HotLine POTS Codec

Section

Section

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. The toll free number from the United Kingdom is 0-800-96-2093. Product information along with Engineering Notes and User Reports are available through our Fax-on-Demand system. Simply dial 978-264-9973 from any TouchTone phone and follow the instructions.

This information can also be found 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, 65 Nonset Path, Acton, MA 01720 USA. For return authorization, contact Comrex at 800-237-1776 or 978 263-1800 or fax 978 635-0401.

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

What is the HotLine?

The Comrex HotLine is a Digital Audio Coding device designed for use on analog, dial-up telephone lines. The HotLine integrates a high speed modem and a low bit rate audio coding algorithm, providing wideband audio in full duplex across the digital channel provided by the modems. Generically, this equipment may be referred to as a POTS codec: A digital encoder/decoder that works on **P**lain **O**ld **T**elephone **S**ervice.

What does it do?

Depending on the connect rate, the HotLine will provide up to 10 kHz audio bandwidth. This wide bandwidth is provided in each direction simultaneously, with no "crosstalk" between the incoming and outgoing channels. The modems in the HotLine will negotiate the highest possible connect rate achievable for a particular telephone connection. The HotLine provides high quality audio at connect rates as low as 12 kB/s, allowing it to operate on fairly poor telephone connections.

Audio Facilities

The HotLine's main audio input is through a standard 3-pin XLR connector and is switchable between microphone and line levels, A second tape input is provided on an 1/8" 2-conductor mini jack for a fixed -10 dBu level. Two outputs are available: a professional, balanced line level on a
3-pin XLR connector and a direct 1/4" 3-conductor headphone jack. To further eliminate the need for external mixers at a remote site, the audio output is a user adjustable mix of return audio and local program.

Additional Features

In addition to its audio functions, the HotLine provides several features which make it versatile and easy to use. The system provides two indications and contact closures, one indicating correct connection, and the other which can be triggered by the user during program transmission. These can be used to engage automation systems or other remote control functions.

The HotLine offers the ability to store four Quick Dial numbers of up to 35 digits in length (including a "," for inserting a pause in the dialing string.) These numbers are stored in nonvolatile memory and can be dialed via a single keystroke. Pressing *Q-DIAL 0* will automatically redial the last number dialed. Also, the HotLine allows the user to dial from its internal memory, its keypad, or from an externally connected telephone. It can be configured to answer an incoming call automatically, or to require a manual answer.All setup information is saved when the power is turned off. The modem can be factory configured to comply with many international telephone systems.

What the HotLine W ill Not Do

1.) The HotLine will not work on cellular telephones.

2.) It will not allow connections to lines without a HotLine.
In other words, you need two HotLines – one at each end of the circuit.

3.) It will not provide connections to ISDN codecs.

4.) The HotLine is not compatible with other brands of POTS codecs. It is compatible with the Comrex Vector POTS Codec

About the HotLine Algorithm

To our knowledge, two approaches are common. The first, a high bandwidth derivative of Code Excited Linear Prediction, uses the same technology as digital cellular and satellite phones. In this process, the voice audio is actually synthesized by the decoder, based on information about the audio sent from the encoder. This process allows very high data reduction, but is based solely on voice models for audio reproduction. This means that non-voice audio (such as music, street roar, sports sounds, etc.) may tend to sound a little strange.

The other common approach is to build on the success of coding methods used for higher bandwidth applications, such as ISDN and audio archiving. These algorithms, like the ones in the MPEG family, are based on modeling which shows what the human ear can perceive and what it cannot. The usual approach is to modify an existing MPEG algorithm with a lower sampling rate and some psychoacoustic model manipulation. The disadvantages here are that the manipulation often proves lacking in audio quality, and that very high delays in audio coding are experienced (1/2 second or more!)

The approach taken in the Hotline is similar to the second approach above, with the exception that our algorithm was built “from the ground up” to maximize quality at these lower data rates. Also, it has the benefit of a very short frame length, resulting in a delay which is a fraction of other approaches. Since it is not based on voice models, it will not sound especially strange on music (although any coder has a harder time with music than voice.)

Rate negotiation and error correction

Because a POTS codec performance depends on the quality of the actual telephone circuit that is dialed, Comrex has provided several features to help ensure that a solid modem connection is made, with a minimum of errors. First, if errors are detected on a call, the HotLine can be made to renegotiate to the next lowest connection data rate while a call is in progress. This will allow a "guard band" by connecting the modem at less than its optimum rate, thereby enhancing reliability. The user also has the ability to set a maximum connect rate for the modems before a call is placed. This is a useful feature for regularly placed calls. Finally, the user can enable "forward error correction" in the HotLine encoder, which is useful in eliminating the short, occasional errors that can be found, particularly on long distance circuits.

Upgrades

A substantial portion of the functions and features of the HotLine are software driven which will allow upgrades to these units by a simple exchange of EPROMs. We will keep our customers apprised of software updates and make these available at no charge.

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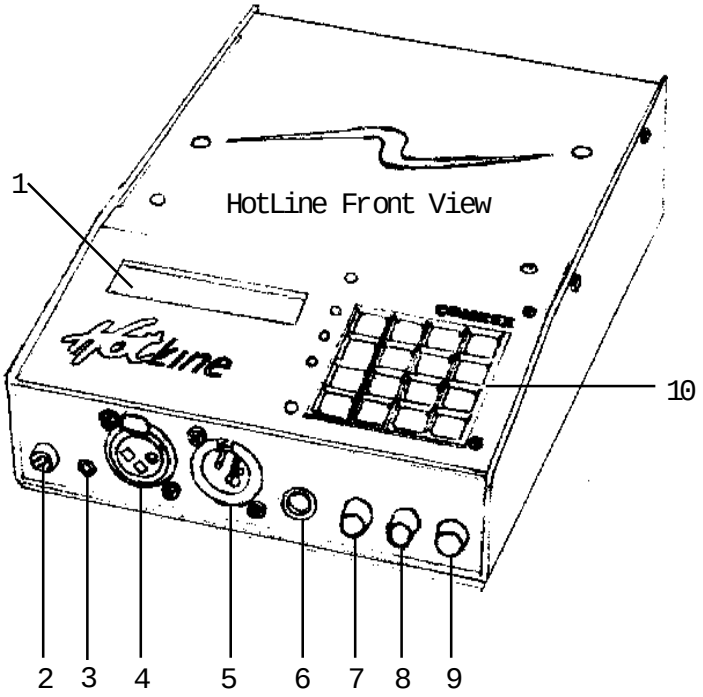
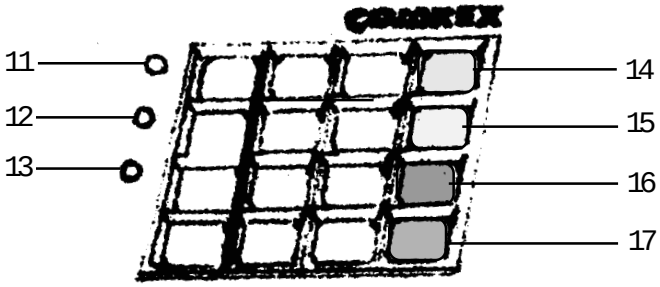
SECTION 2. HOTLINE CONTROLS

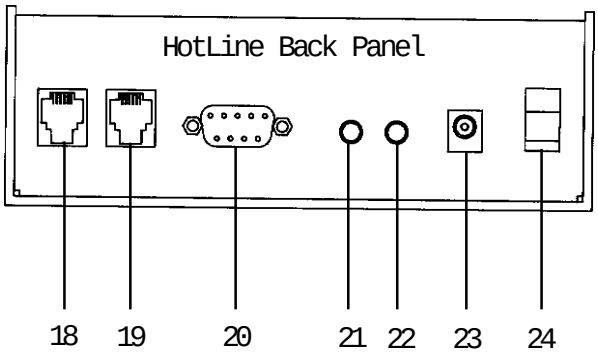
1. **LCD Display** – shows status information and menu choices.
2. **MIC/LINE Switch** – selects microphone or line input level.
3. **Tape In** – 1/8" mini jack tape input.
4. **Mic/Line In** – 3-pin female XLR balanced input.
5. **Line Out** – 3-pin male XLR balanced output.
6. **Headphone** – 1/4" phone jack tip/ring/sleeve
7. **Local** – Level adjust for local program audio output.
8. **Return** – Level adjust for codec return audio output.
8. **Input** – Level adjust for audio input. (XLR only)
10. **Keypad** – for dialing and function selections.
11. **Peak LED** – internal limiter is activating on peak audio. Should flash occasionally on program audio at the correct input level.
12. **Ready LED** – signals that decoder has locked on an incoming HotLine digital audio stream.
13. **Carrier Detect and Ring Indicate LED** – flashes when "ring" is detected on incoming call and goes steady when modems have achieved handshake.
14. **ENTER** function key – to advance into menu and accept dialing numbers. When call is connected, used to intiate momentary contact closure at far end.
15. **CANCEL** function key – to back up through menu and as a backspace when entering dialing numbers.
16. **Q-DIAL** function key – to dial pre-programmed numbers; to redial last number; also to force the modem to reset at a lower connect rate while on line.
17. **HANG UP** function key – to disconnect a call.
18. **Tel Line** – 6-pin RJ11C modular jack for connecting phone line.
19. **Tel Set** – 6-pin RJ11C modular jack for connecting external telephone set (optional.)
20. **Diagnostic Port** – 9-pin "D" connector

    (Used for factory testing.)
21. **"Ready"** – 1/8" mini jack providing dry contact closure when modem ready light illuminates.
22. **"Enter"** – 1/8" mini jack provides dry contact closure when *ENTER* key is pressed at far end.
23. **Power Input** – 2.1 mm i.d. / 5.5 mm o.d. barrel type connector for power module.
24. **Power On/Off** – Rocker switch for a/c power.

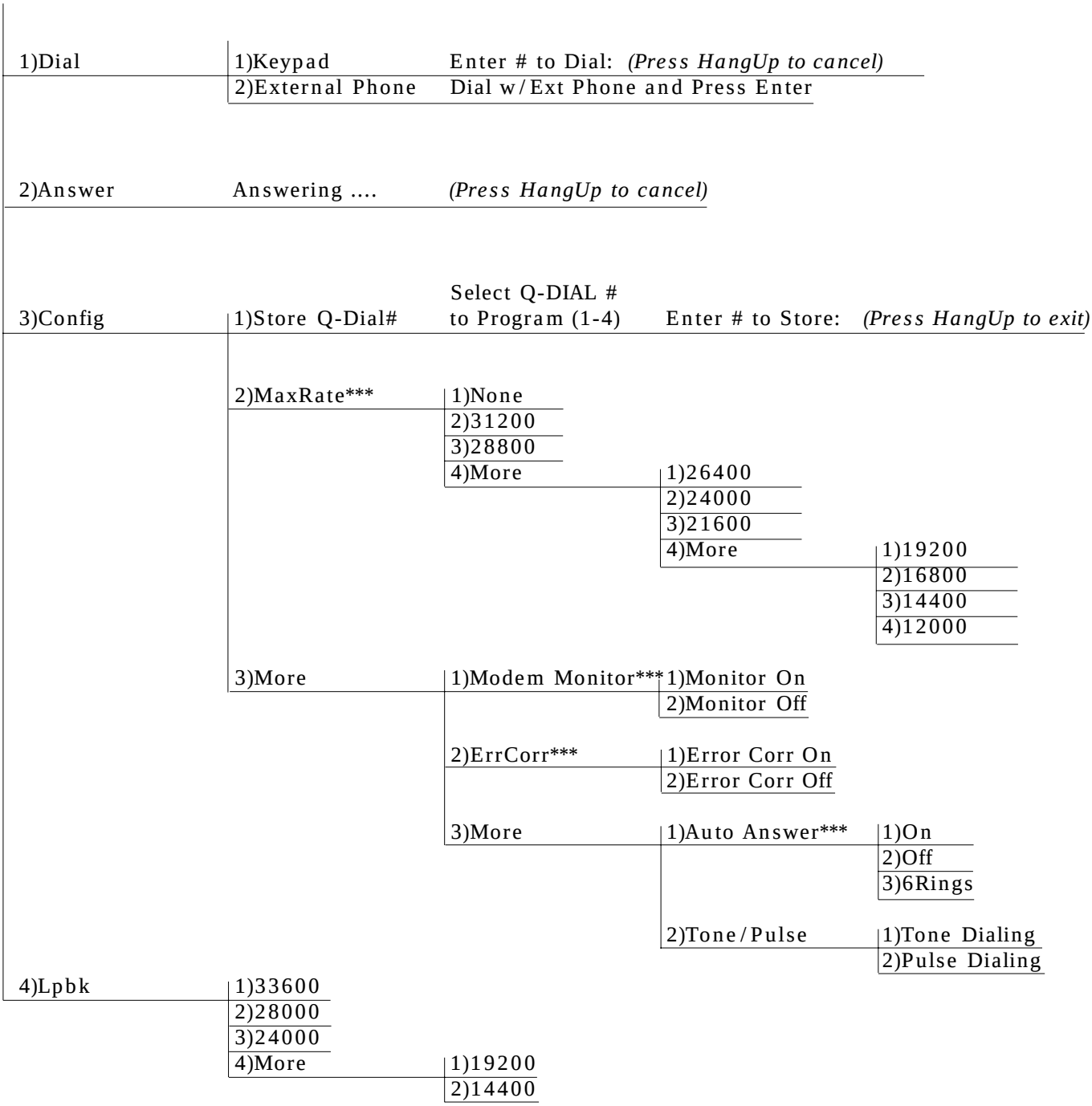




Keypad Enlargement



SECTION 3. HOTLINE MENU SELECTION TREE



***** These selections are displayed in the Main Status display.**

For example, the following display indicates that Auto Answer is enabled on the 6th ring; the Modem Monitor is on; Error Correction is enabled; and the modem is set for a maximum connect rate of 24 kB/s.

AA6 MM EC Max240 Enter for Menu

SECTION 4. PRELIMINARY CONFIGURATION

What Comes with the HotLine?

The following items are shipped with a new HotLine:

(1) Comrex HotLine POTS codec
(1) A/C power module with A/C cord
(1) RJ11C modular telephone cord
(1) Adhesive-mount strain relief
(1) Operating manual
(1) Warranty Card (Please fill out and return)

Power-up Sequence

First, unpack the HotLine and verify that you have all the items listed above. If you wish to use the enclosed strain relief for the power module, we suggest that you do this by removing the adhesive backing and mounting it on the back lower corner of the left side panel. You will now need to connect the HotLine power supply to an A/C source*. Set the power switch on the rear panel to the *Power On* position. During power up, you will see the following three LCD screens in fairly rapid succession.

** For HotLines with s/n less than 220, connect to 110VAC/60Hz only. HotLine with s/n 220 and above have power supplies that will work at any voltage in the range of 110-240VAC/50-60Hz.*

Self Test Please Wait

No. Amer. Version Please Wait

or another country, depending on configuration.

Comrex HotLine Enter for Menu

Then the Main Status Display will appear and the top line of the LCD screen will display a series of options which have been selected for HotLine operation:

A A means that the auto answer function is enabled.
M M means that the modem monitor is enabled.
EC means that error correction has been enabled on the HotLine encoder.
Max xxx (where xxx is a number) means that the HotLine has been configured to connect at no rate higher than the stated number.

If any of the above indications do not appear, it means that a particular function is disabled. A typical main status display may appear as follows:

```
AA MM
  Enterfor Menu
```

Main status display

As shipped from the factory, the HotLine is set up in the following configuration: Modem Monitor ON; Auto Answer ON; Tone Dialing; Error Correction OFF; Max Rate NONE. Procedures for changing or resetting these parameters are detailed below.

Modem Monitor

To enable the modem monitor, Press the *ENTER* key to access the main menu. Press ***3*** on the keypad to access the configuration menu. Press ***3*** again on the keypad for more configuration options. Then press ***1*** for the Modem Monitor. Now you will select whether you prefer to hear the modem dial and negotiate when a connection is made. If you turn the modem monitor on, all the "modem chat" (dial tone, touch tones and pulses, ringing and modem negotiation tones) will be heard through the same audio output you will use to monitor your wideband audio. This can be valuable to those who are concerned about whether a call will be completed correctly. If you turn modem monitor off, the first sounds you hear through the output will be the wideband audio, and the modems will dial and negotiate silently. There is no internal speaker to monitor dialing in the HotLine.

```
AA MM
  Enterfor Menu
```

Main status display

```
1)Dial  2)Answer
3)Config  4)Lpbk
```

Main menu

```
1)Store Q-DIAL #
2) MaxRate 3) More
```

1st configuration menu

```
 1) Modem Monitor
2)ErrCorr  3)More
```

```
1) Monitor On
2) Monitor Off
```

Auto-Answer

To choose how you want the HotLine to answer incoming calls, press *ENTER* from the Main status display, press ***3*** for config and then **3** for more options and **3** for yet more options. Then press ***1*** to select how you would like the HotLine to answer calls. You will notice the following choices available: **1) on, 2) off, and 3) 6 rings.** Simply select whether you wish for the HotLine to answer a call automatically, on the first ring ***1***, on the sixth ring ***3***, or not at all ***2***.

AA MM **Enter**for Menu	***Main status display***
1)Dial 2)Answer **3)Config** 4)Lpbk	***Main menu***
1) Store Q-DIAL # 2) MaxRate **3)More**	***1st configuration menu***
1) Modem Monitor 2)ErrCorr **3)More**	***2nd configuration menu***
1) Auto Answer 2) Tone/Pulse	Auto Ans 1) On 2) Off 3) 6 Rings

Tone/Pulse Dialing

The HotLine may be set up for either Tone Dialing or Pulse Dialing. Follow the above menu selection sequence to choose the Tone/Pulse option and then select either Tone Dialing ***1*** or Pulse Dialing ***2***, depending on the requirements of your telephone line.
(The HotLine is factory configured for Tone Dialing operation.)

1) Auto Answer **2) Tone/Pulse**	1) Tone Dialing 2) Pulse Dialing

Press *CANCEL* four times, until you return to the Main Status Menu. You have now completed the preliminary setup and are ready to make your connections to the HotLine.

SECTION 3. BASIC OPERATING INSTRUCTIONS

Audio Input

You have a choice here as to whether the audio input to the HotLine will be a mic or line level. If you are feeding directly from a microphone or a mixer which states it has a microphone level output, set the audio input switch to "mic" setting. Most other sources will require this switch be set to "line." Connect your audio source to the audio input XLR connector, referencing the pinouts found on page 31.

Now you will feed in audio at a typical level and adjust the front panel control labeled "input" until the HotLine indicator labeled "peak" flashes occasionally on program peaks. This means that the internal limiter is activating on your highest level audio peaks and will protect your audio from clipping should the level rise suddenly. If you can't get the light to flash at all, check your connections and that you are feeding a line level signal (if you have the mic/line switch set to line.) If your audio input level control is nearly at minimum, you may need to try the "line" setting or cut the input level to the HotLine.

Audio Output

Connect your audio output to the HotLine, using either the XLR connector (again, referencing the pinout description on page 31) or a stereo headphone, or both. While feeding your typical audio level to the input, adjust the "local" control until a comfortable level is achieved. This will also serve to make certain that your audio connections and levels are correct. Any noise or distortion that is present during an audio check at this point is most likely due to a source external to the HotLine and should be rectified before your broadcast.

If you do not wish to add local audio to the HotLine output during actual use, simply turn the "local" control all the way down. We will set the "return audio" level when a connection has been established.

Telephone Line Connection

The HotLine connects to your telephone line just like any modem or fax machine, via an RJ-11 connector. The HotLine works best when connected directly to a telephone company line, rather than behind an in-house phone system. If you must connect behind your in-house system, be aware that if it does work, you may experience a degradation in connect rate, and likewise in audio bandwidth. You may also find that you need to dial from an external telephone, since the dial tones and signalling are often different on in-house phone systems.

Connect the telephone line to the jack on the rear panel labeled "telephone line." If you desire, connect a telephone set to the jack labeled "telephone set" on the rear panel. This will facilitate an audio ringing signal, as well as allow dialing and communications should your in-house system confuse the built-in dialer.

Placing a Call

There are a number of other functions and features to learn about the HotLine which are discussed later in this manual. You are now ready, however, to place a call. If you have only one HotLine, contact us at Comrex, (978) 263-1800, and we will provide you with a test number.

Since this is the quick-setup section, we will assume you are dialing manually, using the built-in dialer. Press the "enter" key to access the main menu. Press ***1*** to dial. Then press ***1*** to dial from the built-in keypad.

AA MM **Enter** for Menu	***Main status display***
1)Dial 2)Answer 3)Config 4)Lpbk	***Main menu***
1) Keypad 2) External Phone	**Enter # to Dial** _

Key in the phone number you wish to dial. If you make a mistake, press the *CANCEL* key to backspace. If you want to exit from dialing, press the *HANGUP* key to return to the Main Menu. You may enter up to 35 digits in a dialing string. A 2-second pause may be entered anywhere in the dialing sequence by pressing the *Q-DIAL* key. This will insert a comma (",") to indicate the position of the pause. This pause may be needed to dial through certain PABXs or to place credit card calls. Also you may wish to enter other characters, such as "*70", which is typically used at the beginning of a number to disable call waiting.

Note: For complex dialing situations (especially when an operator may be involved) the HotLine may also be dialed from an external phone. *See page 18.*

To dial the call, press the *ENTER* key when you have finished entering the number. Note that the phone line doesn't go "off hook" until the *ENTER* key is pressed (much like a fax machine.) The far end unit will either auto answer, or will need to be answered manually, depending on its configuration. Once the far end has answered, the HotLines will negotiate and a "connect" message will be displayed on both units, including the rate at which the connection was accomplished. Within a second or two, the "ready" light on each HotLine should turn on. At this point, you will have wideband audio (response dependent on connect rate) in both directions.

You can now adjust the "return" audio to an appropriate level. Ask the remote end to send typical program audio at the correct level and adjust the return output to suit.

Contact Closures

The contact closure labeled "ready," available through the 1/8" mini jack on the rear panel of the HotLine will be closed for the duration of the call.

If you wish to provide an indication to the other HotLine user at any time during the audio transfer or activate a device remotely through the far end HotLine, simply press the *ENTER* key. While this key is pressed, two things will occur:

1) An asterisk (*) will appear on the top line of the display on the remote end.
2) A contact closure will be made across the "Enter" terminal on the remote end (silently.) This is a momentary "dry closure" available through the 1/8" mini jack on the rear panel of the HotLine, marked "enter."

This will have no effect on audio quality.

Disconnecting a Call

When you wish to disconnect your call, simply press the *HANGUP* key. After several seconds, the call will be cleared and your main status display will return. If the other end disconnects, your unit will disconnect and revert to the main status display as well. Note that it takes about 5 seconds between the time you terminate the call and the time the HotLine releases the line for the next call. Also, after the *HANGUP* key is pressed, the far end HotLine will briefly show *Renegotiating* on its LCD screen before hanging up the call. This will not inhibit the HotLine from terminating the call as requested, nor will it delay the disconnect process.

SECTION 6. MORE SETUP AND OPERATION

Last Number Redial

Redialing the last number is easy – simply press the *Q-DIAL* key from the Main status display and press 0 on the keypad. The last number you dialed from the HotLine will be dialed again. This number will not remain in memory after the HotLine is powered down.

AA MM **Enter**for Menu	***Main status display -*** ***Press the Q-DIAL key at this display***
Q-DIAL # (1-4) or ('0') for redial	

Program Q-DIAL

Using the four stored Q-DIAL options require that you first program them into memory. Q-DIAL numbers will remain in memory even when the power is turned off

Press the *ENTER* key from the Main status display and press ***3*** for config. Select ***1*** to store a Q-DIAL # and then enter the Q-DIAL position (1-4) that you wish to program

AA MM **Enter**for Menu	***Main status display***
1)Dial 2)Answer **3)Config** 4)Lpbk	***Main menu***
1) Store Q-DIAL # 2) MaxRate 3) More	***1st configuration menu***

Select Q-DIAL # to Program **(1-4)**	**Enter # to Store** **_**

Key in the number you wish to save, along with any country, area, or other codes you wish (up to 35 digits.) To insert a 2 second pause (shown on the LCD screen as a comma ",") press the *Q-DIAL* key. Use the *CANCEL* key to back over any mistakes. Press the *ENTER* key when the number is correct to store the number. The *HANGUP* key aborts this process and returns you to the first configuration menu

To Place a Q-DIAL Call

From the Main status display, press the *Q-DIAL* key and select the Q-DIAL number (1-4) that you wish to dial.

AA MM **Enter**for Menu	***Press the Q-DIAL function key from this menu.***
Qdial # (1-4) or '0'for Redial	***Select the Q-DIAL # (1-4)***

The number will appear in the display and the HotLine will dial it. Disconnect the calls in the usual way, using the *HANGUP* key.

Modem Reset

This function forces the modem to renegotiate and to reconnect at least one step down from the previous connection rate. For a discussion of the uses of Modem Reset, see page 21. To reset the modem, press the *Q-DIAL* function key while your call is connected. The audio will mute for several seconds during the modem renegotiation phase and the LCD will then show the new transmission rate.

Error Correction

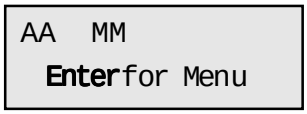
Error correction must be set before a call is placed. It is not possible to enable or disable error correction while a call is in progress. When configured for error correction, the letters EC will appear on the top line of the LCD display in the Main status menu. Once set for EC, the HotLine will remain that way until the setting is changed - even if powered off. For a further discussion of Error Correction, see page 21. To control EC, press *ENTER* from the Main Status Display. Press **3** for Config, press **3** for more, and then **2** to select whether EC is on or off

AA MM **Enter**for Menu	***Main status display***
1)Dial 2)Answer **3)Config** 4)Lpbk	***Main menu***
1) Store Q-DIAL # 2) MaxRate **3) More**	***1st configuration menu***
1) Modem Monitor **2) ErrCorr** 3) More	1) Error Corr On 2) Error Corr Off

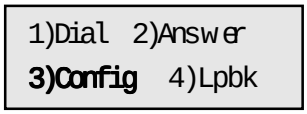
Setting a MaxRate

The MaxRate option allows you to specify the maximum modem negotiation rate, allowing the modems to work at less than the highest possible connection speed. For a further discussion of the uses of Setting a Max Rate, see page 22.

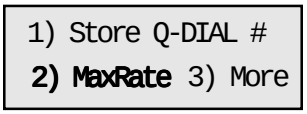
To set a Max Rate, press ENTER from the Main Status Display. Press **3** for Config and then press **2** for MaxRate selection. For no Max Rate setting, press **1** for None. For a specified MaxRate, select the connection rate desired (31,200 kB/s through 12,000 kB/s.) The selected rate will then appear in the Main status display in the upper right corner.



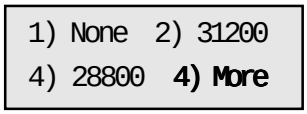
Main status display



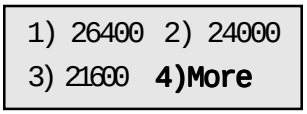
Main menu



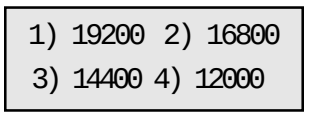
1st configuration menu



1st MaxRate selection menu



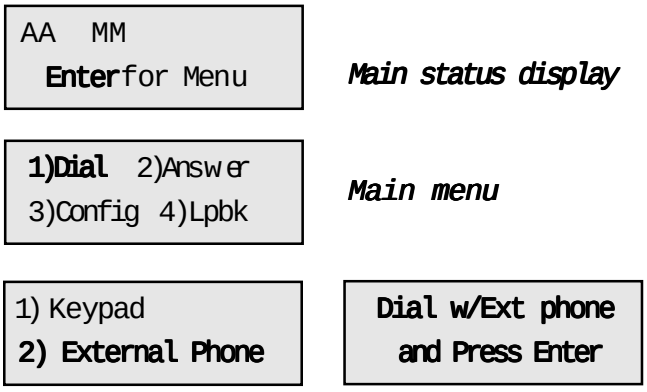
2nd MaxRate selection menu



3rd MaxRate selection menu

Dialing from an External Phone

Make sure your phone line is connected to the *TelLine* jack on the rear panel and a telephone set to the *TelSet* jack. From the Main status menu, press the *ENTER* key on the HotLine. Then press **1** for Dial and **2** for the External Phone option. Pick up your telephone handset and dial the number of the HotLine you wish to call. Immediately after you hear the first ring, press the *ENTER* key and quickly hang up the phone. The modems should negotiate normally. Speed is somewhat of the essence here because the modem negotiation process is most reliably done without an external telephone handset off- hook across the line. Note that when the external telephone option is used, the number you are dialing does not appear on the display.You can disconnect the call normally on either end by pressing the *HANGUP* key.



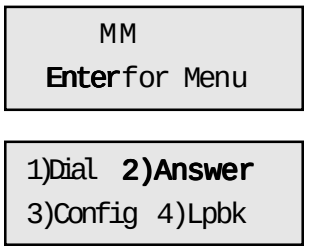
Main status display

Main menu

Answering a Call Manually

First, make sure your auto answer is off by checking that neither *AA* or *AA6* appear in the top left corner of the Main status display. If they do, set Auto Answer to Off by following the procedure on page 11 of this manual.

You can connect a telephone set to the *TelSet* jack on the rear panel to hear the line ring. Otherwise, you will need to wait for the yellow *Carrier Detect & Ring Indicate* light on the HotLine to begin flashing to indicate an incoming call. Then press the *ENTER* key and press **2**. The HotLine will answer the incoming call and negotiate a connect speed. The call can be disconnected normally by pressing the *HANGUP* key on either end.



Main status display

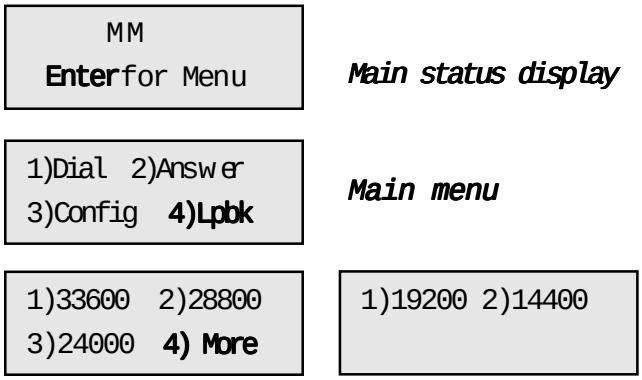
Main menu

Loopback

Loopback allows the user to test the encoder and decoder portion of the HotLine and also gives the ability to listen to audio at various data rates. If you are not familiar with the audio connections on the HotLine, read more about these on page 12 of this manual.

To initiate a loopback, first feed audio into the HotLine at a typical level and adjust the front panel control labeled "input" until the HotLine indicator labeled "peak" flashes occasionally on program peaks. Connect your audio output to the HotLine, using either the XLR connector or a stereo headphone, or both. Turn the "local" level control all the way down.

Enable the loopback function, by pressing *ENTER* from the Main status display and then ***4*** for Lpbk. Select a data rate. (For more data rate choices, press ***4*** for More.) When the "ready" LED comes on, adjust the "return" level control unil you have a comfortable level in your headphone and/or monitor.To exit Loopback, press the *CANCEL* key.



Modem Reboot

In rare occasions, it is possible for the modem registers to become set incorrectly and an error message appears on the LCD screen. If this occurs, turn the power off on the HotLine and then turn it back on. Press the *CANCEL* function key while *Self Test* appears on the LCD screen. (You will have about a two seconds to accomplish this.) "Resetting Modem" appears in the display. This procedure will reset all the modem registers to the factory default state.

SECTION 7. HOW TO ACHIEVE OPTIMUM HOTLINE PERFORMANCE

For those who have used digital telephone technology (like ISDN), good data performance is taken for granted. This is because the information transmitted is kept in digital form from end to end and is therefore somewhat impervious to the nasty effects of telephone carriers. When using analog modems, however (as in the HotLine), data is converted to analog tones which are sent through the telephone channel. These tones are much more likely to be affected by the limitations of the telephone channel.

Moving high speed data along analog telephone lines can best be described as a "balancing act." It requires sophisticated modem technology which senses the quality of each telephone connection and then dynamically adapts all kinds of parameters in short order to "clean up" the connection. These parameters are set and locked during the "negotiation sequence" which takes place shortly after the HotLines are connected together. (This is the hash sound you hear when the modem monitor is enabled.) During this sequence, the modems also measure bandwidth and noise level on the phone connection to determine the highest data rate which may be supported.

This adaptation is usually done quite well, and the modems can usually be trusted to optimize for a reliable data rate and a solid connection. If the adaptation to the phone call is less than perfect, the result will be errors. Errors manifest themselves in the HotLine audio as occasional clicks, dropouts, or frame repeats (almost like a "cd skipping" sound.) Errors are more likely to occur on long distance calls than local ones and are often a problem when connected to in-house phone systems (another reason to bypass them.)

To address this potential problem, the HotLine has several features which allow the user to minimize the number of errors during an audio feed. Each has its advantages and often can be used in conjunction with each other to fix any error problems which might occur. Modem reset, or renegotiation of the connection data rate is the first and most obvious step to take when experiencing errors on a given call. If errors still exist after renegotiation, try adding error correction. If the connection is to be done regularly, a MaxRate setting may be appropriate.

1) Modem Reset

This function allows the HotLine modems to perform a downward renegotiation of the data connection rate while a line remains connected. Audio will be muted during this phase for several seconds and the modems will shake hands again. Renegotiation occurs in two ways:

First, if the line quality becomes exceedingly bad, the modems will sense this and renegotiate automatically. During the retraining sequence, the audio will mute for several seconds until the modems have resynchronized at a lower connection rate.

Second, if you want the HotLines to renegotiate without waiting for them to do it automatically, you can make this happen by pressing the *Q-DIAL* key during a connection. If a retrain is initiated, the HotLines are programmed to "fall back" at least one data rate. Once trained on a lower rate, they will not "fall forward" if the line quality increases.

Also, rarely, on the first manual rate negotiation request, the HotLine will go through the entire initial modem setup sequence, but will not fall back to the next lowest connection rate. If this happens, simply press *Q-DIAL* again and the HotLine will step down correctly.

2) Error Correction

This option instructs the encoder to perform Reed-Soloman Forward Error Correction on the outgoing data. This means that approximately 10% of the available data is set aside to embed information which will allow the decoder to detect and correct some errors.

Error correction has its limitations and is most effective against short, occasional errors (the type that cause an occasional "click" in the audio) and will not be effective if the connection gets dramatically bad. Also, since it steals audio data from the audio encoder, it affects the audio quality.

When error correction is selected on a HotLine, the encoder for that unit begins adding the error correction and the decoder automatically senses and decodes the error correction. It is possible to add error correction in one direction and not the other. In other words, if you are receiving a feed with errors, you must instruct the far end to reconfigure their HotLine to enable error correction in order for you to hear the corrected audio.

3) MaxRate

This option allows the user to tell the HotLine not to connect at any rate higher than the one selected. If the HotLine modem is allowed to negotiate on an unrestricted basis, it will find the highest possible connect rate. It may then begin to transfer audio correctly, but subsequently "break down" due to factors on the telephone lines which vary over time, i.e. crosstalk, burst error sources and other changing parameters. If these errors appear regularly, it will probably help to set a "Max Rate" at a level or two below the maximum unrestricted connect rate. This might best be used in a scenario where a connection is made regularly, say daily, between two points to provide a "guard band" of sorts against the noise and corruption which may cause errors on the line. If two HotLines are configured for MaxRate, the unit with the lowest MaxRate setting will determine the maximum connect rate.

A final note:

Under most circumstances, the options described above should normally not be necessary. The HotLine contains the most sophisticated modem technology available, and will negotiate the highest reliable speed. No modem can, however, predict what will happen to a telephone connection in the future. Modem Reset, Error Correction and Max Rate setting are provided as tools to enhance the reliability of the phone network. Please understand that POTS coding has its inherent limitations and risks, and that the HotLine was designed specifically to minimize these problems. These problems exist in the phone network, however, not in the HotLine.

SECTION 8. SOME OPERATING TIPS

1. Use direct, outside telephone lines for best performance.

2. A line used by a fax machine usually provides this direct access. (Be sure to disconnect the fax machine before connecting the the HotLine!)

3. Do not even think of using cellular phones with the HotLine.

4. Check to see that there are no extensions or modems on the line you are using - or at least arrange that no one uses these during your broadcast.

5. If there is call-waiting on your line, disable it by entering *"*70"* in front of the number you are dialing.

6. If possible, try the HotLine out at the remote site before your actual broadcast, at about the same time of day that you plan to use it. This will give you a good idea of expected connect rates and possible line problems.

7. At minimum, connect a few minutes before airtime to assess the connection quality. If you experience low connection rates or errors, try the following:

Low Connection Rate (or no connect at all):

a. Try redialing. If a good connection is found, keep that line up.
b. Dial from the other end.
c. If the call is long distance, try forcing to another carrier (see page 24.)
d. Verify that you have a direct, outside connection and that there is nothing else connected to that line.

Errors:

a. Renegotiate to a lower connect rate by pressing *Q-DIAL* (see page 16.)
b. For repeated feeds, set the modem to a comfortable Max Rate (see page 17.)
c. Enable error correction at the encoder of the sending HotLine (see page 16.)

Using Long Distance Access Codes

In our field tests with the HotLine, we have seen a wide variety in the quality of connections, particularly in long distance calls. This makes sense, because there is no way of predicting how a call will be routed by the telephone companies involved. We looked for meaningful statistical results from our trials which would show an advantage in using a particular long distance carrier and did not come up with anything concrete. What we did find, however, is that it may help to be able to force a different routing, if your particular connection is not good. To find out which long distance access has been selected for a given line, dial 0-0.

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 (978 263-1800) via AT&T, you would enter 1028819782631800.

AT&T	10288
MCI	10222
Sprint	10333
LDDS/Worldcom	10450
Cable & Wireless	10223
Frontier	10444

Using the HotLine Internationally

(for HotLine s/n 220 and above.)

The HotLine's modem can be user configured for operation in twenty different countries. Once configured, the HotLine will remain in this mode until the country parameter is changed. Country configuration is confirmed during the Power Up Self Test, where the HotLine will display the current configuration (like No. American Ver., etc.) for a second.

Country configurations change dialing parameters, like DTMF level and pulse and ring cadence, as well as call progress tone detection, such as dial and busy tones.

To change country configuration, power the HotLine off. Wait a few seconds, power it back on, and as soon as you see the Self Test display, momentarily press the *Q-DIAL* key. The display will read:

```
Input Cntry Code
_
```

Now you must key in the two digit country code shown to the left. The *CANCEL* key acts as a backspace, and the *HANGUP* key will escape this menu. Press *ENTER* after the code, and the new country mode will be displayed. If you enter an invalid code, no change will take place.

Note the country parameter only needs to be changed when dialing from a country, not to it. Also some experimentation may yield a listed code which works well in countries not listed here. Also, dialing from an external phone is a good method to avoid issues with international phone systems altogether.

01	Austria
02	Belgium
03	Denmark
04	Finland
05	France
06	Germany
07	Ireland
08	Italy
10	Netherlands
11	Norway
12	Portugal
13	Spain
14	Sweden
15	Switzerland
16	U.K.
17	Greece
22	North America
40	Australia
43	Japan
47	Singapore

International A/C Power Cords

For HotLines s/n 220 and above, A/C adapter cords are available which will connect the standard IEC 320 Inlet on the in-line HotLine switching supply to a wide range of international power receptacles. These may be purchased from:

Panel Components Corp.
P.O. Box 115
Oskaloosa, IA 52577-0115

Tel: 800-662-2290 (USA)
515-673-5000 (INT)
Fax: 800-645-5360 (USA)
515-673-5100 (INT)

Computer Modems vs. HotLine Modem

Some users attempt to compare the connect rate message they receive when using their computer modem to that which is produced by the Hotline. Often, they find the Hotline message reports a dramatically lower connect rate than their computer. This is because most computer modems default to reporting the speed between the computer and the modem, rather than the actual speed between the modems. Most computer modems can be programmed to report the actual connect speed using the following procedure

Using Procomm, Windows terminal, or some other communications program, get the attention of your modem:

Type:

AT
The modem will respond
O K
Now Type:
AT W 1
The modem should again respond :
O K
If you want to make your modem always work this way type:
AT & W
And the modem will respond:
O K
Now the modem should report the actual connect speed, which is more likely to compare to Hotline speeds on similar circuits. Note that the initialization strings of some programs (like internet access or on-line service programs) may delete these settings in their initialization strings. You may need to edit the initialization string in your program by removing any reference to Wx in the string, where x is any number. Don't remove it if the W is preceded by a symbol (like & or !).

HotLine Rechargeable Battery Pack

Frezzolini Electronics, Inc. has a rechargeable battery option for the HotLine that will provide approximately two hours running time. It consists of a battery pack, wall charger,regulator and a plug that matches the HotLine power jack. Their model number is MN-1 and the price is $295. Shipping weight is 3 lbs. For futher details or to place an order, contact:

Frezzolini Electronics, Inc.
5 Valley Street
Hawthorne, NJ 07506
Tel: 201 427-1160
Fax: 201 427-0934
Attn: Jim Crawford

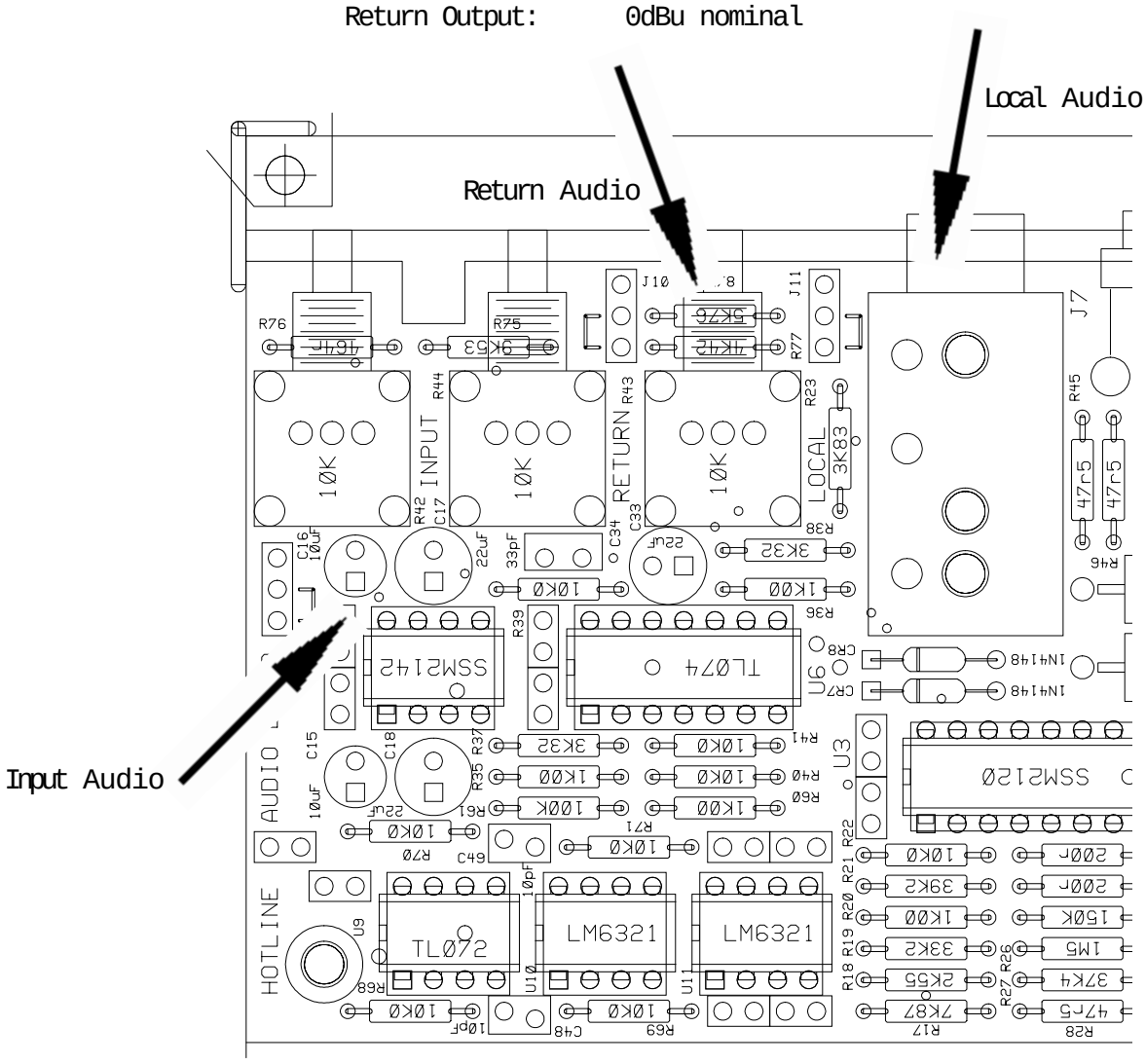
SECTION 9. TECHNICAL DETAILS

Disabling Audio level Controls

The audio level controls can be disabled on the Hotline by opening the unit, gaining access to the audio PC board (the one with the audio connectors attached) and moving three jumpers on that board. The location of the jumpers are shown in figure below.

The legend on the PC board shows the two pins which should be closed in order for the controls to be enabled. To disable the controls, move all three jumpers to close the other two pins on the header. With the controls disabled, the levels are as follows:

Input:	Line 0 dBu nominal Mic -75 dBu nominal
Return Output:	0dBu nominal



Troubleshooting the HotLine

Because of the delicate nature of moving audio data over telephone lines, it is likely that you will experience problems at some point with establishing a reliable connection using the Hotline. There are dozens of factors that can affect the success or failure of a Hotline call, some within the user's control and some not. Comrex has support personnel to help troubleshoot problems which may occur, but please use this section first to "run down" the most common issues when using the Hotline.

1) Are you on an in-house phone system?
There are only so many times we can say this... an in house phone system is almost always a bad idea with the Hotline. If at all humanly possible, use the Hotline on a direct telephone company line. If you call for support, and you are using an in-house phone system, the first request you are likely to receive is to move the Hotline to a direct, "Ma Bell" line.

2) Have you checked your audio quality going into the Hotline?
Often problems with noise or distortion in audio are added before the Hotline, but since the Hotline is the most mysterious link in the chain, it is assumed to fail first.

Check your audio in and out of the Hotline locally, by listening to the "local" program output. Any noise or distortion present in the Hotline audio input will be present on this output. Next, select "Lpbk" from the Main menu and then select a loopback rate similar to the rate at which you have been able to establish. (See page 18 for further details on loopback.) This will allow you to monitor audio after it has gone through the encoder and decoder section. (Turn down the local control and use the "return" audio control to monitor this.) Due to the extremely high compression of the Hotline, some artifacts due to the coding are unavoidable. Also check that your input level is correct, and the "peak" light on the Hotline is flashing on occasional audio peaks.

3) Have you disconnected any other devices from your lines?
Be absolutely certain that other fax machines, modems, etc. are removed from your telephone line on each end, not simply disabled. Even "on-hook", some devices can affect the Hotline performance. Also, their removal will prevent anyone from inadvertently "picking up" the line during audio transfer and causing the Hotline to drop out.

4) Have you tried redialing and/or changing lines or carriers?
Some telephone connections simply won't support the movement of data at the rates required by the Hotline. If you have trouble establishing a reliable connection even with a speed drop, try redialing several times.

The telephone systems often route calls differently each time, and you may pick up a cleaner circuit on a different call. The problem may also be that your local loop runs a very long distance, is subject to cross-talk, or is "loaded" by the phone company, causing the modems in the Hotline (or any modems, for that matter) to perform poorly. If possible, try a different line. Finally, we find a change in long distance carriers (assuming you are dialing long distance) can make a world of difference. Try dialing the access code of a different carrier if you have difficulty. In general we find better connections with the larger carriers (avoid "Joe's phone company" if possible.)

Hotline performance can be affected by factors such as time of day, weather, and geographic location. Once you have used the Hotline, you will probably gain a better understanding of how it works on different lines and what can go wrong.

If you call Comrex for support, we will likely attempt to connect to each of your HotLines from our office. This way, by connecting from a known good line and carrier, we can often at least isolate which end of the connection is causing the difficulty.To save your time and ours, please be sure you have run through the above checklist before calling for support.

Specifications

Connections

Audio In 3-pin XLR female

Tape In 1/8" 2-conductor mini-jack

Audio Out 3-pin XLR male

Headphone Out 1/4" stereo phone jack

Telephone Line RJ11C Modular Jack

Telephone Set RJ11C Modular Jack

Levels

Audio input 10K ohms

Mic levels -85 to -40 dBu

Line Levels -10 to +10 dBu

Tape input -10 dBu (fixed)

Audio output

Line level out: +12 dBu max

Headphone out: 1 watt

Telephone Line out -9 dBm @ 600 ohms

Audio Bandwidth

Connect rate	Bandwidth
12 kB/s	4.5 kHz
14.4 kB/s	5.4 kHz
16.8 kB/s	5.6 kHz
19.2 kB/s	5.8 kHz
21.6 kB/s	6.5 kHz
24 kB/s	7 kHz
26.4 kB/s	8 kHz
28.8 kB/s	8.6 kHz
31.2 kB/s	9.3 kHz
33.6 kB/s	10 kHz

Contact closures: "Ready" provides dry closure when decoder is in sync with encoder. "Enter" provides dry closure when "enter" key is pressed during connection.

Nominal Coding Delay 128 mS

Power: External supply - 5V, 2.5 Amp; 110 to 240 VAC 50/60 Hz

(note: Hotlines with serial numbers 101-220 have been shipped with 110VAC/60Hz supplies. If a 110-240VAC / 50-60Hz switching powersupply is required, please contact Comrex Corporation.)

Power connection

2.1mm i.d., 5.5mm o.d., coaxial.

Size 6.25" W x 9.5" D x 2" H

Weight Net: 2.4 lbs Shipping: 5 lbs

HotLine Pinouts

Tel Line & Tel Set:
- Physical: RJ11C 6-pin modular jack
- Pin 3: Tip
- Pin 4: Ring

Main input:
- Physical: 3-pin female XLR
- Pin 1: Ground
- Pin 2: + Audio In
- Pin 3: - Audio In

Tape input
- Physical: 2-conductor 1/8" mini jack
- Tip: + Audio In
- Sleeve: Ground

Main output:
- Physical: 3-pin male XLR
- Pin 1: Ground
- Pin 2: + Audio Out
- Pin 3: - Audio Out

Headphone output:
- Physical: 3-conductor 1/4" phone jack
- Tip: Audio Out L
- Ring: Audio Out R (same as L)
- Sleeve: Ground

"Ready" & "Enter" Contact Closures:
- Physical: 2-conductor 1/8" mini jack
- Dry closure between Tip and Sleeve

Power:
- Physical: 2.1mm i.d., 5.5mm o.d., coaxial.
- Outer shield: Ground
- Inner core: +5V

Diagnostic Port:
- *Please consult the factory before making any connections to this port*
- Physical: DB9
- Pin 1: TXD
- Pin 2: TXCLK
- Pin 3: RXD
- Pin 4: RXCLK
- Pin 5: routing control
- Pin 6: Rate select A
- Pin 7: Rate select B
- Pin 8: Renegotiating indicator
- Pin 9: Ground

FCC Requirements

1.) This equipment complies with Part 68 of the FCC rules. On the bottom of the Hotline is a label that contains, among other information, the FCC registration number and ringer equivalence number (REN) for this equipment. The USOC jack required is an RJ-11C. If requested, this information must be provided to the telephone company.

2.) The REN is used to determine the quantity of devices which may be connected to the telephone line. Excessive REN's on the telephone line may result in the devices not ringing in response to an incoming call. In most, but not all areas, the sum of the REN's should not exceed five (5.0). To be certain of the number of devices that may be connected to the line, as determined by the total REN's, contact the telephone company to determine the maximum REN for the calling area.

3.) If the HotLine caused harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice isn't 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.

4.) The telephone company may make changes in its facilities, equipment, operation or procedures that could affect the operation 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.

5.) If trouble is experienced with the HotLine, 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 you remove the equipment from the network until the problem is resolved.

Comrex Corporation
65 Nonset Path
Acton, MA 01720
Tel: 978-263-1800

6.) The HotLine cannot be used on public coin service provided by the telephone company. Connection to Party Line Service is subject to state tariffs. Contact the state public utility commission, public service commission or corporation commission for information.

SECTION 10. HOTLINE CIRCUIT DESCRIPTIONS

The HotLine consists of three boards: The Display/Keypad board, the Audio Board, and the Main Board. The Main Board consists of mostly surface mounted parts on a multilayer PCB so troubleshooting to the component level is discouraged.

Display/Keypad Board

The Display/Keypad board simply holds the panel components and connects to the main board.

Audio Board

Main audio enters through the input XLR into a SSM2117 preamp chip. The input MIC/LINE selector switch connects a pad across the input of the preamp when line level is selected. The audio then runs through the input level control and gets summed with the tape input audio. This audio is then applied to the SSM2120 which is configured as a peak limiter. The control voltage from the peak limiter, when higher than ground, triggers the peak light through a comparator. The audio runs next through a simple filter and is AC coupled to the main board. This audio is also tapped here to be delivered to the "local" level pot to drive the output.

The output of the main board is AC coupled to the buffer and return level pot before it is summed with the local audio. It is next delivered both to the SSM2142 output driver, and a headphone amp which utilizes high current output buffers.

Main Board

The audio is converted to digital via the CS5330 A/D converter, and fed serially to the TX TMS320C32 DSP Processor. The DSP runs at 50 Mhz and has 32K x 32 12nS SRAM attached. The TX DSP boots from an EPROM. The DSP is then connected serially to the Rockwell modem chipset, which is contained on a small daughterboard near the rear of the main board. The chipset consists of an L39 microcontroller which processes all the commands and a modem datapump chip, which interfaces with the telephone audio and performs all the line adaptation. The chipset runs from an EPROM located under the daughter board. The modem data pump is connected to a Xecom XE1030 DAA which provides telephone line isolation and ring detect and hookswitch capabilities. The Rockwell modem chipset is also connected serially to the RX DSP, which is identical in format to the TX. The RX DSP is connected serially to the CS4330 D/A converter. The LCD display and keypad are controlled by an Atmel 89C52 microcontroller, which runs the user interface, and is also connected serially to the Rockwell modem controller.A/D and D/A clocks are generated by a 74HCT4046 Phase lock loop and the associated dividers flip flops and inverters.