NHRC
REPEATER CONTROLLERS

NHRC-4 Operating Manual

Software Version: 3.0

User Guide Version: 2006-Feb-03

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Thank You!

Thank you for purchasing the NHRC-4 Repeater Controller. Please review this manual carefully before putting your controller into operation.

This manual represents a large documentation effort. Your comments are important to us. If you find an error or find any passages that are not clearly understandable, we would like to hear about it. Please send your comments to ***software-support@nhrc.net***.

Support for the controller is available by email or telephone. Please direct software-related questions via email to ***software-support@nhrc.net***. Please direct hardware-related questions via email to ***hardware-support@nhrc.net***. Your question(s) will be answered promptly.

Questions of a more urgent nature can be answered by telephone support. Telephone support is available Monday through Friday, from 6 PM until 10 PM, Eastern time.

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NHRC-4 Operating Manual

1. Introduction

The NHRC-4 Repeater Controller represents the current state-of-the-art in repeater controller designs. It utilizes the latest available technology to provide maximum functionality with the lowest number of parts. This results in very reliable operation.

The key features of the NHRC-4 are:

- Remote base/link port.
- Unique courtesy tones to indicate status of link port.
- Transmitter fan control output automatically runs fan while transmitting and for a programmable delay after.
- "Carrier," and DTMF access modes.
- Granular security features that allow tailored control operator access.

This manual describes the operation of the NHRC-4 software. It should be used in conjunction with the NHRC-4, NHRC-4/M2, or NHRC-4/MVP installation and adjustments manual, depending on which controller you are using.

1.1 Sending commands

All of the controller's commands are sent by DTMF (Touch-Tone®) sequences that are received on the main repeater. DTMF tones received will be evaluated, and if correct, executed, when either the DTMF inter-digit timer expires (2.0 seconds) or the CAS (receiver unsquelched) signal drops; whichever comes first. This allows the controller to be commanded even when a weak on-channel signal is holding the receiver's squelch open.

To send a command over the main repeater,

1. Key your transmitter.
2. Enter the DTMF command digits.
3. Unkey the transmitter.

This will cause the command to be evaluated immediately.

If you pause for more than 2.0 seconds while sending a command, the command you entered prior to the pause will be evaluated, the command buffer will be emptied, and you can immediately enter another command.

When a command is successfully evaluated, the controller will send a response. Each command's possible responses are detailed with the command description.

In general, if you do not receive a command response, then the controller did not accept your command.

1.2 ID Messages

The controller has one CW ID message. The CW ID message is programmed by sending a single DTMF sequence to the controller. The CW ID may contain up to 12 letters or numbers.

1.3 "Unlocked Mode"

All of the controller's important programming information is protected by a special password, the "unlock code."

Programming the unlock code requires physical access to the controller to place a jumper on the circuit board.

The unlock code cannot be programmed without physical access to the controller.

When the unlock code is successfully entered into the controller, the controller will transmit "OK" in CW, and a special courtesy tone will be used to indicate the controller is unlocked.

The controller can be locked by:

- sending the "#" command, or
- the controller will lock itself after two minutes of inactivity.

When the controller returns to the locked (normal) mode:

- the courtesy tone will revert to the normal tone for the controller's current state.

2. Programming the Controller

This section of the User Guide describes how the repeater operator programs the repeater.

It is intended for repeater operators and users who have an interest in how the controller is customized for specific configurations.

⇒ ***Note:*** ***n commands are only available when the controller has been unlocked by sending the unlock command.**

2.1 Quick Start

This section of the User Guide is intended to get a first-time user "up and running" quickly using a minimum of the customizable features.

Procedure:

- **Make all the necessary electrical connections**. See the appropriate installation and adjustments manual for your NHRC-4.
- **Install the initialize jumper.** See your installation and adjustments manual for the location of this jumper. Also see section 2.2 for important information about the INIT jumper.
- **Apply power to the NHRC-4**. After a short pause, the controller will transmit "NHRC 4" in CW. At this time, NHRC recommends that you immediately program the unlock code.
- **Leave the initialize jumper installed** for this operation.
- **Send the default unlock code (05) to the controller**. The controller should respond with a CW "OK."
- **Use the *2 command to program command prefix 05: the unlock prefix**. To program the unlock code to 314159, send the following command: *205314159. The controller will send "OK" in CW when the unlock code is accepted. (Note: the unlock code can be from 1 to 7 DTMF digits in length.)
- **Send the "#" command to lock the controller**. The controller should respond with "OK" in CW and the courtesy tone should return to the normal tone.
- **Remove the initialize jumper.**

You should program the CW ID at this time. See Sections 2.10.1 for information on programming the CW

This is a good time to program all the command prefixes. See Section 2.5 for information on programming command prefixes.

⇒ ***Note:*** **NHRC strongly recommends that you do not leave the initial default command prefixes in the controller.**

2.2 Initializing the Controller

Initializing the controller will re-program the controller's non-volatile EEPROM memory with the factory defaults. All customized settings are lost, including command prefixes, timer presets, and the CW ID.

⇒ ***Important Note about the NHRC-4 INIT Jumper:*** The NHRC-4 shares the INIT jumper with the main receiver muting logic. When the INIT jumper is installed, the main receiver will be un-muted, and unsquelched audio will play through the repeater whenever the transmitter is on. This is normal; however, it may make the controller's CW messages hard to hear during programming. You can temporarily lower the MAIN RX AUDIO LEVEL pot to during initialization or unlock prefix reprogramming if the squelch noise covers up the controller CW messages. Once the INIT jumper is removed, the controller will operation normally.

⇒ ***Note:*** The controller should never require initialization except for new installations.

Procedure:

- **Install the initialize jumper.** . See the appropriate installation and adjustments manual for your NHRC-4
- **Apply power to the controller.** After a short delay of about 10 seconds, the controller will sent the CW message "NHRC 4".
- **Remove the initialize jumper** (otherwise the controller will initialize again the next time it is powered up).

⇒ ***Caution:*** **DO NOT LEAVE THE INITIALIZE JUMPER INSTALLED**.

See the Appendix for factory defaults for the controller.

*2.3 *0: Unlocked Mode Control Operator Access*

2.3.1 Set Control Operator Switches

The *0 command allows access to control operator switch groups while the controller is unlocked. In addition to that, this command allows access to groups 8 and 9 which are not accessible using the control operator prefix. These groups help to implement controller security by controlling write access to controller data and control operator access to the other 8 groups.

The format of this command is

***0<g><i><s>**

where:

<g> specifies the group number. Valid range is 0 to 9.

<i> specifies the switch number. Valid range is 0 to 7.

<s> is optional. If present, it is the new state of the switch. Valid values are 0 and 1.

Upon receipt of a valid *0 command without the state, the controller will transmit the current state of the selected control operator switch.

Example: Sending the command *000 will inquire of the state of control operator group 0 item 0, and the controller will read back the current state: either “ON” or “OFF” in CW.

See Section 4 for more information about control operator switches.

*2.4 *1: Save Setup*

The NHRC-4 Repeater Controller has two “saved configuration setups” that allow the repeater operator to save two presets of all 80 of the control operator switches.

The default setup is #0 which is loaded when the controller is powered up.

2.4.1 Save configuration setup

***1<n>**

where:

<n> specifies the setup number to save. Valid range is 0 or 1.

After a valid command is received, the controller will respond with “OK” in CW.

A saved setup can be loaded by using the load saved setup command:

See Section 4.3 for information about the Load Saved Setup command.

Example: To save the current controller state (all 10 control operator switch groups) as state #1, send the following command with the controller unlocked: “*11”. The controller will transmit "OK" in CW if the command is accepted.

*2.5 *2: Program Command Prefixes*

Every command accepted by the NHRC-4 controller when it is locked consists of a command prefix and optional command arguments.

Each prefix can be programmed to restrict access to certain functions to only those users who know the prefix. This gives the repeater operator the ability to only allow certain users to access certain features.

Command Prefix Rules:

- A command prefix is one to seven digits long.
- A command prefix cannot be left blank.
- No two command prefixes should be programmed the same or be programmed the same as the beginning of a different prefix. For example, do not program the control operator prefix to 1234 and the digital output control prefix to 12345, because the controller would not understand whether 123456 was intended to set control operator switches or change the state of the digital outputs.

Section 5.1.1 describes the Factory Default Command Prefixes.

2.5.1 Set command prefix

***2<pp><prefix>**

where:

<pp> specifies the prefix number to set. Valid values are in the range 00 to 15. Two digits must be used. See the Command "Prefixes by Number Table" to determine the prefix number you want to set.

<prefix> specifies the new prefix to assign. Must be 1 to 7 digits in length. Valid digits are 0-9, A-D, * and #.

After a valid command is received, the controller will respond with "OK" in CW.

This table shows the prefix number and default prefix value for each command. The default prefixes are set when the controller is initialized, and are overwritten when the prefix is programmed with a new value.

Command Prefixes by Number

Prefix Number	Default Prefix	Description
00	00	**Control Operator**
01	01	**DTMF Access**
02	02	**Digital Output Control**
03	03	**Load Saved Setup**
04	04	**Remote Base Control**
05	05	**Unlock Controller**

Example: To set the DTMF access prefix to 4321, send the following command with the controller unlocked: "*2014321". The controller will respond with a CW "OK" if the command is accepted.

⇒ **Note:** For security reasons, *command prefix 5 (the unlock code) cannot be changed unless the initialize jumper (INIT) is installed*. This means that the unlock code cannot be changed without physical access to the controller. To change the code, install the jumper, enter the command, and remove the jumper. Do not leave the initialize jumper installed, and do not power up the controller with the initialize jumper installed, unless you want to reset the controller to factory defaults.

⇒ **Caution:** Do not set any prefix to use the same initial digits as any other prefix, because the controller will not be able to tell the difference between them. For example, if the DTMF access code is set to "123", and the load saved setup code is set to "1234", then when a user sends "1234123456" the controller will try to load saved setup 123456, rather than correctly enabling the controller.

*2.6 *3: Set timers*

The NHRC-4 has 9 “timers.”

Each timer has its own resolution which is the amount of time each timer count represents.

For example, the hang timer’s resolution is .1 second. To program a hang time of 5.0 seconds, the hang timer would actually be programmed to 50 because there are 50 .1 second intervals in 5.0 seconds.

2.6.1 Description of Timers

Timer 00 (hang timer long) and 01 (hang timer short) are “hang” timers. One of these timers can be selected. The hang timer specifies the amount of time the transmitter stays on after the receiver input signal goes away. This is sometimes called the “tail” timer. You can select either the long hang timer or the short hang timer. The resolution of the hang timers is .1 seconds.

Timers 02 is the ID timer. This timer controls how long the period is before a CW ID message is sent. This timer ks set in tens of seconds. For example, to set a 9 minute ID timer interval: 9 minutes is 540 seconds, so the timer would be set for 54.

Timer 03 is the DTMF access mode timer. In DTMF access mode, the repeater is activated by sending a DTMF command. The repeater can be de-activated with another DTMF command, or if a period of inactivity occurs. The DTMF access mode timer sets the amount of inactivity before the repeater automatically deactivates. This timer has a 10 second resolution.

Timers 04 (timeout timer long) and 05 (timeout timer short) control the timeout period. Timeout is the maximum amount of time the receiver can be active before the repeater assumes a stuck mike and stops repeating. These timers are set with a 1 second resolution.

Timer 06 (fan timer) controls how long the fan control output will remain active after the controller’s PTT signal is released. This timer uses 10-second resolution.

Timer 07 (CW pitch) and Timer 08 (CW speed) allow the repeater owner to tailor the tone of the transmitted CW characters. They are technically not timers, but parameter settings. The CW pitch can be set to any of the 32 tones shown in section 5.1.3, and the CW speed set from 5 to 30 WPM.

2.6.2 Program a timer

The NHRC-4 timers are programmed as follows:

***3<nn><time>** where:

<nn> specifies the timer to set. Valid range is 00 to 06. Both digits must be present. Consult the table below to determine the number of the timer you want to change.

<time> The value to program the timer to. The valid range for <time> is 0 to 255

After a valid set timer command is received, the controller will respond with "OK" in CW.

NHRC-4 Timers, by Number

Timer No.	Description	Timer Resolution	Default Value
00	**Hang Timer Long**	**.1**	**10.0 seconds**
01	**Hang Timer Short**	**.1**	**5.0 seconds**
02	**ID Timer**	**10**	**540 seconds (9 minutes)**
03	**DTMF Access Timer**	**10**	**600 seconds (10 minutes)**
04	**Time-out Timer Long**	**1**	**180 seconds**
05	**Time-out Timer Short**	**1**	**30 seconds**
06	**Fan Timer**	**10**	**120 seconds**
07	**CW Pitch**	**N/A**	**20 (C6)**
08	**CW Speed**	**N/A**	**20 WPM**

Examples:

To program the ID timer to 6 minutes (480 seconds), send the following command with the controller unlocked: "*30248". If the command is accepted, the controller will respond with "OK" in CW.

To set the long hang timer for 20 seconds, send the following command with the controller unlocked: "*300200". If the command is accepted, the controller will respond with "OK" in CW.

⇒ **Note:** The short hang timer, and the long time-out timer are selected by the controller's initial defaults. Consult section 3.1 for instructions on selecting the long hang timer, and section 3.2 for instructions on selecting the short time-out timer..

*2.7 *4: (Reserved for NHRC)*

This command is reserved by NHRC for future expansion.

*2.8 *5: (Reserved for NHRC)*

This command is reserved by NHRC for future expansion.

*2.9 *6: (Reserved for NHRC)*

This command is reserved by NHRC for future expansion.

*2.10 *7: Program CW and Beep Messages*

The *7 command is used to program or play the CW ID and courtesy tones.

2.10.1 Program the CW ID

The CW ID can be programmed or played with the *70 command, as follows.

***70<dd..dd..dd..>** where:

<dd..dd..dd..> is the CW ID message. If left blank, the current CW ID message will play. When present, the part of the command represented by <dd..dd..dd…> consists of 1 to 12 digit pairs. Each pair of digits represents one CW character.

See Section 5.1.4, the CW Character Table, to look up the code for each CW character.

Example: To program "DE N1KDO/R" as the CW ID, the following command would be entered: *70 31 32 11 62 01 52 63 12 72.

To play the CW ID, the following command would be entered: *70

2.10.2 Program or Play Courtesy Tones

The NHRC-4 supports eight different courtesy tones. Courtesy tones are composed of up to four segments of tones. Each segment has a tone frequency and duration.

The courtesy tone is selected based on the selected link state and main and link receiver activity.

The courtesy tones are played and programmed with command *71 as follows:

***71<n><ddtt ddtt ddtt ddtt>** where:

<n> is the courtesy tone number to play or program. The valid range of values is 0 to 7.

<ddtt ddtt ddtt ddtt> is up to four sets of duration and tone.

Duration is in 10 ms increments, valid range is 01-98. Both digits must be specified. Tone is the number of the tone from Section 5.1.3, the Courtesy Tone Component Tones Table.

Example: The default courtesy tone #0, (four 50MS bursts of notes E5, G5, B5, D6) would be programmed like: *7100517052005240527.

Courtesy Tone Uses

Tone	Use
0	**Main receiver courtesy tone.**
1	**Main receiver courtesy tone, link alert mode, link receiver active**
2	**Main courtesy tone, link transmit enabled**
3	**Link receiver courtesy tone, link transmit disabled.**
4	**Link receiver courtesy tone, link transmit enabled.**
5	**Reserved for NHRC**
6	**Reserved for NHRC**
7	**Controller unlocked courtesy tone**

2.10.3 CW Letter Courtesy Tone

Any courtesy tone can be programmed to play any CW letter. The courtesy tone should be recorded as 99xx, where xx is the CW character code from table 5.1.4.

Example: To program courtesy tone #4 (the link transmit enabled courtesy tone) to play the CW letter "L", send `*71 4 9953`.

*2.11 *8: (Reserved for NHRC)*

This command is reserved by NHRC for future expansion.

*2.12 *9: (Reserved for NHRC)*

This command is reserved by NHRC for future expansion.

*2.13 **: Reset Controller*

Command ** is used to reset the controller to the power-up state for any reason.

The controller will send “NHRC 4” in CW.

3. Control Operator Commands

The NHRC-4 supports 80 different control operator settings arranged into ten groups of eight "software switches." Each software switch represents an item in the controller that can be set to either on or off. Every switch is addressed by naming the group, then the item number. The first eight groups are accessible through the control operator prefix.

The format for all control operator commands is:

<ctl-op-prefix><group><item><state>

<ctl-op-prefix> The control operator prefix assigned by the repeater operator. (See Section 2.5 for information on programming command prefixes.)

<group> The group code for the switch to set or inquire. The valid range for <group> is 0 to 7. Groups 8 and 9 can only be accessed with the programming *0 command. (See Section 3.3 for information about *0: Unlocked Mode Control Operator Access.)

<item> The item number to set or inquire. The valid range for <item> is 0 to 7.

<state> is optional. If present, it is the state (1=on, 0=off) to which the control operator switch is to be set.

When <state> is not present, or after a successful control operator command that sets the switch state, the controller will respond by transmitting either the CW word "ON" or the CW word "OFF", depending on the state of the particular switch.

For example, to set group 0 item 0 to enabled, the following command would be sent: *<ctl-op-prefix>001*.

The controller will respond by transmitting the word "ON" in CW.

All 80 of the control operator switches are saved when the controller's state is saved. Saved state 0 is the power-up state, so if you want your changes to the control operator switches be restored after a power failure, it is important to save the controller's setup. See section 2.4 for information on the save setup command.

3.1 Group 0 Switches: Repeater Control

Group 0 contains switches that control the main repeater and access to the main repeater.

Group 0 Switches:

Switch	Name	Description
0	Repeater Enable	This is the repeater's master enable/disable control. Set this to 0 to disable the repeater.
1	Reserved	Reserved for NHRC
2	Key Up Delay ("Kerchunker Filter")	Allows the "kerchunker filter" to be enabled. The "kerchunker filter" requires a signal for more than ½ second before the repeater will begin to repeat, but only when the transmitter is not on.
3	Hang Timer Enabled	Normally enabled, but can be disabled when the repeater runs on battery power, or to discourage "kerchunkers."
4	Hang Timer Select	Allows the control operator to select which hang timer value is used. Allows the long (1) or short (0) timer to be selected.
5	DTMF Access Mode Select	Allows the control operator to place the repeater into DTMF access mode. In DTMF access mode, the repeater, , can only be activated from idle by sending the DTMF access prefix, followed by a 1 to enable the repeater. The repeater will remain active until either disabled with the DTMF access prefix followed by a 0, or the repeater remains idle for longer than the time specified in the DTMF access timer. See section 4.1 for more information on the DTMF access mode prefix.
6	Courtesy Tone Enabled	Allows the courtesy tone to be enabled or disabled.
7	Reserved	Reserved for NHRC

3.2 Group 1 Switches: More Repeater Control

Group 1 contains switches that control the main repeater and access to the main repeater.

Group 1 Switches:

Switch	Name	Description
0	Repeater Time-out Timer Enable	Allows the time-out timer on the main repeater to be enabled or disabled. Normally the time-out timer will be enabled. However, certain applications may require the time-out timer be disabled (nets, shuttle rebroadcast, etc.). Set this switch to 1 to enable the repeater time-out timer.
1	Time-out Timer Long Select	Allows the long (1) or short (0) timer to be selected.
2	Reserved	Reserved for NHRC
3	DTMF Muting Enable	Enables DTMF tone muting. When enabled (1), the controller will mute the receiver *audio* to prevent received DTMF command tones from being broadcast over the repeater.
4	Reserved	Reserved for NHRC
5	Link Port is Slaved Repeater	Setting this switch will cause the link port PTT to follow the main port PTT, for using the link port as a slave repeater.
6	Reserved	Reserved for NHRC
7	Reserved	Reserved for NHRC

3.3 Group 2 Switches: Misc. Control

Group 2 controls several miscellaneous settings on the controller..

Group 2 Switches:

Switch	Name	Description
0	Reserved	Reserved for NHRC
1	Reserved	Reserved for NHRC
2	Reserved	Reserved for NHRC
3	Reserved	Reserved for NHRC
4	Digital Output Fan Control	When enabled (1), configures the digital output on the main repeater connector to be a fan control output. A fan connected to this output will run while the transmitter is keyed, and a programmable amount of time after the transmitter is unkeyed. When disabled, this input is controlled by the state of the Group 2 Item 5 switch.
5	Digital Output Control	If the automatic fan control is disabled (Group 2 Switch 4 is off/0) this switch can be used to turn the Fan Control digital output on and off.
6	Digital Audio Delay is Present on Main Port	When enabled (1), changes the timing of the CAS logic in the controller to support the use of a NHRC-DAD on the main repeater port.
7	Digital Audio Delay is present on Link/Remote Base Port	When enabled (1), changes the timing of the CAS logic in the controller to support the use of a NHRC-DAD on the link/remote base port.

3.4 Group 3 Switches: Link/Remote Base Port Control

Group 3 contains switches that control the state and operation of the Link/Remote Base port.

Group 3 Switches:

Switch	Name	Description
0	Set Link Port Alert Mode	When enabled (1), configures the link port into "Alert Mode." In alert mode, a different courtesy tone is played when the main receiver drops if the link receiver is active. **Note:** The link audio is not repeated. Only the alert tone is present to indicate channel activity. This mode can be overridden by switch 1 or switch 2. This switch, as well as switches 1 and 2, can also be set with the link prefix. See Section 4.4.1 for more information on the Link/Remote Base Prefix.
1	Set Link Port Receive Mode	When enabled (1), configures the link port into "Receive Mode." In receive mode, the link port audio is transmitted over the main repeater, but the main repeater is not transmitted over the link port. This mode can be overridden by switch 2.
2	Set Link Port Transmit Mode	When enabled (1), configures the link port into "Transmit Mode." In this mode, the link receive audio is transmitted over the main repeater, and the main repeater's receive audio is transmitted over the link.
3	Main receiver has priority over link receiver	When enabled (1), the link receiver will be muted when the main receiver is active. When disabled (0), the main and link receiver audio is mixed.
4	Reserved	Reserved for NHRC.
5	Link Port Time-out Timer Enable	Setting this switch enables the link port time-out timer. If this switch if off, the link port will not time-out..
6	Link Port Time-out Timer Long Select	Allows the long (1) or short (0) timer to be selected.
7	Link Port Drops PTT to mute DTMF	Setting this switch will cause the link port to drop PTT during DTMF muting..

3.5 Group 4 Switches: Additional Control

Group 4 contains switches that control DTMF muting using the "drop TX" method.

Group 4 Switches:

Switch	Name	Description
0	Reserved	Reserved for NHRC.
1	Reserved	Reserved for NHRC.
2	Reserved	Reserved for NHRC.
3	Reserved	Reserved for NHRC.
4	Reserved	Reserved for NHRC.
5	Reserved	Reserved for NHRC.
6	Drop TX to mute DTMF	When enabled (1), causes the controller to "drop" PTT on the main transmitter to mute DTMF. This might be useful if you wanted to play DTMF down the link. Note that DTMF Audio Muting (Group 1 switch 3) needs to be off (0) if you don't want to mute the DTMF *audio*.
7	NHRC Test Mode	Reserved for NHRC.

3.6 Group 5 Switches: Reserved

Group 5 contains switches that are reserved for NHRC.

Group 5 Switches:

Switch	Name	Description
0	Reserved	Reserved for NHRC.
1	Reserved	Reserved for NHRC.
2	Reserved	Reserved for NHRC.
3	Reserved	Reserved for NHRC.
4	Reserved	Reserved for NHRC.
5	Reserved	Reserved for NHRC.
6	Reserved	Reserved for NHRC.
7	Reserved	Reserved for NHRC.

3.7 Group 6 Switches: Reserved for NHRC

Group 6 contains switches that are reserved for NHRC

Group 6 Switches:

Switch	Name	Description
0	Reserved	Reserved for NHRC.
1	Reserved	Reserved for NHRC.
2	Reserved	Reserved for NHRC.
3	Reserved	Reserved for NHRC.
4	Reserved	Reserved for NHRC.
5	Reserved	Reserved for NHRC.
6	Reserved	Reserved for NHRC.
7	Reserved	Reserved for NHRC.

3.8 Group 7 Switches: Reserved for NHRC

Group 7 contains switches that are reserved for NHRC.

Group 7 Switches:

Switch	Action	Description
0	Reserved	Reserved for NHRC.
1	Reserved	Reserved for NHRC.
2	Reserved	Reserved for NHRC.
3	Reserved	Reserved for NHRC.
4	Reserved	Reserved for NHRC.
5	Reserved	Reserved for NHRC.
6	Reserved	Reserved for NHRC.
7	Reserved	Reserved for NHRC.

3.9 Group 8 Switches: Programming Write Protect

Group 8 contains switches which enable or disable modification to controller data. These switches serve as a "write protect" to help prevent accidental reprogramming of repeater features. Each switch, when enabled (1), write protects its associated setup information. This entire group cannot be accessed by the control operator, it can only be accessed when the repeater is unlocked, by using the *0 command. (See Section 2.3 for information on the unlocked mode control operator access.)

Group 8 Switches:

Switch	Name	Description
0	Write Protect Control Group Setups	When enabled (1), causes the *1 command (Save Setup) to fail, effectively disallowing control groups to be saved.
1	Write Protect Command Prefixes	When enabled (1), causes the *2 Program Command Prefix command to fail, effectively disallowing modification of the command prefixes.
2	Write Protect Timers	When enabled (1), causes the *3 Set Timers command to fail, effectively disallowing modification of the timer values.
3	Reserved	Reserved for NHRC.
4	Reserved	Reserved for NHRC.
5	Reserved	Reserved for NHRC.
6	Write Protect CW Messages and Courtesy Tones	When enabled (1), causes the *70 and *71 commands to fail when new messages are specified, effectively disallowing modification of the CW ID and courtesy tones.
7	Reserved	Reserved for NHRC.

3.10 Group 9 Switches: Control Operator Group Access

Group 9 contains switches which enable or disable control operator access to the control operator groups. This entire group cannot be accessed by the control operator. It can only be accessed when the repeater is unlocked, by using the *0 command. These switches allow the repeater operator to selectively disable control operator functions on a group-by-group basis, allowing more granularity of controller security. (See Section 2.3 for information on the unlocked mode control operator access.)

Group 9 Switches:

Switch	Name	Description
0	Enable Control Operator Access to Group 0	When enabled (1), allow the control operator to change the settings in Group 0.
1	Enable Control Operator Access to Group 1	When enabled (1), allow the control operator to change the settings in Group 1.
2	Enable Control Operator Access to Group 2	When enabled (1), allow the control operator to change the settings in Group 2.
3	Enable Control Operator Access to Group 3	When enabled (1), allow the control operator to change the settings in Group 3.
4	Enable Control Operator Access to Group 4	When enabled (1), allow the control operator to change the settings in Group 4.
5	Enable Control Operator Access to Group 5	When enabled (1), allow the control operator to change the settings in Group 5.
6	Enable Control Operator Access to Group 6	When enabled (1), allow the control operator to change the settings in Group 6.
7	Enable Control Operator Access to Group 7	When enabled (1), allow the control operator to change the settings in Group 7.

4. User Commands

This section describes commands that are available to the repeater users. Every command has a command prefix which is set by the repeater operator. The prefixes can be kept secret, so only certain users have access to certain functions. (See Section 2.5 for more information on programming command prefixes.)

Throughout this section of the manual, the command prefix will be shown as <prefix>, which must be replaced with the actual command prefix as programmed by the repeater operator.

4.1 DTMF Access

The NHRC-4 Repeater Controller supports a DTMF access mode which allows the repeater to be left in a secured disabled state, but users who know the DTMF access code can enable the repeater. The repeater reverts to the secured disabled state when either the repeater is idle for longer than the DTMF access mode timer, or a user sends the DTMF access code followed by a zero.

The repeater is put into DTMF access mode by setting control operator Group 0, Item 5 to enabled (1). (See section 3.1 for information about this control operator switch, section 2.5 for information on programming the DTMF access prefix and section 2.6 for information on setting the DTMF access timer.)

When the repeater is in the DTMF access mode, the DTMF access command is used as follows:

<prefix><state> where:

<prefix> is the DTMF access mode prefix.

<state> is 1 to enable the repeater. <state> is 0 to return the repeater to the secure disabled mode.

Example: If the repeater is in DTMF access mode, and the DTMF access prefix is "567", the repeater can be activated by sending “5671”. At that time the repeater will remain on until either no activity occurs on the repeater for a period longer than the DTMF Access Mode timer or the repeater is manually deactivated by sending “5670”.

4.2 Digital Output Control

The NHRC-4 fan control/digital output can be directly set with a user command.

The output can be turned on, turned off, or have its state reported.

When the output is turned on, the controller will respond with the word “on” sent in CW. When the output is turned off, the controller will respond with the word “off” sent in CW. When the outputs state is checked, the controller will respond with either “on” or “off” sent in CW, depending on the output’s state.

To use the Digital Output Control feature, enter the following command:

<prefix><port #><state> where:

<prefix> is the Digital Output Control prefix as programmed by the repeater operator

<**state**> Is 1 to turn the port on, 0 to turn the port off. The ports current state will be reported if the state digit is not sent.

Example: Assuming the Digital Output Control prefix is 99, if you want to set the output off, you can send "990" to the controller. The controller will respond with “off” sent in CW. To test the state of the output, you can send “99” to the controller; the controller will respond with either “on” or “off”, depending on the state of the output.

4.3 Load Saved Setup

The NHRC-4 supports two saved setups of all 80 control operator switches. (See section 2.4 for information about saving the controller state.)

This command allows users or control operators to select one of the preset repeater states.

The format for the load saved state command is:

<prefix><state-number> where:

<prefix> is the load saved state prefix as programmed by the repeater operator.

<state-number> is the state to load. Valid state numbers are 0 and 1.

Example: Assuming the Load Saved Setup prefix is set to 314159, and you want to select your "net mode", saved as setup #1, send "3141591". The controller will respond with the morse message "OK".

4.4 Remote Base

The NHRC-4 Repeater Controller supports a remote base radio which can be used as a link to another repeater system, a "slaved" repeater, or a remote base. The remote base prefix is used to control the state of the remote base port. The remote base port can be configured into four different modes:

- In "alert mode," repeater users are alerted to remote-base channel activity by a different courtesy tone.
- "Receive mode" transmits the remote base audio over the main repeater, but the repeaters audio is not transmitted over the remote base.
- "Transmit mode" is a completely linked state where the remote base audio is transmitted over the repeater, and the repeater audio is transmitted over the repeater.
- The "Off" mode is an Off state where the remote base port is ignored.

4.4.1 Select remote base operating mode

To select a remote base operating mode, use the following command:

<prefix><mode>

where:

<prefix> is the remote base command prefix as programmed by the repeater owner.

<mode> is the remote base operating mode.

Remote Base Operating Modes

Mode	Description
0	**Off**
1	**Alert Mode**
2	**Receive Mode**
3	**Transmit Mode**

4.5 Unlock Controller

The NHRC-4 repeater controller normally operates in the “locked” mode, which prevents unauthorized access to or modification of the repeater controller configuration. In order to access the protected configuration the “unlock” code must be sent to the controller.

NHRC-4 repeater controller programming is discussed in section 2 of this manual.

4.5.1 Unlock Controller

To unlock the controller, use the following command:

<**prefix**> where:

<**prefix**> is the unlock code. remote base prefix as programmed by the repeater operator.

See section 1.3 for more information about the controller’s “unlocked mode.”

5. Appendices

5.1 Factory Defaults

5.1.1 Default Command Prefixes Table

Index	Description	Default Prefix
00	**Control Operator**	**00**
01	**DTMF Access**	**01**
02	**Digital Output Control**	**02**
03	**Load Saved Setup**	**03**
04	**Remote Base Control**	**04**
05	**Unlock Controller**	**05**

5.1.2 Timer Defaults Table

Timer Number	Description	Multiplier	Timer Value	Effective Value
00	**Hang Timer Long**	**.1**	**100**	**10.0**
01	**Hang Timer Short**	**.1**	**50**	**5.0**
02	**ID Timer**	**10**	**54**	**540**
03	**DTMF Access Timer**	**10**	**60**	**600**
04	**Time-Out Timer Long**	**1**	**180**	**180**
05	**Time-Out Timer Short**	**1**	**30**	**30**
06	**Fan Timer**	**10**	**12**	**120**
07	**CW Pitch**	**N/A**	**20**	**C5**
08	**CW Speed**	**N/A**	**20**	**20 WPM**

5.1.3 Courtesy Tone Tones Table

Tone Code	Tone
00	**No tone**
01	**F4**
02	**F#4**
03	**G4**
04	**G#4**
05	**A4**
06	**A#4**
07	**B4**
08	**C5**
09	**C#5**
10	**D5**
11	**D#5**
12	**E5**
13	**F5**
14	**F#5**
15	**G5**
16	**G#5**
17	**A5**
18	**A#5**
19	**B5**
20	**C6**
21	**C#6**
22	**D6**
23	**D#6**
24	**E6**
25	**F6**
26	**F#6**
27	**G6**
28	**G#6**
29	**A6**
30	**A#6**
31	**B6**

5.1.4 CW ("Morse Code") Character Table

Letter	Code
0	**00**
1	**01**
2	**02**
3	**03**
4	**04**
5	**05**
6	**06**
7	**07**
8	**08**
9	**09**
A	**21**
B	**22**
C	**23**
D	**31**
E	**32**
F	**33**
G	**41**
H	**42**
I	**43**
J	**51**
K	**52**
L	**53**
M	**61**
N	**62**
O	**63**
P	**71**
Q	**70**
R	**72**
S	**73**
T	**81**
U	**82**
V	**83**
W	**91**
X	**92**
Y	**93**
Z	**90**
Space	**11**
/	**12**

5.2 Control Operator Controls

5.2.1 Control Operator Group 0 (Repeater Control) Operations Table

Group #	Item #	Function	Default	Comments
0	0	**Repeater Enable**	**1**	
0	1	**Reserved**	**0**	**Reserved for NHRC**
0	2	**Key Up Delay (Kerchunk Filter)**	**0**	
0	3	**Hang Timer Enabled**	**1**	
0	4	**Hang Timer Short/Long Select**	**0**	**0=short, 1=long, see related timer values.**
0	5	**DTMF Access Mode**	**0**	**See related DTMF access code and timer information**
0	6	**Courtesy Tone Enabled**	**1**	
0	7	**Reserved**	**0**	**Reserved for NHRC**

5.2.2 Control Operator Group 1 (Repeater Control II) Operations Table

Group #	Item #	Function	Default	Comments
1	0	**Repeater Time-Out Timer Enable**	**1**	**See related timer value**
1	1	**Time-Out Long / Short**	**1**	**0=short, 1=long, see related timer values short time-out**
1	2	**Reserved**	**0**	**Reserved for NHRC**
1	3	**Enable DTMF Muting**	**1**	**Repeater mutes touch tones**
1	4	**Reserved**	**0**	**Reserved for NHRC**
1	5	**Link Port Is Slaved Repeater**	**0**	**Set to 1 for slaved repeater**
1	6	**Reserved**	**0**	**Reserved for NHRC**
1	7	**Reserved**	**0**	**Reserved for NHRC**

5.2.3 Control Operator Group 2 (Misc. Control) Operations Table

Group #	Item #	Function	Default	Comments
2	0	**Reserved**	**0**	**Reserved for NHRC**
2	1	**Reserved**	**1**	**Reserved for NHRC**
2	2	**Reserved**	**1**	**Reserved for NHRC**
2	3	**Reserved**	**1**	**Reserved for NHRC**
2	4	**Digital Output/Fan Control**	**0**	**0=digital output, 1=fan control**
2	5	**Digital Output Control**	**0**	**1=on, 0=off**
2	6	**Delay Present On Repeater Port**	**0**	**NHRC-DAD installed on repeater.**
2	7	**Delay Present On Link/Remote-Base Port**	**0**	**NHRC-DAD installed on link/remote-base port.**

5.2.4 Control Operator Group 3 (Link Port Control) Operations Table

Group #	Item #	Function	Default	Comments
3	0	**Link Port Alert Mode**	**0**	
3	1	**Link Port Receive Mode**	**0**	
3	2	**Link Port Transmit Mode**	**0**	
3	3	**Main Port receiver has priority**	**0**	**Set to 1 to mute link receiver when main receiver is active.**
3	4	**Reserved**	**0**	**Reserved for NHRC**
3	5	**Link Port Time-Out Timer Enable**	**0**	
3	6	**Link Port Time-Out Timer Long**	**0**	
3	7	**Link Port Drops To Mute DTMF**	**0**	

5.2.5 Control Operator Group 4 (TX Mute Control) Operations Table

Group #	Item #	Function	Default	Comments
4	0	**Reserved**	**0**	**Reserved for NHRC**
4	1	**Reserved**	**0**	**Reserved for NHRC**
4	2	**Reserved**	**0**	**Reserved for NHRC**
4	3	**Reserved**	**0**	**Reserved for NHRC**
4	4	**Reserved**	**0**	**Reserved for NHRC**
4	5	**Reserved**	**0**	**Reserved for NHRC**
4	6	**Drop main TX to mute DTMF**	**0**	
4	7	**NHRC Test Mode**	**0**	**Reserved for NHRC**

5.2.6 Control Operator Group 5 (Reserved for NHRC)

Group #	Item #	Function	Default	Comments
5	0	**Reserved**	**0**	**Reserved for NHRC**
5	1	**Reserved**	**0**	**Reserved for NHRC**
5	2	**Reserved**	**0**	**Reserved for NHRC**
5	3	**Reserved**	**0**	**Reserved for NHRC**
5	4	**Reserved**	**0**	**Reserved for NHRC**
5	5	**Reserved**	**0**	**Reserved for NHRC**
5	6	**Reserved**	**0**	**Reserved for NHRC**
5	7	**Reserved**	**0**	**Reserved for NHRC**

5.2.7 Control Operator Group 6 (Digital Output Mode Control) Operations Table

Group #	Item #	Function	Default	Comments
6	0	**Reserved**	**0**	**Reserved for NHRC**
6	1	**Reserved**	**0**	**Reserved for NHRC**
6	2	**Reserved**	**0**	**Reserved for NHRC**
6	3	**Reserved**	**0**	**Reserved for NHRC**
6	4	**Reserved**	**0**	**Reserved for NHRC**
6	5	**Reserved**	**0**	**Reserved for NHRC**
6	6	**Reserved**	**0**	**Reserved for NHRC**
6	7	**Reserved**	**0**	**Reserved for NHRC**

5.2.8 Control Operator Group 7 (Digital Output Control) Operations Table

Group #	Item #	Function	Default	Comments
7	0	**Reserved**	**0**	**Reserved for NHRC**
7	1	**Reserved**	**0**	**Reserved for NHRC**
7	2	**Reserved**	**0**	**Reserved for NHRC**
7	3	**Reserved**	**0**	**Reserved for NHRC**
7	4	**Reserved**	**0**	**Reserved for NHRC**
7	5	**Reserved**	**0**	**Reserved for NHRC**
7	6	**Reserved**	**0**	**Reserved for NHRC**
7	7	**Reserved**	**0**	**Reserved for NHRC**

5.2.9 Control Operator Group 8 (Programming Write Protect) Operations Table

Group #	Item #	Function	Default	Comments
8*	0	**Write Protect Control Group Setups**	**0**	
8*	1	**Write Protect Prefixes**	**0**	
8*	2	**Write Protect Timers**	**0**	
8*	3	**Reserved**	**0**	**Reserved for NHRC**
8*	4	**Reserved**	**0**	**Reserved for NHRC**
8*	5	**Reserved**	**0**	**Reserved for NHRC**
8*	6	**Write Protect CW Messages & Courtesy Tones**	**0**	
8*	7	**Reserved**	**1**	**Reserved for NHRC**

5.2.10 Control Operator Group 9 (Control Operator Group Access) Operations Table

Group #	Item #	Function	Default	Comments
9*	0	**Enable Access To Group 0**	**1**	
9*	1	**Enable Access To Group 1**	**1**	
9*	2	**Enable Access To Group 2**	**1**	
9*	3	**Enable Access To Group 3**	**1**	
9*	4	**Enable Access To Group 4**	**1**	
9*	5	**Enable Access To Group 5**	**1**	
9*	6	**Enable Access To Group 6**	**1**	
9*	7	**Enable Access To Group 7**	**1**	

* Controller must be unlocked to access Groups 8 and 9

5.3 Terminology and Abbreviations

Term	Description
CAS	Carrier Activated Squelch, where receipt of a signal, with or without CTCSS will activate the controller.
CW	Continuous Wave signals, commonly using “Morse Code.” The term “CW” refers to the radio emission type, while “Morse Code” refers to the signaling type used. Typically, they are incorrectly used interchangeably.
Digital Audio Delay (DAD)	Digital Audio Delay (DAD) removes squelch crashes and allows DTMF tones to be fully muted.
DTMF	Also known as “Touch Tone®” codes.
ID	Identification.
PTT	Push-to-Talk.
Unlock Code	A special password used to enable programming of the controller.

6. NHRC LLC Limited Warranty

NHRC LLC warrants that its assembled and tested products will be free from defects in materials and workmanship for a period of NINETY (90) 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 its kit products will contain components that are free from defects in materials and workmanship for a period of THIRTY (30) 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 its 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.

NHRC

REPEATER CONTROLLERS