Mobile Audio/Modem Daughter Card Specification

Rev 1.0

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LIST OF CONTRIBUTORS

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Conexant Systems, Inc.

ESS Technology, Inc.

GVC Corporation

Motorola, Inc.

PC-TEL, Inc.

Shark Multimedia, Inc.

1. INTRODUCTION

The mobile audio/modem daughter card (MDC) specification provides a mobile form-factor module and interface for audio and modem solutions based upon AC'97 Rev. 2.1. The mobile audio/modem daughter card specification is open to the industry in the hopes that it will facilitate mobile OEM inclusion of internal AC'97 modem designs. The objective is to produce a specification that will provide an appropriate mobile form factor module, reduce the baseline implementation cost, facilitate the certification of AC'97-based modems, and thus improve the time-to-market of platforms with said modem implementations.

The MDC specification will free modem board manufacturers from the burden of repeated certification of modem daughter cards tailored for each customer. OEMs, on the other hand, will be able to leverage off of the certification obtained by preceding MDC implementations. All in all, the MDC specification will provide a low cost, small form factor modem and/or audio module suitable for mobile systems.

Note that the MDC does NOT define a user-accessible I/O expansion slot. This specification defines a system manufacturer, motherboard-only, daughter card interface that is intended to be fully configured prior to the initial shipment of the system.

This specification defines the MDC architecture, required electrical characteristics of the daughter card interface, and mechanical form factor requirements.

1.1 Related Documents

- Audio Codec '97 Component Specification Revision 2.1
(http://developer.intel.com/pc-supp/platform/ac97)

- Audio/Telephony Integration
(http://developer.intel.com/pc-supp/platform/ac97/papers.htm)

- Hardware Acceleration and Re-direction of Audio Streams
(http://developer.intel.com/pc-supp/platform/ac97/papers.htm)

- AC'97 Controller/Codec/System Recommendations
(http://developer.intel.com/pc-supp/platform/ac97/papers.htm)

- ACPI (Advanced Configuration and Power Interface) Specification
(http://www.teleport.com/~acpi/)

- PCI Bus Power Management Interface Specification Revision 1.1
(http://www.pcisig.com)

- Instantly Available PC Power Management Design Guide
(http://developer.intel.com/design/power/pcpower.htm)

- Instantly Available PC Power Delivery Requirements and Recommendations
(http:// developer.intel.com/design/power/supply98.htm)

2. ARCHITECTURAL OVERVIEW

2.1 Baseline Architecture

Figure 1 below illustrates the baseline architecture of an audio and modem subsystem implementing the mobile daughter card. The MDC will be available in two configurations: one, a singular functionality option - either modem-only or audio-only module - and two, a dual functionality option - an audio and modem module.

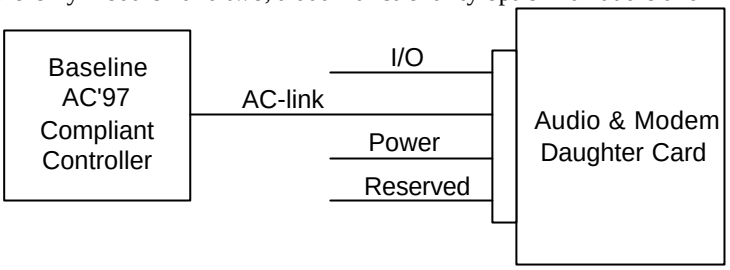

Figure 1: Baseline Audio/Modem Daughter Card

The system interconnect of the mobile audio/modem daughter card is an AC' 97 compliant AC-Link with support for up to two codecs on the daughter card.

Additional signals on the mobile audio/modem daughter card system interface support:

- **I/O:** Includes signals used in split partition codec implementation (e.g. audio codec on the motherboard, modem codec on the daughter card), signals to support audio signals commonly routed on the motherboard (e.g. CD-ROM analog audio signals), and an additional GPIO for amplifier control. These signals also include legacy analog I/O for call progress monitoring.

- **Power:** Signals required to support Instantly Available PC power management including wake-on-ring (WOR) as well as the main power supplies to operate the audio and modem circuitry on the daughter card.

- **Reserved:** Signals reserved for future expansion/modifications of the system interface. Designers must not rely on the absence or characteristics of any features or instructions marked "reserved" or "undefined." Intel reserves these for future definition and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to them.

2.2 Mobile Audio/Modem Daughter Card Configurations

2.2.1 MODEM-ONLY DAUGHTER CARD

Figure 2 below diagrams a modem-only daughter card with a single MC'97 codec. The Modem-Only MDC supports audio and modem configurations that implement the audio subsystem down on the motherboard with the modem codec and DAA up on the daughter card (Figure 2) as well as MC'97 modem-only configurations.

The Modem-Only MDC comes in two styles either with a header over to the RJ11 jack or, alternately, with the RJ11 jack mounted on the daughter card.

These two designs will be further described in Section 4.1.

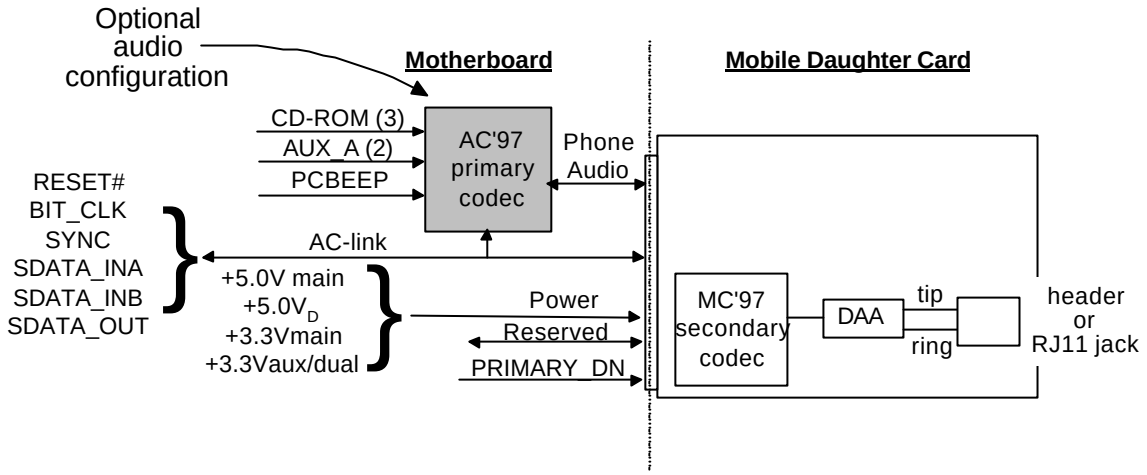

Figure 2: Block Diagram of a Modem-Only MDC Implementation

2.2.2 AUDIO-ONLY DAUGHTER CARD

Figure 3 below diagrams an audio only MDC implementation with a single AC'97 codec. The audio-only daughter card was designed to support headers on the MDC to cable over to the audio analog mini-jacks mounted on a separate PCB.

The design will be further detailed in Section 4.2 Audio-Only MDC.

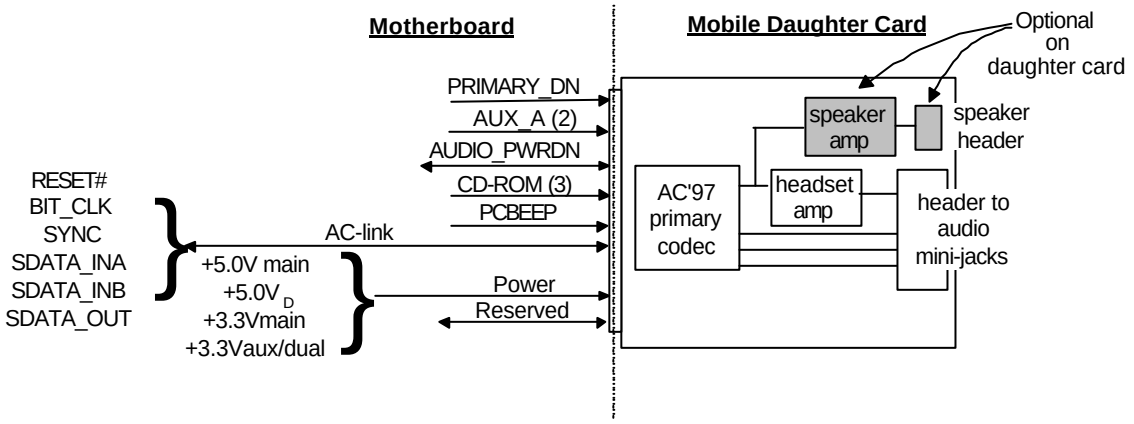

Figure 3: Block Diagram of Audio-Only MDC Implementation

2.2.3 COMBINED AUDIO-AND-MODEM DAUGHTER CARD

Figure 4 below diagrams a combined audio and modem MDC module. The audio-and-modem MDC can supports either a combined AMC' 97 codec or split AC' 97 codec and MC' 97modem codec on the daughter card. The DAA and supporting circuitry is also located on the daughter card.

The Audio-and-Modem MDC was designed with the greatest flexibility such that the system manufacturer may choose between headers or jacks for both or either the audio or modem analog I/O.

These details of these options will be further described in Section 4.3.

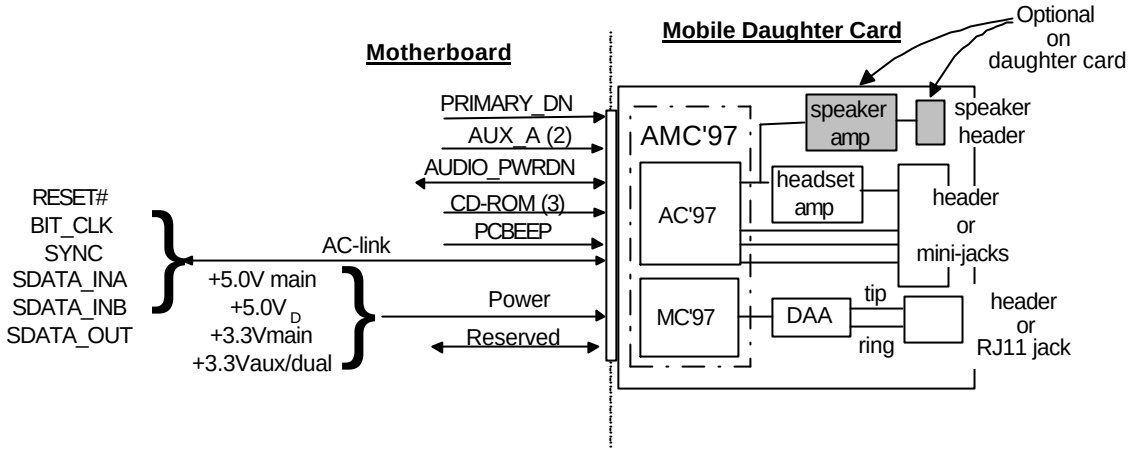

Figure 4: Block Diagram of an Audio-and-Modem MDC Implementation

2.3 Unsupported Configurations

The mobile audio/modem daughter card is limited to two AC' 97 codecs. Any daughter card configuration with more than two codecs is not supported.

The MDC does not limit the number of codecs on the AC-link.

The MDC does **NOT** support aftermarket audio or modem upgrades as the module is internal to the sealed laptop box. Once a system manufacturer has shipped a system into the field, regardless of the motherboard/MDC configuration capabilities, all future audio and modem upgrades must be brought into the system via industry-standard expansion options such as a PCMCIA slot or a Universal Serial Bus (USB) port.

2.4 Docking Support

The Mobile Daughter Card interface contains one reserve pin for future docking support. The MDC in no other way explicitly supports or limits docking capability. Motherboard and MDC manufacturers will need to coordinate their designs so as to insure proper synchronization, configuration, electricals, and routing to support the wide variety of docking scenarios.

2.5 Hardware Scalability Model

Support for hardware acceleration is inherent to the mobile daughter card architecture. The daughter card is compatible with any associated controller that complies with the AC' 97 Rev. 2.1 specification. Therefore, scalable solutions implementing hardware accelerated controllers are also supported by this specification as shown below in Figure 5.

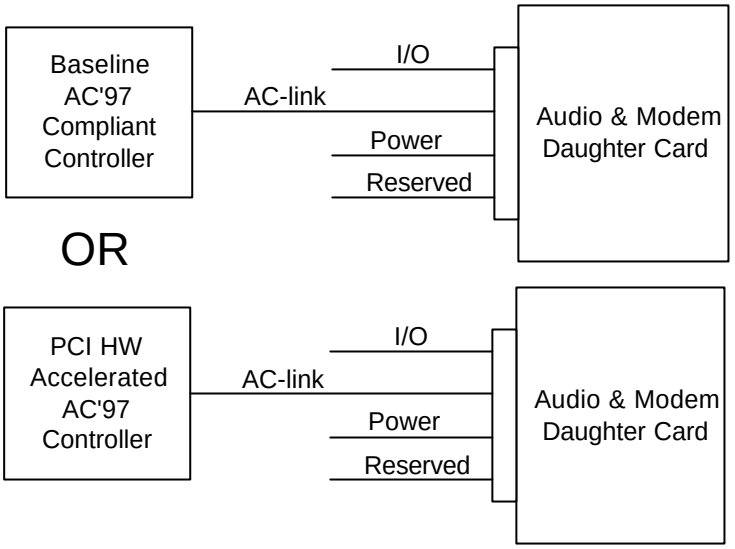

Figure 5: Mobile Audio and Modem Daughter Card with and without Hardware Acceleration

3. SYSTEM INTERFACE

3.1 Mobile Daughter Card System Interface Connector

The mobile daughter card system connector is the interface between the motherboard and the audio and/or modem circuitry located on the MDC. The system interface connector is a 30 pin AMP* 0.8mm fine pitch SMT connector or equivalent. The connector has low profile, variable parallel board stacking height with a minimum of 3mm to a maximum of 4.5mm. The plug (Part Number 3-179396-0) - as shown in Figure 6 - is situated on the daughter card. The receptacle (Part Number 3-179397-0) - as shown in Figure 7 - is mounted on the motherboard.

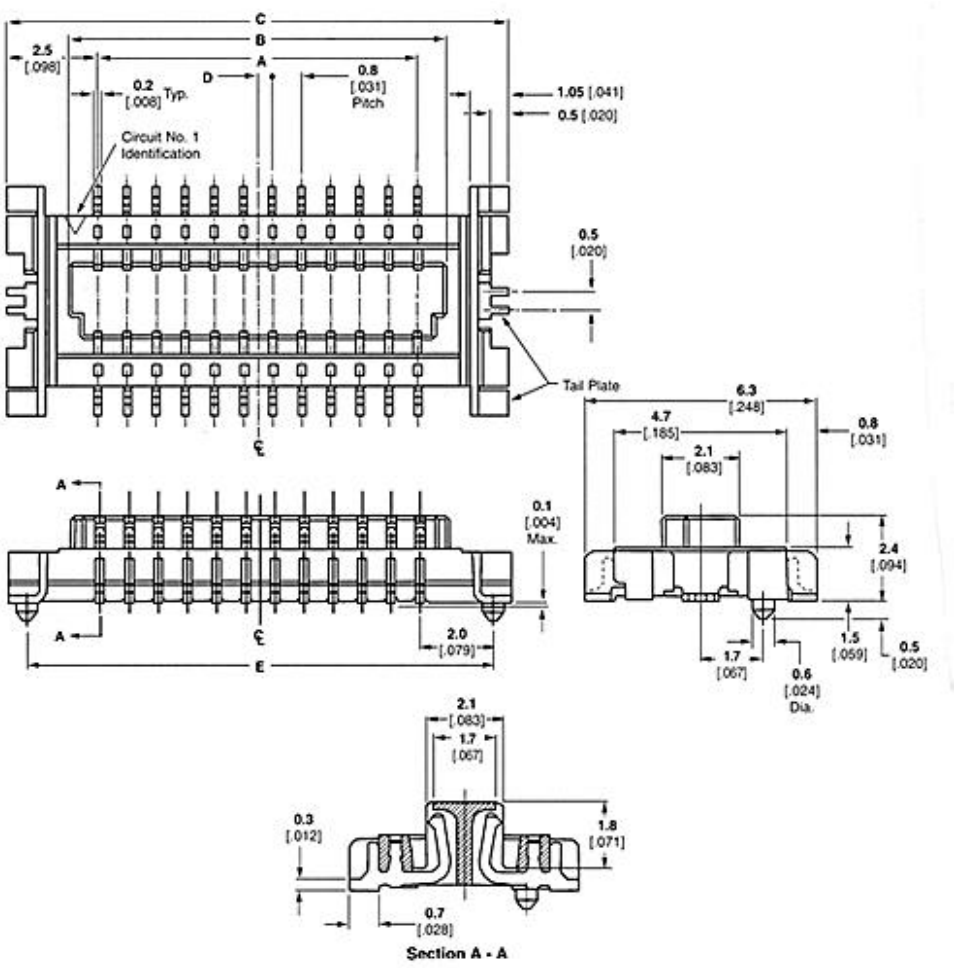

Figure 6: 30 pin AMP* 0.8mm fine pitch SMT connector plug

Features of 30 pin AMP* fine pitch SMT connector plug	
Sex	Plug
# of Positions	30
# of Rows	Dual
Centerline Spacing	.031 [0.8] in. [mm]
Keyed	Yes
Board-to-Board Stack Height	.118 [3.00] in. [mm]
Connector Size	.031 [0.8] in. [mm]
Contact Mating Area Plating	Tin-Lead
Locating Posts	With
Packaging Method	Tape Mounted
Dim. A	.441 [11.20] in. [mm]
Dim. B	.502[12.75] in. [mm]
Dim. C	.638[16.2] in. [mm]
Dim. E	.598 [15.20] in. [mm]
Housing Material	6T Nylon
Housing Color	Natural
Housing Material Temp.	High
Contact Material	Phosphor Bronze
Solder Tail Plating	Tin-Lead

Table 1: Features of 30 pin AMP* SMT Connector Plug

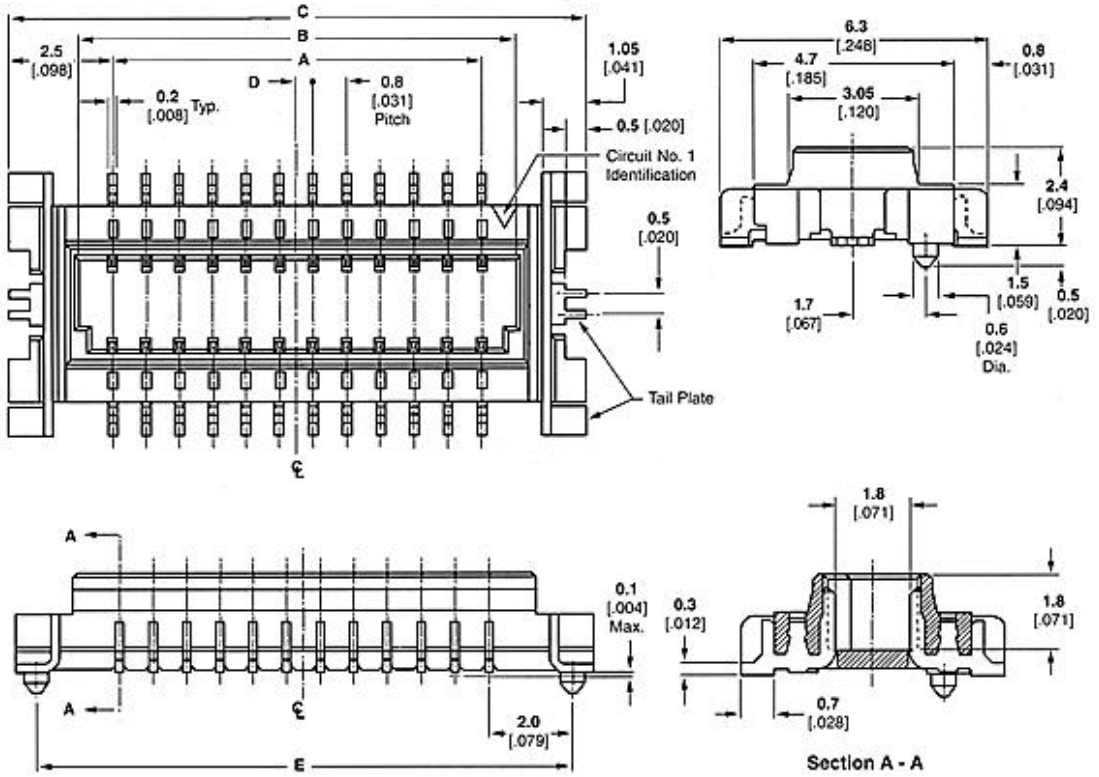

Figure 7: 30 pin AMP* 0.8mm fine pitch SMT connector receptacle

Features of 30 pin AMP* fine pitch SMT connector receptacle	
Sex	Receptacle
# of Positions # of Rows	30 Dual
Centerline Spacing	.031 [0.8] in. [mm]
Keyed	Yes
Board-to-Board Stack Height	.118 [3.00] in. [mm]
Connector Size	.031 [0.8] in. [mm]
Contact Mating Area Plating	Tin-Lead
Locating Posts	With
Packaging Method	Tape Mounted
Dim. A	.441 [11.20] in. [mm]
Dim. B	.504 [12.80] in. [mm]
Dim. C	.638[16.2] in. [mm]
Dim. E	.598 [15.20] in. [mm]
Housing Material	6T Nylon
Housing Color	Natural
Housing Material Temp.	High
Contact Material	Phosphor Bronze
Solder Tail Plating	Tin-Lead

Table 2: Features of 30 pin AMP* SMT Connector Receptacle

The following sections describe the signal names, descriptions, and electrical properties of the MDC system interface.

3.2 Signal Names and Pinout

1	MONO_OUT/PC_BEEP	AUDIO_PWRDN	2
3	GND	MONO_PHONE	4
5	AUXA_RIGHT	RESERVED	6
7	AUXA_LEFT	GND	8
9	CD_GND	5 V_{main}	10
11	CD_RIGHT	RESERVED	12
13	CD_LEFT	RESERVED	14
15	GND	PRIMARY_DN	16
17	3.3$V_{aux/dual}$	5V_D	18
19	GND	GND	20
21	3.3 V_{main}	AC97_SYNC	22
23	AC97_SDATA_OUT	AC97_SDATA_INB	24
25	AC97_RESET#	AC97_SDATA_INA	26
27	GND	GND	28
29	AC97_MSTRCLK	AC97_BITCLK	30

Table 3:Pin out for Mobile Daughter Card Interface

3.2.1 INTERFACE CONNECTOR PIN DESCRIPTION

Signal Name	Type	Pin Number	Description
AC97_BITCLK	In/Out	30	Serial data clock from primary codec to AC'97 controller and secondary codecs. The nominal frequency of this signal is 12.288MHz.[1]
AC97_SYNC	Input	22	Synchronization pulse from an AC'97 compliant controller to all of the AC'97 compliant codecs on the link. This signal is nominally 1.3 us wide pulse that is used to synchronize the AC link.[1]
AC97_RESET#	Input	25	Active low AC'97 link reset signal.[1]
AC97_SDATA_OUT	Input	23	AC'97 serial data from an AC'97 compliant controller to all of the AC'97 compliant codecs on the link.[1]
AC97_SDATA_INA	Output	26	AC'97 serial data from an AC'97 compliant codec to an AC'97 compliant controller.[1] SDATA_INA is to be used **first** on the daughter card, i.e. if there is only one codec on the daughter card - an audio or a modem codec - it will use SDATA_INA for its input to the controller regardless of its designation as a primary or a secondary codec. On an audio-and-modem combo daughter card, SDATA_INA is to be used by the primary codec for input to the controller.
AC97_SDATA_INB	Output	24	AC'97 serial data from an AC'97 compliant codec to an AC'97 compliant controller.[1] SDATA_INB is to be used only for an audio-and-modem combo daughter card as the input for the second codec.

Table 4: AC'97 Pin List for MDC

[1] For detailed information, refer to the current version of the AC'97 Component Specification. The reset state of this signal must meet the current version of the AC'97 Component Specification.

Signal Name	Type	Pin Number	Description
AC97_MSTRCLK	Input	29	24.576MHz master clock for AC'97 link. This signal is optionally sourced from the motherboard to the riser in support of existing AC'97 compliant codecs and controllers. If the motherboard does not support this signal, then the pin must be connected to ground on the motherboard at the MDC system connector.
PRIMARY_DN	Input	16	Signal is used to indicate the absence or presence of a primary codec on the motherboard. When high, this signal indicates the presence of a primary codec on the motherboard. When low, this signal indicates the absence of a primary codec on the motherboard. PRIMARY_DN is therefore used on a modem-only daughter card to configure the codec as either primary (00) or secondary (01), thus eradicating the need for strap pins, separate hardwired primary modem-only daughter cards and secondary modem-only daughter cards, and other configuration methods.
AUDIO_PWRDN	In/Out	2	Signal used to place the audio amplifier in a low power state. When AUDIO_PWRDN is high, the audio amplifier will be placed in a low power state. When low, the audio amplifier will function normally. The state of this signal during reset must be low. If not supported, the pin must be connected to ground. See Section 4.2 for implementation details.
MONO_PHONE	Output	4	Routes mono audio signal from modem subsystem on daughter card to audio subsystem on motherboard for use in call progress monitoring of modem connection.
PC_BEEP/ MONO_OUT	Input	1	When the audio subsystem is located on the MDC, this signal is defined as PC_BEEP in order to support routing of motherboard beep signal to audio subsystem for use in POST. When the audio subsystem is located on the motherboard and the modem subsystem is on the MDC, this signal is defined as MONO_OUT in order to support routing of the mono audio signal from audio subsystem to modem subsystem for use in implementing speakerphone.The two implementations of this signal are mutually exclusive of one another.
AUXA_RIGHT	Input	5	Analog audio right channel input.
AUXA_LEFT	Input	7	Analog audio left channel input.
CD_LEFT	Input	13	Left audio channel from the CD-ROM.
CD_RIGHT	Input	11	Right audio channel from the CD-ROM.
CD_GND	Input	9	Common mode ground connected to CDROM ground input to provide common-mode noise rejection.

Table 5: I/O Pin List for MDC

Signal Name	Type	Pin Number	Description
$3.3V_{aux/dual}$	Supply	17	$3.3V_{aux/dual}$ supply providing auxiliary power during system states in which ring detection is necessary. Ring detection is necessary during active states for modem operation as well as sleep states for wake-on-ring. $3.3V_{aux/dual}$ may optionally provide full power during system states in which the modem subsystem is active. System designers should refer to the specifics of the modem design to determine if the modem makes use of this property.
Ground	Ground	15	Power supply ground return for $3.3V_{aux/dual}$.
$3.3V_{main}$	Supply	21	$3.3V_{main}$ supply providing full power during system states in which the audio and/or modem subsystem is active.
Ground	Ground	19	Power supply ground return for $3.3V_{main}$.
$5.0V_{main}$	Supply	10	$5.0V_{main}$ supply provides full power during system states in which the audio and/or modem subsystem is active.

Ground	Ground	8	Power supply ground return for $5.0V_{main}$.
$5.0V_D$	Supply	18	Optional $5.0V_D$ supply providing full power during system states in which the audio subsystem is active. **This rail will typically be sourced from the same power plane as the $5V_{main}$.**
Ground	Ground	20	Power supply ground return for $5.0V_D$.
Ground	Ground	3	Analog signal ground return.
Ground	Ground	28	Digital signal ground return for AC97_BITCLK.
Ground	Ground	27	Digital signal ground return for AC-Link signals except AC97_BITCLK.

Table 6: Power and Ground Pin List for MDC

Signal Name	Type	Pin Number	Description
RESERVED	N/A	12	Reserved for USB.[2]
RESERVED	N/A	14	Reserved for USB.[2]
RESERVED	N/A	6	Reserved for future docking support.[2]

Table 7: Reserved Pin List for the MDC

3.3 Electrical Specifications

Signal Name	Min.	Max.	Units	Comments
PC_BEEP				Must be attenuated to a level compatible with audio codecs.
Amplitude	0	1.0	V_{RMS}	
Source Impedance	2.0	2.5	kΩ	
Load Impedance	10	--	kΩ	
MONO_PHONE				
Amplitude	--	1.0	V_{RMS}	
Load Impedance	10	--	kΩ	
MONO_OUT				
Amplitude	--	1.0	V_{RMS}	
Source Impedance	--	1	kΩ	
Load Impedance	10	--	kΩ	
AUDIO_PWRDN				V_{DD} refers to the digital supply operating the circuitry on the daughter card module that interfaces to the specified signal.
V_{IL}	--	$.35xV_{DD}$	V	
V_{IH}	$.65xV_{DD}$	--	V	
CD_LEFT, CD_RIGHT				
Amplitude	1		V_{RMS}	
Load Impedance	10		kΩ	
CD_GND				Refer to preferred CD-ROM drive specifications.
Source Impedance	--	--	--	
Load Impedance	--	--	--	
AC97_BITCLK,	--	--	--	Refer to current version of the Audio Codec '97 Component Specification.
AC97_MSTRCLK,	--	--	--	
AC97_SYNC,	--	--	--	
AC97_RESET#,	--	--	--	
AC97_SDATA_OUT,	--	--	--	
AC97_SDATA_IN	--	--	--	

Table 8: Electrical Specifications for the MDC System Interface Connector

[2] Designers must not rely on the absence or characteristics of any features or instructions marked "reserved" or "undefined." Intel reserves these for future definition and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to them.

3.4 Power Specifications

3.4.1 MODEM-ONLY DAUGHTER CARD

Power Rail	Min.	Max.	Units	Comments
+3.3$V_{aux/dual}$				3.3$V_{aux/dual}$ supply provides auxiliary power when ring detection is necessary, i.e. when the modem is active and when wake-on-ring functionality is desired.
Tolerance	--	+/-5	%	
Supply Current				3.3$V_{aux/dual}$ supply may also ***optionally*** provide full power when the modem is active as per modem subsystem design requirements.[3]
active	--	*0.5*	*Amps*	
auxiliary	--	3.0	mAmps	
+3.3V				3.3V_{main} supply provides full power when audio and/or modem subsystem is active.[3]
Tolerance	--	+/-5	%	
Supply Current	--	0.5	Amps	
+5.0V_{main}				5V_{main} supply provides full power when audio and/or modem subsystem is active.
Tolerance	--	+/-5	%	
Supply Current	--	0.25	Amps	

Table 9: Power specifications for Modem-Only MDC

The 3.3$V_{aux/dual}$ rail can either be supplied by the 3.3V auxiliary rail ***or*** a combination of the 3.3V_{main} and 3.3V_{aux} rails as shown below in Figure 8. The switch can be any implementation that results in a muxing of the main and auxiliary power supplies. The switch can be controlled via a power management signal or GPIO.

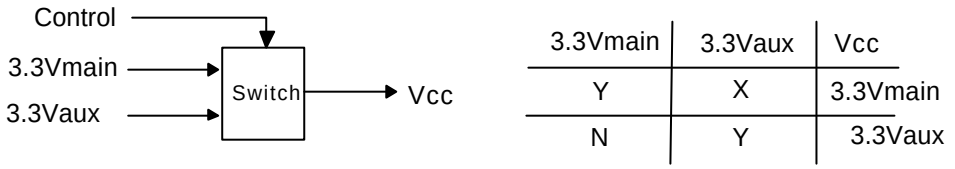

Figure 8: Switching algorithm for 3.3V dual operation

It may be desired that the modem subsystem wake the system from sleep upon detection of a ring (wake-on-ring). The AC'97 Specification Revision 2.0 Appendix B defines an AC-Link wake-up event as a 0 to 1 transition on SDATA_IN when the AC-Link is powered down (Register 26h PR4=1)[4]. When wake-on-ring is desired, the necessary logic to enable wake-on-ring must be powered by the +3.3$V_{aux/dual}$ supply as it is the only power rail that provides auxiliary current in low power system states, i.e. system states in which the main power rails have been turned off. The maximum auxiliary current provided on the +3.3$V_{aux/dual}$ rail to enable wake-on-ring is 3.0 mAmps.

Since the logic necessary for a ring detection is also necessary during active operation of the modem, the +3.3$V_{aux/dual}$ supply must ***at minimum*** provide the auxiliary current during all system states and may ***optionally*** provide full power as per the modem subsystem design requirements specified by the modem vendor/manufacturer.

---

[3] When 3.3$V_{aux/dual}$ provides full power during the active state, the 3.3V_{main} supply may optionally not be used and therefore a No Connect on both the motherboard and daughter card.

[4] Please refer to AC'97 Specification Revision 2.1 for a complete description of AC-Link wake-up protocol.

The system designer is responsible for coordinating with the modem vendor/manufacturer to provide the necessary current via the +3.3$V_{aux/dual}$ rail when wake-on-ring is desired as modem implementations may require less than the 3.0 mAmp maximum.

	+5.0V_{main}	+3.3V_{main}	+3.3$V_{aux/dual}$
AC-link (codec signals) • BIT_CLK • SDATA_IN			√(if MC is primary)[5] √
AC-link (controller signals) • SYNC • RESET# • SDATA_OUT		√ √	 √
Modem digital logic		√	
Modem analog circuitry	√(see text)		
Modem wake logic			√

Table 10: Recommended Power Distribution: Modem-Only Daughter Card

All AC-link signals originating on the mobile daughter card must be powered by a +3.3V supply[6]. A +3.3V supply[6] must also be used to power both the digital portion of the AC' 97 codec and the AC-link portion of the digital controller.

Both the +5.0V_{main} and +3.3V_{main} rails are available to power the analog portion of the modem subsystem not necessary for wake-on-ring. No part of the modem subsystem necessary for wake-on-ring functionality should draw from the +5.0V_{main} or +3.3V_{main} power supply, including the ring detection circuitry of the DAA, since these rails are shut down in low power system states.

It is the responsibility of the daughter card manufacturer to provide a "clean" power supply derived from the digital supply to the analog circuitry. The performance of the audio and modem subsystem is in part dependent upon the purity of the derived analog power supply.

3.4.2 AUDIO-ONLY DAUGHTER CARD

Power Rail	Min.	Max.	Units	Comments
+3.3$V_{aux/dual}$				3.3$V_{aux/dual}$ supply provides auxiliary power when ring detection is necessary, i.e. when the modem is active and when wake-on-ring functionality is desired. 3.3$V_{aux/dual}$ supply may also ***optionally*** provide full power when the modem is active as per modem subsystem design requirements.[7]
Tolerance	--	+/-5	%	
Supply Current				
active	--	*0.5*	*Amps*	
auxiliary	--	3.0	mAmps	
+3.3V_{main}				3.3V_{main} supply providing full power when audio and/or modem subsystem is active.[3]
Tolerance	--	+/-5	%	
Supply Current	--	0.5	Amps	
+5.0V_{main}				5V_{main} supply providing full power when audio and/or modem subsystem is active.
Tolerance	--	+/-5	%	
Supply Current	--	0.5	Amps	
+5.0V_D				Optional 5V_D supply providing full power when audio and/or modem subsystem is active. Available to designers choosing to implement high power
Tolerance	--	+/-5	%	
Supply Current	--	0.5	Amps	

[5] This is typically a modem-only MDC module with a **non-AC' 97** motherboard audio subsystem employed.

[6] The +3.3V supply may be either +3.3V_{main} or 3.3$V_{aux/dual}$ depending upon the requirements of the particular audio/modem solution. Please refer to the technical specification produced by the audio and/or modem vendor for more information.

[7] When 3.3$V_{aux/dual}$ provides full power during the active state, the 3.3V_{main} supply may optionally not be used and therefore a No Connect on the motherboard and daughter card.

				amplifiers on the daughter card. **This rail will typically be sourced from the same power plane as the $5V_{main}$.**

Table 11: Power specifications for Audio-Only MDC

The Audio-Only MDC must have a higher supply current on the $+5.0V_{main}$ rail in order to meet the supply requirements of the audio subsystem. However, the maximum supply current of 500 mAmps may not provide enough power on the $5V_{main}$ rail for an Audio-Only MDC that houses a high-powered stereo amplifier. As such, an additional $5V_D$ supply is provided for those daughter card designs that include a high-powered stereo amplifier for internal speakers rated at greater than 1 Watt each.

The following table defines the recommended voltages for an audio only daughter card.

	$+5.0V_{main}$	$+3.3V_{main}$
AC-link (codec signals) • BIT_CLK • SDATA_IN		 √ √
AC-link (controller signals) • SYNC • RESET# • SDATA_OUT		 √ √ √
Daughter card digital logic		√
Daughter card analog circuitry	√(see text)	

Table 12: Recommended Power Distribution: Audio-Only Daughter Card

The $+5.0V_{main}$ and the $+3.3V_{main}$ rails as well as the optional $+5V_D$ rail are available to power the analog portion of the audio codec and peripheral audio circuitry. It is the responsibility of the daughter card manufacturer to provide a "clean" power supply derived from the digital supply to the analog circuitry. The quality of the audio subsystem is in part dependent upon the purity of the derived analog power supply.

3.4.3 AUDIO-AND-MODEM DAUGHTER CARD

Power Rail	Min.	Max.	Units	Comments
$+3.3V_{aux/dual}$				$3.3V_{aux/dual}$ supply provides auxiliary power when ring detection is necessary, i.e. when the modem is active and when wake-on-ring functionality is desired. $3.3V_{aux/dual}$ supply may also ***optionally*** provide full power when the modem is active as per modem subsystem design requirements.[8]
Tolerance	--	+/-5	%	
Supply Current				
active	--	*0.5*	*Amps*	
auxiliary	--	3.0	mAmps	
+3.3V				$3.3V_{main}$ supply provides full power when audio and/or modem subsystem is active.[3]
Tolerance	--	+/-5	%	
Supply Current	--	0.5	Amps	
$+5.0V_{main}$				$5V_{main}$ supply provides full power when audio and/or modem subsystem is active.
Tolerance	--	+/-5	%	
Supply Current	--	0.5	Amps	
$+5.0V_D$				Optional $5V_D$ supply providing full power when audio and/or modem subsystem is active. Available to designers choosing to implement high power amplifiers on the daughter card. **This rail will typically be sourced from the same power plane as the $5V_{main}$.**
Tolerance	--	+/-5	%	
Supply Current	--	0.5	Amps	

Table 13: Power specifications for Audio-and-Modem MDC

[8] When $+3.3V_{aux/dual}$ provides full power during the active state, the $+3.3V_{main}$ supply is not used and is therefore a No Connect.

Table 14 below depicts the power distribution to enable audio and modem functionality, including wake-on-ring, on the daughter card.

	+5.0V$_{main}$	+3.3V$_{main}$	+3.3V$_{aux/dual}$
AC-link (codec signals) • BIT_CLK • SDATA_IN (audio) • SDATA_IN (modem)		√[9] √[9]	 √
AC-link (controller signals) • SYNC • RESET# • SDATA_OUT		√[9] √[9]	 √
Audio digital logic		√	
Audio analog logic	√(see text)		
Modem digital logic		√	
Modem analog circuitry	√(see text)		
Modem wake logic			√

Table 14: Recommended Power Distribution: Audio-and-Modem Daughter Card

Both the +5.0V$_{main}$ and +3.3V$_{main}$ rails are available to power the analog portion of the modem subsystem that are not necessary for wake-on-ring. No part of the modem subsystem necessary for wake-on-ring functionality should draw from the +5.0V$_{main}$ or +3.$_{3Vmain}$ power supply, including the ring detection circuitry of the DAA, since these rails are shut down in low power system states.

All audio driven AC-link signals as well as other digital logic associated with the audio subsystem must be powered by a +3.3V rail. Both the +5.0V$_{main}$ and +3.3V$_{main}$ as well as the 5V$_D$ rail are available to power the analog portion of the audio codec and peripheral audio circuitry. The optional 5V$_D$ supply is provided in addition to the +5.0V$_{main}$ for those daughter card designs that include a high-powered stereo amplifier for internal speakers rated at greater than 1 Watt each.

It is the responsibility of the daughter card manufacturer to provide a "cleaned" power supply derived from the digital supply to the analog circuitry. The quality of the audio subsystem is in part dependent upon the purity of the derived analog power supply.

3.5 Reset Consideration

The AC' 97 architecture defines 3 types of reset that AC' 97 compatible codecs must comprehend.

1. Cold Reset — Performs a complete codec hardware reset
2. Warm Reset — Brings the AC-link out of PR4 low power mode, no internal initialization required.
3. Register Reset — Reinitializes the codec via a software command.

Prior to AC' 97 Version 2.1, when the PC is sleeping in either the ACPI S3, S4, or S5 states and a wake event occurs, the system brings the audio/modem subsystems back to full operation by reapplying power to the AC-link and asserting a cold reset sequence.[10]

AC' 97 Version 2.1 imposes a new requirement for AC-link RESET# behavior. This new requirement dictates that RESET# remain actively driven during S3, S4, or S5 states so that auxiliary modem codecs know that the AC-link RESET# was asserted as opposed to floating at or near ground. +3.3V auxiliary powered circuitry would then look for the trailing low to high transition on the AC-link RESET# signal that would indicate the AC-link was powered back up and a "resume" reset sequence had occurred.

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[9] In an AMC device, these AC-Link signals may reside on the +3.3V$_{main}$ or +3.3V$_{aux/dual}$ power rails.

[10] This is the same treatment as with PCI functions resuming from D3cold with a hardware PCI bus reset sequence.

This presents an issue for modem codecs that are designed to wake the system from S3 or S4 sleep states. An auxiliary powered modem codec must retain portions of its internal state, including the wake event state[11], after experiencing this resume sequence. The root issue is that the auxiliary powered codec must be capable of determining how to interpret and deal with an AC-link RESET# assertion so that its internal state is not corrupted when resuming.

There are numerous ways ranging from hardware only solutions to hardware/driver solution of addressing this issue without impacting either this specification or the AC'97 Component Specification. Disclosure of any detailed implementation specific information is beyond the scope of this specification.

3.6 Clocking Considerations

3.6.1 ACPI S0 "WORKING STATE" CLOCKING

In a multiple codec design where audio is the primary codec, i.e. the source of BIT_CLK, ACPI S0 "working state" power management of the primary codec can present a clocking issue for the secondary codec. Specifically, when the system is currently in the "working state" (ACPI S0) and the O/S power management policy manager determines that the audio (primary codec) is idle, it may decide to transition the audio subsystem to its lowest power state, e.g. D3cold. If the audio driver were to then place that audio codec into its lowest power state (including PR4), the AC-link would enter its low power mode with the BIT_CLK stopped.

If the modem is in use or is needed at any time during or after this scenario, it would be incapable of operating correctly since the audio driver has disabled its working state clock source, BIT_CLK. For information on how this problem should be resolved, please refer to the AC'97 Component Specification, Version 2.1.

Note that in any event, the audio and modem drivers are recommended to remain mutually exclusive of one another, i.e. they must not be required to have any knowledge of each other's state.

3.6.2 ACPI S3 AND S4 "SLEEPING STATE" CLOCKING

A modem codec (MC'97) configured as the secondary codec depends upon BIT_CLK from the primary codec - typically the audio codec - for its normal, working state clock source. When the system is in ACPI S3, S4, or optionally S5 sleep states[12], the MC'97 must make provisions for a free running clock source if needed for support of wake event related circuitry. This clock source must be powered by $3.3V_{aux/dual}$ and thus included in the limited auxiliary power budget. The frequency of the free running clock is recommended to be as low as possible as it is both economical and technologically possible in order to conserve power while the PC is asleep.

4. MECHANICAL REQUIREMENTS

4.1 Modem-Only MDC

The following dimensions for the mobile daughter card apply to Modem-Only implementations on the module. All dimensions labeled are in millimeters with a tolerance of +/-.25mm.

4.1.1 HEADER/CABLE OPTION FOR MODEM-ONLY MDC

The Modem-Only MDC module can be equipped with a header to accommodate a cable over to one RJ11 jack mounted on a separate PCB with the surge protection circuitry. The modem header is a 2 pin JAE* header (Part Number FI-S2P-HF) or equivalent. Pin 1 is defined as "TIP" and Pin 2 is defined as "RING."

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[11] "PME context" in PCI-PM parlance.

[12] Or any other power state where the primary audio codec is not providing a free running BIT_CLK.

The cable to the RJ11 jack from the 2 pin JAE* connector is 28 gauge stranded wire with a suggested length of less than 4 inches. Any changes to the cable design will result in re-certification of the modem. The cable must be insulated or shrink wrapped to pass a 1500V (US) or 3000V (Worldwide) high pot test for certification.

The cable will terminate on a separate PCB where the RJ11 jack is mounted. It should be noted that the surge protection component must be located on the PCB where the RJ11 jack is mounted and is therefore **not** on the daughter card for the header/cable option. Please refer to Section 7 MDC Design Rules for more information.

4.1.1.1 US/Japan Modem Configuration

In order to provide for the most limited of form factors, a US/Japan modem discrete DAA configuration yields the smallest Modem-Only daughter card dimensions. The overall dimensions of the US/Japan Modem-Only MDC module are 27mm width x 45mm length x 5.0mm height.

These dimensions may also be applicable to international modems implementing a smaller DAA form factors.

The placement of the system connector, drill holes, and modem header is shown in Figure 9 below. The system connector and header are mounted on the ***bottom*** of the daughter card in order to minimize the height of the module. The thru hole adjacent to the 30 pin system connector is plated for connection to ground. The thru hole adjacent to the 2 pin JAE* header is non-plated in order to avoid any chance of arcing in the DAA section of the daughter card.

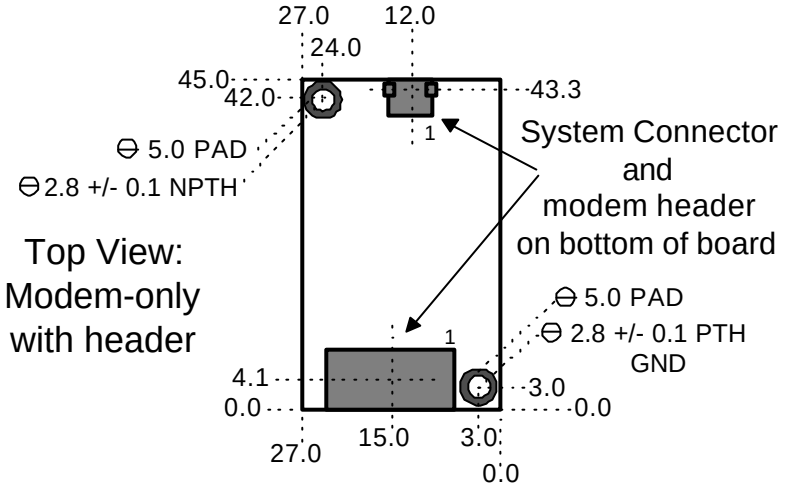

Figure 9: Mechanical dimensions for US/Japan Modem-Only MDC with header

Figure 10 details the component height restrictions of the Modem-Only MDC. The mated height of the system interface connector is variable and is shown here at its minimum of 3.0mm. All dimensions labeled are in millimeters with a tolerance of +/-.25mm.

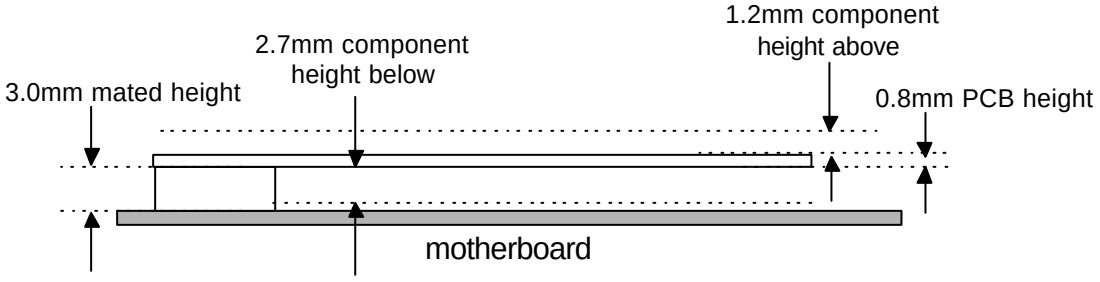

Figure 10: Component height restrictions for Modem-Only MDC with header (side view)

4.1.1.2 International Modem Configuration

Due to the differing DAA requirements around the world, the international modem discrete DAA configuration requires a larger form factor than the US/Japan only version shown above. The overall dimensions of the International Modem-Only MDC module are 37mm width x 45mm length x 5.0mm height.

The placement of the system connector, drill holes, and modem header is shown in Figure 9 below. The system connector and header are again mounted on the ***bottom*** of the daughter card in order to minimize the height of the module. In addition, the placement of the system connector, drill holes, and header are in the exact same relative position in the international Modem-Only MDC configuration as in the US/Japan Modem-Only MDC configuration. This is to allow for build-to-order flexibility for different international markets.

Figure 10 details the component height restrictions of the Modem-Only MDC. The mated height of the system interface connector is variable and is shown here at its minimum of 3.0mm. All dimensions labeled are in millimeters with a tolerance of +/-.25mm. The thru hole adjacent to the 30 pin system connector is plated for connection to ground. The thru hole adjacent to the 2 pin JAE* header is non-plated in order to avoid any chance of arcing in the DAA section of the daughter card.

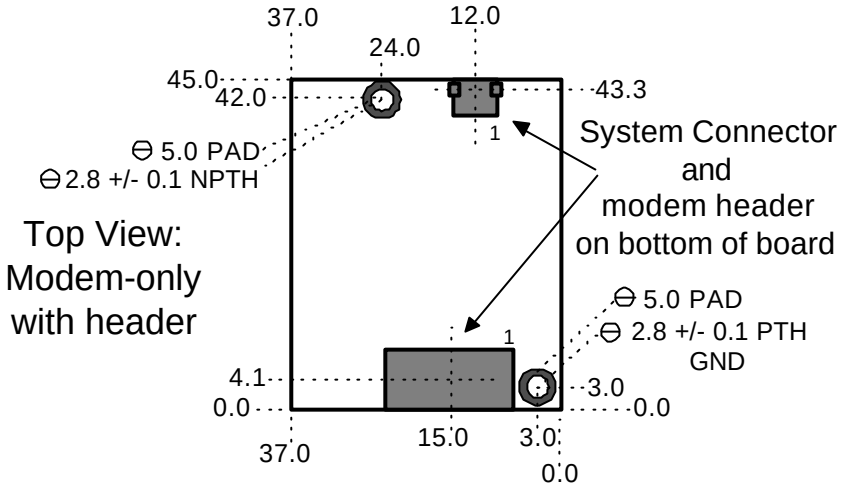

Figure 11: Mechanical dimensions for International Modem-Only MDC with header

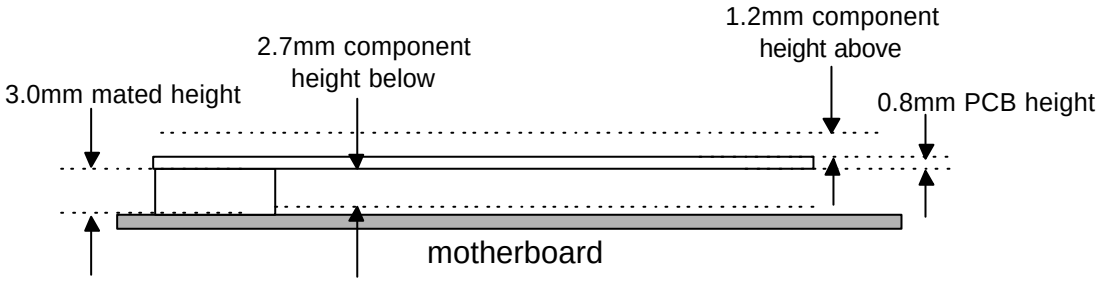

Figure 12: Component height restrictions for Modem-Only MDC with header (side view)

4.1.2 TELEPHONE JACK OPTION

The Modem-Only MDC module can alternately house one RJ11 jack with the surge protection circuitry. The RJ11 jack is from Hirose* (Part Number TM18R-62) or equivalent.

4.1.2.1 US/Japan Modem Configuration

Once again, a US/Japan modem discrete DAA configuration yields the smallest Modem-Only daughter card dimensions. The overall dimensions of the US/Japan Modem-Only MDC module are 27mm width x 55mm length. These dimensions may also be applicable to international modems implementing a smaller DAA form factor.

The placement of the system connector, drill holes, and RJ11 jack is shown in Figure 13 below. The system connector remains mounted on the ***bottom*** of the daughter card while the RJ11 jack is mounted on the top. The thru hole adjacent to the 30 pin system connector is plated for connection to ground.

The thru hole adjacent to the 2 pin JAE* header is non-plated in order to avoid any chance of arcing in the DAA section of the daughter card.

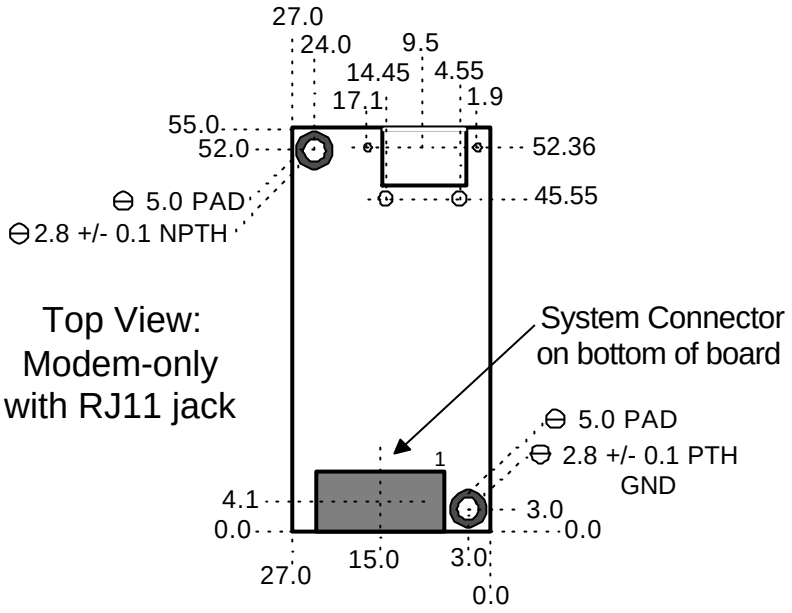

Figure 13: Mechanical dimensions for US/Japan Modem-Only MDC with RJ11 jack

4.1.2.2 International Modem Configuration

The international modem discrete DAA configuration with an RJ11 jack requires a larger form factor than the US/Japan only version shown above. The overall dimensions of the International Modem-Only MDC module are 37mm width x 55mm length.

The placement of the system connector, drill holes, and RJ11 jack is shown in Figure 9 below. The system connector is again mounted on the ***bottom*** of the daughter card while the RJ11 jack is mounted on the top. In addition, the placement of the system connector, drill holes, and RJ11 jack are in the exact same relative position in the international Modem-Only MDC configuration as in the US/Japan Modem-Only MDC configuration. This is to allow for build-to-order flexibility for different international markets.

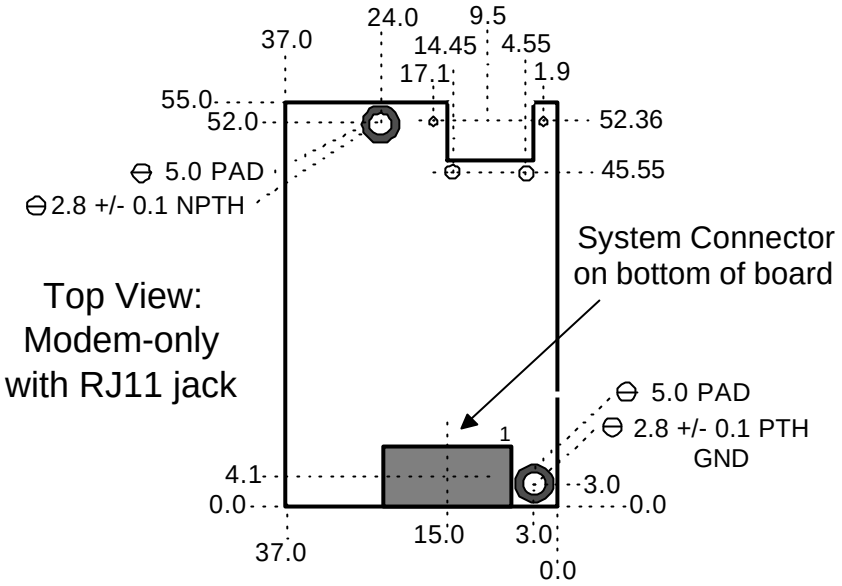

Figure 14: Mechanical dimensions for International Modem-Only MDC with RJ11 jack

4.2 Audio-Only MDC

The following dimensions for the mobile daughter card apply to Audio-Only implementations on the module. All dimensions labeled are in millimeters with a tolerance of +/-.25mm.

4.2.1 HEADER/CABLE CONFIGURATION FOR AUDIO-ONLY MDC

The Audio-Only MDC module comes equipped with a header for a cable over to the audio mini-jacks mounted on a separate PCB either with or without the audio amplifier. If the audio amplifier is mounted on the Audio-Only MDC, then another header will be available for a cable over to the internal speaker(s).

The header for the audio mini-jack connection is a 10 pin JAE* header (Part Number FI-S10P-HF) or equivalent with the following pin-out. The JAE* FI series accepts 28 to 32 gauge wire for cabling.

Pin Number	Definition
1	Mic_In
2	Ground
3	Line_In_Left
4	Line_In_Right
5	Ground
6	Line_Out_Left
7	Line_Out_Right
8	Ground
9	Headphone_Out_Left
10	Headphone_Out_Right

Table 15: Pin-out for Header to Audio Mini-Jacks

Common mobile designs provide for a mechanical selector at the microphone jack that connects the internal microphone to the audio subsystem when there is no external microphone attached and alternately connects the external microphone signal to the audio subsystem when the external jack is occupied. The microphone input to the header should be the "selected" internal and external microphone signal.

Similarly, mobile designs often provide a mechanical selector at the Headphone jack. For systems that chose to provide this feature, the Headphone Output from the MDC should cable over to the mechanical selector at the headphone jack that switches between the internal speakers and external headphones. The audio amplifier is typically a part of the switching mechanism between the headphones and the internal speakers and is therefore located on the same PCB as the audio mini-jacks, not on the MDC.

For systems that chose to differ from this implementation, the audio amplifier may reside on the MDC module along with the other audio circuitry. In these systems, there is an option for a header to cable over to the internal speaker(s). This header is a 4 pin JAE* header (Part Number FI-S4P-HF) or equivalent which accepts 28 to 32 gauge cable.

The AUDIO_PWRDN signal is defined as an input or an output based on the aforementioned choice between the location of the audio amplifier. For example, on an Audio-and-Modem MDC, if the AC'97 audio codec supplies the amplifier power-down control (see EAPD definition in AC'97 Rev. 2.1 specification) ***and*** the headset/internal speaker amplifier resides on the daughter card, this pin would not be used and thus would be connected to ground. If, on the other hand, the same audio codec is implemented up on the MDC ***and*** the system designer has placed the headset/internal speaker amplifier on the PCB mounting the audio mini-jacks, this pin would be an output for routing to the amplifier.

The overall dimensions of the Audio-Only MDC module are 27mm width x 45mm length x 5.0mm height.

The placement of the system connector, drill holes, and audio headers is shown in Figure 15 below. The system connector and all headers are mounted on the ***bottom*** of the daughter card in order to minimize the height of the module.

Figure 16 details the component height restrictions of the Audio-Only MDC. The mated height of the system interface connector is variable and is shown here at its minimum of 3.0mm. All dimensions labeled are in millimeters with a tolerance of +/-.25mm.

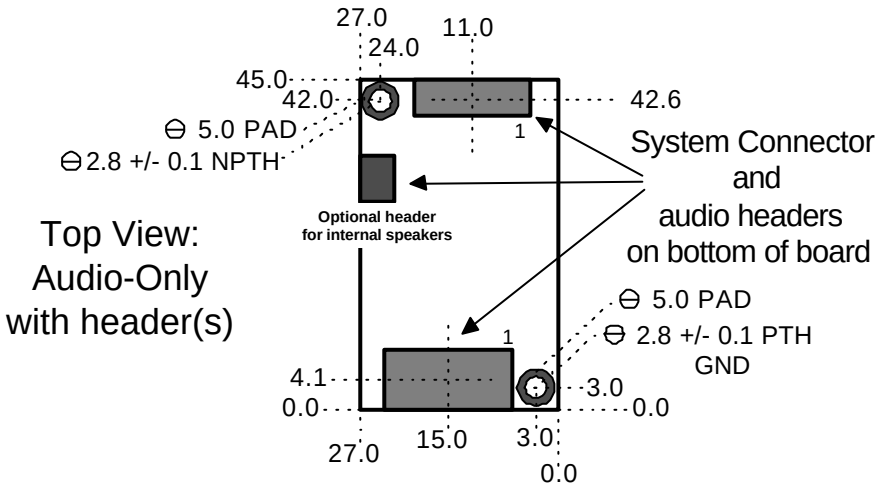

Figure 15: Mechanical dimensions for Audio-Only MDC with header(s)

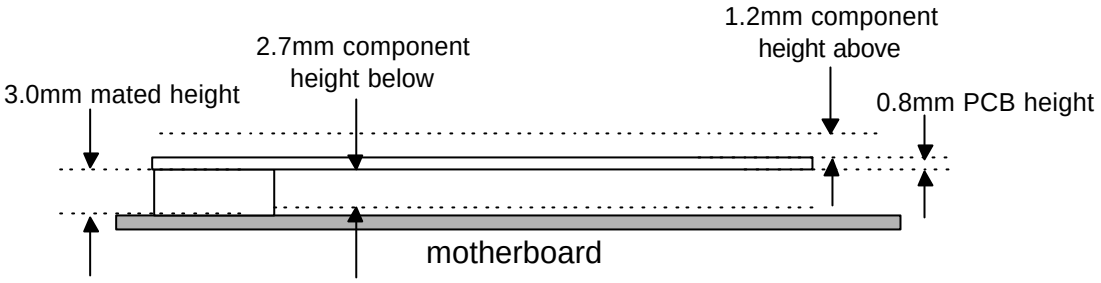

Figure 16: Component height restrictions for Audio-Only MDC with headers (side view)

4.3 Audio-and-Modem MDC

The following dimensions for the mobile daughter card apply to Audio-and-Modem MDC implementations, whether combined AMC' 97 or split AC' 97/MC' 97, on the module. All dimensions labeled are in millimeters with a tolerance of +/-.25mm.

4.3.1 HEADER/CABLE OPTION FOR AUDIO-AND-MODEM MDC

The Audio-and-Modem MDC module can be equipped with the header configurations applicable to both the Audio-Only and Modem-Only varieties discussed above. At most, the Audio-and-Modem MDC module will house a modem header for connection to the RJ11 jack and the audio headers for connection to the audio mini-jacks and the internal speaker(s).

4.3.1.1 US/Japan Modem Configuration

In order to provide for the most limited of form factors, a US/Japan modem discrete DAA configuration yields the smallest audio-and-modem combo daughter card dimensions. The overall dimensions of the US/Japan Modem-Only MDC module are 55mm width x 45mm length x 5.0mm height.

These dimensions may also be applicable to international modems implementing a smaller DAA form factors.

The placement of the system connector, drill holes, and modem header is shown in Figure 9below. The system connector and header are mounted on the ***bottom*** of the daughter card in order to minimize the height of the module. The thru hole adjacent to the 30 pin system connector is plated for connection to ground. The thru hole adjacent to the 2 pin JAE* header is non-plated in order to avoid any chance of arcing in the DAA section of the daughter card.

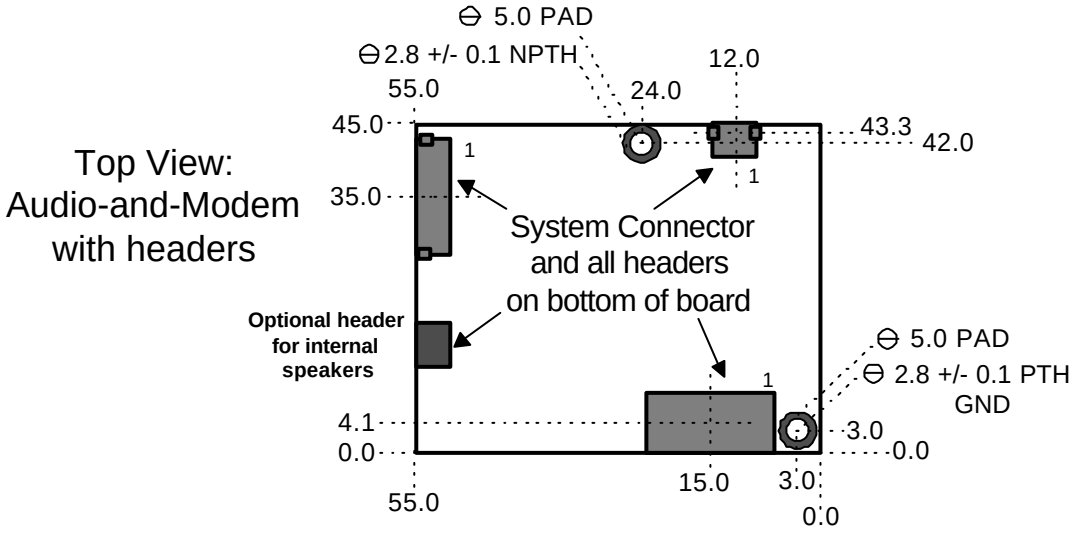

Figure 17: Mechanical dimensions for US/Japan Audio-and-Modem MDC with header

Figure 18 details the component height restrictions of the Audio-and-Modem MDC. The mated height of the system interface connector is variable and is shown here at its minimum of 3.0mm. All dimensions labeled are in millimeters with a tolerance of +/-.25mm. The thru hole adjacent to the 30 pin system connector is plated for connection to ground. The thru hole adjacent to the 2 pin JAE* header is non-plated in order to avoid any chance of arcing in the DAA section of the daughter card.

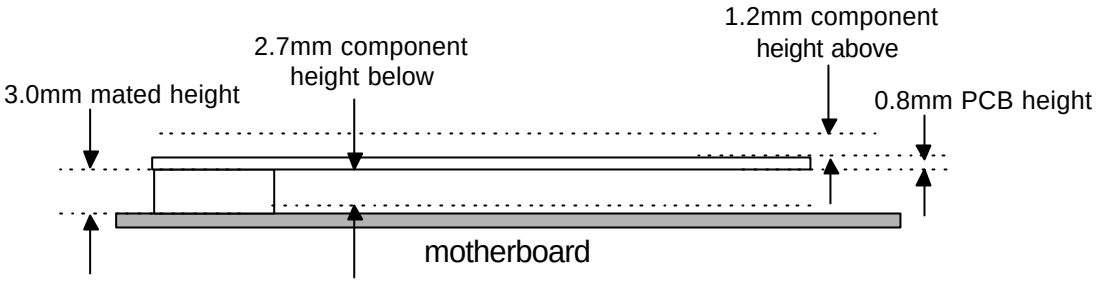

Figure 18: Component height restrictions for Audio-and-Modem MDC with headers (side view)

4.3.1.2 International Modem Configuration

The Audio-and-Modem MDC module dimensions include the space to house an international modem discrete DAA configuration. The overall dimensions of the Audio-and-Modem MDC module is 70mm width x 45mm length x 5.0mm height.

The placement of the system connector, drill holes, and all headers is shown in Figure 19. The system connector and headers are mounted on the ***bottom*** of the daughter card in order to minimize the height of the module.

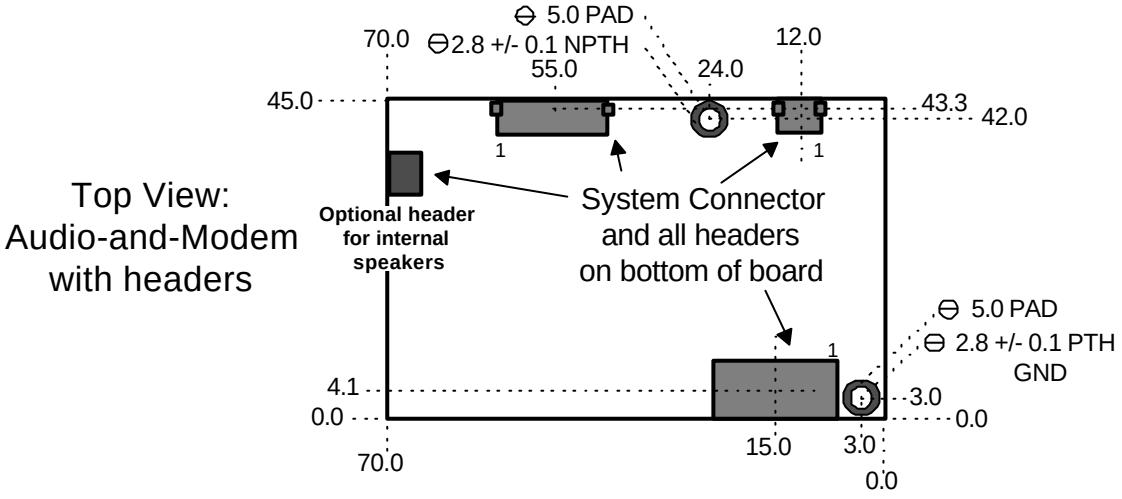

Figure 19: Mechanical dimensions for International Audio-and-Modem MDC with headers

4.3.2 TELEPHONE AND AUDIO JACKS OPTION

The Audio-and-Modem MDC module can alternately house one RJ11 jack with the surge protection circuitry and three audio mini-jacks as discussed previously. The RJ11 jack is from Hirose* (Part Number TM18R-62) or equivalent. The audio mini-jack is from Foxconn* (Part Number JA6033L) or equivalent.

4.3.2.1 International Modem Configuration

The Audio-and-Modem MDC module dimensions include the space to house an international modem discrete DAA configuration as well as the RJ11 jack and three audio mini-jacks. The overall dimensions of the Audio-and-Modem MDC module is 73.5mm width x 55mm length x 5.0mm height.

The placement of the system connector, drill holes, and all headers is shown in Figure 19. The system connector and headers are mounted on the ***bottom*** of the daughter card in order to minimize the height of the module.

Another drill hole is placed in the left hand corner of the module in order to provide further support of the additional jacks.

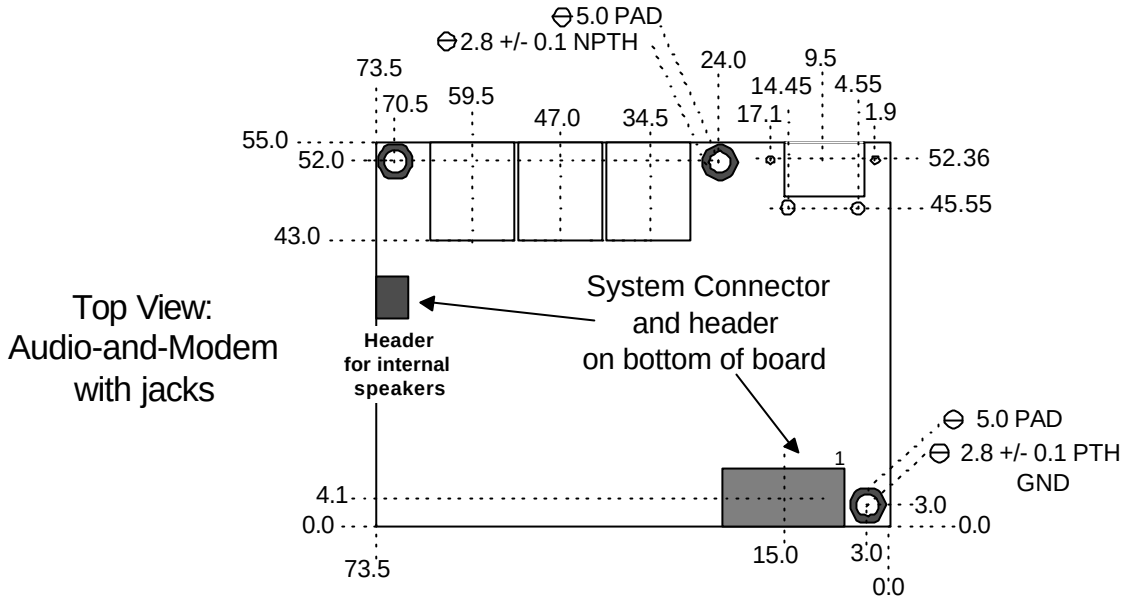

Figure 20: Mechanical dimensions for Audio-and-Modem MDC with jacks

4.4 Ground Isolation

Ground isolation techniques are used to improve the separation of the digital noise from the quieter analog sections of a circuit board. The manufacturer of the mobile daughter card may choose to implement isolated ground regions in the audio sections of the daughter card. To allow a system motherboard to take advantage of a mobile daughter card with ground isolation, certain pins on the mobile daughter card connector can be used to pass the isolated ground from the daughter card to the motherboard. These grounds are currently listed as the analog signal ground returns for MONO_PHONE and PC_BEEP/MONO_OUT.

The manufacturer of both the motherboard and the MDC module must be sure to coordinate their designs when using isolated grounds.

4.5 Discovery, Configuration, and Control

Audio and modem subsystems implemented using the MDC architecture are to be considered motherboard devices only. The functional capabilities of the codec(s) residing on the daughter card are fully visible to their corresponding device driver through the standard AC'97 audio and modem register files.

Identification and control of any additional components or features on the daughter card, e.g. the DAA, is the responsibility of the device driver that is shipped by the daughter card manufacturer.

A mobile daughter card is always seen by the system as a motherboard device. This, by definition, indicates that all pertinent functional information for every element of the design is readily available thus eliminating the need for any automatic capability of discovery mechanisms that would otherwise add unnecessary cost to the daughter card.

If an MDC module absolutely requires feature identification; the audio and/or modem device driver may go about identifying the mobile daughter card features be any number of means.

For example, a codec could be designed to latch a field of strapped pins when coming out of AC-link RESET#. These pins would then be encoded for any number of specific daughter card designs. The encoded daughter card ID field could then be read back through one of the Vendor Specific AC'97 registers.

4.6 EMI, RFI, and Shielding Requirements

It is the responsibility of the mobile daughter card designer to ensure that the daughter card does not prevent a system from meeting the required regulatory requirements concerning EMI and RFI.

5. BIOS/SOFTWARE REQUIREMENTS

A mobile daughter card based audio and/or modem subsystem must always be configured as a motherboard integrated subsystem. The mobile daughter card vendor is responsible for development of all drivers and/or BIOS code needed to configure and manage all the mobile daughter card based subsystem hardware resources.

6. MOTHERBOARD DESIGN RULES

- It is not recommended to run traces, situate resistors, or place any metal pins on the surface of the motherboard below the DAA section of a modem without either a 1 in. (US) / 5 mm (Worldwide) air gap to protect from arcing. As such, it is recommended to increase the board-to-board spacing between the motherboard and MDC by increasing the stack height of the 30 pin system connector to provide for the necessary air gap **OR** isolate the modem and DAA with a mylar sheath if there is a need to mount components or run traces on the motherboard below the DAA.

- If the controller sourcing the AC-link signals does **not** incorporate internal pull-downs on the AC97_BITCLK and the AC97_SDATA_IN[0:1] signals, then the motherboard must provide these pull-downs. The pull-down value must not be less than 10kΩ.

- Trace length capacitance on any AC-link signal on the motherboard must be AC' 97 Version 2.1 compliant.

7. MDC DESIGN RULES

- If the RJ11 is not mounted on the MDC, then the surge protection circuitry must be located on the same PCB as the RJ11 jack. Surge protection circuitry changes per country and per design. Figure 21 shows a generic design of the RJ11 and surge protection circuitry for reference. It is important to remember that this circuitry requires the same isolation as the modem and DAA on the daughter card.

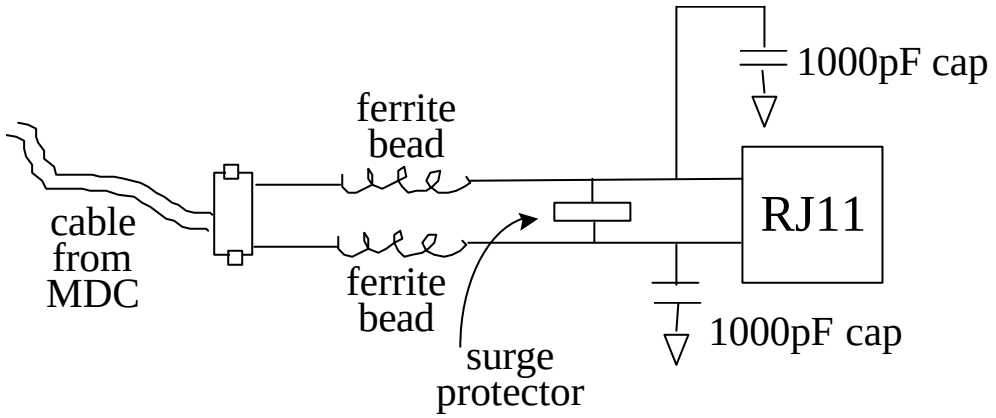

Figure 21: Surge Protection Circuitry with RJ11 jack