Universal Station X Troubleshooting

UX13-400

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UX13-400
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About This Publication

The *Universal Stations*\up2(\s\up2(X)) *Troubleshooting* Guide provides the preliminary troubleshooting information necessary to assist Honeywell and customer technical personnel to isolate a TDC 3000[X] Universal Station[X] problem to a particular component or area. It is not intended to be a service manual—it is intended to help identify the area that requires service.

For service information, refer to the *Universal Station*[X]*Service* manual in this binder.

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Figures and Tables

Acronyms

AIA ... Application Integration Architecture
CIM ... Computer Integrated Manufacturing
IWSM ... Industrial Work Space Manager
LAN ... Local Area Network
LCN ... Local Control Network
OSF ... Open Systems Foundation
OSI ... Open Systems Interconnection
TDC ... Total Distributed Control
TPDG ... Turbo Peripheral Display Generator
UCN ... Universal Control Network
UNPX ... Universal Personality X
U^{X}S ... Universal Station with Extensions
WSI ... Workstation Interface

References

Publication Title	Publication Number	Binder Title	Binder Number
Universal Station Service	US13-400	LCN Service - 1	TDC 2060
Five/Ten-Slot Module Service	LC13-400	LCN Service - 1	TDC 2060
TDC 3000^X Universal Station^X Specification and Technical Data	UX03-400	Universal Station^X	TDC 2093
Universal Station ^{X} User Guide	UX09-400	Universal Station^X	TDC 2093
Universal Station^X System Administration Manual	UX11-400	Universal Station^X	TDC 2093
Universal Station^X Service	UX13-410	Universal Station^X	TDC 2093
Universal Station^X (Ergonomic) Service	UX13-430	Universal Station^X	TDC 2093
Troubleshooting HP-UX Systems Error Diagnosis and Recovery	92453-90026	Hewlett Packard Manual	

Section 1 – General Information

1.1 Overview

Introduction

The *Universal Station^X Troubleshooting Guide* provides information to help you isolate a Universal Station^X (U^XS) problem to a particular component or area. It is not intended to be a service manual—it is intended to help identify the area that requires service.

Intended audience

This guide is intended for Honeywell and customer technical personnel.

It is assumed that the users of this document are experienced in the installation, configuration, and usage of traditional Universal Stations, have been exposed to or trained to use Universal Station^X, and have a thorough understanding of UNIX commands and user interfaces.

Some of the steps recommended in this guide will require the user to log in to the Universal Station^X for purposes of examination and problem correction. This will require authorization to use the “root” account to perform these tasks.

What is covered

This guide covers the initial diagnosis of a Universal Station^X. The goal of this diagnosis is to determine the most likely reason for a failure or problem so that corrective actions can be focused on the most probable causes.

In addition, this guide is intended to provide a quick tutorial on the operational characteristics of Universal Station^X that are unique or differ from those of a standard Universal Station.

After identifying a problem, refer to *Universal Station^X Service* in this binder for corrective action procedures.

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Types of failures addressed

The types of failures addressed here are those that are unique to Universal Station^X and include problems of the Universal Station^X coprocessor, Ethernet LAN interface, High Performance Display Generator (TPDG), keyboard, and mouse/trackball pointing devices.

Importance of skilled operation and maintenance

This guide also addresses equipment failures and problems introduced through user error. Experience has shown that many Universal Station^X problems are the result of incorrect or inappropriate system configuration or operation by end users. Errors of this type can cause the software to appear to function improperly, but this should not be mistaken for "failure." Such errors are usually recoverable with little difficulty; however, further damage can be done by inappropriate troubleshooting procedures. Before you take any troubleshooting action, be sure you are familiar with UNIX system administration procedures, are aware of what "used to work," and how or what events occurred prior to the "failure" or degradation. In extreme cases, such user error can require the reinstallation of system software. For this reason, it is important that your Universal Station^X system should be maintained by experienced and trained personnel, and that appropriate file system configuration and maintenance is performed regularly to ensure timely recovery from loss of data through user error.

Using this guide

This guide is structured to provide step-by-step isolation of a failure in a Universal Station^X to the failing component. The types of failures are grouped by initial appearance or behavior. For example, "No Display" or "Personality will not load." Once the group has been identified, the specific nature of a failure within that group can then be determined.

1.2 Universal Station^X Basics

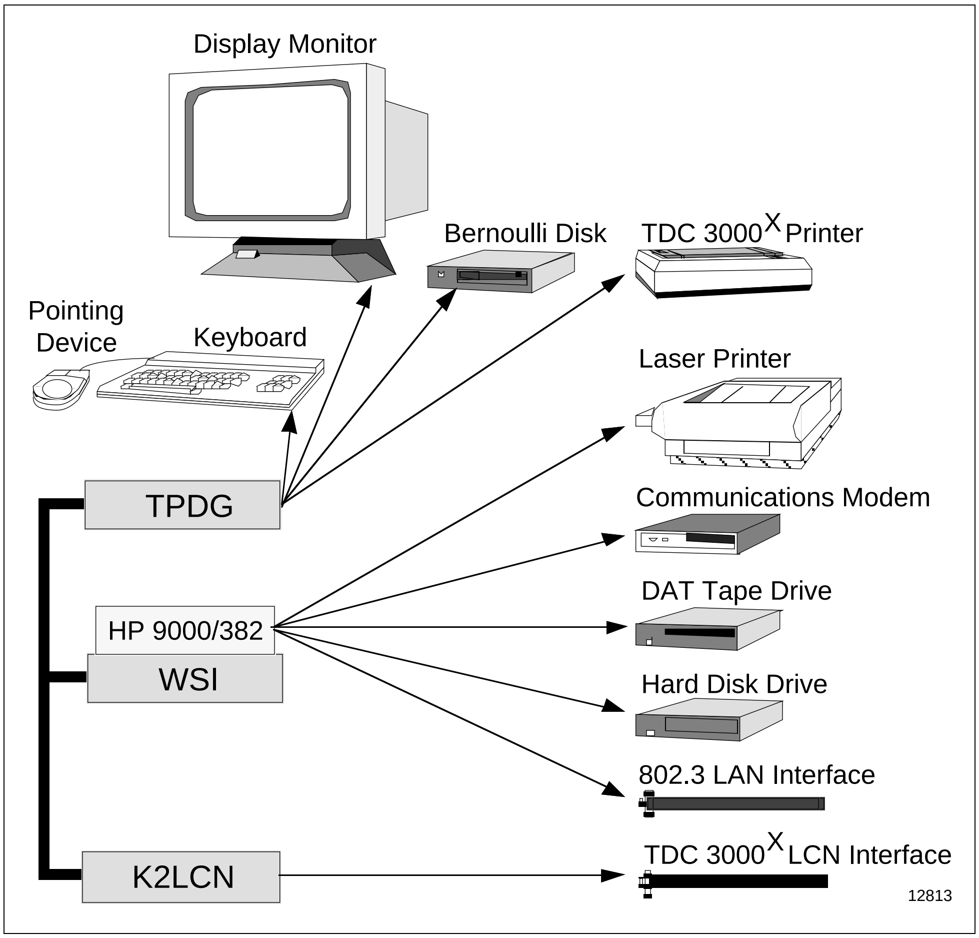
Introduction

It is important that you have a fundamental understanding of the components and processes of a Universal Station^X before attempting to troubleshoot the station. This subsection will describe the main functional components, hardware and software, of the Universal Station^X and describe how these components operate and interact.

Primary functional components of a Universal Station^X

The Universal Station^X is a hybrid combination that includes both a standard Universal Station and a coprocessor that provides the full functional services of a UNIX workstation. Figure 1-1 shows the primary functional components of a Universal Station^X and their physical relationships.

Figure 1-1 Universal Station^X Primary Functional Components



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TPDG functions

As shown in Figure 1-1, the primary Universal Station^X user interactive interfaces (display, keyboard, and pointer device) are supported by the Turbo Peripheral Display Generator (TPDG) board. Physical interfaces are provided by the companion TPDG I/O board. In addition, the TPDG provides support for Bernoulli (cartridge) disk and TDC 3000^X console printer options. This functionality is the same as that provided in the standard Universal Station.

WSI functions

The UNIX workstation support is provided by the WSI board. This board has a coprocessor board mounted on it. The coprocessor is a Hewlett Packard 9000/382. The HP 9000/382 coprocessor uses a 400 MB hard disk drive for program and data storage, an IEEE 802.3 compatible Local Area Network (LAN) interface, and optional peripheral devices for printing, tape backup, and remote communications over telephone lines. Physical interfaces are provided by the WSI I/O board.

K2LCN functions

The TDC 3000^X software (the Universal Station^X personality) executes in the K2LCN, which also provides the LCN interface in conjunction with the LCN I/O board.

Backplane interaction

All three electronics modules, the TPDG, WSI, and K2LCN, are connected together by a standard Five-Slot Module backplane. The backplane provides Direct Memory Access (DMA) to the memory (RAM) on the K2LCN for the TPDG and WSI boards. All bus arbitration and control is provided by the K2LCN.

U^XS Universal Personality

The full Universal Station^X functionality involves software in both the K2LCN and the coprocessor. The K2LCN provides the execution environment for the Universal Station^X Personality. This software personality is identical to the standard Universal Personality, with the addition of software elements that control the exchange of data with the coprocessor through K2LCN memory. The Universal Station^X Personality provides the complete functionality of a standard Universal Station independent of the coprocessor.

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Coprocessor software

The coprocessor provides the execution environment for UNIX applications programs, as well as associated software to enhance the display capabilities of Universal Station^X (the X-Window display manager and utility programs). The display manager provides display resource control and services that allow multiple programs to display their information on the same screen simultaneously in individual windows. The X-Window display mode is operational only when a valid user login has been executed. When there is no user logged in, the Universal Station^X operates without windows, in a manner identical to that of a standard Universal Station.

LCN Native Window

The display of data on the screen of the Universal Station^X is controlled by the TPDG. All standard TDC 3000^X displays generated by the Universal Station^X Personality on the K2LCN are presented in a window reserved for this purpose. This window is known as the LCN Native Window.

The display monitor in the Universal Station^X provides a resolution of 1280 by 1024 pixels, which is much greater than the standard Universal Station (640 by 448 pixels). Therefore, a standard full-screen Universal Station display can be presented on a Universal Station^X screen using less than 1/4 of the display surface. When Universal Station^X is operating in the X-Window mode, this method of display for the standard, or native, LCN display window is the default. This window shares the display with other windows, and can be manipulated, sized, and moved the same as for all other windows.

Behavior without UNIX/X-Windows

When the X-Window manager is running, the display data generated by the Universal Station^X Personality is presented on the screen in its own individual window, which shares the display surface with other windows owned by other programs running in the UNIX environment on the coprocessor. If for any reason, the coprocessor should fail or be intentionally shut down, the TPDG automatically reverts to a mode of operation identical to that of the standard Universal Station. In this mode, the native window display data occupies a full screen image. The failure of the coprocessor has no other impact on the Universal Station^X Personality.

Behavior without Universal Station^X Personality

Similarly, shutdown or failure of the Universal Station^X Personality has no effect on the software programs running on the coprocessor. A brief disruption of displays can occur whenever the K2LCN processor is reset, as this requires the TPDG to also be reset and reinitialized.

1.3 High-Level Diagnosis

Introduction

The Universal Station^X functionality is designed to provide reliable display services and operator interaction with LCN and PIN (Plant Information Network) software simultaneously. If the full functionality of the Universal Station^X is impaired, the following guidelines should help in determining the basic cause of the problem.

The following procedures will help you determine the type of failure and the functional group of software or hardware where the problem exists. Once the group has been determined, you will find guidelines that indicate the suggested steps to take to correct the problem.

Determining what has failed

The first step in determining a failure cause is to locate the general area, or group of functions that are not working properly. This is accomplished by both visual inspection and functional testing of the Universal Station^X .

In most cases, the differentiation between what works and what does not will be obvious to the user; however, there are some modes of failure or degradation of function that are unique to Universal Station^X. For this reason, the user should always determine if the loss of function is associated with the coprocessor only, the K2LCN environment only, or both. This step is important to determine the next appropriate action.

Visual inspection of Universal Station^X

First, verify the correct installation and configuration of the Universal Station^X. Refer to the *LCN System Installation* manual (SW20-400) in the *LCN Installation* binder. You may also find helpful information in the appropriate *Universal Station^X Service* manual—UX13-410 (old furniture) or UX13-430 (new furniture). Both are in the *Universal Station^X* binder. Ensure that all external cable connections for power, LCN, LAN, and peripheral devices (keyboard and mouse/track-ball), as well as internal devices (monitor, floppy/Bernoulli disk, and DAT tape) are properly installed.

Second, determine the nature of the difficulty and the associated platform. The functions provided by Universal Station^X are supported on two separate hardware platforms that are integrated in the same electronics enclosure. Most TDC 3000^X functions are provided by a standard Universal Station kernel and provided by the K2LCN/TPDG electronics. The control of all windows operating mode functions is provided by the WSI coprocessor. Use this differentiation as a basic guide to determine which processor is affected.

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1.3 High-Level Diagnosis, Continued

Visual inspection example

For example, if the standard cursor (‘>’) is displayed in the upper left corner of the display screen after reset, and the node responds to the “LOAD” key with the correct prompt, there is a high probability that most, if not all, of the hardware associated with standard Universal Station functions is operational. On the other hand, if the blue login dialog box is displayed on the bottom of the display screen, this is a good indication that all of the coprocessor functions are operational.

Functional Testing

After the proper installation and configuration of the Universal Station^{X} has been determined to be satisfactory, but normal operation of the station has not been restored, it is necessary to perform some functional tests to determine the area, or group, of functions that are at fault.

The basic steps in determining component failure are described in the *Universal Station^{X} Service* manual—UX13-410 (old furniture) or UX13-430 (new furniture). These manuals include information about the status indicators on the K2LCN, TPDG, and WSI boards. They also include information about board pinning and cabling, as well as maintenance and service information on drives, keyboards, and the monitor.

Summary of initial checks

The following is a brief summary of the initial checks that you should make:

- Check board and cable installation
- Check board pinning
- Check status indicators on the power supply, K2LCN, WSI, and TPDG boards. (Checking the diagnostic display on the WSI coprocessor is covered separately in a later subsection of this publication.)
- Check that the node address is properly displayed on the K2LCN
- Check for the LCN cursor in the top left of the screen
- Check for the UNIX login banner at the bottom of the screen.

Section 2 – Universal Station^X Problems and Fixes

2.1 Display Problems

No display

This problem is usually indicative of a failure of either the TPDG and TPDG I/O modules or the monitor. As a minimum, you should observe a cursor on the screen after the node has been powered on or reset. Remember that all displays for both the K2LCN and coprocessor are provided by the TPDG, and that the coprocessor is not required to obtain basic Universal Station display functions.

If a cursor is visible, a login window should appear on the bottom portion of the screen. If the login window fails to appear, it is an indication that the coprocessor is not functioning properly. Proceed to the subsection titled "UNIX Software Problems."

Incorrect display

This category includes a variety of possible symptoms. A few are given in the following table.

Table 2-1 Incorrect Display Types and Possible Causes

Symptom	Possible Cause
Incorrect colors	Can be caused by of a failed monitor, TPDG, or TPDG I/O, or possible incorrect or corrupted system software configuration.
Fuzzy, wavy displays	Usually indicates a failed monitor or TPDG. Refer to the *Universal Station^X Service* manual—UX13-410 (old furniture) or UX13-430 (new furniture) for Universal Station^X monitor service.
No display interaction	Usually indicates a failure of the TPDG, TPDG I/O, Touchscreen, or Keyboard. CAUTION: This problem can possibly be the result of attempts to interact with a window that is not the current active window. Ensure that the cursor is physically positioned within the window before attempting to interact with the application running there.

2.2 Personality Load Problems

The personality load process

The Universal Station^{X} Personality is stored on disk media maintained by the coprocessor. When a load operation is requested by depressing the LOAD key, the following steps occur:

Table 2-2 Steps in the Universal Station^{X} Load Process

Step	Action
1	The prompt W,1,2,3,4,N? is presented on the screen. The user presses W and then the ENTER key to initiate a load of Universal Station^{X} by the coprocessor.
2	The K2LCN firmware sends a message to the coprocessor requesting a load of the default Universal Station^{X} Personality software.
3	The coprocessor program “lcndaemon” locates the Universal Station^{X} Personality files and loads them into K2LCN memory. Dialog messages are presented on the screen indicating the progress of the load.
4	The coprocessor program “lcndaemon” sends an “EXECUTE” message back to the K2LCN firmware.
5	The K2LCN firmware checksums the image in memory and then transfers control. The node begins startup and the message NODE STARTING UP is displayed.

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Failure of the personality load

Table 2-3 shows some of the failures that can occur during a Universal Station^X Personality load and suggests corrective action for each.

Table 2-3 Correcting Universal Station^X Personality Load Failures

Symptom	Possible Cause and Corrective Action
No prompt	K2LCN, Keyboard, or TPDG is not functioning. Check K2LCN/TPDG/Keyboard.
No load messages	K2LCN is not functioning properly, WSI is not operational, coprocessor is not running, “lcndaemon” is not running, or WSI interface is not operational. Ensure that coprocessor is running properly. Login window should be displayed at the bottom of the screen. If it is not, proceed to “UNIX Software Problems.” Attempt to load from a local Bernoulli, or select “N” at the prompt, to ensure that a standard Universal Station personality (OPR, ENG, or UNP) can be loaded (as opposed to the Universal Station^X Personality).
Load completes, personality fails to start or run	Personality image may be corrupt on disk media, personality may be wrong version, or LCN problem prevents startup. Attempt to load from a local Bernoulli, or select “N” at the prompt, to ensure that a standard personality can be loaded. If this fails, troubleshoot same as failure to load any Universal Station. If this works, reinstall current Universal Station^X software.
Personality continuously prompts NCF N,1,2,3,4?	Universal Station^X is not properly connected to the LCN network and/or cannot access History Module. Validate LCN connections. Ensure that “LCN Re-Connect” is not in progress. Is Universal Station^X Personality version compatible with others on LCN?

2.3 UNIX Software Problems

Categories of errors

The coprocessor UNIX environment provides all management of windows display resources. In addition, the coprocessor is the host for all Universal Station^X enhanced features. Any failure that occurs within these functions usually will not affect the functioning of Universal Station^X in the standard Universal Station mode of operation.

Errors in the UNIX operating environment can be categorized in two basic groups:

- Loss of function
- Degraded operation

Loss of function

A loss of function problem is defined as one that prevents the normal operation of the station, prevents user interaction, or appears to indicate total coprocessor failure.

In most cases, troubleshooting of a loss of function problem will require direct access to the UNIX environment. This may not be directly possible from the Universal Station^X console keyboard and screen when the failure prevents the user interactive windows session from being initiated. When such a failure occurs, it is impossible to differentiate the loss of display interaction from total UNIX failure.

Loss of display—no login window

This problem indicates a loss of display integration services, and may even indicate total failure of the UNIX environment. This problem cannot be investigated directly from the Universal Station^X console keyboard. Direct access to the coprocessor is required to determine the nature of the problem.

To obtain direct access to the coprocessor, it is necessary to connect a UNIX console directly to the coprocessor. This is covered in the next subsection.

2.4 Connecting a Coprocessor Console

Connecting a console to the coprocessor

Use the procedures below to connect a terminal to J1 of the WSI I/O board. Figure 2-1 shows the connector locations and functions for the WSI I/O board. Appendix B gives the wiring for a typical cable that might be used.

If possible, choose a terminal that is Digital Equipment Corporation (DEC) VT-100 compatible. You may also use a PC running suitable terminal emulation software (such as Microsoft Windows Terminal) to provide VT-100 compatible terminal capability.

Configure the terminal for 9600 bits/second, full-duplex, 8 bits/character, and no parity. Honeywell's TAC (Technical Assistance Center) recommends a US Robotics Sportster 14,400 baud modem with all DIP switches in the factory default position.

ATTENTION

ATTENTION—The terminal connection described here is a powerful diagnostic aid and will be invaluable for troubleshooting certain types of failures. We strongly suggest that you try this connection ahead of time, if possible, so that you test your terminal or emulation software and cable. This simple preparation will save time and allow you to focus on the problem rather than the test equipment should a problem arise.

The following procedure includes node shutdown and power turnoff. It is generally accepted practice to connect and disconnect RS-232 cables with power on. However, since our goal is to observe the boot process, we suggest turning off power here unless doing so would adversely affect or risk your process.

Table 2-4 Procedure to Connect a Coprocessor Console

Step	Action
1	If your Universal Station^X has a personality loaded and is online with the LCN, do a shutdown of the node.
2	Turn off the power switch on the Five-Slot Module.
3	Connect the communications cable to the terminal (or PC) and to J1 on the WSI I/O board (see Figure 2-1).
4	If you are using a PC with VT-100 emulation software, invoke the emulation software.

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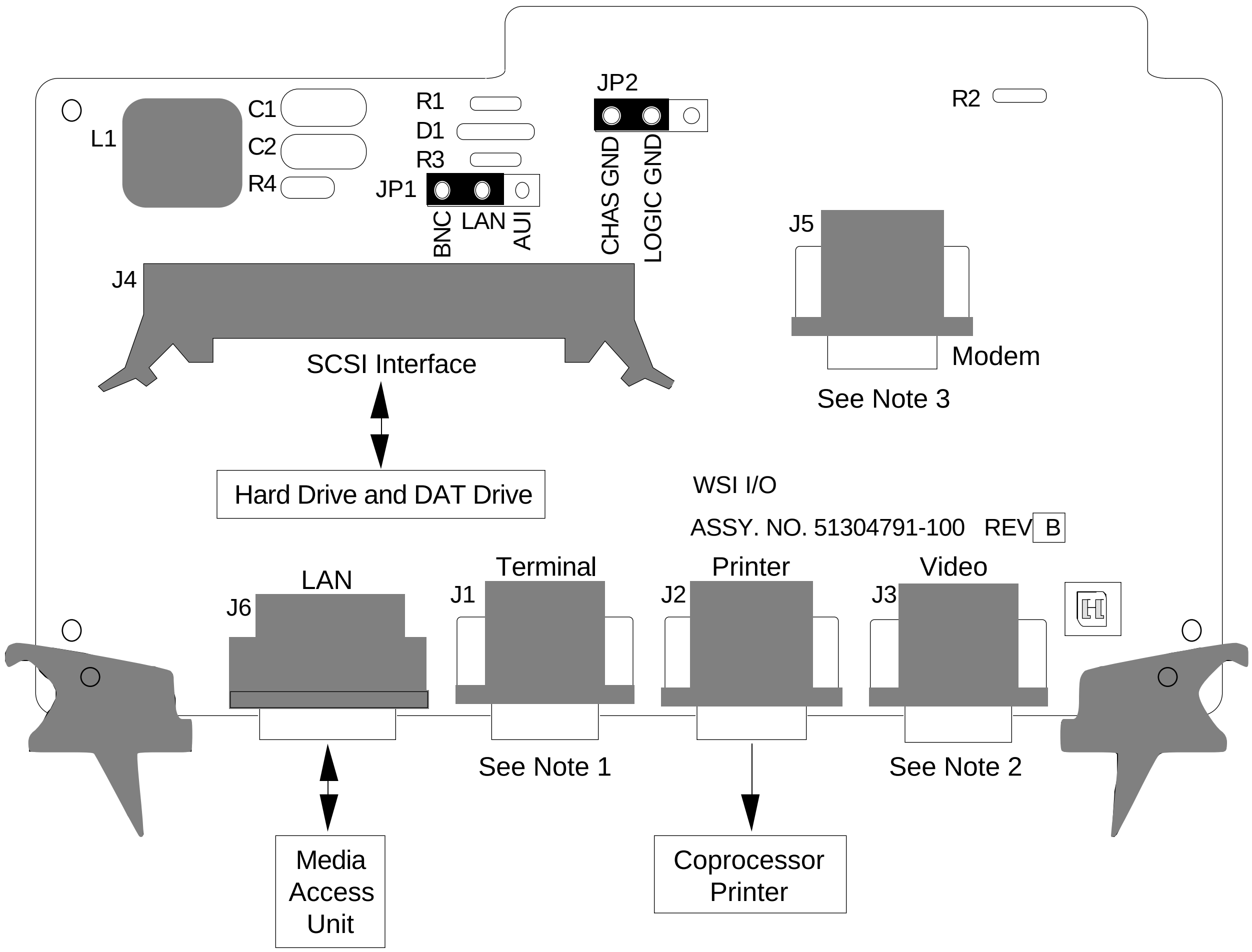
Figure 2-1 WSI I/O Board Connector Locations and Functions



Note 1 Not normally used. Can be used to connect a dumb terminal for in-depth troubleshooting of the coprocessor.

Note 2 Not normally used. Can be used to connect a VGA monitor for in-depth troubleshooting of the coprocessor.

Note 3 Connects to free-standing modem for TAC coprocessor troubleshooting access.

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2.5 Determining if UNIX is Operational

Testing with a UNIX console

If you have a loss of display problem, the first step is to determine if UNIX is operational. Because you cannot communicate with the coprocessor through the Universal Station^X keyboard and monitor, you must connect a UNIX console directly to the coprocessor. Then you can observe the boot process and try keyboard input.

Connect a console terminal to the coprocessor as described in the previous subsection.

Observe the attempted boot

Turn on power to initiate the bootload process.

Watch the console terminal and observe whether the bootload process starts, and if so, how it terminates and what error messages, if any, are reported.

A bootload, as monitored on the terminal, begins with the copyright information. This is followed by a self-test, the bootload of system software, and initiation of internal processes. A successful bootload ends with the prompt `Console Login`: on the terminal screen.

What to do next

If UNIX appears to be operational, go to the subsection titled "*Troubleshooting if UNIX is Operational*." If UNIX does not appear operational, continue with the next subsection to perform additional checks.

2.6 Coprocessor Diagnostic LED Status Display

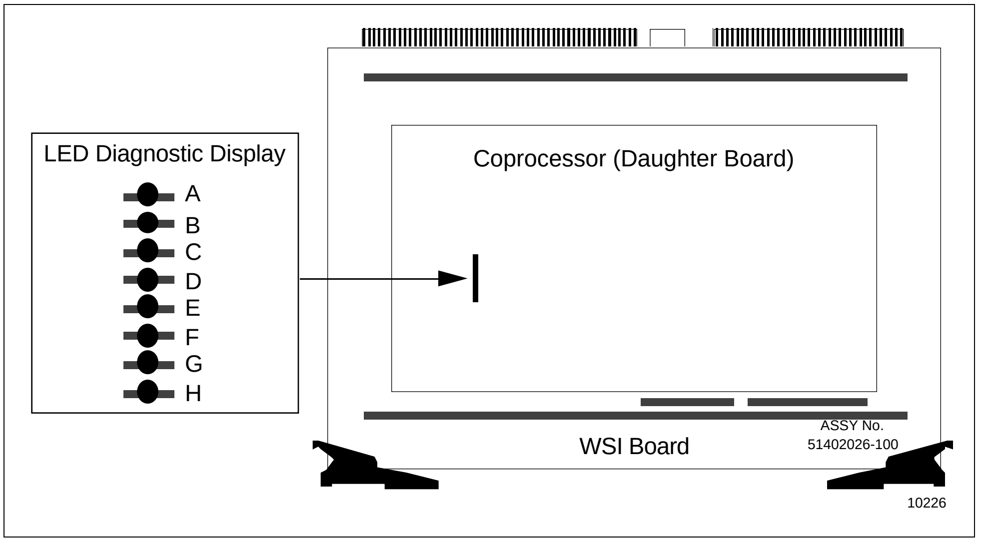
Function of the display

The Diagnostic LED Display indicates the current status of the HP 9000/382 coprocessor. The display consists of eight LEDs that provide information about the status of the hardware and the UNIX kernel.

Location of the display

The LED diagnostic display is located on the HP coprocessor board, which is mounted as a daughter board on the WSI board. The WSI board is located in Slot 2 of the Five-Slot Module. Figure 2-2 shows the location of the display. A flashlight and small nonconductive mirror will help you view the display.

Figure 2-2 Coprocessor Diagnostic LED Display



Interpreting the display

Table 2-5 Meaning of the Display Indicators

LED	Indication	Meaning
A	On or blinking	Network transmit in progress.
B	On or blinking	Network receive in progress.
C	On or blinking	Disk access in progress.
D	Pulsing	Operating system running (heartbeat).
E	Off	Always off if operating system is running.
F	Off	Always off if operating system is running.
G	Off	Always off if operating system is running.
H	Off	Always off if operating system is running.

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Display when UNIX is running

Table 2-5 shows the normal behavior of the LEDs in the display.

The "operating system running" flag, LED D, will normally pulse as an indication of a "heartbeat," indicating that the UNIX kernel is running. LEDs A, B, and C will normally blink at intermittent rates to indicate the activities shown. LEDs E, F, G, and H will always be off in normal operation.

No heartbeat

If LED D, the heartbeat LED, is not pulsing at a regular rate (approximately 1 second on and one second off), try resetting the node by turning power off for a few seconds and then turning it back on again. If the heartbeat doesn't start within 2 minutes, continue with the following procedures.

Display when UNIX is not running

You may be able to obtain additional diagnostic information by checking the status of the LED display when heartbeat is not present.

After a power on or reset, the coprocessor firmware conducts a sequence of self-tests and then boot procedures that normally culminate in a functioning kernel. The diagnostic LEDs illuminate in seemingly random patterns during this startup phase. If a failure is detected, the LEDs will "freeze" with the pattern indicating the specific error that occurred. Appendix A contains a table of these patterns and their meanings. Record the error information—if you discuss your problem with Honeywell TAC, it may provide useful information.

Hardware failure

Generally, if the LEDs freeze in a pattern that is listed in the appendix, this indicates a hardware failure. The procedure in this case is to replace the WSI and coprocessor assembly as a unit; however, before you do this, you should perform the procedures in the next subsection to check for a corrupt file system or hard drive problem.

2.7 Troubleshooting if UNIX is not Operational

Overview

If there is no heartbeat indicated on the LED display, the UNIX kernel is not running. The next step is to determine why the UNIX kernel cannot run. The console terminal connection described in subsection 2.4 is required to monitor the boot process.

File system corruption

The most common problem affecting UNIX's ability to boot is file system corruption typically caused by improper shutdown or a failure of power to the coprocessor and its subsystems. If the station is improperly shut down, the latest changes to files may not have been updated to disk, resulting in file system corruption. For performance reasons, file system writes are cached, or accumulated in memory, until they can be written to the disk in an efficient manner. If the system is improperly shut down (manually or by power failure or crash) while disk data are cached, there will be a difference between what UNIX "thinks" is on the disk and what is actually there. A process called "fsck" (File System Check) is run automatically at boot time to check for and correct this (and other) problems. Usually, this process will correct the problems automatically; however, multiple power failures occurring in a short period of time can cause the process to be interrupted. This can result in an inconsistency that cannot be corrected automatically. When this occurs, the boot process will pause in the fsck process and prompt the user to enter a choice of corrective action from the console.

To determine if this is the reason your Universal Station^{X} is not functioning, attach the console device to the TERM0 port (J1) on the WSI I/O board. Reset the system and monitor the boot process on the console to determine if the fsck process is waiting for input. If so, provide the appropriate input to allow the process to complete. For further information on appropriate actions to take in the case, refer to the Hewlett Packard reference manual *Troubleshooting HP-UX Systems Error Diagnosis and Recovery*.

Disk failure

Another potential reason for a nonfunctional UNIX system is the failure of the local disk storage unit. When the Universal Station^{X} is powered on, the HP 9000/382 firmware will automatically search for a boot file on all attached disk and tape units. This search is indicated on the console device. If the local disk storage device has failed, the system will remain in system search mode indefinitely until appropriate action is taken.

The recommended method of recovering from this failure is to replace the disk unit with a new unit provided by Honeywell. The new unit, if provided by Honeywell, will have the complete basic Universal Station^{X} software suite already installed. Once this action has been taken, the original system configuration and user files can be restored from the most recent backup.

2.8 Troubleshooting if UNIX is Operational

Overview

If you do not get the login banner on the Universal Station^{X} console and observation of the diagnostic LED display indicates that UNIX is running, the next step is to check the status of Honeywell Universal Station^{X} support software. The console terminal connection described in subsection 2.4 is required to ascertain this information.

Check the Honeywell support software

One cause for this type of failure is incomplete installation of a Universal Station^{X} software update. This type of failure is indicated by error messages that can be observed at the console device during system boot and startup, or by analysis of log files kept by the Honeywell software subsystems.

To obtain further information, perform the steps in Table 2-6 to obtain a list of running Honeywell tasks.

Table 2-6 Procedure to List Running Honeywell Tasks

Step	Action
1	Connect a console terminal as described in subsection 2.4.
2	At the console device, enter the following command: `ps -ef	more` This command will provide a listing of all running processes.
3	Determine if the primary processes required for Universal Station^{X} are running. These processes are: `-X` The X11 window manager `-tsdaemon` The Honeywell manager daemon. There should be two copies of this process. `-lcndaemon` The Honeywell LCN interface manager. There should be two copies of this process running. `-iwsm` The Honeywell Industrial Work Space Manager `-startusx` The Universal Station^{X} display manager startup script `-usxinitrc` The Universal Station^{X} display manager initialization script

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Check the Honeywell support software, continued

Table 2-6 Procedure to List Running Honeywell Tasks, continued

4	If any of the above processes listed in the previous step are not running, there is a problem in the startup sequence of the Universal Station^X. Check the log files in the directory `/tmp` for indications of why this process is not functioning properly. These log files are:
	
	`/tmp/Xlogfile.log`
	`/tmp/Tpdg_server.log`
	`/tmp/LCN_daemon.log`

5	If there has been a recent installation of a software update, inspect the file `/tmp/update.log` to determine if an error occurred during the installation.

2.9 Degraded Operation

Definition

A degraded operation problem is one that prevents the use of a specific function where all or most others continue to function normally.

Causes and things to check

These types of failures are usually caused by the incorrect setting of user authorizations, privileges, and X-window display attributes. These parameters should be installed and maintained by the system administrator; however, a user can inadvertently alter his own configuration, causing problems unique to that user.

All user attributes that affect specific display client software are selected by default selections contained in the file `/usr/lib/X11/system.Xdefaults`. Attributes that affect the display of windows and associated resources common to all users are defaulted in the file `/usr/lib/X11/system.mwmrc`.

These default attributes can be over-ridden by the individual user by local files in the users home directory. These files are "`.Xdefaults`", "`.mwmrc`", and "`.session`". These files should be inspected carefully whenever a specific software function fails to operate for a single user.

Additional client software configuration attributes are found in the directory `/usr/lib/X11/app-defaults`. Files in this directory provide the default resources for specific client software programs. To take advantage of these defaults, a user must have a local shell variable set that provides a path to these variables. By default, this variable is normally named "`XAPPLRESDIR`", and should be set to "`/usr/lib/X11/app-defaults`". Check for this whenever a user has difficulty using a specific or newly installed software application.

Incorrect settings of access rights is another problem that can affect execution of specific software functions. A user can be denied access to a needed file or directory if these rights are incorrectly set.

All of the configuration settings, and any problems resulting from these settings, are normally handled by the responsible Universal Station^X system administrator. The responsible individual should be trained or have appropriate experience in the required tasks.

2.10 Using the Modem Port

Coordinate with TAC

The modem port (J5 on the WSI I/O board) can be used for remote maintenance and support by the Honeywell Technical Assistance Center (TAC). This procedure must be coordinated with TAC to ensure modem compatibility and to schedule time. A discussion of the problem, symptoms, and history should precede a modem session.

Configure the modem port

Before a modem session, you must configure the modem port. Use the procedure in Table 2-7 to configure the modem port. This procedure requires the coprocessor (root) password.

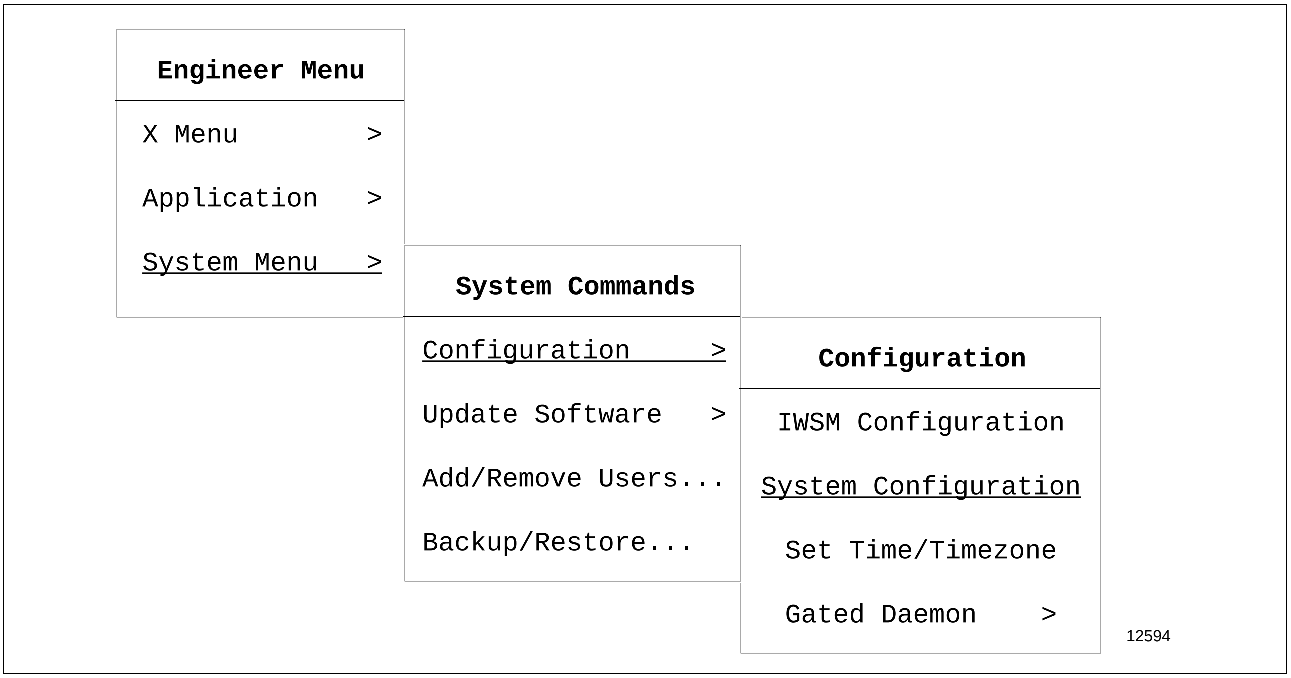
Table 2-7 Procedure to Configure the Modem Port

Step	Action
1	Log in as "engineer."
2	Position the cursor in the workspace (where there are no windows) and press and hold down the left mouse or trackball button to display the `Engineer Menu`.
3	As shown in Figure 2-3, while holding down the mouse or trackball button, select `System Menu`, then `Configuration`, and then `System Configuration`. Release the mouse or trackball button.
4	In response to the "`Password:`" prompt, enter the coprocessor (root) password.
5	Use the down arrow key to select "Peripheral Devices" and then press <RETURN>.
6	Use the down arrow key to select "Add a Terminal or Modem" and then press [ENTER].
7	Use the down arrow key to position the cursor block in front of "_modem" and then enter "x" in that position to select modem.
8	In response to the question "Do you want the device for calling out?", enter "n".
9	In response to the question "Is this a CCITT modem?", provide the appropriate response ("y' or "n"). In the United States, this will undoubtedly be "n."
10	Select `DONE` (position the cursor on the `DONE` button and click the left mouse or trackball button).
11	For "`Select Code`", enter "6" and for "`Port Number`" enter "3".
12	Select `PERFORM TASK` and then `EXIT TASK`.

Continued on next page

Selecting process to change system configuration

Figure 2-3 Accessing the Menu to Change System Configuration



Connect the modem

Connect the modem to J5 on the WSI I/O board. Because of the location of J5 (see Figure 2-1) you will need to remove the WSI I/O board to make this connection. This will require shutting down the node and powering down the station. Also, because of space constraints, a D-9 connector with full-size hood cannot be installed on J5. One way to avoid both of the above problems is to install a short 9-pin ribbon cable with a male ribbon connector on one end and a female connector on the other. The ribbon connector will fit on J5 and the cable extends the interface out of the I/O card cage so that a modem cable can be connected without shutting down the station.

Appendix B includes a wiring diagram for a modem cable that will work with many modems. Consult with TAC for specific situations. If your modem has option switches, check with TAC for the appropriate settings.

Prepare ahead

As we mentioned earlier in conjunction with the console terminal interface, it is important to try these interfaces before trouble necessitates their use. If you anticipate using a modem for troubleshooting, do a trial when the system is running (if possible) to ensure that the configuration, cable, and modem are proper.

Section 3 — Troubleshooting the Ethernet LAN

3.1 Local Area Networking (LAN) Overview

Related publications

The Hewlett Packard publications covering ARPA, NFS, and NS Services detail the use and configuration of networking services available on the TCP/IP Local Area Network (LAN).

These publications are not required to troubleshoot faults with the physical components such as loose cable connections or improper termination. This manual covers the tools and techniques required to locate and correct common internet faults with the physical layer of the OSI (Open System Interconnection) reference model. Additionally, this manual suggests corrective actions for problems with the data link, network, and transport layers and identifies the appropriate Hewlett Packard publication.

The publications of interest are:

Publication Title	Publication Number
Networking Overview	B1012-90003
Using ARPA Services	B1014-90000
Installing and Administering ARPA Services	B1014-90001
ARPA/Berkeley Reference Pages	B1014-90002
Installing and Administering NFS Services	B1013-90001
Installing and Administering Network Services	B1012-90001

Network standards

The International Standards Organizations (ISO) has developed the Open System Interconnection (OSI) model. A design by which individual components of the communications system may be replaced, allowing computers from any vendors to exchange data without regards to the operating system or processor hardware. The approach was to divide the communications system into its functional components and specify a hierarchical method of designing protocols so that each layer connects only to the layer above and below it. This design structure allows an ethernet cable to carry multiple protocols simultaneously.

IEEE 802 standard

The Institute of Electrical and Electronic Engineers established standards that specify interface and protocol specifications for various LAN topologies. The 802 standard corresponds with the Physical and Data Link layers of the OSI model and provides a common interface to the higher layers of software over networks with differing topologies, protocols, and media.

Continued on next page

How TCP/IP fits OSI

The TCP/IP protocol suite's relationship to the ISO-OSI model and IEEE's 802 standard is shown below. The software utilities and their test programs perform discreet functions corresponding to each OSI layer.

ISO-OSI MODEL	IEEE 802 STANDARDS	TCP/IP PROTOCOLS	TCP/IP TESTS
APPLICATION LAYER #7		FTP	ftp -d
PRESENTATION LAYER #6			telnet with trpt
SESSION LAYER #5		TELNET	
TRANSPORT LAYER #4		TCP UDP	netstat mbd
NETWORK LAYER #3		IP	
DATA LINK LAYER #2	802.2 802.3 802.4 802.5		ping
PHYSICAL LAYER #1			

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Layer 7 — This layer consists of application programs and serves as the window, or network interface, through which all exchange of data occurs between communication users.

Layer 6 — This layer performs data conversions and ensures that data is exchanged in an understandable format.

Layer 5 — This layer sets up and terminates communications on the network and manages the dialogue between users and systems.

Layer 4 — This layer controls the quality of data transmission. It is mainly implemented by communications software protocols such as TCP.

Layer 3 — This layer determines the path that the data will take through the network. Packets of information contain routing information that aid passage through the network.

Layer 2 — This level packages data for transmission and unpackages it for receipt.

Layer 1 — This layer defines the physical connection (connector and pin assignments, voltage levels, and the initial cable connections) between a computer and network , and also controls the transmission of information.

3.2 TCP/IP Overview

Standard protocol

The Transmission Control Protocol (TCP) and the Internet Protocol (IP), referred to as TCP/IP, provide services allowing dissimilar computer systems to communicate and exchange data.

The original TCP/IP development by the Defense Advanced Research Projects Agency (DARPA) has received widespread support from computer manufacturers of all types.

Protocol vs. physical device

TCP/IP protocols were designed to provide communications services over a variety of physical networks—from computer networks to radio networks. The protocols define how to send and receive messages, but not what the physical device must do to send or receive messages. This enables vendors to create device drivers specific to the hardware.

TCP/IP utilities

The utilities provided through TCP/IP are:

- `telnet` —provides communications using the Telnet Protocol
- `ftp`—File Transfer Protocol transfers files to/from a remote site.
- `lpr`—Remote Line Printer queues and prints files to shared printers.
- `rcp`—Remote Copy of files between machines.
- `rexec`—Execution of commands on a remote system.
- `rlogin`—Login to a remote host.
- `remsh`—Execute a shell command on a remote host.

Hosts, gateways, bridges, and routers

Computers that use the TCP/IP protocols to communicate are called TCP/IP hosts. A host can also be a gateway, bridge, or router to another network.

Gateways connect two incompatible networks providing a physical link that is transparent to the users. Communications between users on separate networks is “routed” through the gateway that provides translation of all seven OSI protocol layers. For example, a gateway must translate the protocols and the physical interface connections when joining TCP/IP over Ethernet to Apple Computer’s AppleTalk protocol over LocalTalk cabling.

Bridges connect two similar networks allowing each to function independently. Traffic addressed to users on the remote network is routed across the bridge connection, yet local traffic is isolated to its respective network.

Routers connect networks with different protocols but similar cabling systems. The router provides protocol translation only.

Continued on next page

Host names

The Internet Protocol's ability to correlate alias names (host names) to address numbers, allows users to reference systems on the LAN by a name assigned on the basis of the computers function or location (for example, `Inventory` vs. `Unit1_Station3`) . This "hostname" is aliased to the internet address by its entry in the `/etc/hosts` file.

How /etc/hosts is used

At boot time, each computer on the network must have a minimum host file on its local disk to initialize the hostname-to-internet address mapping. Once the host has loaded the appropriate name server, service is used to resolve hostname to Internet protocol requests.

A minimum `/etc/hosts` file contains the following entries:

```
# The form for each entry is:
# <internet address>  <official hostname> <aliases>
#
# See the hosts(4) manual page for more information.
# Note: The entries cannot be preceded by a space.
#
#   To use subnet masking uncomment the defaultmask entry
#   and enter the desired value (e.g. 255.255.255.0).
#
#  255.255.255.0   defaultmask
127.0.0.1          localhost     loopback
127.0.0.2          unknown
###.###.###.###    hostname      alias_for_hostname
```

Where the *`hostname`* entry will resemble this:

```
129.30.114.211     uxs.iac.honeywell.com     uxs1
```

Name servers

The Internet Protocol defines services to simplify `/etc/hosts` file maintenance on large networks. The Berkeley Internet Name Domain (BIND) service is often referred to as the "name server." The configuration and troubleshooting of the domain name service is covered by Hewlett Packard's publication "Installing and Configuring ARPA Services."

Overview of BIND

With BIND service, the `/etc/hosts` file is maintained on one system (the primary or master) that provides host-to-internet address mapping for the other systems on the LAN.

The master system is configured with the IP daemon `named` to resolve host-to-address requests. Flexibility in configuration can provide continuous operation by secondary name servers should the primary fail or be shutdown for maintenance. Updating the master's `/etc/hosts` file initiates a transfer of the update information to all secondary servers and gateways.

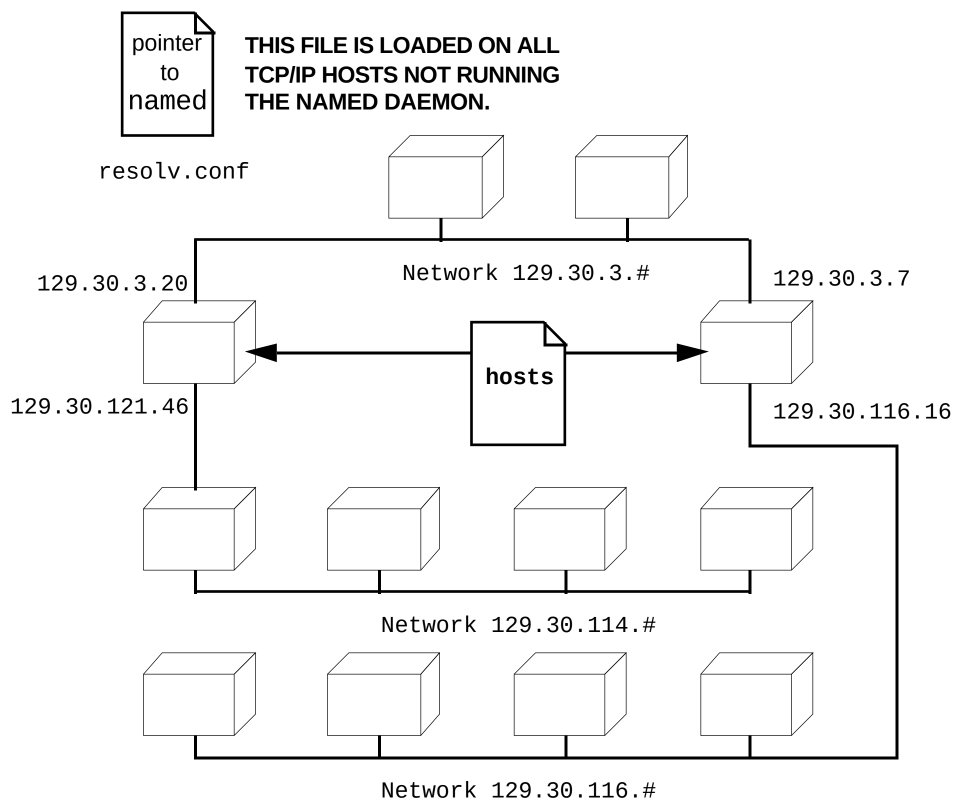
Continued on next page

Overview of BIND, continued

Using the name service eliminates problems caused by incorrect or missing `/etc/hosts` entries. Problems are eliminated by supplying the address from the master server's `/etc/hosts` file when starting a communications session. Communication tasks can be automated without fear of future address changes requiring any alteration to the scripts. Referencing the system by hostname ensures the address is looked up each time the script is executed.

Typical name server architecture

This shows a typical configuration of the name server in a workstation environment. The name service is run on each internet segment's gateway node to reduce traffic on the main segment and provide secondary servers in case of server node failure. Each system has a minimum `/etc/hosts` file and a `/etc/resolv.conf` file to configure host to query the appropriate name server.



Two name servers with host infomation using named.boot

The Master is a router in Minneapolis and serves as our secondary nameserver. The Slave is a local gateway/router and serves as our primary nameserver.

Changes to the name service are performed at the Master server and automatic updates for all Slaves are transmitted across the internet.

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3.3 TCP/IP Services and Processes

What is a daemon?

The server process necessary to provide TCP/IP services. These processes are run in the background (transparent to user) on TCP/IP hosts.

The daemons provide the following:

- Control user access to network resources
- Respond to requests for data
- Record statistics concerning health of the network
- Control external communication pathways outside the local network.

TCP/IP daemons

Daemons used to provide TCP/IP services are:

- `routed` — dynamically maintains network routing tables. It starts at boot time on all nodes, but is stopped on host nodes after "routed" initializes the local routing table. Gateway nodes run this daemon continuously.
- `inetd` — this is a single process started by `/etc/rc` at boot and serves as a "super daemon" invoking the appropriate Internet servers as services are requested. The `inetd` process must be running to use the servers `ftpd`, `telnetd`, `rexecd`, `rlogind`, `remshd` or `tftpd`.
- `ftpd` — this server daemon is run by `inetd` as requests for File Transfer Protocol (FTP) services are received.
- `telnetd` — this server daemon is run by `inetd` as requests for Telnet services are received.
- `rexecd` — this server daemon is run by `inetd` as requests from hosts to execute UNIX commands remotely are received. `rexecd` must receive a valid user ID and password from `rexec`.
- `rlogind` — this server daemon is run by `inetd` as requests from hosts for remote logins are received. Users can login on any host running `remshd` and if the remote host is listed in `/etc/hosts.equiv`, no password is required to connect.
- `remshd` — this server daemon is run by `inetd` as requests from hosts a remote shell server servicing requests from the `rsh` program and the `rcmd` functions. Users can execute UNIX commands on hosts running `remshd` and if the remote host is listed in `/etc/hosts.equiv`, no password is required to connect.
- `tftpd` — this server daemon is run on-demand by `inetd` as requests for Trivial File Transfer Protocol (TFTP) are received.

Continued on next page

TCP/IP daemons, continued

- rwhod — this daemon is run by the /etc/rc file at boot time and provides an Internet system status server. rwhod maintains a database of status information used by the rwho and ruptime programs.
- gated — this routing daemon uses Routing Information Protocol (RIP) and HELLO protocol to collect information from within one network and the Exterior Gateway Protocol (EGP) to announce its routes to another system.

TCP/IP daemons vs. processes

System operation consists of individual applications providing a portion of the system functionality as it is needed. Network services require various daemons to enable the communication protocols and complete the logical connection between operating systems.

Boot sequence

The communication daemons providing the network services are initialized during the UNIX boot process. The system "run commands" file /etc/rc is executed at boot time to initialize the daemon processes that provide system services. These processes continue to execute (listening for requests) as long as the coprocessor is operational and powered ON. They are said to be "background processes or daemons" and are not directly visible to the network users. They remain executing as user's login during network operations /etc/inetd appears to respond to your telnet requests. However, the user's original telnet request is redirected by the daemon process /etc/inetd, which creates a new daemon process /etc/telnetd assigned to interpret the user's internet commands. This process will die at completion of the logout sequence.

3.4 Troubleshooting Steps

Overview of troubleshooting process

The LAN administrator will be a valuable resource when troubleshooting coprocessor LAN communication problems. The goal of the troubleshooting process is to identify the problem node.

Documentation of the network's design and layout is extremely important, as are any changes you may make as a result of the corrective actions. Inform the network administrator of any changes including descriptions of the problems: indication, suspected component(s), and the resolution or work around with printed copies of configuration changes.

Initial tests

It is important during the initial tests to locate the suspect node (and if possible, the protocol layer) before proceeding to the detailed software testing. The initial procedures test the physical hardware and will quickly identify the problem node. Specific tests are performed at the suspect node to confirm the fault and determine the corrective action.

The software tests produce a significant amount of data and require time to interpret. Always test on the principal of "from the local to the remote." Confirm local communications (with yourself through software loopback connection) and progress in steps to the big picture. Tests of communications with hosts located across components such as LAN router or gateway nodes may identify problems with the other resources. Again, the network diagram will direct your troubleshooting efforts.

Detailed protocol tests

Communication failures caused by software problems are generally easy to identify. They often show the physical hardware connections to be functional. The node's ability to communicate with other Internet hosts depends on many processes possibly executing on computers outside of your area of operations. For example, the domain name server is located/administered at the corporate headquarters and has not been updated with the latest network changes. Consult your network administrator and follow local procedures concerning the updating/testing of these remote resources.

It is suggested that you check the TCP/IP software on each host and gateway involved. For example, ensure that the `/etc/inetd` daemon is running and does start the `/etc/telnetd` process when `telnet` is invoked.

The TCP/IP error messages identify the common problems and point you toward the node or software layer most likely to contain the fault.

Continued on next page

Detailed protocol tests, continued

If the error message doesn't readily identify the problem, the network troubleshooting utilities will be needed to observe each protocol's function and interaction with the other protocols. The tools provided for this are `landiag`, `netstat`, `ping`, `dtcb`, and `mdb`.

The `netstat` tool provides network status information used to locate problems at the network layer. The `ping` tool verifies a remote system to be active and available on the network and secondarily confirms a functional path (physical layer) between the systems.

Listing the current processes

To list all currently running processes, use the process status command (`ps`) and arguments to help confirm proper process activity. Determine the daemon(s) that should be running and check the process status. Remember many daemons are only active when a connection is open.

To list your processes, type: `ps <RETURN>`
to produce this output:

```
PID       TTY       TIME       COMMAND
```

To list all processes, type: `ps -e <RETURN>`
to produce this output:

```
PID       TTY       TIME       COMMAND
```

To list full information on all processes, type: `ps -ef <RETURN>`
to produce this output:

```
UID    PID    PPID   C   STIME    TTY    TIME   COMMAND
```

To view one page at a time, type: `ps -ef | more <RETURN>`
use `<space>` to page down, `<RETURN>` to line down.

To locate a specific process, type:
`grep` *`ProcessName`* `| ps -ef <RETURN>`
to produce this output:

```
UID    PID    PPID   C   STIME    TTY    TIME   COMMAND
```

Continued on next page

Compare current with expected status

The network architecture and configuration influences the type and number of active Internet daemons. Using the descriptions covered in TCP/IP Services and Processes, compare the current process listing with the expected Internet daemon activity.

Check these items if you suspect missing daemon processes:

1) Is the daemon running (note: some daemons run only as needed)?
2) Is the daemon executable?
3) Start the daemon manually in an HPterm window for `tcpd` or `telnetd` start, using the debugging options as listed in the `man` pages.

The basic syntax to invoke the daemons in debug mode is:

- `/etc/tcpd -d foff<RETURN>`
- `/etc/named -d<RETURN>`
- `/etc/ftpd -d<RETURN>`
- `trpt` in conjunction with `telnet`

Continued on next page

Determine the name server

To make sure the administrative node is running, find out which node the host or gateway is using to resolve addresses. There are several methods to determine the nameserver node used by a host to provide (resolve) the TCP/IP address from the hostname query.

Using the nslookup method

The first method attempts the `nslookup` command of NS-ARPA Services (Network Services-) to resolve an address query, where the nameserver will respond with the query result and identify itself by hostname and TCP/IP address. This command exercises network communications and will identify hosts that are not registered with the name service.

nslookup example

```
nslookup ac_usx2 <RETURN>
```

Returns this response from the nameserver:

```
Name Server:  fishery.honeywell.com
Addresses:    129.30.3.16

Name:       ac_usx2.iac.honeywell.com
Addresses:  129.30.114.22
```

Using the look for server link method

The second method is to list the `/etc` directory and look for a link to the `/etc/hosts` file. The link shows the hostname of the administrative node.

Type `ls -S /etc <RETURN>`

Look for this link indication:

```
hosts -> //tcp_admin/etc/hosts
tcp_admin -> //admin_host
```

Where *`admin_host`* will be the hostname of the administrative node.

Continued on next page

Check the administrative nameserver

Where *admin_host* will be the hostname of the administrative node.

Now see if the name server administrative node is operational.

Type ping *admin_host* count 5 <RETURN>

The administrative node response should resemble this example.

```
PING admin_host:  0 data byte
8 bytes from 129.30.114.2:  icmp_seq=0.
8 bytes from 129.30.114.2:  icmp_seq=1.
8 bytes from 129.30.114.2:  icmp_seq=2.
8 bytes from 129.30.114.2:  icmp_seq=3.
8 bytes from 129.30.114.2:  icmp_seq=4.

----admin_host PING Statistics----
5 packets transmitted, 5 packets received, 0% packet loss
```

If there is packet loss noted but it is less than 100%, several possibilities should be investigated. The node's processor loading may prevent a timely response to the `ping` command or there may be a crashed node generating noise on the LAN network through its Ethernet interface.

If the packet loss is 100%, the most likely problem is an open cable segment on the Ethernet LAN.

3.6 Check the Software Loopback

Check configuration of local host

TCP/IP provides a software loopback interface to troubleshoot the local software from the network layer up. Use the software loopback interface to check local TCP/IP software operation. This is done by sending a message to internet address `127.0.0.1` which, by convention, is assigned the host name `localhost`. This address and host name should be included in the networks `/etc/hosts` file and the `localhost` line should be uncommented in the file `/etc/netlinkrc`. as shown in bold below:

```
case $NODENAME in
  $ROOTSERVER)
    /etc/ifconfig lan0 inet 129.30.255.255 netmask 255.255.255.0 up
      /etc/lanconfig lan0
      ;;
  *) /etc/ifconfig lan0 inet `hostname` up
     /etc/lanconfig lan0 ether ieee
     ;;
esac
/etc/ifconfig  lo0  inet  127.0.0.1  up
```

Check operation of the local host

Use the software loopback interface to check local TCP/IP software operation. This is done by sending a message to internet address 127.0.0.1 which, by convention, is assigned the host name `localhost`. Sending to this software loopback is equivalent to sending to your own address. The IP protocol command `ping` uses only the `/etc/inetd` daemon process for communications. Under normal conditions, the `/etc/inetd` daemon is active on all coprocessors awaiting network traffic from the LAN connection.

To use `ping`:

Type `ping hostname count<RETURN>`
Where count=number of ICMP requests (use 3-10 to limit network traffic)

As an alternative, use the following options:
Type `/etc/ping` *`option hostname count`*`<RETURN>`

- `-d` Displays debugging information
- `-r` Send direct without route information if node is on same network
- `-v` Verbose output. Lists ICMP packets other than ECHO RESPONSE

See the `man` pages about `ping` for more information.

Section A – Diagnostic Display Codes

A.1 WSI Coprocessor Diagnostic Display Status Codes

Table of codes

In the following table, the “LED Display” column, “0” indicates LED off, and “1” indicates LED on. Refer to Figure 2-2 for LED location.

Table A-1 HP 9000/382 Display Status Codes

LED Display A B C D E F G H	Error Indication
0 0 0 0 0 0 0 0	No failure
0 0 0 0 0 0 0 1	Failed CPU register test
0 0 0 0 0 0 1 0	Testing top 16 K of memory
0 0 0 0 0 0 1 1	Top 16 K of memory failed
0 0 0 0 0 1 0 0	Top 16 K of memory missing
0 0 0 0 0 1 0 1	Searching for user ROM
0 0 0 0 0 1 1 0	Executing extension ROM
0 0 0 0 0 1 1 1	Starting test vector list
0 0 0 0 1 0 0 0	Resetting all interfaces
0 0 0 0 1 0 0 1	Searching for console display
0 0 0 0 1 0 1 0	IODC test RAM under test
0 0 0 0 1 1 0 1	Console failure
0 0 0 0 1 1 1 0	Failed boot ROM checksum
0 0 0 0 1 1 1 1	Preloading memory for main test
0 0 0 1 0 0 0 0	Testing memory
0 0 0 1 0 0 0 1	Insufficient memory
0 0 0 1 0 0 1 0	ROM system failure
0 0 0 1 0 0 1 1	Boot error
0 0 0 1 0 1 0 0	Operating system
0 0 0 1 0 1 0 1	Not enough memory for OS
0 0 0 1 0 1 1 0	Failure during system scan
0 0 1 0 0 0 0 0	4 ms timer problem

Continued on next page

Table of codes, continued

Table A-1 HP 9000/382 Display Status Codes, continued

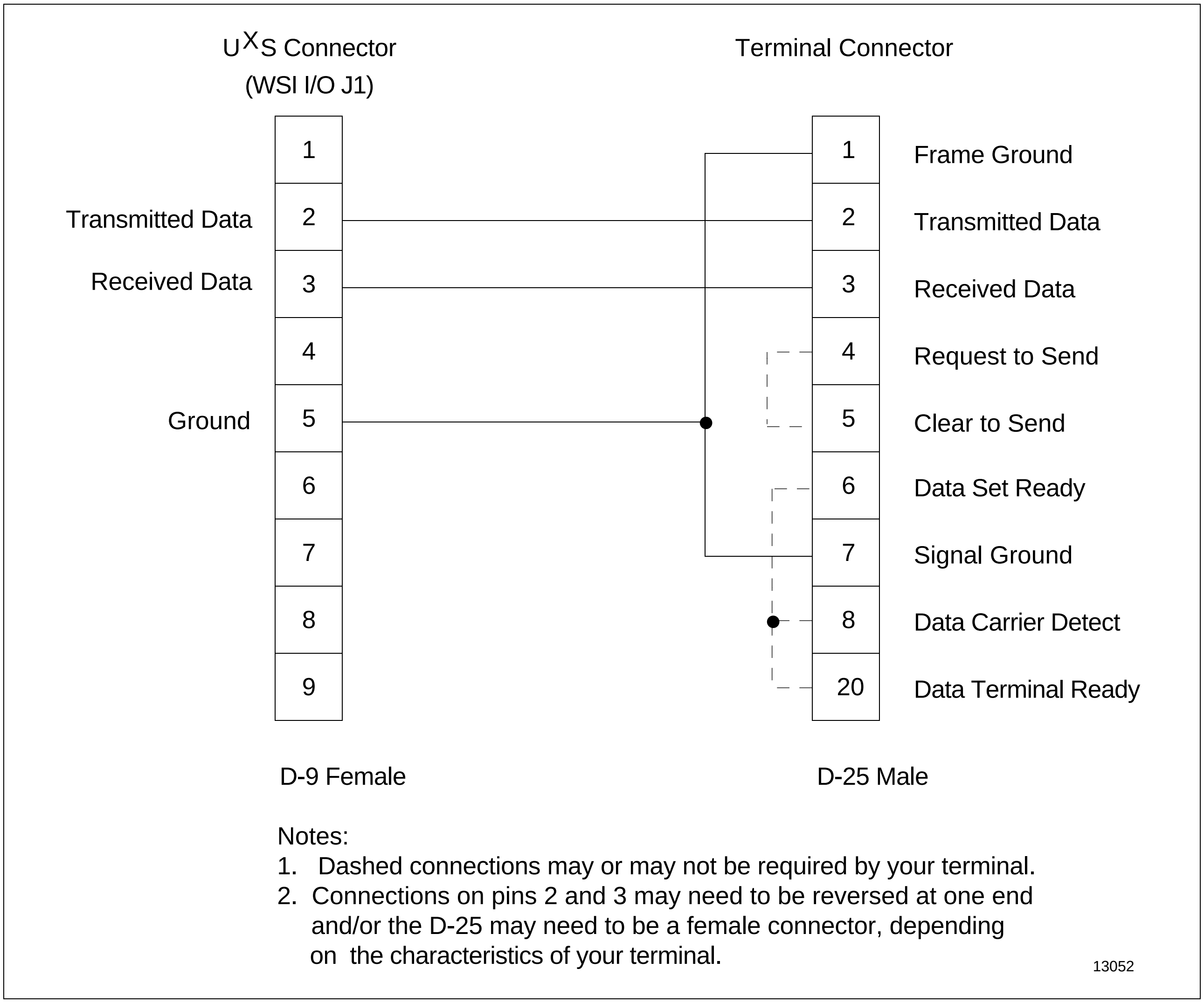
LED Display A B C D E F G H	Error Indication
0 0 1 0 0 0 0 1	EEPROM malformed
0 0 1 0 0 0 1 0	Failure of HP-HIL circuit
0 0 1 0 0 1 0 0	Failure of HP-IB circuit
0 0 1 0 1 0 0 0	Failure of DMA circuit
0 1 0 0 0 0 0 0	Failure of DIO interface

Section B – Cables

B.1 Console Terminal Cable

Suggested cable for terminal connection

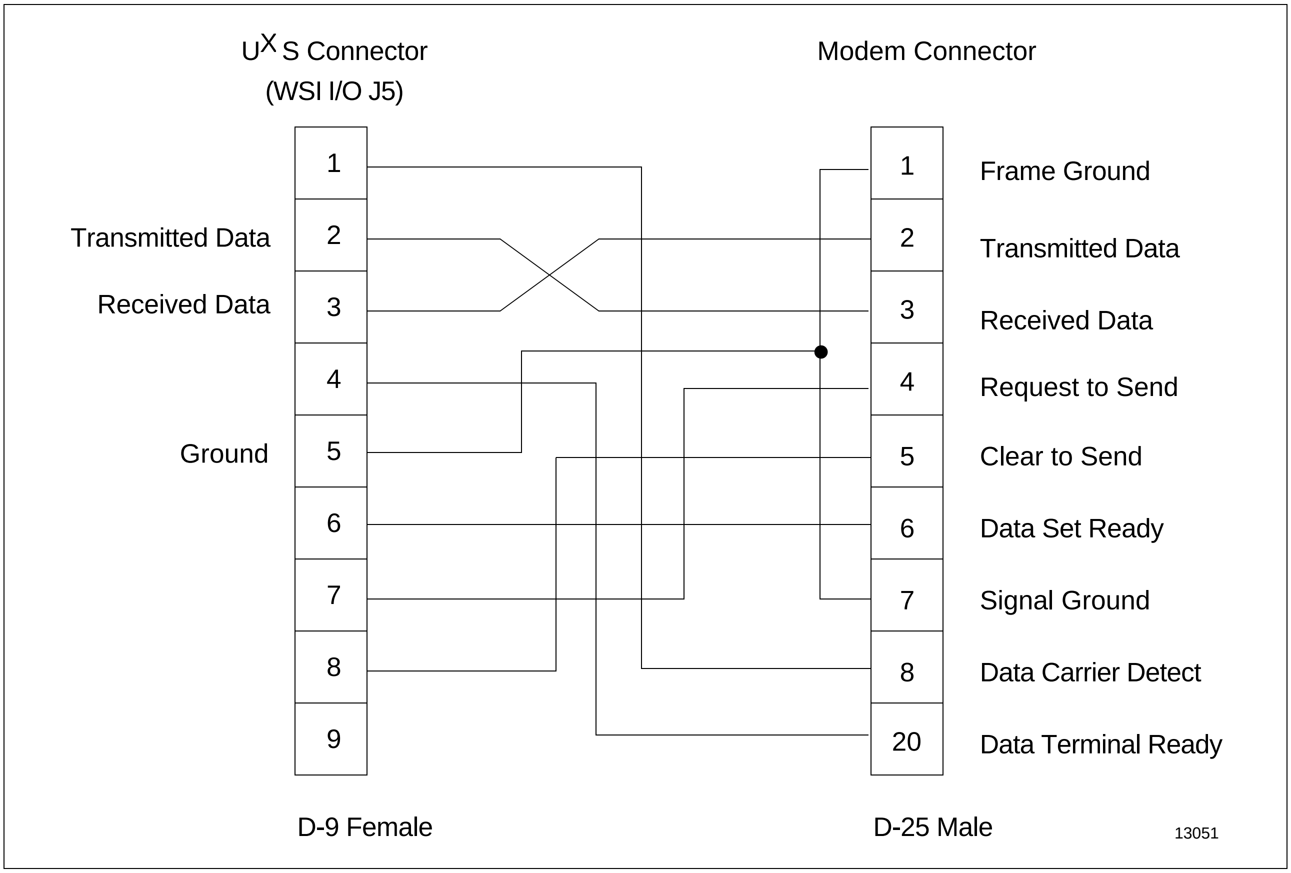
Figure B-1 Console Terminal Cable



B.2 Modem Cable

Suggested cable for modem connection

Figure B-2 Modem Cable



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