MOTOROLA
intelligence everywhere™

ASTRO™ DIU3000 Digital Interface Unit

Phone Patch Interface and E & M Console Interface

Owner's Manual

68P02934C10-B

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Contents

PART 1:

Phone Patch Interface

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Land Mobile Products Sector
1301 E. Algonquin Road, Schaumburg, IL 60196

68P02934C10-B
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PHONE PATCH INTERFACE

MODEL COMPLEMENT

FKN4389A	MRTI Adaptor cable (used with MRTI 1000 or MRTI 2000 only)
68P02934C10	*ASTRO DIU Phone Patch Interface and Local Desk Set Interface Owner's manual* (this manual)

RELATED MANUALS

68P02949C65	*DIU3000, Owner's Manual*
68P02924C15	*ASTRO DIU RSS, User's Manual*
68P02949C75	*DIU3000, Service Manual*
68P81090E45	*Encryption Cartridge, User Manual (Models T5371, T5373, T5375)*
68P81090E50	*Encryption Cartridge, User Manual (All Models)*
68P80801G85	*Universal Crypto Module, Instraction Manual (Model T6721)*
68P81090E85	*Encryption Cartridge, Service Manual (Models T5371, T5373, T5375)*
68P81090E95	*Encryption Cartridge, Service Manual (All Models)*
68P80801G90	*Universal Crypto Module, Service Manual (Model T6721)*
68P02949C70	*CENTRACOM Signalling Link, Owner's Manual*
68P02949C95	*DIU3000 Trunking Operation Option, Owner's Manual*

Description

Scope of Part 1 – Phone Patch Interface

This manual provides instructions for connecting the DIU to a Telephone Inteconnect system, programming the DIU Phone Patch interface and operating it. For a complete description of the DIU refer to the *DIU3000 Owner's Manual* 68P02949C65. In addition, for the customer convenience, this manual covers all other aspects of connecting the Telephone Interconnect to the DIU, even if previously covered in other DIU manuals.

General Description

The ASTRO DIU interfaces analog control equipment to the ASTRO base station/ comparator. The ASTRO DIU Phone Patch Interface enables connection to MRTI for supporting telephone interconnect services (see Figure 1).

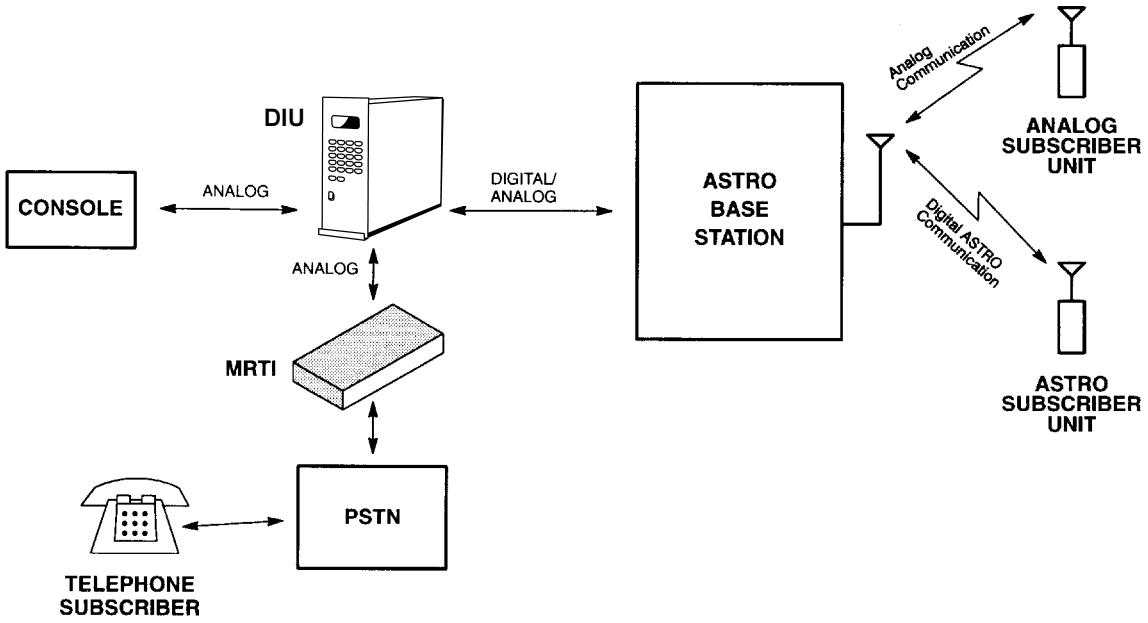


Figure 1
Telephone Interconnect Typical Connection

The C54BF phone patch interface consists of the following:

- DIU to MRTI Adaptor cable FKN4389A
- *ASTRO DIU Phone Patch Interface manual* 68P02934C10 (this manual)

Note: C54 is no longer available.
C54 was necessary when interfacing the DIU to a MRTI 1000 or MRTI 2000.
The MRTI 1000 and MRTI 2000 are cancelled, and the replacement product is the Zetron Model 30.

Functional Description

General

The DIU is an interface between the ASTRO fixed equipment (infrastructure) and the analog control equipment. The DIU converts the analog voice from the analog control equipment into digital format and passes it to the fixed equipment. In the opposite direction, it converts the voice coming from the fixed equipment in digital format into analog and passes it to the analog control equipment. The DIU also incorporates the encryption/decryption capability to allow for secure communications.

The DIU Phone Patch Interface extends the above–mentioned DIU capabilities and interconnects to a public telephone service via the Motorola MRTI Telephone Interconnect.

Call Initiation and Establishment

An interconnect call may be initiated by a subscriber or a landline user. A landline user (i.e telephone user) initiates a call by dialing into the Telephone Interconnect device (MRTI). A subscriber initiates a call by transmitting the MRTI access code. The DIU role, as described in the subsequent sections, is transferring the analog signals and voice to/from MRTI.

Subscriber Initiated Call

A subscriber initiates an interconnect call by transmitting an access code to the Telephone Interconnect device. Upon receiving its access code, the MRTI accesses the telephone line, activates the MRTI PTT and then the subscriber hears the dial tone. When the dial tone is heard, the subscriber may enter a telephone number. When the called party answers, an interconnect call is established.

At the end of the conversation the subscriber transmits the disconnect code to the Telephone Interconnect.

Landline Initiated Call

A landline user (i.e phone user) initiates a call by dialing into the Telephone Interconnect. As a response, the patch activates a PTT and sends a ring tone, without answering the telephone line. If ringing to the patch is allowed to continue for 1 minute, it will answer the phone line momentarily in an attempt to release the calling party to prevent locking up the phone line. Once the subscriber answers the phone ring, by sending the access code, the call is established and proceeds in the same way as the call initiated by the subscriber (see "Subscriber Initiated Call" section above).

Half Duplex Operation

Once an interconnect session is established, the phone–patch receives the control over the outbound capability of the system and potentially holds it for the duration

of the session. In order to reduce voice truncation in the ASTRO modes, the DIU operates in a half duplex mode, as follows:

– The DIU terminates the Telephone Interconnect outbound transmission (even though MRTI PTT is activated) as soon as the subscriber inbound activity is detected; MRTI outbound transmission is re–enabled when the inbound reception ends.

Outbound Transmission Mode

The Telephone Interconnect outbound transmission mode and key are determined according to the Slaving mode (defined by the DIU RSS). There are three slaving modes: Strap, Slave and Steer.

Strap (fixed) Mode

In this slaving mode, the outbound transmission mode and key are fixed (set by the DIU RSS).

Slave (inherit) Mode

In this slaving mode, the mode and key of the interconnect session initial outbound transmission, is determined by the Default Mode and Key defined by the DIU RSS. As the session proceeds, the outbound attributes (mode and key) are inherited from the last inbound reception from the subscriber.

Steering Mode

In this slaving mode, the mode and key of the interconnect session initial outbound transmission, is determined by the Default Mode and Key defined by the DIU RSS. As the session proceeds, the outbound attributes (mode and key) are inherited from the last inbound reception, but only if its security level is equal or higher than the previous reception. The following mode transitions are allowed:

- Analog Clear ⇒ Astro Clear
- Analog Clear ⇒ Astro Encrypted
- Astro Clear ⇒ Astro Encrypted

DIU Audio Routing

Subscriber Inbound Audio

Subscriber inbound audio is routed in an analog form, to both the console and Telephone Interconnect inbound interfaces.


Note

IMPORTANT

If the subscriber call is in Astro mode, its audio is decoded from Astro clear or Encrypted into the analog form. Therefore, even if the inbound audio is secure, it is routed to the MRTI in *clear analog form.*

Telephone Interconnect Outbound Audio

The telephone interconnect output audio is transmitted to the base station. If the mode of the interconnect session is Astro clear or Astro encrypted, the telephone interconnect outbound audio is encoded by the DIU into the Astro infrastructure signalling. The telephone interconnect outbound audio is also routed in an analog form, to the console.

Console Take Over

The DIU provides a console take over capability that allows a dispatcher to take over the DIU resources (according to console's defined mode and key), while an interconnect call is in progress. Once a console PTT is detected, the DIU terminates the MRTI outbound transmission (even though MRTI PTT is activated). The MRTI outbound transmission is resumed (in the previous mode and key) as soon as the console PTT is released.

Go–Ahead Tone

The Go–Ahead tone indicates that the subscriber has dekeyed and the landline party may proceed with the conversation. The Go–Ahead tone is generated by the MRTI in both Astro and Analog sessions. The DIU does not generate the Go–ahead tone.

Signal Description

This section contains a brief description of the logic interface between the DIU and the MRTI. For a detailed description of the interface signals, refer to the MRTI Instruction manual.

- **MRTI PTT.** This signal is continuously activated by the MRTI for the duration of the telephone conversation.
- **PATCH INHIBIT.** This input signal to MRTI completely disables the MRTI. When activated, patch inhibit drops any accessed lines. The telephone interconnect is re–enabled when the PATCH INHIBIT input is reset. This line is activated by the DIU upon reception of the “Patch Inhibit On" command from the console and released upon reception of the “Patch Inhibit Off" command from the console.
- **RECEIVER LOGIC CARRIER INDICATOR** (DIU call detect). This input to the MRTI indicates that an inbound call is active, and it is required for the following purposes:
  - Switching the audio paths within MRTI during a telephone conversation.
  - Resetting the subscriber timer (Mobile Inactivity Control) – the patch disconnects if the subscriber is inactive for a period of time defined by a MRTI parameter.
  - Detecting control commands from the subscriber. The subscriber can send control commands by “stretching" the first digit or by pushing PTT for one second before sending the first control signalling digit.

– **INBOUND AUDIO.** An analog line used by the DIU for transferring audio to the telephone interconnect.

– **OUTBOUND AUDIO.** An analog line used by the DIU for receiving audio from the telephone interconnect.

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 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.

Installation

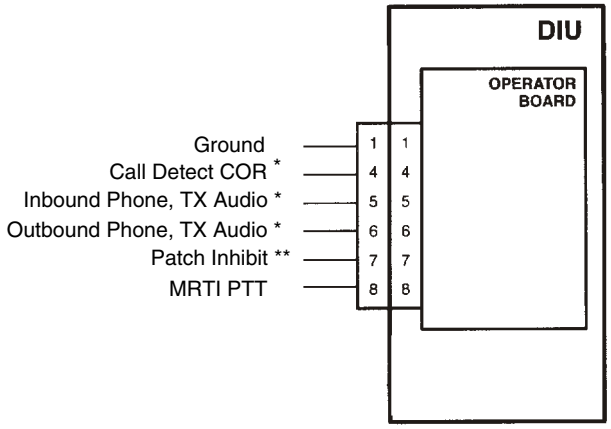
General

This chapter provides connection and setup instructions for the DIU Phone Patch Interface. It is suggested to perform the instructions sequentially. The following are the general steps:

- Electrical connections
- Programming the DIU for operation with the phone patch interface.
- Testing the installation.

Generic MRTI Connection Diagram

Figure 2 describes the generic MRTI connection diagram.



* Zetron reference
** Not supported with Zetron

Figure 2

Generic MRTI Connection Diagram

Electrical Connections

Step 1. Solder the MRTI multiconductor cable conductors, to the 9–pin D–Type connector supplied with the DIU, according to Figure 3.

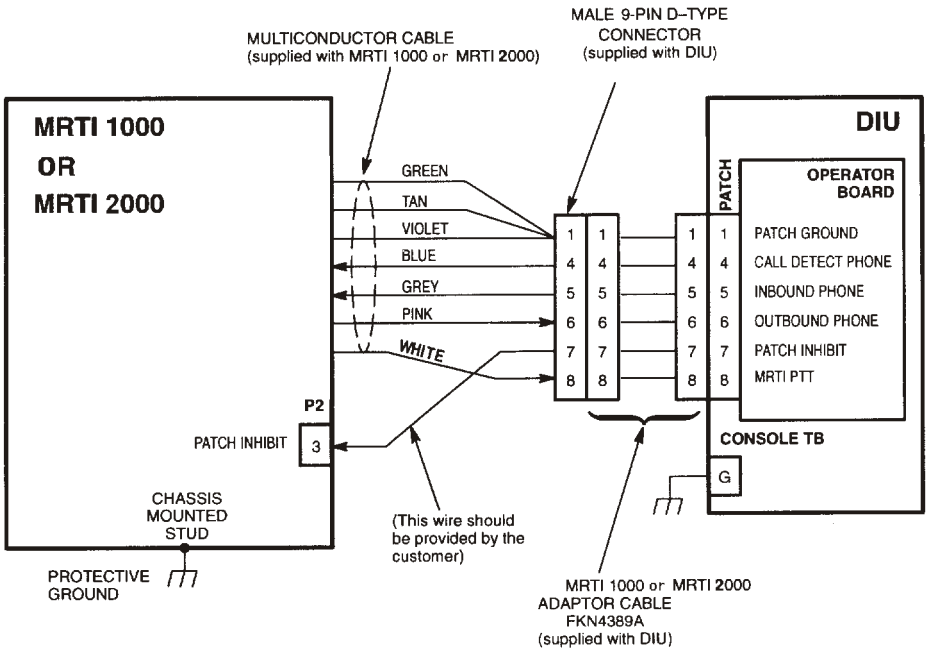


Figure 3
DIU to MRTI Interconnect Diagram

Note

If you are using non–standard cables, ensure that their length does not exceed the original length of the supplied cables.

Step 2. Solder a wire (not included), between pin 7 of the 9–pin D–Type connector supplied with the DIU, and pin 3 of the optional plug supplied with the MRTI, according to Figure 3.

Step 3. Connect the soldered connector to the MRTI Adaptor cable supplied with the DIU.

Step 4. Connect the MRTI Adaptor cable to the PATCH connector on the DIU rear panel.

Step 5. Connect the chassis mounted stud of MRTI to the protective ground.

Step 6. Connect the G terminal of the DIU's Console TB to the protective ground.

Programming the DIU

CHANGE/VIEW : **ASTRO System**

This section describes the parameters specific for the DIU Phone Patch Interface.

Note

For a description of the complete DIU programming, refer to the DIU RSS manual 68P02924C15.

General

The ASTRO SYSTEM is a data entry screen used to customize the DIU to the ASTRO system in which the DIU is installed (see Figure 4). Other RSS screens are affected by the selections made in this screen.

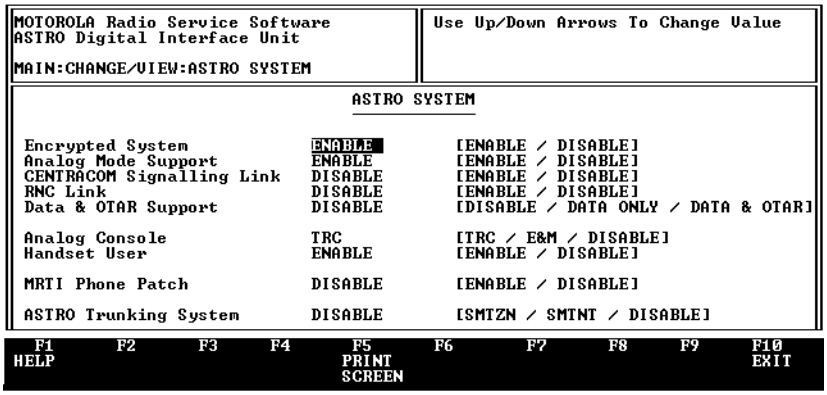


Figure 4
ASTRO System Parameters Screen

System Limitations

The DIU supports up to two consumers (analog devices) at a time. The following table lists all the possible combinations of two consumers:

Table 1

	Consumers (Analog Devices)		
	Console	**DIU Handset**	**MRTI**
1	•		•
2	•	•	
3		•	•

Parameter Description

MRTI Phone Patch

Disables/selects support mode of the MRTI Phone Patch.

Default	Range/Choice List	Set to:	Comments
DISABLE	ENABLE/DISABLE	ENABLE	Use arrows to toggle between the choices.

CHANGE/VIEW : **Cons&Mics : MRTI Phone Patch**

MRTI Phone Patch is a data entry screen, used to change/view the intensity level and PTT polarity of the MRTI Phone Patch (see Figure 5). These parameters are described below.

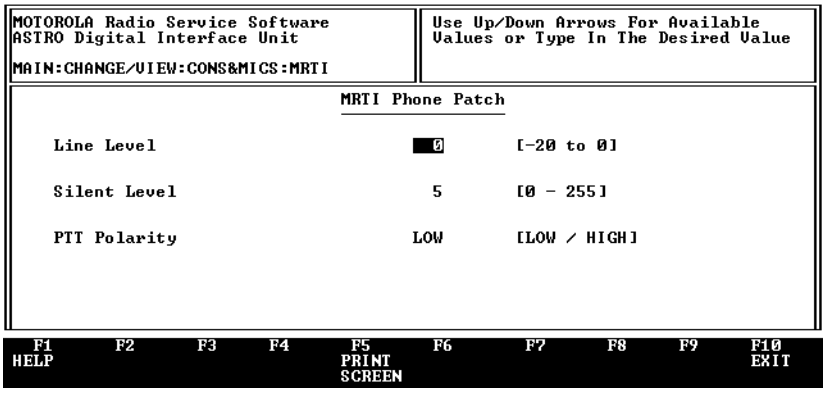


Figure 5
MRTI Phone Patch (Interfaces) Screen

Line Level

Indicates the intensity level of the DIU transmission to the phone patch.

Default	Range/Choice List	Comments
0	-20 to 0 dBm	Use ↑/↓ arrows to scroll value or type in the required value in 1 dBm steps.

Note

Because the DIU passes and generates voice and tones at various levels, it is not possible to set an absolute output level. The output level setting should be thought of as a volume gain control. 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.

Silent Level

Defines the Silent Level allowable range.

Default	Range/Choice List	Comments
5	0 to 255	Use ↑/↓ arrows to scroll value or type in the required value.

PTT Polarity

Selects the polarity of the MRTI PTT signal.

Default	Range/Choice List	Comments
LOW	LOW / HIGH	Use ↑/↓ arrows to scroll between the choices.

CHANGE/VIEW : Tx Default Attributes : **Interconnect/phone Patch**

The INTERCONNECT/PHONE PATCH DEFAULT TX ATTRIBUTES is a data entry screen used to change/view the default attributes for interconnect/phone patch (see Figure 6).

Note

To access this screen, on the ASTRO SYSTEM parameters screen, set the MRTI Phone Patch parameter to ENABLE.

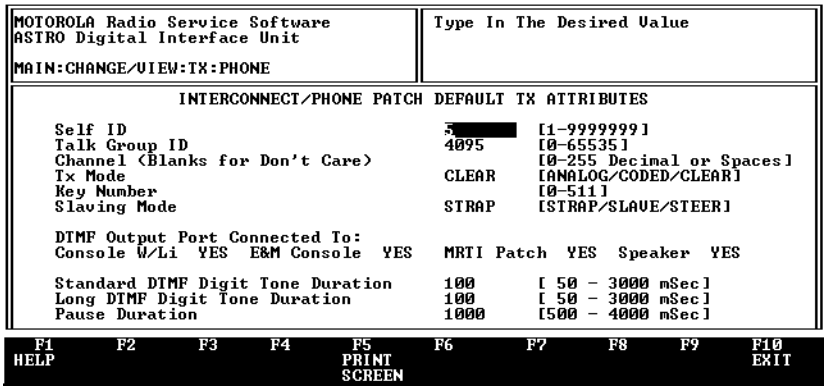


Figure 6
INTERCONNECT/PHONE PATCH DEFAULT TX ATTRIBUTES Screens

Self ID

This parameter defines the source ID used in transmissions initiated by the phone patch.

Talk Group ID

Defines the DIU Talk Group ID that will be used as a default for transmissions initiated by the phone patch.

Default	Range/Choice List	Comments
4095	0 - 65535	Key in a numeric value

Channel

Defines the RF channel number that will be used as a default for transmission.

If “blanks" are entered, no default channel is defined. In such a case, the base station will use the channel used for the last transmission.

Default	Range/Choice List	Comments
blank	0 - 255, blank	Use ↑/↓ arrows to scroll value or type in the required value.

Tx Mode

Defines the initial interconnect transmission mode that will be used. The mode of subsequent transmissions will be determined by the Slaving Mode parameter.

Default	Range/Choice List	Comments
Clear	Analog/(ASTRO)Clear/ (ASTRO) Coded	Press Shift and ? to display the choices in a pop–up window. Then scroll to the required choice and press Enter.

Key Number

Defines the encryption key number that will be used as a default for transmission from the MRTI.

If “blanks" are entered, no default key is defined.

Default	Range/Choice List	Comments
blank	0 - 511, blank	For EMC configuration PID
blank	1 - 65439, blank	For EMC configuration CKR
		Use ↑/↓ arrows to scroll value or type in the required value.

Leaving this field as “blank” may result in a transmission failure. A transmission failure will happen if the default transmit mode is Coded, no default key is selected, and there has been no previous encrypted call handled by the DIU when the phone patch keys up.

Slaving Mode

Defines the slaving mode for the MRTI Phone Patch:

STRAP –The transmission always is the default mode and key.

SLAVE– The transmission follows the last inbound mode and key.

STEER– The transmission follows the last inbound mode and key so that mode upgrades are achieved (analog to digital clear, analog to digital coded, digital clear to digital coded), but the transmission mode is never downgraded.

Default	Range/Choice List	Comments
STRAP	STRAP/SLAVE/ STEER	Press Shift and ? to display the choices in a pop–up window. Then scroll to the required choice and press Enter.

DTMF Output Port Connected to Console W/L, E&M Console, MRTI Patch, Speaker

Defines the potential DTMF audio destination for each of the above.

Default	Range/Choice List	Comments
YES	YES/NO	Use ↑/↓ arrows to scroll.

Standard DTMF Tone Duration

This parameter defines the duration of the standard DTMF tone (on–time). The DIU off–time (time between two DTMF digits) is constant and set to 100 msec. The user can adjust the on–time only. Note that the Standard DTMF Tone Duration value should be smaller than the Long DTMF Tone Duration value (see below).

Default	Range/Choice List	Comments
100 ms	50 to 3000 ms	Use ↑/↓ arrows to change value in 10 ms steps or type in the required value.

Long DTMF Tone Duration

This parameter defines the duration of the long DTMF tone (on–time). The subscriber instructs the DIU what DTMF duration to use for the current dialing: standard or long. The off–time is not affected by the DTMF on–time duration. Note that the Long DTMF Tone Duration value should be higher than the Standard DTMF Tone Duration value (see above).

Default	Range/Choice List	Comments
100 ms	50 to 3000 ms	Use ↑/↓ arrows to change value in 10 ms steps or type in the required value.

Pause Duration

This parameter defines the time delay the DIU waits to dial the next DTMF digit when the “pause" DTMF digit is received.).

Default	Range/Choice List	Comments
1000 ms	500 to 4000 ms	Use ↑/↓ arrows to change value in 500 ms steps or type in the required value.

CHANGE/VIEW : **CONS&MICS : TRC CONSOLE**

The *HLGT Duration* parameter range is limited to 120 - 5000 ms (as opposed to 60 - 5000) when the phone patch interface is used.

Parameter Check List

This section contains a check–list of all the parameters that the user has to check/change in order to configure the DIU for the telephone interconnect operation. It is assumed that all other DIU parameters not related to the telephone interconnect operation are programmed according to the ASTRO DIU RSS User's manual 68P02924C15. 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 “Required" column. After all the parameters in the table are checked/changed, the user can proceed to the actual parameters programming, using the DIU RSS computer program. The user can use the last column in the table to mark with a “✓" each parameter already programmed.

Table 2
DIU Parameter Configuration Check-List

Parameter Path / Name	Default	Range	Required	✓
CHANGE/VIEW : Astro System Parameters				
MRTI Phone Patch	Disable	Enable/Disable	Enable	
CHANGE/VIEW : CONS & MICS : MRTI Phone Patch				
Line Level	0	-20 to 0		
Silent Level	5	0 - 255		
PTT Polarity	Low	Low / High		
CHANGE/VIEW : CONS & MICS : TRC Console				
HLGT Duration	120	60 - 5000 ms	≥120 ms	

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

Parameter Path / Name	Default	Range	Required	✓
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 to 255, blank		
Tx Mode	Clear	Analog/(ASTRO)Clear/ (ASTRO) Coded		
Key Number	blank	0 - 511, or 1 - 65439, blank		
Slaving Mode	STRAP	STRAP/SLAVE/STEER		
DTMF Output Connected to:				
Console W/L	Yes	Yes/No		
E & M Console	Yes	Yes/No		
MRTI Patch	Yes	Yes/No		
Speaker	Yes	Yes/No		
Standard DTMF Tone Duration	100 ms	50 to 3000 ms		
Long DTMF Tone Duration	100 ms	50 to 3000 ms		
Pause Duration	1000 ms	500 to 4000 ms		

Testing the Installation

If the following test cannot be successfully completed, refer to the *Troubleshooting* chapter in this part of the manual.


Note

IMPORTANT

In order to perform the following procedure, you will need a real telephone interconnect system.

Step 1. Perform the DIU functional tests, as described in the *DIU Installation Instructions Manual* 68P02920C65*, Troubleshooting chapter,* section 6 *– DIU Functional Tests.*

Step 2. Use the DIU RSS to program the DIU Slaving Mode parameter to *Strap,* and the Tx Mode parameter to *Analog.*


Note

Install the DIU in a real telephone interconnect system, and then proceed with step 3. (A typical telephone interconnect system is shown in Figure 1 of the *Description* chapter*.)*

Step 3. Verify that the DIU link to the base station/comparator is established (refer to the *DIU Installation Instructions Manual 68P02920C65, Installation* chapter, section 6.1 *– DIU Power–On).*

Step 4. Connect the MRTI to a PSTN using the MRTI connector, line 1. Verify that all MRTI LEDs are off.

Step 5. Initiate voice transmission from the subscriber (a regular analog or digital, not an interconnect transmission). Verify that the MRTI's RADIO BUSY[1] LED is on, as long as the subscriber PTT is active.

Step 6. Set the subscriber to analog mode.

Step 7. Send the MRTI connect command from the subscriber (the default key is "*"). Verify that the MRTI's RADIO BUSY[1] LED turns on and then off, and then the MRTI's CONNECT,[2] TX and PL STRIP[3] LEDs turn on. The dial tone is heard in the subscriber.

Step 8. Dial a number of a nearby phone from a subscriber.

Step 9. Verify that the interconnection with the subscriber works properly (no noises or interruptions occur during the conversation). Also verify, that the MRTI's CONNECT,[2] TX and PL STRIP[3] LEDs are continuously on, while the RADIO BUSY[1] turns on only when the subscriber presses PTT.

Step 10. Send the MRTI release command from the subscriber (the default key is "#"). Verify that all MRTI LEDs are turned off.[4]

Step 11. Initiate a landline call by dialing to the MRTI. Verify that the MRTI CONNECT[2] LED turns on during the ring tones and off, during the pauses. The MRTI's TX and MONITOR[3] LEDs turn on for several seconds,and then turn off. The ringing tones are heard in the subscriber.

Step 12. Send the MRTI connect command from the subscriber (the default key is "*"). Verify that the MRTI's RADIO BUSY[1] LED turns on and then off, and then the MRTI's CONNECT, TX and PL STRIP LEDs turn on.

Step 13. Verify that the interconnection with the subscriber works properly (no noises or interruptions occur during the conversation). Also verify, that the MRTI's CONNECT,[2] TX and PL STRIP[3] LEDs are continuously on, while the RADIO BUSY turns on, only when the subscriber presses PTT.

Step 14. Send the MRTI release command from the subscriber (the default key is "#"). Verify that all MRTI LEDs are turned off.[4]

Step 15. Use the DIU RSS to program the DIU Slaving Mode parameter to *Strap,* and the Tx Mode parameter to *Clear.*

Step 16. Set the subscriber to Astro mode.

Step 17. Repeat steps 3, and 7 through 14.

---

[1] Refer to Zetron "Carrier LED"

[2] Refer to Zetron "Phone LED"

[3] Zetron does not have an equivalent LED for PL Strip and Monitor

[4] Zetron does not support "#" or Patch Inhibit

Operation

General

All the DIU operating instructions covered by the *DIU3000 Owner's manual* 68P02949C65 are applicable to the DIU equipped with a telephone Interconnect. In addition, this chapter provides instructions for using the telephone Interconnect specific features.

Menu Commands

Modified Menu Tree

The parameters and functions accessed via the MENU/ESC key are organized in a tree-like structure, or a "menu", shown in Figure 7. The menu operations related to the telephone interconnect are emphasized, while the standard DIU operations (covered in the *DIU3000 Owner's manual*) are shaded.

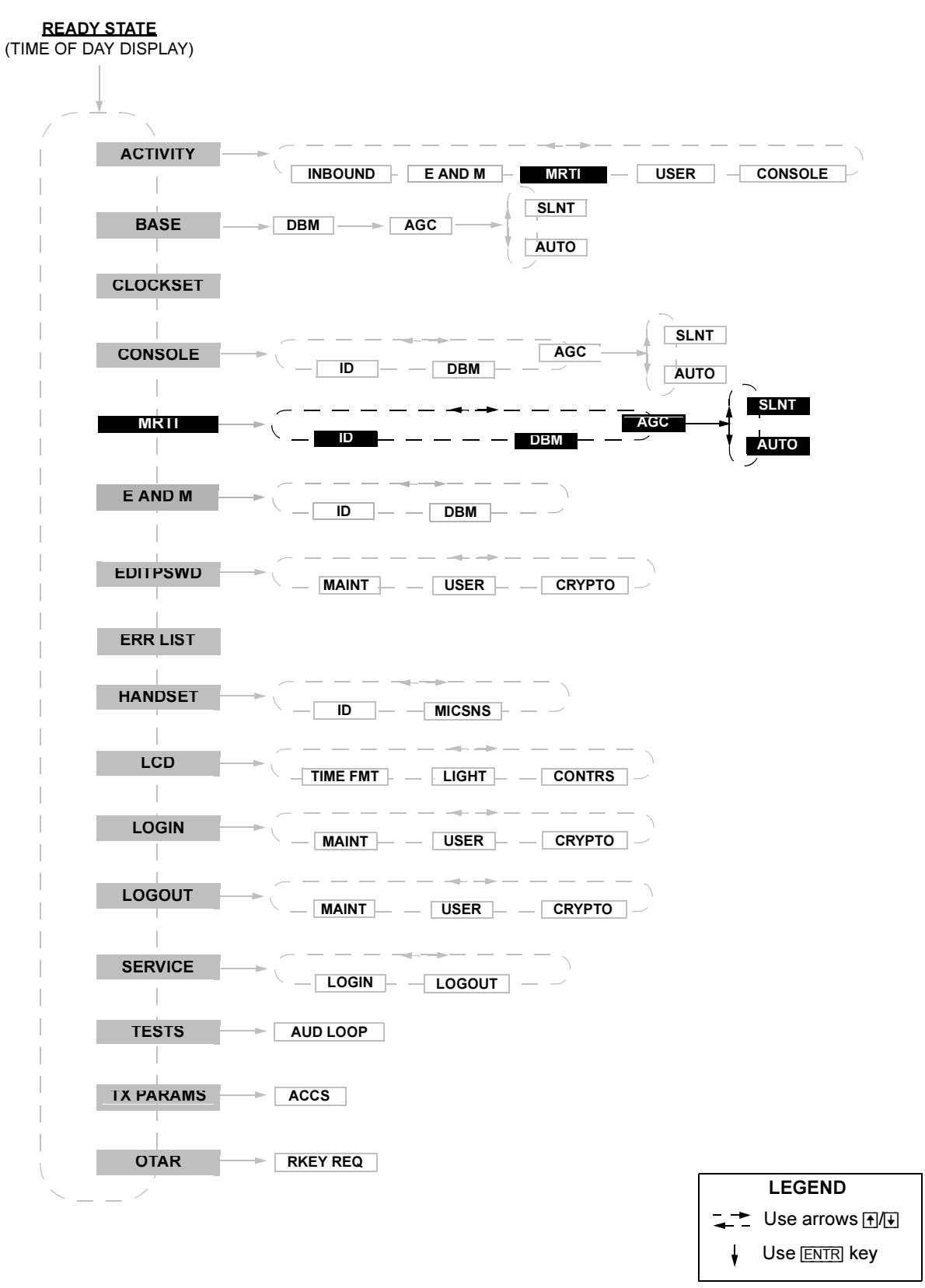


Figure 7
Phone Patch Related Menu Operations

Activity

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

– For the MRTI (MRTI telephone interconnect), the CHaNneL and MODE parameters of the current transmission can be traced. If not currently transmitting, the last active parameters are displayed.

Table 3

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 INBOUND or E AND M or MRTI or USER**	
4. Scroll to display the required device option.	**MRTI**	
5. Press ENTR to display activity parameters that can be traced for the selected device.	**CHNL nnn or ANALOG/ CLEAR/ ENCR nnn**	• 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.
6. Use the arrow keys to scroll between the available parameters.		
7. Press MENU/ESC to return to the ready state.		

MRTI (MRTI Telephone Interconnect)

This menu controls the parameters of the communication interface to the telephone interconnect. The following parameters can be changed:

Note

Changing the telephone interconnect interface parameters requires entering the Service password, "039302164".

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

– ID. Enables viewing the phone patch ID.

– AGC. This parameter adjusts the silent level of the MRTI port AGC (i.e. it sets the activation point of the MRTI AGC for outbound speech).

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 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.

Table 4

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 MRTI is shown.	**MRTI**	
3. Press ENTR to display the options.	**DBM nn** **or** **ID HHH** **or** **AGC**	
NOTE The setting of AGC has no effect on DIU operation with MRTI.		
4. Scroll to display the required option.		ID HHH shows the console ID in hexadecimal format
5. If changing/viewing of line signal level is not required, skip to step 10.		
6. Scroll to select the DBM option.	**DBM nn**	“nn” indicates the currently selected signal level in dBm units.
7. Press ENTR.	**DBM nn**	“nn” blinks.
8. Scroll to select the required value.	**DBM mm**	“mm” indicates the new selected signal level.
9. Press ENTR to confirm the selection.	**DBM mm**	
10. Press MENU/ESC twice to return to the ready state.	**8 : 46 : 16**	

Troubleshooting

If a subscriber or a landline party cannot initiate a call, use the troubleshooting chart given in Figure 8 to isolate the problem.

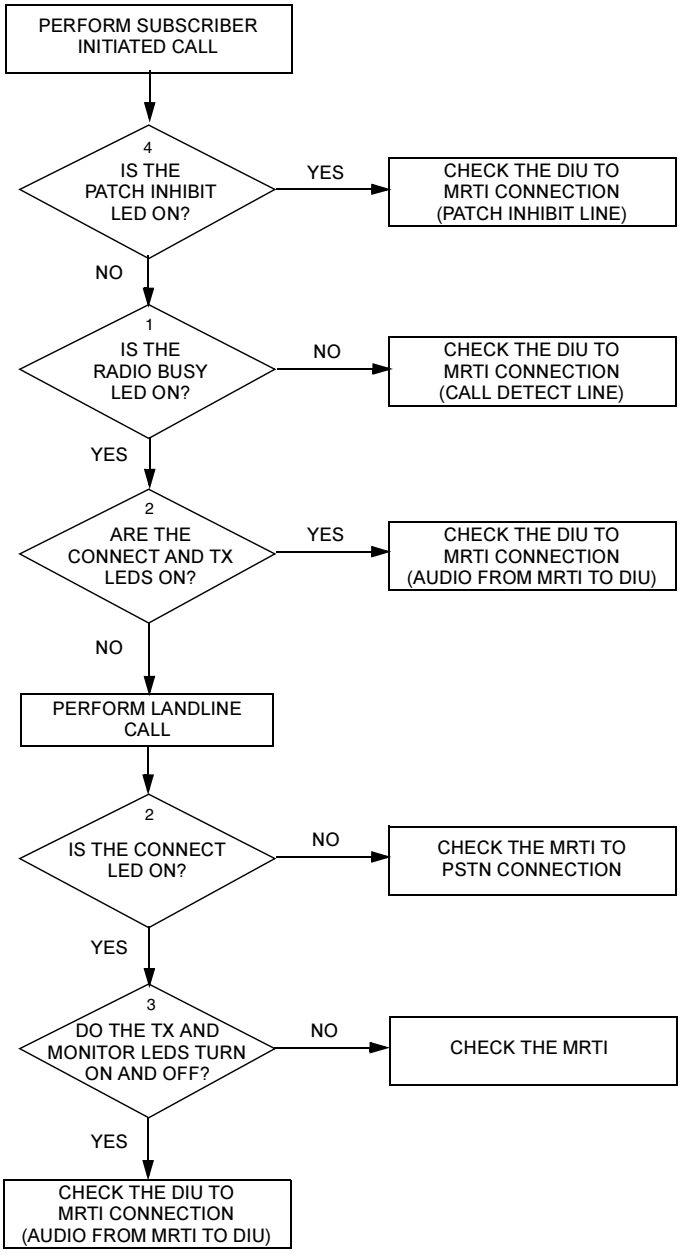


Figure 8
Troubleshooting Chart

[1] Refer to Zetron "Carrier LED"

[2] Refer to Zetron "Phone LED"

[3] Zetron does not have an equivalent LED for PL Strip and Monitor

[4] Zetron does not support "#" or Patch Inhibit

Appendix A: Connectors and Cables

Table 5
Patch Connector Pin Description

Pin No.	Description	I/O Type (in DIU)
1	Patch Ground	
2	Not used	
3	Not used	
4	Call Detect, COR[1]	digital output
5	Inbound Phone, TX Audio[1]	analog output
6	Outbound Phone, RX Audio[1]	analog input
7	Patch Inhibit[2]	digital output
8	MRTI PTT	digital input

[1] Zetron Reference

[2] Not supported with Zetron

Appendix B: Acronyms

DIU	Digital Interface Unit
DTMF	Dual Tone Multi-Frequency (signal)
EMC	Encryption Module Cartridge
MRTI	Microprocessor Radio Telephone Interconnect (Acronym used to reference MRTI 1000, MRTI 2000, or Zetron Model 30 Telephone Interconnect device)
RSS	Radio Service Software

PART 2:

E & M Console

Contents

E & M CONSOLE INTERFACE

PERFORMANCE SPECIFICATIONS

Parallel E & M console	Up to 3
Base station and DIU Control Support	Available using customer supplied external switches.

Specifications are subject to change without notice.

RELATED MANUALS

68P02949C65	*DIU3000, Owner's Manual*
68P02924C15	*ASTRO DIU RSS, User's Manual*
68P02949C75	*DIU3000, Service Manual*
68P81090E45	*Encryption Cartridge, User Manual (Models T5371, T5373, T5375)*
68P81090E50	*Encryption Cartridge, User Manual (All Models)*
68P81090E85	*Encryption Cartridge, Service Manual (Models T5371, T5373, T5375)*
68P81090E95	*Encryption Cartridge, Service Manual (All Models)*
68P02949C70	*CENTRACOM Signalling Link, Owner's Manual*
68P02949C95	*DIU3000 Trunking Operation Option, Owner's Manual*

Description

Scope of Part 2 – E & M Console Interface

This manual provides instructions for connecting the DIU to a E & M Console, programming the DIU E & M Console interface and operating it. For a complete description of the DIU, refer to the *DIU3000 Owner's manual* 68P02949C65. In addition, for the customer's convenience, this manual covers all other aspects of connecting the E & M Console to the DIU, even if they are already covered in other DIU manuals.

General Description

The ASTRO DIU interfaces analog control equipment to the ASTRO base station/ comparator (see Figure 1).

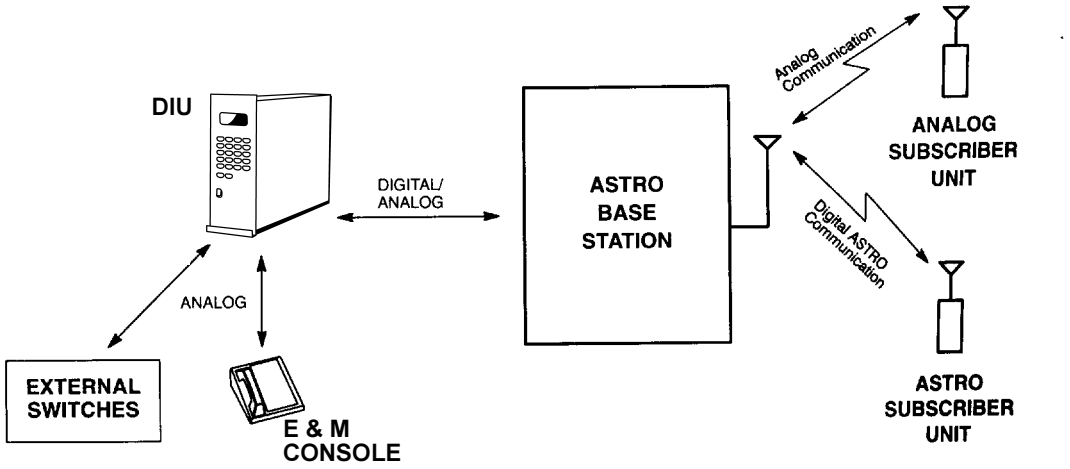


Figure 1
E & M Console Typical Connection

Functional Description

General

The DIU E & M Console Interface allows the E & M Console to be used as a dispatch point. The DIU converts the analog voice from the E & M Console into digital format and passes it to the fixed equipment. In the opposite direction, it converts the voice coming from the fixed equipment in digital format into analog, and passes it to the E & M Console. The DIU also allows for secure communications between the E & M Console operator and the ASTRO fixed equipment.

The DIU supports base station control and DIU control from the E & M Console via discrete logic inputs. Supporting these functions requires external switches, defined in this manual, which should be provided by the customer.

Transmission from E & M Console

The E & M Console initiates transmission by activating its PTT output. The DIU keys up the base and routes the audio from the E & M Console to the base station and to additional consumers connected to the DIU.

Reception

The DIU routes the inbound voice to the defined consumers, including the E & M Console.

Half and Full Duplex Operation Support

The DIU supports E & M Consoles configured for both half and full duplex operation. E & M Consoles connected in parallel to the DIU should be configured for a half duplex mode.

E & M Console Feature Enhancement

Similarly to all consumers, the DIU RSS defines the default TX attributes for the E & M Console. In addition, the DIU provides two logic inputs that can be used by the E & M Console for sending base station and DIU control commands. The use of these inputs requires external switches, as defined in the INSTALLATION chapter of this manual. The external switches have to be provided by the customer (see also Figure 2).

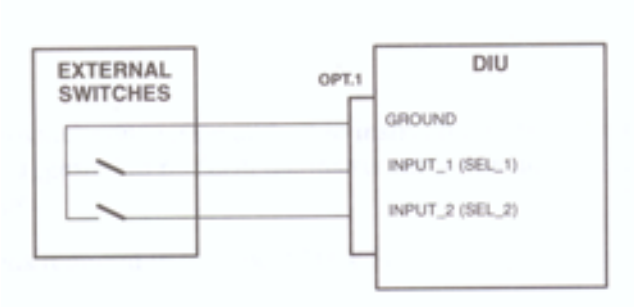


Figure 2
External Logic for Enhanced DIU Control

Two logic inputs enable four logic combinations, each of which may serve as a Function REQuest (FREQ) and execute base station and DIU control commands. These commands are associated to a logic combination via the DIU RSS. A setting of a TX attribute controlled by a logic combination overrides the default setting of this attribute defined by the RSS.

If external switches are not installed, the DIU interprets both logic inputs as being high. This combination may be used as a legal function request in the RSS, thus expanding the control over the default TX attributes.

E & M Console Logic Signal Description

This section contains a brief description of the logic interface between the DIU and the E & M Console. For a detailed description of the interface signals, refer to the *E & M Console Instruction manual*.

- **PTT.** This signal is activated when the E & M Console operator presses either the TRANSMIT key or the handset PTT, in order to initiate transmission.
- **REPEAT DISABLE/ENABLE.** This signal is activated when the console operator presses the Repeat Disable key, in order to disable (or enable) repeat operation.

Installation

General

This chapter provides connection and setup instructions for the DIU E & M Console Interface. It is suggested to perform the instructions sequentially. The following are the general steps:

- Electrical connections.
- Programming the DIU for operation with the E & M Console.
- Testing the installation.

Electrical Connections

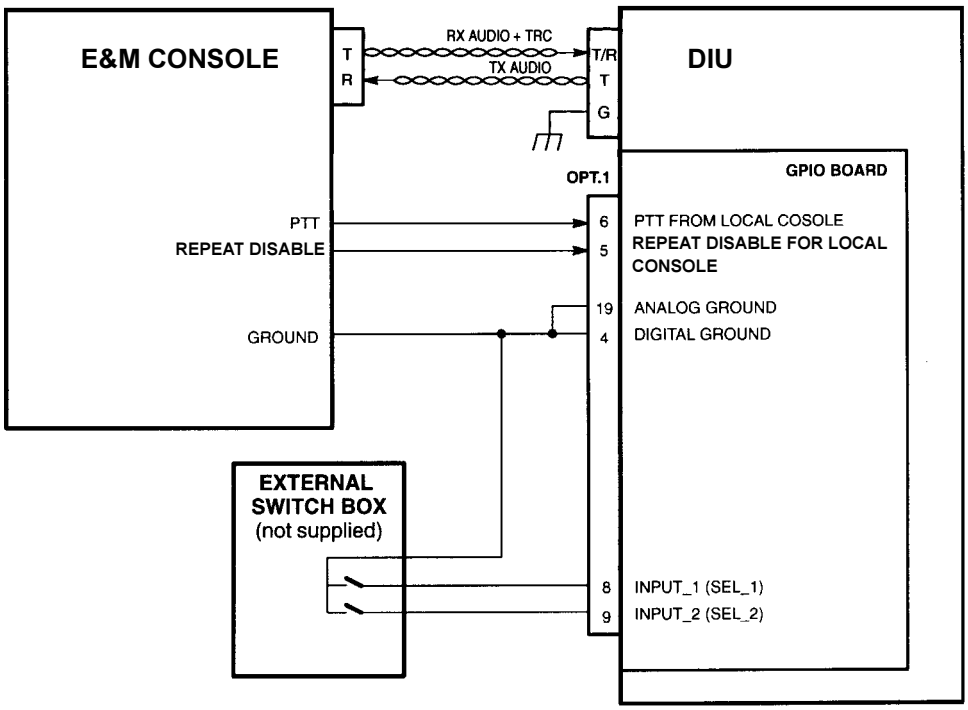


Figure 3
DIU to Single E & M Console Interconnect Diagram

Note

If an external switch box is not installed and the INPUT_1 and INPUT_2 are left open, the DIU refers to their logic combination as "HH" (see "CHANGE/VIEW : CONS&MICS : E&M Console : E&M Functionality Table" section on page 8 and Figure 6).

Programming the DIU

CHANGE/VIEW **: ASTRO System**

This section describes the parameters specific for the DIU E & M Console Interface option.

Note

For a description of the complete DIU programming, refer to the DIU RSS manual 68P02924C15.

General

The ASTRO SYSTEM is a data entry screen used to customize the DIU to the ASTRO system, in which the DIU is installed (see Figure 4). Other RSS screens are affected by the selections made in this screen.

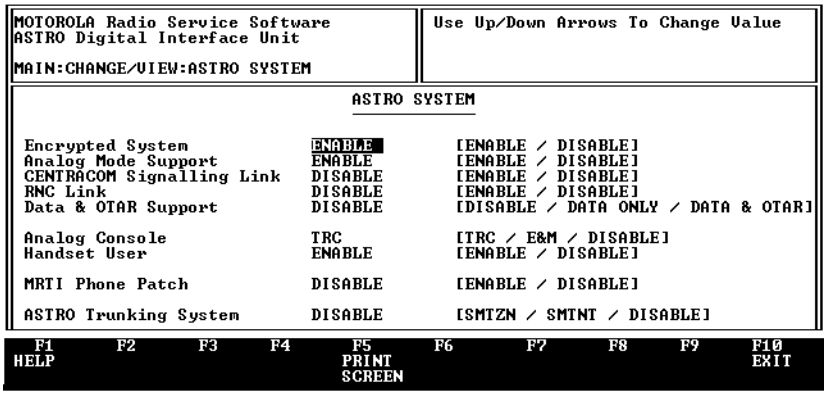


Figure 4
ASTRO System Parameters Screen

System Limitations

The DIU supports up to two consumers (devices) at a time. The following table lists all the possible combinations of the two consumers:

Table 1

	Consumers (Devices)		
	Console	**DIU Handset**	**MRTI**
1	•		•
2	•	•	
3		•	•

Parameter Description

Analog Console

This parameter enables specific analog console functionality in the DIU.

TRC – This enables Tone Remote Control operation in the DIU. The DIU will monitor the console analog port for TRC commands. Inbound audio will be routed to the 4-wire console interface.

E&M – This enables the E&M operation in the DIU. When selected, console audio will be routed from the 4-wire console interface (i.e. console wireline board) upon "E" lead PTT, and inbound audio will be routed to the 4-wire console interface. In addition, the DIU will send Repeat Enable and/or Disable commands outbound in response to changes in the "Repeat Disable" logic line.

Default:TRC.

CHANGE/VIEW : CONS&MICS : E&M Console : **Console Interfaces**

E&M CONSOLE INTERFACE is a data entry screen, used for setting the transmission parameters (see Figure 5). These parameters are described below.

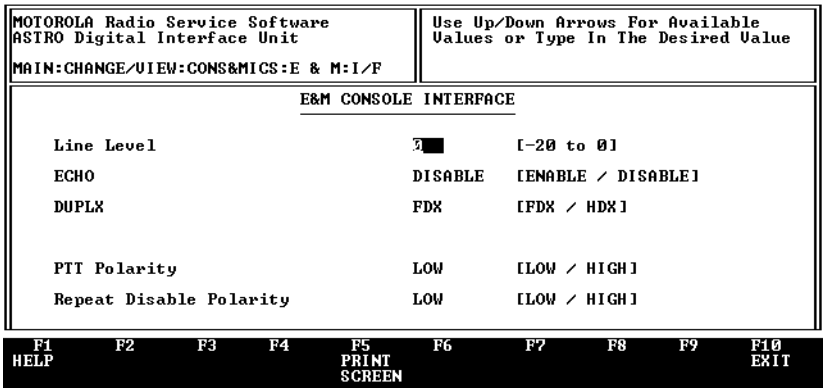


Figure 5
E&M Console Interfaces Screen

Line Level

Indicates the intensity level of the DIU transmission to the console.

Default	Range/Choice List	Comments
0	-20 to 0 dBm	Use ↑/↓ arrows to scroll value or type in the required value in 1 dBm steps.

Note

Because the DIU passes and generates voice and tones at various levels, it is not possible to set an absolute output level. The output level setting should be thought of as a volume gain control. 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.

ECHO

Enables/Disables the Echo option. When this option is enabled, a second E&M console may be connected in parallel to the first one, and concomitantly receive the first console audio.

Default	Range/Choice List	Comments
DISABLE	ENABLE / DISABLE	Use ↑/↓ arrows to scroll between the choices.

DUPLX

Defines the E&M Console half/full duplex operation mode.

Default	Range/Choice List	Comments
FDX	FDX / HDX	Use ↑/↓ arrows to scroll between the choices.

PTT Polarity

Selects the polarity of the E&M Console PTT signal.

Default	Range/Choice List	Comments
LOW	LOW / HIGH	Use ↑/↓ arrows to scroll between the choices.

Repeat Disable Polarity

Selects the polarity to be used by the DIU for the active state of the E&M console's Repeat Disable Signal.

Default	Range/Choice List	Comments
LOW	LOW / HIGH	Use ↑/↓ arrows to scroll between the choices.

CHANGE/VIEW : CONS&MICS : E&M Console : **E&M Functionality Table**

When operating in ASTRO modes, the DIU converts the external logic input command (if the external switches installed, see "Electrical Connections" section on page 4) into a combination of ASTRO commands, referred to as Function REQuests (FREQs). Up to four logic combinations are available. Each logic combination is converted into a different FREQ. A FREQ may include up to seven Base Station and DIU control commands. The E&M FUNCTIONALITY TABLE defines the FREQ functions.

Up to seven functions can be assigned to each sequence. These functions are defined in the following section.

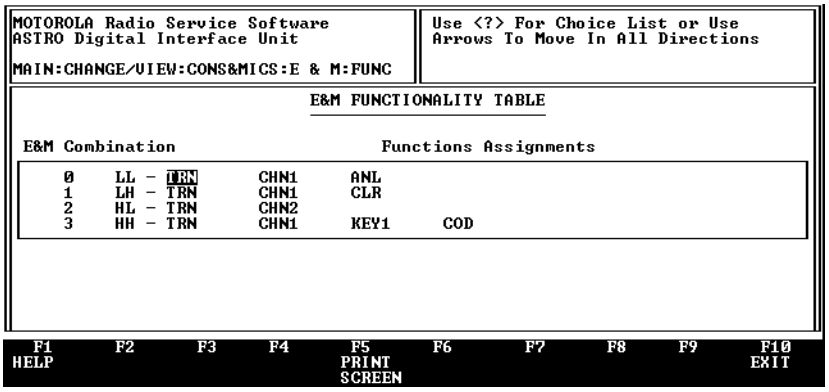


Figure 6
TRC FUNCTIONALITY TABLE – A Typical Screen

Function Definitions

Up to seven functions can be assigned to a FREQ. A pop–up window, containing all available choices, is invoked by simultaneously pressing Shift and ?. The ↑ and ↓ arrows are used to scroll between the choices within the pop–up window, the Enter key is used to confirm the selection, and the Esc (or F10) key, to cancel the selection. The following functions are available:

- CHN. Selects the transmit channel in the base station. Requires entering a channel number (0 - 255).
- COD. Selects ASTRO Coded (Encrypted) Mode for transmission (see note 1 below).
- CLR. Selects ASTRO Clear Mode for transmission (see note 1 below).
- ANL. Selects Analog mode for transmission (see note 1 below).
- KEY. Selects a New Encryption Key to be used in the subsequent transmissions.
- ICM. Selects Intercom Mode.
- MON. Sends Monitor mode command to the base station. In this mode, the base station transfers all receptions regardless of the Private Line code (for Analog mode) or the Access code (for digital mode).

- ACC. Selects an Access Code. The user must enter a number from 0 to 255 after selecting this choice.
- RTN. Sends a command to the base station to switch the repeater on.
- RTF. Sends a command to the base station to switch the repeater off.
- PLF. Selects Private Line OFF. This means that the access code is not attached to the transmissions. The Private Line mode is set back to ON in any sequence that does not specify PLF.
- TRN. Selects the Transmit function (activates PTT).
- AUT. Sets encryption key selection mode to Auto. In this mode, the transmit key is defaulted to the receive key. Thus the DIU console operator can immediately talk back to the radio user by simply keying up, with the same encryption key that the radio user was using. Refer to Table 2 for a comprehensive list of TRC sequences that include the AUT command and their effect on the DIU operation. (See also description of the parameter MAN in this list.)
- The key used to decrypt a message is still determined by the received key.
- MAN. Sets encryption key selection mode to Manual. In this mode, the current default encryption key is used. Refer to Table 2 for a comprehensive list of TRC sequences that include the MAN command and their effect on the DIU operation. (See also description of the parameter AUTO in this list.)
- TMP. When this command is included in the FREQ, the functions included in the FREQ are used only for the current transmission. After the transmission, their values are reset to the values active before the transmission.
- R2N. A command activates the second receiver (if installed) in the base station.
- R2F. Mutes the second receiver (if installed) in the base station.
- PHI. Inhibits MRTI's Phone Patch operation.
- PHE. Enables MRTI's Phone Patch operation.

Table 2
Effect of Auto and Manual Mode Commands in the TRC Sequences

TRC Sequence	New Mode	Current Transmission Key	New Default Key
1.The DIU is in Auto mode.			
AUT	Auto	N/A	x
MAN	Manual	N/A	x
TRN COD	Auto	Last received key	x
TRN COD KEYn	Manual	Last received key	n
TRN COD AUT	Auto	Last received key	x
TRN COD MAN	Manual	x	x
TRN COD TMP AUT	Auto	Last received key	x
TRN COD TMP MAN	Auto	x	x
TRN COD AUT KEYn	Auto	Last received key	n
TRN COD MAN KEYn	Manual	n	n
TRN COD TMP AUT KEYn	Auto	Last received key	x
TRN COD TMP MAN KEYn	Auto	n	x
2.The DIU is in Manual mode.			
AUT	Auto	N/A	x
MAN	Manual	N/A	x
TRN COD	Manual	x	x
TRN COD KEYn	Manual	n	n
TRN COD AUT	Auto	Last received key	x
TRN COD MAN	Manual	x	x
TRN COD TMP AUT	Manual	Last received key	x
TRN COD TMP MAN	Manual	x	x
TRN COD AUT KEYn	Auto	Last received key	n
TRN COD MAN KEYn	Manual	n	n
TRN COD TMP AUT KEYn	Manual	Last received key	x
TRN COD TMP MAN KEYn	Manual	n	x

LEGEND:
"x" represents the current default key.
"n" represents the key number included in the current KEYn command.
"N/A" - not applicable.

CHANGE/VIEW : TX DEFAULT ATTRIBUTES **:**
E&M Console Default TX Attributes

E&M CONSOLE DEFAULT TX ATTRIBUTES is a data entry screen used to change/view the default attributes to be used upon transmission from the E&M consoles (see Figure 7).

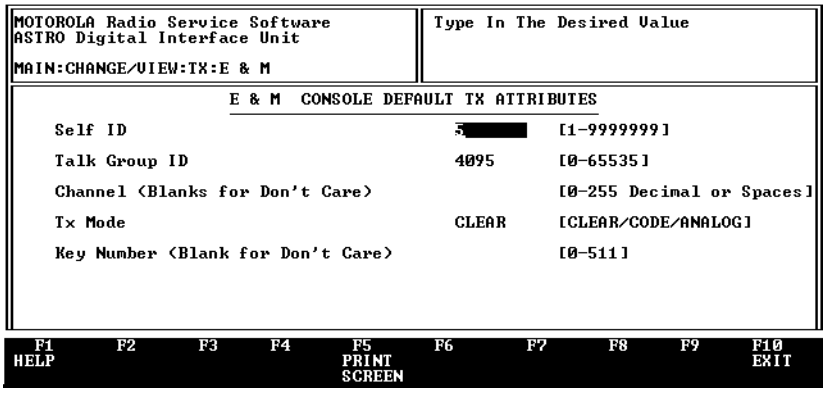


Figure 7
E&M CONSOLE DEFAULT TX ATTRIBUTES Screen

Note

The E&M CONSOLE DEFAULT TX ATTRIBUTES screen is not available if the “E&M Console" parameter in the ASTRO SYSTEM menu is set to DISABLE.

Self ID

Defines the E&M console Self ID.

Default	Range/Choice List	Comments
5	1 - 9999999	Key in a numeric value.

Talk Group ID

Defines the E&M console Talk Group ID.

Default	Range/Choice List	Comments
4095	0 - 65535	Key in a numeric value.

Channel

Defines the RF channel number that will be used by the base station as a default for transmission, if no channel was specifically selected by the FREQ.

If “blanks" are entered, no default channel is defined. In such a case, if no channel was specifically selected by the FREQ, the base station will use the channel used for the last transmission.

Default	Range/Choice List	Comments
blank	0 - 255, blank	Use ↑/↓ arrows to scroll value or type in the required value.

Tx Mode

Defines the transmission mode that will be used by the base station for transmission, if no mode was specifically selected by the FREQ.

Default	Range/Choice List	Comments
Clear	Analog/(ASTRO)Clear/ (ASTRO) Coded	Press Shift and ? to display the choices in a pop–up window. Then scroll to the required choice and press Enter.

Key Number

Defines the encryption key number that will be used as a default for transmission from the MRTI.

If "blanks" are entered, no default key is defined.

Default	Range/Choice List	Comments
blank	0 - 511, blank	For EMC configuration PID.
blank	1 - 65439, blank	For EMC configuration CKR.
		Use ↑/↓ arrows to scroll value or type in the required value.

Leaving this field as "blank" may result in a transmission failure. A transmission failure will happen if the console keys up secure, does not specify a key, and there has been no previous encrypted call handled by the DIU.

Parameter Check List

This section contains a check–list of all the parameters that the user has to check/ change in order to configure the DIU for the E & M Console operation. It is assumed that all other DIU parameters not related to the E & M Console operation are programmed according to the ASTRO DIU RSS User's manual 68P02924C15. 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 "Required" column. After all the parameters in the table are checked/changed, the user can proceed to the actual parameters programming, using the DIU RSS computer program. The user can use the last column in the table to mark with a "✓" each parameter already programmed.

Table 3
DIU Parameter Configuration Check-List

Parameter Path / Name	Default	Range	Required	✓
CHANGE/VIEW : Astro System Parameters				
Analog Console	TRC	TRC / E & M / Disable	E & M	
CHANGE/VIEW : CONS & MICS : E&M CONSOLE: E&M Console Interface				
Line Level	0	-20 to 0		
Echo	Disable	Enable / Disable		
DUPLX	FDX	FDX / HDX		
PTT Polarity	Low	Low / High		
Repeat Disable Polarity	Low	Low / High		
CHANGE/VIEW : TX DEFAULT ATTRIBUTES : E&M Console Default TX Attributes				
Self ID	5	1 - 9999999		
Talk Group ID	4095	0 - 65535		
Channel	blank	0 to 255, blank		
Tx Mode	Clear	Analog/(ASTRO)Clear/ (ASTRO) Coded		
Key Number	blank	0 - 511, or 1 - 65439, blank		

Testing the Installation

If the following test cannot be successfully completed, refer to the *Troubleshooting* chapter in this part of the manual.

Step 1. Perform the DIU functional tests, as described in the *DIU Installation Instructions Manual* 68P02920C65*, Troubleshooting* chapter, section 6 *– DIU Functional Tests.*

Step 2. If external switches are installed, set both of them to high.

Step 3. Enter the E&M Activity display mode on the DIU LCD (refer to the "Activity" section on page 16*).*

Step 4. Press the E & M Console PTT. The DIU Transmit LED should turn on, and the activity display should show the mode and channel programmed by the RSS for the "HH" combination. E & M Console audio should be heard by the subscriber.

Step 5. Initiate voice transmission from subscriber; the subscriber audio should be heard by the E & M Console.

Operation

General

All the DIU operating instructions covered by the *DIU3000 Owner's manual* 68P02949C65 are applicable to the DIU equipped with an E & M console. In addition, this chapter provides instructions for using the E & M console specific features.

Menu Commands

Modified Menu Tree

The parameters and functions accessed via the MENU/ESC key are organized in a tree-like structure, or a "menu", shown in Figure 8. The menu operations related to the E & M console are emphasized, while the standard DIU operations (covered in the *DIU3000 Owner's manual*) are shaded.

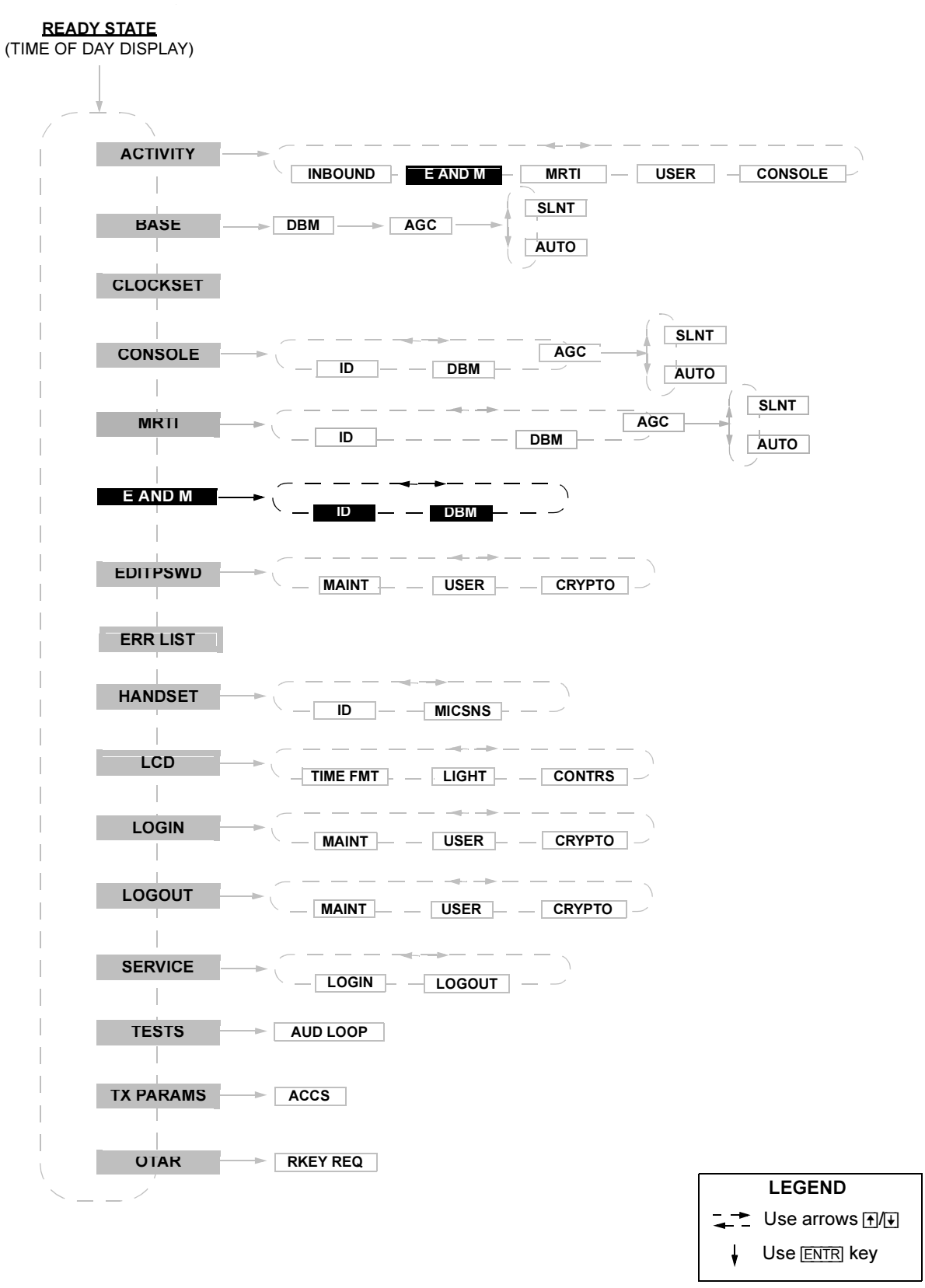


Figure 8
E & M Console Related Menu Operations

Activity

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

– For the E AND M (E & M Console), the CHaNneL and MODE parameters of the current transmission can be traced. If not currently transmitting, the last active parameters are displayed.

Table 4

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** **INBOUND** **or** **E AND M** **or** **MRTI** **or** **USER**	
4. Scroll to display the required device option.	**E AND M**	
5. Press ENTR to display activity parameters that can be traced for the selected device.	**CHNL nnn** **or** **ANALOG/ CLEAR/ ENCR nnn**	• 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.
6. Use the arrow keys to scroll between the available parameters.		
7. Press MENU/ESC to return to the ready state.		

E and M

This menu controls the parameters of the communication interface to the E & M Console. The following parameters can be changed:

Note

Changing the E & M console interface parameters requires entering the service password.

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

– ID. Enables viewing the E & M Console ID, shown in decimal format.

Note

Changing the line signal level requires entering the service password.

Table 5

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 E AND M is shown.	**E AND M**	
3. Press ENTR to display the options.	**DBM nn** **or** **ID HHH**	
4. Scroll to display 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**	

Troubleshooting

In case of DIU malfunctioning when the E & M Console is used, first perform the troubleshooting procedures given in the *TROUBLESHOOTING* chapter of the *DIU3000 Owner's manual* 68P02949C65. If the DIU is found operational, follow the E & M Console function troubleshooting chart given below.

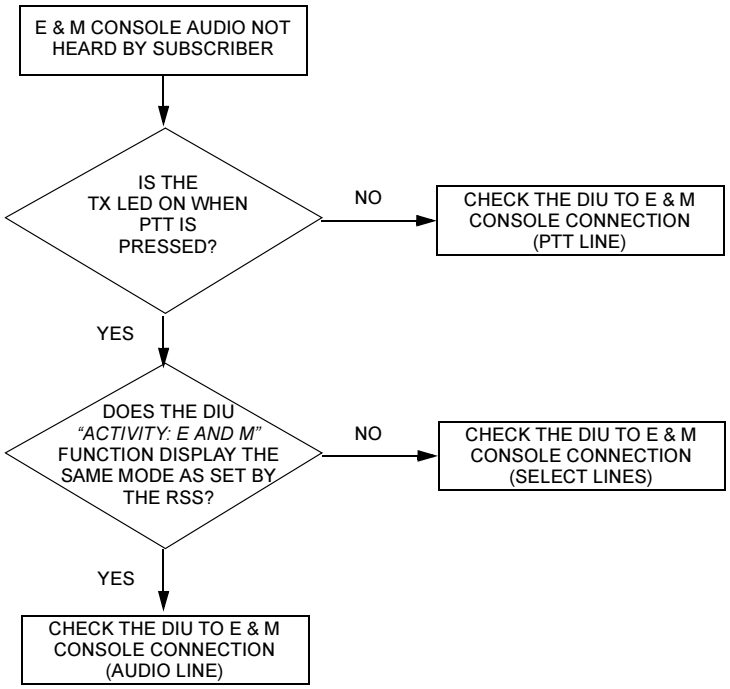


Figure 9
Troubleshooting Chart

Appendix A: Connectors and Cables

Table 6
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	MONITOR	logic input	Unsquelch‡	TB4–4
6	PTT from E & M Console	logic input	PTT active‡	TB3–1
7	M_LEAD (PTT output)	logic output†	PTT active	TB2–1
8	Input_1 (SEL_1)	logic input		TB3–2
9	Input_2 (SEL_2)	logic input		TB3–7
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 ground			TB1–2
20	Not used			
21	Mode indication to Centracom	logic output†	Mode 1‡	TB4–1
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 Vdc by a 10 KΩ resistor.
‡.Polarity can be reversed (to active high) using RSS.

Appendix B: Acronyms

DIU	Digital Interface Unit
DTMF	Dual Tone Multi-Frequency (signal)
EMC	Encryption Module Cartridge
E & M	Ear and Mouth
FDX	Full Duplex
FREQ	Function Request
HDX	Half Duplex
RSS	Radio Service Software