

CISPR 25 Class 5: Evaluating EMI in Automotive Applications

Explore the CISPR 25 international standard, which sets the guidelines for measuring radio disturbances in vehicles, boats, and electrical components. Learn about test methods and equipment.

CISPR 25 is an international standard (Edition 5.0; CISPR 25:2021) that contains limits and procedures to measure radio disturbances within the frequency range of 150 kHz to 2.5 GHz. This standard applies to any [electronic or electrical component intended for use in vehicles](#), trailers, internal combustion engines, boats, and any electronic/electrical component design for use in other such devices.

The standard's limits are designed to provide protection for receivers, which are installed within an automotive vehicle, from any disturbances made via components or modules within that vehicle. The process and limits for a complete vehicle (even if it's connected to the power mains for charging purposes or not) and the methods and limits for components

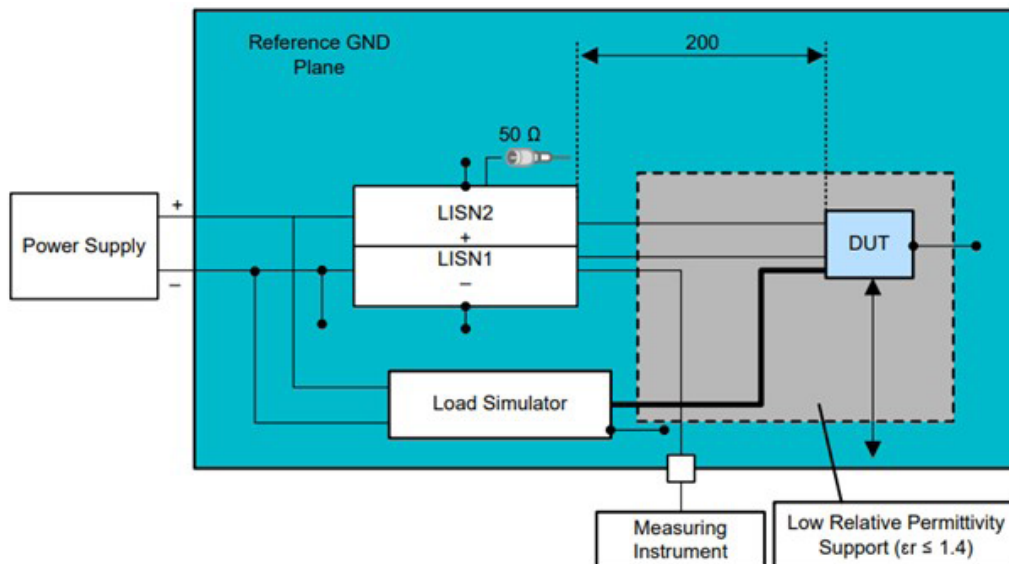
or modules are specified in the CISPR 25 standard.

CISPR 25 Current Probe

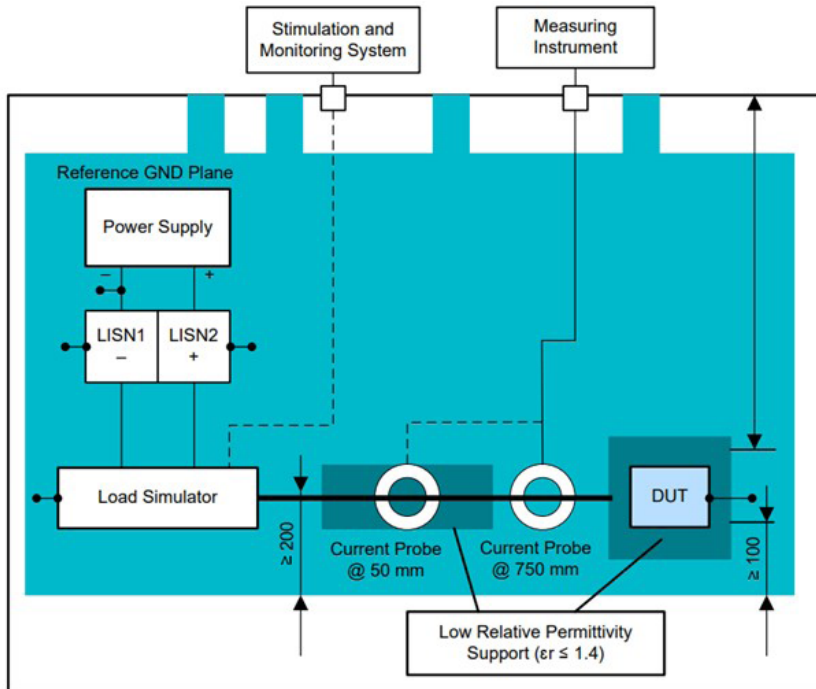
For the CISPR 25 Current Probe and conducted emissions (CE), the CISPR 25 standard offers two methods for CE testing: the current-probe and voltage-probe methods. Either may be employed to determine if the device under test (DUT) will pass or fail the CE test limits.

Required equipment for the tests include:

- Reference ground plane
- Power supply
- Artificial network
- Load simulator



1. Shown is the voltage method's remote ground test setup. (Image courtesy of Reference 2)



2. In the current method's remote ground test setup, the probe is clamped around the entire wire harness to the DUT, which is connected to the spectrum analyzer. (Image courtesy of Reference 2)

Figures 1 and 2 outline the physical test setup for the voltage method's remote ground and the current method's remote ground, respectively. The complete setup is described in CISPR 25.

Performing CISPR 25 CE Measurements with the Voltage Method

CISPR 25 CE measurements for the voltage-probe method were performed within the frequency range of 0.15 to 108 MHz. In the voltage method's remote ground test setup, it's important that the line impedance stabilizer network (LISN2), which isn't connected to the measuring instrument, is terminated with a 50-Ω load. This impedance match ensures that no reflections will reflect back into the source and that the measurements will be valid.

Figure 1 demonstrates the voltage method. This test will take the measurement directly from the artificial network by connecting one end of the cable to the LISN1 and the other end to the spectrum analyzer.

CISPR 25 CE measurements, for the current probe method, were performed within the frequency range of 0.15 MHz to 245 MHz.

Performing CISPR 25 CE Measurements with the Current Method

In the current-probe method (Fig. 2), the probe must be

clamped around the entire wire harness to the DUT, which is then connected to the spectrum analyzer to take the measurement.

The artificial network, a.k.a. LISN, is located directly upon the reference ground plane shown in Figures 1 and 2. The LISN serves to stabilize the impedance that's detected via the DUT, which looks at the DC battery, and blocks any external noise that may appear on the power cables.

The two separate LISNs are connected to the negative (-) and positive (+) terminals of the battery—LISN1 to the (-) and LISN2 to the (+).

We need to note that CISPR 25 conducted emission levels for the current and voltage methods were selected to have almost equal limit lines. In the simulations, it was shown that at low frequencies, the impedance of the 5-μH inductor in the LISN network will allow for some current to flow through it instead of flowing through the 50-Ω resistor. This will result in the voltage method having limits below 5 MHz. Both methods are widely used, and it's crucial that designers understand how they compare to each other.

The following section will outline an automotive charger reference design example that meets the CISPR 25 Class-5 conducted EMI standards.

Real-World Application: USB Type-C Charger Reference Design

This reference design is EMI-optimized for automotive USB Type-C chargers with dual 15-W outputs.³ Texas Instruments' [TPS25850-Q1](#) is used as a DC-DC regulator and port controller. Switching frequency is 2.2 MHz. The front-end filter is well-designed, and the PCB layout is optimized to meet the stringent [CISPR 25 Class-5 conducted electromagnetic interference \(EMI\) standards](#). This reference design has been tested to CISPR 25 Class 5 conducted EMI standards, which will help accelerate customer design time.

USB Type-C eliminates the need for different plug and receptacle types for host and device functionality. The Type-C receptacle displaces both the Type-A and Type-B receptacles since the Type-C cable is pluggable in either direction between the device and host.

Every USB Type-C port will be able to operate in one of following data modes:

- *Host mode*: The port can only be a host (i.e., a provider

- of power).
- *Device mode*: The port can only be a device (i.e., a consumer of power).
- *Dual-role mode*: The port can be either a host or device.

Texas Instruments has another similar reference design: [“Isolated 5V bias supply for automotive CISPR 25, class 5 emissions.”](#)

References

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3. [“Test Report: PMP40723 CISPR 25 Class-5 2.2-MHz Rated 30-W Automotive Dual USB Type-C® Charger Reference Design,”](#) Texas Instruments, 2021.
4. [CISPR 25 Edition 5.0, Testups](#)
5. PMP9398 reference design: “CISPR 25 Class 5 Rated 6.6W Automotive Power Reference Design.”
6. [PMP9397 reference design:](#) “CISPR 25 Class 5 Rated 3.3W Automotive Power Reference Design.”
7. [PMP9481 CISPR 25 Class 5, 3-W SEPIC reference design](#) for automotive infotainment display power.
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10. [“UCC12051-Q1, Automotive, 500-mW, 5-kVrms isolated DC/DC module with integrated transformer,”](#) Texas Instruments.
11. [“A review of EMI standards, part 1 – conducted emissions.”](#)
12. [“A review of EMI standards, part 2 – radiated emissions.”](#)