

System and Installation Manual

EDACS® BCU/CAL
Billing Correlation Unit/
Centralized Activity Logger

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NOTICE!

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1. INTRODUCTION

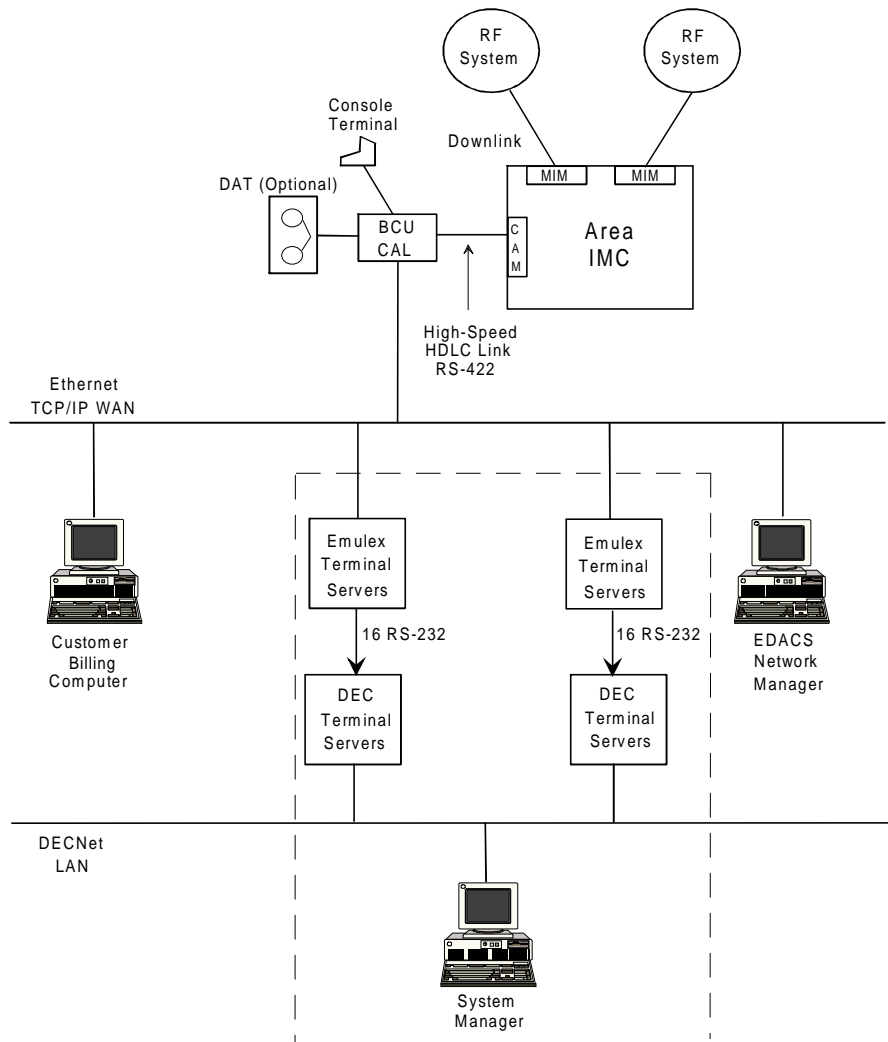
This manual contains installation instructions, physical and functional descriptions, specifications, and usage information for the Enhanced Digital Access Communications System (EDACS) Billing Correlation Unit and the Centralized Activity Logger (BCU/CAL). A block diagram of the BCU/CAL is shown below.

The BCU/CAL works as a subsystem attached to an Ericsson Private Radio Systems (PRS) Integrated Multisite and Console Controller (IMC) and can be set to operate as a BCU, a CAL, or both. Each IMC node must have its own BCU/CAL.

BCU and CAL are two separate capabilities which can run independently of each other on the same machine, yet still utilize resources and utilities common to both.

Additional information for BCU/CAL can be found in the following publication:

- LBI-38967, EDACS Billing Correlation Unit/Centralized Activity Logger User Interface Manual



The dotted lines enclose the CAL-specific interfaces of the BCU/CAL.

Figure 1 - BCU/CAL Architecture

1.1. BCU FUNCTIONAL DESCRIPTION

The main function of the BCU is to generate call detail records (CDRs) to be transferred to an external billing system for invoice generation. To accomplish this, the BCU scans an input stream of activity messages supplied by the IMC, archives these messages in their raw form, uses those messages which indicate channel assignment and channel drop events to calculate air time, and then generates the CDR.

Call Types Supported

All EDACS call types except for the following are supported by the BCU:

1. Console calls.
2. Conventional site calls.
3. Local interconnect calls.
4. System all calls.

NOTE

Non-EDG data calls are supported only if radios are "wide-area enabled" on the site.

1.2. CAL FUNCTIONAL DESCRIPTION

EDACS system administrators require both site monitor and activity download capabilities. These functions are normally supported by the System Manager in conjunction with the Site Controller at each Radio Frequency (RF) System. The CAL provides this capability for EDACS networks not equipped with a Site Controller.

1. Site Monitor
Provides the system operator at a System Manager terminal with a real-time display of the calls in progress on the RF channels at the selected trunked system.
2. Activity Download
Call activity and system status information are collected by the CAL and buffered in internal memory. Once an operator-defined buffer content threshold is exceeded, the CAL initiates a download of buffer contents to the System Manager. The downloaded information is used to prepare traffic reports on system usage.

In existing EDACS networks, the System Manager communicates with Site Controllers at RF systems using modems and dial-up or leased line connections, routed through a DECServer terminal server. A communications session is set up via a DECServer port between the System Manager and the Site Controller. The System Manager associates the DECServer physical port number with the Site Controller's identity.

Since the IMC is already connected to all the sites, it has centrally available much of the data that individual Site Controllers normally output to the System Manager—for all the sites. The CAL connects to the IMC and demultiplexes incoming call activity information messages—the same messages that the BCU uses for billing—into activity download data and site monitor data to send to a System Manager using Site Controller protocol.

The CAL uses two Internet Protocol (IP) terminal servers on the local area network (LAN) to communicate with the System Manager's DECServer(s). Up to 32 RS-232 asynchronous serial connections are available, 16 per terminal server. One System Manager DECServer port and one IP terminal server port are required per EDACS system being monitored by CAL.

Call Types Supported

All EDACS call types except for the following are supported by the CAL:

1. Console calls.
2. Conventional site calls.
3. Local interconnect calls.
4. System all calls.

NOTE

Non-EDG data calls are supported only if radios are “wide-area enabled” on the site.

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2. PHYSICAL DESCRIPTION AND COMPATIBILITY

This section outlines the specifications, depicts the physical architecture, and provides compatibility information for the BCU/CAL.

Software for the BCU and the CAL are merged into one software package. Feature encryption allows or disallows BCU or CAL functionality. The two products can also run on the same hardware platform with minor additions for CAL.

2.1. PHYSICAL SPECIFICATIONS

General Specifications

BCU/CAL:

ELMA VME System 12 7-slot enclosure with PSU and integral cooling fan

TVME 147 single-board computer with TVME 712/M Transition Module

Formation WANServer fv5310

1.2 GB 3½" half-height 8.5ms hard disk drive, internal (SCSI ID 2)

1.44 MB 3½" half-height floppy disk drive, internal (SCSI ID 1)

Tape Drive (Optional with BCU only):

4/8 GB 3½" half-height 4mm digital audio tape (DAT) drive, internal (SCSI ID 3)

(Recommended Archive/Maynard 4324NP)

Console Terminal:

DEC VT100 or compatible console terminal

Terminal Servers (CAL only)

Emulex Performance Series P2516-SLTL (16 ports per terminal server)

Power Supply

BCU/CAL:

115/230 VAC, 47-63 Hz, 500 W

Physical (EGE Standard Cabinet)

BCU/CAL:

6 rack units: 26.67 cm (10.5 in.) high x 48.26 cm (19 in.) wide x 49.99 cm (19.68 in.) deep

Environmental

Storage Temperature: -40 to +85°C

Operating Temperature: 0 to 40°C (ambient)

Operating Altitude: < 15,000 feet

Shipping Altitude: < 50,000 feet

Relative Humidity: < 90% (non-condensing)

2.2. BCU/CAL ARCHITECTURE

The BCU/CAL's internal architecture is shown in Figure 2. The individual components and their primary functions are outlined below.

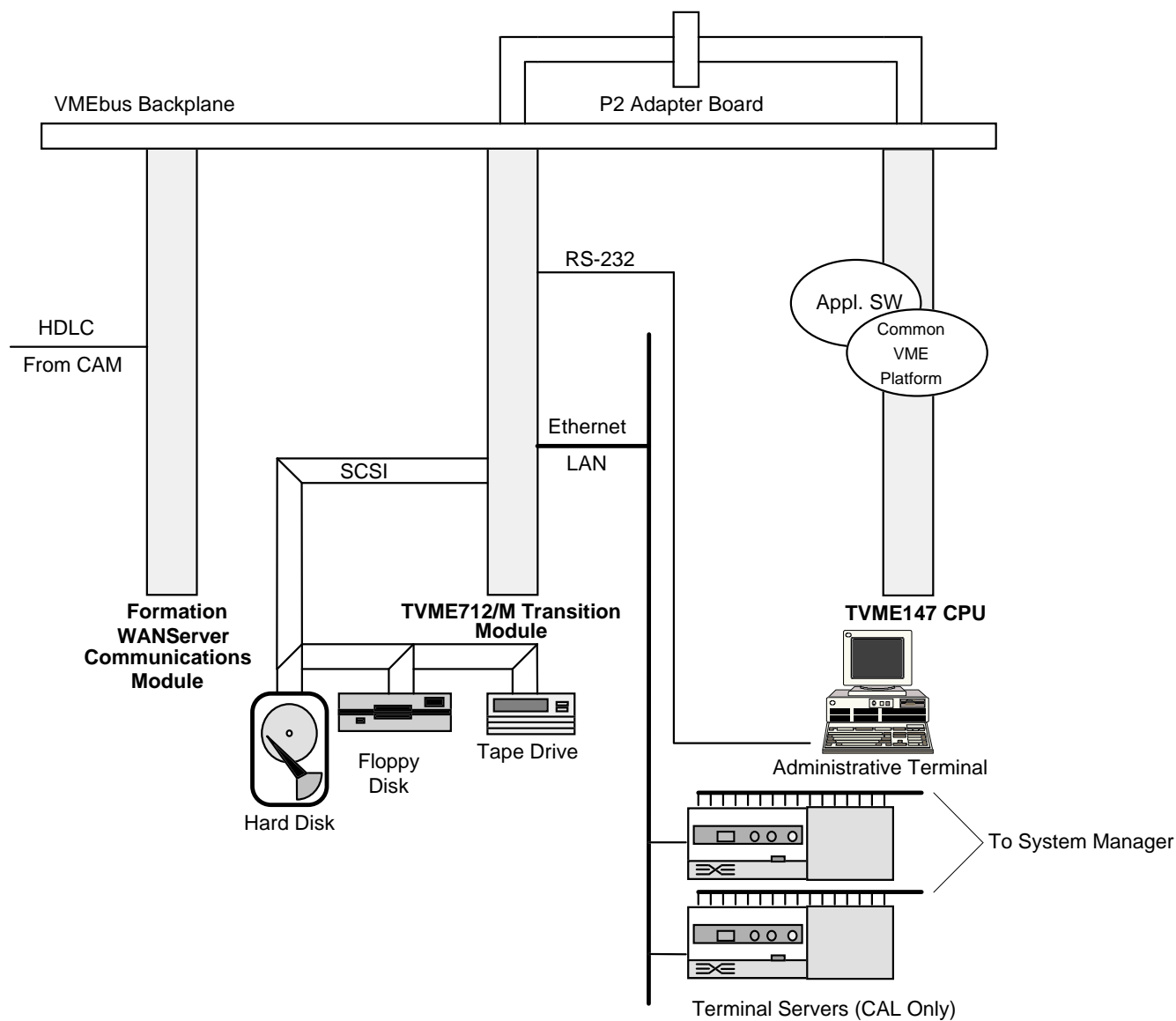


Figure 2 - BCU/CAL Architecture

The BCU/CAL is based on a VMEbus computing platform with the following components:

CPU

Technico TVME 147 single-board computer based on a 68030 microprocessor

- Supports BCU/CAL application processing
- Interfaces to hard disk, floppy disk, and tape drive via an on-board small computer systems interface (SCSI) with a connector on the transition module
- Interfaces to the console terminal via an RS-232 serial port with a connector on the transition module
- Network physical connection is 802.3 Ethernet, 10 BASE-15 (Thick Wire). A MAU may be used for connection to a Thin Wire (coaxial) network

Internal Drives

Hard Disk: 3½" 1.2 GB

- Provides configuration parameter storage
- Provides call detail record (CDR) storage
- Provides raw activity record (RAR) buffering/storage

Floppy Disk: 3½" 1.44 MB

- Used for application program updates

Tape: 3½" 4/8 GB 4mm DAT

- Provides call detail record (CDR) file archival storage
- Provides general purpose file interchange with UNIX
- UNIX Tar format, 512-byte tape block size, no data compression

Communications Module

Formation WANServer fv5310

- Interfaces the BCU/CAL via high-speed high-level data link control (HDLC) link to the Central Activity Module (CAM) in the Integrated Multisite and Console Controller (IMC)

System Manager Interface (CAL only)

One or Two Emulex Performance Series P2516-SLTL Terminal Servers

- Communicates with the BCU/CAL over the network and with the System Manager over RS-232
- Converts between Transmission Control Protocol (TCP) sockets and asynchronous serial protocol

2.3. COMPATIBILITY

The BCU/CAL software is compatible with the following IMC and System Manager versions:

- IMC Software V4.01 and later
- IMC CAM Controller Board (P/N 19D903299P3)
- Networks/Data VME Controller ROM V1.03
- MicroVax System Manager Software V3.01 and later (CAL only)

The System Manager Software version requirement applies only to the CAL feature. The BCU feature operates independent of the System Manager. Thus, the BCU is “compatible” with any System Manager software version.

Backwards Compatibility

The BCU/CAL will function with IMC software versions down to V3.04, with minor performance degradation. The following features are not available with IMC software versions older than V4.01:

BCU/CAL

- The User Interface *stats* command will not provide information regarding queued, denied, system busy, and convert-to-callee channel events.

CAL-Specific

- Activity records and site monitoring will not reflect queued, denied, system busy, and convert-to-callee channel events.
- The site monitor will not provide current control channel indication.

3. SPECIFICATIONS

3.1. COMMON BCU AND CAL OPERATIONAL SPECIFICATIONS

3.1.1. EDACS System Interface

The BCU/CAL interfaces to EDACS via a full duplex port supporting high-level data link control (HDLC) protocol. The BCU/CAL will adapt to the data transmission rate to which the Central Activity Module (CAM) is set to operate (64K or 360K, selectable via CAM dip switches).

BCU/CAL Input Data

Each raw activity record (RAR) contains the following information:

1. Day and time of event accurate to ± 0.1 second
2. Type of event (i.e., assignment or drop)
3. Call type (individual clear voice, group clear voice, individual digital voice, group digital voice, data, etc.)
4. Site number or console number
5. Channel number (to match assignments with drops)
6. Caller ID
7. Callee ID
8. Digitally dialed PSTN digits for outgoing interconnect calls

The dialed digits correspond to the digits sent by a radio to the interconnect system to initiate an interconnect call; dual tone multi-frequency (DTMF) over dial digits sent by the radio once an interconnect call is in progress are not registered by the BCU.

3.1.2. Throughput

The BCU/CAL's interface to the IMC is capable of receiving a peak data rate of 192 raw activity records (RARs) per second. A buffer stores incoming RARs at the peak rate of 192 RARs per second for a minimum of 300 seconds (5 minutes).

3.1.3. Hard Disk Interface

The BCU/CAL provides nonvolatile storage of the BCU/CAL operating software, CDRs, system configuration data, system defaults, and subscriber attributes. The hard disk provides concurrent support of call record processing and the operator interface.

3.1.4. Operator Interface

Most BCU/CAL operator functions are capable of being performed without impacting or reducing the capacity of the call processing functions below specified rates. Refer to the User Interface Manual, LBI-38967, for further information.

3.2. BCU OPERATIONAL SPECIFICATIONS

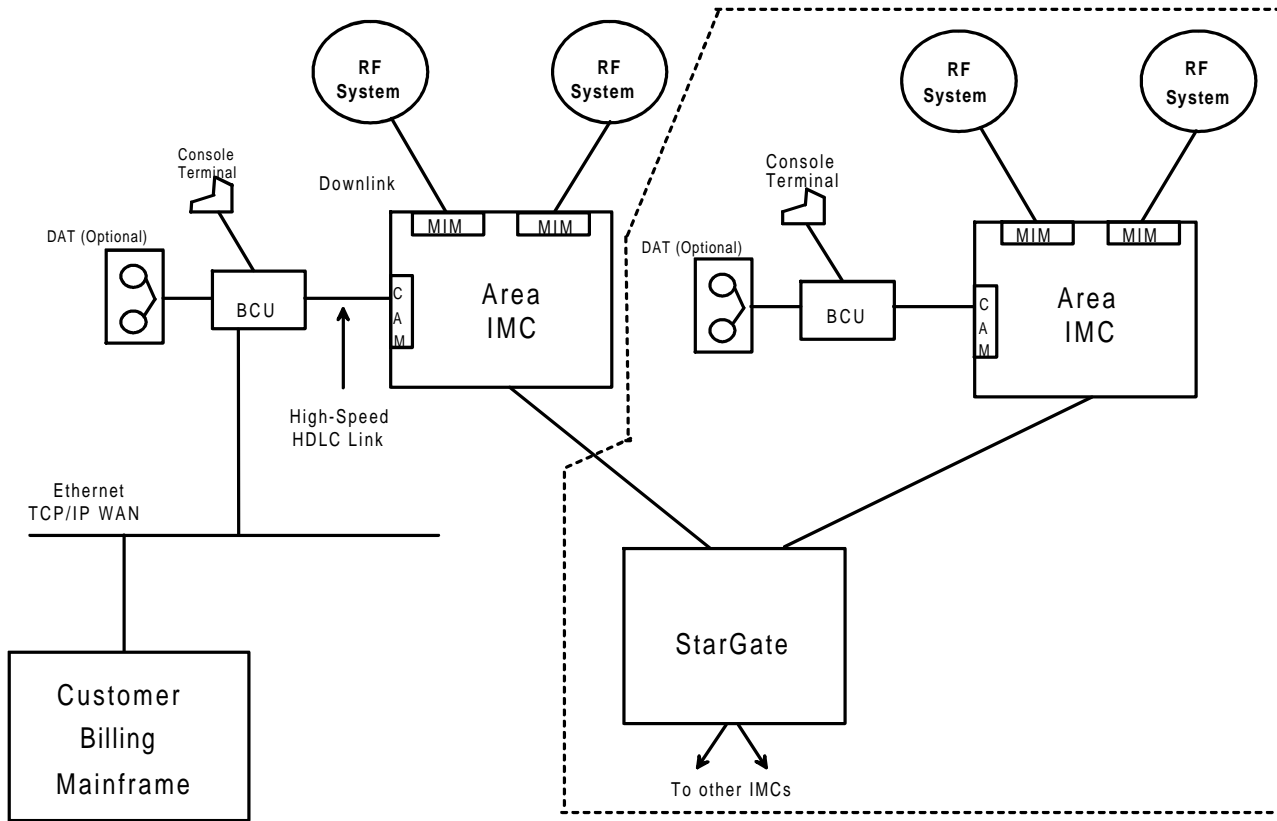
This section outlines the specifications that are unique to the BCU personality.

3.2.1. Subscriber Attribute Database

Each system subscriber and each group defined on the system is assigned a record in the subscriber attribute database. This database supports a maximum of 16,383 individual subscribers and a maximum of 2048 groups.

3.2.2. Billing Architecture

The EDACS billing system architecture is shown in Figure 3. Each IMC is connected to a BCU/CAL via a high-speed serial communications link using HDLC protocol.



The dotted lines enclose one optional setup for a StarGate (multi-node) billing architecture.

Figure 3 - Billing Architecture

3.2.3. BCU Operation Overview

Each RF system sends all call information to the IMC via the downlink. This is true for single-channel autonomous trunking (SCAT), Conventional Network Interface (CNI), basic EDACS, and RF systems operating in failsoft mode.

All call activity information messages received by the IMC are collected by the Central Activity Module (CAM), where each call message is time stamped. These messages, called raw activity records (RARs), are then passed via the high-speed serial link to the BCU/CAL. The BCU examines each RAR and uses the time stamp values to determine the length of each call. The actual billing algorithm is quite complex and depends on the BCU's keeping a memory of outstanding calls. The output of the billing algorithm is stored to a regular disk file as a series of call detail records (CDR).

The CDR format is compatible with Cincinnati Bell Information System's (CBIS) Cellware billing software.

3.2.3.1. RF Channel Usage (Air Time)

The basic unit of RF channel usage for billing purposes is a channel assignment. One or more working RF channels is assigned in response to a request from a subscriber unit (mobile radio, data terminal, etc.). Each channel assignment event results in air time, which is defined as the period of time during which the RF channel or group of channels is in use, repeating the signal from a subscriber unit. If the system is operating in transmission trunked mode, one channel assignment occurs each time the unit is keyed and unkeyed. In a multisite network, more than one channel assignment can occur in a single call—since multiple sites can participate in a call—and a channel is used on each participating site. The air time for such a call is defined as the sum of the air time associated with all of the channel assignments occurring in that call.

In a multiple node network (StarGate or MultiLink), a single call may involve channel assignments on sites on more than one node. In theory, these channel assignments are part of the same call. In practice, the BCU deals with data at the node level and does not correlate channel assignment air time from remote nodes. A multiple node call is identified by the StarGate interface ID as the site ID in the CDR; this facilitates the correlation of records across nodes in the external billing system.

3.2.3.2. Conversations

If a CDR were created for each call, the data storage requirements for the BCU/CAL would be excessive. For this reason, a different unit of RF channel usage, called a conversation, has been defined. A conversation includes one or more calls. Calls are summed into conversations based on the subscriber (radio) units participating in the calls and the duration of the time interval between the end of one call and the beginning of the subsequent call. The criteria for inclusion in a conversation are explained in detail below.

Grouping Calls

A set of calls may be grouped into a conversation only if each call involves the same participants and is of the same call type as all other calls in the set. For group calls, only calls made with the same Group Identification (GID) may be linked. In this case, the Logical Identification (LID) of the caller is irrelevant, except for the LID of the first caller in a sequence (this is explained in the next subsection). For individual calls, the caller's LID must be the same as either the caller's or the callee's LID in every other call in the set.

Broken Call Sequences

A set of calls must occur in an unbroken sequence. A sequence is broken when one of the call participants calls a non-participant. For individual calls, this means that either the caller or the callee from the first call in the sequence calls some third party, either a group or individual. For group calls, the sequence is broken if the caller from the first call in the sequence calls a different group or an individual. Note that a subscriber unit may participate in multiple group conversations overlapping in time, as long as that unit was not the first caller in at least one of the conversations.

A sequence of calls is also broken when the time interval separating the end of one call and the beginning of the subsequent call in the sequence exceeds an arbitrary value. This value is called the pseudo hang time and is configurable on a unit or group basis in the BCU.

3.2.3.3. Group Billing Mode

A group call may be charged to the caller or to the group. The CDR includes a flag indicating which party to bill. The choice is determined by a billing mode associated with each group ID or by the default billing mode. Individual calls are always charged to the caller, except for land-to-mobile interconnect calls and incoming data calls. In each of these cases, the ID of the caller (or sender of the data) is unknown; thus, the call must be billed to the callee.

3.2.3.4. Input Messages

Input to the BCU consists of a stream of activity messages. As a minimum, the messages include all channel assignment events and channel drop events generated on EDACS. This includes channel assignment and drop from the Jessica Private Branch Exchange (PBX) Gateway and StarGate interfaces.

Channel assignment and channel drop messages contain the following information:

- Date and time of event to the nearest tenth of a second
- Type of event (i.e., assignment or drop)
- Call type (individual clear voice, group clear voice, individual digital voice, group digital voice, data, etc.)
- Site number or console number
- Channel number
- Caller ID
- Callee ID

3.2.3.5. Time Synchronization

The time of channel event value is derived from the IMC's internal clock. This is slaved to the CEC/IMC Manager clock, which can be synchronized externally from a WWVB signal, via a Spectracom clock unit. This unit is available as an option for the CEC/IMC Manager. The Spectracom unit includes an internal high-stability reference clock, which maintains synchronization even in the event of loss of the WWVB signal for an extended period. This configuration ensures that RAR timestamps are accurate at all times.

3.2.3.6. Output Records

The BCU creates CDRs by processing the input messages due to channel assignments and channel drops. The format of a CDR record entry is discussed in detail in Appendix A. Each CDR records the following information about each conversation:

- The Logical Identification (LID) of the caller
- The identity of the callee (either LID or GID)
- The location (node, site, and channel number) of each RF channel involved in the conversation
- The call type (individual clear voice, group clear voice, individual digital voice, group digital voice, data, etc.)
- A flag indicating which party to bill (caller or callee)
- The start time of the first call
- The elapsed time from the start time until the end of the final call
- The number of channel assignments included in the conversation
- The total accumulated air time (Note that this is not the same as the elapsed time because of the pseudo hang time, and the effect of multiple channels per call.)

3.2.3.7. BCU Configuration Files

The BCU uses binary configuration files to store various configuration values. The file names and their contents are as follows:

File Name	Contents
SYSTEM.BIN	Specifies system parameters, default pseudo hang times, and billing modes.
UNIT.BIN	Specifies the pseudo hang time associated with each LID.
GROUP.BIN	Specifies the pseudo hang time and the group billing mode associated with each GID.

These files are located in the 1.2/cnfg directory.

Since they are stored in binary form, these configuration files can be modified only by using the BCU/CAL Configuration Service (BCS) program, which is described in the User Interface Manual (LBI-38967). The BCU is able to operate with no terminal input by using all default values for configuration parameters.

Pending development by Ericsson Inc. of a system-wide database management strategy, there is a method by which the BCU configuration "database" can be maintained without using BCS to configure each unit manually.

The three configuration files can be created by running BCS on a BCU/CAL used as a master. Then, these files can be copied to the appropriate directory (1.2/cnfg) on a target BCU, and the target will assume the same configuration values. Changes specific to the target must be made either by running BCS on the target or by making the changes on the master, copying the configuration files to the target, then reversing the changes to restore the master to its baseline configuration.

NOTE

To copy or delete the configuration files from a BCU/CAL, you must NOT be running BCS on that system. BCS keeps all the configuration files open while it is running, thereby preventing them from being deleted or overwritten.

3.2.3.8. Operator Functions

An EDACS system operator is able to perform the following functions locally or remotely using a terminal interface program running on the BCU/CAL:

- Input of default configuration database.
- Default pseudo hang time.
- Default group billing mode.
- Input of configuration data for individual LIDs and/or GIDs to override the default configuration database. (Configuration data may be input for an individual ID or range of IDs.)
 - LID pseudo hang time.
 - GID pseudo hang time.
 - GID group billing mode.
- Creation of a magnetic tape archive of CDRs.
- Transfer CDR files from the hard drive to the floppy drive.

Refer to LBI-38967 for a detailed explanation of the available operator functions.

3.2.3.9. Database Elements

This section describes the elements of the BCU's configuration database.

Default Data

A set of subscriber default attributes maintained on the system contains the following information:

1. Default unit pseudo hang time (seconds)
2. Default group pseudo hang time (seconds)
3. Default group billing mode (caller or group)
4. Default data call pseudo hang time (seconds)

Unit Data

Each subscriber can be assigned a record in the subscriber attribute database. This record contains the following information: Pseudo_Hang-Time (seconds).

Group Data

Each group defined on the system shall be assigned a record in the subscriber attribute database containing the following information:

1. Group pseudo hang time (seconds)
2. Billing mode (group or caller)

3.2.3.10. Call Processing

This section contains specifications on the BCU's call processing capability.

CDR Processing

A record of each conversation is maintained by the system. A conversation is a collection of calls detailed by RARs that have been correlated based upon call participants and caller pseudo hang time. Each CDR contains the following information:

1. Caller billing ID (BID)
2. Callee BID or GID (group ID)
3. Call type (individual, group, Digital Voice, data, interconnect, etc.)
4. Bill flag (caller or callee)
5. Identification of each RF channel (node, site, and channel)
6. Start time of the first call
7. Number of channel assignments included in the conversation
8. Total elapsed time from start time to end of final call
9. Total accumulated node air time to within ± 0.5 seconds
10. PSTN number dialed on outgoing interconnect calls
11. PSTN line number on incoming interconnect calls

Call Processing CDR Output

The call processing software redirects file output to a new file when the current file being written to exceeds a maximum size. The system administrator can set this maximum size.

CDR Storage Requirements

The BCU is capable of storing all CDRs from the previous 30 days on its internal hard drive. CDR files are maintained on the system for a programmable time period.

CDR Processing Errors

The call processing software recovers automatically from the following error conditions:

1. Link time-out exceeded
2. Unmatched channel drops
3. Unmatched channel assignments
4. CAM hardware reset
5. WANServer reset

3.2.3.11. Call Detail Records

A CDR is a series of ASCII characters terminated by a newline (NL) character. The records are variable length, but they contain a fixed length segment, which is always present, followed by zero or more suffix segments.

There are two types of suffix segments. The first is an additional site segment, which identifies the sites and channels used in a multisite call. The second type of suffix is a PSTN phone number field, which is appended to a mobile-originated interconnect call record and contains the digits dialed by the caller.

3.3. CAL OPERATIONAL SPECIFICATIONS

This section outlines the specifications that are unique to the CAL personality. Refer to Figure 4 for the CAL architecture.

NOTE

Before linking a CAL to a System Manager, consult the EDACS VAX/VMS System Manager's User's Manual (LBI-38984) to assure that the proper System Manager configuration has been chosen to handle the number of sites to be monitored. Failure to install a properly sized System Manager may result in the loss of logging data during peak periods.

3.3.1. System Manager Interface

The CAL interfaces to the System Manager's DECServer(s) via one or two terminal servers capable of supporting up to 32 independent asynchronous RS-232 serial connections. The ports on the CAL's terminal servers are connected to the ports on the System Manager's DECServers via RS-232 cables.

3.3.2. Protocol Supported

The CAL is capable of communicating with the System Manager using the System Manager-to-Site Controller (SM-SC) and Site Controller-to-System Manager (SC-SM) protocol defined in *EDACS Protocol Specification, System Manager/Site Controller Version 1.1*.

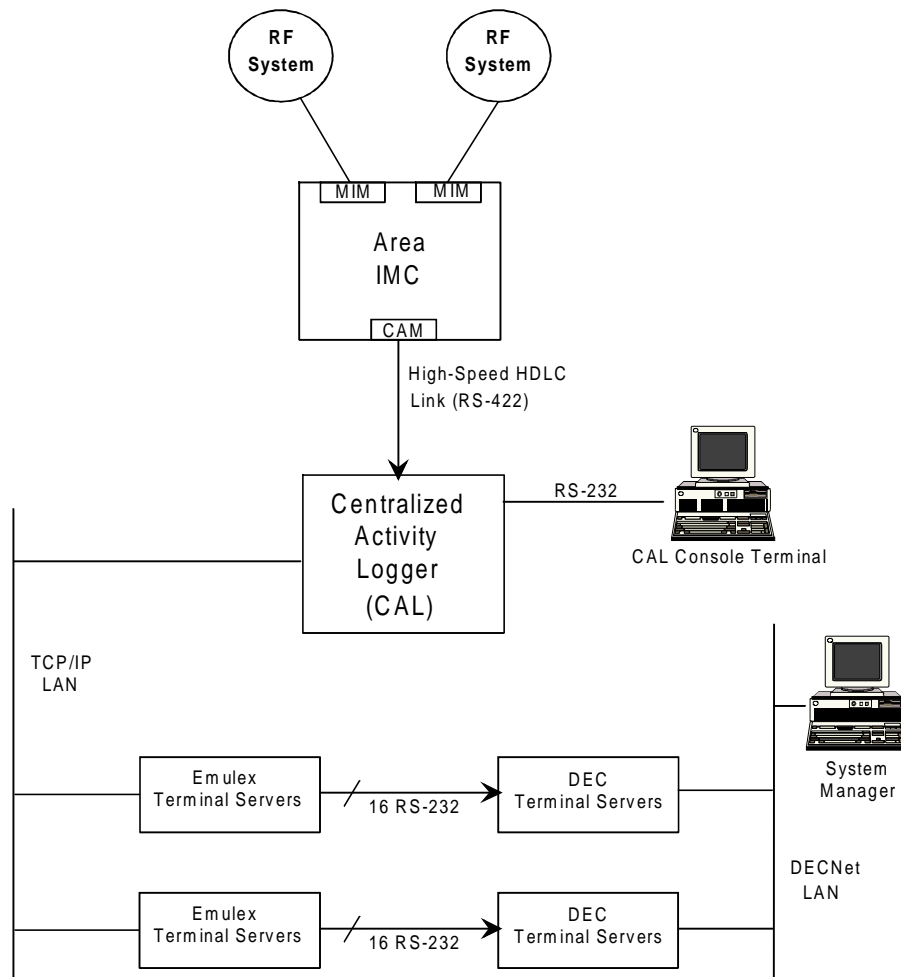


Figure 4 - CAL Architecture

3.3.3. CAL Operation Overview

As new RARs enter the system, they are dispatched to an appropriate site handler which reformats and queues the data. When the number of activity records queued exceeds a threshold value obtained from the System Manager at startup, a download request is sent to the System Manager. At any point, the System Manager may log in to the site object and request it to purge its queue of activity messages, start/stop download of activity messages, or start/stop the transmission of monitoring messages.

3.3.4. Additional Product Features**Network File Server**

The BCU/CAL can be licensed to function as a Network File Server (NFS). This feature allows the BCU/CAL system disk to be mounted by client hosts, such as a billing mainframe computer. The NFS feature is provided at no charge for units licensed for BCU operation. It may be purchased as an additional feature for the CAL.

4. INSTALLATION

4.1. HARDWARE INSTALLATION

CAUTION

Turn off the power before removing or installing VMEbus boards. Removing or reinstalling the boards while the power is on will damage the boards.

This section describes the physical installation of the BCU/CAL. Other configuration is performed during manufacturing, and the information necessary is provided in Appendix C.

Follow these steps to connect a BCU/CAL to an IMC for the first time (except where indicated otherwise, these steps apply to all configurations; BCU only, CAL only, or BCU and CAL).

Using the LAPB cable provided, connect the BCU/CAL's CAM control port 0, a female DB-25 connector located on the rear of the BCU enclosure, to the lower connector on the IMC backplane which corresponds to the slot in which the CAM resides. The cable is keyed so that it fits properly only when it is correctly oriented.

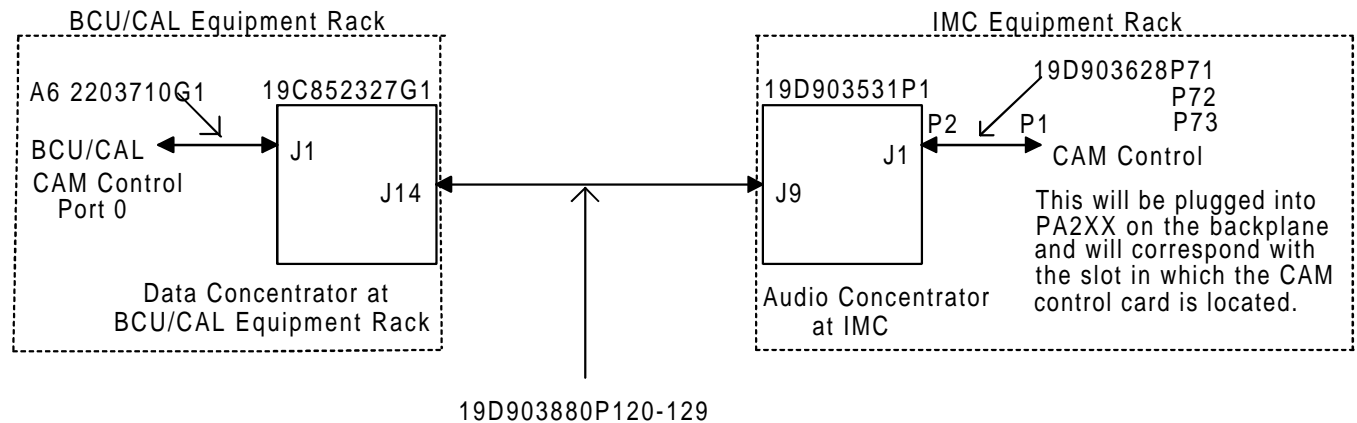


Figure 5 - BCU/CAL to IMC

Next, connect the console terminal to the female DB-25 connector labeled "SERIAL PORT 1/CONSOLE" on the TVME-712/M transition module located in the rear of the BCU/CAL enclosure. (For reference, the BCU/CAL is delivered preconfigured from the factory in a 19-inch rack.) Connect the other end of this cable to the console terminal's "host" port, or equivalent. If a PC is used as the console terminal, then a DB-9 adapter may be needed. In either case, the serial cable for the console is wired straight-through.

Configure the console terminal for the communications parameters below.

- 9600 Baud
- No Parity
- 8 Data Bits
- 1 Stop Bit

If the BCU/CAL is being connected to a network, plug a MAU (either coaxial or twisted pair) into the 15-pin female connector labeled "ETHERNET" on the TVME-712/M transition module on the rear of the BCU/CAL enclosure and attach the MAU to the network. If the BCU/CAL is being connected to a 10BASE-15 (Thick Ethernet) network, no MAU is required. Attach the transceiver cable directly to the 15-pin connector on the transition module.

If CAL is to be enabled for this installation, then connect the Emulex P2516 terminal server(s) to the same network segment to which the BCU/CAL is connected and switch on the power. Be sure to wait 5 minutes after applying power to the P2516 before continuing on to the next step. Even though it is a separate unit, the terminal server is an integral part of the CAL. The terminal server must be situated near the VAX System Manager's terminal server (DECServer). The ports on the P2516 connect to the ports on the DECServer with RS-232 cables. The port connections will be different for each installation, depending on which sites will be monitored by CAL.

Turn on all power switches and wait for approximately 2 minutes. The following indications signify that the BCU/CAL is functioning properly:

- The red LEDs on the BCU/CAL are not illuminated.
- The amber "STATUS" LED on the TVME-147 is lit dimly or is flashing.
- The green "RUN" LED on the fv5310 is illuminated.
- The console terminal displays the message `Login:`

If any of these conditions are not met, then double-check the connections and try to restart the BCU/CAL by switching off the power, waiting 15 seconds, and switching on the power again. If normal operation is not achieved, then leave the power switched on and the network connected. It may be possible to diagnose the BCU/CAL remotely over the network.

The personality of the BCU/CAL unit is set during manufacturing, but can be changed by using the *product* utility, which can be run from the BCU/CAL command line after logging in. For details on this utility, see the User Interface Manual (LBI-38967).

For BCU/CAL operation via the console terminal, refer to the User Interface Manual (LBI-38967).

4.2. SOFTWARE INSTALLATION

The following section describes the software distribution, installation, and configuration of the BCU/CAL application(s).

4.2.1. Distribution Media

The BCU/CAL software is distributed on four 1.44 Mb MS-DOS compatible floppy diskettes. The first three disks contain Ericsson PRS executable code, supplied in ASCII S-Record format. The head (first few lines) of the files on these disks identifies the software revision of the distribution.

The fourth disk (Installation Disk 4) contains template ASCII configuration files which are intended to be modified by the end user.

The table below summarizes the contents of the distribution disks.

Table 1 - BCU/CAL Installation Diskettes

Installation Diskette	Contents
1	LOADER.SX - "Bootstrap" loader for the BCU/CAL application.
2	BC_A.SX - First segment of the BCU/CAL executable image.
3	BC_B.SX - Second segment of the BCU/CAL executable image.
4	Product configuration files to be modified by the BCU/CAL end user.

The following table summarizes the configuration files contained on Installation Diskette 4. These files are provided in template form, and should be modified to suit customer-specific requirements. The files are in MS-DOS format, and may be edited with any ASCII text editor.

Table 2 - BCU/CAL Configuration Diskette

File Name	Usage
IP.DAT	Defines the IP address, subnet mask, and host name of the BCU/CAL.
ROUTES.DAT	Defines network routing paths between the BCU/CAL and other hosts on the customer's network. Syntax is similar to the UNIX /etc/gateways file.
EXPORTS.DAT	Defines the BCU/CAL NFS export list for units which have been purchased with the NFS file server software feature. File contents specify NFS client IP address(es) and the BCU/CAL directory(s) they are privileged to mount. Syntax is similar to the UNIX/etc/exports file.
CAL.DAT	Defines the site interfaces from CAL to the EDACS System Manager. Contents of this file are directly related to configuration parameters which must be set on the Emulex Terminal Server(s).

4.2.1.1. User Configuration Files

This section discusses the contents of the user configuration files contained on Installation Diskette 4. These files should be modified according to customer requirements. When changes are made to the file contents, the BCU/CAL should be rebooted with the diskette installed in the floppy drive.

4.2.1.1.1. IP.DAT Configuration File

The IP.DAT configuration file is provided in template form on Installation Diskette 4. This file is common to both the BCU and CAL feature licenses. It defines the unit's Internet parameters on the end user's local or wide area network. The following three lines show the default contents of the IP.DAT file. The values shown in **bold** print should be modified by the end user. Any errors detected in the file will be displayed on the local console during system boot. The "#" character is a comment delimiter.

```
#####
#####
IP_ADDRESS      147.abc.bc.bbc
SUBNET_MASK     255.xxx.yyy.z      # or FFFFF000
HOST_NAME       bcu01
```

Table 3 - IP.DAT File Parameters

Parameter	Meaning
IP_ADDRESS	IP address of the BCU/CAL (in Internet dotted-decimal notation).
SUBNET_MASK	IP subnet mask for the BCU/CAL. May be specified as Internet dotted-decimal notation or as 8 hexadecimal digits.
HOST_NAME	Host name of the BCU/CAL (up to 32 characters long).

4.2.1.1.2. ROUTES.DAT Configuration File

The ROUTES.DAT configuration file specifies network routing paths to be established at system boot. Typically, this file will only be required if the BCU/CAL is connected to a wide area network, where routers exist between the unit and other customer host facilities. The template file contains a few example routes, which are commented out (i.e., preceded with a # character). If no network routing is required, this file may be omitted, or left unaltered.

A log file (1.2/log/routes.log) is generated on each system boot. This file contains a summary of successful routing additions, as well as any errors detected during processing of the ROUTES.DAT file.

Network routes are specified in the following form:

```
type      destination_ip      gateway      gateway_ip
```

Table 4 - ROUTES.DAT File Parameters

Parameter	Meaning
type	Keyword for the type of route being added (either <i>host</i> or <i>network</i>).
destination_ip	IP address of the destination host or network (in Internet dotted-decimal notation).
gateway	Keyword indicating that the next field is that of the gateway node.
gateway_ip	IP address of the gateway to be used to communicate with the host address specified by destination_ip.

Parameter specification is not case-sensitive, and is parsed (i.e., net is equivalent to network). White space and/or tabs may separate the parameters. Trailing comments (#) are allowed.

The following are examples of routing entries in the file ROUTES.DAT. In this example, packets destined for host 147.abc.a.b will be routed to gateway 147.abc.bc.cde for forwarding. All packets destined for hosts on network 147.bbb.c.c will be routed to gateway 147.abc.cd.e for forwarding. Similarly, destinations on network 147.ccc.d.e will be routed through 147.aaa.bb.c.

```
host    147.abc.a.b gateway 147.abc.bc.cde    # Example of a host route
network 147.bbb.c.c gateway 147.abc.cd.e      # Example of a network route
net     147.ccc.d.e gate   147.aaa.bb.c       # Example of parsing
```


Configuration Tips

Network routes should be entered in a logical order. That is, if there are multiple gateways between the BCU/CAL and a destination, the most direct route(s) should be specified first.

Network routes may be manually added and deleted using the **route** command discussed in the User Interface Manual (LBI-38967). If you are unsure of proper routing, use the **route** command to experimentally determine the proper, or most efficient, parameters and then add these to the ROUTES.DAT file.

Proper routing is intimately related to the IP address and subnet mask specified in the IP.DAT configuration file. Keep these parameters in mind when adjusting ROUTES.DAT contents.

4.2.1.1.3. EXPORTS.DAT Configuration File

The EXPORTS.DAT file only applies to BCU/CAL units which have been purchased with the NFS software feature. The NFS feature is always provided with the BCU. It is an option for the CAL. BCU users may disable the NFS by using the **product** command discussed in LBI-38967.

EXPORTS.DAT defines which network clients are privileged to mount the BCU/CAL system disk. Example exports provided on the template disk are commented out (i.e., preceded with a # character), and thus have no effect when the file is processed.

A log file (1.2/log/nfs.log) is generated on each system boot. The log summarizes the processing of this file, indicating what has been exported, who received the export, and any errors encountered in processing the EXPORTS.DAT file.

Export entries are specified in the following form:

directory **client_ip**

Table 5 - EXPORTS.DAT File Parameters

Parameter	Meaning
directory	Directory structure(s) to be exported. Must be a fully specified, valid directory on the BCU/CAL system disk (volume 1.2). Note that directories are case-sensitive. Specifying the BCU/CAL root directory (1.2/) indicates that the entire volume may be mounted by the host specified by client_ip .
client_ip	Internet address of the NFS client permitted to mount directory , specified in dotted-decimal notation. If no address is specified, it indicates that any client may mount the directory.

The examples below show several valid export entries in the EXPORTS.DAT file:

```
#####
# In the following example, hosts `fallwell' and `hagee' may NFS mount
# the entire BCU/CAL system disk (volume 1.2).
# Host `robertson' may only mount the BCU/CAL cdr directory.
# Any host may mount the log directory.
#####

1.2/      147.aaa.ab.abc    # host name - fallwell
1.2/      147.xxx.yy.zzz   # host name - hagee
1.2/cdr   147.zzz.aa.ccc   # host name - robertson
1.2/log   # any client may mount
```

4.2.1.1.4. CAL.DAT Configuration File

The CAL.DAT is a mandatory file for execution of the CAL software feature. It defines the interface parameters between the BCU/CAL and the System Manager. The template file defines 32 example sites, which are commented out (i.e., preceded with a # character) and thus have no effect when the file is processed. Entries must be provided for each site interface the CAL will be supporting. The information contained in the CAL.DAT file must also be used to properly configure the Emulex Terminal Server(s). Terminal server configuration is discussed in detail in a separate section of this document.

EDACS System Manager site entries are specified in the following form:

```
SITE.ss.PASSWD    system_manager_password
SITE.ss.IP        terminal_server_ip
SITE.ss.PORT      tcp_port_number
```

where *ss* designates the associated site number, ranging from 01 to 32 (inclusive). The site number in CAL should correspond to the site number of the System Manager port to which it will be connected.

A log file (1.2/log/cal_ini.log) is generated on each system boot. This log summarizes the processing of this file, indicating which sites are supported, the values assigned as PASSWD, IP, and PORT for each site, and any errors encountered in processing CAL.DAT.

Table 6 - CAL.DAT File Parameters

Parameter	Meaning
SITE. <i>ss</i> .PASSWD	Specifies the System Manager password to be used for logins to/from this site. <i>system_manager_password</i> must match the associated value programmed on the System Manager for the site specified by <i>ss</i> .
SITE. <i>ss</i> .IP	Defines the Internet IP address, in dotted-decimal notation, of the Emulex Terminal server for the site specified by <i>ss</i> . Note that the address <i>terminal_server_ip</i> should be chosen to be on a directly connected network with the BCU/CAL IP address (as specified in IP.DAT).
SITE. <i>ss</i> .PORT	Defines the TCP/IP port number used to communicate between the BCU/CAL and the associated port on the terminal server. Note that each terminal server port is associated with the site number specified by <i>ss</i> . The value <i>tcp_port_number</i> must be unique for every site defined.

The following example shows how sites 1 and 2 might be defined in the CAL.DAT file.

```
#####
#####
SITE.01.PASSWD    SITE01          # System Manager Password for the site
SITE.01.IP        147.xxx.yy.zz   # IP address of the terminal server
SITE.01.PORT      5001            # TCP port number

SITE.02.PASSWD    SITE02
SITE.02.IP        147.yyy.zz.xx
SITE.02.PORT      5002
```

Configuration Tips

The TCP port number selection can be of significance if the BCU/CAL is attached to a large or TCP protocol intensive network. If you are unsure of TCP port usage on your network, consult you network administrator prior to assigning these values. In general, beginning TCP port definition at **5000** is safe for most applications. A convenient rule of thumb is to start at 5000, with the lower digits of the port reflecting the associated site number. For example, use TCP port number 5010 for site 10.

The parameters defined in CAL.DAT must be known when the Emulex terminal servers are to be configured. Have a hard copy of this file available when you are ready to set up the terminal servers.

The System Manager *must* be properly configured to recognize the sites that the BCU/CAL is simulating. Be sure that these sites have been defined and the passwords are correct prior to connection establishment attempts between the System Manager and the BCU/CAL.

4.2.2. Initial Installation

The following section discusses software installation on a new BCU/CAL. An example of the expected terminal display during this sequence is also provided. This example is annotated with comments indicating user activity/procedures during the installation, as well as general information regarding the process.

PREREQUISITES

1. Verify that the BCU/CAL unit does not have power currently applied.
2. Verify that the BCU/CAL is correctly connected to a VT100-compatible terminal (user console), the IMC CAM, and the local area network (LAN) (if applicable).
3. Verify that the user console is configured as follows:
 - a. 9600 baud, 1 start bit, 1 stop bit, no parity.
 - b. VT100 personality. Terminal is DTE.
 - c. No translation of CR to CR/LF.
 - d. Local echo off. Tab stop at 8 characters.
 - e. DCE/DTE handshaking off.
 - f. XON/XOFF flow control is optional. The BCU/CAL does support flow control.
4. Edit the user configuration files contained on Installation Diskette 4.
 - a. Edit the text file, IP.DAT, to define the unit's Internet parameters on the local network. If the unit will not have a network connection, the file IP.DAT may be left unmodified from that supplied with the release distribution.
 - b. If initial routing entries are desired, edit the file ROUTES.DAT.
 - c. If the NFS feature is purchased, edit EXPORTS.DAT. It is a template file for configuring NFS clients of the BCU/CAL. Client entries are specified as a BCU/CAL system disk directory, followed by the IP address of the client permitted to mount it. A log file (1.2/log/nfs.log) is generated on each system boot. The log summarizes processing of this file, indicating what has been exported, who received the export, and any errors encountered in this file. This file is processed during the application loading (boot) phase only. Modifications made after the unit is up and running will take effect during the next system boot.

- d. If the BCU/CAL has been purchased with the CAL software feature, the file CAL.DAT on Installation Diskette 4 must be modified. This modification should define each site interface to the System Manager for which the CAL feature is to provide service. If the unit is only licensed for the BCU feature, the file CAL.DAT may be left unmodified from that supplied with the release distribution.
- e. Reboot the BCU/CAL.

INSTALLATION

1. Insert **Installation Diskette 1** into the BCU/CAL floppy disk drive.
2. Apply unit power, and observe the user console. The remainder of the installation is provided by way of example. Actual observed output may be slightly different.

If the BCU/CAL hard disk drive has never been formatted (i.e., system integrator installation or the field unit's hard drive has been replaced) output similar to the following will be observed. If this message is displayed, the operator should answer “**yes <RET>**” or simply “**<RET>**” when prompted.

```
The hard disk drive could not be mounted.
Do you wish to perform a high level format [Y/N]? <RET>
Beginning high level format...
High level format successfully completed.
```

```
<OS> Beginning bootstrap loader: Wed Nov 15 14:23:03 1995
```

```
<OS> Floppy disk has been mounted.
<OS> Scanning floppy disk for LOADER.SX...
Deleting file 01.02/backup/LOADER.BAK
Moving 01.02/backup/LOADER.SX to 01.02/backup/LOADER.BAK
Moving 01.02/LOADER.SX to 01.02/backup/LOADER.SX
```

```
<OS> Copying LOADER.SX to the hard disk....
<OS> Copy complete. 267041 bytes copied.
<OS> Floppy disk has been unmounted.
<OS> Scanning hard disk for LOADER.SX...
<OS> Loading file LOADER.SX from the hard disk...
<OS> Load complete. 87200 bytes loaded.
<OS> Hard disk has been unmounted.
<OS> Transferring program control to LOADER module...
<LOADER> Installing BCU/CAL: Wed Nov 15 14:23:52 1995
```

```
<LOADER> Floppy disk has been mounted.
Scanning floppy disk for BCU/CAL installation files...
```

```
<LOADER> Floppy disk has been unmounted.
```

```
<LOADER> USER ATTENTION REQUIRED.
Remove the current installation floppy diskette.
Insert the next installation disk (if any).
Strike <RETURN> to continue.
```

USER ACTION: Remove Installation Diskette 1. Insert Installation Diskette 2. Press the Enter key.

```
<LOADER> Floppy disk has been mounted.
Scanning floppy disk for BCU/CAL installation files...
Deleting file 01.02/backup/BC_A.BAK
Moving 01.02/backup/BC_A.SX to 01.02/backup/BC_A.BAK
Moving 01.02/loads/BC_A.SX to 01.02/backup/BC_A.SX

Copying BC_A.SX to 01.02/loads/BC_A.SX... Done! 1200391 bytes copied.

<LOADER> Floppy disk has been unmounted.
<LOADER> USER ATTENTION REQUIRED.
Remove the current installation floppy diskette.
Insert the next installation disk (if any).
Strike <RETURN> to continue.
```

USER ACTION: Remove Installation Diskette 2. Insert Installation Diskette 3. Press the Enter key.

```
<LOADER> Floppy disk has been mounted.
Scanning floppy disk for BCU/CAL installation files...
Deleting file 01.02/backup/BC_B.BAK
Moving 01.02/backup/BC_B.SX to 01.02/backup/BC_B.BAK
Moving 01.02/loads/BC_B.SX to 01.02/backup/BC_B.SX

Copying BC_B.SX to 01.02/loads/BC_B.SX... Done! 687063 bytes copied.

<LOADER> Floppy disk has been unmounted.

<LOADER> USER ATTENTION REQUIRED.
Remove the current installation floppy diskette.
Insert the next installation disk (if any).
Strike <RETURN> to continue.
```

USER ACTION: Remove Installation Diskette 3. Insert Installation Diskette 4. Press the Enter key.

```
<LOADER> Floppy disk has been mounted.
Scanning floppy disk for BCU/CAL installation files...
Moving 01.02/cnfg/IP.DAT to 01.02/backup/IP.DAT

Copying IP.DAT to 01.02/cnfg/IP.DAT... Done! 792 bytes copied.
Moving 01.02/cnfg/ROUTES.DAT to 01.02/backup/ROUTES.DAT

Copying ROUTES.DAT to 01.02/cnfg/ROUTES.DAT... Done! 2357 bytes copied.
Moving 01.02/cnfg/EXPORTS.DAT to 01.02/backup/EXPORTS.DAT

Copying EXPORTS.DAT to 01.02/cnfg/EXPORTS.DAT... Done! 1625 bytes copied.
Moving 01.02/cnfg/CAL.DAT to 01.02/backup/CAL.DAT

Copying CAL.DAT to 01.02/cnfg/CAL.DAT... Done! 5043 bytes copied.

<LOADER> Floppy disk has been unmounted.
```

<LOADER> USER ATTENTION REQUIRED.
Remove the current installation floppy diskette.
Insert the next installation disk (if any).

USER ACTION: Remove Installation Diskette 4. Press the Enter key.

<LOADER> Processing file 01.02/cnfg/IP.DAT.
<LOADER> Initialized network parameters:
IP Address: 147.zzz.aa.abc Name: bcu02
Subnet Mask: 255.qqq.zzz.a Network: 147.xyz.yy.z

<LOADER> Loading file 01.02/loads/BC_A.SX from the hard disk...
<LOADER> First load complete. 394824 bytes loaded.
<LOADER> Loading file 01.02/loads/BC_B.SX from the hard disk...
<LOADER> Second load complete. 224522 bytes loaded.
<LOADER> Application load complete. 619346 bytes loaded.
<LOADER> Hard disk has been unmounted.
<LOADER> Transferring program control to BCU/CAL...

<DISK CHECK> Verifying system disk integrity: Wed Nov 15 14:30:04 1995
<DISK CHECK> Disk verification complete. No faults detected.

<BCU/CAL> System startup: Wed Nov 15 14:30:51 1995
<BCU/CAL> Beginning boot of fv5310 Wanserver.
Wanserver boot succeeded.
<BCU/CAL> Beginning application installation...
<BCU/CAL> Checking system directories.
<BCU/CAL> Checking system configuration files.
<BCU/CAL> Checking product feature license.
<CAL/BCU> Checking CAL site configuration
<Agent> Processed file 1.2/bin/SNMP.DAT.
<BCU/CAL> Application installation complete.
<SNMP> Reading threshold alarms.

```
*****
*           Welcome to the EDACS BCU/CAL.           *
*                                                    *
* Copyright (C) Ericsson, Inc.                      *
* Private Radio Systems (PRS)                       *
* Mountain View Road                               *
* Lynchburg, Virginia 24502  USA                   *
* 1993,1994,1995                                    *
*****
```

System boot complete: Wed Nov 15 14:31:30 1995

Login:

USER INFORMATION

The Welcome banner and Login prompt indicate a successful software installation and system boot. At this point, the operator should log into the unit under the "root" account to perform some first-time configuration operations.

4.2.2.1. First-Time Configuration

The following section describes the minimal set of system initializations that a user must perform to set up a BCU/CAL.

When the BCU/CAL software is first installed, three user accounts are initialized. Each account has a varying level of system access security. The following table defines the initial accounts and their passwords, arranged in decreasing levels of access. The login name and password are case-sensitive. These passwords can be changed from their default values, and new accounts installed, using the *passwd* command. Any new accounts added will have the same level of access as the "user" account.

Table 7 - Default System Accounts

Login	Password	Access Level
root	root	Anything. This account is the "super-user."
admin	admin	Can access any BCS commands for system configuration.
user	user	Most restricted, particularly for the BCS commands.

Log onto the BCU/CAL under the "root" account. The console display will be similar to the following:

```
Login: root
Password:
```

```
Copyright (c) Integrated Systems, Inc., 1992.
Welcome to pSOSystem...
pSH+>
```

USER INFORMATION: Enter "ls" to observe the root level directory files and subdirectories which were created during the software installation process.

```
pSH+> ls
BITMAP.SYS      backup      etc         mnt
FLIST.SYS       bin         export      tmp
LOADER.SX       cdr         loads       usr
activity        cnfg        log         var
```

USER INFORMATION: The following example shows the configuration files for the unit. The .BIN files were created during the software installation process.

```
pSH+> cd cnfg
pSH+> ls -als
total 41
  2 -rwxrwxrwx  1 root          622 Feb 01 1994 10:45 CAL.DAT
  2 -rwxrwxrwx  1 root          892 Feb 01 1994 10:45 IP.DAT
  2 -rwxrwxrwx  1 root          568 Feb 01 1994 10:47 SYSTEM.BIN
  1 -rwxrwxrwx  1 root       131072 Feb 01 1994 10:47 UNIT.BIN
 33 -rwxrwxrwx  1 root       16384 Feb 01 1994 10:47 GROUP.BIN
```

USER ACTION: Two system parameters may need to be set. If the BCU/CAL is operating in a Multi-Node/StarGate configuration, the IMC NIM slot number needs to be defined. If the BCU/CAL service area (IMC) has a Jessica interconnect system installed, the IMC PIM slot number needs to be defined. These parameters must be set appropriately for the BCU to correctly provide billing for calls involving these “sites” (i.e., StarGate or Jessica). They are required by the CAL to simulate secondary drops from the site(s) it is providing service for. If the parameter (NIM or PIM slot) does not apply, it should be set to zero (default value).

These parameters are defined using the BCU/CAL Configuration Service (BCS) program. BCS is discussed in detail in LBI-38967. The following example is provided for reference to get the BCU set up and running as quickly as possible.

PREREQUISITE

1. Obtain the IMC slot number of the NIM and PIM modules, if any.
2. If not already logged into the BCU/CAL, log in under the "root" account as previously discussed. Enter the following commands at the indicated prompts.

USER INFORMATION: Entering "bcs" invokes the BCS program.

```
pSH+> bcs
```

```
Welcome to the BCU-CAL Configuration Service (BCS)
```

```
System Administrator privilege acknowledged.
```

USER INFORMATION: Entering "show system" displays the default system parameters that were initialized during the initial software installation.

```
BCS> show system
Default unit pseudo hangtime = 10
Default group pseudo hangtime = 10
Default group billing mode = Bill callee
Data call pseudo hangtime = 10
Data call billing = On
Phone digits mandatory = Off
CDR maximum file records = 1024
CDR sequence wrapping = On
Offload time = 00:00:00
Tape logging = Off
CDR archive(s) lifetime = 7
IMC time synchronization = Off
System ID = 0
Node ID = 0
NIM slot = 0
PIM slot = 0
Telephony Call Answer Feedback = Off
Telephony CDR Control = Normal
```

The following example shows how individual entries in the system table can be displayed.

```
BCS> show system /unit_hang /tape_log
Default unit pseudo hangtime = 10
Tape logging = Off
BCS>
```


USER ACTION: To define the IMC NIM slot, execute the following command. This example assumes that the NIM occupies slot 32. The actual value should reflect the end user's IMC configuration. If the IMC does not have a NIM, disregard this command.

```
BCS> set system /nim = 32
```

USER ACTION: To define the IMC PIM slot (for Jessica), execute the following command. This example assumes that the PIM occupies slot 16. The actual value should reflect the end user's IMC configuration. If the IMC does not have a PIM, skip this command.

```
BCS> set system /pim = 16
```

USER ACTION: If either of the previous commands were executed, they may be verified by entering the following command. The previous two steps may be repeated in case the values were incorrectly entered by the operator.

```
BCS> show system /nim /pim
NIM slot = 32
PIM slot = 16
```

USER ACTION: Exit BCS, which returns the operator the pSH+> prompt.

```
BCS> exit
```

```
pSH+>
```

4.2.2.2. System Disk Booting

After software has been installed on the BCU/CAL system disk, the BCU/CAL will use these files for any subsequent (re)boot. The following example shows the typical console output observed when the BCU/CAL boots from its hard disk. No user action is required for this process. The BCU/CAL will immediately begin normal application processing when the boot cycle is complete.

```
<OS> Beginning bootstrap loader: Tue Nov  7 17:30:56 1995

<OS> Scanning hard disk for LOADER.SX...
<OS> Loading file LOADER.SX from the hard disk...
<OS> Load complete. 87202 bytes loaded.
<OS> Hard disk has been unmounted.
<OS> Transferring program control to LOADER module...
<LOADER> Installing BCU/CAL: Tue Nov  7 17:31:15 1995
<LOADER> Processing file 01.02/cnfg/IP.DAT.
<LOADER> Initialized network parameters:
        IP Address:  147.xxx.yy.zzz  Name: bcu02
        Subnet Mask: 255.zzz.aaa.x  Network: 147.xxx.ab.z

<LOADER> Loading file 01.02/loads/BC_A.SX from the hard disk...
<LOADER> First load complete. 394863 bytes loaded.
<LOADER> Loading file 01.02/loads/BC_B.SX from the hard disk...
<LOADER> Second load complete. 221729 bytes loaded.
<LOADER> Application load complete. 616592 bytes loaded.
<LOADER> Hard disk has been unmounted.
<LOADER> Transferring program control to BCU/CAL...
```

```
<DISK CHECK> Verifying system disk integrity: Tue Nov  7 17:32:38 1995
<DISK CHECK> Disk verification complete. No faults detected.
```

```
<BCU/CAL> System startup: Tue Nov  7 17:33:13 1995
<BCU/CAL> Beginning boot of fv5310 Wanserver.
Wanserver boot succeeded.
<BCU/CAL> Beginning application installation...
<BCU/CAL> Checking system directories.
<BCU/CAL> Checking system configuration files.
<BCU/CAL> Checking product feature license.
<CAL/BCU> Checking CAL site configuration
<Agent> Processed file 1.2/bin/SNMP.DAT.
<BCU/CAL> Application installation complete.
<SNMP> Reading threshold alarms.
```

```
*****
*                               *
*      Welcome to the EDACS BCU/CAL.      *
*                               *
* Copyright (C) Ericsson, Inc.           *
*      Private Radio Systems (PRS)       *
*      Mountain View Road                *
*      Lynchburg, Virginia 24502  USA    *
*      1993,1994,1995                   *
*****
```

```
System boot complete: Tue Nov  7 17:33:36 1995
```

```
Login:
```

4.2.2.3. Proper System Shutdown

The BCU/CAL must be shut down in an orderly fashion prior to a system reboot. This procedure essentially disconnects the link to the IMC CAM, gracefully closes any open files (especially significant for the BCU), and secures the hard drive file system. The proper way to shut down the BCU/CAL can be executed from either the "root" or "admin" accounts. This procedure is shown by way of example.

USER INFORMATION: Invoke the BCS program.

```
pSH+> bcs
```

```
Welcome to the BCU-CAL Configuration Service (BCS)
System Administrator privilege acknowledged.
```

USER INFORMATION: The BCS *halt* command performs the proper shutdown procedure.

```
BCS> halt
```

USER INFORMATION: Wait at least 2 minutes from issuing the *halt* command, then exit BCS.

```
BCS> exit
pSH+>
```

At this point, the BCU/CAL may be powered-down, or rebooted, without concern for disk data integrity. Under extreme (i.e., panic) circumstances, the "root" user can force an immediate reboot by entering **reboot -h** at the pSH+> prompt, either at the user console or via a telnet connection.

4.2.3. Software Upgrades

Software upgrades are similar to the initial installation procedure discussed above. Each time the BCU/CAL boots, it will check to determine whether a floppy diskette is installed. If a diskette is present, it will be scanned to check whether any BCU/CAL installation files are present. If applicable files are detected, they will be copied to the appropriate system disk directory. As in the initial installation procedure, the operator will be prompted to remove the current diskette and insert the next one.

This method also applies to customer modifications to the contents of Installation Diskette 4. Specifically, if (new) changes are made to either the IP.DAT or CAL.DAT files, the BCU/CAL should be rebooted with the modified diskette inserted in the floppy drive.

Note that previous software loads and user configuration files are not destroyed when an upgrade or configuration change is installed. The BCU/CAL archives up to 3 of the last installations in the "1.2/backup" directory. These can be retrieved by the operator in the event of problems with a new software installation, or errors in the end user modified configuration files.

4.3. CAL TERMINAL SERVER CONFIGURATION

The CAL feature of the BCU/CAL supports up to 2 Emulex P2516 Terminal Servers. Each terminal server provides 16 serial ports. Of these, 15 are readily accessible for System Manager and Site Controller interfaces, with one port (port 1) being used for initial terminal server configuration.

Temporarily disconnect the Ethernet LAN connection from the terminal server. Connect a "dumb" VT100 compatible terminal to port 1 of the terminal server to be configured. This corresponds to port 1 on the BCU/CAL distribution panel for the first terminal server and port 17 for the second terminal server. The terminal should be configured for 9600 baud, 1 start bit, 1 stop bit, and no parity.

Log in to the first terminal server under the privileged account.

If you are greeted with a **#** prompt, first execute the following command:

```
# access
```

If the server requests a password enter **<CTRL-Z>**.

```
Server> su  
Password> system
```

system is the default privileged account password. This can be changed later.

Set the terminal type used to configure the server.

```
Server>> change port 1 type VT100
```

Define the IP address and subnet mask of the terminal server. The IP address, *terminal_server_ip*, must reflect the associated address defined in the CAL.DAT file. The subnet mask, *subnet_mask*, should be the same as defined for the BCU/CAL in the IP.DAT configuration file. Note that *subnet_mask* should be in dotted decimal notation instead of the hex format shown in the IP.DAT file.

```
Server>> define server ip terminal_server_ip
Server>> define server subnet mask subnet_mask
```

EXAMPLE:

```
Server>> define server subnet mask 255.255.240.0
```

For each site defined in the CAL.DAT file, configure the associated port on the terminal server as follows:

```
Server>> change port port_no access remote
Server>> change port port_no type softcopy
Server>> change port port_no autobaud disabled
Server>> change port port_no speed 19200
Server>> change service PORT_<port_no> <TCP port_no> port port_no telnet disabled
Server>> change port port_no queuing disabled
Server>> change port port_no flow control disabled
```

TCP port_no is the value defined in CAL.DAT for a particular site.

EXAMPLE:

Assume that the file CAL.DAT has the following two site entries: System Manager site 2 is connected to port 3 on the distribution panel, and System Manager site 10 is connected to port 6 on the distribution panel.

SITE.02.PASSWD	SITE02	
SITE.02.IP	147.xxx.ab.aa	#Terminal server IP address
SITE.02.PORT	5002	#TCP port_no used for site 2
SITE.10.PASSWD	SITE10	
SITE.10.IP	147.aaa.zz.bb	
SITE.10.PORT	5010	#TCP port_no used for site 10

Inserting the information below would configure the terminal server for the values shown above.

```
Server>> change port 3 access remote
Server>> change port 3 type softcopy
Server>> change port 3 autobaud disabled
Server>> change port 3 speed 19200
Server>> change service PORT_3 5002 port 3 telnet disabled
Server>> change port 3 queuing disabled
Server>> change port 3 flow control disabled

Server>> change port 6 access remote
Server>> change port 6 type softcopy
Server>> change port 6 autobaud disabled
Server>> change port 6 speed 19200
Server>> change service PORT_6 5010 port 6 telnet disabled
Server>> change port 6 queuing disabled
Server>> change port 6 flow control disabled
```

After completing the configuration, reconnect the Ethernet LAN connection to the terminal server. If a second terminal server is installed, repeat the procedure above.

Configuration Tips

If all 16 ports of a terminal server are needed for System Manager interface, first configure 15 of them using a “dumb” terminal connected to port 1. Port 1 (configuration port) may then be re-assigned to a remote port, accessible via a telnet connection. Telnet into the terminal server on the OVERRIDE port number, and reconfigure port 1 as required. Refer to the Emulex Terminal Server user’s manual for additional information on server configuration via a telnet connection.

The up arrow on a VT100 can be used to recall commands to the terminal server, allowing the user to reissue the same command to each port on the server by only changing *port_no*.

NOTE

The push button switch (marked default) on the front of the Emulex P2516 terminal server will erase all configuration information in the terminal server and return it to the factory default state. Do not use this switch to reset the terminal server. Cycle power or issue the “Initialize server” command from the server configuration port to restart the terminal server.

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5. EDACS NETWORK MANAGEMENT SUPPORT BY THE BCU/CAL

Refer to LBI-39171, “EDACS Network Management Installation and Technical Reference Manual,” for additional information on setting up the BCU for use with the EDACS Network Manager.

5.1. NETWORK MANAGER CONFIGURATION

Ensure that the BCU/CAL contains the following settings for Network Manager connectivity.

1. Log into the BCU/CAL under the *root* account.

Login: root
Password:

2. Enable the Ethernet Interface by setting up the IP.DAT configuration file as discussed in section 4 herein.

3. Enter the following information at the prompts:

```
pSH+> bcs
BCS> show system
BCS> set system/PIM = 16 (This is the SITE_ID, which ranges from 1 to 32. The default is 16.)
BCS> set system/NIM = 32 (This is the NIM Number of the IMC. This number ranges from 1 to 32.)
BCS> set system/node = 33
BCS> exit
pSH+> product -1 (Ensure that the Multisite Monitor (MSM) license is enabled if the BCU/CAL is
                  providing Multisite Monitor/Site Monitor information. Note: A reboot is
                  required to see any license change.)
```

3. Execute the *trap* command to define to which Network Manager Station the traps are sent.

For example: pSH+> **trap -a -i IP Address of NM**

4. Enter the *comm* command to define which Network Manager Station may read or write to this platform.

For example: pSH+> **comm -a -i IP Address of NM -c edacs -v write**

5.2. MIB-II SUPPORT

An agent which supports Simple Network Management Protocol (SNMP) and standard Management Information Bases (MIBs) is implemented on the BCU/CAL. The MIB records contain the status of each network connection, traffic statistics, and error counts.

The BCU/CAL supports MIB-II variables as defined by RFC-1213 except as noted below.

Group Name	Starting Node	Comments
system	1.3.6.1.2.1.1	Fully implemented.
interfaces	1.3.6.1.2.1.2	Fully implemented.
at	1.3.6.1.2.1.3	Fully implemented. Note(1)
ip	1.3.6.1.2.1.4	Fully implemented.
icmp	1.3.6.1.2.1.5	Fully implemented.
tcp	1.3.6.1.2.1.6	Fully implemented.
udp	1.3.6.1.2.1.7	Fully implemented.
egp	1.3.6.1.2.1.8	Not implemented. Note(2)
transmission	1.3.6.1.2.1.10	RFC-1381: lapb - transmission(16). Note(3)
snmp	1.3.6.1.2.1.11	Fully implemented.

Note(1): The address translation group is deprecated under MIB-II. It is supported (via ARP cache) for computability with MIB-I management nodes.

Note(2): The BCU/CAL does not implement the Exterior Gateway Protocol.

Note(3): RFC-1381 is the MIB for LAPB type interfaces. This MIB applies to the current BCU/CAL-IMC CAM link. This MIB shall be fully implemented, with the exception of LAPB XID {lapbXidTable}.

5.3. COMMON EDACS MIBS

This section provides a summary of the common EDACS MIBs supported by BCU/CAL.

EDACS MIB Number	Title	BCU/CAL Release 2 Implementation
101	EDACS Common Managed Element Parameters	Fully implemented.
102	EDACS Alarm-Threshold	Fully implemented.
103	EDACS Site Performance	Implemented, except for variables that measure circuit queuing time. (siteTotalCktQTime, siteCktQTimeIndivVoice, siteCktQTimeGroupVoice, siteCktQTimeIndivData, siteCktQTimeGroupData, siteCktQTimeIndivOutboundTelephony, siteCktQTimeIndivInboundTelephony, siteCktQTimeGroupInboundTelephony, and siteCktQTimeOther will always be 0.)
104	EDACS Node Performance	Implemented, except for variables that measure circuit queuing time. (nodeTotalCktQTime, nodeCktQTimeIndivVoice, nodeCktQTimeGroupVoice, nodeCktQTimeIndivData, nodeCktQTimeGroupData, nodeCktQTimeIndivOutboundTelephony, nodeCktQTimeIndivInboundTelephony, nodeCktQTimeGroupInboundTelephony, and nodeCktQTimeOther will always be 0.)

5.4. EDACS COMMON MANAGED ELEMENT PARAMETERS

5.4.1. Implementation Limits

The BCU/CAL has the following limits in implementing the edacs101.mib:

Limit/Feature	Value	Related MIB Variable
Is EDACS softwareFeatureCode supported?	NO. Any set request will return badValue. Any get request will return a 0 length string.	softwareFeatureCode
Are software components supported?	BCU/CAL Release 2 will support the following 3 software components: VME Operating System ROM Set BCU/CAL Application	softwareTable
Are mass storage components supported?	BCU/CAL Release 2 will support 2 mass storage components: System Hard Drive Floppy Drive (NOTE: If the floppy drive is queried when there is not a disk in the drive, zeros are returned for floppy drive fsDisk variables.)	fsDiskTable
Is remote reset supported?	YES	operRemoteReset
Is remote status supported?	YES	operRemoteStatus
What is the maximum size of the trap destination table?	10	trapDestinationTable
What is the maximum size of the authentication failure table?	10	authFailTable
Which method is used for handling authentication failure table overflow?	The oldest failure record is overwritten with the new failure information.	authFailTable

5.5. EDACS ALARM-THRESHOLD

5.5.1. Implementation Limits

The BCU/CAL has the following limits in implementing the edacs102.mib:

Limit/Feature	Value	Related MIB Variable
Maximum number of alarm entries	10	alarmThreshNextIndex
Minimum sampling interval	1 second	alarmThreshMinInterval
Default sampling interval	10 minutes	alarmThreshDefaultInterval
Can Alarm entries be made permanent?	YES	alarmThreshPermanence

5.5.2. Default Threshold Alarms

By default, BCU/CAL Release 2 will have the threshold alarms listed in the table below. Since threshold alarm settings can be saved on disk, these defaults will only be set on initial installation or if the alarm file is deleted.

Variable	Sample Type	Startup Alarm	Rising Threshold	Falling Threshold	Sampling Interval
fsDiskPercentBlocksUsed [From edacs101.mib]	absolute Value(1)	rising Alarm(2)	90	70	1 hr
fsDiskPercentInodesUsed [From edacs101.mib]	absolute Value(1)	rising Alarm(2)	90	70	1 hr

5.6. EDACS SITE PERFORMANCE

BCU/CAL Release 2 will not support the Circuit Queuing parameters from the edacs103.mib for the BCU/CAL Site (as defined by the configuration parameter SITE_ID).

5.7. SNMP TRAP SUMMARY

This section lists all SNMP Traps that the BCU/CAL can generate.

5.7.1. Generic Traps

The following are the generic traps as specified in RFC-1215 (see LBI-39169, EDACS Network Manager User's Manual).

Trap	Description	MIB Variables Included	Controls
coldStart	Signifies that the BCU/CAL is reinitializing itself.	NONE	Always enabled
warmStart	Signifies that the BCU/CAL is reinitializing itself without changing agent configuration.	NONE	Always enabled
linkDown	Signifies that a link has failed. The following links are supported: BCU/CAL-IMC Control link	ifIndex	Always enabled
linkUp	Signifies that a link has come up. The following links are supported: BCU/CAL-IMC Control link	ifIndex	Always enabled
authenticationFailure	Signifies that an SNMP message was not properly authenticated.	NONE	snmpEnableAuthen-Traps

5.7.2. EDACS101 Traps

The following are the standard status traps as specified in edacs101.mib.

Trap	Description	MIB Variables Included	Controls
operResetEvent	A complete system reset is being performed.	trapSequenceNumber operRemoteReset	alarm- ThreshStatus
operStatusEvent	A significant change in operational status has occurred.	trapSequenceNumber operRemoteStatus	alarm- ThreshStatus

5.7.3. EDACS102 Traps

The following are the standard threshold traps as specified in edacs102.mib (See section 5.5. EDACS Alarm-Threshold).

See section 5.5.2. Default Threshold Alarms for a description of the default threshold alarms in the BCU/CAL.

Trap	Description	MIB Variables Included	Controls
alarmRisingThreshold	A rising threshold has been exceeded.	trapSequenceNumber alarmThreshVariable, alarmThreshSampleType, alarmThreshValue, alarmThreshRisingTheshold, alarmThreshOwner, alarmThreshIndex	oper- Announce- Reset
alarmFallingThreshold	A falling threshold has been exceeded.	trapSequenceNumber alarmThreshVariable, alarmThreshSampleType, alarmThreshValue, alarmThreshFallingTheshold, alarmThreshOwner, alarmThreshIndex	oper- Announce- Status

5.8. MULTISITE MONITOR

The Multisite Monitor is a Network Manager feature that allows the display of call activity for an entire node simultaneously. For details on the Network Manager requirements see the “EDACS Network Manager User’s Manual,” LBI-39169.

5.9. SECURITY MANAGEMENT

The BCU/CAL only supports trivial authentication procedures as delineated under the SNMP group of RFC-1213.

- The BCU/CAL supports a unique community name for all SNMP get, set, and trap operations. The maximum length of each community name is 32 ASCII characters. The community names are maintained in non-volatile storage.
- The community name is part of the BCU/CAL configuration data, and access to the community name is restricted to the super-user (root) account.
- The BCU/CAL supports the ability to generate authentication failure notification to the Network Management stations(s) for operations attempted with an invalid community name.

In order to support the Network Manager Security Management on the BCU/CAL product, two new user interface commands were implemented. These commands, *comm* and *trap*, are described in detail in the “EDACS BCU/CAL User Interface Manual,” LBI-38967.

The *comm* command allows the root user to view, add an entry to, delete an entry from, or modify an entry in the SNMPv1 Get-Set Community Profile Table. The table contains a specific machine’s IP address, get-set community name, and MIB view.

The *trap* command allows the root user to view, add an entry to, or delete an entry from, the SNMPv1 Trap Table. The table contains IP addresses to which the traps will be sent. The trap community name is always “edacs.”

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APPENDIX A
EDACS BILLING (CDR) FORMAT

This appendix defines the EDACS call detail record (CDR) format for the collection of system resource usage data in a multisite trunked radio system. The document is intended for use primarily by air time billing software developers who use this record format as input, as well as for developers of equipment and software to collect and archive call detail data from EDACS.

1. OVERVIEW

The EDACS CDR is designed to record call activity on an EDACS multisite trunked radio system. The records are intended primarily for billing purposes. The EDACS CDR format balances efficient storage with comprehensive resource utilization data.

2. BILLING BY CONVERSATION

EDACS uses transmission trunking to allocate RF channels. Unlike a landline telephone conversation, where a single circuit is established at the beginning of the call and disconnected at the end, EDACS establishes a new "circuit" (assigns an RF channel) each time a conversation participant presses the PTT switch on a radio, and disconnects (drops the channel) as soon as the PTT switch is released. Thus, a single conversation may result in several RF channel assignments. Rather than designate each of these brief transmissions as a call requiring its own CDR, the EDACS CDR format permits all of the transmissions making up a single conversation to be recorded in a single CDR. The CDR records the elapsed time of the conversation, the actual accumulated air time (time that an RF channel was in use) and the number of transmissions involved. A list of the channels used in the call is also part of the record.

3. BILLING FOR MULTIPLE SITES

EDACS allows calls which originate on one radio site and use RF channels on one or more additional sites. The EDACS CDR format accommodates these calls by recording the site number and a list of the RF channels used for each site participating in the call. In addition, the accumulated air time field in the CDR contains the total air time used on all sites. In this case, the accumulated air time value will usually be greater than the elapsed time.

4. RECORD ENCODING

An EDACS CDR is an ASCII text record terminated by a linefeed character (LF, decimal 10). The record consists of fixed length fields. The total number of fields in the record is variable, depending on whether the call involved multiple sites or was a radio-originated telephone interconnect call.

Most of the fields are numeric data and are specified as either Decimal or Hex format. Decimal format fields are radix-10 integers encoded using the ASCII characters from decimal 48 ("0") through decimal 57 ("9"). Hex fields are radix-16 integers encoded using the ASCII characters from decimal 48 ("0") through decimal 57 ("9") and decimal 65 ("A") through decimal 70 ("F"). Two additional formats are used. The radix-64 format is used to provide a sequence number for each record. The last format used is the dialed digits format. This format is used to record a telephone number dialed by the originator of a mobile-to-land telephone interconnect call. The standard digits on a telephone DTMF keypad are encoded using the ASCII characters decimal 35 ("#"), decimal 42 ("*"), and decimal 48 ("0") through decimal 57 ("9").

The following table defines the ASCII characters used in the CDR radix-64 sequence number field, and their associated decimal values.

CDR Radix-64 Digit	Decimal Equivalent
0123456789	0 to 9
ABCDEFGHIJ	10 to 19
KLMNOPQRST	20 to 29
UVWXYZabcd	30 to 39
efghijklmn	40 to 49
opqrstuvwxyz	50 to 59
yz#\$	60 to 63

5. RECORD LAYOUT

5.1. SINGLE-SITE CALLS

The following diagram shows the layout of the fields in a basic CDR for a single-site call. The top row shows the field name and number, the middle row shows the subfield name and letter, if applicable, and the bottom row shows the byte offset within the record.

1. Record Type		2. Node ID No.				3. Record ID No.				4. Start Date							5. Start Time						
		a. System		b. Node						a. Year				b. Month		c. Day		a. Hour		b. Minute		c. Second	
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

6. Call Type		7. Caller ID No.													8. Callee ID No.											
24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45					

9. Elapsed Time				10. Accumulated Air Time					11. No. of Channel Assignments					12. No. of Sites		13. Site of Origin							
																a. No.		b. Channel Map					
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69

Figure A.1 - Call Detail Record, Single-Site Call

5.2. MULTIPLE-SITE CALLS

A CDR may have 0 to n additional fields added beginning at byte offset 70, where $n = \text{No. of Sites} - 1$. The format of the additional fields is identical to the Site of Origin field (field 13) and is shown in the diagram below. The offset, x , of the first byte in each additional field is calculated as $x = 62 + (8n)$.

13 +n. Additional Site n							
a. No.				b. Channel Map			
x	x+1	x+2	x+3	x+4	x+5	x+6	x+7

Figure A.2 - Call Detail Record, Additional Site Field

5.3. MOBILE-TO-LAND TELEPHONE INTERCONNECT CALLS

A CDR for a mobile-to-land telephone interconnect call will have an additional field beginning at byte offset 70. This field contains the digits dialed by the caller. A mobile-to-land call never involves multiple sites, so the PSTN Telephone Number field is never combined with the Additional Site fields described in the preceding section.

14. PSTN Telephone No.																					
70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91

Figure A.3 - Call Detail Record, PSTN Telephone Number Field

5.4. CALCULATING THE NUMBER OF BYTES IN A CDR

Note that the final linefeed character which terminates the record is not shown in these diagrams. The actual number of bytes in a CDR is calculated by adding 2 to the offset of the final byte. For example, a group call involving 4 sites contains 3 additional site fields, beginning at offset 70 and ending at offset 93 (from the formulae above). The actual length of the record, including the linefeed character, is thus 95 bytes.

5.5. CDR FIELD DESCRIPTIONS

Table A.1 contains detailed descriptions of each of the CDR fields.

Table A.1 - Call Detail Record Field Descriptions

No.	Name	Size	Format	Range/Values	Description
1.	Record Type	2	Hex	00 - FF	Defines the type of record. 00 = Mobile to Mobile 01 = Mobile to Land Interconnect 02 = Illegal 03 = Land to Mobile Interconnect 04 = Data 05- FF = Reserved
2.	Node ID No.	4			Unique identification number for the EDACS node where the call activity in this CDR occurred. User configurable.
a.	System	2	Hex	00 - FF	System ID Number (Multiple nodes)
b.	Node	2	Hex	00 - FF	Node ID Number (Multiple sites)
3.	Record ID No.	4	Radix-64		Unique identifier for the Call Detail Record.
4.	Start Date	8			The date when the call was initiated.
a.	Year	4	Decimal	1970-2038	
b.	Month	2	Decimal	01 - 12	
c.	Day	2	Decimal	01 - 31	
5.	Start Time	6			The time of day when the call was initiated. Hours are in military format.
a.	Hour	2	Decimal	00 - 23	
b.	Minute	2	Decimal	00 - 59	
c.	Second	2	Decimal	00 - 59	
6.	Call Type	2	Hex	00 - FF (See Table A.2)	The type of call as defined in Table A.2. Indicates whether call is group or individual, whether to bill the caller or the callee, etc.
7.	Caller ID No.	10	Decimal	0000000000 - 9999999999	For Record Types 00 and 01, this field contains the Logical ID (LID) of the caller. For Record Type 03, the field contains the Interconnect Line number.
8.	Callee ID No.	10	Decimal	0000000000 - 9999999999	For Record Types 00 and 03, this field contains the Logical ID (LID) of an individual callee, or the Group ID (GID) of a call group. (The Call Type field indicates individual or group call.) For Record Type 01, the field contains the Interconnect Line number.
9.	Elapsed Time	4	Hex	0000 - FFFF	The duration of the call in seconds
10.	Accumulated Air Time	5	Hex	00000 - FFFFF	The number of seconds of actual air time used on all sites on the local node for this call. Does not include air time on site 32 which is a remote node.
11.	No. of Channel Assignments	5	Hex	00000 - FFFFF	The number of times a channel assignment occurred on a site within the local node for this call.
12.	Number of Sites	2	Decimal	01 - 32	The number of sites on the local node which participated in this call.

Table A.1 - Call Detail Record Field Descriptions (Cont.)

No.	Name	Size	Format	Range/Values	Description
13.	Site of Origin /	8			Information on the site of Origin (field 13) and any additional sites participating in the call.
13+n	Additional Site n				
a.	Site Number	2	Decimal	01 - 32	Site number (site 32 represents a remote node).
b.	Channel Map	6	Hex	000000 - FFFFFFFF	A hexadecimal bitmap, where bit 0 = channel 1. A bit value of 1 indicates at least one channel assignment on the indicated channel.
14.	PSTN Telephone No.	32	Dialed Digits		Occurs in Record Type 01 only. Contains up to 32 digits dialed by the caller. The digits are left justified and padded with ASCII SP (decimal 32) on the right.

6. CALL TYPE DEFINITIONS

Table A.2 contains the typical values of the call type (CDR field 6). Note that many call types are invalid, and most call types are valid only in conjunction with particular record types (CDR field 1). An "invalid call type" simply indicates that these values are not generated with this version of BCU/CAL software. They may be used by other EDACS components, such as Enhanced Local Interconnect (ELI).

In developing a billing system to process CDRs, the call type bit fields in Table A.3 should be used to identify a particular call type.

Table A.2 - Call Types

Call Type		Description	Valid with Rec. Type
Hex	Decimal		
00	0	Individual, Clear Voice, Bill Caller	00, 01
01	1	Group, Clear Voice, Bill Caller	00
02	2	ICall II, Clear Voice, Bill Caller	00
03	3	**** Invalid Call Type ****	
04	4	Individual, Digital Voice or Data, Bill Caller	00, 01, 04
05	5	Group, Digital Voice or Data, Bill Caller	00, 04
06	6	ICall II, Digital Voice, Bill Caller	00
07-08	7-8	**** Invalid Call Type ****	
09	9	Group, Clear Voice, Emergency, Bill Caller	00
0A-0C	10-12	**** Invalid Call Type ****	
0D	13	Group, Digital Voice or Data, Emergency, Bill Caller	00, 04
0E-10	14-16	**** Invalid Call Type ****	
11	17	Group, Clear Voice, Bill Callee	00, 03
12-14	18-20	**** Invalid Call Type ****	
15	21	Group, Digital Voice or Data, Bill Callee	00, 03, 04
16-18	22-24	**** Invalid Call Type ****	
19	25	Group, Clear Voice, Emergency, Bill Callee	00, 03
1A-1C	26-28	**** Invalid Call Type ****	
1D	29	Group, Digital Voice or Data, Emergency, Bill Callee	00, 03, 04
1E-1F	30-31	**** Invalid Call Type ****	

Table A.2 - Call Types (Cont.)

Call Type		Description	Valid with Rec. Type
Hex	Decimal		
20	32	Individual, Clear Voice, Special Call, Bill Caller	00, 01
21	33	Group, Clear Voice, Special Call, Bill Caller	00
22-23	34-35	**** Invalid Call Type ****	
24	36	Individual, Digital Voice, Special Call, Bill Caller	00, 01
25	37	Group, Digital Voice, Special Call, Bill Caller	00
26-2F	38-47	**** Invalid Call Type ****	
30	48	Individual, Clear Voice, Special Call, Bill Callee	00, 03
31	49	Group, Clear Voice, Special Call, Bill Callee	00, 03
32-33	50-51	**** Invalid Call Type ****	
34	52	Individual, Digital Voice, Special Call, Bill Callee	00, 03
35	53	Group, Digital Voice, Special Call, Bill Callee	00, 03
36-38	54-56	**** Invalid Call Type ****	
39	57	Group, Clear Voice, Emergency, Special Call, Bill Callee	00
3A-3C	58-60	**** Invalid Call Type ****	
3D	61	Group, Digital Voice, Emergency, Special Call, Bill Callee	00
3E-40	62-64	**** Invalid Call Type ****	
41	65	Group, Clear Voice, System All Call, TX Trunked	00
42-44	66-68	**** Invalid Call Type ****	
45	69	Group, Digital Voice, System All Call, TX Trunked	00
46-48	70-72	**** Invalid Call Type ****	
49	73	Group, Clear Voice, Update, System All Call, TX Trunked	00
4A-4C	74-76	**** Invalid Call Type ****	
4D	77	Group, Digital Voice, Update, System All Call, TX Trunked	00
4E-50	78-80	**** Invalid Call Type ****	
51	81	Group, Clear Voice, System All Call, MSG Trunked	00
52-54	82-84	**** Invalid Call Type ****	
55	85	Group, Digital Voice, System All Call, MSG Trunked	00
56-58	86-88	**** Invalid Call Type ****	
59	89	Group, Clear Voice, Update, System All Call, MSG Trunked	00
5A-5C	90-92	**** Invalid Call Type ****	
5D	93	Group, Digital Voice, Update, System All Call, MSG Trunked	00
5E-5F	94-95	**** Invalid Call Type ****	

Table A.2 - Call Types (Cont.)

Call Type		Description	Valid with Rec. Type
Hex	Decimal		
60	96	Individual, Clear Voice, Jessica, Bill Caller	01
61-63	97-99	**** Invalid Call Type ****	
64	100	Individual, Digital Voice, Jessica, Bill Caller	01
65-6F	101-111	**** Invalid Call Type ****	
70	112	Individual, Clear Voice, Jessica, Bill Callee	03
71	113	Group, Clear Voice, Jessica, Bill Callee	03
72-73	114-115	**** Invalid Call Type ****	
74	116	Individual, Digital Voice, Jessica, Bill Callee	03
75	117	Group, Digital Voice, Jessica, Bill Callee	03
76-78	118-120	**** Invalid Call Type ****	
79	121	Group, Clear Voice, Emergency, Jessica, Bill Callee	03
7A-7C	122-124	**** Invalid Call Type ****	
7D	125	Group, Digital Voice, Emergency, Jessica, Bill Callee	03
7E-7F	126-127	**** Invalid Call Type ****	
80	128	Individual, Clear Voice, Jessica Special Call, Bill Caller	01
81-83	129-131	**** Invalid Call Type ****	
84	132	Individual, Digital Voice, Jessica Special Call, Bill Caller	01
85-8F	133-143	**** Invalid Call Type ****	
90	144	Individual, Clear Voice, Jessica Special Call, Bill Callee	03
91-93	145-147	**** Invalid Call Type ****	
94	148	Individual, Digital Voice, Jessica Special Call, Bill Callee	03
95-9F	149-159	**** Invalid Call Type ****	
AO-DF	160-223	RESERVED TYPES	
EO	224	No Answer/System Busy, Individual, Clear Voice, Bill Caller	01, 03
E1-E3	225-227	**** Invalid Call Type ****	
E4	228	No Answer/System Busy, Individual, Digital Voice, Bill Caller	01, 03
E5-E7	229-231	**** Invalid Call Type ****	
E8	232	No Answer/System Busy, Individual, Clear Voice, Emergency, Bill Caller	01, 03
E9-EB	233-235	**** Invalid Call Type ****	
EC	236	No Answer/System Busy, Individual, Digital Voice, Emergency, Bill Caller	01, 03
ED-EF	237-239	**** Invalid Call Type ****	

Table A.2 - Call Types (Cont.)

Call Type		Description	Valid with Rec. Type
Hex	Decimal		
FO	240	No Answer/System Busy, Individual, Clear Voice, Bill Callee	01, 03
F1-F3	241-243	**** Invalid Call Type ****	
F4	244	No Answer/System Busy, Individual, Digital Voice, Bill Callee	01, 03
F5-F7	245-247	**** Invalid Call Type ****	
F8	248	No Answer/System Busy, Individual, Clear Voice, Emergency, Bill Callee	01, 03
F9-FB	249-251	**** Invalid Call Type ****	
FC	252	No Answer/System Busy, Individual, Digital Voice, Emergency, Bill Callee	01, 03
FD-FF	253-255	**** Invalid Call Type ****	

Call Type Bit Fields

The call type values have been selected so that individual attributes of the call type may be associated with single- or double-bit fields within the call type byte. (The call type byte is the 8-bit value represented by the ASCII encoded, 2-digit hexadecimal number in the CDR call type field.) Table A.3 shows these bit fields and their meaning.

Table A.3 - Call Type Bit Field Definitions

Bit Position	7	6	5	4	3	2	1	0	
	0	0	0						Normal Call
	0	0	1						Special Call
	0	1	0						System All Call (*Modifies meaning of bits 3 and 4)
	0	1	1						Jessica
	1	0	0						Jessica Special Call
	1	0	1	0	0	0	0	0	Reserved
	1	1	0	1	1	1	1	1	Reserved
	1	1	1						No Answer/System Busy
				0					Bill Caller (*TX Trunked)
				1					Bill Callee (MSG Trunked)
					0				Normal
					1				Emergency (*Update Call)
						0			Clear Voice
						1			Digital Voice or Data
							0	0	Individual Call
							0	1	Group Call
							1	0	ICall II
							1	1	Reserved

7. CDR FILE TOPICS

CDR files are located in the 1.2/cdr directory. All closed CDR files are named *tdddhhmm.CDR*, where

ddd = Day of the year the record was created (001 to 366).
hh = Hour of the day the record was created (00 to 23).
mm = Minute of the hour the record was created (00 to 59).

The maximum number of call records which will be written to a single CDR file is controlled by the “*bcs*” utility. Refer to LBI-38967 for further discussion of CDR file control parameters.

A log file (1.2/log/cdr.log) is maintained which contains information regarding when and why a CDR file has been closed. The contents of this file can be useful in customer tuning and diagnostics of the CDR file generation process.

A file with a .CTM extension will exist in the 1.2/cdr directory when the BCU is actively generating CDRs. This is a temporary file which will grow to the user specified size, then be renamed as a .CDR file. Users should never attempt to modify (edit, delete, etc.) the .CTM file.

If the BCU is logging CDR files to an optional DAT tape drive, files with a .CDP will be present in the 1.2/cdr directory. A .CDP is a backup copy of a CDR file which has successfully been archived to tape. The number of days that a .CDP will remain on the disk is also controlled using the *bcs* command.

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APPENDIX B
TRAFFIC ANALYSIS STATISTICS

This appendix discusses two traffic activity files generated by the BCU/CAL. In particular;

- **1.2/activity/summary.log** -- Provides an hourly textual summary of traffic statistics.
- **1.2/activity/traffic.log** -- Provides an hourly traffic distribution report intended for post-processing by third party database or spreadsheet applications.

Please note that the statistical correlations provided by these files are autonomous to the user interface (UI) *stats* command and SNMP private enterprise site and node level object instances. Specifically, the user can reset the UI and/or MIB statistics without impacting the data integrity of these files.

1. TRAFFIC SUMMARY REPORT

The call traffic summary file contains information collected on an hourly basis (typically). This file is intended to provide a readily available “human” readable summary of system behavior.

At the top of each hour, a textual summary is written to the file (summary.log). The file is opened in “append+” mode, and allowed to grow to a maximum file size of approximately 1.4 Mb (so that it can be copied to a floppy disk). The file is closed after the information has been written so that the customer can delete the file at any time (an error message will be displayed in the unlikely event that the user attempts to delete the file while an update is in progress). Please note that each hourly update is prepended with a ^L.

If the file size exceeds the maximum at the top of an hourly update, the file will be renamed to “summary.old” and the records will be written to a new “summary.log” file. Please note that if a current “summary.old” exists, it will be overwritten. Each hourly summary update adds about 3Kb to the existing file; thus, a summary.log file will roll over to summary.old after approximately 20 days.

The following is a sample of the traffic summary information provided in the file **1.2/activity/summary.log**. As an informational reference, note that site 13 is a Jessica PI, and site 32 is a NIM (StarGate/linked multisite) site. The other sites comprise standard transmission trunked and SCAT sites.

```
#####
# Traffic sample started: Tue Nov 14 13:00:00 1995
# Traffic sample ending: Tue Nov 14 14:00:00 1995
# BCU/CAL hostname:      snow_dog
# IMC node number:      33
#####
```

Site:	Assigned	Queued	Denied	System-Busy
1	5958 [90%]	290 [4.38%]	2 [0.03%]	372 [5.62%]
2	1443 [100%]	0 [0%]	0 [0%]	0 [0%]
3	0 [0%]	0 [0%]	0 [0%]	0 [0%]
4	0 [0%]	0 [0%]	0 [0%]	0 [0%]
5	0 [0%]	0 [0%]	0 [0%]	0 [0%]
6	29 [100%]	0 [0%]	0 [0%]	0 [0%]
7	468 [91.9%]	41 [8.06%]	0 [0%]	0 [0%]
8	101 [100%]	0 [0%]	0 [0%]	0 [0%]
9	0 [0%]	0 [0%]	0 [0%]	0 [0%]
10	86 [93.5%]	0 [0%]	6 [6.52%]	0 [0%]
11	293 [99%]	0 [0%]	3 [1.01%]	0 [0%]
12	0 [0%]	0 [0%]	0 [0%]	0 [0%]
13	752 [98.8%]	0 [0%]	9 [1.18%]	0 [0%]
14	346 [100%]	0 [0%]	0 [0%]	0 [0%]
15	0 [0%]	0 [0%]	0 [0%]	0 [0%]
16	0 [0%]	0 [0%]	0 [0%]	0 [0%]
17	0 [0%]	0 [0%]	0 [0%]	0 [0%]
18	0 [0%]	0 [0%]	0 [0%]	0 [0%]
19	0 [0%]	0 [0%]	0 [0%]	0 [0%]
20	0 [0%]	0 [0%]	0 [0%]	0 [0%]
21	0 [0%]	0 [0%]	0 [0%]	0 [0%]
22	0 [0%]	0 [0%]	0 [0%]	0 [0%]
23	0 [0%]	0 [0%]	0 [0%]	0 [0%]
24	0 [0%]	0 [0%]	0 [0%]	0 [0%]
25	0 [0%]	0 [0%]	0 [0%]	0 [0%]
26	0 [0%]	0 [0%]	0 [0%]	0 [0%]
27	0 [0%]	0 [0%]	0 [0%]	0 [0%]
28	0 [0%]	0 [0%]	0 [0%]	0 [0%]
29	0 [0%]	0 [0%]	0 [0%]	0 [0%]
30	0 [0%]	0 [0%]	0 [0%]	0 [0%]
31	34 [38.2%]	1 [1.12%]	54 [60.7%]	0 [0%]
32	206 [100%]	0 [0%]	0 [0%]	0 [0%]
Node:	Assigned	Queued	Denied	System-Busy
	9716 [92.6%]	332 [3.16%]	74 [0.7%]	372 [3.54%]

The algorithm used to calculate the percentages above is extremely simple, and is merely intended to provide a course approximation of system behavior. End users requiring a finer degree of granularity should refer to the information below. The algorithm used to arrive at the indicated percentages is as follows:

Call_Attempts = Number_Assigned + Number_Queued + Number_Denied + Number_System_Busy

Percent_Assigned = Number_Assigned / Call_Attempts

Percent_Queued = Number_Queued / Call_Attempts

Percent_Denied = Number_Denied / Call_Attempts

Percent_Busy = Number_System_Busy / Call_Attempts

The node (e.g., IMC) level row simply totals the raw numbers for sites 1 through 32, inclusive, and repeats the algorithm above to provide a switching system level approximation.

2. TRAFFIC DISTRIBUTION REPORT

The call traffic distribution file contains information collected on an hourly basis (typically). The file is intended for import by any popular database package for customer-based calculations of system accessibility and utilization. Typical applications of “bouncing busy hour,” loading distribution, average call duration, and daily/weekly activity analysis summaries may be readily derived.

At the top of each hour, 32 records will be written to the file -- one record entry for each possible site. The file (traffic.log) will be opened in “append+” mode, and allowed to grow to a maximum file size of approximately 1.4 Mb (so that it can be copied to a floppy disk). The file is closed after the records have been written so the customer can delete the file at any time (an error message will be displayed in the unlikely event that the user attempts to delete the file while an update is in progress).

If the file size exceeds the maximum at the top of an hourly update, it will be renamed to “traffic.old” and the records will be written to a new “traffic.log” file. Please note that if a current “traffic.old” exists, it will be overwritten.

Each record entry contains 45 comma delimited fields (conceptual columns). The field formats are specified below.

Fields 1 through 8 provide record time stamp information, which delineates when the traffic sampling interval was concluded.

Field	Description
1	Record type. “1” == the following format. The record type is provided for identification compatibility with future releases, which may employ a differing record format.
2	Year (1995 or greater).
3	Month of the year (1 to 12).
4	Day of the month (1 to 31).
5	Hour of the day (0 to 23).
6	Minute of the hour (0 to 59).
7	Second of the minute (0 to 59).
8	Seconds of the sample interval, elapsed prior to time stamp datum specified by Fields 2 through 7 (unsigned 32-bit maximum value).

Field 9 identifies the IMC node number associated with this record.

Field	Description
9	IMC node number (33 to 64). Zero indicates that the node number is unknown.

Field 10 identifies the site number associated with this record.

Field	Description
10	Site number (1 to 32).

Fields 11 through 17 provide the total number of successful resource assignments (e.g., a channel) made on a per call type basis.

Field	Description
11	Number of Individual (unit) Voice call assignments.
12	Number of Group Voice call assignments.
13	Number of Individual Data call assignments.
14	Number of Group Data call assignments.
15	Number of Individual Outbound Telephony interconnect call assignments.
16	Number of Individual Inbound Telephony interconnect call assignments.
17	Number of Group Inbound Telephony interconnect call assignments.

Fields 18 through 24 provide the total number of times that an attempt to allocate resources (e.g., a channel) resulted in the call being queued on a per call type basis.

Field	Description
18	Number of Individual Voice call queued events.
19	Number of Group Voice call queued events.
20	Number of Individual Data call queued events.
21	Number of Group Data call queued events.
22	Number of Individual Outbound Telephony interconnect call queued events.
23	Number of Individual Inbound Telephony interconnect call queued events.
24	Number of Group Inbound Telephony interconnect call queued events.

Fields 25 through 31 provide the total number of times that an attempt to allocate resources (e.g., a channel) resulted in the call being denied on a per call type basis.

Field	Description
25	Number of Individual Voice call denied events.
26	Number of Group Voice call denied events.
27	Number of Individual Data call denied events.
28	Number of Group Data call denied events.
29	Number of Individual Outbound Telephony interconnect call denied events.
30	Number of Individual Inbound Telephony interconnect call denied events.
31	Number of Group Inbound Telephony interconnect call denied events.

Fields 32 through 38 provide the total number of times that an attempt to allocate resources (e.g., a channel) resulted in the call not being placed due to a lack of system resources (e.g., system busy, or the callee was already involved in another call) on a per call type basis. Please note that distinction between a “true” system busy versus callee busy event is not implicitly provided by a type 1 record. This heuristic distinction may be qualified in future record type enumerations.

Field	Description
32	Number of Individual Voice call system busy events.
33	Number of Group Voice call system busy events.
34	Number of Individual Data call system busy events.
35	Number of Group Data call system busy events.
36	Number of Individual Outbound Telephony interconnect call system busy events.
37	Number of Individual Inbound Telephony interconnect call system busy events.
38	Number of Group Inbound Telephony interconnect call system busy events.

Fields 39 through 45 provide the total number of seconds of circuit connection time (e.g., channel assignment duration) provided on a per call type basis. The “theoretical” limit for any one of these fields is 86,400 seconds for a 1-hour sampling interval (e.g., 24 channels remaining assigned for 3600 seconds each). As this value is relatively implausible, values of 86,400 or greater should be considered errant. This event could possibly occur if the IMC message time stamps are gyrating wildly, or a time shift to/from daylight saving's time was not gracefully handled.

Field	Description
39	Number of seconds of circuit connection time provided for Individual Voice calls.
40	Number of seconds of circuit connection time provided for Group Voice calls.
41	Number of seconds of circuit connection time provided for Individual Data calls.
42	Number of seconds of circuit connection time provided for Group Data calls.
43	Number of seconds of circuit connection time provided for Individual Outbound Telephony interconnect calls.
44	Number of seconds of circuit connection time provided for Individual Inbound Telephony interconnect calls.
45	Number of seconds of circuit connection time provided for Group Inbound Telephony interconnect calls.

[illegible]

EXAMPLE 1B

The following example decomposes the record associated with site 1 in the example above.

Examination of fields 2 through 7 indicates this sample concluded on 11/14/95 at 2:0:0 PM. The sampling interval (field 8) was 3600 seconds (1 hour). Thus, the sample covers traffic from 1:0:0 PM through 2:0:0 PM on 11/14/95. Field 9 delineates that these data pertain to IMC node/device number 33.

Call Assignments (Fields 11 through 17)

Assigned Individual Voice:	3003
Assigned Group Voice:	2136
Assigned Individual Data:	87
Assigned Group Data:	96
Assigned Outbound Interconnect:	597
Assigned Inbound Interconnect:	39
Assigned Group Interconnect:	0

Total Assignments:	5958

Call Queued (Fields 18 through 24)

Queued Individual Voice:	212
Queued Group Voice:	55
Queued Individual Data:	0
Queued Group Data:	0
Queued Outbound Interconnect:	20
Queued Inbound Interconnect:	3
Queued Group Interconnect:	0

Total Queued:	290

Call Denied (Fields 25 through 31)

Denied Individual Voice:	1
Denied Group Voice:	0
Denied Individual Data:	0
Denied Group Data:	0
Denied Outbound Interconnect:	1
Denied Inbound Interconnect:	0
Denied Group Interconnect:	0

Total Denied:	2

System Busy (Fields 32 through 38)

System Busy Individual Voice:	26
System Busy Group Voice:	3
System Busy Individual Data:	0
System Busy Group Data:	0
System Busy Outbound Interconnect:	333
System Busy Inbound Interconnect:	10
System Busy Group Interconnect:	0

Total System Busy:	372

Airtime (Fields 39 through 45)

Airtime Individual Voice:	11867
Airtime Group Voice:	5045
Airtime Individual Data:	177
Airtime Group Data:	79
Airtime Outbound Interconnect:	29420
Airtime Inbound Interconnect:	1965
Airtime Group Interconnect:	0

Total Airtime:	48493 (seconds)

EXAMPLE 1C

As a further example, let us examine some behavioral aspects of outbound telephony interconnect calls on site 1.

- Average outbound interconnect call duration: 29420/597 = 49.3 seconds
- Percentage outbound interconnect assignments: 597/5958 = 10.0%
- Percentage outbound interconnect circuit time: 29420/48493 = 60.7%
- Percentage outbound interconnect busy: 333/(597 + 333) = 35.8%

From the above, one first observes that only 10% of resource (e.g., channel) allocations are being performed on behalf of outbound telephony interconnect calls. However, 60.7% of the circuit connection time is being dedicated to these calls (hint - call duration can be far more statistically relevant than assignment counts, especially for message trunked calls). From this, one can conclude that the customer profiles subscribed on site 1 are heavy interconnect users. Additionally, note that approximately 1 out of 3 users (35.8%) was unable to place said calls due to system busy conditions. In this scenario, the system busy events are resulting from the Jessica (PI) having insufficient resources (e.g., IMC 4W audio boards <most likely> or MD110 ISDN T1/E1 DS0 slots <least likely>) to accommodate the subscriber loading profile. Specifically, in this example, the carrier provider should consider increasing the aggregate bandwidth availability of the Jessica PI network entity.

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APPENDIX C
PHYSICAL CONFIGURATION DETAILS

This appendix contains information about jumper settings and cable pinouts for the BCU/CAL.

1. JUMPER SETTINGS

Jumper settings for the BCU/CAL components are shown on the pages listed below.

Figure	Page
C.1 TVME 147SA1 Single-Board Computer	C-3
C.2 TVME 712/M Transition Module.....	C-4
C.3 TVME 147P2 Adapter Board	C-4
C.4 fv5310 Main Board.....	C-5
C.5 fv5310 Mezzanine Card	C-6
C.6 Hard Disk.....	C-7
C.7 Teac FD235 Floppy Disk.....	C-8
C.8 Connor CTD4004H-S 114324NP DAT	C-9
C.9 Archive/Maynard 4324NP DAT	C-9

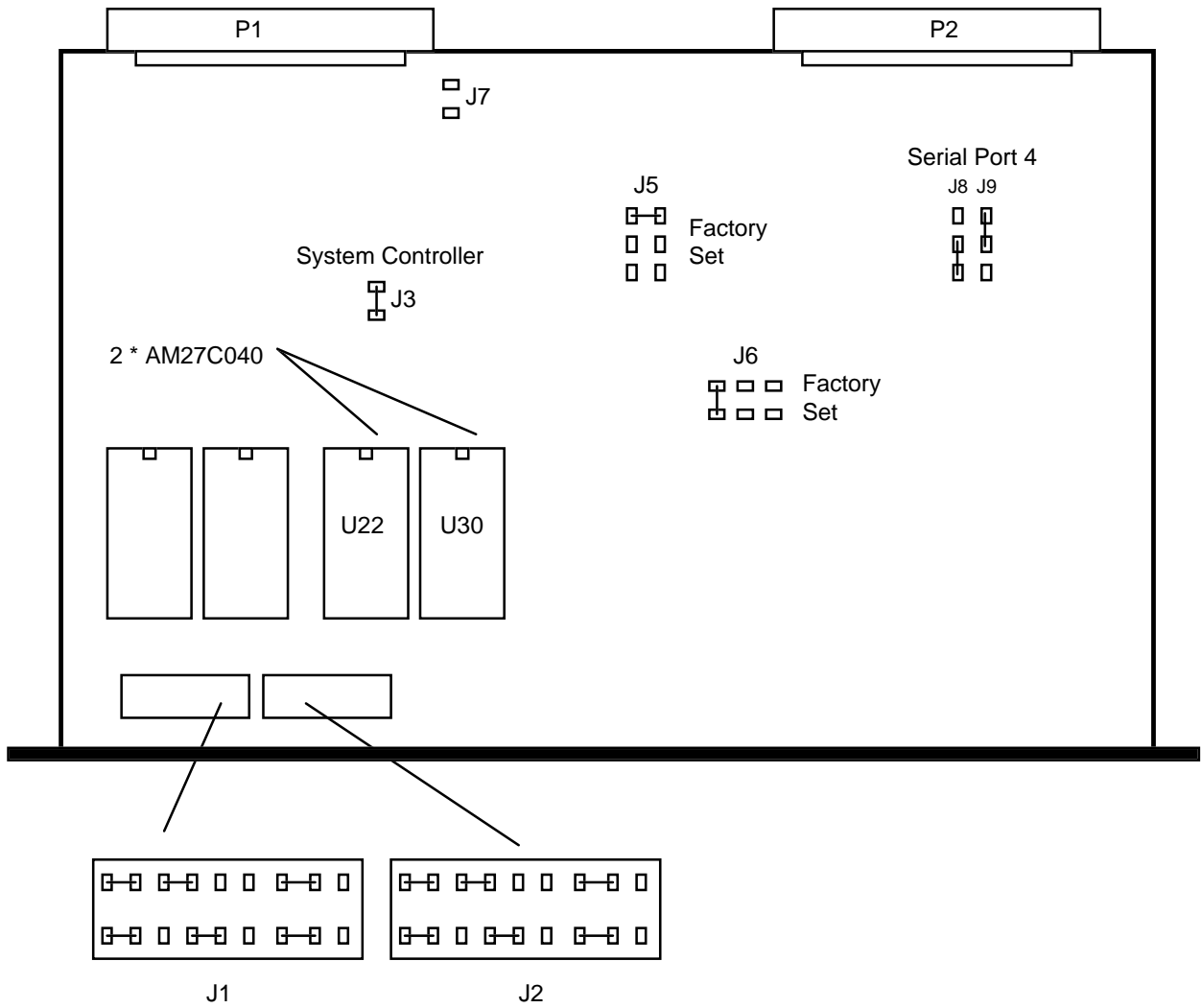


Figure C.1 - TVME 147SA1 Single-Board Computer

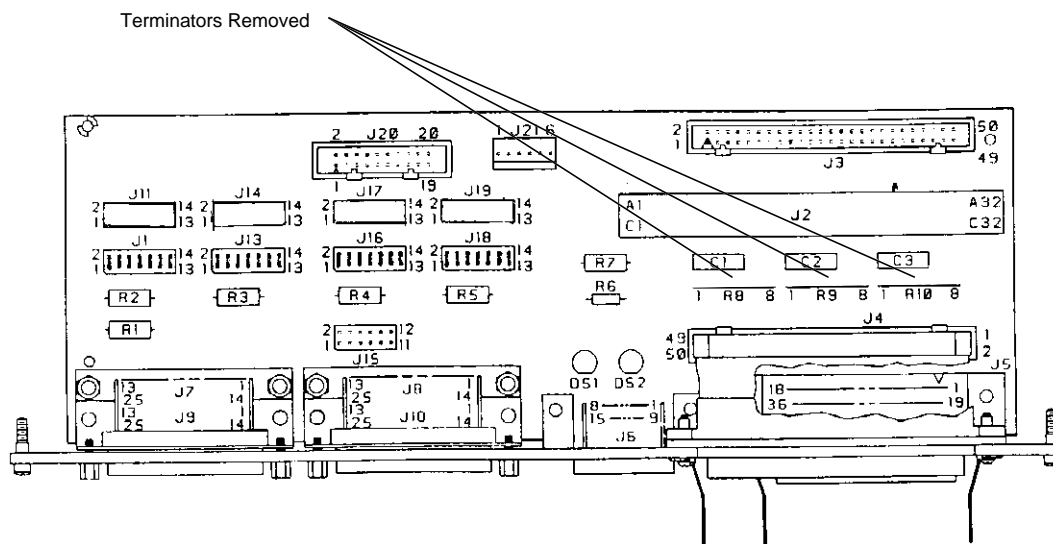


Figure C.2 - TVME 712/M Transition Module

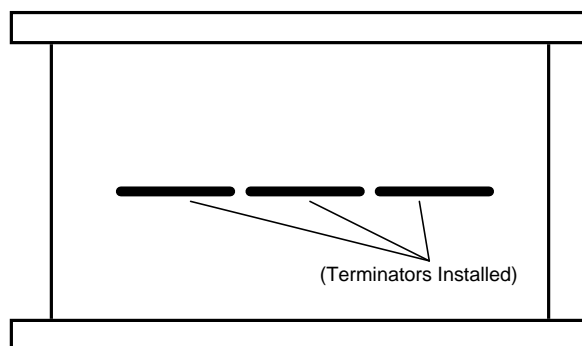


Figure C.3 - TVME 147P2 Adapter Board

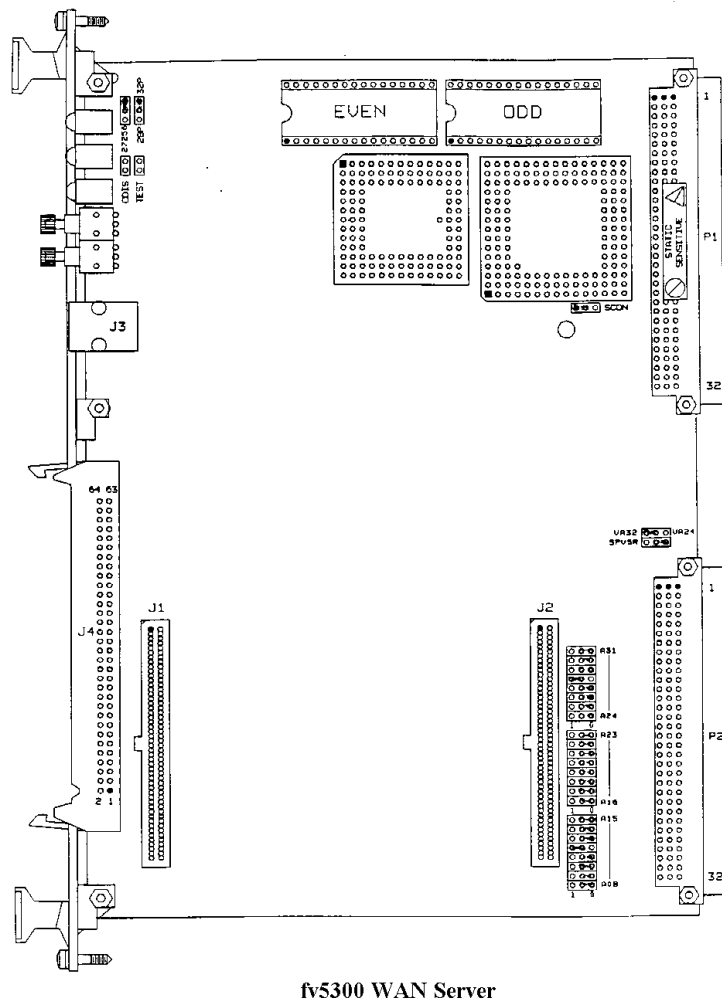
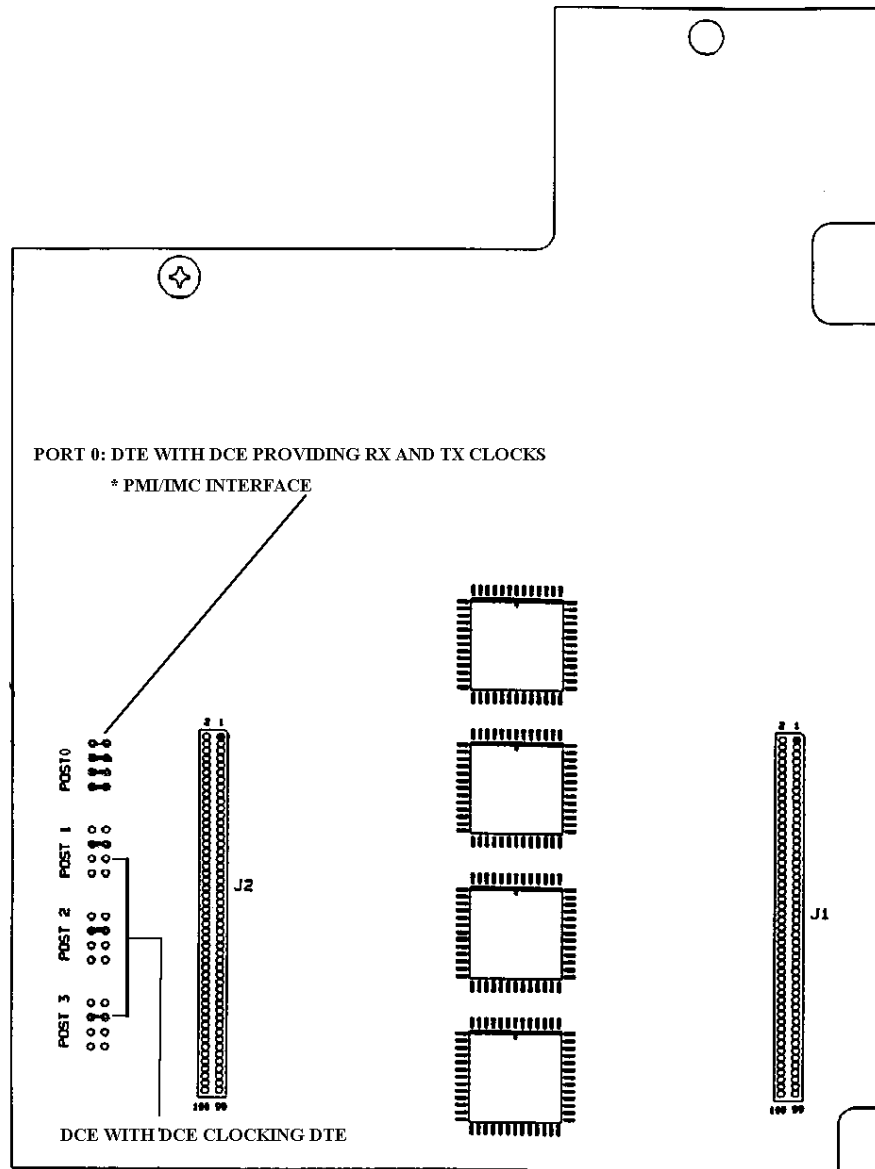


Figure C.4 - fv5310 Main Board



MEZZANINE CARD

Figure C.5 - fv5310 Mezzanine Card

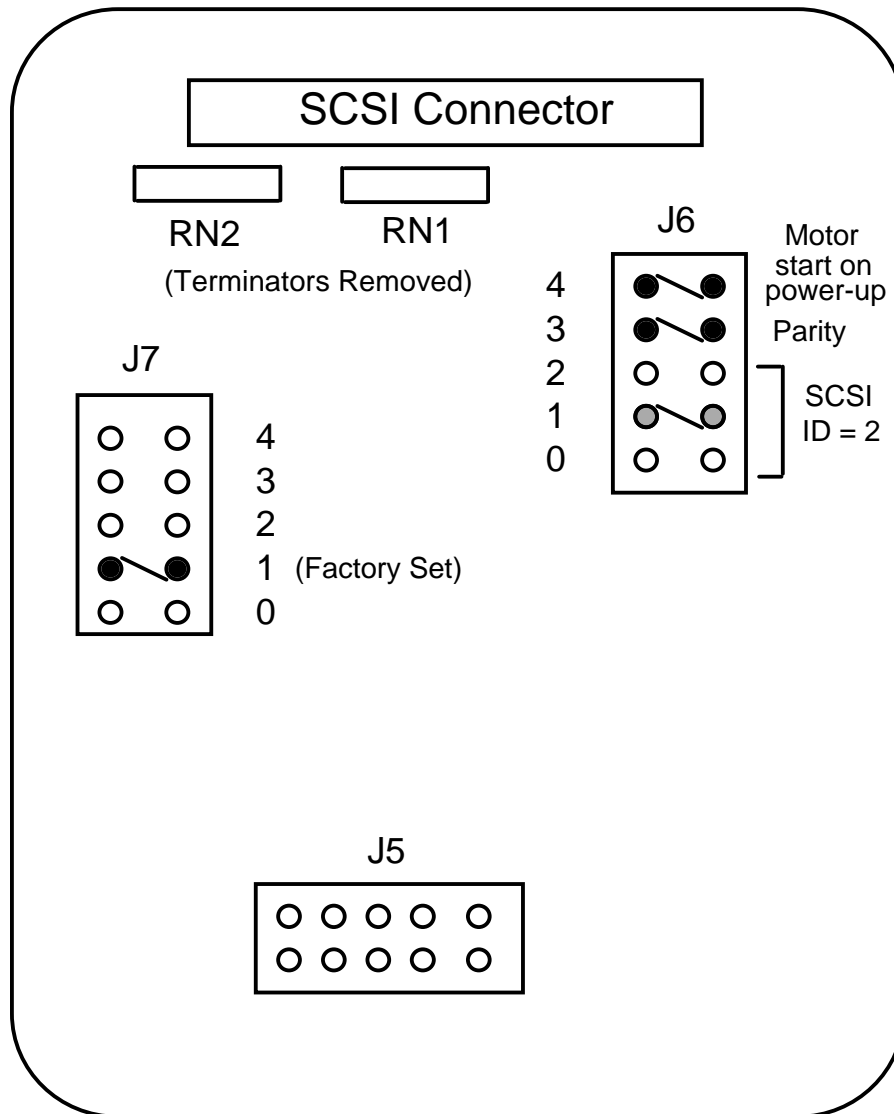


Figure C.6 - Hard Disk

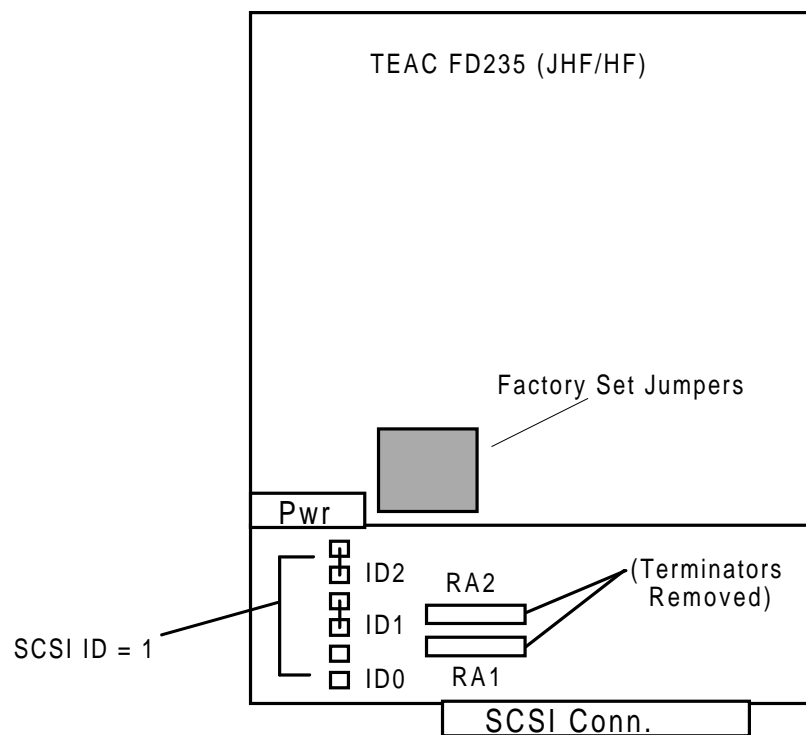


Figure C.7 - Teac FD235 (JHF/HF) Floppy Disk

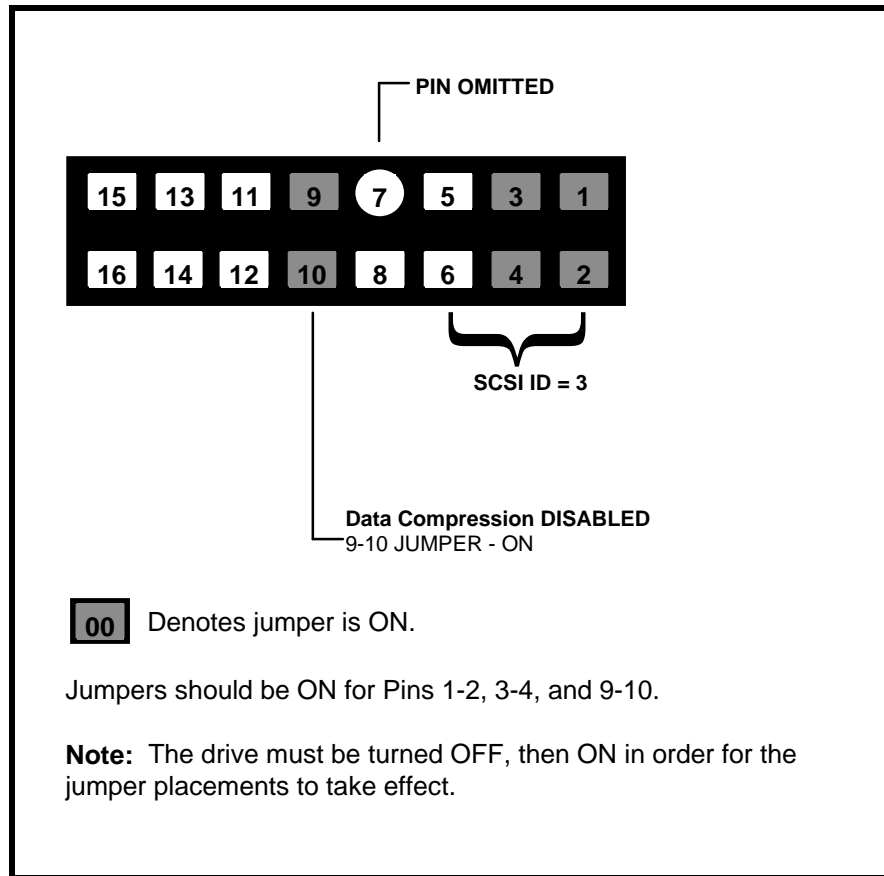


Figure C.8 - Connor CTD4004H-S 114324NP DAT

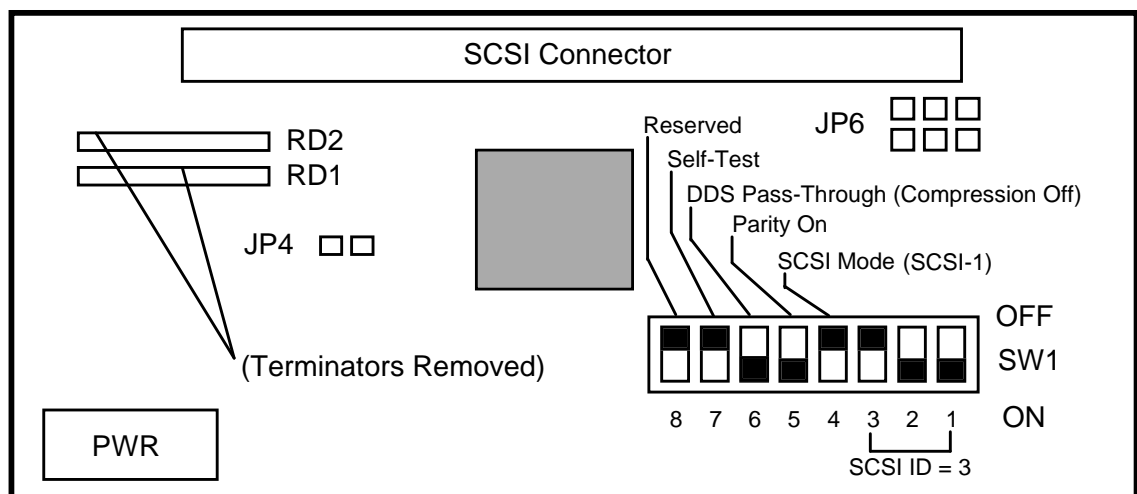


Figure C.9 - Archive/Maynard 4324NP DAT

2. CABLE PINOUTS

BCU/CAL Internal Wiring - VME P2 Backplane connector (of WANServer card) to DB-25 connectors on backplate

Table C.1 - WANServer Port 0

VME P2 Connector	DB-25F Connector	Signal Name	Function
A-02	02	XMT-P	Transmit Data
C-03	14	XMT-N	
A-01	03	RCV-P	Receive Data
C-01	16	RCV-N	
C-02	15	TSET-P	Transmit Clock
C-08	12	TSET-N	
C-04	17	RSET-P	Receive Clock
A-06	09	RSET-N	
A-04	04	RTS-P	Request To Send
A-08	19	RTS-N	
A-03	05	CTS-P	Clear To Send
A-05	13	CTS-N	
C-06	06	DCEReady-P	DCE Ready
A-07	22	DCEReady-N	
C-05	20	DTEReady-P	DTE Ready
C-07	23	DTEReady-N	

Table C.2 - WANServer Port 1

VME P2 Connector	DB-25F Connector	Signal Name	Function
A-10	02	XMT-P	Transmit Data
C-11	14	XMT-N	
A-09	03	RCV-P	Receive Data
C-09	16	RCV-N	
C-10	15	TSET-P	Transmit Clock
C-16	12	TSET-N	
C-12	17	RSET-P	Receive Clock
A-14	09	RSET-N	
A-12	04	RTS-P	Request To Send
A-16	19	RTS-N	
A-11	05	CTS-P	Clear To Send
A-13	13	CTS-N	
C-14	06	DCEReady-P	DCE Ready
A-15	22	DCEReady-N	
C-13	20	DTEReady-P	DTE Ready
C-15	23	DTEReady-N	

Table C.3 - WANServer Port 2

VME P2 Connector	DB-25F Connector	Signal Name	Function
A-18	02	XMT-P	Transmit Data
C-19	14	XMT-N	
A-17	03	RCV-P	Receive Data
C-17	16	RCV-N	
C-18	15	TSET-P	Transmit Clock
C-24	12	TSET-N	
C-20	17	RSET-P	Receive Clock
A-22	09	RSET-N	
A-20	04	RTS-P	Request To Send
A-24	19	RTS-N	
A-19	05	CTS-P	Clear To Send
A-21	13	CTS-N	
C-22	06	DCEReady-P	DCE Ready
A-23	22	DCEReady-N	
C-21	20	DTEReady-P	DTE Ready
C-23	23	DTEReady-N	

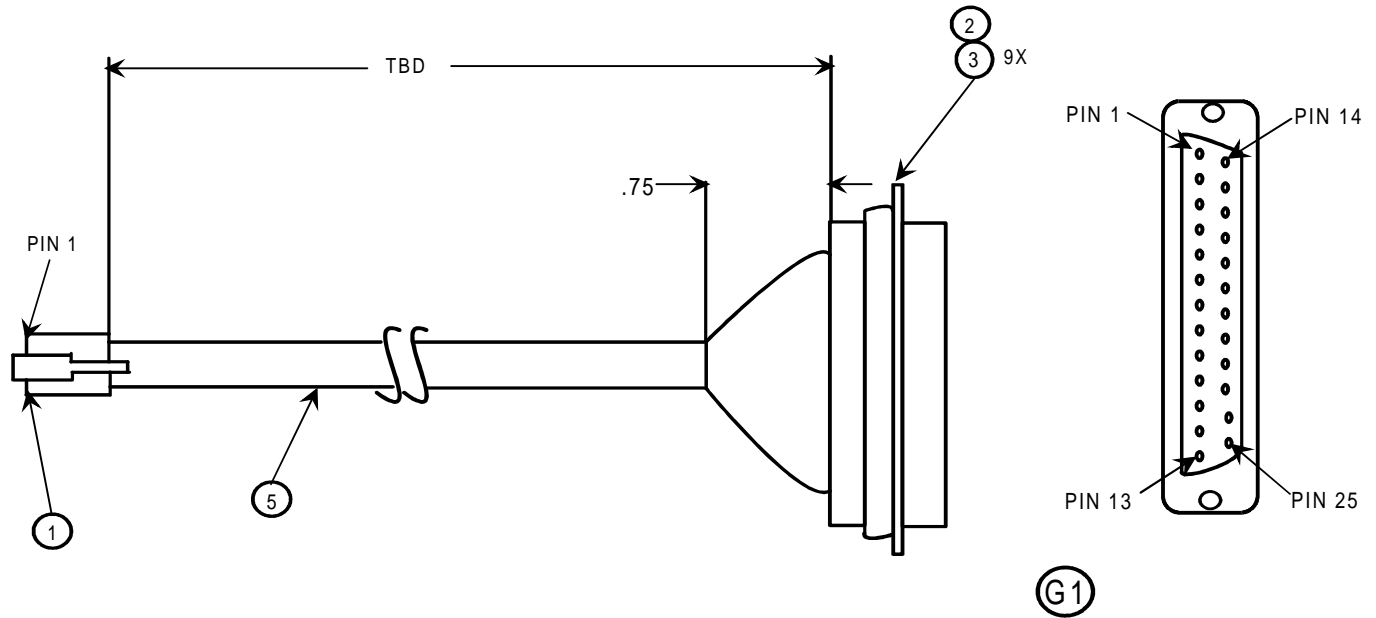
Table C.4 - WANServer Port 3

VME P2 Connector	DB-25F Connector	Signal Name	Function
A-26	02	XMT-P	Transmit Data
C-27	14	XMT-N	
A-25	03	RCV-P	Receive Data
C-25	16	RCV-N	
C-26	15	TSET-P	Transmit Clock
C-32	12	TSET-N	
C-28	17	RSET-P	Receive Clock
A-30	09	RSET-N	
A-28	04	RTS-P	Request To Send
A-32	19	RTS-N	
A-27	05	CTS-P	Clear To Send
A-29	13	CTS-N	
C-30	06	DCEReady-P	DCE Ready
A-31	22	DCEReady-N	
C-29	20	DTEReady-P	DTE Ready
C-31	23	DTEReady-N	

Table C.5 - BCU/CAL HDLC Loopback Cable Specification

DB-25M Connector M/W BCU/CAL Port 1	DB-25M Connector M/W BCU/CAL Port 0	Signal Name	Function
02	03	XMT-P	Transmit Data
14	16	XMT-N	
03	02	RCV-P	Receive Data
16	14	RCV-N	
15	15	TSET-P	Transmit Clock
12	12	TSET-N	
17	17	RSET-P	Receive Clock
09	09	RSET-N	
04	05	RTS-P	Request To Send
19	13	RTS-N	
05	04	CTS-P	Clear To Send
13	19	CTS-N	
06	20	DCEReady-P	DCE Ready
22	23	DCEReady-N	
20	06	DTEReady-P	DTE Ready
23	22	DTEReady-N	

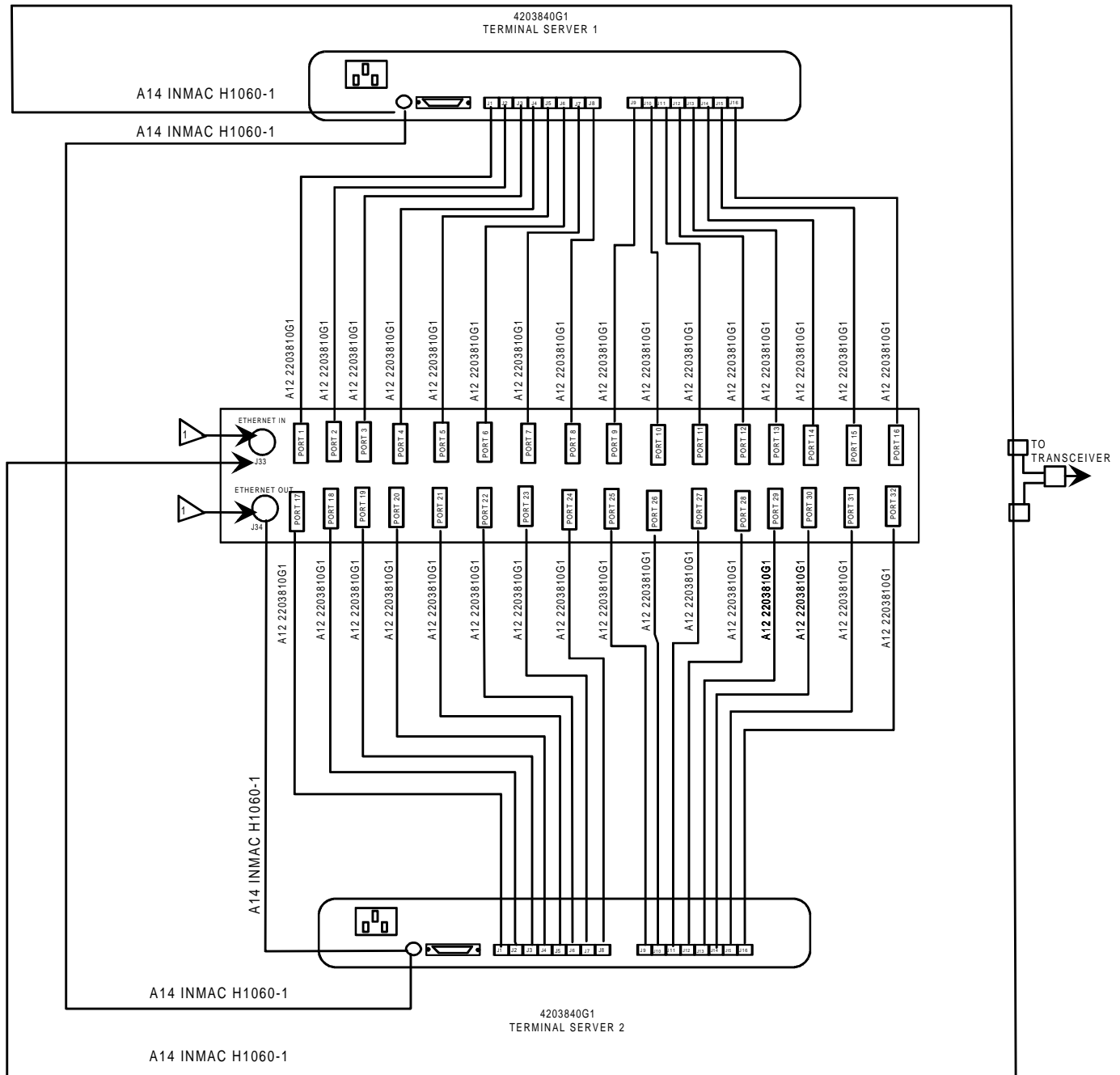
WIRING TABLE				
FROM (ITEM 1)	TO (ITEM 2)	SIGNAL	WIRE	WIRE COLOR
RJ12-1	DB25-6	DTR	ITEM 5	WHITE
RJ12-2	DB25-3	TXD	ITEM 5	BLACK
RJ12-3	DB25-7	GND	ITEM 5	RED
RJ12-3	DB25-7	GND	ITEM 5	GREEN
RJ12-4	DB25-2	RXD	ITEM 5	YELLOW
RJ12-5	DB25-20	DSR	ITEM 5	BLUE
DB25-6	DB25-8	DCD	ITEM 4	WHITE
DB25-4	DB25-5	RTS/CTS	ITEM 4	WHITE



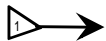
NOTES:

1. FABRICATE CABLE TO LENGTH INDICATED. NOTE CONNECTOR ORIENTATION CAREFULLY.

Figure C.10 - CAL Terminal Server- to-Distribution Panel Cable



NOTES:



ETHERNET THIN WIRE COAX CONNECTOR FOR NETWORK CONNECTION

Figure C.11 - CAL 32-Port Configuration

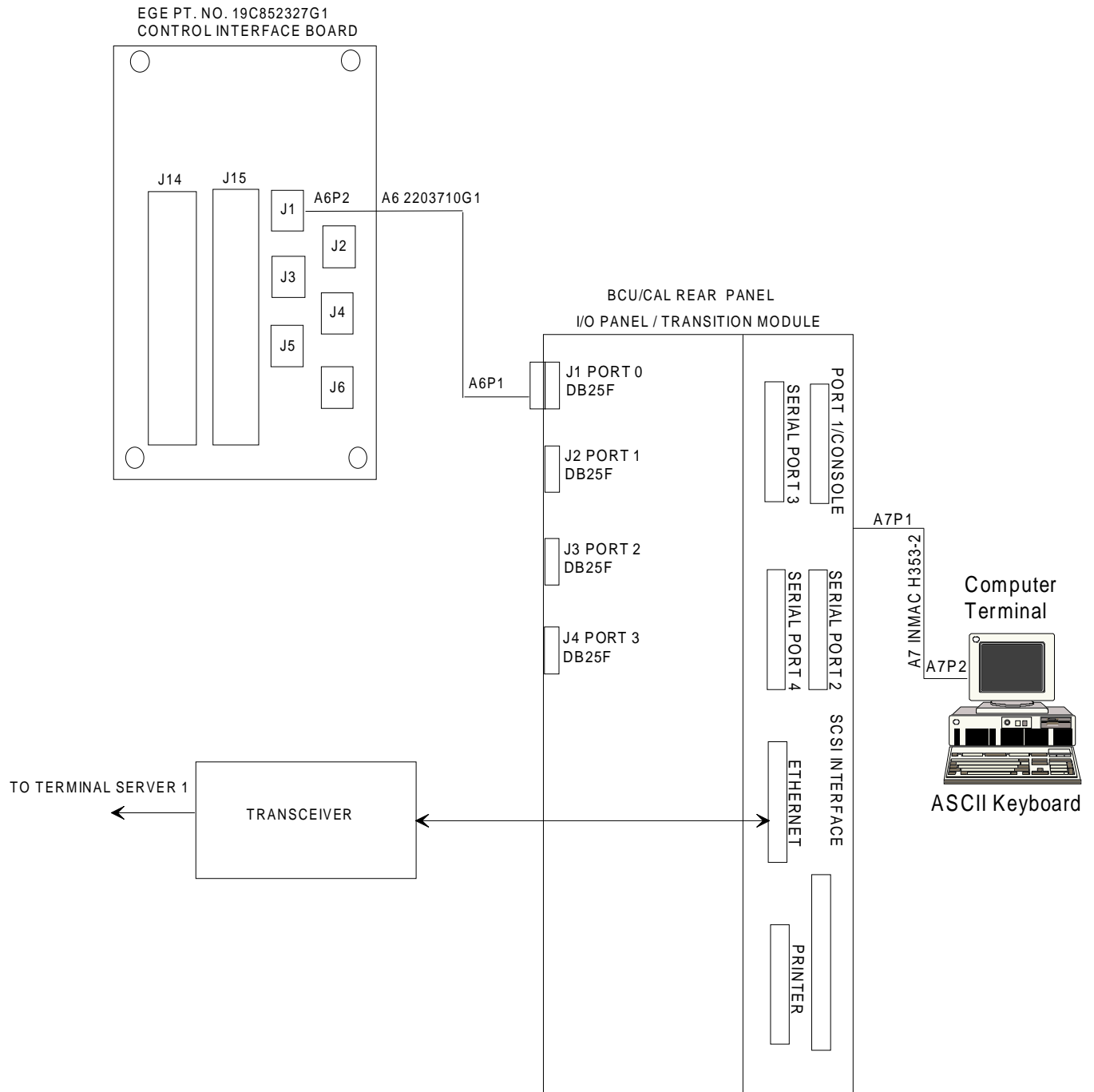


Figure C.12 - BCU/CAL Rear Panel I/O

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**APPENDIX D
FAULT TOLERANCE**

Figure D.1 shows the architecture for a fault tolerant EDACS billing system.

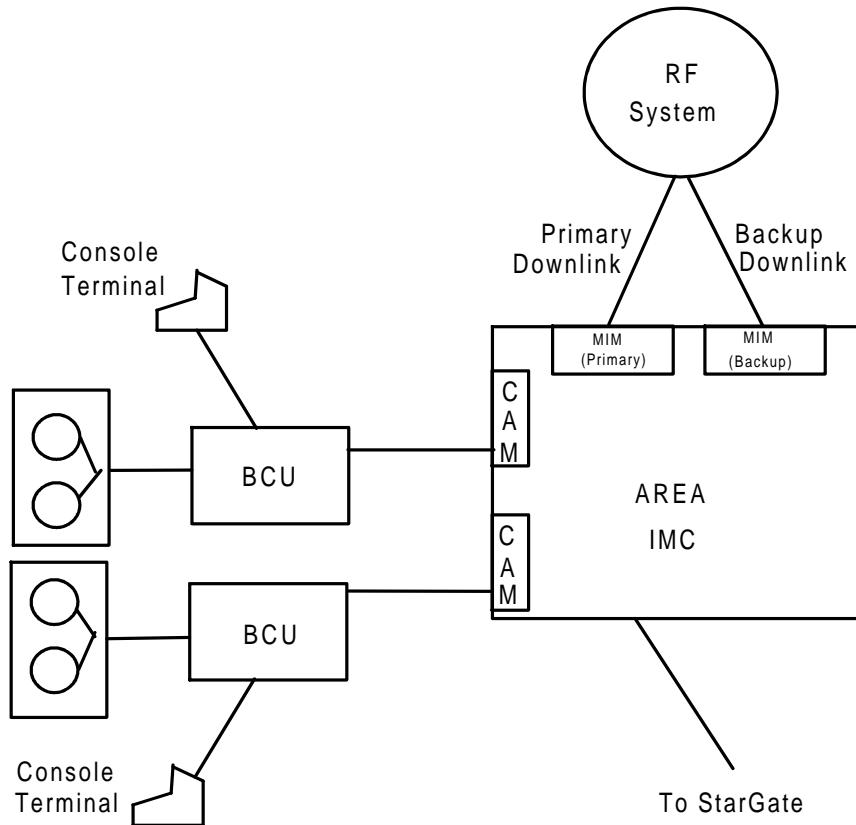


Figure D.1 - EDACS Billing Fault Tolerant Architecture

Redundant MIM processors are added to each RF System interface within the IMC. A duplicate CAM is added, which connects to the redundant BCU/CAL and tape drive.

REDUNDANT OPERATION

The primary and redundant MIM processors operate in a hot standby configuration, i.e., once primary unit failure is detected, the backup becomes the active processor with minimal disruption to calls in progress. The redundant CAM, BCU/CAL and tape drive are operated as on-line mirror duplicates. This eliminates any changeover operation; in the event of failure of one BCU/CAL, or its associated components; the remaining unit continues to operate and process call activity.

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Ericsson Inc.
Private Radio Systems
Mountain View Road
Lynchburg, Virginia 24502
1-800-528-7711 (Outside USA, 804-528-7711)

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