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SPECTRUM DIGITAL INCORPORATED

OMAP-L137 Evaluation Module

Technical Reference

2008 ***DSP Development Systems***

OMAP-L137 Evaluation Module Technical Reference

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Contents

About This Manual

This document describes the board level operations of the OMAP-L137 Evaluation Module (EVM). The EVM is based on the Texas Instruments OMAP-L137 Processor.

The OMAP-L137 Evaluation Module is a table top card that allows engineers and software developers to evaluate certain characteristics of the OMAP-L137 processor to determine if the processor meets the designers application requirements. Evaluators can create software to execute on board or expand the system in a variety of ways.

Notational Conventions

This document uses the following conventions.

The OMAP-L137 Evaluation Module will sometimes be referred to as the OMAP-L137 EVM or EVM.

Program listings, program examples, and interactive displays are shown in a special italic typeface. Here is a sample program listing.

equations
!rd = !strobe&rw;

Information About Cautions

This book may contain cautions.
This is an example of a caution statement.
A caution statement describes a situation that could potentially damage your software, or hardware, or other equipment. The information in a caution is provided for your protection. Please read each caution carefully.

Related Documents, Application Notes and User Guides

Information regarding the OMAP-L137 can be found at the following Texas Instruments website:

http://www.ti.com

Table 1: Manual History

Revision	History
A	Beta

Table 2: Board History

PWB Revision	History
D	Beta Release

Chapter 1

Introduction to the OMAP-L137 EVM

Chapter One provides a description of the OMAP-L137 EVM along with the key features and a block diagram of the circuit board.

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1.1 Key Features

The OMAP-L137 EVM is a standalone development platform that enables users to evaluate and develop applications for the OMAP-L137 processor. Schematics and application notes are available to ease hardware development and reduce time to market.

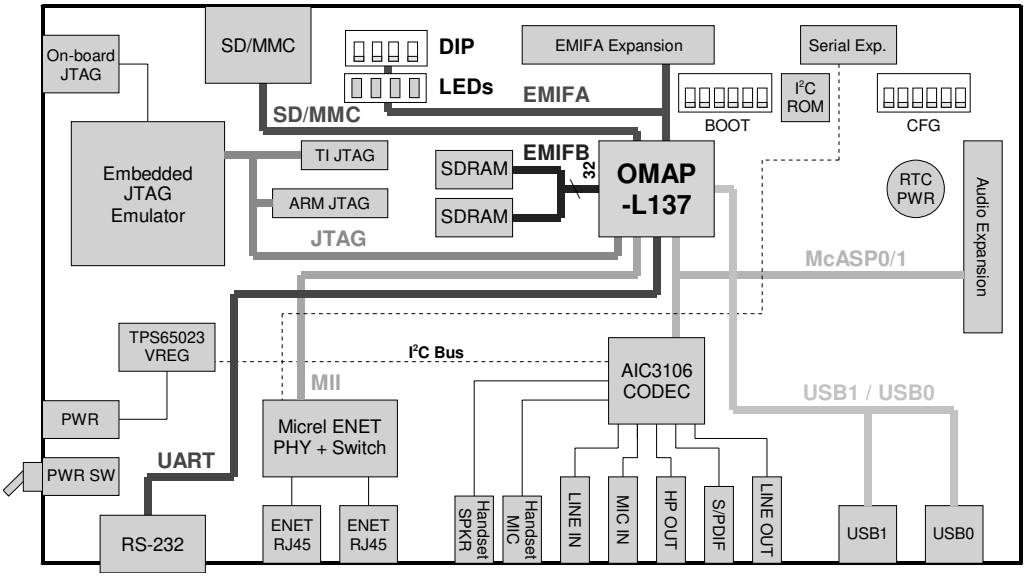

Figure 1-1, Block Diagram OMAP-L137 EVM

The EVM comes with a full complement of on board devices that suit a wide variety of application environments. Key features include:

- A Texas Instruments OMAP-L137 device with a C674x VLIW DSP floating point processor and an ARM926EJ-S processor operating up to 300 Mhz.
- 64 Megabytes SDRAM
- SPI Boot EEPROM
- 2 Port Ethernet Phy/switch
- SD/MMC/MMC Plus media card interfaces
- TLV320AIC3106 Stereo Codec
- USB 1.1 High speed interface
- USB2 2.0 Full speed interface
- RS-232 Interface

- On chip real time clock
- Configurable boot load options
- 4 user LEDs/4 position user DIP switch
- Single voltage power supply (+5V)
- Expansion connectors for daughter card use
- Embedded JTAG Emulation
- 14 Pin TI JTAG/20 Pin ARM JTAG Interfaces

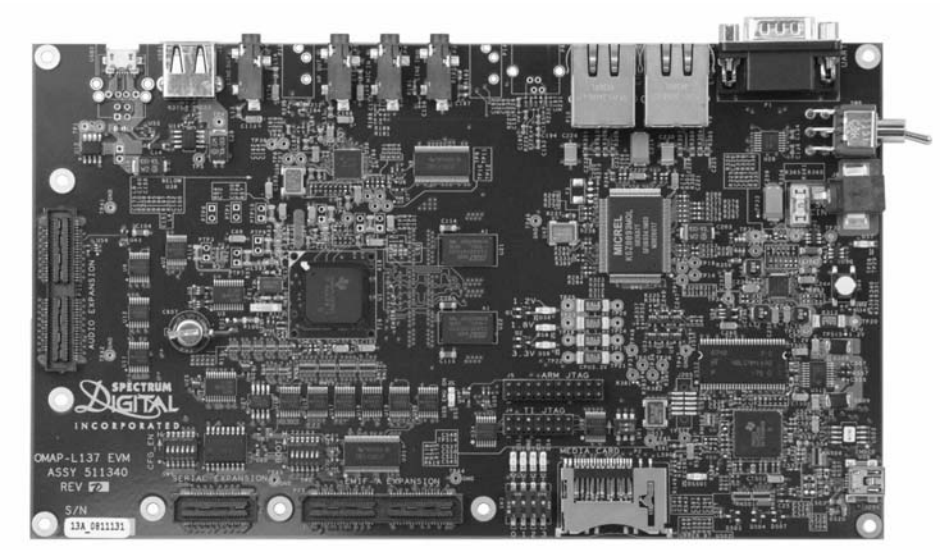

Figure 1-2, OMAP-L137 EVM

1.2 Functional Overview of the OMAP-L137 EVM

The OMAP-L137 on the EVM interfaces to on-board peripherals through the 16-bit wide multiplexed EMIF interface pins. The SDRAM memory is connected to its own dedicated 32 bit wide bus.

An on-board AIC3106 codec allows the DSP to transmit and receive analog audio signals. The I^2C bus is used for the codec control interface, while the McASP controls the audio stream. Signal interfacing is done through 3.5mm audio jacks that correspond to microphone input, headphone output, line input, and line output.

The EVM includes 4 user LEDs, a 4 position user DIP switch, and on chip real time clock. On board multi-plexing allows ease of interfacing to the daughter cards.

An included +5V external power supply is used to power the board. On-board switching voltage regulators provide the CPU core voltage, +3.3V, +1.8V for peripheral interfacing. The board is held in reset by the on board power controller until these supplies are within operating specifications.

Code Composer Studio communicates with the EVM through an embedded emulator or via the TI 14 pin or ARM 20 pin external JTAG connectors.

1.3 Basic Operation

The EVM is designed to work with TI's Code Composer Studio IDE™, or MontaVista tool environments. Code Composer communicates with the board through an on board JTAG emulator. This EVM is shipped with an EVM specific Code Composer Studio environment. To start, follow the instructions in the Quick Start Guide to install Code Composer. This process will install all of the necessary development tools, documentation and drivers.

1.4 Memory Map

The OMAP-L137 processor has a byte addressable address space. However, there are some limitations to byte addressing determined by peripheral interconnection to the OMAP-L137 device. Program code and data can be placed anywhere in the unified address space. Addresses are multiple sizes depending on hardware implementation. Refer to the appropriate device data sheets for more details.

The memory map shows the address space of a generic OMAP-L137 processor on the left with specific details of how each region is used on the right. By default, the internal memory sits at the beginning of the address space. Portions of memory can be remapped in software as L2 cache rather than fixed RAM.

The part incorporates a dual EMIF interface. One dedicated EMIF, EMIF-B, directly interfaces to the SDRAM memory. EMIF-A has 3 separate addressable regions called chip enable spaces (CE0, CS2, CS3), however the EVM uses this interface as a peripheral interface to daughter card connectors. The memory map of the OMAP-L137 EVM is shown in the table below.

Table 1: OMAP-L137 EVM Memory Map

Start Address	End Address	ARM Mem Map	DSP Mem Map
0x0080 0000	0x0083 FFFF		DSP L2 RAM
0x00E0 0000	0x00f0 7FFFF		DSP L1P RAM
0x00F0 0000	0x00F0 8000		DSP L1D RAM
0x0184 0000	0x0184 FFFF		DSP Memory System
0x1180 0000	0x1183 FFFF	DSP L2 RAM	
0x11E0 0000	0x11E0 7FFF	DSP L1P RAM	
0x1FF0 0000	0x11F0 7FFF	DSP L1D RAM	
0x8000 0000	0x8001 FFFF	Shared RAM	
0xB000 0000	0xB000 7FFF		EMIFB control regs
0xC000 0000	0xDFFF FFFF		EMIFB SDRAM Data
0xFFFE E000	0xFFFE FFFF	ARM Interrupt Controller	
0xFFFF 0000	0xFFFF 1FFF	ARM Local RAM	

1.5 Boot Switch Settings

The EVM has a 5 position switch that allow users to configure the operational state of the processor when it is released from reset and determine the source for processor booting. Switch SW2 configures the boot mode that will be used when the DSP starts executing. By default the switches are configured to serial EEPROM boot. The table below shows the boot mode sources and their respective switch positions.

Table 2: SW2, Boot Mode Select

Pos 1 Boot[7]	Pos 2 Boot[2]	Pos 3 Boot[1]	Pos 4 Boot[0]	Pos 5 Boot[3]	Boot Pin BTMODE[7,2,1,0,3]	Boot Mode
OFF	OFF	OFF	ON	NA	0 0 0 1 x	NOR
OFF	OFF	ON	OFF	NA	0 0 1 0 x	HPI
OFF	ON	OFF	ON	NA	0 1 0 1 x	SPI0 Flash
OFF	ON	ON	OFF	NA	0 1 1 0 x	SPI1 Flash
OFF	ON	ON	ON	NA	0 1 1 1 x	NAND 8-bit
OFF	OFF	OFF	OFF	OFF	0 0 0 0 0	I^2C0 Master
OFF	OFF	OFF	OFF	ON	0 0 0 0 1	I^2C0 Slave
OFF	OFF	ON	ON	OFF	0 0 1 1 0	I^2C1 Master
OFF	OFF	ON	ON	ON	0 0 1 1 1	I^2C1 Slave
OFF	ON	OFF	OFF	OFF	0 1 0 0 0	SPI0 EEPROM *
OFF	ON	OFF	OFF	ON	0 1 0 0 1	SPI1 EEPROM
ON	OFF	OFF	ON	OFF	1 0 0 1 0	SPI0 Slave
ON	OFF	OFF	ON	ON	1 0 0 1 1	SPI1 Slave
ON	OFF	ON	ON	OFF	1 0 1 1 0	UART0
ON	OFF	ON	ON	ON	1 0 1 1 1	UART1
ON	OFF	ON	OFF	OFF	1 0 1 0 0	UART2 *
ON	ON	ON	ON	OFF	1 1 1 1 0	Emulation Debug *

* Supported on Standalone EVM

1.6 Power Supply

The EVM operates from a single +5V external power supply connected to the main power input (J6), a 2.5 MM. barrel-type plug. Internally, the +5V input is converted into core voltage, +1.8V and +3.3V using Texas Instruments TPS65023 Power Management Unit. The +3.3V and +1.8V supply are used for the DSP's I/O buffers and other chips on the board.

Chapter 2

Board Components

This chapter describes the operation of the major board components on the OMAP-L137 EVM.

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2.1 EMIF-A Interfaces

A separate 16 bit EMIF with three chip enables divide up the address space and allow for asynchronous accesses on the EVM. The EVM uses this interface for peripheral interfaces to the daughter card.

2.1.1 EMIF-B SDRAM Memory Interface

The OMAP-L137 device incorporates a dedicated 32 bit wide SDRAM memory bus. The EVM uses two 256 Megabit, 16 bit wide memories on this bus, for a total of 64 megabytes of memory for program, data, and video storage. The internal SDRAM controller uses a PLL to control the SDRAM memory timing. Memory refresh for SDRAM is handled automatically by the OMAP-L137 internal SDRAM controller.

2.1.2 Memory Card Interface

The EVM supports SD/MMC/MMC PLUS media card interfaces. This interface is multiplexed with other function the EMIFA bus.

2.1.3 UART Interface

The internal UART2 on the OMAP-L137 device is driven to connector P1. The UART's interface is routed to the RS-232 line drivers prior to being brought out to a DB-9 connector, P1.

2.1.4 USB Interface

The OMAP-L137 incorporates two on chip USB controllers. The USB 2.0 interface is brought out to a micro A/B connector. A jumper is provided to make a flexible host, peripheral, and USB on the go interface. The second USB 1.1 interface is brought out to an A type host interface connector.

2.2 AIC3106 Interface

The EVM incorporates a Texas Instruments TLV320AIC3106 stereo codec for input and output of audio signals. The codec samples analog signals on the microphone or line inputs and converts them into digital data so it can be processed by the DSP. When the DSP is finished with the data it uses the codec to convert the samples back into analog signals on the line output so the user can hear the output.

The codec communicates using two serial channels, one to control the codec's internal configuration registers and one to send and receive digital audio samples. The I^2C bus is used as the AIC3106's control channel. The control channel is generally only used when configuring the codec, it is typically idle when audio data is being transmitted,

McASP1 is used as the bi-directional data channel. All audio data flows through the data channel. Many data formats are supported based on the three variables of sample width, clock signal source and serial data format. The EVM examples generally use a 16-bit sample width with the codec in master mode so it generates the frame sync and bit clocks at the correct sample rate without effort on the DSP side.

The codec is clocked via a 24.576 Mhz oscillator. The internal sample rate generator subdivides the default system clock to generate common audio frequencies. The sample rate is set by a codec register. The figure below shows the codec interface on the OMAP-L137 EVM.

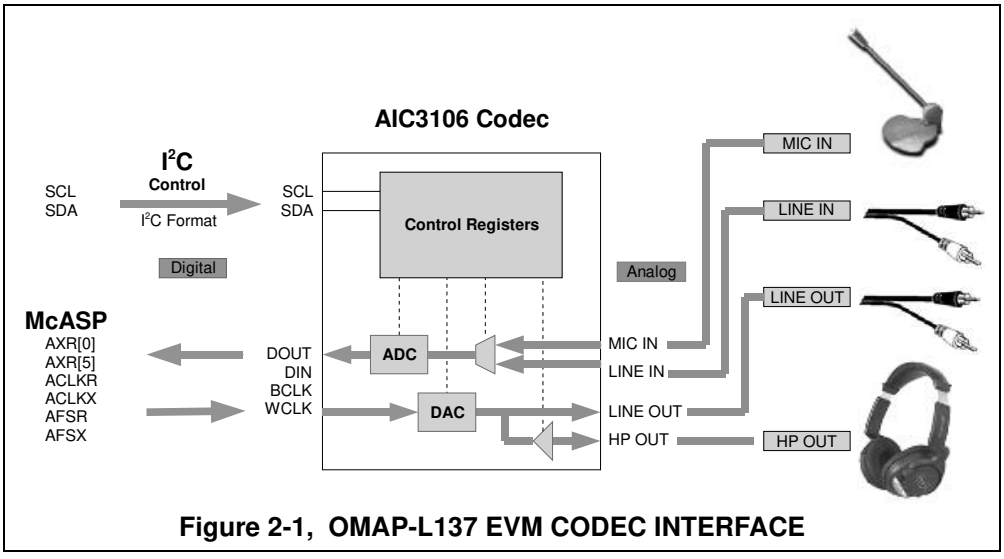

Figure 2-1, OMAP-L137 EVM CODEC INTERFACE

2.3 Ethernet Interface

The OMAP-L137 incorporates an ethernet MAC which interfaces to a Micrel KSZ8893MQL ethernet switch. The multi-port 10/100 Mbit interface is isolated and brought out to two RJ-45 standard ethernet connectors, P9, P10. The ethernet addresses is stored in the on board I^2C EEPROM. The 2 ethernet addresses stored in the EEPROM are the first address and the address + 1. The first address should always be an even number. The I^2C bus is also used to control configuration registers in the switch that are not accessible via the MDIO module.

Two ports provide the ability to input and pass data for Voice Over IP (VOIP) or other daisy chained applications. Connector P9 is the primary port for normal operation.

The RJ-45 jacks have 2 LEDs integrated into their connector. The LEDs are green and yellow and provide link and transmit status from the ethernet controller.

The MAC address for each EVM is also written on a label on the bottom of the board. The figure below shows an examples of this.

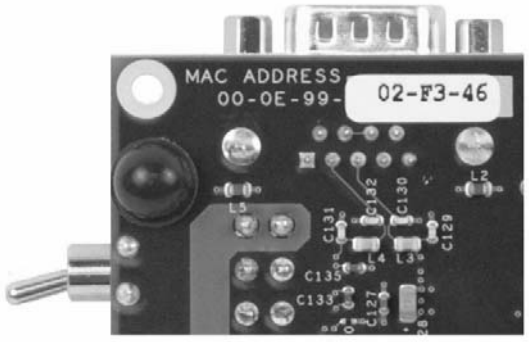

Figure 2-2, OMAP-L137 MAC Address

2.4 I²C0 Interface

The I²C0 bus on the OMAP-L137 is ideal for interfacing to the control registers of many devices. On the OMAP-L137 EVM the I²C0 bus is used to configure the ethernet phy and Codec. An I²C ROM is also interfaced via the serial bus. The format of the bus is shown in the figure below.

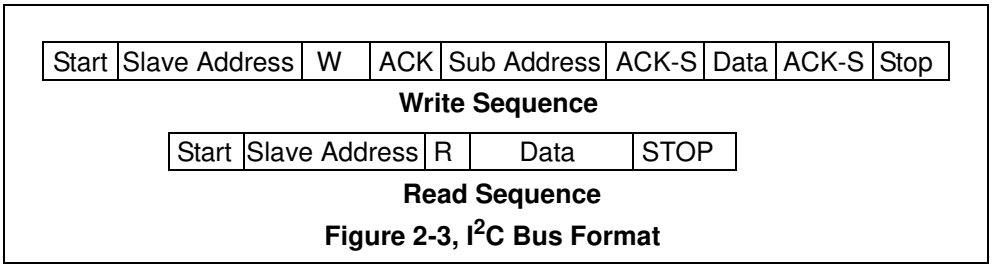

Figure 2-3, I²C Bus Format

The addresses of the on board peripherals are shown in the table below.

Table 1: I²C0 Memory Map

Device	Address	R/W	Function
KSZ8893MQL	0x5D	R/W	Ethernet Switch
TLV320AIC3106	0x1B	R/W	CODEC
I²C EEPROM	0x25	R/W	I²C EEPROM

2.5 Daughter Card Interfaces

The EVM provides expansion connectors that can be used to accept plug-in daughter cards. The daughter card allows users to build on their EVM platform to extend its capabilities and provide customer and application specific I/O. The expansion connectors are interfaces which include McASP, and serial I/O expansion. The EMIF-A signals are brought out as LCD, peripheral, or EMIF signals.

The daughter card connectors used on the EVM are shown in the table below.

Table 2: Daughter Card Connectors

Reference Designator	Part Numbers Used On EVM	Manufacturer
P11	QSE-040-01-L-D-A-K	Samtec
P12	QSE-020-01-L-D-A-K	Samtec
P13	QSE-040-01-L-D-A-K	Samtec

One of the compatible mating daughter card connectors used to interface to the EVM are shown in the table below (other heights are available).

Table 3: Mating Daughter Card Connectors

Reference Designator	Part Numbers Used On EVM	Manufacturer
XP11	QTE-040-02-L-D-A-K	Samtec
XP12	QTE-020-02-L-D-A-K	Samtec
XP13	QTE-040-02-L-D-A-K	Samtec

Chapter 3

Physical Description

This chapter describes the physical layout of the OMAP-L137 EVM and its interfaces.

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3.1 Board Layout

The OMAP-L137 EVM is a 5.0 x 8.55 inch (127 x 217 mm.) ten (10) layer printed circuit board which is powered by an external +5 volt only power supply. Figure 3-1 shows the layout of the top side of the OMAP-L137 EVM.

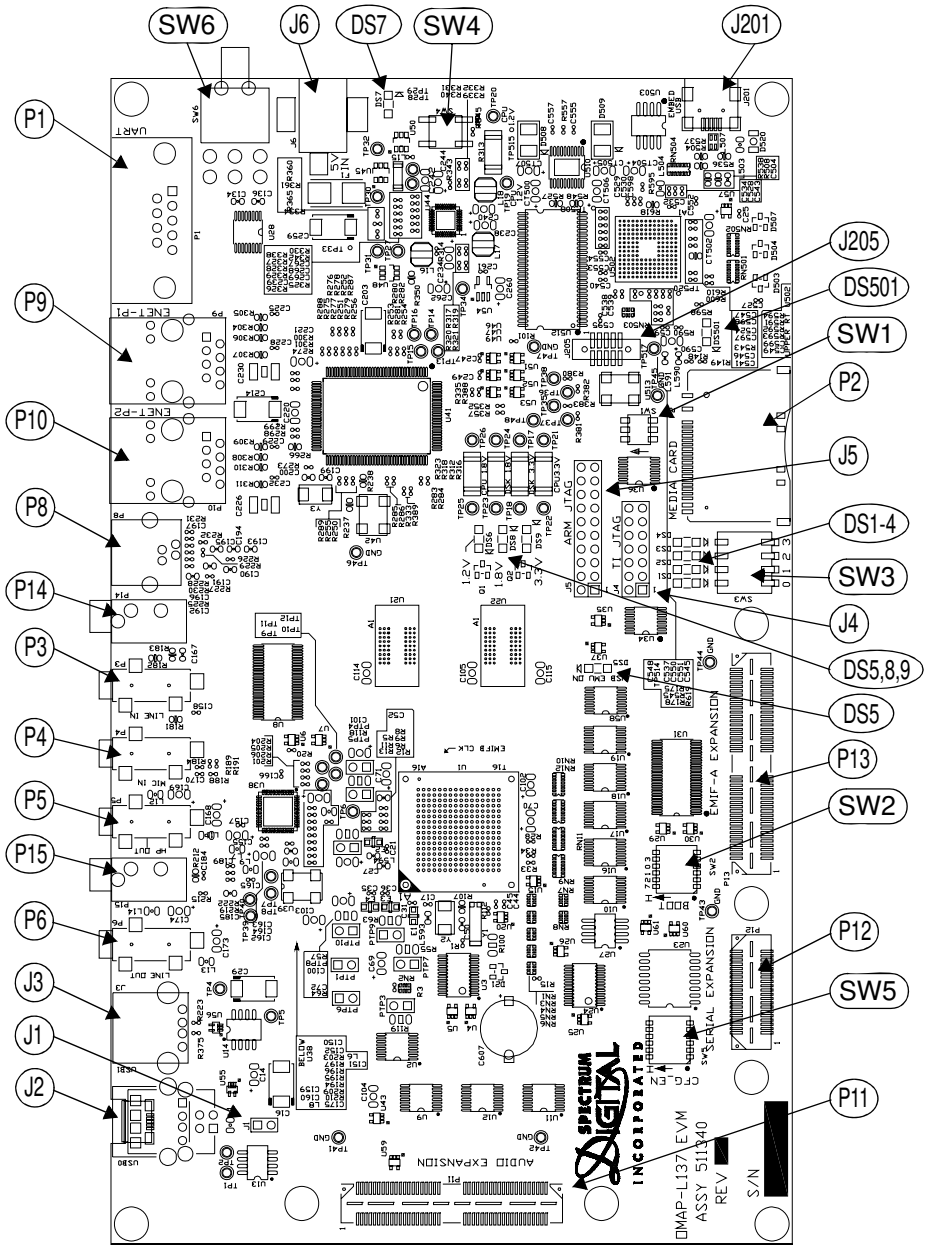

Figure 3-1, OMAP-L137 EVM, Interfaces Top Side

3.2 Connectors

The EVM has numerous connectors and option jumpers to control and provide connections to various peripherals. These connectors and jumpers are described in the following sections.

Table 1: Connectors

Connector	Size	Function
J1	1 x 2	USB Capacitance Select
J2	2	USB Interface
J3	6	USB Interface
J4	2 x 7	TI 14 Pin JTAG
J5	2 x 8	ARM JTAG Emulation Header
J6	2	+5V In
P1	9	RS-232 UART
P2	28	SD/MMC Connector
P3	4	Line In
P4	4	Microphone In
P5	4	Headphone Out
P6	4	Line Out
P8	4	RJ9 Connector
P9	12	Ethernet
P10	12	Ethernet
P11	2 x 45	Audio Expansion Connector
P12	2 x 22	Expansion 2
P13	2 x 45	Expansion 3
P14	3	Phono Jack
P15	3	Phono Jack
J201		Embedded JTAG Interface
J205	2 x 5	Not populated, factory use only

3.2.1 J1, USB Capacitance Select

Connector J1 is a jumper is used to provide more capacitance when the USB connector is used in the host mode. When the jumper is shorted the extra capacitance is provided. These open and shorted position are shown below.

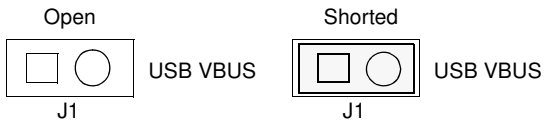

Figure 3-2, J1, USB Capacitance Select

Table 2: J1, USB Capacitance Select

Position	Function
Open	6.8 uF Capacitance
Shorted	106.8 uF Capacitance