

# Layout Recommendations for MC13783 Applications

Power Management and Audio Application Team

## 1 Introduction

This application note provides general layout recommendations for MC13783 applications.

## 2 General Overview of MC13783 Usage

The MC13783 is a highly integrated power management, audio and interface component. It is dedicated to the handset and portable applications covering GSM, GPRS, EDGE and UMTS standards. The MC13783 Power Management Device is part of Freescale's 2G and 3G platform solutions. This IC also implements high performance audio functions suited for multi-media applications such as smartphone and UMTS handsets, MP3 players and other portable handheld applications.

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## 3 Layout Recommendations

The layout recommendation outlined below are provided to guide board level recommendations of MC13783 with particular emphasis on power robustness and audio quality.

### 3.1 LDO with Internal Pass Device

- Cout should be as close as possible to Vout pin.
- Trace from BO should have very low resistivity.
- Bigger traces to handle extra load currents.

### 3.2 LDO with External Pass Device

- Put Cin Capacitor close to the Emitter. Increase stability during transient.
- Cout ESR should be  $> 20\text{m}\Omega$  (Cout ESR or layout or additional resistor).
- Trace from BP to the emitter should have very low resistivity.

### 3.3 Switchers

- Minimize resistance in power traces to avoid efficiency degradation.
- SWFB is a sense but acts as a brake during overshoot, so treat as a power trace.
- SWIN will drive I load maximum up to I limit maximum.
- Vin cap recommended, locate near the pin. (1 $\mu$ F or  $>$ ).
- Do not share any IC GNDs with GNDSWxy. This is a noisy GND which carries switching currents. GNDSWxy should go directly to system GND.

### 3.4 Boost Switcher

- Minimize resistance in power traces to avoid efficiency degradation.
- SWFB is a sense but acts as a brake during overshoot, so treat as a power trace.
- SWIN will drive I load maximum up to I limit maximum.
- Vin cap recommended, locate near the pin.

### 3.5 Clock

- XTAL load caps connect directly to GNDRTC, then GNDRTC should be connected to system GND.
- Place XTAL components as close to the IC as possible.
- Traces should be as short as possible.
- CLK32K and CLK32KMCU must be kept away from the crystal / load capacitor.
- Crystal choice should meet frequency tolerance requirements.
- Tuning capacitors should take into account trace length if not negligible.

## 3.6 USB

- 50 ohm matched; shielded and symmetrical.
- Add a 22R series resistor on line UDM/UDP to meet USB impedance requirements.
- The GND shield line for UDM UDP should be connected to the main GND at GNDUSBA pins.
- Shielding must be connected to GNDUSBA, then GNDUSBA should be connected to system GND.

## 3.7 Audio

Audio recommendations are divided into general and specific considerations.

### 3.7.1 General

- The audio section should be shielded to isolate it from the RF section, which is also shielded. This includes the power management IC. The shield should be strapped to a solid ground, free of pulsing high current flow.
- Traces containing audio signals or power should not be parallel to those containing pulsing RF or pulsing DC.
- Whether on the same or different inner layers, audio traces should be isolated from non-audio traces by a ground trace with enough via holes to act as a Faraday shield.
- Traces containing pulsing RF or pulsing DC should not pass directly under audio components.
- Solid, largely unbroken audio ground should be on the layer below the MC13783, connected to the main ground with numerous via holes.

### 3.7.2 Specific

- Audio feedback and inter-stage coupling components should be placed as close as possible to the IC and isolated from RF energy. For example, all of the input caps connected to MC1LIN, MC1RIN, MC2IN, RXINL, RXINR, and the coupling cap between TXOUT and TXIN.
- Integrated filter devices that may be used on the Headset Speaker Amp output lines should be placed as close as possible to the headset jack or transducer.
- The following signals must be kept in shortest length and routed as far as possible from noisy RF signals, power signals, and clock signals: Differential Amp Outputs SPP, SPM, LSPP, LSPM (from IC to transducer), Microphone Amp Inputs MC1LIN, MC1RIN, MC2IN (from the MIC itself to the IC MIC amp input), and Headset Speaker Amp Outputs and Headset MIC Inputs (from IC to headset jack).
- Keep the Differential Amp Output signal trace SPP as equal in length as possible to the SPM signal trace (from IC to transducer), and keep Differential Amp Output signal trace LSPP as equal in length as possible to the LSPM signal trace (from IC to transducer).
- PLL Filter - Connect RC GND directly to GNDPLL, then GNDPLL to system GND. No other GND should be connected directly to GNDPLL.
- PLL Filter - Place all filter components as close to the IC as possible.

## Layout Recommendations

- Audio Reference Caps - Place the cap connected from REFA, REFB, REFC, and REFD to ground as close to the IC as possible.
- CLIA / CLIB (if used) - Lines should be shielded.
- FSYNCn, BCLKn, TXn, RXn - Parallel and Same length; preferably shielded (but this is not critical).

### 3.8 Charger

- BATT, BATTISNS, CHRGISNSN, CHRGISNSP are sense lines and must be tapped as close as possible to the ends of the sense resistors (if applicable).

### 3.9 GND

- All GNDXXX are to be connected directly to system GND.
- Use several via holes, five if possible, to bring every component ground to the ground layer.
- Isolate the solid ground plane for all circuits from pulsing current.
- Signal Traces, other than ground, running on the same layer as ground traces, should not intersect those ground traces.

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Freescale Halbleiter Deutschland GmbH  
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+46 8 52200080 (English)  
+49 89 92103 559 (German)  
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Freescale Semiconductor Japan Ltd.  
Headquarters  
ARCO Tower 15F  
1-8-1, Shimo-Meguro, Meguro-ku,  
Tokyo 153-0064  
Japan  
0120 191014 or +81 3 5437 9125  
[support.japan@freescale.com](mailto:support.japan@freescale.com)

### **Asia/Pacific:**

Freescale Semiconductor China Ltd.  
Exchange Building 23F  
No. 118 Jianguo Road  
Chaoyang District  
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China  
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