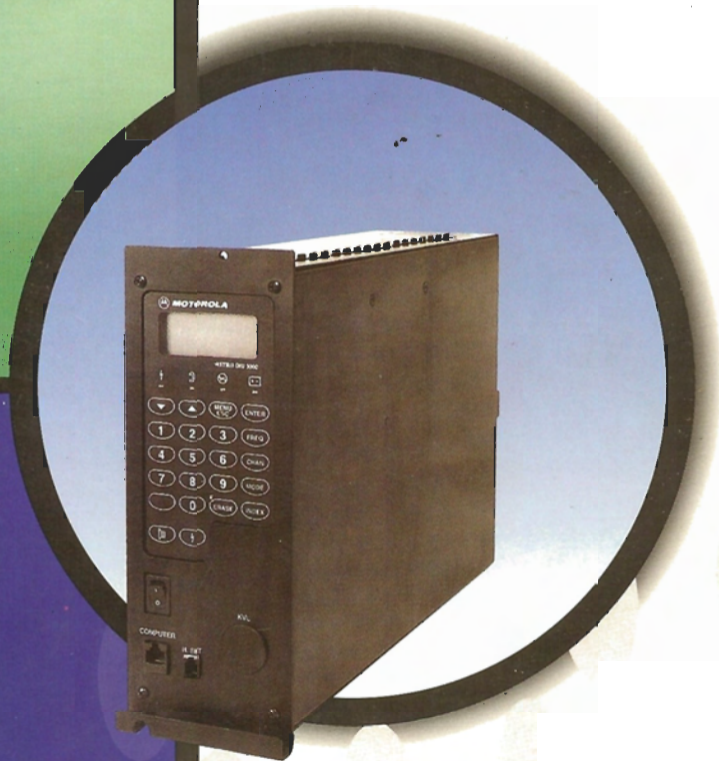




MOTOROLA

ASTRO™ DIU3000 Digital Interface Unit



Owner's Manual

68P02949C65-A





MOTOROLA

Land Mobile Products Sector

ASTRO™ DIU3000

Digital Interface Unit

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Land Mobile Products Sector

16 Kremenetski Street, Tel Aviv 67899

Owner's Manual

Printed in Israel, September 1999

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All DIU's covered by the Warranty that require depot service must be sent or taken to the following depot:

Motorola System Support Center
1311 East Algonquin Road
Schaumburg, IL. 60196
1-800-221-7144
1-847-576-7300

FCC INTERFERENCE WARNING

The FCC Requires that manuals pertaining to Class A and Class B computing devices must contain warnings about possible interference with local residential radio and TV reception. This warning reads as follows:

NOTE: This equipment has been tested and found to comply with limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial or residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

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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 (e.g., PTT ID, Voice Selective Calling, Emergency) Supplementary data transferred stand-alone (e.g., Radio-check, Selective Radio Inhibit, Emergency) Data Transfer RNC to Remote Data Terminal 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 Ω balanced output.
TRC Function Tone Sensitivity	-25 dBm W/L Board version A and B -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 -12 dBm 1 KHz tone, W/L Board version C with JU7 IN
Output to Console	Adjustable, maximum 0 dBm into 600 Ω

BASE STATION WIRELINE INTERFACE

Line Type	4-wire, 600 Ω balanced output. 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 -12 dBm 1 KHz tone, W/L Board version C with JU7 IN
Output to Base Station	Adjustable, maximum 0 dBm into 600 Ω

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 CA1 (IMBE) for Trunking
X806AK	APCO CA1 (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 SIGNALLING / DIGITAL KEYING	RNC (DATA)	PHONE- PATCH	OPTION
1.	MODEM	NO	NO	NO	NO	X959, X437, X560
2.	MODEM MODEM	NO NO	YES X	X YES	NO 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

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.

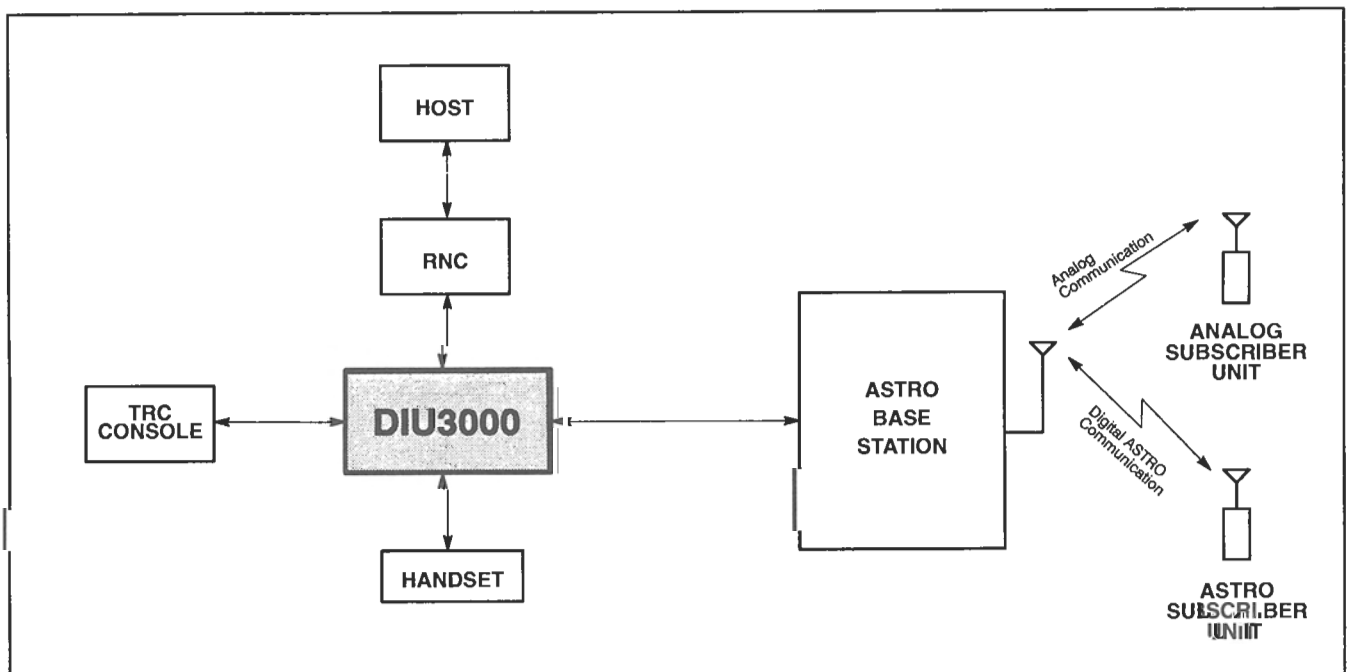


Figure 1
DIU3000 Typical Connection

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

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.

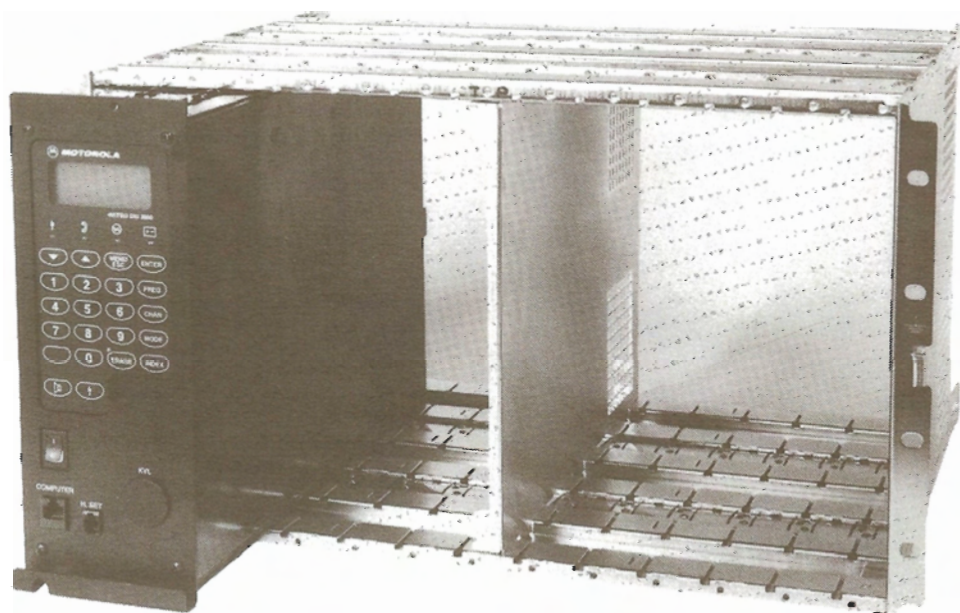
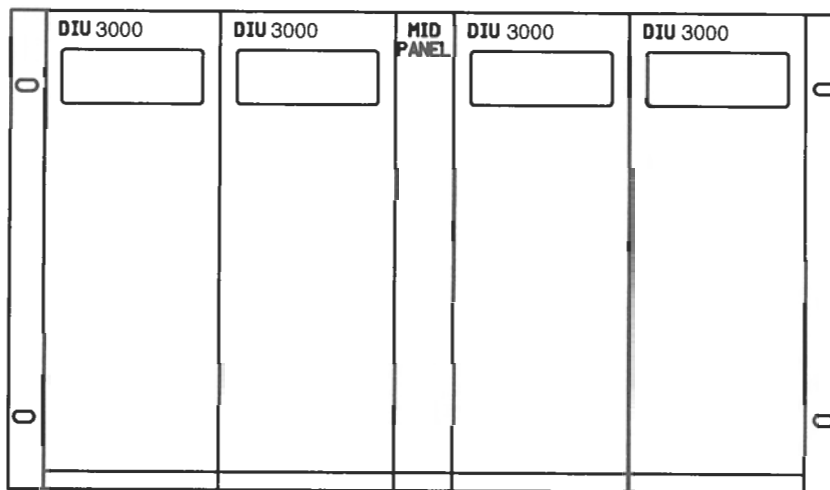


Figure 4
DIU3000 Installation in a Card Cage

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.

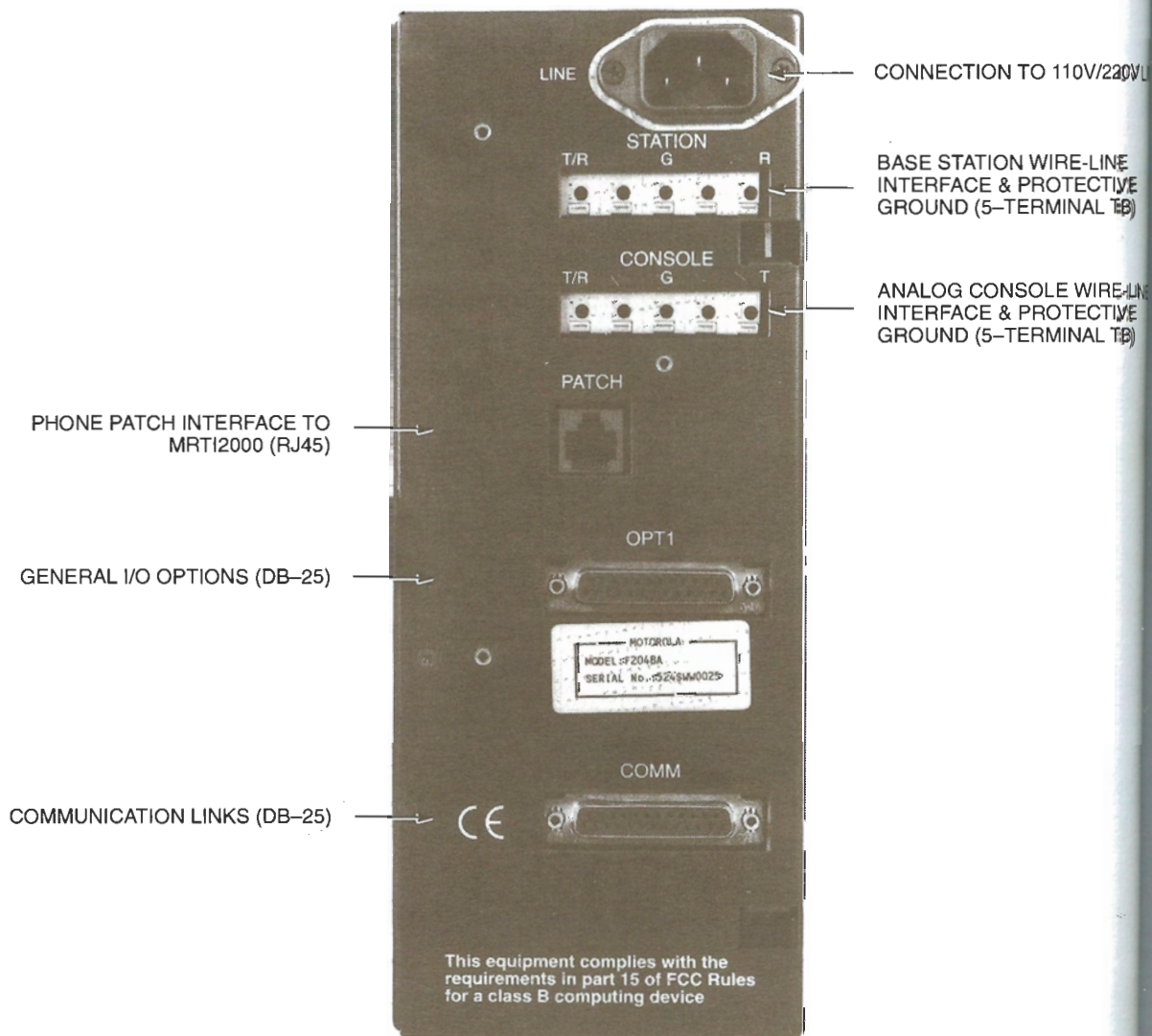


Figure 7
DIU3000 Rear Panel

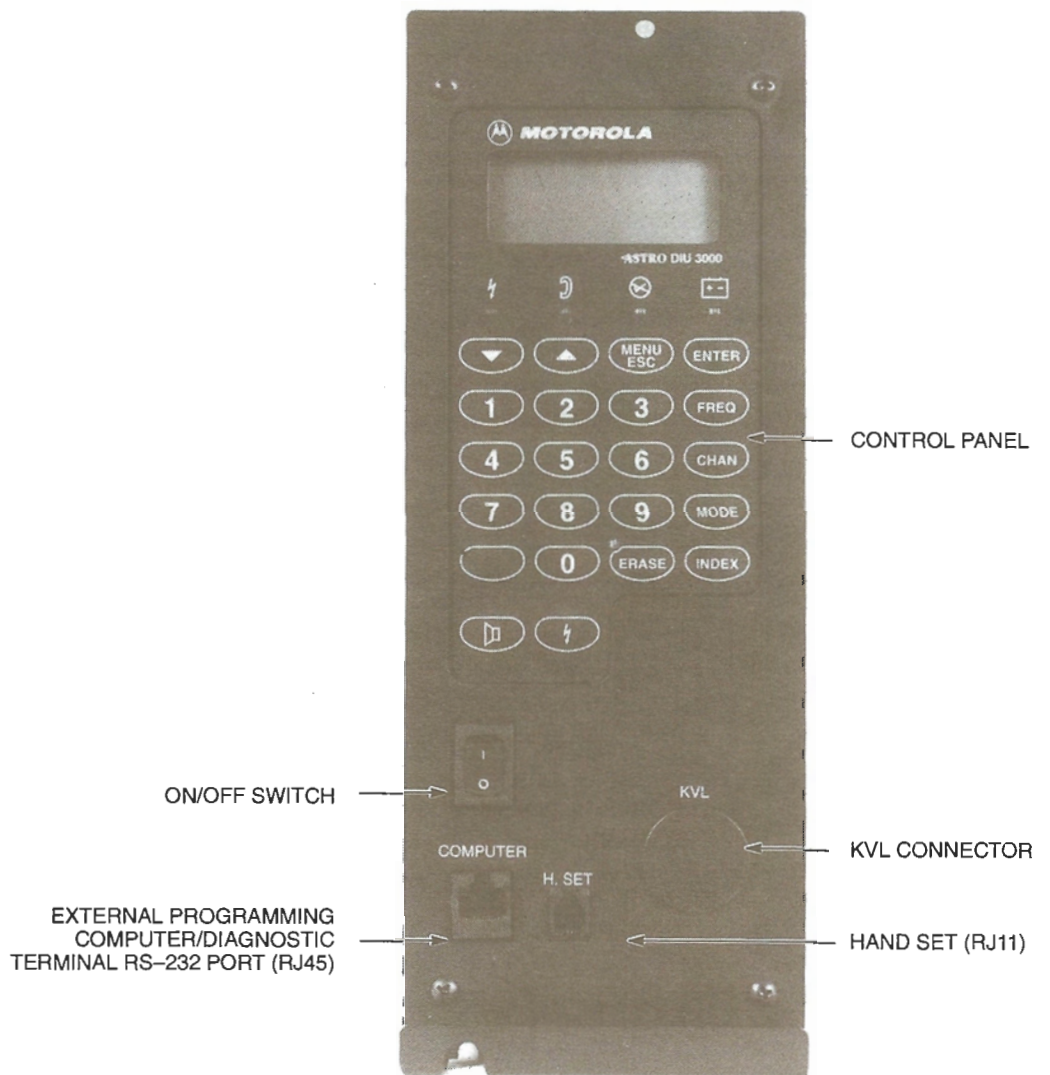


Figure 8
DIU3000 Front Panel

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.

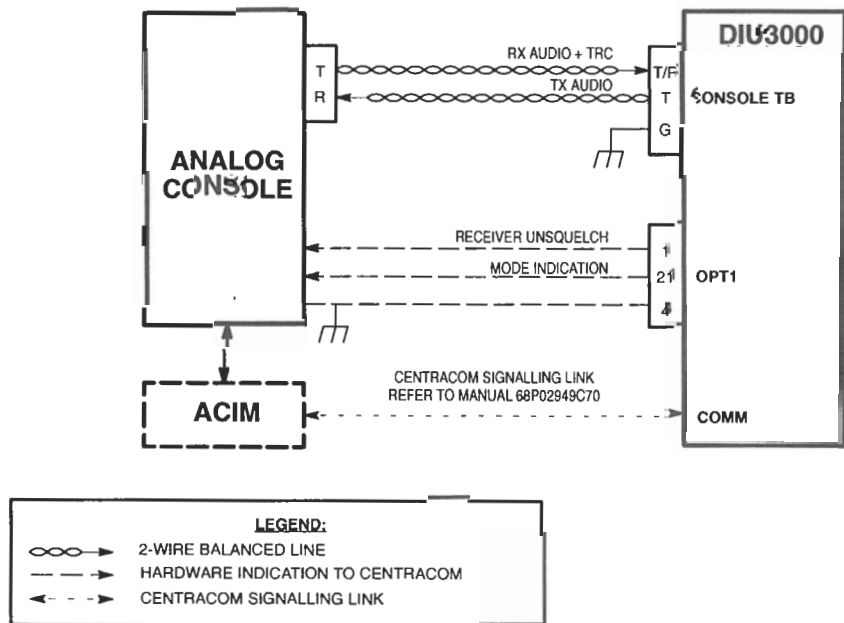


Figure 9
DIU3000 Connection to Analog Console

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.



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

Note

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.

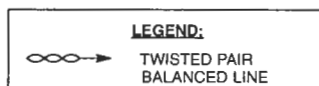
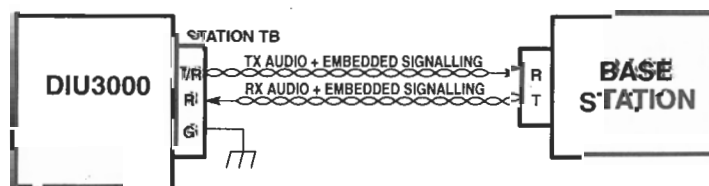


Figure 10
DIU3000 Connection to Base Station



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

Notes

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.

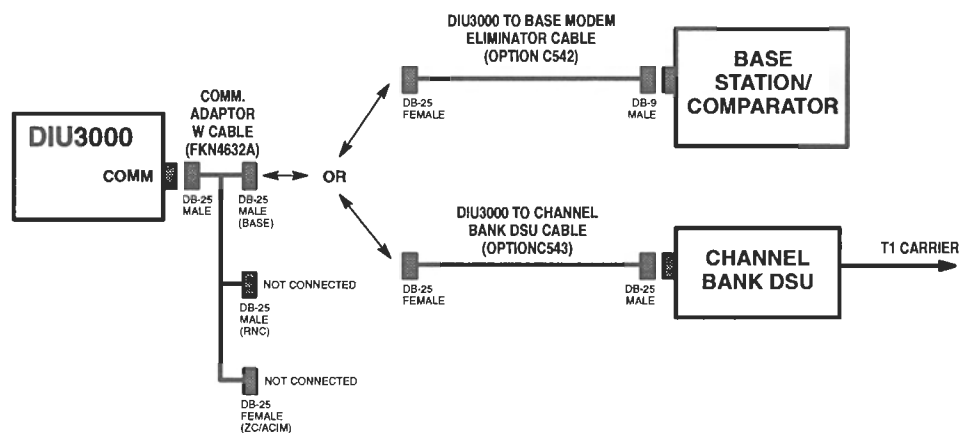


Figure 11
DIU3000 to Base/Channel Bank DSU Digital Link Connections

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 electromagnetic 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. NOTE 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 PLS WAIT is displayed. Upon successful database programming, the message PROG OK is displayed shortly. If the DIU3000 fails to restore the database, an error message is displayed instead of the PROG OK 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. • During LED tests, all front panel LEDs are lit. • During LCD tests, all LCD segments are lit in sequence. • Four tones are heard from the console speaker. • If the handset option is installed, four tones are heard from the handset earpiece.
TST PASS	The self-test has been successfully completed. NOTE If the self test fails, the TST FAIL message is displayed and an alert tone is sent to the console and to the handset earpiece. 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	✓
CHANGE/VIEW : ASTRO System Parameters				
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		
CHANGE/VIEW : Alert Tones				
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		
CHANGE/VIEW : CONS&MICS : TRC Console : TRC Tuning				
Guard-Tone Frequency (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)		
CHANGE/VIEW : CONS&MICS : TRC Console : Console Interface				
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 Astro-Clear / Analog-Clear Astro-Coded / Astro-Clear Astro-Coded / Analog-Clear Astro-Clear / Undefined Analog-Clear / Undefined		
DUPLX	FDX	FDX/HDX		
Silent Level	0	0 - 255		
Num of Wires	4W	4W/2W		
CHANGE/VIEW : CONS&MICS : RNC				
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	✓
CHANGE/VIEW : CONS&MICS : Microphone Sensitivity				
Handset Microphone Sensitivity	9	0 - 9		
CHANGE/VIEW : CONS&MICS : E&M Console Interface				
Line Level	0	-20 - 0		
ECHO	Disable	Enable / Disable		
DUPLX	FDX	FDX / HDX		
PTT Polarity	Low	Low / High		
Repeat Disable Polarity	Low	Low / High		
CHANGE/VIEW : CONS&MICS : MRTI Phone Patch				
Line Level	0	-20 - 0		
Silent Level	5	0 - 255		
PTT Polarity	Low	Low / High		
CHANGE/VIEW : CONS&MICS : CAI DATA Definitions				
Number of Data Tx Attempts	4	2 - 10		
Acknowledgment Timeout	4000	1000 - 6000 ms		
CAI Individual Address	5	1 - 9999999		
CHANGE/VIEW : ASTRO Base Station Parameters				
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		
CHANGE/VIEW : Encryption Parameters : Encryption Configuration				
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		
CHANGE/VIEW : Encryption Parameters : APCO Key Management				
KLK Feature	Disable	Disable / Enable		
Manual Keypad Change	Disable	Disable / Enable		
Key Management Mode	PID	PID / CKR		
Rekey Request Type	Clear	Clear / Encrypted		
CHANGE/VIEW : Astro Trunking Parameters : SmartZone				
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		
CHANGE/VIEW : Astro Trunking Parameters : SmartNet				
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		
CHANGE/VIEW : TX Default Attributes : TRC/SN Console Default Tx Attributes				
Self ID	5	1 - 9999999		
Talk Group ID	4095	0 - 65535		
Channel	blank	0 - 255, blank		
Tx Mode	Clear	Analog / (Astro) Coded / (Astro) Clear		
Default/Failsoft Key Number	blank	0 - 511, or 1 - 65439, blank		
CHANGE/VIEW : TX Default Attributes : Interconnect/Phone Patch Default Tx Attributes				
Self ID	5	1 - 9999999		
Talk Group ID	4095	0 - 65535		
Channel	blank	0 - 255, blank		
Tx Mode	Clear	Analog / (Astro) Coded / (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		
CHANGE/VIEW : TX Default Attributes : Handset Default TX Attributes				
Self ID	5	1 - 9999999		
Talk Group ID	4095	0 - 65535		
Channel	blank	0 - 255, blank		
Tx Mode	Clear	Analog / (Astro) Coded / (Astro) Clear		
Key Number	blank	0 - 511, or 1 - 65439, blank		
CHANGE/VIEW : TX Default Attributes : E&M Console Default Attributes				
Self ID	5	1 - 9999999		
Talk Group ID	4095	0 - 65535		
Channel	blank	0 - 255, blank		
Tx Mode	Clear	Analog / (Astro) Clear / (Astro) Coded		
Key Number	blank	0 - 511, or 1 - 65439, blank		

Operation

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.

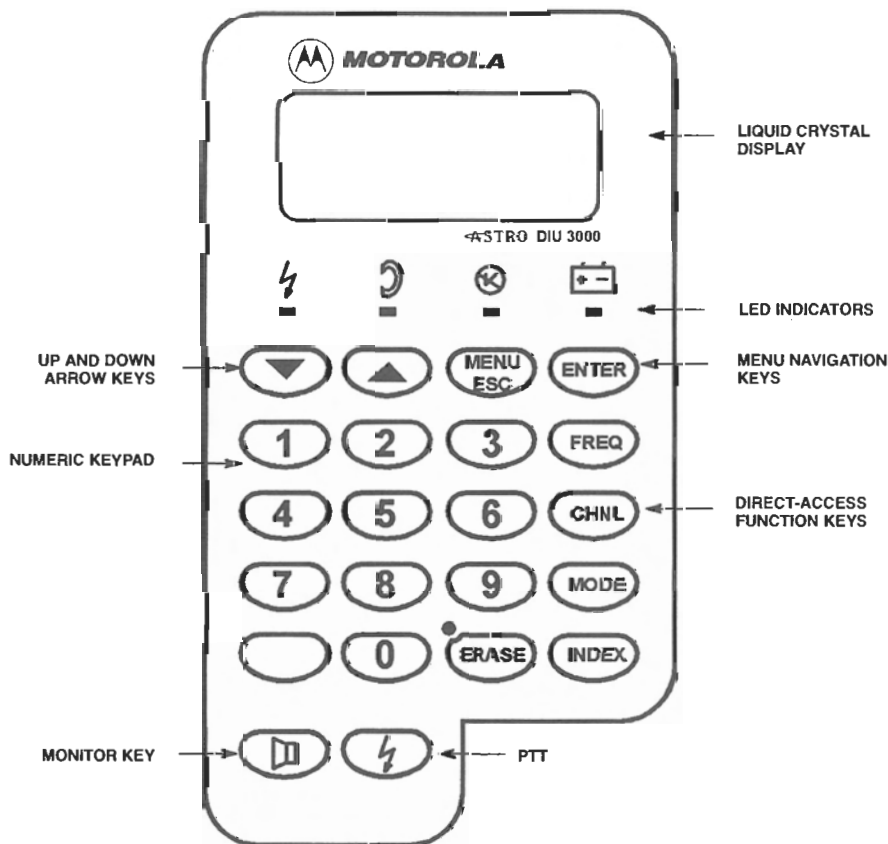


Figure 12
DIU3000 Control Panel

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 Arrows	a. Selection of volume for local monitor. 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 Unscquelch 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
CHK DB	Database checking operations. Restoring the parameter database from backup. NOTE 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 PLS WAIT is displayed. Upon successful database programming, the message PROG OK is displayed for a short duration. If the DIU3000 fails to restore the database, an error message is displayed instead of the PROG OK message. If this occurs, refer to "Troubleshooting" section on page 66.
LOAD SRV	Software server handling.
DSP BOOT	Loading DSP processors' software.
SELF TST	Checking hardware peripherals. <ul style="list-style-type: none"> • During LED tests, all front panel LEDs are lit. • During LCD test, all LCD segments are lit in sequence. • Four tones are heard from the console speaker. • If the handset option is installed, four tones are heard from the handset earpiece.
TST PASS	The self-test has been successfully completed. NOTE If the self test fails, the TST FAIL 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.
LOADING	Loading application.
HH:MM:SS	The time of day is displayed. If the self test has failed, the TST FAIL message is displayed again, and remains until the operator presses either the MENU/ESC or a direct access key. 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.

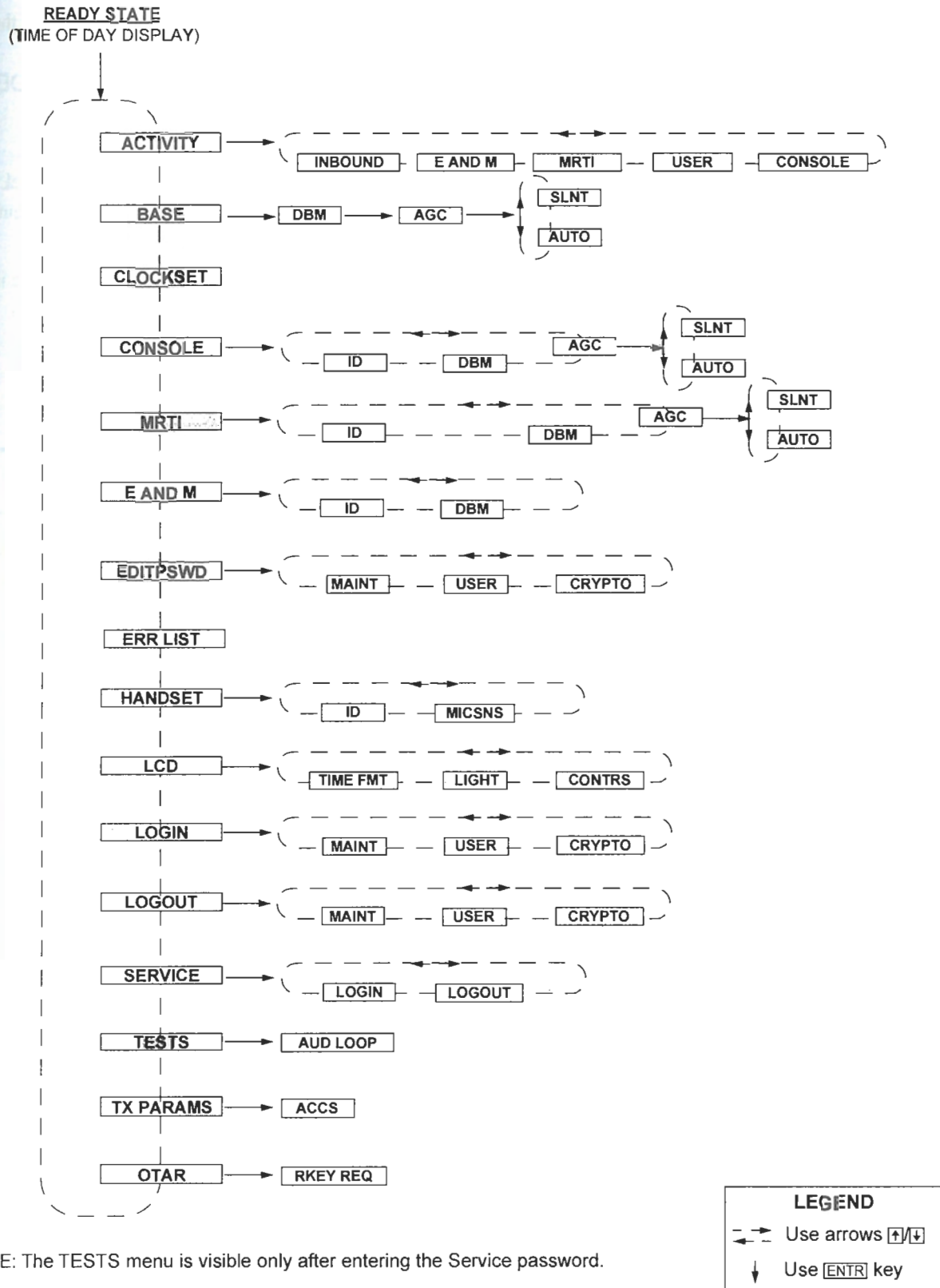
If the numeric keypad is used for changing a value, and the value is out of range, an error message is displayed for a short period, and the previously active value is displayed again.

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.



*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 ACTIVITY is shown.	ACTIVITY	
3. Press ENTR to enter the device selection menu.	CONSOLE or USER or INBOUND	
4. Scroll to display the required device option.		
5. Press ENTR to display activity parameters that can be traced for the selected device.	FREQ nnn or CHNL nnn or ANALOG/ CLEAR/ ENCR nnn	<ul style="list-style-type: none"> • The data displayed is updated once a second, or if ENTR is pressed. • If there was no inbound process since power-up and ENTR is pressed while in INBOUND ACTIVITY display state, the message NO INFO is displayed.
NOTE		
<ul style="list-style-type: none"> • For the CONSOLE activity, only the CHaNneL and MODE parameters can be traced. • For the INBOUND activity, only the MODE parameter can be traced. 		
6. Use the arrow keys to scroll between the available parameters.	CONSOLE or USER or INBOUND	
7. Press MENU/ESC to return to the device selection menu.		
8. Repeat steps 4 to 7 to trace another device, or press MENU/ESC 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.	BASE	
3. Press ENTR.	DBM nn	
4. Press ENTR.	DBM nn	"nn" blinks.
5. Scroll to select the required value.	DBM mm	"mm" indicates the new selected signal level.
6. Press ENTR to confirm the selection.	DBM mm	
7. Press MENU/ESC twice to return to the ready state.	8 : 46 : 16	

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.	CLOCKSET	
3. Press ENTR to enter the hour setting state.	HH:MM:SS	
4. Scroll to select the required value.	HH:MM:SS	
5. Press ENTR to enter the minute setting state.	HH:MM:SS	
6. Scroll to select the required value.	HH:MM:SS	
7. Press ENTR to confirm the new time setting.	HH:MM:00	The seconds are reset and the new time is displayed.
8. Press MENU/ESC key to return to the ready state.	8 : 45 : 16	

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.	CONSOLE	
3. Press ENTR to display the options.	DBM nn or ID HHH	
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.	DBM nn	"nn" indicates the currently selected signal level in dBm units.
6. Press ENTR.	DBM nn	"nn" blinks.
7. Scroll to select the required value.	DBM mm	"mm" indicates the new selected signal level.
8. Press ENTR to confirm the selection.	DBM mm	
9. Press MENU/ESC twice to return to the ready state.	8 : 46 : 16	

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 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 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 on the DIU's front panel. The screen should now flash "AUTO RDY".
9. While the tone is being transmitted press 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.	EDITPSWD	
3. Press ENTR to display the password types.	USER or CRYPTO or MAINT	
4. Scroll to select the required option.		
5. Press ENTR .	USER PSWD or CRY PSWD or MAI PSWD	The display blinks.
6. Key in the password.	-----	A short bar is displayed for each key depression.
7. Press ENTR.	NEW PSWD	
8. Key in the new password.	-----	
NOTE		
The password may contain from 6 to 10 digits. For passwords that exceed eight digits, only the last eight are shown.		
9. Press ENTR.	AGAIN	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.	PSWD OK	
12. Press MENU/ESC to return to the ready state.	8 : 45 : 16	

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

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 ERR LIST is shown.	ERR LIST	
3. Press ENTR.	NO ERR or TOT nn	"NO ERR" indicates that no failures have been detected. "TOT nn" indicates the total number of detected failures.
4. If TOT nn is displayed, scroll to view the stored failures.	ERR n	"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.	8 : 46 : 16	

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.	HANDSET	
3. Press ENTR.	ID HHH or MICSNS n	"ID HHH" indicates the current ID in hexadecimal format; "MICSNS n" indicates the current microphone sensitivity.
4. Scroll to select the required option.	ID HHH or MICSNS n	
5. Press ENTR.	MICSNS n	"n" blinks.
6. Scroll between the available options or key in the required value (0 - 9).	MICSNS m	"m" blinks.
7. Press ENTR to confirm the selection.	MICSNS m	
8. Press MENU/ESC twice to return to the ready state.	8 : 46 : 16	

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 or LIGHT n or TIME FMT	"n" indicates the currently selected level.
4. Scroll to select the required option.	CONTRS n or LIGHT n or 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 or 24 HR	"12" or "24" blinks.
3. Scroll to select the required option.	12 HR or 24 HR	"12" or "24" blinks.
4. Press ENTR to confirm the selection.	HH : MM : SS or A HH : MM : SS or 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.	LOGIN	
3. Press ENTR to display session types.	USER or CRYPTO or MAINT	
4. Scroll to display the required option.		
5. Press ENTR to initiate password entry.	USR PSWD or CRY PSWD or MAI PSWD	The display blinks.
6. Key in the password.	-----	A short bar is displayed for each key depression.
7. Press ENTR.	PSWD OK	The message "PSWD OK" is displayed for a few seconds and the DIU3000 returns to the login mode entry state.
NOTE		
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.	8 : 45 : 16	

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.	LOGOUT	
3. Press ENTR to display session types.	USER or CRYPTO or MAINT	
4. Scroll to display the required option.		
5. Press ENTR to logout.	LOG OUT ... and then LOGOUT	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.	8 : 45 : 16	

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.	SERVICE	
3. Press ENTR to display options.	LOGIN or LOGOUT	
4. Scroll to display LOGIN.	LOGIN	
5. Press ENTR to initiate password entry.	SRV PSWD	The display blinks.
6. Key in the password - "039302164".	-----	A short bar is displayed for each key depression.
7. Press ENTR.	PSWD OK	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.	8 : 45 : 16	

Terminating a Service Session

Table 20

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.	SERVICE	
3. Press ENTR to display options.	LOGIN or LOGOUT	
4. Scroll until LOGOUT is shown.	LOGOUT	
5. Press ENTR to logout.	LOG OUT ... and then SERVICE	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.	8 : 45 : 16	

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.	TX PARMS	
3. Press ENTR to display the parameter options (currently only the Access Code).	ACCS nnn	"nnn" indicates the current access code value.
4. Press ENTR to enter the access code editing state.	ACCS nnn	"nnn" blinks.
NOTE		
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.	ACCS mmm	"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.	ACCS mmm	The DIU3000 returns to the access code display state.
7. Press MENU/ESC key twice to return to the ready state.	8 : 45 : 16	

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.	OTAR	
3. Press ENTR to display Rekey .	Rekey RQ	
4. Press ENTR to initiate a rekey request.	OTR WAIT	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.	FREQ nnn	"nnn" indicates the currently selected FREQ number.
NOTE		
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.	FREQ nnn	"nnn" blinks.
3. Key in the required value or scroll through the available values using the arrows.	FREQ mmm	The selected value blinks.
NOTE		
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.	FREQ mmm	The DIU3000 returns to the frequency display state.



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

Action	LCD Display	Comments
1. Press CHNL to enter the channel display state.	CHNL nnn	"nnn" indicates the currently selected channel number.
2. Press ENTR to enter the channel editing state.	CHNL nnn	"nnn" blinks.
3. Key in the required value or scroll through the available values using the arrows.	CHNL mmm	The selected value blinks.
NOTE		
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.	CHNL 46	

MODE

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.	ANALOG or CLEAR or ENCR nnn	The current mode is displayed.
2. Press ENTR to enter the mode selection state.		The displayed mode blinks.
NOTE		
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).	ANALOG or CLEAR	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

Action	LCD Display	Comments
1. Press MODE to enter the mode display state.	ANALOG or CLEAR or ENCR hnn	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.	ENCR nnn	"ENCR" blinks and "nnn" indicates the active encryption key.
4. Press ENTR to enter encryption key selection state.	KEY nnn	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.	KEY mmm	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.
NOTE		
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.	ENCR mmm	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 Keyset 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

Action	LCD Display	Comments
1. Press INDX to enter the index display state.	NAME1 or NAME2	The alias of the currently active index is displayed.
2. Press ENTR to enter the index selection state.	NAME1 or NAME2	The active index name blinks.
3. Use arrows to scroll between the available indexes.	NAME1 or NAME2	The name of the selected index blinks.
NOTE		
Pressing INDX or MENU/ESC at this stage will return to the index display state without changing the index.		
4. Press ENTR to confirm the selection.	NEW'INDX or SAME'INDX	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 Keypad

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.	KEYERSE	The prompt indicates that the key zeroization function is active and the LED on the ERSE key is lit.
NOTE		
Pressing ERSE or MENU/ESC at this stage will exit the key zeroization function without performing the zeroization.		
2. Press ENTR to initiate the zeroization procedure.	ZEROIZED	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

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

Problem / Indication	Possible Cause	Remedy
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"> 1. The link is busy (Link Busy LED is lit). 2. Tone1 and Tone2 frequencies of a dual tone TRC command are identical. 3. The encrypted session has not been opened. 4. Trial to transmit in encrypted mode, while the encryption cartridge is not properly installed or not installed at all. 5. Trial to transmit with an encryption key that is not loaded. 	<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
Self Test: 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.
Self Test Fail: Eight tones of 26 ms with alternating frequencies of 500 and 1000 Hz.	The self test has failed.	Have the unit serviced.
Clear Tx / Clear Rx: 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.
Tx Key Fail: 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.
Rx Key Fail: 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.
Key Erase: 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.
Multi-Key Verification: 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.
Duplicate LID's: 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.
Data Busy: 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, 8 - 25, 31 - 44, 46 - 48, 55	DIU3000 internal failure.	Call service.
7, 49, 50	Encryption cartridge related failure.	<ol style="list-style-type: none"> 1. Verify that the encryption cartridge is properly installed, and then restart the unit. If the error persists, replace the encryption cartridge. 2. If the Encryption cartridge is not installed and the ENCRYPTION parameter is enabled, disable this parameter via the RSS.
51, 53, 54	<ol style="list-style-type: none"> 1. Encryption cartridge related failure. 	<ol style="list-style-type: none"> 1. Verify that the encryption cartridge is properly installed, and then restart the unit. If the error persists, replace the encryption cartridge. 2. If the Encryption cartridge is not installed and the ENCRYPTION parameter is enabled, disable this parameter via the RSS.
	<ol style="list-style-type: none"> 2. DIU3000 internal failure. 	Call service.
52	<p>EMC crypto violation.</p> <p style="text-align: center;">NOTE</p> <p>In any case of crypto violation, the encryption cartridge automatically erases all encryption keys.</p>	<ol style="list-style-type: none"> 1. Verify that the encryption cartridge has not been tampered. 2. Verify that voltage supply is correct. 3. Verify that the temperature conditions are appropriate. 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.
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. (W) Warning only. (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 vself from DSP	Software problem
(11) (W) Wrong vself number from DSP	Software problem
(12) (W) Timeout getting vself from EMC	Software problem
(11) (W) Wrong vself 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-escync 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 vself from infrastructure	Link problem
(27) (W) Wrong vself number from infrastructure	Link problem
(28) (W) Timeout getting esync from infrastructure	Link problem
(29) (W) EMC is not installed	

Table 33 (Continued)

Messages Printed	Possible Cause for Failure
(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)

Messages Printed	Possible Cause for Failure
(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

Error No.	Error Name
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)

Error No.	Error Name
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"> 1. You are trying to perform an action that involves encryption while FIPS is enabled, but a corresponding encryption session has not been initiated. 2. The selected encryption key does not correspond to the user type.
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



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

Note

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.

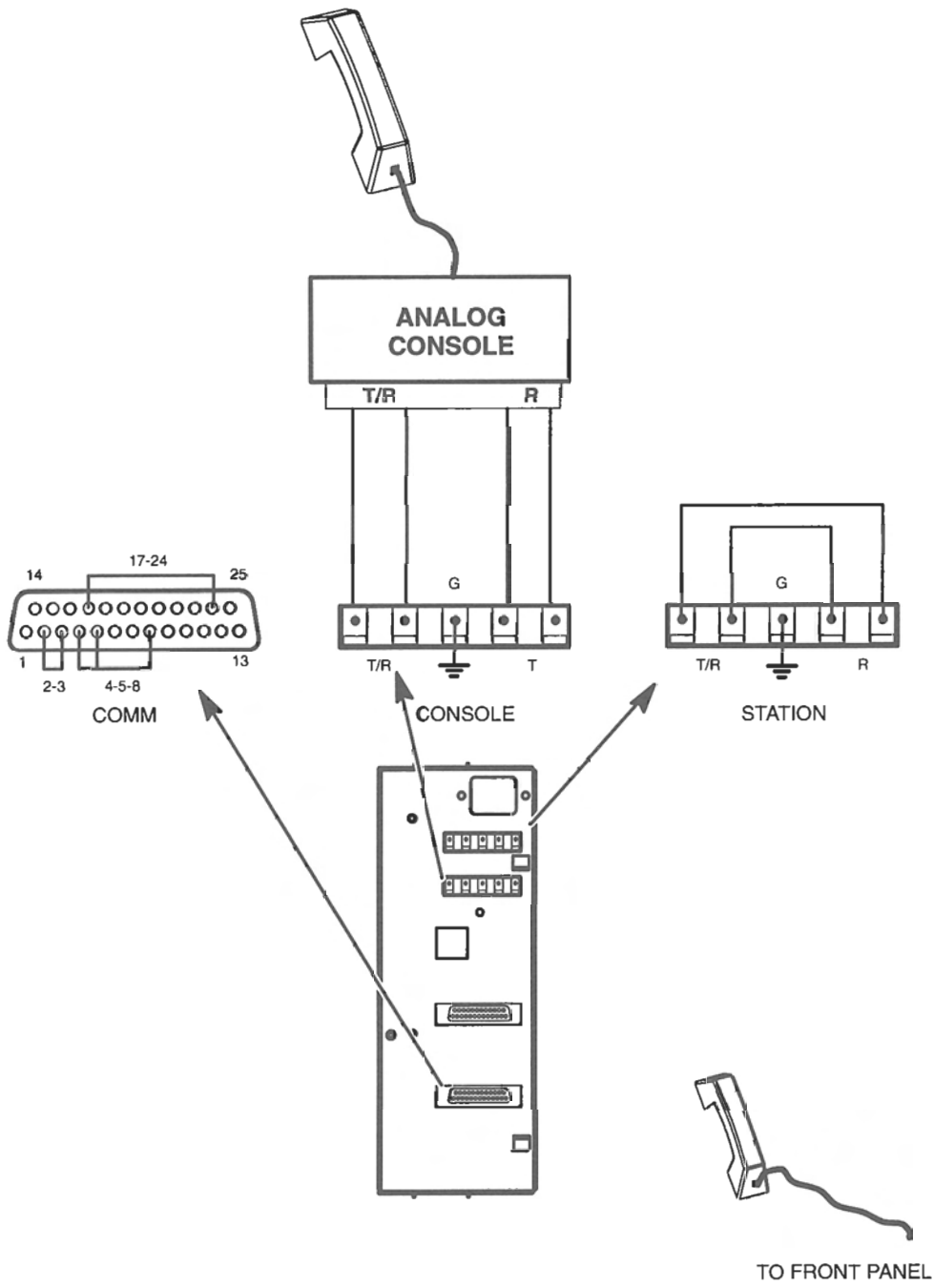


Figure 14
Testing the DIU3000 with Loop-Back on Base Station

DIU Stand Alone Audio Loop Test



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

Note

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.

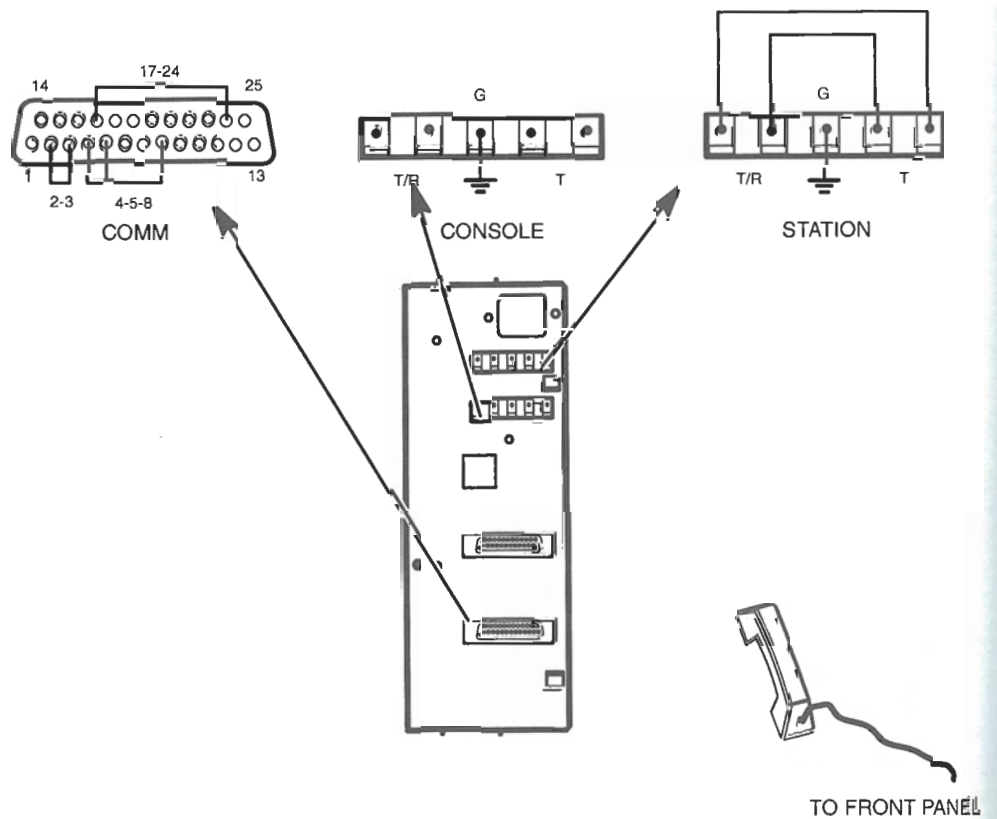


Figure 15
Stand Alone Audio Loop Test Setup

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.	SERVICE	
3. Press ENTR to display options.	LOGIN or LOGOUT	
4. Scroll to display LOGIN.	LOGIN	
5. Press ENTR to initiate password entry.	SRV PSWD	The display blinks.
6. Key in the password - "039302164".	-----	A short bar is displayed for each key depression.
7. Press ENTR.	PSWD OK	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.	SERVICE	
9. Scroll until TESTS is shown.	TESTS	
10. Press ENTR to display options and scroll to display AUD LOOP.	AUD LOOP	
11. Press ENTR to enter the Audio Loop test mode.	LOOP RDY	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.

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/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

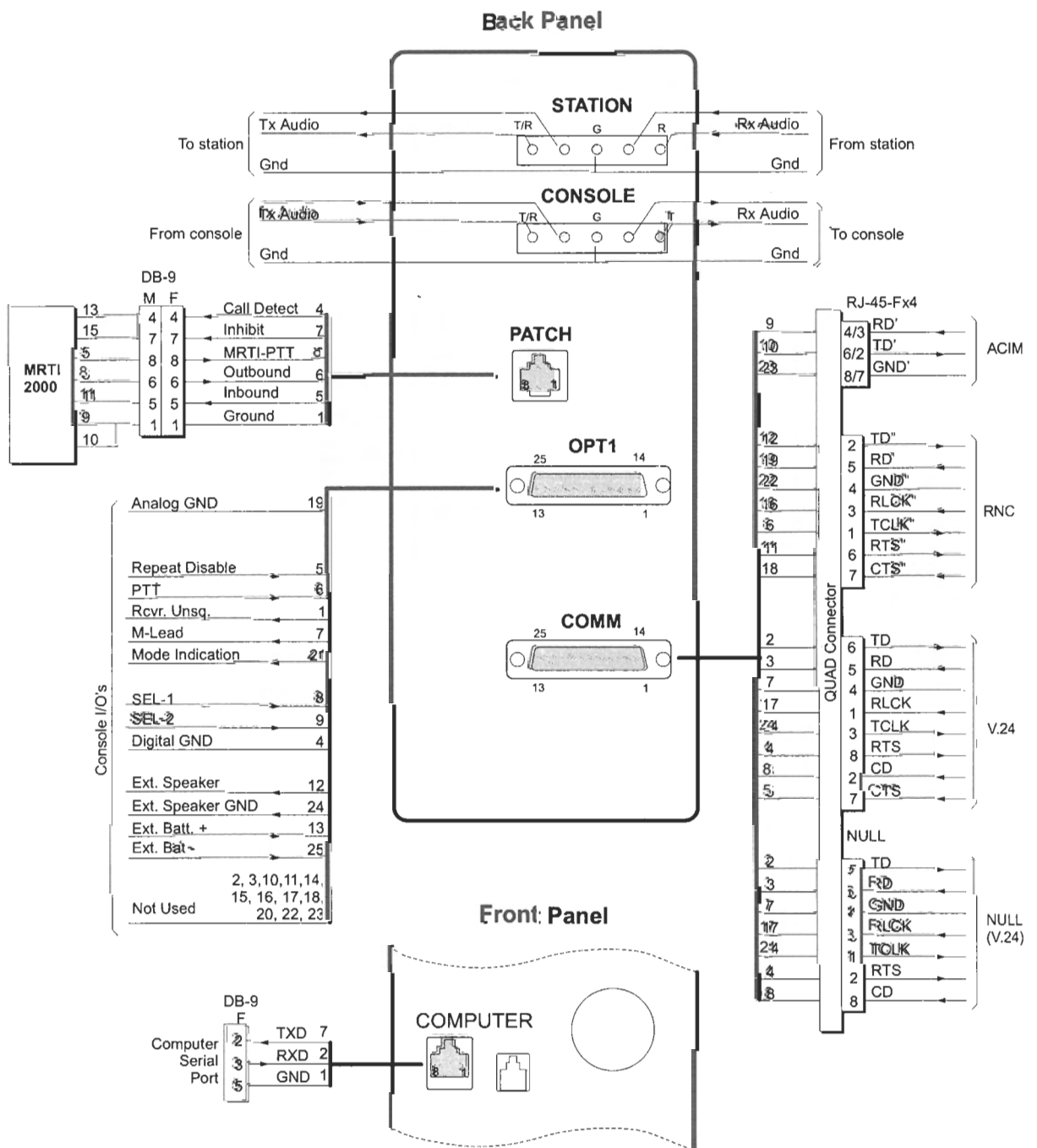


Figure 16
DIU3000 Interface Diagram

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 [†]	Unsquelch [‡]	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 [†]	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 [†]	Mode 1 [‡]	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 Ω 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"	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"	Request to Send to RNC	digital
12	TD"	Transmit data to RNC	digital
13		Not used	
14		Not used	
15	CD"	Carrier Detect from RNC	digital
16	RCLK"	Receive Clock from RNC	digital
17	RCLK	Receive Clock from Base Station	digital input
18	CTS"	Clear to Send from RNC	digital
19	RD"	Receive data from RNC	digital
20		Not used	
21		Not used	
22	GND"	Ground from RNC	
23	GND"	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 DB-25M PIN	V.24 (null) RJ-45 #1	V.24 RJ-45 #2	ACIM/SZ RJ-45 #3	RNC RJ-45 #4
PROT. GND	1				
TD	2	5	6		
RD	3	6	5		
RTS	4	2	8		
CTS	Jmpr #4 DB25-5 to DB25-4 & DB25-5 to Jmpr #6-1		7		
TCLK"	6				1
SIG GND	7	4	4		
CD	DB25-8 to Jmpr #6-2	RJ#1-8 to Jmpr #6-3	RJ#2-2 to Jmpr #6-3		
RD'	9			Jmpr #2 DB25-9 to RJ#3-3 & DB25-9 to RJ#3-4	
TD'	10			Jmpr #3 DB25-10 to RJ#3-2 & DB25- 10 to RJ#3-6	
RTS"	11				6
TD"	12				2
Not used	13				
Not used	14				
CD"	Jmpr #5 DB25- 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 to RJ#3-7 & DB25- 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.

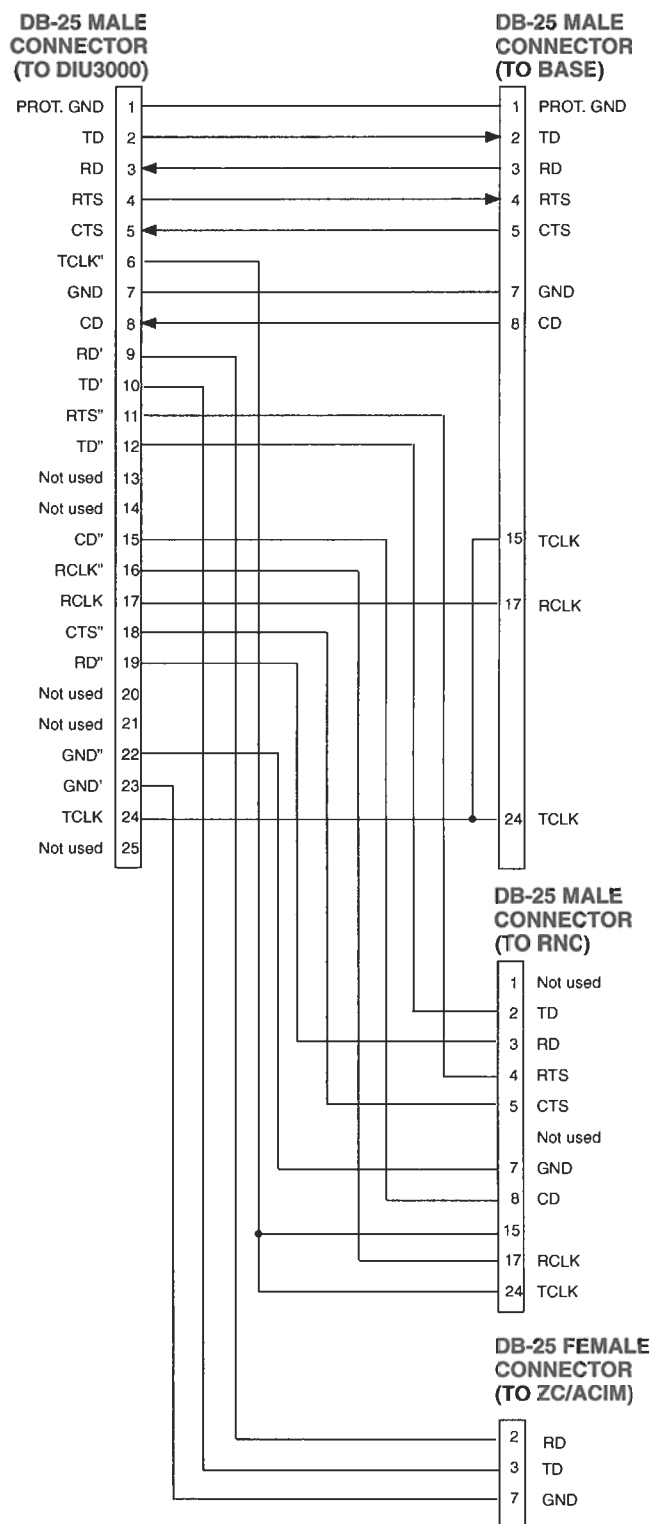


Figure 17
DIU3000 Communication Adaptor Cable FKN4632A (W cable)

Appendix B: Communcation Cables

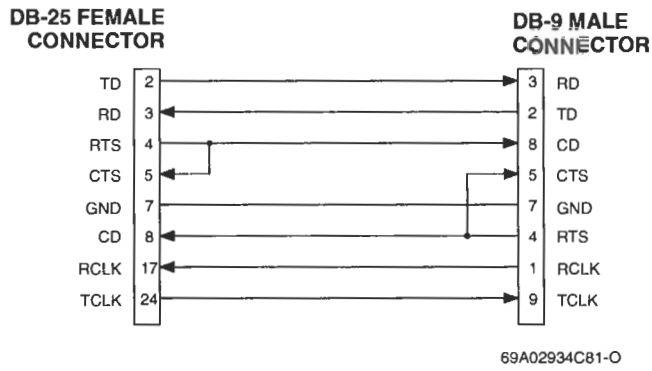


Figure 18
DIU3000-to-Base Station Modem Eliminator Cable (options C542AC and C542AD)

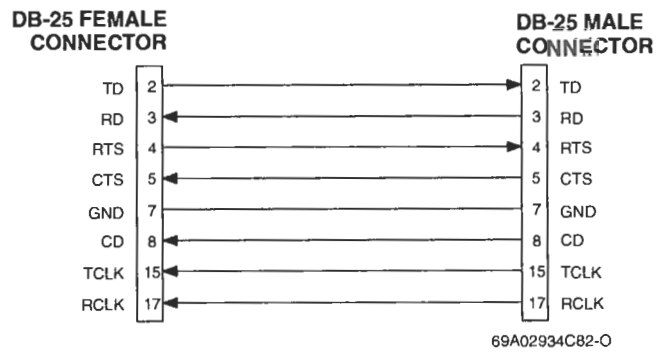


Figure 19
DIU3000 to Channel Bank DSU Cable (options C543AC and C543AD)

Appendix C: Glossary of Terms and Phrases

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

Appendix D: Acronyms

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