



**MOTOROLA**

*Land Mobile Products Sector*

# **ASTRO™ DIU3000**

## **Digital Interface Unit**

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## **Owner's Manual**

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# PERFORMANCE SPECIFICATIONS

## ENCRYPTION

|                               |   |
|-------------------------------|---|
| Encryption Type               | Digital (9.6 kbps versions of DES-XL, DES-OFB, DVI-XL and DVP-XL)       |
| Method                        | Multi-register non-linear combiner                                      |
| Synchronization               | Counter addressing (XL) or output feedback (OFB)                        |
| Encryption Key Initialization | Internally derived pseudo-random initializing vector                    |
| Encryption Key Generation     | External hand-held, microprocessor controlled key variable loader (KVL) |
| Key Storage                   | Non-volatile electronic secure memory                                   |
| Encryption Algorithm Capacity | Up to two algorithms per DIU  |
| Encryption Keys per DIU       | Up to 512 keys (only eight accessible by a TRC console)                 |
| Encryption Key Erasure        | Tamper detection, battery removal and keyboard command                  |

## INFRASTRUCTURE CONTROL SIGNALLING

|   |   |
|---|---|
| Console to DIU3000                      | TRC, LOGIC (E&M) and Digital Keying           |
| DIU3000 to QUANTAR/QUANTRO Base Station | ASTRO DRC (Digital Remote Control) signalling |

**DATA TRANSFER (TRANSPARENT DATA TRANSFER FROM CONSOLE TO SUBSCRIBER AND VICE VERSA)**

|                       |   |
|-----------------------|---|
| In ASTRO Digital Mode | Signalling Data Embedded in Voice<br>(e.g., PTT ID, Voice Selective Calling, Emergency)<br><br>Supplementary data transferred stand-alone<br>(e.g., Radio-check, Selective Radio Inhibit, Emergency)<br><br>Data Transfer RNC to Remote Data Terminal<br><br>APCO CAI Data Messages |
| In Analog Mode        | Stat-Alert (MDC 1200)   |

**GENERAL**

Operating Voltage

Normal operation

At power supply input:

120 V ac 50/60 Hz at 1 A, or  
240 V ac 50/60 Hz at 0.5 A

Backup operation  
(codeplug programming is inhibited)

11 to 14 V dc at backup battery connector

Size (H × L × W)

26.5 cm × 38.0 cm × 10.1 cm /  
10.4" × 15.0" × 4.0"

Weight

5.5 kg / 12 lb

Mounting

Rack mounted: card cage 6U, part number CHN1009  
(4 units/card cage)

Operating Temperature

-30 to +60°C

Voice Coding Method

Improved Multi-Band Excitation (IMBE\*)

Vocoder Rate

4.8 kbps IMBE

Channel Rate

9.6 kbps (for modem or V.24 links)

Hum and Noise

-50 dBm (1000 Hz, 0 dBm)

Audio Distortion

3% (clear mode; 1000 Hz, 0 dBm line output)

\*contains technology patented by "Digital Voice Systems, Inc"

### CONSOLE WIRELINE INTERFACE

|                               |  |
|-------------------------------|--|
| Line Type                     | 4-wire, 600 $\Omega$ balanced output.  |
| TRC Function Tone Sensitivity | -25 dBm W/L Board version A and B<br>-20 dBm W/L Board version C with JU7 IN                         |
| AGC Input Knee                | -30 dBm 1 KHz tone, W/L Board version A and B<br>-12 dBm 1 KHz tone, W/L Board version C with JU7 IN |
| Output to Console             | Adjustable, maximum 0 dBm into 600 $\Omega$  |

### BASE STATION WIRELINE INTERFACE

|                         |  |
|-------------------------|--|
| Line Type               | 4-wire, 600 $\Omega$ balanced output.<br><br>For best modem performance, private line or 3002 channel with C5 conditioning is recommended. |
| Modem Input Sensitivity | -5 dBm to -25 dBm  |
| AGC Input Knee          | -30 dBm 1 KHz tone, W/L Board version A and B<br>-12 dBm 1 KHz tone, W/L Board version C with JU7 IN                                       |
| Output to Base Station  | Adjustable, maximum 0 dBm into 600 $\Omega$  |

## BASIC MODEL

|            |  |
|------------|--|
| F2048      | DIU3000 ASTRO  |
| FKN1626    | DIU3000 Cables   |
| FKN4632    | W Cable Metal Connector                                  |
| or         |  |
| FLN5462    | Quad Connector   |
| FPN5580    | Power Supply 110/220 V                                   |
| FBN5784    | Packing and Manuals                                      |
| FHN5901    | DIU3000 Hardware   |
| FLN6518    | WLI Board (2)  |
| FLN6524    | General I/O Board  |
| FLN6591    | Adaptor Board  |
| FLN6659    | Host Memory  |
| FLN6660    |  |
| or         | DSP Board  |
| FCN6007    |  |
| FLN6858    | Additional Kit to Customer (non-standard DB25 connector) |
| FLN8225    | Communication Board (COMM2)                              |
| FLN8707    | Display Board  |
| FLN8708    | Basic Board  |
| FLN8800    | Operator Board   |
| HKN9452    | AC Line Cord   |
| 6802949C65 | Owner's Manual   |

## MODEL OPTIONS

|         |   |
|---------|---|
| C28DG   | Battery Revert Cable                    |
| C41AF   | 220 V ac Power Supply                   |
| C54BF   | Phone Patch                             |
| C62AB   | Junction Box                            |
| C109AA  | Test Handset                            |
| C542AC  | Modem Eliminator to Base 25 ft Cable    |
| C542AD  | Modem Eliminator to Base 45 ft Cable    |
| C543AC  | DIU3000 to Channel Bank DSU 25 ft Cable |
| C543AD  | DIU3000 to Channel Bank DSU 45 ft Cable |
| CHN1009 | Card Cage                               |
| X437AF  | 9.6 kbps ASTRO Modem                    |
| X560AE  | Omit COMM2 Board Adaptor Cable          |
| X806AJ  | APCO CAI (IMBE) for Trunking            |
| X806AK  | APCO CAI (IMBE) for Conventional        |
| X959AA  | Conventional Release Software           |
| X960AA  | Trunking Release Software               |
| C823AA  | Quad Connector                          |

## ENCRYPTION MODELS

|       |                                    |
|-------|------------------------------------|
| T5371 | DVP–XL Encryption Module           |
| T5372 | DES–XL Encryption Module           |
| T5373 | DVI–XL Encryption Module           |
| T5374 | DVP–XL / DES–XL Encryption Module  |
| T5375 | DVI–XL / DVP–XL Encryption Module  |
| T5771 | DES–OFB Encryption Module          |
| T5772 | DES–OFB / DVP–XL Encryption Module |
| T5773 | DES–OFB / DVI–XL Encryption Module |

## OPTION COMBINATIONS

### CONVENTIONAL

| No. | Modem / V.24   | APCO     | ACIM<br>SIGNALLING /<br>DIGITAL KEYING | RNC<br>(DATA) | PHONE-<br>PATCH | OPTION           |
|-----|----------------|----------|--|---------------|-----------------|------------------|
| 1.  | MODEM          | NO       | NO                                     | NO            | NO              | X959, X437, X560 |
| 2.  | MODEM<br>MODEM | NO<br>NO | YES<br>X                               | X<br>YES      | NO<br>NO        | X959, X437       |
| 3.  | V.24           | NO       | X                                      | X             | NO              | X959             |
| 4.  | X              | X        | X                                      | X             | YES             | ADD C54          |
| 5.  | X              | YES      | X                                      | X             | X               | ADD X806         |

### TRUNKING SMARTNET

| No. | APCO | OPTION   |
|-----|------|----------|
| 1.  | NO   | X960     |
| 2.  | YES  | ADD X806 |

### TRUNKING SMARTZONE

| No. | APCO | OPTION   |
|-----|------|----------|
| 1.  | NO   | X960     |
| 2.  | YES  | ADD X806 |

## RELATED MANUALS

|             |   |
|-------------|---|
| 68P02949C65 | <i>DIU3000, Owner's Manual</i>  |
| 68P02924C15 | <i>ASTRO DIU RSS, User's Manual</i>                                       |
| 68P02949C75 | <i>DIU3000, Service Manual</i>  |
| 68P81090E45 | <i>Encryption Cartridge, User Manual (Models T5371, T5373, T5375)</i>     |
| 68P81090E50 | <i>Encryption Cartridge, User Manual (All Models)</i>                     |
| 68P81090E85 | <i>Encryption Cartridge, Service Manual (Models T5371, T5373, T5375)</i>  |
| 68P81090E95 | <i>Encryption Cartridge, Service Manual (All Models)</i>                  |
| 68P02949C70 | <i>CENTRACOM Signalling Link, Owner's Manual</i>                          |
| 68P02934C10 | <i>Phone Patch Interface and Local Desk Set Interface, Owner's Manual</i> |
| 68P02949C95 | <i>DIU3000 Trunking Operation Option, Owner's Manual</i>                  |

# Description

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## ASTRO System Overview

### General

Modern two-way communication demands secure communication, data signalling, and higher quality voice transfer. With these goals in mind, ASTRO system designers have developed a system, based on digitized voice, that successfully answers these three needs.

The main features of the ASTRO system are:

- Enhanced digital audio quality
- Expanded signalling capabilities
- More efficient use of the existing RF spectrum
- Expanded encryption capabilities
- Integrated voice and data

In addition, the ASTRO system allows the use of the existing analog subscribers, concurrently with the new ASTRO subscribers, thus creating a smooth migration from the existing analog two-way environment, to the new, digital ASTRO environment.

### ASTRO System Technologies

#### Voice Digitizing

Voice digitizing is performed using the IMBE (Improved Multi-Band Excitation) technique, if option X806 is installed. These techniques provide high-quality audio on 12.5 kHz bandwidth channels.

#### Usage of the RF Spectrum

Efficient use of the existing RF spectrum is achieved by using 12.5 kHz bandwidth channels for both analog and ASTRO communications. The ASTRO equipment can also be used on the 25 kHz channels, for backward compatibility.

#### Encryption

ASTRO systems utilize the same IC-based digital encryption algorithms used in SECURENET systems. These are linear functions that operate bit-by-bit and are governed by the selection of an encryption key variable.

However, the ASTRO digital technology introduces several enhancements, previously unavailable in encrypted voice radio systems, as follows:

- There is no range degradation in the encrypted mode, regardless of the algorithm employed.

- There is no voice truncation at the beginning of the voice message.
- Multiple algorithm capability.
- Support of the Over-the-Air-Rekeying (OTAR) future option.

### **Error Protection**

The error protection required by a high quality communication system is achieved by using a variety of forward error correcting methods, to protect the various fields of the digital transmission against noise interferences. In addition, the modulation scheme adopted for the over-the-air transmission is the Compatible Four Level Frequency Modulation, which provides reduced probability of error for a given signal strength.

### **Data in the ASTRO System**

ASTRO systems transmit data in three ways:

- Data embedded in voice, used for the following purposes:
  - To control the base station/repeater/comparator, and the DIU3000 during the voice communication.
  - To provide encryption information (synchronization, key).
  - To convey information related to the system users that communicate with each other (source/destination ID, talkgroup ID, voice selective calling, emergency, transmit power level, received signal quality, etc.).
- Supplementary data, sent when no voice communication is in progress, and used for supervisory, control purposes and pure data transmission.
- APCO CAI data transmission to/from the Host computer (via the RNC) and remote data terminals.

### **Tone Remote Control**

The DIU3000 control by an analog console (Centracom Series II or T5600) is made possible by the DIU3000 capability to decode Tone Remote Control sequences.

## **ASTRO System Building Blocks**

The following are the main building blocks of an ASTRO system:

- ASTRO field radios:
  - ASTRO Digital SABER: A fully digital portable radio available in three different models of variable radio complexities.
  - ASTRO Digital SPECTRA: A fully digital mobile radio that can be physically configured as per customer application.
- ASTRO infrastructure devices:
  - Quantar (VHF band), Quantro (UHF and 800 MHz bands): A fully digital station. Both versions are ASTRO-transparent; no voice processing takes

place in either. However, digital signal error correction is performed on all received digital ASTRO signals.

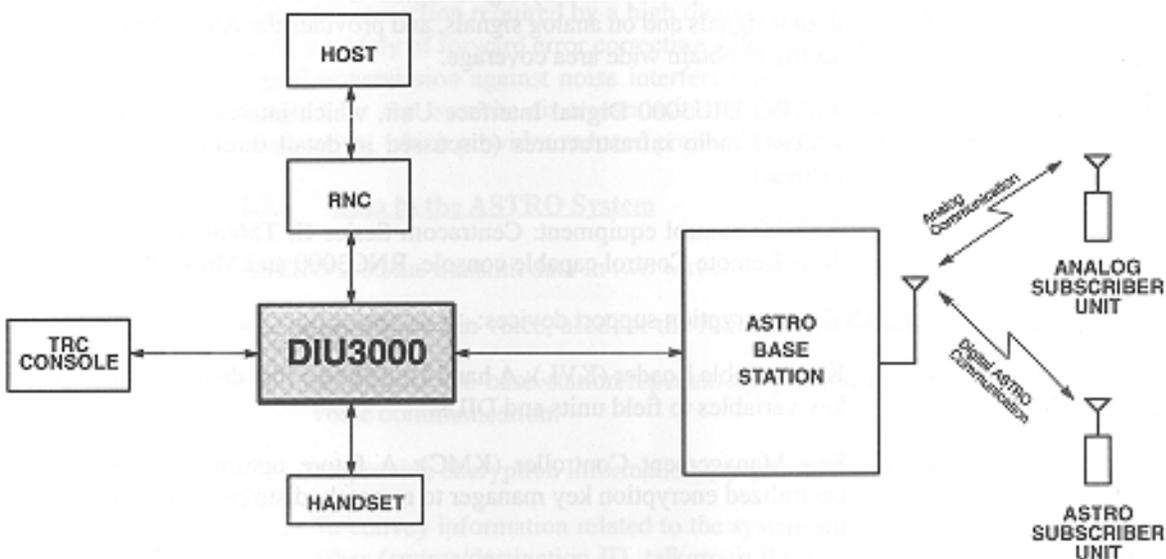
- ASTRO satellite receivers: Consist of the same components as the base station, but without the transmitting capability.
- ASTRO comparator: A fully digital signal voter which can vote both on ASTRO digital signals and on analog signals, and provides the ASTRO systems with the ability to obtain wide area coverage.
- ASTRO DIU3000 Digital Interface Unit, which interfaces analog consoles to ASTRO radio infrastructures (discussed in detail throughout the rest of this manual).
- ASTRO control equipment: Centracom Series II, T5600 series, and any other Tone Remote Control capable console, RNC3000 and MRTI2000.
- ASTRO encryption support devices:
  - Key Variable Loader (KVL): A hand-held device that distributes the encryption key variables to field units and DIUs.
  - Key Management Facility (KMF): A facility that serves as a centralized encryption key manager to remotely distribute encryption keys over the air.

### A Sample ASTRO System

A conventional single channel dispatch system is shown in Figure 1. In the system shown, a DIU3000 is connected to the TRC (Tone Remote Control) console, to one ASTRO base station/repeater/comparator and to an RNC (Radio Network Controller).

The DIU3000 routes the audio from/to the TRC console to/from the subscriber units, via the base station/repeater/comparator.

The DIU3000 also routes the data from/to the RNC (which is connected to the Host) to/from the subscriber units, via the base station/repeater/comparator.



**Figure 1**  
DIU3000 Typical Connection

## Digital Interface Unit

### General

The ASTRO DIU3000 Digital Interface Unit (see Figure 2) enables remote control of a digital ASTRO base station using existing analog desktop controllers, consoles, and other analog non-ASTRO remote control devices. In addition, the DIU3000 adds the ASTRO digital encryption capability to the existing analog remote control equipment, provided that the appropriate optional encryption cartridge is installed.



**Figure 2**  
ASTRO DIU3000 – General View

The DIU3000 is connected between the ASTRO base station and the non-ASTRO analog console/device, as shown in Figure 1.

The DIU3000 front panel, consists of a keyboard, a liquid crystal display (LCD) and LED indicators. These controls are used mainly during operations involving encryption and during servicing.

Most of DIU3000 features and parameters are programmable by means of an external Radio Service Software (RSS).

## DIU3000 Features

- **Multi-Mode Operation.** The DIU3000 can operate in the clear (non-encrypted) analog, clear ASTRO digital, and the optional encrypted ASTRO digital modes, providing backward compatibility with existing analog equipment. The DIU3000 provides seamless transitioning between different types of calls by automatically switching to match the mode of each.
- **Full Duplex Operation.** The DIU3000 is capable of handling inbound and outbound signals simultaneously.
- **Integrated Modem.** A digital modem that provides access to ASTRO digital fixed equipment is optionally integrated into the DIU3000, saving valuable site space.
- **Encryption Capability.** The Encryption Cartridge options provide the DIU3000 with encryption capability.

Single- or Dual-algorithm models are available, all operating at 9.6 kbps. The dual-algorithm feature allows organizations using different encryption algorithms to interoperate in the secure mode.

All encryption types provide the same high level of security as the Motorola SECURENET systems, but the ASTRO technology provides better audio quality – there is no quality degradation due to range and no voice truncation in the beginning of the message.

- **Multikey Capability.** Up to 512 encryption keys can be selected by a TRC console position. Up to 512 keys can be selected by a Digital Keying Console (DKC). These keys are used to encode outbound calls from the console. Inbound transmissions from a subscriber are decoded with the key specified in the received message. This capability provides the flexibility to configure your system to interoperate securely with several user groups using different encryption keys.
- **Compliance with FIPS 140-1 Security Requirements.** The DIU3000 can be programmed by the RSS to restrict access to encryption/decryption services in compliance with the FIPS 140-1 security requirements.
- **Alert Tones.** When an encryption option is installed and the alert option is enabled via the RSS, the DIU3000 alerts the console operator if there is key failure or when the operator tries to transmit in the clear mode.
- **Keyboard and LCD.** The DIU3000 is provided with a keyboard and an LCD that greatly facilitate installation and maintenance operations.
- **Handset Support.** The optional Handset facilitates installation and maintenance operations. The handset allows maintenance personnel to monitor incoming calls and perform test transmissions.
- **AC Battery Backup Interface.** The DIU3000 supports the use of an external battery as a backup for the ac power supply.
- **Centracom Digital Link Interface.** The Centracom Digital Link Interface is supplied with the basic model and, in conjunction with the ACIM (ASTRO

Console Interface Module) installed in the Centracom, enables the Centracom analog console to use ASTRO signalling (such as PTT ID, Radio Check, etc.).

Console transmission can also be controlled by a digital keying console. In this case, the console uses the digital ACIM path to send commands such as "key up the Base Station" to the DIU3000. The protocol on this interface supports all the same functionality as supported by TRC. This operation is required for the SmartNet Trunking System configurations and is optional for conventional system configurations. Digital keying reduces the console key up time, eliminates the console dependency on the limited number of tones allowed in its tone tables and is a more appropriate keying method for a digital radio system.

For additional information, refer to the *Centracom Signalling Link Owner's Manual*.

- **Trunking Operation.** The DIU3000 Trunking Operation option is required for integrating the DIU3000 into an ASTRO system provided with SmartZone/SmartNet capabilities. For additional information, refer to the DIU3000 Trunking Operation option manual (68P02949C95).
- **Phone Patch Support.** The Phone Patch option allows the connecting of the MRTI2000 telephone line interface to the DIU3000, for mobile-to-land and land-to-mobile telephone interconnection. For additional information, refer to the Phone Patch and Logic Console option manual 68P02934C10.
- **Logic (E&M) Console Support.** The Logic Console option allows the connecting of non-TRC consoles to the DIU3000. For additional information, refer to the Phone Patch and Logic Console option manual 68P02934C10.
- **External Terminal Interface.** The DIU3000 provides an RS-232 interface that can be used for connecting a diagnostic printer, a terminal or an RSS running computer. The interface provides the user with the flexibility to program DIU3000 parameters, perform in-box diagnostics and retrieve stored diagnostic information.
- **Built-In Test Equipment (BITE).** The DIU3000 has an extensive BITE that performs self-testing at power-on and during operation. Detected failures are stored in the DIU3000 memory and can either be displayed on the DIU3000 LCD or retrieved via the printer/terminal interface.
- **Mounting.** The DIU3000 can be mounted in a card cage style 6-U, part number CHN1009.

## DIU3000 Basic Model and Options

### Digital Link to Base Station/Comparator

The DIU3000 Communication board provides a V.24 digital link to the base station/comparator. The digital link supports only the ASTRO operation modes - Clear and Encrypted.

The V.24 digital link is limited to indoor use and its physical length should not exceed 50 feet. To enable long distance digital communication, Channel Bank DSU is used to interconnect the V.24 digital link to the T1 link.

The Digital Link includes the DIU3000 Communication Adaptor Cable, FKN4632A. In addition, it is possible to order one of the following cable options:

- Option C542AC - 25 feet long Modem Eliminator to Base Cable
- Option C542AD - 45 feet long Modem Eliminator to Base Cable
- Option C543AC - 25 feet long DIU3000 to Channel Bank DSU Cable
- Option C543AD - 45 feet long DIU3000 to Channel Bank DSU Cable

### Centracom Signalling Link

The DIU3000 basic model includes a digital link in addition to the basic analog link between the DIU3000 and the CENTRACOM console. The digital link enables the transfer of ASTRO digital signalling information, such as Talk Group ID, Selective Calling, Emergency Alarm, Radio Check, etc. The digital keying consoles gain a full benefit from the ACIM link since they allow keying up using a digital frame.

The CENTRACOM console should include the ACIM module and an additional cable for interfacing between the ACIM and DIU3000.

The CENTRACOM Signalling Link is covered in detail in manual no. 68P02949C70.

### Battery Revert Cable (option C28DG)

This option allows connecting a backup battery to the DIU3000. A 12 V, size-A, 10 Ah battery, should provide backup power for at least five hours in case of ac power failure. The customer must supply the battery and ensure that it is kept charged.



**Note**

If you purchased both the Battery Revert Cable and Junction Box (C62AB) options, you will have to remove the DB-25 connector from the battery revert cable and connect the battery via the junction box.

### 220 V Primary Power (option C41AF)

Replaces the standard 110 V ac input power supply with the 220 V supply.

### **Junction Box (option C62AB)**

The junction box splits the General Purpose I/O (GPIO) board output port (connector "OPT. 1") on the DIU3000 rear panel into several TBs and thus facilitates wire connection to the connector (DB-25, female). This option is especially useful when more than one device should be connected to this general purpose I/O connector.

The following functions are supported by the GPIO board via the junction box:

- Two hardware indication output lines (RECEIVE UNSQUELCH and MODE INDICATION) for a Centracom console (see also "Connecting the Hardware Indications to CENTRACOM (two lines, for CENTRACOM only)" on page 23).
- External battery for power backup (see also "Battery Revert Cable (option C28DG)" on page 27).
- M-lead digital output indicating transmission from DIU3000 (closed contact to ground).

### **Test Handset (option C109A, part number CDN6209)**

The test handset complements the DIU3000 features to allow a console-like operation. Using this option effectively facilitates system testing and troubleshooting.

### **DIU3000 Trunking Operation (option X960AA)**

This option includes the SmartZone operation and the SmartNet operation.

#### **DIU3000 in SmartZone Operation**

In the SmartZone system, the DIU3000 is connected to the Zone Controller and to the Audio Switch, rather than to being connected directly to the base station and the console. The DIU3000 serves as a SmartZone system resource for the analog, ASTRO clear and ASTRO encrypted dispatch and the telephone interconnect.

There are four links connected to the DIU3000 in the SmartZone architecture:

- V.24 digital link to the DSU, used to communicate with the base station over a T1 link via the Audio Switch.
- Analog four-wire link, used to transfer voice to/from the CENTRACOM console over a T1 link via the Audio Switch.
- RS-232 communication link to the Multi-Drop Data Broadcast device, used by the Zone Controller for controlling the DIU3000.
- Analog four-wire link, used to transfer analog voice to/from the base station over a T1 link via the Audio Switch.

Additional cables (optional) used to connect the Channel Bank DSU (options C543AC and C543AD) are necessary.

**DIU3000 in SmartNet Operation**

In a SmartNet system, the DIU3000 is controlled by the base station commands, and by a local console. The DIU3000 option described here refers to those DIU features that enable it to work in a SmartNet system.

There are five links connected to the DIU in the SmartNet architecture:

- V.24 digital link, used to communicate with the base station. Over this link the DIU receives commands from base station, regarding the transmission attributes. It is also used to transfer digital audio data to/from the base station.
- Analog 4W link, used to transfer voice to/from the base station.
- Asynchronous RS-232 communication link, used for digital communication control to/from the console, mainly KEY-UP commands issued by the console.
- Analog 4W link, used to transfer voice to/from the console.
- 2W link, used to transfer voice between the DIU and the Public Switched Telephone Network. This link physically connects the DIU Patch connector to a two-to-four wire convertor.

For additional information, refer to the DIU3000 Trunking Operation option, manual 68P02949C95.

**DIU3000 Conventional Operation (option X959AA)**

This option is used when no trunking capability is required from the DIU. In conventional systems the DIU3000 is connected to a console and a base station/comparator/repeater.

**9.6 kbps ASTRO Modem (option X437AF)**

This option adds a modem board to the DIU3000, that allows digital voice communication via an analog link to the base station/comparator/repeater, providing the capability to connect the DIU3000 far away from the base.

When this option is installed, the full DIU3000 connection capabilities may be implemented: modem or V.24 links, connection to TRC or digital consoles, as well as phone patch.

**Phone Patch (option C54BF)**

This option provides the DIU3000 with the telephone interconnect capability. In this application, the DIU3000 is connected to the radio-telephone interconnect equipment (MRTI2000) in addition to its connection to the console and the base station.

**Encryption Cartridge (models T5371, T5372, T5374, T5375, T5771-T5773)**

The encryption cartridge adds cryptographic features to the DIU3000. The circuit components and embedded software, making up the cartridge, are fitted on a

printed circuit which is mounted in a cartridge-like housing, designed to be a removable component in the DIU3000.

### Communication QUAD Connector (option C823AA)



**Figure 3**  
Quad Connector – General View

This QUAD connector provides an interface connection to the DIU3000, F2048A COMM connector.

The QUAD connector can be used as an alternative—but not as a direct replacement—to the W-cable, FKN4632A.

The QUAD connector connects to the BD-25, female COMM connector and provides access via four RJ45 connectors to the following alternative infrastructure devices:

- a co-located RNC, Radio Network Controller
- an ACIM/SMARTZONE (jumper selectable)
- a co-located station/comparator
- a remote station/comparator.

## ASTRO System Modes of Operation

The DIU3000 supports the following ASTRO system modes of operation:

- Analog
- ASTRO Clear
- ASTRO Encrypted

## **Analog Mode**

In the Analog mode, the ASTRO base station communicates with analog subscriber equipment. In this mode, the DIU3000 transfers the voice to and from the base station in analog format. Encryption is not supported in the analog mode. (The ASTRO base station keying command sequences are converted into ASTRO digital remote control signalling.)

## **ASTRO Clear Mode**

In the ASTRO Clear mode, all communications between the DIU3000 and base station and between the base station and subscriber equipment are performed in the ASTRO digital format and all voice messages are not encrypted.

## **ASTRO Encrypted Mode**

In the ASTRO Encrypted mode, all communications between the DIU3000 and base station and between the base station and subscriber equipment are performed in the ASTRO digital format and all voice messages are encrypted.

All the encryption and decryption operations are performed by the optional encryption cartridge installed in the DIU3000. In order to activate a function involving either encryption/decryption or access an encryption parameter when FIPS capability is enabled, an encrypted session must be opened. To open an encrypted session, the operator must login to the module. Login requires entering a valid password, known only to authorized personnel.

Once an encrypted session has been opened, it is no longer required to login before additional functions involving encryption should be performed.

The DIU3000 supports separation of responsibilities and duties between several operators, according to the FIPS 140–1 requirements. The following encryption related operator roles are supported:

- User. The user can obtain the encryption/decryption services from the cryptographic module, but cannot access or modify the cryptographic parameters and management functions.
- Crypto-officer. The crypto-officer is authorized to perform cryptographic initialization and management functions (such as cryptographic key and parameter entry).
- Maintenance role. The maintenance operator is authorized to perform tests and obtain interim results in order to maintain or troubleshoot the cryptographic module. The module automatically clears all operational keys and other security parameters when entering the maintenance role. When exiting the maintenance role, the module automatically clears all maintenance keys and other security parameters.

Each operator role requires a different password. The DIU3000 prevents opening concurrent sessions in the same operator role.

The operator is required to logout in order to terminate an encrypted session. Once a logout has been completed, a login is required in order to establish a new encrypted session.

## DIU3000 Functional Description

### Interface and Processing Functions

The DIU3000 interfaces analog control equipment to the ASTRO radio systems. It is a stand alone device connected between a control console and the ASTRO base station/comparator.

Without the console operator intervention, the DIU3000 performs several interface and processing functions, described in the following sections.

#### Voice Processing

In the ASTRO Clear and Encrypted modes, the DIU3000 converts the analog voice messages from the console or local handset into digital form, and converts the digital voice from the base station into analog form. The DIU3000, as a part of the ASTRO system, uses the IMBE (Improved Multi-Band Excitation) technique, if option X806 is installed, for compressing the digitized voice.

In the analog mode, the DIU3000 transfers the audio between the console and the base station in the original analog form.



**Note**

MRTI (analog and digital inbound), Console (analog and digital inbound) and Base Station (analog outbound) audio levels may be set in RSS or from the front panel display (after entering service mode, password: 039302164). Each interface may be changed by 20 dB in 1 dB increments. Because the DIU3000 passes and generates voice and tones at various levels, there is no absolute output level as suggested by the term 'dBm' on the front panel display. The term 'dBm' that accompanies gain settings in RSS and the front panel display should be interpreted as a rough estimate of signal output. In other words, the output level display should be thought of as a volume gain control, not as an absolute level indicator. The exact output, in dBm, is a function of 1) the source level, 2) the output level setting and 3) the averaging method used to measure the signal

#### Encryption (Optional)

The DIU3000, by means of the encryption cartridge, provides digital encryption of outbound voice and decryption of inbound voice. Depending on the model purchased, single- or dual-algorithm operation is supported.

The DIU3000 performs the encryption and decryption operations using encryption keys. For decryption of received messages, the received key is used. For encryption of outbound messages, there are two key selection modes, controlled by the console: Manual and Automatic. In the Manual mode, the required key is selected by the console operator via a TRC command (see also section 5.1.6), or a digital keying command. In the AUTO mode, the transmit key

is almost exclusively dependent on the received message key. For additional details on key selection, refer to your Encryption Cartridge manual.

The DIU3000 supports encryption key indexing for mapping encryption key numbers to actual encryption keys used for ASTRO encrypted transmission. If a key number is defined as indexed, two actual keys are mapped to that key number via the key indexes. One of the actual keys is specified by index 1, while the other, by index 2. The actual key used for transmission is determined according to the active key index.

The key indexing feature allows the keys in the inactive index to be available for rekeying. After the inactive key has been rekeyed, the key index can be switched, but the key number is still unchanged from the user's perspective.

### **Error Protection**

The DIU3000 inserts an error protection code into the digital voice datastream (both clear and encrypted). This allows the receiving ASTRO subscriber to correct corrupted messages to the desired level. In the receiving direction, the DIU3000 uses the same error correction method to detect and correct errors in the received messages.

### **Embedded Signalling**

ASTRO systems can transfer signalling information by intermixing it with the digital voice. This type of signalling is referred to as "embedded signalling".

The DIU3000 uses embedded signalling to include the following information in the transmitted messages:

- *Source Unit and Destination Unit IDs*, to facilitate selective calling.
- *Talkgroup ID*, that can be used for sending and receiving selective group calls.
- *Encryption Key ID*, that is used to inform the receiving ASTRO unit which key must be used for decryption of the voice message, thus allowing *selective* secure calling.
- *Additional Encryption Related Information*.

### **Base Station Control**

The DIU3000 converts TRC sequences, logic control or digital keying commands sent by the analog console into ASTRO DRC (Digital Remote Control) signalling. The DIU3000 controls the following functions in the base station using the DRC signalling:

- Selection of transmission channel number
- Selection of ASTRO System mode (analog, ASTRO Clear, or ASTRO Encrypted, see "ASTRO System Modes of Operation" on page 11.)
- Repeater activation/deactivation
- Controlling the second receiver (on/mute)
- Monitor activation/deactivation

## TRC Command Handling

The DIU3000 converts the TRC command into a combination of ASTRO commands, referred to as Function REQuests (FREQs). Each TRC function tone (single- or dual-tone) is converted into a different FREQ. A FREQ may include up to seven ASTRO Signalling, Base Station control and DIU3000 control commands. The DIU RSS maintains the TRC FUNCTIONALITY TABLE that defines the FREQ functions and assigns FREQ numbers to function tones.

## Alert Tone Indication

Under certain operating conditions the DIU3000 sends alert tones to the console. Some of the alert tones can be enabled/disabled via the RSS. The following alert tones are available:

- Power-on.
- Power-on self-test failure.
- Completion of key loading from KVL. Different alert tones indicate either loading success or failure.
- Transmission or reception in either analog or ASTRO clear mode (this alert tone can be disabled by the RSS).
- Absence of a key required for encryption/decryption (this alert tone can be disabled by the RSS).
- Intentional zeroization of all encryption keys (this alert tone can be disabled by the RSS).

## Local Operation

There are several functions, that can/should be performed by the DIU3000 operator via the DIU3000 front panel, as follows:

- **Controlling encryption/decryption services.** When the appropriate parameter is enabled by the RSS, using the ASTRO encryption and decryption services is restricted, and requires initiating an encrypted session. This is done from the DIU3000 using the LOGIN function.
- **Encryption key erasure.** The DIU3000 can be used for erasing the encryption keys currently programmed into the encryption module memory.
- **Controlling Local Transmission Parameters.** The DIU3000 front panel is used to change/view the local PTT/handset transmission parameters.
- **Activity monitoring.** The DIU3000 can be used for monitoring system transmit/receive parameters.
- **Monitor.** The DIU3000 can be used to unquench the base station receiver and monitor the receive path.
- **Built-In Test Equipment (BITE).** The DIU3000 has an extensive BITE that performs self-testing at power-on and during operation. Detected failures are stored in the DIU3000 memory and can either be displayed on the DIU3000 LCD or retrieved via the printer/terminal interface.

## Installation Instructions

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### General

This chapter provides the DIU3000 installation and setup instructions. It is suggested to perform the instructions sequentially, skipping those that do not apply to your site. Following are the general steps:

- Initial inspection
- Planning the installation
- Mounting the unit
- Electrical connections
- Setup

### Initial Inspection

As soon as possible after delivery, inspect the shipping package for signs of rough handling. Unpack the DIU3000 and inspect it thoroughly. If damage was incurred in transit, notify the transportation company immediately.

### Planning the Installation

The DIU3000 interfaces between an analog console and the ASTRO base station and it is therefore placed on the link between the console and the base. It is recommended that the DIU3000 be located at the analog console site.

Choose a location that minimizes detrimental environment characteristics, such as excessive heat, moisture, vibration, sunlight and dust.

Ensure convenient access to an AC power source, base station wire lines, keyboard, display and handset (if installed), and a good earth ground. Cabling must have a sufficient length to prevent stress on unanchored connectors. Use strain relief.

The DIU3000 uses a 4-wire configuration – two pairs of two wires to the base station and two pairs of two wires to the analog console. If the analog console is a Centracom type, three additional unbalanced wires for the Mode and Receiver Unsquench indications are required (refer also to Figure 9).

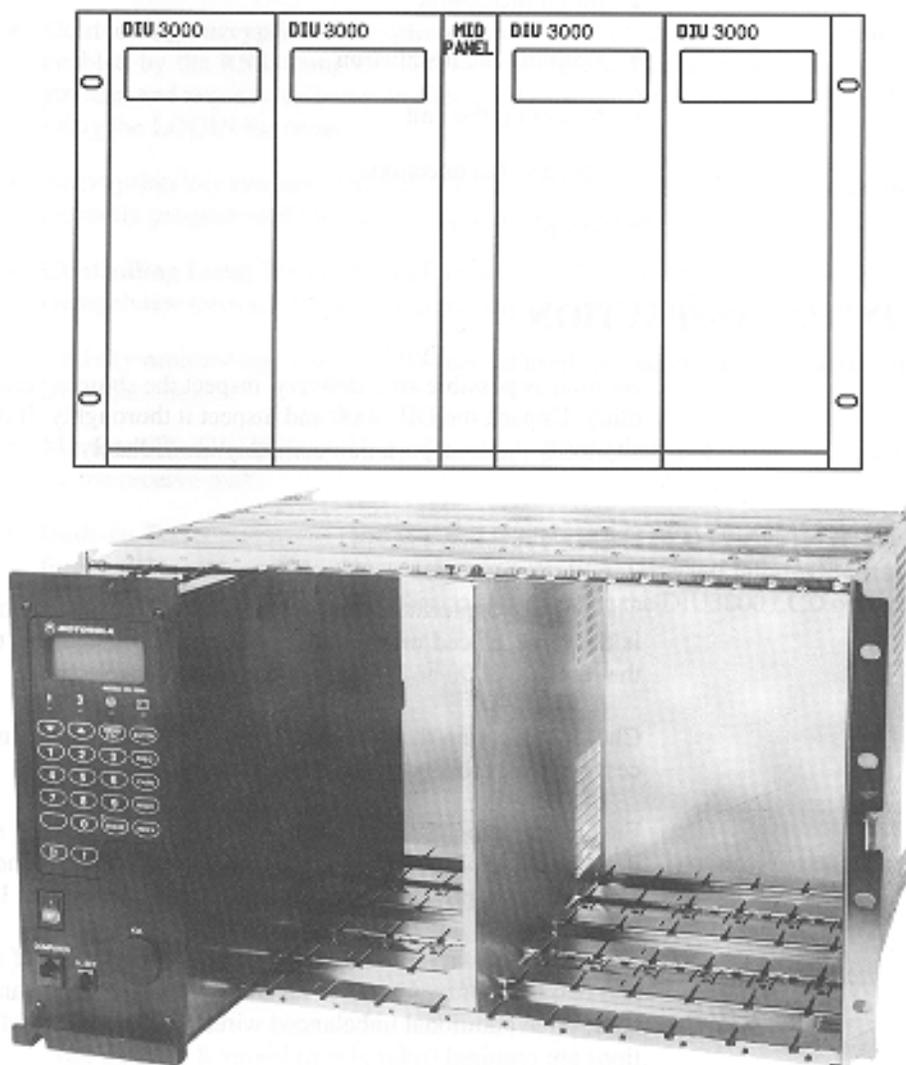
The DIU3000 is especially designed for easy installation. A standard installation does not require opening the DIU3000 housing. Rather, all adjustments are carried out via an external PC using the ASTRO DIU Radio Service Software (RSS) and via the DIU3000 keypad.

This chapter provides information for mounting the DIU3000 equipment (see page 17) and making the necessary electrical connections (see page 20). In addition, the DIU3000 programmable parameters usually have to be customized

for the particular site. The programming is done mainly via RSS (refer to the ASTRO DIU RSS User's manual 68P02924C15). Some of the frequently used parameters are also programmable via the DIU3000 front panel.

## Mounting

Up to 4 DIU3000 units may be mounted in one card cage (see Figure 3), or up to 28 units in one 7.5' or 8' rack.



**Figure 4**  
DIU3000 Installation in a Card Cage

The mid-panel, part number FLN8840, is optional and may be used to hang the hand-set, see Figure 4.



**Figure 5**  
Mid-panel

When a card cage contains less than 4 DIU3000 units, the blank panel, part number FLN8841 shown in Figure 5 may be installed.



**Figure 6**  
Blank Panel

The DIU3000 is secured, using one screw. The mid and blank panels require 2 screws each.

## Installing Encryption Cartridge



**Note**

This section provides the procedure for installing the encryption cartridge when the DIU3000 is already installed in the card-cage.

1. Unscrew the four screws fastening the front panel and remove it.
2. Insert the encryption cartridge into its slot.
3. Return the front panel to its place.



**Note**

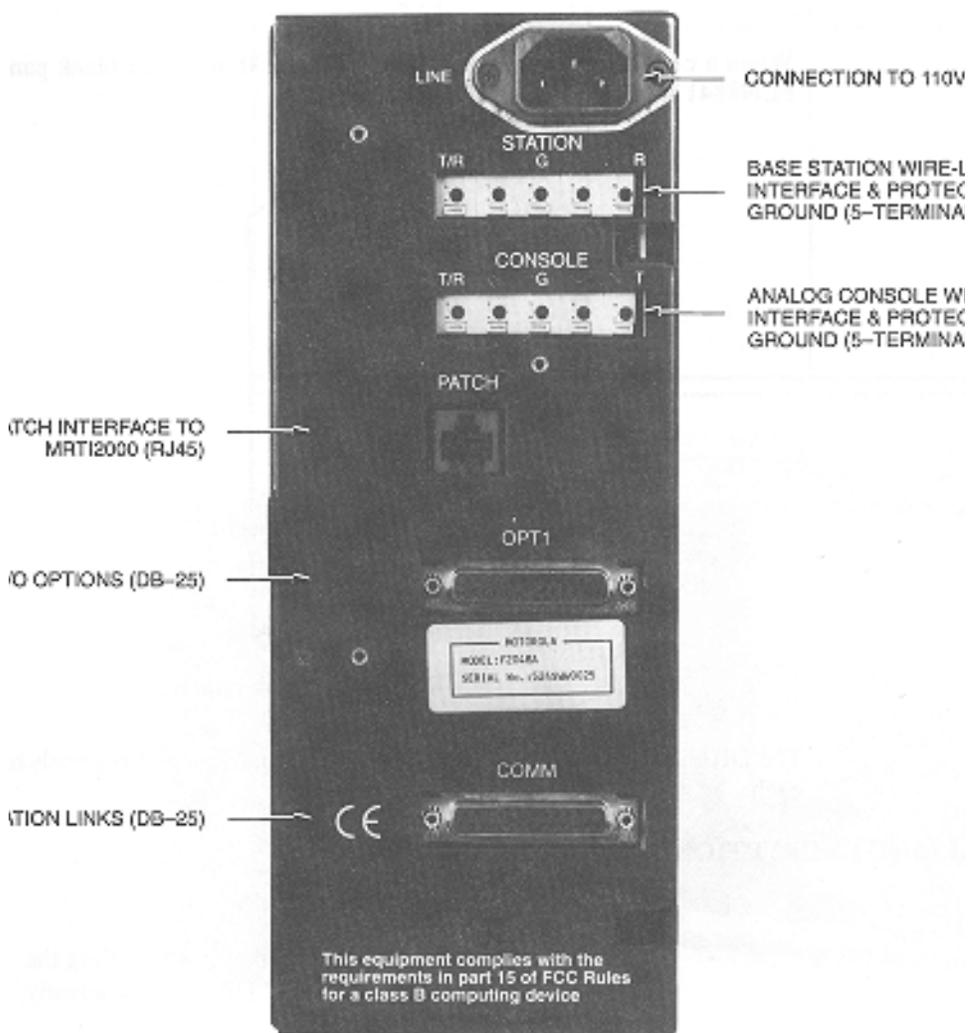
To remove the encryption cartridge, it is necessary to use a tool supplied to the DIU3000 service shops, Motorola part number 6686064C01.

## Electrical Connections

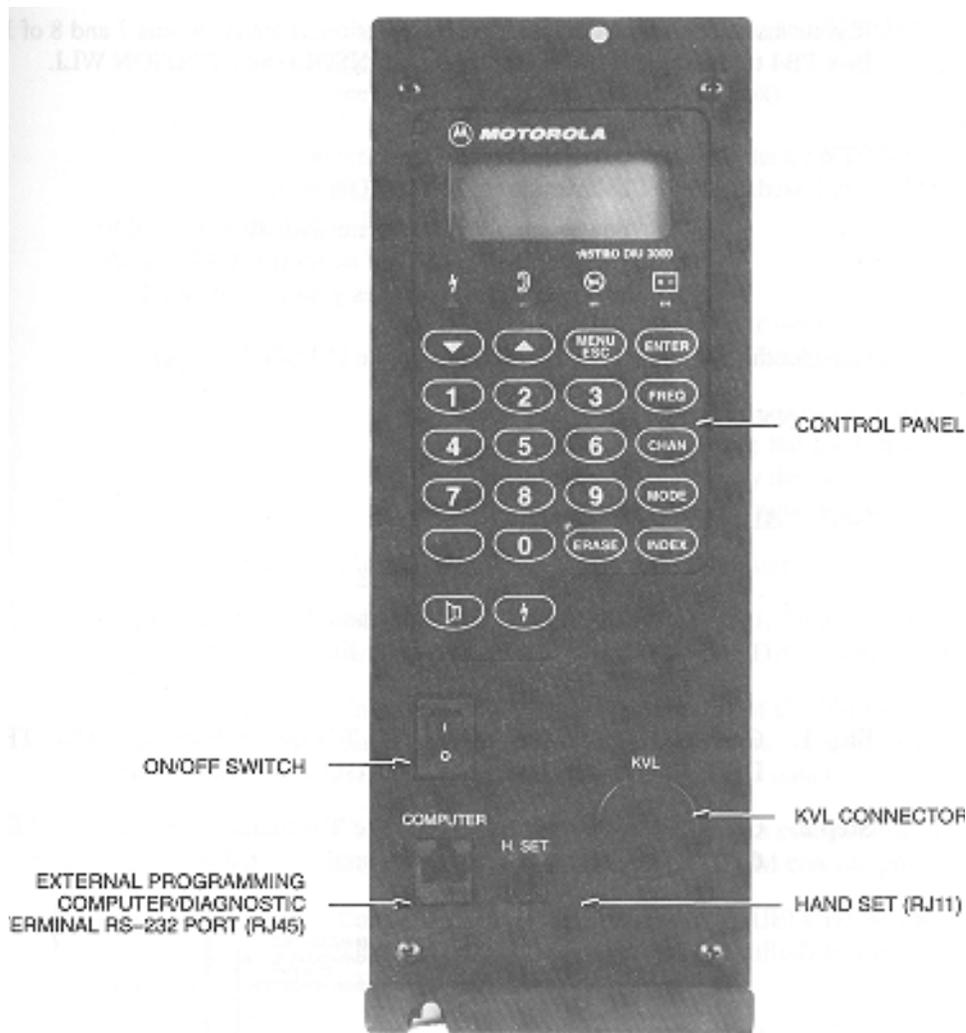
(See Figure 6 and Figure 7)

### General

This section describes the various connections between the DIU3000 and other devices: analog link to console, analog link to base station/repeater/comparator, digital link (V.24) to base station/repeater/comparator, hardware indications to CENTRACOM, connection to computer, test handset.



**Figure 7**  
DIU3000 Rear Panel



**Figure 8**  
DIU3000 Front Panel

### Jumper Setting

The DIU3000 is supplied with a set of default jumper settings. No additional jumper setting is required for standard installations.

### Ground Connection

This must be the first connection. Connect a ground wire from the 'G' terminals of the CONSOLE and STATION wire line interfaces (WLI) on the DIU3000 rear panel directly to a good earth ground. The ground should preferably be a buried water pipe.



**Note**

When you insert a wire into a TB, press the corresponding terminal latch with a flat blade screwdriver. Make sure to hold the screwdriver perpendicular to the latch.

If your installation includes Junction Box (optional), connect pins 7 and 8 of Junction Box TB4 to the same earth ground as the CONSOLE and STATION WLI.

### AC Power



Two power supply models are available, for either 110 V ac (standard) or 220 V ac (option C41). Verify that the power supply matches your local network.

Connect the AC cable to the LINE plug on the DIU3000 rear panel.

### Analog Console Connection

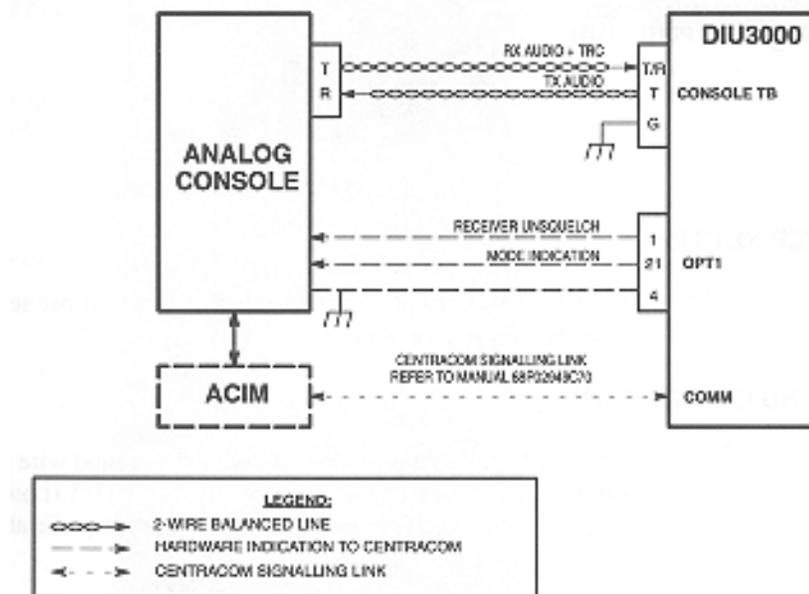
(See Figure 8)

#### Analog Link Connection



The DIU3000 and console should be interconnected by either a four-wire private line or a 3002 channel with C5 conditioning.

1. Connect two wire lines between the T/R terminals of CONSOLE TB (on the DIU3000 rear panel) to the T connector on the analog console.
2. Connect two wire lines between the T terminals of the CONSOLE TB (on the DIU3000 rear panel) to the R connector on the analog console.



**Figure 9**  
DIU3000 Connection to Analog Console

## Connecting the Hardware Indications to CENTRACOM (two lines, for CENTRACOM only)

(See also “Junction Box (option C62AB)” on page 9.)

The connection of the hardware indications to the CENTRACOM console should only be indoors. The total recommended length of these lines is 1000 feet. The connector type is DB–25 female.



### Notes

The standard DB–25 connector does not fit into the DIU3000 “OPT1” connector. Use the DB–25 connector supplied in kit FLN6858A.

The wires used for connecting the hardware indications lines should be supplied by the customer, according to the specific installation requirements.

1. If the Junction Box is used, skip this step.  
Prepare the cable for the hardware indication signal connections by soldering three wires to pins 1, 4 and 21 of the DB–25 male connector.
2. Connect the DB–25 male connector of the Hardware indications cable (prepared in the previous step) or the Junction Box flat cable connector to the OPT.1 connector on the DIU3000 rear panel.
3. Connect pin 4 (Ground) of the DB-25 connector or TB4-3 on the Junction Box (if installed) to the CENTRACOM console ground.
4. Connect pin 1 (RECEIVER UNSQUELCH) of the DB-25 connector or TB4-2 on the Junction Box (if installed) to the corresponding pin in the CENTRACOM console.
5. Connect pin 21 (MODE INDICATION) of the DB-25 connector or TB4-1 on the Junction Box (if installed) to the corresponding pin on the CENTRACOM console.



### Note

It is recommended to use rigid wires for connection to the TB. In most cases, soldering the wire tip is a good practice.

## Connecting the CENTRACOM Signalling Link

Refer to the CENTRACOM Signalling Link manual, part no. 68P02949C70.

## Connecting the E&M Console

Refer to *Phone Patch Interface and Local Desk Set Interface, Owner's manual*, part no. 68P02934C10.

## Base Station/Comparator Connection

### General

The DIU3000 can be connected to the base station/comparator using several methods. They are as follows:

- Via a wire line analog link that uses the internal modem (option X437AF) to support the ASTRO modes of operation (clear/encrypted).
- Via a digital V.24 link. This link supports the ASTRO modes of operation only and is limited to indoor use (up to 50 feet long).
- Via both the V.24 link and the wire line link. The V.24 link supports the ASTRO modes of operation, while the wire line provides the analog mode support. Since the V.24 link is used, this configuration is limited to indoor use, as well.

### Wire Line Link Connection

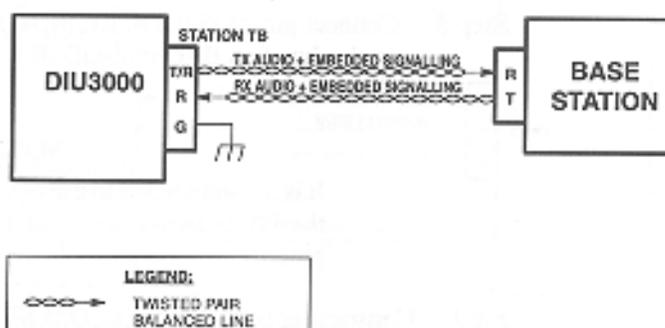
See Figure 9.



#### Note

The DIU3000 and the base station/comparator should be interconnected by either a four-wire private line or a 3002 channel with C5 conditioning.

1. Connect two wire lines between the T/R terminals of STATION TB (on the DIU3000 rear panel) to the R connector on the base station/comparator.
2. Connect two wire lines between the R terminals of STATION TB (on the DIU3000 rear panel) to the T connector on the base station/comparator.



**Figure 10**  
DIU3000 Connection to Base Station



#### Notes

It is recommended to use rigid wires for connection to the TB. In most cases, soldering the wire tip is a good practice.

When you insert a wire into a TB, press the latch of the corresponding terminal with a flat blade screwdriver. Make sure to hold the screwdriver perpendicular to the latch.

## Digital Link to Base Station/Channel Bank DSU Connections



### Notes

To use the digital link to base station, the Communication board should be installed in the DIU3000. The basic model is supplied with the board installed (FLN8255A).

Connect the W cable (FKN4632A) or QUAD Connector (FLN5462A) to the COMM port. Do not connect a Y cable (FKN4119A) which was used with the previous Communication board (FLN6799A). This model has been discontinued.

### General

The DIU3000 can be connected to the base station/comparator via the following digital links:

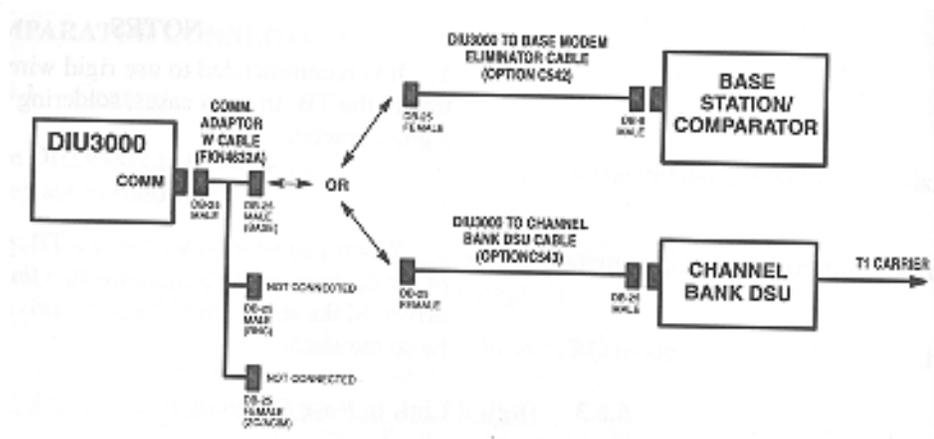
- W-Cable V.24 (modem eliminator) link, limited to indoor use.
- W-Cable V.24 interconnected to T1 carrier via the Channel Bank DSU.
- QUAD connector V.24
- QUAD connector Null connection.

### DIU3000-to-Base Modem Eliminator Connection Procedure

(See Figure 10)

Connecting the digital link to the base station/comparator requires the use of adaptor cable FKN4632A (W cable), and an additional communication cable. The additional cable may be ordered as the DIU3000 to Base Modem Eliminator option C542AC or C542AD (25 ft / 45 ft, respectively) or prepared by the customer according to Appendix B.

1. Connect the common connector of the adaptor cable, supplied with the option, to the COMM connector on the DIU3000 rear panel.
2. Connect the DIU3000-to-base modem eliminator cable's female connector to the DIU3000 communication adaptor cable's male (BASE) connector.
3. Connect the DIU3000-to-base modem eliminator cable to the base station/comparator.



**Figure 11**  
DIU3000 to Base/Channel Bank DSU Digital Link Connections

### DIU3000 to Channel Bank DSU Interconnection Procedure

(See Figure 11).

The digital link that uses the V.24 link is limited to indoor use; long distance digital interconnection to the base station/comparator can be achieved via the T1 carrier. This connection requires the use of the W adaptor cable (FKN4632A) and an additional communication cable. The additional cable may be ordered as the DIU3000 to Channel Bank DSU cable option C543AC or C543AD (25 ft / 45 ft, respectively) or prepared by the customer according to Appendix B.



**Note**

Using the DIU3000 to Channel Bank DSU interconnection requires setting the Tx Clock Source parameter value to "EXTERNAL" (Change/View:Base Station screen in the DIU3000 RSS).

1. Connect the W adaptor cable's common connector, supplied with the option, to the COMM connector on the DIU3000 rear panel.
2. Connect the DIU3000-to-Channel Bank DSU cable's female connector to the DIU3000 communication adaptor cable's male (BASE) connector.
3. Connect the DIU3000-to-Channel Bank DSU cable to the Channel Bank DSU.

### DIU3000 QUAD Connector

DIU connection to a base station or Astrotac comparator can be achieved through the DIU QUAD connector. The Null connection is designed for connecting directly to a station or comparator. The V.24 connection is designed for connection through a channel bank DSU. This connector allows standard telco 8 wire cable to be used with standard RJ45 connectors. Refer to Table 43 on page 86 for the QUAD connector pin-outs and to Table 44 on page 87 for the Jumper Settings.

### Computer/Diagnostic Terminal

Use the COMPUTER connector (RJ45) on the DIU3000 front panel to connect a computer or a diagnostic terminal. For detailed instructions on RSS programming, refer to the DIU RSS User's manual 68P02924C15.

### Encryption Cartridge (models T5371, T5372, T5374, T5375, T5771 – T5773)

Refer to the appropriate Encryption Cartridge User manual Part No. 68P81090E45/50.

### Test Handset (option C109AA)

Connect the handset cable to the "H. SET" connector (RJ11) on the DIU3000 front panel.

### Battery Revert Cable (option C28DG)

A 12–14 V lead acid type battery should be used. A size–A, 10 Ah battery should provide backup for at least five hours in case of ac power failure. The customer must ensure that the battery is kept charged.

Connect the battery revert cable between the battery (provided by the customer) and the DIU3000 as follows:

- **If the Junction Box is not used:**
  - Plug in the revert cable into the "OPT1" connector on the DIU3000 rear panel.
- **If the Junction Box is installed:**
  - Remove the DB–25 connector from the battery revert cable.
  - Connect the revert cable positive lead to TB5–6 on the JB.
  - Connect the revert cable negative lead to TB5–7 on the JB.

### Quad Connector (FLN5462)

The Quad Connector is used to interface the DIU3000 to a Base Station or Comparator, to an RNC, and to a Centracom Signaling Link. Before securing the Quad Connector to the "Comm" port of the DIU3000 please refer to Table 43 for the connector pin description, and Table 44 for jumper placement information.

Connect the Quad Connector to the Comm Port of the DIU3000 and secure it to the DIU3000 with the screws supplied.

Three ferrite beads are supplied with the DIU3000. These beads impede electromagnet emissions, EMI, from the DIU3000 and from cables connecting the DIU3000 to other infrastructure equipment. These beads should be placed on each cable connected to the Quad Connector. One loop should be placed in the cable and around the bead. The bead should be placed as close as possible to the Quad Connector.

## DIU3000 Setup

### DIU3000 Power-on

After installing the DIU3000, check all wire connections and verify good ground connection. Connect the ac power and monitor the messages on the DIU3000 display. The following is the sequence of LCD messages during a proper power-on process:

**Table 1**  
Power-on Process Messages

| Message  | Meaning   |
|----------|---|
| CHK DB   | Database checking operations.   |
| PLS WAIT | Restoring the parameter database from backup.<br><b>NOTE</b><br>Usually, this message is too short to notice. However, if this is the first power-on after downloading new parameters from the RSS, or if in the previous stage the database was found corrupted, it is restored (reprogrammed) from the internal backup. This may take up to five minutes, for the duration of which the message <b>PLS WAIT</b> is displayed. Upon successful database programming, the message <b>PROG OK</b> is displayed shortly. If the DIU3000 fails to restore the database, an error message is displayed instead of the <b>PROG OK</b> message. In this case, refer to the TROUBLESHOOTING section. |
| LOAD SRV | Software server handling.   |
| DSP BOOT | Loading DSP processors' software.   |
| SELF TST | Checking hardware peripherals.<br><ul style="list-style-type: none"> <li>• During LED tests, all front panel LEDs are lit.</li> <li>• During LCD tests, all LCD segments are lit in sequence.</li> <li>• Four tones are heard from the console speaker.</li> <li>• If the handset option is installed, four tones are heard from the handset earpiece.</li> </ul>   |
| TST PASS | The self-test has been successfully completed.<br><b>NOTE</b><br>If the self test fails, the <b>TST FAIL</b> message is displayed and an alert tone is sent to the console and to the handset earpiece.<br>If this occurs, see the TROUBLESHOOTING section  |
| LOADING  | Loading application.  |
| HH:MM:SS | The clock is displayed.   |

After the power-on sequence, the DIU3000 tries to establish a link to the base station using a handshake procedure. During the link establishment, which takes a few seconds, the BUSY LED is lit. If the link is not connected or the base station

is not responding for some other reason, the LED remains lit and the DIU3000 does not allow transmission.

In the ready state, the LCD displays the time of day and the unit is ready for operation.

## Programming the DIU3000

The DIU3000 is supplied with a set of default parameters. This means that the unit is operational and allows preliminary system testing. However, it probably does not fit your specific requirements and some of its parameters have to be changed to fit the system in which the DIU3000 is installed. A full description of the DIU3000 parameters is given in the *DIU RSS User's manual* 68P02924C15.

This section contains the **DIU3000 Parameters Check-list** which helps the user to design the DIU3000 parameters.

This is a list of all the parameters (except for TRC sequences and some of the encryption parameters provided in separate tables) that the user has to check/change in order to configure the DIU3000 for the specific system requirements. The table contains the path in the RSS menu tree leading to the screen that contains the parameter, the parameter default value, and the range of values the parameter can have. If it is necessary to change the parameter value, the user can record the new value in the empty column provided. After all the parameters in the table are checked/changed, the user can proceed to the actual parameters programming, using the DIU3000 RSS computer program. The user can use the last column in the table to mark with a "✓" each parameter already programmed.

It is important to note that the DIU3000 programming has to be performed in conjunction with the programming of the other units/elements in the Astro system: console and base station/comparator. A complete agreement between the element parameters has to be achieved for the system to operate properly.

**Table 2**  
DIU3000 Parameter Configuration Check-List

| Parameter Path / Name                        | Default | Range                             | Required | ✓ |
|--|---------|-----------------------------------|----------|---|
| <b>CHANGE/VIEW : ASTRO System Parameters</b> |         |                                   |          |   |
| Encrypted System                             | Enable  | Enable / Disable                  |          |   |
| Analog Mode Support                          | Enable  | Enable / Disable                  |          |   |
| CENTRACOM Signalling Link                    | Disable | Enable / Disable                  |          |   |
| RNC Link                                     | Disable | Enable / Disable                  |          |   |
| Data & OTAR Support                          | Disable | Disable / Data Only / Data & OTAR |          |   |
| Analog Console                               | TRC     | TRC / E&M / Disable               |          |   |
| Handset User                                 | Enable  | Enable / Disable                  |          |   |

**Table 2**  
DIU3000 Parameter Configuration Check-List (Continued)

| Parameter Path / Name  | Default     | Range   | Required | ✓ |
|--|-------------|---|----------|---|
| MRTI Phone Patch   | Disable     | Enable / Disable  |          |   |
| ASTRO Trunking System  | Disable     | SMTZN / SMTNT / Disable   |          |   |
| <b>CHANGE/VIEW : Alert Tones</b>                                     |             |   |          |   |
| Alert Tone Level   | Medium      | Low / Medium / High   |          |   |
| Clear Tx   | Disable     | Enable / Disable  |          |   |
| Clear Rx   | Disable     | Enable / Disable  |          |   |
| Tx Key Fail  | Disable     | Enable / Disable  |          |   |
| Rx Key Fail  | Disable     | Enable / Disable  |          |   |
| Key Erase  | Disable     | Enable / Disable  |          |   |
| Data Busy Tone   | Disabel     | Enable / Disable  |          |   |
| <b>CHANGE/VIEW : CONS&amp;MICS : TRC Console : TRC Tuning</b>        |             |   |          |   |
| Guard-Tone Frequency<br>(for both HLGT and LLGT)                     | 2175        | 1500 - 2800 Hz  |          |   |
| HLGT Duration  | 120         | 60 - 5000 ms  |          |   |
| Function Tone Duration   | 40          | 40 - 5000 ms  |          |   |
| LLGT Level   | -32         | -40 - 0 dB (relative to HLGT)   |          |   |
| Function Tone Level  | -10         | -40 - 0 dB (relative to HLGT)   |          |   |
| <b>CHANGE/VIEW : CONS&amp;MICS : TRC Console : Console Interface</b> |             |   |          |   |
| Line Level   | 0           | -20 - 0   |          |   |
| Receiver Unsquelch to Centracom                                      | High        | Low / High  |          |   |
| Mode1 Indication (Centracom)   | Low         | Low / High  |          |   |
| Mode1 / Mode2 Configuration  | Free-Format | Free-Format<br>Astro-Clear / Analog-Clear<br>Astro-Coded / Astro-Clear<br>Astro-Coded / Analog-Clear<br>Astro-Clear / Undefined<br>Analog-Clear / Undefined |          |   |
| DUPLX  | FDX         | FDX/HDX   |          |   |
| Silent Level   | 0           | 0 - 255   |          |   |
| Num of Wires   | 4W          | 4W/2W   |          |   |
| <b>CHANGE/VIEW : CONS&amp;MICS : RNC</b>                             |             |   |          |   |
| Receive Ready Support  | Disable     | Disable / Enable  |          |   |
| V.24 Tx Clock Source   | Internal    | Internal / External   |          |   |
| PTT Log Feature  | Disable     | Disable / Enable  |          |   |

**Table 2**  
DIU3000 Parameter Configuration Check-List (Continued)

| Parameter Path / Name   | Default  | Range               | Required | ✓ |
|---|----------|---------------------|----------|---|
| <b>CHANGE/VIEW : CONS&amp;MICS : Microphone Sensitivity</b>           |          |                     |          |   |
| Handset Microphone Sensitivity  | 9        | 0 - 9               |          |   |
| <b>CHANGE/VIEW : CONS&amp;MICS : E&amp;M Console Interface</b>        |          |                     |          |   |
| Line Level  | 0        | -20 - 0             |          |   |
| ECHO  | Disable  | Enable / Disable    |          |   |
| DUPLX   | FDX      | FDX / HDX           |          |   |
| PTT Polarity  | Low      | Low / High          |          |   |
| Repeat Disable Polarity   | Low      | Low / High          |          |   |
| <b>CHANGE/VIEW : CONS&amp;MICS : MRTI Phone Patch</b>                 |          |                     |          |   |
| Line Level  | 0        | -20 - 0             |          |   |
| Silent Level  | 5        | 0 - 255             |          |   |
| PTT Polarity  | Low      | Low / High          |          |   |
| <b>CHANGE/VIEW : CONS&amp;MICS : CAI DATA Definitions</b>             |          |                     |          |   |
| Number of Data Tx Attempts  | 4        | 2 - 10              |          |   |
| Acknowledgment Timeout  | 4000     | 1000 - 6000 ms      |          |   |
| CAI Individual Address  | 5        | 1 - 9999999         |          |   |
| <b>CHANGE/VIEW : ASTRO Base Station Parameters</b>                    |          |                     |          |   |
| Line Level  | -10      | -20 - 0             |          |   |
| Fast Unmute   | Disable  | Disable / Enable    |          |   |
| Link Type   | Modem    | Modem / V.24        |          |   |
| Digital Link Check  | Disable  | Disable / Enable    |          |   |
| Carrier Detect Level  | High     | Low / High          |          |   |
| Analog Call Timeout   | 120      | 20 - 300 sec        |          |   |
| Analog Link Check   | Disable  | Disable / Enable    |          |   |
| V.24 Tx Clock Source  | Internal | Internal / External |          |   |
| Silent Level  | 5        | 0 - 255             |          |   |
| Station TEI Address   | 1        | 1 - 63              |          |   |
| DIU Self Address  | 13       | 1 - 63              |          |   |
| <b>CHANGE/VIEW : Encryption Parameters : Encryption Configuration</b> |          |                     |          |   |
| FIPS Enable   | No       | Yes / No            |          |   |
| Console Erase Old Index   | No       | Yes / No            |          |   |

**Table 2**  
DIU3000 Parameter Configuration Check-List (Continued)

| Parameter Path / Name   | Default | Range  | Required | ✓ |
|---|---------|--|----------|---|
| Key Indexing  | Disable | Disable / Enable                             |          |   |
| <b>CHANGE/VIEW : Encryption Parameters : APCO Key Management</b>                            |         |  |          |   |
| KLK Feature   | Disable | Disable / Enable                             |          |   |
| Manual Keypad Change  | Disable | Disable / Enable                             |          |   |
| Key Management Mode   | PID     | PID / CKR                                    |          |   |
| Rekey Request Type  | Clear   | Clear / Encrypted                            |          |   |
| <b>CHANGE/VIEW : Astro Trunking Parameters : SmartZone</b>                                  |         |  |          |   |
| Analog Link Tx Delay  | 100     | 10 - 10000 mSec                              |          |   |
| DIU ID In Zone Controller Link  | 0       | 0 - 32                                       |          |   |
| Line Level to Analog Line   | 0       | -20 - 0                                      |          |   |
| Console Hybrid Link   | Disable | Disable / Enable                             |          |   |
| Go-Ahead Level  | Medium  | Dis / Low / Medium / High                    |          |   |
| Console Silent Level  | 0       | 0 - 255                                      |          |   |
| <b>CHANGE/VIEW : Astro Trunking Parameters : SmartNet</b>                                   |         |  |          |   |
| DIU SUB-SITE ID   | 1       | 1 / 2  |          |   |
| Line Level to Analog Line   | 0       | -20 - 0                                      |          |   |
| Line Level to Phone Line  | 0       | -20 - 0                                      |          |   |
| Go-Ahead Level  | Medium  | Dis / Low / Medium / High                    |          |   |
| <b>CHANGE/VIEW : TX Default Attributes : TRC/SN Console Default Tx Attributes</b>           |         |  |          |   |
| Self ID   | 5       | 1 - 9999999                                  |          |   |
| Talk Group ID   | 4095    | 0 - 65535                                    |          |   |
| Channel   | blank   | 0 - 255, blank                               |          |   |
| Tx Mode   | Clear   | Analog /<br>(Astro) Coded /<br>(Astro) Clear |          |   |
| Default/Failsoft Key Number   | blank   | 0 - 511, or 1 - 65439, blank                 |          |   |
| <b>CHANGE/VIEW : TX Default Attributes : Interconnect/Phone Patch Default Tx Attributes</b> |         |  |          |   |
| Self ID   | 5       | 1 - 9999999                                  |          |   |
| Talk Group ID   | 4095    | 0 - 65535                                    |          |   |
| Channel   | blank   | 0 - 255, blank                               |          |   |
| Tx Mode   | Clear   | Analog /<br>(Astro) Coded /<br>(Astro) Clear |          |   |

**Table 2**  
DIU3000 Parameter Configuration Check-List (Continued)

| Parameter Path / Name   | Default | Range  | Required | ✓ |
|---|---------|--|----------|---|
| Key Number  | blank   | 0 -511, or 1 - 65439, blank                  |          |   |
| Slaving Mode  | STRAP   | STRAP / SLAVE / STEER                        |          |   |
| DTMF Output Connected to: Console W/Li  | Yes     | Yes / No                                     |          |   |
| DTMF Output Connected to: E&M Console   | Yes     | Yes / No                                     |          |   |
| DTMF Output Connected to: MRTI Patch  | Yes     | Yes / No                                     |          |   |
| DTMF Output Connected to: Speaker   | Yes     | Yes / No                                     |          |   |
| Standard DTMF Digit Tone Duration   | 100     | 50 - 3000 mSec                               |          |   |
| Long DTMF Digit Tone Duration   | 100     | 50 - 3000 mSec                               |          |   |
| Pause Duration  | 1000    | 500 - 4000 mSec                              |          |   |
| Auto Dial HoldOff Count   | 0       | 0 - 20                                       |          |   |
| <b>CHANGE/VIEW : TX Default Attributes : Handset Default TX Attributes</b>      |         |  |          |   |
| Self ID   | 5       | 1 - 9999999                                  |          |   |
| Talk Group ID   | 4095    | 0 - 65535                                    |          |   |
| Channel   | blank   | 0 - 255, blank                               |          |   |
| Tx Mode   | Clear   | Analog /<br>(Astro) Coded /<br>(Astro) Clear |          |   |
| Key Number  | blank   | 0 - 511, or 1 - 65439, blank                 |          |   |
| <b>CHANGE/VIEW : TX Default Attributes : E&amp;M Console Default Attributes</b> |         |  |          |   |
| Self ID   | 5       | 1 - 9999999                                  |          |   |
| Talk Group ID   | 4095    | 0 - 65535                                    |          |   |
| Channel   | blank   | 0 - 255, blank                               |          |   |
| Tx Mode   | Clear   | Analog /<br>(Astro) Clear /<br>(Astro) Coded |          |   |
| Key Number  | blank   | 0 - 511, or 1 - 65439, blank                 |          |   |

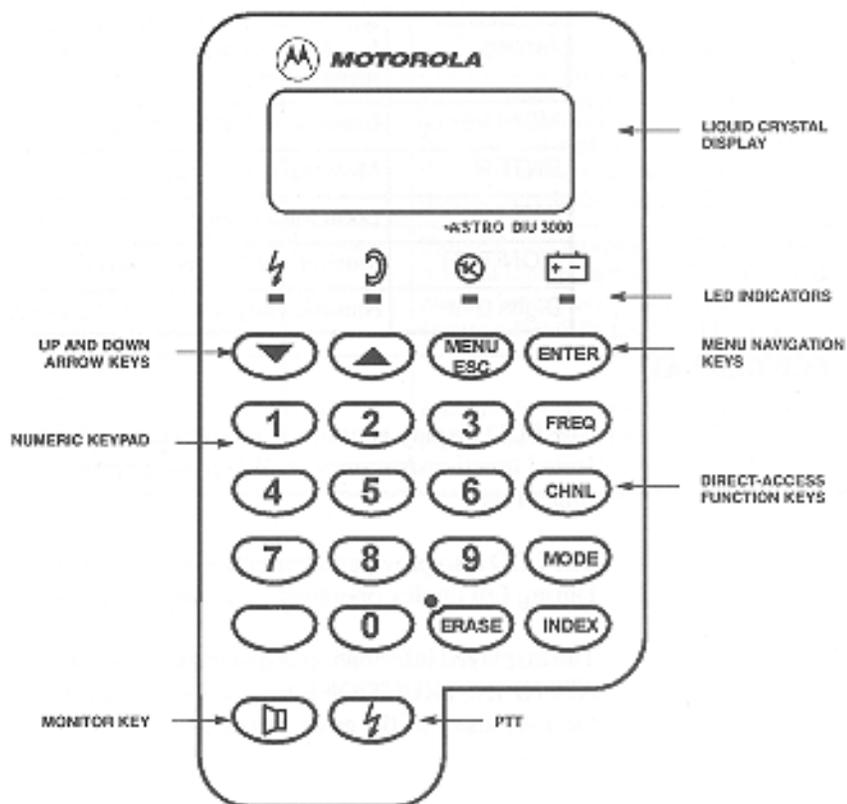
## Operation

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### Controls and Indicators

The DIU3000 controls and indicators are located on the front panel and include a keypad, an LCD display and LED indicators, as shown in Figure 12. The keypad incorporates 21 keys: 15 (one with a LED) are used for direct-access functions and as a numeric keypad, 4 are used for Up, Down, MENU/ESC and ENTER functions, and 2 are used for the PTT and Monitor.

The display is an 8 character LCD with a bar graph indicator. Under the display there are 4 functional LEDs.



**Figure 12**  
DIU3000 Control Panel

The functions of the controls and indicators are briefly defined in the following subparagraphs. Detailed operating instructions are given in "Operating Instructions" on page 37.

## DIU3000 Keypad

The DIU3000 keypad functions are defined in Table 3.

**Table 3**  
DIU3000 Keypad Functions

| Key               | Function   |
|-------------------|--|
| FREQ              | Selection and display of the Function REQuest (FREQ) number associated with the local PTT/handset.   |
| CHNL              | Selection and display of the channel that will be used for transmission from the local PTT/handset.  |
| MODE              | Selection and display of the mode (Analog / ASTRO–Clear / ASTRO Coded) that will be used for transmission from the local PTT/handset. For the Coded mode, the encryption key is selected/displayed, as well. |
| INDEX             | Selection and display of encryption key index (or CKR keyset) that will be used for transmissions.   |
| ERASE             | Encryption key erase (see also “LED Indicators” on page 36).   |
| UP/DOWN<br>Arrows | a. Selection of volume for local monitor.<br>b. Menu navigation and value selection (in conjunction with the menu commands).   |
| MENU/ESC          | Enter menu (MENU)/menu navigation (ESC).   |
| ENTER             | Menu navigation and value confirmation.  |
| PTT               | Local transmission.  |
| MONITOR           | Monitor and Unsquench receive audio path.  |
| Digits 0-9        | Numeric entry (e.g. for channel selection).  |

## LCD Display

The LCD display is used for prompting to operator commands and displaying the selected functions/parameters. When no operations are performed, the LCD displays the time of day.

The LCD also provides a bar graph that indicates the transmit and receive audio levels. During full duplex operation in analog mode, the bar graph is not displayed.

The displayed information is discussed in detail for each procedure given in the “Operating Instructions” on page 37. Refer also to the “Troubleshooting” section on page 66 for a summary of the error messages.

## LED Indicators

The LED functions are as follows:

**Table 4**  
LED Indicators

| LED   | Name           | State    | Indicates that:  |
|---|----------------|----------|--|
|    | Transmit Voice | ON       | A voice transmission to the base station is being performed.   |
|   |                | OFF      | No message is being sent.  |
|    | Receive Voice  | ON       | Indicates voice reception from the base station.   |
|   |                | OFF      | No message from base station.  |
|    | Link Busy      | OFF      | Link establishment to Base Station is in progress and transmission is inhibited.   |
|   |                | ON       | Link to base is up and ready for transmission.   |
|   |                | Flashing | Link establishment to RNC is in progress and data transmission is inhibited.   |
|    | Battery        | OFF      | Proper power supply conditions.  |
|   |                | ON       | No ac power supply - DIU3000 operates from the external backup battery. Downloading codeplug from RSS is disabled.   |
|   |                | Flashing | External backup battery voltage is low, or internal lithium battery voltage is low, or encryption battery voltage is low. Refer to "Troubleshooting" section on page 66. |
|  | Key Erase      | ON       | Encryption key erase operation is either being performed or has been requested.  |

## Operating Instructions

### DIU3000 Power-on

Upon power-on (connection to an ac outlet), the DIU3000 performs power-up self-test and then loads the operating software into the active memory. The following is the sequence of LCD messages during a proper power-on process:

**Table 5**  
Power-On Messages

| Message         | Meaning   |
|-----------------|---|
| <b>CHK DB</b>   | Database checking operations.<br><br>Restoring the parameter database from backup.<br><b>NOTE</b><br>This message is usually too short to notice. However, if this is the first power-on after downloading new parameters from the RSS, or if in the previous stage the database was found corrupted, it is restored (reprogrammed) from the internal backup. This may take up to five minutes, for the duration of which the message <b>PLS WAIT</b> is displayed. Upon successful database programming, the message <b>PROG OK</b> is displayed for a short duration. If the DIU3000 fails to restore the database, an error message is displayed instead of the <b>PROG OK</b> message. If this occurs, refer to "Troubleshooting" section on page 66. |
| <b>LOAD SRV</b> | Software server handling.   |
| <b>DSP BOOT</b> | Loading DSP processors' software.   |
| <b>SELF TST</b> | Checking hardware peripherals.<br><ul style="list-style-type: none"> <li>• During LED tests, all front panel LEDs are lit.</li> <li>• During LCD test, all LCD segments are lit in sequence.</li> <li>• Four tones are heard from the console speaker.</li> <li>• If the handset option is installed, four tones are heard from the handset earpiece.</li> </ul>  |
| <b>TST PASS</b> | The self-test has been successfully completed.<br><b>NOTE</b><br>If the self test fails, the <b>TST FAIL</b> message is displayed, an alert tone is sent to the console and to the handset earpiece. If this occurs, refer to the "Troubleshooting" section on page 66.   |
| <b>LOADING</b>  | Loading application.  |
| <b>HH:MM:SS</b> | The time of day is displayed.<br>If the self test has failed, the <b>TST FAIL</b> message is displayed again, and remains until the operator presses either the MENU/ESC or a direct access key.<br>In such a case, have the unit serviced.   |

After the power-on sequence, the DIU3000 tries to establish a link to the base station, using a handshake procedure. During the link establishment, which takes a few seconds, the LINK BUSY LED is lit. If the link is not connected or the base station is not responding for some other reason, the LED remains lit and the DIU3000 does not allow transmission.

In the ready state, the LCD displays the time of day and the unit is ready for operation. Any control equipment connected to the DIU3000 can now be used for controlling the base station.

## **Menu Command Reference**

Most of DIU3000 operating parameters can be controlled using the DIU RSS. However, some of the parameters should be set or changed more frequently, without the need to connect an external computer. These parameters are accessed via the MENU/ESC key.

### **Menu Navigation**

#### Accessing the Menu Commands

The parameters and functions accessed via the MENU/ESC key are organized in a tree-like structure, or a "menu", shown in Figure 13.

Moving between same level menu entries is performed using the  $\uparrow/\downarrow$  arrows; moving to an inner level menu entry is performed using the ENTR key.

The states at which parameter value can actually be set and functions activated are located at an additional level, not shown in Figure 13. The figure shows only the paths to those states. The states are accessed by pressing the ENTR key from the last level shown.

#### Changing a Value

In this state the LCD display usually blinks. There are two possible methods to change a value:

- Scrolling through the available options using the  $\uparrow/\downarrow$  arrow keys.
- Keying in a numeric value using the 10-digit numeric keypad.

In some of the cases only one of the methods is available, as detailed in the procedures in the following paragraphs. Both methods require the usage of the ENTR key for selection confirmation and movement to the upper tree level.

If arrow keys are used for displaying the available values, then the process is circular.

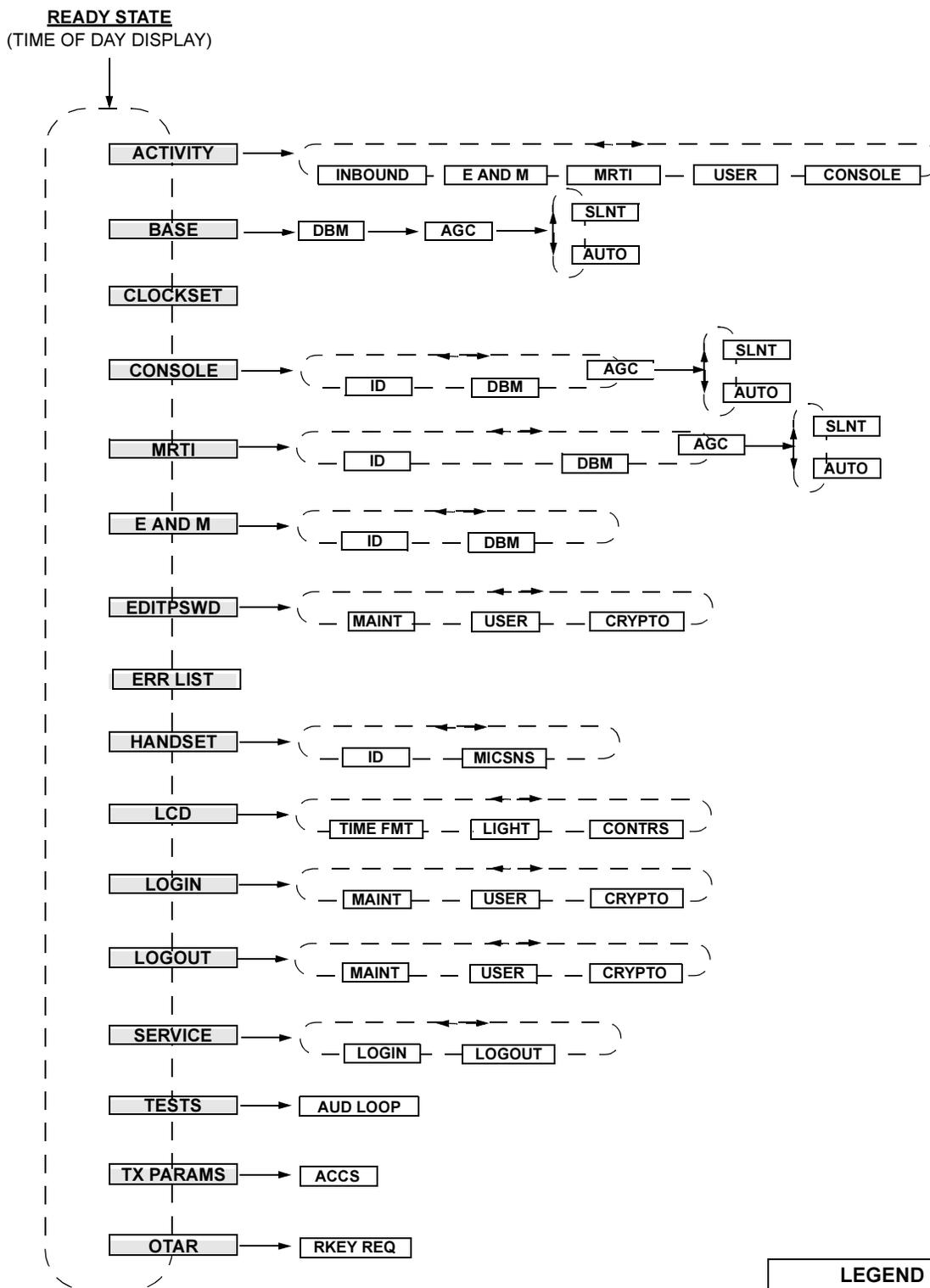
If the numeric keypad is used for changing a value, and the value is out of range, an error message is displayed for a short period, and the previously active value is displayed again.

#### Cancelling the Menu Commands

Pressing MENU/ESC while performing a Menu command will return to the previous level menu entry without performing the selected function. If the first level has already been reached, pressing MENU/ESC will exit the menu command mode and return to the ready state (time of day display).

#### Error Messages

The "Troubleshooting" section on page 66 describes the error messages that are displayed in case of incorrect operation.



**LEGEND**

- -> Use arrows  $\uparrow/\downarrow$
- ↓ Use  $\text{[ENTR]}$  key

\*NOTE: The TESTS menu is visible only after entering the Service password.

**Figure 13**  
Menu Operation Tree

**ACTIVITY**

This menu provides a means of monitoring transmit/receive parameters of the DIU3000 and control devices connected to it.

- For the **CONSOLE** (TRC type analog console), the **CHaNneL** and **MODE** parameters of the current transmission can be traced. If not currently transmitting, the last active parameters are displayed.
- For the **USER** (local user, handset), the Function **REQ**uest no., **CHaNneL** and **MODE** parameters of the current transmission can be traced. If not currently transmitting, the last active parameters are displayed.
- For the **INBOUND** activity, the **MODE** parameter can be traced. If there is currently no inbound activity, the **MODE** of the last inbound reception is displayed.

**Table 6**

| Action   | LCD Display  | Comments   |
|--|--|--|
| 1. While in the ready mode, press MENU/ESC to enter the menu mode.   |  | The last accessed menu entry is shown.   |
| 2. Scroll until <b>ACTIVITY</b> is shown.  | <b>ACTIVITY</b>  |  |
| 3. Press <b>ENTR</b> to enter the device selection menu.   | <b>CONSOLE</b><br>or<br><b>USER</b><br>or<br><b>INBOUND</b>                              |  |
| 4. Scroll to display the required device option.   |  |  |
| 5. Press <b>ENTR</b> to display activity parameters that can be traced for the selected device.  | <b>FREQ nnn</b><br>or<br><b>CHNL nnn</b><br>or<br><b>ANALOG/<br/>CLEAR/<br/>ENCR nnn</b> | <ul style="list-style-type: none"> <li>• The data displayed is updated once a second, or if <b>ENTR</b> is pressed.</li> <li>• If there was no inbound process since power-up and <b>ENTR</b> is pressed while in <b>INBOUND ACTIVITY</b> display state, the message <b>NO INFO</b> is displayed.</li> </ul> |
| <b>NOTE</b>  |  |  |
| <ul style="list-style-type: none"> <li>• For the <b>CONSOLE</b> activity, only the <b>CHaNneL</b> and <b>MODE</b> parameters can be traced.</li> <li>• For the <b>INBOUND</b> activity, only the <b>MODE</b> parameter can be traced.</li> </ul> |  |  |
| 6. Use the arrow keys to scroll between the available parameters.  | <b>CONSOLE</b><br>or<br><b>USER</b><br>or<br><b>INBOUND</b>                              |  |
| 7. Press <b>MENU/ESC</b> to return to the device selection menu.   |  |  |
| 8. Repeat steps 4 to 7 to trace another device, or press <b>MENU/ESC</b> twice to return to the ready state.   |  |  |

## BASE STATION

This function allows changing/viewing the signal level of the communication interface to the base station. The line signal level can be set within the range of -20 to 0 dBm.



**Notes**

Changing the signal level requires entering the Service password (see "SERVICE" section on page 55).

MRTI (analog and digital inbound), Console (analog and digital inbound) and Base Station (analog outbound) audio levels may be set in RSS or from the front panel display (after entering service mode, password: 039302164). Each interface may be changed by 20 dB in 1 dB increments. Because the DIU passes and generates voice and tones at various levels, there is no absolute output level as suggested by the term 'dBm' on the front panel display. The term 'dBm' that accompanies gain settings in RSS and the front panel display should be interpreted as a rough estimate of signal output. In other words, the output level display should be thought of as a volume gain control, not as an absolute level indicator. The exact output, in dBm, is a function of 1) the source level, 2) the output level setting and 3) the averaging method used to measure the signal.

### Changing the Base DBM Value

**Table 7**

| Action   | LCD Display        | Comments                                      |
|--|--------------------|---|
| 1. While in the ready mode, press MENU/ESC to enter the menu mode. |                    | The last accessed menu entry is shown.        |
| 2. Scroll until BASE is shown.                                     | <b>BASE</b>        |   |
| 3. Press ENTR.   | <b>DBM nn</b>      |   |
| 4. Press ENTR.   | <b>DBM nn</b>      | "nn" blinks.                                  |
| 5. Scroll to select the required value.                            | <b>DBM mm</b>      | "mm" indicates the new selected signal level. |
| 6. Press ENTR to confirm the selection.                            | <b>DBM mm</b>      |   |
| 7. Press MENU/ESC twice to return to the ready state.              | <b>8 : 46 : 16</b> |   |

### Changing the Base AGC

This menu controls the setting of the base analog port AGC silent level. The allowable range of values for the silent level is 0–255. The following silent level values should be considered default values:

- 5–when version B or earlier wireline board is used.
- 50–when version C or later wireline board is used.

Version numbers can be obtained via RSS in the Main/Service/DIU-Config/HW-Version screen.

Once the correct default value is chosen, perform the following verification procedure for NON-ZERO silent levels.

**Silent Level Verification Test:**

This procedure should be used to verify that NON-ZERO silent levels are set properly.

1. Enter the DIU's Maintenance Password (039302164) at the DIU's front panel.
2. Go to the DIU's front panel menu labeled Base -> AGC -> AUTO.
3. Press **[Enter]** on the DIU's front panel. The screen should now flash "AUTO RDY".
4. Start an inbound analog call. If using a subscriber, use strong signal conditions.
5. While background noise is being transmitted (i.e. no audio), press **[Enter]** on the DIU's front panel.
6. Take note of this number returned on the DIU's display.
7. While the inbound call is still active, place a -10 dBm tone on the base -> DIU wireline.
8. Press **[Enter]** on the DIU's front panel. The screen should now flash "AUTO RDY".
9. While the tone is connected press **[Enter]** on the DIU's front panel.
10. Take note of the number returned on the DIU's display.
11. Verify or change the silent level using the "Results" section below and program the DIU with this value.

**Results:**

- If the default silent level is equal to or greater than the number returned in step 6, use the default silent level. This number should be less than the number returned in step 10.
- If the default silent level is less than the number returned in step 6 and the DIU has version B or earlier Wireline board, use the number returned in step 6 as the silent level.
- If the default silent level is less than the number returned in step 6 and the DIU has version C or later Wireline board, use the number returned in step 6 and add 20 to it.

**Note**

The silent level chosen should be in between the two numbers returned in steps 6 and 10. If the DIU input is noisy then the two numbers may be very close. This situation will lead to poor operation. The DIU will not be able to accurately differentiate between audio and noise. In this case it is best to select the value returned in step 6 to ensure audio will trip the silent level.

## CLOCK SETting

This menu is used for setting the LCD clock time. The time is set by changing the hours and minutes, according to the time format set via the LCD menu.

**Table 8**

| Action   | LCD Display        | Comments   |
|--|--------------------|--|
| 1. While in the ready mode, press MENU/ESC to enter the menu mode. |                    | The last accessed menu entry is shown.               |
| 2. Scroll until CLOCKSET is shown.                                 | <b>CLOCKSET</b>    |  |
| 3. Press ENTR to enter the hour setting state.                     | <b>HH:MM:SS</b>    |  |
| 4. Scroll to select the required value.                            | <b>HH:MM:SS</b>    |  |
| 5. Press ENTR to enter the minute setting state.                   | <b>HH:MM:SS</b>    |  |
| 6. Scroll to select the required value.                            | <b>HH:MM:SS</b>    |  |
| 7. Press ENTR to confirm the new time setting.                     | <b>HH:MM:00</b>    | The seconds are reset and the new time is displayed. |
| 8. Press MENU/ESC key to return to the ready state.                | <b>8 : 45 : 16</b> |  |

## CONSOLE

This menu controls the parameters of the communication interface to the analog console. In the current version of the DIU3000, only the TRC type analog console is supported. The following parameter can be changed:

- Line signal level. The line signal level can be set within the range of –20 to 0 dBm.



### Notes

Changing the line signal level requires entering the Service password (see “SERVICE” section on page 55).

MRTI (analog and digital inbound), Console (analog and digital inbound) and Base Station (analog outbound) audio levels may be set in RSS or from the front panel display (after entering service mode, password: 039302164). Each interface may be changed by 20 dB in 1 dB increments. Because the DIU passes and generates voice and tones at various levels, there is no absolute output level as suggested by the term 'dBm' on the front panel display. The term 'dBm' that accompanies gain settings in RSS and the front panel display should be interpreted as a rough estimate of signal output. In other words, the output level display should be thought of as a volume gain control, not as an absolute level indicator. The exact output, in dBm, is a function of 1) the source level, 2) the output level setting and 3) the averaging method used to measure the signal.

The following parameter can be viewed:

- ID. Enables viewing the console ID, shown in hexadecimal format.

**Table 9**

| Action  | LCD Display                          | Comments   |
|---|--------------------------------------|--|
| 1. While in the ready mode, press MENU/ESC to enter the menu mode.        |                                      | The last accessed menu entry is shown.                           |
| 2. Scroll until CONSOLE is shown.   | <b>CONSOLE</b>                       |  |
| 3. Press ENTR to display the options.                                     | <b>DBM nn</b><br>or<br><b>ID HHH</b> |  |
| 4. Scroll to select the required option.                                  |                                      | ID HHH shows the console ID in hexadecimal format.               |
| If changing/viewing of line signal level is not required, skip to step 9. |                                      |  |
| 5. Scroll to select the DBM option.                                       | <b>DBM nn</b>                        | “nn” indicates the currently selected signal level in dBm units. |
| 6. Press ENTR.  | <b>DBM nn</b>                        | “nn” blinks.   |
| 7. Scroll to select the required value.                                   | <b>DBM mm</b>                        | “mm” indicates the new selected signal level.                    |
| 8. Press ENTR to confirm the selection.                                   | <b>DBM mm</b>                        |  |
| 9. Press MENU/ESC twice to return to the ready state.                     | <b>8 : 46 : 16</b>                   |  |

### Console AGC

This menu controls the setting of the console analog port AGC silent level. The allowable range of values for the silent level is 0-255. The following silent level values should be considered default values.

- 0—only TRC consoles with version B or earlier wireline board.
- 5—only digital keying consoles (DKC) with version B or earlier wireline board.
- 0—both TRC and DKC consoles with version B or earlier wireline board.
- 50—if TRC, DKC, or both (TRC and DKC) consoles with version C or later wireline board.

Wireline version numbers can be obtained via RSS in the Main/Service/DIU-Config/HW-Version screen.

Once the correct default value is chosen, perform the following verification procedure for NON-ZERO silent levels.

#### **Silent Level Verification Test:**

This procedure should be used to verify that NON-ZERO silent levels are set properly.

1. Enter the DIU's Maintenance Password (039302164) at the DIU's front panel.
2. Go to the DIU's front panel menu labeled CONSOLE -> AGC -> AUTO.
3. Press **[Enter]** on the DIU's front panel. The screen should now flash “AUTO RDY”.
4. Start an outbound call from the console.
5. While background noise is being transmitted (i.e. no audio), press **[Enter]** on the DIU's front panel.
6. Take note of the number returned on the DIU's display.
7. While the console is still keyed, place a -10 dBm tone on the console ->DIU wireline.
8. Press **[Enter]** on the DIU's front panel. The screen should now flash “AUTO RDY”.
9. While the tone is being transmitted press **[Enter]** on the DIU's front panel.
10. Take note of the number returned on the DIU's display.
11. Verify or change the silent level using the “Results” section below and program the DIU with this value.

#### **Results:**

- If the default silent level is equal to or greater than the number returned in step 6, use the default silent level. This number should be less than the number returned in step 10.
- If the default silent level is less than the number returned in Step 6 and the DIU has version B or earlier Wireline Board, use the number returned in step 6 as the silent level.

- If the default silent level is less than the number returned in step 6 and the DIU has version C or later Wireline Board, use the number returned in step 6 and add 20 to it.



**Note**

The silent level chosen should be in between the two numbers returned in steps 6 and 10. If the DIU input is noisy then the two numbers may be very close. This situation will lead to poor operation. The DIU will not be able to accurately differentiate between audio and noise. In this case it is best to select the value returned in step 6 to ensure audio will trip the silent level.

## EDIT PASSWORD

The EDITPSWD function is used to change the password. All three types of passwords can be changed via this function, one password at a time.

**Table 10**

| Action   | LCD Display  | Comments   |
|--|--|--|
| 1. While in the ready mode, press MENU/ESC to enter the menu mode.   |  | The last accessed menu entry is shown.   |
| 2. Scroll until EDITPSWD is shown.   | <b>EDITPSWD</b>  |  |
| 3. Press ENTR to display the password types.   | <b>USER</b><br>or<br><b>CRYPTO</b><br>or<br><b>MAINT</b>           |  |
| 4. Scroll to select the required option.   |  |  |
| 5. Press ENTR .  | <b>USER PSWD</b><br>or<br><b>CRY PSWD</b><br>or<br><b>MAI PSWD</b> | The display blinks.  |
| 6. Key in the password.  | -----  | A short bar is displayed for each key depression.  |
| 7. Press ENTR.   | <b>NEW PSWD</b>  |  |
| 8. Key in the new password.  | -----  |  |
| <b>NOTE</b>  |  |  |
| The password may contain from 6 to 10 digits. For passwords that exceed eight digits, only the last eight are shown. |  |  |
| 9. Press ENTR.   | <b>AGAIN</b>   | The operator is required to confirm the new password by reentering it again.                                       |
| 10. Key in the new password again.   | -----  | The message "PSWD OK" is displayed for a few seconds and the DIU3000 returns to the EDITPSWD function entry state. |
| 11. Press ENTR.  | <b>PSWD OK</b>   |  |
| 12. Press MENU/ESC to return to the ready state.   | <b>8 : 45 : 16</b>   |  |

**ERRor LIST**

The DIU3000 performs a series of tests (BIT) upon power-on. If a test fails, a general error message is displayed on the LCD and the failed test number is stored in the DIU3000 memory. Failures can also be detected during normal operation, in which case they are also recorded. The ERR LIST function is used to retrieve the recorded numbers of the failed tests.

**Table 11**

| <b>Action</b>  | <b>LCD Display</b>              | <b>Comments</b>  |
|--|---------------------------------|--|
| 1. While in the ready mode, press MENU/ESC to enter the menu mode. |                                 | The last accessed menu entry is shown.   |
| 2. Scroll until ERR LIST is shown.                                 | <b>ERR LIST</b>                 |  |
| 3. Press ENTR.   | <b>NO ERR<br/>or<br/>TOT nn</b> | "NO ERR" indicates that no failures have been detected.<br>"TOT nn" indicates the total number of detected failures. |
| 4. If TOT nn is displayed, scroll to view the stored failures.     | <b>ERR n</b>                    | "n" indicates the number of the recorded failed test. Refer to TROUBLESHOOTING section for error definitions         |
| 5. Press MENU/ESC twice to return to the ready state.              | <b>8 : 46 : 16</b>              |  |

## HANDSET

This menu is used for controlling the local handset microphone sensitivity and for viewing the handset ID. The microphone sensitivity allowed range is 0 - 9. The handset ID can be viewed but not changed. It can be set only by the RSS. The handset ID is shown in hexadecimal format.



**Note**

Changing the microphone sensitivity level requires entering the Service password (see "SERVICE" section on page 55).

**Table 12**

| Action  | LCD Display                            | Comments   |
|---|--|--|
| 1. While in the ready mode, press MENU/ESC to enter the menu mode.            |  | The last accessed menu entry is shown.   |
| 2. Scroll until HANDSET is shown.   | <b>HANDSET</b>                         |  |
| 3. Press ENTR.  | <b>ID HHH</b><br>or<br><b>MICSNS n</b> | "ID HHH" indicates the current ID in hexadecimal format;<br>"MICSNS n" indicates the current microphone sensitivity. |
| 4. Scroll to select the required option.                                      | <b>ID HHH</b><br>or<br><b>MICSNS n</b> |  |
| 5. Press ENTR.  | <b>MICSNS n</b>                        | "n" blinks.  |
| 6. Scroll between the available options or key in the required value (0 - 9). | <b>MICSNS m</b>                        | "m" blinks.  |
| 7. Press ENTR to confirm the selection.                                       | <b>MICSNS m</b>                        |  |
| 8. Press MENU/ESC twice to return to the ready state.                         | <b>8 : 46 : 16</b>                     |  |

## LCD

This menu controls the current setting of the LCD. The following display properties may be changed:

- Brightness. Three brightness levels are available: LIGHT 0 through LIGHT 2.
- Contrast. Ten levels are available: CONTRS 0 through CONTRS 9.
- Time format. The user can select either a 12 and 24 hour format.

**Table 13**

| Action   | LCD Display                                 | Comments                                    |
|--|---|---|
| 1. While in the ready mode, press MENU/ESC to enter the menu mode. |   | The last accessed menu entry is shown.      |
| 2. Scroll until LCD is shown.                                      | LCD   |   |
| 3. Press ENTR to display the options.                              | CONTRS n<br>or<br>LIGHT n<br>or<br>TIME FMT | "n" indicates the currently selected level. |
| 4. Scroll to select the required option.                           | CONTRS n<br>or<br>LIGHT n<br>or<br>TIME FMT |   |

For the following instructions refer to

- "Changing the LCD Contrast Level" section on page 51 for changing the contrast; or
- "Changing the LCD Brightness (Light) Level" section on page 52 for changing the brightness; or
- "Changing the Time Format" section on page 52 for changing the time format.

### Changing the LCD Contrast Level

**Table 14**

| Action   | LCD Display | Comments  |
|--|-------------|---|
| 1. Perform the instructions given in "LCD" section on page 51. | CONTRS n    | "n" indicates the currently selected level.   |
| 2. Press ENTR  | CONTRS n    | "n" blinks.   |
| 3. Scroll to select (or key in) the required value.            | CONTRS m    | The display contrast is updated immediately upon each change. The number indicating the contrast level continues blinking to indicate that the DIU3000 is still in the contrast changing mode |
| 4. Press ENTR or MENU/ESC to exit the contrast changing state. | CONTRS m    | The MENU/ESC key can also be used in this step to exit the property changing state, since the display contrast is updated immediately and no selection confirmation is required.              |
| 5. Press MENU/ESC twice to return to the ready state.          | 8 : 46 : 16 |   |

Changing the LCD Brightness (Light) Level**Table 15**

| Action   | LCD Display | Comments   |
|--|-------------|--|
| 1. Perform the instructions given in "LCD" section on page 51. | LIGHT n     | "n" indicates the currently selected level.  |
| 2. Press ENTR.   | LIGHT n     | "n" blinks.  |
| 3. Scroll to select (or key in) the required value.            | LIGHT m     | The display brightness is updated immediately upon each change. The number indicating the brightness level continues blinking to indicate that the DIU3000 is still in the brightness changing mode. |
| 4. Press ENTR to exit the brightness changing state.           | LIGHT m     | The MENU/ESC key can also be used in this step to exit the property changing state, since the display brightness is updated immediately and no selection confirmation is required.                   |
| 5. Press MENU/ESC twice to return to the ready state.          | 8 : 46 : 16 |  |

Changing the Time Format**Table 16**

| Action   | LCD Display  | Comments   |
|--|--|--|
| 1. Perform the instructions given in "LCD" section on page 51. | TIME FMT   |  |
| 2. Press ENTR.   | 12 HR<br>or<br>24 HR   | "12" or "24" blinks.   |
| 3. Scroll to select the required option.                       | 12 HR<br>or<br>24 HR   | "12" or "24" blinks.   |
| 4. Press ENTR to confirm the selection.                        | HH : MM : SS<br>or<br>A HH : MM : SS<br>or<br>P HH : MM : SS | The time is displayed in the selected format for a short period. |

## LOGIN

If FIPS is enabled (by RSS), login command allows opening an encrypted session by entering a password. The DIU3000 differentiates between three operator roles, each of which requiring a separate password. For initial installation, role and password assignments are made with the DIU3000 RSS and may subsequently be changed either from the RSS or from the DIU3000 (see “EDIT PASSWORD” section on page 48).



### IMPORTANT

Login in MAINTenance role results in zeroization of all key variables.

**Table 17**

| Action  | LCD Display   | Comments  |
|---|---|---|
| 1. While in the ready mode, press MENU/ESC to enter the menu mode.  |   | The last accessed menu entry is shown.  |
| 2. Scroll until LOGIN is shown.   | <b>LOGIN</b>  |   |
| 3. Press ENTR to display session types.   | <b>USER</b><br>or<br><b>CRYPTO</b><br>or<br><b>MAINT</b>          |   |
| 4. Scroll to display the required option.   |   |   |
| 5. Press ENTR to initiate password entry.   | <b>USR PSWD</b><br>or<br><b>CRY PSWD</b><br>or<br><b>MAI PSWD</b> | The display blinks.   |
| 6. Key in the password.   | -----   | A short bar is displayed for each key depression.   |
| 7. Press ENTR.  | <b>PSWD OK</b>  | The message "PSWD OK" is displayed for a few seconds and the DIU3000 returns to the login mode entry state. |
| <b>NOTE</b>   |   |   |
| If an invalid password is entered more than 10 times consecutively, the encryption processor in the DIU3000 assumes a “tamper” operation and locks the access to the encryption functions. Unlocking the encryption requires servicing. |   |   |
| 8. Press MENU/ESC to return to the ready state.   | <b>8 : 45 : 16</b>  |   |

## LOGOUT

This command is used to terminate an encrypted session. The operator is required to indicate the type of session that should be terminated.

**Table 18**

| Action   | LCD Display                                    | Comments   |
|--|--|--|
| 1. While in the ready mode, press MENU/ESC to enter the menu mode. |  | The last accessed menu entry is shown.   |
| 2. Scroll until LOGOUT is shown.                                   | <b>LOGOUT</b>                                  |  |
| 3. Press ENTR to display session types.                            | <b>USER<br/>or<br/>CRYPTO<br/>or<br/>MAINT</b> |  |
| 4. Scroll to display the required option.                          |  |  |
| 5. Press ENTR to logout.   | <b>LOG OUT<br/>...<br/>and then<br/>LOGOUT</b> | The LOG OUT message (with a space between LOG and OUT) is displayed for a few seconds to indicate termination of an encrypted session and then returns to the logout mode entry state. |
| 6. Press MENU/ESC to return to the ready state.                    | <b>8 : 45 : 16</b>                             |  |

## SERVICE

The **SERVICE** menu is used to log into and out of the service session. Logging into the service session is a prerequisite for changing the following DIU3000 parameters:

- The signal level of the communication interface to the base station (see “BASE STATION” section on page 41).
- The signal level of the communication interface to the console (see “CONSOLE” section on page 44).
- The local handset microphone sensitivity level (see “HANDSET” section on page 50).

The service password is constant and preset to “039302164”.

The Service session can be active concurrently with any of the encrypted sessions.

### Initiating a Service Session

**Table 19**

| Action   | LCD Display                         | Comments   |
|--|-------------------------------------|--|
| 1. While in the ready mode, press MENU/ESC to enter the menu mode. |                                     | The last accessed menu entry is shown.   |
| 2. Scroll until SERVICE is shown.                                  | <b>SERVICE</b>                      |  |
| 3. Press ENTR to display options.                                  | <b>LOGIN</b><br>or<br><b>LOGOUT</b> |  |
| 4. Scroll to display LOGIN.  | <b>LOGIN</b>                        |  |
| 5. Press ENTR to initiate password entry.                          | <b>SRV PSWD</b>                     | The display blinks.  |
| 6. Key in the password - “039302164”.                              | -----                               | A short bar is displayed for each key depression.  |
| 7. Press ENTR.   | <b>PSWD OK</b>                      | The message “PSWD OK” is displayed for a few seconds and the DIU3000 returns to the SERVICE display. |
| 8. Press MENU/ESC to return to the ready state.                    | <b>8 : 45 : 16</b>                  |  |

Terminating a Service Session**Table 20**

| <b>Action</b>  | <b>LCD Display</b>                              | <b>Comments</b>   |
|--|---|---|
| 1. While in the ready mode, press MENU/ESC to enter the menu mode. |   | The last accessed menu entry is shown.  |
| 2. Scroll until SERVICE is shown.                                  | <b>SERVICE</b>                                  |   |
| 3. Press ENTR to display options.                                  | <b>LOGIN<br/>or<br/>LOGOUT</b>                  |   |
| 4. Scroll until LOGOUT is shown.                                   | <b>LOGOUT</b>                                   |   |
| 5. Press ENTR to logout.   | <b>LOG OUT<br/>...<br/>and then<br/>SERVICE</b> | The LOG OUT message (with a space between LOG and OUT) is displayed for a few seconds to indicate termination of an encrypted session and then returns to the service mode entry state. |
| 6. Press MENU/ESC to return to the ready state.                    | <b>8 : 45 : 16</b>                              |   |

## TESTS

This menu currently includes the Audio Loop test. In the future DIU3000 versions, the menu will provide access to additional tests.



**Note**

Performing the Audio Loop test requires entering the Service password.

### Audio Loop Test

This test is used for stand alone testing of the DIU3000 during system troubleshooting. For details, refer to Figure 14 on page 77.

## TX PARAMS

The TX PARMS (Transmission Parameters) menu is used only for changing the access code for local transmission. This access code is attached to the outgoing messages sent from the DIU3000 using the PTT or local handset.

The access code allowable range is 0 to 255 and "none". When "none" is selected ("- - -" is displayed), no access code is included in the transmission. The value "none" is selected by scrolling to "- - -" or keying in a value larger than 255.

**Table 21**

| Action   | LCD Display        | Comments  |
|--|--------------------|---|
| 1. While in the ready mode, press MENU/ESC to enter the menu mode.   |                    | The last accessed menu entry is shown.  |
| 2. Scroll until TX PARMS is shown.   | <b>TX PARMS</b>    |   |
| 3. Press ENTR to display the parameter options (currently only the Access Code).                           | <b>ACCS nnn</b>    | "nnn" indicates the current access code value.  |
| 4. Press ENTR to enter the access code editing state.  | <b>ACCS nnn</b>    | "nnn" blinks.   |
| <b>NOTE</b>  |                    |   |
| Pressing MENU/ESC at this stage will return to the access code display state retaining the previous value. |                    |   |
| 5. Scroll between the available values or key in the required value.                                       | <b>ACCS mmm</b>    | "mmm" blinks. Selecting the "- - -" value by scrolling or keying in a value larger than 255 sets the access code to "none". |
| 6. Press ENTR to confirm the selection.  | <b>ACCS mmm</b>    | The DIU3000 returns to the access code display state.   |
| 7. Press MENU/ESC key twice to return to the ready state.  | <b>8 : 45 : 16</b> |   |

## OTAR

This menu controls the initiation of an OTAR rekey request.

**Table 22**

| Action                                     | LCD Display     | Comments   |
|--|-----------------|--|
| 1. Press ESC to enter menu mode.           |                 |  |
| 2. Scroll until OTAR is shown.             | <b>OTAR</b>     |  |
| 3. Press ENTR to display Rekey .           | <b>Rekey RQ</b> |  |
| 4. Press ENTR to initiate a rekey request. | <b>OTR WAIT</b> | Other OTAR statuses will be displayed as the request is processed. |

## Local Console-Like Functions

### General

In addition to interfacing other control equipment to the base station, the DIU3000 flexible design also provides the user with console-like capabilities. The built-in PTT allows sending of the ASTRO signalling data and base station control commands to the base station. Adding an optional handset allows operating the DIU3000 in a console-like manner, such as transmitting and receiving audio messages.

The following sections describe how to control the DIU3000 "local console" parameters related to PTT and handset operation, and how to use the DIU3000 "console" functions. The following procedures are covered:

- Function REQuest (FREQ) Selection
- CHaNneL Selection
- MODE Selection
- Key Index Selection
- Volume Control
- Transmission
- Encryption Key Erasure
- Monitor



**Note**

The memory that stores the DIU3000 "local console" parameters is backed up by a battery. Therefore, these parameters are not erased when the DIU3000 is turned off and restored when the DIU3000 is turned on again.

### Error Messages

Refer to the "Troubleshooting Using the Error List Function" section on page 69 for description of error messages that are displayed in case of incorrect operation.

**FREQ****Function Request Selection**

The DIU3000 converts the TRC command into a combination of ASTRO commands, referred to as Function REQuests (FREQs). Each TRC function tone (single- or dual-tone) is converted into a different FREQ. A FREQ may include up to seven ASTRO Signalling, Base Station control and DIU3000 control commands. The DIU3000 RSS maintains the TRC FUNCTIONALITY TABLE that defines the FREQ functions and associates FREQ numbers to function tones.

The FREQ key is used to select the FREQ No. associated with transmission from the local PTT/handset.

**Table 23**

| Action   | LCD Display     | Comments  |
|--|-----------------|---|
| 1. Press FREQ.   | <b>FREQ nnn</b> | "nnn" indicates the currently selected FREQ number. |
| <b>NOTE</b>  |                 |   |
| An asterisk is displayed in front of the FREQ number (e.g., "FREQ * 123"), when some of the transmit parameters controlled by this FREQ have been manually set via the direct access keys. The asterisk is removed when another FREQ is selected or the same FREQ is reselected. |                 |   |
| 2. Press ENTR to enter the FREQ number editing state.  | <b>FREQ nnn</b> | "nnn" blinks.                                       |
| 3. Key in the required value or scroll through the available values using the arrows.  | <b>FREQ mmm</b> | The selected value blinks.                          |
| <b>NOTE</b>  |                 |   |
| Pressing CHNL or MENU/ESC at this stage will return to the FREQ number display state retaining the previous frequency value.   |                 |   |
| 4. Press ENTR to confirm the selection.  | <b>FREQ mmm</b> | The DIU3000 returns to the frequency display state. |

**CHNL****Channel Selection**

The CHNL key is used to select the channel command associated with the local PTT.

The available values are 0 through 255. An additional value allowed for the channel selection is the "don't care". When the channel is set to this value (" - - ") is displayed in the value field) the channel is determined by the base station (usually the last channel used). It is also possible to select the "don't care" value by keying in an out of range value.

**Table 24**

| <b>Action</b>  | <b>LCD Display</b> | <b>Comments</b>  |
|--|--------------------|--|
| 1. Press CHNL to enter the channel display state.  | <b>CHNL nnn</b>    | "nnn" indicates the currently selected channel number. |
| 2. Press ENTR to enter the channel editing state.  | <b>CHNL nnn</b>    | "nnn" blinks.  |
| 3. Key in the required value or scroll through the available values using the arrows.                                  | <b>CHNL mmm</b>    | The selected value blinks.                             |
| <b>NOTE</b>  |                    |  |
| Pressing CHNL or MENU/ESC at this stage will return to the channel display state retaining the previous channel value. |                    |  |
| 4. Press ENTR to confirm the selection and to return to the channel display state.                                     | <b>CHNL 46</b>     |  |



### Mode Selection

The MODE key is used to select the base station mode that will be used for the local handset communications. The available modes are Analog, ASTRO Clear and ASTRO Encrypted. For operation in the ASTRO Encrypted mode, this procedure is used for selection of the transmission encryption key, as well.

Selection of the Encrypted mode differs from other modes and therefore is described separately.

#### Analog and Clear Mode Selection

The following table describes the selection of the Analog and ASTRO Clear base station modes.

**Table 25**

| Action  | LCD Display  | Comments  |
|---|--|---|
| 1. Press MODE to enter the mode display state.  | <b>ANALOG</b><br>or<br><b>CLEAR</b><br>or<br><b>ENCR nnn</b> | The current mode is displayed.  |
| 2. Press ENTR to enter the mode selection state.  |  | The displayed mode blinks.  |
| <b>NOTE</b><br>Pressing MODE or MENU/ESC at this stage will return to the mode display state retaining the previous mode. |  |   |
| 3. Scroll to display the required mode (ANALOG or CLEAR).   | <b>ANALOG</b><br>or<br><b>CLEAR</b>                          | The displayed mode blinks.  |
| 4. Press ENTR to confirm the selection.   |  | Use the MENU/ESC key instead of the ENTR key, to abort mode selection and return to the mode display state retaining the previous mode. |

#### ASTRO Encrypted Mode Selection

This paragraph describes the selection of the ASTRO Encrypted mode and its associated encryption key. The following rules apply to the key selection:

- The USER and the CRYPTO officer are allowed to select the 1 – 8 and the “don't care” (see below) keys.
- The MAINTenance officer is allowed to select the 996 – 999 (test) and the “don't care” (see below) keys.
- When the key is set to “**don't care**” (“- - -” is selected), the encryption key is determined by the last key used. It is also possible to select the “don't care” value by keying in an out of range value.

**Note**

When FIPS is enabled, entering the ASTRO Encrypted mode is allowed only if the operator has already entered a valid password (see "LOGIN" section on page 53).

**Table 26**

| <b>Action</b>  | <b>LCD Display</b>   | <b>Comments</b>  |
|--|--|--|
| 1. Press MODE to enter the mode display state.   | <b>ANALOG</b><br>or<br><b>CLEAR</b><br>or<br><b>ENCR nnn</b> | The current mode is displayed.   |
| 2. Press ENTR to enter the mode selection state.   |  | The displayed mode blinks.   |
| 3. Scroll to display the Encrypted mode selection.   | <b>ENCR nnn</b>  | "ENCR" blinks and "nnn" indicates the active encryption key.   |
| 4. Press ENTR to enter encryption key selection state.   | <b>KEY nnn</b>   | The active encryption key number blinks.   |
| 5. Key in the required value or scroll through the available values using the arrows. The "don't care" key is accessed by scrolling to "--" or by keying in an out of range value. | <b>KEY mmm</b>   | The selected value blinks. The USER and the CRYPTO officer are allowed to select the 1 – 8 and the "don't care" (- -) keys. The MAINTenance officer is allowed to select the 996 – 999 (test) and the "don't care" (- -) keys. |
| <b>NOTE</b>  |  |  |
| Pressing MODE or MENU/ESC at this stage will return to the mode display state retaining the previous key value.  |  |  |
| 6. Press ENTR to confirm the selection.  | <b>ENCR mmm</b>  | Use the MENU/ESC key instead of the ENTR key, to abort value entry and return to the mode display state retaining the previous mode.   |

**INDEX****Key Index/CKR Keypad Selection**

Key indexing is a feature that allows instantaneous switchover between different sets of encryption keys. This way a set of new keys can be programmed into the various system devices (DIU3000s, subscribers, etc.) at different times and remain stored in the device's memories in an inactive state. Later, all those devices can simultaneously be switched to the new key set.

Key Index

The DIU3000 supports two encryption key sets, referred to as indexes. A distinct name (also referred to as "alias") is assigned to each index and loaded by means of the KVL (KEY Variable Loader) on the front panel.

The **INDX** key allows switching between the two available indexes. The index alias cannot be altered from the DIU3000 front panel.

Note that if the RSS parameter "ERASE OLD INDEX KEYS" is enabled, changing the index once will erase the previously active index, and changing the index twice will erase all encryption keys in the encryption module.

**Table 27**

| <b>Action</b>  | <b>LCD Display</b>                      | <b>Comments</b>   |
|--|---|---|
| 1. Press <b>INDX</b> to enter the index display state.   | <b>NAME1</b><br>or<br><b>NAME2</b>      | The alias of the currently active index is displayed.   |
| 2. Press <b>ENTR</b> to enter the index selection state.   | <b>NAME1</b><br>or<br><b>NAME2</b>      | The active index name blinks.   |
| 3. Use arrows to scroll between the available indexes.   | <b>NAME1</b><br>or<br><b>NAME2</b>      | The name of the selected index blinks.  |
| <b>NOTE</b>  |   |   |
| Pressing <b>INDX</b> or <b>MENU/ESC</b> at this stage will return to the index display state without changing the index. |   |   |
| 4. Press <b>ENTR</b> to confirm the selection.   | <b>NEWINDX</b><br>or<br><b>SAMEINDX</b> | Either the "NEWINDX" or "SAMEINDX" message is displayed for a short period to indicate if the index change has occurred. Then, the name of the currently active index is displayed. |

### CKR Keyset

For APCO key management configurations, the DIU3000 supports numerous keysets. The keysets provide for functionality similar to Indexing.

**Table 28**

| Action   | LCD Display | Comments   |
|--|-------------|--|
| 1. Press INDX to display the active keyset.            |             |  |
| 2. Press ENTER to enter the keyset selection state.    |             |  |
| 3. Use arrows to scroll between the available keysets. |             | Active keysets will be blinking. Inactive keysets will be solid. |
| 4. Press ENTER to select and make the keyset active.   |             |  |

### **Volume Control**

The  and  arrows on the DIU3000 keypad can control the volume of the handset speaker. To do so, the DIU3000 should be in one of the following states:

- Time of day *display state*
- Function request (FREQ) *display state*
- Mode *display state*
- Channel *display state*
- Index *display state*

The  arrow increases the volume, while the  arrow decreases the volume. There are 10 available volume levels, designated 0 through 9.

When either of the arrows is pressed, the volume is adjusted and the updated volume level is displayed on the LCD (e.g., VOL x, where "x" indicates the updated volume level).



### **Transmission**

The DIU3000 PTT is used to key in the base station. The transmission includes ASTRO signalling, determined by parameters set from the DIU3000 front panel via the direct access keys, as described in the previous sections. Note that these parameters are stored in a memory backed up by a battery, so that they are retained after the DIU3000 has been turned off and on.

When the Link Busy LED is lit, transmission is inhibited. During transmission, the Transmit LED is lit.

**Note**

The DIU3000 can be programmed by the RSS to issue an alert tone to the console, to indicate transmission in clear mode when the encrypted mode is enabled.



### Encryption Key Erasure

The ERSE direct access function key enables erasing (zeroization) of all traffic encryption keys in the encryption module via the DIU3000 keypad. For CKR and OTAR configurations, all key encryption keys will also be erased. However, if the Key Loss Key feature is enabled, the key loss key will not be erased.



**Note**

The DIU3000 can be programmed by the RSS to issue an alert tone to the console, to indicate key zeroization.

**Table 29**

| Action  | LCD Display     | Comments   |
|---|-----------------|--|
| 1. Press the ERSE key to enter the key zeroization function.  | <b>KEYERSE</b>  | The prompt indicates that the key zeroization function is active and the LED on the ERSE key is lit.   |
| <p><b>NOTE</b><br/>Pressing ERSE or MENU/ESC at this stage will exit the key zeroization function without performing the zeroization.</p> |                 |  |
| 2. Press ENTR to initiate the zeroization procedure.  | <b>ZEROIZED</b> | The LED on the ERSE key goes off and the "ZEROIZED" prompt is shown for several seconds to indicate successful zeroization. The DIU3000 then returns to the ready state. |



### Monitor

Pressing the monitor key on the DIU3000 front panel allows unsquelching and monitoring the receive path.

## **Troubleshooting**

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### **General Checks**

In case of malfunctioning, and before consulting the troubleshooting procedures, verify the following:

- The ac power cable and all the other cables are firmly connected to the unit.
- The encryption cartridge is properly installed (if present).
- The DIU3000 has been appropriately programmed by the RSS.

## General Indications

**Table 30**

| <b>Problem / Indication</b>            | <b>Possible Cause</b>  | <b>Remedy</b>   |
|--|--|---|
| Power-on self-test reports "TST FAIL". | DIU3000 internal failure.  | Refer to "Information and Error Messages".  |
| Link Busy LED is on.                   | The link establishment between the DIU3000 and the Base Station is in progress. This indication is normal if it appears immediately after the power-on sequence and lasts for about 30 seconds.  | If still on after 30 seconds, then check the connection to the Base Station/Comparator. Check the connectors, line, Base Station or the Comparator functionality (either Modem link or V.24 link).  |
| Link Busy LED is flashing.             | The link establishment between the DIU3000 and the RNC is in progress. This indication is normal if it appears immediately after the power-on sequence and lasts for about 30 seconds.   |   |
| Battery LED is on.                     | No ac power (DIU3000 operates from external backup battery).   | Connect DIU3000 to ac power.  |
| Battery LED is flashing.               | Low voltage problem.   | Refer to "Information and Error Messages".  |
| The transmission fails.                | <ol style="list-style-type: none"> <li>1. The link is busy (Link Busy LED is lit).</li> <li>2. Tone1 and Tone2 frequencies of a dual tone TRC command are identical.</li> <li>3. The encrypted session has not been opened.</li> <li>4. Trial to transmit in encrypted mode, while the encryption cartridge is not properly installed or not installed at all.</li> <li>5. Trial to transmit with an encryption key that is not loaded.</li> </ol> | <p>Wait till the Link Busy LED goes off.</p> <p>Use RSS to correct the frequency values of the particular FREQ.</p> <p>Login into an encrypted session.</p> <p>Verify that the encryption cartridge is present and properly installed.</p> <p>Load the required encryption key using KVL or if possible, use another key.</p> |
| "BAD EPRM" message on the LCD.         | Internal memory failure.   | Have the unit serviced.   |
| "BAD FLSH" message on the LCD.         | Internal memory failure.   | Have the unit serviced.   |
| "BAD RAM" message on the LCD.          | Internal memory failure.   | Have the unit serviced.   |
| "ERSE ERR" message on the LCD.         | The key erase operation has failed.  | Verify that the encryption cartridge is properly installed.   |
| "LOG FAIL" message on the LCD.         | The logout operation has failed.   | Verify that the encryption cartridge is properly installed.   |
| "PWR LOW" message on the LCD.          | Low voltage problem.   | Refer to "Information and Error Messages".  |

## Alert Tones

**Table 31**

| Alert Tone Type   | Meaning  | Remedy   |
|---|--|--|
| <b>Self Test:</b><br>Four tones during self test (476 Hz, 600 Hz, 712 Hz and 950 Hz, 200 ms each).  | This is a normal indication during testing of the speaker/earpiece.                      | Not required.  |
| <b>Self Test Fail:</b><br>Eight tones of 26 ms with alternating frequencies of 500 and 1000 Hz.   | The self test has failed.  | Have the unit serviced.  |
| <b>Clear Tx / Clear Rx:</b><br>750 Hz for 85 ms.  | Indicates transmission/reception in the clear mode, while the encrypted mode is enabled. | Use the encrypted mode for transmission or use the RSS to disable either the encrypted mode or the Clear Tx / Clear Rx alert tone. |
| <b>Tx Key Fail:</b><br>Two tones of 750 Hz, 350 ms long, separated by a 350 ms silent interval.   | Indicates a transmission key failure.  | Load the required encryption key using KVL, or, if possible, use another key or use the RSS to disable the Tx Key Fail alert tone. |
| <b>Rx Key Fail:</b><br>750 Hz tones, 85 ms long, repeated every 360 ms, for the entire duration of reception.                                 | Indicates a reception key failure.   | Load the required encryption key using KVL, or, if possible, use another key or use the RSS to disable the Rx Key Fail alert tone. |
| <b>Key Erase:</b><br>Three tones of 750 Hz 100 ms long, separated by silent intervals of 100 ms.  | Indicates an intentional zeroization of all encryption keys.                             | Reload keys using KVL and reset the DIU3000.   |
| <b>Multi-Key Verification:</b><br>A sequence of 175 ms tones with alternating frequencies of 911 and 1823 Hz, for a period of 1.05 seconds.   | Indicates KVL keyloading was successful.   | Not required.  |
| <b>Duplicate LID's:</b><br>A sequence of 25 ms tones with alternating frequencies of 911 and 1823 Hz, for a period of 1.05 seconds.           | Indicates that more than one key number is allocated to the same LID.                    | This is a warning.   |
| <b>Data Busy:</b><br>A sequence of 80 ms tones with alternating frequencies of 911 and 1823 Hz, for the entire duration of data transmission. | Indicates the outbound audio path is busy with data.                                     | This is a warning tone, and there is no remedy.  |

## Troubleshooting Using the Error List Function

This section describes the troubleshooting procedures that should be performed if failures are detected by the DIU3000 self-test. Follow the steps below to display the error list.

1. While the time of day is displayed, press MENU/ESC to enter the menu mode.
2. Scroll until ERR LIST is shown and press ENTR.
3. Scroll to view the stored failures.

Refer to the troubleshooting table below and the full error list summary in Table 34.

**Table 32**

| Error No.                                    | Possible Cause   | Remedy   |
|--|--|--|
| 1 - 6,<br>8 - 25,<br>31 - 44,<br>46 - 48, 55 | DIU3000 internal failure.  | Call service.  |
| 7, 49, 50                                    | Encryption cartridge related failure.  | <ol style="list-style-type: none"> <li>1. Verify that the encryption cartridge is properly installed, and then restart the unit. If the error persists, replace the encryption cartridge.</li> <li>2. If the Encryption cartridge is not installed and the ENCRYPTION parameter is enabled, disable this parameter via the RSS.</li> </ol>   |
| 51, 53, 54                                   | <ol style="list-style-type: none"> <li>1. Encryption cartridge related failure.</li> </ol>   | <ol style="list-style-type: none"> <li>1. Verify that the encryption cartridge is properly installed, and then restart the unit. If the error persists, replace the encryption cartridge.</li> <li>2. If the Encryption cartridge is not installed and the ENCRYPTION parameter is enabled, disable this parameter via the RSS.</li> </ol>   |
|  | <ol style="list-style-type: none"> <li>2. DIU3000 internal failure.</li> </ol>   | Call service.  |
| 52   | <p>EMC crypto violation.</p> <p style="text-align: center;"><b>NOTE</b></p> <p>In any case of crypto violation, the encryption cartridge automatically erases all encryption keys.</p> | <ol style="list-style-type: none"> <li>1. Verify that the encryption cartridge has not been tampered.</li> <li>2. Verify that voltage supply is correct.</li> <li>3. Verify that the temperature conditions are appropriate.</li> <li>4. Reload keys and reset DIU3000. If the temperature was not suitable, shut the DIU3000 for about 15 minutes, and then reload keys and reset.</li> </ol> |
| 29   | External battery voltage is low.   | Charge external battery as soon as possible.   |
| 30   | DIU3000 internal lithium battery voltage is low.   | Replace the battery as soon as possible.   |
| 45   | Encryption battery voltage is low.   | Replace the battery as soon as possible.   |

## Run-time Messages on External Terminal

Table 33

| Messages Printed   | Possible Cause for Failure                               |
|--|--|
| LEGEND:(F) fatal error. The DIU3000 may reset itself.<br>(W) Warning only.<br>(I) Information (no problem) |  |
| (1) (F) Problem with system calls  | Host Memory board  |
| (2) (F) Could not set wireline   | I/O Controller or Host Memory board                      |
| (5) (F) Could not set attenuator   | I/O Controller or Host Memory board                      |
| (6) (F) Unexpected inner task message  | I/O Controller or Host Memory board                      |
| (8) (W) Encryption key error   | EMC Key not loaded                                       |
| (9) (F) Could not set analog matrix  | I/O Controller or Host Memory board                      |
| (10) (W) Timeout getting vselp from DSP  | Software problem   |
| (11) (W) Wrong vselp number from DSP   | Software problem   |
| (12) (W) Timeout getting vselp from EMC  | Software problem   |
| (11) (W) Wrong vselp number from EMC   | Software problem   |
| (14) (W) Esync error   | Software problem   |
| (15) (W) Error sending STOP (no CTS)   | Bad Modem board or Communications board (V.24) connector |
| (16) (F) Cannot update infra-structure Data Base   | Host Memory board  |
| (17) (W) Error sending Data (no CTS)   | Bad Modem board or Communications board (V.24) connector |
| (18) (W) Could not initialize modem using V.24   | Modem board is required, but does not exist or Bad       |
| (19) (F) Fail to receive start message   | Host Memory board  |
| (20) (I) Got message from infrastructure that require ack  | –  |
| (21) (W) Got an unknown RECEIV mode from infrastructure  | –  |
| (22) (W) Bad pre-async received  | Link problem   |
| (23) (F) Fail to receive stop message  | Host Memory board  |
| (24) (F) Could not configure DSP1  | BAD DSP board  |
| (25) (F) Could not configure EMC   | BAD EMC module   |
| (26) (W) Timeout getting vselp from infrastructure   | Link problem   |
| (27) (W) Wrong vselp number from infrastructure  | Link problem   |
| (28) (W) Timeout getting esync from infrastructure   | Link problem   |
| (29) (W) EMC is not installed  |  |

**Table 33** (Continued)

| <b>Messages Printed</b>                       | <b>Possible Cause for Failure</b>  |
|---|------------------------------------|
| (30) (F) Could not get ESYNC from EMC         | BAD EMC module                     |
| (31) (F) Could not figure DSP2                | BAD DSP board                      |
| (32) (W) Operator board problem               | Problem with OPERATOR Board        |
| (34) (W) Operator board problem               | Problem with OPERATOR Board        |
| (35) (W) Undefined function tone              | Problem with TRC decoding          |
| (36) (I) Start Link Establishment process     |                                    |
| (37) (W) Missing STOP in analog               | Modem missed fast train            |
| (38) (I) Sending SABM frame                   | Part of Link establishment process |
| (39) (I) Sending UA frame                     | Part of Link establishment process |
| (40) (I) Receive SABM frame                   | Part of Link establishment process |
| (41) (I) Receive UA frame                     | Part of Link establishment process |
| (42) (W) Link establishment failed            | Link problem                       |
| (43) (W) Link establishment O.K               | Part of Link establishment process |
| (44) (W) Link failure                         | Link problem                       |
| (45) (W) Analog timeout                       | Link problem                       |
| (46) (W) Link Degradation (TOD)               | Link problem                       |
| (47) (W) Modem Self-Test Failed               | Local Modem Problem                |
| (48) (I) Modem Self-Test Passed               |                                    |
| (49) (W) Link failure on remote modem         | Remote Modem Problem               |
| (54) (W) CRC Errors Counter Critical Value    | Link problem                       |
| (55) (W) Unknown Command from ZC              | Zone controller Link Problem       |
| (60) (W) EMC status timeout                   | Bad EMC Module                     |
| (62) (I) Start RNC Link establishment process |                                    |
| (63) (I) Sending SABM frame to RNC            | Part of Link establishment process |
| (64) (I) Sending UA frame from RNC            | Part of Link establishment process |
| (65) (I) Sending SABM frame from RNC          | Part of Link establishment process |
| (66) (I) Receive UA frame to RNC              | Part of Link establishment process |
| (67) (W) Link establishment with RNC failed   | RNC link problem                   |
| (68) (I) Link establishment with RNC O.K      |                                    |
| (69) (W) RNC Link Failure                     | RNC link problem                   |
| (74) (W) No Receive ready from Base           | Link problem                       |
| (75) (W) HLM: DIU-Base link is down           | Hybrid base link problem           |

**Table 33** *(Continued)*

| <b>Messages Printed</b>                  | <b>Possible Cause for Failure</b>  |
|--|------------------------------------|
| (76) (I) HLM: DIU–Base link is up        |                                    |
| (77) (W) HLM: DIU–Console link is down   | Hybrid console link problem        |
| (78) (I) HLM: DIU–Base link is up        |                                    |
| (79) (W) ACIM link is down               | ACIM link problem                  |
| (80) (I) ACIM link is up                 |                                    |
| (82) (W) DIU Main Battery Failure        | Lithium Battery problem            |
| (83) (I) DIU Main Battery O.K            |                                    |
| (84) (W) DIU EMC Battery Failure         |                                    |
| (85) (I) DIU EMC Battery O.K             |                                    |
| (99) (I) Sending XID Command to Base     | Part of Link establishment         |
| (100) (I) Sending XID Response to Base   | Part of Link establishment process |
| (101) (I) Receive XID Command from Base  | Part of Link establishment process |
| (102) (I) Receive XID Response from Base | Part of Link establishment process |
| (103) (W) No Receive Ready from RNC      | RNC link problem                   |
| (107) (I) Sending XID Command to RNC     | Part of Link establishment process |
| (108) (I) Sending XID Response to RNC    | Part of Link establishment process |
| (109) (I) Receive XID Command from RNC   | Part of Link establishment process |
| (110) (I) Receive XID Response from RNC  | Part of Link establishment process |

**Table 34**  
ERR LIST Error Summary

| <b>Error No.</b> | <b>Error Name</b>            |
|------------------|------------------------------|
| 1                | DSP1 Comm.Test               |
| 2                | DSP1 RAM Test                |
| 3                | DSP1 Bootstrap               |
| 4                | DSP2 Comm. Test              |
| 5                | DSP2 RAM Test                |
| 6                | DSP2 Bootstrap               |
| 7                | Host EMC Comm. Test          |
| 8                | Host MODEM Comm. Test        |
| 9                | Host V24 Link Comm. Test     |
| 10               | Basic Board Existence        |
| 11               | Base WLI Board Existence     |
| 12               | Memory Board Existence       |
| 13               | Base WLI Board Existence     |
| 14               | Operator Board Existence     |
| 15               | Console WLI Board Existence  |
| 16               | GPIO Board Existence         |
| 17               | Comm. Board Existence        |
| 18               | EMC Server Test              |
| 19               | HC11 Server Test             |
| 20               | DSP Server Test              |
| 24               | DSP to EMC Test              |
| 25               | DSP Software Version Test    |
| 29               | 14 V Power Supply Test       |
| 30               | DIU3000 Lithium Battery Test |
| 32               | DTMF Generator Test          |
| 38               | Base WLI Board Test          |
| 39               | Console WLI Board Test       |
| 40               | Modem Test                   |
| 43               | Host RAM Test                |
| 45               | EMC Battery Test             |

**Table 34**  
ERR LIST Error Summary (Continued)

| <b>Error No.</b> | <b>Error Name</b>           |
|------------------|-----------------------------|
| 46               | EMC Memory Backup Test      |
| 47               | GPIO Board Test             |
| 48               | DSP Tone Generation Test    |
| 49               | EMC Software Integrity Test |
| 50               | EMC Crypto Security Test    |
| 51               | EMC Error Condition Test    |
| 52               | EMC Crypto Violation Test   |
| 53               | EMC SCI Test                |
| 54               | EMC Board Existence         |
| 55               | EMC Adaptor Board Existence |

## Information and Error Messages

|          |   |
|----------|---|
| BAD EPRM | Internal memory failure (see Table 30).   |
| BAD FLSH | Internal memory failure (see Table 30).   |
| BAD RAM  | Internal memory failure (see Table 30).   |
| DIFF VER | A flash programming failure has been encountered. Because of the problem, different codeplug versions may exist in flash, RAM, and RSS. If the problem persists, have the DIU serviced.   |
| ERSE ERR | The key erase operation has failed (see Table 30).  |
| FIPS DIS | FIPS Disabled. When disabled, using encryption functions does not require password entry. The FIPS parameter is controlled by the RSS.  |
| LOG FAIL | The logout operation has failed (see Table 30).   |
| NO EMC   | You are trying to perform an action that involves encryption, while the encryption cartridge is either not installed or disabled by the RSS (Service: DIU Configuration : Hardware Configuration data screen in the RSS).   |
| NO INFO  | There was no inbound process since power-up.  |
| NO LOGIN | <ol style="list-style-type: none"> <li>1. You are trying to perform an action that involves encryption while FIPS is enabled, but a corresponding encryption session has not been initiated.</li> <li>2. The selected encryption key does not correspond to the user type.</li> </ol> |
| NO KEY   | You are trying to perform an action that involves encryption, but the encryption key requested does not exist. The DIU3000 can be programmed by the RSS to send an alert tone to the console when this error occurs.  |
| NO SRVC  | Not a Service Session. This error message is displayed when trying to perform an action that involves changing certain parameters that require being in a Service session.  |
| PWR LOW  | The external battery voltage is lower than 14 V (see Table 30).   |
| PSWD ERR | Password Error. A message informing that an incorrect password was entered.   |
| VAR ERR  | The selected value is out of range.   |

## DIU3000 Functional Tests

### General

The DIU3000 is a full duplex device, that allows establishing a link with itself by interconnecting the transmit and receive lines on the DIU3000 rear panel connectors. The following sections provide instructions on performing such tests for fault isolation purposes during system problems.

It is possible to disconnect the base station and create a direct connection between the DIU3000 transmit and receive terminals to/from the base station. This enables the DIU3000 functional operation to be checked in all modes of operation. Refer to section "Testing the DIU3000 with Loop-Back on Base Station" below.

An additional test requires placing the DIU3000 in a special test mode. In this mode, it is possible to completely disconnect it from the outside world (both from the base station and the console), and functionally test about 99% of the DIU3000 hardware. Refer to section "DIU Stand Alone Audio Loop Test" on page 78.

### Testing the DIU3000 with Loop-Back on Base Station



**Note**

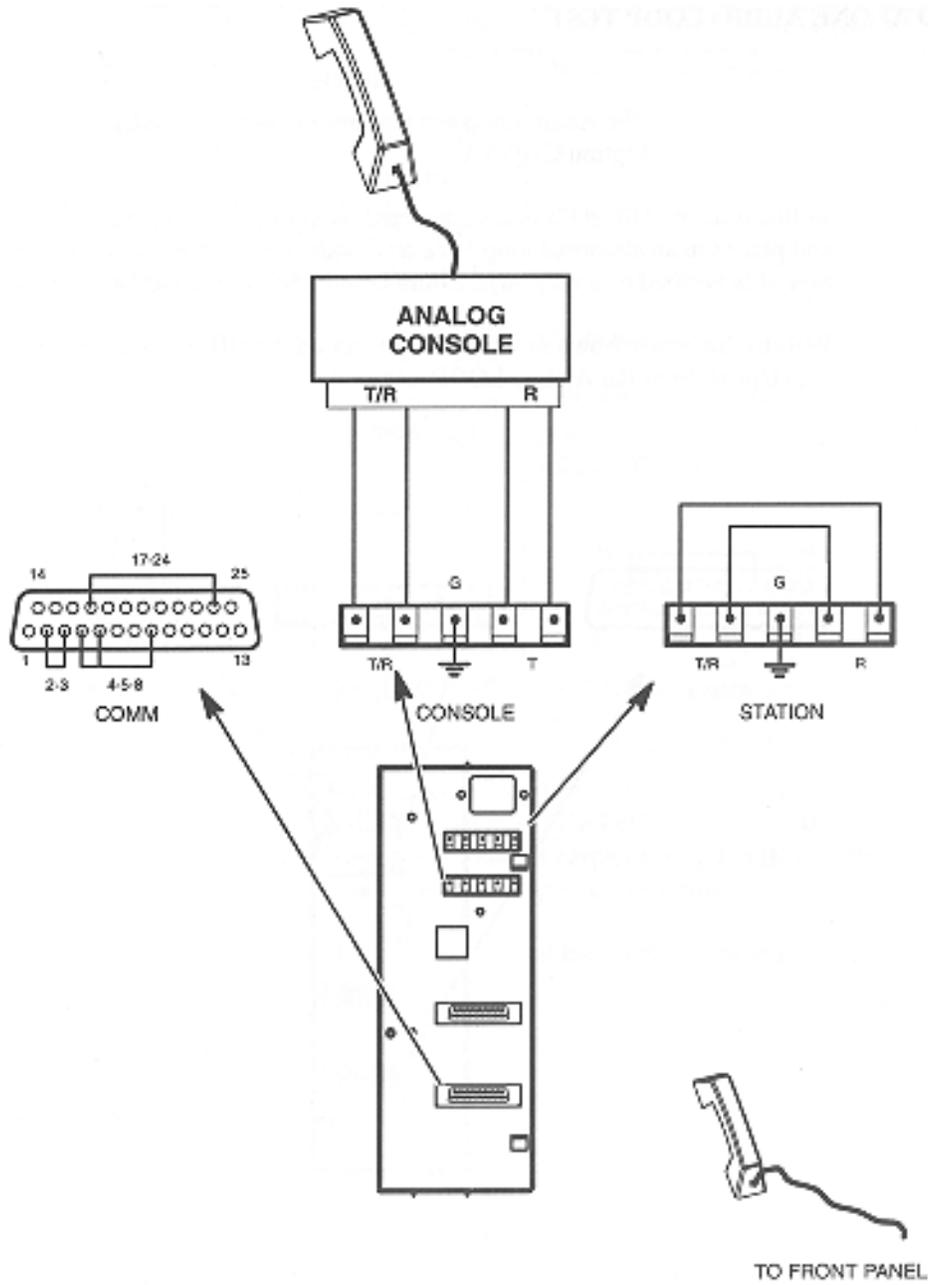
The Audio Loop test requires the use of a test handset (option C109AA).

This test allows testing the DIU3000 functional operation without connecting it to the base station. Perform the following setup (see Figure 14):

- For the Modem analog link (option X437AF): connect jumper wires between the T/R and R terminals of the "STATION" connector.
- For the V.24 Digital link: connect jumper wires between the following pins of the "COMM" connector: 2 (TD) and 3 (RD), 24 (TCLK) and 17 (RCLK), 4 (RTS), 5 (CTS) and 8 (CD). Connect jumper wires between the T/R and R terminals of the "STATION" connector.

Use the DIU3000 handset to speak and monitor your voice (with some delay). Only if the DIU3000 circuits function properly, will you hear your voice through the handset earpiece. You can perform the test in all the modes of operation.

Use the analog console handset in full duplex mode to speak and monitor your voice (with some delay). Only if the DIU3000 circuits function properly, will you hear your voice through the handset earpiece. You can perform the test in all modes of operation.



**Figure 14**  
Testing the DIU3000 with Loop-Back on Base Station

### DIU Stand Alone Audio Loop Test

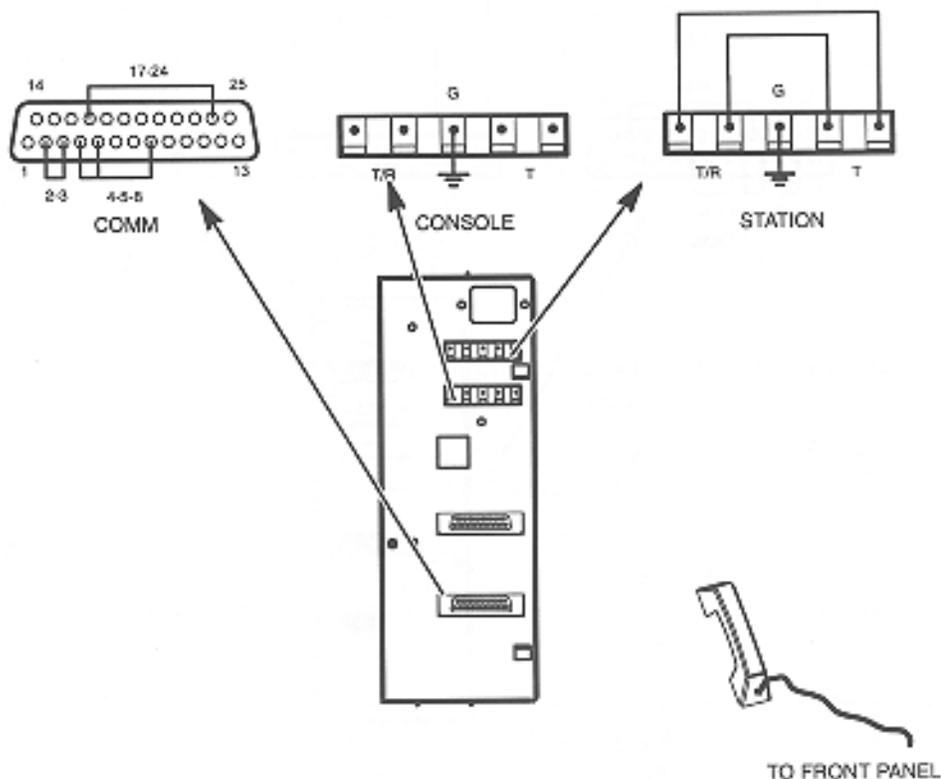


**Note**

The Audio Loop test requires the use of a test handset (option C109AA).

In this test, the DIU3000 is disconnected from both the base station and the console and placed in an abnormal loop-back test mode. Under these conditions, proper operation of is verified to a very large extent (about 99% of the hardware is tested).

Perform the setup shown in Figure 15. Power up the DIU3000 and perform the following steps to enter the AUDio LOOP test mode.



**Figure 15**  
Stand Alone Audio Loop Test Setup

**Table 35**

| Action   | LCD Display                         | Comments   |
|--|-------------------------------------|--|
| 1. While in the ready mode, press MENU/ESC to enter the menu mode. |                                     | The last accessed menu entry is shown.   |
| 2. Scroll until SERVICE is shown.                                  | <b>SERVICE</b>                      |  |
| 3. Press ENTR to display options.                                  | <b>LOGIN</b><br>or<br><b>LOGOUT</b> |  |
| 4. Scroll to display LOGIN.  | <b>LOGIN</b>                        |  |
| 5. Press ENTR to initiate password entry.                          | <b>SRV PSWD</b>                     | The display blinks.  |
| 6. Key in the password - "039302164".                              | -----                               | A short bar is displayed for each key depression.  |
| 7. Press ENTR.   | <b>PSWD OK</b>                      | The message "PSWD OK" is displayed for a few seconds and the DIU3000 returns to the SERVICE display. |
| 8. Press MENU/ESC to return to the menu mode.                      | <b>SERVICE</b>                      |  |
| 9. Scroll until TESTS is shown.                                    | <b>TESTS</b>                        |  |
| 10. Press ENTR to display options and scroll to display AUD LOOP.  | <b>AUD LOOP</b>                     |  |
| 11. Press ENTR to enter the Audio Loop test mode.                  | <b>LOOP RDY</b>                     | The DIU3000 is ready for the loop-back testing   |

You are now in the audio loop test mode. Use the handset to speak and monitor your voice (with some delay). Only if the DIU3000 circuits function properly, will you hear your voice through the handset earpiece. Use the  and  arrows on the DIU3000 keypad to control the handset speaker's volume.

Use the MENU/ESC key to exit the Audio Loop test mode.

# APPENDIXES

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## Appendix A: DIU3000 External Connectors

**Table 36**  
DIU3000 External Connector List

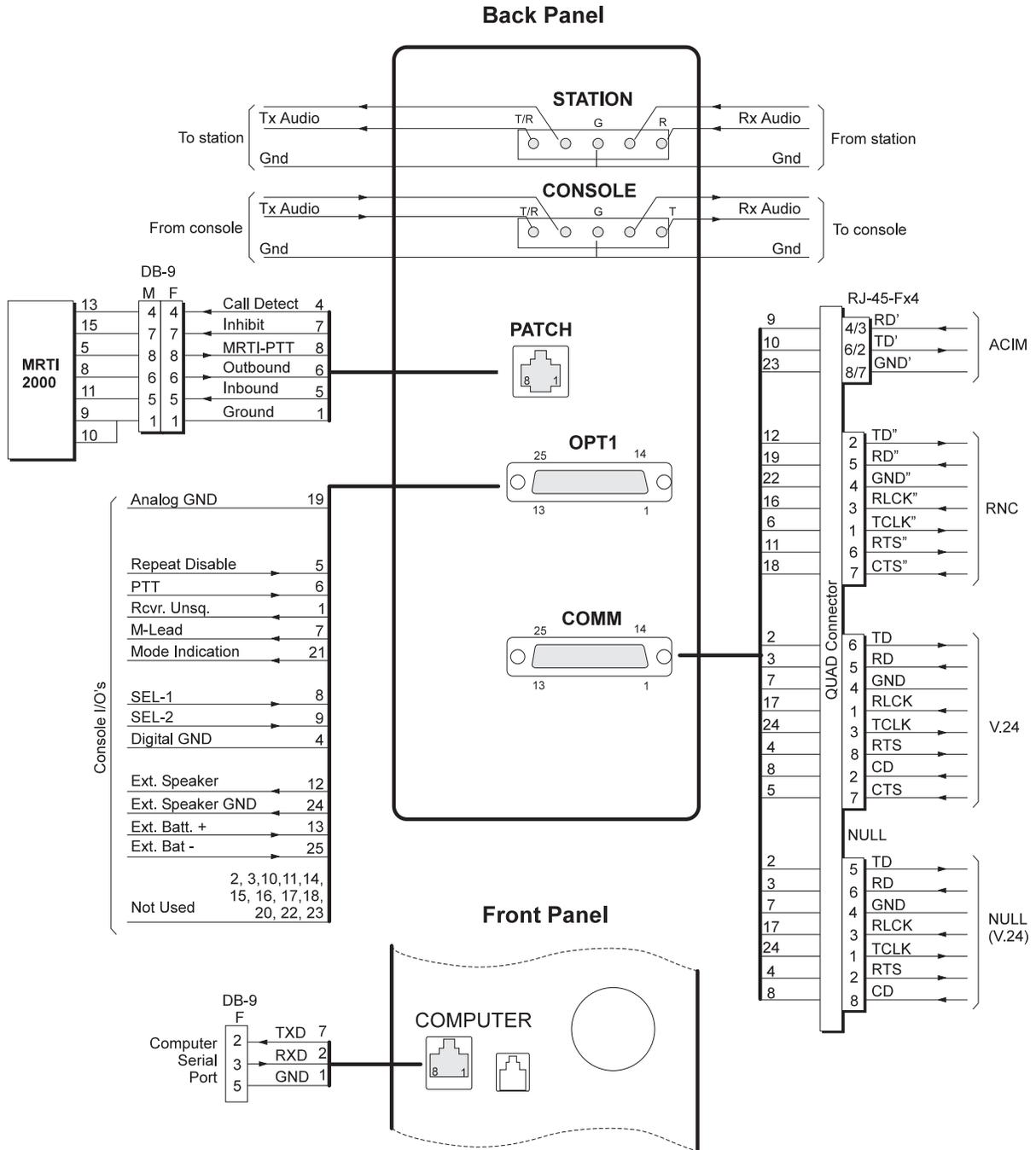
| Name     | Type    | Description  |
|----------|---------|--|
| STATION  | Line    | Base station line connection   |
| CONSOLE  | Line    | Console line connection  |
| PATCH    | RJ45    | Reserved for phone patch   |
| MIC      | RJ45    | Desk microphone  |
| H. SET   | RJ11    | Test handset connection  |
| LINE     | AC jack | AC line input  |
| OPT1     | DB-25   | General I/O connector  |
| COMPUTER | RJ45    | Serial communication RS-232 port for connecting external computer/<br>terminal/printer |
| COMM     | DB-25   | Optional communication links   |

**Table 37**  
STATION Connector Pin Description

| Pin No. | Type | Description  | I/O Type      |
|---------|------|--|---------------|
| 1, 2    | T/R  | Transmit audio and embedded signalling to base station   | analog output |
| 3       | GND  | Protective ground  |               |
| 4, 5    | R    | Receive audio and embedded signalling from base station. | analog input  |

**Table 38**  
CONSOLE Connector Pin Description

| Pin No. | Type | Description                        | I/O Type      |
|---------|------|------------------------------------|---------------|
| 1, 2    | T/R  | Receive audio and TRC from console | analog input  |
| 3       | GND  | Protective ground                  | –             |
| 4, 5    | T    | Transmit signalling to console     | analog output |



**Figure 16**  
DIU3000 Interface Diagram

**Table 39**  
H. SET Connector Pin Description

| Pin No. | Description                    | I/O Type      |
|---------|--------------------------------|---------------|
| 1       | Ground                         | –             |
| 2       | PTT and On/Off hook indication | analog input  |
| 3       | Earpiece                       | analog output |
| 4       | Microphone                     | analog input  |

**Table 40**  
OPT. 1 (General Purpose I/O) Connector Pin Description

| Pin No. | Description                             | I/O Type                  | Logic Low =            | Junction Box Corresponding Pin No.* (option C62AB) |
|---------|---|---------------------------|------------------------|--|
| 1       | Receiver unsquelch to Centracom console | logic output <sup>†</sup> | Unsquelch <sup>‡</sup> | TB4–2  |
| 2       | Not used                                |                           |                        |  |
| 3       | Not used                                |                           |                        |  |
| 4       | Digital ground                          |                           |                        | TB4–3  |
| 5       | Repeat disable                          | logic input               |                        |  |
| 6       | PTT                                     | logic input               |                        |  |
| 7       | M_LEAD                                  | logic output <sup>†</sup> | PTT active             | TB2–1  |
| 8       | SEL-1                                   |                           |                        |  |
| 9       | SEL-2                                   |                           |                        |  |
| 10      | Not used                                |                           |                        |  |
| 11      | Not used                                |                           |                        |  |
| 12      | External speaker                        | analog output             |                        | TB5–5  |
| 13      | External battery (+)                    | power input               |                        | TB5–6  |
| 14      | Not used                                |                           |                        |  |
| 15      | Not used                                |                           |                        |  |
| 16      | Not used                                |                           |                        |  |
| 17      | Not used                                |                           |                        |  |
| 18      | Not used                                |                           |                        |  |
| 19      | Analog GND                              |                           |                        |  |
| 20      | Not used                                |                           |                        |  |
| 21      | Mode indication                         | logic output <sup>†</sup> | Mode 1 <sup>‡</sup>    | TB4–1  |

**Table 40**  
OPT. 1 (General Purpose I/O) Connector Pin Description

| Pin No. | Description             | I/O Type     | Logic Low = | Junction Box Corresponding Pin No.* (option C62AB) |
|---------|-------------------------|--------------|-------------|--|
| 22      | Not used                |              |             |  |
| 23      | Not used                |              |             |  |
| 24      | External speaker ground |              |             | TB5-8  |
| 25      | External battery (-)    | power return |             | TB5-7  |

\*.When using the Junction box connect TB4-7 and 8 to good earth ground to ensure surge protection.

†.Internally pulled up to 15 V dc by a 10 K $\Omega$  resistor.

‡.Polarity can be reversed (to active high) using RSS.

**Table 41**  
COMPUTER Connector Pin Description

| Pin No. | Signal Name | Description   | I/O Type              |
|---------|-------------|---|-----------------------|
| 1       | GND         | Ground  |                       |
| 2       | RXD         | Asynchronous data from computer to DIU3000 controller | RS-232 digital input  |
| 3       |             | Not used  |                       |
| 4       |             | Not used  |                       |
| 5       |             | Not used  |                       |
| 6       |             | Not used  |                       |
| 7       | TXD         | Asynchronous data from DIU3000 controller to computer | RS-232 digital output |
| 8       |             | Not used  |                       |

**Table 42**  
COMM Connector Pin Description

| Pin No. | Signal Name       | Description                                    | I/O Type       |
|---------|-------------------|--|----------------|
| 1       | Prot. GND         | Protective Ground                              |                |
| 2       | TD                | Transmit data to Base Station                  | digital output |
| 3       | RD                | Receive data from Base Station                 | digital input  |
| 4       | RTS               | Request to Send to Base Station                | digital output |
| 5       | CTS               | Clear to Send from Base Station                | digital input  |
| 6       | TCLK <sup>”</sup> | External Tx clock for RNC                      | digital        |
| 7       | GND               | Ground from Base Station                       |                |
| 8       | CD                | Carrier Detect from Base Station               | digital input  |
| 9       | RD’               | Receive Data from CENTRACOM or Zone Controller | digital input  |
| 10      | TD’               | Transmit Data to CENTRACOM or Zone Controller  | digital output |
| 11      | RTS <sup>”</sup>  | Request to Send to RNC                         | digital        |
| 12      | TD <sup>”</sup>   | Transmit data to RNC                           | digital        |
| 13      |                   | Not used                                       |                |
| 14      |                   | Not used                                       |                |
| 15      | CD <sup>”</sup>   | Carrier Detect from RNC                        | digital        |
| 16      | RCLK <sup>”</sup> | Receive Clock from RNC                         | digital        |
| 17      | RCLK              | Receive Clock from Base Station                | digital input  |
| 18      | CTS <sup>”</sup>  | Clear to Send from RNC                         | digital        |
| 19      | RD <sup>”</sup>   | Receive data from RNC                          | digital        |
| 20      |                   | Not used                                       |                |
| 21      |                   | Not used                                       |                |
| 22      | GND <sup>”</sup>  | Ground from RNC                                |                |
| 23      | GND <sup>”</sup>  | Ground from CENTRACOM or Zone Controller       |                |
| 24      | TCLK              | Internal Tx Clock for Base Station             | digital output |
| 25      |                   | Not used                                       |                |

**Table 43**  
Quad Connector FLN5462A Pin Description

| Function  | DIU Comm Port<br>DB-25M PIN                             | V.24 (null)<br>RJ-45 #1 | V.24<br>RJ-45 #2       | ACIM/SZ<br>RJ-45 #3                                  | RNC<br>RJ-45 #4 |
|-----------|---|-------------------------|------------------------|--|-----------------|
| PROT. GND | 1   |                         |                        |  |                 |
| TD        | 2   | 5                       | 6                      |  |                 |
| RD        | 3   | 6                       | 5                      |  |                 |
| RTS       | 4   | 2                       | 8                      |  |                 |
| CTS       | Jmpr #4 DB25-5<br>to DB25-4 &<br>DB25-5 to Jmpr<br>#6-1 |                         | 7                      |  |                 |
| TCLK"     | 6   |                         |                        |  | 1               |
| SIG GND   | 7   | 4                       | 4                      |  |                 |
| CD        | DB25-8 to<br>Jmpr #6-2                                  | RJ#1-8 to<br>Jmpr #6-3  | RJ#2-2 to<br>Jmpr #6-3 |  |                 |
| RD'       | 9   |                         |                        | Jmpr #2 DB25-9 to<br>RJ#3-3 & DB25-9<br>to RJ#3-4    |                 |
| TD'       | 10  |                         |                        | Jmpr #3 DB25-10<br>to RJ#3-2 & DB25-<br>10 to RJ#3-6 |                 |
| RTS"      | 11  |                         |                        |  | 6               |
| TD"       | 12  |                         |                        |  | 2               |
| Not used  | 13  |                         |                        |  |                 |
| Not used  | 14  |                         |                        |  |                 |
| CD"       | Jmpr #5 DB25-<br>15 to DB25-11                          |                         |                        |  |                 |
| RCLK"     | 16  |                         |                        |  | 3               |
| RCLK"     | 17  | 3                       | 1                      |  |                 |
| CTS"      | 18  |                         |                        |  | 7               |
| RD"       | 19  |                         |                        |  | 5               |
| Not used  | 20  |                         |                        |  |                 |
| Not used  | 21  |                         |                        |  |                 |
| GND"      | 22  |                         |                        |  | 4               |
| GND"      | 23  |                         |                        | Jmpr #1 DB25-23<br>to RJ#3-7 & DB25-<br>23 to RJ#3-8 |                 |
| TCLK      | 24  | 1                       | 3                      |  |                 |
| Not used  | 25  |                         |                        |  |                 |

**Table 44**  
Quad Connector FLN5462A Jumpers

| Jumper # | Application     | Jumper Table | Standard Jumper Installation |
|----------|-----------------|--------------|------------------------------|
| 1*       | ACIM Position   | 23 & 8       | Default                      |
|          | SZ Position     | 23 & 7       |                              |
| 2*       | ACIM Position   | 9 & 4        | Default                      |
|          | SZ Position     | 9 & 3        |                              |
| 3*       | ACIM Position   | 10 & 6       | Default                      |
|          | SZ Position     | 10 & 2       |                              |
| 4        | V.24 and Null   | 4 & 5        | Default                      |
|          | Open Connection | 5 & N/C      |                              |
| 5        | RNC             | 11 & 15      | Default                      |
|          | Open Connection | 15 to N/C    |                              |
| 6        | Internal CD     | 8 & 5        | Default                      |
|          | External CD     | 8 & 8/2      |                              |

\*.Jumpers 1, 2, and 3 must all be in the ACIM position or SZ position.

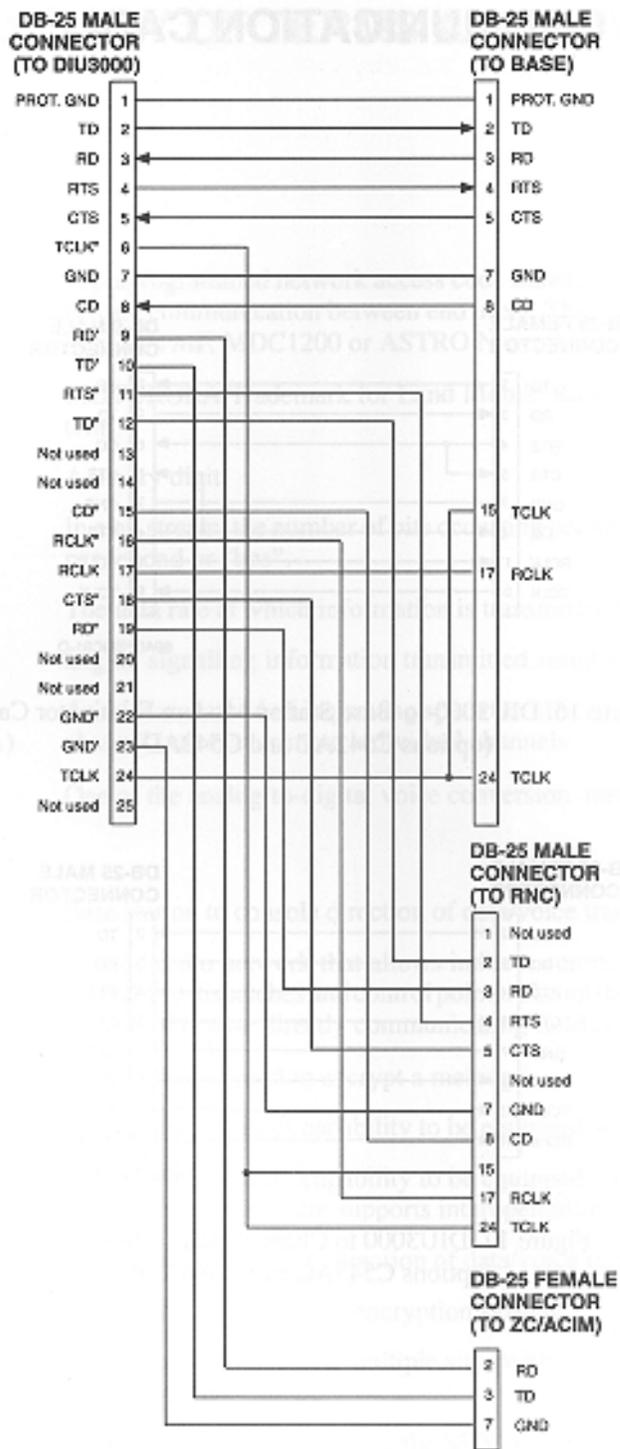


**Note**

#### *Jumper Access*

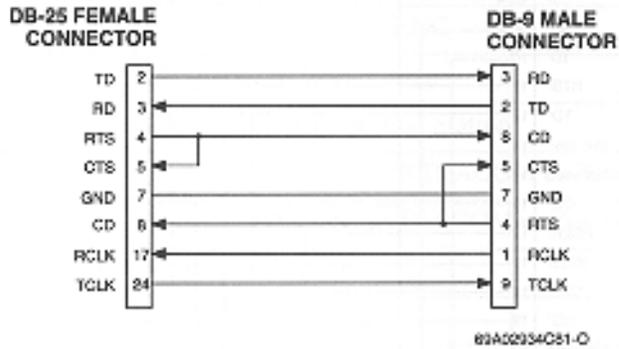
The top cover of the Quad Connector is secured to the bottom via four tabs. To access the jumpers, gently pull the sides of the top cover out from the sides of the bottom cover to release the tabs. DO NOT overbend so as to cause deforming of the top cover.

The top cover is keyed by the tabs. When re-connecting the top cover, make certain the tabs snap into place and the letters are right side up. If not, the top cover may be upside down.

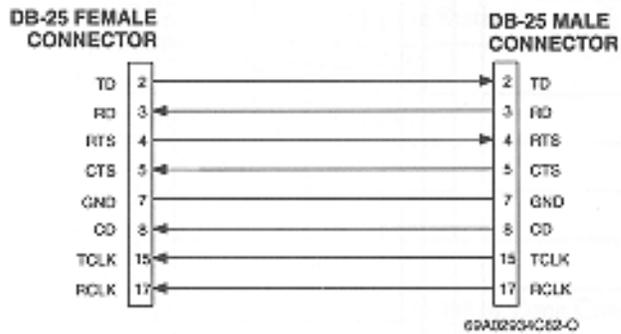


**Figure 17**  
DIU3000 Communication Adaptor Cable FKN4632A (W cable)

## Appendix B: Communcation Cables



**Figure 18**  
DIU3000-to-Base Station Modem Eliminator Cable (options C542AC and C542AD)



**Figure 19**  
DIU3000 to Channel Bank DSU Cable (options C543AC and C543AD)

## Appendix C: Glossary of Terms and Phrases

|  |  |
|--|--|
| <b>Access Code</b>                                   | A preprogrammed network access code transferred on the radio channel, that allows private communication between end users. The access code may be PL, DPL, Single Tone, DTMF, MDC1200 or ASTRO N word.                           |
| <b>ASTRO™</b>  | MOTOROLA Trademark for Land Mobile Radio Sector's FDMA digital radio system.   |
| <b>Bit</b>   | A binary digit.  |
| <b>Bit Rate</b>                                      | In a bit stream, the number of bits occurring per unit of time, usually expressed as bits per second or "bps".   |
| <b>Channel Rate</b>                                  | The data rate at which information is transmitted through the channel.   |
| <b>Embedded Signalling</b>                           | Digital signalling information transmitted simultaneously with the voice.  |
| <b>Frequency Division Multiple Access (FDMA)</b>     | An access method of improving spectrum efficiency that divides the communication channel into two or more individual channels.   |
| <b>Improved Multi-Band Excitation* (IMBE) coding</b> | One of the analog-to-digital voice conversion methods used by the DIU3000.   |
| <b>Inbound</b>                                       | Base station to console direction of data/voice transfer.  |
| <b>Infrastructure</b>                                | A fixed radio network that allows indirect communication between field radios and centralized dispatches and control points. The infrastructure also expands the coverage area of otherwise directly communicating field radios. |
| <b>Logical ID (LID)</b>                              | A key variable used to encrypt a message.  |
| <b>Multikey</b>                                      | The ASTRO devices capability to be equipped with multiple encryption keys.   |
| <b>Multiple Algorithm</b>                            | The ASTRO devices capability to be equipped with two hardware-based encryption algorithms. This feature supports interoperability and migration.   |
| <b>Outbound</b>                                      | Console to base station direction of data/voice transfer.  |
| <b>SECURENET</b>                                     | Motorola's 12 kbps voice encryption system.  |
| <b>SmartZone™</b>                                    | A trunking system using multiple sites with a variable number of repeaters to cover large geographic areas.  |
| <b>Stat-Alert™</b>                                   | A signalling scheme based on the MDC standard.   |
| <b>Zeroization (of encryption keys)</b>              | The process of erasing encryption keys.  |

## Appendix D: Acronyms

|             |  |
|-------------|--|
| <b>ACIM</b> | ASTRO Console Interface Module                 |
| <b>AGC</b>  | Automatic Gain Control                         |
| <b>BER</b>  | Bit Error Rate                                 |
| <b>BIT</b>  | Built In Test                                  |
| <b>CEB</b>  | Central Electronics Bank (CENTRACOM Series II) |
| <b>CKR</b>  | Common Key Reference                           |
| <b>DIU</b>  | Digital Interface Unit                         |
| <b>DKC</b>  | Digital Keying Console                         |
| <b>DRC</b>  | Digital Remote Control                         |
| <b>DSP</b>  | Digital Signal Processing                      |
| <b>DSU</b>  | Data Service Unit                              |
| <b>EMC</b>  | Encryption Module Cartridge                    |
| <b>FDMA</b> | Frequency Division Multiple Access             |
| <b>FIPS</b> | Federal Information Processing Standards       |
| <b>FREQ</b> | Function Request                               |
| <b>FT</b>   | Function Tone                                  |
| <b>HLGT</b> | High Level Guard Tone                          |
| <b>IMBE</b> | Improved Multi-Band Excitation                 |
| <b>KMC</b>  | Key Management Controller                      |
| <b>KVL</b>  | Key Variable Loader                            |
| <b>LID</b>  | Logical ID                                     |
| <b>LLGT</b> | Low Level Guard Tone                           |
| <b>OTAR</b> | Over-the-Air-Rekeying                          |
| <b>PL</b>   | Private-Line                                   |
| <b>RNC</b>  | Radio Network Controller                       |
| <b>RSS</b>  | Radio Service Software                         |
| <b>TRC</b>  | Tone Remote Control                            |