

5 μ H Line Impedance Stabilisation Network

1 Introduction

The TBL0550-1 5 μ H LISN is a device required to setup conducted noise measurements of DC-powered electronic equipment. It is designed to be used for measurements in the frequency range of 150kHz to 110 MHz according to CISPR 16-1-2, CISPR-25, EN55025, MIL-STD-461F, ISO11452-4 and with limitations DO-160/ED-14G and ISO 7637-2.

The LISN is inserted into the supply line of the DUT (Device Under Test). Conducted noise which is present at the supply terminals of the DUT can be measured at the BNC connector using a spectrum analyzer or a measurement receiver. The source (supply) terminal and the DUT terminal are decoupled by a 5 μ H inductor. Two TBL0550-1 in combination with the Tekbox LISN Mate enable separate measurement of common mode and differential mode noise.

The unit comes equipped with a BNC-male to N-male RG232 cable, mating connectors and ground brackets to attach it to a ground plane.



2 Parameters

Frequency range: 100 kHz – 150 MHz

DC Resistance: < 7 m Ω Source+ to DUT+; < 2 m Ω Source- to DUT-

Maximum current: 50A continuous, 70 A for 3 minutes

Nominal operating voltage range: 0 – 60V DC;

Component rating: 250V

High current plug/screw terminals - male: Phoenix Contact 1998933, female: Phoenix Contact 1967375

1 μ F capacitor can be disconnected internally by removing a jumper

Nist traceable calibration data / certificate

Dimensions: 120 mm x 100 mm x 225 mm (270 mm including ground brackets); weight: 1.6 kg

5 μ H Line Impedance Stabilisation Network

3 Warning

Spectrum Analyzer / Measurement Receiver protection:

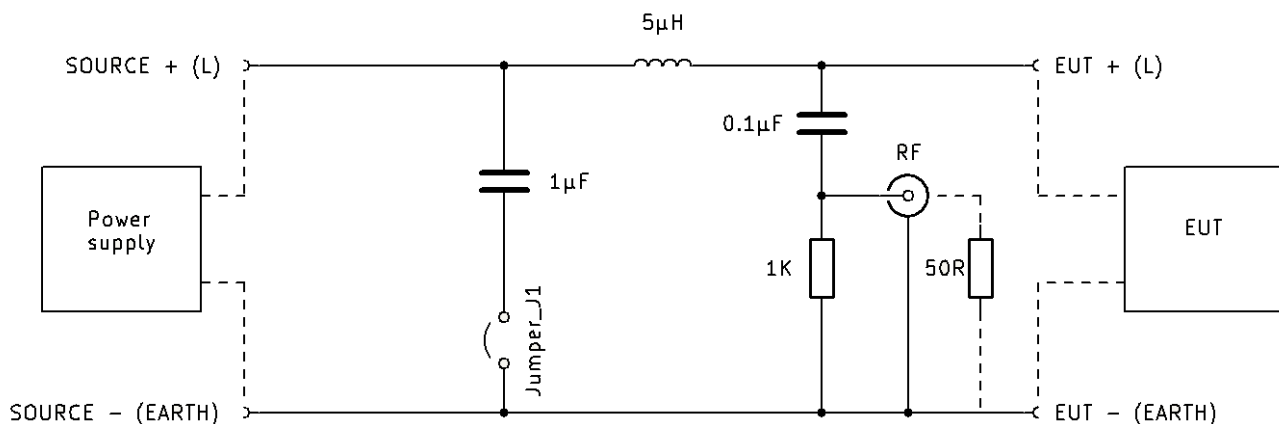
The TBL05100-1 LISN does not contain any protective elements in the RF path. Use an external attenuator and/or limiter to protect the spectrum analyzer / measurement receiver input from harmful transients or high RF noise levels.

Safety:

Because of the CISPR 16-1-2, CISPR 25 (EN 55025), MIL-STD-461G and DO-160 design requirements, LISNs do not do not comply with the maximum permissible leakage current as specified in EN61010-1. Furthermore, LISNs do not fulfil the isolation requirements of CAT II.

The LISN housing is connected to the negative / ground SOURCE and EUT pin of the terminal block and the ground of the RF connector. Inadvertently connecting the positive voltage or line voltage to the ground pin puts you at risk of a lethal electric shock. The TBL0550-1 is exclusively for use in laboratories and must be operated by qualified personnel.

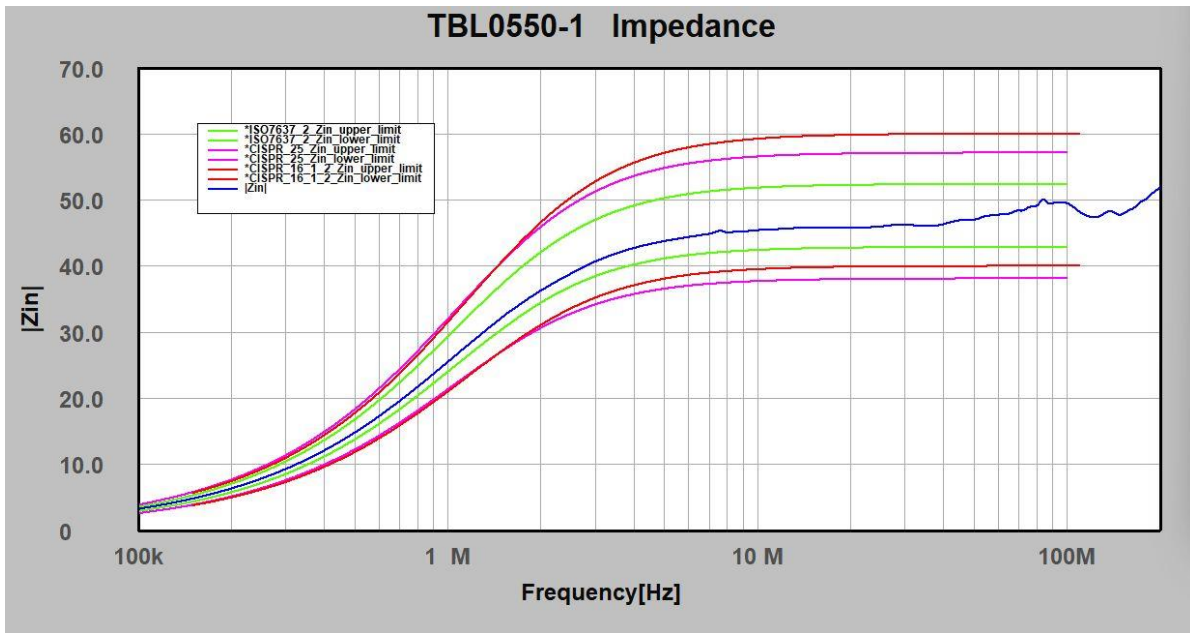
4 Principle schematic



Picture 1: principle schematic

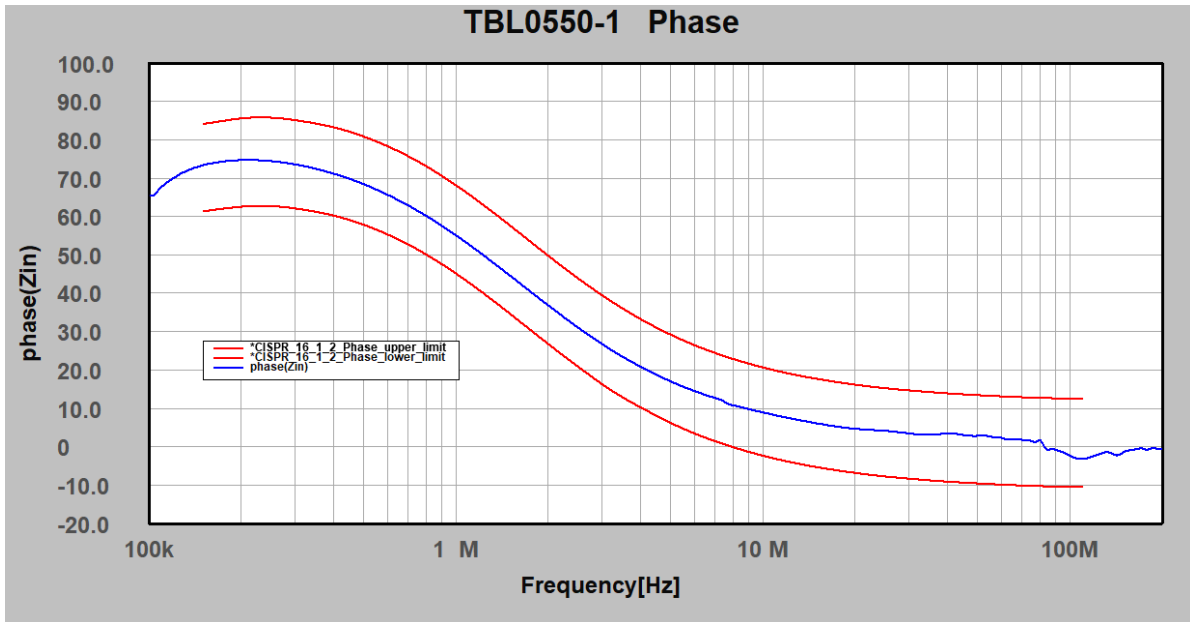
5μH Line Impedance Stabilisation Network

5 Impedance



Picture 2: LISN impedance, 100 kHz – 200MHz

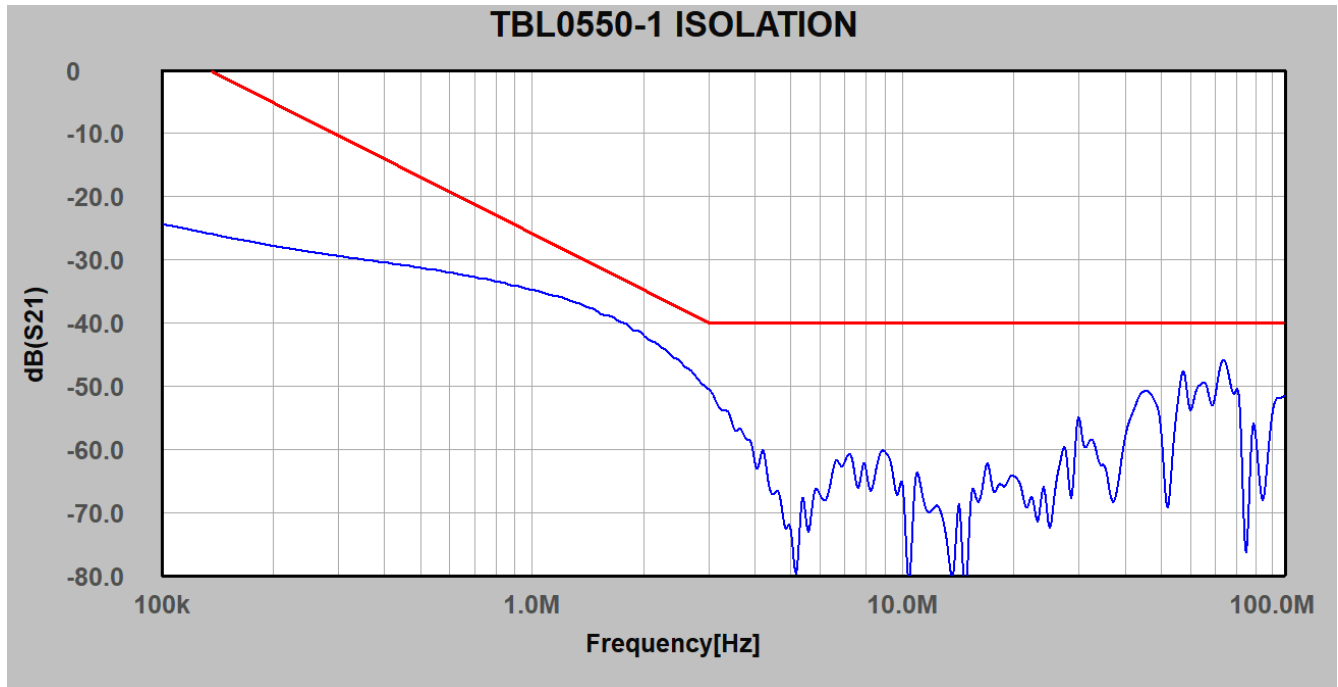
6 Phase



Picture 3: LISN phase, 100 kHz – 200MHz

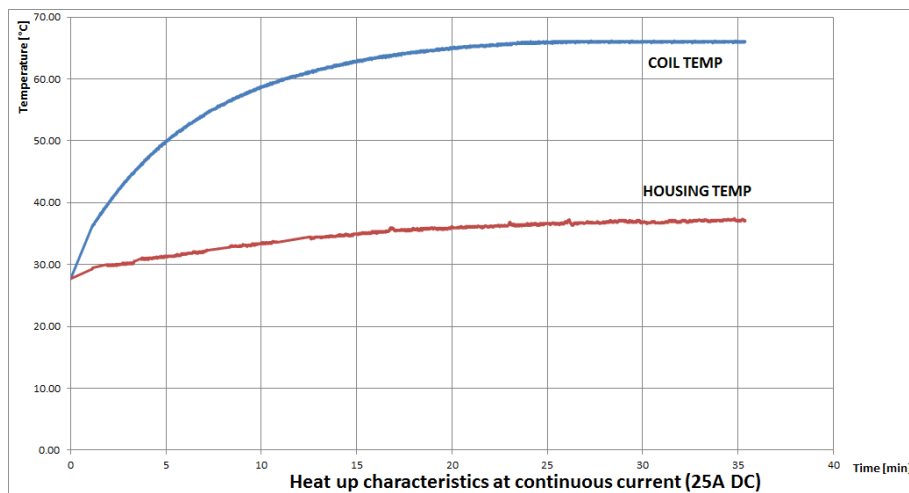
5 μ H Line Impedance Stabilisation Network

7 Isolation



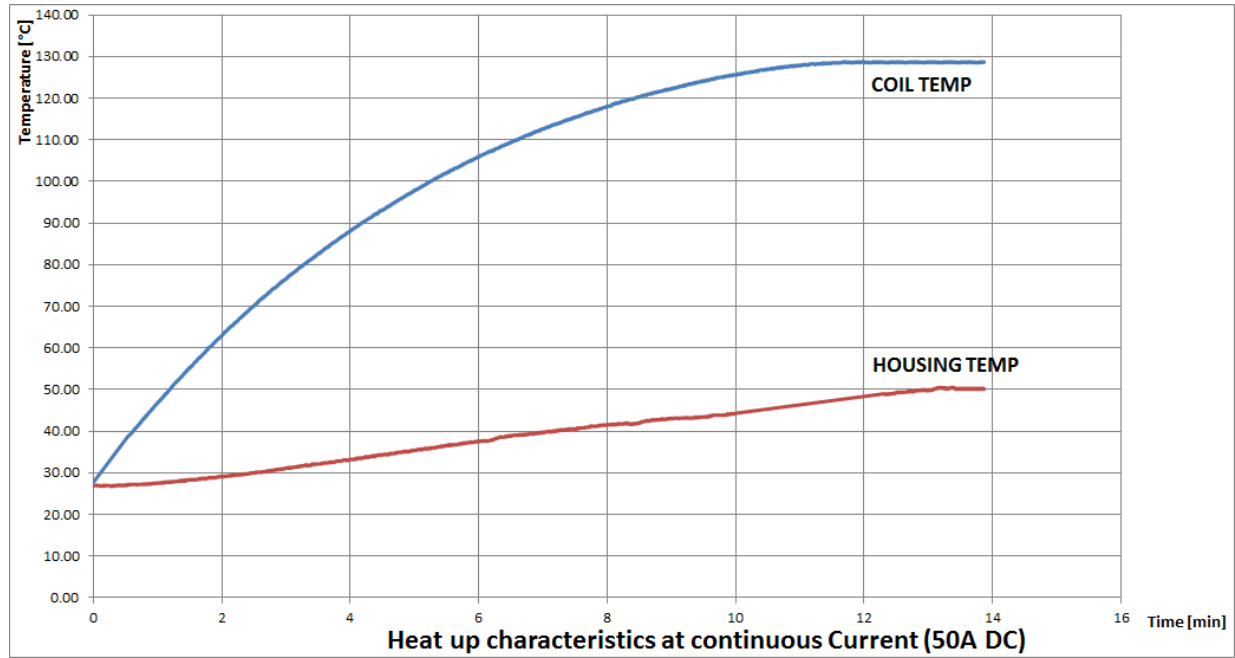
Picture 4: LISN Isolation, 100 kHz – 110MHz

8 Thermal characteristics

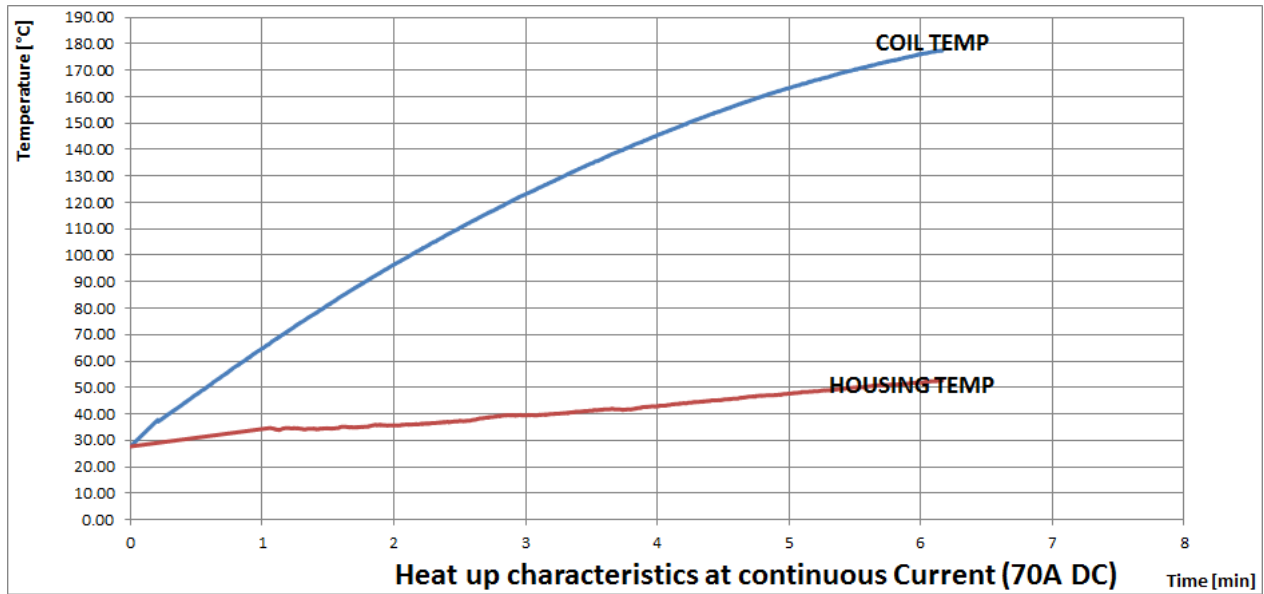


Picture 5: Coil and housing temperature at 25 A DC current

5 μ H Line Impedance Stabilisation Network



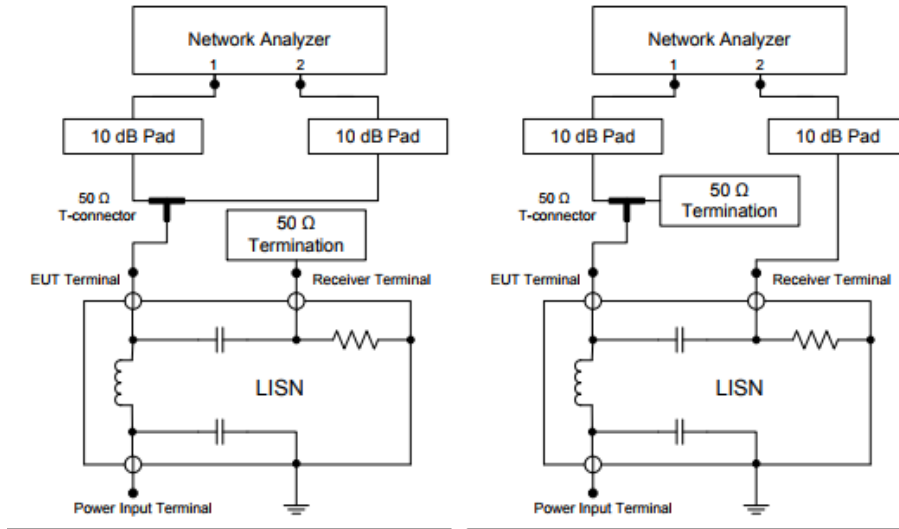
Picture 6: Coil and housing temperature at 50 A DC current



Picture 7: Coil and housing temperature at 70 A DC current

5 μ H Line Impedance Stabilisation Network

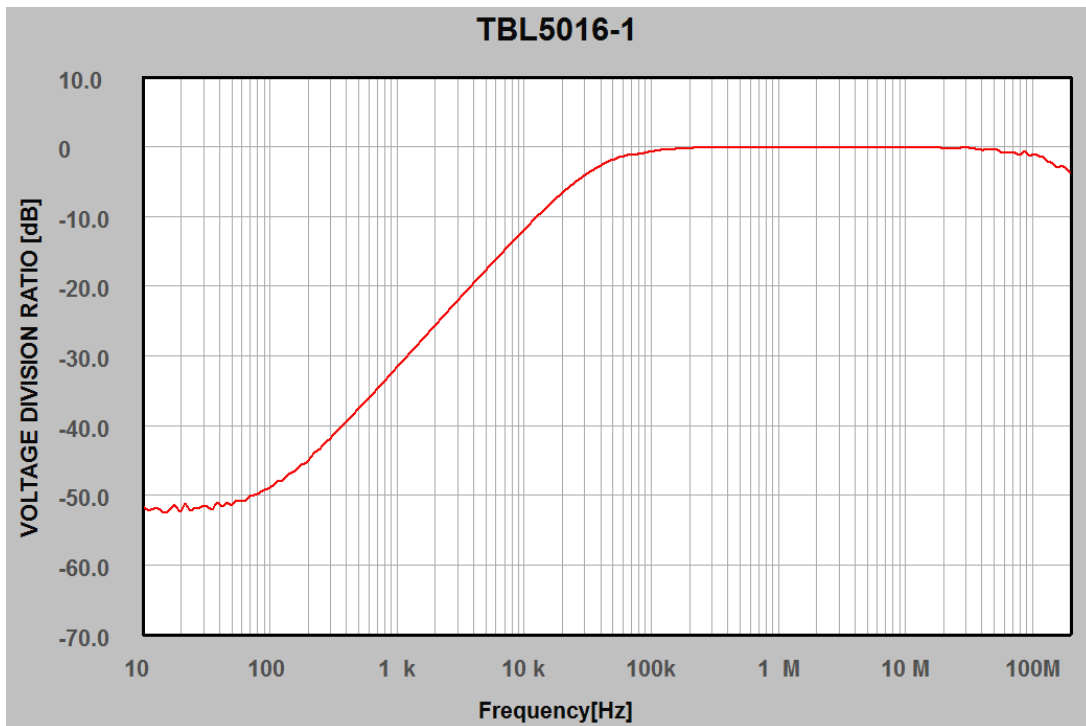
9 Calibration data according to CISPR 16 -1-2 Annex A8



Reference measurement setup using network analyzer.

Transmission measurement setup using network analyzer.

Picture 8: Calibration set up according to CISPR 16-1-2 Annex A.8.



Picture 9: Voltage division ratio DUT terminals to RF connector

5 μ H Line Impedance Stabilisation Network

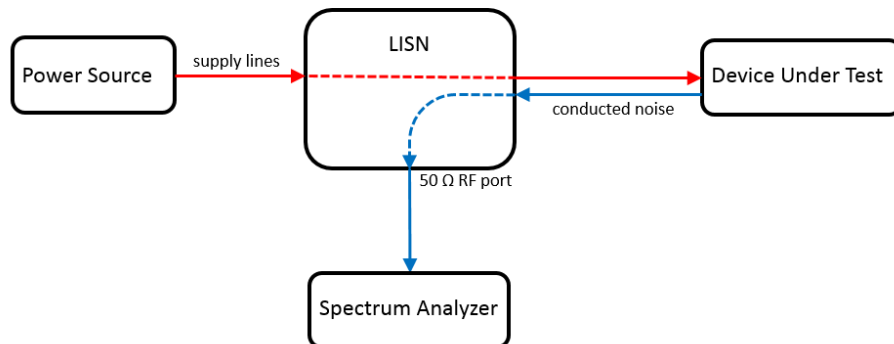
Frequency [MHz]	Voltage Division Ratio DUT port to RF port (1 μ F across source terminals) [dB]	Frequency [MHz]	Voltage Division Ratio DUT port to RF port (1 μ F across source terminals) [dB]
0.01	-11.81	70	-0.82
0.025	-5.13	80	-0.97
0.05	-1.86	90	-0.98
0.075	-1.33	100	-1.21
0.1	-0.72	110	-1.36
0.15	-0.39	120	-1.52
0.25	-0.16	130	-2.07
0.5	-0.01	140	-2.36
1	-0.01	150	-2.77
10	-0.13	160	-2.93
20	-0.24	170	-2.85
30	-0.18	180	-3.1
40	-0.47	190	-3.49
50	-0.38	200	-3.86
60	-0.66		

Table 1 - LISN calibration data

10 Application

The abbreviation LISN stands for Line Impedance Stabilisation Network.

- It is a low pass filter typically placed between a power source and the supply terminals of a device under test (EUT).
- It has a feed-through path to supply the EUT with power
- It provides a well-defined RF-impedance to the EUT
- It couples electrical noise generated by the EUT to a 50 Ω RF port, which can be connected to a spectrum analyser or measurement receiver
- It suppresses electrical noise from the supply side towards the EUT
- It suppresses electrical noise from EUT side towards the supply



Picture 10: Basic diagram of a conducted emission measurement setup with a LISN

Further applications such as conducted noise measurements using RF current monitoring probes, radiated emission tests, BCI tests and voltage transient tests require LISNs to establish a defined supply line impedance.

5 μ H Line Impedance Stabilisation Network

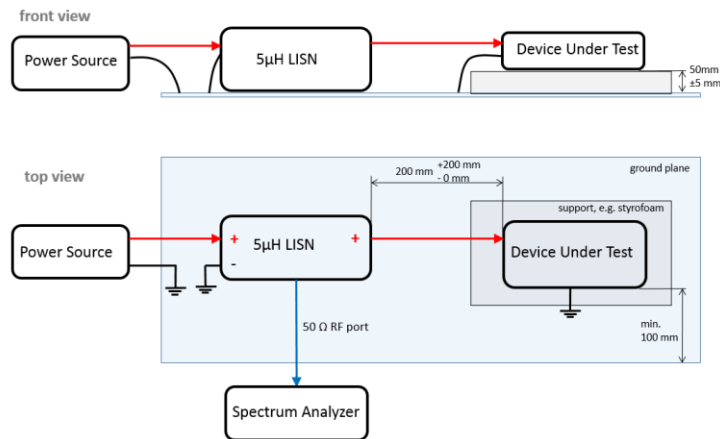
10.1 Conducted Emission Measurement Setup, Voltage Method

CISPR 25 specifies two measurement configurations:

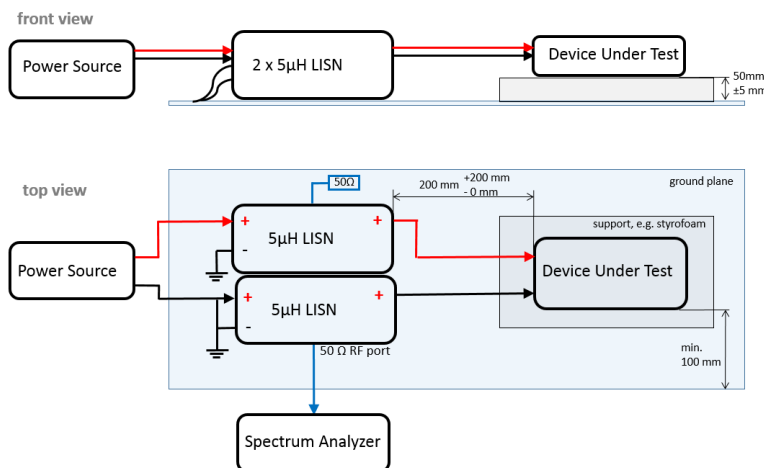
If the EUT is grounded to the vehicle chassis with a power return line shorter than 20 cm in length, a single LISN is adequate, and the conducted noise is monitored only on the positive supply line.

If the power return line of the EUT is longer than 20 cm, two LISNs are required. One LISN connects the positive supply line to the EUT, and another LISN connects the power return line to the EUT. Conducted noise is measured on both lines. It is actually measured on one LISN at a time, with the other LISN's RF port terminated with a 50 resistor.

Professional noise measurements are performed in shielded chambers since any ambient noise picked up by the wires connecting LISN to EUT or by the EUT itself will be present at the RF terminal. In pre-compliance setups, a test should be performed with the EUT turned off to distinguish between conducted noise generated by the EUT and emissions from other sources (ambient noise). Tekbox provides low cost, desktop shielded tents or shielded bags to suppress ambient noise for pre-compliance conducted noise measurements.



Picture 11: conducted emission measurement, voltage method, DUT with power return line locally grounded



Picture 12: conducted emission measurement, voltage method, DUT with power return line remotely grounded

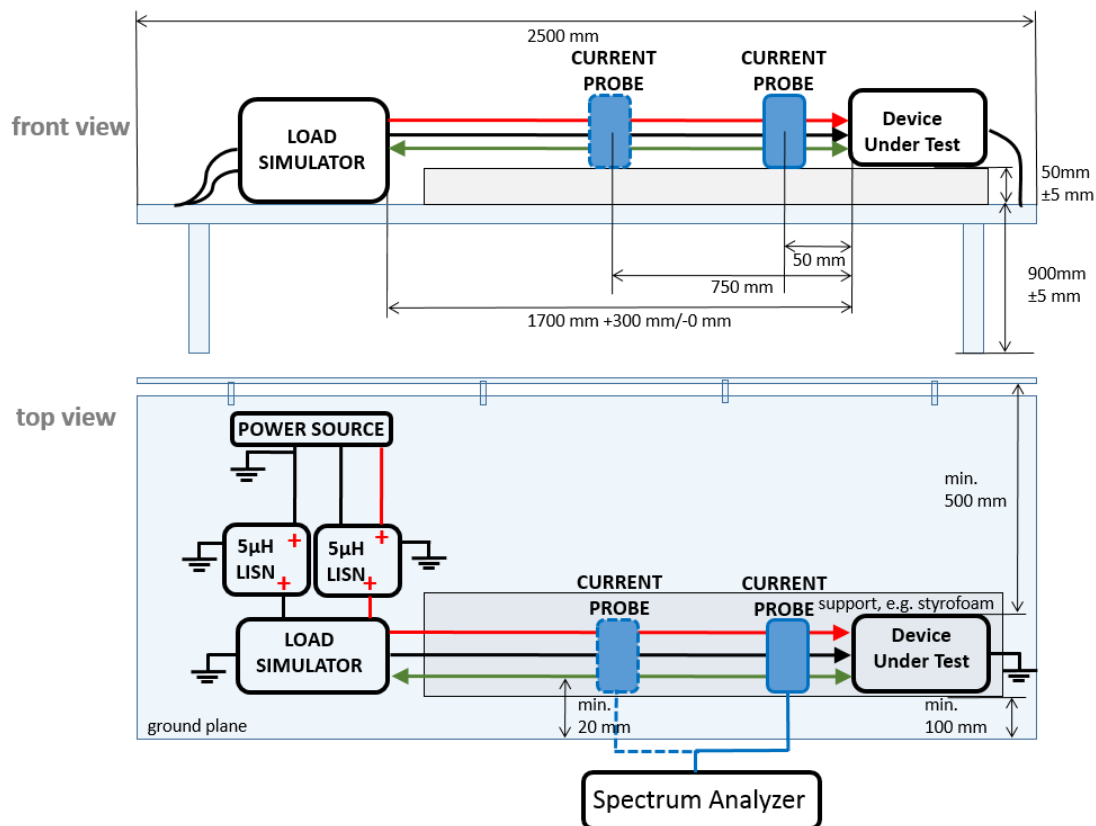
5 μ H Line Impedance Stabilisation Network

Pictures 11 and 12 depict conducted noise measurement setups using the voltage method, as specified in CISPR 25. If the EUT is connected to additional peripheral devices, they should also be connected or emulated using a load box. If a remotely powered EUT's housing is designed for chassis grounding, it should also be grounded to the ground plane. The grounding lead should be no more than 150mm length.

Because most devices are remotely grounded, the configuration shown in Picture 12 is more frequent. The measurement must then be performed alternately on both the positive and negative power lines. The unused RF port is always terminated with 50 Ohm.

It should be noted that conducted noise testing per DO160 necessitates the insertion of a 10 μ F capacitor across the LISN's source terminals.

10.2 Conducted emission measurement set up, current probe method



Picture 13: conducted emission measurement according to CISPR 25, current probe method

The CISPR 25 current probe measurement is used to monitor conducted emissions on a wire harness, including control/signal lines of an EUT. Some vehicle manufacturers utilise the wide bandwidth of current probes to measure conducted emissions on power supply lines over a wider frequency range than LISNs can. Measurements are typically taken on various lines – plus, minus, control signals, plus + minus, plus + minus + control lines. In order to account for cable harness resonance effects, the current probe is measured at 50 mm and 750 mm distances from the EUT. Each LISN's RF output must be terminated with 50 Ohm.

5µH Line Impedance Stabilisation Network

The current probe picks up the conducted emissions. To establish a defined impedance on the power lines, two LISNs are necessary. The load simulator is a specially designed device that simulates the load existing at the EUT's signal/control interface.

10.3 Bulk Current Injection

Immunity tests performed in accordance with ISO11452-4 employ a configuration similar to that used for current probe-based conducted emission measurements. However, instead of using a current probe to measure conducted emissions, a signal generator / power amplifier feeds an interferer signal into the BCI probe. Again, two LISNs are required to establish a defined supply impedance. The LISNs' RF output must be terminated with an external 50 Ohm termination with enough power handling capacity.

10.4 Voltage transient testing

When utilising the LISN for voltage transient testing according to ISO 7637-2, the 1µF capacitor at the LISN's source input must be unplugged. To do so, open the top cover of the LISN housing and remove the Harwin jumper next to the source terminal block.

It should be noted that the TBL0550-1 impedance is slightly outside the tight ISO 7637-2 limits.

11 Ordering Information

Part Number	Description
TBL0550-1	5µH LISN, 2 pcs. ground brackets, 2pcs. female terminal blocks Phoenix Contact 1967375, 1 pc. 75 cm BNC-male to N-male RG223 cable Nist traceable calibration data / certificate

12 History

Version	Date	Author	Changes
V1.0	1.10.2019	Mayerhofer	Creation of the document
V1.1	8.11.2019	Mayerhofer	Chapter 2 updated
V1.2	22.04.2020	Mayerhofer	drawings updated
V1.3	26.11.2021	Mayerhofer	Updated table 1, picture 9
V1.4	15.6.2023	Mayerhofer	All chapters updated

Table 2 – History