

NHRC

REPEATER CONTROLLERS

Intelligent DTMF Remote Control Programming and Operations Guide

Introduction:

The NHRC Intelligent Remote Control was born from the requests for a simple way to remotely control things around your shack or at your repeater site. Unlike other "dumb" remote controllers, the Intelligent Remote sends a command response in CW to all valid commands when connected to a transceiver. The Intelligent Remote is a very cost effective (read: CHEAP) but elegant way to implement control of any device or help you comply with FCC rules to have a control channel for your repeater. The Intelligent Remote can be connected to most any audio source, receiver or transceiver without the need to dig around inside the radio for any signals. All connections are similar to connecting a TNC to your transceiver. Consult your transceivers operating manual for TNC connection instructions.

The NHRC-Intelligent Remote DTMF remote controller provides the remote control of 6 loads by sending DTMF commands over any audio circuit. The heart of the Intelligent Remote is a Microchip PIC16F84 microcontroller and the Teltone M8870 DTMF decoder IC.

The NHRC-Intelligent Remote has the ability to send command confirmation messages via Morse code, which can be sent over any audio circuit. This makes the device useful for radio or wireline applications. For radio applications, the NHRC-Intelligent Remote can send a Morse code ID message a user defined amount of time after first transmitting.

Theory of operation:

When audio arrives at the DTMF decoder, valid DTMF tones decoded by the M8870 cause the STD data valid signal to go high, at which point the microprocessor starts "listening" to the data from the DTMF decoder. Since it is only listening to the audio it does not know when you have stopped transmitting. The internal program starts a timer (inter-digit timer) that is refreshed with each valid DTMF received from the DTMF decoder. All commands are evaluated and executed after the inter-digit timer expires. (The inter-digit timer is hard coded at 1.5 seconds) If the first four digits match the user defined password stored in the internal EEPROM of the microprocessor then the following four command digits are evaluated and executed if valid. Besides your password, the current output states, port configurations, the CW call sign, and the ID timer value are stored in the microcontrollers internal EEPROM and are retained indefinitely. All of this happens inside the PIC microcontroller at approximately 1 MIP (million instructions per second). The microprocessor clock is driven by the clock output of the M8870 saving the cost of an additional crystal.

The microcontroller processes the received command and sends the appropriate logic signal to the IRF510 power MOSFET's. A high on the gate of the MOSFET causes the drain of the MOSFET to close to ground. We chose open drain MOSFET outputs instead of relay outputs because relays can bounce making connection to digital circuitry a problem in some cases. The Intelligent Remote's outputs can drive well in excess of 1 amp allowing control of huge relays if required. Valid commands are acknowledged by asserting the PTT line (pulling it to ground) and sending a CW messages of "1 HI", "1 LO", or "1 PU" ("PU" is used to indicate pulsed operation) depending on the channel commanded. Status indicator LED's

show at a glance the state of all channels, valid DTMF digit decode and the PTT line status. The status LED's can be disabled for lower power consumption. The NHRC Intelligent Remote draws about 14mA @13.8V with the LED's disabled making it ideal for solar powered applications. Since the Intelligent Remote uses a unique user defined 4-digit password up to 10,000 Intelligent Remote boards could be addressed on the same audio channel.

Initial setup and Initialization

The NHRC Intelligent Remote uses a user defined four-digit password for access to all commands. This four-digit password can only be set by initializing the processor. The microcontroller stores the password, CW messages and all output configurations and states internally in non-volatile EEPROM. After a power failure the Intelligent Remote will power back up in the exact state it was in before the interruption of power.

To INIT the processor, short the INIT jumper and apply power and release the short. The first four valid DTMF digits received become the password. For the rest of this document, the symbol **pppp** will indicate the password entered. *Note:* There will not be a response after the INIT sequence.

The Intelligent Remote has only two adjustments; VR2 controls the audio input level to the touch-tone decoder. Set this pot for reliable touch-tone decode as noted by the DTMF decode LED D7. VR1 sets the audio level of the CW output. Set this level to drive your transmitter to 4KHz deviation.

Port Configuration:

The 6 output ports can be configured for ON/OFF or PULSED (½ second on) operation. The default port configuration is for ON/OFF mode. Each port (1-6) can be individually configured. To configure port "n" for PULSED operation, send the command **pppp710n**. To configure port "n" for ON/OFF operation, send the command **pppp700n**. In either case, the Intelligent Remote will respond with "OK" in Morse code.

Pulsed operation is especially useful for toggling the up down keys on a transceiver to change channels remotely, or it could be used to activate your garage door opener, etc.

Port Control:

The 6 output ports can be turned ON or OFF or PULSED. If the port is configured for PULSED operation, then setting the port to ON will result in the port being turned on for ½ second. To set port "n" on, (or pulsed it if so configured) send the command **pppp610n**. To set port "n" off, send the command **pppp600n**. If an output is configured for pulsed operation it cannot be latched on by this control method.

The entire output port may also be addressed as a "word" allowing writing to all outputs with one command by programming the port control register directly. (See memory map table) Example 1: To set all outputs OFF enter **pppp0000**. Example 2: To set all outputs ON enter **pppp00FF**. *Note:* Since you are writing directly to the output register that drives the output FET's, any port configured for pulsed operation will be latched on and will stay on until commanded off. *Note:* The least-significant two bits in the port control word are ignored because the output port is only 6 bits wide.

CW ID AND CW Message Programming:

The ID messages and command response messages are programmed into successive locations in the Intelligent Remote's EEPROM memory. There are 40 characters reserved for the ID message, from address 12h to address 39h. The address and data bytes must be entered as hexadecimal bytes. These locations are programmed by entering the command **ppppxxyy**, where "xx" is the address to program and "yy" is the data. The message must be terminated with the "magic" end of message character "FF" in the

location immediately following the last letter in your ID. CW characters are mapped to hex numbers per the character map table following below.

Hex numbers (base 16) and your DTMF pad.

There are 16 hex digits in base 16: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, A, B, C, D, E and F. These map directly to your 16 key DTMF pad on your radio except for E and F. We have mapped E to the * key and F to the # keys on you DTMF pad.

Morse character encoding table

Character	Morse Code	Hex Encoding
sk	...--	68
ar	-.--	2A
bt	-...-	31
/	-...-	29
0	-----	3F
1	.-----	3E
2	..----	3C
3	...---	38
4--	30
5	20
6	-.....	21
7	--....	23
8	---...	27
9	----.	2F
a	.-	06
b	-...	11
c	-.-.	15
d	-..	09
e	.	02
f	..-	14
g	--.	0B

Character	Morse Code	Hex Encoding
h	10
i	..	04
j	.---	1E
k	-.-	0D
l	.-..	12
m	--	07
n	-.	05
o	---	0F
p	.--.	16
q	---.	1B
r	.-.	0A
s	...	08
t	-	03
u	..-	0C
v	...-	18
w	.-.-	0E
x	-...-	19
y	-.---	1D
z	---..	13
space		00
EOM		FF

ID Timer Programming:

The ID timer can be set by programming a hex value representing tens (10s) of seconds of delay into address 02. **Remember:** The addresses and data values are in HEX. Example: The default timer value is 32 hex. 32 hex equals 50 in decimal. Since the ID timer is incremented in 10 sec increments $50 \times 10 = 500$ sec or 8.33 min. The Intelligent Remotes will ID 8.33 min after if sent a confirmation message. **Note:** The calculator in Windows 95 or 98 (in scientific view) can convert between decimal and hex for you.

Programming Memory Map

Address	Default Data	Purpose/Use
00	00	Port Control
01	00	Port Mode
02	32	ID Timer
03	10	'H'
04	04	'I'
05	FF	EOM
06	12	'L'
07	0F	'O'
08	FF	EOM
09	16	'P'
0A	0C	'U'
0B	FF	EOM
0C	0F	'O'
0D	0D	'K'
0E	FF	EOM
0F	05	'N'
10	0B	'G'
11	FF	EOM
12	09	'D'
13	02	'E'
14	00	Space
15	05	'N'
16	10	'H'
17	0A	'R'
18	15	'C'
19	29	'/'
1A	0a	'R'
1B	02	'E'
1C	07	'M'
1D	0F	'O'

Address	Default Data	Purpose/Use
1E	03	'T'
1F	02	'E'
20	FF	EOM
21	FF	EOM
22	FF	EOM
23	FF	EOM
24	FF	EOM
25	FF	EOM
26	FF	EOM
27	FF	EOM
28	FF	EOM
29	FF	EOM
2A	FF	EOM
2B	FF	EOM
2C	FF	EOM
2D	FF	EOM
2E	FF	EOM
2F	FF	EOM
30	FF	EOM
31	FF	EOM
32	FF	EOM
33	FF	EOM
34	FF	EOM
35	FF	EOM
36	FF	EOM
37	FF	EOM
38	FF	EOM
39	FF	EOM
3A	FF	EOM
3B	FF	EOM

Summary

The NHRC Intelligent Remote is a simple and inexpensive way to keep things under control around your shack or repeater site. Its compact 3"x 3" size will allow it to be even embedded inside your project or repeater. Its unique ability to respond to your commands eliminates the guesswork in remotely controlling your station. You won't be wondering "Did I make it?" You will always know if the Intelligent Remote controller heard your command. The Intelligent Remote can be built in about an hour and you may already have some of the parts hanging around in your shack.

The NHRC Intelligent Remote is available assembled and tested for \$89.00 + \$7.00 S+H or as a partial kit for \$35.00 + \$6.00 S+H. Prices are for domestic delivery, please inquire for international orders. The partial kit contains the printed circuit board (PCB is double sided with plated through holes, solder mask and silk screen), programmed microprocessor and DTMF decoder, a printed manual with a parts list for ordering all of the additional components from Digi-Key Corp. and detailed assembly instructions. The additional components needed to complete the kit cost approx. \$20 from Digi-Key Corp. Digi-Key can be reached at 1-800-344-4539. Technical support, answers to FAQ and ordering info is also available at our web site at <http://www.nhrc.net>

Orders can be sent to:

NHRC
444 Micol Rd.
Pembroke, NH 03275.

Copyright © 1999, 2000, 2001 NHRC LLC. All rights reserved.

Assembly of the NHRC Intelligent Remote:

The NHRC-REMOTE is a fairly simple project to build. Minimal electronic experience is required. Assembly time should be around 1 hour.

Organize your parts per the parts list. Use a small soldering iron of approx. 25 watts. (DO NOT USE A SOLDERING GUN). Consider using a water-soluble flux-core solder (such as Alpha Metals Aqualine 6000). A quick rinse under warm water in your sink after assembly and your finished product will look professional. Rosin flux-core solder is OK as well, but be sure to clean your board after assembly with isopropyl alcohol.

As you install a part check it off on your parts list. *Socket your chips!* Pin 1 of many components are denoted by the square pad on the PCB. Install the IRF510 FET's (Q1-6) so the heatsink surface faces JP2, note the silkscreen orientation of the LED's (D1-8) and small transistors (Q7-9) when installing them. If the resistor pack (RP1) you use has 10 pins, cut off the 10th pin before installing (rev A PCB only). Be careful to install all polarized capacitors (C2, C5, and C6) per the silkscreen (note the "+" sign). Reversing the polarity of the caps will let out the smoke! The band (cathode) of the zener diode (D9) goes to the square pad on the PCB.

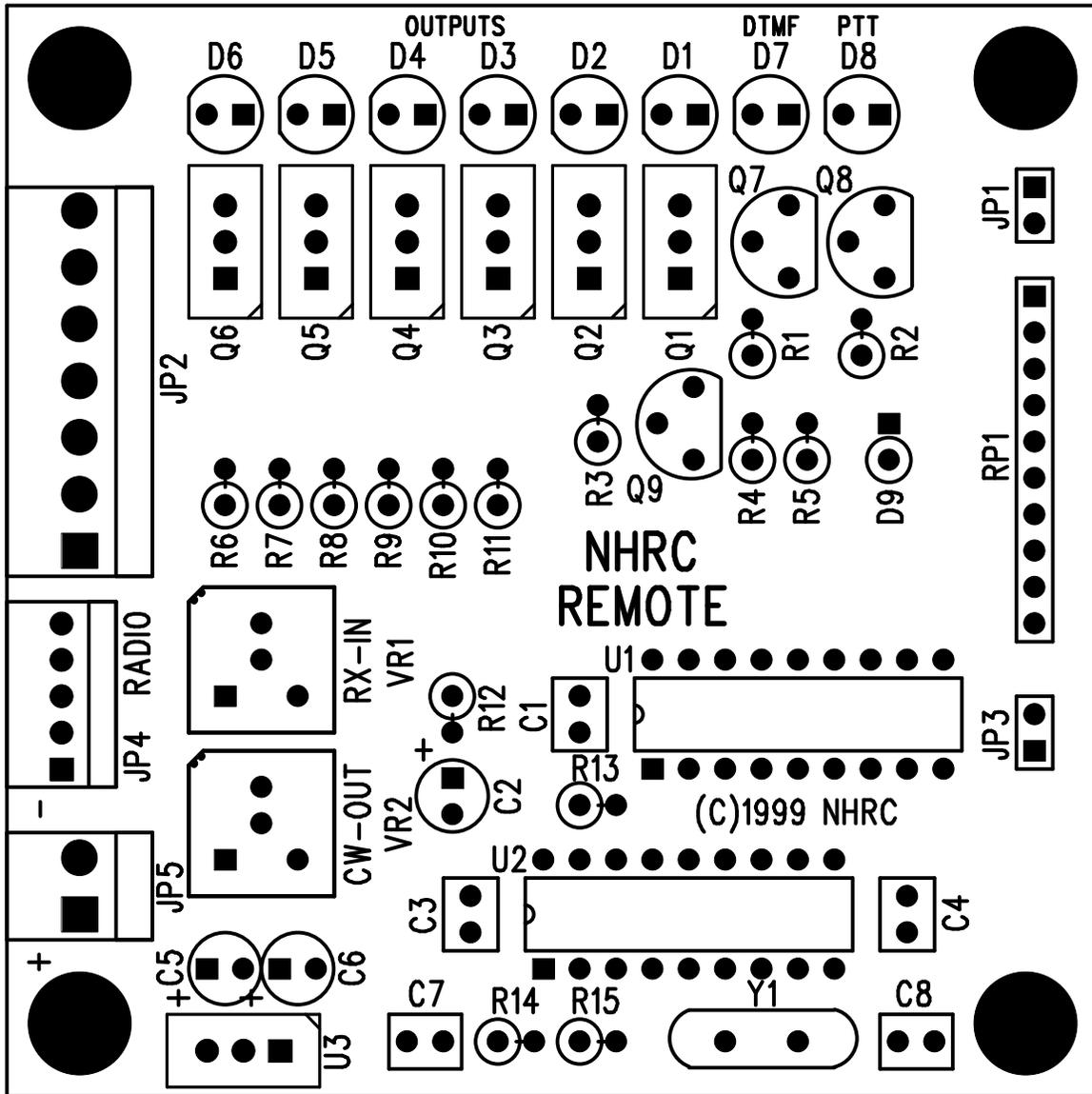
Once assembly is complete, power up your board without the chips installed. Refer to the schematic and check voltages to your chips. (Example: +5 volts across bypass caps C1 and C4) When all checks out OK, install the chips in their sockets, power-up the board, INIT the processor and enjoy!

Notes:

A detailed trouble shooting guide is available on our web site at <http://www.nhrc.net>.

Alpha Metals solder info is available at <http://www.alphametals.com>

SOCKET YOUR CHIPS!



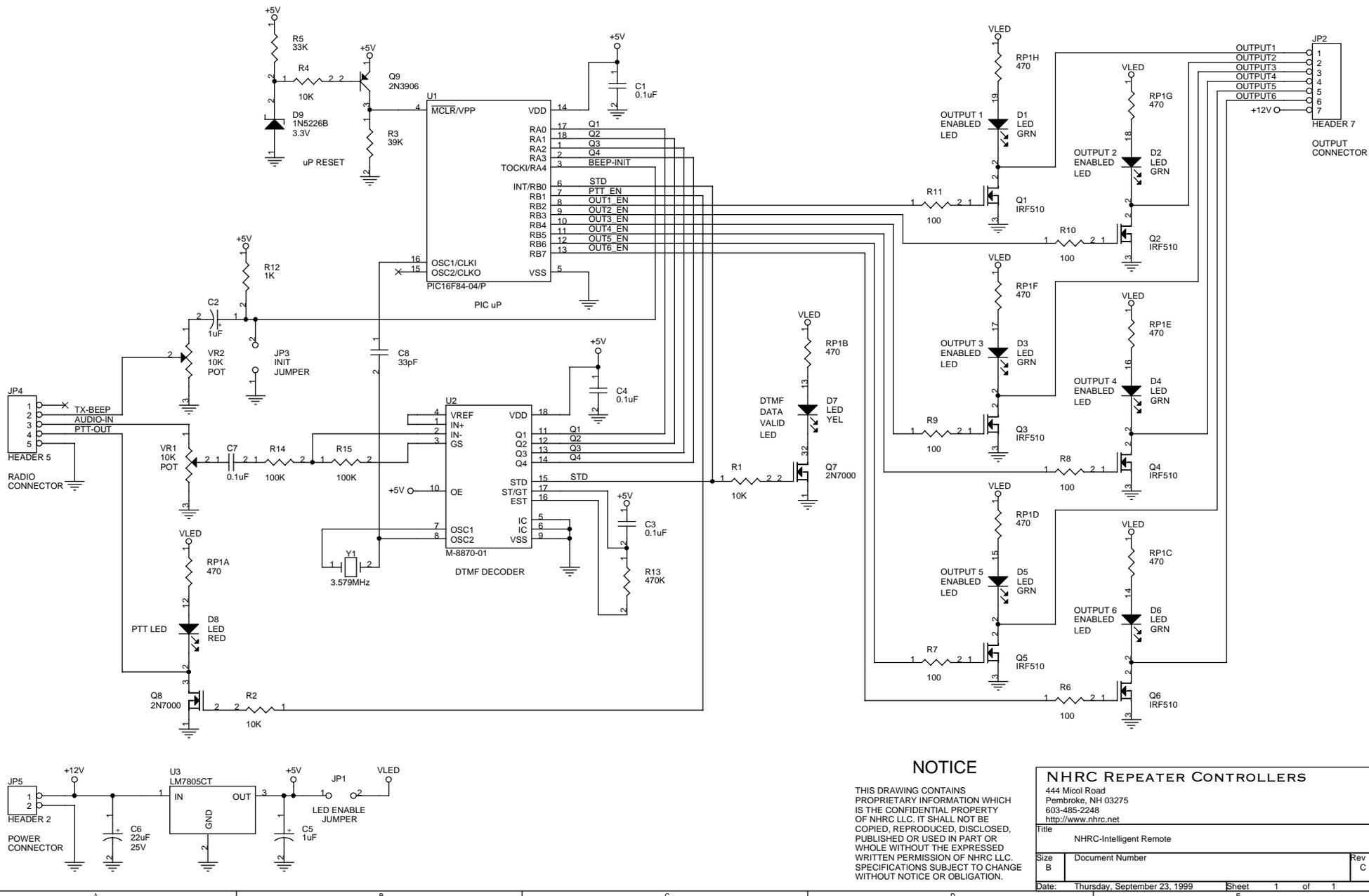
(C)1999 NHRC

TOP ASSEMBLY

ASSEMBLY NOTES FOR PCB REV B

1. SOCKET ALL OF YOUR CHIPS!
2. SQUARE PAD DENOTES PIN 1 ON ALL PARTS, "+" LEAD ON CAPACITORS, CATHODE (BAND) ON DIODES AND ANODE ON LED'S
3. U3 (LM7805) HEAT SINK FACES OUT
4. DO NOT USE A SOLDERING GUN! USE A SOLDERING IRON (~25W) AND ROSIN CORE FLUX SOLDER ONLY

TECH SUPPORT IS AVAILABLE ON OUR WEB SITE AT <http://www.nhrc.net>



NOTICE

THIS DRAWING CONTAINS PROPRIETARY INFORMATION WHICH IS THE CONFIDENTIAL PROPERTY OF NHRC LLC. IT SHALL NOT BE COPIED, REPRODUCED, DISCLOSED, PUBLISHED OR USED IN PART OR WHOLE WITHOUT THE EXPRESSED WRITTEN PERMISSION OF NHRC LLC. SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE OR OBLIGATION.

NHRC REPEATER CONTROLLERS

444 Micol Road
 Pembroke, NH 03275
 603-485-2248
<http://www.nhrc.net>

Title		NHRC-Intelligent Remote	
Size	B	Document Number	
Date:	Thursday, September 23, 1999	Sheet	1 of 1
Rev	C		

NHRC Repeater Controllers

NHRC-Intelligent Remote Controller

Bill Of Materials

Revised: Thursday, September 23, 1999

Revision: C

NHRC Repeater Controllers

444 Micol Road

Pembroke, NH 03275

603-485-2248

<http://www.nhrc.net>

Item	Qty.	Ref.	Schematic Value		Description	Mfg.	Mfg. P/N	Digi-Key P/N	Unit Cost	Notes
1	4	C1	0.1uF		0.1uF 50V Z5U Ceramic Radial Cap	Panasonic	ECU-S1H104MEA	P4924-ND	\$ 0.21	
		C3	0.1uF		0.1uF 50V Z5U Ceramic Radial Cap	Panasonic	ECU-S1H104MEA	P4924-ND	\$ 0.21	
		C4	0.1uF		0.1uF 50V Z5U Ceramic Radial Cap	Panasonic	ECU-S1H104MEA	P4924-ND	\$ 0.21	
		C7	0.1uF		0.1uF 50V Z5U Ceramic Radial Cap	Panasonic	ECU-S1H104MEA	P4924-ND	\$ 0.21	
2	2	C2	1uF		1uF 16V Tantalum Cap	Panasonic	ECS-F1CE105K	P2105-ND	\$ 0.28	
		C5	1uF		1uF 16V Tantalum Cap	Panasonic	ECS-F1CE105K	P2105-ND	\$ 0.28	
3	1	C6	22uF	25V	22uF 25V Tantalum Cap	Panasonic	ECS-F1EE226	P2051-ND	\$ 1.74	
4	1	C8	33pF		33pF 100V C0G Ceramic Radial Cap	Panasonic	ECU-S2A330JCA	P4843-ND	\$ 0.18	
5	6	D1	LED	GRN	Green T1 $\frac{3}{4}$ LED	Lite-On	LTL-4233	LT1130-ND	\$ 0.23	
		D2	LED	GRN	Green T1 $\frac{3}{4}$ LED	Lite-On	LTL-4233	LT1130-ND	\$ 0.23	
		D3	LED	GRN	Green T1 $\frac{3}{4}$ LED	Lite-On	LTL-4233	LT1130-ND	\$ 0.23	
		D4	LED	GRN	Green T1 $\frac{3}{4}$ LED	Lite-On	LTL-4233	LT1130-ND	\$ 0.23	
		D5	LED	GRN	Green T1 $\frac{3}{4}$ LED	Lite-On	LTL-4233	LT1130-ND	\$ 0.23	
		D6	LED	GRN	Green T1 $\frac{3}{4}$ LED	Lite-On	LTL-4233	LT1130-ND	\$ 0.23	
6	1	D7	LED	YEL	Yellow T1 $\frac{3}{4}$ LED	Lite-On	LTL-4253	LT1133-ND	\$ 0.23	
7	1	D8	LED	RED	Red T1 $\frac{3}{4}$ LED	Lite-On	LTL-4203	LT1124-ND	\$ 0.23	
8	1	D9	1N5226B	3.3V	3.3V 5% 500mW Zener Diode	Diodes Inc.	1N5226B	1N5226BCT-ND	\$ 0.21	
9	2	JP1	JUMPER		2 Circuit Header, .100" Straight	Molex	22-03-2021	WM4000-ND	\$ 0.25	
		JP3	JUMPER		2 Circuit Header, .100" Straight	Molex	22-03-2021	WM4000-ND	\$ 0.25	
10	1	JP2	HEADER 7		7 Circuit Header, .156" Straight w/ lock	Molex	26-60-4070	WM4625-ND	\$ 0.68	
11	1	JP4	HEADER 5		5 Circuit Header, .100" Straight w/ lock	Molex	22-23-2051	WM4203-ND	\$ 0.60	
12	1	JP5	HEADER 2		2 Circuit Header, .156" Straight w/ lock	Molex	26-60-4020	WM4620-ND	\$ 0.26	
13	6	Q1	IRF510		N Channel HEXFET	IRF	IRF510	IRF510-ND	\$ 0.77	
		Q2	IRF510		N Channel HEXFET	IRF	IRF510	IRF510-ND	\$ 0.77	
		Q3	IRF510		N Channel HEXFET	IRF	IRF510	IRF510-ND	\$ 0.77	
		Q4	IRF510		N Channel HEXFET	IRF	IRF510	IRF510-ND	\$ 0.77	
		Q5	IRF510		N Channel HEXFET	IRF	IRF510	IRF510-ND	\$ 0.77	
		Q6	IRF510		N Channel HEXFET	IRF	IRF510	IRF510-ND	\$ 0.77	
14	2	Q7	2N7000		N Channel MOSFET	Fairchild	2N7000	2N7000-ND	\$ 0.78	
		Q8	2N7000		N Channel MOSFET	Fairchild	2N7000	2N7000-ND	\$ 0.78	
15	1	Q9	2N3906		PNP Transistor	Fairchild	2N3906	2N3906-ND	\$ 0.31	
16	1	RP1	470		470x8 Bussed Resistor Network	Bourns	4610X-101-471	4610X-1-471-ND	\$ 0.39	see note 2
17	3	R1	10K		10K $\frac{1}{4}$ W 5% Carbon Film Resistor	Yaego	CFR-25JB 10K	10KQBK-ND	\$ 0.06	
		R2	10K		10K $\frac{1}{4}$ W 5% Carbon Film Resistor	Yaego	CFR-25JB 10K	10KQBK-ND	\$ 0.06	
		R4	10K		10K $\frac{1}{4}$ W 5% Carbon Film Resistor	Yaego	CFR-25JB 10K	10KQBK-ND	\$ 0.06	
18	1	R12	1K		1K $\frac{1}{4}$ W 5% Carbon Film Resistor	Yaego	CFR-25JB 1K0	1.0KQBK-ND	\$ 0.06	
19	1	R3	39K		39K $\frac{1}{4}$ W 5% Carbon Film Resistor	Yaego	CFR-25JB 39K	39KQBK-ND	\$ 0.06	

NHRC Repeater Controllers

Item	Qty.	Ref.	Schematic Value	Description	Mfg.	Mfg. P/N	Digi-Key P/N	Unit Cost	Notes
20	1	R5	33K	33K ¼W 5% Carbon Film Resistor	Yaego	CFR-25JB 33K	33KQBK-ND	\$ 0.06	
21	6	R6	100	100 ¼W 5% Carbon Film Resistor	Yaego	CFR-25JB 100R	100QBK-ND	\$ 0.06	
		R7	100	100 ¼W 5% Carbon Film Resistor	Yaego	CFR-25JB 100R	100QBK-ND	\$ 0.06	
		R8	100	100 ¼W 5% Carbon Film Resistor	Yaego	CFR-25JB 100R	100QBK-ND	\$ 0.06	
		R9	100	100 ¼W 5% Carbon Film Resistor	Yaego	CFR-25JB 100R	100QBK-ND	\$ 0.06	
		R10	100	100 ¼W 5% Carbon Film Resistor	Yaego	CFR-25JB 100R	100QBK-ND	\$ 0.06	
		R11	100	100 ¼W 5% Carbon Film Resistor	Yaego	CFR-25JB 100R	100QBK-ND	\$ 0.06	
22	1	R13	470K	470K ¼W 5% Carbon Film Resistor	Yaego	CFR-25JB 470K	470KQBK-ND	\$ 0.06	
23	2	R15	100K	100K ¼W 5% Carbon Film Resistor	Yaego	CFR-25JB 100K	100KQBK-ND	\$ 0.06	
		R14	100K	100K ¼W 5% Carbon Film Resistor	Yaego	CFR-25JB 100K	100KQBK-ND	\$ 0.06	
24	1	U1	PIC16F84-04/P	PIC Microcontroller (Blank)	Microchip	PIC16F84-04/P	PIC16F84-04/P-ND	\$ 6.88	see notes 1&3
25	1	U2	M-8870-01	DTMF Decoder	Holtek	HT9170	HT-9170-ND	\$ 2.63	see notes 1&3
26	1	U3	LM7805CT	5V 1.0A Voltage Regulator	Nat'l Semi	LM340T-5.0	LM340T-5.0-ND	\$ 0.70	
27	2	VR2	10K	POT 10K 6mm Carbon Trimpot	Panasonic	EVN-D8AA03B14	D4AA14-ND	\$ 0.22	
		VR1	10K	POT 10K 6mm Carbon Trimpot	Panasonic	EVN-D8AA03B14	D4AA14-ND	\$ 0.22	
28	1	Y1	3.579MHz	3.579545MHz Crystal	ECS	ECS-35-17-4	X079-ND	\$ 1.30	
Additional Items									
29	1			NHRC-Remote PCB rev A or B	NHRC	NHRC-REMOTEPCB	N/A		see note 1
30	2			18 Pin DIP Socket	AMP	2-640359-3	A9318-ND	\$ 0.10	use at U1/U2
31	1			7 Circuit Housing, .156" w/ lock and polarizer	Molex	09-50-8073	WM2116-ND	\$ 0.50	mate for JP2
32	2			5 Circuit Housing, .100" w/ lock and polarizer	Molex	22-01-3057	WM2003-ND	\$ 0.35	mate for JP4
33	2			2 Circuit Housing, .156" w/ lock and polarizer	Molex	09-50-8023	WM2111-ND	\$ 0.25	mate for JP5
34	5			Crimp Terminal for Molex .100" Housing	Molex	08-50-0114	WM2200-ND	\$ 0.11	
35	9			Crimp Terminal for Molex .156" Housing	Molex	08-50-0106	WM2300-ND	\$ 0.08	
36	2			Shorting Jumpers	3M	929950-00-I	929950-00-ND	\$ 0.10	for JP1/JP3
Other Notes: <ol style="list-style-type: none"> 1. U1 (Programmed), U2 and PCB are included w/ the NHRC-Intelligent Remote kit. 2. For PCB rev A: Cut off pin 10 of part prior to assembly. 3. Items are shown in case you require a replacement. 4. Digi-Key pricing based on Catalog No. Q991. Pricing may vary. Check with Digi-Key for the latest pricing at http://www.digikey.com 									

Item	Qty.	Schematic Value	Description	Mfg.	Mfg. P/N	Digi-Key P/N	Unit Cost	Ext. Cost	Notes
1	4	0.1uF	0.1uF 50V Z5U Ceramic Radial Cap	Panasonic	ECU-S1H104MEA	P4924-ND	\$ 0.21	\$ 0.84	
2	2	1uF	1uF 16V Tantalum Cap	Panasonic	ECS-F1CE105K	P2105-ND	\$ 0.28	\$ 0.56	
3	1	22uF	25V 22uF 25V Tantalum Cap	Panasonic	ECS-F1EE226	P2051-ND	\$ 1.74	\$ 1.74	
4	1	33pF	33pF 100V C0G Ceramic Radial Cap	Panasonic	ECU-S2A330JCA	P4843-ND	\$ 0.18	\$ 0.18	
5	6	LED	GRN Green T1¼ LED	Lite-On	LTL-4233	LT1130-ND	\$ 0.23	\$ 1.38	
6	1	LED	YEL Yellow T1¼ LED	Lite-On	LTL-4253	LT1133-ND	\$ 0.23	\$ 0.23	
7	1	LED	RED Red T1¼ LED	Lite-On	LTL-4203	LT1124-ND	\$ 0.23	\$ 0.23	
8	1	1N5226B	3.3V 3.3V 5% 500mW Zener Diode	Diodes Inc.	1N5226B	1N5226BCT-ND	\$ 0.21	\$ 0.21	
9	2	JUMPER	2 Circuit Header, .100" Straight	Molex	22-03-2021	WM4000-ND	\$ 0.25	\$ 0.50	
10	1	HEADER 7	7 Circuit Header, .156" Straight w/ lock	Molex	26-60-4070	WM4625-ND	\$ 0.68	\$ 0.68	
11	1	HEADER 5	5 Circuit Header, .100" Straight w/ lock	Molex	22-23-2051	WM4203-ND	\$ 0.60	\$ 0.60	
12	1	HEADER 2	2 Circuit Header, .156" Straight w/ lock	Molex	26-60-4020	WM4620-ND	\$ 0.26	\$ 0.26	
13	6	IRF510	N Channel HEXFET	IRF	IRF510	IRF510-ND	\$ 0.77	\$ 4.62	
14	2	2N7000	N Channel MOSFET	Fairchild	2N7000	2N7000-ND	\$ 0.78	\$ 1.56	
15	1	2N3906	PNP Transistor	Fairchild	2N3906	2N3906-ND	\$ 0.31	\$ 0.31	
16	1	470	470x8 Bussed Resistor Network	Bourns	4610X101-471	4610X1-471-ND	\$ 0.39	\$ 0.39	see note 2
17	3	10K	10K ¼W 5% Carbon Film Resistor	Yaego	CFR-25JB 10K	10KQBK-ND	\$ 0.06	\$ 0.17	
18	1	1K	1K ¼W 5% Carbon Film Resistor	Yaego	CFR-25JB 1K0	1.0KQBK-ND	\$ 0.06	\$ 0.06	
19	1	39K	39K ¼W 5% Carbon Film Resistor	Yaego	CFR-25JB 39K	39KQBK-ND	\$ 0.06	\$ 0.06	
20	1	33K	33K ¼W 5% Carbon Film Resistor	Yaego	CFR-25JB 33K	33KQBK-ND	\$ 0.06	\$ 0.06	
21	6	100	100 ¼W 5% Carbon Film Resistor	Yaego	CFR-25JB 100R	100QBK-ND	\$ 0.06	\$ 0.34	
22	1	470K	470K ¼W 5% Carbon Film Resistor	Yaego	CFR-25JB 470K	470KQBK-ND	\$ 0.06	\$ 0.06	
23	2	100K	100K ¼W 5% Carbon Film Resistor	Yaego	CFR-25JB 100K	100KQBK-ND	\$ 0.06	\$ 0.11	
24	1	PIC16F84-04/P	PIC Microcontroller (Blank)	Microchip	PIC16F84-04/P	PIC16F84-04/P-ND	\$ 6.88		see notes 1&3
25	1	M-8870-01	DTMF Decoder	Holtek	HT9170	HT-9170-ND	\$ 2.63		see notes 1&3
26	1	LM7805CT	5V 1.0A Voltage Regulator	Nat'l Semi	LM340T-5.0	LM340T-5.0-ND	\$ 0.70	\$ 0.70	
27	2	10K	POT 10K 6mm Carbon Trimpot	Panasonic	EVN-D8AA03B14	D4AA14-ND	\$ 0.22	\$ 0.44	
28	1	3.579MHz	3.579545MHz Crystal	ECS	ECS-35-17-4	X079-ND	\$ 1.30	\$ 1.30	
Additional Items									
29	1		NHRC-Remote PCB rev A or B	NHRC	NHRC-REMOTEPCB	N/A			see note 1
30	2		18 Pin DIP Socket	AMP	2-640359-3	A9318-ND	\$ 0.10	\$ 0.20	use at U1/U2
31	1		7 Circuit Housing, .156" w/ lock and polarizer	Molex	09-50-8073	WM2116-ND	\$ 0.50	\$ 0.50	mate for JP2
32	2		5 Circuit Housing, .100" w/ lock and polarizer	Molex	22-01-3057	WM2003-ND	\$ 0.35	\$ 0.70	mate for JP4
33	2		2 Circuit Housing, .156" w/ lock and polarizer	Molex	09-50-8023	WM2111-ND	\$ 0.25	\$ 0.50	mate for JP5
34	5		Crimp Terminal for Molex .100" Housing	Molex	08-50-0114	WM2200-ND	\$ 0.11	\$ 0.53	
35	9		Crimp Terminal for Molex .156" Housing	Molex	08-50-0106	WM2300-ND	\$ 0.08	\$ 0.70	
36	2		Shorting Jumpers	3M	929950-00-1	929950-00-ND	\$ 0.10	\$ 0.21	for JP1/JP3
Notes: <ol style="list-style-type: none"> U1 (Programmed), U2 and PCB are included w/ the NHRC-Intelligent Remote kit. For PCB rev A: Cut off pin 10 of part prior to assembly. Items are shown in case you require a replacement. Digi-Key pricing based on Catalog No. Q991. Pricing may vary. Check with Digi-Key for the latest pricing at http://www.digikey.com 									

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.