amtelco

Infinity Series H.110 512/256 Port Conference Board

TECHNICAL MANUAL

Documentation Revision 0.5: May 11, 2005

Compatibility Notice:

This document refers to firmware versions 0.5c and later dated May 10, 2005 This version of firmware will not run on early prototype boards due to a change in conferencing chips. Versions of firmware earlier than 0.4 will not run on the boards referred to in this manual. For questions on compatibility consult Customer Service.

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FCC Part 15 Requirements

WARNING: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

FCC Part 68 Registration

This equipment is registered with the FCC under Part 68 as a component device for use with any generic PC Type computer or compatible. In order for FCC registration of this product to be retained, all other products used in conjunction with this product to provide your telephony function must also be FCC Part 68 registered for use with these hosts. If any of these components are not registered, then you are required to seek FCC Part 68 registration of the assembled equipment prior to connection to the telephone network. Part 68 registration specifies that you are required to maintain the approval and as such become responsible for the following:

-        any component device added to your equipment, whether it bears component registration or not, will require that a Part 68 compliance evaluation is done and possibly that you have testing performed and make a modification filing to the FCC before that new component can be used;

-        any modification/update made by a manufacturer to any component device within your equipment, will require that a Part 68 compliance evaluation is done and possibly that you have testing performed and make a modification filing to the FCC before the new component can be used;

-        if you continue to assemble additional quantities of this compound equipment, you are required to comply with the FCC's Continuing Compliance requirements.

The telephone company has the right to request the registration information.

The telephone company has the right to temporarily discontinue service. They are required to provide notification and advise of the right to file a complaint.

In case of trouble, you may be required to disconnect the board from the telephone lines until the problem is resolved.

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The authorized repair center is:

American Tel-A-System, Inc.
800-356-9148
4800 Curtin Drive
McFarland, WI 53558

There are no user serviceable components on the board. All repairs should be accomplished by returning the board to Amtelco with a description of the problem.

WARNING: This device contains Electrostatic Sensitive Devices. Proper care should be taken when handling this device to avoid damage from static discharges.

Canadian Customers
CP-01, Issue 8, Part 1
Section 14.1

> **Notice:** "The industry Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements as prescribed in the appropriate Terminal Equipment Technical Requirements document(s). The Department does not guarantee the equipment will operate to the user's satisfaction.

> Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

> Repairs of certified equipment should be coordinated by a representative designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

> Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, ir present, are connected together. This precaution may be particularly important in rural areas.

> **CAUTION:** Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

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European Approvals

CE Approval

EN55022 EMC declaration

This is a class B product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.

No changes or modifications to the Conference board are allowed without explicit written permission from American Tel-A-Systems, Inc., as these could void the end user's authority to operate the device.

1.0 Introduction

The Infinity Series H.110 512 Port Conference Board is designed to provide enhanced conferencing facilities for up to 168 conferences with a total of 512 participants. Enhanced features include individual DTMF detection for each conference participant, a "clamping" function to prevent conferees from hearing DTMF tones generated by other conferees, and energy detection capabilities for conference inputs. A bidirectional analog port is also provided for such functions as music on hold and monitoring. For application requiring less conferencing resources, a 256 port version of the board is available.

The H.110 bus was devised by the Enterprise Computer Telephony Forum (ECTF) to provide a single telecom bus for the entire industry. It is intended for add-in boards using the PCI form factor. A wide variety of boards are available from a number of different vendors.

The board is equipped with a processor that can be used to control the lower level functions of the board. The host PC controls the board using messages passed through dual-ported RAM. The board shares a common message passing and control scheme with other Infinity Series H.110 boards. This scheme is also compatible with legacy XDS boards for the MVIP-90 bus and SCbus.

1.1 Features and Capabilities

This section presents an overview of the features and capabilities of the Infinity Series H.110 512/256 Port Conference Board.

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Figure 1: H.110 Conference
Board Functional Areas

```
         ┌─────────────────────────────────┐
         │                                 │
  ╲      │  AUDIO INPUT                    │
   ╲     │                                 │
         │                       ┌──────┐  │
         │  CONFERENCE           │      │  │
         │  RESOURCES    H.110   │      │  │
         │             TELEPHONY │      │  │
         │             INTERFACE │      │  │
         │                       └──────┘  │
         │                                 │
         │                                 │
         │                                 │
         │                  CPCI           │
         │                INTERFACE        │
         │                       ┌──────┐  │
         │  PROCESSOR            │      │  │
         │  CONTROL              │      │  │
  ╲      │                       │      │  │
   ╲     │                       └──────┘  │
         └─────────────────────────────────┘
```
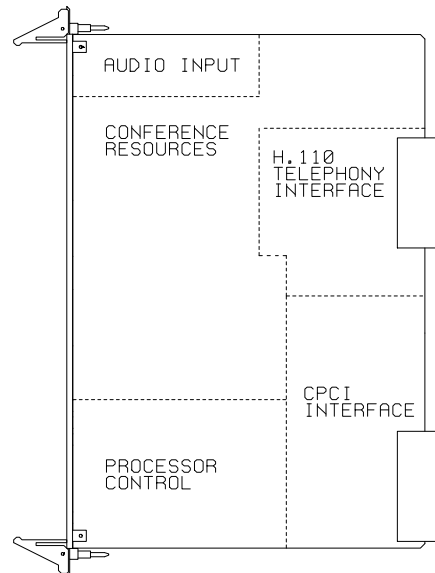
1.1.1 H.110 Bus

The H.110 bus is a digital bus for transporting PCM (Pulse Code Modulation) signals between telephony boards. It was created by the ECTF to provide a common bus structure for future development that would end the "bus wars" between the various legacy busses such as the SCbus and the MVIP bus.

PCM is a standard method of digitizing phone signals. It involves encoding each channel at an 8 kHz rate using eight bits. The signals from multiple channels are then combined into a frame. On the H.110 bus, each frame consists of 128 channels or timeslots. The bit rate of the H.110 bus is 8.192 MHZ. Thirty-two wires, also called streams, each carrying 128 timeslots, are combined to form the bus, and provide a total of 4096 timeslots. Two timeslots are required for a full conversation, one for each talker.

In addition to the streams, a number of other signals necessary to maintain synchronization between all the boards in the system are carried on the bus. These signals provide the clocking and framing information. Redundant clocks are provided to aid in recovery if the primary clock should fail.

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The H.110 bus consists of backplane connections on a 6U *Compact*PCI backplane that is used to interconnect the boards in the system. The CT Bus connections are made through the J4/P4 connector. The electrical and mechanical requirements of H.110 boards are tightly specified to insure the reliability and consistent performance of the CT Bus in any valid configuration of conforming boards.

1.1.2 Conferencing

The H.110 512/256 Port Conference Board includes conferencing facilities similar to those used on other XDS and Infinity Series Boards. Up to 168 simultaneous conferences can be supported with a total of 512 participants. The transmit and receive attenuation of each conferee can be controlled independently improving audio quality and making larger conferences practical. The 256 port version can support up to 84 conferences with 256 participants.

1.1.3 DSP Functions

The H.110 512/256 Port Conference Board is equipped with eight DSP's associated with the conferencing facilities. A DTMF detector is available for each potential conferee. The DSPs also provide a "clamping" feature which when enabled will temporarily interrupt a connection when a DTMF digit is detected. This can be used to prevent other members of a conference from hearing a DTMF tone generated by a conferee. There is also an energy detection capability that can be used to detect the loudest talkers in a conference.

1.1.4 Analog Audio Port

The H.110 512/256 Port Conference Board also provides a bidirectional analog port that can be used for such purposes as providing music on hold or monitoring.

1.1.5 Clock Modes

The H.110 512/256 Port Conference Board can operate in a variety of clock modes. Modes are available so that the master clock can either be derived from the H.110 bus or be generated internally on the Conference Board.

1.1.6 Message Passing

The board occupies 8K of memory space on the host PC. This 8K may reside anywhere within the PC's address space. As a PCI board, the address and interrupt of the board is assigned at boot time. The message passing scheme used by the Infinity Series H.110 512/256 Port Conference Board is identical to that of the other Infinity Series H.110 boards, allowing for the easy combination of a variety of Infinity Series H.110 boards in a single system.

The message passing scheme and message syntax of Infinity Series H.110 boards is similar to that of the older XDS series of MVIP and SCbus boards. At the driver and API level, support is provided for both series of boards so that the H.110 boards may interoperate with legacy boards using a common interface.

1.1.7 Flash EAROM for Firmware

The firmware for both the main processor and for the DSP's is contained in Flash EAROM. This allows for easy upgrades of the firmware on the board in the field without requiring time consuming downloads every time a system boots. Once reprogrammed, the new firmware is retained even when the power is removed. The original, factory programmed firmware is also retained on board and can be accessed by installing a jumper.

1.2 How to Use This Manual

The first five sections in this manual are organized in the order you should read and use them to get started with your H.110 512/256 Port Conference Board. We recommend that you begin with these three steps.

1. Follow the instructions in section 2.0 (Quick Start) and 3.0 (Installation). These sections will tell you if your board is operating correctly within your system. You don't need to be familiar with the board's command set to complete this step.

2. Read section 4.0 (Initialization) to initialize the board within your system. Your application must perform these initialization procedures whenever you power-up your PC in order for the board to communicate with the PC.

3. Read section 5.0 (Communications with the PC) for an overview of how to communicate with the H.110 Conference Board. Section 5.0 includes a summary of the commands for constructing your application and details concerning system interrupts.

Before you can actually build your application, read section 6.0 (The H.110 bus and Clock Modes), 7.0 (H.110 Bus Switching) and 8.0 (Conferencing). These sections explain, with practical examples, how the H.110 Conference Board operates and how to use the command set to achieve the desired results.

Section 9.0 explains diagnostic and error messages that may occur.

The Appendix contains diagnostic information that will be helpful if you have problems installing your H.110 Conference Board.

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2.0 Quick Start

This section describes the first steps you should perform to determine if your Infinity Series H.110 512/256 Port Conference Board is communicating correctly with your *Compact*PCI system. You can perform this quick check without connecting any cables.

The exact procedure will vary depending on which operating system you are running. For each operating systems, drivers are required to interface to the boards. The drivers supplied by Amtelco have tests built into them to verify communications with the boards. These drivers also come supplied with utility programs that allow the developer to test communications with the board. Please consult the appropriate documentation for the driver and operating system you are using.

Quick Start Procedure

1.   With the chassis power off, insert the board into a slot.

2.   Turn on the computer.

3.   If the Amtelco driver is not already installed, install it now, following the instructions supplied with the driver.

4.   Most Amtelco drivers will display a list of boards that are installed (see the documentation for the particular driver that you are using). If the H.110 Conference board is listed, skip to step 6.

5.   If the board is not listed, there may be a problem with the board not being seated correctly in the backplane. There may also be a problem with a memory or interrupt conflict. Power down the chassis and check that the board is properly seated

in the connector and repeat steps 1-4. If this does not remedy the problem, try removing any other computer telephony boards in the system. If your PC is unable to find the board, consult the number at the end of this section.

6.   Run the program "xdsutil" supplied with the driver. Send the message "IN" to the H.110 Conference board. The board should respond with the message "IA".

7.   Send the message "VC" to the board. Verify that the Receive Message reads: `VCxxxxvvvvHK` (where `xxxxvvvv` is a variable indicating the firmware version).

8.   If the Communications screen shows the correct command responses, your H.110 Conference Board is communicating with the PC. You may now power down the computer and attach the necessary cables (see section 3.4)

For technical assistance, call Amtelco at 1-608-838-4194 ext.168.

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3.0 Installation

This section describes how to install your Infinity Series H.110 512/256 Port Conference Board into your computer and how to set the switches, jumpers, and connectors. Before you begin the installation procedure, be sure to test the board as described in section 2.0 (Quick Start).

Figure 2: Location of Jumpers
Headers, and Connectors
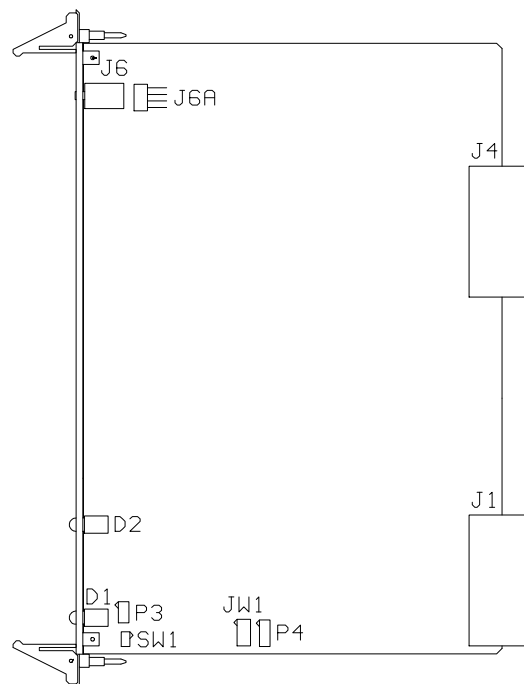
3.1 PCI Configuration

As Infinity Series boards conform to the PCI standards, there are no switches to set to configure the H.110 Conference Board's memory address, I/O addresses, or interrupt. The host processor's bios will automatically configure the board at boot time to avoid conflicts with other boards in the system.

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3.2 Jumpers & Headers

The following is a complete list of all jumpers for the H.110 Conference Board:

JW1-1   Firmware Select. If firmware has been downloaded to the board, this jumper selects whether the downloaded firmware or the factory default firmware is used. When this jumper is installed, the factory default firmware is executed whenever the board is reset. When the jumper is not installed, the downloaded firmware will be executed after a reset if it is present. If no downloaded firmware is present, the factory default firmware is executed after reset.

JW1-2   DSP Firmware Select. Two separate firmware programs are included in the EAROM, one for the board processor and one for the DSP. If JW1-2 is installed and downloaded DSP firmware is present, the factory DSP firmware is executed after reset. Otherwise, the downloaded firmware is executed if present. See JW1-1

JW1-3   Undefined, reserved for future use.

JW1-4   Undefined, reserved for future use..

JW3   This jumper is used for factory testing and should not have jumpers installed.

JW4   Installed if M66EN is not present on the chassi backplane.

P3   Diagnostic port. Never install jumpers here.

P4   This header is used for programming internal logic and should never be jumpered.

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3.3 Connectors: J1 & J1A

J1   Analog port. This port can be used to connect a music source or other device analog port for music on hold. The connector is a standard 1/8" headphone jack. The music source should be at standard line levels.

J1A   Analog input. This header is connected in parallel with J1. It will connect with the audio output of a PC CD-ROM drive.

3.4 Installation

To install the H.110 Conference Board in your system:

1.   Follow the quick check procedures described in section 2.0 to verify the operation of the board.

2.   If the quick check is successful, turn off the chassis power and remove the board from the chassis.

3.   Install any necessary board jumpers. See section 3.2 for jumper configurations.

4.   Insert the board into the chassis. Seat it properly in a slot in the chassis and secure it with the front panel handles.

5.   If the analog port is to be used, connect the music source or other compatible device.

6.   Power up the computer.

3.5 Hot Swapping a Board

The Infinity Series H.110 Conferencing Board can be "hot swapped," that is it can be removed from a functioning system without turning the power off or interrupting applications. However, to be able to do this, the host processor must be equipped with suitable hot swap drivers as well as a hot swap manager which will alert applications when a board has been inserted or removed from the system so that resources can be properly managed. It is beyond the scope of this manual to describe the operation of either the hot swap driver or hot swap manager.

Each H.110 board is equipped with a switch linked to the lower ejector tab and a blue LED. This combination is used to coordinate the actions of an operator with the system software. When inserting a board, the board is pushed in part of the way until the blue LED is illuminated. The insertion may then be completed. When the connection process is complete, the LED will go out. To remove a board, the lower ejector handle is depressed until it is in the unlatched position. When the blue LED comes on, the board may be removed from the system.

To install the board in a system under power:

1.   Insert the board with the ejector tabs spread apart until partially engaged.

2.   Wait until the blue LED is illuminated.

3.   Finish inserting the board by pushing the ejector tabs towards each other. The LED should then go out.

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To remove the board from a system under power:

1. Depress the lower ejector tab until it is in the unlatched position.

2. Wait until the blue LED is illuminated.

3. Finish removing the board by spreading the ejector tabs apart until the board is ejected.

Figure 3: Front Panel with Status
and Hot Swap LEDs, Audio Connector,
and Top and Bottom Ejector Handles
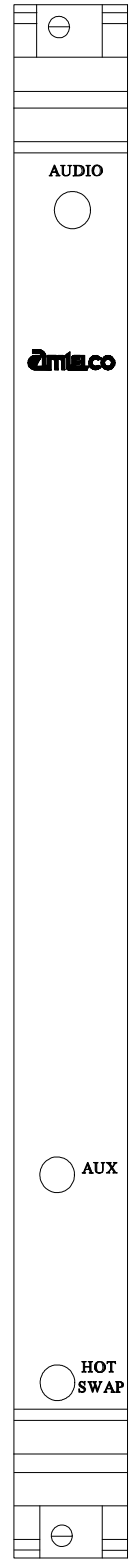
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4.0 Initialization

This section describes the procedures necessary to initialize the system and enable the PC to communicate with the Infinity Series H.110 512/256 Port Conference Board. XDS drivers will implement some of these procedures.

4.1 PCI Initialization

The system BIOS is responsible for recognizing PCI boards and mapping them into the I/O and memory spaces as required. It is also responsible for assigning interrupts to the board. This is done through a set of on board registers which contain information specifying the memory, I/O, and interrupt needs of the board. A set of BIOS functions exist for accessing this information. A detailed description of these functions can be found in the *PCI BIOS Specification* published by the PCI SIG, the PCI Special Interest Group.

Normally, the drivers supplied by Amtelco will take care of the process of finding Infinity Series boards and establishing communications. The information in the rest of this subsection is for background only.

The configuration registers of every PCI board contain a vendor ID and device ID code. These codes are unique to each board vendor. All Infinity Series H.110 boards have the same vendor and device IDs. The vendor ID is 14E3h and the device ID is 0101h. A BIOS function exists that will find each instance of a particular vendor and device ID, and which returns with a bus and device number. The bus and device number is then used in functions to read the configuration registers.

The configuration registers contain information on the base address of the memory and I/O assigned to the board by the BIOS. A PCI board may have up to six different base addresses. On Infinity Series H.110 boards,

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the first two base addresses are used by the PCI bus interface logic. The third base address which is contained in registers 18-1Bh contains the memory location of the dual-ported memory that is used to pass messages. The interrupt information is contained in register 3Ch. The information in these configuration registers can be used by a driver to address the board.

4.2 Initialization Commands

The H.110 Conference Board is initialized by sending a sequence of command messages to the board. The process of sending messages is described in detail in Section 5.0, but normally it is accomplished either with a low-level driver XMT command or the API function **xds_msg_send.** Response messages are read using the low-level driver RCV command or the API function **xds_message_receive**.

To enable communications with the H.110 Conference Board, an **IN** command message should be sent to the board. The board will respond with an **IA** message.

The board may be reset using the command message **RA**. The board will respond with an **RA** message.

Your application can now configure the H.110 Conference Board using these commands

Command   Purpose

SCmsabb(c)   Sets the clock mode for the board. The parameter m is the clock-mode. The parameter s is the clock sub-mode.   The parameters a, bb, and c are used to specify additional clock control information such as compatibility modes, clock rates, local network, and CT_NETREF settings. The default mode on power-up or restart is mode 0. See section 6.0 of this manual for details of clock mode arguments.

SEx   Sets the encoding mode for the board. The parameter x can be either M for Mu-Law as used in North America and Japan, or A for A-Law as used in Europe and Asia. The default value is for Mu-Law.

SKa   This command is used to enable or disable conferencing. If the parameter a is E, conferencing will be enabled, if the parameter a is D, conferencing will be disabled.

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5.0 Communicating with the Host

This section describes how the host computer communicates with the Infinity Series H.110 512/256 Port Conference Board. It includes the definitions for the H.110 Conference Board commands and responses along with a description of the mailboxes used for messaging.

The board is controlled by the host computer through a system of two mailboxes. The messages consist of short NUL-terminated ASCII strings, which are easy for the host software to compose and parse. The board is capable of buffering up to eight messages in either direction and can drive an interrupt line when it has a message for the host. Messages may not exceed 32 characters.

There are two mailboxes, one for messages to the board and one for messages from the board, and two flags associated with them. A 00h in a flag byte indicates the mailbox is free, a non-zero value indicates that the mailbox is occupied. The mailboxes and their flags are contained in an 8K block of dual-ported memory at the following offsets:

receive mailbox	1F80h
transmit mailbox	1FC0h
transmit flag	1FFCh
receive flag	1FFEh

The board's base address is determined by reading PCI Configuration Space offset 18h. The 32-bit value at this location is the base address for the dual-ported memory on the board.

To send a message, the message is placed in the mailbox and the flag is set to 01h. To read a message, the message is removed from the mailbox and the flag is cleared to 00h. This will clear the interrupt hardware.

5.1 Command and Response Protocol

This section describes the necessary step-by-step procedures for the host to send a command to the board and to remove a response from the board.

5.1.1 Sending Commands to the Board

The basic steps to sending a command to the H.110 Conference Board are:

1.   Build a command. Broadly speaking, a command is a string of ASCII characters with a NUL (00h) termination character.

2.   Check the transmit flag. If the flag is 0, continue with the next step to put the command in memory. If the flag is not 0, wait until the flag is 0.

3.   Insert the command in transmit mailbox memory beginning at the address of the transmit mailbox.

4.   Write 01h to the transmit flag. This notifies the board that a message is waiting.

5.1.2 Reading Messages From the Board

1.   Check the receive flag. If the flag is 0, there is no message. If it is non-zero, a message is waiting. Continue with the next step to read the message.

2.   Remove the message from memory, starting at the address of the receive mailbox. Messages are NUL-terminated ASCII strings.

3.   Write 0h to the receive flag.

5.1.3 Reading Board Information

A range of board information is included in memory so that it can be checked without sending a message:

Type of Information	Offset Address
Board ID	1F00-1F03
Firmware Version	1F04-1F07
Shelf and Slot ID	1F08-1F09
Number of transmit timeslots	1F10-1F11
Clock mode settings	1F18-1F1B
Board configuration	1F1C-1F1E
Clock status bits	1F1F

The board stores its identity upon power up or a hardware restart. The phrase Restart cPCI HK © Amtelco 2001 appears in the receive mailbox. The receive flag is not set and no interrupt is generated.

5.2 Interrupts

The H.110 Conferencing Board can generate an interrupt to the PC indicating that a message is available. The interrupt for PCI boards is assigned by the BIOS or Operating System at boot time. The assignment is dependent on which PCI slot the board is in. The interrupt line is usually shared by more than one device. If multiple Infinity Series boards are installed they may or may not all share the same interrupt line.

In order for an Infinity Series board to send interrupts to the PC, the PCI Interface circuit on the board must be programmed to enable interrupts. This is accomplished by setting bits 0 and 3 in the board's Interrupt Control/Status Register. This is a byte-wide register located at an offset of 69h from PCI Base Address 0. PCI Base Address 0 is contained in PCI Configuration Space register 10h. The Base address is a 32-bit value and is mapped into memory.

When an Infinity Series board sends a message, it generates a local

interrupt to the PCI Interface circuit on the board. If the PCI Interface circuit has been programmed to generate interrupts to the PC, the local interrupt is passed through to the PC. When the PC receives an interrupt, its Interrupt Service Routine (ISR) should check the Infinity board's receive flag to see if a message is pending (i.e. the receive flag is non-zero). It should then process the message for the board and write a 0 to the board's receive flag.

5.2.1 Interrupt Initialization

1.   Clear the board's receive flag.

2.   Read the PCI Base Address 0 from PCI Configuration Space offset 10h (this must be a 32-bit access).

3.   Set bits 0 and 3 of PCI Base Address 0 + 69h. Do not modify any other bits in this register. This register is a byte-wide memory mapped register.

5.2.2 Step-by-Step Interrupt Processing Summary

1.   Check to see if the receive flag is non-zero.

2.   Remove the message from the receive mailbox.

3.   Write 0h to the receive flag.

4.   Re-enable the interrupt controller on the PC.

5.3 Commands and Responses

This section gives a general overview of the H.110 Conference Board commands and responses. The commands are grouped by function and then listed in alphabetical order by two-letter command. Refer to sections 7.0 through 10.0 for examples and explanations of how to use these commands.

5.3.1 Characteristics of Command Strings

<   All commands consist of null (00h) terminated ASCII strings.

<   There are no spaces or other delimiters between parameters in the commands.

<   All letters in command strings must be UPPERCASE unless otherwise noted.

<   Lowercase monospaced letters (such as xx) in the following command references represent parameters within commands. Each letter represents one ASCII digit.

<   Numeric parameters are always hexadecimal numbers.

5.3.2 Command Parameters

The following table documents the common parameters for many of the commands listed in the next sections. Other less common parameters are defined with individual commands.

Common Command Parameters		
Parameter	**Definition**	**Values**
hh	Conference handle	01-A8h
cc	Conference Control Address	00-FFh
pp	Output pattern value	00-FFh
iiii	1st & 2nd i, H.110 receive stream	00-1Fh
	2nd & 3rd i, H.110 receive timeslot	00-7Fh
oooo	1st & 2nd o, H.110 transmit stream	00-1Fh
	3rd & 4th o, H.110 transmit timeslot	00-7Fh
bsstt	MVIP-95 terminus, b - bus, ss - stream, tt - timeslot	C, H, L, 0000-1F7Fh

5.3.3 Commands to the H.110 Conference Board

Note that sections 7.0-9.0 provide supplemental information and examples for the commands and messages documented here.

Conference Commands

CAhhoooooiiiian	Conference H.110 timeslot iiii, output on timeslot oooo, conference hh, attenuation a, noise threshold n
CDoooo	Disable output to H.110 timeslot oooo
CEiiii(cc)	Enable DTMF detection on conferenced timeslot iiii, cc = clamping time .02 sec increments
CEiiiiD	Disable DTMF detection on conferenced timeslot iiii
CIhhiiiian	Add H.110 input timeslot iiii to conference hh attenuation a, noise threshold n
CMhhoooooan	Monitor conference hh on H.110 timeslot oooo, attenuation a, noise threshold n
CUhh	Dissolve conference handle hh
CXhhiiii	Remove H.110 timeslot iiii as an input to conference hh

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Analog Port Control (Music on Hold)

AD	Disable Music on Hold transmit
AEoooo	Enable Music on Hold output to H.110 timeslot oooo
AGttrr	Set transmit attenuation to tt and receive attenuation to rr in .1 dB steps
ARiiii	Enable analog input from H.110 timeslot iiii
ARX	Disable analog input

MVIP Compatibility Commands

MAm	Audio port control mode m = D - disabled, m = E - enabled
MDcccmdd	DTMF detection control, ccc - CCA, m = D - disabled, m = E - enabled, dd - duration
MGcccgg	Set output gain, ccc - CCA, gg - gain value
MIcccgg	Set input gain, ccc - CCA, gg - gain value
MKhhccman	Conference control, hh - conference handle, cc - CCA,m = D - disabled, m = E - enabled a - attenuation, n - noise threshold
MObssttD	Set_output disable mode, bsstt - output terminus
MObssttEbsstt	Set_output enable mode, bsstt - output terminus, bsstt - input terminus
MObssttPpp	Set_output pattern mode, bsstt - output terminus, pp - pattern value

Interrupt Control Commands

IF	Disable transmit interrupts and messages
IN	Enable transmit interrupts and messages

Reset Commands

RA	Reset All
RD	Reset DSP's

Setup Commands

SAhhan	Set conference with handle hh to attenuation and noise threshold n
SCmsabb(c)	Set clock mode m submode s, arguments a, bb, & c

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SDm	Set energy detection mode,
	m = D - disabled, m = E - enabled
SEm	Set encoding mode, m = M - mu-Law, A - A-Law
SGoooogg	Set output gain for conference output on timeslot oooo to gain value gg, range of gg -F to +F in 3 dB steps
SIhhiiiigg	Set input gain for conference input on timeslot iiii, conference handle hh, gain value gg, range of gg -F to +F in 3 dB steps
SKm	Set Conference mode, m = E - enabled, D - disabled

Version Requests

VA	Checksum of alternate segment request
VC	Version request
VD	DSP version request

Download Commands

@xxxx	Download 1K block to address xxxx
@Es	Erase segment s
GA	Jump to Alternate Program
GM	Jump to Main Program
@Ws	Write from RAM to segment s

Diagnostics

QC	Query Clock Mode information
QL	Query geographical information (shelf & slot)
QMR0zzzz	Query H.110 Receive, zzzz = H.110 stream & timeslot
QMT0yyyy	Query H.110 Transmit, yyyy = local stream & timeslot
QObsstt	Query Output for terminus bsstt
QPd(cmnd)	Send command to DSP d

5.4.4 Responses from the H.110 Conferencing Board

Acknowledgements

IA	Interrupt On acknowledge
RA	Reset all acknowledge

Error Messages

ECxx	Clock error bits xx
EKhhxxsstt	Conference error for conference handle hh, sstt are the stream and timeslot in the command, xx - error
	01 - illegal handle
	02 - no free conference inputs
	03 - not an input to conference
EPoooo	Path error for H.110 output timeslot oooo

Query Responses

QCmsabrrttkkrs	Reply to Query Clock Mode
	m - mode, s - submode, a, b - arguments
	rr - stream rate byte, tt, kk - enable flags
	rs - reset byte
QLaabb	Reply to location query, shelf aa, slot bb
QMR0zzzzhhlldd	Reply to Query H.110 Receive,
	hh = backplane connection memory high
	ll = backplane connection memory low
	dd = backplane data memory
QMT0yyyyhhlldd	Reply to Query H.110 Transmit
	hh = local connection memory high
	ll = local connection memory low
	dd = local data memory
QObssttm(bsstt)	Query_output reply, bsstt - output terminus, m - mode (bsstt) input terminus
QPd(string)	Response from DSP d

DTMF Detection Messages

STiiiit	DTMF tone t detected on H.110 stream & timeslot iiii
STXccct	DTMF tone t detected on CCA ccc

Diagnostic Responses

VAcccc	Alternate segment checksum, cccc - checksum
VCccccvvvviix	Version request response, cccc - checksum
	vvvv - version, ii - board identifier
	HK - cPCI Conference board, x - population level
VDxxxx	DSP version number

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VKxxxx	Conference DSP version number
U(msg)	undefined or unparseable message

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6.0 The H.110 Bus & Clock Modes

The Infinity Series H.110 512/256 Port Conference Board provides a means of connecting conference facilities to the H.110 bus. Through this bus, the conference ports can be connected to other H.110 compatible boards. The H.110 Conference Board also has an analog port for music on hold or monitoring. It is capable of operating in a variety of clock modes compatible with H.110 operation.

6.1 The H.110 Bus

The H.110 bus consists of 32 Pulse Code Modulation (PCM) streams operating at an 8.192 MHZ. clock rate. Each stream contains 128 timeslots, for a total of 4096 timeslots. In addition to the PCM data signals, there are a number of bit, frame, and network reference signals that are used to synchronize the operation of multiple boards.

For the purposes of commands, a particular H.110 timeslot is referred to by a four digit hexadecimal number. The first two digits are the stream number, while the last two digits are the timeslot within the stream. Streams range from 00h to 1Fh, and timeslots from 00-7Fh.

The physical H.110 bus is a backplane connection using the J4/P4 connector. The H.110 specification defines allowable impedance and signal lengths on each board so that additional bus termination is not needed to insure the proper operation of the bus. The maximum length of the bus (24.8 in.) and the maximum number of slots (21) are also specified.

Different length pins are also used on the various connectors. This is done so that the various signals are staged in the correct order.

6.2 Clock Modes

The H.110 bus specification defines a variety of clock signals. Two clock signals CT bus A and CT bus B are provided for redundancy. In addition, two signals called CT_NETREF_1 and CT_NETREF_2 are defined which may be referenced to an external clock source such as a T1 or E1 span. These signals exist to aid in recovery if the primary clock source should fail.

The clock mode must be set before any connections can be made with other boards. The clock mode is set using the Set Clock command "SCmsabbc", where m is the clock mode, s is the sub-mode, and a, bb, and c are additional arguments used to select clock sources and specify compatibility modes. The default clock mode on a power up is to provide a local clock, but to neither source clock signals to the bus or derive the clock from the bus. The possible clock modes are:

0	no clocks to or from the bus
1	clocks slaved to the CT bus
2	the board is clock master CT bus clock A
3	the board is clock master CT bus clock B

Connections are possible only when all boards within a system are synchronized to the same clock. Only one board in a system can provide the H.110 bus clock. The other boards in the system must slave their internal clocks to the master. If the H.110 Conference Board is to use the H.110 bus clock, this clock must be provided by another board before switching can be accomplished.

6.2.1 Clock Mode Compatibility with other H.110 Boards

Due to hardware differences, the H.110 Conference Board does not support the full range of clock modes available on other Infinify Series H.110 boards. In particular, secondary master modes and modes where the clock is derived from CT_NETREF_1 and CT_NETREF_2 are not available. It is also **NOT** recommended that the H.110 Conference Board

act as a provider of either CT bus clock A or B unless no other board in the system is capable of providing this clock.

6.2.2 Slave Mode

In the Slave Mode, the H.110 Conference board derives its clocks from one of the clock signals on the CT bus. The clock signal is selected with the submode argument in the **SC** command. The possible clock signals are:

> 0 - CT bus clock A
> 1 - CT bus clock B
> 6 - CT bus clock A, auto-fallback mode
> 7 - CT bus clock B, auto-fallback mode

Argument a is used to set the CT_NETREF mode, while argument bb is used to select the source of CT_NETREF. As the H.110 Conference Board is not capable of deriving a clock from an external network, the value of these arguments should always be 000 when in the slave mode.

6.2.3 Primary Master Mode

In modes 2 or 3, the board supplies the CT master clocks A or B respectively. Other boards on the H.110 bus will synchronize to one of these clocks. The source of the clock is selected by the submode argument s. The choice is:

> 0 - freerun, the board's internal clock

For all modes, arguments a and bb should be set to 0. On H.100 boards, argument a is used to select the legacy bus compatible clocks that the board will supply. As the H.110 bus is not compatible with the SC or MVIP bus, the only valid option is 0, no compatibility clocks provided. The board can not use CT_NETREF_1 or CT_NETREF_2 as the clock source.

Due to interworking issues, it is **<u>NOT RECOMMENDED</u>** that the H.110 Conference Board act as a clock master unless no other board in the

system is capable of providing a master clock.

6.2.4 Secondary Master Modes

When a board is operating as a secondary master, it uses the other clock signal as a source, i.e. if a board is the secondary master for CT clock B, it uses CT clock A as a source and provides CT clock B. If the primary clock fails, the secondary master then becomes the clock master. Typically, one board will be set as the master for clock A and another board as the secondary master for clock B, or vice versa. If the clock source specified by the submode is either of the CT_NETREF signals or a local network, the board will automatically fall-back on that source if the primary clock should fail. If set to free-run, it will fall back to a PLL that was locked to the primary master clock. The H.110 Conference Board **<u>CAN NOT</u>** act as a secondary master.

In all secondary master modes, if the primary master fails, the board will automatically become the new primary master. If the original primary master is restored, the clock mode for the original secondary master must be reset

6.2.5 Clock Fallback

The H.110 Specification details a scheme for automatically recovering from a clock failure. One of the CT bus clocks, either A or B is designated the master clock. The other clock is the secondary master and is generated by a different board than the primary clock. While the primary clock is valid, the secondary clock is locked to it. If the primary clock should fail, the secondary clock takes over using a local oscillator, CT_NETREF_1, CT_NETREF_2, or a local network as the source. Boards that are slaves should automatically fall back to the secondary clock. After a failure of the master clock, system software should designate new primary and secondary clocks. The new primary may be the previous secondary clock master. For Infinity Series H.110 boards, this will involve sending a set clock command with the new primary clock information.

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When an Infinity Series board is set for automatic fallback, the board will automatically switch to the secondary clock if the primary clock fails. When this occurs, the board will send an "EC" message indicating the failure. When the application designates a new primary master, it should send a new clock mode command to the board even though auto-fallback may have occurred.

6.2.6 Clock Errors

If the board detects a problem with the clocks, it will generate a clock error, which notifies the application that it should take appropriate action. Clock errors are reported in the Clock Error Bit message, **ECxx** where the **xx** is a hexadecimal value in which each bit identifies a specific error. A value of 1 indicates an error condition. The bits are as follows:

bit	Error Description
0	CT bus clock A
1	CT bus clock B

These two bits indicate if either CT bus Clock A or CT bus Clock B goes away. The other bits can be ignored.

6.3 Configuration Information

Information on the clock mode setting, stream rates, and other configuration settings is available in the dual-ported memory in an eight byte block beginning at an offset of 1F18h. The first four bytes are the clock mode, the submode, and the a and bb arguments from the set clock command **SC**. On H.100 boards the sixth byte is used to indicate the state of the H.110 and MVIP termination and can be ignored on H.110 boards. Bits 0 and 1 of the seventh byte indicate whether conferencing and the audio port have been enable. The eighth byte contains the clock error status bits. These are in the same order as in the **EC** clock error message (Sec. 6.2.5)

6.4 Hot Swap

Hot swapping is the capability of being able to insert or remove a board from a live system without having to power down or interrupt the operation of the system. The H.110 specification provides for hot swap capabilities, and these are implemented on the H.110 Conferencing Board.

Each board has a switch that is linked to the ejector tab. This switch is used to assert a signal called ENUM# when a board is inserted or about to be removed. Each board also has a blue LED which is used to indicate the status of the board. Upon insertion, this LED is illuminated until the hardware connection process is complete. The LED is then turned off. When removing the board, the ejector tab is partially depressed to signal that the board is to be removed. The blue LED will then be illuminated indicating that it the board may be fully removed.

The ENUM# signal is used to notify a Hot Swap Driver of the impending insertion or removal of the board. It is the responsibility of the driver to take what ever steps are necessary to connect or disconnect the hardware.

7.0 CT Bus Switching

This section describes the operation of the Computer Telephony bus switching capabilities of the Infinity Series H.110 512/256 Port Conference Board. Topics include the H.110 bus, MVIP-95 compatible commands, and the operation of the analog port.

7.1 The H.110 Switching Hardware

The H.110 Conference Board consists of a switch block that is used for switching between the H.110 computer telephony bus and a local bus that is used to connect to the conferencing facilities. The local bus consists of sixteen streams, each of which has 32 timeslots. A seventeenth stream is used for connecting to the audio port.

7.2 MVIP-95 Compatibility Commands

Several commands exist for compatibility with the MVIP-95 driver specification. This specification uses the concept of a "terminus" to define an input or output timeslot. The terminus argument consists of three parts, a bus, a stream within the bus, and a timeslot on that stream. In MVIP compatibility messages, a terminus is represented by a five character string. The first character indicates the bus. Valid bus selections are "C" for the conference inputs and outputs, "H" for the H.110 CT bus, and "L" for the local bus connected to the audio port.

In the MVIP compatibility mode, connections are controlled using the Set Output command **MO**. This command takes the form **MObssttm**, where "bsstt" is the output terminus being controlled, and m is the mode. Valid modes are "D" for disable, "E" for enable, and "P" for pattern output. In the enabled mode, the input terminus follows the mode character, and in

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the pattern mode, a two digit hexadecimal number representing the value of the byte to be output follows the mode. As an example, the message "MOH0123EC0000" would enable a connection from the conference port 0000 to the H.110 timeslot 23h, stream 1.

A query command **QObsstt** is also available to query the state of the output terminus "bsstt". This command corresponds to the Query_Output command in the MVIP-95 specification. The response takes the form **QObssttm(bsstt)** where "bsstt" is the output terminus, "m" is the mode, and if the mode is enable, the second "bsstt" is the input terminus.

The audio port is timeslot 0 of stream 0 of the "Local" bus. No other timeslots exist on this bus. To access the audio port, it must be enabled using a command of the form **MAm** where m is the mode, either "E" for enabled, or "D" for disabled. To make a connection from the port to the bus, the port must be enabled, and the connection made using the Set Output command "MO". Gain can be controlled as described in the following section.

In the MVIP compatibility mode, the conference function consists of two streams of 256 timeslots which correspond to the Conference Control Addresses or CCAs. The first stream is the connections for conferences with handles 01-84, and the second stream is for conferences with handles 85-168 (see the table below). Input and output connections are made between the H.110 CT bus and the conference bus using the "MO" command. Each conference input/output pair, or CCA is controlled with a command of the form **MKhhccman** where hh is the conference handle, cc is the CCA, m is the mode, either "E" for enable or "D" for disable, and a and n are the attenuation and noise threshold parameters. See section 8.1 for a more detailed description of the operation of the conferencing hardware.

When using the MVIP compatibility commands, it is the responsibility of the application to allocate the CCAs. CCAs 0-255 are associated with conference handles 01-84 and 256-511 are associated with handles 85-168.

Conference Handle	Conference Control Address	Conference Timeslot
01-84 (01-54h)	000-255 (00-FFh)	0000-00FFh
85-168 (54-A8h)	256-511 (100-1FFh)	0100-01FFh

To add a party to a conference, connections need to be made to the conference input and output using the "MO" command, and the CCA controlled using the "MK" command. This command takes the form:

MKhhccman

where hh is the conference handle, cc is the CCA, m is the mode, a is the attenuation parameter, and n is the noise threshold parameter. Note that only the last two digits of the CCA are used in the command. The handle is used to determine the most significant digit. The allowed modes are "D" for disable, and "E" for enable.

As an example the commands add a party to a conference:

MOC0001EH0123   connection to the input of CCA 1
MOH0555EC0001   connection from the output of CCA 1
MK0201E00   enable CCA 1 for conference 2

The previous commands add a party to the conference with a handle of 02 using CCA 01. The input stream 1 timeslot 23, and the output is stream 5 timeslot 55 on the H.110 bus. To remove the party from the conference the commands would be:

MOC0001D   disable input to CCA 1
MOH0555D   disable output to the H.110 bus
MK0201D   disable CCA 1

To create an output to monitor a conference, the input to the conference is set to a silence pattern as in the following commands:

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    MOC0002P00   pattern 00 to the input of CCA 2
    MOH0555EC0002   connection from the output of CCA 2
    MK0202E00   enable CCA 2 for conference 2

To set a timeslot to serve as an input to a conference, the output command would be omitted. Note that a timeslot can serve as an input to more than one conference:

    MOC0003EH0123   connection to the input of CCA 3
    MK0203E00   enable CCA 3 for conference 2

7.3 The Analog Port

An analog port is provided for use either as a music on hold source or for monitoring timeslots on the H.110 bus. The external connection to this port can be made through either the **J1** or **J1A** connectors. The signal levels at this port are assumed to be at line levels compatible with most electronic equipment. An attenuation command is provided to make adjustments.

The command to enable the music on hold feature is of the form **AEoooo** where oooo is the H.110 timeslot the port will transmit on. The port may be disabled with a command of the form **AD**.

To use the port to monitor a timeslot, the command is of the form **ARiiii** where iiii is the H.110 timeslot. The monitor can be disabled using the command **ARX.**

The input or output level can be attenuated using the gain command. This takes the form **AGttrr** where tt is the attenuation in the transmit direction and rr is the attenuation in the receive direction. The attenuation can be specified in steps of .1 dB.

The analog port may also be enabled or diabled with a command of the form **MAx** where x is D to disable the port or E to enable it. When using this command, the audio path is set using the MO command with the analog port argument set to L0000. The audio level is controlled using **AG**

command.

Though the port is bi-directional, it is not recommended that it be used for both transmitting to the H.110 bus and receiving from the H.110 bus at the same time because it is a 2-wire circuit and there is no isolation between the input and the output.

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8.0 Conferencing

This section describes the conferencing facilities available on the Infinity Series H.110 512/256 Port Conference Board. This description will include an overview of the conferencing hardware, the commands for conferencing, the DTMF capabilities associated with conferencing and examples of how to establish and dissolve a conference.

8.1 The Conferencing Hardware

The conferencing hardware on the H.110 Conference Board is arranged into two blocks. Each block consists of 84 conferences and 256 inputs and outputs. Conferences can be of any size up to the maximum limit of 256, but the total number of parties for all the conferences within one block can not exceed 256. Conferences can not cross block boundaries.

The two conferencing blocks are connected to the four local streams. The first two streams are connected to the first block, while the third and fourth streams are connected to the second conferencing block. Eight DSPs, two for each local stream, are connected in line between the MT90866 switch block and the conference inputs. These DSPs are used for tone and energy detection and tone clamping.

The 256 port conference board is a depopulated version of the 512 port board and uses the first four conferencing blocks. It also has half the number of DSPs as the full board.

8.1.1 Conference Handles

Each conference is identified with a handle. The value of this handle ranges from 1-168 on the 512 port board and 1-84 on the 256 port board. The handle is selected by the application. The handle is used in the

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conferencing commands to identify which conference the command applies to. On the 512 port board, a new handle is assigned to the conference block that has the fewest resources in use. If an attempt to add a party to a conference is blocked by the 256 party limit within the block, the firmware will move the conference to the other block if there is room. The handle allocation is hidden from the user.

Each conference input and output is defined by a Conference Control Address, or CCA. These range from 0-511 with the first 256 CCAs being associated with the first conference block, and the second 256 with the second conference block. Conference Control Addresses are associated with fixed timeslots on the local conferencing streams. CCAs 0-127 are associated with the 128 timeslots of the first local stream, CCAs 128-255 with the second local stream, and so on. On the H.110 Conference Board, the CCAs are hidden from the user, and they are assigned dynamically.

8.1.2 Command Set

The Conferencing command set consists of commands that begin with the letter "C". Each of these commands performs all of the switching and conference control for the command function.   When using these commands, the on board processor manages the allocation of the CCAs which are hidden from the application. Commands exist for adding or removing a party from a conference, dissolving a conference, monitoring a conference or adding an input to a conference.

8.1.3 Attenuation & Noise Threshold

Each conference input and output can have its attenuation controlled. This can be done individually or globally for all members of a conference. The attenuation is set with an attenuation parameter that is part of various conferencing commands. The amount of attenuation required to maintain the desired level of audio quality depends on a number of factors such as the type and quality of the incoming lines. It also depends on the number of parties being conferenced, with larger conferences requiring more attenuation. Typically, no attenuation is needed for conferences of four or

fewer parties. The following table gives the amount of attenuation the parameter selects:

Value of a	Input Attenuation	Output Attenuation
0	0 dB	0 dB
1	0 dB	3 dB
2	3 dB	0 dB
3	3 dB	3 dB
4	6 dB	0 dB
5	6 dB	3 dB
6	9 dB	0 dB
7	9 dB	3 dB

A noise threshold can also be set for each conference input. When this function is enabled, signals below a threshold will be suppressed. The setting "0" disables the function, while settings of "1" to "3" raise the threshold to progressively higher values. It should be noted that high threshold levels may introduce distortion and so should be used with discretion.

8.1.4 DSP Facilities

The H.110 Conference Board is equipped with eight DSPs which are connected in the conference input streams between the bus and the conference blocks. The DSPs can be used to detect DTMF tones from the conference inputs. A "clamping" function can be enabled which isolates DTMF tones by temporarily interrupting the input connection to the conferencing hardware when a tone is detected. This can be used to prevent the other parties of a conference from hearing the DTMF signals. Because a finite amount of time is required to detect the presence of a

DTMF signal, a short burst of tone of approximately 20 msec. will get through before the tone is clamped.

An energy detection feature is also available. This feature can be used to determine the "loudest talker" in a conference. If this feature is enabled, the energy of each input to a conference is periodically placed in a table in the dual-ported memory. This table is arranged by H.110 timeslot.

8.2 Controlling Conferences

A party can be added to a conference using the conference add command. This command takes the form **CAhhoooooiiiian** where hh is the conference handle, iiii is the H.110 timeslot of the input, oooo is the H.110 timeslot of the output, and a and n are optional parameters for attenuation and noise threshold. If these parameters are left off, the default values of no attenuation and no noise threshold are used. If the timeslot was involved in another conference at the time the command is issued, that connection will be broken. Each party to a conference must be added using the same conference handle.

A party can be removed from a conference using the disconnect command. This command is of the form **CDoooo** where oooo is the H.110 timeslot. All parties to a conference can be disconnected at once using the unconference command. This command takes the form **CUhh** where hh is the conference handle.

A conference can be monitored, that is, an output from the conference is created for which there is no associated input. This is done using the conference monitor command which is of the form **CMhhooooan**, where hh is the conference handle, oooo is the H.110 output timeslot, a is the attenuation parameter, and n is the noise threshold parameter. The conference monitor function uses up a CCA just as does a full party to a conference, therefore, if more than one party is monitoring a conference, they should use the same timeslot. The monitor path is disabled by using either the "CD" or "CU" commands.

A timeslot can serve as an input to a conference without there being a corresponding output. This is done using the conference input command "CI". This command takes the form **CIhhiiiian** where hh is the conference handle, iiii is the conference input timeslot, and a and n are the attenuation and noise parameters. The same timeslot can serve as an input to multiple conferences. Note, however, that if a "CA" command is issued for that timeslot after it is defined as an input for another conference, the input will be disabled. However, subsequent "CI" commands can be used to reestablish the inputs if desired. A "CD" will remove the timeslot from all conferences. The timeslot can be removed as an input to a conference by using the "CX" command. This command takes the form **CXhhiiii** where hh is the conference handle and iiii is the timeslot. Participation by that timeslot in other conferences will be unaffected. A "CU" command will dissolve all inputs and outputs for a particular conference handle, but will leave inputs to other conferences unaffected.

8.3 Changing the Attenuation and Noise Threshold

Once a conference is established, the attenuation and noise threshold can be changed in one of two ways. To change the parameters for a single member of a conference, the "CA" command can be reissued with the new parameters. It is not necessary to remove the party from the conference first. However, if a party is an input only, it must first be removed from the conference before changing parameters. Otherwise, there will be two occurrences of that party.

The parameters of all members of a conference can also be changed at once using the Set Attenuation command "SA". This command takes the form **SAhhan** where hh is the conference handle and a and n are the attenuation and noise threshold parameters.

It is also possible to control the output level for an individual conference party using a command of the form **SGoooogg** where oooo is the output timeslot and gg specifies the gain level. The level can be specified in 3 dB

steps over a range from -42 to +24 dB (+8 to +F produce the same gain, +24 dB). For example the value +2 would represent a positive gain of 6 dB and -3 would be represent a negative gain of 9 dB. A value of -F will disable the output. For conferences established using the "MK" command, a command of the form **MGcccgg** should be used where ccc is the CCA and gg is the gain value as described above. Note that the first digit of the CCA is '0' if the conference handle is 01-54 and '1' if 55-A8. The last two digits are the same as used in the "MK" command.

The input gain can also be controlled with a command of the form **SIhhiiiigg** where hh is the conference handle, iiii is the input timeslot and gg is the gain value. The gain value has the same range as for the "SG" command described in the previous paragraph. For conferences established using the "MK" command, a command of the form **MIcccgg** should be used where ccc is the CCA and gg is the gain value.

8.4 DTMF Detection

The H.110 Conference Board is equipped with eight DSPs for DTMF detection. The DSPs are connected between the H.110 bus and the conference inputs, and there is one detector for each input. This means that DTMF digits can be detected simultaneously on all the parties to all the conferences.

To enable DTMF detection in conferences established using the "C" commands, the detection enable command "CE" is used. This takes the form **CEiiii** where iiii is the input timeslot of the conferee. Detected digits are reported in a message of the form **STiiiid** where iiii is the timeslot and d is the digit detected. Detection is disabled with a command of the form **CEiiiiD**. It is also disabled when a "CD" or "CU" command is issued.

One of the problems that can arise is that if detection is enabled for one party of a conference, a DTMF digit generated by another party to that conference may also be detected. This can pose problems if the intention is to determine which party has generated a DTMF digit, for instance when these digits are being used to control the conference.

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To resolve this problem, a feature called "clamping" has been added. With this feature enabled, the input from a party is interrupted for a short period when a DTMF digit is detected. This allows the DSP to determine which party is generating the digit. It also prevents the tone from being passed to the other members of the conference eliminating an annoying blast of sound. Because it takes a short amount of time to determine if a tone is present, the first 20 msec. of tone will pass through.

To enable this feature, an optional argument is added to the "CE" command. The command now takes the form **CEiiiidd** where dd is the duration of the interruption interval in 20 msec. increments. For example, **CE000305** would interrupt the signal for 100 msec. The range of the interruption interval is 01-CFh or between 20 and 4140 msec.

8.5 Energy Detection

The DSPs on the H.110 Conference Board can provide an energy detection function. In this function, the energy of each conference input is averaged over a period of 100 msec. This information is then placed in a table in the dual-ported memory where it can be accessed by an application.

The table begins at an offset of 0 bytes and consists of 4096 (1000h) bytes arranged in order to correspond to H.110 timeslots. The values in these tables will run from 00h to 1Fh with each step corresponding to approximately 3 dB. A flag at an offset of 7934 (1EFEh) from the base address of dual-ported memory is set to 01h every time the tables are updated. The flag should be cleared by the application after it reads the energy tables.

The energy detection feature is enabled by sending an **SDE** command. This will enable energy detection for all conferences. An **SDD** command will disable energy detection.

8.6 Conferencing Examples

This section will give examples of how to create and dissolve conferences, set up inputs and monitors, and detect DTMF digits.

In the first example, three input timeslots, 0110, 0112, and 0114 are conferenced together using conference handle 03 with the outputs at 0000, 0001, and 0002 respectively:

CA030000011000
CA030001011200
CA030002011400

To enable DTMF detection with 80 msec. of clamping:

CE011004
CE011204
CE011404

To add an input to this conference and conference 05 from timeslot 0205:

CI03020500
CI05020500

And to monitor the conference on timeslot 0917

CM030917

Timeslot 0001 and the corresponding input at 0112 could be removed from the conference by:

CD0001

Or the conference could be dissolved with the command:

CU03

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9.0 Diagnostics & Error Messages

9.1 Diagnostic Commands

Several diagnostic commands are available:

VA   Used to request the checksum of the firmware in the alternate segment of the board. This is returned in a message of the form `VAxxxx` where `xxxx` is the checksum of the firmware in the alternate segment of ROM.

VC   Used to request the version of the firmware on the board. The version information is returned in a message of the form `VCxxxxyyyyHK`, where `xxxx` is the checksum of the firmware stored in the main segment of ROM, `yyyy` is a four-digit version number and `HK` indicates the board type. An `HK1` indicates a depopulated board with only 256 conference ports. This message takes the same form with all Infinity Series boards, and can be used to determine the configuration of the system.

VD   Used to request the version of the DSP software. The version of the DSPs used for tone detection/clamping is returned in a message of the form `VDxxxx`, where `xxxx` is the version number. The DSPs used for conferencing will return their version n a message of the form `VKxxxx` where `xx` is the version number. Both messages will be sent as a response to the "VD" message.

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QMR0zzzz This command queries the MT90866 interface chip `x` for the contents of the backplane connection memory and data memory for the H.110 timeslot `zzzz`. The results are returned in a message of the form `QMR0zzzzhhlldd` where hh and ll are the high and low byte contents of the backplane connection memory and dd is the contents of the backplane data memory. This command refers to the details of the internal switching circuitry, and is ordinarily of limited use to the application, though it may be used to look for a pattern byte on either the H.110 bus.

QMTxyyyy This command queries the MT90866 interface chip `x` for the contents of the local bus connection memory and receive path data memory for local timeslot `yyyy`. The results are returned in a message of the form `QMTxyyyyhhlldd` where hh and ll are the high and low byte contents of the local bus connection memory and dd is the contents of the local bus data memory. This command refers to the details of the internal switching circuitry, and is ordinarily of limited use to the application, though it may be used to look for a pattern byte on either the H.110 or local busses.

9.2 Error Messages

The board will detect a number of error conditions and respond with appropriate error messages. These messages are:

ECxx A clock error bit event `xx` has occurred. The value xx is a hexidecimal number where the bits are (a bit value of 1 is an error)

bit	description
0	CT bus clock A
1	CT bus clock B

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EKhhxxsstt An error has occurred while attempting to make a conference using handle hh. If `xx` equals 01, a handle outside the range of 01-A8h was used. If `xx` equals 02, all conference facilities available for that handle are in use. The first timeslot in the command causing the error is given in `sstt`.

U*[cmnd]* If the board does not recognize a command message, or if it does not have the appropriate number of arguments, the same message will be returned by the board preceded by a U to indicate an undefined message.

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Appendix A:
Environmental Specifications

The Infinity Series H.110 512/256 Port Conference Board meets the following environmental specifications:

TEMPERATURE EXTREMES:

Operating: 0EC (+32EF) to +50EC (+122EF).
Storage: –40EC (–40EF) to +70EC (+158EF).

AMBIENT HUMIDITY:

All boards will withstand ambient relative humidity from 0% to 95% non-condensing in both operating and storage conditions.

MECHANICAL:

All Infinity Series H.1100 boards conform to PCI-SIG mechanical specifications for 6U *Compact*PCI Cards.
MTBF:

50,000 hours.

ELECTRICAL REQUIREMENTS:

+5 volts ±5% @ 4.0 amps maximum.
-12 volts @ 15mA. maximum
+3.3 volts, -5 volts, & +12 volts not required

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