



Infinity Series H.100 256 Port Conference Board

TECHNICAL MANUAL

Documentation Revision 1.0: June 4, 2003

Copyright © 2000, 2003
by American Tel-A-Systems, Inc.
All rights reserved.
257M005A

NOTE: This manual specifically refers to firmware version V02.0. Some aspects of this manual relating to conferencing limits apply only to this and later versions. As this firmware version will only run on boards of hardware revision 257A002F, they are not applicable to earlier boards. For details on earlier boards refer to manual 257M005.

Contents

1.0	INTRODUCTION	1-1
1.1	Features and Capacities	1-1
1.1.1	The H.100 Bus	1-2
1.1.2	Conferencing	1-3
1.1.3	DSP Functions	1-3
1.1.4	Analog Audio Port	1-4
1.1.5	Clock Modes	1-4
1.1.6	Message Passing	1-4
1.1.7	Flash EAROM for Firmware	1-4
1.2	How to Use This Manual	1-5
2.0	QUICK START	2-1
3.0	INSTALLATION	3-1
3.1	PCI Configuration	3-1
3.2	Jumpers & Headers	3-2
3.3	Connectors: P2 and J1	3-3
3.4	Installation	3-3
4.0	INITIALIZATION	4-1
4.1	PCI Initialization	4-1
4.2	Initialization Commands	4-2
5.0	COMMUNICATING WITH THE PC	5-1
5.1	Command and Response Protocol	5-2
5.1.1	Sending Commands to the Board	5-2
5.1.2	Reading Messages From the Board	5-2
5.1.3	Reading Board Information	5-3
5.2	Interrupts	5-3
5.2.1	Interrupt Initialization	5-4
5.2.2	Step-by-Step Summary	5-4

5.0	COMMUNICATING WITH THE PC (CONTINUED):	
5.3	Commands and Responses	5-5
5.3.1	Characteristics of Command Strings	5-5
5.3.2	Command Parameters	5-5
5.3.3	Commands to the H.100 Conference Board	5-6
	< Conference Commands	5-6
	< Analog Port Control	5-7
	< MVIP Compatibility Commands	5-7
	< Interrupt Control Commands	5-7
	< Reset Commands	5-7
	< Setup Commands	5-8
	< Version Requests	5-8
	< Download Commands	5-8
	< Diagnostics	5-8
5.4.4	Responses from the H.100 Conference Board	5-9
	< Acknowledgments	5-9
	< Error Messages	5-9
	< Query Responses	5-9
	< DTMF Detection Messages	5-9
	< Diagnostic Responses	5-10
6.0	THE H.100 BUS & CLOCK MODES	6-1
6.1	The H.100 Bus	6-1
6.1.1	Legacy Bus Compatibility	6-2
6.2	Clock Modes	6-3
6.2.1	Slave Mode	6-4
6.2.2	Primary Master Mode	6-5
6.2.3	Secondary Master Mode	6-5
6.2.4	Clock Fallback	6-6
6.2.5	Clock Errors	6-7
6.3	Configuration Information	6-7

7.0	CT BUS BUS SWITCHING	7-1
7.1	The H.100 Switching Hardware	7-1
7.2	SCbus Compatability	7-1
7.2.1	Timeslot Assignment	7-2
7.3	MVIP Compatibility	7-4
7.3.1	MVIP Compatibility Commands	7-5
7.4	The Analog Port	7-7
8.0	CONFERENCING	8-1
8.1	The Conferencing Hardware	8-1
8.1.1	Conference Handles	8-1
8.1.2	Command Set	8-2
8.1.3	Attenuation & Noise Threshold	8-2
8.1.4	DSP Facilities	8-3
8.2	Controlling Conferences	8-4
8.3	Changing the Attenuation and Noise Threshold	8-5
8.4	DTMF Detection	8-5
8.5	Energy Detection	8-6
8.6	2 kHz. Tone Generation and Detection	8-7
8.7	Conferencing Examples	8-8
9.0	DIAGNOSTICS & ERROR MESSAGES	9-1
9.1	Diagnostic Commands	9-1
9.2	Error Messages	9-2

APPENDIXES:

A.	Environmental Specifications	A-1
----	------------------------------------	-----

Infinity Series H.100 256 Port Conference Board Technical Manual

Copyright © American Tel-A-Systems, Inc., June 2003

Printed in U.S.A. All rights reserved.

This document and the information herein is proprietary to American Tel-A-Systems, Inc. It is provided and accepted in confidence only for use in the installation, operation, repair and maintenance of Amtelco equipment by the original owner. It also may be used for evaluation purposes if submitted with the prospect of sale of equipment.

This document is not transferable. No part of this document may be reproduced in whole or in part, by any means, including chemical, electronic, digital, xerographic, facsimile, recording, or other, without the express written permission of American Tel-A-Systems, Inc.

The following statement is in lieu of a trademark symbol with every occurrence of trademarked names: trademarked names are used in this document only in an editorial fashion, and to the benefit of the trademark owner with no intention of infringement of the trademark. "MVIP", "H-MVIP" and "MVIP-90" are registered trademarks of GO-MVIP. "SCSA" and "SCbus" are registered trademarks of the Dialogic Corporation. "CT bus" and "ECTF" are registered trademarks of the Enterprise Computer Telephony Forum

American Tel-A-System, Inc.

800-356-9148

• 4800 Curtin Drive • McFarland, WI 53558 •

• 4145 North Service Road, Suite 200 • Burlington, Ontario L7L 6A3 •

• 257M005B •

The H.100 256 Port Conference Board

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.

The H.100 256 Port Conference Board

• vi •

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.

The H.100 256 Port Conference Board

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, if 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.

• viii •

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.

The H.100 256 Port Conference Board

1.0 Introduction

The Infinity Series H.100 256 Port Conference Board is designed to provide enhanced conferencing facilities for up to 84 conferences with a total of 256 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. This board is based on the H.100 MC3/Conferencing board, but has had the MC3 hardware removed to provide a lower cost solution in those situations where only the conferencing capabilities are required.

The H.100 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.100 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 256 Port Conference Board.

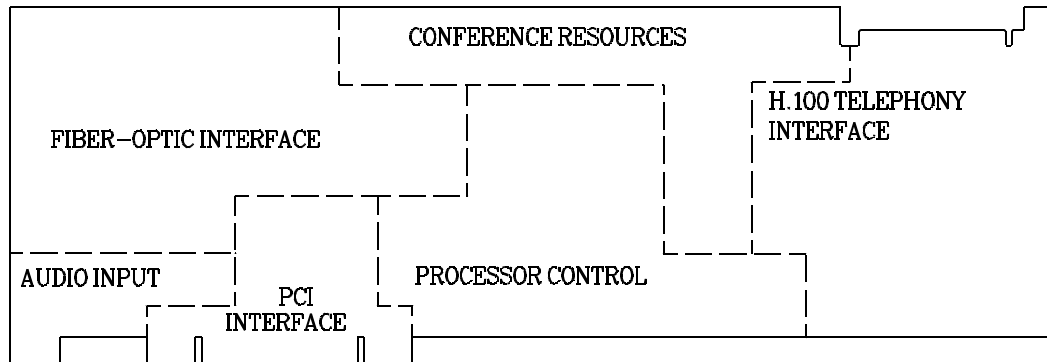


Figure 1: The H.100 256 Port Conference Board Functional Areas

1.1.1 H.100 Bus

The H.100 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.100 bus, each frame consists of 128 channels or timeslots. The bit rate of the H.100 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. For compatibility purposes with legacy busses, the first sixteen streams can also run at either 2.048 or 4.096 MHz. with 32 or 64 timeslots respectively.

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

The H.100 256 Port Conference Board

clocks are provided to aid in recovery if the primary clock should fail. For interoperation with the SCbus, MVIP bus, or H.MVIP bus a number of compatibility clock signals are also defined.

The H.100 bus consists of a 68 conductor ribbon cable that is used to interconnect the boards in the system. This cable connects to a header at the upper right hand edge on each board.

1.1.2 Conferencing

The H.100 256 Port Conference Board includes conferencing facilities similar to those used on other XDS and Infinity Series Boards. Up to 84 simultaneous conferences can be supported with a total of 256 participants. The transmit and receive attenuation of each conferee can be controlled independently improving audio quality and making larger conferences practical.

1.1.3 DSP Functions

The H.100 256 Port Conference Board is equipped with four 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.

In addition to DTMF tone detection, the DSPs can be used to generate and detect 2 kHz. tones which are used for performing continuity checks for Signaling System 7.

1.1.4 Analog Audio Port

The H.100 256 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.100 256 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.100 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.100 256 Port Conference Board is identical to that of the other Infinity Series H.100 boards, allowing for the easy combination of a variety of Infinity Series H.100 boards in a single system.

The message passing scheme and message syntax of Infinity Series H.100 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.100 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.100 256 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.100 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.100 bus and Clock Modes), 7.0 (H.100 Bus Switching) and 8.0 (Conferencing). These sections explain, with practical examples, how the H.100 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.100 Conference Board.

this page intentionally left blank

2.0 Quick Start

This section describes the first steps you should perform to determine if your Infinity Series H.100 256 Port Conference Board is communicating correctly with your PC system. You can perform this quick check without securing the board to the PC chassis or 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. Make sure the PC power is off, then insert the board into a PCI slot.
2. Turn on your PC.
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.100 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 motherboard. There may also be a problem with a memory or interrupt conflict.

The H.100 256 Port Conference Board

Power down the PC 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.100 Conference board. The board should respond with the message “IA”.
7. Send the message “VC” to the board. Verify that the Receive Message reads: VCxxxxvvvvPK2A (where xxxxxvvvv is a variable indicating the firmware version).
8. If the Communications screen shows the correct command responses, your H.100 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.

3.0 Installation

This section describes how to install your Infinity Series H.100 256 Port Conference Board into your PC 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).

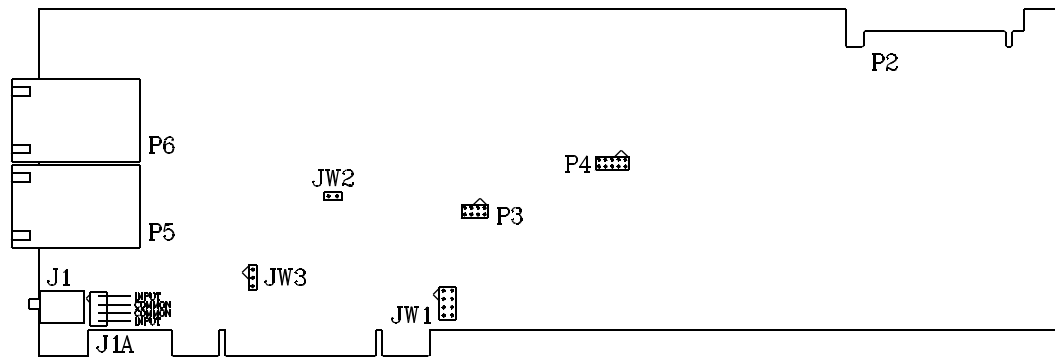


Figure 2: Location of Jumpers, Headers, and Connectors

3.1 PCI Configuration

As Infinity Series boards conform to the PCI standards, there are no switches to set to configure the H.100 Conference Board's memory address, I/O addresses, or interrupt. The PC's bios will automatically configure the board at boot time to avoid conflicts with other boards in the system.

3.2 Jumpers & Headers

The following is a complete list of all jumpers for the H.100 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..
- JW2, JW3** These jumpers are used for factory testing and should not have jumpers installed.
- P3** Diagnostic port. Never install jumpers here.
- P4** This header is used for programming internal logic and should never be jumpered.

3.3 Connectors: P2, and J1

- P2** H.100 bus. The H.100 bus connector (P2) is a standard H.100 bus header. Use an H.100 bus ribbon cable to connect the H.100 Conference Board to other H.100 boards within the same PC chassis.
- 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.100 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 PC 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 PCI slot in the PC chassis and tighten the screw in the back of the board to secure it.
5. Connect the H.100 bus cable to P2.

• 3-4 •

Installation

6. If the analog port is to be used, connect the music source or other compatible device.
7. Power up the computer.

4.0 Initialization

This section describes the procedures necessary to initialize the system and enable the PC to communicate with the Infinity Series H.100 256 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.100 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.100 boards,

The H.100 256 Port Conference Board

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.100 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.100 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.100 MC3/Conference Board using these commands

<u>Command</u>	<u>Purpose</u>
SCmsabb(c)	Sets the clock mode for the board. The parameter <i>m</i> is the clock-mode. The parameter <i>s</i> is the clock sub-mode. The parameters <i>a</i> , <i>bb</i> , and <i>c</i> 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.

- SBabcd** This command is used to define the clock rate for the lower 16 streams for compatibility with the SCbus or MVIP bus. The parameters a, b, c, d are used to set the rate for streams 0-3, 4-7, 8-11, and 12-15 respectively. The default is 8.192 MHZ. The possible settings are:
- 0 - 2.048 MHZ., 32 timeslots per stream
 - 1 - 4.096 MHZ., 64 timeslots per stream
 - 2 - 8.192 MHZ., 128 timeslots per stream
- 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(2)** This command is used to enable or disable conferencing. If the parameter a is D, conferencing will be disabled, if the parameter a is E, conferencing with 128 conferees will be enabled. If the optional “2” is added, conferencing will be enabled with 256 possible conferees.
- SPstt** When operating in SCbus compatibility mode, it may be desirable to restrict the number of timeslots that the board can use to transmit to the SCbus. This command restricts the total number of SCbus timeslots to $s * 64 + tt$, where s and tt are in hexadecimal. This command is used in conjunction with the **SX** command and should only be used when operating in the SCbus mode.
- STab** Controls termination. Parameters a and b control termination for the H.100 and MVIP bus respectively. When set the E, termination is enable and when set to D, termination is disabled. Boards on the end of the H.100 cable should have termination enabled. When

operating in MVIP compatibility mode, the MVIP termination should be enabled when the following condition exists:

For systems with five or fewer MVIP Bus connections and less than 90 pF load on the clock lines, it is adequate to place the circuit board that is the master clock source at one end of the cable and provide termination on the circuit board which is physically at the other end of the cable.

On systems with more than five MVIP connections or more than 90 pF load on the clock lines, both ends of the cable should be electrically terminated with the 1000 Ohm/ 1000 pF termination. No other boards should terminate these lines.

SXstt

This command is used to set the base timeslot on the SCbus when reserving timeslots to transmit on. The parameters *s* and *tt* are hexadecimal numbers setting the lowest timeslot of the block of timeslots reserved for the board. The number of timeslots reserved is defined by the **SP** command. This command should only be used when operating in the SCbus mode.

5.0 Communicating with the PC

This section describes how the PC communicates with the Infinity Series H.100 256 Port Conference Board. It includes the definitions for the H.100 Conference Board commands and responses along with a description of the mailboxes used for messaging.

The board is controlled by the host PC 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 PC 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.100 Conference Board are:

1. Build a command. Broadly speaking, a command is a string of ASCII characters with a null (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. The message is a NUL-terminated ASCII string.
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:

<u>Type of Information</u>	<u>Offset Address</u>
Board ID	1F00-1F03
Firmware Version	1F04-1F07
Number of transmit timeslots	1F10-1F11
Base timeslot	1F12-1F13
Base timeslot of conferences	1F14-1F15
Base timeslot of analog port	1F16-1F17
Clock mode settings	1F18-1F1B
Board configuration	1F1C-1F1E
Clock status bits	1F1F

Note: The number of reserved transmit timeslots, and base timeslots are used only in the SCbus compatibility mode when reserving transmit timeslots.

The board stores its identity upon power up or a hardware restart. The phrase **Restart PCI PK2 (C) Amtelco 2003** appears in the receive mailbox. The receive flag is not set and no interrupt is generated.

5.2 Interrupts

The H.100 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

The H.100 256 Port Conference Board

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.100 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 9.0 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	01-54h
cc	Conference Control Address	00-FFh
pp	Output pattern value	00-FFh
iiii	1st & 2nd i, H.100 receive stream	00-1Fh
	2nd & 3rd i, H.100 receive timeslot	00-7Fh
oooo	1st & 2nd o, H.100 transmit stream	00-1Fh
	3rd & 4th o, H.100 transmit timeslot	00-7Fh
bsstt	MVIP terminus, b - bus, ss - stream, tt - timeslot	C, H, L 0000-1F7F

5.3.3 Commands to the H.100 Conference Board

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

Conference Commands

CAhhooooiiiiian	Conference H.100 timeslot iiiii, output on timeslot oooo, conference hh, attenuation a, noise threshold n
CDoooo	Disable output to H.100 timeslot oooo
CEiiii(cc)	Enable DTMF detection on conferenced timeslot iiiii, cc = clamping time .02 sec increments
CEiiiiD	Disable DTMF detection on conferenced timeslot iiiii
CIhhiiiiian	Add H.100 input timeslot iiiii to conference hh attenuation a, noise threshold n
CLiiii	Enable 2 kHz. tone detection on H.100 timeslot iiiii
CLiiiiD	Disable 2 kHz. tone detection on H.100 timeslot iiiii
CMhhoooo	Monitor conference hh on H.100 timeslot oooo
CTooooE	Enable 2 kHz. tone on H.100 timeslot oooo
CTooooD	Disable 2 kHz. tone on H.100 timeslot oooo

The H.100 256 Port Conference Board

CUhh Dissolve conference handle hh
CXhhiiii Remove H.100 timeslot iiii as an input to conference
hh

Analog Port Control (Music on Hold)

AD Disable Music on Hold transmit
AEoooo Enable Music on Hold output to H.100 timeslot oooo
AGttrr Set transmit attenuation to tt and receive attenuation to
rr in .1 dB steps
ARiiii Enable analog input from H.100 timeslot iiii
ARX Disable analog input

MVIP Compatibility Commands

MAm Audio port control mode
m = D - disabled, m = E - enabled
MDccmdd DTMF detection control, cc - CCA,
m = D - disabled, m = E - enabled, dd - duration
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
MTD Disable output to the CT Bus (tristate)
MTE Enable output to the CT Bus

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
SBabcd	Set bit rate for streams 0-3, 4-7, 8-11, and 12-15 0 - 2.048 MHZ. 1 - 4.096 MHZ. 2 - 8.192 MHZ.
SCmsabb(c)	Set clock mode m submode s, arguments a, bb, & c
SDm	Set energy detection mode, m = D - disabled, m = E - enabled
SEm	Set encoding mode, m = M - mu-Law, A - A-Law
SKD	Disable Conferencing
SKE	Enable Conferencing with 128 conference ports
SKE2	Enable Conferencing with 256 conference ports
SPstt	Set maximum number of transmit timeslots to stt
STab	Set bus termination, a = H.100 bus, b = MVIP bus
SXstt	Set base SCbus transmit timeslot to stt

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
QHcrrrr	Query CT812, c = CT812, rrrr = register
QObsstt	Query Output for terminus bsstt
QPd(cmdnd)	Send command to DSP d
QXxxx	Query SCbus transmit timeslot for port xxx

5.4.4 Responses from the H.100 Conferencing Board

Acknowledgments

A(msg) Verify set response to a message
IA Interrupt On acknowledge
RA Reset all acknowledge

Error Messages

ECxx Clock error bits xx
EG01 Conflict while enabling the 2 kHz. generator
EKhhxx Conference error for conference handle hh, error xx
01 - illegal handle
02 - no free conference inputs
03 - not an input to conference
EPoooo Path error for H.100 output timeslot xxx

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
QH0rrrrddddd Reply to CT812 query, ddddd is register data
QObssttm(bsstt) Query_output reply, bsstt - output terminus, m - mode
(bsstt) input terminus
QPd(string) Response from DSP d
QXxxxstt SCbus transmit timeslot for port xxx
QXxxxZ No SCbus transmit timeslot set for port xxx

DTMF Detection Messages

STiiii DTMF tone t detected on H.100 stream & timeslot iii
STX0cct DTMF tone t detected on CCA cc

Diagnostic Responses

VAcccc	Alternate segment checksum, cccc - checksum
VCccccvvvvPK2A	Version request response, cccc - checksum vvvv - version, PK2A- PCI 256 Port Conference board identifier
VDxxxx	DSP version number
VKxxxx	Conference DSP version number
U(msg)	undefined or unparseable message

6.0 The H.100 Bus & Clock Modes

The Infinity Series H.100 256 Port Conference Board provides a means of connecting conferencing facilities to the H.100 bus. Through this bus, the conference ports can be connected to other H.100 compatible boards. The H.100 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.100 operation. In addition, the board is capable of interoperating with legacy MVIP and SCbus boards.

6.1 The H.100 Bus

The H.100 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 interoperation with the legacy SCbus, MVIP-90 bus and the H-MVIP bus there are some additional clock signals that are included on the bus.

For the purposes of commands, a particular H.100 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.100 bus is a 68 conductor ribbon cable that connects the various boards in the system. As in any such bus, termination is important for its proper operation. The board at each end of the H.100 cable must have the proper termination installed or enabled, while any board between the ends must not terminate the bus. For the H.100 Conference Board, termination is enabled using a command of the form **STab** where a controls the H.100 termination and b the MVIP bus termination. Termination is

enabled if a is “E” and disabled if a is “D”.

6.1.1 Legacy Bus Compatibility

The H.100 specification provides for inter-operability with several common legacy PCM busses. These include the SCbus, the MVIP-90 bus and the H-MVIP bus. Because these busses run at different bit rates than the 8.192 MHZ. of the H.100 bus, provisions exist in the specification to run the first 16 streams at either 4.096 MHZ. or 2.048 MHZ. For inter-operability with the SCbus, these streams typically should be run at 4.096 MHZ. (2.048 MHZ. and 8.192 MHZ are also possible choices) and with the MVIP-90 bus they should be run at 2.048 MHZ. H-MVIP runs these streams at either 2.048 or 8.192 MHZ. depending on whether MVIP-90 compatibility is desired.

On the H.100 Conference Board, the bit rate of the first 16 streams is set using the “SB” command. This command takes the form **SBabcd** where the parameters a, b, c, and d select the bit rate for streams 0-3, 4-7, 8-11, and 12-15 respectively. The choices for these parameters are:

- 0 - 2.048 MHZ.
- 1 - 4.096 MHZ
- 2 - 8.192 MHZ.

Thus to operate with the SCbus at 4.096 MHZ. the command would be **SB1111** and to operate with the MVIP-90 bus **SB0000**. The default selection for these streams is the H.100 rate of 8.192 MHZ.

When operating in a compatibility mode, the timeslot in board commands range from 00 to the maximum number of timeslots allowed by the bit rate. At 2.048 MHZ. timeslots within a stream are numbered 00-1Fh and at 4.096 the timeslots are 00-3Fh. MVIP-90 bus streams are numbered 00-0Fh. This numbering corresponds to the DSo/DSi convention according to the following table:

H.100 stream	MVIP-90 stream	MVIP-95 stream	H.100 stream	MVIP-90 stream	MVIP-95 stream
00h	DSo0	HDS0	08h	DSo4	HDS8
01h	DSi0	HDS1	09h	DSi4	HDS9
02h	DSo1	HDS2	0Ah	DSo5	HDS10
03h	DSi1	HDS3	0Bh	DSi5	HDS11
04h	DSo2	HDS4	0Ch	DSo6	HDS12
05h	DSi2	HDS5	0Dh	DSi6	HDS13
06h	DSo3	HDS6	0Eh	DSo7	HDS14
07h	DSi3	HDS7	0Fh	DSi7	HDS15

6.2 Clock Modes

The H.100 bus specification defines a variety of clock signals. Two clock signals CT bus A and CT bus B are provided for redundancy. In addition, a signal called CT_NETREF is defined which may be referenced to an external clock source such as a T1 or E1 span. This signal exists to aid in recovery if the primary clock source should fail. The specification also includes clock signals for compatibility with both the MVIP90 and SCbus.

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 master CT bus clock A
- 3 the board is master CT bus clock B
- 4 the board is secondary master for CT bus clock A
- 5 the board is secondary master for 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.100 bus clock. The other boards in the system must slave their internal clocks to the master. If the H.100 Conference Board is to use the H.100 bus clock, this clock must be provided by another board before switching can be accomplished.

6.2.1 Slave Mode

In the Slave Mode, the H.100 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
- 2 - SCbus clock at 2 MHZ.
- 3 - SCbus clock at 4 MHZ.
- 4 - SCbus clock at 8 MHZ.
- 5 - MVIP90 clock signal
- 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.100 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.

6.2.2 Primary Master Mode

In modes 2 or 3, the board supplies the CT master clocks A or B respectively. Other boards on the H.100 bus will synchronize to one of these clocks. The source of the clock is selected by the submode argument *s*. The choices are:

- 0 - freerun, the board's internal clock
- 1 - CT_NETREF_1
- 2 - CT_NETREF_2 (not present on the H.100 bus)

For submode 1 and 2, argument *bb* will select the frequency of the CT_NETREF signal. The choices are:

- 00 - 8 kHz. (frame rate)
- 01 - 1.536 MHZ. (T1 rate)
- 02 - 1.544 MHZ. (T1 extended superframe rate)
- 03 - 2.048 MHZ. (E1 rate)

For all modes, argument *a* will select the legacy bus compatible clocks that the board will supply. The options are:

- 0 - no compatibility clocks
- 1 - SCbus clocks at 2 MHZ.
- 2 - SCbus clocks at 4 MHZ.
- 3 - SCbus clocks at 8 MHZ.
- 4 - MVIP 90 clocks
- 5 - H-MVIP clocks

6.2.3 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.

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.

When operating in secondary master mode, the arguments s, a, and bb are the same as when operating as a primary master.

6.2.4 Clock Fallback

The H.100 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 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.100 boards, this will involve sending a set clock command with the new primary clock information.

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.

6.2.5 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 the specific error. A value of 1 indicates an error condition. The bits are as follows:

<u>bit</u>	<u>Error Description</u>
0	CT bus clock A
1	CT bus clock B
2	SCbus clocks
3	MVIP bus clocks
4	Master PLL error
5	Frame Boundary

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**. The next byte contains the stream rate information from the **SB** command with bits 0-1 containing the value for streams 0-3, bits 2-3 for streams 4-7, and so on. Bits 0 and 1 of the sixth byte indicate the state of the H.100 and MVIP termination, respectively, with a value of 1 being the enabled state. 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)

this page intentionally left blank

7.0 CT Bus Switching

This section describes the operation of the Computer Telephony bus switching capabilities of the Infinity Series H.100 256 Port Conference Board. Topics include the H.100 bus, the operation of the board when operating in SCbus or MVIP bus compatibility mode and the operation of the analog port. In this chapter, the term “Computer Telephony” or CT bus shall include not only the H.100 bus, but also the MVIP-90, H-MVIP, and SCbus

7.1 The H.100 Switching Hardware

The H.100 Conference Board consists of two separate switch blocks. The H.100 256 Port Conference Board is based on that of the H.100 MC3/Conferencing Board which has two separate switch blocks, one for the MC3 bus and one for conferencing. On the Conferencing Board, the MC3 switch block is only used for clock control and is not available for switching. The other switch block is used for switching between computer telephony bus and the conferencing facilities. This switch block has 256 inputs from CTbus to the conferencing facilities and 256 outputs to the CTbus from the conferencing facilities. The analog port adds an additional input and output.

7.2 SCbus Compatibility

The SCbus is a 16 stream bus. Each stream on the bus normally operates at 4.096 MHZ. and has 64 timeslots per stream for a total of 1024 timeslots. However, the SCbus may optionally run at either 2.048 MHZ. with 32 timeslots per stream for a total of 512 timeslots or 8.192 MHZ. with 128 timeslots per stream and a total of 2048 timeslots on the 16 streams. When inter-operating H.100 Conference board with the SCbus at

The H.100 256 Port Conference Board

either 2.048 or 4.096 MHZ. the bit rate on the lower 16 H.100 streams must be set appropriately using the “SB” command.

The SCbus uses a 26 conductor ribbon cable. Because of this, an adapter must be used between the P2 connector on the H.100 board and the SCbus.

7.2.1 Timeslot Assignment

Typically, drivers and libraries conforming to the SCbus specification use a scheme called “timeslot assignment” to insure that no two devices are transmitting on the same timeslot. Not only will having two transmitters on the same timeslot degrade audio signals, but they also may damage some SCbus boards. To prevent this, each device or “port” is assigned a unique timeslot to transmit on during boot-up. For purposes of timeslot assignment, each possible conference input or output can be considered a port.

Transmit timeslots are reserved on the H.100 Conference board using the “SX” command. The same command is used to reserve timeslots on XDS SCbus boards. The command takes the form **SXstt** where s is the stream and tt is the timeslot on that stream of the timeslot reserved for the first port on the board. As an example, if the first timeslot reserved for the board is 100 in decimal, then the message **SX124** would be sent (timeslot 100 corresponds to stream 1, timeslot 24h).

The H.100 Conference Board can transmit on a maximum of 257 timeslots. There may be situations where it is desirable to reduce this number where not all of the conference resources are needed or timeslots are needed for other boards. To allow this, the “SP” command can be used to restrict the number of “ports” that the board will present to the SCbus. This command takes the form **SPstt** where stt is the number of streams and timeslots to be reserved for the board. This command assumes that there are 64 timeslots per stream.

When conferencing is enabled, the 128 or 256 conference ports will use the

The H.100 256 Port Conference Board

highest 128 or 256 timeslots reserved for the board depending on which enable mode is selected. If the analog port is enabled, it will use the timeslot below the first conferencing timeslot.

If 256/128 or fewer timeslots are reserved, the conferencing ports will begin from the base timeslot and continue to the last timeslot reserved. Ports above this number will be unavailable. To reserve a timeslot for the analog port, 257/129 timeslots must be reserved. In this case, the analog port will use the first timeslot and the conferencing will use timeslots starting with the second reserved timeslot. If fewer than 257/129 timeslots are reserved, the analog port can still be accessed by specifying an absolute timeslot on which to transmit.

As an example, 129 timeslots can be reserved for the board by sending a command of the form **SP201** (2 streams of 64 timeslots each plus one timeslot for the analog port). If the base timeslot of the board is set at 96, a command of the form **SX120** should be sent to the board. 128 timeslots from 97 to 224 (121-320h) would be assigned to the conference ports. The analog port would use timeslot 96 (121h).

When timeslots have been assigned, the actual output timeslot value is no longer used in commands that control outputs to the CT bus. Instead, a port number is used. This port number will be from 0 to the maximum number of timeslots reserved for the function (conferencing) and will be represented in stream timeslot notation (0stt) in the commands. In the example above, the conference functions each have 128 ports and these would run from 0000-013F. As an example, to monitor the output for the conference with a handle of 1 to the 3rd timeslot reserved for conferencing the command would be **CM010002**.

Normally, the timeslot assignment process is carried out as part of the initialization and loading of the driver. A configuration file is used to specify the number of timeslots to be reserved for the board. The function **xds_xmt_timeslot** is used for finding the transmit timeslot of a port. To aid this process, information on the number of reserved timeslots and the base timeslot is presented in the dual-ported memory. This information is available at the following locations:

The H.100 256 Port Conference Board

1F10h	total number of timeslots for the board
1F12h	1st timeslot assigned to MC3 connections
1F14h	1st timeslot assigned to conferencing
1F16h	timeslot assigned to the analog port

(note that the MC3 timeslot is present for compatibility purposes)

The command **QXstt** can also be used to inquire as to which timeslot is reserved for a port stt. The reply takes the form **QXsttabb** where a is the stream and bb is the timeslot on the stream that is reserved for stt. If no timeslots have been reserved on the board, the response will take the form **QXsttZ**.

7.3 MVIP Compatibility

The MVIP-90 bus has 16 streams with 32 timeslots each. The streams run with a bit rate of 2.048 MHz. When the H.100 Conference Board is inter-operating with the MVIP bus, the bus rate on the lower 16 streams must be set using the “SB” command.

The MVIP-90 bus uses a 40 pin ribbon cable. To connect the H.100 Conference Board to the MVIP-90 bus an adapter must be used. The MVIP rules for termination must also be followed (see Section 4.2).

Timeslots on the MVIP bus are normally paired, that is timeslot x on DSoy is paired with timeslot x on DSiy. One timeslot of a pair must be defined as an input and the other as an output. With most MVIP boards, an attempt to use both timeslots of a pair as inputs or as outputs will result in a conflict. The table in Section 6.1.1 gives the association between H.100 stream numbers and the DSi and DSo streams.

MVIP-90 applications normally assign timeslots dynamically, so the fact that the H.100 Conference Board can transmit on more timeslots than are available on the MVIP bus is not a concern. Connections that are not enabled are tri-stated.

The H-MVIP bus has 24 streams. The H-MVIP specification has several modes. One mode is compatible the MVIP-90 specification, that is the lower 16 streams run at a 2.048 MHZ. rate while streams 16-23 run at 8.192 MHZ. This mode can be treated as the MVIP-90 case. In another mode, all 24 streams run at the same 8.192 MHZ. rate as the H.100 bus. In this case, only the physical cabling between the H-MVIP bus and the H.100 bus and clock issues need to be addressed.

7.3.1 MVIP 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.100 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 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.100 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 a single stream of 128 or 256 timeslots which correspond to the Conference Control Addresses or CCAs. Input and output connections are made between the H.100 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.

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. As an example the commands:

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.100 bus. To remove the party from the conference the commands would be:

MOC0001D	disable input to CCA 1
MOH0555D	disable output to the H.100 bus
MK0201D	disable CCA 1

When using the MVIP compatibility commands, it is the responsibility of the application to allocate the CCAs.

The H.100 256 Port Conference Board

7.4 The Analog Port

An analog port is provided for use either as a music on hold source or for monitoring timeslots on the H.100 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. When enabled, the analog port will use one of the 1024 possible connections between the board and the H.100 bus.

The command to enable the music on hold feature is of the form **AEoooo** where oooo is the H.100 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.100 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.

Though the port is bi-directional, it is not recommended that it be used for both transmitting to the H.100 bus and receiving from the H.100 bus at the same time because it is a 2-wire circuit and there is no isolation between the input and the output.

this page intentionally left blank

8.0 Conferencing

This section describes the conferencing facilities available on the Infinity Series H.100 256 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.100 Conference Board is arranged into a block that is separated from the MC3 switching. Up to 84 conferences may be supported with either 128 or 256 inputs and outputs depending on which conference enable mode is selected. Conferences can be of any size up to the maximum limit of 128 or 256.

The conferencing block is connected to the last 4 local streams of the last CT812 H.100 bus switch block. Four DSPs, one for each local stream are connected in line between the CT812 and the conference inputs for tone and energy detection and tone clamping..

8.1.1 Conference Handles

Each conference is identified with a handle. The value of this handle ranges from 1-84. The handle is selected by the application. The handle is used in the conferencing commands to identify which conference the command applies to. Each conference input and output is defined by a Conference Control Address, or CCA which range from 0-255. Conference Control Addresses are associated with fixed timeslots on the local conferencing streams. CCAs 0-63 are associated with the 64 timeslots of the first local stream, CCAs 64-127 with the second local stream, and so on.

The H.100 256 Port Conference Board

On the H.100 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 following table gives the amount of attenuation the parameter selects:

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.

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.

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

8.1.4 DSP Facilities

The H.100 Conference Board is equipped with four DSPs which are connected in the conference input streams between the H.100 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.100 timeslot.

8.2 Controlling Conferences

A party can be added to a conference using the conference add command. This command takes the form **CAhhooooiian** where hh is the conference handle, iiii is the H.100 timeslot of the input, oooo is the H.100 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.100 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 **CMhhoooo**, where hh is the conference handle and oooo is the H.100 output timeslot. 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 **CIhhiiiiian** 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.

8.4 DTMF Detection

The H.100 Conference Board is equipped with four DSPs for DTMF detection. The DSPs are connected between the H.100 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.

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 **CEiiiiidd** where *dd* is the duration of the interruption interval in 20 msec. increments. For example, **CE00305** 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.100 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.100 timeslots. If streams 0-15 are operated at less than 8.192 MHz for compatibility with the SCbus or MVIP-90 bus, each stream will still occupy 128 bytes with the data in the first 64 or 32 bytes reserved for that stream. 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 2 kHz. Tone Generation and Detection

Signaling System 7 uses a 2 kHz. tone for performing continuity checks to verify the operation of speech circuits. The H.100 Conference Board is capable of generating and detecting this tone. A single generator is provided to play a 2 kHz. tone to an H.100 bus timeslot. Up to 256 detectors are available for the detection of the 2 kHz. tones. The DSP resources for 2 kHz. detection are shared with those used for DTMF detection and clamping of conferenced inputs. Conferencing **must** be enabled for the 2 kHz. detection and generation to be available. Note, that at most, 256 detectors, generators and conference parties can be assigned at a time.

Because the DSP facilities are located in the input leg of the conferencing facility, each detector and generator utilize one of the 256 Conference Control Addresses (CCA). The assignment of CCAs is done dynamically. To minimize conflicts between conferencing and the 2 kHz. detection, the assignment of CCAs for the 2 kHz. detection is done from the highest numbered CCA on down. The 2 kHz. generator, when enabled, uses the highest numbered CCA, 127 (255 if 256 conference parties are enabled).

The generator is enabled using a command of the form **CToooo** where oooo is the H.100 bus stream and timeslot that the tone will be output on. The generator should not be enabled if any of the 2 kHz. detectors are enabled as this may result in a possible CCA assignment conflict. If a conflict occurs, an error message of the form **EG01** will be reported. The generator may be disabled with a command of the form **CTooooD** where oooo is the H.100 bus stream and timeslot. In practice, it is best to enable

The H.100 256 Port Conference Board

the generator at start up time and leave it connected to the H.100 bus.

To enable tone detection, a one-way path is created to the H.100 bus from the source. The path enabling the detector is created with a command **CLoooo** where oooo is the H.100 stream and timeslot. Detection of the tone is reported with a message of the form **STooooA** where oooo is the H.100 stream and timeslot used by the detector. Detection is disabled with a command of the form **CLooooD** to disable the detector.

8.7 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
```

The H.100 256 Port Conference Board

Conferencing

• 8-9 •

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

this page intentionally left blank

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 `VCxxxxyyyyPK2A`, where `xxxx` is the checksum of the firmware stored in the main segment of ROM, `yyyy` is a four-digit version number and `PK2A` indicates the board type. 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 is returned in a message of the form `VDxxxx`, where `xxxx` is the version number. All DSP's on the board use the same software version.
- QHcrrrr** Queries the contents of the CT812 chip `c`, for register `rrrr`. The contents are returned as the 24 bit value `dddddd` values in the message `QHcrrrrdddddd`. This command refers to the details of the internal switching circuitry, and is ordinarily of limited use to the application.

QXxxx Queries the transmit timeslot reserved for port xxx. This command is only valid if the board is operating in SCbus mode. The reply takes the form QXxxxstt where stt is the stream and timeslot for the port. If no timeslot is assigned, the reply will be QSxxxZ. This command is common to all Infinity Series boards operating in the SCbus mode and all XDS SCSA boards. The H.100 Conference Board is capable of transmitting on 129 timeslots, but may be restricted to fewer timeslots (See section 7.2.1 for details of SCbus timeslot assignment).

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 hexadecimal number where the bits are (a bit value of 1 is an error)

<u>bit</u>	<u>description</u>
0	CT bus clock A
1	CT bus clock B
2	SCbus clocks
3	MVIP bus clocks
4	Master PLL error
5	Frame Boundary

EG01 A conflict has occurred when attempting to enable the 2 kHz. tone generator.

EKhxx An error has occurred while attempting to make a conference using handle hh. If xx equals 01, a handle outside the range of 01-2Ah was used. If xx equals 02, all conference facilities available for that handle are in use.

U[cmd] 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.

this page intentionally left blank

Appendix A: Environmental Specifications

The Infinity Series H.100 256 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.100 boards conform to PCI-SIG mechanical specifications for full-length PCI cards.

MTBF:

50,000 hours.

ELECTRICAL REQUIREMENTS:

+5 volts $\pm 5\%$ @ 4.0 amps maximum.

-12 volts @ 15mA. maximum

+3.3 volts, -5 volts, & +12 volts not required

this page intentionally left blank