Application Note 611-0200: EMI/RFI Suppression

INTRODUCTION

All Cermetek modem modules incorporate high speed system clocks. Any system employing a clock with an operating frequency greater than 9 KHz is subject to FCC Part 15 rules governing EMI (Electromagnetic Interference) and RFI (Radio Frequency Interference). Following good design practices will prevent EMI/RFI from being an issue in the final system.

EMI/RFI regulations focus on two sources of interference: Radiated Emissions and Conducted Emissions. Radiated Emissions are those that are transmitted through the air. Conducted Emissions are high frequency signals transmitted along conductors such as power and ground traces.

RADIATED EMISSIONS

Control of Radiated Emissions requires proper PCB (Printed Circuit Board) design and trace placement. This is particularly important in systems utilizing a modem because the telephone line cable makes a good (albeit unintended) antenna.

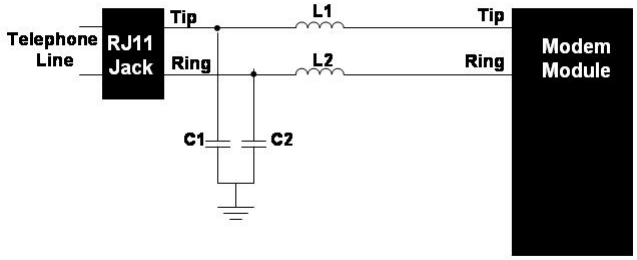
The most important aspect of the PCB routing scheme is the geometry and location of both the ground and power traces. Cermetek recommends separate power and ground planes on any PCB which contains a high frequency clock. The power and ground planes should be continuous with minimal breaks.

Caution: The Power and ground planes should not be routed in any area of the PCB containing telephone line connections. This exclusion area includes the telephone jack and modem Tip and Ring pin connections. Note that telephone line circuitry is classified as high voltage because it interfaces directly external PSTN systems and is, therefore, exposed to high voltages. Placement of power and ground planes in a high voltage area compromises safety.

The PCB layout should avoid long uninterrupted signal traces. Long continuous traces may also act as antennas and pickup system clock harmonics. Keep signal traces as short a possible.

Additional protection against Radiated Emissions can be afforded the overall design by the inclusion of filters on the Tip and Ring traces. As shown in Figure 1, EMI/RFI filters typically consist of a high voltage capacitor which directs high frequency signals to the system ground and a series inductor or ferrite bead which attenuates the high frequency signals. For maximum effectiveness, the EMI/RFI filter should be placed as close to the telephone jack as possible.

Figure 1 EMI/RFI Filter



COMPONENT REQUIREMENTS

The filter capacitors must be rated at a minimum of 1500 Volts to maintain an adequate safety barrier between the telephone line and system ground. Cermetek recommends UL recognized Y2 safety rated capacitors with values not exceeding 0.005 µf. However, the precise value of the capacitors will depend upon the frequencies of concern during EMI testing, and will be product specific.

The inductors or ferrite beads are selected to attenuate any high frequency signals present. Harmonics of the modem clock frequency as well as the clock frequency of any other clocks present in the system are the leading causes of radiated EMI issues. Typically, the ferrite bead value is chosen to provide greater than 100 ohms impedance at frequencies above 100 MHz. Commercially available ferrite beads provide very low impedance at audio frequencies and therefore have little or no affect on FCC Part 68 compliance. Any inductors or ferrite beads utilized should be UL recognized.

CONDUCTED EMISSIONS

Conducted Emissions occur when a high frequency signal finds its way onto power or ground traces. Conducted emissions can result from an interface cable carrying high frequency signals in close proximity to a power cord. The power supply itself can also generate Conducted Emissions.

To prevent the AC Line cord from acting as an antenna and picking up high frequency signals, ferrite beads can be added at the power connection interface to block the high frequency signals. In this case, and because the ferrite beads are connected directly to the AC Line, use ferrite beads that are specifically designed for this application and are UL recognized.

Switching power supplies are notorious for generating high frequency signal components. When using this type of power supply, be sure that a high quality line

filter is integrated into the power supply to prevent conducted emissions.

CERMETEK RECOMMENDATIONS SUMMARY

1. The PCB design should incorporate separate power and ground planes. The ground planes should continue uninterrupted in the area of low voltage circuits.
2. Signal traces as short as possible to prevent pick-up of system harmonics.
3. Employ EMI/RFI Filters, built from safety rated capacitors and inductors, on the PCB.
4. Use Ferrite Beads on power cables to prevent pick up of high frequency signals.
5. Select a power supply that will not inject high voltage signal components onto the power traces.
6. For safety reasons, do NOT route the ground and power planes in the areas of the telephone jack and Tip/Ring pin connections.

ADDITIONAL APPLICATION NOTES

The following additional Cermetek Application Notes may be of further assistance.

1. Application Note 611-0130: Summary Recommended Suppliers.
2. Application Note 611-0201: Surge, Over Voltage and EMI Protection.

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