



Wave Server Hardware Reference Guide

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Revision History

Release	Date	Documentation Changes	Page No.
	07/11	GENERAL RELEASE:	
2.5		Added the DECT/Ranger cordless phones to the telephone compatibility table for the 12-Port/24-Port Digital Station Modules and 48-Port Digital Station Card (for Edge 700/Vodavi phones).	17-5
2.0 SP1	04/11	SERVICE PACK RELEASE:	
		Corrected model numbers as needed.	Throughout
		Updated Caution to indicate that no modules or cards are hot-swappable .	3-5
		Updated Caution to emphasize that the exterior ground lug should always be properly connected .	3-5
		Corrected the order of steps 1 and 2 in "Local system power-on."	3-6
		Corrected the order of steps 1 and 2 in "Installation verification."	4-9
		Added Caution about location of hatch cover insulation strip when replacing the Backplane Terminator Board or adding another EXU.	6-6
		Clarified that on the Wave IP 2500, you can use Expansion Units (EXUs) to support more analog trunks and/or analog stations than can be supported by analog cards or modules .	9-2, 14-2
		Clarified usage of USB1 and USB2 ports on the ISC1 (Wave IP 2500 Server only).	12-13
		Clarified usage of ENET1 and ENET2 ports on the ISC1 (Wave IP 2500 Server only).	12-14
		Added section describing the 2 configurations supported by the 8+8 Port Analog Universal Module (VWU-8X8AU-M) .	14-2
		Added Caution stating that the rocker switch at the rear of the Wave IP 500 Server should be only be used to power off the Server failed to shut down normally .	18-8
		Clarified usage of USB1-3 ports on the ISC2 (Wave IP 500 Server only).	18-14
		Added entry for "Embedded firmware had too many failed boot attempts" error to the Early Boot Error table of LED settings.	E-19

Revision History

Release	Date	Documentation Changes	Page No.
2.0	09/10	GENERAL RELEASE:	
		Updated Uniform Service Order Code (USOC) table to include new VWU-8AT-W and VWU-1T1S-M modules described below.	1-7
		Corrected the maximum cable run length for digital station ports on the 12-Port Digital Station Module (VW-12DS-M, VW5-12DS-M) and 24-Port Digital Station Card (IO-24DS-C).	8-5
		The new 8-Port Analog Trunk Module (VWU-8AT-W) is compatible with both Wave Server models. This new module replaces the 8-port analog trunk module (VW-8AT-M) for the Wave IP 2500 and the 8-port analog trunk module (VW5-8AT-M) for the Wave IP 500, both of which have been discontinued.	13-1
		The new 8+8 Port Analog Universal Module (VWU-8X8AU-M) is compatible with both Wave Server models. This new module replaces the 8 + 8 port analog universal module (VW-8X8AU-M) for the Wave IP 2500 and the 8 + 8 port analog universal module (VW5-8X8AU-M) for the Wave IP 500, both of which have been discontinued.	14-1
		The new 1-Port T1/PRI Module with serial interface (VWU-1T1S-M) is compatible with both Wave Server models. This new module replaces the 1-port T1/PRI module with serial interface (VW-1T1S-M), which has been discontinued.	15-1
		The new 24-Port Digital Station Module (VWU-24DS2-M) is compatible with both Wave Server models. This new module replaces the 24-Port Digital Station Module (VW-24DS2-M) for the Wave IP 2500 and the 24-Port Digital Station Module (VW5-24DS2-M) for the Wave IP 500, both of which have been discontinued.	17-1
		All Wave IP 500 Servers now ship with dual (redundant) SATA hard disk drives configured from the factory which will further increase overall reliability. This new configuration (VW5-IP500-STD2A) replaces the single hard disk drive configuration (VW5-IP500-STD2) which has been discontinued.	18-2
		Added information about how the new dual SATA hard drives included on the Wave IP 500 are physically mounted and cabled.	18-3
		Removed Appendix F, "Software License Agreement". This information is now covered in Appendix C in the Wave Global Administrator Guide.	---
		Added text labels to System Status and Card LED tables to help users interpret the graphical representation of status LEDs when viewing a printed version of Appendix E.	E-2

Revision History

Release	Date	Documentation Changes	Page No.
1.5 SP2	06/09	SERVICE PACK RELEASE:	
		Added information on the new 1-Port T1/PRI Module.	15-1
		Added new chapter covering the Quad BRI Module.	16-1
		Added Important note to section "Resetting Factory Default IP Settings".	E-1
1.5	01/09	GENERAL RELEASE:	
		The Wave IP 500 Server is now supported; chapter 17 contains material specific to IP500; references also appear in other chapters when applicable. NOTE: Name of manual changed to "Wave Server Hardware Reference Guide".	18-1
	11/08	Added E1 EuroISDN, primarily to Chapter 15, but also to various other places in the Guide.	15-1
		Multiple changes to Appendix A.	---
		Appendix E is revised to show updated ISC1 LED indications.	E-1
1.0 SP2	01/08	SERVICE PACK RELEASE:	
		Chapter 16 has been added to cover the digital card/modules that support Vertical Vodavi and Edge 700 phones.	17-1
1.0 SP1	12/07	SERVICE PACK RELEASE:	
		Release identifier has been modified on the Title page to reflect current s/w version. Manual content is unchanged.	---
1.0	10/07	GENERAL RELEASE:	
		Initial Release.	---

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Welcome to the *Wave Server Hardware Reference Guide*. This guide provides detailed technical information about the Wave IP 2500 and Wave IP 500 Servers and available expansion options.

Getting the most out of this guide

This guide is intended for technicians who are responsible for maintaining the Wave IP 2500 or Wave IP 500 Server chassis in the following ways:

- Replacing or installing new expansion cards, modules, and power supplies
- Connecting network and telephone cables to the modules
- Attaching third-party music-on-hold, public address, and external voice mail systems

This guide describes the physical characteristics, hardware configuration features, installation or replacement instructions, and troubleshooting procedures of cards, modules, power supplies, cables, and other chassis components.

This guide also provides information about using the Fault Monitor Module (FMM) to select error-reporting options and view the system trace log on the Wave Server.

Acronyms and definitions of selected terms

- **Check Disk.** This is the Win32-based, user-mode command-line program that can be invoked manually to verify, and optionally repair, a file system at runtime.
- **iCom.** This is a Vertical Engineering term used to refer to the TCP/IP link between the VAM and the ISC1.
- **ISC1.** Integrated Services Card used on the Wave IP 2500 Server.
- **ISC1 Firmware:** The firmware that runs on the ISC1's embedded processor.
- **ISC2.** Integrated Services Card used on the Wave IP 500 Server.
- **ISC2 Firmware.** The firmware that runs on the ISC2's embedded processor.
- **IXP.** ISC processor, or simply the ISC1/ISC2.
- **Linux.** The operating system that runs on the ISC1/ISC2 embedded processor.
- **PCI.** Peripheral Component Interconnect bus between the VAM and the ISC1/ISC2.

- **PLD Programmer.** A software component on the VAM that is responsible for checking the version of the ISC1/ISC2 firmware and reflashing it with a newer version if available on the VAM's hard drive.
- **VAM.** Vertical Application Module.
- **Wave Server.** Refers to both Wave IP 2500 and Wave IP 500 Server models.

Related reading

Manuals

Wave Global Administrator Guide—This guide is a four-part book. The first part, Initial Configuration and Administration, provides instructions for initially configuring the Wave system. The second part, Advanced Configuration and Administration, provides instructions about how to perform advanced configuration tasks that can be done after your Wave system is up and running. The third and fourth parts, Key Wave Concepts and Reference, provide information about telephony and data concepts as they relate to the Wave system.

Wave Server Installation Guide Installation Guide—This guide provides detailed instructions for physically installing a Wave system and performing initial system configuration.

Wave ISM System Recovery Guide System Recovery Guide—This guide describes how to use the Wave System Recovery Disk to restore your Wave Server to its original factory settings for emergency recovery.

Wave ViewPoint User Guide—This guide provides task-based instructions on how to use the Wave system, including working from remote locations, participating in a contact center, and so forth.

Wave Phone User Guide—This guide describes how to use the Vertical Wave SIP phones, Vertical Edge digital phones, and analog phones with Wave.

Quick Reference Guides

Wave Analog Phone Quick Reference Guide—This guide provides instructions for using PBX features—such as transfer, conference call, or call forward—with your standard analog telephone.

Wave Digital Phone Quick Reference Guide—This guide provides instructions for using the Vertical Communications digital telephones.

Wave SIP Phone Quick Reference Guide—This guide provides instructions for using the Vertical Communications SIP telephones.

Wave Voice Mail Quick Reference Guide—This guide provides an action map for using Wave Voice Mail features—such as retrieving messages, forwarding messages, replying to messages, and changing passwords.

Support services

Vertical has worked diligently to produce the highest quality communications system possible. In the course of installing or customizing a system, however, customers may require personal attention.

For technical support contact your reseller. For more information about Vertical Communications, Inc. and its products, contact your Wave provider.

Web site

The following Web site provides information about Vertical Communications, Inc. and the Wave product line.

<http://www.vertical.com>

System security

You are responsible for the security of your Wave system. Unauthorized use of the Wave system could result in toll fraud. Your system administrator must read all system administration documentation to understand which configuration options can introduce the risk of toll fraud, and which configuration options can be activated or deactivated to prevent fraud.

Vertical Communications, Inc. does not warrant that the configuration software is immune from or will prevent unauthorized use of common-carrier telecommunications facilities and services accessed through or connected to the Wave IP 2500 or Wave IP 500 Server chassis. Vertical Communications, Inc. is not responsible for any charges that could result from unauthorized use.

Compliance statements

Federal Communication Commission (FCC) statement

The following statements are provided in accordance with the Federal Communications Commission (FCC) regulations. Please read these statements carefully before installing your system.

FCC Part 15

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by Vertical Communications, Inc. could void your authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Part 68

This equipment complies with Part 68 of the FCC rules. Located on the equipment is a label that contains, among other information, the FCC registration number and Ringer Equivalence Number (REN). If requested, this information must be provided to the telephone company.

The REN is used to determine the quantity of devices which may be connected to the telephone line. Excessive RENs on the telephone line may result in the devices not ringing in response to an incoming call. In most but not all areas, the sum of the RENs should not exceed five (5.0). To be certain of the number of devices that may be connected to the line, as determined by the total RENs, contact the telephone company to determine the maximum REN for the calling area.

This equipment cannot be used on the telephone company-provided coin service. Connection to Party Line Service is subject to State tariffs.

If this equipment causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. If advance notice isn't practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

The telephone company may make changes in its facilities, equipment, operations or procedures that could affect the operation of the equipment. If this happens, the telephone company will provide advance notice in order for you to make the necessary modifications in order to maintain uninterrupted service.

If trouble is experienced with this equipment, please contact your reseller.

If the trouble is causing harm to the telephone network, the telephone company may require you to remove the equipment from the network until the problem is resolved.

It is recommended that the customer install an AC surge arrester in the AC outlet to which this device is connected. This is to avoid damage to the equipment caused by local lightening strikes and other electrical surges.

This equipment is Hearing-Aid Compatible (HAC).

If your facility has specially wired alarm equipment connected to the telephone line, ensure the installation of Vertical equipment does not disable your alarm equipment. If you have questions about what will disable alarm equipment, consult your telephone company or a qualified installer.

Wave Server models

The following table list the FCC registration number and REN for each supported Wave Server model.

Wave Server	FCC registration number	REN
Wave IP 2500	6F-USA-33307-PF-E	0.9
Wave IP 500	6F-JUSA-33307-PF-E	0.9

Embedded processors, expansion cards, and modules

This equipment uses the following Uniform Service Order Code (USOC) jacks and codes:

Model Name	Facility Interface Code	REN or Service Order Code	Jack Type
VWU-8AT-M	02LS2	0.2B	RJ-21X
VWU-8AT-M	02GS2	0.2B	RJ-21X
VW-IS1-C	02LS2	0.2B	RJ-21X
VW5-IS2-C	02LS2	0.2B	RJ-11X
VWU-IT1S-M, VW5-T1-M	04DU9-BN	6.0Y	RJ-48C
VWU-IT1S-M, VW5-T1-M	04DU9-DN	6.0Y	RJ-48C
VWU-IT1S-M, VW5-T1-M	04DU9-1KN	6.0Y	RJ-48C
VWU-IT1S-M, VW5-T1-M	04DU9-1SN	6.0Y	RJ-48C
VWU-IT1S-M, VW5-T1-M	04DU9-1SN (PRI)	6.0Y	RJ-48C
VWU-8X8AU-M	02LS2	0.2B	RJ-21X
VWU-8X8AU-M	02GS2	0.2B	RJ-21X
VWU-8X8AU-M	02RV2-T	AS.2	RJ-21X

Direct Inward Dialing (DID) interfaces

Allowing this equipment to be operated in such a manner as to not provide for proper answer supervision is a violation of Part 68 of the FCC rules.

Proper answer supervision is when:

- The equipment returns answer supervision to the Public Switched Telephone Network (PSTN) when Direct Inward Dialing (DID) calls are:
 - Answered by the called station
 - Answered by the attendant
 - Routed to a recorded announcement that can be administered by the Customer Premise Equipment (CPE) user
- The equipment returns answer supervision on all DID calls forwarded to the PSTN. Permissible exceptions are:
 - A call is unanswered
 - A busy tone is received
 - A reorder tone is received

Underwriter's Laboratory (UL) and Canadian Underwriter's Laboratory (CUL)

This equipment complies with UL 60950-1, First Edition and CSA C22.2 No. 60950-1, First Edition. The equipment has been Safety tested and Listed by MET Laboratories, Baltimore, Maryland.

To reduce the risk of fire: use 26 AWG line cords that have been evaluated as Communication Circuit Accessories, UL 1863, for all telephone connections. This statement applies to all cards and modules that connect to telephones or the Public Switched Telephone Network (PSTN).

Industry Canada

This section describes the requirements for end users in accordance with CS-03.

The Industry Canada marking 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 documents. 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 certain situations.

Repairs to 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 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.

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

The Ringer Equivalence Number (REN) for each device (embedded processor, expansion card or module) is listed in the table on page 1-7.

The standard connecting arrangement (telephone jack type) for each device (embedded processor, expansion card or module) is listed in the table on page 1-7.

Chapter 2

Overview of the Wave IP 2500 Chassis and Components

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Fans 2-9

This chapter describes the chassis and hardware components that make up the Wave IP 2500 Server.

Note: See Chapter 18 for similar information about the chassis and hardware components on the Wave IP 500 Server.

System summary

The Wave IP 2500 Server base unit consists of a 19-inch rack-mountable chassis that contains the following:

- Wave Integrated Services Card 1 (ISC1) is an embedded processor that provides primary system control including voice processing and packet switching elements. The ISC1 also includes:
 - 6 SIP Gateway ports
 - 4 analog FXO trunk ports (first four pairs on a shared RJ-21X connector)
 - 4 analog FXS station ports (last four pairs on a shared RJ-21X connector)
 - 2 10/100 Mbps Ethernet ports (ports are mirrored and are not separately addressable)
 - 2 partial-width slots that can accommodate 2 expansion modules
 - 2 full-width universal slots that can accommodate 2 expansion cards or modules
 - 1 USB device port
 - 1 USB host port
 - RJ-21X connector (with embedded FXS and FXO ports)
 - Audio port for an external music-on-hold source
 - 1 port for an external paging system
 - V.34 Fax modem
 - Status LEDs (described in detail in Appendix E)
- Base unit power supply



Minimum configuration

The ISC1 is the minimum requirement for a Wave IP 2500 Server system. Expansion modules and cards are available to expand the Wave IP 2500 Server base unit to support a wide variety of trunk and station configurations.

Redundancy

The Wave IP 2500 Server chassis has been designed to support redundant hard drives. All Wave IP 2500 Servers ship with redundant hard drives as part of the standard configuration.

In case of a primary (master) hard drive failure, you can use the redundant (slave) hard drive to run the Wave IP 2500 Server chassis. See “Hard drive” on page 6-3 for more about the hard drive options on the Wave IP 2500 Server.

Fault monitoring

A proprietary Fault Monitor Module is an integral part of the embedded firmware running on the ISC1, and receives system error-trace messages and stores them in memory. As soon as the Wave Server is powered on, the Fault Monitor Module starts monitoring the status of the Microsoft Windows Server operating system, the power supply status, the ISC1 temperature, and the Power-on/Shutdown button. You can configure the Fault Monitor Module to dial a pager number that notifies the system administrator of system errors.

For more information about the Fault Monitor Module, refer to Appendix A, “Fault Monitor Module and Trace Log.”

To configure the Fault Monitor Module, see the *Wave Global Administrator Guide*.

Adding capacity

As customer needs expand, the Wave IP 2500 Server chassis can be expanded to handle additional users and increased traffic. The chassis has been designed to accept specialized communication cards and modules to provide additional telephone station support, such as analog trunks and T1 lines. Procedures for adding additional cards and modules are described in Chapter 4, “Installing Wave Expansion Cards and Modules.”

Reconfiguring the system

As Wave system capacity is expanded or changed, the software configuration needs to be updated. In most cases, the Wave Global Administrator software autodetects hardware changes and updates the user and system databases automatically. Refer to the *Wave Global Administrator Guide* for more information.

Technical specifications

Physical specifications—Wave IP 2500 Server

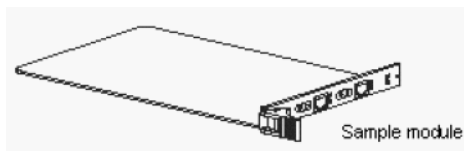
Dimensions:	4.35 inches high x 17.6 inches wide x 17.9 inches deep (2.5U rack height) (11.1 x 44.7 x 45.5 cm)
Weight:	26 lb (11.8 kg)

Cards and modules

Wave systems are custom configured to meet or exceed customer communication requirements. Capacity and features are provided by a combination of specialized communication cards and modules shipped with all of the components required to meet customer configuration requirements.

Cards and modules are field installable.

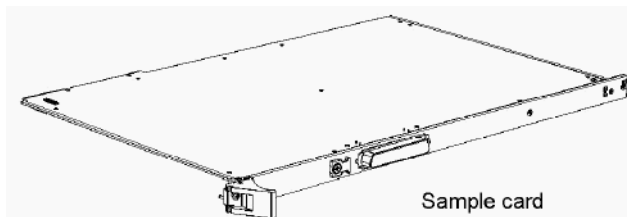
- **Expansion cards and modules.** The Wave IP 2500 Server supports two kinds of expansion boards - modules and cards:
 - **Modules** are partial-width boards that can be installed in module slots or universal slots in the base unit or in Expansion Units (EXUs, described below).



The following modules are available:

- **8-Port Analog Trunk Module (VWU-8AT-M).** Supports 8 analog FXO loop start or ground start trunk ports. See Chapter 13.
- **8+8 Port Analog Universal Module (VWU-8X8AU-M).** Supports either of the following configurations. Where indicated, analog FXO trunks can be loop-start or ground-start, configured individually. See Chapter 14.
 - 8 analog FXS station ports and 8 analog FXO trunks.
 - 8 DID trunks and 8 analog FXO trunks.
- **12-Port Digital Station Module (VWU-12DS-M).** Supports 12 digital station ports. See Chapter 8.
- **12-Port Digital Station Module (VWU-12DS2-M).** Supports 12 digital station ports for Edge or Vodavi phones. See Chapter 17.
- **24-Port Digital Station Module (VWU-24DS2-M).** Supports 24 digital station ports for Edge or Vodavi phones. See Chapter 17.
- **1-Port T1/PRI Module with Serial Interface (VWU-1T1S-M).** Supports a single T1 (PRI or CAS signaling) digital trunk. It features an integrated CSU/DSU, and allows shared data and voice services over a single T1 circuit. See Chapter 15.
- **1-Port T1/PRI Module (VW5-T1-M).** Supports a single T1 (PRI or CAS signaling) digital trunk. See Chapter 15.
- **1-Port E1 EuroISDN Module with Serial Interface (VW-1ES1-M).** Supports a single E1 ISDN digital trunk. It features an integrated CSU/DSU, and allows shared data and voice services over a single E1 circuit. See Chapter 15.
- **Quad BRI Module (VW5-4BRI-M).** Supports 4 BRI interfaces. See Chapter 16.

- **Cards** are full-width boards that support higher port densities than modules. Cards can be installed in the universal slots in the base unit or in EXUs.



The following cards are available:

- **24-Port Analog Station Card (VW-24AS-C)**. Supports 24 analog FXS station ports See Chapter 9.
- **24-Port Digital Station Card (VW-24DS-C)**. Supports 24 digital station ports. See Chapter 8.
- **48-Port Digital Station Card (VW-48DS2-C)**. Supports 48 digital station ports. See Chapter 17.
- **Expansion Units (EXUs)**. Up to 4 modular EXUs can be mounted on top of the Wave IP 2500 Server base unit. Each EXU provides 2 universal slots that can each support one module or card. A fully expanded system with 4 EXUs provides 8 additional universal slots See Chapter 5.



Wave with one EXU being installed

- **Media Resource Module (MRM).** You can upgrade the voice processing resources (or DSPs) on the ISC1 by installing one of 3 available MRM models that support up to 128, 256, or 384 additional voice processing channels. Only one MRM at a time can be installed on the ISC1. See Chapter 7.

Status indicators

Each Wave communications card or module (except for the system card) contains at least two light-emitting diodes (LEDs) indicating status. Other cards and modules contain additional indicators to signify their status in the system. The ISC1 has an additional 4 status LEDs that are explained in Appendix E.

Card and module status indicators are located on the right side of each faceplate. The indicator on the top is a green LED. The indicator on the bottom is a red LED. The combined states of the LEDs and their meanings are shown in Table 2-1.

Table 2-1 Status indicators—Wave IP 2500 Server

Ready LED (Green)	Error LED (Red)	Status
ON	OFF	The card or module is operational.
OFF	ON	Initial state when power is turned on. Software on host or card or module has not yet initialized. If the board remains in this state after the Wave system has fully powered up, the card or module is receiving power, but there is an initialization problem.*
ON	ON	Software is initializing. If the card or module remains in this state after the Wave system has fully powered up, it has failed initialization.*
OFF	OFF	There is no power. If the card or module is correctly plugged into the chassis and the power to the chassis is on, lack of lights on the card or module indicates a fatal error, and the card or module should be replaced.

* See “Card and module troubleshooting” on page E-10 for possible solutions.

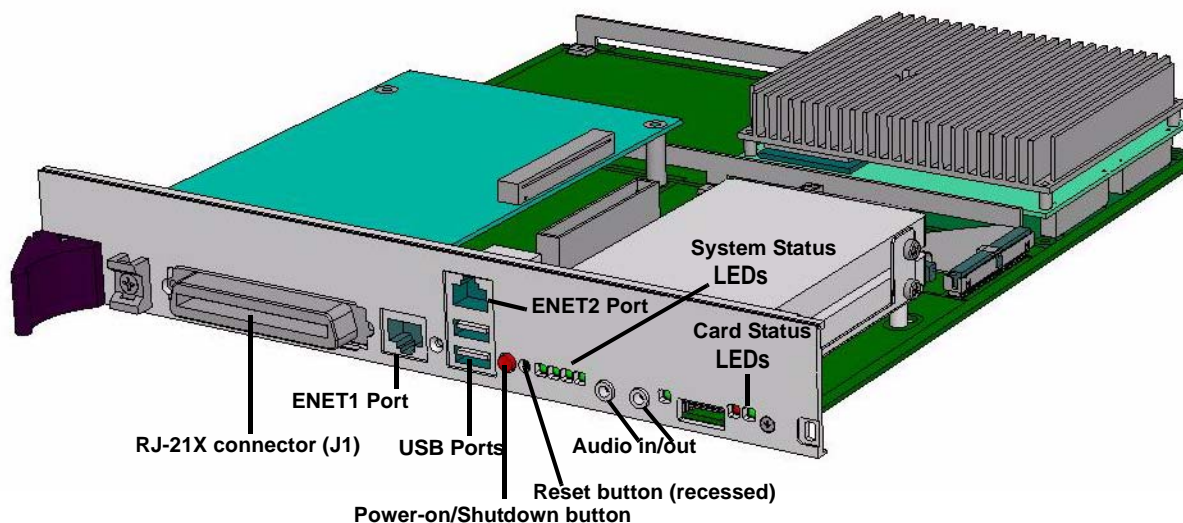
Backplane

The Wave IP 2500 Server backplane is a proprietary component that provides electrical and communication connectivity to Wave cards and modules. The backplane is mounted inside the chassis.

The power supply provides power to the backplane. The backplane provides power and signal connections to the rest of the system.

The Backplane Terminator Board is a field-replaceable unit. See page 6-6 for more information.

System ports on the ISC1



Power supply

The Wave IP 2500 Server chassis is equipped with one power supply.

If a power failure occurs, an optional Uninterruptable Power Supply (UPS) can provide several minutes of system power, allowing a technician to properly shut down the Wave Server. Wave can also integrate with 3rd-party UPS software to provide graceful shutdown of the system via network or USB signalling.

A UPS is not provided by Vertical, but can be purchased from a third-party source. For information about recommended UPS specifications, refer to Appendix C, “Uninterruptible Power Supply Specifications.”

Fans

The two Wave IP 2500 Server fans are located at the back of the chassis. Fan performance is monitored by the Fault Monitor Module, located on the ISC1. The whole power supply tray is replaced when a fan fails.

Powering On and Shutting Down

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Theory of operation 3-2

Safety guidelines for servicing the Wave Server 3-3

Local power-on/shutdown 3-4

Remote restart 3-6

Reset button. 3-7

This chapter describes the power supply, the activities that you can perform while the chassis is still receiving power, and those activities that you can perform only after the chassis is completely without power. It also lists the safety precautions to take when working around the chassis, and procedures for powering the chassis on or off.

Theory of operation

The Wave Server chassis has been designed with a single power supply. If the power supply becomes nonoperational, the entire chassis will cease to operate, and all voice and data calls will be terminated.

The power supply can become nonoperational due to an internal component failure, if the power supply switch is turned to the Off position or if external power is removed either by unplugging the power cord or turning off external power.

Activities allowed when power is on

The following activities are allowed when the power is on:

- Plugging in additional cables to the digital station card, analog station card, analog DID trunk module, analog trunk module, analog universal module, and T1/E1 modules for ports that have already been configured

Caution: Do not install or replace cards or modules while the Wave Server is powered on.

For information about replacing a nonoperational power supply, refer to Chapter 6, “Field Replaceable Units (Wave IP 2500 only).”

Activities allowed only when power is off

The following activities are allowed only when the power is off:

- Installation or replacement of cards and modules
- Installation of an EXU
- Upgrade or replacement of system card components, such as the battery, VAM, hard drives, and MRM
- Installation or replacement of the power supply tray
- Installation or replacement of a hard drive

For information about installing or replacing cards and modules, refer to Chapter 4, “Installing Wave Expansion Cards and Modules.”

For information about replacing the power supply or hard drive(s), refer to Chapter 6, “Field Replaceable Units (Wave IP 2500 only).”

Safety guidelines for servicing the Wave Server

Follow these safety guidelines to help ensure personal safety to any person working on or around the Wave Server chassis, to avoid possible disruption in service to Wave users, and to prevent potential damage to the chassis, cables, and other hardware components.

- Ensure that nothing rests on the cables and that the cables are located where they cannot be stepped on.
- Do not place any food or drink on the chassis.
- Do not push any objects into the slots or other openings.
- Use correct tools and antistatic grounding devices.
- Never touch bare conductors of cables that connect to the RJ-21X connectors (located on the ISC1, digital station card, analog station card, analog DID trunk module, analog trunk module, and analog universal module).
- Do not touch water while working on or near the chassis.
- Ensure adequate lighting while working on or near the chassis.
- Make sure the chassis is located away from radiators and heat and water sources.
- Do not block the cooling vents on the chassis.
- Set the chassis on an antistatic mat. Do not put the chassis on a rug, carpeting, or any fabric-covered surface.
- Make sure that the chassis is mounted at least two feet above the floor.

Local power-on/shutdown

The Wave Server chassis can be powered on and off locally using the Power rocker switch located on the back of the chassis (refer to Figure 3-2).

Local system shutdown

The Shutdown button is the red button located on the front of the ISC1/ISC2, as shown in Figure 3-1 and Figure 18-1.

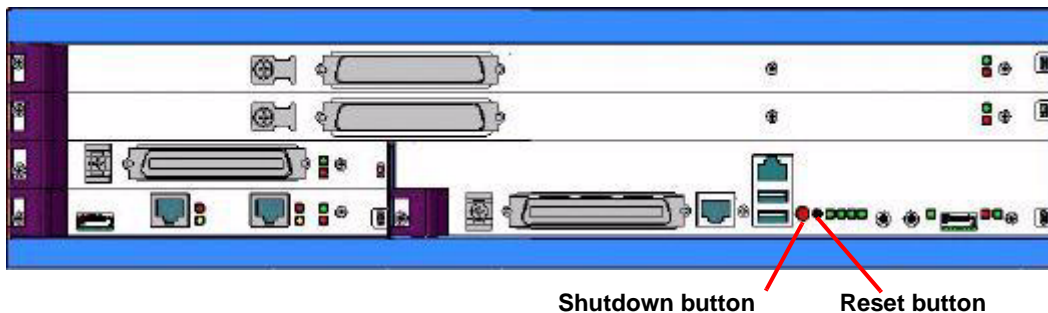


Figure 3-1 Shutdown and Reset buttons

When the Shutdown button is pressed and held for at least 4 seconds, the system automatically performs the following tasks:

- Terminates all telephony and data connections
- Shuts down the Wave system, allowing data to be saved first
- Turns off power to the power supply in the chassis

Caution: You must shut the system down properly to avoid losing data.

To shut down and power off the Wave Server chassis:

1. Schedule a time when you can power off the Wave Server chassis, and inform all users of this time.

Alert users to the scheduled down time to prevent work loss and inconvenience to users.

2. Press the Shutdown/Power Off button on the ISC1/ISC2, as shown in Figure 3-1 and Figure 18-1, and hold for four seconds, then release.

The third status LED, flashing red-green, indicates that shutdown is in progress.

3. Verify that the power has been turned off by noting the unlit LEDs.

The shutdown process takes approximately two minutes.

4. Turn off the power to the Wave Server chassis and unplug the power cable from the power supply, as shown in Figure 3-2 (similar positioning on the Wave IP 500).

Caution: Cards and modules are not hot-swappable. You must shut down the system and turn off the power to the Wave Server chassis before removing any cards or modules to avoid possible damage to yourself, the chassis, or the cards and modules.

Warning: Severe injury to yourself as well as damage to the equipment can result if work is performed on a system that is still powered on and plugged in. Make sure the power switch is in the OFF position and the cable is unplugged from the power supply.

Caution: The chassis will no longer be grounded when the power cord is disconnected, unless the chassis is grounded using the exterior ground lug. The exterior ground lug should always be properly connected. Refer to the *Wave Server Installation Guide* for information about how to connect the ground lug.

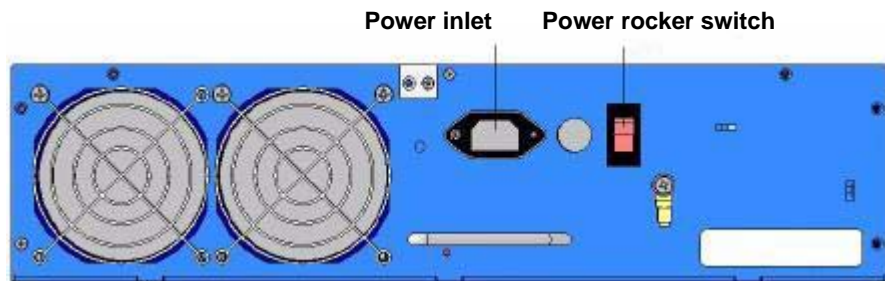


Figure 3-2 The Power inlet and Power rocker switch

5. Discharge static electricity from your body by touching an unpainted metal surface and by wearing an antistatic wrist strap.

To ground yourself, clip the strap to a grounded rack or other grounded surface. Once you are grounded, you can proceed with installing, replacing, or upgrading the cards, modules, or other chassis components.

Local system power-on

You can only reapply power to the system once all cards, modules, or other components have been properly installed, as described in Chapter 4, “Installing Wave Expansion Cards and Modules” and Chapter 6, “Field Replaceable Units (Wave IP 2500 only).”

1. Make sure that the Power rocker switch is in the OFF position.
2. Connect the power cord.
3. Turn the Power rocker switch to the ON position.
4. Verify that all cards and modules are operational by noting the status of the LEDs, as described in “Status indicators” on page E-7.

Remote restart

Refer to the *Wave Global Administrator Guide* for instructions on how to restart the Wave Server remotely via the Global Administrator Management Console to perform an orderly shutdown and restart.

Note: When shutting down and restarting the system by this method, the power supply is not switched off.

Reset button

The Reset button is used to restart the system if the system software is not responding. When the Reset button is pressed, the system automatically performs the following tasks:

- Restarts the Wave system
- Terminates all telephony and data connections

Caution: Do not press the Reset button unless the Shutdown button does not shut down the system. Pressing the Reset button can result in a loss of data.

Note: The Reset button is recessed and must be activated with a pen tip or other small tool.

The Reset button, as shown in Figure 3-1 and Figure 18-1, is located on the front of the Wave Server chassis.

Installing Wave Expansion Cards and Modules

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Removing a card or module	4-3
Installing a card or module	4-4
Cable connections	4-5
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Card and module troubleshooting	4-10

This chapter describes how to remove and install Wave expansion cards and modules. See the individual card and module chapters for additional information.

Warning: Only an authorized service representative trained on the Wave system may perform the procedures described in this chapter.

Warning: Before performing any of the procedures described in this chapter, be sure to read and follow all guidelines in “Safety guidelines for servicing the Wave Server” on page 3.

Required tools

You will need the following tools for the procedures described in this chapter:

- #1 Phillips screwdriver
- Antistatic wrist strap
- Antistatic mat

Identifying cards and modules

When describing Wave components, the large printed circuit boards are called *cards*, and the smaller printed circuit boards are called *modules*. An example of a card and a module is shown in Figure 4-1.

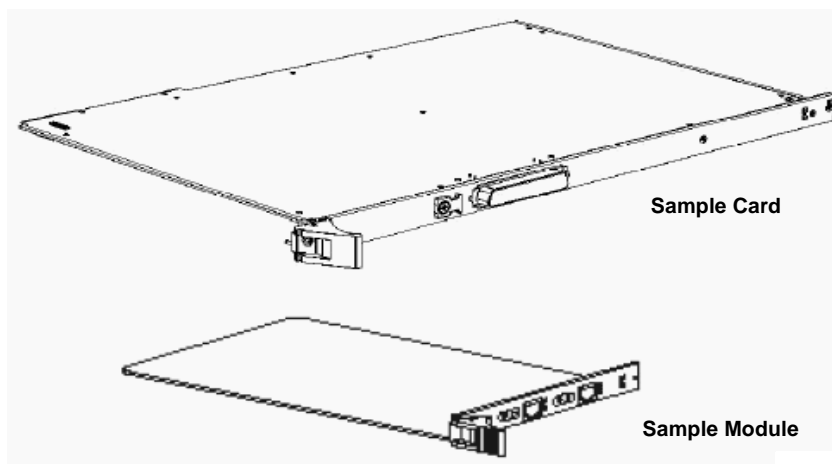


Figure 4-1 Wave card and module

You can install additional cards or modules in the Wave Server chassis to increase capacity or to provide new features as long as there are slots available, and the new configuration does not exceed the maximum allowed configuration limits.

Each chassis may contain a variety of card/module combinations. In addition, cards and modules can be replaced, and additional cards and modules can be added. Removing and installing cards and modules can be performed at the client site.

Note: When replacing a card or a module, install the replacement in the same slot where the original card or module resided to avoid having to reconfigure the new card or module.

Caution: Place all cards and modules on an antistatic surface prior to their installation in or after their removal from the Wave Server chassis to avoid possible damage from static electricity. Use a grounded wrist strap to prevent electrostatic discharge (ESD) damage when handling cards and modules.

Removing a card or module

You may need to remove a card or a module if it is nonoperational or if you are reconfiguring your system.

Warning: Even low voltages can cause injury or shock. Remove all cables connected to the module or card and avoid touching any exposed connectors.

Caution: Shut down the system and remove all the power cables before proceeding.

To remove a card or a module from the Wave Server chassis

1. Disconnect any cables attached to the card or module you are replacing by removing the cable connector or modular plug.

Do not pull on any cable. Doing so can weaken or damage the electrical connections between the cable and connector pins.

Hint: Make sure all cables are labeled before you remove them to avoid confusion about cable connections.

2. Using a #1 Phillips screwdriver, loosen the retaining screw in the left insertion lever on the left, and on the right side of the faceplate. and the screw mounted directly to the faceplate.

Note: All cards and modules are held to the chassis with two screws.

One of the screws is installed through the insertion lever and must be loosened before the lever can be opened.

3. Open the insertion lever.
4. Pull firmly on the lever until the card or module slides out of the slot.
5. Place the card or module on an antistatic mat.

Caution: Do not touch any electrical components. Touch only the faceplate. This prevents possible damage to the card or module from static electricity.

Installing a card or module

If you are installing a new card or module to add capacity to your Wave system, you must first remove a blank faceplate.

Hint: When replacing a card or a module, install the replacement card or module in the same slot where the original card or module resided to avoid having to reconfigure the new card or module.

To remove a blank faceplate:

1. Verify that the appropriate type of slot is available for the card or module you are installing.
2. Using a #1 Phillips screwdriver, loosen the retaining screws from the right and left of the blank faceplate.
Both retaining screws must be loosened before you can remove the blank faceplate.
3. Pull the blank faceplate out of the chassis.

To install a card or a module in the Wave Server chassis

1. Locate the right-hand side of the card or module to ensure proper installation.
Each Wave card and module has two status LEDs, one green and one red, on the right-hand side of the board.
2. Grasp the insertion lever located on the left of the board and faceplate and position the board so it is aligned with the right and left slot guides of the appropriate slot. Slot guides help you position the board correctly.

- Slide the card or module into the slot until the insertion levers makes contact with the front of the chassis. Firmly press the levers toward the center of the faceplate until the card or module is flush with the other faceplates.

Caution: If the card or module does not insert easily, do not force it. Doing so can damage the equipment. Make sure the board is aligned properly in the slot guides and that you are inserting it in the appropriate slot.

When the insertion lever is flush with the faceplate, the gold edge connectors on the circuit board are firmly seated in the backplane connectors.

- Tighten the retaining screws until snug.

Caution: The screws can be damaged if overtightened.

- If you need to install additional cards or modules, repeat steps 1 through 4.

Hint: When replacing a card or a module, install the replacement card or module in the same slot where the original card or module resided to avoid having to reconfigure the new card or module.

If you want to verify that the card or module is installed correctly and is working, refer to “Installation verification” on page E-9.

Cable connections

Wave cards and modules use standard cable connectors and jacks, as shown in Table 4-1.

Table 4-1 Type and number of connectors

Card or Module	RJ-11	RJ-21X	RJ-45	RJ-48C	3.5 mm Audio	USB
ISC1 (VW-IS1-C or VW-IS1HDD-C)		1	2		2	2
ISC2	4		1		2	3
24-Port Digital Station Card (IO-24DS-C)		1				
48-Port Digital Station Card (VW-48DS2-C)		1				
12-Port Digital Station Module (VW-12DS-M)		1				
-and- 12-Port Digital Station Module (VW5-12DS-M)						

Table 4-1 Type and number of connectors

Card or Module	RJ-11	RJ-21X	RJ-45	RJ-48C	3.5 mm Audio	USB
24-port Digital Station Module (VWU-24DS2-M)		1				
24-Port Analog Station Card (IO-24AS-C)		1				
8-Port Analog Trunk Module (VWU-8AT-M)		1				
8+8 Port Analog Universal Module (VWU-8X8AU-M)		1				
1-Port T1/PRI Module with Serial Interface (VWU-1T1S-M)				1		
1-Port E1 EuroISDN Module with Serial Interface (VW-1ES1-M)				1		
-and-						
1-Port E1 EuroISDN Module with Serial Interface (VW5-1ES1-M)						
1-Port T1/PRI Module (VW5-T1-M)				1		
Quad BRI Module (VW5-4BRI-M)			4			

Connecting cables

Refer to later chapters in this guide for detailed information about the connectors used on a particular card or module.

To connect cables to Wave IP 2500 cards or modules

1. Connect the cable(s) to the connector(s). A cable can be a 180° cable where the cable comes straight out the back of the connector, as shown in Figure 4-2. A cable can also be a 90° cable where the cable comes out of the side of the connector and makes a 90° turn as shown in Figure 4-3. The 180° version can be attached to the board in one of two methods - by bale clips that are on the board to a slot on the cable housing or by screws. The 90° version can be attached on one side with a screw, but the other side can't be secured with either a bale clip or a screw. On that side, use a tie down on the board to secure the cable to the board with a tie wrap.

Note the following:

- If screws are used to attach a 90° or 180° cable with Amphenol Connector to the board, ensure the screws are ¾-inch 4-40 captive (partially threaded) pan head screws.
 - Some modular connectors look alike. Verify that your cables use standard connectors specified for a particular card or module.
2. Make sure the cables are securely connected. The tabs on modular connectors click in when the cables are secure. Secure the cable to an RJ-21X connector with the cable strap.

The following figures illustrate the two methods of connecting a cable to an RJ-21X connector.

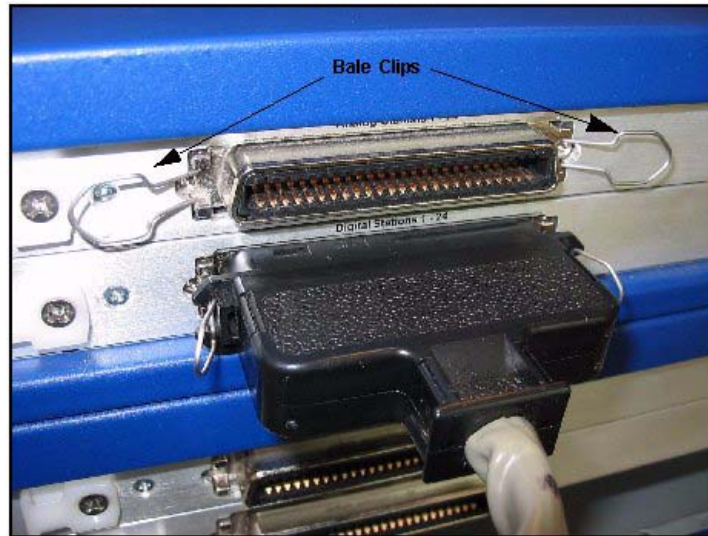


Figure 4-2 Connecting a cable to an RJ-21X connector—180° method.



Figure 4-3 Connecting a cable to an RJ-21X connector—90° method

Installation verification

Once all of the cards and modules have been installed, verify that they are operational.

To verify that the cards or modules are operational

1. Make sure the power switch is in the OFF position before turning it ON. (After an automatic shut down, it may have been left in the ON position even though the power is OFF.)

The power switch is located on the back panel of the chassis.

2. Reconnect the power cable to the Wave Server chassis.

Be sure to plug the power cable into a properly grounded receptacle.

3. Observe the status indicators located on the right front of the card or module.

The LEDs light in conjunction with software initialization. Refer to “Status indicators” on page E-7 to interpret the different combinations of lit LEDs.

4. Verify that the green LED on each card and module is lit and that the green LED on the ISC1 is blinking. The red LED on all cards and modules should be off. These states indicate that the card or module initialized properly and is operational.

Note: It takes several minutes for initialization to complete.

If you see any other combination of lights, refer to “Card and module troubleshooting” on page E-10 for assistance.

Reconfiguring the Wave system

You must update the configuration whenever you perform the following tasks:

- Add a new card or a module
- Remove a card or a module
- Change the configuration of a card or a module

Refer to the *Wave Global Administrator Guide* for additional information about configuration options.

Card and module troubleshooting

This section contains general troubleshooting information. Refer to later chapters in this guide for additional information about a specific card or module.

Card or module does not slide in properly

Possible reasons why a card or a module does not slide in properly:

- The card or module is not aligned in both the right-hand and left-hand slot guides. Remove the card or module and realign in the slot guides, then insert it into the slot again.
- The card or module may be inserted upside down. Remove the card or module, then reinstall it with the green and red LEDs on the right-hand side of the card or module.

LEDs do not light correctly

If the LEDs do not light, check the following

- Make sure the power supply ON/OFF switch is on and the power cable is connected.

If the power is on, the initialization process did not complete properly.

Follow the power-on instructions in “Local power-on/shutdown” on page E-4.

- If there is one card or module which has LEDs that do not light, and you need to run the Wave system immediately, disable the card or module. Refer to the *Wave Global Administrator Guide* or the *Wave Global Administrator Help* system for information about how to disable a card or a module.
- Swap the card or module. Refer to “Removing a card or module” on page E-3, and “Installing a card or module” on page E-4, for instructions.

If the red and green LEDs are both on, check the following

- The initialization process did not complete properly. Follow the power-on instructions in “Local power-on/shutdown” on page E-4.
- Swap the card or module. Refer to “Removing a card or module” on page E-3 and “Installing a card or module” on page E-4, for instructions.

Expansion Units (Wave IP 2500 only)

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This chapter describes Expansion Units that are supported only on the Wave IP 2500 Server.

Functional description

Expansion Units (EXUs) - Up to 4 modular EXUs (VW-IP2500EXU) can be mounted on top of the Wave IP 2500 base unit. Each EXU provides 2 universal slots that can each support one module or card. A fully expanded system with 4 EXUs provides 8 additional universal slots.

The EXU has its own power supply (VW-IP2500EXUPS). To use a module in a universal slot of an EXU requires the use of a Module Conversion Kit (VW-IP2500-CONV).

Physical description



Figure 5-1 Wave IP 2500 base unit with one EXU

Ports

Ports are based on the installed cards/modules. Each EXU has an AC power input, fuse, and power on/off switch.

Connecting EXUs

Each EXU has a connector which connects to the Wave Server base unit or to another EXU mounted below. Each EXU also has a connector which connects to another EXU mounted above or to the backplane terminator board if it is the top EXU.

You use the 3 plastic connector clips on each EXU (one located on the center back, and one on each side near the front) and the receivers for the connector clips of an EXU mounted above (located above each set of connector clips) to secure each EXU to the EXU or base unit mounted below it.

Indicators

Indicators are based on the installed cards/modules. EXU power supply and fan status is sent to the ISC1.

Technical specifications

Physical specifications

Dimensions:	2.6 inches high x 17.6 wide x 17.9 inches deep (1.5U rack height) (6.4 x 44.7 x 45.5 cm)
Weight:	19 lb (8.6 kg)

Cable connections

110V AC input power. Other cable requirements are based on the installed cards/modules.

Field Replaceable Units (Wave IP 2500 only)

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Vertical Application Module 6-5

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This chapter describes how to install and replace major chassis components of the Wave Server.

Caution: Only an authorized service representative trained on the Wave Server chassis may perform the procedures described in this chapter.

Required tools

You will need the following tools to remove or install a Wave Server chassis component:

- #1 and #2 Phillips screwdrivers for component screws
- Antistatic wrist strap
- Antistatic mat

Preparation

Follow these instructions before installing or replacing chassis components.

Warning: Severe injury to yourself as well as damage to the equipment can result if work is performed on a system that is still powered on and plugged in. Make sure the power switch is in the OFF position and the cable is unplugged from the power supply.

- Observe all safety rules as described in “Safety guidelines for servicing the Wave Server” on page 3.
- Shut down the system according to the directions in “Local system shutdown” on page E-4.

Power supply

The Wave system contains one power supply assembly (VW-IP2500MPS) that supplies power to the backplane of the Main Chassis. The backplane supplies power to all other Wave components. Each cabinet has its own power supply that will supply power to all Wave components associated with that cabinet.

To replace the power supply:

1. Turn the system power off by pressing the Shutdown button on the ISC1 and holding for four seconds.

Refer to “Local system shutdown” on page E-4 for detailed instructions on how to power off the system.

2. After the shutdown procedure is complete, turn off the power supply (by turning the switch to the off position), and unplug the Wave power cord.

3. Remove the ground wire.
4. Unscrew the seven screws securing the power supply tray to the back of the system.
5. Pull the handle on the power supply tray straight back to remove the tray.
6. Place the power supply tray on an antistatic mat.
7. Slide the new power supply tray into the system. The tray is fully seated when there is no gap between the rear panel and the chassis.
8. Secure the power supply tray by installing the seven screws removed earlier.
9. Reconnect the ground wire.
10. Plug in the power cord.
Make sure that the power source is turned off before plugging in the power cord.
11. Press the power supply ON/OFF switch to the ON position.

Hard drive

The hard drive stores all of the software required by Wave, including:

- Microsoft Windows Server 2003 operating system
- Network and telephony configuration and routing applications
- PBX and voice mail applications
- Wave online Help

A maximum of two hard drives can be installed in each Wave Server chassis, enabling you to configure RAID-1 redundancy between the hard drives.

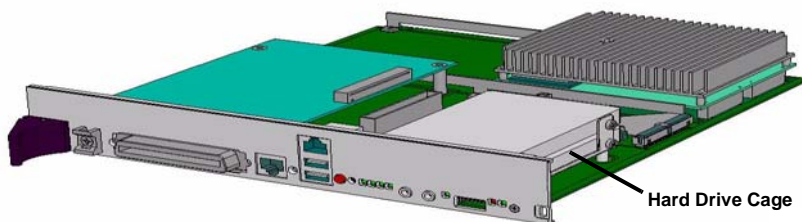
- VW-IS1HDD-C is an IP 2500 ISC1 with dual HDD.
- VW-IP2500HDD is a single hard drive that can be used in an ISC1 (VW-IS1-C) that does not have a hard drive or in an ISC1 (VW-IS1HDD-C) that needs to have a drive replaced. A dual hard drive assembly (VW-IP2500-2HDDA) with the mounting bracket can be ordered if necessary.

RAID-1 Redundancy

RAID-1 (Redundant Array of Independent Disks Level 1) signifies that there are two disks with exactly the same attributes. One is a master, the other is a slave, or backup disk. All data is redundantly and dynamically recorded on or deleted from each disk simultaneously to provide data security.

Refer to the *Wave Global Administrator Guide* for instructions on configuring hard drives for RAID-1 redundancy.

Note: The master hard drive occupies the bottom position in the hard drive cage on the system card. The master hard drive occupies the space at the rear of the Mainboard when the board is installed in the Wave IP 2500 Server chassis.



To remove a hard drive:

1. Turn the system power off by pressing the Shutdown button on the ISC1 and holding for four seconds.

Refer to “Local system shutdown” on page E-4 for detailed instructions on how to power off the system.

2. After the shutdown procedure is complete, turn the power switch to the off position and unplug the Wave power cord.
3. Remove the ISC1.

Refer to “Removing a card or module” on page E-3 for detailed instructions.

4. Loosen the four hard drive cage screws on the bottom of the ISC1 and remove the cage.

5. Disconnect the cable.
6. Locate the hard drive to be removed, loosen the screws on the sides of the drive, and slide the drive out of the cage. It may be helpful to slightly loosen the screws on the side of the drive that is not being removed to allow the other drive to slide out easily.
7. Place the hard drive on an antistatic mat.

To install a hard drive:

1. Remove the system card if it is not already removed.
2. Insert the screws into the hard drive, then attach the hard drive to the hard drive cage. Tighten the screws.
3. Attach the cable to the hard drive.

Caution: If you need to replace a hard drive on an ISC1 with an IDE drive, use extreme care—the ribbon cable must be perfectly lined up to the hard drive. If you are off by one pin, your ISC1 board will become inoperable.

4. Secure the hard drive cage to the system card.
5. Insert the system card into the system.
6. Tighten the two retaining screws.
7. Connect the power cord to the power supply and turn on the system.

Refer to “Local system power-on” on page E-6 for instructions on how to connect the power cord and power on the system.

Media Resource Module

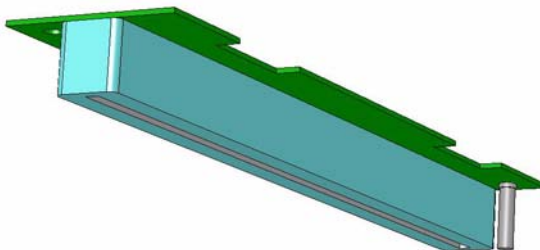
See Chapter 7 for details on the Media Resource Module (MRM).

Vertical Application Module

See Chapter 10 for details on the Vertical Application Module (VAM).

Backplane Terminator Board

The Backplane Terminator Board is a small printed circuit board that conditions the signals on the backplane for reliable operation. It plugs into the top-most chassis of a Wave IP 2500 Server. If EXUs are added, the Backplane Terminator Board must be moved from its current chassis to the top-most EXU in the stack. This board is keyed, so it cannot be installed backwards.



To remove a Backplane Terminator Board:

1. Properly shut down the system.
2. Turn the power supply off.
3. Remove the two screws and metal hatch cover from the top cover of the top-most chassis.
4. Carefully lift up on the Backplane Terminator Board using the cut-outs to grab it with your fingers.
5. Either install a replacement Backplane Terminator Board, or another EXU and then the Backplane Terminator Board, and then replace the hatch cover and screws.

Caution: The hatch cover from the Wave IP 2500 chassis has a strip of insulation material that prevents the pins on the Backplane Terminator Board from shorting out on the metal hatch cover. Make sure that this hatch cover has the strip and is the cover that you replace on the topmost EXU.

6. Reapply power to the system.

To install a Backplane Terminator Board:

1. Properly shut down the system.
2. Turn the power supply off.
3. Remove the two screws and metal hatch cover from the top cover of the top-most chassis.
4. Align the connector of the Backplane Terminator Board over the end of the backplane. Make sure that it is aligned so that the key will allow the board to be seated all the way down.
5. Press firmly on the Backplane Terminator Board so it seats all the way onto the backplane.
6. Replace the hatch cover and screws.

Media Resource Module

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This chapter describes the Media Resource Module (MRM).

Functional description

Each Wave IP 2500 or Wave IP 500 Server is pre-configured to support a specific number of users and concurrent voice applications. Media Resource Modules (MRMs) enable you to expand the system's core telephony, voice processing, and VoIP capabilities.

As additional communications capacity is required, one of the following MRMs can be added. Only one MRM at a time can be installed on the ISC1/ISC2.

For all Wave Server models:

- **Media Resource Module A**—Provides up to 128 additional voice processing channels (VW-MRMA). Supported on both Wave IP 2500 and Wave IP 500 Server.

For the Wave IP 2500 Server only:

- **Media Resource Module B**—Provides up to 256 additional voice processing channels (VW-MRMB). Supported on the Wave IP 2500 Server only.

For the Wave IP 500 Server only:

- **Media Resource Module C**—Provides up to 384 additional voice processing channels (VW-MRMC). Supported on the Wave IP 2500 Server only.

Note: You must have at least one MRM if you plan to use QoS with IP resources for VoIP calls.

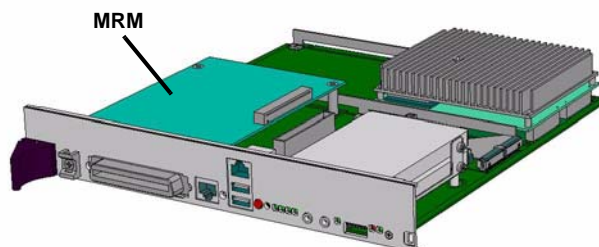
Usable channels

Expansion MRM channels are in addition to the base MRM capacity pre-integrated on the Integrated Services Card.

Since different services (IVR, Conferencing, VoIP Gateway, Fax, and so forth) consume different levels of resource (even if it is one voice processing channel), the actual number of usable channels is dependent on the types of services running on the MRM.

Physical description

The MRM is a mezzanine-style daughter board containing additional media services. These services include FAX, Tone Generation, Tone Detection, Caller ID Generation, Call ID Detection, VOIP Codecs, Media Channels, and conference ports.



To install an MRM on a Wave IP 2500 Server

1. Secure the MRM to the ISC1 by installing the screws from the bottom of the ISC1 into the MRM standoffs.
2. Connect the MRM cable to the ISC1.
3. Install the ISC1 in the Wave IP 2500 Server chassis.
4. Turn on the system.

To remove an MRM from a Wave IP 2500 Server

1. Turn off the system.
2. Remove the ISC1.
3. Remove the four screws from the bottom of the ISC1 that secure the MRM.
4. Disconnect the MRM cable from the ISC1 and place on antistatic mat.

To install an MRM A in a Wave IP 500 Server

1. Remove the top of the Wave IP 500 Server chassis.
2. Install the MRMA to the ISC2 while the ISC2 is still installed in the chassis.

To remove an MRM A from a Wave IP 500 Server

1. Turn off the system.
2. Remove the top of the Wave IP 500 Server chassis.
3. Remove the MRMA from the ISC2 while the ISC2 is still installed in the chassis.

12-Port Digital Station Module and 24-Port Digital Station Card (for Edge 100/Comdial Phones)

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This chapter describes the following expansion cards and modules:

For all Wave Server models:

- 12-Port Digital Station Module (VWU-12DS-M). This module includes two faceplates, one for the Wave IP 500 Server (screw-in faceplate) and one for the Wave IP 2500 Server (faceplate with a locking lever).

For the Wave IP 2500 Server only:

- 24-Port Digital Station Card (VW-24DS-C) for Edge 100 or Comdial phone support

Functional description

Up to two digital station cards can be installed in each Wave Server chassis. A fully loaded Wave Server with two 24-Port Digital Station Cards and two 12-Port Digital Station Modules can support 72 digital stations. This 72 digital station configuration would leave no space for trunk cards, but is a reasonable configuration if you are relying on SIP trunking.

Physical description

The digital station card consists of a printed circuit board and a metal faceplate mounted to the front of the board, as shown in Figure 8-1. The insertion levers on the faceplate facilitate insertion and removal of the card. Each digital station card occupies a single chassis slot.

The digital station card is powered through its connection to the Vertical backplane. The RJ-21X connector on the front of the card connects to a standard RJ-21X cable that typically terminates to a punchdown block.

Warning: When the system power is on, high voltages may be present on the digital station card and may be present on the RJ-21X connector. To prevent exposure to these high voltages, hold the card by the insertion levers.

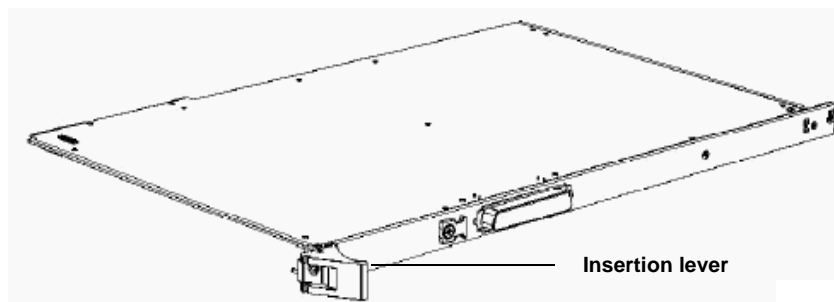


Figure 8-1 Digital station card

Ports

Digital telephone ports on the 24-Port Digital Station Card provide dial tone and telephone service for up to 24 digital telephones.

Digital telephone ports on the 12-Port Digital Station Module provides dial tone and telephone service for up to 12 digital telephones.

Indicators

The digital station card contains two status indicators (a green LED and a red LED), as shown in Figure 8-2.

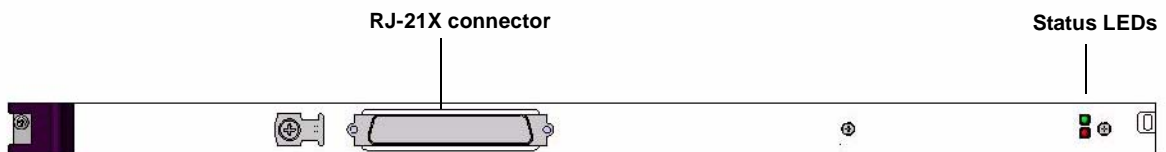


Figure 8-2 Digital station card indicators and RJ-21X connector

The indicator on the top is a green LED. The indicator on the bottom is a red LED. The digital station card is operational when the green LED lights steadily after the system has fully initialized.

For more information, refer to “Status indicators” on page E-7.

Technical specifications

General specifications

Emissions:	FCC Part 15 Class A (EMI)
Electrical safety and protection:	FCC Part 68 (network compatibility) UL 60950-1

Physical specifications

Dimensions:	16.2 x 10.9 x 0.8 in (41.0972 x 27.686 x 1.905 cm)
Weight:	1 lb (0.454 kg)

Electrical specifications

Power consumption:	
24-port card	3.3V @ 0.5A 5V @ 1A
12-port module	3.3V @ 0.5A 5V @ 0.5A
Voltage, Ring to Tip:	36 Vdc (typical)

Telephone compatibility

Type:	Vertical Communications digital telephone
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Telephony port specifications

Port connector type:	RJ-21X Amphenol-type connector
Cable type:	Category 3 or Category 5 (recommended)
Maximum cable run:	1000 ft (304 m)

RJ-21X port specifications for 24-Port Digital Station Card

Port connector type: RJ-21X	Port numbers:	Corresponding pin pairs:	
Digital station designations:	Port 1	Pin 1 - Ring 1	Pin 26 - Tip 1
	Port 2	Pin 2 - Ring 2	Pin 27 - Tip 2
	Port 3	Pin 3 - Ring 3	Pin 28 - Tip 3
	Port 4	Pin 4 - Ring 4	Pin 29 - Tip 4
	Port 5	Pin 5 - Ring 5	Pin 30 - Tip 5
	Port 6	Pin 6 - Ring 6	Pin 31 - Tip 6
	Port 7	Pin 7 - Ring 7	Pin 32 - Tip 7
	Port 8	Pin 8 - Ring 8	Pin 33 - Tip 8
	Port 9	Pin 9 - Ring 9	Pin 34 - Tip 9
	Port 10	Pin 10 - Ring 10	Pin 35 - Tip 10
	Port 11	Pin 11 - Ring 11	Pin 36 - Tip 11
	Port 12	Pin 12 - Ring 12	Pin 37 - Tip 12
	Port 13	Pin 13 - Ring 13	Pin 38 - Tip 13
	Port 14	Pin 14 - Ring 14	Pin 39 - Tip 14
	Port 15	Pin 15 - Ring 15	Pin 40 - Tip 15
	Port 16	Pin 16 - Ring 16	Pin 41 - Tip 16
	Port 17	Pin 17 - Ring 17	Pin 42 - Tip 17
	Port 18	Pin 18 - Ring 18	Pin 43 - Tip 18
	Port 19	Pin 19 - Ring 19	Pin 44 - Tip 19
	Port 20	Pin 20 - Ring 20	Pin 45 - Tip 20
	Port 21	Pin 21 - Ring 21	Pin 46 - Tip 21
	Port 22	Pin 22 - Ring 22	Pin 47 - Tip 22
	Port 23	Pin 23 - Ring 23	Pin 48 - Tip 23
	Port 24	Pin 24 - Ring 24	Pin 49 - Tip 24
		Pin 25 - Ground	Pin 50 - Ground

RJ-21X port specifications for 12-Port Digital Station Module

Port connector type:	Port numbers:	Corresponding pin pairs:	
RJ-21X			
Digital station designations	Port 1	Pin 1 - Ring 1	Pin 26 - Tip 1
	Port 2	Pin 2 - Ring 2	Pin 27 - Tip 2
	Port 3	Pin 3 - Ring 3	Pin 28 - Tip 3
	Port 4	Pin 4 - Ring 4	Pin 29 - Tip 4
	Port 5	Pin 5 - Ring 5	Pin 30 - Tip 5
	Port 6	Pin 6 - Ring 6	Pin 31 - Tip 6
	Port 7	Pin 7 - Ring 7	Pin 32 - Tip 7
	Port 8	Pin 8 - Ring 8	Pin 33 - Tip 8
	Port 9	Pin 9 - Ring 9	Pin 34 - Tip 9
	Port 10	Pin 10 - Ring 10	Pin 35 - Tip 10
	Port 11	Pin 11 - Ring 11	Pin 36 - Tip 11
	Port 12	Pin 12 - Ring 12	Pin 37 - Tip 12
	Port 13 - Port 24	Not Used	Not Used
		Pin 25 - Ground	Pin 50 - Ground

Cable connections

One RJ-21X cable plugs into the RJ-21X connector located on the digital station card or digital station module.

Warning: To reduce the risk of fire, use minimum 26 AWG line cords that have been evaluated as Communication Circuit Accessories, UL 1863, for all telephone connections.

24-Port Analog Station Card (Wave IP 2500 only)

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This chapter describes the 24-Port Analog Station Card.

For the Wave IP 500 Server only:

- 24-Port Analog Station Card (VW-24AS-C)

Functional description

The 24-Port Analog Station Card provides telephony connectivity for up to 24 stations, including telephones, fax machines, and modems.

Up to two 24-Port Analog Station Cards can be installed in each Wave Server base chassis. Including the analog station ports on the ISC1, the Wave system can provide service to a maximum of 68 analog stations (telephony devices).

Note: On the Wave IP 2500, you can use Expansion Units (EXUs) to support additional analog trunks and/or stations. See Chapter 5 for more information.

Physical description

The 24-Port Analog Station Card consists of a printed circuit board and a metal faceplate mounted to the front of the board, as shown in Figure 9-1. The insertion lever on the faceplate facilitates the insertion and removal of the card. Each analog station card occupies a single chassis slot.

The analog station card is powered through its connection to the backplane. The RJ-21X port on the front of the card connects to a standard RJ-21X cable that terminates to a punchdown block.

Warning: When the system power is on, high voltages may be present on the analog station card and may be present on the RJ-21X connector.

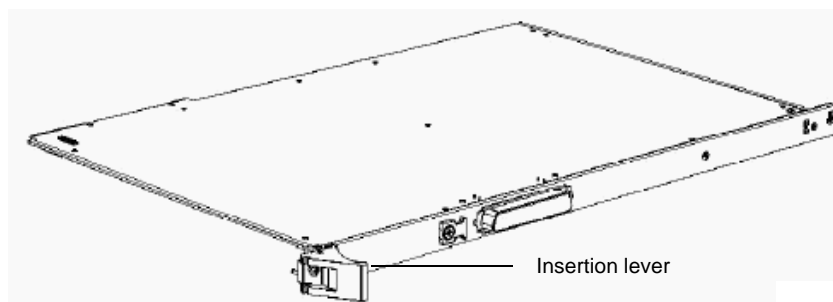


Figure 9-1 Analog station card

Ports

Analog telephone ports on the analog station card provide dial tone and telephone service for up to 24 analog telephony devices, including telephones, fax machines, and modems.

Indicators

The analog station card contains two status indicators (a green LED and a red LED), as shown in Figure 9-2.

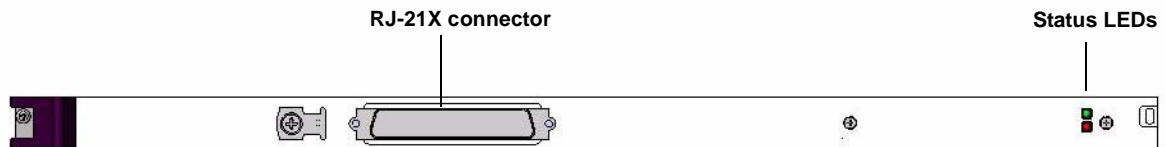


Figure 9-2 Analog station card indicators and RJ-21X connector

The indicator on the top is a green LED. The indicator on the bottom is a red LED. The analog station card is operational when the green LED lights steadily after the system has fully initialized.

For more information, refer to “Status indicators” on page E-7.

Technical specifications

General specifications

Emissions:	FCC Part 15 Class A (EMI)
Electrical safety and protection:	FCC Part 68 UL 60950-1
Compatibility with industry and protocol standards:	EIA/TIA-464B
REN drive (phone port):	3.0B RENs

Physical specifications

Dimensions:	16.2 x 10.9 x 0.8 in (41.0972 x 27.686 x 1.905 cm)
Weight:	1 lb (0.454 kg)

Electrical specifications

Power consumption:	1.2 A @ 5 Vdc (maximum) 3.5 A @ 12 Vdc (maximum)
On-hook voltage (Ring to Tip):	-50 Vdc (typical)
Ring:	55 VACrms, 1.3 Crest factor (typical)

Telephone compatibility

Type:	Any FCC Part 68-compliant analog telephone (DTMF only)
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Telephony port specifications

Port connector type:	RJ-21X Amphenol-type connector
Cable type:	Category 3 or Category 5 (recommended)
Maximum cable run:	3280 ft (1000 m)

RJ-21X port specifications

Port connector type: RJ-21X	Port numbers:	Corresponding pin pairs:	
Analog station designations:	Port 1	Pin 1 - Ring 1	Pin 26 - Tip 1
	Port 2	Pin 2 - Ring 2	Pin 27 - Tip 2
	Port 3	Pin 3 - Ring 3	Pin 28 - Tip 3
	Port 4	Pin 4 - Ring 4	Pin 29 - Tip 4
	Port 5	Pin 5 - Ring 5	Pin 30 - Tip 5
	Port 6	Pin 6 - Ring 6	Pin 31 - Tip 6
	Port 7	Pin 7 - Ring 7	Pin 32 - Tip 7
	Port 8	Pin 8 - Ring 8	Pin 33 - Tip 8
	Port 9	Pin 9 - Ring 9	Pin 34 - Tip 9
	Port 10	Pin 10 - Ring 10	Pin 35 - Tip 10
	Port 11	Pin 11 - Ring 11	Pin 36 - Tip 11
	Port 12	Pin 12 - Ring 12	Pin 37 - Tip 12
	Port 13	Pin 13 - Ring 13	Pin 38 - Tip 13
	Port 14	Pin 14 - Ring 14	Pin 39 - Tip 14
	Port 15	Pin 15 - Ring 15	Pin 40 - Tip 15
	Port 16	Pin 16 - Ring 16	Pin 41 - Tip 16
	Port 17	Pin 17 - Ring 17	Pin 42 - Tip 17
	Port 18	Pin 18 - Ring 18	Pin 43 - Tip 18
	Port 19	Pin 19 - Ring 19	Pin 44 - Tip 19
	Port 20	Pin 20 - Ring 20	Pin 45 - Tip 20
	Port 21	Pin 21 - Ring 21	Pin 46 - Tip 21
	Port 22	Pin 22 - Ring 22	Pin 47 - Tip 22
	Port 23	Pin 23 - Ring 23	Pin 48 - Tip 23
	Port 24	Pin 24 - Ring 24	Pin 49 - Tip 24
		Pin 25 - Ground	Pin 50 - Ground

Cable connections

One RJ-21X cable plugs into the RJ-21X connector located on the analog station card.

Warning: To reduce the risk of fire, use minimum 26 AWG line cords that have been evaluated as Communication Circuit Accessories, UL 1863, for all telephone connections.

Vertical Application Module (Wave IP 2500 only)

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Removing and installing a VAM 10-4

This chapter describes the Vertical Application Module (VAM) supported on the Wave IP 2500 Server.

Important: The VAM supported on the Wave IP 500 Server is built into the ISC2 and is very different than the VAM described in this chapter. For more information on the Wave IP 500 version, see “Vertical Applications Module (VAM)” on page 18-9.

Functional description

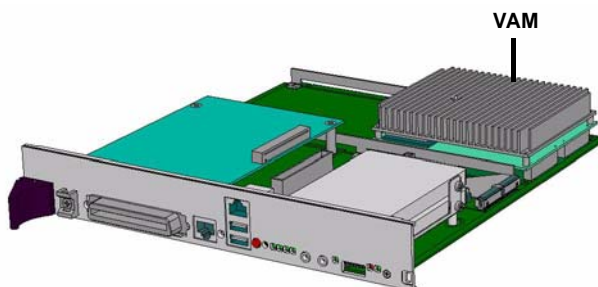
The VAM runs the Integrated Services Manager (ISM1) and the majority of Wave applications, such as Call Center, Voicemail, IVR, Fax Manager, Call Recording, and other high-level Wave functions.

Note: The Wave IP2500 now ships with the VW-VAM830. The major physical difference between the new model and the previous version (VW-VAM05) is that the heat sink now contains a cooling fan which connects to the ISC1 via a separate connector.

Physical description

The VAM is a single-board computer in an ETX form factor and contains an Intel Core 2 Duo with 2Ghz per processor and 2GB of RAM on board

The VAM installs as a mezzanine-style daughter board to the ISC1. The ISC1 also supports the VAM peripherals such as the RTC Battery, Hard Disk Drives, USB, and Ethernet.



Ports

The only external port is the USB connector on the faceplate. There are serial communication and VGA ports internally for engineering use only. All other interfaces (PCI, Ethernet, IDE) are integrated with the ISC1.

Relative to the VAM, the 2 USB ports on the ISC1 perform different functions:

- **USB1 (top port)** is wired to the Wave Server's embedded processor and will never be accessed or used by anyone other than Vertical's engineering staff. Do not connect any devices to USB1.
- **USB2 (bottom port)** is the only port a service technician will need to use. See "Cable connections" on page 10-3.

The VAM05 also has two SATA drive connectors.

Indicators

The right-most System Status LED on the ISC1 (LED4), when blinking green, indicates that the VAM is operational. See "Boot Complete" on page E-7.

Cable connections

The USB2 port on the ISC1 is the only external port connection for the VAM. The USB2 port can be used in the following ways:

- To connect an external USB drive for moving files on and off the system.
- To perform certain Vertical-specified upgrades.
- To connect a USB-keyboard/mouse combination for diagnostic purposes if you are directed to do so by your Vertical support representative.
- To execute a system recovery procedure should one become necessary. For more information, see the *Wave ISM System Recovery Guide*.

Removing and installing a VAM

Warning: Always use an anti-static grounding strap when removing or installing a VAM.

To remove the VAM:

1. Turn off the system.
2. Remove the ISC1 from the Wave IP 2500 Server by loosening the screws on each side of the front of the card.
3. **VAM05 only:** Disconnect the two SATA cables from the VAM05 and disconnect the Fan Power connector from the ISC1.
4. Remove the four screws securing the VAM to the ISC1.
5. Carefully remove the VAM from the ISC1 connectors and place it on an antistatic mat.

To install a VAM:

1. Place the ISC1 on a firm surface.
2. Orient the VAM over the mating connectors on the ISC1 so that the connectors are aligned. Note that the VAM will only fit one way.
3. Carefully push the VAM onto the ISC1 connectors. Check the fit from both sides to make sure the connectors are completely seated.
4. Secure the VAM to the ISC1 with four screws.
5. Check the connectors again from both sides to guarantee that the connectors are fully seated.
6. **VAM05 only:** Connect the two SATA cables to the VAM05. Note that the top HDD connects to the connector closest to the front of the ISC1. Connect the CPU fan to the FAN PWR connector on the ISC1.
7. Install the ISC1 in the Wave IP 2500 Server chassis.
8. Turn on the system.

Module Conversion Kit (Wave IP 2500 only)

CHAPTER CONTENTS

Functional description 11-2

Physical description 11-2

Assembly 11-2

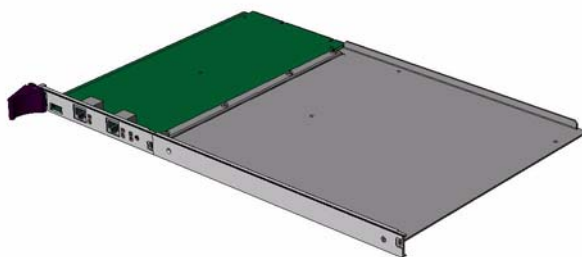
This chapter describes Module Conversion Kit supported on the Wave IP 2500 Server.

Functional description

The IP 2500 Module Conversion Kit (VW-IP2500-CONV) is a mechanical assembly which, when attached to a module, allows it to be plugged into a universal card slot.

Physical description

The IP 2500 Module Conversion Kit is a sheetmetal assembly which fastens to a module.



Assembly

1. Remove the L-bracket that joins the faceplate to the circuit board of the module to be installed. This bracket is located next to the red and green status LEDs and is held on with two screws - one to the faceplate and one to the circuit board. Save these screws. They are different so remember which one attaches through the faceplate and which one attaches through the circuit board.
2. Loosen but do not remove the four screws on the bottom of the metal adapter plate that holds the metal keeper strip to the adapter plate.
3. Remove the two screws on the metal adapter plate from the L-shaped tab that will hold the module in place. These screws are provided as replacements for the two screws removed earlier from the L-bracket in case they are needed.

4. Slide the module in between the metal adapter plate and the metal keeper strip. The faceplate of the module will line up with the faceplate of the adapter plate.
5. Using the two screws removed earlier, attach the module to the L-shaped tab on the adapter plate.
6. With the edge of the module resting against the edge of the adapter plate, tighten the four keep screws.

Integrated Services Card 1 (Wave IP 2500 only)

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This chapter describes the Wave Integrated Services Card 1 (ISC1) that is supported on the Wave IP 2500 Server.

Important: On the Wave IP 500 Server, the Wave Integrated Services Card 2 (ISC2) is used instead. See Chapter 18, “Integrated Services Card 2 (ISC2),” for more information.

Functional description

The Wave ISC1 is based on a patented communications switch engine and provides multiple functions and interfaces for data and telephony features.

ISC1 features include interoffice networking, remote access, Internet access, and analog station and trunk interfaces.

The ISC1 provides electrical connection through the Wave Server backplane to the other option cards and modules.

Physical description

The ISC1 consists of a printed circuit board, a metal board stiffener, and a metal faceplate mounted to the front of the board. The insertion lever on the left of the faceplate facilitates the insertion and removal of the card.

The LEDs located at the right-hand side of the faceplate indicate the operational status of the ISC1. The LEDs located on each RJ-45 port indicate link status and data activity for the port. Refer to “Status indicators” on page E-8 for information about status LEDs.

Only one ISC1 is allowed in a Wave system. Additional capacity and features are provided by other cards and modules.

The ISC1 provides the following features, as shown in Figure 12-1:

- 4 analog station ports (accessed through the RJ-21X connector)
- 4 analog trunk ports (loop start only, accessed through the RJ-21X connector)
- 2 Ethernet switched 10/100Base-T ports
- 1 input audio port and 1 output audio port
- 1 Digital Signal Processor (DSP) (not visible on faceplate) - up to 3 additional with an MRM
- 1 Shutdown button
- 1 Reset button

- 1 Fault Monitor Module (not visible on faceplate)
- 1 56 KB general use modem, shared with the fault monitor (not visible on faceplate)
- Power failure transfer capability (not visible on faceplate)

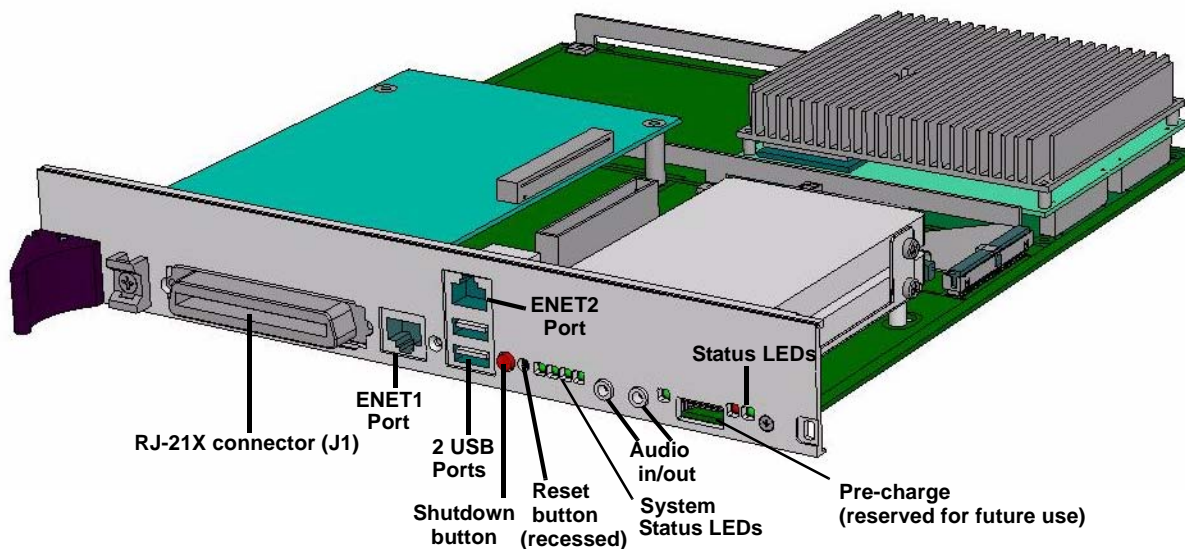


Figure 12-1 Integrated Services Card 1

Available ports

Network and telephone functionality is enabled through multiple interfaces on the ISC1. See “Ports” on page 12-13 for details.

Digital Signal Processing

There is one general-purpose Digital Signal Processor (DSP) located on the ISC1 which is shared between the VAM and the Fault Monitor Module.

The DSP on the ISC1 also contains resources for a V.34 modem, FAX tone detections, DTMF tone generators, Caller ID detectors/generators, VoIP codecs, media channels and conferencing channels.

Important: The DSP on the ISC1 contains sufficient DSP resources to support a basic PBX with approximately 32 users, however this does not *guarantee* adequate DSP resources for *all* 32-user applications. Your specific applications may require a Media Resource Module (MRM) to provide additional resources. (See Chapter 7 for more about MRMs.)

You must allocate an appropriate number of resources to cover your system demand. If you under-allocate resources, calls may be lost or not handled as expected. To determine whether you have adequate resources on your Wave system to support your required applications, use the Wave Resource Management Advisor, which calculates requirements for most resource types based on your answers to a series of questions, and on the cards, modules, and Wave licenses installed on your Wave Server. For details about how to use the Resource Manager Advisor, see “Managing Wave system resources” in Chapter 23 in the *Wave Global Administrator Guide*.

Shutdown button

The Shutdown button is located on the right side of the ISC1, to the left of the reset button, as shown in Figure 12-2.

The Shutdown button provides a way to perform an orderly shutdown of Microsoft Windows Server 2003 before turning off the power supply. The Shutdown button has a red cap.

The Shutdown button needs to be pressed down and held for four seconds before the shutdown process starts. Once the shutdown begins, the third status LED will flash alternately red and green.

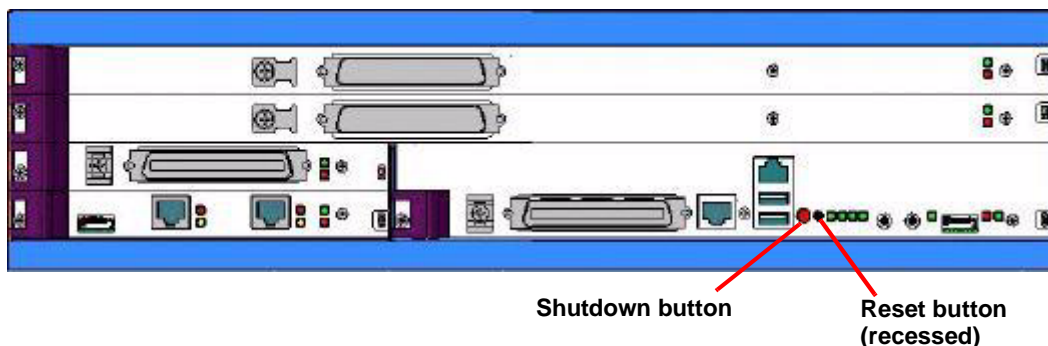


Figure 12-2 ISC1 buttons

Reset button

The Reset button provides a way to restart the entire system without turning the power supplies off and on. It is used when the Microsoft Windows Server 2003 operating system cannot be shut down by using the Shutdown button. The Reset button is recessed and must be activated with a pen tip or other small tool.

Caution: Always attempt to shut the system down using the Shutdown button before using the Reset button. Using the Reset button can lead to data loss since it bypasses the orderly shutdown of the Microsoft Windows Server 2003 operating system.

The Reset button is located on the right side of the ISC1, right of the Shutdown button.

Fault Monitor Module

The Fault Monitor Module is contained in the embedded microcontroller subsystem. The Fault Monitor Module is designed to monitor and report on critical system events.

Alternatively, the Fault Monitor Module error-trace log can be retrieved and viewed using the General Settings applet (Fault Monitor tab) of the Wave Global Administrator.

The Fault Monitor Module is in regular contact with the following Wave Server components:

- Microsoft Windows Server 2003 operating system
- Shutdown button
- Fans/power supply status bits

Microsoft Windows Server 2003 operating system

The FMM communicates with the operating system through a proprietary, low-level driver at intervals of once per second. The fourth status LED blinks at a corresponding once-per-second rate during normal operation and the third status LED flashes at a rate of once every 10 seconds to indicate hardware connectivity. If the operating system fails to contact the Fault Monitor Module at the regular interval, the FMM begins to restart the operating system after about 4 minutes. The watchdog timer waits for 15 minutes after the initial system startup to verify that the operating system is functioning.

Shutdown button

The Fault Monitor Module also monitors the Shutdown button located on the front of the ISC1. If the button has been pressed, the Fault Monitor Module signals the operating system to perform a shutdown procedure. All operating system anomalies are sent as error messages to the error-trace log by the Fault Monitor Module.

Fans/power supply status bits

The FMM checks the status of the power supply tray once per second. If there is a failure, an error message is sent to the error-trace log and an SNMP alarm is generated.

Additional information

For information about connecting the Fault Monitor Module to a separate phone line, refer to the *Wave Server Installation Guide*.

For information about enabling the Fault Monitor Module, refer to the *Wave Global Administrator Guide*. For more information about viewing the error-trace log, refer to Appendix A, “Fault Monitor Module and Trace Log.”

Modem

The modem port on the ISC1 allows the Wave Server system to function as a communications server, routing data using Microsoft Routing and Remote Access Service (RRAS). The Wave Server modem serves as a system resource for dial-in and dial-out calls.

- *Dial-in calls* come from remote clients over a trunk line to the Wave Server chassis. The modem is configured so that remote dial-in calls automatically connect to the Wave system. Modem calls can come in over T1/E1, ISDN, or analog trunks. They are not limited to the trunks on the ISC1.
- *Dial-out calls* are made from the Wave system over a trunk line to an Internet service provider or to another site. The type of dial-out call made when a user requests an Internet connection, known as dial-on-demand or *demand-dial calls*, can be set up through the RRAS administrator application.

Power failover support

Wave provides failover telephone service (power failure lifeline) in the event of a power failure.

If the power fails, the analog phone connected to Station Port 1 on the ISC1 automatically connects to the analog trunk plugged into Trunk Port 1, enabling that analog phone to make calls even if the Wave Server is not functioning.

See “Connecting to trunk and station ports on the ISC1” in Chapter 4 in the *Wave Server Installation Guide*. Also in the *Wave Server Installation Guide*, see Appendix B, “Trunk and Station Ports and Pinouts” for RJ-21X interface port descriptions and pinout pairs for the ISC1.

When using that analog phone during a power failure, you do not need to dial an outside access digit (for example 9) to place an outside call.

Hint: When setting up your telephones, locate the analog telephone connected to Station Port 1 in a convenient area, such as the lobby or front desk, so that it is easily accessible during a power failure.

Alarm relay

The RJ-21X port of the ISC1 includes pins that provide the C, NC, and NO contacts of a relay, which can be used as an alarm relay to an external device in the event of a system issue such as a power failure. See “RJ-21X (J1) connector specifications” on page 12-11 for details about the specific pins used for this purpose.

Expansion slot

MRM expansion slot

One MRM expansion slot accommodates an MRM. This allows a way to increase media resources (refer to Chapter 7, “Media Resource Module,”).

Indicators

Status indicators

The status indicators are located on the right side of the faceplate. The indicator on the right is a green LED. The indicator on the left is a red LED. The ISC1 is operational when the green LED lights steadily after the system has fully initialized. A blinking green LED indicates that the Fault Monitor Module is operational. For more information, refer to “Status indicators” on page E-7.

Ethernet status indicators

Ethernet status indicators show data activity and link status. Two LED indicators are integrated into each RJ-45 connector. The link LED is yellow. The activity LED is green. Ethernet status can be determined by the status of the LEDs, as shown in the following table:

Speed LED (Green)	Link/Activity LED (Yellow)	Status
ON	BLINKING	Data is being received on the port from the attached device at 100Mbit.
OFF	BLINKING	Data is being received on the port from the attached device at 10Mbit.
ON	ON	The link is connected at a speed of 100Mbit.
OFF	ON	The link is connected at a speed of 10Mbit.
OFF	OFF	There is no operational device connected to the port.

Technical specifications

General specifications

Compatibility with industry and protocol standards:	EIA/TIA-464B
Emissions:	FCC Part 15 Class A (EMI)
Electrical safety and protection:	FCC Part 68 UL 60950-1

Physical specifications

Dimensions:	11 x 11.2 x 1.6 in (27.9 x 28.4 x 4.1 cm)
Weight:	1 lb (0.45 kg)

Electrical specifications

Power consumption (includes ISC1 with VAM and hard drives):	3.8 A @ 3.3Vdc 8.3 A @ 5 Vdc
On-hook voltage (Ring to Tip):	-50 Vdc (typical)
Ring:	55 VACrms, 1.3 Crest factor (typical)

Telephone compatibility

Telephone:	Any FCC Part 68-compliant analog telephone (DTMF only) REN drive (phone port) 2.0B REN
Telephone line:	Analog loop start (trunk) REN load (trunk port) 0.2B REN

Telephony port specifications

Port connector type:	RJ-21X Amphenol-type connector
Cable type:	Category 3 or Category 5 (recommended)
Maximum cable run:	3280 ft (1000 m)

RJ-21X (J1) connector specifications

Port connector type: RJ-21X	Port numbers:	Corresponding pin pairs:	
Analog Stations	Station ports:		
	Port 1 (Failover)	Pin 1 - Ring 1	Pin 26 - Tip 1
	Port 2	Pin 2 - Ring 2	Pin 27 - Tip 2
	Port 3	Pin 3 - Ring 3	Pin 28 - Tip 3
	Port 4	Pin 4 - Ring 4	Pin 29 - Tip 4
Analog Trunks	Trunk ports:		
	Port 1 (Failover)	Pin 21 - Ring 1	Pin 46 - Tip 1
	Port 2	Pin 22 - Ring 2	Pin 47 - Tip 2
	Port 3	Pin 23 - Ring 3	Pin 48 - Tip 3
	Port 4	Pin 24 - Ring 4	Pin 49 - Tip 4
Alarm Relay	Alarm Relay	Pin 17 - C	Pin 42 - NC
	Alarm Relay	Pin 18 - C	Pin 43 - NO
Chassis Ground		Pin 25 - CHGND	Pin 50 - CHGND

The pin locations and designations for an RJ-21X connector are shown in Figure 12-3.

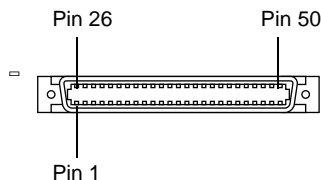


Figure 12-3 RJ-21X pin designations

10/100Base-T Ethernet port specifications

Compatibility with industry and protocol standards:	IEEE 802.3 CSMA/CD IEEE 802.3i 10Base-T (using RJ-45 connectors) IEEE 802.3u 100Base-T ISO 8802-3 Ethernet
Data rate and encoding:	10 or 100 Mbps/half- or full-duplex; Manchester encoding 100 Mbps/half- or full-duplex; MLT3 4B5B encoding
Port connector type:	RJ-45 modular connector (ISO 8877)
RJ-45 port pin designations:	Pin 1: RX + Pin 2: RX - Pin 3: TX + Pin 6: TX -
Cable type:	EIA CAT3, NEMA 100-24 -STD, or UL Level III (10Base-T only) EIA CAT5, NEMA 100-24 -XF, or UL Level V (10Base-T and 100Base-T)
Maximum cable run:	328 ft (100 m)

Audio port specifications

Port connector type:	3.5 mm stereo (only mono supported)
Input line impedance:	10 k Ω
Output line impedance:	300 Ω
Normal peak levels:	± 1 V
Normal frequency range:	200 Hz to 3400 Hz

There are two audio ports on the ISC1. The one on the left is for music-on-hold (input). The one on the right is for a paging/public address system (output).

Ports

Telephony ports

An RJ-21X connector provides the following:

- 4 analog station ports (FXS) provide telephone service for up to 4 telephony devices, including telephones, fax machines, and modems.
- 4 analog trunk ports (FXO) provide for connectivity to PSTN lines. These ports support loop-start trunk types only.

Ethernet network ports

Two RJ-45 ports (ENET1 and ENET2) provide Ethernet connectivity.

Important: Only the port labeled ENET1 should be used in any Wave installation. Do not connect the ENET2 port to the network unless you are specifically directed to do so by your Vertical support representative.

Audio ports

Two audio ports (one input, one output) provide connection to audio peripherals, such as a music-on-hold device and a paging/public address system. The ports are standard 3.5 mm stereo connectors. See “Cable connections” on page 12-14 for an important note about cable requirements when connecting a music-on-hold device to the Wave Server.

USB ports

There are 2 USB ports on the ISC1 that perform different functions:

- **USB1 (top port)** is wired to the Wave Server’s embedded processor and will never be accessed or used by anyone other than Vertical’s engineering staff. USB1 cannot be used for any field-serviceable operations.

Important: Do not connect any devices to USB1.

- **USB2 (bottom port)** is the only port a service technician can access or use for field-serviceable operations.

Pre-charge port

The Pre-charge port is reserved for future use.

Cable connections

Ethernet, telephony, and audio cables can be plugged into the ISC1 as described in the following sections.

10/100Base-T Ethernet switched connections

Up to two Ethernet cables can be plugged into the RJ-45 connectors located on the ISC1.

- Only ENET1 should be connected to your network.
- ENET2 should only be used if you are directed to do so by your Vertical support representative.

Warning: Under no circumstances should both connectors be connected to the same switch or LAN segment. Doing so will result in a loss of connectivity to the Wave IP 2500 Server.

Telephony connections

One RJ-21X cable plugs into the RJ-21X connector located on the ISC1.

Warning: To reduce the risk of fire, use minimum 26 AWG line cords that have been evaluated as Communication Circuit Accessories, UL 1863, for all telephone connections.

Audio connections

One audio output device (such as a paging or public address system) can be plugged into the audio output port. One audio input device (such as a music-on-hold system) can be plugged into the audio input port. These ports are shown in Figure 12-1.

Note: You must use a cable with a stereo plug to connect your music-on-hold device to the Wave Server chassis. If this cable is not provided with the device, you need to purchase a separate cable. For more information about connecting audio devices, refer to Appendix B, “Connecting Audio Devices.”

8-Port Analog Trunk Module

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Physical description	13-2
Ports	13-3
Indicators	13-3
Technical specifications	13-4
Cable connections	13-5

This chapter describes the 8-Port Analog Trunk Module expansion module.

For all Wave Server models:

- **8-Port Analog Trunk Module (VWU-8AT-M).** This module includes two faceplates, one for the Wave IP 500 Server (screw-in faceplate) and one for the Wave IP 2500 Server (faceplate with a locking lever).

Functional description

The 8-Port Analog Trunk Module provides connectivity for any combination of up to eight loop start or ground start trunks. The analog trunk module detects when a line is ringing and when it is off hook in order to place and receive calls to and from outside locations.

The analog trunk module can also pass along Caller ID information provided by the telephone company. It transmits and receives voice and modem data between the Central Office (CO) and the PBX portion of the Wave Server chassis.

Up to two 8-Port Analog Trunk Modules can be installed in each Wave Server chassis for a maximum of 20 incoming analog trunks.

Physical description

The analog trunk module consists of a printed circuit board and a metal faceplate mounted to the front of the board, as shown in Figure 13-1. The insertion lever on the left side of the faceplate facilitates the insertion and removal of the module.

The analog trunk module is powered through its connection to the backplane. There is also a small amount of power received through the trunks. The RJ-21X connector on the front of the module connects to a standard RJ-21X cable that terminates to the punchdown block.

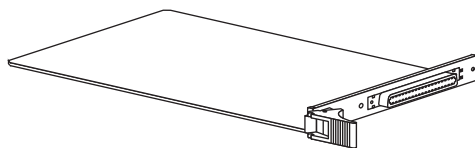


Figure 13-1 Analog trunk module

Ports

The RJ-21X connector on the analog trunk module provides connections to a maximum of eight CO trunks (see Figure 13-2).

Indicators

The analog trunk module contains two status indicators (a green LED and a red LED), as shown in Figure 13-2.

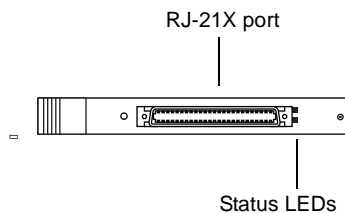


Figure 13-2 Analog trunk module indicators and RJ-21X connector

Status indicators

The status indicators are located on the right side of the faceplate. The indicator on the top is a green LED. The indicator on the bottom is a red LED. The analog trunk module is operational when the green LED lights steadily after the system has fully initialized. For more information, refer to “Status indicators” on page E-7.

Technical specifications

General specifications

Compatibility with industry and protocol standards:	EIA/TIA-464B
Emissions:	FCC Part 15 Class A (EMI)
Electrical safety and protection:	FCC Part 68 (network compatibility) UL 60950-1
Ringer Equivalent Number (REN):	0.2B RENs

Physical specifications

Dimensions:	4.66 x 10.90 x 0.80 in (11.84 x 27.69 x 1.91 cm)
Weight:	0.5 lb (0.23 kg)

Electrical specifications

Power consumption:	1.0 A @ 5 Vdc (maximum) 0.2 A @ 12 Vdc (maximum)
--------------------	---

RJ-21X port specifications

Port connector type: RJ-21X	Port numbers:	Corresponding pin pairs:	
Analog trunk designations:	Port 1	Pin 1 - Ring 1	Pin 26 - Tip 1
	Port 2	Pin 2 - Ring 2	Pin 27 - Tip 2
	Port 3	Pin 3 - Ring 3	Pin 28 - Tip 3
	Port 4	Pin 4 - Ring 4	Pin 29 - Tip 4
	Port 5	Pin 5 - Ring 5	Pin 30 - Tip 5
	Port 6	Pin 6 - Ring 6	Pin 31 - Tip 6
	Port 7	Pin 7 - Ring 7	Pin 32 - Tip 7
	Port 8	Pin 8 - Ring 8	Pin 33 - Tip 8
		Pin 9 - Pin 24 not used	Pin 34 - Pin 49 not used
		Pin 25 - Ground	Pin 50 - Ground

Compatibility

Trunks:	Two-wire ground start and loop start analog trunks
---------	--

Cable connections

One male RJ-21X cable plugs into the female RJ-21X connector located on the analog trunk module.

Warning: To reduce the risk of fire, use minimum 26 AWG line cords that have been evaluated as Communication Circuit Accessories, UL 1863, for all telephone connections.

8+8-Port Analog Universal Module

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Functional description	14-2
Physical description	14-3
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Technical specifications	14-4
Cable connections	14-7

This chapter describes the 8+8-Port Analog Universal Module expansion module.

For all Wave Server models:

- **8+8 Port Analog Universal Module (VWU-8X8AU-M).** This module includes two faceplates, one for the Wave IP 500 Server (screw-in faceplate) and one for the Wave IP 2500 Server (faceplate with a locking lever).

Functional description

The 8+8-Port Analog Universal Module provides 16 ports divided into two 8-port sets. One of the 8-port sets supports analog stations or DID trunks, and the other supports loop start or ground start trunks.

On a base Wave IP 2500 Server (with 2 card slots and 2 module slots) you can install any combination of the following types of cards or modules (in the proper slots) that support analog trunks and/or analog stations

- 8+8-Port Analog Universal Module
- 8-Port Analog Trunk Module
- 24-Port Analog Station Card

You can use Expansion Units (EXUs) to support additional analog trunks and/or stations on the Wave IP 2500. See Chapter 5 for more information.

Supported configurations

The 8+8-Port Analog Universal Module can support either of the following configurations.

- 8 analog FXS station ports and 8 analog FXO trunks.
- 8 DID trunks and 8 analog FXO trunks.

Analog FXO trunks can be loop-start or ground-start, configured individually.

Physical description

The analog universal module consists of a printed circuit board and a metal faceplate mounted to the front of the board, as shown in Figure 14-1. The insertion lever on the left side of the faceplate facilitates the insertion and removal of the module. Each analog universal module occupies a single slot.

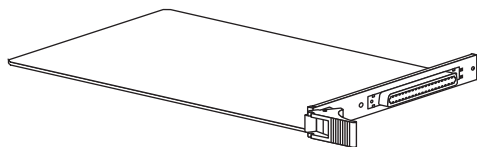


Figure 14-1 Analog universal module

The analog universal module is powered through its connection to the backplane. The RJ-21X connector on the front of the analog universal module connects to a standard RJ-21X cable that terminates on the punchdown block.

For ports configured as analog loop start or ground start trunks, there is also a small amount of power received through the trunks. For ports configured as analog DID trunks, by contrast, the analog universal module is responsible for supplying the battery voltage to the CO.

Caution: Connecting the analog universal module to a trunk with voltage present can damage the module. Before installing the analog universal module, test the incoming DID trunks with a technician's test set to ensure that no voltage is present.

Indicators

The analog universal module contains two status indicators (a green LED and a red LED), located on the right side of the faceplate, as shown in Figure 14-2.

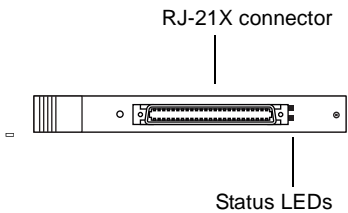


Figure 14-2 Analog universal module indicators and RJ-21X connector

The indicator on the top is a green LED. The indicator on the bottom is a red LED. The analog universal module is operational when the green LED lights steadily after the system has fully initialized.

For more information, refer to “Status indicators” on page E-7.

Technical specifications

General specifications

Emissions:	FCC Part 15 Class A (EMI)
Electrical safety and protection:	FCC Part 68 (network compatibility) UL 60950-1
Compatibility with industry and protocol standards:	EIA/TIA-464B
Ringer Equivalence Number (REN):	3.0B RENs (for analog stations) 0.2B RENs (for analog trunks)

Physical specifications

Dimensions:	4.66 x 10.90 x 0.80 in (11.84 x 27.69 x 1.91 cm)
Weight:	0.5 lb (0.23 kg)

Electrical specifications

Power consumption:	1.8 A @ 3.3Vdc (maximum) 1.4 A @ 12 Vdc (maximum)
On-hook voltage (Ring to Tip):	-50 Vdc (typical)
Ring:	55 VACrms, 1.3 Crest factor (typical)

Compatibility

Trunk:	Two-wire analog ground start, loop start, or DID wink start
Telephone:	Any FCC Part 68-compliant analog telephone (DTMF only)

Port specifications (when configured as analog stations)

Port connector type:	RJ-21X Amphenol-type connector
Cable type:	Category 3 or Category 5 (recommended)
Maximum cable run:	3280 ft (1000 m)

RJ-21X port specifications

When a port is configured as:	Port numbers:	Corresponding pin pairs:	
Analog trunk (Ground/Loop):	Port 1	Pin 1 - Ring 1	Pin 26 - Tip 1
	Port 2	Pin 2 - Ring 2	Pin 27 - Tip 2
	Port 3	Pin 3 - Ring 3	Pin 28 - Tip 3
	Port 4	Pin 4 - Ring 4	Pin 29 - Tip 4
	Port 5	Pin 5 - Ring 5	Pin 30 - Tip 5
	Port 6	Pin 6 - Ring 6	Pin 31 - Tip 6
	Port 7	Pin 7 - Ring 7	Pin 32 - Tip 7
	Port 8	Pin 8 - Ring 8	Pin 33 - Tip 8
Analog trunk (DID) or station	Port 1	Pin 17 - Ring 1	Pin 42- Tip 1
	Port 2	Pin 18- Ring 2	Pin 43- Tip 2
	Port 3	Pin 19- Ring 3	Pin 44- Tip 3
	Port 4	Pin 20- Ring 4	Pin 45- Tip 4
	Port 5	Pin 21- Ring 5	Pin 46- Tip 5
	Port 6	Pin 22- Ring 6	Pin 47- Tip 6
	Port 7	Pin 23- Ring 7	Pin 48- Tip 7
	Port 8	Pin 24- Ring 8	Pin 49- Tip 8

Pins 9-16 and 34-41 are not used. Pins 25 and 50 are assigned to Ground.

Cable connections

One male RJ-21X cable plugs into the female RJ-21X connector located on the analog universal module.

Warning: To reduce the risk of fire, use minimum 26 AWG line cords that have been evaluated as Communication Circuit Accessories, UL 1863, for all telephone connections.

1-Port T1/PRI and 1-Port E1 EuroISDN Modules

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Cable connections	15-10

This chapter describes the following expansion modules:

T1/PRI Modules

For all Wave Server models:

- 1-Port T1/PRI Module with Serial Interface (VWU-1T1S-M). This module includes two faceplates, one for the Wave IP 500 Server (screw-in faceplate) and one for the Wave IP 2500 Server (faceplate with a locking lever).
- 1-Port T1/PRI Module (VW5-T1-M). This module does not include a serial interface. It comes with the Wave IP 500 Server faceplate installed and a Wave IP 2500 Server faceplate included in the box.

E1 EuroISDN Modules

For the Wave IP 2500 Server only:

- 1-Port E1 EuroISDN Module with Serial Interface (VW-1ES1-M)

For the Wave IP 500 Server only:

- 1-Port E1 EuroISDN Module with Serial Interface (VW5-1ES1-M)

Important: The E1 EuroISDN with serial interface module for the Wave IP 500 Server is the same as the module for the Wave IP 2500 Server that is described in detail in this chapter, except that the faceplate on the Wave IP 500 Server version is different and there is no locking lever. See Chapter 18 for more information about the Wave IP 500 Server.

Functional description

1-Port T1/PRI (or E1 EuroISDN) Module with Serial Interface

The 1-Port T1/PRI (or E1 EuroISDN) Module with Serial Interface is a plug-in module with one T1/E1 interface and a V.35 DCE serial interface. Data is added to a T1/E1 data stream, or terminated from a T1/E1 data stream, to other devices connected to the equipment.

The module has a single V.35 Synchronous DCE serial interface which provides up to 32 64Kbps channels for data.

Note: If there are any EXUs attached to the Wave system, the first two T1 or E1 ports must be installed in the main chassis.

1-Port T1/PRI Module

The 1-Port T1/PRI Module with no serial interface provides a cost effective solution for systems with T1/PRI applications in which drop-and-insert functionality is not required.

Physical description

The module consists of a printed circuit board and a metal faceplate mounted to the board. The insertion lever on the bottom of the faceplate facilitates the insertion and removal of the module (see Figure 15-1).

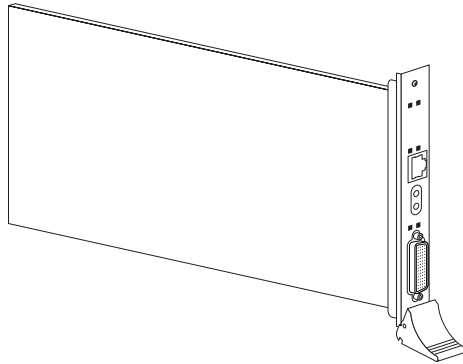


Figure 15-1 1-Port T1/PRI (or E1 EuroISDN) Module with Serial Interface

Ports

Connection to the serial interface is provided by a standard DB-60 connector, as shown in Figure 15-2. Connection to the T1 or E1 port is provided by an RJ-48C connector.

Caution: Use care when connecting or disconnecting the serial cable to the module's DB-60 connector. Because of the connector's small size and high pin count, pins on the cable connector can be easily bent and the DB-60 connector on the module may be damaged.

Indicators

The 1-Port T1/PRI (or E1 EuroISDN) Module with Serial Interface contains two status indicators. Each port has two alarm indicators (see Figure 15-2).

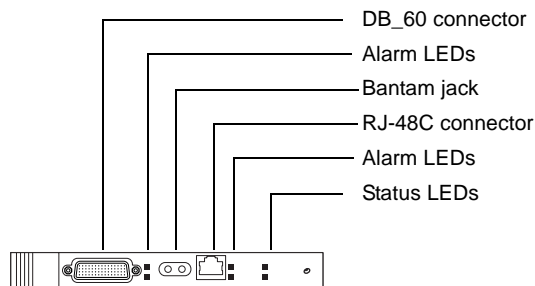


Figure 15-2 1-Port T1/PRI (or E1 EuroISDN) Module with Serial Interface indicators and connectors

Status indicators

The module status indicators are located on the right of the faceplate.

- The top indicator is a green LED.
- The bottom indicator is a red LED.

The module is operational when the green LED lights steadily after the system has fully initialized. The function of the status LEDs is described in Table 15-1. For more information, refer to “Status indicators” on page E-7.

Alarm indicators

Two alarm indicators are located to the right of the RJ-48C connector to indicate T1 or E1 status. The yellow LED lights when there is a yellow carrier failure alarm. The red LED lights when there is a blue or red carrier failure alarm. The status of the alarm LEDs is described in Table 15-1.

Table 15-1 T1/E1 Carrier failure alarm indicators

Red LED	Yellow LED	Status
OFF	OFF	Transmission is active, with no alarm conditions.
ON	OFF	The module is not currently receiving data.
OFF	ON	The other end is reporting trouble with the signal.
ON	ON	The module is not activated in the Wave database.

All blue, red, and yellow alarms are tracked and stored in a log. Refer to the *Wave Global Administrator Guide* for information about how to view the T1/E1 error log and to activate the module.

Two alarm indicators are located to the right of the serial connector. The status of the alarm LEDs is described in Table 15-2.

Table 15-2 V.35 Port failure alarm indicators

Red LED	Yellow LED	Status
OFF	OFF	Cable attached, no alarms
ON	OFF	Cable not attached, or wrong cable
OFF	ON	Cable attached, serial status down or in local loopback
ON	ON	Port out of service

Technical specifications

General T1 specifications

Compatibility with industry and protocol standards:	ANSI T1.403 - 1995 AT&T TR41458 Bellcore TR-TSY-000303 NIS A211-1 AT&T TR62310 ANSI T.410-1992 EIA/TIA-464B CCITT V.35
Emissions:	FCC Part 15 Class A (EMI)
Electrical safety and protection:	FCC Part 68 (network compatibility) UL 60950-1
T1 framing:	Superframe (SF) Extended Superframe (ESF)
T1 line coding:	Binary 8 Zero Suppression (B8ZS)
Frequency:	
T1:	1.544 MHz \pm 50 Hz
V.35:	64 kHz - 2.048 MHz in 64kHz increments
Programmable long-haul mode:	Line attenuation up to 36dB at 772 kHz with automatic line equalization
Programmable short-haul mode:	Programmable line build-out steps of 0 dB, -7.5 dB and -15dB
Alarm monitoring:	Blue, red, and yellow
Channel loopback, line loopback, and payload loopback:	AT&T 54016

General E1 specifications

Compatibility with industry and protocol standards:	ANSI T1.403 Bellcore TR-TSY-000303 ITU-T Q.921 ITU-T Q.931 ETSI ETS 300 102-1 CCITT V.35
Emissions:	EN 55022:2006 2006-09 EN 55024:1998+A1:2001+A2:2003 2003-01 EN 61000-3-2 2006-04 EN 61000-3-3:1995+A1:2001+A2:2005 2005-11
Electrical safety and protection:	EN 60950
E1 Framing	CRC4 PCM30
E1 Line Coding	HDB3
Frequency	
E1:	2.048 MHz \pm 50Hz
V.35:	64 kHz - 2048 MHz in 64 kHz increments
Programmable long-haul mode:	Line attenuation up to 36dB at 772 kHz with automatic line equalization
Programmable short-haul mode:	Programmable line build-out steps of 0 dB, -7.5 dB and -15dB
Alarm monitoring:	Blue, red, and yellow

Physical specifications

Dimensions:	4.66 x 10.90 x 0.80 in (11.84 x 27.69 x 1.91 cm)
Weight:	0.5 lb (0.23 kg)

Electrical specifications

Power consumption (maximum):	1.2A @ 3.3Vdc
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T1/E1 port specifications

Port connector type:	RJ-48C modular connector
RJ-48C port pin designations:	Pin 1: CI Receive Ring, - Pin 2: CI Receive Tip, + Pin 3: Shield / Ground Pin 4: CI Transmit Ring, - Pin 5: CI Transmit Tip, + Pin 6: Shield / Ground Pin 7: not used by T1/E1 module Pin 8: not used by T1/E1 module
Maximum cable run:	6200 ft #22AWG (1889.76 m)

V.35 port specifications

Port connector type:	DB-60 connector
DB-60 connector pin designations:	<div>Pin 17: RD- (Receive Data)</div> <div>Pin 18: RD+ (Receive Data)</div> <div>Pin 19: TxC (Send SCT+)</div> <div>Pin 20: TxC+ (Send SCT)</div> <div>Pin 21: RxC (Receive SCR)</div> <div>Pin 22: RxC (Receive SCR)</div> <div>Pin 27: TxD (Send SD)</div> <div>Pin 28: TxD (Send SD)</div> <div>Pin 33: LL (Loopback Test)</div> <div>Pin 34: DTR (Data Terminal Ready)</div> <div>Pin 35: RTS (Request to Send)</div> <div>Pin 42: CTS (Clear to Send)</div> <div>Pin 43: DSR (Data Set Ready)</div> <div>Pin 44: DCD (Data Carrier Detect)</div> <div>Pin 47: CableType[2] 5-in-1 cable type Bit 2</div> <div>Pin 49: CableType[1] 5-in-1 Cable Type Bit 1</div> <div>Pin 50: CableType[0] 5-in-1 Cable Type Bit 0</div> <div>Pin 52: Mode_DCE (DCE Mod)</div> <div>Pins 1-16, 30, 45, 46, 48, 51, 56: GND</div> <div>Pins 23-26, 29, 31-32, 36-41, 53-55, 57-60: Not used</div>

Cable connections

One RJ-48C cable plugs into the RJ-48C connector located on the 1-Port T1/PRI (or E1 EuroISDN) Module with Serial Interface.

The serial interface supports V.35 DCE cables, allowing the attached router to connect to the module directly through a single cable. The cable has a V.35 DCE to V.35 DTE universal connector to universal connector and will appear to both devices as a V.35 interface.

Bantam jacks

A Bantam jack is provided for diagnostic purposes and is to be used only by an authorized technician. A Bantam jack is located to the left of the RJ-48C connector. The Bantam jack accepts a 3-conductor Bantam cable. The left side of the jack is for the T1/E1 receive signal and the right side of the jack is for the T1/E1 transmit signal.

Quad BRI Module

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This chapter describes the Quad BRI Module expansion module.

For all Wave Server models:

- Quad BRI Module (VW5-4BRI-M). This module includes two faceplates, one for the Wave IP 500 Server (screw-in faceplate) and one for the Wave IP 2500 Server (faceplate with a locking lever).

Functional description

The Quad BRI Module is a plug-in module with 4 BRI interfaces. Each interface port carries 2 channels of voice for a total of 8 voice channels per Quad BRI module.

Physical description

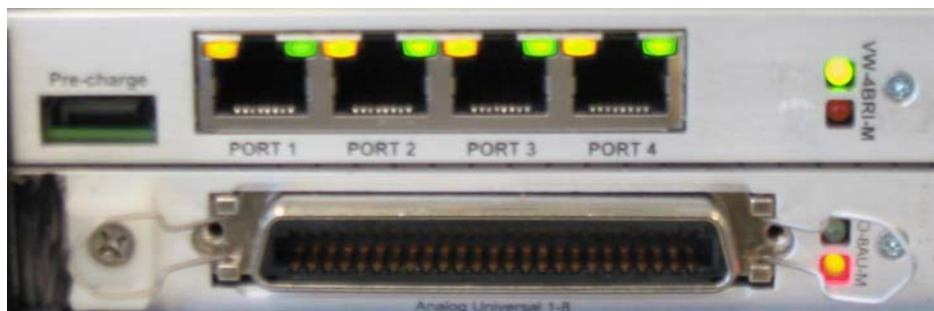
The module consists of a printed circuit board and a metal faceplate mounted to the board. The insertion lever on the bottom of the faceplate facilitates the insertion and removal of the module.

Ports

Connection to each of the 4 BRI ports is provided by a separate RJ-45 connector.

Indicators

The Quad BRI Module contains 2 module status indicators located on the right of the faceplate. Additionally, each of the 4 BRI ports has 2 port status alarm indicators (labeled “PORT 1” - “PORT 4”).



Module status indicators

The module status indicators are located on the right of the faceplate. The indicator on the top is a green LED. The indicator on the bottom is a red LED. The Quad BRI Module is operational when the green LED lights steadily after the system has fully initialized. The function of the status LEDs is described in Table 16-1. For more information, refer to “Status indicators” on page E-7.

Port status indicators

Two port status indicators are located above and incorporated into the RJ-45 connectors to indicate BRI status. The green LED lights when the associated BRI circuit is ready for use or actually in use. The amber LED lights for the conditions described in Table 16-1.

Table 16-1 BRI port status indicators

Amber LED	Green LED	Status
OFF	OFF	No signals or no connection detected.
ON	OFF	The module is not activated in the Wave database.
OFF/ON	ON	Port is active and/or ready for use.

Port status conditions are tracked and stored in an error log. Refer to the *Wave Global Administrator Guide* for information about how to view the error log and to activate the module.

Technical specifications

General BRI S/T specifications

Compatibility with industry and protocol standards:	ITU-T I.430 ETSI ETS 300 125 ETSI ETS 300 102 ETSI TBR 3
Emissions:	EN 55022:2006+A1:2008 2008-05 EN 55024:1998+A1:2001+A2:2003 2003-01
Electrical safety and protection:	EN 61000-4-4/5/6
Interface	ISDN BRI S/T
Termination:	Tx, Rx - 100 ohms selectable
Nominal pulse level:	750 mV zero-to-peak

Physical specifications

Dimensions:	4.66 x 10.90 x 0.80 in (11.84 x 27.69 x 1.91 cm)
Weight:	0.5 lb (0.23 kg)

Electrical specifications

Power consumption (maximum):	1.5A @ 3.3Vdc 0.1 A @ 5Vdc
------------------------------	-------------------------------

BRI S/T port specifications

Port connector type:	RJ-45 modular connector
RJ-45 port pin designations:	Pin 1: Not used Pin 2: Not used Pin 3: Transmit, + Pin 4: Receive, + Pin 5: Receive, - Pin 6: Transmit, - Pin 7: Not used Pin 8: Not used
Maximum cable run:	1000 meters, low-capacitance cable

Cable connections

Up to 4 RJ-45 cables can be plugged into the RJ-45 connectors located on the Quad BRI Module.

12-Port/24-Port Digital Station Modules and 48-Port Digital Station Card (for Edge 700/Vodavi phones)

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This chapter describes the expansion modules and cards that support Edge 700/Vertical Vodavi digital phones.

For all Wave Server models:

- 12-Port Digital Station Module (VWU-12DS2-M)
- 24-Port Digital Station Module (VWU-24DS2-M).

These modules includes two faceplates, one for the Wave IP 500 Server (screw-in faceplate) and one for the Wave IP 2500 Server (faceplate with a locking lever).

For the Wave IP 2500 Server only:

- 48-Port Digital Station Card (VW-48DS2-C) for Edge 700/Vodavi phone support

Functional description

Up to two digital station cards can be installed in each Wave Server chassis. A fully loaded Wave Server system with two 48-port digital station cards and two 24-port digital station modules can support 144 digital stations. This 144 digital station configuration would leave no space for trunk cards, but it can reasonably be used if relying on SIP trunking.

Physical description

The digital station card consists of a printed circuit board and a metal faceplate mounted to the front of the board, as shown in Figure 17-1. The insertion lever on the faceplate facilitate insertion and removal of the card. Each digital station card occupies a single chassis slot.

The digital station card is powered through its connection to the Vertical backplane. The RJ-21X connectors on the front of the card connects to a standard RJ-21X cable that typically terminates to a punchdown block.

Warning: When the system power is on, high voltages may be present on the digital station card and may be present on the RJ-21X connector. To prevent exposure to these high voltages, hold the card by the insertion levers.

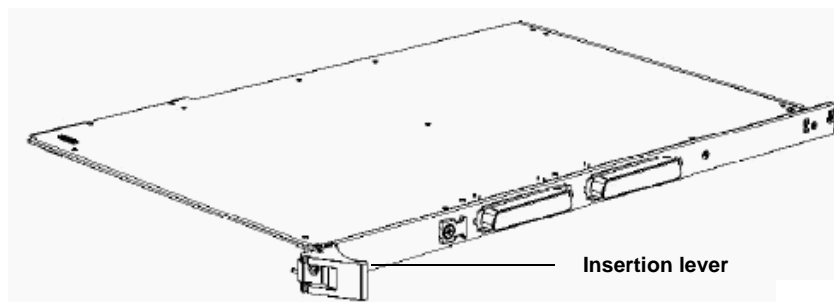


Figure 17-1 Digital station card

Ports

Digital telephone ports on the 48-Port Digital Station Card provide dial tone and telephone service for up to 48 digital telephones.

Digital telephone ports on the 12-Port/24-Port Digital Station Modules provide dial tone and telephone service for up to 12/24 digital telephones.

Indicators

The digital station card contains two status indicators (a green LED and a red LED), as shown in Figure 17-2.

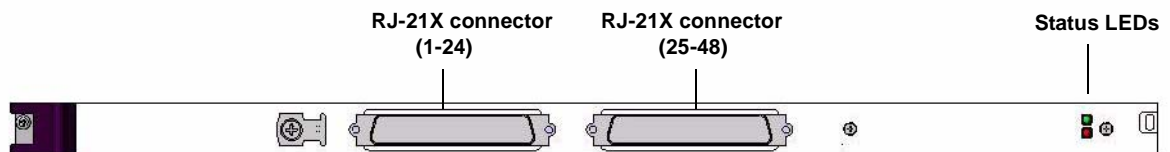


Figure 17-2 Digital station card indicators and RJ-21X connectors

The indicator on the top is a green LED. The indicator on the bottom is a red LED. The digital station card is operational when the green LED lights steadily after the system has fully initialized.

For more information, refer to “Status indicators” on page E-7.

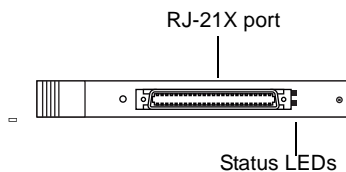


Figure 17-3 12-Port/24-Port Digital Station Module indicators and RJ-21X connector

The status indicators are located on the right side of the faceplate. The indicator on the top is a green LED. The indicator on the bottom is a red LED. The digital station module is operational when the green LED lights steadily after the system has fully initialized. For more information, refer to “Status indicators” on page E-7.

Technical specifications

General specifications

Emissions:	FCC Part 15 Class A (EMI)
Electrical safety and protection:	FCC Part 68 (network compatibility) UL 60950-1

Physical specifications

	Card	Modules
Dimensions:	16.2 x 10.9 x 0.8 in (41.0972 x 27.686 x 1.905 cm)	4.66 x 10.90 x 0.80 in (11.84 x 27.69 x 1.91 cm)
Weight:	1 lb (0.454 kg)	0.5 lb (0.23 kg)

Electrical specifications

Power consumption:	
48-port card	3.3V @ 325mA 5V @ 70mA
24-port module	3.3V @ 298mA 5V @ 43mA
12-port module	3.3V @ 285mA 5V @ 43mA
Voltage, Ring to Tip:	36 Vdc (typical)

Telephone compatibility

Type:	Vertical Communications digital telephone models: <ul style="list-style-type: none">Edge 100 12-button VW-E100-12Edge 100 24-button VW-E100-24Edge 700 8-button VW-E700-8Edge 700 24-button VW-E700-24Edge 700 DSS Console VW-E700-C48Vertical Vodavi 30-button Executive 3015-71/3016-71Vertical Vodavi 8-button Enhanced 3011-71Vertical Vodavi 8-button Executive 3012-71Vertical Vodavi DSS Console 3010-71DECT/Ranger cordless telephone
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Telephony port specifications

Port connector type:	RJ-21X Amphenol-type connector
Cable type:	Category 3 or Category 5 (recommended)
Maximum cable run:	1968 ft (600 m)

RJ-21X port specifications for 48-Port Digital Station Card

Port connector type: RJ-21X	Port numbers	Corresponding pin pairs:	
	Connector 1:		
Digital station designations	Port 1	Pin 1 - Ring 1	Pin 26 - Tip 1
	Port 2	Pin 2 - Ring 2	Pin 27 - Tip 2
	Port 3	Pin 3 - Ring 3	Pin 28 - Tip 3
	Port 4	Pin 4 - Ring 4	Pin 29 - Tip 4
	Port 5	Pin 5 - Ring 5	Pin 30 - Tip 5
	Port 6	Pin 6 - Ring 6	Pin 31 - Tip 6
	Port 7	Pin 7 - Ring 7	Pin 32 - Tip 7
	Port 8	Pin 8 - Ring 8	Pin 33 - Tip 8
	Port 9	Pin 9 - Ring 9	Pin 34 - Tip 9
	Port 10	Pin 10 - Ring 10	Pin 35 - Tip 10
	Port 11	Pin 11 - Ring 11	Pin 36 - Tip 11
	Port 12	Pin 12 - Ring 12	Pin 37 - Tip 12
	Port 13	Pin 13 - Ring 13	Pin 38 - Tip 13
	Port 14	Pin 14 - Ring 14	Pin 39 - Tip 14
	Port 15	Pin 15 - Ring 15	Pin 40 - Tip 15
	Port 16	Pin 16 - Ring 16	Pin 41 - Tip 16
	Port 17	Pin 17 - Ring 17	Pin 42 - Tip 17
	Port 18	Pin 18 - Ring 18	Pin 43 - Tip 18
	Port 19	Pin 19 - Ring 19	Pin 44 - Tip 19
	Port 20	Pin 20 - Ring 20	Pin 45 - Tip 20
	Port 21	Pin 21 - Ring 21	Pin 46 - Tip 21
	Port 22	Pin 22 - Ring 22	Pin 47 - Tip 22
	Port 23	Pin 23 - Ring 23	Pin 48 - Tip 23
	Port 24	Pin 24 - Ring 24	Pin 49 - Tip 24
		Pin 25 - Ground	Pin 50 - Ground

Port connector type: RJ-21X	Port numbers	Corresponding pin pairs:	
	Connector 2:		
Digital station designations	Port 25	Pin 1 - Ring 1	Pin 26 - Tip 1
	Port 26	Pin 2 - Ring 2	Pin 27 - Tip 2
	Port 27	Pin 3 - Ring 3	Pin 28 - Tip 3
	Port 28	Pin 4 - Ring 4	Pin 29 - Tip 4
	Port 29	Pin 5 - Ring 5	Pin 30 - Tip 5
	Port 30	Pin 6 - Ring 6	Pin 31 - Tip 6
	Port 31	Pin 7 - Ring 7	Pin 32 - Tip 7
	Port 32	Pin 8 - Ring 8	Pin 33 - Tip 8
	Port 33	Pin 9 - Ring 9	Pin 34 - Tip 9
	Port 34	Pin 10 - Ring 10	Pin 35 - Tip 10
	Port 35	Pin 11 - Ring 11	Pin 36 - Tip 11
	Port 36	Pin 12 - Ring 12	Pin 37 - Tip 12
	Port 37	Pin 13 - Ring 13	Pin 38 - Tip 13
	Port 38	Pin 14 - Ring 14	Pin 39 - Tip 14
	Port 39	Pin 15 - Ring 15	Pin 40 - Tip 15
	Port 40	Pin 16 - Ring 16	Pin 41 - Tip 16
	Port 41	Pin 17 - Ring 17	Pin 42 - Tip 17
	Port 42	Pin 18 - Ring 18	Pin 43 - Tip 18
	Port 43	Pin 19 - Ring 19	Pin 44 - Tip 19
	Port 44	Pin 20 - Ring 20	Pin 45 - Tip 20
	Port 45	Pin 21 - Ring 21	Pin 46 - Tip 21
	Port 46	Pin 22 - Ring 22	Pin 47 - Tip 22
	Port 47	Pin 23 - Ring 23	Pin 48 - Tip 23
	Port 48	Pin 24 - Ring 24	Pin 49 - Tip 24
		Pin 25 - Ground	Pin 50 - Ground

RJ-21X port specifications for 24-Port Digital Station Module

Port connector type: RJ-21X	Port numbers:	Corresponding pin pairs:	
Digital station designations:	Port 1	Pin 1 - Ring 1	Pin 26 - Tip 1
	Port 2	Pin 2 - Ring 2	Pin 27 - Tip 2
	Port 3	Pin 3 - Ring 3	Pin 28 - Tip 3
	Port 4	Pin 4 - Ring 4	Pin 29 - Tip 4
	Port 5	Pin 5 - Ring 5	Pin 30 - Tip 5
	Port 6	Pin 6 - Ring 6	Pin 31 - Tip 6
	Port 7	Pin 7 - Ring 7	Pin 32 - Tip 7
	Port 8	Pin 8 - Ring 8	Pin 33 - Tip 8
	Port 9	Pin 9 - Ring 9	Pin 34 - Tip 9
	Port 10	Pin 10 - Ring 10	Pin 35 - Tip 10
	Port 11	Pin 11 - Ring 11	Pin 36 - Tip 11
	Port 12	Pin 12 - Ring 12	Pin 37 - Tip 12
	Port 13	Pin 13 - Ring 13	Pin 38 - Tip 13
	Port 14	Pin 14 - Ring 14	Pin 39 - Tip 14
	Port 15	Pin 15 - Ring 15	Pin 40 - Tip 15
	Port 16	Pin 16 - Ring 16	Pin 41 - Tip 16
	Port 17	Pin 17 - Ring 17	Pin 42 - Tip 17
	Port 18	Pin 18 - Ring 18	Pin 43 - Tip 18
	Port 19	Pin 19 - Ring 19	Pin 44 - Tip 19
	Port 20	Pin 20 - Ring 20	Pin 45 - Tip 20
	Port 21	Pin 21 - Ring 21	Pin 46 - Tip 21
	Port 22	Pin 22 - Ring 22	Pin 47 - Tip 22
	Port 23	Pin 23 - Ring 23	Pin 48 - Tip 23
	Port 24	Pin 24 - Ring 24	Pin 49 - Tip 24
		Pin 25 - Ground	Pin 50 - Ground

RJ-21X port specifications for 12-Port Digital Station Module

Port connector type: RJ-21X	Port numbers:	Corresponding pin pairs:	
Digital station designations	Port 1	Pin 1 - Ring 1	Pin 26 - Tip 1
	Port 2	Pin 2 - Ring 2	Pin 27 - Tip 2
	Port 3	Pin 3 - Ring 3	Pin 28 - Tip 3
	Port 4	Pin 4 - Ring 4	Pin 29 - Tip 4
	Port 5	Pin 5 - Ring 5	Pin 30 - Tip 5
	Port 6	Pin 6 - Ring 6	Pin 31 - Tip 6
	Port 7	Pin 7 - Ring 7	Pin 32 - Tip 7
	Port 8	Pin 8 - Ring 8	Pin 33 - Tip 8
	Port 9	Pin 9 - Ring 9	Pin 34 - Tip 9
	Port 10	Pin 10 - Ring 10	Pin 35 - Tip 10
	Port 11	Pin 11 - Ring 11	Pin 36 - Tip 11
	Port 12	Pin 12 - Ring 12	Pin 37 - Tip 12
	Port 13 - Port 24	Not Used	Not Used
		Pin 25 - Ground	Pin 50 - Ground

Cable connections

One RJ-21X cable plugs into the RJ-21X connector located on the digital station card or digital station module.

Warning: To reduce the risk of fire, use minimum 26 AWG line cords that have been evaluated as Communication Circuit Accessories, UL 1863, for all telephone connections

Overview of the Wave IP 500 Chassis and Components

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This chapter provides descriptions of the chassis and hardware components that make up the Wave IP 500 Server.

Wave IP 500 overview

The Wave IP 500 Standard Edition (VW5-IP500-STD2) consists of the following:

- 19-inch rack-mountable chassis that includes room for expansion
- VAM (1GHz Celeron, 1GB memory)
- Power supply
- Integrated Services Card 2 (ISC2), an embedded processor that provides primary system control including voice processing and packet switching elements.
- Dual serial ATA (SATA) hard disk drives

About the ISC2

The ISC2 board in the basic chassis is the minimum requirement for a Wave IP 500 Server. It is a scaled down version of the ISC1 in the IP 2500, and, along with the VAM, is the basic control of the system. It is not field replaceable.

The ISC2 contains the following onboard features:

- Embedded Intel IXP processor
- Fault Monitor Module
- Digital Signal Processor (DSP)
- Media Resource Module (MRM) connector for an optional MRMA module for expanded DSP functionality
- 2 analog station ports (RJ-11 connectors)
- 2 analog trunk ports, loop-start only (RJ-11 connectors)
- 1 external Ethernet switched port, 10/100 base-T
- 2 USB host ports for communication to the VAM (type A connectors)
- 1 USB device port for service console connection to the embedded processor (type mini-B connector)

Important: This USB port is not for use by field technicians.

- 1 audio input port for an external music-on-hold source
- 1 audio output port for an external paging system
- 4 system status LEDs
- 2 card status LEDs
- Power on/off button
- Reset button
- Internal 56K soft modem
- 1 station to trunk power fail connection relay
- 1 alarm relay

About the dual SATA hard drives

The Wave IP 500 Server chassis has been designed to support redundant hard drives. Dual SATA hard drives are stacked in the mounting bracket.

- Disk 0 is physically mounted on top of Disk 1 in the bracket.
- The disks are labeled as follows:
 - Disk 0 SATA cable is labeled “HD0-TOP”.
 - Disk 1 SATA cable is labeled “HD1-BOTTOM”.

Maximum phone capacity

- Supports a maximum of 50 end users
- Supports SIP-only configurations of up to 50 SIP telephones (this maximum assumes 0 digital stations)
- Supports digital-only configurations of up to 48 digital stations (this maximum assumes 0 SIP endpoints)

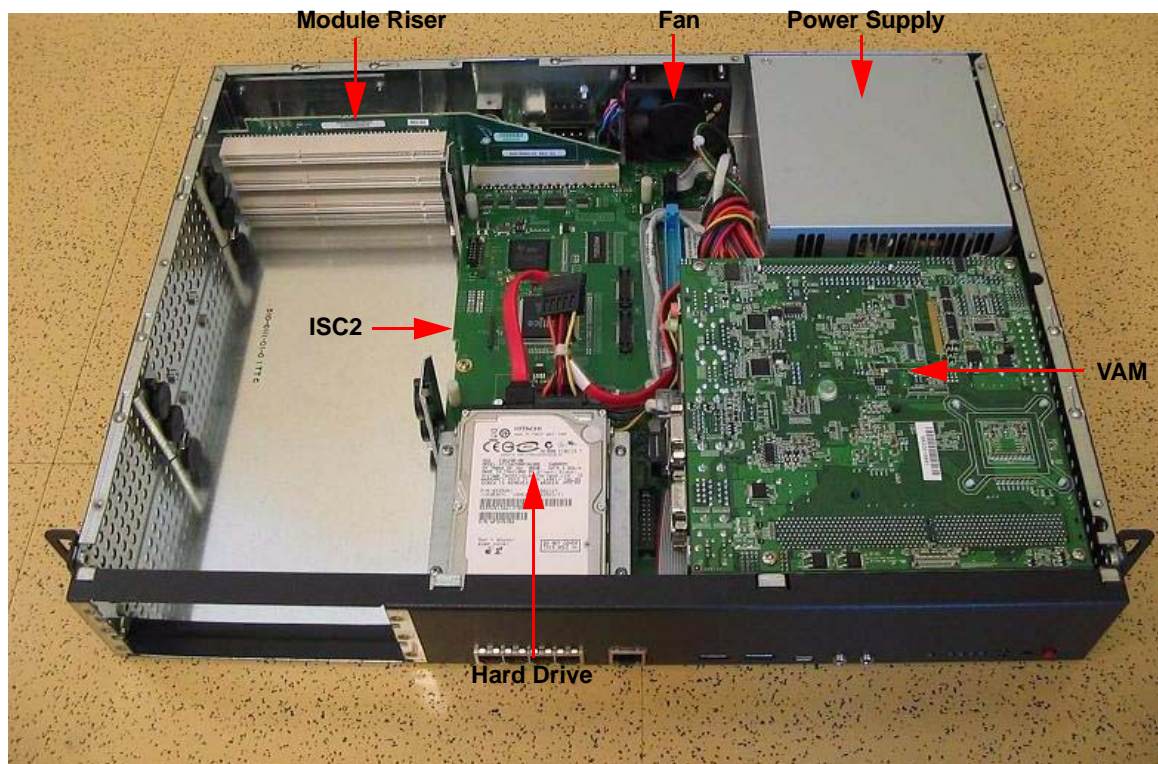
Adding capacity

As customer needs expand, the Wave IP 500 Server chassis can be expanded to handle additional users and increased traffic, up to the 50-user limit. The Wave IP 500 Server chassis has been designed to accept specialized communication modules to provide additional telephone station support, such as analog trunks and T1/E1 lines. Up to three modules can be installed in the Wave IP 500 chassis. Procedures for adding additional modules are described in Chapter 4, “Installing Wave Expansion Cards and Modules.”

Reconfiguring the system

As Wave system capacity is expanded or changed, the software configuration needs to be updated. In most cases, the Wave Global Administrator software autodetects hardware changes and updates the user and system databases automatically. Refer to the *Wave Global Administrator Guide* for more information.

Wave IP 500 chassis (interior view)



Technical specifications

Physical specifications

Dimensions:	2.6 inches high x 17.6 inches wide x 13.75 inches deep (1.5U rack height)
Weight:	14.0 lb (6.4 kg)

Supported expansion modules

Wave systems are custom configured to meet or exceed customer communication requirements. Capacity and features are provided by specialized communication modules shipped with all of the components required to meet customer configuration requirements.

Note: Modules for the Wave IP 500 are essentially the same as the modules that can be used in the Wave IP 2500 as far as functionality and specifications. The only difference is that for modules used in the Wave IP 500, a screw-in faceplate is used.

The modules described in the following section have cross-references to the chapter where the module is described in greater detail. Part numbers for modules used in the Wave IP 500 Server may be different than for the modules used in the Wave IP 2500 Server, unless a universal version of the module is available (universal module part numbers start with “VWU-”). Also, the MRMA for the Wave IP 500 Server is the same (VW-MRMA) as the MRMA used on the Wave IP 2500 Server.

Modules are field installable.

- **Modules** are boards that can be installed in the three module slots.

The following modules are supported on the Wave IP 500:

- **8-Port Analog Trunk Module (VWU-8AT-M).** Supports 8 analog loop start or ground start trunk ports. See Chapter 13.
- **8+8 Port Analog Universal Module (VWU-8X8AU-M).** Supports either of the following configurations. Where indicated, analog FXO trunks can be loop-start or ground-start, configured individually. See Chapter 14.
 - 8 analog FXS station ports and 8 analog FXO trunks.
 - 8 DID trunks and 8 analog FXO trunks.
- **12-Port Digital Station Module (VWU-12DS-M).** Supports 12 digital station ports for Edge 100 or Comdial phones. See Chapter 8.
- **12-Port Digital Station Module (VW-12DS2-M).** Supports 12 digital station ports for Edge 700 or Vodavi phones. See Chapter 17.
- **24-Port Digital Station Module (VWU-24DS2-M).** Supports 24 digital station ports for Edge 700 or Vodavi phones. See Chapter 17.
- **1-Port T1/PRI Module with Serial Interface (VWU-1T1S-M).** Supports a single T1 (PRI or CAS signaling) digital trunk. It features an integrated CSU/DSU, and allows shared data and voice services over a single T1 circuit. See Chapter 15.

- **1-Port E1 EuroISDN Module with Serial Interface (VW5-1ES1-M).** Supports a single E1 ISDN digital trunk. It features an integrated CSU/DSU, and allows shared data and voice services over a single E1 circuit. See Chapter 15.
- **1-Port T1/PRI Module (VW5-T1-M).** Supports a single T1 (PRI or CAS signaling) digital trunk, with no serial interface. See Chapter 15.
- **Quad BRI Module (VW5-4BRI-M).** Supports 4 BRI interfaces. See Chapter 16.
- **Media Resource Module (MRM).** You can upgrade the voice processing resources (or DSPs) on the ISC2 by installing a Media Resource Module A that supports up to 128 additional voice processing channels. Only one MRMA can be installed on the ISC2 (VW-MRMA). The MRMA part number is the same for both the Wave IP 500 and the Wave Server systems. See Chapter 7.

Status indicators

Each Wave communications module (except for the system card) contains at least two light-emitting diodes (LEDs) indicating status. Other modules contain additional indicators to signify their status in the system. The ISC2 has an additional 4 status LEDs that are explained in “” in Appendix E.

Module status indicators are located on the right side of each faceplate. The indicator on the top is a green LED. The indicator on the bottom is a red LED. The combined states of the LEDs and their meanings are shown in the following table.

Ready LED (Green)	Error LED (Red)	Status
ON	OFF	The card or module is operational.
OFF	ON	Initial state when power is turned on. Software on host or card or module has not yet initialized. If the board remains in this state after the Wave system has fully powered up, the card or module is receiving power, but there is an initialization problem.*

Ready LED (Green)	Error LED (Red)	Status
ON	ON	Software is initializing. If the card or module remains in this state after the Wave system has fully powered up, it has failed initialization.*
OFF	OFF	There is no power. If the card or module is correctly plugged into the chassis and the power to the chassis is on, lack of lights on the card or module indicates a fatal error, and the card or module should be replaced.

* Refer to “Card and module troubleshooting” on page E-10 for possible solutions.

Module Riser

The Module Riser (VW5-IP500MOD-R) is a backplane that plugs into the ISC2 and allows for connectivity to up to 3 Wave IP 500 modules.

The ISC2 provides power to the Module Riser.

Power supply

The Wave IP 500 Server is equipped with one power supply. The power supply provides power to the ISC2, VAM, and Module Riser. It is not field replaceable. With the power cord plugged in and the power supply switch on the rear of the system in the ON position, the red button on the front of the ISC2 is used to start the power supply.

To shut down the Wave IP 500 Server, press and hold the red button on the front of the ISC2 for 4 seconds.

Caution: The rocker switch at the rear of the Wave IP 500 Server should only be used if the system fails to shut down normally. Cutting power with this switch may result in loss of data. The system will initiate a full start-up any time this rocker switch is turned on.

If a power failure occurs, an optional Uninterruptable Power Supply (UPS) can provide several minutes of system power, allowing a technician to properly shut down the Wave Server. Wave can also integrate with 3rd-party UPS software to provide graceful shutdown of the system via network or USB signalling.

A UPS is not provided by Vertical, but can be purchased from a third-party source. For information about recommended UPS specifications, refer to Appendix C, “Uninterruptible Power Supply Specifications.”

External power supply for digital phones

An additional external desktop power supply is required to power digital phones (there is no power for digital phones in the Wave IP 500 Server itself). This power supply is not included with the base unit and must be ordered separately.

Important: You must use the external power supply supplied by Vertical—do not substitute a power supply obtained elsewhere.

Vertical Applications Module (VAM)

The Wave IP 500 Server uses a mini-ITX form factor single board computer (SBC). It has a 1GHz Celeron M processor and 1GB of DDR2 memory. It connects to the ISC2 with standoffs, multiple cables, and a custom PCI connection PCB. It is not field replaceable.

Integrated Services Card 2 (ISC2)

Digital Signal Processing

There is one general purpose Digital Signal Processor (DSP) located on the ISC2 which is shared between the VAM and the Fault Monitor Module. The ISC2 provides a V.34 Modem, FAX, tone generators, tone detectors, caller ID generators, caller ID detectors, VOIP Codecs, media channels, and conference channels.

The ISC2 contains sufficient Digital Signal Processing to support a 32-user system. This includes a V.34 Modem, FAX, tone generators, tone detectors, caller ID generators, caller ID detectors, VOIP Codecs, media channels, and conference channels.

Important: The DSP on the ISC2 contains sufficient DSP resources to support a basic PBX with approximately 32 users, however this does not *guarantee* adequate DSP resources for *all* 32-user applications. Your specific applications may require a Media Resource Module (MRM) to provide additional resources. (See Chapter 7 for more about MRMs.)

You must allocate an appropriate number of resources to cover your system demand. If you under-allocate resources, calls may be lost or not handled as expected. To determine whether you have adequate resources on your Wave system to support your required applications, use the Wave Resource Management Advisor, which calculates requirements for most resource types based on your answers to a series of questions, and on the cards, modules, and Wave licenses installed on your Wave Server. For details about how to use the Resource Manager Advisor, see “Managing Wave system resources” in Chapter 23 in the *Wave Global Administrator Guide*.

Power On/Off Button

With the power cord plugged in and the power supply switch on the rear of the system in the on position, the red Power On/Off button (refer to Figure 18-1) on the ISC2 is used to start the power supply and also to perform an orderly shutdown of Microsoft Windows Server 2003 before turning off the power supply.

Reset button

The Reset button provides a way to restart the entire system without turning the power supplies off and on. It is used when the Microsoft Windows Server 2003 operating system cannot be shut down by using the Power On/Off button. The Reset button is recessed and must be activated with a pen tip or other small tool.

Caution: Always attempt to shut the system down using the Power On/Off button before using the Reset button. Using the Reset button can lead to data loss since it bypasses the orderly shutdown of the Microsoft Windows Server 2003 operating system.

The Reset button is located on the right side of the ISC2, left of the Power On/Off button (refer to Figure 18-1).

Fault Monitor Module

The Fault Monitor Module is contained in the embedded microcontroller subsystem. The Fault Monitor Module is designed to monitor and report on critical system events.

Alternatively, the Fault Monitor Module error-trace log can be retrieved and viewed using the General Settings applet (Fault Monitor tab) of the Wave Global Administrator.

The Fault Monitor Module is in regular contact with the following components:

- Microsoft Windows Server 2003 operating system
- Power On/Off button
- Power supply status bits

Microsoft Windows Server 2003 operating system

The FMM communicates with the operating system through a proprietary, low-level driver at intervals of once per second. The fourth status LED blinks at a corresponding once-per-second rate during normal operation and the third status LED flashes at a rate of once every 10 seconds to indicate hardware connectivity. If the operating system fails to contact the Fault Monitor Module at the regular interval, the FMM begins to restart the operating system after about 3 minutes. The watchdog timer waits for 15 minutes after the initial system startup to verify that the operating system is functioning.

Power On/Off button

The Fault Monitor Module also monitors the Power On/Off button located on the front of the ISC2. If the button has been pressed, the Fault Monitor Module signals the operating system to perform a shutdown procedure. All operating system anomalies are sent as error messages to the error-trace log by the Fault Monitor Module.

Additional information

For information about connecting the Fault Monitor Module to a separate telephone line, refer to the *Wave Server Installation Guide*.

For information about enabling the Fault Monitor Module, refer to the *Wave Global Administrator Guide*. For more information about viewing the error-trace log, refer to Appendix A, "Fault Monitor Module and Trace Log."

Modem

The modem port on the ISC2 allows the Wave IP 500 Server to function as a communications server, routing data using Microsoft Routing and Remote Access Service (RRAS). The Wave IP 500 modem serves as a system resource for dial-in and dial-out calls.

- *Dial-in calls* come from remote clients over a trunk line to the Wave IP 500 Server chassis. The modem is configured so that remote dial-in calls automatically connect to the Wave system. Modem calls can come in over T1/E1, ISDN, or analog trunks. They are not limited to the trunks on the ISC2.
- *Dial-out calls* are made *from* the Wave system over a trunk line to an Internet service provider or to another site. The type of dial-out call made when a user requests an Internet connection, known as dial-on-demand or *demand-dial calls*, can be set up through the RRAS administrator application.

Power failover support

Wave provides failover telephone service (power failure lifeline) in the event of a power failure.

If the power fails, the analog phone connected to the SLT 1 port on the ISC2 automatically connects to the analog trunk plugged into the Trunk 1 port, enabling that analog phone to make calls even if the Wave Server is not functioning.

See “Connecting to trunk and station ports on the ISC2” in Chapter 3 in the *Wave Server Installation Guide*. Also in the *Wave Server Installation Guide*, see Appendix B, “Trunk and Station Ports and Pinouts” for RJ-11 interface port descriptions and pinout pairs for the ISC2.

When using that analog phone during a power failure, you do not need to dial an outside access digit (for example 9) to place an outside call.

Hint: When setting up your telephones, locate the analog telephone connected to the SLT 1 port in a convenient area, such as the lobby or front desk, so that it is easily accessible during a power failure.

Alarm relay

Alarm relay only has common (C) and normally open (NO), but no NC pin. The alarm relay is part of the RJ-11 connector for station 2. The station ring and tip are connected to pins 2 and 3 respectively and the alarm relay NO and C signals are connected to pins 1 and 4 respectively.

System ports on the ISC2

Network and telephone functionality is enabled through multiple interfaces on the ISC2, as shown in Figure 18-1.

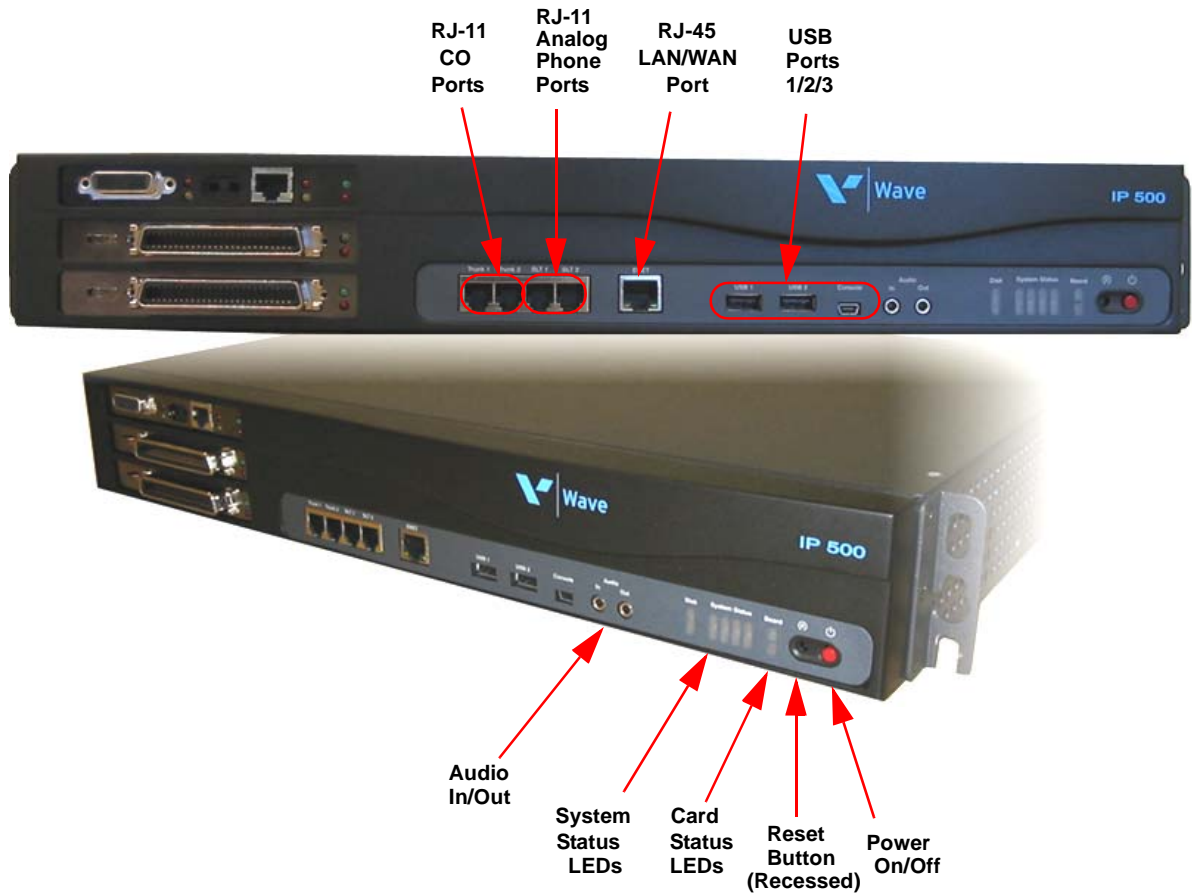


Figure 18-1 System ports, LEDs, and buttons on the ISC2

Telephony ports

2 analog trunk ports provide connection to the local telephone company.

2 analog station ports provide telephone service for up to 2 telephony devices, including telephones, fax machines, and modems.

Ethernet network port

An Ethernet port located on the ISC2 functions as a LAN and Management connection point.

Audio ports

Two audio ports (one input, one output) provide connection to audio peripherals, such as a music-on-hold device and a paging/public address system. The ports are standard 3.5 mm stereo connectors.

Note: You must use a cable with a stereo plug to connect your music-on-hold device to the Wave IP 500 Server chassis. If this cable is not provided with the device, you need to purchase a separate cable. For more information about connecting audio devices, refer to Appendix B, “Connecting Audio Devices.”

USB ports

USB1 and USB2 ports are host ports that both connect devices to the VAM.

Important: USB3 is a device port that connects to a USB host such as a laptop used for debug console support. This port is not normally used by field service personnel and should only be used at the direction of your Vertical support representative.

Technical specifications

General specifications

Compatibility with industry and protocol standards:	EIA/TIA-464B
Emissions:	FCC Part 15 Class A (EMI)
Electrical safety and protection:	FCC Part 68 UL 60950-1

Telephone compatibility

Telephone:	Any FCC Part 68-compliant analog telephone (DTMF only) REN drive (phone port) 3.0B REN
Telephone line:	Analog loop start (trunk) REN load (trunk port) 0.2B REN

Telephony port specifications

Port connector type:	RJ-11 connector
Cable type:	Category 3 or Category 5 (recommended)
Maximum cable run:	3280 ft (1000 m)

10/100Base-T Ethernet port specifications

Compatibility with industry and protocol standards:	IEEE 802.3 CSMA/CD IEEE 802.3i 10Base-T (using RJ-45 connectors) IEEE 802.3u 100Base-T ISO 8802-3 Ethernet
Data rate and encoding:	10 or 100 Mbps/half- or full-duplex; Manchester encoding 100 Mbps/half- or full-duplex; MLT3 4B5B encoding
Port connector type:	RJ-45 modular connector (ISO 8877)
RJ-45 port pin designations:	Pin 1: RX + Pin 2: RX - Pin 3: TX + Pin 6: TX -

Cable type:	EIA CAT3, NEMA 100-24 -STD, or UL Level III (10Base-T only) EIA CAT5, NEMA 100-24 -XF, or UL Level V (10Base-T and 100Base-T)
Maximum cable run:	328 ft (100 m)

Audio port specifications

Port connector type:	3.5 mm stereo (only mono supported)
Input line impedance:	10 kΩ
Output line impedance:	300 Ω
Normal peak levels:	± 1 V
Normal frequency range:	200 Hz to 3400 Hz

There are two audio ports on the ISC2. The one on the left is for music-on-hold (input). The one on the right is for a paging/public address system (output).

Cable connections

Ethernet, telephony, and audio cables can be plugged into the ISC2 as described in the following sections.

10/100Base-T Ethernet switched connections

An Ethernet cable can be plugged into the RJ-45 connector located on the ISC2.

Telephony connections

Four RJ-11 connectors are located on the ISC2 - two for CO ports and two for analog phone ports.

Warning: To reduce the risk of fire, use minimum 26 AWG line cords that have been evaluated as Communication Circuit Accessories, UL 1863, for all telephone connections.

Audio connections

One audio output device (such as a paging or public address system) can be plugged into the audio output port. One audio input device (such as a music-on-hold system) can be plugged into the audio input port. These ports are shown in Figure 18-1.

You must use a cable with a stereo plug to connect your music-on-hold device to the Wave IP 500 Server chassis. If this cable is not provided with the device, you need to purchase a separate cable. For more information about connecting audio devices, refer to Appendix B, “Connecting Audio Devices.”

Fault Monitor Module and Trace Log

This appendix describes how to view and change the Fault Monitor Module (FMM) settings and how to review messages sent to the Fault Monitor Module trace log. It includes the following topics:

- Overview
- Features and functionality
- Accessing the Fault Monitor Module
- Menu options
- Trace log

Overview

The Fault Monitor Module (FMM) is an integral part of the embedded firmware running on the ISC1/ISC2 cards. As soon as the Wave Server is powered on, the Fault Monitor Module starts monitoring the status of the Microsoft Windows Server operating system, the power supply status, the ISC1/ISC2 temperature, and the Power-on/Shutdown button.

The Fault Monitor Module receives a subset of error-trace messages from the system traces that can be critical when troubleshooting the system. Selected system messages are sent to the Fault Monitor Module trace log by the low-level driver as they occur. Messages can be generated by any of the platform modules. Some messages reflect changes in status of system components; other messages pertain to system performance.

The major features of the Fault Monitor Module are:

- Watchdog timer
- 32K SRAM trace log buffer
- ISC1/ISC2 Status indicator

Watchdog timer

The FMM watchdog timer can restart the system automatically if it does not receive a “keep alive” command, or “handshake”, from the low-level system driver. The timer is normally cleared once per second when it receives the handshake. The timer is always running. However, if it is disabled, no action is taken when it times out. By default, it is set to time out at 3 minutes without a handshake, or 15 minutes at the initial system startup.

32K SRAM trace log buffer

The Fault Monitor Module trace log is a subset of the system trace log, with additional trace entries from the Fault Monitor Module itself. The FMM log is stored in flash memory whenever the system is shutdown or restarted in an orderly fashion: a) Red button press on the ISC1/ISC2 face plate; b) Windows restart or shutdown from a Remote Desktop session, or a monitor/keyboard connected to the system; or c) Shutdown from the *Wave Global Administrator*. The FMM log will NOT be saved in flash memory if the power supply is turned off abruptly (i.e., not following an orderly shutdown), or if the reset button on the ISC1/ISC2 face plate is pressed.

Fault monitor buffer

The Fault Monitor main buffer is implemented as a circular buffer so that it always contains the most current traces. The buffer is 32K bytes, and can contain around 250 traces, depending on the size of each trace entry. On each system reboot, the entire contents of this buffer is saved to the file *fmlog.*.txt*, where the * represents the date and time the traces were saved. You can find the *fmlog.*.txt* files on the Wave hard drive in the *C:/Program Files/InstantOffice/Logs* directory.

Status indicators

There are four status LEDs and two card LEDs on the ISC1/ISC2 that indicate the boot progress and general health of the system. Refer to Appendix E for more information about the ISC1 and ISC2 LEDs.

Features and functionality

This section describes the Fault Monitor Module features and functionality in greater detail. Topics include:

- Command line interface (CLI)
- Handshake and time-out Intervals

Command line interface (CLI)

The Fault Monitor Module settings and functions are accessed through an SSH/Telnet communications interface, such as the open source PuTTY utility. Detailed instructions on accessing the Fault Monitor Module using PuTTY are provided in “Accessing the Fault Monitor Module” in the following section.

Handshake and time-out Intervals

The watchdog timer handshake and time-out intervals, and the possible Fault Monitor Module responses to events, are described in Table A-1.

Table A-1 Handshake and time-out intervals and possible responses

Event	Handshake and Time-out Intervals	Possible Response to event
Initial system startup	1st time-out: 15 minutes	System reset
	2nd time-out: 30 minutes	System reset
	Additional time-outs: 60 minutes (Up to 2 attempts)	System reset
Post initial startup: Periodic handshake between the VAM and the ISC1/ISC2.	Every second Time-out: 3 minutes	System reset

Accessing the Fault Monitor Module

This section describes the procedure for accessing the Fault Monitor Module from any PC on the same LAN as the Wave system. That PC can be the VAM itself.

Access to the ISC1/ISC2 from a Windows machine is done via PuTTY. The following is a one time PuTTY installation and configuration setup that is needed:

1. Download and install PuTTY:
<http://the.earth.li/~sgtatham/putty/latest/x86/putty-0.60-installer.exe>

Note: The PuTTY utility is pre-installed on the VAM, which is then accessible via a Remote Desktop session to the VAM.

2. Launch PuTTY.

Setup an SSH session:

- Under Window/Behavior, set Window title to “ISC1” or “ISC2”
- Under Connection/Data, set “Auto-login username” to “root”
- Under Session
 - set Protocol to SSH
 - set Host Name (or IP address) to the IP address of the ISC1/ISC2.
 - set Port to 22
 - set Saved Sessions to “ISC1” or “ISC2” and click Save

SSH Into Linux and Fault Monitor

Follow the procedure below to establish an SSH shell session with Linux on the ISC1/ISC2 using PuTTY:

1. Power on the ISC1/ISC2 if it isn't already.
2. If power was just applied, it is useful to do a continuous ping from a Command Prompt window to know when Linux is ready to accept an SSH connection:

C:\> ping -n -l isc1_ip_address or C:\> ping -n -l isc2_ip_address

Note: The very first time the ISC1/ISC2 boots, Linux does some SSH book keeping and PuTTY will not be available to connect to for about 30-40 seconds during that book keeping. On subsequent boots, Linux will be available for SSH connections as soon as the ping replies come back.

3. Launch PuTTY when the ping is answered in step 2.
4. Load the “ISC1” or “ISC2” session that you setup in the previous section.
5. Click on Open. The default password (for user root) is Vertical4VoIP! You should see a [root@rsc4 ~]# prompt. Note: “RSC4” is the internal Vertical engineering name for “ISC1” or “ISC2”.
6. enter [root@rsc4~]# screen -x rsc4 -p 1

You will get a DBG n> prompt where you can enter commands to the Fault Monitor (described below):

Menu options

This section describes options and corresponding prompts for the following commands:

- H - Help
- V - Version and date of Fault Monitor Module
- S - Status
- L - List trace log
- W - Watchdog timer
- D - Dialout string (unimplemented command)
- C - Clear trace log
- R - Reset Host
- Q - Quit = NMI (unimplemented command)

H - Help

Entering `cli h` or `cli ?` after the DBG prompt, displays the entire Fault Monitor Module option menu, as shown in Figure A-1.

```
cli h
VNI Fault Mon. Cmd. list:
'h' - Help (displays this list)
'v' - FMM Vers. & Date
's' - Status (fans, wdog)
'l' - List trace log
'w' - Watchdog timer
'd' - Dialout string (Unimplemented feature)
'c' - Clear trace log
'r' - Reset host
'q' - Quit (Unimplemented feature)
```

Figure A-1 Fault Monitor Module options menu

V - Version and date of Fault Monitor Module

Entering `cli v` after the DBG prompt, displays the version number of the Fault Monitor Module and the date it was compiled, as shown in Figure A-2.

```
cli v
FMM Version 6.00 Jun 4 2008 19:39:59
```

Figure A-2 Version and date of the Fault Monitor Module

S - Status

Entering `cli s` after the DBG prompt, displays the status of the fans and the watchdog timer, as shown in Figure A-3 (Wave Server system) and Figure A-4 (Wave IP 500 Server).

```
cli s
PwrOKMain=1 ,PwrOKExpansion=0 0 0 0
Watchdog enabled: Page-N, Reset-Y
Host is running: Days = 0, Hrs = 20, Mins = 17, Secs = 37
```

Figure A-3 Status of the fans and the watchdog timer (Wave IP 500 Server)

```
cli s
PwrOKMain=1 Fan status Running
Watchdog enabled: Page-N, Reset-Y
Host is running: Days = 0, Hrs = 20, Mins = 17, Secs = 37
```

Figure A-4 Status of the fan and the watchdog timer (Wave IP 500 Server)

PWROK (Power OK)

Wave IP 2500 Server—This value indicates whether the main and expansion power supplies and/or the fans are operational. The value 0 means the power supply or fan is not functioning properly. The value 1 means the power supply and fan is OK.

Wave IP 500 Server—This value indicates whether the main power supply is operational. The value 0 means the power supply is not functioning properly. The value 1 means the power supply is OK.

These values indicate whether power supplies 1 and 2 are operational. The value 0 means the power supply is not functioning properly. The value 1 means the power supply is OK.

Watchdog timer status

The watchdog timer is always running. However, the status of “enabled” or “disabled” determines how it responds when a time-out occurs.

L - List trace log

Entering cli l after the DBG prompt, lists the following options:

- m (main screen): lists the full 32K main buffer
- l (last 4K): lists only the last 4K of traces in the main buffer

W - Watchdog timer

Entering cli w after the DBG prompt, displays the watchdog timer settings, as shown in Figure A-5.

```
cli w
Watchdog enabled: Page=N, Reset=Y.
Change settings? (y or n)
```

Figure A-5 Watchdog timer

To change watchdog timer settings:

1. Enter cli w after the colon on the command line to invoke the watchdog timer option.
2. Enter cli y after the Change Settings? prompt. The prompt Page on time-out (y or n): is displayed.
3. Enter cli y or cli n. This selection has no effect on this unimplemented feature. The prompt Reset on time-out (y or n): is displayed.
4. Enter cli y or cli n. The command line colon is displayed. You can enter cli w again to confirm your selections.

C - Clear trace log

Entering `c` after the command line colon displays a prompt confirming that you want to clear the entire contents of the Fault Monitor Module trace log, as shown in Figure A-6.

```
c
Clear tracelog now? (cli y or cli n):
```

Figure A-6 Clear trace log

Since the trace log is circular, clearing the buffer is never necessary.

Trace log

System trace messages are generated by the various system software modules and stored in the system trace log. Each module has discretion as to which trace messages are flagged as errors. The trace driver forwards “serious or fatal” error messages to the low-level driver to be forwarded to the Fault Monitor Module.

There are four fields in each message:

- Date
- Time
- System module or component
- Text of message

Viewing the Fault Monitor Module trace log

The Fault Monitor Module trace log is used by technicians to view critical system traces and troubleshoot system anomalies. A sample of the Fault Monitor Module trace log is shown in Figure A-7.

Trace log messages consist of the following information:

- A date formatted as 00-00-00 indicates messages originating from the FM.
- A date formatted as 00/00/00 indicates messages originating from the VAM.
- Date column
- Time column
- System module or component name
- Message text

```

l
list 'cli m','cli b','cli l' (main, bluescreen, last4K)?
l
08-16-2008 13:47:36.306 00134^0400 VNI FMM TraceLog - Power-up
08-16-2008 13:47:36.308 00134^0400 VNI FMM TraceLog - Startup watchdog set to 15 minutes
08-16-2008 13:47:36.309 00134^0400 Version: 0.1 FMM application for RSC4 Aug 3
2008 15:09:10
08-16-2008 13:47:36.311 00134^0400 show_boot_reason: Warm boot
08-16-2008 13:47:36.469 00147^1005 FMMWatchdogProcess Succeeded in starting hardware watchdog 30 seconds
08-16-2008 13:47:47.590 00179^4412 DoCmdKeepAlive - fmmWdogState changed to Running
08-16-2008 13:48:08.080 00179^4412 FMMPProcessIncomingQ command: CMD_WDOG_ENAB len 3 0x9c from: FMM
3 2 ff ff ff ff ff
08-16-2008 13:48:08.907 00179^4412 FMMPProcessIncomingQ command: CMD_STARTUP len
76 0xc0 from: FMM 81 ff ff 4c 0 0 0
08-16-2008 13:48:08.918 00179^4412 VNI FMM TraceLog - Former time.
08-16-2008 13:48:08.921 00179^4412 VNI FMM TraceLog - New time set
08-16-2008 13:49:18.069 00179^4412 VNI FMM TraceLog - Failsafe relays are now disabled.(default)
08/16/2008 13:49:28.040 Minor cm Duplicate streamChan from database (00031000 & 00131000)
08/16/2008 15:46:49.555 Major LowLvl A temperature sensor exceeds acceptable
range - Sensor: Board primary, Measured: 51 C
08/17/2008 00:00:00.766 Minor TRACE Could not retrieve serial number from registry for CDR record.

```

Figure A-7 Fault Monitor Module trace log messages

Connecting Audio Devices

This appendix discusses the following third-party audio topics:

- Music-on-hold systems
- Public Address systems
- Recommendations

Music-on-hold systems

Music-on-hold systems provide background music or custom messages for callers to listen to when they are placed on hold and during a transfer. A user places a caller on hold by pressing the Flash, Link, or Hold buttons or by pressing the flash hook.

A music-on-hold system consists of a device that plays prerecorded music or messages, either from a tape or CD. A radio can also be connected to the Wave system to provide background audio for callers on hold.

Note: Many music-on-hold suppliers provide royalty-free music or a custom message.

The Wave music-on-hold feature is compatible with most standard music-on-hold devices.

Music-on-hold must be enabled in the General Settings applet of the Management Console. Refer to the *Wave Global Administrator Guide* or the online Help system for information about enabling music-on-hold.

Input audio

The music-on-hold audio ports located on the ISC1/ISC2 are stereo jacks; however, only mono output is provided as music-on-hold is only heard when a caller is on hold.

Note: You must use a cable with a stereo plug to connect your music-on-hold device to the Wave Server chassis. If the cable is not provided with the device, you need to purchase a separate cable.

The audio input port located on the ISC1/ISC2 is compatible with all 3.5 mm stereo jacks and plugs.

To install a music-on-hold device:

Warning: Always follow the manufacturer's instructions to avoid possible injury to yourself or damage to the equipment.

1. Follow the directions supplied by the manufacturer of your music-on-hold device to install it and connect it to the Wave Server chassis.

The device plugs into the left-hand side audio port on the Wave ISC1/ISC2. However, each device has instructions for power connections, volume control, and media (such as tape or CD) unique to its own design.

Note: Vertical Communications cannot supply information about specific music-on-hold devices.

2. Attach the device to the Wave Server chassis using a cable with stereo plugs.
Be sure to insert the audio plug into the left jack on the ISC1/ISC2.
3. Start your music-on-hold device by following the manufacturer's instructions.

Note: The Wave Server does not control the performance of the music-on-hold device.

To verify that music-on-hold is operating:

1. Make sure that the music-on-hold device is plugged into the left-hand audio port on the ISC1/ISC2.
2. Make sure the music-on-hold device is operational, as described in the manufacturer's instructions.

Note: The Wave system does not control the performance of the music-on-hold device.

3. From a telephone on the Wave system, call another party.
You will need two people at two different extensions for this procedure.
4. When the party answers, press the button labeled Hold, Flash, or Link (on an analog phone), or press the flash hook (flash hook only works on an analog phone), as shown in Figure B-1.

The party placed on hold hears the music or message played by the music-on-hold device.

Note (for analog phones users only): Callers placed on hold by using the Flash or Link button, or by pressing the telephone flash hook will hear music-on-hold. Callers placed on hold using the button labeled Hold on the telephone will hear nothing.



Figure B-1 Locating the flash hook

Public Address systems

Public Address (PA) systems allow Wave users to make public announcements over a loud speaker, or to page a specific individual on a telephone speaker. A public address system consists of a line out that connects to a PA system that allows you to select the volume of the announcement. The device connects to the Wave system through the output audio connector.

Paging can be restricted to certain Wave users, depending on how your PA system is configured. To page a group of digital phones simultaneously, create a zone paging group according to the instructions in Chapter 16 in the *Wave Global Administrator Guide*.

The Wave paging feature is compatible with the Vertical Communications digital telephones and most standard PA devices.

Paging must be enabled in the General Settings applet of the Management Console. Refer to the *Wave Global Administrator Guide* or the online Help system for information about enabling paging.

Output audio

The public address audio port located on the ISC1/ISC2 is a mono jack.

Installation

The audio output port located on the ISC1/ISC2 is compatible with all 3.5 mm mono plugs. Follow the directions supplied by the manufacturer of your public address system to install it and connect it to the Wave Server chassis.

To install a public address system:

Warning: Always follow the manufacturer's instructions to avoid possible injury to yourself or damage to the equipment.

1. Follow the directions supplied by the manufacturer of your PA system to install it and connect it to the Wave Server chassis.

You must decide how many speakers you need, where they will be located, and how much cabling you require. The PA system plugs into the right audio port on the Wave ISC1/ISC2. However, each system has instructions for power connections, volume control, and other adjustments unique to its own design.

Note: Vertical Communications cannot supply information about specific PA systems.

2. Attach the PA system to the Wave Server chassis using a cable with a mono plug.
Be sure to insert the audio plug into the right jack on the ISC1/ISC2.
3. Start your PA system by following the manufacturer's instructions.

Note: The Wave system does not control the performance of the public address system.

To verify that the PA system is operating:

1. Make sure that the PA system is plugged into the right-hand audio port on the ISC1/ISC2.
2. Make sure all speakers are connected to the PA system and are operational, as described in the manufacturer's instructions.

Note: The Wave system does not control the performance of the PA system.

3. From a telephone on the Wave system, lift the handset, press the Page button or *11, then make an announcement.

The announcement is broadcast over the PA system and each digital telephone speaker that is a part of the associated zone paging group.

Adjust the volume and other settings on the PA system by following the manufacturer's instructions.

Recommendations

Vertical Communications does not recommend any specific brand or manufacturer for music-on-hold devices or public address systems.

Your third-party telecommunications consultant may be able to recommend a brand or model that suits your company's needs.

Uninterruptible Power Supply Specifications

This appendix contains technical specifications for an Uninterruptible Power Supply (UPS). Vertical Communications strongly recommends use of a UPS system that not only provides power for continued operation in the event of a power failure, but also supports unattended shutdown software. Use of a UPS safeguards the Wave system from data loss, hardware damage, and downtime.

A list of UPS systems that have been tested and certified for use can be found under Service and Support on the Vertical Communications Web site. A certified UPS system signifies that the software associated with the UPS has been successfully installed and tested on the Wave system.

A UPS is AC power sourced from a battery. UPS sizing is a function of power requirements and battery size. The higher the power rating, the longer the runtime for the same amount of power consumption.

The maximum power consumption from the AC source for a fully loaded and fully operational Wave IP 2500 Server is 900 watts for the main chassis and 500 watts for each EXU, and 580 watts for the Wave IP 500 Server. A fully loaded chassis has the maximum number of cards, modules, and hard drives installed.

You should select a UPS based on the configuration of your Wave system and desired run time. Refer to UPS web sites for information about expected runtimes for specific UPS systems. Manufacturers may offer different battery options. Discuss your UPS requirements with your reseller.

Many power outages occur as a result of lightning. Florida and Texas are the leading states for lightning strikes and power outages. Most power outages last for less than 15 minutes; however, you must determine the amount of time you want your system to operate without external power.

Environmental Specifications

The following table provides information on minimum and maximum temperature, humidity, and altitude for operating and storing the Wave Server system and all hardware components described in this manual.

.	
Operating temperature:	32° to 104° F (0 to 40° C)
Operating humidity:	80% maximum relative humidity, noncondensing
Operating altitude:	Up to 10,000 ft (3050 m) maximum
Storage temperature:	-4° to 140° F (-20° to 60° C)
Storage humidity:	85% maximum relative humidity, noncondensing
Clearance for servicing	minimum 24 in (61 cm) front and back
Clearance for cooling	minimum 4 in (10 cm) on all sides
AC power source	15-amp circuit required for main chassis and 10-amp for each EXU
Heat emitted	maximum 3080 BTU/hour main chassis, 2050 BTU/hour EXU chassis
Power consumption	maximum 900W main chassis, 600W EXU chassis
Internal US power supply	input voltage: 100-120 VAC, 50/60 Hz input current: maximum 9A main chassis, 6A EXU chassis
Internal International power supply	input voltage: 100-240 VAC, 50/60 Hz input current: maximum 9A main chassis, 6A EXU chassis

The following table provides information on minimum and maximum temperature, humidity, and altitude for operating and storing the Wave IP 500 system and all hardware components described in this manual.

Operating temperature:	32° to 104° F (0 to 40° C)
Operating humidity:	80% maximum relative humidity, noncondensing
Operating altitude:	Up to 10,000 ft (3050 m) maximum
Storage temperature:	-4° to 140° F (-20° to 60° C)
Storage humidity:	85% maximum relative humidity, noncondensing
Clearance for servicing	minimum 24 in (61 cm) front and back
Clearance for cooling	minimum 4 in (10 cm) on all sides
AC power requirements, main system	100-240VAC, 50/60 Hz, 4-2A
AC power requirements, 120W external digital phone power supply	100-240VAC, 50/60 Hz, 2-1A
AC power requirements, 180W external digital phone power supply	100-240VAC, 50/60 Hz, 2.4-1.2A
Heat emitted	1980 BTU/hour max
Power consumption	580W max

LEDs on the ISC1/ISC2

Introduction

There are 4 System Status LEDs and 2 Card LEDs on the Wave ISC1/ISC2 embedded processors.

- The 4 bi-color red, green, off) **System Status LEDs** are used to show detailed information about the current boot progress or state of the Wave Server.
- The 2 (Red and Green) **Card LEDs** are used to indicate the macro status of the system state.

See “General Role of the Card LEDs” on page E-14 for more information.

This Appendix covers the behavior of the System Status LEDs and Card LEDs in the following scenarios:

- **Normal Boot Progress**, including LED Lamp Test, VAM Boot Progress Bar, and Boot Complete. See page E-2.
- **System Shutdown**. See page E-8.
- **Software Updates**, including Firmware Flashing Progress Bar, System Upgrade Status, and Wave System Recovery Progress Bar. See page E-9.
- **Resetting Factory Default IP Settings**. See page E-13.
- **Error Conditions**, including Early Boot Progress Errors, Lost Heartbeat Errors, and VAM Errors. See page E-16.

Normal Boot Progress













A normal boot up of the system, assuming no firmware flashing occur during boot up and no errors, is divided into 3 distinct phases before the system is fully operational:

- LED Lamp Test. See page E-7.
- Early Boot Progress Bar. See page E-3.
- VAM Boot Progress Bar. See page E-5.

See “Boot Complete” on page E-7 for the LED pattern that indicates that the Wave Server booted successfully.

LED Lamp Test


























When the Wave Server is first powered on, an LED lamp test is performed so the administrator can verify that all of the LEDs on the ISC1/ISC2 main board are functioning.







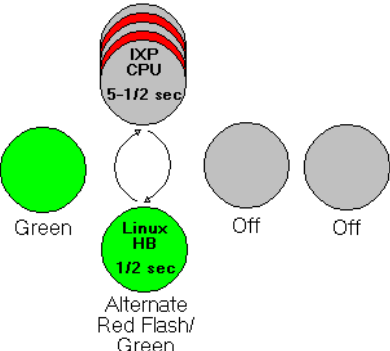


Current Status	Expected Time	System Status LEDs:				Card LEDs:	
		LED1	LED2	LED3	LED4	Red	Green
ISC1/ISC2 boot loader LED Lamp Test: • Red LEDs	0.5s	 Red	 Red	 Red	 Red	 Red	 Off
ISC1/ISC2 boot loader LED Lamp Test: • Green LEDs	0.5s	 Green	 Green	 Green	 Green	 Off	 Green

Early Boot Progress Bar

Once the LED Lamp Test completes successfully, the following sequence of LED settings indicates the progress of the early boot process.

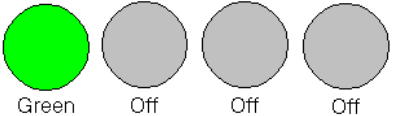
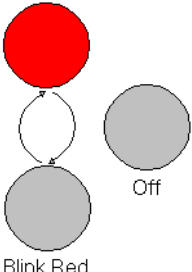
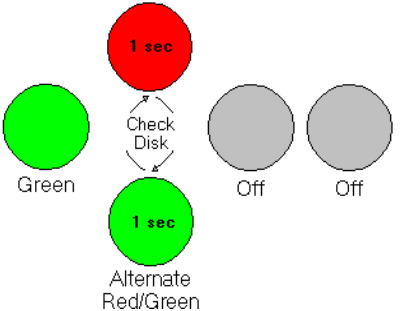
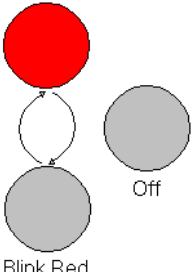
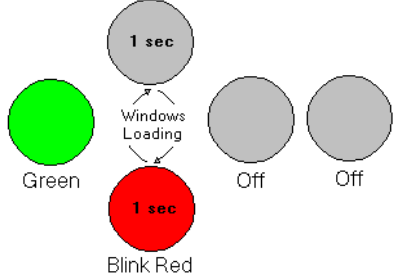
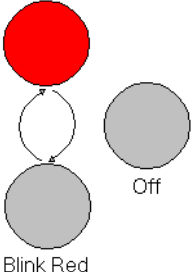
Note: If System Status LED1 is red, it indicates that the LEDs are currently controlled by ISC1/ISC2 boot loader in the early boot phase. If System Status LED1 is green it indicates that the system is in transition to or being controlled by the LED Manager.






















Current Status	Expected Time	System Status LEDs:				Card LEDs:	
		LED1	LED2	LED3	LED4	Red	Green
ISC1/ISC2 boot loader: Early boot initialization and Flash verification	~15s	 Red	 Off	 Off	 Off	 Off	 Off
ISC1/ISC2 boot loader is waiting for PLD Programmer on VAM to connect. Timing can be affected by: <ul style="list-style-type: none"> • BIOS memory test. • The Windows Troubleshooting and Advance Startup menu appearing due to a failure to start Windows on the previous boot. 	~15s with 1.5GHz VAM (up to 150s)	 Red	 1/2 sec  1/2 sec Blink Green Waiting for PLD	 Off	 Off	 Off	 Off
PLD Programmer has connected to ISC1/ISC2 boot loader and is verifying the embedded firmware image.	~12s	 Red	 Green	 Off	 Off	 Off	 Off
ISC1/ISC2 boot loader is loading Linux kernel image into memory.	~5s	 Red	 Green	 Green	 Off	 Off	 Off







Current Status	Expected Time	System Status LEDs:				Card LEDs:	
		LED1	LED2	LED3	LED4	Red	Green
ISC1/ISC2 boot loader is transferring execution control to Linux.	~2s	 Red	 Green	 Green	 Green	 Off	 Off
Linux started.	~6s					 Off	 Off

VAM Boot Progress Bar

Once the early boot process completes successfully, the following sequence of LED settings indicates the progress of the VAM boot process.


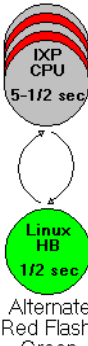
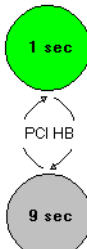
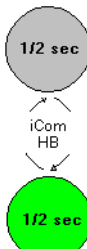

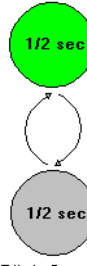
Current Status	Expected Time	System Status LEDs: LED1 LED2 LED3 LED4	Card LEDs: Red Green
LED Manager started.	~5s	 Green Off Off Off	 Blink Red
Check Disk in progress.	0s - or - Several minutes if Check Disk occurs.	 Green 1 sec 1 sec Off Off Alternate Red/Green	 Blink Red
Windows Loading.	~2 mins	 Green 1 sec 1 sec Off Off Blink Red	 Blink Red

Current Status	Expected Time	System Status LEDs:				Card LEDs:	
		LED1	LED2	LED3	LED4	Red	Green
Windows is up.	~5 secs	 Green	 Green	 Off	 Off	  Blink Red	 Off
Loading Basic PBX Services.	~4 mins	 Green	 Green	 1 sec Loading Basic Services 1 sec Blink Red	 Off	  Blink Red	 Off
Basic PBX Services are up. Phone calls can now be made.	~5 secs	 Green	 Green	 Green	 Off	  Blink Red	 Off

Current Status	Expected Time	System Status LEDs:				Card LEDs:	
		LED1	LED2	LED3	LED4	Red	Green
Loading Advanced PBX Services.	~6 mins	 Green	 Green	 Green	 1 sec Loading Advanced Services 1 sec Blink Red	 Blink Red	 Off







Boot Complete

Once the VAM boot process completes successfully, the following LED settings indicates that the system boot process has completed normally and the system is operational.

Current Status	Expected Time	System Status LEDs:				Card LEDs:	
		LED1	LED2	LED3	LED4	Red	Green
System is now fully booted and operational.	Indefinitely	 Green	 IXP CPU 5-1 1/2 sec Linux HB 1/2 sec Alternate Blink Green/ Red Flash/ Green	 1 sec 9 sec	 1/2 sec 1/2 sec Blink Green	 Off	 1/2 sec 1/2 sec Blink Green

System Shutdown







When you press the red Power button on the Wave Server to initiate a system shutdown, the following LEDs are displayed:

Current Status	System Status LEDs:				Card LEDs:	
	LED1	LED2	LED3	LED4	Red	Green
LED Manager Power button— System shutdown in progress	 Green	 5-1/2 sec	 Linux HB 1/2 sec	 1/2 sec	 1/2 sec	 1/2 sec
		Alternate Red Flash, Green/Red Green	Alternate Green/Red	Alternate Red/Green	Blink Red	Blink Green

- If the shutdown type is “reboot”, the Wave Server will restart and the LED Lamp Test will be executed.
- If you press and hold the red Power button for at least 4 seconds, the system power will be turned off when shutdown is complete.

Powering off older Wave IP 2500 Servers

Older Wave IP 2500 Servers with backplane rev 0x34 do not have the capability of turning off the power via programming. On these older systems, the following LEDs indicate that the system can now be powered off manually:

Current Status	System Status LEDs:				Card LEDs:	
	LED1	LED2	LED3	LED4	Red	Green
Shutdown complete. Power off unsuccessful.	 <p>Green</p>	 <p>Red</p>	 <p>Red</p>	 <p>Red</p>	 <p>Off</p>	 <p>Off</p>








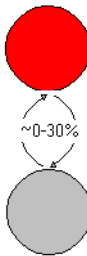




Software Updates

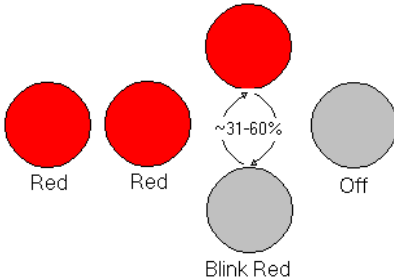
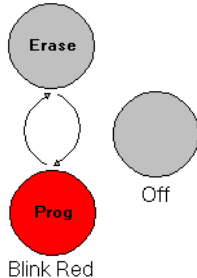
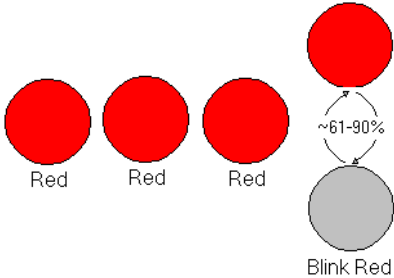
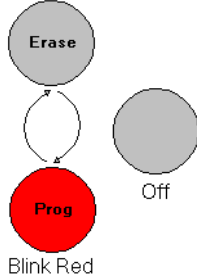
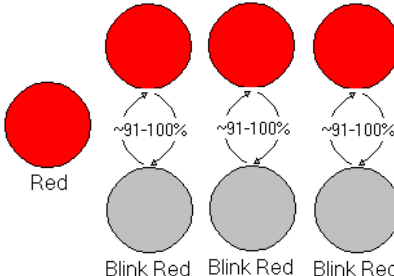
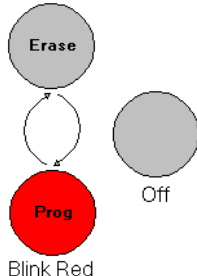


This section covers the following LED progress bars:

- Firmware Flashing Progress Bar. See page E-9.
- System Upgrade Status. See page E-11.
- Wave System Recovery Progress Bar. See page E-11.

Firmware Flashing Progress Bar








During the Early Boot Progress, the ISC1/ISC2 boot loader and PLD Programmer verify the embedded flash image and determine if the firmware needs to be flashed.

Current Status	Expected Time	System Status LEDs:				Card LEDs:	
		LED1	LED2	LED3	LED4	Red	Green
PLD Programmer has connected to ISC1/ISC2 boot loader and is verifying the embedded firmware image.	~12s	 Red	 Green	 Off	 Off	 Off	 Off
ISC1/ISC2 boot loader is flashing the embedded firmware: • ~0-30% complete	~2 ½ mins	 Red	 Blink Red	 Off	 Off	 Erase	 Prog

Current Status	Expected Time	System Status LEDs:				Card LEDs:	
		LED1	LED2	LED3	LED4	Red	Green
ISC1/ISC2 boot loader is flashing the embedded firmware: • ~31-60% complete	~2 ½ mins						
ISC1/ISC2 boot loader is flashing the embedded firmware: • ~61-90% complete	~2 ½ mins						
ISC1/ISC2 boot loader is flashing the embedded firmware: • ~91-100% complete	~1 min						
PLD Programmer is verifying the flash image that was burned.	~12s						













System Upgrade Status

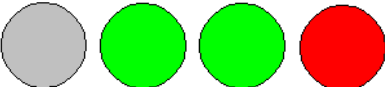

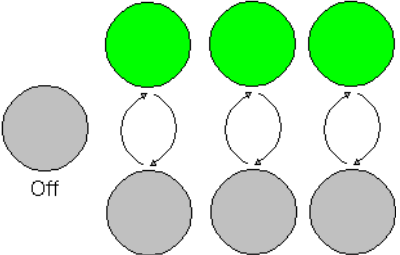
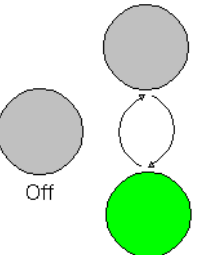
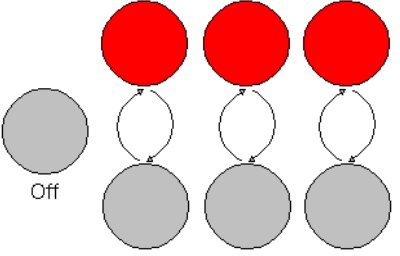
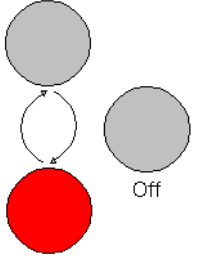
During a System Upgrade, the following LEDs are displayed:

System Status LEDs:				Card LEDs:	
LED1	LED2	LED3	LED4	Red	Green
				 	
Green	Green	Off	Off	Blink Red	Off

Wave System Recovery Progress Bar

The following LEDs settings show the progress of the Wave system recovery process. This process is the same whether the system is imaged from a DVD drive or USB Flash drive.

Current Status	System Status LEDs:				Card LEDs:	
	LED1	LED2	LED3	LED4	Red	Green
USB Flash drive/DVD drive progress: • Partitioning hard drive						
	Off	Red	Red	Red	Red	Green
USB Flash drive/DVD drive progress: • Formatting hard drive						
	Off	Green	Red	Red	Red	Green

Current Status	System Status LEDs: LED1 LED2 LED3 LED4	Card LEDs: Red Green
USB Flash drive/DVD drive progress: • Unpacking CAB file	 Off Green Green Red	 Red Green
USB Flash drive/DVD drive imaging complete. The USB/DVD drive can now be removed.	 Off Blink Green Blink Green Blink Green	 Off Blink Green
USB Flash drive/DVD drive imaging failed. The USB/DVD drive can now be removed.	 Off Blink Red Blink Red Blink Red	 Blink Red Off

Resetting Factory Default IP Settings







The system factory default IP settings of 192.168.205.1 for the VAM and 192.168.205.10 for the ISC1/ISC2 can be reset if needed.

To do so:

1. Make sure that the system power is turned off.
2. Press and hold the red button on the faceplate while turning on the system.



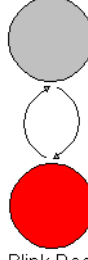


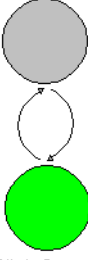
Important: Be sure to continue to press and hold the red button until System Status LED1 and LED4 are both red (this may take up to 15 seconds.)

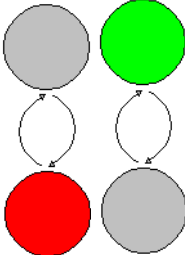
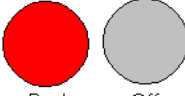
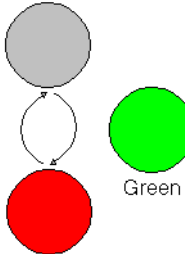
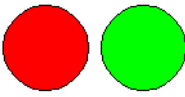
The factory default IP settings will be in effect by the time the system boot is complete as indicated by “Boot Complete” on page E-7.

Current Status	System Status LEDs:				Card LEDs:	
	LED1	LED2	LED3	LED4	Red	Green
Red button detected at power on. Programming factory default IP settings: <ul style="list-style-type: none">• VAM – 192.168.205.1• ISC1/ISC2 – 192.168.205.10	 Red	 Off	 Off	 Red	 Red	 Off

General Role of the Card LEDs



The Card LEDs are used to indicate the general (macro) status of the Wave Server.

Macro Status	Card LEDs:	
	Red	Green
The system is in an early boot phase.	 Off	 Off
System boot is in progress. - or - A firmware flash update is in progress.	 Blink Red	 Off
The system is operational with no errors.	 Off	 Blink Green

Macro Status	Card LEDs: Red Green
System shutdown in progress.	 Blink Red Blink Green
An error condition exists on the system. See “Error Conditions” on page E-16 for more information about specific errors.	 Red Off
System upgrade is in progress.	 Blink Red Green
Wave System Recovery USB Flash Drive hard drive imaging in progress.	 Red Green

Error Conditions

If an error condition occurs, the red Card LED will be turned on solid:

Macro Status	Card LEDs:	
	Red	Green
An error condition exists on the system.	 Red	 Off

There are two general types of errors that are reported via the LEDs:

- Early Boot Progress errors can occur when the ISC1/ISC2 boot loader is booting.
- Heartbeat Lost errors can occur during the VAM Boot Progress if no heartbeat is ever received from the VAM within the startup timeout period, or after the system is fully operational.





































See the following sections for LED patterns for specific errors:































- Early Boot Progress Errors. See page E-17.
- Lost Heartbeat Errors. See page E-19.
- VAM Errors. See page E-21.







Early Boot Progress Errors

An Early Boot Progress error can occur when ISC1/ISC2 boot loader encounters an error condition. The following table shows the possible error conditions.

Important: If you experience a fatal condition, contact your Vertical support representative.


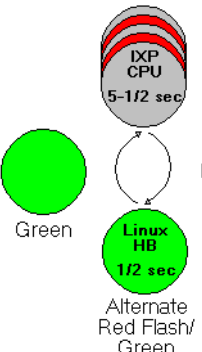

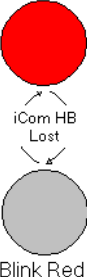


Current Status	Recoverable?	System Status LEDs:				Card LEDs:	
		LED1	LED2	LED3	LED4	Red	Green
LED power on default. ISC1/ISC2 boot loader failed to start.	No— Fatal condition.	 Off	 Off	 Off	 Off	 Red	 Off
ISC1/ISC2 SDRAM memory test failed.	No— Fatal condition.	 Red	 Green	 Red	 Red	 Red	 Off
VAM not detected.	Possibly— Reseat the VAM module.	 Red	 Red	 Off	 Red	 Red	 Off
Administrator has established a session with ISC1/ISC2 boot loader and aborted the boot process for maintenance purposes.	Yes.	 Red	 Red	 Green	 Off	 Red	 Off
Invalid fconfig found in flash. Default fconfig being set.	Yes— IP settings restored.	 Red	 Red	 Green	 Red	 Red	 Off
Flash checksum failure.	Yes— Firmware is reflashed.	 Red	 Off	 Red	 Off	 Red	 Off

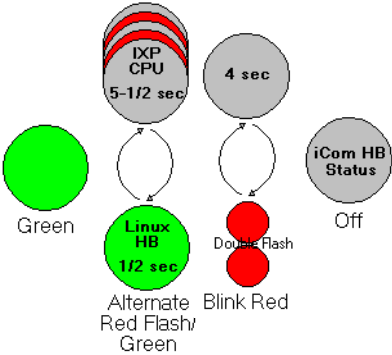


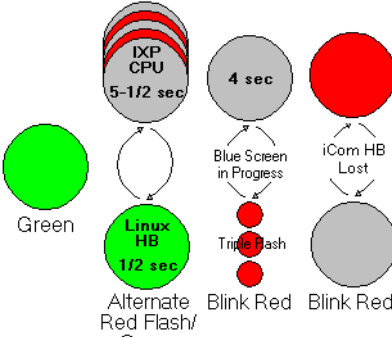


Current Status	Recoverable?	System Status LEDs:				Card LEDs:	
		LED1	LED2	LED3	LED4	Red	Green
PLD Programming failure	Possibly— Firmware reflash is attempted.	 Red	 Off	 Red	 Red	 Red	 Off
Flash checksum failure after PLD Programming.	Possibly— Firmware reflash is attempted.	 Red	 Off	 Green	 Red	 Red	 Off
Too many failed flash programming attempts	No— Fatal condition.	 Red	 Off	 Red	 Green	 Red	 Off
First time MAC/Serial Number programming. This error condition is only seen during the manufacturing process and will not occur during normal system operation.	Yes— Program via Serial Port on ISC1/ISC2.	 Red	 Green	 Off	 Green	 Red	 Off
Normal transient state, however if the LEDs stay in this state longer than 5 seconds, it indicates that Linux failed to start.	Recovery depends on Wave ISM version on the Wave Server: <ul style="list-style-type: none"> On a Wave Server running <2.0: No—Fatal condition. On a Wave Server running 2.0 or higher: Possibly—First the system attempts to recover, and if unsuccessful, the LEDs proceed to the state illustrated in the next table entry indicating too many failed boot attempts. 	 Red	 Green	 Green	 Green	 Off	 Off

Current Status	Recoverable?	System Status LEDs:				Card LEDs:	
		LED1	LED2	LED3	LED4	Red	Green
Embedded firmware had too many failed boot attempts.	No— Fatal condition.						
		Red	Red	Green	Green	Red	Off

Lost Heartbeat Errors

Lost Heartbeat errors are indicated by System Status LED3 and LED4.

Current Status	System Status LEDs:				Card LEDs:	
	LED1	LED2	LED3	LED4	Red	Green
<p>iCom heartbeat has been lost, indicated by blinking LED4.</p> <p>This is usually an indication that there is an IP address problem between the VAM and ISC1/ISC2.</p>						
	Green		Off		Red	Off

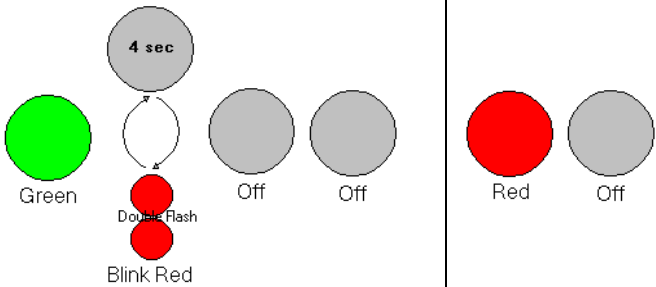
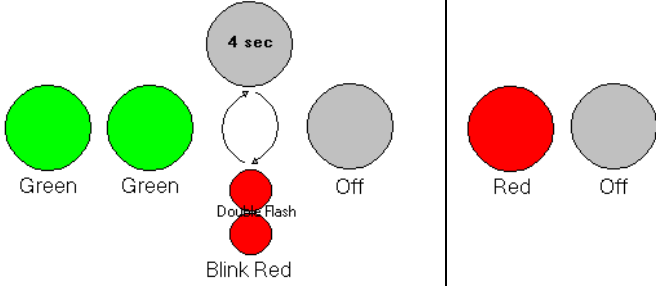
Current Status	System Status LEDs:				Card LEDs:	
	LED1	LED2	LED3	LED4	Red	Green
<p>Fault Monitor Watchdog state:</p> <ul style="list-style-type: none">WARNING ISSUED <p>PCI heartbeat has been lost, indicated by double-flashing LED3.</p>						
<p>Fault Monitor Watchdog state:</p> <ul style="list-style-type: none">NMI ISSUED <p>Blue Screen in Progress, indicated by triple-flashing LED3.</p> <p>By definition in this state the iCom heartbeat will not be present.</p>						




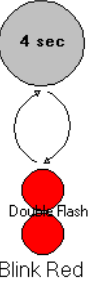


VAM Errors

There are 2 links between the VAM and the ISC1/ISC2: A link running on the PCI bus and a link running over TCP/IP using the embedded Ethernet switch.

The VAM errors described below indicate that a problem was encountered during system startup.

Note: VAM errors may not be fatal, and they may clear automatically.

Current Status	System Status LEDs:				Card LEDs:	
	LED1	LED2	LED3	LED4	Red	Green
Windows failed to start.	 <p>Green 4 sec Off Off Red Off</p> <p>Blink Red</p>					
Basic PBX Services failed to start.	 <p>Green Green 4 sec Off Red Off</p> <p>Blink Red</p>					

Current Status	System Status LEDs:				Card LEDs:	
	LED1	LED2	LED3	LED4	Red	Green
Advanced PBX Services failed to start.	 Green	 Green	 Green	 4 sec Double Flash Blink Red	 Red	 Off

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