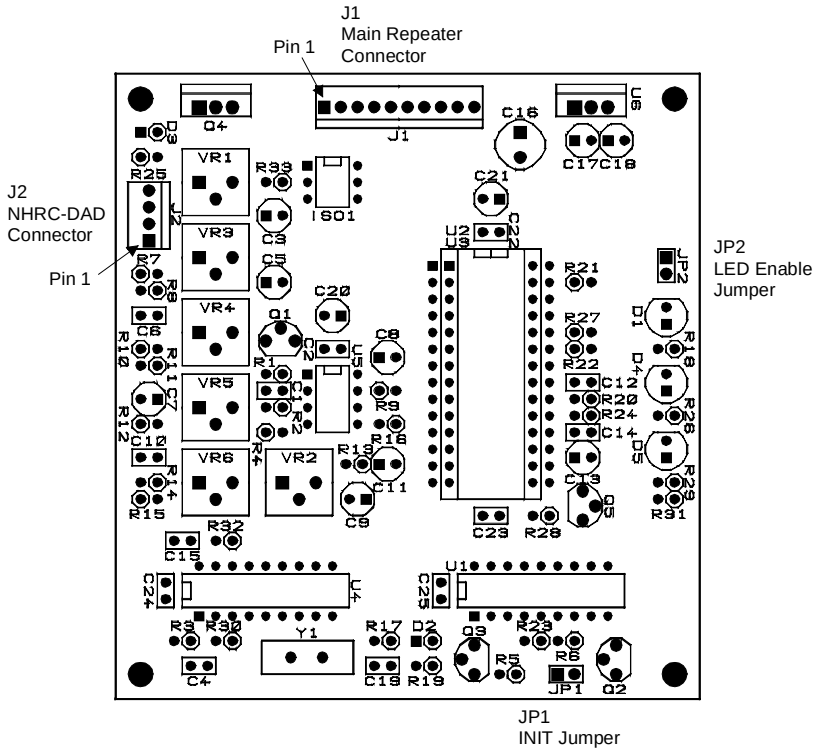
NHRC-3 Repeater Controller

Installation Instructions

These instructions will guide you in the installation and adjustment of the NHRC-3 repeater controller.

Contents

1. **Electrical Connections**
2. **The LED status indicators**
3. **Installing the Audio Delay**
4. **Adjustment of the Audio Levels**



Board Layout

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1. Electrical Connections

The controller uses a 10 pin .100 header for all signals. It requires receiver audio and a signal present indication (CAS) from the receiver, supplies transmit audio and PTT to the transmitter, and requires 13.8 volts DC for power. Be very careful when wiring DC power to the controller, reverse polarity will destroy the ICs. The connector pinouts are shown in the table below.

J1 Controller Electrical Connections

Pin	Use
1	+13.8 Volts
2	+13.8 Volts
3	CAS +
4	CAS -
5	PTT (active low)
6	Ground
7	TX Audio (to transmitter)
8	Ground/TX Audio Return
9	RX Audio (from receiver)
10	Ground/RX Audio Return

J2 Audio Delay Connections

Pin	Use
1	+13.8 Volts to delay board
2	Audio to delay board
3	Audio from delay board
4	Ground/Audio Return

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Receiver audio can typically be taken from the high side of the squelch control. This audio must be de-emphasized with the controller's optional de-emphasis circuit, which provides a -6dB/octave slope. Optionally, audio can be taken from later in the receiver's audio chain, where it is already de-emphasized. Care must be taken that this source of audio is not subject to adjustment by the radio's volume control. If the receiver audio has not been properly de-emphasized, either in the receiver itself or on the controller board, the repeater will have a very "tinny", unnatural sound to it.

To de-emphasize the receiver audio on the controller board, install a .0068 F capacitor in position C1, change R2 to 51K, and change R1 to 510K. These values should be considered a good starting point. You may want to experiment with the values of C1 and R1 to get better sounding audio. We have had consistently good results with this de-emphasis network.

The receiver must provide a signal present indication (also called COR, RUS, CAS) to the controller. Because of the varieties of polarity and state that this signal can take, we have chosen to implement the controller's signal present input with an opto-isolator (ISO1). The anode and cathode of the LED in the opto-isolator are exposed through a current limiting resistor (R30). This allows easy interfacing to active-high, active-low, and combinations of both to indicate the presence of a received signal to the controller. Clever wiring can allow the user to create CTCSS and COR, CTCSS or COR, etc. configurations. Note that **both** the CAS+ and CAS- terminals must be connected to something in order for the controller to detect the signal present indication.

Transmitter audio can be fed directly into the microphone input of the transmitter. VR2 is the master level control, used to set the audio level into the transmitter. The transmitter's deviation limiter (sometimes called IDC) should be set such that the transmitter cannot overdeviate, regardless of input signal level. One way to adjust transmitter deviation is to set the transmitter deviation limiter wide open (unlimited), adjust the controller's master output until the transmitter is slightly overdeviating, then set the transmitter's deviation limiter to limit just below 5 KHz deviation. Then reduce the controller's master output until the transmitted audio does not sound compressed or clipped. Transmitter deviation should be adjusted with a service monitor or deviation meter.

Transmitter keying is provided by a power MOSFET (Q6) configured in an open-drain circuit. This can be used to key many transmitters directly. The MOSFET essentially provides a closure to ground for PTT. For other transmitters, the MOSFET can drive a small relay to key the radio. Although this MOSFET can handle several amps, we recommend that no more than 500 mA of current be drawn through it.

2. The LED Status Indicators

The NHRC-3 repeater controller is equipped with three status LEDS that aid in setup and

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troubleshooting. The green LED indicates that the controller is getting a valid CAS (carrier operated switch) and, if the TS-32 is connected, a valid CTCSS decode signal. This LED should light when the repeater's receiver is active, and, when the TS-32 is properly installed, the correct CTCSS tone is present. The yellow LED indicated that a DTMF signal is being decoded. This LED should light for the entire duration that the DTMF signal is present on the receiver. The red LED indicates transmit. This LED will light when the transmitter is transmitting.

The LEDS can be disabled to reduce the power consumption of the controller. Remove jumper JP2 to disable the LEDS.

3. Installing the Audio Delay

Remove the jumper between pins 2 and 3 of J2, then plug the cable from the audio delay board onto the J2 header. If the audio delay is not installed, then the jumper must be present between pins 2 and 3 of J2.

4. Adjusting the Audio Levels

Preset all potentiometers to midrange. Key a radio on the input frequency, send some touch-tones, and adjust VR1 (the main receive level) until DTMF decoding is reliably indicated by yellow LED D4.

The repeater's deviation is set with VR2 (the master level) on the controller board and the transmitter's deviation/modulation control. The key to properly adjusting these controls is to remember that the limiter in the tranmitter is *after* VR2 but probably *before* the transmitter's deviation/modulation control. The transmitter's deviation/modulation control will set the actual *peak* deviation, and VR2 will set the level into the transmitter. You do not want excessive limiting on normal speech going through the repeater; it sounds bad and tends to "pump-up" background noise. On the other hand, some limiting is desirable. An oscilloscope connected to the audio output of a receiver tuned to the transmitter's frequency will show limiting as the audio gets "flat-topped" or clipped by the limiter. Ideally, a 4.5KHz deviation signal input to the repeater should result in a 4.5 KHz deviation output, and 5.5 KHz of input deviation should result in just under 5.0 KHz of deviation out of the repeater. A service monitor (or two), deviation meter, and/or a signal generator are necessary to do this job right.

Adjust VR6 (the beep level) to set the courtesy tone and CW tone level.

The easiest way to adjust the ISD2590 input and output levels is to select the simplex repeater mode and record and play messages until the audio sounds right. VR3 adjusts the record audio level into the ISD2590. Adjust this control for the best sounding record

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audio. VR5 sets the ISD2590 playback level. Adjust this control for best acceptable transmitter deviation. Note that the ISD2590 includes on-chip limiting/compression; this may fool you into thinking that you have the input level set just right when it is really too high. Try recording a whisper, it should play back quietly, also try recording normal speech with large gaps between words in a somewhat noisy environment to listen for background noise pumping. Properly adjusted, the ISD2590 recorded audio should be indistinguishable from normal audio repeated through the system.

VR4 is used to set the receiver audio level, and may not need to be adjusted from midpoint.

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NHRC-3 Series Repeater Controllers

Operation Instructions
Firmware Version 5.x

These instructions will guide you in the operation of the NHRC-3 Series repeater controllers. For installation instructions, see the appropriate installation manual.

Contents

1. Introduction

2. Initializing

3. Programming

1. **Controller Modes**
2. **Programming the Controller**

   Programming the Timers
   Programming the CW Messages
   Programming the Flag Bits
   Recording the Voice Messages

3. **Enabling/Disabling the Repeater**

4. Operating

1. **About the IDs**
2. **About the Special ID Mode**
3. **The Tail Message**
4. **Using the Tail Message as the Courtesy Tone**
5. **Using the NHRC-DAD Digital Audio Delay with the NHRC-3 series repeater controllers**

5. Programming Example

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Index of Tables

- Configuration Flag Bits
- Message Commands
- Message Numbers
- Morse Code Character Encoding
- Programming Memory Map
- Timer Address and Resolution

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1. Introduction

The controller's programming is protected from unauthorized access by a 4-digit secret passcode. The controller is programmed by 8-digit DTMF commands that all begin with the 4 digit passcode. Throughout this manual, commands will be shown as **ppppNNNN**, where **pppp** represents the passcode, and **NNNN** is the actual command to the controller.

In order to save space in the microprocessor memory, the NHRC-3 repeater controllers represent all numbers in "hexadecimal" notation. Hexadecimal, or hex for short, is a base-16 number format that allows a 8-bit number to be represented in two digits. Hex numbers are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, and F. Converting decimal (the normal base-10 numbers that 10 fingered humans prefer) to hex is simple: divide the decimal number by 16 to get the 1st hex digit (10=A, 11=B, 12=C, 13=D, 14=E, 15=F), the remainder is the 2nd hex digit. Many scientific calculators can convert between these two number systems, and the Windows 95/98/ME calculator can, too, if the "scientific" view is selected.

We provide a WWW page that can generate all the programming data for the NHRC-3 controllers quickly and easily, see: http://www.nhrc.net/nhrc-3/nhrc3prog.html.

2. Initializing the Controller

The controller will need to be initialized to allow you to set your secret passcode. Initializing the controller also resets all programmable settings to the factory defaults, including the CW ID message, and sets all the stored voice messages to blank. It should not be necessary to initialize the controller again, unless you want to change the passcode. **The only way to change the passcode is to initialize the controller.**

To initialize the controller, remove power and install the INIT jumper (JP1). Apply power to the controller, and after a few seconds, remove the INIT jumper. The controller

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is now in the initialize mode. If you "kerchunk" the controller now, it will send the default CW ID of "DE NHRC/3". Now transmit your 4-digit passcode. The controller will respond by sending "OK" in CW **once**. The controller will store the passcode and enter the disabled condition.

At this time, the controller will seem to be "dead", it will not respond to keyups, kerchunks, etc.

In fact, the controller will now only respond to correctly formatted 8-digit command messages. The controller initializes into the disabled condition specifically to allow programming and configuration of simplex repeaters; if it came up into a duplex operating condition, simplex repeaters *could not be programmed!*

To select duplex mode (before enabling the repeater), send the following DTMF sequence:

`pppp0100`

Note: Duplex mode is enabled by default on initialization.

To select simplex mode (before enabling the repeater), send the following DTMF sequence:

`pppp0102`

Note: Do not enable a simplex repeater without first selecting simplex mode, or else you will not be able to program the controller until you initialize it again!

If the controller is connected to a full-duplex repeater or link radio, you may wish to enable it at this time. To put the repeater into the enabled condition, send the following DTMF sequence:

`pppp0001`

This command will "turn on" the repeater.

3. Programming

1. Controller Modes

The controller can operate in 3 different modes:

- Repeater Controller Mode
  The controller operates a full-duplex repeater, with a courtesy tone and stored voice messages.

- Link Controller Mode
  This is a variation of Repeater Controller Mode where the ISD2590 voice

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storage chip is deleted to lower the cost of the controller. This mode is intended to control remote receivers that are essentially crossband repeaters. Normally, when using link controller mode, the hang time is set to 0 seconds, and the controller is programmed to suppress DTMF muting, so the user's DTMF commands will appear on the input of a "downstream" controller. The controller adds remote control, a timeout timer and CW ID capability to remote or link receivers.

- Simplex Repeater Controller Mode
  This mode allows simplex (as opposed to duplex) radios to be used as repeaters. Up to 90 seconds of received audio is stored in the ISD2590 voice storage chip, and is "parroted" back when the user unkeys. The ID message is played in CW.

2. Programming the Controller

All programming is done by entering 8-digit DTMF sequences. The first 4 digits are the *passcode* chosen at initialization. The next 2 digits are an *address* or a *function code*. The last 2 digits are the *data* for address or function. To enter programming information, you must key your radio, enter the 8 digits, then unkey. If the controller understands your sequence, it will respond with "OK" in CW. If there is an error in your sequence, but the passcode is good, the controller will respond with "NG". If the controller does not understand your command at all, it will not respond with anything other than a courtesy beep, and then only if the courtesy beep is enabled. If the controller is disabled, and an unrecognized command is entered, no response will be transmitted at all.

3. Responses to Commands

Response	Meaning
"OK"	Command Accepted
"NG"	Command address or data is bad
courtesy beep or nothing	Command/password not accepted

If you enter an incorrect sequence, you can unkey before all 8 digits are entered, and the sequence will be ignored. If you enter an incorrect address or incorrect data, just re-program the location affected with the correct data.

In order to save space, reduce keystrokes, and eliminate some software complexity, all programming addresses and data are entered as hexadecimal

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numbers. Hexadecimal (or hex, for short) is a base-16 notation that is particularly convenient for use in digital computer systems because each hex digit represents 4 bits of a value. The controller uses pairs of hex digits to represent 8-bit values for the address and data of programming information. Any decimal number from 0 to 255 may be represented by two hex digits. Hex digits are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F, where A through F represent values from 10 to 15. To convert a decimal number from 0 to 255 to hex, divide the decimal number by 16. The quotient (number of whole 16s) forms the left (high) digit, and the remainder forms the right (low) digit. Thus, 60 decimal = 3 x 16 + 12 = 3C hex.

The DTMF keys 0-9 and A-D map directly to their corresponding digits.

Important!: Use the * key for digit E and the # key for digit F.

A 16-key DTMF generator is required to program the controller.

1. **Programming the Timers**
   The NHRC-3 series repeater controllers provide several timers which control the operation of your repeater. The *Hang Timer* controls how long the repeater will continue to transmit after a received signal drops. This is often called the repeater's "tail". The tail is useful to eliminate annoying squelch crashes on users' radios; as long as a reply is transmitted before the hang timer expires, the repeater will not drop, which would cause a squelch crash in the users' radios.

   The *Timeout Timer* controls the maximum duration of the retransmission of a received signal. It is more of a safety measure to protect the repeater from damage than a way to discourage long-winded users, even though it is often used that way.

   The *ID Timer* sets the maximum duration between transmissions of the repeater's ID message(s). Note that the NHRC-3 may transmit an ID message before the timer expires in order to avoid transmitting the ID message while a user is transmitting.

   The timer values are stored as an 8-bit value, which allows a range of 0 to 255. Some of the timers require high-resolution timing of short durations, and others require lower resolution timing of longer durations. Therefore, timers values are scaled by either 1/10, 1, or 10 seconds, depending on the application.

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Timer Address and Resolution

Timer	Address	Resolution Seconds	Max. Value Seconds
Hang Timer	02	1/10	25.5
Timeout Timer	03	1	255
ID Timer	04	10	2550

Enter the 4 digit passcode, the timer address, and the timer value, scaled appropriately.

Example: To program the Hang Timer for 10 seconds, enter **`pppp0264`**, where **`pppp`** is your passcode, **`02`** is the hang timer address, and **`64`** is the hexadecimal value for 100, which would be 10.0 seconds.

2. **Programming the CW Messages**
   CW messages are programmed by storing encoded CW characters into specific addresses in the controller. Use the Morse Code Character Encoding table and the Programming Memory Map to determine the data and address for the CW message characters.

   Example: To program "DE N1KDO/R" for the CW ID, you would use the following commands:

DTMF Command	Address	Data	Description/Purpose
*pppp*0#09	0F	09	D
*pppp*1002	10	02	E
*pppp*1100	11	00	space
*pppp*1205	12	05	N
*pppp*133*	13	3E	1
*pppp*140D	14	0D	K

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*pppp*1509	15	09	D
*pppp*160#	16	0F	O
*pppp*1729	17	29	/
*pppp*180A	18	0A	R
*pppp*19##	19	FF	End of message marker

The CW ID can store a message of up to 40 characters. Do not exceed 40 characters. To play CW messages, use command **`pppp40xx`**, where **`xx`** is the number of the CW message you want to play.

3. **Programming the Flag Bits**
Controller features can be enabled of disabled with the use of the Configuration Flag Bits. These bits are encoded into a single byte, which is programmed into the controller at address 01. Multiple flag bits can be selected by adding their hex weights. For example, to set up a link controller with no ISD chip, no courtesy tone, and suppress the DTMF muting, you would add 01, 10, and 20 to produce hex 31, which you would then program into address 01 in the controller as **`pppp0131`**.

   In addition to programming the flag bits as a group using address 01, the controller supports commands to set or clear these bits individually. Command 60 is used to clear (zero) a specified configuration bit, and command 61 is used to set (one) a specified configuration bit.

   Example: To set (turn on) bit 4 (to suppress the courtesy tone), enter the following command: **`pppp6104`**. To clear bit 4 and enable the courtesy tone, enter this command: **`pppp6004`**. Note that the bit *number*, not it's hex weight is used for commands 60 and 61.

Configuration Flag Bits

Bit	Hex Weight	Feature
0	01	ISD Absent
1	02	Simplex repeater mode
2	04	Audio Delay Installed

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3	08	(reserved)
4	10	suppress courtesy tone
5	20	suppress DTMF muting
6	40	use tail message for courtesy tone
7	80	special ID mode

Example Configurations

Flag Bits Value	Features Selected
00	Duplex Repeater Mode
02	Simplex Repeater Mode
04	Duplex Repeater Mode audio delay installed
31	Link Controller Mode: no ISD chip no courtesy tone no DTMF muting
40	Duplex Repeater Mode tail message is courtesy tone
80	Duplex Repeater Mode special ID mode
C0	Duplex Repeater Mode tail message is courtesy tone special ID mode
C4	Duplex Repeater Mode Audio Delay Installed tail message is courtesy tone special ID mode

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4. **Recording the Voice Messages**
   Stored voice messages can be played and recorded, and CW messages can be played by using the message commands. Command 40 is used to play stored voice or CW messages, and command 41 is used to record stored voice messages.

   To record stored voice messages, use command **`pppp41xx`**, where **`xx`** is the number of the message you want to record, found in the message numbers table below. Unkey after the command sequence, then key up, speak your message, and unkey. The controller will remove about 100 ms from the end of your message to remove any squelch crash that might have been recorded.

   To play stored voice messages, use command **`pppp40xx`**, where **`xx`** is the number of the stored voice message you want to play.

Message Numbers

Message Number	Contents
10	Voice Initial ID Message
11	Voice Normal ID Message
12	Voice Timeout Message
13	Voice Tail Message

You may wish to have a family member or member of the opposite sex record your ID messages. The recorded audio sounds natural enough that people have actually tried to call the amateur whose callsign is recorded in the controller after the ID message plays!

4. Enabling/Disabling the Repeater

The repeater can be disabled or enabled by remote control by setting the value in location 00. Set this location to zero to disable, or non-zero to enable. For instance, to disable the repeater, send command **`pppp0000`**. To enable the repeater, send command **`pppp0001`**.

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4. Operating

1. About the IDs

When the repeater is first keyed the controller will play the “Initial ID”. If the repeater is keyed again before the ID timer expires, the controller will play the “Normal ID” when the ID timer expires. If the repeater is not keyed again, and the ID timer expires, the controller will reset and play the “Initial ID” the next time the repeater is keyed. If the repeater is keyed while the controller is playing a stored voice message ID, the controller will cancel the stored voice message ID and play the CW ID.

The idea behind this IDing logic is to prevent unnecessary IDing. For instance, if a repeater user keys the machine and announces “This is N1KDO, monitoring”, the controller will play the “Initial ID”, and no further IDing will occur unless the repeater is keyed again. If users commence with a QSO, keying the repeater at least once more, the controller will play the “Normal ID” and reset the ID timer when the ID timer expires. If the repeater becomes idle for one ID timer period after the last ID, then the next time it is keyed it will play the “Initial ID”. The intent is that the repeater users only hear the “Initial ID” the first time that they key the repeater.

2. About the Special ID Mode

The "Special ID Mode" operates differently in "normal" repeater mode than in simplex repeater mode. In normal repeater mode, enabling special ID mode will cause a CW ID to be sent instead of the “Normal ID” message. In Simplex Repeater Mode, enabling special ID mode will cause the controller to play the "Initial ID” (stored as voice message #10) instead of playing a CW ID. In simplex mode, the maximum repeated message duration is reduced by 1/4 to accommodate this voice ID. (About 67 seconds instead of 90). In summary, the special ID mode will cause a CW ID to play instead of the normal voice ID in normal repeater mode, or will allow a voice ID to be played instead of a CW ID in simplex repeater mode.

3. The Tail Message

The controller supports a "Tail Message" that plays the *n*th time the hang timer expires. The number of times the hang timer must expire before the tail message plays (*n*) is the "tail message counter" at address 05. The tail message counter can be set from 1 to 255. The tail message is disabled if the tail message counter is set to 0. Program the tail message counter value into address 05.

Example: To have the tail message play after the 4th tail drop, program **`pppp0504`**. *Try it.*

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4. Using the Tail Message as the Courtesy Tone

The tail message can be used as the courtesy tone if bit 6 is set in the configuration flags. In this case, you will likely want to set the tail message counter value to 0 to keep the message from playing twice occasionally. The message could store the sound of a bell, a dog's bark, or the repeater trustee saying "what?"!

5. Using the NHRC-DAD Digital Audio Delay with the NHRC-3 series repeater controllers

The NHRC-3 series repeater controllers support the optional NHRC-DAD digital audio delay board. The NHRC-DAD allows complete muting of received DTMF tones (no leading beep before muting), and suppression of squelch crashes when the received signal drops. The NHRC-DAD has a 128 ms delay on all received audio. NHRC-3 repeater controllers support the DAD with a software switch, settable by a configuration flag bit, and a dedicated connector on the controller for the DAD.

Note: If the DAD is not present, then a jumper must be installed between pins 2 and 3 of the DAD connector (see installation manual.) If the DAD is present, then the appropriate configuration flag bit must be set (in the case of the NHRC-3 series controller, set bit 2, hex weight 04.)

5. Programming Example

Programming the NHRC-3 series repeater controllers can seem quite complicated at first. This section of the manual is intended as a tutorial to help you learn how to program your controller.

Let's assume we want to program a NHRC-3 Series Repeater Controller with the following parameters:

CW ID: DE N1LTL/R FN42
Hang Time 7.5 seconds
Timeout timer 120 seconds
Play tail message every 6 tail drops.

First, we will initialize the controller. Install JP1 and apply power to the controller to initialize. After a few seconds, remove JP1. Send DTMF **`2381`** to set access code to 2381. The controller will send "OK" in CW to indicate the passcode was accepted. Now the controller is initialized, and disabled.

If we were programming a simplex repeater, we would now set the configuration flags for simplex mode, so we could turn the controller on and still be able to program it. For duplex repeaters, this step should not be performed. Send DTMF **`23810102`** to set the simplex repeater mode flag bit.

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Now we will enable the controller. Send DTMF **23810001** (passcode=2381, address=00, data=01). The controller will send "OK" in CW to indicate the command was successful.

We will now program the CW ID. Looking at the "Programming Memory Map", we can see that the first location for the CW ID is 0F. The first letter of the ID is 'D', which we look up in the "Morse Code Character Encoding" table and discover that the encoding for 'D' is 09. So location 0F gets programmed with 09. Since the F digit is represented by the DTMF digit '#', the '#' is used to send the 'F'.

Send DTMF **23810#09** to program the letter 'D' as the first character of the CW ID. The controller will send "OK" in CW if the command is accepted. If you entered the command correctly, but you don't get the "OK", your DTMF digits may not all be decoding. See the Installation guide for your controller to readjust the audio level for the DTMF decoder.

The next character is the letter 'E', which is encoded as 02, and will be programmed into the next address, which is 10. Send DTMF **23811002**.

The next character is the space character, and it will be programmed into address 11. Send DTMF **23810B00**. Here are the rest of the sequences to program the rest of the ID message:

23811205 (N in address 12)
2381133* (1 in address 13)
23811412 (L in address 14)
23811503 (T in address 15)
23811612 (L in address 16)
23811729 (/ in address 17)
2381180A (R in address 18)
23811900 (space in address 19)
23811A14 (F in address 1A)
23811B05 (N in address 1B)
23811C30 (4 in address 1C)
23811D3C (2 in address 1D)

After the last character of the CW ID is programmed, the End-of-Message character must be programmed. In this case, the last character of the ID message was programmed into address 1D, so the EOM character, which is encoded as FF, goes into address 1E: **23811*##** (EOM into address 1E.)

To program the hang timer, we must first determine the address of the hang timer by consulting the Programming Memory Map. The Hang Timer preset is stored in location 02. Next, we need to convert the 7.5 seconds into tenths, which would be 75 tenths of a second. Then the 75 gets converted to hex:

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75 / 16 = 4 with a remainder of 11, so 75 decimal equals 4B hex.

Now program the hang timer preset by sending **2381024B**.

To program the timeout timer with 120 seconds, we get the address of the timeout timer preset, which is 03, and then convert 120 seconds to hex:

120 / 16 = 7 with a remainder of 8, so 120 decimal equals 78 hex.

So we will program location 03 with 78: **23810378**

To program the tail message counter, we determine the address of the counter (05) and since 6 is less than 16, the hex conversion is easy:

6 / 16 = 0 remainder 6, so 6 decimal equals 06 hex.

We will program location 05 with 06: **23810506**

If we were programming a simplex repeater, we would stop here. Except in the case of the "special ID mode" no voice messages need to be stored for simplex repeater mode.

Now we can record the 4 voice messages. The voice messages are recorded by "programming" address 41 with the message number, then recording the message. We will program the Initial ID Message (message number 10, see the "Message Numbers" table) first:

Send **23814110**, then key up again and clearly speak the message to be recorded "This is N1LTL repeater in Candia, New Hampshire, an open repeater available to all licensed amateur radio operators." Unkey after you are done speaking.

The "Normal ID" (11), Timeout Message (12), and Tail Message (13) can be recorded the same way:

Send **23814111**, speak "N1LTL repeater".
Send **23814112**, speak "A longwinded blatherskite has timed out the repeater."
Send **23814113**, speak "Free Beer Tonight at N1LTL's!"

Any message can be played back at any time by "programming" location 40 with the message code you want to play. To play the CW ID, send **23814000**. To play the tail message, send **23814013**.

This tutorial did not discuss programming the ID timer, but the concepts described here apply to that timer as well.

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Tables

Message Commands

Command	Description
40xx	00 <= xx <= 03, play CW message xx
40xx	10 <= xx <= 13, play voice message xx
41xx	10 <= xx <= 13, record voice message xx

CW Message Numbers

Message Number	Contents
00	CW ID
01	CW Timeout Message "TO"
02	CW Confirmation Message "OK"
03	CW Invalid Command Message "NG"

Voice Message Numbers

10	Voice Initial ID Message
11	Voice Normal ID Message
12	Voice Timeout Message
13	Voice Tail Message

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Programming Memory Map

Address	Default Data	Comment	Address	Default Data	Comment
00	01	enable flag	1c	ff	(empty)
01	00	configuration flags	1d	ff	(empty)
02	32	hang timer, in tenths	1e	ff	(empty)
03	1e	time-out timer, in seconds	1f	ff	(empty)
04	36	ID timer, in 10 seconds	20	ff	(empty)
05	00	tail message counter	21	ff	(empty)
06	0f	'O' OK Message	22	ff	(empty)
07	0d	'K'	23	ff	(empty)
08	ff	EOM	24	ff	(empty)
09	05	'N' NG Message	25	ff	(empty)
0a	0b	'G'	26	ff	(empty)
0b	ff	EOM	27	ff	(empty)
0c	03	'T' TO Message	28	ff	(empty)
0d	0f	'O'	29	ff	(empty)
0e	ff	EOM	2a	ff	(empty)
0f	09	'D' CW ID starts here	2b	ff	(empty)
10	02	'E'	2c	ff	(empty)
11	00	space	2d	ff	(empty)
12	05	'N'	2e	ff	(empty)
13	3e	'1'	2f	ff	(empty)
14	0d	'K'	30	ff	(empty)

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15	09	'D'	31	ff	(empty)
16	0f	'O'	32	ff	(empty)
17	29	'/'	33	ff	(empty)
18	0a	'R'	34	ff	(empty)
19	ff	(end of message mark)	35	ff	(empty)
1a	ff	(empty)	36	ff	(empty)
1b	ff	(empty)	37	ff	(empty)

Note: The entire range of 0F-37 is available for your CW ID message.
Important!: Do not forget to terminate the message with the FF (end-of-message) character.

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Morse Code Character Encoding

Character	Morse Code	Binary Encoding	Hex Encoding	Character	Morse Code	Binary Encoding	Hex Encoding
sk	. . . - . -	01101000	68	h	. . . .	00010000	10
ar	. - . - .	00101010	2a	i	. .	00000100	04
bt	- . . . -	00110001	31	j	. - - -	00011110	1e
/	- . . - .	00101001	29	k	- . -	00001101	0d
0	- - - - -	00111111	3f	l	. - . .	00010010	12
1	. - - - -	00111110	3e	m	- -	00000111	07
2	. . - - -	00111100	3c	n	- .	00000101	05
3	. . . - -	00111000	38	o	- - -	00001111	0f
4	. . . . -	00110000	30	p	. - - .	00010110	16
5	. . . . .	00100000	20	q	- - . -	00011011	1b
6	-	00100001	21	r	. - .	00001010	0a
7	- - . . .	00100011	23	s	. . .	00001000	08
8	- - - . .	00100111	27	t	-	00000011	03
9	- - - - .	00101111	2f	u	. . -	00001100	0c
a	. -	00000110	06	v	. . . -	00011000	18
b	- . . .	00010001	11	w	. - -	00001110	0e
c	- . - .	00010101	15	x	- . . -	00011001	19
d	- . .	00001001	09	y	- . - -	00011101	1d
e	.	00000010	02	z	- - . .	00010011	13
f	. . - .	00010100	14	space		00000000	00
g	- - .	00001011	0b	EOM		11111111	ff

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Notes:

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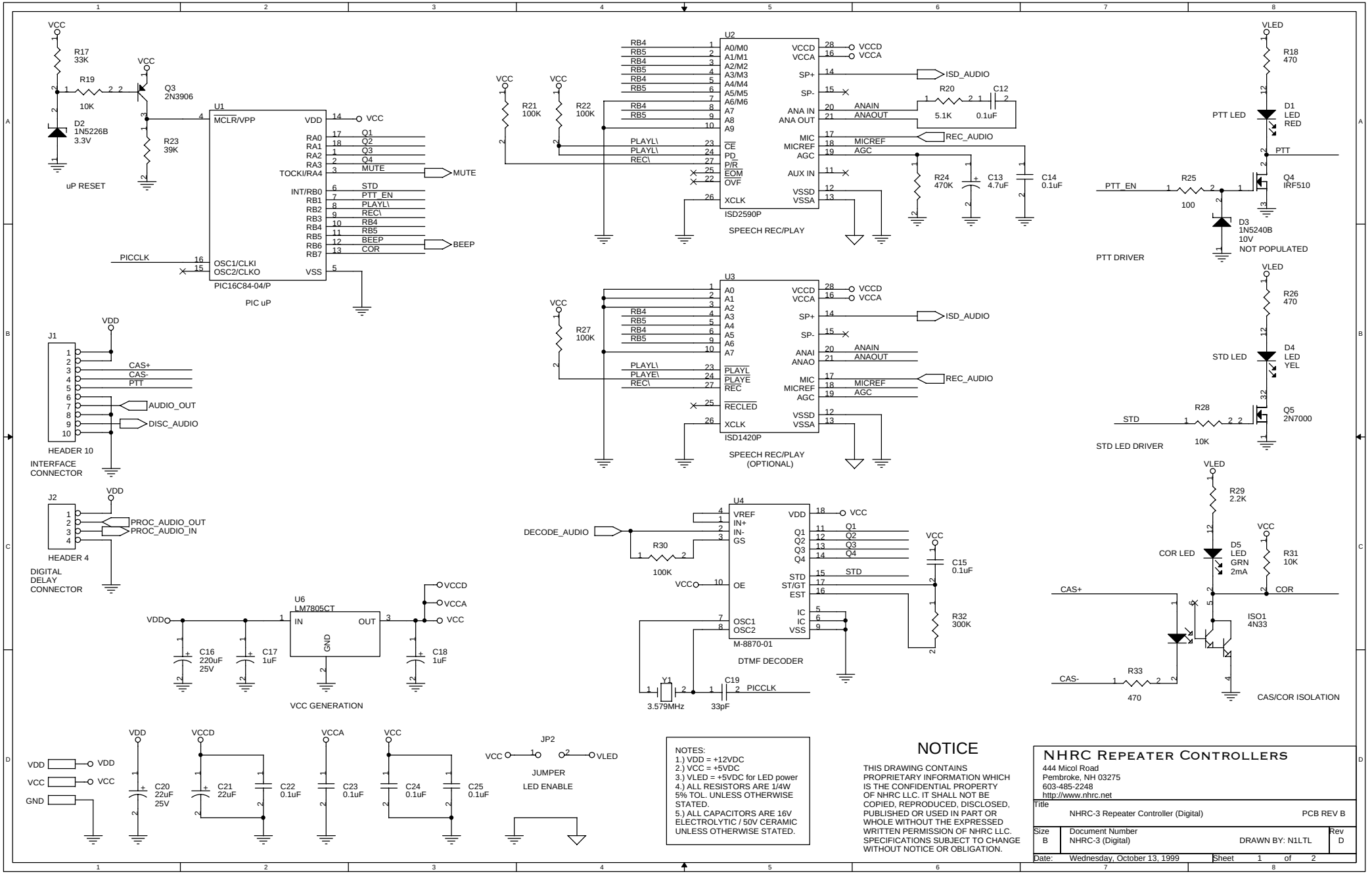

NOTES:
1.) VDD = +12VDC
2.) VCC = +5VDC
3.) VLED = +5VDC for LED power
4.) ALL RESISTORS ARE 1/4W 5% TOL. UNLESS OTHERWISE STATED.
5.) ALL CAPACITORS ARE 16V ELECTROLYTIC / 50V CERAMIC UNLESS OTHERWISE STATED.

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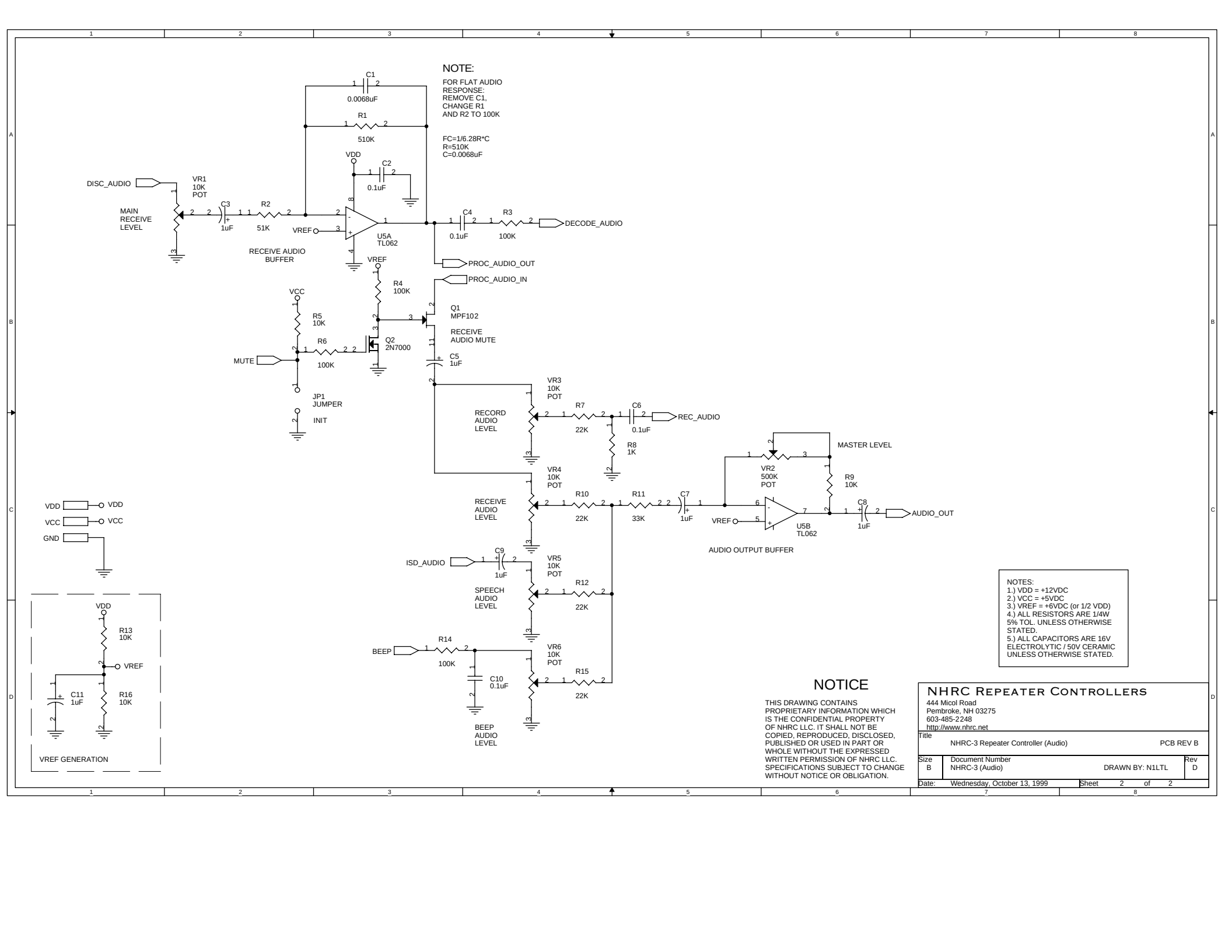
NHRC Repeater Controllers
444 Micol Road
Pembroke, NH 03275
603-485-2248
http://www.nhrc.net

Title	NHRC-3 Repeater Controller (Digital)	PCB REV B
Size B	Document Number NHRC-3 (Digital)	DRAWN BY: N1LTL Rev D
Date: Wednesday, October 13, 1999	Sheet 1 of 2	



NOTES:
1.) VDD = +12VDC
2.) VCC = +5VDC
3.) VREF = +6VDC (or 1/2 VDD)
4.) ALL RESISTORS ARE 1/4W 5% TOL. UNLESS OTHERWISE STATED.
5.) ALL CAPACITORS ARE 16V ELECTROLYTIC / 50V CERAMIC UNLESS OTHERWISE STATED.

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NHRC Repeater Controllers
444 Micol Road
Pembroke, NH 03275
603-485-2248
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Title	NHRC-3 Repeater Controller (Audio)	PCB REV B
Size B	Document Number NHRC-3 (Audio)	DRAWN BY: N1LTL — Rev D
Date: Wednesday, October 13, 1999	Sheet 2 of 2	

NHRC LLC Limited Warranty

NHRC LLC warrants that it's assembled and tested products will be free from defects in materials and workmanship for a period of NINETY DAYS from the date of shipment. During this period, NHRC LLC will repair or replace, at our option, any of our products that fail as a result of defects in materials or workmanship. NHRC LLC's liability will be limited to parts, labor, and return shipping for this period.

NHRC LLC warrants that it's kit products will contain components that are free from defects in materials and workmanship for a period of THIRTY DAYS from the date of shipment. During this period, NHRC will replace any of the components in a kit ONCE. Subsequent replacement of any component any subsequent times is completely at the discretion of NHRC LLC, and may require the complete return of the kit.

In no case will NHRC LLC be liable for products damaged by improper wiring (including, but not limited to, over-voltage or application of reverse polarity), physical damage resulting from misuse and/or abuse of the product, neglect, or acts of God (lightning, floods, etc.).

Unauthorized modification of a NHRC product will void the warranty on the modified product.

In no case will NHRC LLC be liable for any direct, consequential, or incidental loss or damage resulting from the use or inability to use any of it's products.

Some states or countries do not allow the limitation of incidental or consequential damages, so the paragraph above may not apply to you.

This warranty applies only to the original purchaser of the product; proof of purchase must be presented to receive warranty service.

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