

NIR-10

Noise / Interference Reduction Unit

Instruction Manual

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JPS Communications, Inc.

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SECTION 1
BRIEF
DESCRIPTION

The NIR-10 is an audio processor designed to enhance the quality of received voice and CW transmissions. Its modes of operation are explained below. Basically, the unit takes audio from a receiver or transceiver, processes it, then feeds it to an external speaker or headphones for listening. It does this processing using a powerful 40 MHz Digital Signal Processor (DSP) for the filtering, noise reduction, and heterodyne removal. The technical information section explains how the DSP works.

**NOISE REDUCTION
MODE (NIR)**

The Noise and Interference Reduction (Spectral Subtraction) mode automatically enhances speech by recognizing the characteristics of human vocal cord physics and the subsequent relationships of speech frequencies relative to frequencies of non-speech. The speech frequencies are then allowed to pass, while non-speech frequencies may be reduced by using a front panel control. In this mode, which is language and male/female voice independent, the NIR-10 removes noise and heterodynes occurring in the presence of speech without reducing the audio bandwidth and with minimal corruption of the speech itself. The amount of noise reduction is continuously variable from zero to maximum by means of the NIR LEVEL control on the front panel. As long as the NIR LEVEL control is not advanced so far as to overprocess the signal, the NIR mode will also effectively remove noise from CW and data signals as well as voice.

**NOTCH FILTER
MODE**

The Notch Filter (NF) mode provides cancellation of tones from tune-ups, heterodynes, CW, RTTY, or similar signals without interfering with voice signals. Unlike conventional notch filters, this mode easily removes multiple tones. The NF mode is made operational by placing the BW

(FUNCTION) switch in the WIDE/NF position while the MODE switch is in either BYPASS or NIR position. See Table I. When energized, this mode automatically removes offending tones regardless of the position of the NIR control. The NF mode is disabled by placing the BW switch in NARROW (lower) position. NF doesn't function in the BANDPASS filter mode. The NOTCH mode operates in "real time", so there is no processing delay.

PEAK MODE

The PEAK (Dynamic Peaking) mode is useful for reducing white or pink noise (atmospheric) and other similar noise types from audio. It can be used alone or in conjunction with the NIR mode. PEAK mode provides dynamic bandpass filters around all coherent frequencies (voice, CW, data, etc.) within the audio passband. It rejects the non-coherent frequencies of white noise and similar noise types. This provides a second means of noise reduction for the user. With CW signals, if a CW tone can be separated with the receiver filter, it can be further peaked and noise-reduced using the PEAK function.

The PEAK mode is made operational in either BYPASS or NIR modes by placing the BW (FUNCTION) switch in the MED/PK position. The PEAK function is disabled by placing the BW switch in the NARROW (lower) position. So the PEAK mode may be used by itself (MODE in BYPASS) or along with the NIR mode. In some cases, the PEAK function will be most effective, or the NIR mode will best remove the unwanted interference, and there will be occasions where the PEAK and NIR modes together are required to eliminate the noise satisfactorily. The PEAK mode does not function in the BANDPASS filter mode. The

PEAK mode operates in “real time”, so there is no processing delay in this mode.

NOTE

When using the PEAK function on weak signals, the output audio level MAY decrease. So it may be necessary to increase the audio input from the receiver to obtain an adequate listening level. Observe the PEAK LED to be sure that the NIR-10 is not being overdriven. There may also be times when the PEAK function will be most effective at reduction of the noise by REDUCING the audio input from the receiver and increasing the NIR VOLUME to restore the proper listening level.

BANDPASS MODE

BANDPASS mode is intended to enhance CW, RTTY, and voice reception when adjacent channel interference is present; the unit operates as a super-selective digital audio filter with three switch-selectable bandwidths. The filter center frequency may be shifted anywhere in the 300 to 3400 Hz audio range by means of the BP SHIFT control on the front panel. Noise reduction is not usable in conjunction with the BANDPASS filter mode. Other bandwidths are available from the factory on special order.

BYPASS MODE

The DSP audio processing requires some input to output signal delay. Although unimportant when receiving, this delay is objectionable when monitoring your own transmission through the NIR-10. Therefore, a BYPASS mode has been provided to remove all processing and delay from the NIR-10 output. BYPASS may be enabled from your transmitter's key line as well as from the front panel.

SECTION 2

QUICK OPERATION

This section lets you get on the air with the NIR-10 as quickly and as simply as possible. Refer to the connection diagram on page 4. See the following sections of this manual for more detailed operation and connection information.

CONNECT POWER

The NIR-10 operates from a nominal +12 VDC power source. Plug an AC to 12VDC Adapter into the NIR-10's DC IN (J1) jack on the rear panel. Although the electronics are protected for reverse polarity, damage to the printed circuit tracks may result if the correct polarity is not observed. If you solder on your own power plug, be sure to check for the correct polarity - center terminal is positive. An adapter with 1 Amp output current capability is required. The NIR-10 DC IN jack is a coaxial type, 2.5mm ID, 5.0 or 5.5mm OD, center positive (Radio Shack 274-1568 or 274-1573).

CONNECT AUDIO INPUT

Connect the Speaker Output of your receiver or transceiver to the AUDIO INPUT (J3) jack. The NIR-10 AUDIO INPUT jack is an RCA Phono type - it is NOT a 1/8" phone jack.

CONNECT SPEAKER or HEADPHONES

Connect a 3.2 Ω or greater speaker to the SPEAKER OUTPUT (J2), or plug your headphones into the front panel PHONES jack. The NIR-10 SPEAKER OUTPUT jack is an RCA Phono type - it is NOT a 1/8" phono jack.

TURN ON POWER

Now turn on the NIR-10's POWER switch. The LED next to the switch should light. If it doesn't, check your power source and connections. The red PEAK LED next to the VOLUME control should blink three times (long, short, short), indicating that the unit successfully self-tested.

INITIAL SETTINGS

Put the MODE and BW switches all the way down to BYPASS and NARROW positions respectively, and set the NIR LEVEL control fully counter-clockwise to the MIN position. Adjust the VOLUME control to about mid-range.

RADIO SETTINGS

Turn on your receiver or transceiver and tune in a STRONG voice station. Adjust your radio's volume control so that the PEAK LED on the NIR-10 flashes occasionally on voice peaks- this sets the proper audio input level to the NIR-10. Leave your radio's volume at this setting and then adjust your listening level only with the NIR-10's volume control. Turn off your radio's speaker so that you are listening to output from the NIR-10 only.

NIR MODE

Adjust the NIR-10 VOLUME to a comfortable level. Since the NIR-10 is in the BYPASS mode, you are now listening to unprocessed audio from your receiver. Now switch the MODE switch up to the NIR position and experiment with the setting of the NIR LEVEL control. Notice how the noise melts away as the NIR LEVEL control is advanced. The normal setting for this control is between 10 and 12 o'clock. Experiment with CW signals in the NIR mode as this mode is also effective on most CW signals. (However, the NIR-10 may think that slow CW is an interfering signal and remove it.)

BANDPASS MODE

Now put the MODE switch in the center BANDPASS position. Put the BW (Bandwidth) switch in the WIDE position. Adjust the BP SHIFT control back and forth to observe its effect (it's the same control as before; the function has now changed). Tune into a crowded part of the CW band. Narrow the bandwidth using the BW switch. Adjust the BP SHIFT control and notice how you can use it to pick out individual CW signals.

NOTCH MODE

Place the MODE SWITCH in BYPASS position. Tune in a strong tone or heterodyne. Place the BW switch all the way up to WIDE/NF. This engages the NOTCH FILTER. The carrier should disappear immediately.

PEAK MODE

Now place the BW switch in the middle MED/PK position. This engages the PEAK FILTER. The tone should now be peaked and the surrounding noise suppressed. Check this function with voice signals to get familiar with its noise reducing capabilities. Also try the PEAK and NIR modes combined for noise reduction. Remember that the degree of cancellation of noise in the NIR mode is continually adjustable with the NIR LEVEL control.

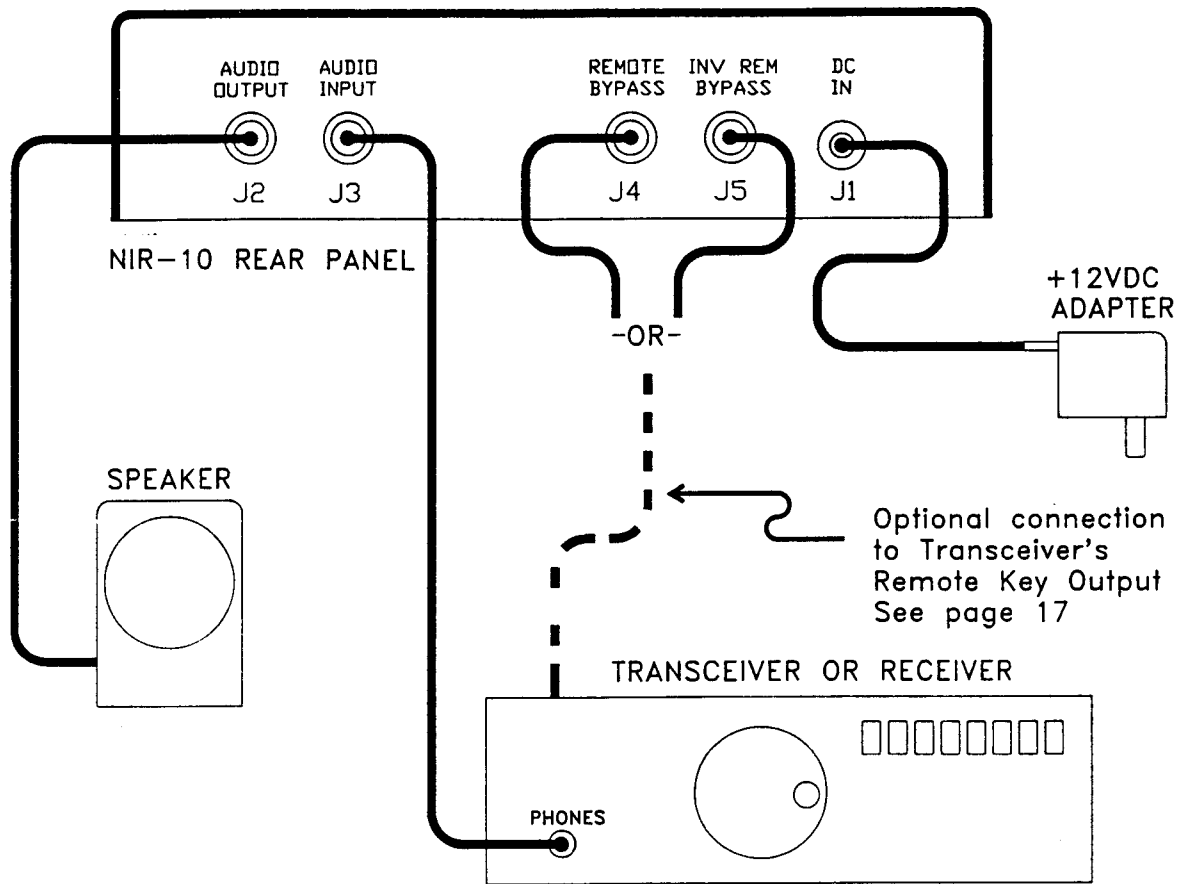


FIGURE 1 Connection Diagram

SECTION 3

CONNECTIONS

This section gives detailed information regarding the connections to the NIR-10. The unit is very simple to connect and use, but for best results, follow the guidelines below.

POWER REQUIREMENTS

The NIR-10 operates from +11 to +16VDC. Audio peaks push current consumption to 1 Amp peak, so an adapter of 1 A capability is required. If you haven't bought our adapter (it's a 1 Amp unit), we recommend the Radio Shack P/N 273-1653 Adapter. Of course, you may also operate the NIR-10 from your radio's auxiliary power or other high-quality +12V source. The mating connector is Radio Shack P/N 274-1568 or 274-1573.

VEHICULAR OPERATION

The NIR-10 may be operated directly from the power system of any 12V negative ground vehicle.

AUDIO INPUT

The NIR-10 may be connected to the speaker, headphone, or audio line outputs of almost any kind of receiver or transceiver. Its audio input is AC coupled, with an impedance of 22Ω . The input impedance may be easily adjusted to a high ($47k\Omega$) impedance (see note below), which means that it may be connected to almost any type of audio output without causing any loading or other adverse effects. The input is protected against overloads of up to ± 50 V.

The front panel PEAK LED makes setting the input level easy: simply advance your radio's volume or audio level control until the PEAK LED flashes occasionally on voice peaks.

NOTE

Some receiver speaker driver amplifiers became unstable when driving earlier versions of the NIR-10. Symptoms of instability included rectification or pickup of transmitted RF which then appeared (possibly distorted and/or at a low level) at the NIR-10's speaker output. This instability has been remedied by loading the receiver's speaker output by inserting a 22 Ω resistor, R5, between the NIR-10's audio input and ground. This resistor is not required in most cases, and can be clipped out if a high impedance audio input is required. The resistor is either soldered directly to the input connector, J3, or is installed on the board near J3.

NOTE

For best operation and maximum dynamic range, the NIR-10 should have a relatively constant input audio level. This means that once set, the volume into the unit should be left alone, and your listening level should be adjusted with the VOLUME control on the NIR-10. Also, overdriving the input will not result in improved performance, but will just cause increased audio

distortion. The unit is being overdriven if the PEAK LED is on more than just an occasional flash.

INPUT LEVEL ADJUST

As shipped from the factory, the gain of the NIR-10 is set for use with most speaker or headphone outputs when they are adjusted for normal listening levels. In an unusual installation, more gain may be needed to boost the input signal level to fully utilize the NIR-10's dynamic range. The NIR-10 has an internal jumper which may be changed to raise its gain when the input signal level is low. This jumper is located on the left edge of the NIR-10 PC board and is accessible with the cover removed. Normal signal level is with the jumper in position 1-2; the low level setting is position 2-3. Make sure that the use of this low level setting is really needed and that its use doesn't result in input overload (the PEAK LED will tell you if it's overloaded).

SPEAKER OUTPUT

The speaker output is the main audio output from the unit. It can furnish more than 2W into a 3.2 Ω speaker, less into higher impedances. It is also a general-purpose output intended to drive any type input. It can't be harmed by an open or short circuit.

HEADPHONE OUTPUT

This output is a stereo phone jack connected to the speaker output through a resistive divider to prevent headphone overdrive. It will satisfactorily drive 8 Ω and higher impedance phones.

NOTE

A mono phone plug inserted all the way into the stereo jack will short both channels and you will get no audio (no damage will occur, however). A mono plug may be used by inserting it only to the first detent (about 1/4" from fully seated in the jack). If you prefer not to do this, a stereo-to-mono adapter is available from Radio Shack.

REMOTE BYPASS

The sophisticated signal processing done in the NIR-10 requires a certain amount of audio delay. This delay, on the order of 1/8 second, is unimportant in receive, but makes transmit signal monitoring through the NIR-10 all but impossible. For this reason, a BYPASS mode, which removes all processing and delay, is included in the NIR-10. The REMOTE BYPASS input allows this mode to be entered via an external control signal, regardless of the MODE switch position. By connecting this input to your transceiver's PTT line or other transmit signal, the NIR-10 will be bypassed automatically when you transmit, allowing you to monitor your own voice or CW transmission through the NIR-10 without annoying audio delay.

This input forces BYPASS MODE while driven to a voltage of +3V or higher. It has a 10k Ω impedance and is protected to \pm 50V input.

**INVERT REMOTE
BYPASS**

This input functions the same as the REMOTE BYPASS input except that it requires the opposite polarity signal. This input requires a ground or less than +2V to activate. It has a 10k Ω input impedance and is protected to $\pm 50V$ input.

The two remote bypass inputs are provided to accommodate virtually any transmitter or transceiver. Section 6 gives further details on connections to your transceiver.

SECTION 4
**CONTROLS &
INDICATORS**

This section explains the operation of each of the NIR-10 controls.

POWER SWITCH

The POWER switch controls the main power to the unit and the indicator next to it glows when power is applied.

MODE SWITCH

The MODE switch determines the operating mode of the NIR-10. When in NIR position, the Noise and Interference Reduction mode is active and the NIR LEVEL control sets the amount of reduction. When the MODE switch is in BANDPASS position, the filter mode is active, with the bandwidth set by the BW switch and the center frequency set by the BP SHIFT control. In BYPASS position, all delay and processing except for the notch filter and peak function are removed. BYPASS may be forced via the remote bypass inputs regardless of the position of this MODE switch.

**BW (FUNCTION)
SWITCH**

This switch sets the filter bandwidth only in BANDPASS mode. It has no effect on audio bandwidth in BYPASS or NIR modes. In BYPASS or NIR modes, this switch is used to engage the NOTCH or PEAK functions. The middle position of the switch (MED/PK) engages the PEAK function, while the upper position of the switch (WIDE/NF) engages the NOTCH filter. To turn off both functions, place this switch in the lower (NARROW) position.

NIR LEVEL/BP SHIFT CONTROL

The NIR LEVEL/BP SHIFT control has two functions, depending on the position of the MODE switch. When in NIR mode, this control is the NIR LEVEL, setting the amount of noise reduction. The normal setting for this control is between 10 and 12 o'clock. Settings above 12 o'clock may be useful for removing interference from strong signals, while fully counterclockwise gives minimum noise reduction.

When in BANDPASS mode, this control is the BP (Bandpass) SHIFT control, setting the operating frequency of the filter. The upper frequency of the bandpass is the reference for this control. The fully counterclockwise position puts the upper edge of the bandpass at the low end of the audio range, near 300 Hz, while fully clockwise puts the upper edge of the bandpass at the high end, near 3400 Hz.

PEAK INDICATOR

The PEAK indicator flashes when the input audio amplitude reaches a level that is somewhat below the maximum signal that the NIR-10 can handle without producing distortion. Using this indicator as a guide, the input audio level may be adjusted to take advantage of maximum dynamic range, yet avoid overload. The proper input audio setting is that which causes the PEAK indicator to flash occasionally on voice peaks. If the PEAK indicator is on continuously, the input audio level is too high, and should be reduced to avoid distortion. (This indicator also flashes on power-up during the self-test.)

VOLUME CONTROL

The VOLUME control sets the NIR-10 output audio level at the speaker and phones outputs.

SECTION 5

OPERATION

This section describes the operating procedure using the NIR-10's various modes with different types of signals.

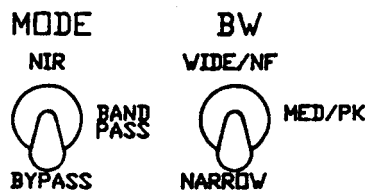
NIR/NF MODE on VOICE

The NIR mode is designed primarily to remove noise occurring in the presence of speech. It does this by examining the input audio, looking for signals with speech characteristics, and reducing everything else. Since the signal and noise levels vary so much on the amateur bands, the NIR-10 allows control of the noise reduction level so the performance may be tailored to the conditions at hand.

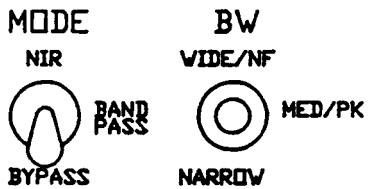
With the NIR LEVEL control set fully counter-clockwise, tune your receiver to a noisy sideband signal. Then adjust the NIR LEVEL control clockwise and notice how the noise is reduced. Also note that if the noise level is very high, it is possible to put in too much noise reduction, reducing speech intelligibility.

Certain types of noise may contain some characteristics of speech, making them difficult to suppress completely. If you find a noise type only partially suppressed, try reducing the audio level going into the NIR-10. It should be noted that the NIR-10 cannot recover intelligibility of a voice signal which is grossly corrupted by noise. For signal-to-noise ratios of 0 dB or better, the unit does an exceptional job of eliminating noise from speech. It can't, however, make an S2 voice signal fully

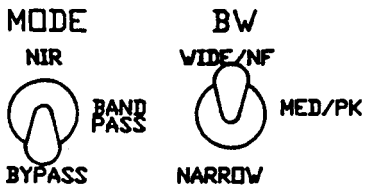
TABLE 1
Selection of Operating Modes By Mode and BW Switch Position



MODE switch in BYPASS.
BW switch in NARROW.
 Unit is **BYPASS**ed for DSP.
 Uses only the internal Speaker Driver. No processing, no delay.

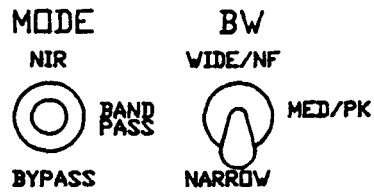


MODE switch in BYPASS.
BW switch in MED/PK.
 Unit now uses **PEAK** mode.
 Good white noise reduction. No delay.

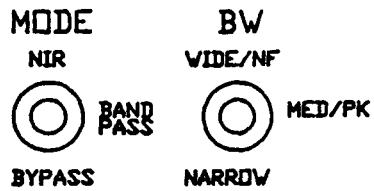


MODE switch in BYPASS
BW switch in WIDE/NF.
 Unit now uses **NOTCH** filter.
 Multiple tone removal. No delay.

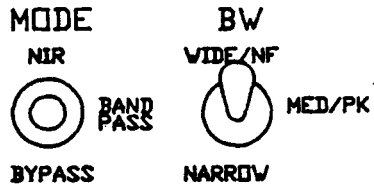
TABLE 1
(Continued)



MODE switch in BANDPASS.
BW switch in NARROW.
Unit is in BANDPASS mode.
NARROW filter selected. 130 msec delay.

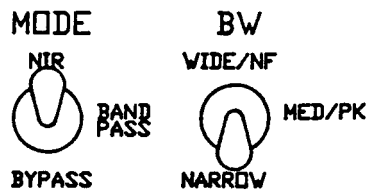


MODE switch in BANDPASS
BW switch in MED/PK
Unit is in BANDPASS mode.
MEDIUM filter selected.
130 msec delay.

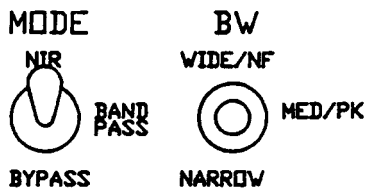


MODE switch in BANDPASS.
BW switch in WIDE/NF.
Unit is in BANDPASS mode.
WIDE filter selected.
130 msec delay.

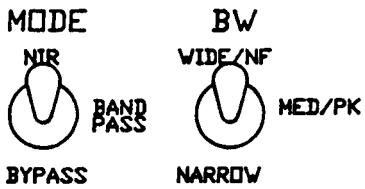
TABLE 1
(Continued)



MODE switch in NIR.
BW switch in NARROW.
Unit is in NIR mode only.
Use NIR control.
130 msec delay.



MODE switch in NIR.
BW switch in MED/PK.
Unit is in both NIR and PEAK modes. Use NIR control.
130 msec delay.



MODE switch in NIR.
BW switch in WIDE/NF.
Unit is in both NIR and NOTCH mode. Use NIR control. 130 msec delay.

readable in an S5 noise level. Heterodynes may be easily removed by placing the BW switch in the Wide (up) position, energizing the NF mode. If several heterodynes exist which are close together in frequency, it may be necessary to advance the NIR control to eliminate them all, otherwise the NF mode will eliminate them without help from the NIR mode. Note that if the received voice level is reduced in the presence of a strong heterodyne, the reduction in volume is caused by the receiver's AGC, not the NIR-10. Also note that if no heterodynes are present, the NF mode may attack some of the voice frequencies, making the voice seem somewhat distorted or "nasal". If this is bothersome, merely disable the NF mode by placing the BW switch in the lower (NARROW) position until a heterodyne appears, then engage it.

PEAK MODE on VOICE

The PEAK mode is designed to peak up any correlated information in the audio passband. It provides a second type of noise reduction by dynamically forming bandpass filters around correlated information, thus automatically reducing the bandwidth to the minimum necessary to pass the information. The PEAK mode is most effective on purely random noise, such as white or pink noise. When more periodic noise types are encountered, such as ignition noise or power line noise, the NIR mode or a combination of NIR and PEAK modes may be more effective.

With the MODE switch in BYPASS, set the BW switch to the NARROW (lower) position. This effectively bypasses the unit except for the internal speaker driver. Now tune in a noisy sideband signal. Place the BW switch in the middle (MED) position to enable the PEAK mode and notice the reduction in the noise level. If desired, the NIR mode may also be enabled

and used in conjunction with the PEAK mode to provide additional noise reduction.

NIR/PEAK MODE on STATIC CRASHES

A static crash causes two problems which are annoying and disrupt communications: First, a static crash of any reasonable duration is offensive to the ears; Second, the receiver AGC is often driven to its limit and requires a relatively long period of time to recover. During this recovery period, the desired signal is momentarily “lost”. The NIR-10 can often provide significant reduction of the static impulse noise, and manipulation of receiver characteristics can allow faster recovery of the desired received signal. To counter the effects of a static crash, set the NIR-10 in the NIR Mode and also in the PEAK mode. Adjust the NIT control to about the 9:00 position (adjustment from this position may be required later). Now change the receiver AGC characteristic from SLOW to FAST. The NIR mode will reduce the long static crashes to “pops” of about 130 millisecond duration, while the FAST AGC will allow the receiver to recover rapidly. The result will be reasonably clear audio with “pops” in the background.

NIR MODE on CW

While the NIR mode is designed to enhance speech, it will also perform well on CW if the following limitations are observed: First, the CW note should be in the range of 300 to 1000 Hz. Second, the CW speed must not be too slow, or the unit will interpret it as an interfering tone and attempt to remove it. In NIR mode, the unit should work well at speeds above about 7 wpm. As with voice signals, adjust the NIR LEVEL control until the noise is reduced and the CW still readable. The PEAK function may also be used to reduce noise and enhance the CW signal

along with the NIR mode. NOTE: Turn off the NF mode when receiving CW in the NIR mode. The notch will remove the tone from the CW signal, making it impossible to copy.

NIR MODE on RTTY, SSTV, PACKET, etc.

The NIR mode is designed to suppress these signals as they are considered an interference to voice traffic. Use the BANDPASS mode for these signals.

PEAK MODE on CW/DATA

The PEAK mode is also quite useful on non-voice audio, such as CW, RTTY, AMTOR, etc. Note that when using the PEAK mode with CW signals, all tones existing in the audio passband are peaked, so if a signal can be separated with the receiver filter, it can be further peaked and noise-reduced using the PEAK function.

BANDPASS MODE

The BANDPASS mode is designed to enhance CW and DATA signals (RTTY, SSTV, and Packet), and provide reduction in interference from adjacent channel “chatter” on voice. When this mode is selected, the NIR-10 becomes a bandpass filter with extremely steep skirts. The NIR LEVEL control becomes the BP SHIFT control. Adjusting this control will tune the filter to any frequency from 300 to 3400 Hz. The filter width is selected by the BW switch and offers three options. Refer to the Specifications in Section 6 for the exact bandwidths. When using BANDPASS mode for CW, it’s best to start with the WIDE bandwidth and narrow it down after you’ve tuned in the signal you’re interested in. Adjust the filter frequency with the BP SHIFT control. Due to the sharpness of the digital filter, it may be necessary to adjust the BP SHIFT control slightly after changing the filter bandwidth. The signal will seem

to “pop” into the passband when properly tuned. If a “buzz” is heard, particularly when in the NARROW bandwidth, it is caused either by not having the received signal properly tuned in the center of the filter passband, or by FM detection of audio harmonics, etc., on the vertical skirts of the filter. Try carefully returning, or increase the bandwidth to MED position to eliminate the “buzz”.

Narrow BW Narrow bandwidth is most useful on CW; it may also be useful for narrow-shift RTTY.

Medium BW Medium bandwidth is useful for CW and RTTY.

Wide BW Wide bandwidth is useful for CW, RTTY, SSTV, Packet and Voice.

**BANDPASS MODE
on VOICE**

Wide bandwidth is the only one useful for voice communications as both the medium and narrow positions are too narrow for voice use. The wide position is useful for eliminating high frequency “chatter” (adjacent channel spillover) from the desired signal. Using the BP Shift control, the bandwidth may actually be reduced below 1800 Hz to eliminate the interference, while providing adequate intelligibility.

**OPERATIONAL
LIMITATIONS**

No physical device is perfect in its operation, and the NIR-10 is no exception. The unit does have some operational limitations in both the NIR and BANDPASS modes. We want you, the user, to be aware of the limits to performance of the unit.

NIR Mode

First, with the techniques used in the NIR-10, it is impossible to completely recover speech when heavily corrupted by noise, because some of the information that characterizes the speech is irretrievably lost. Because of this, use of the NIR mode at signal-to-noise ratios of 0 dB and below may actually reduce intelligibility rather than enhance it. Second, the noise left over after reduction has an “electronic” sound. This is not an artifact introduced by the processing as one might think, but rather it is all that remains of the original input noise, which, because of its random nature, cannot be removed completely. Unfortunately, this residual has also been de-randomized to some extent, so that it occurs in bursts. Thus, it sounds unnatural and can be more annoying than white noise. The higher the level of noise in the input, the higher the level of this residual at the output.

Bandpass Mode

One characteristic common to narrow steep-skirted filters, whether analog or digital, is ringing. The NIR-10 has the digital equivalent of ringing, which manifests itself as a “raspy” sound when an input signal is placed on a band edge. Unlike analog filters, however, no ringing or other disturbance of the signal occurs when it is placed in the passband. Thus, it is usually possible to tune the NIR-10 so that the desired signal is sufficiently far from the passband edges so that the raspy sound doesn’t occur.

Notch Mode on CW

Remember to disengage the NOTCH filter by placing the BW switch in the MED or NARROW positions or removal of the CW note will occur, making CW operation impossible.

Peak Mode

The PEAK mode may not be effective at all on some types of impulse noise. Use the NIR mode for these, or both NIR and PEAK together. The noise reduction effectiveness of PEAK may also be degraded if the audio input level from the receiver is too high. Merely reduce the receiver volume and increase the NIR-10 VOLUME to compensate. Using both the PEAK and NIR modes together will reduce or remove the electronic artifacts and residual mentioned in the previous “NIR mode” paragraph.

TRANSMIT AUDIO PROCESSING

The NIR-10 in NIR mode can also be used to process transmit audio. The advantage is that background noise which may be picked up by your microphone will be removed from your transmitted signal by the NIR mode. This may be useful in a vehicle or other high ambient noise environment.

Figure 4 on page 27 is a diagram of how this is might be accomplished. A relay operated by the transmitter’s keyline output is used to switch the NIR-10 input/output between transmit and receive. During receive, the NIR-10 operates conventionally. During transmit, the NIR-10’s input is fed from the amplified microphone source and its output is fed to the transceiver’s transmit audio input. The microphone amplifier is necessary since the unit hasn’t enough gain to operate on a low-level microphone output directly. Some experimentation will be necessary to determine usable operating levels in this configuration. Parts to implement this circuit are available at Radio Shack or from your junk box.

SECTION 6

**TECHNICAL
INFORMATION**

SPECIFICATIONS

Audio Input	Unbalanced 22 Ω (or 47k Ω). J3 is an RCA-type phono jack)
Frequency Response	300 to 3200 Hz \pm 2 dB.
Input Level	120 mV to 2.8 V rms. (Internal Level Select Jumper)
Absolute Output Delay	
NIR and BP Modes	130 milliseconds.
Bypass Mode	<1 milliseconds.
NIR Mode White Noise Reduction	
MAX Control Position	Approximately 20 dB.
MIN Control Position	0 dB.
PEAK Mode White Noise Reduction	Typically 10 to 20 dB.
NIR Mode Single Tone Reduction	
MAX Control Position	Greater than 40 dB.
MIN Control Position	0 dB.
Time to Cancel a Suddenly-Appearing Tone	
NIR Mode:	About 250 milliseconds.
NF Mode:	About 3 milliseconds.

BP Mode Bandwidths	(Amateur) NAR: 250Hz, MED: 600 Hz, WIDE: 1800Hz (SWL) NAR: 1800Hz, MED: 2400Hz, WIDE: 3000Hz.
BP Mode Center Frequency	Continuously Variable in the 300Hz to 3200Hz range.
BP Mode Ultimate Rejection	Greater than 60 dB.
NF Mode Ultimate Rejection	Typically greater than 50 dB, one to four tones. Less for more than four tones.
Normal Remote Bypass Input	Forces Bypass Mode while driven to +3V or higher.
Inverted Remote Bypass Input	Forces Bypass Mode while pulled to +2V or lower. Each has 10k Ω impedance and is protected to \pm 50V. (Phono Jacks)
Headphone Output	For 8 Ω and higher phones. (Stereo Phone Jack)
Speaker Output	2W @ 10% dist. into an 8 Ω Speaker. J2 is an RCA-type phono jack.
Audio Output Distortion	Less than 0.5% @ 1 kHz @ 0.5W Output.
Input Power	+11 to +16VDC @ 1/2 A Avg., 1 A Peak Reverse Polarity Protected. (2.5mm ID, 5 to 5.5mm OD coaxial jack).
Size	2" x 7" x 6" (HxWxD)
Weight	2 lbs. (0.91 kg).
Operating Temperature	-20° C to +55° C.
Storage Temperature	-40° C to +85° C.
Humidity	Up to 95% @ 55° C.

TROUBLESHOOTING

Symptom	Possible Fault
POWER ON LED does not light.	Check AC power source and power line connection. Check for proper seating of plug in the DC Power jack. Check polarity of DC Power: unit will not operate (but will not be damaged) if polarity is wrong.
POWER LED is on, but unit does not function and PEAKLED does not flash at power-up.	DC Input voltage is too low. Check adapter output voltage: it must be a 12V unit. Less likely: the unit has failed its self-test. Check PROMs U9 and U10 and processor U15 for proper seating. Turn off, then on. If fault continues, contact JPS Customer Service.
Unit passes audio, but won't enter NIR or BANDPASS mode.	Unit is held in BYPASS mode via remote control. Disconnect inputs to J4 and J5; if problem clears, check your remote signal source for correct operation. If problem does not clear, contact JPS.
PEAK LED is on almost continuously.	Input audio level is excessive. Reduce your input level until the indicator flashes occasionally on voice peaks.
PEAK LED flashes at power-up but never lights otherwise.	Input audio level is too low for best NIR-10 performance. If your level cannot be raised, increase the gain of the NIR-10. See Section 3 on Input Level Adjust.
Audio at phones but not at speaker.	Check your speaker and speaker connection.
Audio at speaker but not at phones.	Check your headphones and connections. Also if you are using mono phones, see Section 4 regarding the headphone output.

REMOTE BYPASS CONNECTIONS

This section offers some guidance on hooking up the NIR-10's remote bypass inputs to your transmitter or transceiver. Since there are so many types of radios in existence, it is impossible for us to give specific instructions for interfacing to every radio. For this reason, we have designed the NIR-10 to be as easy to interface as possible.

NOTE

You need to use these remote bypass connections only if you intend to monitor your own transmission (sidetone) through the NIR-10. If you don't need this feature, you may ignore this section.

General Principle

The general principle of the installation is to put the NIR-10 into BYPASS mode whenever your transmitter is keyed. This will remove all processing plus the input to output delay to allow you to monitor your own transmission through the unit. To do this, you must connect one of the NIR-10's REMOTE BYPASS inputs to a signal from your transmitter that tells when your transmitter is keyed.

Connect to your Transceiver's Remote Connector

Most recent commercial transceivers have a remote or accessory connector which contains a signal intended to key a linear amplifier. (Consult your transceiver's instruction manual for the pin number and characteristics.) This is the signal to use to drive the NIR-10. Normally, this signal is a contact closure to ground when keyed. If this is the case, use the INVert REMOTE BYPASS (J5) connector. This connector has a built-in pull-

upresistor, so a shielded cable is all that's needed. (Always use a shielded cable for these interconnections.)

**If the Signal
is already in use**

If this keying signal is already in use on your system (keying an amplifier or some other use), you can generally tie the invert BYPASS INPUT to it anyway without ill effects. The J5 input is high impedance ($10k\Omega$) so that it won't load your output and will withstand high voltages ($\pm 50V$) without damage.

**If your Transceiver
has no Remote
Connector**

If your transceiver does not have a remote connector or remote key output, you can probably connect the NIR-10 in parallel with your microphone's PTT switch or CW key. Caution: if your transceiver is a tube type, make certain that the keying voltage is positive and less than 50V. Again, having the NIR-10 input connected will probably cause no ill effects, because the input impedance is so high. Normally, these switches are contact closures to ground so they'll also connect to the INVert REMOTE BYPASS (J5) input.

**Using the REMOTE
BYPASS Input**

Most transceivers require a contact closure to ground to key them and they supply a contact closure to ground (or equivalent) as an output. If, instead, your transceiver sources a positive logic voltage when keyed, then connect this signal to the REMOTE BYPASS input (J4). This input is also high impedance and will withstand $\pm 50V$.

**Do NOT connect to
the Antenna**

The NIR-10's REMOTE BYPASS inputs are designed to be operated by a DC logic signal only, not RF. Therefore, DO NOT connect either of these inputs to the ANTENNA output of your transmitter. The NIR-10

will be damaged and your transmitter output may be damaged as well.

**AUDIO SECTION
TECHNICAL
DESCRIPTION**

The Audio Circuitry is detailed in Figure 2. The diagram is a full schematic of the audio and power supply and includes all circuitry which is not DSP hardware. The full schematic is given here because we consider it possible to troubleshoot these sections of the circuitry in the field.

Audio Input Audio input at connector J3 is routed to op-amp U18A, a unity-gain buffer amplifier. Resistors R33 and R32 along with diodes CR8 and CR9 protect U18A against input overloads. Op-amp U18B is a variable-gain amplifier that provides the audio input to the DSP section. Jumper JP2 sets the gain range to allow the NIR-10 to function at input audio levels between 120mV and 2.8V.

Audio Output The processed audio signal from the DSP circuitry is fed to the volume control pot R14. The input to speaker driver IC U19 is the signal from the wiper of the front panel volume pot. U19 drives the stereo headphone jack through rfi filter L1-C18. The speaker output J2 is passed through the headphone jack, so that it is disabled whenever headphones are plugged in.

Miscellaneous Gates U16A and U16B and associated components condition the remote bypass inputs. Serial resistors R9 and R10 along with diodes CR1 through CR4 protect the gate inputs against overloads. The output of U16A feeds the DSP parallel input port where its state is read by the

processor. The mode select and bandwidth select switches are also fed to the DSP input port to be read by the DSP. Noise in the input, the higher the level of this residual at the output.

Power Supply

The power supply includes U20, a passive 5V regulator, and U17, a switched-capacitor voltage converter. The DC voltage at J1 is applied through power switch SW3. Series diode CR5 protects against reversed polarity. A filter made up of C18, C19, and L4 suppresses trash that might be radiated by the power leads. U17 furnishes the -5V required by the A/D converter and the op-amps.

The +5V is generated by regulator U20. Series resistor R25 limits U20's dissipation.

DSP SECTION TECHNICAL DESCRIPTION

Figure 3 is a simplified schematic of the DSP section of the NIR-10. Only a simplified schematic is presented because this section is virtually impossible to troubleshoot without specialized equipment.

The general purpose of the DSP hardware is to convert analog signals to the digital domain, operate on and manipulate these signals digitally using the DSP chip, then convert the result back to analog. In the digital domain, the main tasks are to differentiate any speech components from the rest of the incoming signal (NIR mode) and band limit the signal (BANDPASS mode).

DSP and AIC

The heart of the DSP section is U15, a TMS320C25 DSP chip which performs all DSP functions other than A to D and D to A conversion. The chip runs at 40MHz which is supplied by clock oscillator U7. U13 is a 14-

bit Analog to Digital and Digital to Analog Converter. It provides the interface between the analog and digital realms. It supplies to, and accepts from, the DSP chip a serial digital expression of the input and output analog waveforms.

Reset Generator

U103 is a reset generator which ensures an orderly power-up sequence for the DSP and associated components. It senses the voltage on the +5V line and generates a reset while the voltage is below approximately 4.55V. As the voltage rises above the threshold, a delay is generated to ensure processor clock stability before operation commences.

Memory

EPROMS U9 and U10 provide program storage and static RAMs U11 and U12 provide data storage for the program.

Software

Noisy speech is speech that has been corrupted by some type of noise, such as “white” noise, electrical impulse noise, or acoustic noise. Enhancement of noisy speech generally implies that all the noise is removed while the speech remains intact. In practice it’s not quite this simple, since speech which has been corrupted by noise has irretrievably lost some of its original characteristics. Complete removal of all noise components may sometimes result in speech which is harder to listen to and interpret than the same speech passage with some particular noise components retained. There is a trade-off between intelligibility (can one determine what is being said?) and “listenability” (how pleasing...or grating...is the monitored audio?). Maximum noise component removal may turn an irritating noisy and tone-overlaid signal into one that’s much more pleasing to the ear, but the received speech must be

understood as well. The aim of noise reduction in speech is to improve not only the listenability of the noisy speech, but to improve its intelligibility as well. Noisy speech is difficult to listen to, since the brain has to work hard to discriminate between speech and noise. For this reason, fatigue may result when an operator attempts to interpret noisy speech for extended periods. There are times when intelligibility is more important than the pleasantness of the signal, while at other times the emphasis is placed on the listenability.

The NIR-10 software offers continuously variable noise reduction adjustable with the front panel NIR LEVEL control. The voltage set by the arm of the pot is digitized by its own A/D converter, U6. This allows the operator to choose the best balance between intelligibility and listenability. The proper setting of the NIR LEVEL control will be determined mainly by the type of noise and the signal to noise ratio of the noisy speech. In general, signals with low signal to noise ratios (i.e. 0dB or less) will work best at the minimum setting, while stronger, cleaner signals will benefit from more reduction.

Peak Detector

A peak detector monitors the input audio and flashes the Peak LED on audio peaks which are still somewhat below saturation. This function aids in setting up the NIR-10 with the proper audio levels.

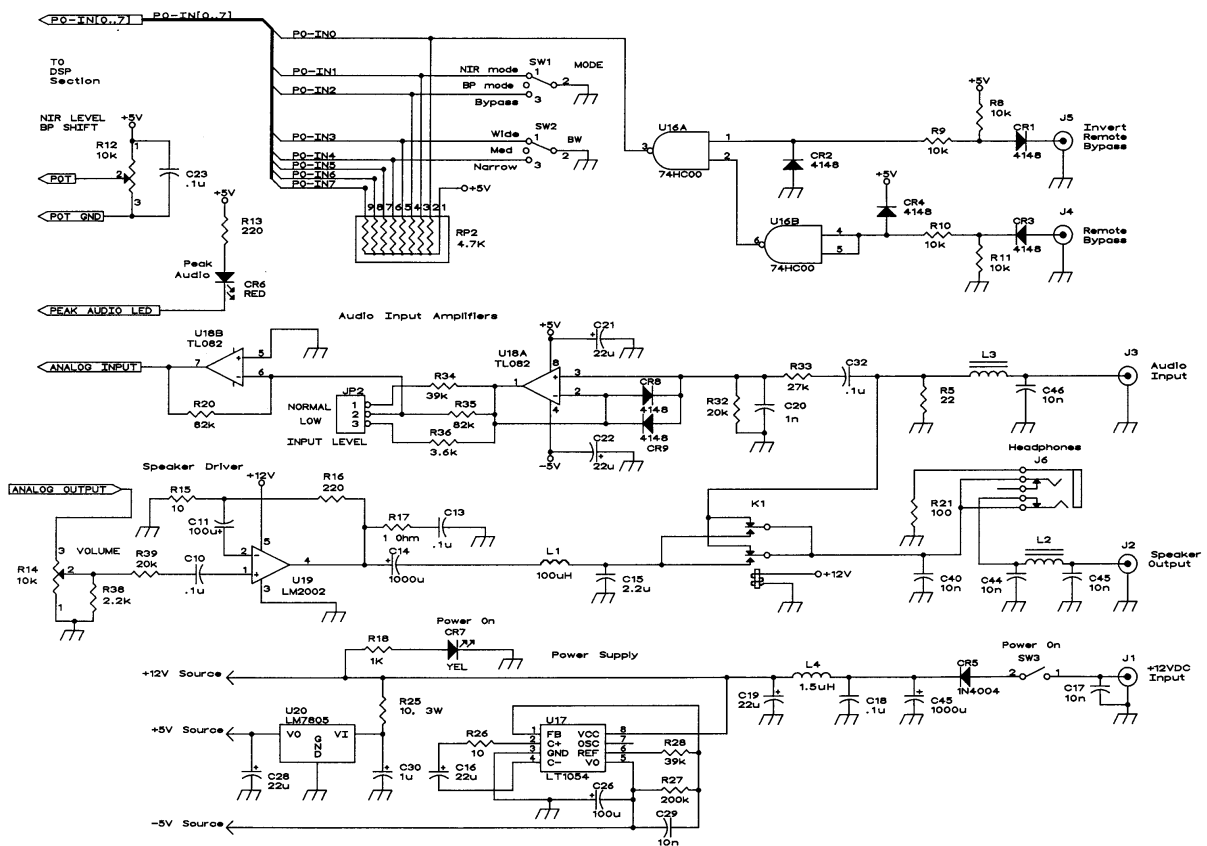


FIGURE 2 NIR-10 Audio and Power Supply Section Schematic

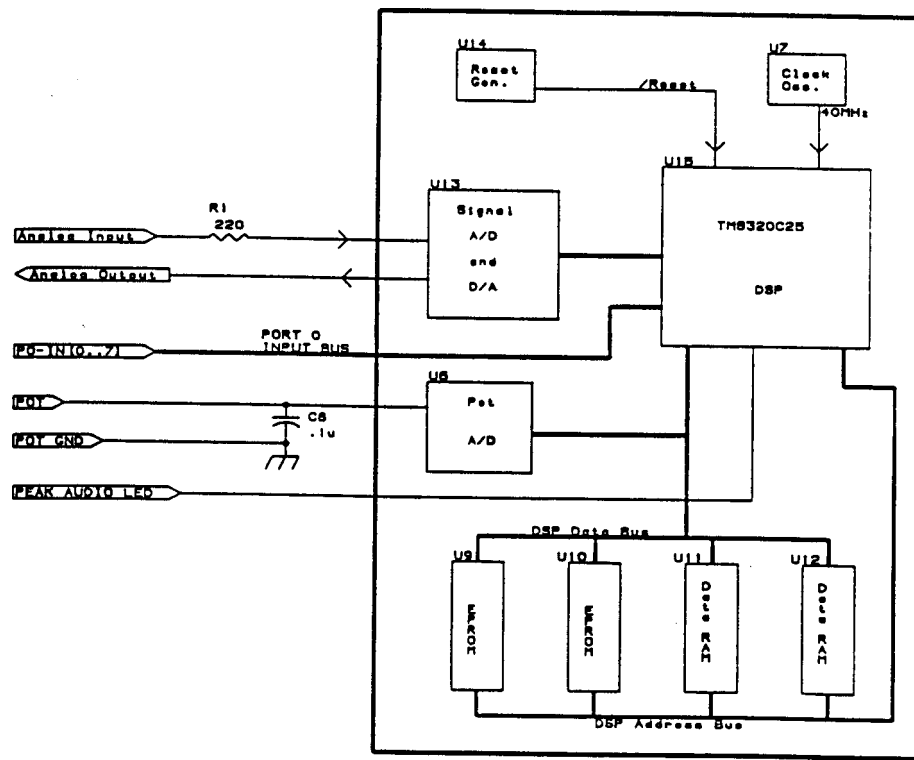


FIGURE 3 NIR-10 DSP Section Schematic

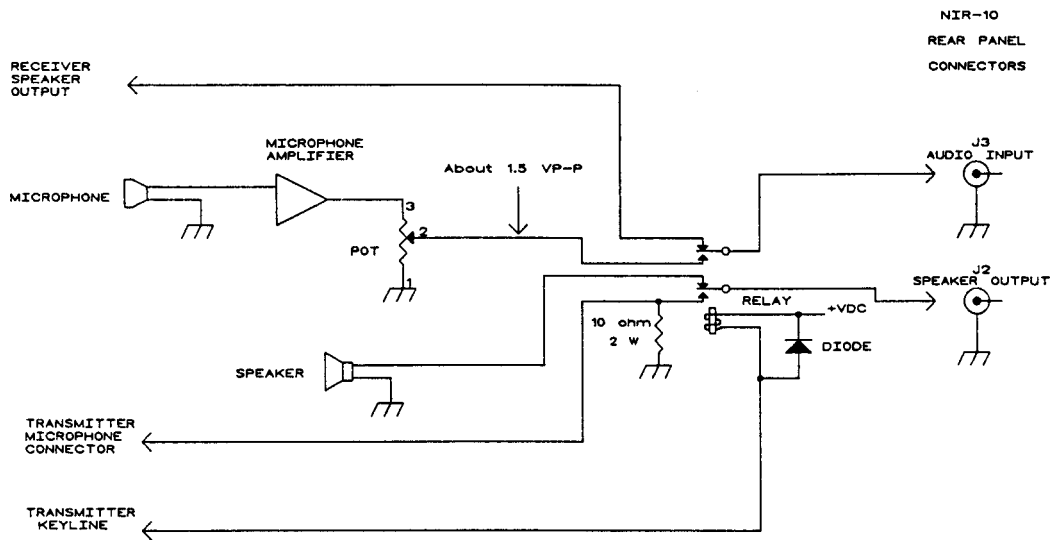


FIGURE 4 Connections for Transmit Audio Processing