EMI Performance for Thunderbird TAS5100EVM Board

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ABSTRACT

This document describes EMI test results of the Thunderbird TAS5100EVM board without an enclosure. Measurements were performed according to EN55013 and EN 55022, Class B equipment.

Radiated noise spectrum in the frequency range from 30 MHz to 1 GHz is measured in a 10-meter semi-anechoic screened room. The Thunderbird EVM board passed the test with 5dB margin to limit.

Conducted noise at the speaker cables is measured with an absorbing clamp. The conducted noise is measured in the frequency range from 30 MHz to 300 MHz. The Thunderbird EVM board passes the test of conducted noise.

Conducted noise at the S/PDIF coaxial cable is measured with an absorbing clamp. The conducted noise is measured in the frequency range from 30 MHz to 300 Mhz. The Thunderbird EVM board passes the test.

Conducted noise at mains terminals (230-volt AC) have been measured with a switch-mode supply connected to the EVM board. Mains terminals pass both performed tests:

- 150 kHz to 30 MHz measured with a mains network inserted between main supply and switch-mode supply.
- 30 MHz to 300 MHz measured with an absorbing clamp.

The Thunderbird TAS5100EVM passes all performed EMI test without any enclosure.

1 Introduction

All performed test are pre-compliance test. During all test, the board is mounted on a black electrically oxidized aluminum plate (see Figure 1).

Figure 1. TAS5100EVM Mounted on a Plate of Aluminum

1.1 Test Locations

Radiated noise measurements are performed at the accredited laboratory:

- DELTA Danish Electronics, Light & Acoustics:
  - Venlighedsvej 4
  - DK-2970 Hørsholm
  - **www.delta.dk**

Conducted noise measurements are performed at the accredited laboratory:

- UL-International DEMKO A/S:
  - Lyskær 8
  - DK-2730 Herlev
  - **www.demko.dk**

1.2 Common Setup Conditions for All Tests

The amplifier was connected to a CD-player (sampling frequency at 44.1 kHz). The CD-player was repeating a 1-kHz sinus tone track during each test.

In compliance with EN55013 (part 5.2.2.1), the output level is equal to 1/8 of the nominal maximum audio output power.

$$\frac{1}{8} \times 30\ \text{W} = 3.75\ \text{W per channel}$$

Both left and right speaker outputs were connected to 6-Ω resistive loads.

2 Radiated Noise

Measurements of radiated noise were performed according to EN55022, Class B equipment. All radiated noise tests were performed in a 10-meter semi-anechoic screened room.

The TAS5100EVM was connected to a CD-player with a Toslink cable (optical). The CD-player was placed outside the anechoic room during all tests. The TAS5100EVM was supplied from a 24-V battery. The length of each speaker cable was 2.5 meters.

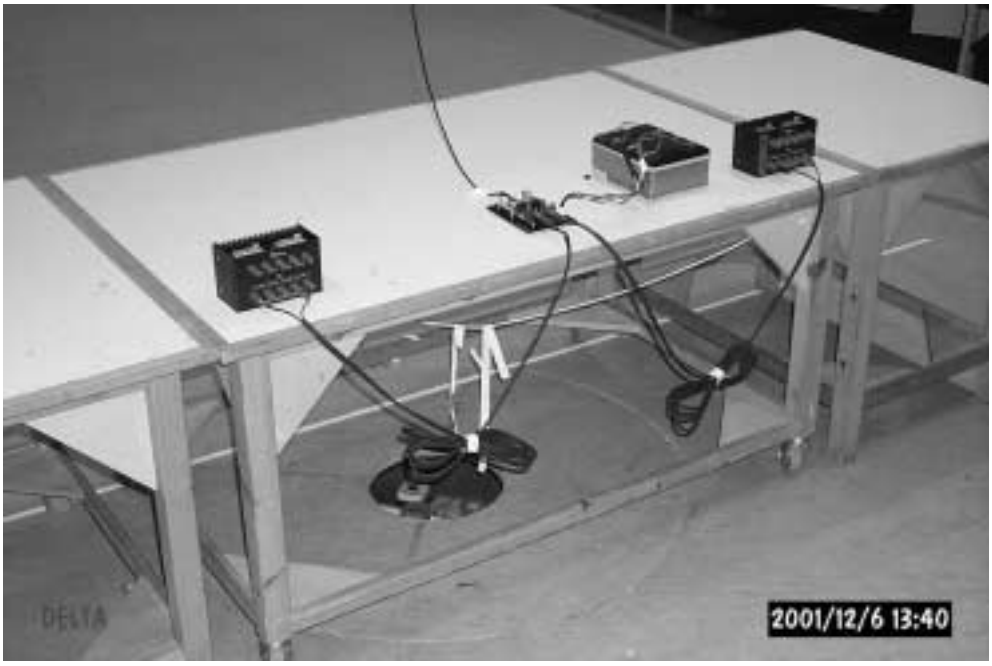


Figure 2. Test Setup in the Anechoic Room

2.1 Description of Test Procedure

Frequency sweeps are performed with both vertical and horizontal antenna polarizations. During the vertical swwep, the antenna is placed one meter above ground and during the horizontal sweep, 4 meters above ground. Peak values are measured during both frequency sweeps.

The six highest disturbance frequencies are located at the two frequency plots. The maximum noise level is tracked for each high disturbance frequency with the following procedure:

1. The antenna position is slowly raised from 1 meter to 4 meters. The antenna position with maximum disturbance is tracked. The searching is performed with both vertical and horizontal antenna polarization. The new antenna position is the height with the maximum measured disturbance.
2. The turntable angle is slowly changed from 0° to 360°. The turntable angle with maximum disturbance is tracked. The search is performed with both vertical and horizontal antenna polarization. The new turntable angle is the angle with the maximum measured disturbance.
3. The antenna position is once again slowly raised from 1 meter to 4 meters. The antenna position with maximum disturbance (measured with a quasi-peak detector) is tracked. The

search is performed with both vertical and horizontal antenna polarization. Noise-frequency, noise-level, antenna position, antenna polarization, and turntable angle are recorded for the each high-disturbance data point.

In order to pass the test, all recorded quasi-peak values must be below the relevant limit.

2.2 Frequency Sweeps Measured with Peak Detector

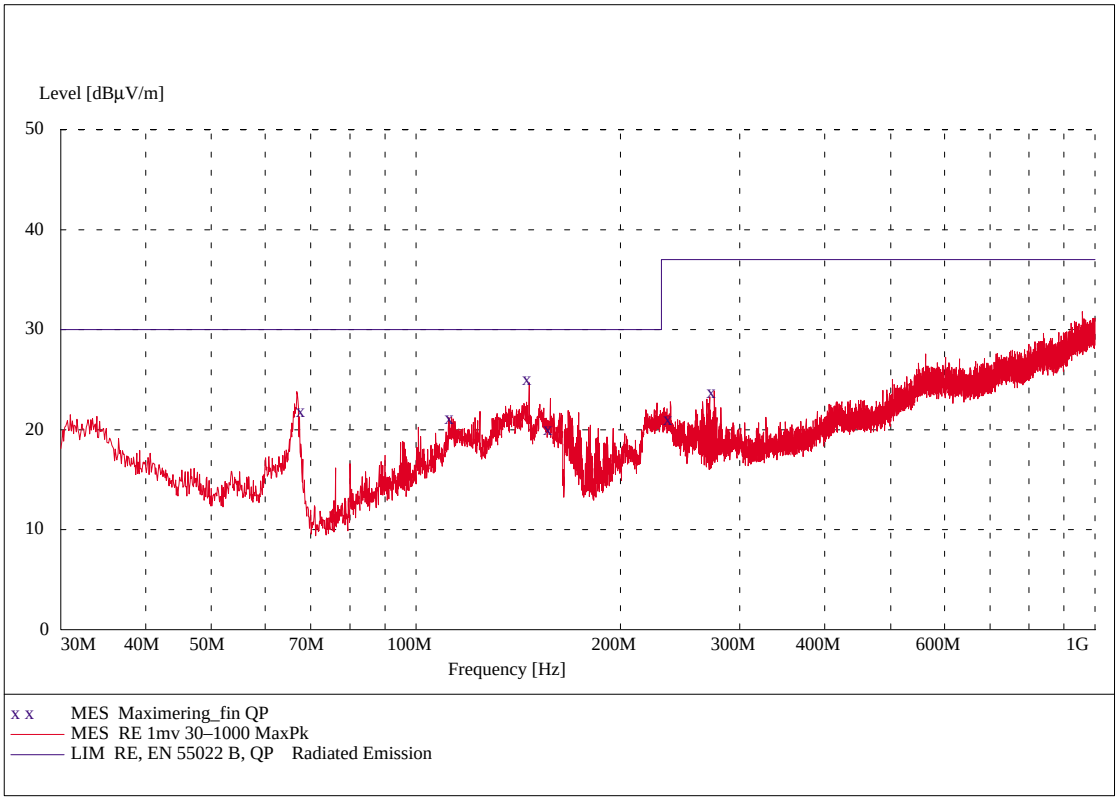


Figure 3. Vertical Antenna Polarization

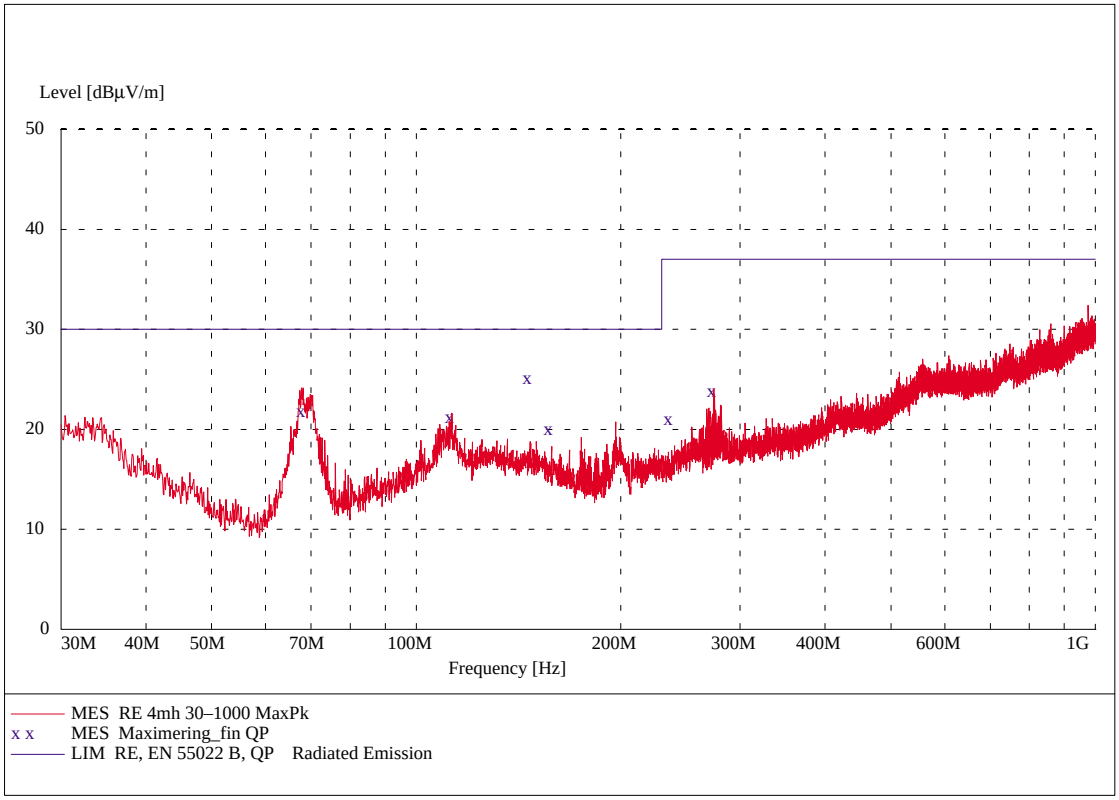


Figure 4. Horizontal Antenna Polarization

2.3 Maximum Measured Quasi-Peak Values

Table 1 contains measurement data for the highest disturbance frequencies.

Table 1. Maximum Measured Quasi-Peak Values

FREQUENCY (MHz)	LEVEL (dBµV/m)	TRANSD (dB)	LIMIT (dBµV/m)	MARGIN (dB)	HEIGHT (cm)	AZIMUTH (deg)	POLARIZATION
68.100000	21.70	7.2	30.0	8.3	387.0	31.00	HORIZONTAL
112.900000	21.10	12.0	30.0	8.9	112.0	324.00	VERTICAL
146.770000	25.00	12.4	30.0	5.0	109.0	164.00	VERTICAL
157.700000	19.90	11.8	30.0	10.1	111.0	164.00	VERTICAL
237.080000	20.90	12.9	37.0	16.1	111.0	340.00	VERTICAL
274.480000	23.70	14.6	37.0	13.3	316.0	311.00	HORIZONTAL

† Quasi-peak values at “critical” frequencies are marked with a cross in the frequency sweep figures

The TAS5100EVM board passes the test with a margin of 5 dB to limit in 55022 Class B.

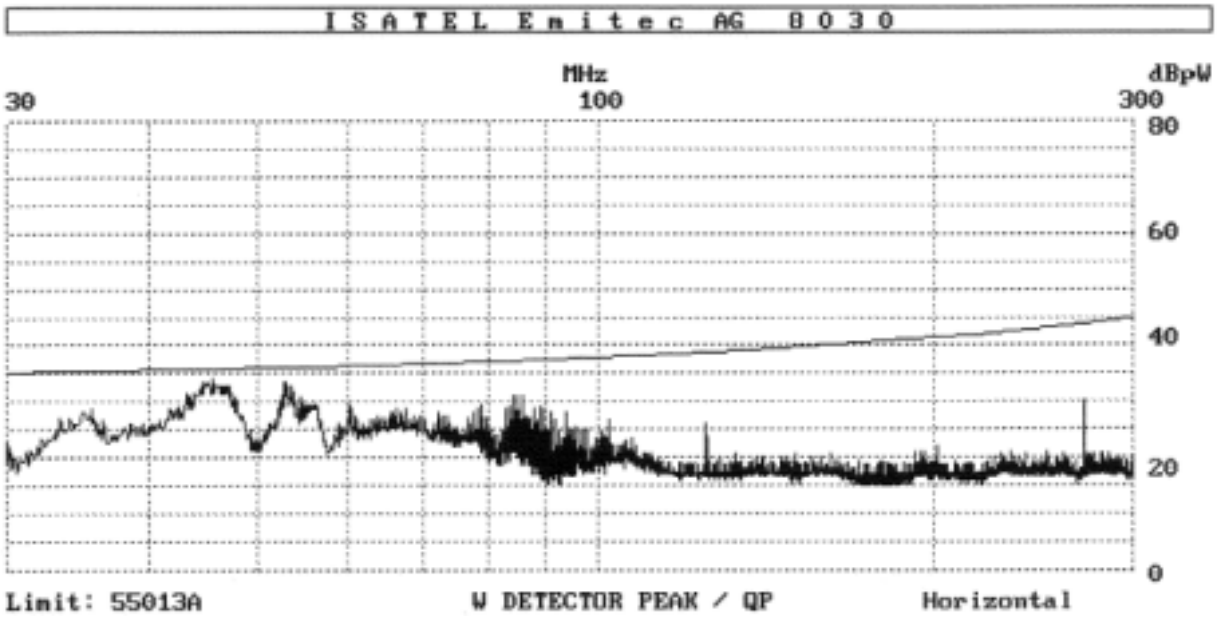
3 Conducted Noise

Measurements of conducted noise were performed according to EN55013, Class B equipment.

3.1 Conducted Noise at Speaker Cables

Conducted noise at the right speaker cable has been measured. The signal source was connected to the amplifier with a Toslink cable (optical). The amplifier was supplied from a 24-V battery. The length of speaker cable was 5 meters.

Conducted noise is measured with quasi-peak detector. If the measurements with the quasi-peak detector give values less than the average limit, measurements with the average detector are not required.



NOTES: A. Conducted noise measured with peak detector. Solid line is the average limit.
B. Quasi-peak limit is 10 dB above the average limit.

Figure 5. Conducted Noise at Speaker Cables

3.2 Conducted Noise at S/PDIF Coaxial Cable

Conducted noise at the coaxial cable has been measured. The amplifier was connected to a CD-player with RG59 cable (Manufacturer: Bedea – www.bedea.com). Length of RG59 cable was 10 meter. Noise from CD-player was damped with clamp cores made of ferrite. Clamps were placed at coaxial cable close to the CD-player. The amplifier was supplied from a 24-V battery.

The conducted noise is measured with quasi-peak detector. If the measurements with the quasi-peak detector give values less than the average limit, measurements with the average detector are not required.

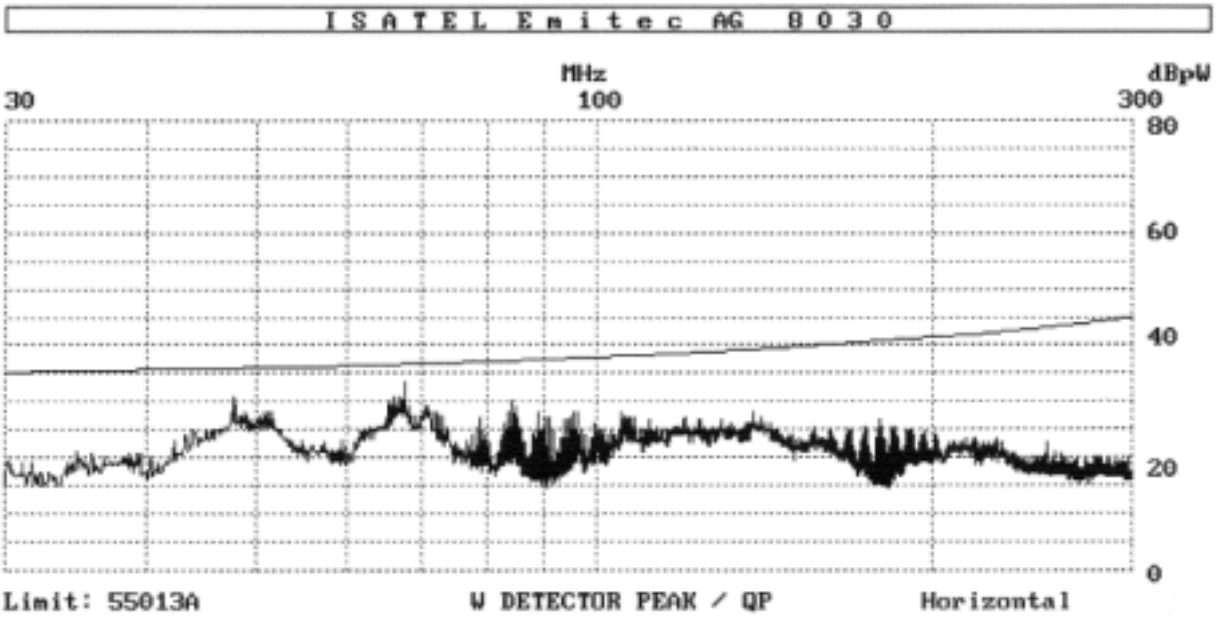


Figure 6. Conducted Noise at S/PDIF Coaxial Cable

The Thunderbird board passes the worst-case test of conducted noise at S/PDIF coaxial cables.

3.3 Conducted Noise at Power Lines

The power supply unit is typically mounted close to the amplifier board and in the same enclosure. Requirements of maximum conducted noise levels at internal cables are not defined in any standard. Performance for a complete amplifier system with power supply unit and TDAA amplifier has been measured. An external switch-mode power supply was used as power supply (manufacturer: www.powerbox.se, part number: SPN-270-19). Conducted noise at main terminals has been measured in the two frequency ranges: 150 kHz to 30 MHz and 30 MHz to 300 MHz.

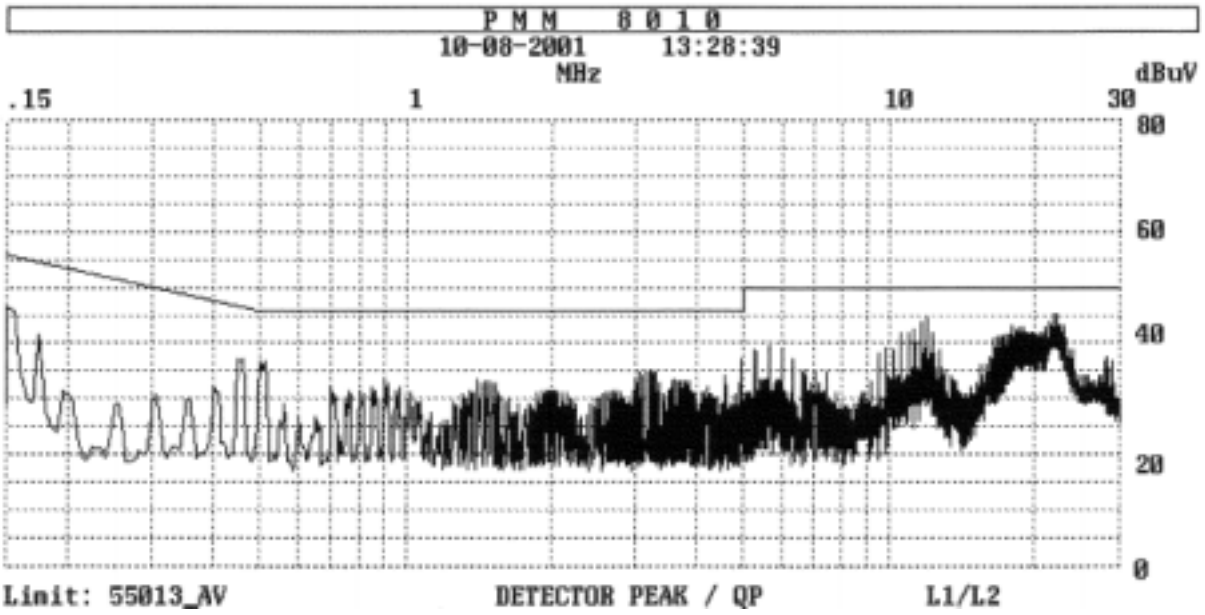


Figure 7. Conducted Noise at Power Lines (150 kHz – 30 MHz)

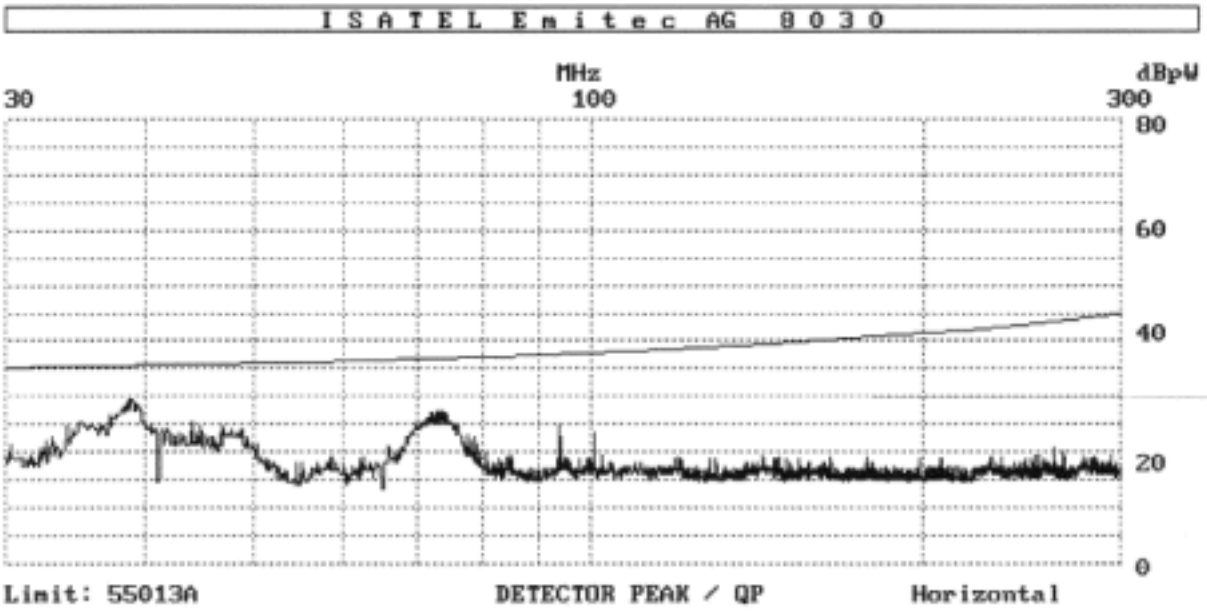


Figure 8. Conducted Noise at Power Lines (30 MHz – 300 MHz)

The Thunderbird EVM board passed both test when a Powerbox SPN-270-19 is used as power supply.

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