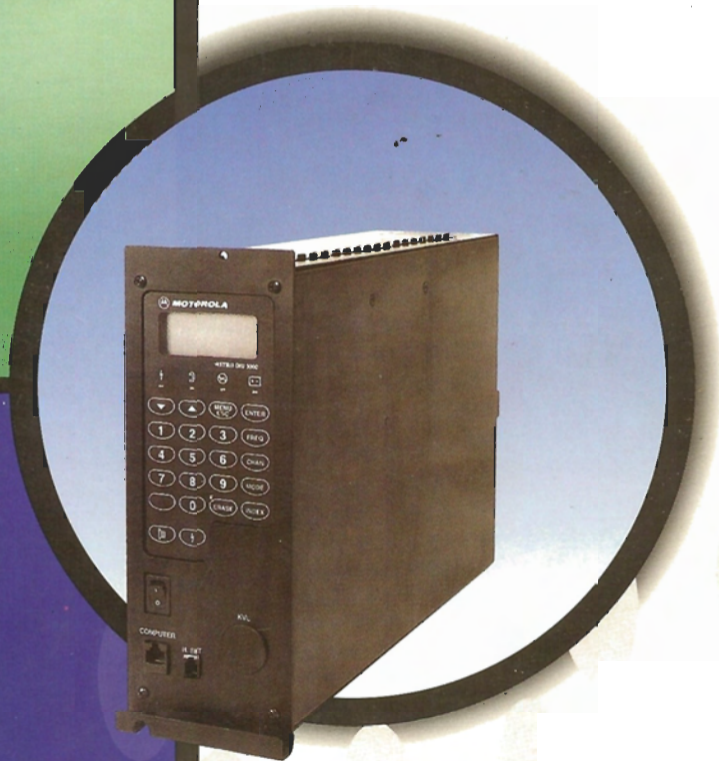




**MOTOROLA**

# ASTRO™ DIU3000 Digital Interface Unit



**Owner's Manual**

68P02949C65-A





**MOTOROLA**

*Land Mobile Products Sector*

# **ASTRO™ DIU3000**

## **Digital Interface Unit**

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16 Kremenetski Street, Tel Aviv 67899

**Owner's Manual**

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1-847-576-7300

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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

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### ASTRO System Overview

#### General

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

The main features of the ASTRO system are:

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

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

#### ASTRO System Technologies

##### Voice Digitizing

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

##### Usage of the RF Spectrum

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

##### Encryption

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

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

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

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

#### **Error Protection**

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

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

ASTRO systems transmit data in three ways:

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

#### **Tone Remote Control**

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

### **ASTRO System Building Blocks**

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

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

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

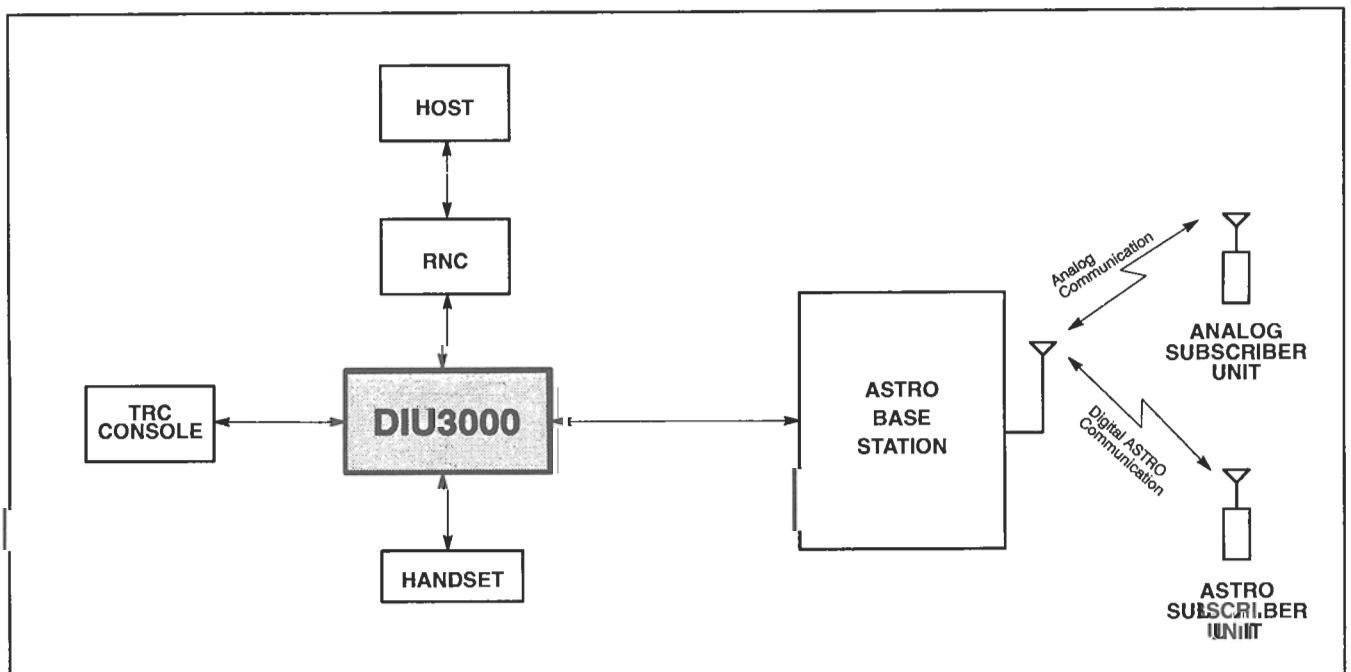
- ASTRO satellite receivers: Consist of the same components as the base station, but without the transmitting capability.
- ASTRO comparator: A fully digital signal voter which can vote both on ASTRO digital signals and on analog signals, and provides the ASTRO systems with the ability to obtain wide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

### A Sample ASTRO System

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

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

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



**Figure 1**  
DIU3000 Typical Connection



## Digital Interface Unit

### General

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



**Figure 2**  
ASTRO DIU3000 – General View

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

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

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

## DIU3000 Features

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

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

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

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

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

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

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

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

## **DIU3000 Basic Model and Options**

### **Digital Link to Base Station/Comparator**

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

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

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

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

### **Centracom Signalling Link**

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

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

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

### **Battery Revert Cable (option C28DG)**

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



**Note**

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

### **220 V Primary Power (option C41AF)**

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

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

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

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

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

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

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

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

This option includes the SmartZone operation and the SmartNet operation.

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

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

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

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

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

### **DIU3000 in SmartNet Operation**

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

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

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

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

### **DIU3000 Conventional Operation (option X959AA)**

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

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

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

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

### **Phone Patch (option C54BF)**

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

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

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

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

### Communication QUAD Connector (option C823AA)



**Figure 3**  
Quad Connector – General View

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

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

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

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

### ASTRO System Modes of Operation

The DIU3000 supports the following ASTRO system modes of operation:

- Analog
- ASTRO Clear
- ASTRO Encrypted

### **Analog Mode**

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

### **ASTRO Clear Mode**

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

### **ASTRO Encrypted Mode**

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

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

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

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

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

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



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

## DIU3000 Functional Description

### Interface and Processing Functions

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

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

#### Voice Processing

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

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



**Note**

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

#### Encryption (Optional)

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

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

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

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

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

#### **Error Protection**

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

#### **Embedded Signalling**

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

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

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

#### **Base Station Control**

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

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

### TRC Command Handling

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

### Alert Tone Indication

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

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

### Local Operation

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

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

## Installation Instructions

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### General

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

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

### Initial Inspection

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

### Planning the Installation

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

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

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

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

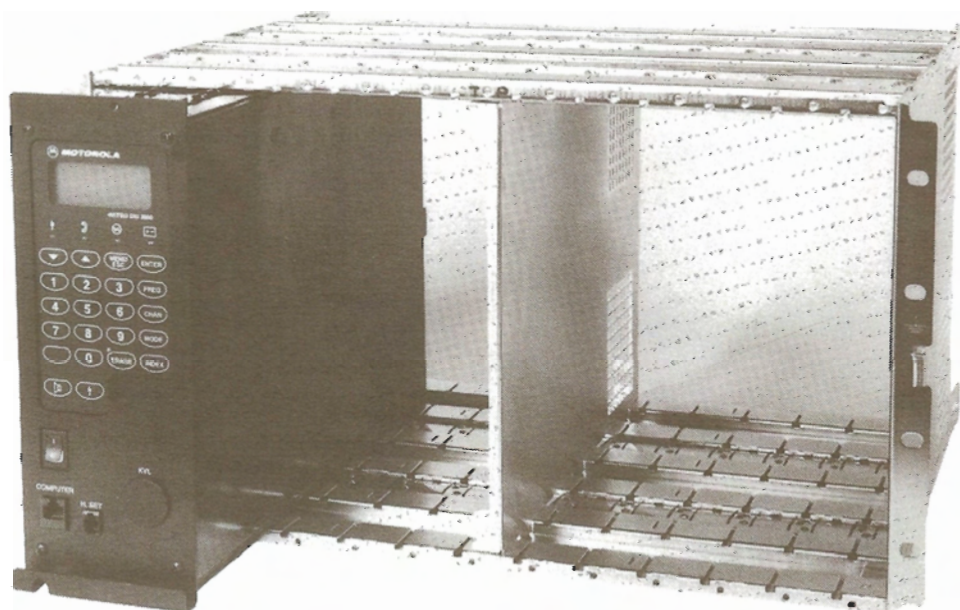
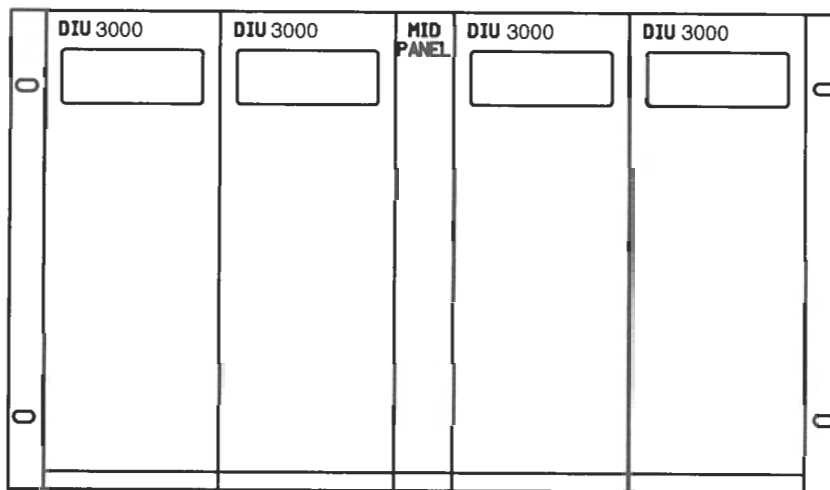
The DIU3000 is especially designed for easy installation. A standard installation does not require opening the DIU3000 housing. Rather, all adjustments are carried out via an external PC using the ASTRO DIU Radio Service Software (RSS) and via the DIU3000 keypad.

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

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

### Mounting

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



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

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



**Figure 5**  
Mid-panel

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



**Figure 6**  
Blank Panel

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

## Installing Encryption Cartridge



**Note**

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

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



**Note**

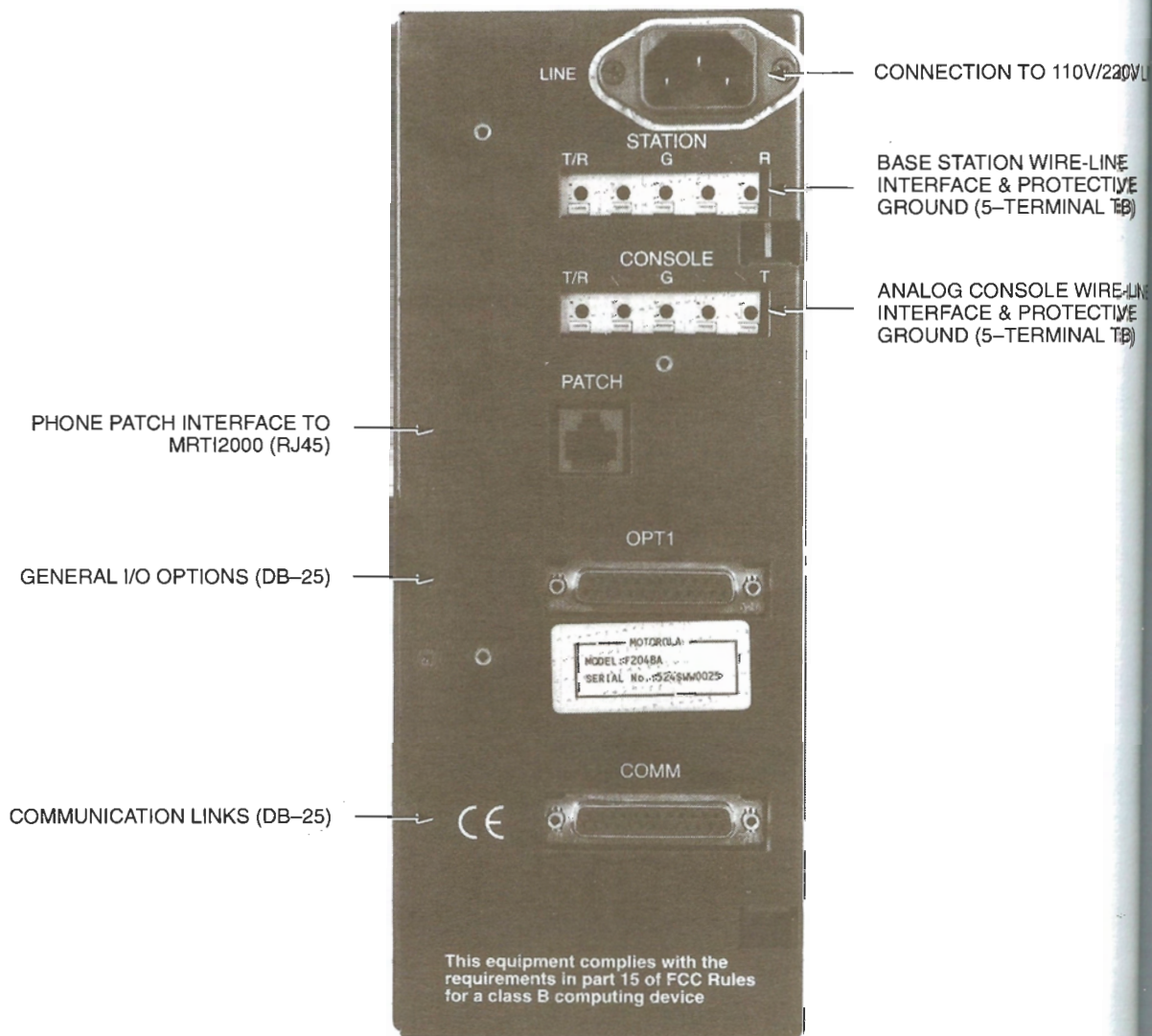
To remove the encryption cartridge, it is necessary to use a tool supplied to the DIU3000 service shops, Motorola part number 6686064C01.

## Electrical Connections

(See Figure 6 and Figure 7)

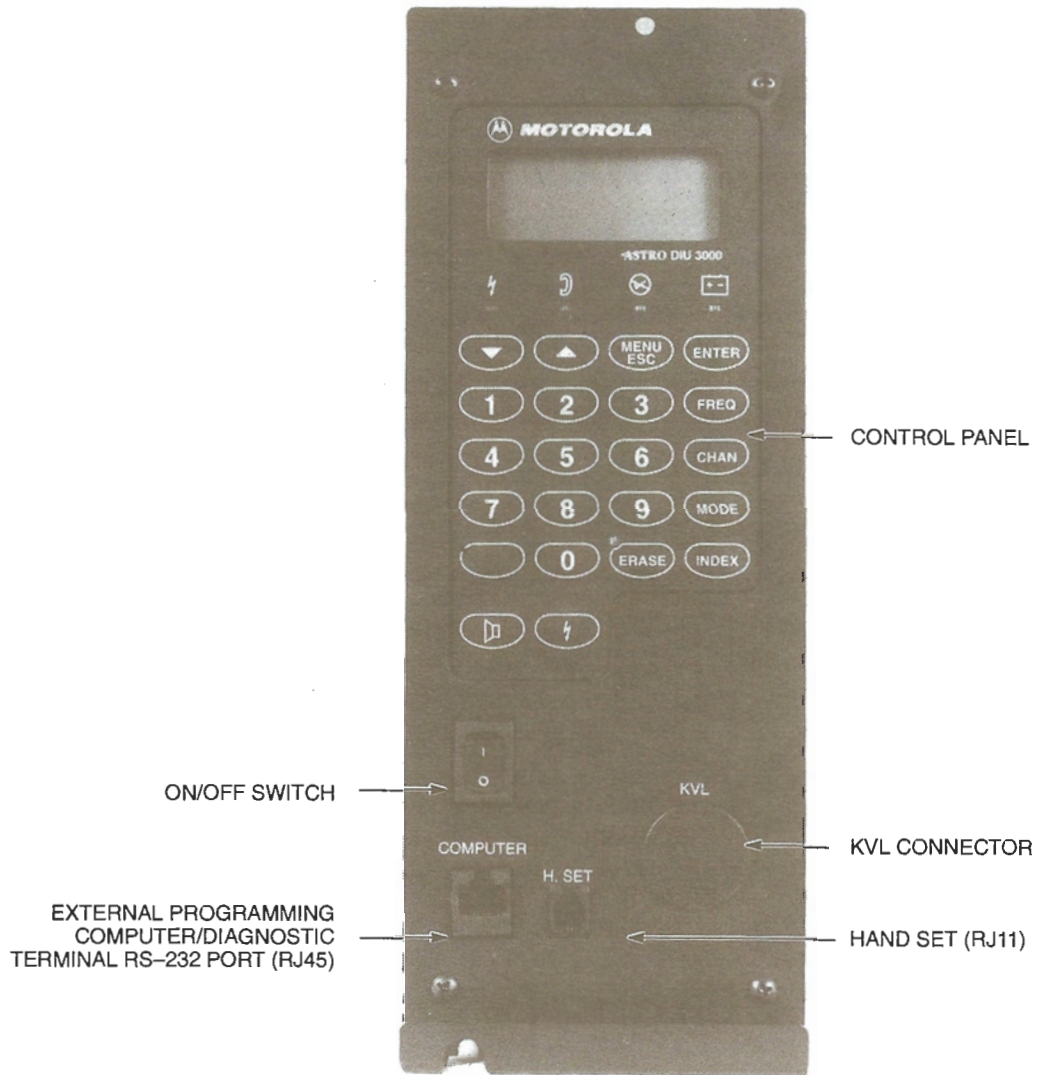
### General

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



**Figure 7**  
DIU3000 Rear Panel





**Figure 8**  
DIU3000 Front Panel

### Jumper Setting

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

### Ground Connection

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



**Note**

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

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

**AC Power**



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

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

**Analog Console Connection**

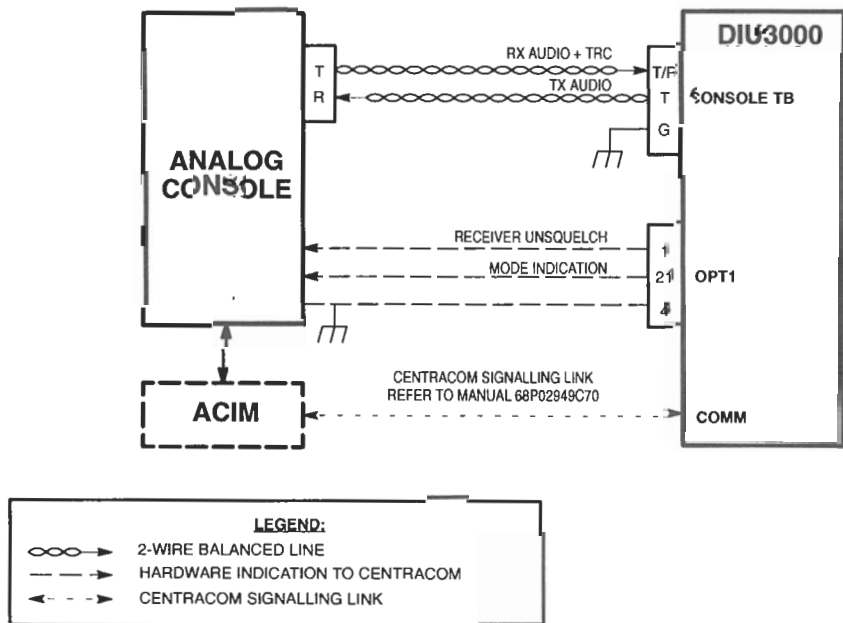
(See Figure 8)

**Analog Link Connection**



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

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



**Figure 9**  
DIU3000 Connection to Analog Console

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

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

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



#### Notes

The standard DB-25 connector does not fit into the DIU3000 "OPT1" connector. Use the DB-25 connector supplied in kit FLN6858A.

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

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



#### Note

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

### Connecting the CENTRACOM Signalling Link

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

### Connecting the E&M Console

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

## Base Station/Comparator Connection

### General

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

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

### Wire Line Link Connection

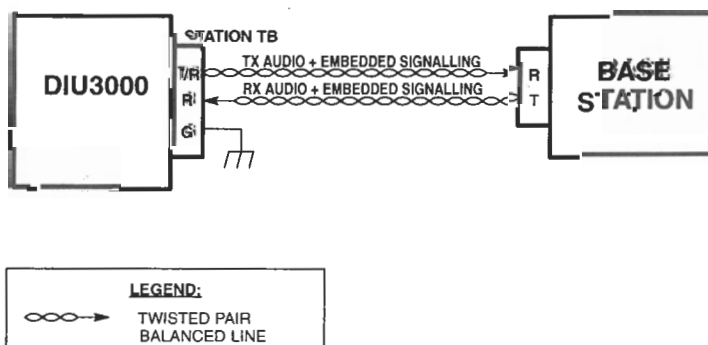
See Figure 9.



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



**Notes**

It is recommended to use rigid wires for connection to the TB. In most cases, soldering the wire tip is a good practice. When you insert a wire into a TB, press the latch of the corresponding terminal with a flat blade screwdriver. Make sure to hold the screwdriver perpendicular to the latch.

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



### Notes

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

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

### General

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

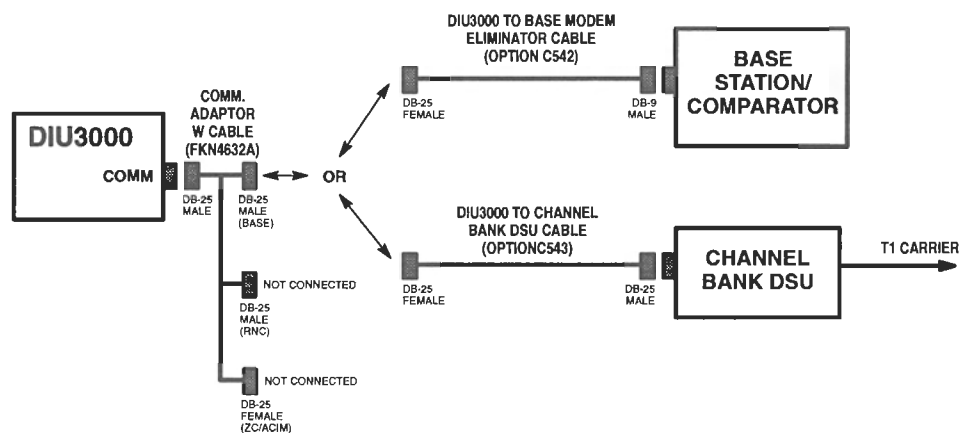
- W-Cable V.24 (modem eliminator) link, limited to indoor use.
- W-Cable V.24 interconnected to T1 carrier via the Channel Bank DSU.
- QUAD connector V.24
- QUAD connector Null connection.

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

(See Figure 10)

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

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



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

DIU3000 to Channel Bank DSU Interconnection Procedure

(See Figure 11).

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



**Note**

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

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

DIU3000 QUAD Connector

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

**Computer/Diagnostic Terminal**

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

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

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

**Test Handset (option C109AA)**

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

**Battery Revert Cable (option C28DG)**

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

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

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

**Quad Connector (FLN5462)**

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

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

Three ferrite beads are supplied with the DIU3000. These beads impede 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. <b>NOTE</b> Usually, this message is too short to notice. However, if this is the first power-on after downloading new parameters from the RSS, or if in the previous stage the database was found corrupted, it is restored (reprogrammed) from the internal backup. This may take up to five minutes, for the duration of which the message <b>PLS WAIT</b> is displayed. Upon successful database programming, the message <b>PROG OK</b> is displayed shortly. If the DIU3000 fails to restore the database, an error message is displayed instead of the <b>PROG OK</b> message. In this case, refer to the TROUBLESHOOTING section.
LOAD SRV	Software server handling.
DSP BOOT	Loading DSP processors' software.
SELF TST	Checking hardware peripherals. • 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. <b>NOTE</b> If the self test fails, the <b>TST FAIL</b> message is displayed and an alert tone is sent to the console and to the handset earpiece. If this occurs, see the TROUBLESHOOTING section
LOADING	Loading application.
HH:MM:SS	The clock is displayed.

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



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

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

**Programming the DIU3000**

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

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

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

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

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

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

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

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

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

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

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

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

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

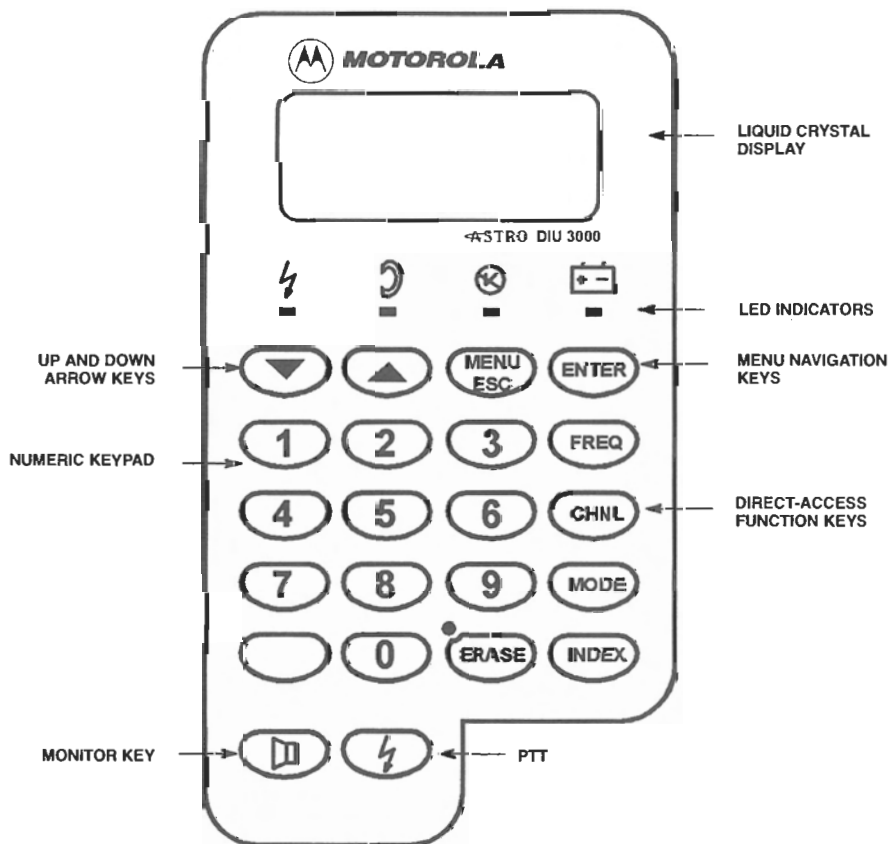
Parameter Path / Name	Default	Range	Required	✓
Key Number	blank	0 - 511, or 1 - 65439, blank		
Slaving Mode	STRAP	STRAP / SLAVE / STEER		
DTMF Output Connected to: Console W/Li	Yes	Yes / No		
DTMF Output Connected to: E&M Console	Yes	Yes / No		
DTMF Output Connected to: MRTI Patch	Yes	Yes / No		
DTMF 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		
<b>CHANGE/VIEW : TX Default Attributes : Handset Default TX Attributes</b>				
Self ID	5	1 - 9999999		
Talk Group ID	4095	0 - 65535		
Channel	blank	0 - 255, blank		
Tx Mode	Clear	Analog / (Astro) Coded / (Astro) Clear		
Key Number	blank	0 - 511, or 1 - 65439, blank		
<b>CHANGE/VIEW : TX Default Attributes : E&amp;M Console Default Attributes</b>				
Self ID	5	1 - 9999999		
Talk Group ID	4095	0 - 65535		
Channel	blank	0 - 255, blank		
Tx Mode	Clear	Analog / (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 Unsquench receive audio path.
Digits 0-9	Numeric entry (e.g. for channel selection).

## LCD Display

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






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

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

## LED Indicators

The LED functions are as follows:

**Table 4**  
LED Indicators

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



## Operating Instructions

### DIU3000 Power-on

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

**Table 5**  
Power-On Messages

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