Preface

Objectives

The *Cisco VCO/4K System Maintenance Manual* provides information on performing preventive and corrective maintenance routines for peripheral equipment, power subsystem, interface circuits, service and control circuits, and host communication links. It also serves as a reference guide on the diagnostic tools incorporated into the system.

This manual concentrates on fault isolation and refers to technical descriptions to remedy a problem with a specific system component. The *Cisco VCO/4K Card Technical Descriptions* contains specific corrective maintenance procedures for individual VCO/4K system components.

Note This document represents the most current information about VCO/4K mechanical assemblies. If you need information pertaining to VCO/4K assemblies, circuit cards, or other components that are not included in this document, see the following URL on Cisco's web site for legacy VCO/4K information:

http://www.cisco.com/univercd/cc/td/doc/product/tel_pswt/index.htm

Audience

This manual is intended for VCO/4K system users and third-party support personnel. If you are unfamiliar with the VCO/4K system, refer to one or more of the related documents listed in the "Related Documentation" section on page x.

This manual assumes that the host application (if it is a hosted system) is written to conform to the *VCO API Programming Reference Manual*. However, that does not preclude problems occurring between the application and the VCO/4K system.

Each release of the VCO/4K Generic is described in the *Cisco VCO/4K Release Notes* that contain detailed information on changes from one release to the next. If your VCO/4K System includes the SS7 subsystem, refer to the *SS7 Release Notes*.

Document Organization

This document is organized as follows:

- Chapter 1, “General Information,” describes the overall maintenance scope and process.
- Chapter 2, “Preventive Maintenance Procedures,” describes routine housekeeping tasks for the system and for peripheral equipment.
- Chapter 3, “Corrective Maintenance,” describes fault isolation concepts, causes of system malfunctionc, diagnostic tools, and repair by replacement.
- Chapter 4, “Corrective Maintenance—Peripheral Equipment,” describes interface problems, equipment self-test, removal and replacement procedures, and the A/B switch.
- Chapter 5, “Corrective Maintenance—Power Subsystem,” describes the power subsystem operation, alarms, removal and replacement procedures, and troubleshooting.
- Chapter 6, “Corrective Maintenance—Interface Circuits,” describes fault isolation, digital interface card problems, interface card configuration, and troubleshooting.
- Chapter 7, “Corrective Maintenance—Service Circuits,” describes service circuit cards, detecting service circuit card problems, card configuration, and troubleshooting.
- Chapter 8, “Corrective Maintenance—Control Circuits,” describes control circut cards, card configuration, and troubleshooting.
- Chapter 9, “Corrective Maintenance—Host Communications,” describes problem isolation techniques, corrective maintenance procedures, and troubleshooting.

Document Conventions

This document uses the following conventions:

Note Means *reader take note.* Notes contain helpful suggestions or references to material not covered in the manual.

Caution Means *reader be careful.* In this situation, you might do something that could result in equipment damage or loss of data.

Warning **Means *danger.* You are in a situation that could cause bodily injury. Before you work on any equipment, you must be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. To see translated versions of the warning, refer to the *Regulatory Compliance and Safety* document that accompanied the device.**

Related Documentation

The following documents are referenced from this guide or contain information that is directly related to system performance and configuration.

- *Cisco VCO/4K System Software Release Note*
- Cisco *VCO/4K SS7 ISUP Release Notes*
- *Cisco VCO/4K TCAP Release Notes*
- *Cisco VCO/4K Product Overview*
- *Cisco VCO/4K Hardware Planning Guide*
- *Cisco VCO/4K Mechanical Assemblies*
- *Cisco VCO/4K Standard Programming Reference*
- *Cisco VCO/4K Extended Programming Reference*
- *Cisco VCO/4K System Administrator's Guide*
- *Cisco VCO/4K Ethernet Guide*
- *Cisco VCO/4K Site Preparation Guide*
- *Cisco VCO/4K Card Technical Descriptions*
- *Cisco VCO/4K Troubleshooting Guide*
- *Ring Generator Instruction Sheet* (included with the ring generator kit)

The VCO/4K documents are available at:

`http://www.cisco.com/univercd/cc/td/doc/product/tel_pswt/`

Obtaining Documentation

The following sections provide sources for obtaining documentation from Cisco Systems.

World Wide Web

You can access the most current Cisco documentation on the World Wide Web at the following sites:

- http://www.cisco.com
- http://www-china.cisco.com
- http://www-europe.cisco.com

Documentation CD-ROM

Cisco documentation and additional literature are available in a CD-ROM package, which ships with your product. The Documentation CD-ROM is updated monthly and may be more current than printed documentation. The CD-ROM package is available as a single unit or as an annual subscription.

Ordering Documentation

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- Registered Cisco Direct Customers can order Cisco Product documentation from the Networking Products MarketPlace:

http://www.cisco.com/cgi-bin/order/order_root.pl

- Registered Cisco.com users can order the Documentation CD-ROM through the online Subscription Store:

  http://www.cisco.com/go/subscription

- Nonregistered CCO users can order documentation through a local account representative by calling Cisco corporate headquarters (California, USA) at 408 526-7208 or, in North America, by calling 800 553-NETS(6387).

Documentation Feedback

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To submit your comments by mail, for your convenience many documents contain a response card behind the front cover. Otherwise, you can mail your comments to the following address:

Cisco Systems, Inc.
Document Resource Connection
170 West Tasman Drive
San Jose, CA 95134-9883

We appreciate your comments.

Obtaining Technical Assistance

Cisco provides Cisco.com as a starting point for all technical assistance. Customers and partners can obtain documentation, troubleshooting tips, and sample configurations from online tools. For Cisco.com registered users, additional troubleshooting tools are available from the TAC website.

Cisco.com

Cisco.com is the foundation of a suite of interactive, networked services that provides immediate, open access to Cisco information and resources at anytime, from anywhere in the world. This highly integrated Internet application is a powerful, easy-to-use tool for doing business with Cisco.

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Customers and partners can self-register on Cisco.com to obtain additional personalized information and services. Registered users can order products, check on the status of an order, access technical support, and view benefits specific to their relationships with Cisco.

To access Cisco.com, go to the following website:

http://www.cisco.com

Technical Assistance Center

The Cisco TAC website is available to all customers who need technical assistance with a Cisco product or technology that is under warranty or covered by a maintenance contract.

Contacting TAC by Using the Cisco TAC Website

If you have a priority level 3 (P3) or priority level 4 (P4) problem, contact TAC by going to the TAC website:

http://www.cisco.com/tac

P3 and P4 level problems are defined as follows:

- P3—Your network performance is degraded. Network functionality is noticeably impaired, but most business operations continue.
- P4—You need information or assistance on Cisco product capabilities, product installation, or basic product configuration.

In each of the above cases, use the Cisco TAC website to quickly find answers to your questions.

To register for Cisco.com, go to the following website:

http://www.cisco.com/register/

If you cannot resolve your technical issue by using the TAC online resources, Cisco.com registered users can open a case online by using the TAC Case Open tool at the following website:

http://www.cisco.com/tac/caseopen

Contacting TAC by Telephone

If you have a priority level 1(P1) or priority level 2 (P2) problem, contact TAC by telephone and immediately open a case. To obtain a directory of toll-free numbers for your country, go to the following website:

http://www.cisco.com/warp/public/687/Directory/DirTAC.shtml

P1 and P2 level problems are defined as follows:

- P1—Your production network is down, causing a critical impact to business operations if service is not restored quickly. No workaround is available.
- P2—Your production network is severely degraded, affecting significant aspects of your business operations. No workaround is available.

CHAPTER 1

General Information

This manual provides two general categories of information:

- Preventive maintenance addresses actions which ensure continued operation of the system.
- Corrective maintenance describes the diagnostic and repair procedures to perform in response to a system malfunction.

You should be thoroughly familiar with the *Cisco VCO/4K Product Overview.* The VCO/4K system should be installed according to the requirements and procedures described in the *Cisco VCO/4K Site Preparation Guide* and the *Cisco VCO/4K Hardware Installation Guide*. You should also have access to the *Cisco VCO/4K Card Technical Descriptions*.

Original equipment manufacturer (OEM) documents contain details on maintaining the peripheral equipment (console, printer, and modems) connected to a VCO/4K system. Specialized OEM telecommunications equipment (such as voice response units, voice store-forward subsystems, telsets, etc.) are also available with similar documentation. Refer to these OEM documents when performing preventive and corrective maintenance.

Maintenance Procedures

This manual describes the following maintenance and fault isolation procedures for a VCO/4K system:

- Preventive maintenance for console, printer, and floppy drive
- Corrective maintenance for peripheral equipment including:
  - System Console (VDT)
  - Printer
  - Remote maintenance modem
- Corrective maintenance for power subsystems
- Corrective maintenance for the following interface cards:
  - T1 Interface Card for domestic or the E1 Interface Card for international.
  - T1-E Interface Card, which is for use in Japan only.
  - Programmable Four Span T1 Interface Card for domestic use or the Programmable Four Span E1 Interface Card for international.
  - Primary Rate Interface Card with NFAS (PRI/N).
  - E1-Primary Rate Interface Card (E1-PRI) which is for international only.

- Corrective maintenance for the following service circuit cards:
  - Digital Tone Generator (DTG and DTG2).
  - Integrated Prompt/Record Card (IPRC) with 8, 64, or 128 ports.
  - Digital Conference Card (DCC).
  - Call Progress Analyzer (CPA).
  - MF Receiver Card (MRC).
  - MF Receiver Card with Compelled R2 Signaling (MFC-R2) for international only.
  - DTMF Receiver Card (DRC) with 8, 24, or 48 ports.
- Corrective maintenance for the following control cards:
  - Central Processing Unit (CPU) Card
  - Storage/Control I/O Module
  - Network Bus Controller (NBC3)
  - Alarm Arbiter Card (AAC)
- Corrective maintenance for host communication links

Maintenance Aids

The VCO/4K is fault tolerant with an optional provision for control and power subsystem redundancy. System logs and statistical reports monitor system performance. Status LEDs and diagnostic utilities help isolate faults to the subsystem and card level. Replacing cards, as opposed to repairing them, minimizes system downtime.

Performance Monitoring

Cisco Systems encourages VCO/4K application developers to incorporate diagnostic capabilities into their application programs. Refer to the *Cisco VCO/4K System Administrator's Guide, Cisco VCO/4K Standard Programming Reference, Cisco VCO/4K Extended Programming Reference, Cisco VCO/4K Supervision and Call Progress Tone Detection,* and *Cisco VCO/4K Conferencing* manuals for additional details on the performance monitoring features of the VCO/4K system software.

Status LEDs

Light emitting diodes (LEDs) on system circuits and subsystems provide a visual indication of the operational status of individual system components. The *Cisco VCO/4K Card Technical Descriptions* and *Cisco VCO/4K Mechanical Assemblies* identify the meaning of the LED states on each component.

System Log

The VCO/4K incorporates error detection features which output messages on the bottom display lines of the system console. A complete listing of these messages is contained in the *Cisco VCO/4K System Messages*. Messages displayed at the console are also time stamped, logged to a specified storage device

(based on selections in the File System Configuration screen), and sent to the system printer. The system software maintains the error log for 30 days. You can recall the log for display or selectively print it using the Maintenance Menu.

The system log on the VCO/4K stores the following information:

- Status messages reflecting changes to the system database
- Messages associated with read/write functions to storage devices
- Status and results from diagnostic utilities
- System status messages generated during normal system reboot and whenever a switchover of redundant controllers occurs
- Alarm conditions, including host communication link failures

Systems with redundant control maintain “shadow” error logs for both controllers. The administrator or technician can specify which controller’s log file to display or print through the Maintenance Menu. System logs include a designation as to whether the message was generated by the left or the right controller.

You should periodically review the system log to spot any trends which might indicate a chronic hardware or software problem. If problems are detected and repaired in the early stages, system downtime is greatly minimized. System logs are also accessible through a remote maintenance terminal and modem connection.

CHAPTER 2

Preventive Maintenance Procedures

A VCO/4K Open Programmable Switch requires a minimum of preventive maintenance. Peripheral equipment, such as a system console and printer, needs routine inspection, cleaning, and replacement of expendable parts.

Good preventive maintenance includes regular visual inspections of the system and daily reviews of traffic reports. Reviewing traffic reports helps identify faulty stations, lines, trunks, VCO/4K circuits, and VCO/4K subsystems, which may require corrective maintenance.

General Exterior Cleaning

This section details the cleaning requirements for the exterior surfaces of the system cabinet and peripheral equipment. Routine cleaning of components is not a requirement.

Caution Observe antistatic precautions near VCO/4K circuit cards. Wear an ESD wrist strap connected to the VCO/4K equipment frame whenever servicing or cleaning circuit cards.

Never spray cleaning solution on the surfaces of any VCO/4K component. Overspray can penetrate into the device and promote electrical problems and corrosion.

Do not use a cleaning solution containing a solvent which might attack plastic components (such as circuit card handles, trim fittings, and PC boards) or dissolve panel labels.

System Cabinets

You can clean the front door of the cabinet and the front panels of circuit cards with window cleaner and a soft rag. Dampen a lint-free rag with the window cleaner and gently wipe the door to remove fingerprints, dust, and so on.

Caution Do not spray the window cleaner directly onto the door.

Video Display Terminal

Clean the CRT screen of the system console with a lint-free cloth and a cleaning solution recommended by the OEM supplier. Most CRT cleaning solutions are ammonia-based and formulated not to attack plastic housings.

Caution Do not spray cleaning solution directly onto the screen. Dampen the cloth and wipe away fingerprints and dust.

Clean the VDT housing with a mild soap solution on a damp cloth. Do not soak the cloth with solution so that moisture drips onto, or lingers on, external surfaces.

Dust keyboards with a soft bristle brush, or vacuum them. Some keyboards have mechanical (not membrane) key-switches that can be sprayed with a fluorocarbon-based contact cleaner that removes dust and dirt, which can contribute to intermittent key contact.

Check the OEM manual supplied with the VDT for additional cleaning recommendations.

Printer

Clean external surfaces of the printer with a mild soap solution on a damp cloth. Remove ribbon smudges with isopropyl (rubbing) alcohol. Vacuum the interior of the printer to remove loose bits of paper, hair, and dust.

Modems

Clean external surfaces of modems with a mild soap solution on a damp cloth.

System

Preventive maintenance of the VCO/4K system requires:

- Verifying free air flow around and through subracks and subsystems
- Cleaning air filters in the cabinet door
- Visually inspecting cables and connectors
- Backing up database files

The VCO/4K has a locking front door to prevent unauthorized modifications to circuit card arrangements and cable connections. Although the front door is removable, Cisco Systems recommends that you keep it on the system and locked for security measures.

Caution The front door must remain on during system operation for NEBS EMI compliance.

In addition, you can protect the system console by using a password to restrict unauthorized changes to database files (refer to the *Cisco VCO/4K System Administrator's Guide* for more information).

Checking Air Flow

You should periodically check the Fan Fail LED on the fan unit. This LED lights up when one or more of the fans fails.

Periodically check the air filter and clean when necessary (see below). The frequency of cleaning depends on the environment.

Cleaning Air Filters

The front door of the system cabinet is equipped with an air filter made of UL 94 HF-1 foam. This filter and its holder fit into channels on the inside of the door. Examine this filter periodically to check for a buildup of dirt and dust. Use a vacuum cleaner to clean this filter. Replacement filters are available.

If your door has a baffle (aluminum plate) attached to the filter assembly (see Figure 2-1), complete the following steps for cleaning the door filter:

Step 1 Remove the front door from your VCO/4K system as follows:

a. Unlock the door (if necessary).

b. Lift up on the two latches at the top.

c. Lift the door up and out.

Step 2 With the filter assembly still in place, vacuum the entire faceplate of your door *from the front only.*

Step 3 Replace the front door on your VCO/4K system.

Caution The front door must remain on during system operation for NEBS compliance and air filtration.

Replacing the Air Filter Assembly

If your door has a baffle (aluminum plate) attached to the filter assembly (see Figure 2-1), complete the following steps for replacing the door filter:

Step 1 Remove the front door from your VCO/4K system as follows:

a. Unlock the door.

b. Lift up on the two latches at the top.

c. Lift the door up and out.

Step 2 Carefully push the two snap latches on the inside of the door assembly entirely up (refer to Figure 2-1).

Caution Watch your fingers when opening or closing snap latches. The latches are tightly spring loaded.

Step 3 Lift the filter assembly up and out, then set it aside.

Step 4 Grasp the new filter assembly by the sides with the baffle at the top and facing you (see arrows in Figure 2-1).

Step 5 Set the bottom of the filter into the door's bottom brackets.

Step 6 Push back on the top of the filter until it fits firmly into place.

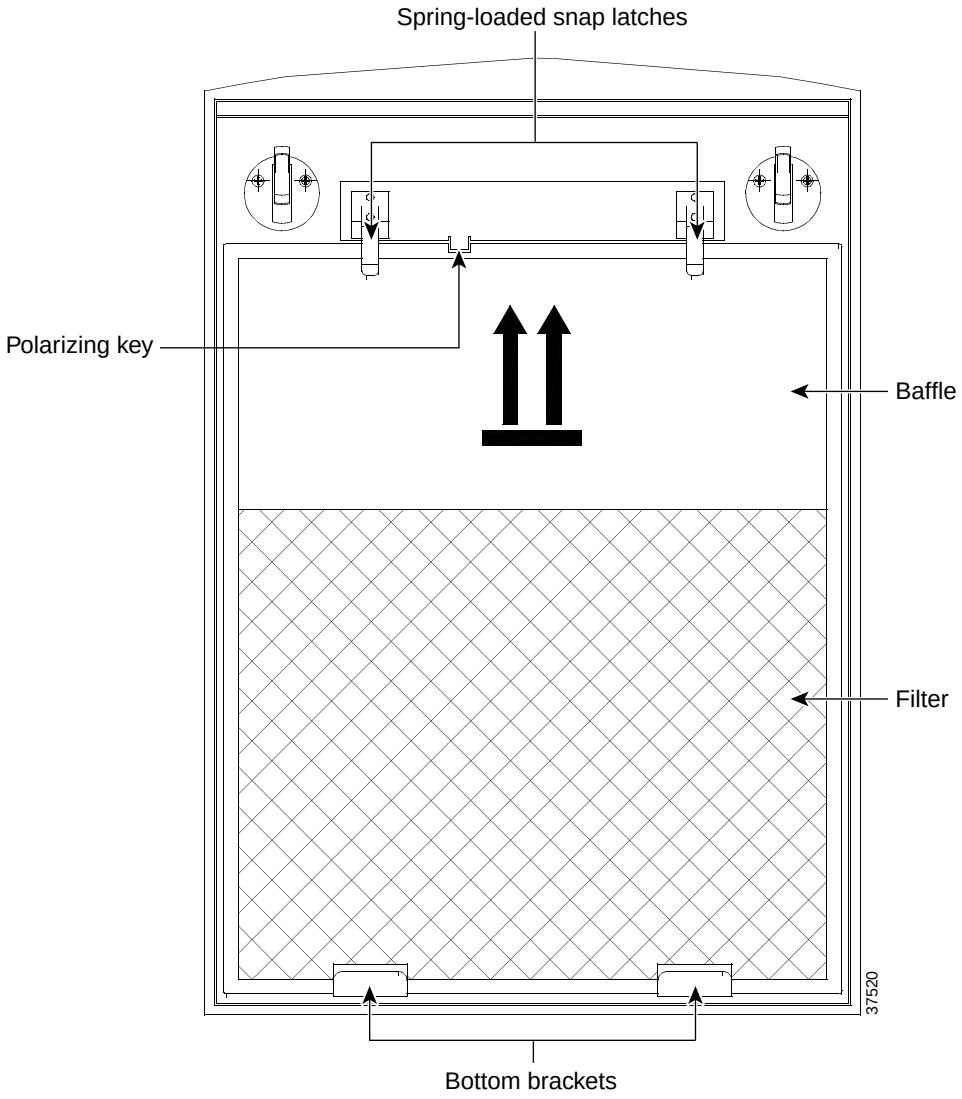
Note The filter assembly is keyed so it will only fit into the door's polarizing key when the baffle is facing up and out.

Step 7 Carefully push the two snap latches on the inside assembly entirely down.

Step 8 Replace the front door on your VCO/4K system.

Caution The front door must remain on during system operation for NEBS compliance and air filtration.

Figure 2-1 Inside View of VCO/4K Door with Baffle



Inspecting Cables and Connectors

Inspect cables and connectors to and from VCO/4K system components periodically to see if they are worn out or loose. Check the cards, power subsystem, and peripheral equipment.

Modules

I/O Modules—Check the connections on the I/O modules. Be sure they are secured to the midplane and have not been jarred loose or mechanically damaged.

Storage/Control I/O Modules—Examine the cable connections to the Storage/Control I/O modules. Check that the cables have not been pinched or jerked loose from peripheral equipment.

Power Subsystem

Examine the input connection to the power entry module. Check that the connection is tight and the cable has not been mechanically damaged. Verify input connections back to the external DC power plant, including the earth ground on the return side of the input loop. Earth ground connections should be checked from the VCO/4K to the earth ground.

Seven cables run from the power backplane to the system backplane, the fan unit, and the Alarm Interface Card (AIC):

- One power cable to the system backplane
- Two 5-volt cables to the system backplane
- Two 5-volt return cables to the system backplane
- One cable to the fan unit
- One 20-pin ribbon cable to the AIC

Checking these cables requires access to the back of the VCO/4K. Remove appropriate cards and blank panels to check the cable connections to the midplane, fan unit, and the AIC.

Peripheral Equipment

Check the peripheral cables and connections to the system console, system printer, and modems. Look for signs of looseness or mechanical damage. Replace damaged cables immediately.

Check all input and output connections to controllers from automatic transfer switches, if you are using these switches. Also examine the cables between the transfer switches and the AAC for signs of looseness or mechanical damage. Replace a damaged cable immediately.

Backing Up Database Files

You should regularly make backup copies of the system database to protect the system against accidental data loss. You can access disk utilities for database backup via the system administration Maintenance Menu. You can also find the utilities on the Installation Utilities diskette. Both utilities copy the system database onto a formatted High Density (HD) 3.5-inch floppy disk.

Use the Database Store function on the Disk Utilities menu (located under the Maintenance Menu) to back up the database on a live system during off-peak call processing hours. Refer to the *Cisco VCO/4K System Administrator's Guide* for complete instructions on backing up data files.

Do not confuse loading software with regular maintenance, for example, database backup. When you load software, use the backup functions provided by the Installation Utilities diskette.

Peripheral Equipment

This section describes general preventive maintenance for VDTs, printers, and modems. Refer to the OEM manuals supplied with the equipment for specific information on preventive maintenance.

Video Display Terminal

A VDT requires little or no preventive maintenance other than routine cleaning of the CRT screen and keyboard. Visual inspection of the EIA cable and keyboard and VDT connections will help spot potential problems caused by damaged cabling.

Self-tests performed on power-up of the terminal indicate the readiness of the VDT for operation. Failure to complete the self-test indicates a need for corrective maintenance.

System Printer

System printers consume ribbons and paper during normal operation. Inspect ribbons for signs of wear and replace as necessary. Replacement ribbons are available from computer supply stores and OEM suppliers. Refer to the OEM manual for ribbon replacement procedures.

Replace paper as necessary. Refer to the OEM manual for details on feeding the paper and setting top of form.

Continuous printer use tends to wear the platen. Platen cleaners are available from computer supply stores. The cleaners restore the rubber surface and help prevent paper slippage. Replace a severely worn platen.

Note Running the printer without a ribbon and/or paper speeds up the wear on the platen.

Moving printer components may require cleaning and lubrication. Components requiring inspection and cleaning or replacement include: home position and out-of-ribbon sensors, print heads and ribbon guides. Refer to the OEM manual for recommended procedures and intervals for cleaning, replacement, and lubrication.

Diagnostics Menu

VCO/4K system software includes a Diagnostics Menu with options for isolating problems and selectively checking the status of individual cards in the system. Details on using the features supported under the Diagnostics Menu are contained in Chapter 3, “Corrective Maintenance” and the *Cisco VCO/4K System Administrator's Guide*.

CHAPTER 3

Corrective Maintenance

The chapter reviews basic corrective maintenance procedures for the VCO/4K system. It covers the hierarchy of possible causes for system malfunctions and the diagnostic tools available. It also includes system reset procedures for nonredundant and redundant systems. The chapter discusses Cisco Systems' repair-by-replacement policy and the concept of field replaceable units. The chapter ends with flowcharts that aid in resolving host communications issues.

Fault Isolation

Fault isolation involves identifying a problem, analyzing its cause, and applying the appropriate solution. VCO/4K systems incorporate extensive error messaging and logging facilities which help in the identification process. Problems tend to have multiple causes which must be identified, individually analyzed, tested, and confirmed. Repair attempts that simply replace components on a hit-or-miss basis usually mask rather than resolve actual causes of system malfunctions.

Host Computer Applications

Because the VCO/4K functions as a server to a host computer, fault isolation must also take into account the state of the host computer and its application software at the time a fault is discovered. Troubleshooting thus requires knowledge of the host computer system, the diagnostic capabilities of the application software, the error logging and diagnostic capabilities of the VCO/4K, and basic telephone network test and service procedures.

This manual describes how to use the diagnostic tools and procedures supported by the VCO/4K itself. Application developers must provide service technicians with details of the diagnostic capabilities of the host computer system and its application package.

System Log

The “Maintenance Aids” section on page 1-2 briefly describes the system log of error and status messages, available through the VCO/4K system administration menus. Daily review of system logs reveals clues as to possible system problems. However, a true indication of overall system performance requires a history of system performance.

Cisco recommends that you keep the daily printed output of error and status logs for a month. The logs record all system error and status messages output by the system. They provide an excellent history of performance problems and maintenance activities requiring system reinitialization.

Note To assure that a continuous hard copy record of the system error log is always available, Cisco recommends not turning off (deselecting or powering off) the system printer except for maintenance purposes. You can also write system log files to either floppy or hard disk for later use depending on the File System Configuration screen selections you make (refer to the *Cisco VCO/4K System Administrator's Guide* for more information).

Hierarchy of the Causes of Malfunctions

When performance monitoring indicates a system problem, you should compare the symptoms of the problem against a possible hierarchy of causes. Except for the human error factor, the causes of a system malfunction are either external or internal.

External causes of malfunctions include:

- Central Office (CO) services
- Host computer, its application, and/or its communications software
- Peripheral equipment
- Specialized communications equipment
- Power and ground irregularities

Internal causes of malfunctions include:

- Database errors
- Bus errors
- CPU and memory
- Mass storage
- Interface and service circuit hardware problems
- Software/firmware incompatibility

Diagnostic Tools and Fault Isolation

VCO/4K software includes diagnostic tools to help isolate the possible causes of a problem. These tools include: error logs, status LEDs, alarm conditions, and administrative maintenance and diagnostic routines.

The diagnostic tools must be complemented by diagnostic routines incorporated into the host application software. The VCO/4K command set includes support for the development of host-controlled diagnostics, including the ability to remove ports from service, monitor card status, and initiate alarms. Thus, the host can trigger events in the VCO/4K that can have the effect of placing portions of the system out of service. Replacing cards and performing other corrective maintenance procedures does not cure a fault caused by the host application.

Human Factor

The most likely cause of a system malfunction remains the human factor. Failure to follow recommended procedures for installing, programming, and maintaining the system, results in problems which can sometimes be very difficult to trace.

The VCO/4K is a system of integrated components. Its operation depends on office data entered into the system database. It is coupled to external CO facilities through a main distribution frame that should be carefully mapped and updated as changes are made to the system configuration.

The technical documentation set contains information about, and organizational tools for, installing and maintaining a VCO/4K system. Technicians responsible for maintaining the system should be thoroughly familiar with the following documents:

- *Cisco VCO/4K Hardware Planning Guide*
- *Cisco VCO/4K Site Preparation Guide*
- *Cisco VCO/4K Hardware Installation Guide*
- *Cisco VCO/4K Card Technical Descriptions*
- *Cisco VCO/4K Mechanical Assemblies*
- *Cisco VCO/4K System Release Notes*
- *Cisco VCO/4K System Administrator's Guide*
- OEM manuals supplied with peripheral equipment installed as part of the system configuration

Technicians should also obtain copies of the documentation set for the host computer system and its application software package. Knowledge of communication protocols and the I/O interface to the VCO/4K is also important.

External Causes of System Malfunctions

This section presents a hierarchy of external causes of malfunctions. Causes appear in the order they are most likely to occur.

CO Facilities

Lines, trunks, and channel banks connect the VCO/4K to the local central office (CO) or to specialized telecommunications equipment. Problems associated with CO facilities include:

- Loss of, or degraded transmission over, incoming direct connect lines from stations
- Loss of, or degraded transmission over, dialup trunks or incoming digital trunks
- Loss of, or degraded transmission over, outgoing analog or digital trunks
- Improper or missing answer supervision on outgoing lines
- Failure to complete routing of incoming calls to VCO/4K over dialup lines
- Failure to complete routing of outgoing calls to terminating numbers
- Failure to complete CO access to InterLATA Carriers
- Hardware damage to interface cards

When individual CO interface circuits fail, calls are blocked from obtaining service or completing a connection to the terminating number. Traffic reports log the loss of service.

When a block of interface circuits fails, the problem is usually the failure of a VCO/4K interface card. The exception to this general rule is the failure of a digital span, which causes the loss of up to 24 channels. A digital span can be lost at the channel bank, the digital switch, or at its interface point with the VCO/4K.

Host Computer System

Because the VCO/4K acts as a peripheral device connected to the host, any hardware or software problems occurring at the host translate into problems with the VCO/4K. Such problems can manifest themselves in the following ways:

- Failure to complete calls through the system due to:
  - Timeouts
  - Erroneous or incomplete commands
  - Mismatched database information (inpulse/outpulse rules)
  - Host computer downtime
  - Throttling caused by improper overall system configuration
- Alarm conditions triggered by the host
- Loss of host communication link(s)
- Frequent reinitialization of the system

The host application must be able to generate its own error messages. This is particularly true whenever the host issues a command to trigger an alarm on the VCO/4K. Such alarms are usually the result of a failure (in call processing or communications) detected by the host application software. A detailed error message should indicate why the alarm was triggered so that you can quickly isolate and remedy the cause.

Peripheral Equipment

Problems with peripheral equipment can cause the following operational failures in a VCO/4K system:

- VDT related
  - Erratic error messaging or display faults on the system console
  - Inability to access or make changes to the database
  - Inability to access error logs or maintenance and/or diagnostic menus
- Printer related
  - Garbled printout
  - Loss of error messages
  - Periodic reports
- Related to the remote maintenance modem
  - Inability to perform remote maintenance
  - Multiple login attempts due to noisy lines

The principal causes of problems related to peripheral equipment are improper installation, improper cabling, and/or loss of setup parameters. The *Cisco VCO/4K Hardware Installation Guide* specifies the cabling and setup parameters required for interface with the VCO/4K. Users must enter peripheral operating parameters in the system database through the Peripheral Configuration screen (refer to the *Cisco VCO/4K System Administrator's Guide* for instructions). These parameters must match the setup parameters defined at the peripheral (refer to the OEM documentation supplied with the peripheral for setup instructions).

VDTs usually experience keyboard and monitor problems because of frequent use. Printer mechanisms wear out over time, and modems can be damaged by line surges over power or CO connections.

Power Subsystem Inputs

Loss of input power to the power entry module results in failure of the VCO/4K. Intermittent power surges and sags, as well as induced noise, can produce the following problems:

- Memory and bus errors causing erratic system performance
- Frequent reinitialization attempts of controllers or individual circuit cards
- Shutdown of power supply modules

Internal Causes of System Malfunctions

This section presents a hierarchy of internal causes of malfunctions. Causes appear in the order they are most likely to occur.

Database

Entering and maintaining database entries that address the system configuration requires a thorough understanding of all the elements in the system. System performance degrades if a discrepancy (such as erroneous additions, moves, and changes to the database) is introduced between system elements and database entries. The *Cisco VCO/4K System Administrator's Guide* describes the procedures required to maintain the system database.

Problems with the database can result in the following:

- Failure to complete calls processed through the system
- Frequent system reinitialization
- Poor grade of service performance
- Rejection of multiple messages sent by the host
- Inability of host computer to connect, or reconnect to the switch
- Frequent inpulse and outpulse aborts

Tracing database problems requires a very detailed examination of database entries across all of the individual menus associated with a potential problem.

Bus Errors

Bus errors can occur as follows:

- During polling communications between interface and service circuit cards and the NBC3
- At the packet communications link between the NBC3 and SWI
- Along the VMEbus in the control system

These occurrences display error messages identifying the affected bus and cards.

Intermittent bus errors can be the result of:

- Abnormal interface signals
- Power surges or sags
- Environmental problems related to operating temperature and humidity

Persistent bus errors can be a sign of:

- Circuit card failure
- Faulty midplane connections
- Interconnecting cables

Combined Controller Assembly

CPU, memory, and peripheral interface problems can be traced to the Combined Controller Assembly (CPU and SWI). Combined Controller Assembly problems can be caused by improper jumper settings on the card, card failure, or bus faults. Problems associated with the Combined Controller include:

- Continuous system reinitialization
- Failure to completely initialize the system
- Frequent file-related errors
- Inability to update database tables
- Failure to recognize and/or complete call attempts
- Update channel failures between redundant controllers
- Communications problems with peripheral equipment
- Host communication link failures
- Message parsing errors

If the Combined Controller fails to establish communications with the NBC during initialization, the CPU performs a Phase 4 reboot. A message on the system console indicates that a reboot is beginning. If this series of events recurs, there could be a problem with SWI and NBC3 communications.

Mass Storage

Mass storage problems are associated with read/write operations from or to the floppy or hard disk drive. The mass storage complex includes the Combined Controller, which houses the floppy drive, and the Storage/Control I/O module, where the hard drive is installed.

Mass storage problems cause the following events to occur:

- File transfer errors between system memory and the database
- Inability to open, close, read from, or write to a file
- Failure to download data from disk to downloadable cards
- Denial of access to error logs
- Inability to log in

Interface and Service Circuit Cards

Causes of hardware failures on individual circuit cards can be:

- Incorrect interface configuration
- Environment (operating temperature and static electricity)
- Transient power surges
- False signaling from external sources (lightning, transient or recurring overvoltage or shorts)
- Faulty midplane connections
- Discrete component failures

Software/Firmware Incompatibility

VCO/4K circuit cards include one or more PROMs. The PROMs contain coded firmware that interacts with the VCO/4K system software to control operation. Refer to the *Cisco VCO/4K Card Technical Descriptions* for the locations of PROMs on VCO/4K circuit cards. The system software release notes lists the firmware revision levels required on all circuit cards. The system does not function properly without the correct firmware.

If you experience system problems after loading the new system software or when replacing a circuit card, check for firmware compatibility. Always refer to the configuration information contained in the release notes. Obtain the correct firmware PROMs from Cisco Systems and install them on all affected circuit cards, including those held as spares.

Diagnostic Tools

The VCO/4K provides diagnostic tools to facilitate fault isolation. These tools consist of error and status logs, status LEDs, alarm conditions, and diagnostic test routines run from the system administration console.

Error Logs

The role of error and status logs in the fault isolation process is described in the “System Log” section on page 3-1. Remote maintenance access to log files allows Cisco technical support and/or administrators of multisystem installations to quickly review the recent performance of a system.

Note During periods of high traffic volume, remote maintenance by way of a modem might not be desirable. Modem access can overload the Combined Controller, causing calls to be dropped or lost.

Status LEDs

Status LEDs indicate the operational status of individual circuit cards and subsystems. Refer to the *Cisco VCO/4K Card Technical Descriptions* and *Cisco VCO/4K Mechanical Assemblies* for the LED patterns for all VCO/4K system components.

Note The operational status of LEDs on peripheral and specialized telecommunications equipment varies according to manufacturer. Review OEM manuals for detailed information.

Alarm Conditions—System Wide

VCO/4K systems support an alarm condition scheme consistent with the alarm requirements described in Bellcore specification *OTGR: Network Maintenance: Network Element*.

Severity Levels

System-wide alarm conditions are divided into four severity levels—fatal, critical, major, and minor. Fatal alarms cause a system switchover (in redundant systems) or a system reset (in nonredundant systems).

Critical, major, and minor alarm conditions require action to resolve the problem. Recovery from a major alarm may require component replacement and a controller reset, thus placing the system out of service. Minor alarms might require software and/or hardware changes before the condition is eliminated and the alarm is reset.

The host can set two additional auxiliary alarms by sending a Set/Reset Host Alarms ($C0 03) command. Refer to the *Cisco VCO/4K Standard Programming Reference* and *Cisco VCO/4K Extended Programming Reference.*

Alarm Condition Indicators

Alarm condition indicators appear:

- On the front panels of system cards
- In several system administration screen displays
- Within system log file messages
- In optional periodic alarm summary reports

The Alarm Arbiter Card (AAC) supports local and remote indications of system-wide problems by a combination of highly visible LEDs and external alarm contacts (when connected). The Major Alarm LED on the card front panel indicates fatal, critical, and major alarm conditions. You can connect the external alarm contacts to audible alarms, to alert technicians to problem conditions. An option on the system administration System Alarms Display screen allows users to disable these audible alarms.

Note The Audible Cutoff (Y/N) option on the System Alarms Display screen disables the Major Alarm LED indicator on the AAC as well as the external audible alarms. It does not clear the alarm condition.

The *Cisco VCO/4K Card Technical Descriptions* and *Cisco VCO/4K Mechanical Assemblies* describe major and minor alarm conditions for individual circuit cards and subsystems.

Screens for Monitoring Alarms

The following system administration screens provide indications of system alarms:

- System Alarms Display—Provides a general description of the alarm condition, the alarm's severity, and its number of occurrences.
- Card Alarm Display—Provides detailed information on alarm conditions for all network interface cards and service circuit cards.
- System Host Configuration—Provides detailed information on host link alarms.

System Log File

The system log file provides information on general alarm conditions. It contains combination messages with both ALM and FRM prefix codes to indicate alarm conditions. These messages are written to the log file only at the initial occurrence of the alarm condition; similarly, messages are generated only for the clearing of the last occurrence of the alarm. In addition to these messages, an optional periodic alarm report can be written to the log file five minutes after system initialization and at 30-minute intervals thereafter. This option is activated or deactivated in the System Features screen (refer to the *Cisco VCO/4K System Administrator's Guide*).

The *Cisco VCO/4K System Administrator's Guide* discusses administration screens that display alarm conditions and system log file alarm messages.

Alarm Condition ($F0) Report

The Alarm Condition ($F0) report notifies the host of alarms. This report provides the same level of information to the host as the System Alarms Display provides to the system administrator. Alarm codes within the report map to the same ALM alarm messages that appear on the System Alarms Display and in logfile messages. Refer to the *Cisco VCO/4K Standard Programming Reference* and *Cisco VCO/4K Extended Programming Reference* for a description of the $F0 report.

Diagnostics Menu

The Diagnostics menu offers the following options:

- *Create voice paths between ports*: You can map a receive port to a transmit port in the system. Use the Set Up Paths screen to create up to eight paths and to maintain and display all the paths.
- *Display card or port data*: The Card Display and Port Display screens show the current operating status of a service circuit or interface card without taking the card out of service. Information on the Card Display varies according to card type. Access the Port Display through the Card Display screen. The Port Display shows processing states, rule processing, links, paths, and digit collection activity.
- *Display conference data*: In systems equipped with SPC cards, the Conference Menu shows the current status of participating line, trunk, and conference ports for any conference structure. An additional screen, the Conference Display, supports multiple screens, each containing listings for up to 14 conference parties. Refer to the *Cisco VCO/4K Conferencing Guide* for additional information on the VCO/4K's conferencing capabilities.
- *Test service circuits*: The Service Circuit Test Utility allows you to initiate tests on selected service circuit cards in the system. The system displays the results of the tests on the system console screen and sends them to the system printer.

- *Test port cards*: Use the Test Port Card function to test individual T1 Card (T1) channels or ISDN B-channels. The test sets a path over the selected channel(s) between selected DTMF or MF receiver circuit(s) and a tone channel, and then sends digits to the receiver. The system compares the digits sent with the digits received. If it detects any discrepancies, it sends an error message, the two digit test strings, and the addresses of the channel to the error log and the system printer. You can test any or all channels on the same card with a single command. Test the channels in sequential order from the start channel specified to the end channel specified.
- *Display virtual call generation port data*: The Call Generation Ports Display shows the status of all virtual call generation ports. A virtual port is a logical entity maintained by VCO/4K generic call processing as an internal resource group. You can also call up the Port Display showing the status of all ports in this special resource group.
- *Monitor call progress tones during call processing*: The Call Progress Tone Monitor screen shows the detection of call progress tones on a line or trunk port. A CPA port detects signaling events that occur during a call. The screen displays event detections, current port states, and transitions for the monitored line or trunk port and for any attached line or trunk port.

For a complete description of these functions and usage instructions, refer to the *Cisco VCO/4K System Administrator's Guide*.

System Reset Procedures

The *Cisco VCO/4K System Administrator's Guide* and the *Cisco VCO/4K Hardware Installation Guide* provide detailed procedures for booting the system from hard or floppy disk. The following sections describe the maintenance implications of a system reset.

Nonredundant Systems

A critical or major alarm in a nonredundant system might cause the AAC to initiate a reset (reinitialization) of the Combined Controller. (A fatal alarm condition always causes a system reset.) The CPU is cleared of all current data, thus dropping all calls in progress. Service disruption lasts until the entire reset process is complete.

Resets are not required to service the Combined Controller (where the floppy drive resides) and/or the Storage/Control I/O module (where the hard drive resides), or to replace an NBC3.

Redundant Systems

A critical alarm in a redundant system can cause the AAC to switch over to the standby controller. (A fatal alarm condition always causes a system switchover.) Port states are maintained during switchover processing to minimize disruption of service.

An enhanced redundancy feature enables the standby controller to process the new SETUP redundancy information. Both the active and standby controllers consistently track all ports in a stable or setup state, as well as conference calls.

A standby controller can be serviced while the active controller maintains system operation.

Note To avoid an inadvertent reset or switchover between controllers, set the **Select** switch on the AAC to the active controller side—not in the AUTO position. Return the **Select** switch to the AUTO position after you have completed servicing one side.

Automatic synchronization utilities copy and restore files from the active to the standby controller prior to restoring the standby controller to service. You can reboot standby controllers from hard disk or floppy disk without disrupting system operation.

Service Circuit and Trunk Card Downloads

The following service circuit and trunk cards require a software download from hard disk prior to being brought into service:

- NBC3
- MVDC-T1
- IPRC
- CPA
- PRI/N
- E1-PRI
- SSC (Subrate Switching Card)
- Drop and Insert Card
- DRC-24 and DRC-48
- Four Span Programmable T1 and Four Span Programmable E1

During initial system power up (cold reset), the software downloads are broadcast simultaneously to each card type. The system is restored to operation after all downloads have been completed. If an individual downloadable circuit card is removed and replaced, it is selectively downloaded when its power-up sequence is completed before being activated.

Repair-by-Replacement

The Cisco repair-by-replacement policy provides maximum system availability with minimum downtime. The technician can remove and replace field-replaceable units (FRUs) to bring the system back to normal operation as quickly as possible. Components removed from service can be returned to the factory for quick turnaround repair.

Spares Inventory

To maintain maximum system availability, Cisco encourages the customer to purchase spares of critical components to have on hand when a component failure is isolated and replacement is required. The *Cisco VCO/4K Hardware Planning Guide* lists spare components available from Cisco Systems.

Obtain spare parts and maintenance kits for peripheral equipment from OEM suppliers. Peripheral and host link cables are available from Cisco and computer supply sources.

Field-Replaceable Units

The *Cisco VCO/4K Hardware Planning Guide* lists spare components that can be replaced in the field by trained technicians. It lists the recommended spares for the VCO/4K system. Items not in the list can only be serviced or replaced by the factory or by Cisco Systems field engineers.

Troubleshooting

For more information about troubleshooting, refer to the *Cisco VCO/4K Troubleshooting Guide.*

CHAPTER 4

Corrective Maintenance—Peripheral Equipment

This chapter reviews fault isolation and general repair procedures for peripheral equipment interfaced with a VCO/4K. Peripheral equipment items include: master console, system printer, and remote maintenance modem. Review the OEM manuals supplied with these items for detailed repair procedures and parts ordering information.

Interconnection and Interface Problems

If the peripheral equipment is not properly configured, or if it is improperly cabled, it may fail to operate or it may exhibit intermittent failures.

Refer to the *Cisco VCO/4K Hardware Installation Guide* and OEM documentation supplied with the peripheral equipment for proper configuration (or setup) parameters. The parameters are defined in the VCO/4K database via the system administration Peripheral Configuration screen. Refer to the *Cisco VCO/4K System Administrator's Guide* for information on how to configure peripheral equipment parameters.

Improper cabling can also cause failure or intermittent problems. Refer to the OEM documentation, *Cisco VCO/4K Hardware Installation Guide* and the *Cisco VCO/4K Site Preparation Guide* for information on peripheral equipment cabling.

Typical problems associated with setup parameters and cable faults are described in the following sections.

Master Console Setup and Interface Parameters

Master console operating parameters (Baud Rate, Stop Bits, Bits per Character and Parity) in the system database must match the VT220/320 and WYSE Technology WY-185/185ES setup parameters. Variations in the data bits settings can cause data fields in menu displays to contain strange-looking characters. Mismatched baud rates may produce erratic screen displays, long blanking intervals, or no screen display at all.

VT220 mode operation, with Application Keypad and Application Cursor Keys selected, enables the feature key functions on the digit keypad and the programmable function key settings along the top row of keys on the keyboard.

A three-conductor serial cable carries the receive and transmit lines along with signal and equipment ground to the Serial Port 1/Console port on the Storage/Control I/O Module. Cable or serial port problems may not blank the screen because the VDT stores the data for each screen display in its own memory.

System Printer

The VCO/4K requires a parallel printer with a Centronics-type interface for use as the system printer. You must define the End of Line terminator (EOL) for the printer interface in the system database, and match the printer setup configuration prior to use. If this parameter is improperly set, the printer may print without advancing the paper. Refer to the OEM documentation supplied with the printer for setup parameters.

If the printer stops in the middle of a print operation, check the Out-Of-Paper switch to determine if it has been erroneously triggered by torn paper walking off the tractor feed mechanism.

Remote Maintenance Modem

You can use a modem for the remote maintenance of a VCO/4K system. Modem operating parameters (Baud Rate, Stop Bits, Bits per Character, and Parity) defined in the system database must match the modem's setup parameters (refer to the OEM documentation supplied with the unit). Because of its high data transfer speed, a remote maintenance modem should not be connected to the switched public network behind a PBX. Induced noise from the PBX can create serious transmission problems.

If the remote maintenance modem is properly installed, problems will most likely be due to a faulty CO line to the modem.

Equipment Self-Test

Begin eliminating potential problems with simple tests. A self-test is generally incorporated in the power-on firmware of most of the peripheral equipment. If the self-test fails, the first step in the corrective maintenance process is to isolate the cause of the failure.

When the self-test is successfully completed, verify the cable connection to a system controller. When a known working device is properly connected to the controller, the remaining causes of peripheral equipment failure are related to system controller hardware and/or the operating system.

Master Console Self-Test

The VT220/320 and WYSE WY-185/185ES compatible terminals recommended by Cisco for use as a master console run a self-test immediately after its power is turned on. If the test is successfully completed, the OK message appears on the screen. Press any key to place the console in service after powering it on.

If nothing happens when the power switch is turned on, check the Power On indicator on the front of the CRT; it should be illuminated. If it is not illuminated, check the power cord, AC outlet and circuit breaker. If the indicator is illuminated but the self-test cannot be completed, refer to the VT320 owner's manual for basic troubleshooting procedures.

If you are not using the VT320 video display terminal, refer to the OEM owner's manual for specific information about self-test and basic troubleshooting procedures.

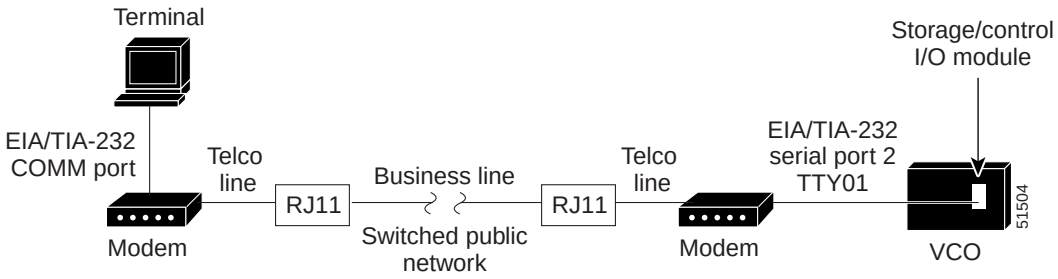
System Printer Self-Test

Before initiating a self-test of the system printer, verify that fan-fold paper is properly loaded and a ribbon cartridge is installed. Refer to the OEM user's manual for specific information about self-test and basic troubleshooting procedures.

Remote Modem Self-Tests

Refer to the OEM manual supplied with your modem for details on hardware test procedures. A VDT and second asynchronous modem, or a PC with a communications package and modem, can be used to dial into the asynchronous modem connected to the VCO/4K. Figure 4-1 is a simplified block diagram of such a test arrangement.

Figure 4-1 Remote Maintenance Modem Test Call Setup



Removal and Replacement Procedures

This section describes remove and replace procedures for peripheral equipment connected to a VCO/4K Storage/Control I/O Module.

Note Use existing peripheral cables between the replacement peripheral device and the system controller(s).

Master Console

The VDT is connected to the master console port (labeled Port 1/Console) on the back of the Storage/Control I/O Module.

To remove a VDT, follow these steps:

Step 1 Power off the VDT and disconnect its power cord.

Step 2 Disconnect the cable from the VDT which attaches to the VCO/4K.

If you are not replacing the VDT immediately, and if the VDT is cabled directly into the VCO/4K, you may want to disconnect the cable from the VCO/4K.

Step 3 Disconnect the keyboard cable from the VDT and remove the keyboard.

Step 4 Remove the CRT portion of the VDT. Repack the CRT and keyboard for shipment to a repair depot.

To replace a VDT, follow these steps:

Step 1 Unpack the replacement VDT from its OEM carton and inspect for shipping damage.

Step 2 Follow the OEM instructions for connecting the keyboard to the CRT. Install the legend strip on the keyboard (optional).

Step 3 Connect the serial cable connector to the port labeled Port 1/Console on the Storage/Control I/O Module on the back of the VCO/4K system.

Step 4 Connect the AC line cord from the VDT to a general-service AC receptacle.

Step 5 Refer to the OEM manual and turn on the VDT.

Step 6 Set the VDT to operate within the parameters defined in the system database.

System Printer

The printer is connected to the system printer port (labeled Printer) on the Storage/Control I/O Module.

To remove a printer, follow these steps:

Step 1 Power off the printer and disconnect its power cord.

Step 2 Remove fan-fold paper from the printer.

Step 3 Disconnect the cable from the printer which attaches to the VCO/4K.

If you are not replacing the printer immediately, and if the printer is cabled directly into the VCO/4K, you may want to disconnect the cable from the VCO/4K.

Step 4 Remove the printer from its stand and pack it for shipment to a repair depot.

To replace a printer, follow these steps:

Step 1 Unpack the replacement printer from its OEM carton and inspect for shipping damage. Remove all packing materials from inside the printer.

Step 2 Position the printer on the printer stand.

Step 3 Connect the parallel cable connector to the Printer port on the Storage/Control I/O Module on the back of the VCO/4K system.

Step 4 Connect the AC line cord from the printer to a general-service AC receptacle.

Step 5 Refer to the OEM manual and set the printer to operate within the parameters defined in the system database.

Step 6 Reinstall the ribbon cartridge and load fan-fold paper into the printer.

Step 7 Power-on the printer and run a self-test.

Remote Maintenance Modem

An asynchronous modem is connected to the remote maintenance modem port (labeled Port 2/TTY01) on the Storage/Control I/O Module.

To remove a moden, follow these steps:

Step 1 Power off the modem and disconnect the power cord.

Step 2 Disconnect the telco line from the modular jack at the rear of the modem.

Step 3 Remove the cable from the modem which attaches to the VCO/4K.

If you are not immediately replacing the modem, and if the modem is cabled directly into the VCO/4K, you may want to disconnect the cable from the VCO/4K.

Step 4 Remove the modem and pack it for shipment to a repair depot.

To replace an asynchronous modem, follow these steps:

Step 1 Unpack the replacement modem from its OEM carton and inspect for shipping damage.

Step 2 Position the modem in the desired location.

Step 3 Connect the telco line to the modular jack at the rear of the modem.

Step 4 Connect the serial cable connector to the modem and to the port labeled Port 2/TTY01 on the back of the Storage/Control I/O Module.

Step 5 Connect the power cord.

Step 6 Refer to the OEM manual and set the modem to operate in Auto Answer mode according to specifications contained in the *Cisco VCO/4K Hardware Installation Guide*.

Step 7 Power-on the modem and run a self-test (refer to OEM instructions).

Servicing the External A/B Transfer Switch

VCO/4K systems with redundant control may be equipped with an external A/B switch and drive cable. This Automatic Switching Unit (ASU) allows one set of peripheral devices to be automatically transferred between system controllers.

The following troubleshooting procedures are recommended if the ASU should fail to transfer connections between system controllers. Refer to the OEM manual supplied with the ASU for additional troubleshooting information.

Step 1 Verify that the Select switch on the front panel of the ASU is in the AUTO position.

Use the Select switch on the Alarm Arbiter Card (AAC) to manually switch from one side to the other. Observe the ASU. If the ASU fails to switch sides, proceed to Step 2.

Step 2 Verify that power is being supplied to the ASU by checking the voltage at the AC outlet into which it is plugged. Correct the AC problem and repeat Step 1.

Step 3 Use the Select switch to manually switch the ASU from side A to side B. If the switching action occurs, proceed to Step 4. If no switching action occurs, replace the ASU.

Step 4 Examine the control cable from the ASU to the AAC. Be sure there is no physical damage and that it is securely connected at both ends. Repeat Step 1. If no switching action occurs, replace the control cable and repeat Step 1.

Step 5 If replacing the control cable fails to correct the switching action of the ASU, replace the AAC. (Refer to the *Cisco VCO/4K Card Technical Descriptions*.) Repeat Step 1.

Always verify that the cables from peripheral devices to the ASU, and from the ASU to the system controllers, are secure and free of signs of mechanical damage. Check these cables and the operation of the ASU before replacing any peripheral device that has passed a self-test but fails to operate properly in the system.

Refer to the *Cisco VCO/4K Hardware Installation Guide* for pin and signal information.

CHAPTER 5

Corrective Maintenance—Power Subsystem

This chapter describes fault isolation techniques for the VCO/4K power subsystem. Refer to the *Cisco VCO/4K Mechanical Assemblies* for a description of the power subsystem components.

Power Subsystem Operation

Starting Up the System

To start the VCO/4K:

Step 1 Turn on the power switch to the right of the power connector on the power entry module. (The VCO/4K is on when the switch is in an upward position.) See Figure 5-1 or Figure 5-2.

Step 2 Check the power LED on the power supply module. Check both LEDs on both power supply modules in a redundant system. The LED is green under normal operating conditions.

Figure 5-1 Power Entry Module with Input Power Type Specified

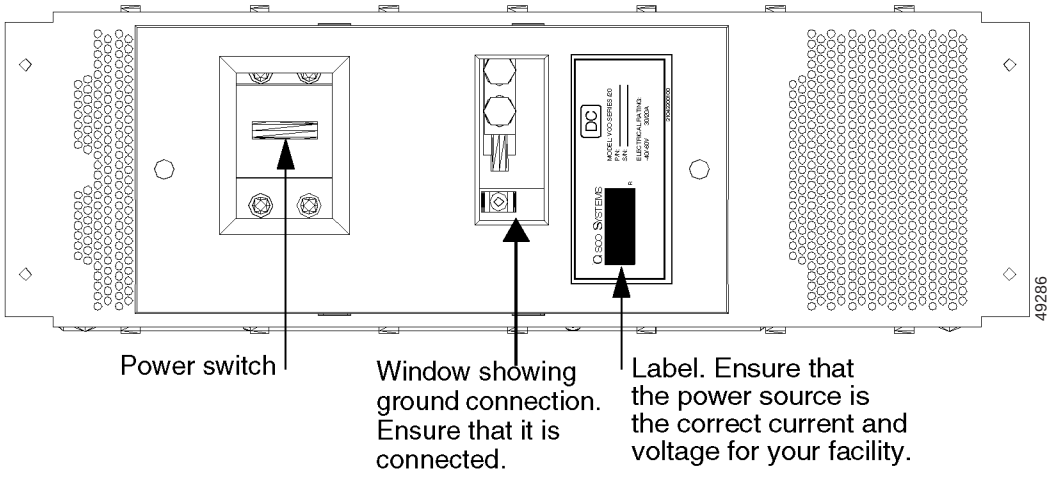
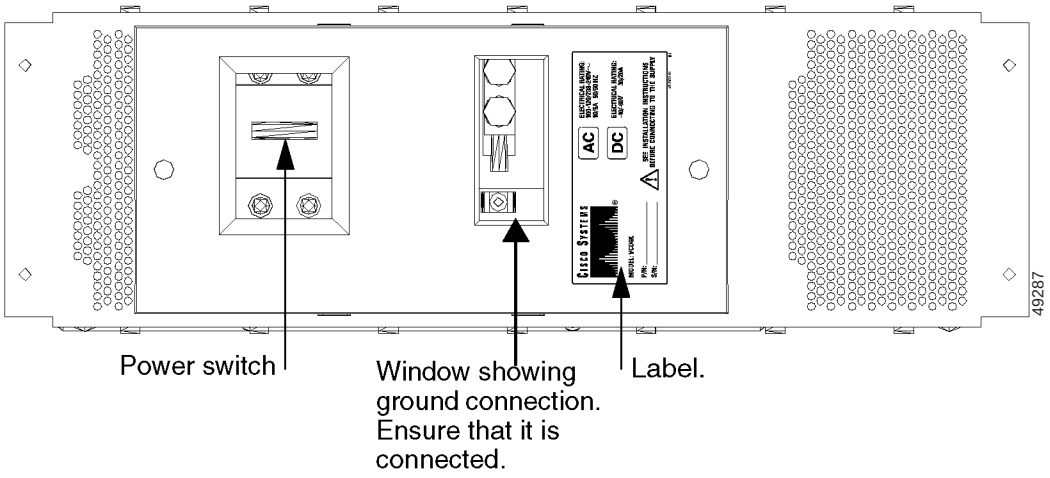


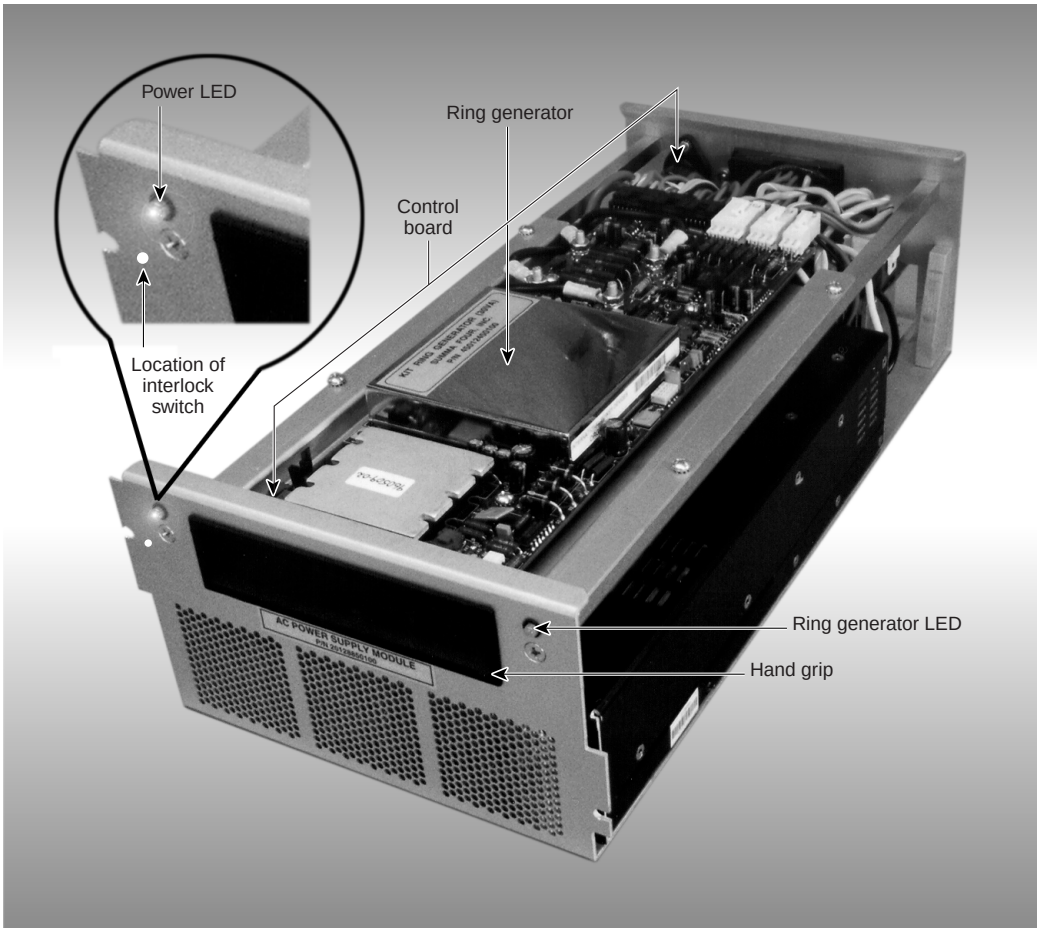
Figure 5-2 Power Entry Module Without Input Power Type Specified



Power LED

When the power is off, the left indicator LED on the power supply module is not illuminated (see Figure 5-3). When the power switch is on and the power LED is not illuminated, either a fuse (see the "Spare Fuse Kit" section on page 5-4) or the power supply module needs to be replaced. Green indicates that the power is on and operation is normal. Red is a warning that there are voltages in the power supply module that are over or under the required voltages or that there is a problem with load sharing. The power supply module needs to be replaced. See the "Removal and Replacement Procedures" section on page 5-4.

Figure 5-3 Power Supply Module



Turning Off the System

To turn off a VCO/4K system, move the power switch on the power entry module to the off (down) position. The LED is no longer illuminated.

Alarms

Two events occur simultaneously whenever voltage monitoring on the control board of the power supply module detects either an overvoltage or an undervoltage condition:

- An alarm is sent to the Alarm Arbiter Card (AAC) and is visually displayed on the AAC. The red MAJOR LED turns on, and the yellow AUX1 LED turns on.
- The power LED on the power supply module turns red.

When these two events occur, you must remove and replace the power supply module. See the “Removal and Replacement Procedures” section on page 5-4.

Spare Fuse Kit

One spare fuse kit used for AC or DC systems comes with the VCO/4K. The contents of the kit is described in Table 5-1.

Table 5-1 Contents of Spare Fuse Kit

Number of Cartridge Fuses	Rating	Location
Four	30 amps	Power Entry Module
Two	25 amps	Power Supply Module

The two replaceable fuses on the power entry module are the main fuses, shown in Figure 5-1. One replaceable 25-amp fuse is located on the back of the power supply module to the right of the power connector socket.

If you choose to go from 120 VAC to 240 VAC as a result of the input power that is available at your site, you do not need to change any fuses. The VCO/4K is an auto-ranging system.

Removal and Replacement Procedures

Caution When you are working inside the VCO/4K system enclosure, ensure that you are ESD protected.

Warning **Voltages present on the power backplane and at other points can produce severe, perhaps fatal electrical shock. Observe all precautions normally associated with the testing of electrical equipment.**

Turn off power at the source before performing any service.

Removing a Nonredundant Power Supply Module

To remove a nonredundant power supply, follow these steps:

Step 1 Turn the switch off on the power entry module if the system does not contain redundant power supply modules, or if both power supply modules are to be removed simultaneously. The power disconnect switch is located in the rear of the system on the power entry module.

Step 2 Remove the front door of the VCO/4K system to access the power supply module.

Step 3 Connect the wrist strap to the system (upper right corner).

Step 4 Remove the two mounting screws on the front panel of the power supply module.

When the upper left screw is removed, the power is cut off from the module (the power LED is off).

If the LED is faintly illuminated red, and the interlock switch screw is removed, it is safe to remove the power module.

Step 5 Grasp the black hand grip on the front of the module with one hand and pull the module out. Use your other hand to provide support underneath the module as you remove it from the system.

Removing a Redundant Power Supply Module

To remove a redundant power supply, follow these steps:

Step 1 Remove the front door of the VCO/4K system to access the power supply module.

Step 2 Connect the wrist strap to the system (upper right corner).

Step 3 Remove the two mounting screws on the front panel of the power supply module.

When the upper left screw is removed, the power is cut off from the module (the power LED is off).

If the LED is faintly illuminated red, and the interlock switch screw is removed, it is safe to remove the power module.

Step 4 Grasp the black hand grip on the front of the module with one hand and pull the module out. Use your other hand to provide support underneath the module as you remove it from the system.

Replacing a Power Supply Module

Caution Follow ESD rules when replacing a system component. Use a wrist strap for grounding.

To replace a power supply, follow these steps:

Step 1 If the power supply module is nonredundant, ensure that the power is off.

Step 2 Remove the front door of the VCO/4K system to access the power supply module.

Step 3 Connect the wrist strap to the system (upper right corner).

Step 4 Grasp the black hand grip on the front of the module with one hand and use your other hand to provide support underneath the module as you push it into its compartment.

Step 5 Fasten the two mounting screws on the front panel of the power supply module.

Step 6 Rotate the plate into position to align the left mounting screw before fastening the screw into place.

Step 7 If necessary, turn the VCO/4K system on.

Step 8 Remove the wrist strap.

Step 9 Check the power LED and ensure that the power supply module is operating. Refer to the “Starting Up the System” section on page 5-1 for information on the LED.

Step 10 Replace the front door.

Caution The front door must remain on during system operation for NEBS EMI compliance.

Troubleshooting the Power Subsystem

There are two tasks you might need to perform when troubleshooting the VCO/4K power subsystem:

- Replace a fuse or fuses
- Replace the power supply module

Red Power LED

When an alarm is sent to the Alarm Arbiter Card and the power LED on the power supply module turns red as a result of a voltage fault condition, you must replace the power supply module.

Power LED Is Not Green When It Should Be

If the power switch is turned on but the power LED is not illuminated (not green), either the power supply module has failed or the power supply within the power supply module is still running (the fans are still operating) even though the power supply module itself is not functioning. See Figure 5-3. In either case, follow the process in listed in the *Cisco VCO/4K Troubleshooting Guide* to determine the cause of the problem, which can be any one of the following conditions:

- A blown fuse in the power entry module
- A blown fuse in the power supply module
- A failed power supply module

When troubleshooting, you can either immediately replace a fuse or as an alternative, test it first by checking its resistance with a meter.

The *Cisco VCO/4K Troubleshooting Guide* presents the process to follow when troubleshooting a single power supply module. In a system with redundant power supply modules, both modules are load sharing; when one of them fails, the other one takes over.

For more information about troubleshooting the VCO/4K, refer to the *Cisco VCO/4K Troubleshooting Guide.*

CHAPTER 6

Corrective Maintenance—Interface Circuits

Digital interface circuits connect the VCO/4K to external telecommunication environments. Problem isolation requires establishing whether the fault stems from external causes or with internal circuit cards and adapters. This chapter reviews general troubleshooting procedures for VCO/4K Port Interface Cards. For detailed information about specific circuit cards, refer to the *Cisco VCO/4K Card Technical Descriptions.*

Fault Isolation

The demarcation point for interface with the VCO/4K is the Storage/Control I/O Module in the rear of the VCO/4K. From this module, problems are external to the VCO/4K and must be corrected using conventional digital telephone troubleshooting techniques.

Database entries define the external telecommunication environment with which the VCO/4K interfaces. If the entries do not reflect the reality of the environment, the system cannot effectively process calls. Problems with the database can be caused by human error in administering the database and by undocumented alterations to the external wiring plan or telephone station programming.

Other hardware-related faults include faulty CO lines, defective interconnect cables and backplane adapters, and software/firmware incompatibility. VCO/4K status LEDs on the front panel provide a visual indication of operating status.

The following sections review the hierarchy of probable faults that may cause problems with VCO/4K interface circuits.

Database Administration

The entries in the system database must meet the requirements of a specific implementation and must correspond to the external telecommunications environment. In VCO/4K systems, the environment includes circuit card locations, trunk or line card configurations, port configurations, inpulse and outpulse rules, answer supervision templates, and resource group configurations.

Altering the Database

Adding or removing stations, lines, and trunks affects the contents of the database. If this environment changes, the database must be altered or incremented to keep the system in harmony with the environment. Unless the database is properly administered, VCO/4K call processing software will be unable to complete calls through the system.

Record Keeping

Cisco Systems recommends careful record keeping to monitor the system configuration as it changes. Record changes made to the database and make appropriate alterations to the system database.

Backing Up Copies of the Database

Make floppy disk backup copies of the original database, the immediate past database, and the current database. Clearly label the floppy disks and store them in a safe place so that you can quickly restore the system database if a hard disk must be replaced or new system software installed.

Note Since the A-side and B-side of the system may differ, for example in the system configuration, host configuration, peripheral, and file system, separate backups are necessary.

Detecting Database Problems

System error messages and general error messages provide some indication of database configuration problems. Status information returned in reports to the host can also indicate configuration problems in the database. The Database Administration Menu can be used to access submenus, which you can use to correct the database configuration.

Refer to the *Cisco VCO/4K System Administrator's Guide* and *Cisco VCO/4K System Messages* for information about database problems and error messages.

Correcting Database Problems

Use the Print Screen key or Print Database Detail function to obtain hardcopy listings of the contents of the database. Compare the listing against the original or immediate past database entries to determine where a change has been made that affects system operation.

Refer to the *Cisco VCO/4K System Administrator's Guide* for details on making changes to the system database.

Station or CO Line/Trunk Problems

Poor signal quality and/or loss of line/trunk service can also adversely affect system operation. Line/trunk connections can also be broken or miswired at the Digital Cross Connector serving the system or through the digital cross cables running to the Storage/Control I/O Module cards.

Poor Signal Quality

A line/trunk with poor transmission characteristics can cause intermittent problems that may be difficult to detect without using special transmission test sets. Answer supervision and in-band call setup signaling can be lost even though voice transmission is intelligible.

If the VCO/4K is implemented behind a PBX, excessive cumulative losses in signal levels going out and returning through the PBX can greatly affect the intelligibility of voice-band transmission and reception. Similar problems may occur with losses through a CO in dial-up implementations.

Loss of Lines/Trunks

Out-of-service lines/trunks can cause a degradation in system performance as calls must wait for available lines/trunks before processing can be completed. Calls made through dial-up stations may be blocked at the CO because no dial-up trunk is available to complete routing to the VCO/4K.

Detecting Station and CO Line/Trunk Problems

The best way to assure early detection of line/trunk problems is to run frequent checks of call completing trunks. Do this at the Digital Cross Connector with a handset. Dial-up service can also be checked, but the procedure is more complicated and would require progressively busying out each dial-up trunk.

Another method of checking trunk status is to use the Card Display function under the Diagnostics Menu to monitor individual trunk cards. If a port on an interface card does not appear to be processing calls, use the Port Display to look at the specific circuit. Use the Set Up Paths Utility to verify voice path to a suspected port.

Permanent signal conditions are reported to the host. Permanent signal conditions informs the host that a line or trunk has not released within 30 seconds of a release by the VCO/4K system. Refer to the $D2 command and the Permanent Signal Condition (PSC) report in the *Cisco VCO/4K Standard Programming Reference* and the *Cisco VCO/4K Extended Programming Reference*.

Correcting Station and CO Line/Trunk Problems

If the problem is on the system side of the Digital Cross Connector, check interconnecting cables, the midplane adapter, and the current status of the interface card to which the faulty line/trunk is connected. If an entire group of lines/trunks is out-of-service, suspect a bad interface card and go to the “Digital Interface Card Problems” section on page 6-3.

If the problem is on the network or direct connect station side of the Digital Cross Connector, the responsibility for repairing the circuit depends on where the system is located and who is supporting line/trunk services. The faulty circuit number should be recorded and a repair history maintained.

Digital Interface Card Problems

Interface with digital channel banks across a T1 span line requires the use of the following Digital Trunk Interface cards:

- T1 (Domestic) or E1 (International)
- T1-E (Japan only)
- Programmable 4 Span T1 (Domestic) or Programmable 4 Span E1 (International)

VCO/4K systems also support the following optional Primary Rate Interface (PRI) cards for ISDN-PRI services:

- PRI/N (Domestic)
- E1-PRI (International)

Note PRI cards must be used in conjunction with Cisco’s ISDN PRI software package.

The NBC3 assures synchronization between VCO/4K internal clocks and incoming/outgoing T1/PRI and E1 channels.

Digital Alarm Conditions

Factors which cause Digital Interface major alarm indications include:

- Loss of carrier
- Failure of internal communications bus test (card self-test)
- Card out-of-service (manually via Master Console or due to a communication bus error)

Table 6-1 summarizes the Master Console actions that affect these cards. For more information, refer to the *Cisco VCO/4K System Administrator's Guide*.

Table 6-1 Master Console Actions Affecting Digital Interface Cards

Action Taken at Master Console	Outward Action
Change card state to Diagnostic from Active or Maintenance	Tears down any active calls and goes into local loopback; sends all 1s, all bits alarm. Stops sending, which causes Red alarm at far end.
Change card state to Maintenance	New seizures are not processed.
Change card status to Active from Diagnostic	Starts sending bits or stops sending all 1s, all bits. Yellow alarm sent from far end causes yellow LED to go on. Far end stops sending Yellow alarm when carrier is restored; yellow LED goes off. If card was previously in Maintenance state, it returns to Maintenance. Otherwise it returns to Active. Any ports that have been deactivated from Card Maintenance Menu or by host command are seized out (busied out).
Change to OOS	Sends all 1s, all bits.
Change card status to Active from OOS or Maintenance	Card is reset. All LEDs ON changes to yellow and green LEDs ON, then red LED ON. Red and Yellow LEDs go off when carrier is restored. Any ports that have been deactivated from Card Maintenance Menu or by host command are seized out (busied out).

Note Refer to the specific digital interface card's technical description for the card's LED states.

Factors which cause Digital Interface minor alarms include:

- Loss of remote carrier
- Detection of a signaling bit alarm
- Slips
- Out-of-Frame (OOF) condition
- Out-of-Frame (OOF) maintenance threshold reached

Loss of carrier can be attributed to a fault in the span line or a failure of the digital side of the terminating equipment. Loss of synchronization can be related to problems with the T1/PRI span line providing external sync with the VCO/4K, an external sync pulse source connected to the NBC3, or NBC3 Digital Interface phase lock timing.

Verify terminating equipment operation and the span line connection before removing and replacing one of the Digital Interface or NBC3 cards. Loss of a channel(s) may be the result of problems on the originating side of the terminating equipment/digital switch.

Test Port Card

The Diagnostics Menu offers the Test Port Card screen which allows a technician to send a digit string through specified channels of a Digital Interface card and loop the results through a DTMF or MF Receiver card. The test compares the expected string against the received string and sends an error message to the file and printer, indicating the error and ports affected.

Note The Test Port Card utility can only be used to test T1 channels or ISDN B-channels. PRI/N D-channels cannot be tested using this utility.

For DTMF receivers, the following string of digits is sent through the first and subsequent T1 channels: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, *, #. For MF receivers the following string of digits is used: KP, 0, 1, 2, 3, ST, 4, 5, 6, 7, ST3, 8, 9, ST1, KP, 0, 1, 2, STP. The test automatically cycles through the range of receiver ports entered by the administrator as each T1/PRI channel is tested.

Note Use the Card Maintenance Menu under the Maintenance Menu to place the desired receiver card and T1/PRI card in Diagnostic (D) mode. This test does not work unless both cards have been placed in Diagnostic mode.

If all messages are printed, the screen shows the RLSP addresses of both the receiver and the Digital Interface card ports, as well as the results when each channel is tested. If a channel passes the test, a message appears on the screen and the port numbers are incremented for the receiver and Digital Interface cards. When all channels of the Digital Interface card have been tested, a message appears at the bottom of the screen.

If a channel fails a test, an error message, the two digit test strings and the address of the channel are sent to the error log and the system printer. For additional information, refer to the *Cisco VCO/4K System Administrator's Guide.*

System Log—Digital Interface Error and Status Messages

Error and status messages associated with Digital Interface cards are listed and described in *Cisco VCO/4K System Messages*.

Interface Card Configuration

Card configuration refers to setting jumpers and switches on interface cards to meet application requirements. *Cisco VCO/4K Card Technical Descriptions* details configuration requirements for VCO/4K digital interface cards.

If a card is improperly configured, it may fail to perform its interface function between external lines/trunks and the system. Verify configuration settings before installing a replacement interface card in the system. Always check the firmware version against the requirements specified in the configuration portion of the system software release notes. If the wrong version of firmware is installed, the system does not operate properly.

Port Configuration refers to the process of specifying appropriate data for each port in the system database. If the port is improperly configured, the system may interpret seizures as disconnects or not see them at all.

Class of Service (COS) also greatly affects operation of the card. A COS of T or 2 sees inward seizures as call originations. A COS of O interprets inward seizures as the port being busied out by the far end. If calls are not being properly processed, check the COS.

Troubleshooting

Refer to the *Cisco VCO/4K Card Technical Description*s and the *Cisco VCO/4K Troubleshooting Guide* for detailed information on troubleshooting and repair/replacement of VCO/4K Port Interface cards.

Caution Observe antistatic precautions when handling interface circuit cards to avoid damaging sensitive CMOS devices. Wear a ground strap connected to the VCO/4K equipment frame whenever servicing or cleaning circuit cards. The ground point is indicated by a label on the upper, right side in the front of the system (with the door removed).

CHAPTER 7

Corrective Maintenance—Service Circuits

Service circuits provide pooled resources to be used by call processing software when answering or initiating calls over interface circuits. Services include tone generation, voice announcements, conference ports, DTMF or MF receivers, speech recognition, and call progress tone detection. This chapter reviews general troubleshooting procedures for the VCO/4K service circuit cards. For detailed information about specific circuit cards, refer to the *Cisco VCO/4K Card Technical Descriptions*.

Overview

VCO/4K tone services, including tone generation and receiving/decoding, are provided by circuit cards containing appropriate firmware. Tone generation is accomplished through DTG cards. Individual tones are output in reserved Port Addresses (PAs) which the system controller can map to an interface circuit. The DTG-2 card is located on the NBC3 card in slot 1 (and slot 2 in redundant systems).

Eight, 24, or 48 tone receivers with separately assigned PAs are contained on pooled receiver cards, including DRC and MRC cards. Receiver cards can be placed in any available slot starting with slot 7.

Note SLIC-2, DID-2 and UTC-2 cards incorporate dedicated DTMF receivers for each circuit on the card. T1 and E+M services require pooled receivers for DTMF signaling applications. If MF signaling must be decoded, pooled MF receivers are required for all line/trunk card types.

Voice announcements are provided by IPRC cards. Announcement data is downloaded from the Storage Subsystem whenever the interface is booted. Voice data is stored in RAM on these cards.

Digital Conference Cards (DCC) allow voice paths to be bridged together for conference calling purposes. The DCC performs all tasks associated with adding callers under host control and tearing down the conference as callers leave the conference bridge.

Call Progress Analyzer (CPA) cards detect a wide range of voice-band signaling, including: presence/cessation of ringback, dial tone, busy, reorder, Special Information Tones (SITs), presence/cessation of voice, and pager cue tones.

The loss of a service circuit card can result in the inability of the system to process calls or in poor performance, as calls must wait for resources to become available.

Digital Tone Generator-2 (DTG-2)

The DTG-2 generates DTMF, MF, and call progress tones required by call processing software, and controls the outpulsing sequence over call-completing trunks. It supports 63 outpulsing channels and 64 ports for static tones. One DTG-2 is required in every VCO/4K. Two DTG-2s are provided in VCO/4K systems equipped with the redundant control system option.

In redundant systems, the redundant DTG-2 is in standby status during normal operation. If the primary DTG-2 fails, the other is automatically placed in active service to process calls. A minor alarm is triggered to indicate the need to service the failed DTG-2.

If a DTG-2 fails in a nonredundant system, calls cannot be completed, a major alarm is triggered, and a Phase 4 reboot occurs.

The DTG-2 card is mounted on the NBC3 card; it occupies the same slot as the NBC3.

Note the following:

- If the active NBC3 card switches to standby, the DTG-2 mounted on that NBC3 switches with it.
- An active DTG-2 does not switch with the NBC3 on which it is mounted if the standby DTG-2 has failed, or if there is no standby DTG-2.
- If the active DTG-2 switches to standby, the corresponding NBC3 does *not* switch with it.
- If you remove the NBC3 card, the DTG-2 mounted on that NBC3 is also removed.
- To remove the DTG-2 card, the NBC3 on which it is mounted must be removed.
- Remove the corresponding Combined Controller before removing the NBC3.

Note that in two cases listed above (bullets 2 and 3), the NBC3 and DTG-2 could be active on different sides, even though they are located on the same card. If you have to remove and replace a problem NBC3 or DTG-2, make certain you know the current active configuration of your system.

Receiver Cards

Depending on the application, DRCs and MRCs may be required, such as for incoming T1 service. Receiver cards can be mounted in any slot in the port subrack. A minimum of eight receiver ports are contained on each receiver card. The number of receiver cards required for a configuration is based on anticipated traffic and desired grade of service performance.

Note All receiver cards must be placed into a single resource groups of the same type.

Failure of a single receiver card in a system with multiple receiver cards results in a lower grade of service, as fewer circuits are available to meet requests for receiver service. The system processes calls as long as at least one receiver card is available in the system.

Integrated Prompt/Record Cards (IPRCs)

The IPRC is designed to play and record digitized voice prompt information. The card is available in the following port configurations:

- 8 playback/4 record ports
- 64 playback/32 record ports

- 128 playback/32 record ports

The IPRC can play voice information on up to 128 channels and record on up to 32 channels. All channels can operate simultaneously. The IPRC supports up to 15 prompt libraries of up to 256 prompts each.

Note All IPRCs must be placed into a single resource group.

Digital Conference Cards (DCCs)

Each DCC has 64 ports and an on-board processor. By mapping the third and subsequent interface ports (up to seven), conference calls with up to eight callers can be established through the system. Each party in the call hears all the other participants in the call.

The DCC is capable of maintaining the summation of seven PCM transmit samples. Since a conference port is only required when more than two participants are engaged in a call, the seven-sample summation allows up to eight callers to participate in a call.

Note All DCCs must be placed into a single resource group.

Depending on the application, loss of the only DCC in a system may block call originations through the switch. If one DCC fails in a system with multiple DCCs, grade of service performance suffers but calls can be completed. Call setup time may increase as delays in mapping conference ports occur.

Call Progress Analyzer Cards (CPA)

The CPA card detects the presence of dial tone, busy, reorder, SIT tones, and pager cue tones, as well as the presence or cessation of audible ringback and voice. Each CPA is equipped with 24 circuits and mounts in any port card slot. A CPA port is allocated and released during a call as specified by outpulse rule processing. Answer supervision templates are used with outpulse rules to configure VCO/4K call processing, timing, reporting, outgoing port answerback, and error processing for signaling and supervision scenarios.

The CPA application is downloaded from hard disk to the CPA via the VCO/4K communication bus. Downloads are simultaneously broadcast to all configured CPA cards whenever a system is reinitialized (rebooted) from hard disk, or a directed download takes place when a CPA is reset and the download file on the hard disk is different than that stored in the CPA's RAM.

Note All CPAs must be placed into a single resource group.

The number and type of CPA cards required by a system is specified by the customer based on anticipated traffic and the call scenario.

Service Circuit Card Problems

DTG-2s, IPRCs, DRCs, MRCs, DCCs, SRCs, and CPAs have three status LEDs on their front panels. All LEDs are off when the card is operating normally. A label on the top handle of the card identifies the card type.

- *Red (top) LED*—Indicates a failure of the card to pass a self-test. The card is out of service and must be replaced if it does not respond to basic corrective card maintenance procedures. If the red LED illuminates during a reboot of the system, remove and reseat the card in the backplane. If this condition persists, replace the card.
- *Yellow (center) LED*—Indicates that the NBC3 has been unable to communicate with this card and therefore, has stopped polling it. The inability to communicate with the card can be due to a card or a communication bus failure. The yellow LED flashes while the NBC3 is establishing communication.
- *Green (bottom) LED*—Illuminates when the card is in standby status (DTG-2) or when it is removed from service using the Card Maintenance menu under the Maintenance Menu. The green LED flashes during card downloads.

Note When a service circuit card is reset, either by the NBC3 following a system controller reboot or because the card has been marked Active via the Master Console, all three front panel LEDs simultaneously turn on and then off. If the LEDs remain illuminated, a hardware fault has been detected. Check all socketed components for proper seating. If seated properly and a fault is detected, the card should be returned for repair.

System error messages appear on the master console screen whenever a major or minor alarm condition occurs. Each message includes the Rack-Level-Slot address of the suspect card. Messages are written to the system error log and output to the system printer. Refer to *Cisco VCO/4K System Messages* for details on the meaning of error messages.

Detecting and Correcting Service Circuit Card Problems

The VCO/4K supports three types of tools for detecting service circuit problems—status LEDs, error messages, and Diagnostic Menus.

Status LEDs

Front Panel LEDs and system error messages provide quick indications of card status. Factors which cause major alarm indications (red LED illuminated) include:

- Failure of internal communications bus testing (card self test)
- A DTG-2 associated major alarm, when it has failed a 1-kHz (Continuous) Tone Test

Minor alarm indications (yellow LED illuminated) occur when:

- Period between communication bus interrupts is greater than 2.5 seconds, indicating a communication bus failure

If the yellow LED illuminates on a service circuit card during normal system operation, use the Card Maintenance Menu to reset the card with the Change Status command (refer to the *Cisco VCO/4K System Administrator's Guide*). If the Change Status command fails, remove the card from the backplane and reseat it. If the red LED illuminates, remove and replace the card (refer to the *Cisco VCO/4K Card Technical Descriptions*).

If a service circuit card has been mounted in the wrong slot or has not been configured in the database, the card's green LED is illuminated, and the system log contains error messages indicating a wrong card.

System Log—Error and Status Messages

The system log contains a record of all error and status messages generated by the master controller and displayed on the master console and printer during system operation. Messages are time stamped by day of week (according to the setting of the system clock/calendar), and by the system controller who generated the message.

In addition to illuminating appropriate status LEDs, all system and card alarm conditions are appropriately identified in the log, such as CARD ALRM SET, CARD ALRM CLRD, MIN ALARM SET, MIN ALRM CLRD.

Chapter 3, "Corrective Maintenance" explains how to use system logs to isolate problems in a VCO/4K. Refer to the *Cisco VCO/4K System Messages* for a complete list of error log messages and meanings.

Test Service Circuits

From the Diagnostics Menu, you can use the Service Circuits Test Utility screen to perform port tests on specified DRC, MRC and CPA cards.

Note Use the Card Maintenance menu from the Maintenance Menu to place the desired service card(s) in Diagnostic (D) mode. This test function does not work unless the card has been placed in Diagnostic mode.

Refer to the *Cisco VCO/4K System Administrator's Guide* for detailed instructions on using this function.

Resetting DTG-2 Cards

VCO/4K systems equipped with redundant control have two DTG-2 cards. The DTG-2 card is mounted on the NBC3 card. Only one DTG-2 is active (all LEDs off) while the other remains in standby (green LED on). The current DTG-2 status is indicated on the Card Maintenance menu.

To change the current status of a DTG-2 card, reset the active card from the Card Maintenance menu. Select the active DTG-2 and use the Change Status (C) function to reset the card to Out-of-Service (O) status.

Note VCO/4K systems do not allow a DTG-2 to be marked OOS if it is the only DTG-2 currently in service.

The system automatically forces a standby DTG-2 card to active status, and places the active DTG-2 in out-of-service status. A minor alarm occurs, but is cleared when the DTG-2 cards have assumed their new operating status. To reset the out-of-service DTG-2, use the Change Status (C) function to reset the card to Active (A) status. The DTG-2 is reset and placed in standby status. This may take up to four minutes. The minor alarm for the card is cleared.

Refer to the *Cisco VCO/4K System Administrator's Guide* for information on the Card Maintenance menu. Refer to the *Cisco VCO/4K Card Technical Descriptions* and to the "Digital Tone Generator-2 (DTG-2)" section on page 7-2 for additional information on the DTG-2 card and its active/standby status in relation to the NBC3.

Service Card Configuration

Card configuration refers to setting jumpers on service circuit cards to meet application requirements. The *Cisco VCO/4K Card Technical Descriptions* details configuration requirements for VCO/4K service circuit cards.

If a card is improperly configured, it may fail to function properly. Verify configuration settings before installing a replacement service circuit card in the system. Always check the firmware version against the requirements specified in the configuration portion of the *Cisco VCO/4K System Software Release Notes*. If the wrong version of firmware is installed, the system will not operate properly.

Troubleshooting

Refer to the *Cisco VCO/4K Card Technical Descriptions* and the *Cisco VCO/4K Troubleshooting Guide* for detailed information on repairing and replaceing VCO/4K Service Circuit cards.

Caution To minimize the risk of injury from hazardous voltages, use the ejector tabs on the cards when removing cards. Wear a ground strap connected to the VCO/4K equipment frame whenever servicing or cleaning circuit cards. The ground point is indicated by a label on the upper left front of the system (with the door removed).

Caution Observe antistatic precautions when handling service circuit cards to avoid damaging sensitive CMOS devices.

CHAPTER 8

Corrective Maintenance—Control Circuits

Control circuits include the Combined Controller, the Storage/Control I/O Module, the Alarm Arbiter Card (AAC), and the Network Bus Controller (NBC3). This chapter reviews general troubleshooting procedures to be used with the control circuit cards for the VCO/4K system. For detailed information about specific circuit cards, refer to *Cisco VCO/4K Card Technical Descriptions*.

Control circuit cards include the microcomputer that controls call processing operations and system administrator applications. Control circuit cards include:

- Central Processing Unit (CPU)—Included in the Combined Controller
- Switch Interface (SWI) card—Included in the Combined Controller
- Alarm Arbiter Card (AAC)
- Network Bus Controller (NBC3)

The Storage/Control I/O Module is also part of the control circuits. It is located at the rear of the VCO/4K. It contains the hard disk drive and the connectors to peripheral devices.

All of the cards, and the Storage/Control I/O Module, have unique switch and status LED implementations as well as removal and replacement procedures. Figure 8-1 shows the locations of the Combined Controller (includes the CPU and SWI), AAC and NBC3. Figure 8-2 shows the location of the Storage/Control I/O Module in the VCO/4K.

Figure 8-1 Front of the VCO/4K

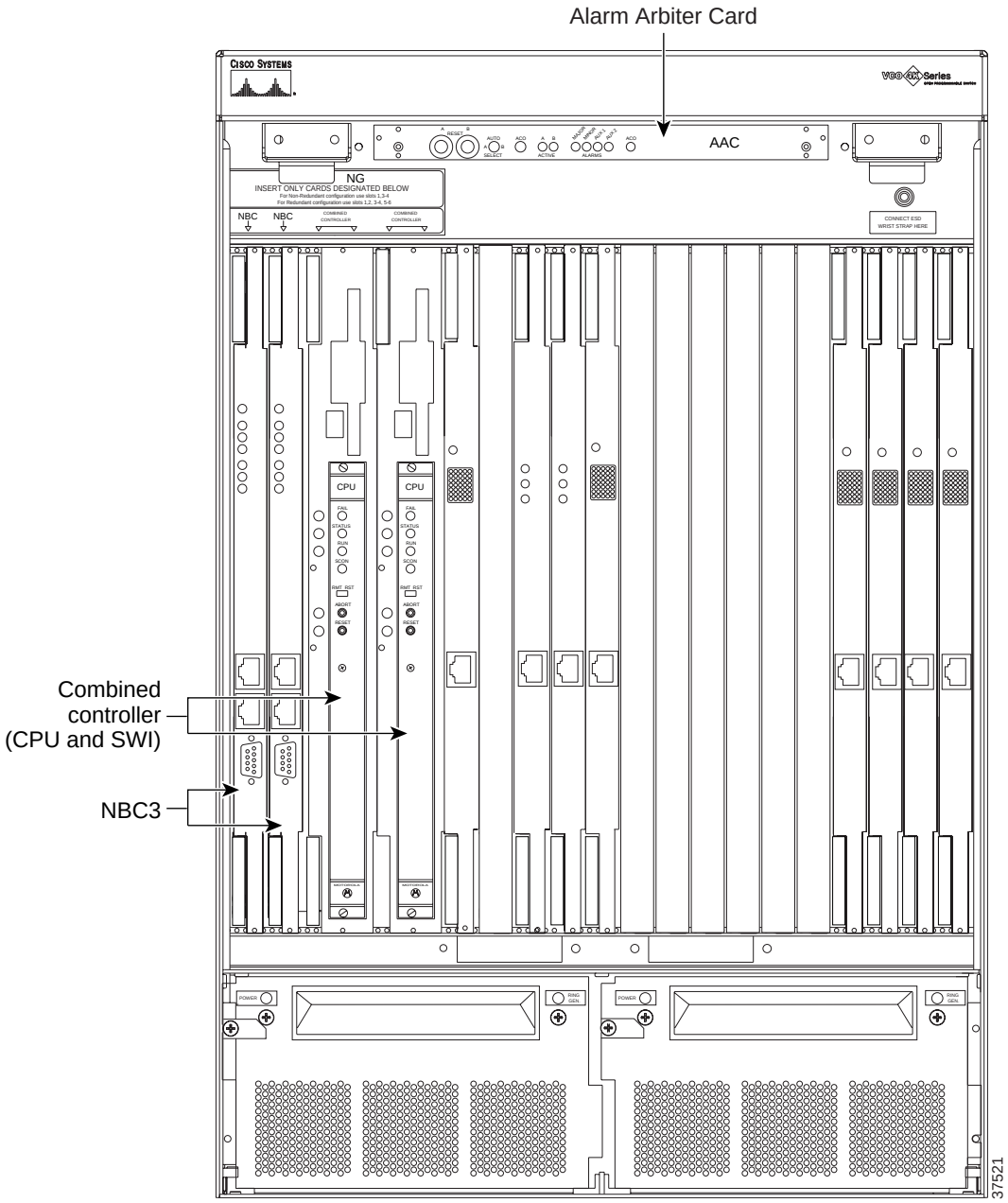
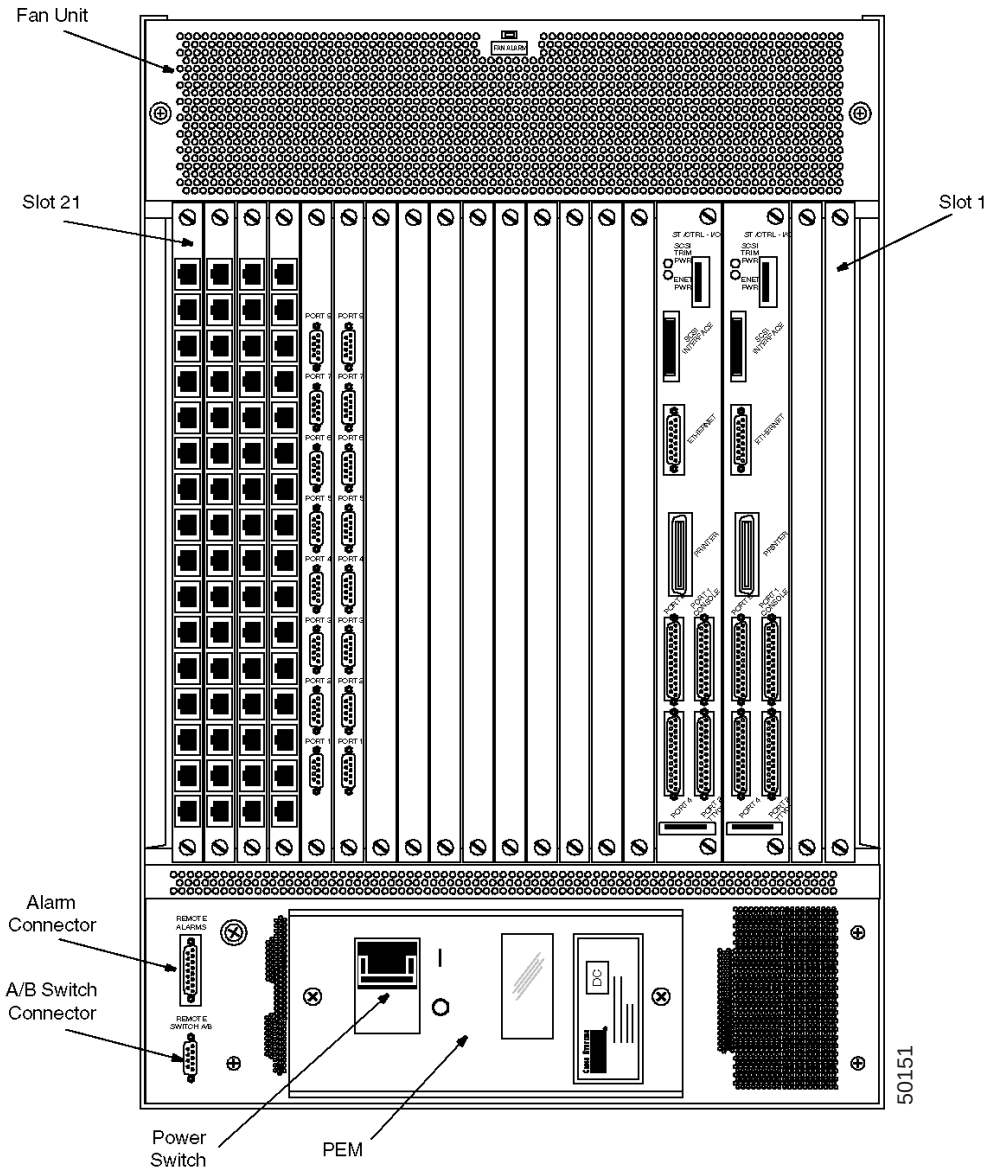


Figure 8-2 Rear of the VCO/4K



Detecting Problems with Control Circuit Cards

Problems with the control circuit cards immediately affect the operation and/or administration of the switch. System-level error messages indicate an inability of the CPU to process calls or access the system hard drive. Refer to *Cisco VCO/4K System Messages* for a list of error messages and meanings.

Each control circuit card is equipped with a status LED that indicates its operating condition. With system error messages as pointers and status LEDs as indicators of specific card failure, you should be able to isolate controller card failures.

Jumper Plugs

Control circuit cards are multipurpose OEM supplied packages, modified for operation in the VCO/4K system by Cisco Systems. Modifications include the installation of custom PROM chips in firmware sockets.

Caution Removing or repositioning the jumpers on control cards will result in system failures and possible damage to the card or to peripheral devices connected to it. Always verify that the jumpers are in their proper positions before installing a new or replacement card.

Removing and Replacing Control Circuit Cards

Caution Observe antistatic precautions whenever handling VCO/4K circuit cards to avoid damage to sensitive CMOS devices. Wear a ground strap connected to the VCO/4K equipment frame whenever removing or replacing circuit cards. The ground point is indicated with a label on the front of the system (with the door removed).

Control circuit cards require specialized procedures for removal and replacement. The required procedures depend on whether the system is equipped with nonredundant or redundant system controllers. Refer to *Cisco VCO/4K Card Technical Descriptions* for detailed instructions on removing and replacing control circuit cards.

Control Circuit Cards

The following subsections briefly describe the control circuit cards found in the VCO/4K system controllers. For complete descriptions of these cards, including removal/replacement and card configuration procedures, refer to *Cisco VCO/4K Card Technical Descriptions*.

Combined Controller

The Combined Controller Assembly consists of the following components:

- Central Processing Unit (CPU) card

  The CPU is a high-performance, single-board computer that is the heart of the system controller.

- Switch Interface (SWI) and Floppy Disk Drive (FDD) assembly

  The SWI provides an interface between the system controller and the following subsystems: Network Bus Controller 3 (NBC3), Alarm Arbiter Card (AAC), and redundant system controller.

- Floppy Disk Drive (FDD)

  The FDD is a 1.44-MB, high-density, 3-1/2-inch, half-height floppy disk drive. The FDD is used to load software and make backup copies of the system database. The system database, and log and trace files can also be stored on the floppy disk.

  The SWI/FDD assembly also acts as a connecting point for the CPU card.

Storage/Control I/O Module

Physical interfaces to host computers and peripheral devices are provided on the Storage/Control I/O Module. Two serial ports support the local system administration console and a remote maintenance modem. An Ethernet Transceiver interface and parallel printer connector are also located on the Storage/Control I/O Module.

Note Master console and remote maintenance modem operating parameters (Baud Rate, Stop Bits, Bits per Character, and Parity) are defined in the system database via the Peripheral Configuration screen (refer to the *Cisco VCO/4K System Administrator's Guide* for more information).

If you have the optional Ethernet Communications Package, refer to the *Cisco VCO/4K Ethernet Guide* for information on Ethernet communication.

Alarm Arbiter Card (AAC)

The AAC is located in the top front and center of the VCO/4K. It serves as a control point for system resets. Switches on the front panel enable system controller resets and select which system controller is to be master. Status LEDs indicate the currently enabled system controller and alarm conditions.

The AAC includes a watchdog timer circuit that automatically resets a nonredundant controller or switches over to a redundant controller (while indicating a fatal, critical, or major alarm condition), if the active controller does not communicate every five seconds. The communication to the AAC can be inhibited by a hardware failure in the control system, by call processing software, or when more than five minutes are required to read a boot file (Installation Utility) when booting from floppy.

The AAC interfaces with system controllers and external alarm systems, which may cause frequent alarm indications. Always investigate the operational status of the system controller(s) and the external alarm contacts for faults before suspecting that the AAC needs replacement.

If the problem is not with the system controller(s) or external alarm circuits, try rebooting the system (both controllers in a redundant system; a system reset may clear the condition. If a reset fails, then remove and replace the AAC.

Network Bus Controller (NBC3)

In systems with nonredundant control, the NBC3 is always located in slot 1 of the backplane (most left, when looking at the front of the VCO/4K). A redundant NBC3 is always mounted in slot 2. Slots 1 and 2 are connected to the control midplane. The control midplane connects each NBC3 to its companion SWI card in a system controller.

The NBC3 contains its own 68360 processor that allows it to serve as bus controller. The SWI card functions as a secondary DMA to the NBC3. Redundant NBC3s operate in active or standby mode depending on which controller has been selected as active by the AAC.

The NBC3 utilizes DRAM for program storage and relies on the system controller to download or boot program tasks over the SWI/NBC3 interface. SWI cards in a redundant system are linked through the controller midplane. The signals to the Alarm Arbiter Card (AAC) are carried to the control midplane via a ribbon cable between the control midplane and the Alarm Interface Card (AIC). The connection between the SWI and the NBC3 is made through the control midplane.

The NBC3 includes special phase-locked-loop (PLL) circuitry to allow system clocks to be synchronized internally, or externally with T1/E1 PRI digital spans, or externally with a BITS clock connected to the front panel.

Because problems with the NBC3 critically affect system operation, VCO/4K software provides numerous system error messages describing what type of NBC3 fault has been detected. These error messages are fully described in *Cisco VCO/4K System Messages*. Messages identifying problems with T1 and NBC3 synchronization are also provided in this document.

Switch Interface Card (SWI)

The SWI card serves as the VME portion of the bus controller complex that includes the Network Bus Controller (NBC3). It functions as the intermediary for direct memory access between the system controller and the NBC3. SWI cards in redundant systems are linked through the controller midplane.

The SWI card is part of the Combined Controller. Refer to Figure 8-1 for the location of the Combined Controller and the SWI.

Information is downloaded to the NBC3 through the SWI. The SWI is an interface between its NBC3 and the system controller. It acts as a path on initial startup for the NBC3 download. Interrupt requests to the VMEbus are initiated by the NBC3 and are processed through the SWI. The SWI handles block mode transfers of data to and from the NBC3.

Control Circuit Card Configuration

Card configuration refers to setting jumpers on service circuit cards to meet application requirements. *Cisco VCO/4K Card Technical Descriptions* details configuration requirements for VCO/4K control circuit cards.

If a card is improperly configured, it may fail to function properly. Verify configuration settings before installing a replacement control circuit card in the system. Always check the firmware version against the requirements specified in the configuration portion of the system software release notes. If the wrong version of firmware is installed, the system does not operate properly.

Troubleshooting

Refer to *Cisco VCO/4K Card Technical Descriptions* and the *Cisco VCO/4K Troubleshooting Guide* for detailed information on troubleshooting and repair/replacement of VCO/4K Control Circuit cards.

CHAPTER 9

Corrective Maintenance—Host Communications

Communications between the host computer and the VCO/4K are supported through Ethernet DB-15 interface on the Storage/Control I/O Module. The connecting cable, host I/O hardware/software, and the VCO/4K host control software comprise host communications links.

This chapter describes general corrective maintenance procedures for host communications links. Refer to the following documents for additional information about VCO/4K Ethernet configuration and communications:

- *Cisco VCO/4K System Administrator's Guide*
- *Cisco VCO/4K Extended Programming Reference*
- *Cisco VCO/4K Standard Programming Reference*
- *Cisco VCO/4K Ethernet Guide*

Other reference materials include the OEM manuals supplied with the host computer I/O package and modems employed for remote access (optional), and any documentation related to the communication and application packages to be run on the host computer.

Overview

In a VCO/4K, the CPU card in the system controller initializes and deinitializes the host link(s) and data transfer to/from the host. All control sequences are initiated by the CPU card; the Storage/Control I/O Module is merely a connector panel which provides physical connectivity between EIA cables and the CPU card.

Before a host communication channel can be initialized, you must first define it from the master console using the Host Configuration menu. (For more information, refer to the *Cisco VCO/4K System Administrator's Guide.*) This menu is used to configure host interfaces and software overlays (TeleRouter) and indicate the status of alarm conditions for host interfaces. You can configure up to eight host computer interfaces (sockets) for the system. In general, the larger the number of host interfaces defined, the more system processing time is dedicated to host interface processing.

Configure the internal interface only if the TeleRouter software overlay is to be used. If you do not configure the internal interface, TeleRouter call routing is not performed.

Table 9-1 lists the host communication parameters to be defined.

Table 9-1 Host Interfaces and Applicable Parameters

Interface	Parameters
Ethernet	Host Name
	Connect Password (for local port)—optional
	Loc. Port (logical port number of local port)
	Rem.Inet.Addr (Remote Internet Address)
	Rem. Port (logical port number of remote port A)
	Trace
	Protocol (fixed at TCP)
	Reset Time

To minimize reconnection times, always set the Rem Port value to 0 and the Reset Time value to 1 second.

A reset deinitializes the link (if it was already in service) and then initializes it and applies the configuration parameters stored in the database. The following events can cause a link reset:

- A system reset occurs on the VCO/4K (system reboots or is powered up)
- The link configuration is modified with from the Host Configuration menu
- An error occurs on the link (polling timeout, signaling error, etc.)

Problem Isolation Techniques

VCO/4K administrative software continuously monitors host communications links. The VCO/4K acts as a subordinate node in a network configuration, and expects the host (master) to poll/check the communications channels at regular intervals for message exchanges.

Error and status messages reflect the status of the data links between the VCO/4K and the host computer. If a communication channel fails, the appropriate message is sent to the VCO/4K error log (stored to disk and/or printed on the local printer, depending on the File System Configuration selections). Messages with the HST prefix indicate errors or status changes in host communication. Refer to the *Cisco VCO/4K System Messages* whenever a host error or status message appears on the local system printer.

The following sections offer general troubleshooting instructions for remedying the cause of a host communications link failure. Because of the uniqueness of each VCO/4K application, these procedures only serve as a guideline for analyzing and correcting communications problems.

Host Communications Failure on Power-On

If the system experiences a general failure of host communications at initial system power-on, check for the following:

- Verify proper installation and connection of communications cables. Refer to the *Cisco VCO/4K Hardware Installation Guide* and *Cisco VCO/4K Card Technical Descriptions* for detailed information.

- The host computer should be on-line and equipped with appropriate I/O hardware and software. Be sure that the host computer operating system and associated applications programs have been properly loaded and started.
- The VCO/4K should be powered-on and system software loaded on the system.
- If a VCO/4K is equipped with redundant system controllers, try switching from side A to side B. Monitor the system log for network messages. If host communication is restored, service the standby controller. If communication is not restored, recheck the I/O circuitry at the host computer.
- Enable the trace facility of the VCO/4K. Refer to the *Cisco VCO/4K System Administrator's Guide* for information on setting message trace bits and using the System Trace Configuration utility. If the trace and message facilities fail to demonstrate data communications with the VCO/4K, insert a protocol analyzer in the communication links to determine whether the VCO/4K (no responses sent) or host (no commands sent) is at fault.

Cables

The *Cisco VCO/4K Hardware Installation Guide* describes possible host communication configurations supported by the VCO/4K. Cables between the host and the VCO/4K are determined by the desired system implementation.

Use the following recommendations to detect and correct cable problems:

- The cable used for the link should be of such quality as to ensure proper electrical performance in accordance with electrical specifications.
- Connectors should be selected and installed on the cable in accordance with the pinout specifications detailed in the *Cisco VCO/4K Hardware Installation Guide* and/or the *Cisco VCO/4K Site Preparation Guide* and the OEM specifications for the I/O port on the host computer. Physical Ethernet connections are determined by the network environment.
- Cables should be routed away from sources of EMI and RFI noise which might induce spurious signals. Induced noise can cause erratic system performance, including loss of service.
- Breakout boxes or other similar adapters/line analyzers should be removed from communications links as soon as possible. This is especially true when long cable runs are used between the host and the VCO/4K. Such devices increase the chance of errors caused by propagation delay of signals and low signal voltages.

Modems

Modem setup parameters are dictated by the type of interface, communication protocol, cabling requirements, and answering mode required for the intended application.

To determine the actual modem setup requirements, review the following documents:

- *Cisco VCO/4K System Administrator's Guide*
- OEM operation manual supplied with the modem
- I/O port driver specifications for the application software on the host computer
- Application throughput and load requirements

If the modems are connected over the switched public network or leased data lines, you must also contend with problems of noise, line losses, and other problems common to data communications over analog networks.

Host Computer I/O Communications

Host computer I/O consists of hardware and software components which control data communications to and from the VCO/4K. The complexity of the data communications requirement is directly proportional to the number of channels between a host computer and the VCO/4K, the telecommunications traffic throughput expected for the intended application, the number of messages per call scenario, and the communications type/protocol selected for the links.

Requirements and Limitations

The following specific requirements and limitations apply to all host computer I/O communications:

- The redundancy required between the host computer(s) and VCO/4K system controllers determines the number of host communications links in the system implementation. Refer to the *Cisco VCO/4K Ethernet Guide* for an analysis of possible link configurations.
- Traffic throughput requirements affect the CPU overhead required in the host computer. CPU overhead must also be provided for I/O processing of the communications links. In all cases, the required overhead can be reduced by the selection of intelligent I/O hardware which offloads communications link processing. However, the host computer can become I/O bound if it is expected to support multiple data communications links to the VCO/4K, even with intelligent I/O controllers on both the VCO/4K and the host computer.
- The host computer must be loaded with appropriate communications software. This software includes drivers for the I/O ports. I/O performance is controlled by the sophistication of the communications package running on the host.
- If excess CPU overhead is expended from running the call processing application, the I/O rate of the data links may be insufficient to prevent timeouts or resets at the interface ports of the VCO/4K. The host may be unable to receive, process, and return a command to the VCO/4K to prevent such autonomous timeouts or resets.
- Host communications links must be operated and serviced in real time. All VCO/4K events and transitions are initiated over these links. Any delays in response affect the timely execution of the application.
- If the call processing application requires sending/receiving a relatively large number of commands and reports over the communications links, the host I/O hardware/software should be selected to accommodate this requirement.

Recommendations

The following recommendations are offered as guidelines to reduce problems resulting from the handling of data communications between the host computer and the VCO/4K:

- Select the host computer and I/O hardware/software based on an analysis of the traffic and I/O requirements of the intended application, specifically the number of interrupts per second and network packets received/transmitted per minute, and buffering requirements to support these throughputs. Large system configurations with relatively complex call processing scenarios will require more powerful CPUs, intelligent I/O controllers, and sophisticated communication protocols.
- Multiple active and redundant data link configurations also greatly affect the selection and configuration of the host computer. Dual host computers are recommended for large system configurations requiring full control redundancy.

- Strictly observe the interconnection and driver specifications for the selected host computer I/O hardware/software. Data communications problems often result from improper connection to, and control of, host I/O ports.
- The call processing application running on the host should incorporate the ability to monitor data communications to/from the VCO/4K. Refer to the *Cisco VCO/4K Standard Programming Reference* or *Cisco VCO/4K Extended Programming Reference* for recommended use of commands and reports supported by the system software.

Corrective Maintenance Procedures

If checking the cables, modem setup, and CPU status does not quickly resolve a host communications link failure, the problem is most likely the result of initial assumptions made when selecting the host computer and data communications options. This is particularly true when link failure occurs as traffic increases through the system. Cisco Systems recommends that physical host communications lines not be multiplexed or data compressed through statistical multiplexers. These devices induce transmit and receive latencies which cause timeouts between the VCO/4K and the host computer.

The steps to be taken to correct host communications problems vary according to the suspected cause. Table 9-2 lists corrective procedures. For more information, refer to the *Cisco VCO/4K Troubleshooting Guide.*

Table 9-2 Host Communication Troubleshooting Procedures

Possible Cause	Erratic or Lost Data Communications at Initial Power-on	Erratic or Lost Data Communications After Successful Power-on
	Corrective Procedure	
Cables	1. Inspect all connections between the host and the VCO/4K. 2. Verify that pinouts meet signaling requirements of the host and the Storage/Control I/O Module.	
CPU card	1. Verify that the CPU card operates at normal parameters. 2. Use the Host Configuration Screen to verify link parameters. 3. Reboot the system. 4. If you are unsuccessful, refer to *Cisco VCO/4K Card Technical Descriptions*.	
Nonredundant controller failure	1. Reboot the system. 2. If you are unsuccessful, service the controller and reboot.	
Redundant controller failure	1. Switch Active to Standby. 2. If you successful, service the Standby controller.	

Table 9-2 Host Communication Troubleshooting Procedures (continued)

Possible Cause	Erratic or Lost Data Communications at Initial Power-on	Erratic or Lost Data Communications After Successful Power-on
Modem setup	Refer to the OEM modem manual and verify setup parameters against desired communication protocols and signaling parameters. Verify the integrity of the analog data link.	
Host I/O failure	1. Reboot the host computer and load application and communications software. 2. Reboot the VCO/4K. 3. If you are unsuccessful, verify host computer I/O performance via a protocol analyzer or other in-circuit device.	1. Verify the operational performance of the host computer and its I/O ports. 2. Enable the message trace facility to determine whether messages are being passed over the communication links. 3. If you are unsuccessful, insert a data communications analyzer in the link. Look to see whether messages are being sent by the host and/or the VCO/4K. Failure to send a command or report isolates the cause to either the host or the VCO/4K. 4. Review the host I/O driver and application package to assure that VCO/4K commands/reports are being properly handled, without excessive delay.