MATRIX ISDN MODULE

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About Comrex

Comrex has been building reliable, high quality broadcast equipment since 1961. Our products are used daily in every part of the world by networks, stations and program producers.

Every product we manufacture has been carefully designed to function flawlessly, under the harshest conditions, over many years of use. Each unit we ship has been individually and thoroughly tested. Most items are available off-the-shelf, either directly from Comrex or from our stocking dealers.

Comrex stands behind its products. We promise that if you call us for technical assistance, you will talk directly with someone who knows about the equipment and will do everything possible to help you.

Our toll free number in North America is 800-237-1776. Product Information, Engineering Notes and User Reports are available on the World Wide Web at http://www.comrex.com. Our internet E-Mail address is info@comrex.com.

Warranty and Disclaimer

All equipment manufactured by Comrex Corporation is warranted by Comrex against defects in material and workmanship for one year from the date of original purchase, as verified by the return of the Warranty Registration Card. During the warranty period, we will repair or, at our option, replace at no charge a product that proves to be defective, provided you obtain return authorization from Comrex and return the product, shipping prepaid, to Comrex Corporation, 19 Pine Road, Devens, MA 01434 USA. For return authorization, contact Comrex at 800-237-1776 or 978-784-1776 or fax 978-784-1717.

This Warranty does not apply if the product has been damaged by accident or misuse or as the result of service or modification performed by anyone other than Comrex Corporation.

With the exception of the warranties set forth above, Comrex Corporation makes no other warranties, expressed or implied or statutory, including but not limited to warranties of merchantability and fitness for a particular purpose, which are hereby expressly disclaimed. In no event shall Comrex Corporation have any liability for indirect, consequential or punitive damages resulting from the use of this product.

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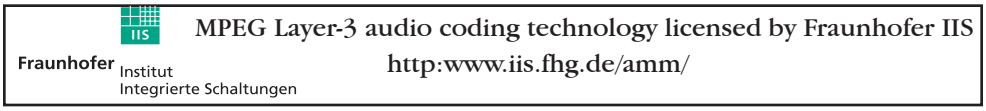


SECTION 1. INTRODUCTION

MATRIX ISDN MODULE FEATURES

The Comrex Matrix ISDN Module converts your Matrix into a full featured ISDN codec. Here's a short list of the Matrix's ISDN Module features:

- Three algorithms are offered in the Matrix ISDN Module including G.722 for widest compatibility, Turbo G.722 for very low delay 15 kHz operation, and ISO MPEG Layer III for compatibility and full fidelity at lower bit rates.
- Includes ability to deliver ISO MPEG Layer III in one direction with a G.722 return for reduced delay on Layer III feeds.
- All ISDN interfaces are present in the module including an international terminal adapter and NT1.
- NT1 may be bypassed when S/T interface is needed.
- Available in portable or rackmount versions.
- Ability to work with a Comrex Nexus as well as most other manufacturer's ISDN codecs.
- Ability to store 19 telephone numbers and last number dialed in nonvolatile memory.
- Up to 10 line configurations may be stored in non-volatile memory.
- Automatic conversion to ISDN codec when module is inserted into portable Matrix.
- Very easy to program through the intuitive Matrix front panel interface.

WHAT COMES WITH AN ISDN MODULE?

The following items are shipped with an ISDN module:

(1) Comrex Matrix ISDN Module (either portable or rackmount version)
(1) RJ-45 cable
(1) Operating manual
(1) Warranty card (Please fill out and return)

UPGRADES

It is possible that your Matrix may need to be upgraded in order to work with this module. Please contact Comrex for instructions on your particular Matrix.

OPERATIONAL CONSIDERATIONS

For use on ISDN, two ISDN codecs are required — one at each end of the line. The Comrex Matrix ISDN codec will work with most other G.722 or ISO MPEG Layer III codecs.

About the Algorithms

The Matrix supports several ways to transfer a mono audio signal over ISDN lines. The two algorithms it supports are:

1) ITU-T G.722

2) ISO-MPEG2 Layer III

The Matrix also incorporates an enhanced, "turbo" version of G.722 that allows higher fidelity than normally available with this algorithm. "Turbo G.722" only inter-works with other Comrex codecs.

ITU-T G.722

This algorithm allows the transfer of 7 kHz audio bandwidth over 56 or 64 kb/s channels, effectively achieving a 4:1 compression ratio. It is incorporated in most audio codecs worldwide. G.722 was developed earlier than some more modern algorithms, but it's still popular due to its low inherent time delay. Comrex's G.722 implementation provides a 6 mS delay in each direction, which is a very small delay for a wideband codec. G.722 is a good choice for voice material.

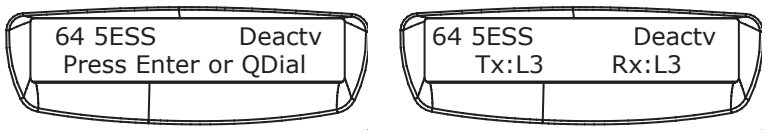
Comrex Turbo G.722

Comrex has implemented a special version of G.722 that takes advantage of the data rate available on both B channels of an ISDN line. Because ISDN channels are supplied in pairs, it is possible to sum the data rate of the two B channels together to create a 112 or 128 kb/s link. Turbo G.722 utilizes the "double data rate" to provide double audio bandwidth. While still maintaining the low delay of G.722, "Turbo" provides 15 kHz full duplex audio. Connection of both B channels is transparent to the user and handled completely by the Matrix. Simply select a data rate of 112 or 128 kb/s, dial your call to a compatible Comrex product, and both channels will connect automatically. Turbo G.722 is only supported in full-duplex mode (you can not send Layer III in one direction).

ISO/MPEG2 Layer III (32KHz)

Sometimes called "MP3" by web-surfers, this algorithm provides nearly 15kHz audio on a single ISDN B channel, delivering a compression ratio of about 8:1. Layer III is implemented using a 32 kHz sampling rate and has a somewhat higher delay than G.722, approaching 1/3 second. Because full fidelity is provided on a single B channel, it costs less to use. Many users prefer to use Layer III for program back haul, and use G.722 for a return link to lower overall round-trip delay. The Matrix only supports Layer III at 56 and 64 kb/s data rates. If not using a Matrix on the other end of the link, be sure to set your codec to Layer III 32 Hz sampling rate mode.

SECTION 2. MATRIX ISDN MODULE MAIN STATUS MENU

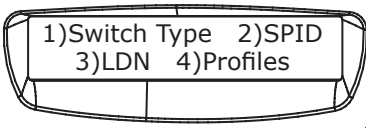


(ALTERNATE BETWEEN THESE TWO DISPLAYS)

- Enter
  - Dial
    - Dial Number
    - Dialing
  - Configure
    - Pgm Qdial — Enter Qdial#: 01-19 Enter Phone Number
    - Ntwrk
      - Switch Type: NI1 / 5ESS / DMS / EURO / NTT / TPH
      - SPID*: Enter SPID #1 — SPID Stored; Enter SPID #2 — SPID Stored
      - LDN: Enter LDN #1 — LDN Stored; Enter LDN #2 — LDN Stored
      - Profile — (See Profile Menu on following page)
    - Kbs: 56 Kb/s ...Data Rate Selected / 64 Kb/s / 112 Kb/s / 128 Kb/s
    - Codec: G.722 ...Algorithm Selected / L3Tx/G.722Rx / L3 / G722Tx/L3Rx
    - More
      - G.722 Anc Options
        - G.722 On/Off: G.722 Anc Off / G.722 Anc On
        - G.722 Anc Baud Rate: G.722 Anc Baud 1200 / G.722 Anc Baud 4800
    - Test
      - Codec Loopback: L3 / G.722 / Turbo G.722
      - TA Loopback ...Loopback Active Cancel=Exit
    - Special
      - STL
      - Ext DCE ... Ext DCE Mode Cancel=Exit
  - Qdial — Enter Qdial #:00-19 ... Dialing xxxxxxxx

* If a EURO, NTT or TPH switch type is selected, this screen will indicate "Not Required."

MATRIX ISDN PROFILES



The Profile menu is used for entering ISDN parameters, coding and data rate selection and dialing number for up to 10 separate configurations.

First, the Profile information is entered into a given location.

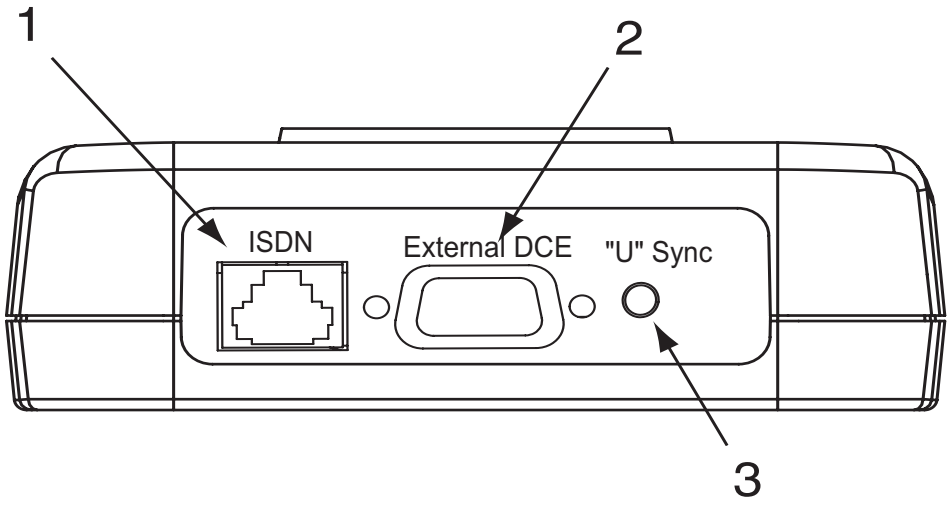
Then, when a given Profile is to be used, it is to be "Loaded" into the Matrix. When a Profile is loaded, all preexisting parameters that have been entered into the Matrix ISDN module will be replaced by the new parameters for the selected Profile number.

Profiles	Enter Profile Info	Profile # (01-10)	Choose Switch	NI1 ... Switch Selected	
				5ESS	
				DMS	
				EURO	
				NTT	
				TPH	
			Enter SPID*	Enter SPID #1	SPID Stored
				Enter SPID #2	SPID Stored
			Enter LDN	Enter LDN #1	LDN Stored
				Enter LDN #2	LDN Stored
			Enter Qdial #1:	Number Stored	
			Choose Algorithm	G722 ...Algorithm Selected	
				L3Tx/G.722Rx	
				L3	
				G722Tx/L3Rx	
			Choose Data Rate	56 Kb/s ...Data Rate Selected	
				64 Kb/s	
				112 Kb/s	
				124 Kb/s	
	Load Profile	Enter Profile# 01-10	Yes (This will change current ISDN settings)		
			No		

* When EURO, NTT or TPH switch types are selected, the SPID selection menu will not appear.

SECTION 3. DIAGRAMS AND DESCRIPTIONS OF CONTROLS AND CONNECTORS

PORTABLE ISDN MODULE - BACK DIAGRAM

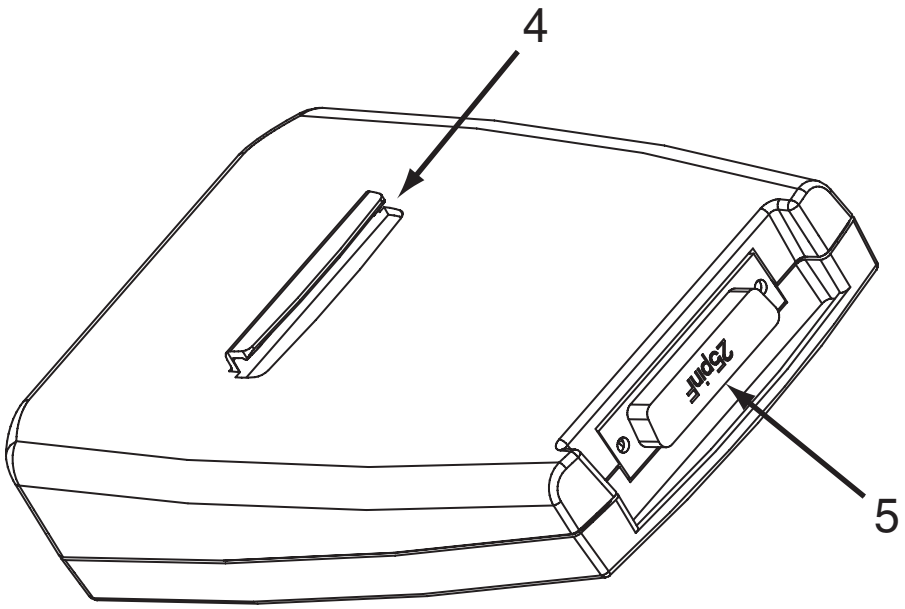


1) ISDN JACK — This RJ-45 jack is for attaching the ISDN line.

2) EXTERNAL DCE PORT — This 9 pin male connector allows you to bypass the terminal adapter in the module and connect to an external terminal adapter, DSU, satellite terminal, etc.

3) "U" SYNC INDICATOR — This indicator gives the status of the NT1. It blinks while finding "U" sync and then is on steady. This indicator is only used on "U" interface ISDN lines.

PORTABLE ISDN MODULE - TOP/FRONT DIAGRAM



4 *HOOK FOR MODULE ATTACHMENT*

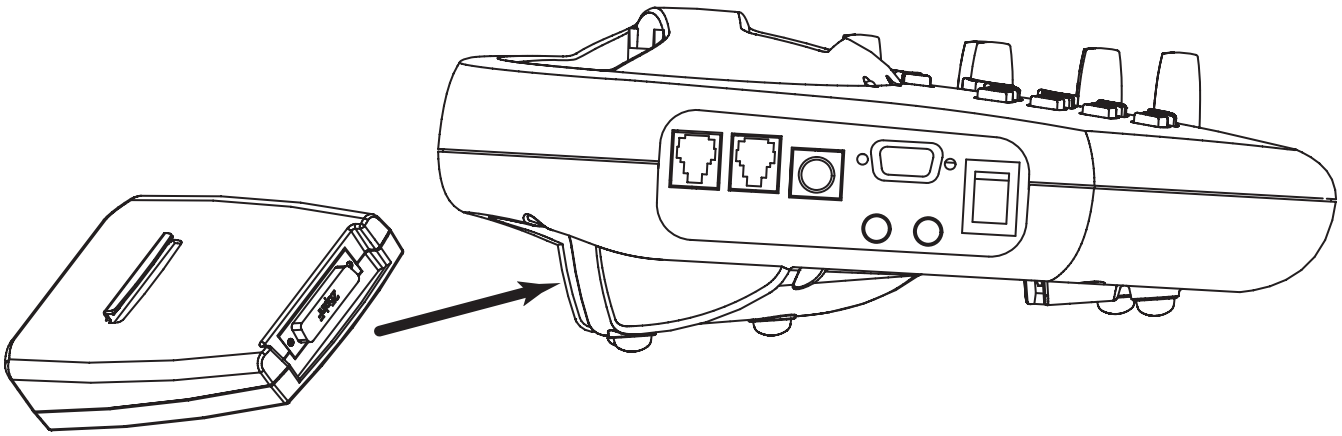
This hook ensures secure attachment of the module to the portable unit. It aids in proper alignment and helps to hold the module firmly in place.

5 *DB25 CONNECTOR*

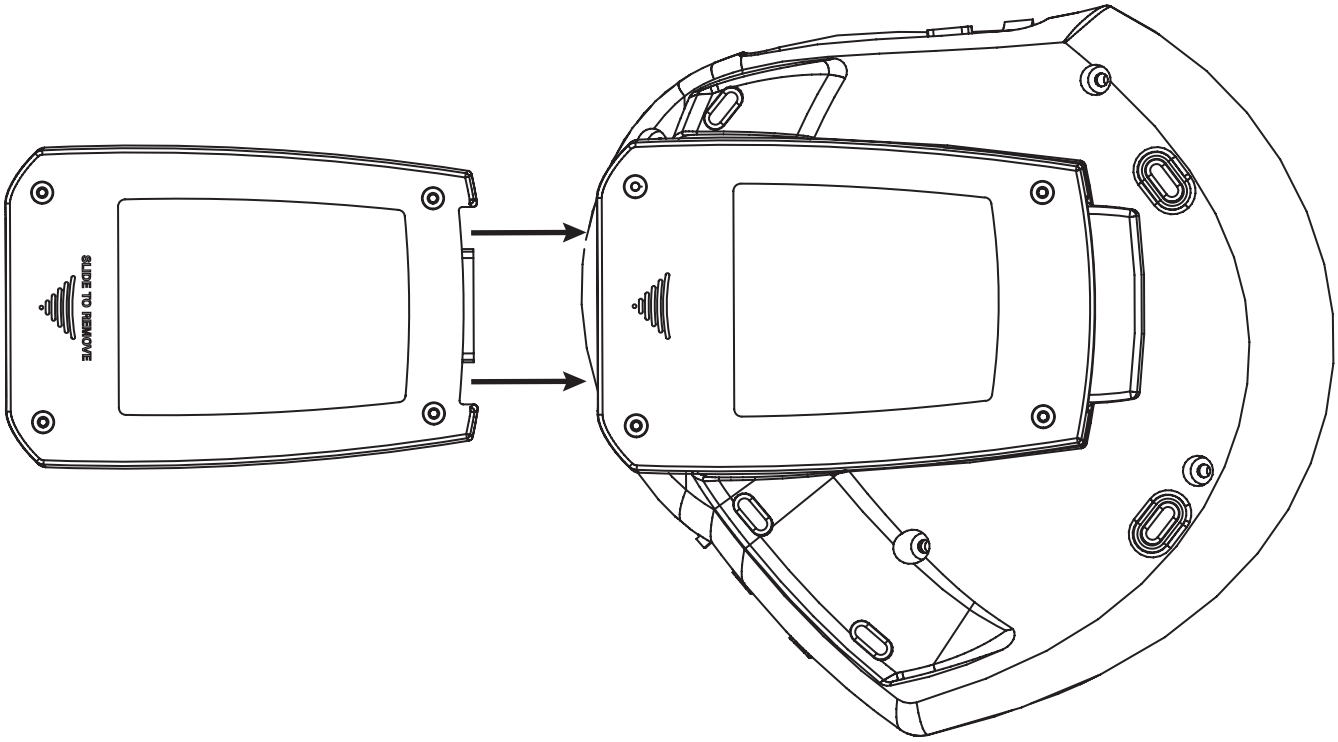
This female DB25 connects the module to the male db25 on the portable unit. Make sure that the unit is fully inserted and that the connections are seated properly.

MODULE - INSERTION DIAGRAMS

Portable unit must be powered OFF prior to insertion of module.



ISDN MODULE - INSERTION INTO PORTABLE HOUSING



ISDN MODULE - INSERTION INTO PORTABLE HOUSING (AS SEEN FROM BELOW)

SECTION 4. INSTALLING THE ISDN MODULE

ATTACHING PORTABLE ISDN MODULE

Make sure that your Matrix portable is powered OFF before inserting the ISDN module. Then slide the module into the channel on the bottom surface of the Matrix portable, paying attention that the DB25 connectors align properly and attach securely. The plastic "hook" on the top surface of the module should insert into the slot on the portable chassis. When the pins on the DB25s are aligned, apply gentle pressure until module is seated securely. When the module is correctly inserted, the fit will be very snug and some effort will be required to disconnect the module from the unit. You are now ready to power up your Matrix and begin programming the unit for use on the ISDN line.

INSTALLING RACKMOUNT ISDN BOARD

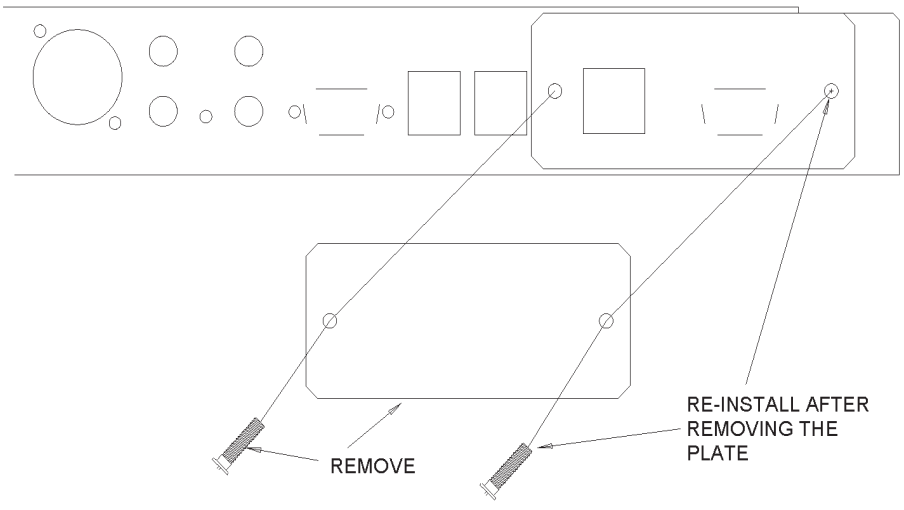
Field installation of the ISDN Rack Module is a bit more involved. If you don't feel comfortable installing this module yourself, contact Comrex, and we will arrange to do the installation at our facility.

Before installing the Rack ISDN Module, you must be sure that the Matrix is REMOVED FROM AC POWER. The inside of the Rack Matrix contains voltages that can cause injury or death so be certain no power is applied during this procedure.

You will need to remove the top cover of the Matrix in order to perform this procedure. Start by removing the four screws that hold on the rack ears (along the front panel) using a large Phillips type screwdriver. Next remove the four pan-head screws along the sides toward the back. Finally, remove the 11 small Phillips screws along the front and back edge of the top cover. The top cover should now lift off.

You will also need to remove the "filler plate" on the rear panel that covers the holes for the ISDN connections. Two medium size Phillips head screws hold this on. See figure 1. This plate can be discarded (along with the screws).

FIGURE 1 - REMOVING THE FILLER PLATE



The ISDN module will be inserted into the chassis as shown in Figure 2 on page 13. Orient the module so the connectors are toward the rear of the chassis, and place the board into the chassis so the connectors protrude from the exit holes in the rear. Use the four small Phillips screws (included) to secure the module using the mounting holes. Also, secure the DB-9 connector on the outside back panel with the provided posts using a 3/16" nut driver.

One cable must be attached from the module to the main Matrix PC board as shown in Figure 3 on page 14. Note carefully the orientation of the cable with respect to the boards.

Once the module is properly attached and secured, reattach the Matrix top cover and rack ears.

To set the Matrix rack to dual ISDN/POTs operation:

A. Power up the Matrix Rack by applying AC power at the main power connector.

B. Wait until the *MAIN STATUS DISPLAY* is shown.

C. Enter the *"HIDDEN MENU"* by pressing the *"HANGUP"* key on the front panel 3 times.

D. Select *"MORE"* from the hidden menu by pressing "4".

E. Select *"ISDN"* by pressing *"1"*.

F. Select *"ENABLE ISDN MENUS"* by pressing *"1"*.

G. Power the unit off for a few seconds, then back on. Matrix operation will now change significantly, so be sure to read the section, "Dual POTS/ ISDN operation" on page 15.

Note: You can change back to POTS only operation by repeating the above steps, except that step "G" will now display "Disable ISDN menus." After you select this, you can leave the ISDN module attached, it simply won't be activated.

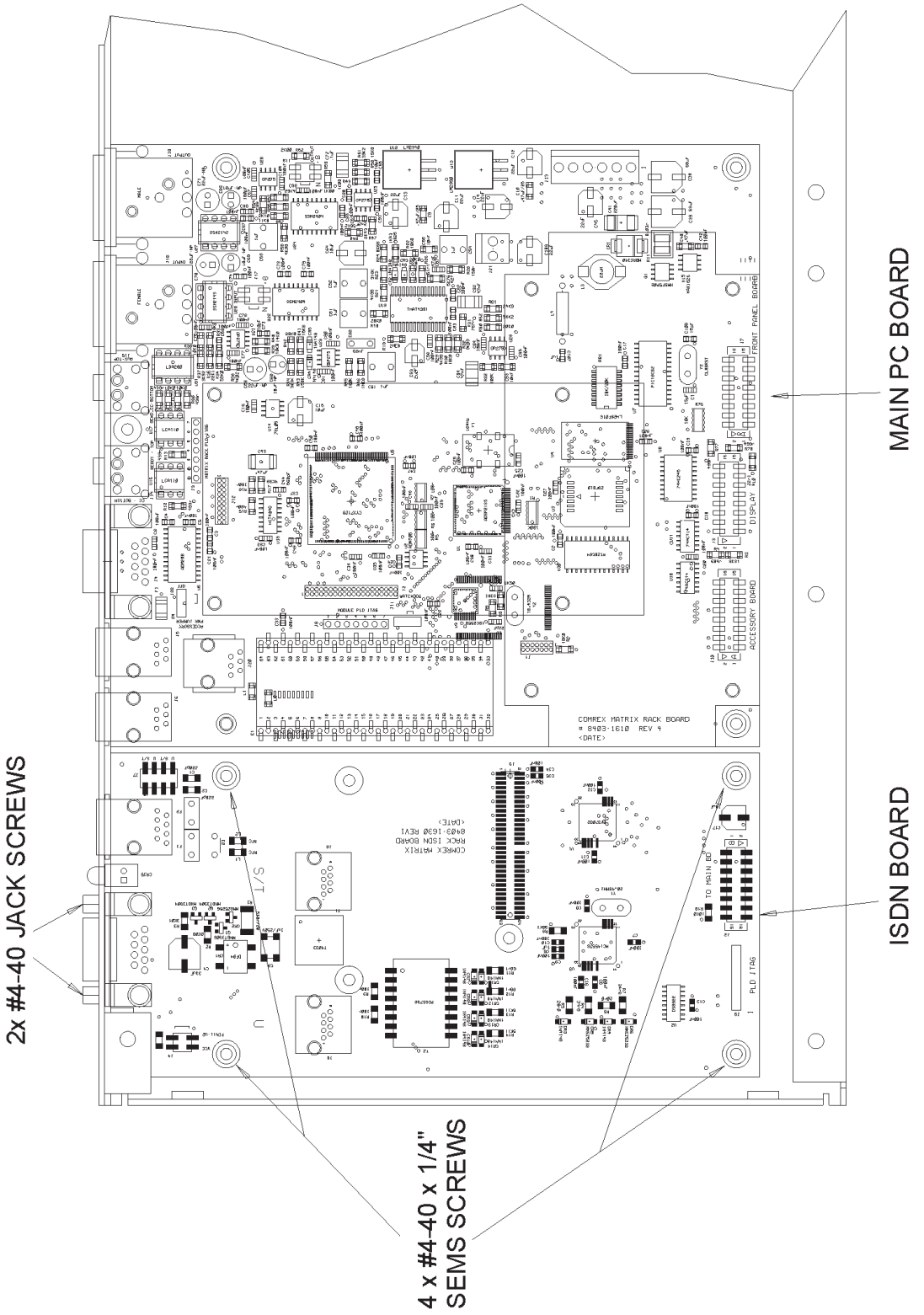


FIGURE 2 - INSTALLING THE ISDN BOARD

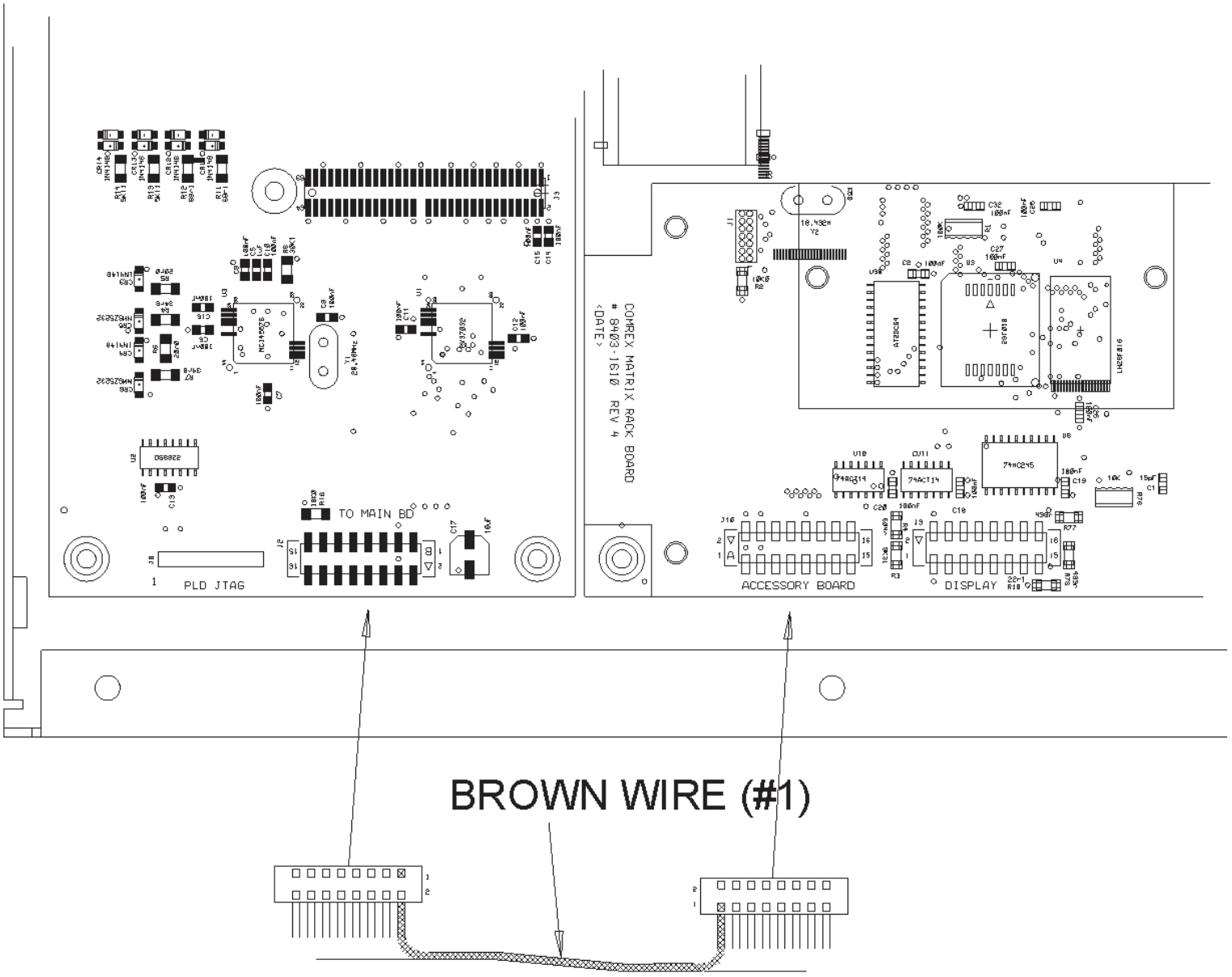


FIGURE 3 - ATTACHING THE CABLE TO THE ISDN BOARD

Dual ISDN/POTS operation (Matrix Rack only)

After a Matrix Rack has been upgraded to support ISDN, there is a significant change to the overall user interface of the unit. This is because in its default mode, the ISDN capable Matrix Rack will accept an incoming call from either the ISDN or POTS line and automatically set to the appropriate mode. When the Matrix Rack is powered up after the ISDN module installation, the following menu will appear in place of the *Main Status Display:*

1) POTS status

2) ISDN status

When this menu is displayed, either type of incoming call (but not both) will be processed automatically. Outgoing calls and configuration for each function can still be made by selecting which status menu you wish to see. Once this selection is made, the Matrix changes function to either POTS or ISDN mode only, and will not process the other type of call. When a call is disconnected, the Matrix will revert to the "Dual Mode" display and be ready to take another call of either type.

STL Backup Mode in Dual Mode Operation

Only ISDN based STL backup mode is possible when the ISDN module is installed. If you wish to operate POTS based STL backup mode, you will need to disable the ISDN menus using the procedure described on page 12. When ISDN mode is enabled in the ISDN menus on the Matrix rack, a contact closure will trigger an outgoing call either from the "Dual Mode" display or from the ISDN status display

Getting Started

You will need to program the Matrix with the following information before use. You must select:

A. An Algorithm (see page 25 for detail)

B. A Data Rate (see page 23 for detail)

C. ISDN Line Parameters (see below)

Programming the ISDN Line Parameters

The following information has to be programmed into the Matrix before it is connected to an ISDN line and each time it is moved to a new line.

A. Switch Type

B. SPID numbers (Service Profile IDentifiers) - Not required on EURO, NTT or TPH Switch Types.

C. Local Dialing Numbers (LDNs)

The Switch Type, SPIDs and LDNs are provided by the telephone company, and they are unique to the specific ISDN line to which you are connecting. Do not let your ISDN installer leave without being certain that you have the correct information in hand. Otherwise, the Matrix may not work at all, or it may "partially" work, requiring time-consuming troubleshooting. Incorrect phone company information is the number one source of difficulty when configuring ISDN equipment. The second is incorrectly installed phone lines.

The switch type, SPID and local phone numbers need to be programmed into the Matrix *before it is attached to the ISDN line*. If you reenter any of these values once the Matrix has "shaken hands" with the line, disconnect the Matrix from the line temporarily or power it down momentarily in order to initiate a new "handshake." Any information entered into the Matrix will be saved if it is turned off or loses power, so you will not need to reprogram the line information unless you move it to another ISDN line.

Note: If you are installing the Matrix for a full time application, we recommend protecting it with an uninterruptable power supply (UPS) with built in surge protection. A model in the 250 watt category should be fine, and prices are now less than $100. They are available from computer and electronic stores.

SECTION 5. CONFIGURING THE MATRIX ISDN MODULE

POWER UP SEQUENCE - PORTABLE

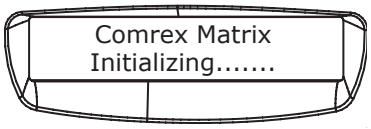
When the Matrix is connected to power and turned on with the ISDN module installed, the unit automatically boots up as an ISDN codec. During the boot up process, the initializing menu appears for approximately five seconds. The next screen (Circuit Info Screen) acknowledges the unit's recognition of the installation of the ISDN module. This screen will display for about five seconds. The Matrix then shows the *MAIN STATUS DISPLAY*. The main setup options including data rate, switch type, line status and selected algorithms are displayed in the top portion of the screen. As shipped from the factory, the Matrix *MAIN STATUS DISPLAY* will be the same as the screen shown below. Again, these selections will remain in non-volatile memory until changed.

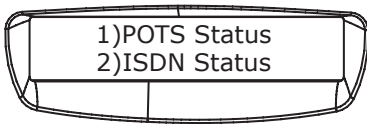
To return to the portable Matrix POTS codec function, disconnect from power, remove the ISDN module, and power the unit back up.

POWER UP SEQUENCE - RACKMOUNT

After the ISDN module has been installed, the power up screen after the initializing screen will give the user the choice of ISDN or POTS modes. After ISDN is selected, power up sequence will be the same as on the portable model.

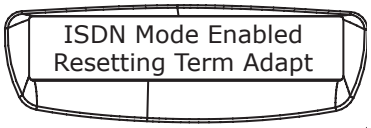
INITIALIZING SCREEN



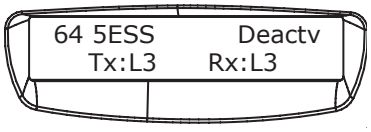


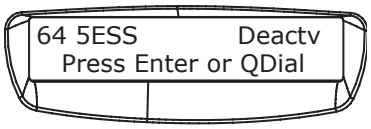
(Rackmount Version)

CIRCUIT INFO SCREEN



MAIN STATUS DISPLAY (ALTERNATES BETWEEN THESE TWO DISPLAYS)





Selecting the Switch Type

The telephone company will need to tell you the switch type so you can select it here. This describes the type of equipment on the telephone company's end of the ISDN line. The choices are AT&T *5ESS*, Northern Telecom *DMS*, National ISDN 1 (NI1), EURO, NTT, and TPH. Note that the AT&T and Northern Telecom switches often work in NI1 mode, so if this is the case, *NI1* is the correct choice. *5ESS* or *DMS* should be selected only if the telephone company has specified these custom configurations for your line. If in doubt about this choice, contact the company that installed your ISDN line. EURO, NTT and TPH are generally for use outside of North America and do not require the use of SPIDS.

To set the Switch Type:

A. Press *Enter* from the *Main Status Display*.

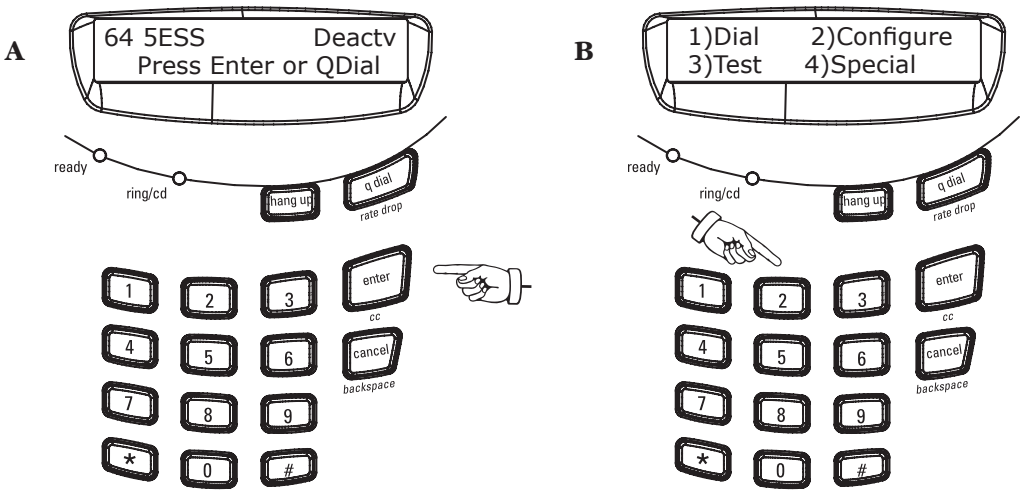
B. Then press *"2"* for *Configure.*

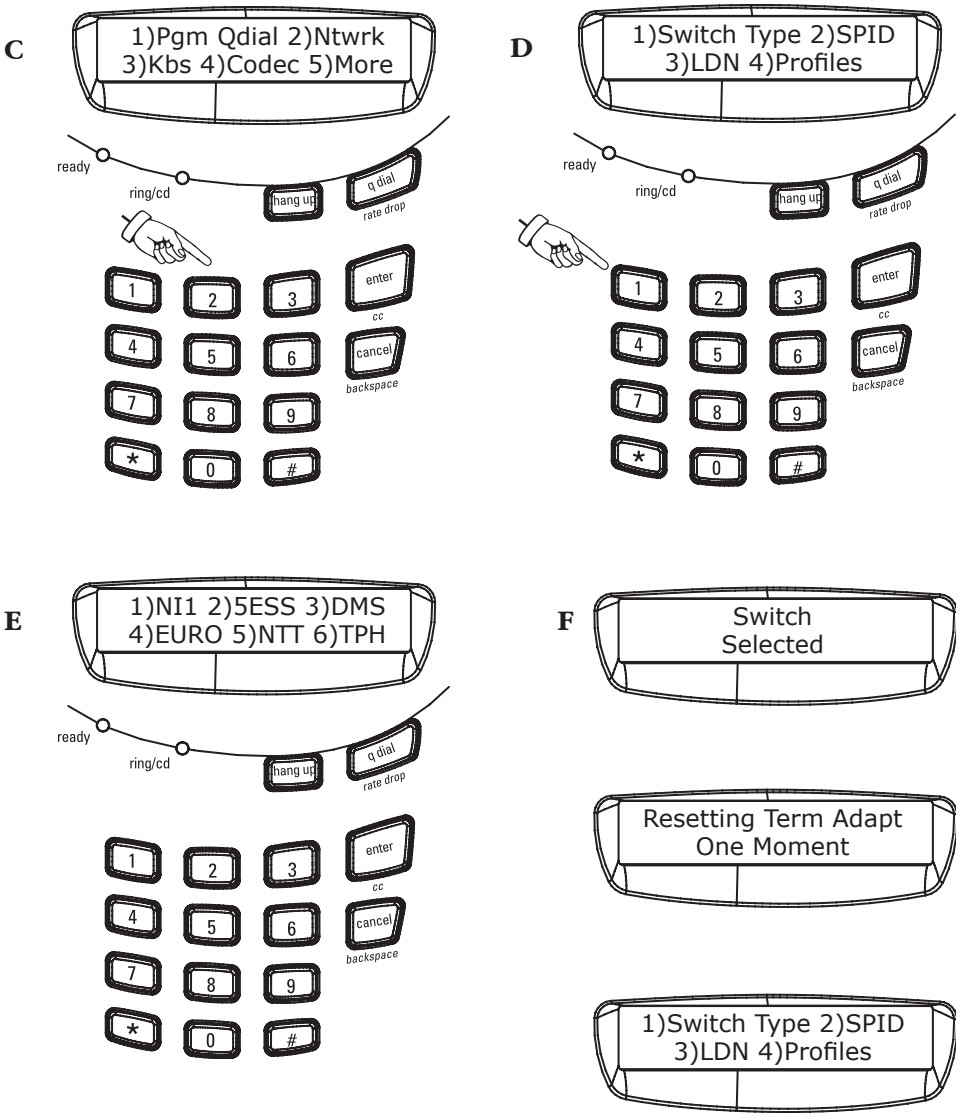
C. Then *"2"* for *Ntwrk* for the *Network Configuration Menu*.

D. Next select "*1"* for *Switch Type.*

E. Using the keypad, press the number which corresponds to the switch type setting you want.

F. The Matrix will store your selection in non-volatile memory and display these screens as it is doing so.





The switch type is now stored and if you press cancel 3 times, you will be returned to the *MAIN STATUS DISPLAY*. Your switch type will now be displayed in the upper left corner of the display, next to the SPIDs.

ENTERING SPIDS (NORTH AMERICAN SWITCH TYPES ONLY)

You will now program the exact **S**ervice **P**rofile **ID** Number that the telephone company gave you for each channel of your ISDN line. This number is used to handshake between the telephone company and the Matrix. If you are not in North America or have switch types EURO, NTT or TPH, you do not need to program SPIDs and should leave these options blank.

If SPIDs were previously programmed into your Matrix, they will appear. If they are correct, press *ENTER* until you return to the *NETWORK CONFIGURATION MENU*. If you wish to change a previously programmed SPID or if you make a mistake while entering the number, press *BACK SPACE* until the number is cleared, and then enter the correct number.

To program the SPIDS:

A. Press *ENTER* from the *MAIN STATUS DISPLAY*.

B. Then press *"2"* for *CONFIGURE*.

C. Then *"2"* for *NTWRK* for the *NETWORK CONFIGURATION MENU*.

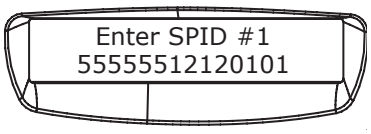
D. Next select *"2"* for *SPID*.

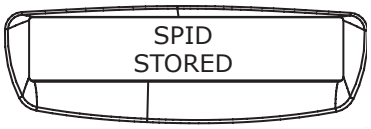
E. Using the keypad, enter the SPID 1 and press the *ENTER* key. If SPIDs were previously programmed into your Matrix, they will appear. Use the *CANCEL* key to backspace if needed. When the correct number appears press *ENTER* to accept.

F. Repeat the process for SPID 2 and press *ENTER*.

G. The Matrix will store your selection in non-volatile memory and display these screens as it is doing so.

E





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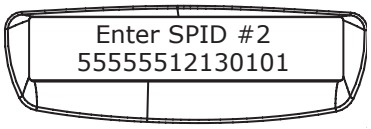
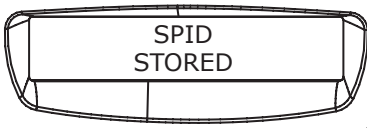
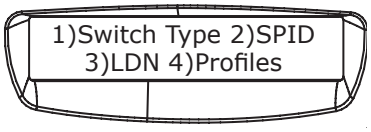






Note: Some ISDN lines use two SPIDs, some use one and some use none at all. Often, your SPID resembles your phone number plus area code with leading or trailing digits. If your line was configured for two SPIDs, you must enter the appropriate numbers exactly as they have been given to you by the phone company into the SPID 1 and SPID 2 menus. If your line has only one SPID, program that number into both SPID 1 and SPID 2 menus. If you have ordered service on only one "B" channel (1B+D), enter the SPID number into SPID 1 and leave SPID 2 blank. Finally, if your line has no SPIDs, verify that there are no numbers programmed into SPID 1 and SPID 2.

PROGRAMMING LDNS

Now you will program the local phone numbers for your ISDN lines. The LDN (Local Dialing Number) is the seven digit local phone number assigned to each "B" channel of your ISDN line.

To program the LDNs number into memory:

A. Press *ENTER* from the *MAIN STATUS DISPLAY*.

B. Then press *"2"* for *CONFIGURE*.

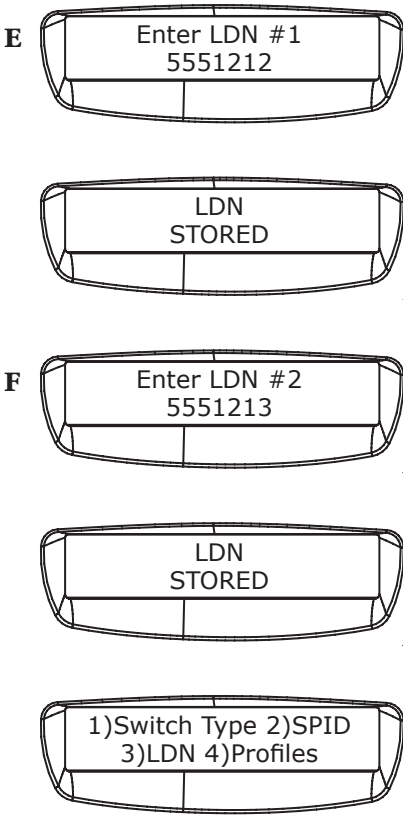
C. Then *"2"* for *NTWRK* for the *NETWORK CONFIGURATION MENU*.

D. Next select *"3"* for *LDN*.

E. Using the keypad, enter the LDN 1 and press the *ENTER* key. If LDNs were previously programmed into your Matrix, they will appear. Use the *CANCEL* key to backspace if needed. When the correct number appears press *ENTER* to accept.

F. Repeat the process for LDN 2 and press *ENTER*.

G. The Matrix will store your selection in non-volatile memory and display these screens as it is doing so.



*Note: The LDN is the **L**ocal **D**ialing **N**umber for your line. It is usually only seven digits long. Do not include your area code in the LDN. For example: The Comrex ISDN test phone number is 978-772-9404 and the LDN is 772-9404. Some ISDN lines have a different number for each of the two channels, some use the same number for both. If you have only one number, program it into both the LDN menus.*

About the NT1

In North America, the customer must supply an NT1 or "U" interface for connection to the ISDN line. This NT1 is included in the Matrix ISDN module and the default setting is a "U" interface.

Outside of North America and on certain other types of ISDN simulation, like satellite terminals or T1 channel banks, ISDN is presented on an "S/T" interface and the NT1 must be bypassed. It is possible to bypass the NT1 and provide an "S/T" interface by swapping a jumper.

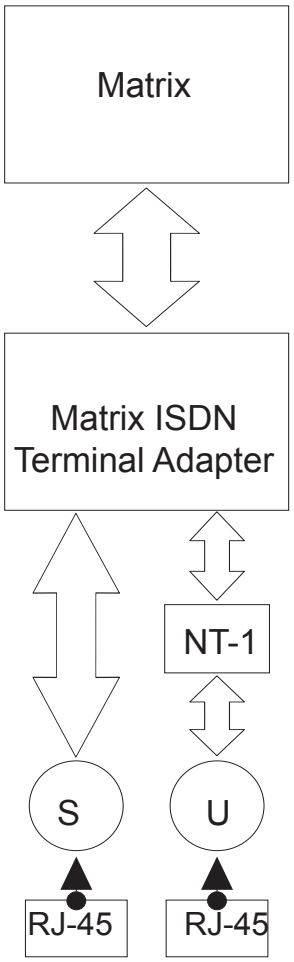


Figure 4 - NT-1

ISDN can be delivered two ways: with a "U" interface, and with an "S" interface. As shown in Figure 4, the Matrix includes an "NT1" device that converts between the "S" and "U" interfaces. Most North American ISDN equipment incorporates the NT1 function, while most European ISDN requires that the NT1 be provided by the phone company. The Matrix NT1 circuit can be disabled in order to provide an "S" interface if necessary.

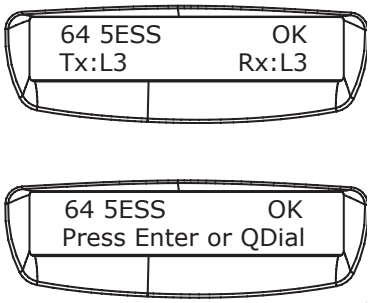
The Matrix is delivered with a "U" interface on all domestic orders. Most Matrix shipped for international use are configured for "S" interface. A note included with the ISDN module specifies which configuration that module supports.

Sometimes, North American users need to install a Matrix behind an ISDN compatible PBX, or use an external NT1 device. Some countries where an "S" interface Matrix is sold may support a "U" interface device. The Matrix ISDN module may be user configured for the either type of interface. See Appendix A on page 55, "Changing the ISDN Module between "U" and "S/T" Interface" for instructions on how to do this.

Connecting the ISDN Line

After the switch type, SPID, and LDN are programmed correctly, press the *Cancel* key until you are again at the *Main Status Menu*. Now, attach the ISDN line to the telephone connector marked *ISDN* on the rear of the Matrix Module. Within about one minute, the Deactv status display should change. Depending on your ISDN Switch type, the display may read "OK" (for North American ISDN) or "Active" (for non-North American types). If the display doesn't change within a minute, refer to *Section 7 - Troubleshooting* on page 35.

Main Status Display (alternates between these two displays)



Selecting a Data Rate

Now that the Matrix has been set up for your ISDN service, you will need to tell it a few things about what you want to accomplish. The first selection will be data rate. The Matrix can communicate at four different data rates: 56, 64, 112 or 128 kb/s. The 56 or 64 kb/s data rates use only one "B" Channel and you will only be billed for one ISDN phone call at these rates. The 112 and 128 kb/s rates actually place two different calls between points using both "B" Channels (although it looks to you like one call is placed), and you are billed for twice the connect charges.

Depending on the algorithm selected, audio bandwidth varies with data rate. Using G.722 at 56 and 64 kb/s, the Matrix carries 7.5 kHz audio bandwidth. This is nearly transparent audio for voice applications, although you might notice a slight cutoff at the "ss" sound in voices. Using Turbo G.722 at 112 or 128 kb/s, the Matrix carries through 15 kHz audio, providing full, FM radio quality bandwidth for voice and music with very low delay. There is little perceivable difference between 56 and 64 kb/s (and also 112 and 128 kb/s). The 56 and 112 kb/s rates are provided for compatibility with ISDN lines which do not provide clear channel 64 kb/s transmission and also to interwork with Switched 56 systems. If you are using ISDN on both ends of your system, you should attempt to connect first at 64 (or 128) kb/s, and if you experience problems, try backing down to 56 (or 112) kb/s. ISO/MPEG Layer III (32KHz) can only be selected at data rates of 56 and 64 kb/s. This algorithm provides the most audio bandwidth using only one ISDN "B" channel.

Under most circumstances, a Matrix will adapt to the lower data rate of an incoming call. This does not work the other way around. If an outgoing Matrix is set to 112 or 128 Kb/s, the incoming Matrix must also be set to one of these rates or the call will fail. This allows for a unit which accepts incoming calls to be set to 128 kb/s and automatically adjust to take calls from units set to lower rates. However, if you are connecting with another manufacturer's codec, it is important to set the data rate to the same rate as the codec on the other end.

To select your Data Rate:

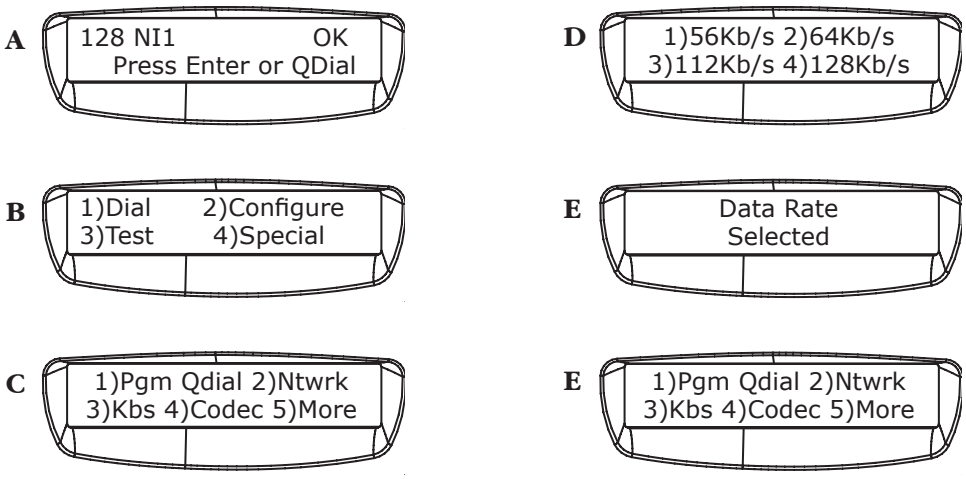
A. Press *ENTER* from the *MAIN STATUS DISPLAY*.

B. Then press *"2"* for *CONFIGURE.*

C. Then *"3"* for *KB/S* or (kilobits per second).

D. Next select the number corresponding to the desired data rate.

E. The Matrix will store your selection in non-volatile memory and your selection will be displayed on the main status menu.



Selecting an Algorithm

You will need to select an algorithm or encoding scheme. For more information on the available algorithms, please read *"About the Algorithms"* on page 5. The algorithm choices are:

1. G.722 - 6 mS delay, 7.5 kHz at 56/64 kb/s or 15 kHz (also known as TurboG.722) at 112/128 kb/s

2. Layer III - 300 mS delay, 15 kHz at 56/64 kb/s (112/128 kb/s not enabled)

3. Layer III transmission and G.722 receive - reduces delay while allowing full fidelity transmission. (56/64 kb/s only - 112/128 kb/s not enabled)

4. G.722 transmission and Layer III receive - reduces delay while allowing full fidelity reception. (56/64 kb/s only - 112/128 kb/s not enabled)

To select your Algorithm:

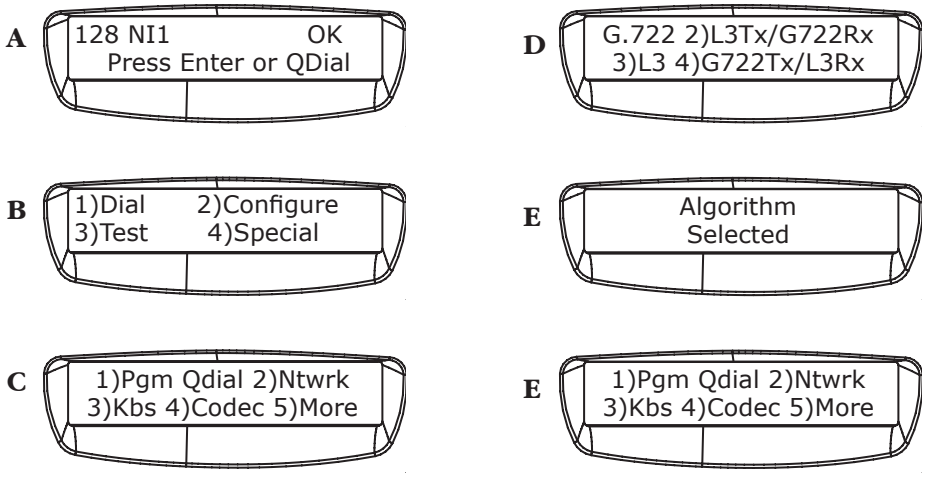
A. Press *Enter* from the *Main Status Display*.

B. Then press *"2"* for *Configure*.

C. Then *"4"* for *Codec*.

D. Next select the number corresponding to the desired algorithm.

E. The Matrix will store your selection in non-volatile memory and your selection will be displayed on the *Main Status Menu*.



Placing a Call

There are two ways to place a call with the Matrix. You can dial manually or use the Quick Dial option for automatic dialing.

To Manually Dial:

A. Press *Enter* from the *Main Status Display*.

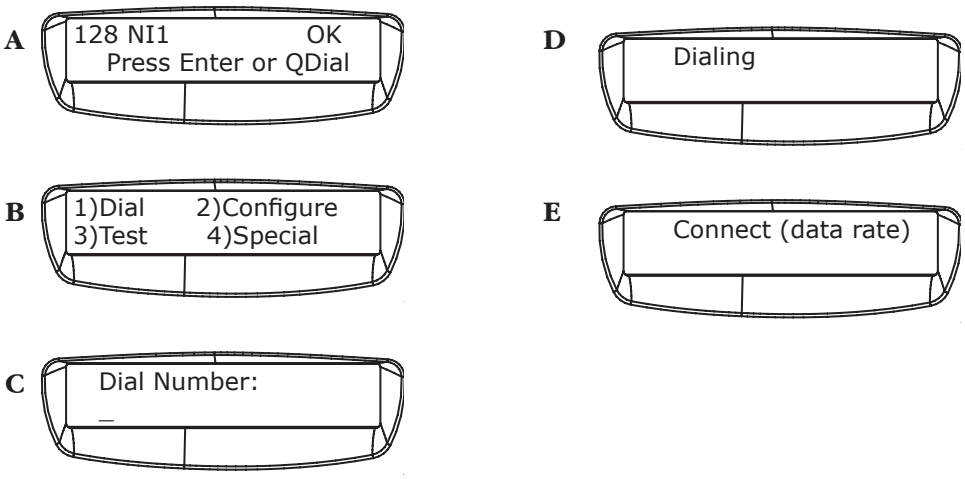
B. Then press *"1"* for *Dial.*

C. Then enter the phone number to be dialed. If you make a mistake, press the cancel key to backspace. The *Hang up* key will abort the call.

D. Press *Enter* to place the call.

E. The Matrix will dial your call. The ready light will glow when the codec is successfully synced with the codec at the other end.

F. If at any point you wish to terminate the call, simply press the *Hang up* key.



Note: ISDN dialing numbers use the same local and international access and area codes as normal analog call, i.e. if you use a "1" before a number for a normal long distance call, use a "1" before the ISDN number.

Placing a QDial Call

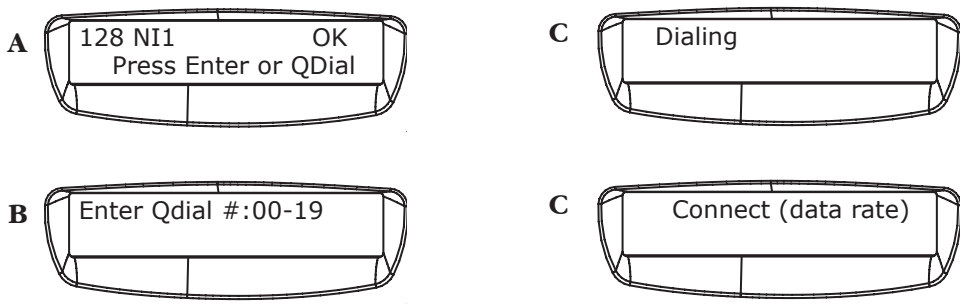
To Place a Qdial Call:

A. Press *QDial* from the *Main Status Display*.

B. Then enter the QDial number (00-19) that you wish to dial. Your call will complete momentarily. QDial 00 = last number redial. Programming QDial is discussed on page 27.

C. If at any point you wish to terminate the call, simply press the *Hang up* key.

Placing a QDial Call



Programming QDial

The Matrix has 20 memory locations which allow you to store a number and dial it quickly using the *QDial* button. QDial memory location 00 holds the last number dialed and pressing QDial 00 will redial this number.

To Program Quick Dial Memory:

A. Press *Enter* from the *Main Status Display*.

B. Then press *"2"* for *Configure.*

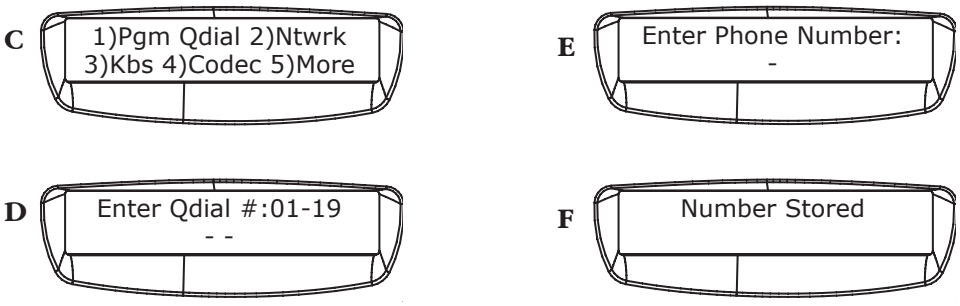
C. Then press *"1"* for *Pgm Qdial.*

D. Enter a number from 01-19 as a memory location. If a number was previously programmed, it will appear and you will need to "backspace" over it using the *Cancel* key.

E. Then enter the phone number to be dialed. If you make a mistake, press the *Cancel* key to backspace. The *Hang up* key will abort this operation.

F. Press *Enter* to store the number.

G. Press *Cancel* until you reach the *Main Status Display.* The QDial numbers will remain in memory, even if the Matrix loses power.



ISDN Line Profiles

For some users who carry their Matrix between different ISDN equipped locations, it can become difficult and confusing to reprogram all the necessary information about the ISDN line into the Matrix each time it is moved. The Matrix eases this task, by allowing you to create ten "profiles" for ISDN lines, which simply need to be "loaded" at each location.

Load a Stored ISDN Profile

To Load a Profile:

A. Press *Enter* from the *Main Status Display*.

B. Then press *"2"* for *Configure.*

C. Then *"2"* for *Ntwrk* for the *Network Configuration Menu*.

D. Next select *"4"* for *Profiles.*

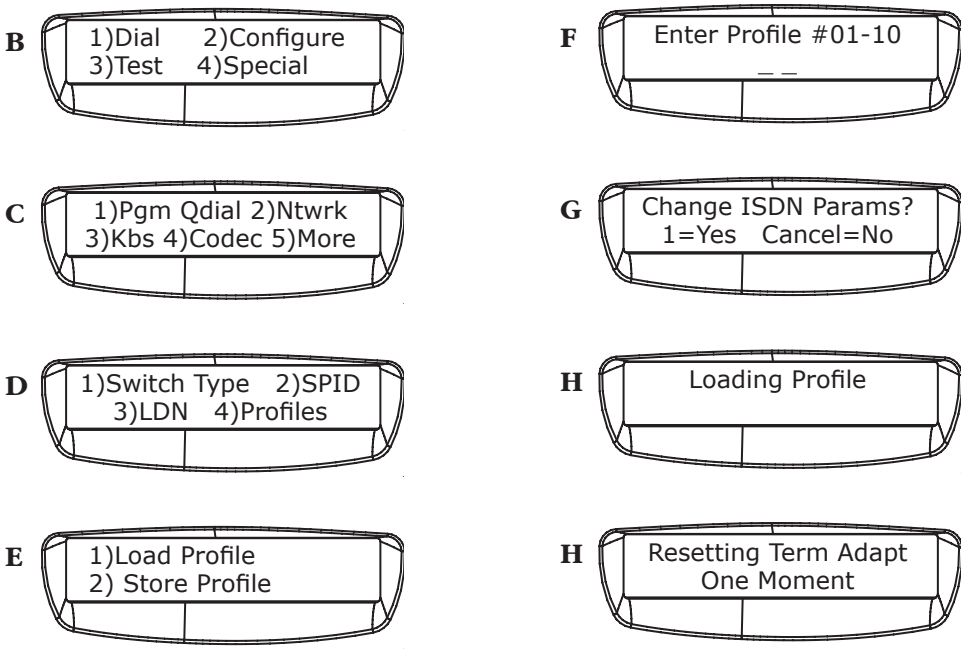
E. Then *"1"* for *Load Profile.*

F. Choose a Profile location to load (a number from 01 to 10).

G. The Matrix will ask if you want to change ISDN Parameters. Choose *1* for *Yes* if you want to load a profile or *Cancel* for *No* if you want to keep the existing set up.

H. The Matrix will automatically load all of the preset parameters. The Matrix will remember your selection until you change it, even when powered down.

Complete instructions on storing an ISDN line profile may be found on the next page.



STORE AN ISDN PROFILE

To Store a Profile:

A. Press *ENTER* from the *MAIN STATUS DISPLAY*.

B. Then press *"2"* for *CONFIGURE.*

C. Then *"2"* for *NTWRK* for the *NETWORK CONFIGURATION MENU*.

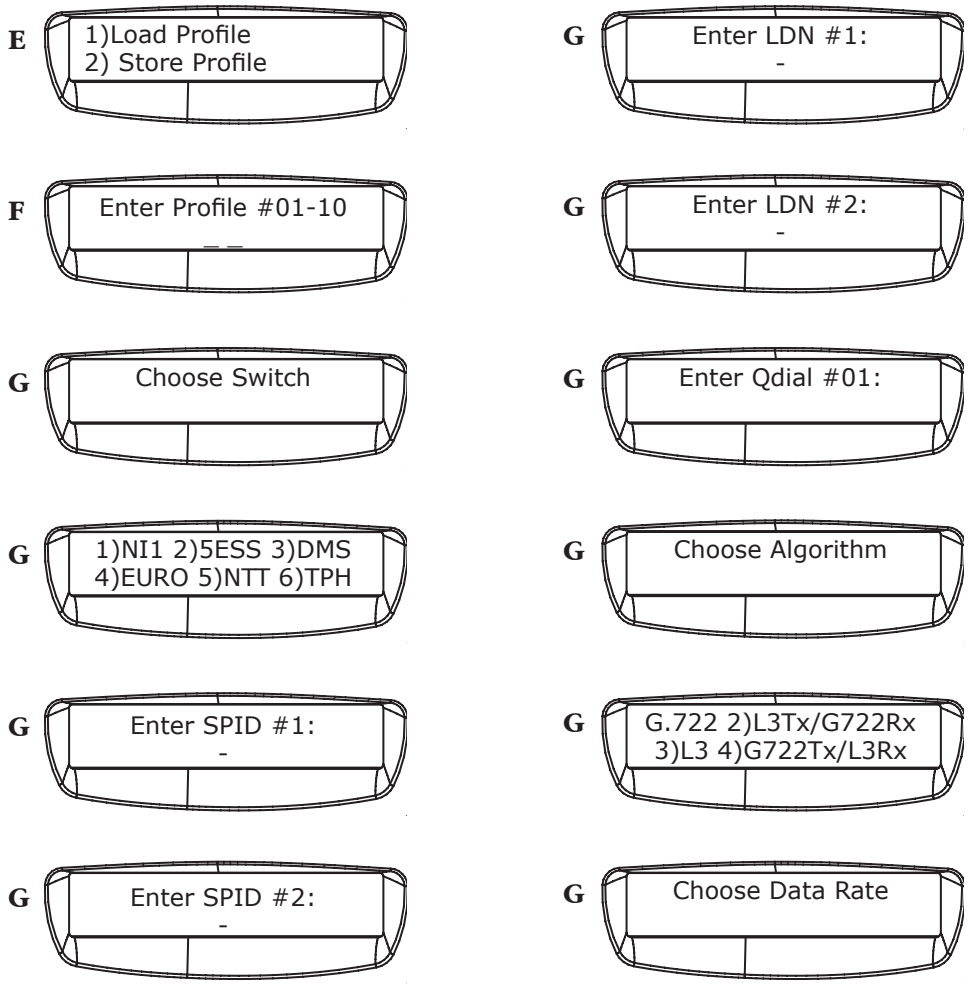
D. Next select *"4"* for *PROFILES.*

E. Then *"2"* for *STORE PROFILE.*

F. Choose a Profile location to store (a number from 01 to 10).

G. Follow on-screen instructions to enter SPIDS, LDNs, Switch Type, QDial number, Algorithm, and Data Rate.

H. Press *CANCEL* until you reach the main status display. The ISDN Line Parameters will remain in memory, even if the Matrix loses power.



Last Number Redial

Redialing the last number is easy – from the *Main Status Display* press the *Qdial* key and 00. The last number you dialed from the Matrix will be redialed. This number will remain in memory after the Matrix is powered down.

Receiving Calls

As long as your options are set to be compatible with the incoming device, the Matrix should automatically answer the incoming call and "wake-up," providing full duplex audio.

Ancillary Data

Ancillary data provides a low speed data channel along the same ISDN phone call used for the coded audio. It has little impact on the audio quality and allows two computers to communicate at 1200 baud. Ancillary data is available in both Layer III and G.722 modes, but is limited to the G.722 direction when operating in split modes.

Layer III ancillary data is always enabled. Data will only be added to the audio bitstream if it is presented at the "Multi-purpose port" at the proper baud rate.

When using G.722 ancillary data, there are a few things to know:

1) G.722 ancillary data is only compatible with other Comrex G.722 codecs (Nexus, Envoy, Matrix). If communicating to a non-Comrex compatible device, G.722 ancillary data mode must be off.

2) Both codecs must be set for G.722 ancillary data operation. If the ancillary data mode is mismatched between codecs, the audio channel will not work correctly.

3) When using G.722 ancillary data in conjunction with a Comrex Nexus or Envoy codec, we recommend changing the G.722 ancillary baud rate to 4800 (see instructions on page 31) to avoid possible data overflow.

To Enable Ancillary Data:

A. Press *Enter* from the *Main Status Display*.

B. Then press *"2"* for *Configure.*

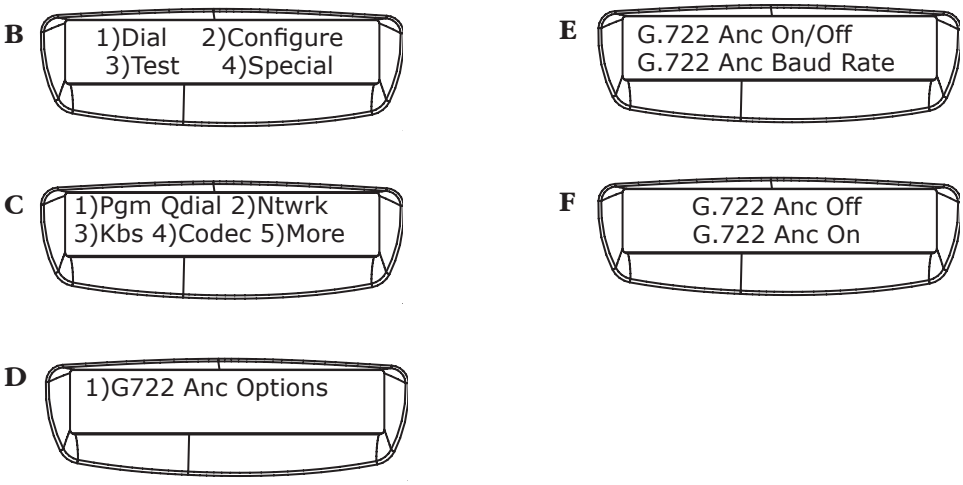
C. Then *"5"* for *More.*

D. Next select *"1"* for *G.722 Anc Options.*

E. Select *"1"* for *G.722 Anc On/Off.*

F. Select *"1* for *G.722 Anc Off* or *"2"* for *G.722 Anc On.*

If you have selected *Anc Data On*, this will be indicated on the *Main Status Display*. Press *Cancel* until you return to this display. Configuration and connection of ancillary devices is covered in the "About Ancillary Data" section on pages 50.



To Change Ancillary Data Baud Rate (For Nexus, Envoy compatibility, select 4800 baud.):

A. Press *ENTER* from the *MAIN STATUS DISPLAY*.

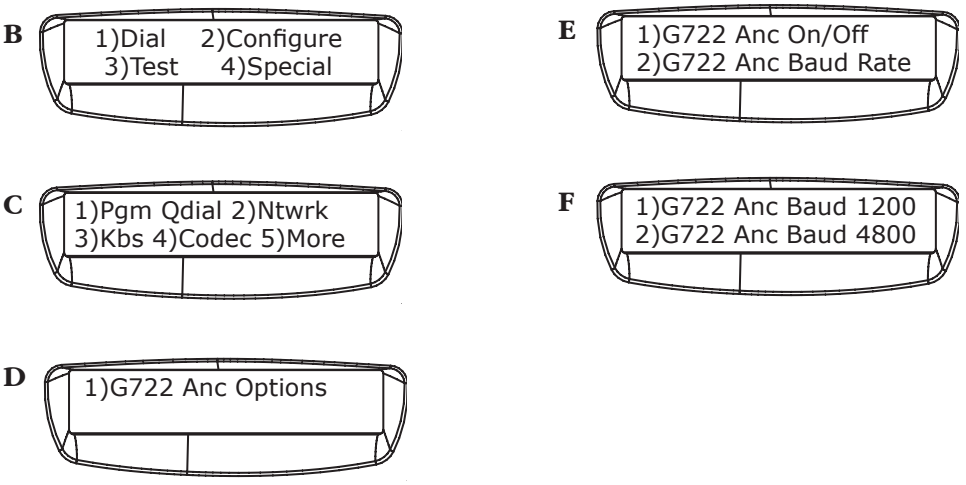
B. Then press *"2"* for *CONFIGURE*.

C. Then *"5"* for *MORE*.

D. Next select *"1"* for *G722 ANC OPTIONS*.

E. Next select *"2"* for *G722 ANC BAUD RATE*.

F. Select *"1"* for *G722 ANC BAUD 1200* or *"2"* for *G722 ANC BAUD 4800*.



SECTION 6. ADDITIONAL FUNCTIONS

SPECIAL MENU

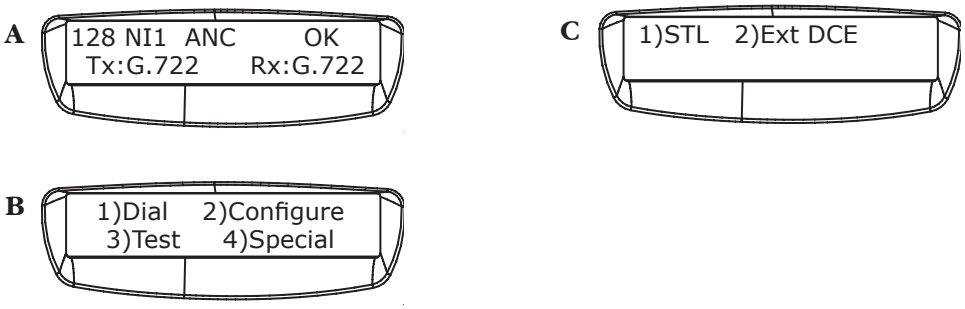
The Matrix has two "special" operational modes: *STL Backup Mode* and *External DCE Mode*. These modes are explained in detail below.

To Access the Special Menu:

A. Press *ENTER* from the *MAIN STATUS DISPLAY*.

B. Select *"4"* for *SPECIAL* in the *MAIN MENU*.

C. Choose the appropriate mode from the special modes menu.



Note: While these special modes are engaged, the other menus are disabled. For this reason you will want to make sure all settings are correct before you enter any "special" mode.

STL BACKUP MODE

The Matrix has a special feature that allows the unit to automatically initiate and maintain an ISDN codec call. When engaged, the Matrix will dial the number stored in *QDIAL 01* and redial the call should the line drop for any reason. STL Backup mode works slightly differently in the Matrix rackmount than in the Matrix portable. Essentially, the Matrix rackmount STL Backup dialing is triggered by the Aux input closure on the rear panel. On the Matrix portable, the stored number is dialed immediately upon entering the status display (after engaging STL mode).

STL Backup mode is engaged on both units from the *SPECIAL MENU* (See *SPECIAL MENU* section above.) To engage STL Backup Mode Select *"1"* for *STL* from the special modes menu once all your Matrix options (kb/s, ancillary data, etc.) have been set. If the Matrix should lose power while in STL Backup, it will return to this mode when power is reapplied.

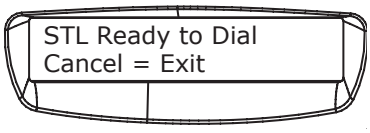
ISDN STL Backup Mode for Matrix Rackmount

The Matrix Rackmount functions normally when in STL Backup Mode until the pins on the Aux connector are closed. In order for STL Backup Mode to work, the Matrix rackmount must be left either at the POTS/ISDN select screen, or the Main ISDN status display. POTS STL Backup is disabled when the ISDN option is engaged.

When a closure is made between the pins on the Aux connector, the Matrix Rackmount will dial the phone number stored in *Qdial 01*. If the number is busy or doesn't connect, it will continue to try to dial until the Aux connector is opened. Once connection is made, the Matrix Rackmount will monitor the Aux connector's status. If the connector opens, the Matrix Rack will drop the call and go back to waiting for the next closure. To disengage STL Backup Mode on the Matrix rackmount, open the Aux connector so the unit will drop the call and not try to redial. Enter the *Special Menu* again. Choose STL, and select option 2 "Disengage STL Mode." Normal operation will resume.

ISDN STL Backup Mode for Matrix Portable

On the Matrix Portable, once STL Backup mode is engaged, it is not possible to access the configuration menu system. For this reason, it is important to configure all parameters and Qdial locations before entering this mode. No external trigger is provided on the Matrix portable. Once engaged, the Matrix portable will drop directly into dial mode as soon as you go back to the ISDN status display. Disengaging STL Backup Mode on the portable can only be done during the few seconds the Matrix is getting ready to dial the STL number. The display will read:



Press the *Cancel* key at this point to disengage STL mode. If the portable Matrix is on-line, press the *Hang up* key to end the call, and then press the *Cancel* key when the above screen reappears.

EXTERNAL DCE MODE

This mode disconnects the terminal adapter from the codec inside the Matrix and allows you to connect to an external terminal adapter, DSU, satellite terminal, etc.

In this mode, the Matrix works very much like a DXP.1 or DXR.1, except that it will allow for ancillary data transmission. The Multipurpose Port connector may easily be adapted to V.35 or X.21 via adapter cables available from Comrex. Algorithm, Data Rate, and Ancillary Data selections must be made before entering Ext DCE mode, since all menus are disabled.

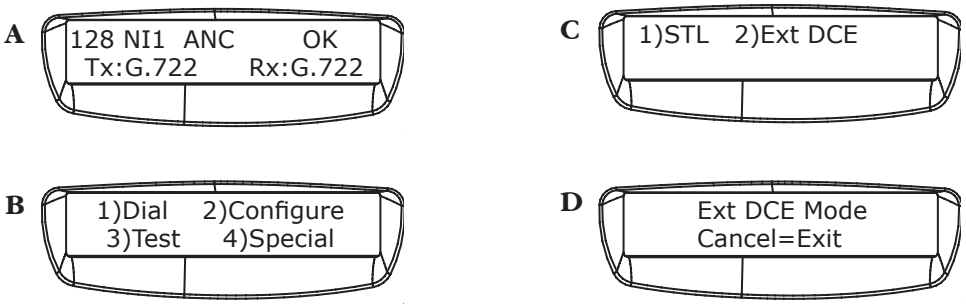
To Access the Special Menu:

A. Press *ENTER* from the *MAIN STATUS DISPLAY*.

B. Select *"4"* for *SPECIAL* in the main menu.

C. Choose *"2"* for *EXT DCE*. When you select the External DCE mode, the Matrix screen will appear as below.

D. Press *CANCEL* at any time to leave External DCE mode. The Matrix will automatically return to this mode if power is lost.



Note: External DCE mode provides access to the codec section, not the TA section. The Matrix cannot be used as a stand-alone terminal adapter.

SECTION 7. TROUBLESHOOTING

The Comrex Matrix coding algorithms eliminate redundancy in audio. For this reason, the Matrix cannot be subjected to traditional specifications of distortion and signal-to-noise ratio. Most tests done with the codec should be by subjective listening between the original source material and codec-processed audio. Because of the algorithm's dynamic processing properties, tests done with tones tend to prove little.

Unlike analog technology, which might work but just be a little off, digital technology tends to either work perfectly or not at all! The trick is to isolate the source of the problem to either the telephone network or the equipment attached to it, so you know where you can turn to for a solution. The Matrix provides some simple diagnostic functions to help you do this: Codec and TA loopback.

CODEC LOOPBACK

This test examines the codec portion of the Matrix, independent of the built-in TA or the digital circuit. Audio must be fed into the unit through one of the audio inputs, and you must be able to monitor an audio output (either headphones or aux out). On a portable Matrix, be certain to turn the LOCAL/RETURN Ratio Control all the way to the right (towards return) so that you are sure you are monitoring the codec return audio only. Power must be connected to the Matrix, and it needs to be turned ON. You do not need to be connected to an ISDN line (or other type of digital service). This test cannot be run while a call is placed.

To Perform a Codec Loopback Test:

A. Press *ENTER* from the *MAIN STATUS DISPLAY*.

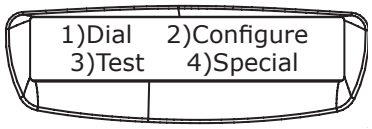
B. Select *"3"* for *TEST* from the Main Menu.

C. Choose *"1"* for *CODEC LOOPBACK*.

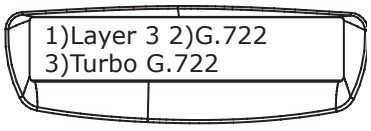
D. Select the number corresponding to the proper encoding algorithm.

E. The codec is now in loopback. This activates two things. It puts the local clock into use to drive the signal, and it connects the encode and decode channels. The "ready" light should be illuminated and audio should be heard. Press *CANCEL* at any time to leave Codec Loopback.

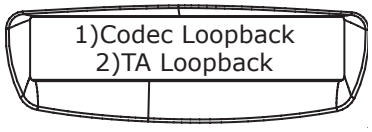
A



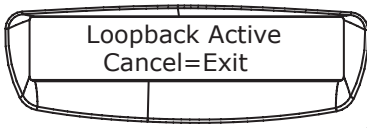
C



B



D



Expected Results in Codec Loopback Test

You will hear the same audio in your headphone that is being fed into the Matrix. The *Ready* light should be on. *Note: There may be a few seconds of noise before your audio is heard.*

If you do not hear audio, or it is distorted:

- Check your connections.
- Make sure the peak light blinks green occasionally on the portable Matrix. On the rackmount Matrix, make sure VU meter peaks occasionally over the "0" mark, which is the yellow LED on the meter.
- Insure that the mic/line switch is in the correct position

If there is still a problem, please contact Comrex.

TA Loopback

This function tests the terminal adapter and the codec portions of the Matrix together. Again, audio must be fed into the unit through one of the audio inputs, and you must be able to monitor an audio output (either headphones or aux out). On a portable Matrix, be certain to turn the Local/Return Ratio Control all the way to the right (towards return) so that you are sure you are monitoring the codec return audio only. Power must be connected to the Matrix, and it needs to be turned On. You do not need to be connected to an ISDN line (or other type of digital service). This test cannot be run while a call is placed. The Matrix must be set up in a symmetric algorithm, meaning the transmit and receive algorithms must be the same. So make sure that on the *Main Status Menu*, Tx and Rx are the same (either both G.722 or Both LIII (for Layer III).

To Perform a TA Loopback Test:

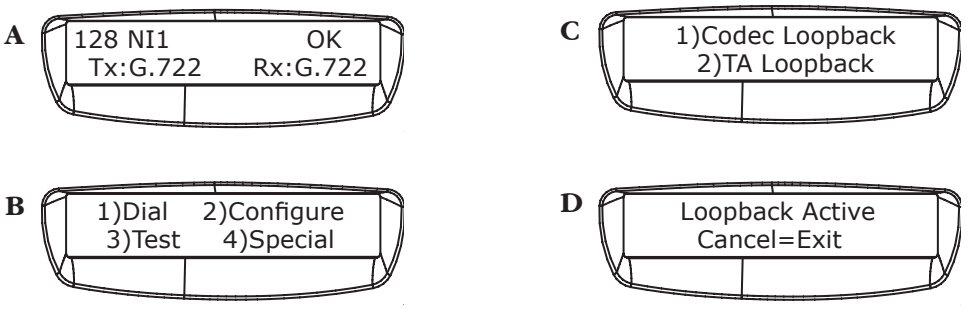
A. When Tx and Rx are the same in the *Main Status Display* press *"Enter"*.

B. Select *"3"* for *Test* from the *Main Menu*.

C. Choose *"2"* for *TA Loopback*.

D. The Codec and TA are now in loopback. This will send your audio through the encoder to the TA and back through the decoder, without going on to the network. The "ready" and "ring/cd" lights should be illuminated and audio should be heard. Press *Cancel* at any time to leave TA Loopback.

TA Loopback Display



Expected Results in TA Loopback Test

You will hear the same audio in your headphones that is being fed into the Matrix. The Ready light should be on. *Note: there may be a few seconds of noise before your audio is heard.* Also, there will be a noticeable delay in the audio returned to the decoder from the TA. This delay is a function of the TA loopback test and does not reflect actual coding delay in program transmission.

If you do not hear audio, or it is distorted:

- Check your connections
- Make sure the peak light blinks green occasionally on the portable Matrix. On the rackmount Matrix, make sure VU meter peaks occasionally over the "0" mark, which is the yellow LED on the meter.
- Insure that the mic/line switch is in the correct position

If there is still a problem, please contact Comrex.

ISDN Status Indicator

In order to "handshake" with an ISDN line, the Switch Type, the Local Dialing Numbers (LDNs) and the Service Profile ID Numbers (SPIDs) pertaining to that particular line must be entered into Matrix. (Read pages 20-23 of this manual). If the information from the phone company is incorrect, or has been incorrectly entered, the Matrix will not work.

If you are using the Matrix with a "U" interface, you should check initial connection status with the ISDN line using the "U sync" indicator on the ISDN module (next to the ISDN jack). This light will flash then go steady when the U interface is synchronized with the line. The ISDN status message on the display is meaningless until the "U sync" light is steady.

If you are using the “S” interface configuration, ignore the “U sync” indicator.

The upper right hand corner of the ISDN *Status Display* is used to reflect the state of the ISDN line. When you first plug in an ISDN line (or turn on the Matrix), a digital handshake takes place between the Matrix and the telephone company.

When no line is plugged into the Matrix, the display will read Deactv (short for Deactivated). If your Matrix stays at this point even while your line is attached, there may be an issue with the line. The physical handshake with the ISDN line then continues as follows: Await- (Awaiting)The Matrix has woken up the ISDN line and is waiting for a response from the network Ident- (Identifying input) The Matrix has received a signal from the network Sync- (Synchronized) The Matrix has received an activation signal from the network Active- (Activated) The Matrix is receiving normal data from the network

On some ISDN lines like Euro-ISDN, the Matrix may remain on Active until a call is placed. On North American ISDN, the display should change to “OK” when the ISDN line is completely ready. If you don’t see “OK” eventually when connected to North American ISDN, check the SPID, LDN, and switch type settings to be sure that they are correct.

Info for North American Switches

If the Matrix stalls out between DEACTV and OK, first check the Switch Type. There are three choices in the Matrix: 5ESS, DMS100 & NI1 for North America. Other switch types are for other parts of the world. Any switch type running the NI1 (National ISDN 1) software becomes an NI1 switch and that option should be selected in the Matrix. Often, the phone company will report that you have an 5ESS or DMS100 switch, but will not mention NI1 - or will put this information somewhere in the fine print.

Second, check the SPIDs. The SPID is usually some combination of the local dialing number, with or without the area code, and often comes with a 2-digit prefix and/or 2-4 digit suffix. (See pages 40-41 for some possible combinations). The phone company should provide this number exactly as it is to be entered. In many cases, however, a Terminal IDentifier (TID) is required at the end of the SPID (usually 00 ,01, or 11) and the phone company will neglect to mention this - or, again, will put it in the fine print.

Third, check that the LDNs are entered with only the 7 digit local dialing number and that LDNs #1 & #2 and SPIDs #1 & #2 have been correctly entered in the #1 and #2 slots.

Finally, if your switch type is an AT&T 5ESS custom point-to-point, try entering no LDNs or SPIDs in the Matrix — even though they have been furnished by the phone company.

If you have doubled-checked that all the information has been entered exactly as provided by the phone company and there is no OK on the Matrix, the best thing to do is contact the phone company immediately to get the correct information.

If your Matrix has an "OK" in the menu, but you cannot place a long distance call, the phone company has probably not connected you to a long distance carrier's Point-of-Presence (POP). Try placing a local call or dial an access code number (see next section) to force a long distance call over a particular carrier. If all else fails, have someone call you (Comrex is happy to help here) to verify that the Matrix is working.

NOTE: Before entering any Network information into the Matrix, disconnect the ISDN line from the Matrix.

Using Long Distance Access Codes

Here is a list of some commonly used long lines carriers and their access codes. To force a particular long distance carrier, simply dial the access code number, followed by the telephone number you would normally dial. For example, to dial Comrex Corporation's main number (978 784-1776) via AT&T, you would enter 101028819787841776.

AT&T	1010288	Sprint	1010333
MCI	1010222	Frontier	1010444

International A/C Power Cords

A/C adapter cords are available which will connect the standard IEC 320 Inlet on the in-line Matrix switching supply to a wide range of international power receptacles. These may be purchased from:

Panel Components Corp.	Tel:	800-662-2290 (USA)
P.O. Box 115		515-673-5000 (INT)
Oskaloosa, IA 52577-0115	Fax:	800-645-5360 (USA)
		515-673-5100 (INT)

A comprehensive source for power cords can be found on the World Wide Web at www.magellans.com.

Some Known SPID Formats

Information from ISDN, What Every Broadcaster Needs to Know, courtesy Douglas A. Lane, 1900 Woodland Drive, North Reading, MA 01864

7 digits = local dialing number
10 digits = area code + local dialing number
NI1 = National ISDN 1

	Switch Type	SPID Format
Ameritech	AT&T 5ESS Custom	01 + 7 digits + 0
	AT&T NI1 (5E8)	01 + 7 digits + 011
	AT&T NI1 (5E9)	10 digits + 0111
	DMS100 - NI1	10 digits + 0111
	DMS100 Custom	10 digits + 0
	Siemens NI1	10 digits + 0111
Verizon	AT&T NI1	01 + 7 digits + 000
	DMS100 NI1	10 digits + 100
	Custom ISDN	01 + 7 digits + 0
Bell Canada	DMS100 NI1	7 digits + 00
Verizon/ Bell South	AT&T NI1	10 digits + 0100
	DMS100 Custom	10 digits + 34 or 4
	DMS100 NI1	10 digits + 0100
	NI-1	10 digits + 0 or 00 or 000
Verizon (NC)	DMS100 NI1	10 digits + 0100 or 0000
Verizon (OR)	AT&T NI1	01 + 7 digits + 000
	AT&T Custom	01 + 7 digits + 0000

Verizon/ Nynex	AT&T Point-to-Point	no SPIDS or LDNs needed
	AT&T NI1	10 digits + 0000
	DMS100 NI1	10 digits + 0001
Pac Bell	AT&T Custom	01 + 7 digits + 0
	AT&T NI1	01 + 7 digits + 000
	DMS100	10 digits + 1 (B1) & + 2 (B2)
	(note: there may be different	10 digits + 10 (B1) & + 20 (B2)
	suffixes for the B1 channel	10 digits + 100 (B1) & 200
(B2)		
	and the B2 channel)	10 digits + 1000 (B1) & 2000 (B2)
		10 digits + 01 (B1) & 02 (B2)
		10 digits + 010 (B1) & 020 (B2)
		10 digits + 0100 (B1) & 0200 (B2)
		or 10 digits + 1
SNET	AT&T NI1	01 + 7 digits + 000
	Custom	10 digits + 0101
SW Bell	DMS100	10 digits + 01
	AT&T NI1	10 digits + 000
	Siemens NI1	10 digits + 0100
US WEST	AT&T NI1	01 + 7 digits + 000
		or 7 digits + 1111
		or 10 digits + 1111

SECTION 8. ABOUT ISDN

ISDN stands for Integrated Services Digital Network and is a special type of telephone system. While most telephone lines are capable of carrying only analog audio, ISDN lines actually carry high speed data. Like plain old analog phone lines, ISDN lines are linked between the telephone company and the customer premises via a single pair of wires, called the local loop. The signal carried on the local loop is fundamentally different than plain old telephone service, and ordinary phones, modems, and fax machines will not work on them without special interface equipment.

Once a call is placed on an ISDN line, the call is treated by the telephone company very much the same way a voice call is. Most of the technology of ISDN lies in the link between the phone company and the customer. The single ISDN phone line has the capability of carrying two, independent telephone channels. These are called “B” channels, and an ISDN user may place a call on either or both “B” channels simultaneously. The device used to place and answer calls on an ISDN line is called a terminal adapter.

When used for data, each “B” channel of an ISDN has the capacity of 64,000 bits per second (64 kb/s). The two “B” channels may be dialed to the same location and their capabilities “summed” together for a total throughput of 128 kb/s. Some ISDN networks use a small piece of this data so they allow the user a little less throughput. The user may have 7/8 of the “B” channel, or 56 kb/s. Two “B” channels may then be summed to 112 kb/s.

SECTION 9. ORDERING ISDN IN NORTH AMERICA

The Matrix ISDN Codec includes both NT1 and Terminal Adapter functionality and supports data rates up to 128 kb/s.

If the telephone company handling your ISDN service order uses the Bellcore National ISDN "Capability Package" designations, simply ask for Capability Package M (or Generic Data M.)

For telephone companies requiring the full details, here they are:
You will request an ISDN Basic Rate Interface (BRI) line with:

- U-interface reference point
- 2B1Q line coding

and either

- 2B+D Service (supports up to 128 kb/s)

or

- 1B+D Service (supports up to 64 kb/s)

Note: We suggest that you order 2B+D Service to allow maximum flexibility in using the Matrix since ordering 1B+D Service will restrict the Matrix to 7.5 KHz audio bandwidth.

The Matrix supports the following North American switch types and software protocols:

- AT&T 5ESS - Custom, 5E6 and later software,
- NTI DMS-100 - BCS-32 and later software (Pvc1)
- National ISDN-1 compatible (may be a Siemens switch, AT&T 5ESS NI1 switch, Northern Telecom PVC2, or other.)

Request that the ISDN line allocate one DYNAMIC Terminal Endpoint Identifier (TEI) per phone number.

AT&T 5ESS Custom Switch

With an AT&T 5ESS switch most telephone companies provide the option of Point-to-Point (one telephone number which operates both B-channels and no SPIDs) or Point-to-Multipoint (two telephone numbers and two SPIDs or Service Profile IDentifiers - one for each "B" channel). Either service may be used with the Matrix.

Request the following features:

Feature - Value
B1 Service - On Demand (DMD)
B2 Service (if two B channels are ordered) - On Demand (DMD)
Data Line Class - Point-to-Point or Point-to-Multipoint
Maximum B Channels - 2 if 2B+D, 1 if 1B+D
Circuit Switched Voice Bearer (CSV) Channel Any Number of CSV calls - 1 (for testing)
Circuit Switched Data (CSD) Bearer Channels Any Number of CSD calls - 2 if 2B+D, 1 if 1B+D
Terminal Type - Type A

Turn the following features OFF:

Packet Mode Data
Multiline Hunt Groups
Multiple Call Appearances
Electronic Key Telephone Sets (EKTS)
Shared Dictionary Numbers
Accept Special Type of Number
Intercom Groups
Network Resource Selector (Modem Pools)
Message Waiting
Hunting
InterLata Competition

DMS-100 Northern Telecom Switch

When accessing a DMS100 switch you are required to have two phone numbers and two SPIDs. Therefore all service is Point-to-Multipoint.

Request an ISDN Basic Rate Interface (BRI) with:

Line type - Basic Rate, Functional
Electronic Key Telephone Sets (EKTS) - No
Call Appearance Handling (CACH) - No
Non-initializing Terminal - No
Packet Switched Data Service - No
TEI - Dynamic

Bearer Service - Circuit Switched Voice and Data permitted on any B Channel (Packet mode data not permitted).

Checklist for All Switch Types

After you have placed your order, make sure that the phone company provides you with the following information for programming the Matrix:

ISDN Switch Type
ISDN phone number(s) or LDN
SPIDs with prefixes and suffixes (if your switch type needs SPIDs)

SECTION 10. TECHNICAL DETAILS

ABOUT ALGORITHM STANDARDS

The codec is a system that encodes and decodes audio signals for transport over digital networks. At the transmit end, the information is encoded and it is decoded at the receive end. Simple. Well, not so simple. As with most things in the world, if everyone created their own method of doing things, nothing would work together. Something as simple as the standardization of power plugs means that we don't think twice about buying appliances or electronic components. But we do think twice about what form our videotape is in - VHS or BETA. But at least it is a small field from which to choose. The same thing is happening with the compression algorithms used to encode and decode audio signals.

International standards bodies have formed to create standards. There are a different standards available (like VHS and BETA), and it is up to you to select which one you will implement. It is also up to you to insure that the vendor you select is implementing the standard with no changes - that can mean your equipment will not work with other manufacturers' equipment, and you will be boxed into a corner.

G.722 ALGORITHM

The international standard known as CCITT G.722 specifies the algorithm that codecs use to convert analog to digital signals and vice versa. The Matrix follows this standard very carefully and can communicate with G.722 codecs from other manufacturers.

The Matrix also incorporates a proprietary upgrade of G.722, known as Turbo G.722 which automatically doubles the audio bandwidth to 15 kHz when the codec “sees” a transmission rate of 112 or 128 kb/s. The Matrix will automatically adjust to the transmission speed, and it is therefore not necessary to make any adjustments to the codec to change from standard G.722 to the upgraded version.

THEORY OF G.722 OPERATION

The Matrix performs a digital algorithm in real time on sampled digital input audio. The unit is based on a high speed computer chip, known as a digital signal processor (DSP). The idea behind the codec (and any other DSP-based device) is to perform functions on analog signals which have been divided into samples taken at discrete times. These samples are then “quantized” (assigned a fixed value) and fed as a stream of binary numbers into the DSP.

The basic assumption of the codec is that digitized audio contains more information than is needed to reproduce it in analog form. By eliminating this redundant information, more audio information may be stored or transmitted.

As mentioned before, the input to the DSP portion of the codec is a series of discrete time samples. Each portion of the codec link (transmitter and receiver) contains a computer program which can predict the next

sample based on previous values processed. This function is performed identically in the transmitter and receiver. The difference between the transmitter and receiver is that only the transmitter knows the true value of the next discrete time sample. Since it already possesses an approximation of this value, it can calculate the difference between the two numbers it possesses. This difference is what the transmitter sends to the receiver. The receiver uses this difference to calculate the true value. Since the difference signal contains less than the data sample, data rate is conserved.

In human speech, (and most other audio) much more energy exists in the lower part of the audio spectrum than in higher frequencies. Therefore, the codec reproduces audio more accurately at the lower end than at the higher end. Using digital filters, audio is divided between high and low sub-bands, and each sub-band is sent through the encoder-decoder combination separately. The lower band can then use up the majority of the bits available, leaving only a few for the relatively less complicated high band.

Discrete time sampling and quantization of an analog waveform is known as Pulse Code Modulation (PCM). Since the codec algorithm uses differences between samples, and since the predictors adapt automatically with changing values of previous input samples, we call the algorithm used Adaptive Differential PCM, or ADPCM. When we add the concept of dividing and conquering individual bands, the process becomes Sub-band (SB) ADPCM. SB-ADPCM is defined as a international standard by the CCITT as recommendation G.722. The text of this specification is public information and is a good source for further information on this algorithm.

The transmitting codec forms its outgoing data into 'words,' each consisting of seven or eight characters. The receiving codec is able to decode and decompress data intelligibly because it has identified the beginning and end of each 'word' it receives. This process of identifying and aligning with the correct word order is called synchronization.

SYNCHRONIZATION

The Matrix uses a 'self synchronizing' technique which allows the encoder to use the entire channel for audio data. With no overhead for synchronization data, the decoder can determine the sync position by performing an algorithm on the raw, incoming data. It takes about 1 second for the decoder to 'find sync' and begin decoding data. The READY light on the front panel is an indication that the decoder is 'in sync.'

Every half second, the Matrix rechecks to make sure that it is still in sync. If the network causes an error that makes the data stream line up differently, the codec can determine this and 'resync' within one second. Remember, because the Matrix is fully duplex, it is simultaneously encoding/compressing outgoing information and decoding/decompressing incoming information.

ISO/MPEG Layer III Algorithm

Layer III is a newer standard than G.722, and has some relative strengths and weaknesses. Layer III is optimized for higher performance than G.722, and it provides approximately twice the audio bandwidth for a given data rate.

Layer III is based on the assumption that noise can be added to audio in places where it can be "masked" by other audio signals. This theory is part of several assumptions of audio that make up the field of "psychoacoustics". Psychoacoustics tries to define what the human ear can and can't perceive, in an attempt to provide only what the ear can perceive. So Layer III is considered a "psychoacoustic" algorithm.

The details of Layer III are rather complex, and lots of technical discussion of it is available on the web. Of importance to broadcasters are two points: Delay and Transcoding.

1) Delay- Layer III takes a "window" of digital audio samples that lasts a discrete amount of time (in our case, 36 mS). It then processes this window through several different steps, incurring more delay. The net result is that slightly over 300 ms (a third of a second) elapses between the time that audio is sent into the encoder, and it appears at the output of the decoder. This delay can be alarming to the uninitiated, but it is manageable. One technique is to use G.722 in the direction of the link that isn't quality critical. This makes the round-trip audio delay only slightly higher than the Layer III delay.

Mix-Minus will be critical when using Layer III operation. Anyone listening to their own audio with 300 mS delay will quickly learn this. For more information see "About Mix-Minus" on Page 59.

2) Transcoding- As mentioned before, psychoacoustic algorithms can be thought of as "adding digital noise" to audio below the threshold of human hearing. Especially when aggressive algorithms like Layer III are used, broadcasters should be aware that transcoding artifacts can occur in the airchain. Because Layer III uses so little data rate to provide so much audio, digital noise is often added very close to this hearing threshold. Digital compression devices before or further along the airchain can cause this noise to be revealed more than intended. A modern radio facility may have compression built into its automation system, STL, and (eventually) its transmitter. So thoughtful use of compression is essential and, where possible, it should be avoided altogether.

Comrex has strived to make the Matrix ISDN system compatible to "real" and "industry standards." In Layer III or G.722 (non-ancillary data mode) the Matrix should be compatible with most other industry devices. Compatibility updates will be provided on the Comrex website at http://www.comrex.com as testing is completed.

COMPATIBILITY

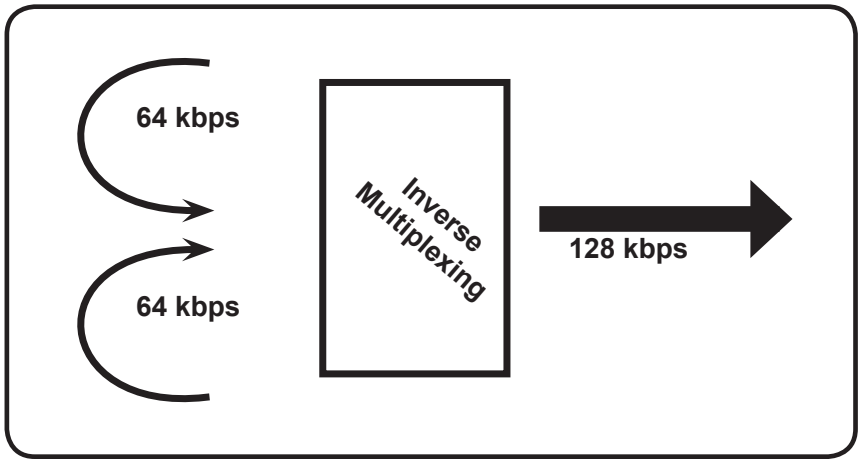
To our knowledge, G.722 ancillary data mode and G.722 Turbo mode are not compatible with non-Comrex devices. Again, check our website for updates on this.

INVERSE MULTIPLEXING

Inverse Multiplexing, or IMUXing for short, sounds complicated but is actually quite simple. It means combining two or more lower data rate channels into one, higher data rate channel. It is an extremely important concept when working on digital phone lines like Switched 56 and ISDN, as digital transmission channels on these services come in chunks of 56 or 64 kb/s. These chunks have very little to do with each other normally. They may be routed differently throughout the telephone network and incur substantially different transmission path delay. Even the two "B" channels of a Basic Rate Interface ISDN installation offer no guarantee that both calls will be routed along the same path. On a North American coast-to-coast link up, for example, the first "B" channel connection may be routed via Texas and the second via Michigan.

The IMUX must be able to measure the time delay between the two digital channels and delay the fastest so that it arrives synchronously with the slowest. This procedure is called "aggregation" and is performed differently with different IMUX protocols.

Since the Matrix doesn't support Layer III at rates higher than 64 kb/s, the IMUX is only utilized for Turbo G.722. The Matrix IMUX uses a protocol called "BONDING" to ensure compatibility with previous Comrex turbo devices. BONDING has the advantage of requiring the user to place only the first ISDN call, while all others are placed automatically.



About Ancillary Data

The Matrix provides an ancillary data channel which allows the user to send low speed data along the same digital telephone channel used for the Matrix audio. The vital information you need to know is that this channel has the following parameters:

1200 Baud; 8 bits; no parity; 1 stop bit (unless changed to 4800 baud for Nexus/Envoy compatibility.)

Now, we will describe a few concepts:

The Matrix ancillary data channel is asynchronous. This is the most common format for information exchange between computers. An asynchronous data link simply provides a "pipe" which passes bits back and forth between the devices. What you do with this data is dependent completely on the computers and software used in the connection.

It is the nature of asynchronous data that we define a *"baud rate."* This is the rate at which individual bits run along the asynchronous link. In some asynchronous systems, however, a continuous stream of data at the specified baud rate will overload the system. This is because the baud rate specifies only the speed on the pipe feeding *into* the system. Further down, the pipe may narrow and less throughput is possible. Asynchronous communication allows *flow control* where the sending device will be triggered by the network when enough capacity is available to send more information. In the Matrix, the "pipe" has the same throughput all the way across, and flow control is not necessary.

Flow control works because asynchronous links do not need to send information at all times. When there are no characters for a computer to send a modem, for example, the asynchronous link is *idle*. When the computer has information to send, it will usually format this information into one or more bytes, attach a start and stop bit, (so the receiving system knows where the byte begins and ends) send it off and again make the line idle. In the most common application for ancillary data, (two terminals with operators sending text characters back and forth) the asynchronous link is active only a small fraction of the time. During a file download, however, the link will most likely be constantly active, with one byte being sent immediately after the next (unless flow control is active).

In G.722 mode the Matrix audio algorithm operates in one of three possible modes. It formats its audio data into either 8, 7, or 6 bit words. Without ancillary data engaged, the Matrix forms its code words into 8 bit words at 64 and 128 kb/s, and 7 bit words at 56 and 112 kb/s. With ancillary data engaged, the code words are each sliced by one bit, i.e. 7 bits at 64/128, and 6 bits at 56/112, in order to make enough room to imbed the data. This "slicing" is done whether or not the ancillary data channel is active or idle, and the audio quality is reduced very slightly with a smaller code word.

Here is a description of a typical ancillary data hookup:

Each Matrix operator will configure his unit for operation at the desired bit rate, and engage the ancillary data function. The call will be completed. Each operator will attach a PC com port to the ancillary data connector on the Matrix (via a straight-through 9-pin cable) and load a terminal emulation program like Windows™ terminal or Procomm™. Each will set the correct com port in software, and set the communications parameters to 1200 baud, 8 bits, no parity, one stop bit. (Note: If you are interworking your Matrix with a Nexus or Envoy, it is recommended that you change the ancillary baud rate to 4800 as described on page 30. Your software settings will also change to 4800). Flow control should be turned off.

In most ways, the link will resemble a normal modem connection. When a key is typed on one terminal, the ASCII byte corresponding to that character will be sent out the computer com port to the Matrix. The Matrix will embed this character into the data it is sending, and the Matrix on the far end will extract this character from the incoming data. It will then send the character to the other computer com port, and it will appear on the other display. Of course, since the channel is full duplex, this exchange may be happening in both directions simultaneously.

A few common options in terminal programs will ease communication:

a) Local echo — Engage this if you wish to see what you are typing on your own display. The Matrix cannot echo the characters you send back to your display, only send them to the other end. You must configure your communications program to do this.

b) Cr->CR-LF — When you type a carriage return (enter key), the CR character is all that is usually sent through the Matrix data link. Your program will likely interpret this correctly and send the cursor back to the beginning of the same line. Your program can probably be set to interpret the CR character as both a CR and LF (line feed) sending the cursor to the beginning of the next line. Your program can also usually be altered to send both characters when the “enter” key is pressed. Usually only one of the above options is required.

c) Other options — The software setup of your communications program may require additional parameters. Keep in mind that the Matrix data channel is simply a “pipe.” What bytes are sent and how they are interpreted is completely dependent on the software being used and how that software is configured.

The loopback testing facility in the Matrix can aid in troubleshooting ancillary data connections. It is often difficult to find a fault in a problem like this, since the trouble could be at either end of the link. By loopback testing the ancillary data channel on each end, at least you can easily find which end has the trouble.

Troubleshooting the Ancillary Data Channel

To loopback test ancillary data:

1) Connect a computer serial port to the Matrix "Multi-purpose Port."

2) Run a program on the computer with basic serial communications functions, like Procomm, Windows Terminal, or Win95 Hyperterminal.

3) Set the communications parameters as follows:

1200 baud
8 bits
no parity
1 stop bit
echo off (half-duplex mode in Hyperterminal)

4) Make sure the software has the serial port chosen which is connected to the Matrix.

5) If not already done, configure the Matrix for ancillary data mode (see page 30 for instructions).

6) Type some characters on your computer, and verify that you do NOT see them on your screen.

7) Go into the test menu on Matrix, and select TA loopback. The "ready" light should come on.

8) Type on your computer keyboard. You should see your characters echoed back to you on the screen.

If this test is successful, you have sent data down the cable to the Matrix, into the encoder, looped through to the decoder, and back to your computer screen.

If not successful, try the following:

1) Type "AT" (Enter). If you get a response "OK" then you are probably talking to a modem inside your computer, configured for the chosen comm setting. Try a different configuration.

2) Try a different comm port. Sometimes these ports "burn out" if connected wrong previously.

3) Remove any adapters, "dongles" or other connectors on the port.

4) Make sure you are using a "straight through" 9-pin to 9-pin cable. Do not use a null modem cable.

Matrix ISDN Module Specifications

Connections

ISDN Interface: 8-pin RJ45 Modular Jack (1)
External DCE Port: DB-9 male connector (1)
Matrix to ISDN Module Interface: 25-pin "D" type connector (1)

Levels

Ancillary Data: RS232
EXT DCE In/Out: RS422

Audio Bandwidth

G.722 - 56, 64 kb/s: 20 Hz - 7.5 kHz
Turbo G.722 - 112, 128 kb/s: 20 Hz - 15 kHz
ISO/MPEG Layer III - 56, 64 kb/s: 20 Hz - 15 kHz

Power

Powered through Matrix.

Size

4.25" W x 6.5" D x 1.5" H

Weight

Net: .68 lbs; Shipping: 2 lbs

Coding Delay

G.722/Turbo G.722 - 6 mS
ISO/MPEG Layer III - 310 mS

INTERFACE CABLES FOR MATRIX EXT DCE PORT

To EIA530

DB9F	Function	DB25M
1	RCLKB	9
2	RDA	3
3	TDB	14
4, shield	GND	7, shield
5	DTRA	20
6	RCLKA	17
7	RDB	16
8	TDA	2
9	DTRB	23

To V.35

DB9F	Function	V.35 (34-pin Winchester-style M)
1	RCLKB	X
2	RDA	R
3	TDB	S
4, shield	GND	B,A, shield
5	DTR	H
6	RCLKA	V
7	RDB	T
8	TDA	P
9	DTRB	n/c

To X.21

DB9F	Function	DB15M
1	RCLKB	13
2	RDA	4
3	TDB	9
4, shield	GND	8, shield
5	DTRA	3
6	RCLKA	6
7	RDB	11
8	TDA	2
9	DTRB	10

APPENDIX A CHANGING THE ISDN MODULE BETWEEN "U" AND "S/T" INTERFACE

PORTABLE

To change the ISDN Module configuration, perform the following steps:

A. Remove the ISDN Module from the Matrix. Be certain to disconnect the Matrix from power before doing this.

B. Remove the four Phillips screws that hold the module together.

C. Lift off the bottom cover of the ISDN module.

Note that inside the ISDN module are two PC boards “sandwiched” together. It will be necessary to separate the boards to make the change.

D. Remove the 3 #4 screws holding on the top board, as shown in Figure 5 on page 56.

E. Carefully remove the top board from the bottom by pulling the board off its multi-pin connector. Note that an RJ-45 cable remains connected between the boards.

F. On the bottom board, move the RJ-45 connector to the desired interface, J6 for S and J9 for U interface.

G. Find the J7 header as shown in Figure 5. Move the two jumpers to the “U” locations for “U” interface operation, or to the “S/T” location for “S” interface operation.

H. Carefully reattach the boards via the multi-pin connector. Be extra sure that all pins fit into the mating socket, and that no pins are “hang off” one side. You may need to fold the interconnecting cable between the board to make it fit.

I. Replace the 3 #4 screws that hold the boards together.

J. Reattach the module bottom cover using the four Phillips screws.

Before installing the Rack ISDN module, you must be sure that the

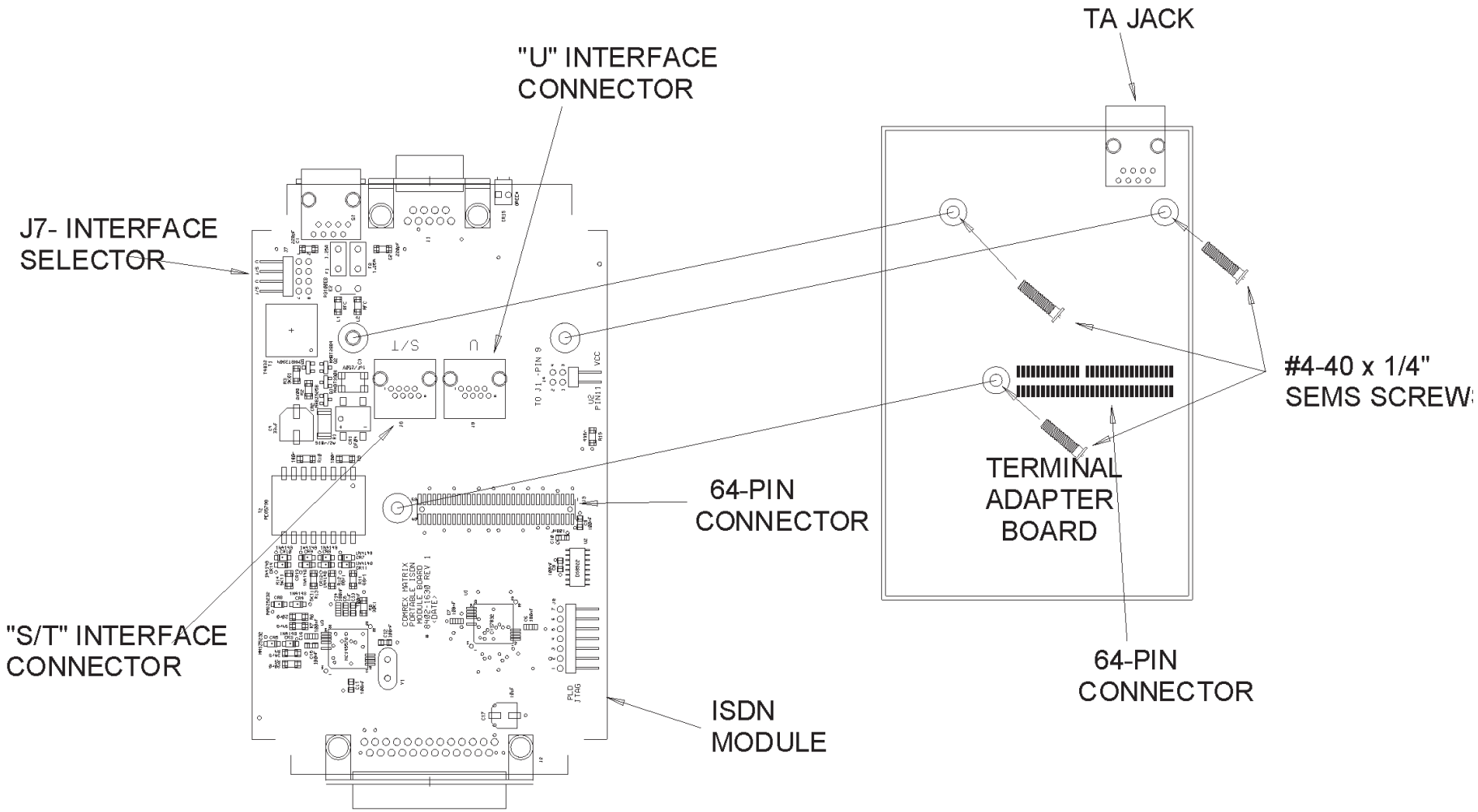


FIGURE 5 - CHANGING THE PORTABLE ISDN MODULE BETWEEN "U" AND "S/T" INTERFACE

RACKMOUNT

Matrix is REMOVED FROM AC POWER. The inside of the Rack Matrix contains voltages that can cause injury or death so be certain no power is applied during this procedure.

A. Remove power from the Matrix.

B. You will need to remove the top cover of the Matrix in order to perform this procedure. Start by removing the four screws that hold on the rack ears (along the front panel) using a large Phillips type screwdriver. Next remove the four pan-head screws along the sides toward the back. Finally remove the 11 small Phillips screws along the front and back edge of the top cover. The top cover should now lift off.

C. Locate the ISDN module inside the chassis as shown in Figure 6 on page 58.

Note that the ISDN module is made up of two PC boards "sandwiched" together. It will be necessary to separate these boards to perform this change.

D. Remove the 3 #4 screws holding on the top board, as shown in Figure 6 on page 58.

E. Carefully remove the top board from the bottom by pulling the board off its multi-pin connector. Note that an RJ-45 cable remains connected between the boards.

F. On the bottom board, move the RJ-45 connector to the desired interface, J6 for "S" and J9 for "U" interface.

G. Find the J7 header as shown in Figure 6 on page 58. Move the two jumpers to the "U" locations for "U" interface operation, or to the "S/T" location for "S" interface operation.

H. Carefully reattach the boards via the multi-pin connector. Be extra sure that all pins fit into the mating socket, and that no pins are "hanging off" one side.

I. Replace the 3 #4 screws that hold the boards together.

J. Reattach the top cover before reapplying power.

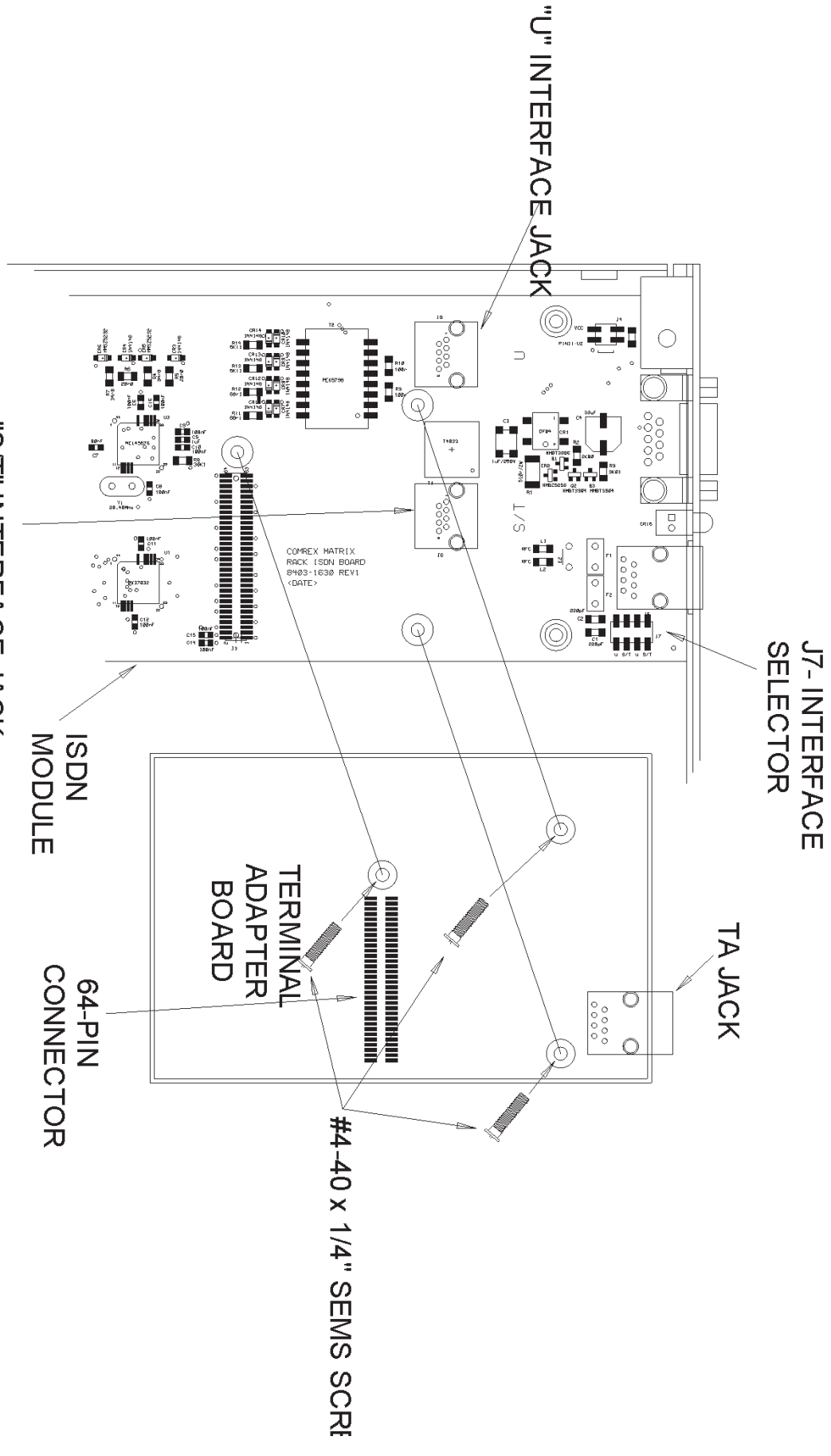


FIGURE 6 - CHANGING THE RACKMOUNT ISDN MODULE BETWEEN "U" AND "S/T" INTERFACE

APPENDIX B ABOUT MIX MINUS

Even the simplest remotes are a two-way process. The remote site must send its audio to the studio and receive a return feed to monitor the programming. This return feed may be done over a radio station's regular transmitter (with an AM or FM radio at the remote), over a special radio link, or over a telephone circuit. This feed may just go to headphones at the remote and it may also be put on speakers for the local audience.

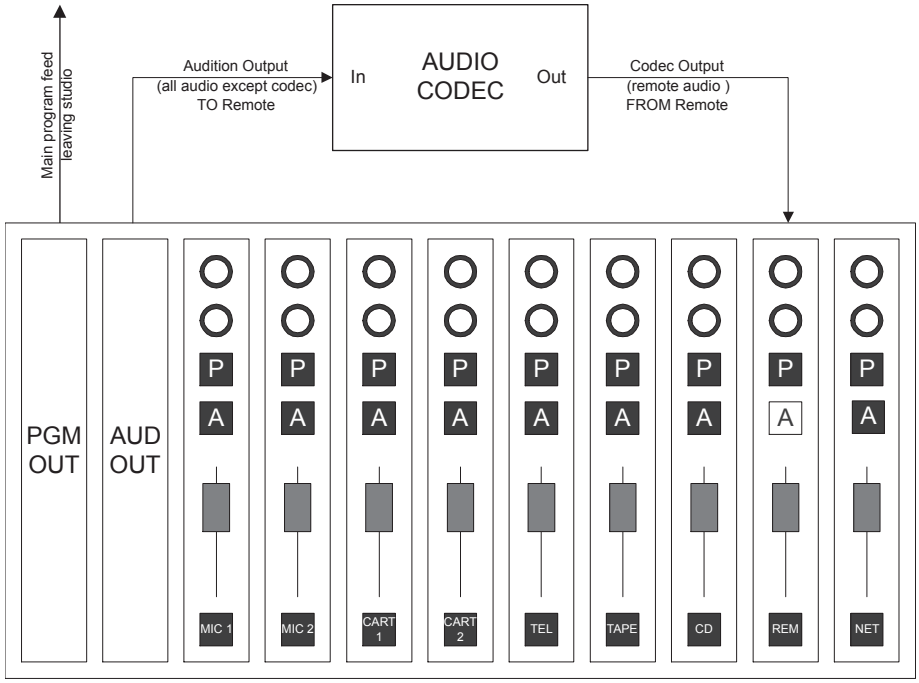
The problem comes when there is a time delay in getting audio to and/or from the studio. In this case, the remote "talent" hears a delayed version of *their* voice in the headphones and may find this very distracting. Even a remote done with simple equipment or a frequency extender on plain phone lines may have this problem on a long-distance call. All remotes using ISDN, Switched-56, and POTS codecs will have delays each way as signals are processed from analog to digital, compressed, uncompressed, and converted back to analog audio. Some digital compression schemes, such as G.722, result in shorter delay times, but there will still be a "reverb" effect in headphones at the remote site if their audio is sent back from the studio. In any of these cases, it may not be possible for the remote people to listen to an off-air or program channel feed.

The solution is **mix-minus**. A mix-minus feed has a mix of all of the programming on the radio station (or network) **minus** the audio from the remote. In other words, the station or network doesn't send the remote audio back to the remote. At the remote end, this mix-minus feed is converted back to an "air monitor" by mixing in the local audio from the remote. This is easily done on the Matrix, with the *OUTPUT MIX* ratio control.

For radio stations, in addition to fixing the time delay problem, using a mix-minus feed has two other advantages. First, if the station uses a 6-7 second delay to allow editing of phone calls, pre-delay audio can be sent to the remote site. Second, if there is a PA system at the remote, they will be able to run the speaker levels higher with the mix-minus audio. This is because the remote microphone audio is not running through the station's audio processing, and the levels stay under the control of the remote operator.

The simplest way to do one mix-minus feed in a typical radio studio is to use the Audition or second program channel. On many audio consoles, each fader's output may be sent to both Program and Audition. If your board will allow those feeds simultaneously, just set all of the modules to Program and Audition, **with the exception of the one carrying the remote audio. Set that one to Program only.** The Audition channel will then be a mix of everything on the console except the remote. That will be your mix-minus, and it should be sent to the remote site. One caution — make sure that audio is being sent to and from any telephone modules

you may have in the console. They may have been designed to work with only one channel at a time — either Program or Audition, but not both. If so, you will have to check with your "tech guy" or the board manufacturer for advice. If you use multiple audio codecs, you should investigate the Comrex Mix-Minus Bridge. This will allow you to expand one Program/ Audition setup to handle five codecs or other remote audio devices. It also provides IFB (talkback) to remote sites.



If you are using a portable Matrix at the studio, check the *Output Mix* knob. If it is turned counterclockwise, audio from the studio board will be sent back to the board, and funny effects will result.

"I'm Using Mix Minus and I Still Hear an Echo!"

If you are doing a call-in talk show on the road, the remote people may complain of hearing an echo when a caller is put on the air. With the telephone pot down, everything is OK. The culprit is the telephone hybrid being used to put callers on the air. Some of the remote audio is "leaking" through the hybrid and mixing with the caller audio. Modern digital hybrids do a much better job of preventing this than the older units that had to be manually "tweaked" for each call. If you are using a digital hybrid and having this problem, dig out the manual and redo the hybrid's initial setup.

Some stations do not feed regular audio back to the remote, particularly for sports broadcasts. Instead, they send a continuous feed of the board operator's microphone out to the game. In this case, the board op must remember to wear headphones and keep the studio speakers *off.* His microphone would pick up the remote audio from the speakers, and the crew at the game would hear themselves in delayed form.

APPENDIX C FCC REQUIREMENTS

This equipment complies with Part 68 of the FCC Rules. On the bottom of the Comrex Matrix ISDN Module is a label that contains, among other information, the FCC Registration Number for this equipment. The USOC jack required is an RJ-11C. If requested, this information must be provided to the telephone company.

If the Comrex Matrix ISDN Module caused harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of the service may be required. But if advance notice is not practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your rights to file a complaint with the FCC if you believe it is necessary.

The telephone company may make changes in its facilities, equipment, operation or procedures that could affect the operations of the equipment. If this happens, the telephone company will provide advance notice in order for you to make the necessary modifications in order to maintain uninterrupted service.

If trouble is experienced with the Comrex Matrix ISDN Module, please contact Comrex Corporation at the address below for repair and warranty information. If the trouble is causing harm to the telephone network, the telephone company may request that you remove the equipment from the network until the problem is resolved.

Comrex Corporation
19 Pine Road
Devens, MA 01434
978-784-1776

When the Comrex Matrix ISDN Module is configured for North American operation on ISDN lines providing a “U” interface, only one such device can be connected to a each line. It cannot be used on conventional analog telephone lines of any kind, including public coin service or party lines. It also cannot be used to place calls to analog telephone equipment, including public emergency numbers.