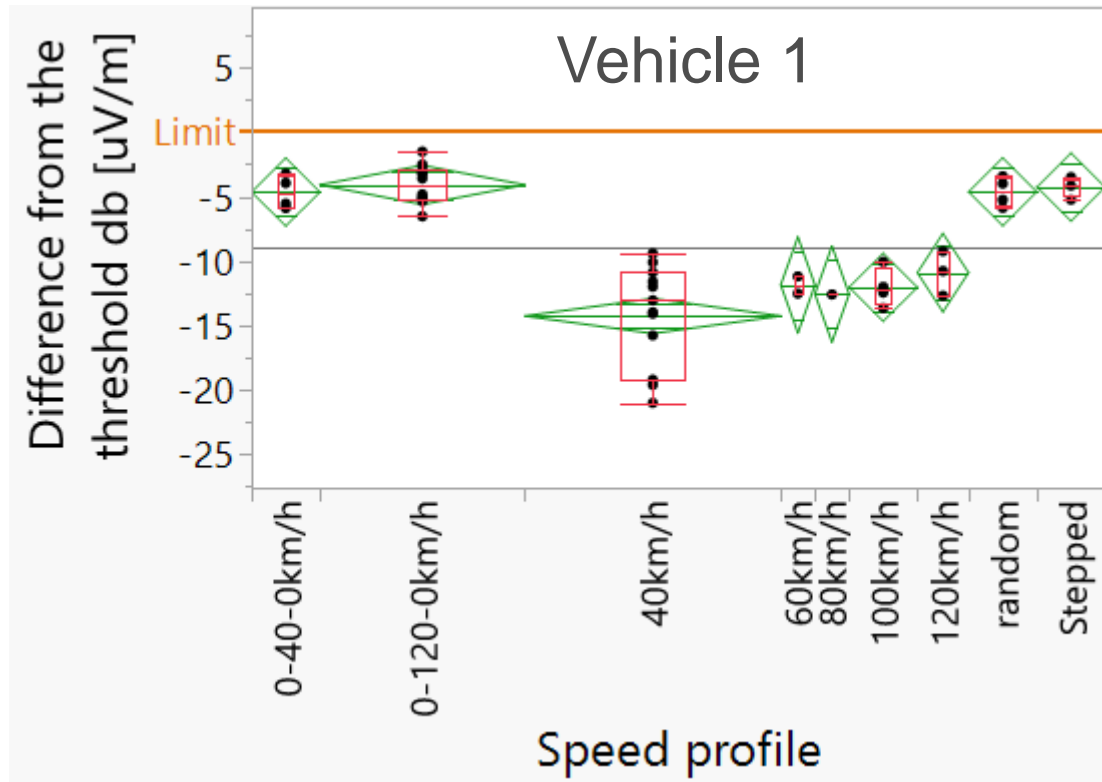
- 6.1.1. “A vehicle and its electrical/electronic system(s) or ESA(s) shall be so designed, constructed and fitted as to enable the vehicle, **in normal conditions of use**, to comply with the requirements of this Regulation.”
- 2.1.1. (ANNEX 4) **All equipment** capable of generating broadband emissions which can be switched on permanently by the driver or passenger should be in operation in maximum load, e.g. wiper motors or fans.



IEC CISPR 12

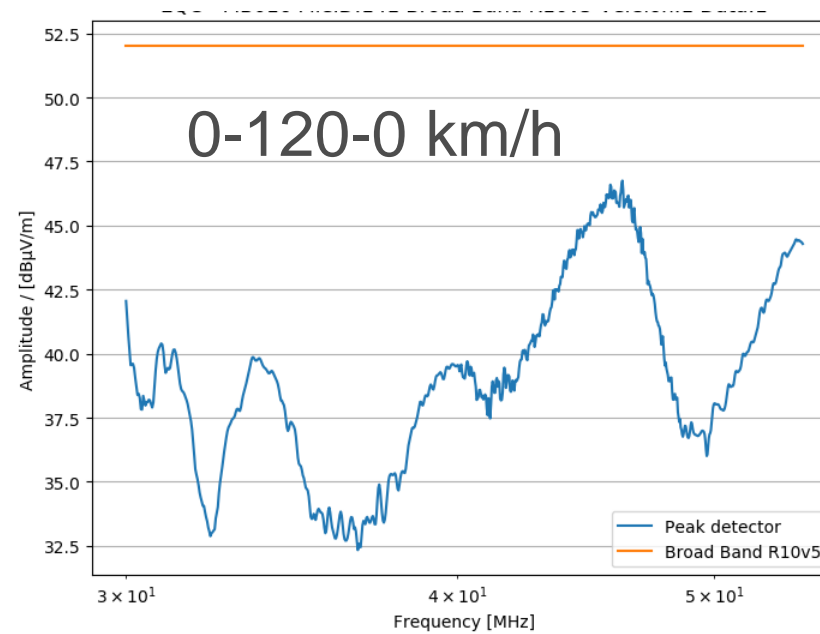
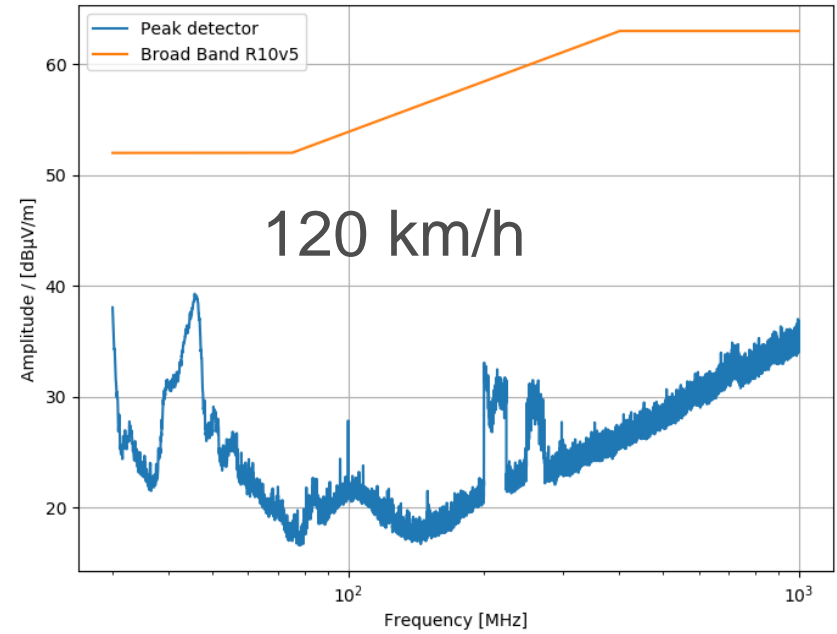
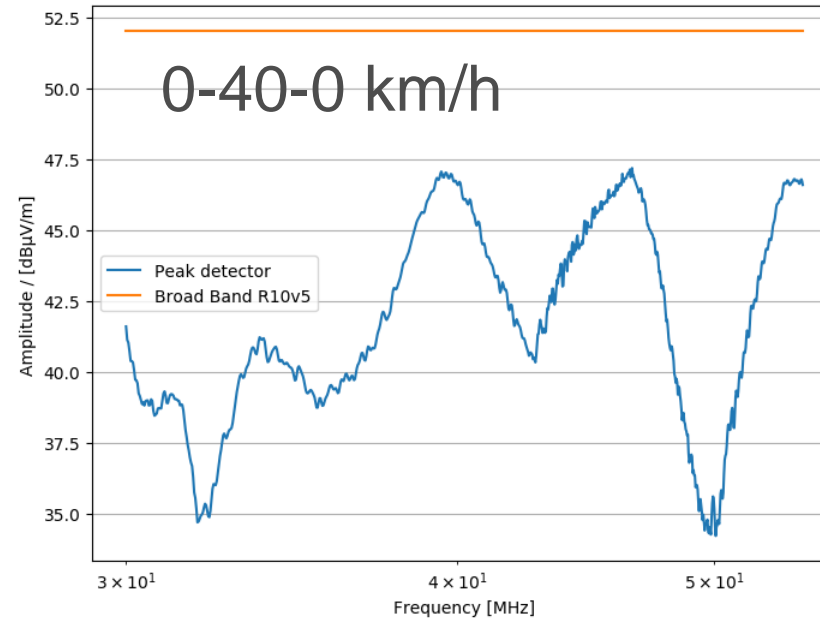
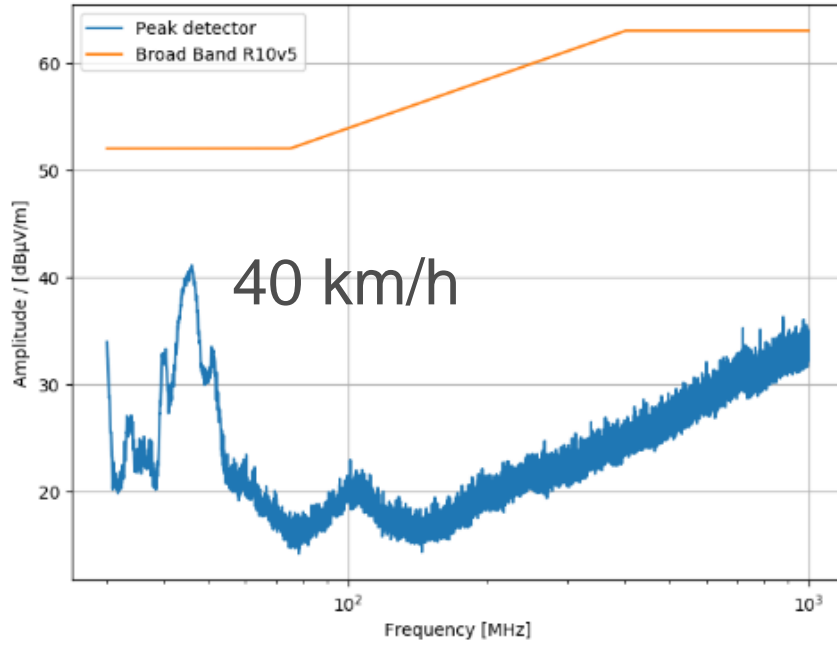
- 5.3.2.2. Vehicles/boats equipped with an electronic propulsion motor shall be test with the vehicle driven on a dynamometer without a load, or on non-conductive axle stands, with **constant speed of 40 km/h...**

Results

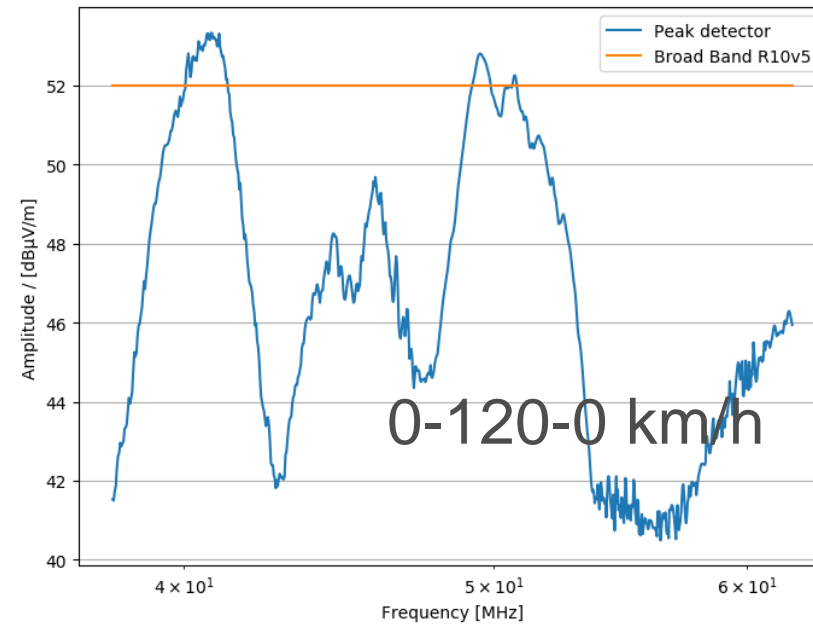
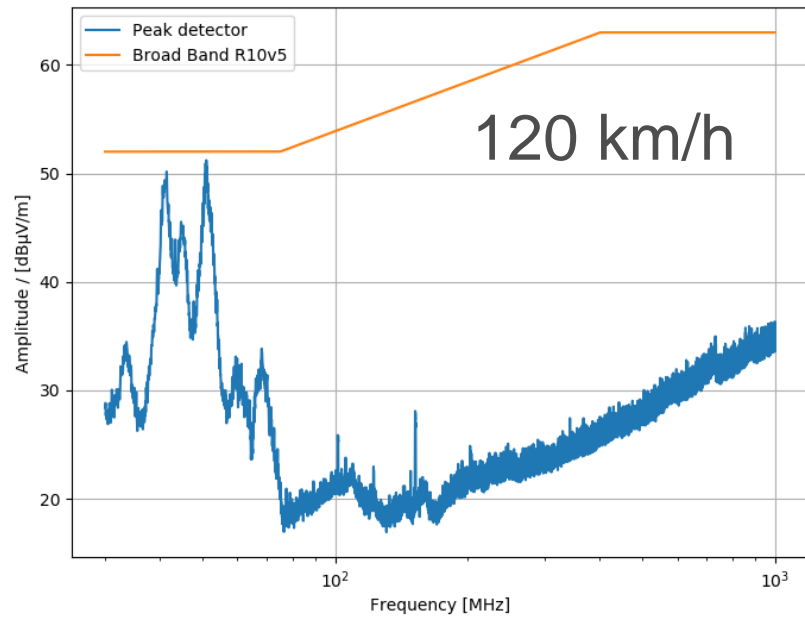
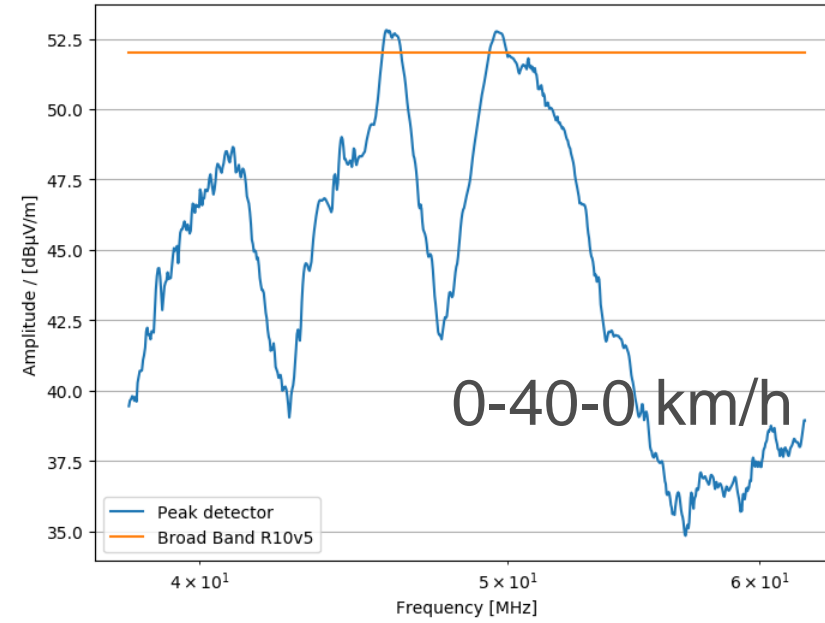
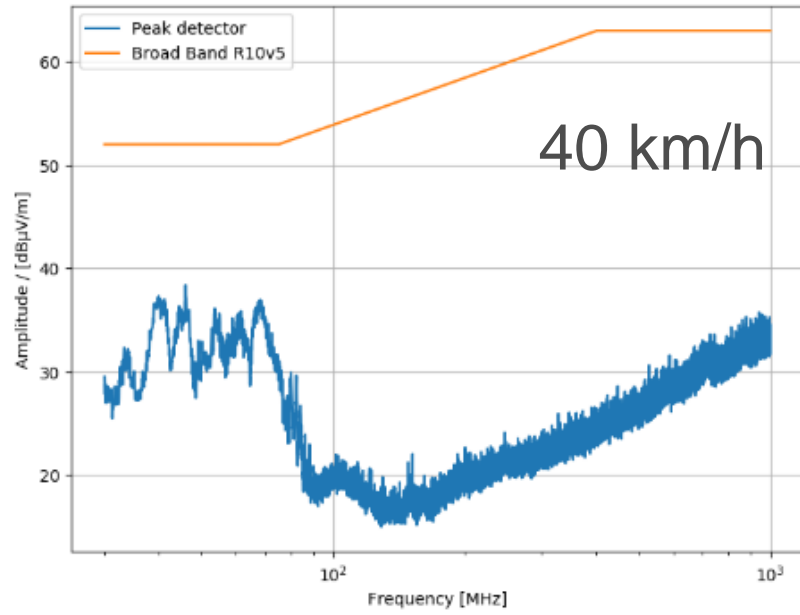


- Both left, right and horizontal and vertical antenna orientation
- Continuous scan was applied for non-constant speeds
- More accurate measuring time is applied than required by regulation for data acquisition
- The broadband emission threshold (R10v5) is used for comparison

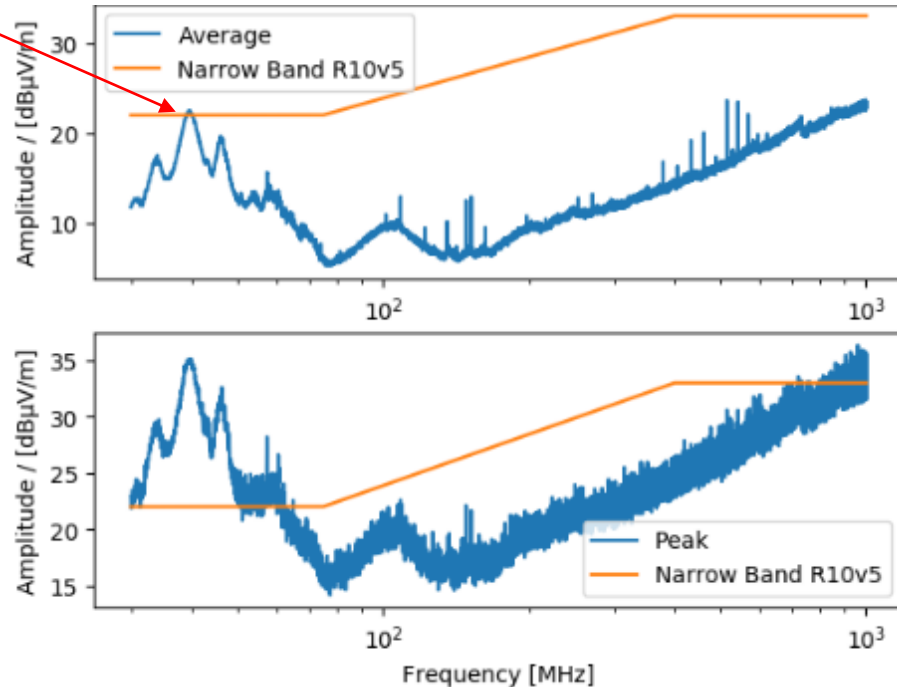
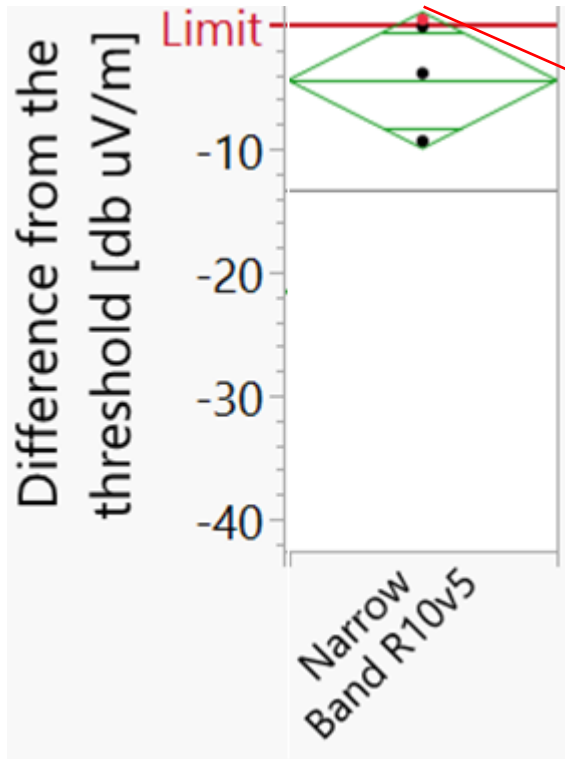
Vehicle 1



Vehicle 2



Vehicle 2 – Narrow band - Engine OFF



- Frequently above the limit, but not always
- Maybe cooling system turns on

CISPR 12 § 6.5 Surveillance (quality audit) of series production: 80% of confidence limit was applied

Key take away

- The propulsion electric engine(s) operation strategy highly depends on the speed and acceleration/deceleration.
- Other than 40 km/h normal driving conditions can lead to non-compliant radiated broadband emission (for some vehicle).
- Narrowband emission can be also influenced by some systems (cooling, heating of the battery) that are frequently on and can lead to ambiguous results
- Different result can be obtained measuring EMC radiated emission not only positioning vehicle in left side and right side but also in front and rear sides

Verification of compliance

- According to the measurement description of CISPR 12 the vehicle shall be driven at 40 km/h at which speed only one engine operates. This condition covers only a part of the normal driving conditions therefore the § 6.1.1. of R10 cannot be verified comprehensively.

What does normal condition of use mean?

- Assess all (worst case) normal conditions of use of the propulsion engine(s), i.e. all propulsion engines both in charge consuming and in recuperation modes.
- **Development of reproducible but versatile testing method would be favorable which covers new technologies with different operation strategies.**

Thank you



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Technical slides

