

Application Note

Ref.: EMC & Radio Integration

Author: EW/LN/CB

EMC & RADIO INTEGRATION

1 - PRESENTATION OF THE DOCUMENT

This document presents the EMC requirements involved in integration of radio means in equipment comprising digital printed circuit boards.

2 - SOURCES AND ELEMENTS INVOLVED

When integrating radio means, only the receiver functions are liable to be disturbed by the electronic environment. Transmitters tend rather to be disturbing elements on account of the HF power generated.

Contrary to commonly held beliefs, the main source of radioelectric pollution is the processor address / data bus when this bus is external (in particular the multiplexing latch !). Clocks are secondary sources as they are less often distributed on the boards.

Complying with the huge range of EMC standards in force does not however guarantee easy integration of a radio receiver. Indeed, although the limit levels of the EMC standards correspond to radiations of a few nanowatts, the powers encountered on the receiver inputs are mere fractions of a picowatt !

Nevertheless, to preserve the sensitivity characteristics of receivers, the simple rules set out below must be respected.

3 - POLLUTION MODES AND PRECAUTIONS

- Conducted pollution of receivers

The disturbances are in this case conducted to the receiver by the connections between the receiver and the associated electronics. These disturbances are rarely at working frequency but more often at intermediate frequencies (21.4, 10.7 or 0.5 MHz) or directly in the base band.

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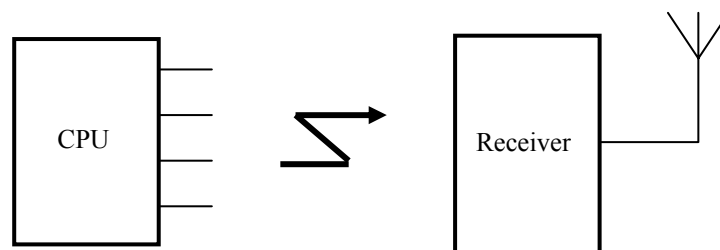
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The various precautions consist in fitting simple filtering elements on the different connections:

- The receiver outputs connected to high impedance inputs of the logic have to be protected by simple 1 K Ω series resistors.
- The receiver inputs have to be uncoupled from the ground by a 100 pF parallel capacitor located as close as possible to the module terminals.
- In case of a clock operating above 8 MHz or DC converter, the receiver power supply has to be isolated by means of a 100nF / 10 μ H / 100 nF front end cell. In other cases uncoupling at 100 pF is sufficient.

- Radiated receiver pollution

The disturbances are in this case radiated to the receiver by the different tracks supporting high-speed signals around the CPU (typical case of the Address / Data bus). These disturbances are generally at working frequency and pollute the HF input of the receiver directly.



The various precautions consist above all in an optimised distribution of the motherboard and a ground plane which is as continuous as possible:

- The receiver must be kept as far away as possible from the high-speed digital signals. The ground plane must be used to isolate the Tracks & CMS face from the Radio module face.
- The ground plane must be as continuous as possible near the receiver. It is still possible to let a few signals pass but "non-polluting" signals must then be chosen. Ground plane interruptions must be as small as possible.
- If there is an antenna track on the motherboard, it must be as short as possible. It must then be surrounded by a guard ring connected to the ground plane by vias situated every 5 mm.
- All the wiring must be made as short as possible and particular care must be taken over the ground distribution.

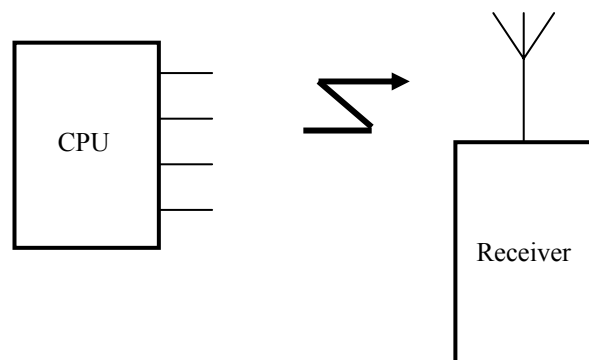
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- Radiated pollution from radiating elements

The disturbances are in this case radiated to the antennas by the various tracks supporting high-speed signals around the CPU. These disturbances are at working frequency.



The various precautions consist in like manner in a rational construction again taking great care over the quality of the ground:

- The antenna must be kept as far away as possible from the high-speed digital signals. The ground planes and chips must then be used to isolate the Tracks & CMS face from the antenna position.
- The coaxial cables of antennas must be routed taking care to avoid running close to sensitive zones. The core of the coaxial cables must be bared over as short a length as possible.
- The length of the various associated wires and cables must as short as possible and must avoid running near the antenna. Although they are "cold" they may however conduct or re-radiate disturbances.
- If it is metallic the chip must be electrically connected to the ground at the foot of the antenna and at the GND HF point of the receiver.
- If the associated electronics is known to be a large source of disturbances, do not hesitate to locate the antenna remotely.