WILD PLANET

PURPLE UNIT

PART 15

AM BROADCAST TRANSMITTER

FCC ID: N3ERADIODJ 70034

BUILT BY

Wild Planet Toys, Inc

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Suite 300
San Francisco, CA 94111

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COMPILED BY JEFF MORRISON APRIL 17, 2015

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PAGE **NOTE: MODIFICATION ARE DONE AT YOUR OWN RISK & WE ARE NOT RESPONSIBLE !!**

Radio DJ

Ages 6 & up

Real DJ Broadcast Studio

IMPORTANT: Keep these instructions. **DO NOT DISCARD**

- Requires 4 x 1.5 "AA" (LR6) batteries.
- Only adults should install and replace batteries.
- Alkaline batteries are recommended for longer life.
- Do not use rechargeable batteries.
- Non-rechargeable batteries are not to be recharged.
- Exhausted batteries should be removed from the toy.
- Do not mix old and new batteries.
- Do not mix alkaline, standard (carbon zinc) or rechargeable (nickel cadmium) batteries.
- Batteries should be inserted with the correct polarity.
- The supply terminals are not to be short-circuited.
- Only the batteries of the same or equivalent type as recommended are to be used.

Features (Figure 1):

- Transmits through any radio up to 30 feet away (AM 1610 frequency)
- Includes four sound effects (siren, clapping, XX, XXX)
- Fade-in microphone and volume controls
- Tape deck to play your tapes on the air
- Plug in jack for your CD player to play your CD's on the air
- Light-up "On Air" sign
- Antenna

Battery Installation and Replacement

The Radio DJ requires 4 x 1.5 Volt "AA" (LR6) batteries (not included).

To install the batteries:

1. With a small Phillips screwdriver, loosen screw from the battery door. **(Figure 2)**
2. Remove the battery door.
3. Discard the old batteries.
4. Insert 4 x 1.5 Volt "AA" batteries per the polarity markings into the battery compartment. **(Figure 3)**
5. Replace the battery door and tighten the screw.

Set Up Your Radio DJ

To set up the Radio DJ:

1. Turn on power On/Off button by rotating counter-clockwise until you hear a click.
2. Tune in radio to AM 1610.
   Note: Radio not included. You must use your own radio to broadcast.
3. Hang the antenna wire out in the open for maximum brightness of the red LED Output Indicator and best reception on the radio. **(Figure 4)** Do not bunch-up the antenna **(Figure 5)** or lay it over metal objects. Suspending the antenna in the air with a piece of string can be helpful. If the antenna is not properly arranged, the red LED will glow dimly or may not glow at all. Move antenna around until best reception and brightness is obtained. If desired, clip the ground wire to a metal object such as a table or chair. **(Figure 4)**
   Warning: Never connect the antenna or ground wire to an electrical appliance or anything connected to the house wiring.
4. You are now ready to broadcast live.

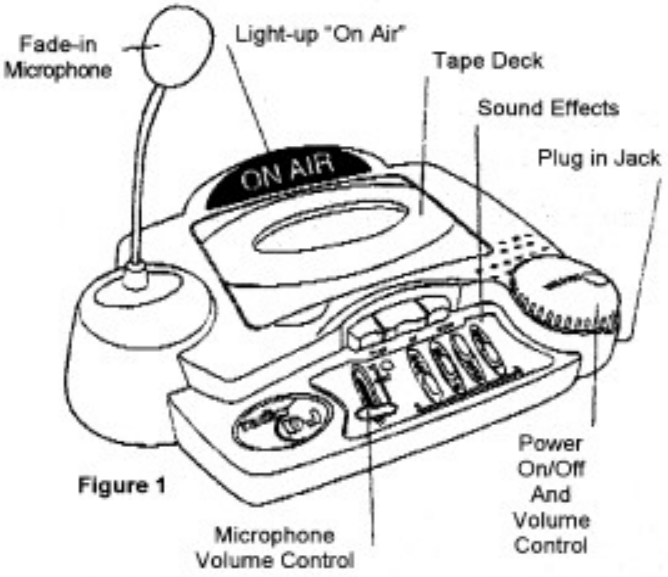


Figure 1

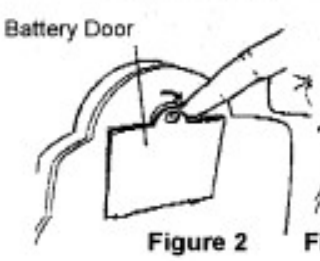


Figure 2

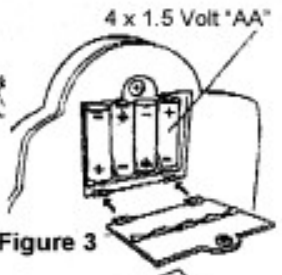


Figure 3

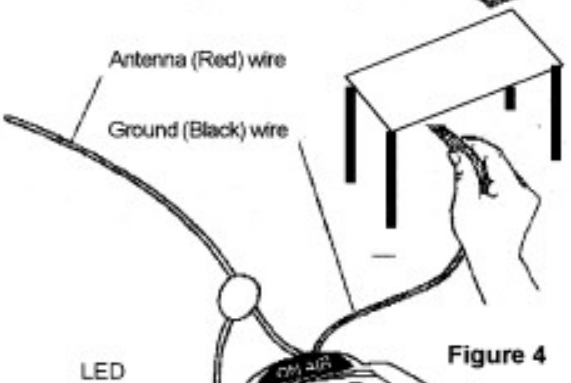


Figure 4

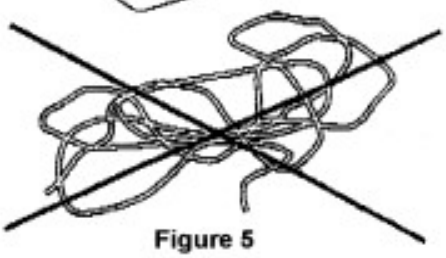


Figure 5

Microphone Usage
1. Make sure microphone volume is set to desired level by moving microphone volume control up or down. **(Figure 6)**
2. Speak into the microphone and hear your voice on the air.

Sound Effects
There are four sound effects buttons you can use when broadcasting over the radio. To use these buttons: **(Figure 7)**
1. Move the microphone volume control up or down to control volume.
2. Press your desired sound effects button and release. You will hear this sound over the radio.

Note: If you press one of the sound effects buttons and then press another one before the first one is finished, it will cut off the first sound effect and start the new one.

Play Music Using the Tape Deck
1. Select a tape.
2. Lift tape deck door with your fingers and insert tape as shown. **(Figure 7)**
3. Close tape door. **(Figure 8)**
4. Press "Play".
5. Turn power On/Off button clockwise or counter-clockwise to control volume.
6. To fast-forward the tape, press the "FF" button.

Note: There is no rewind button. If you need to rewind a tape, press eject button and remove tape. Flip tape over, reinsert and press "FF". This will rewind the tape on the opposite side. Then remove tape and flip over again and reinsert into tape deck. Press Play.

CD Jack
There is a CD jack on the side of the Radio DJ so you can plug in your CD player and play your favorite CD's over the radio. Just plug it in and play your CD's. The volume control is the same as the tape player volume control.

Use All Features Together to Create a Cool Show
Use your Radio DJ to create a show so incredible you won't believe your own ears! You can introduce and play your favorite tapes and CD's, report the news, or start your own talk show. The Radio DJ will send your voice and music through any radio in your room, house, or car. It can transmit up to 30 feet so your friends can listen to you on the radio in another room. You can be a real DJ!

Warning: Changes or modifications to this toy that are not expressly approved by Wild Planet Toys, Inc. could void the user's authority to operate the toy.

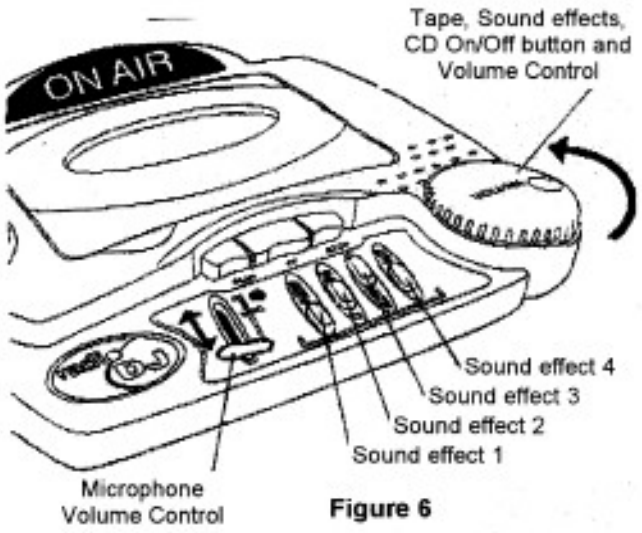


Figure 6

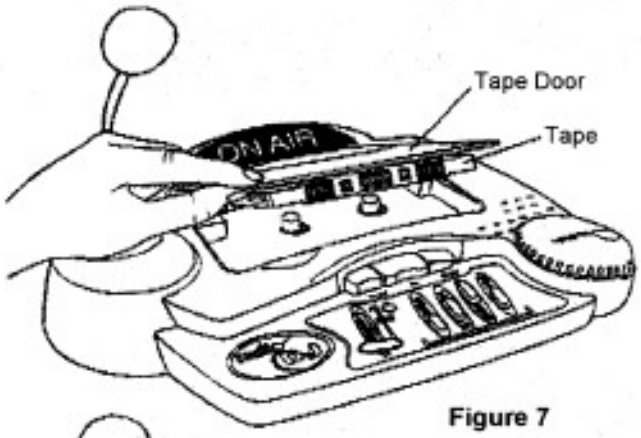


Figure 7

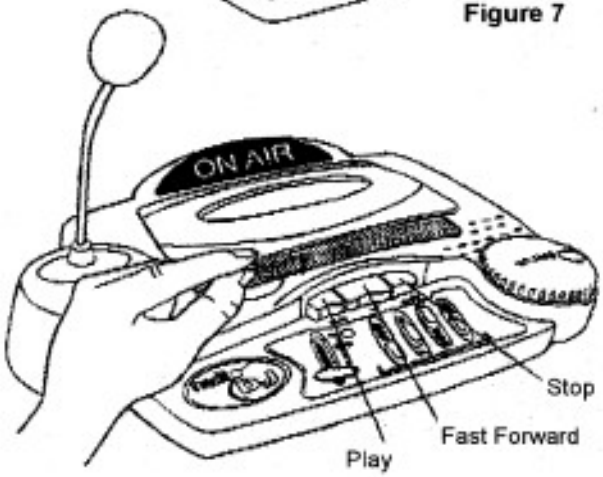


Figure 8

If you have any questions please contact us:
1-800-247-6570
www.wildplanet.com

⚠ WARNING:
CHOKING HAZARD: Small Parts
Not for Children Under 3 Yrs.

Radio DJ Studio – Reference Guide

Important: Keep these instructions. **Do Not Discard.**

Thank you for your recent purchase of our product. While every attempt has been made to ensure a satisfactory experience with your **Radio DJ Studio**, some questions or problems may arise during usage. Please read the following material for reference. It is our intent at Wild Planet to address those questions which may come up during normal play.

Description:
The reception on my "Am" radio seems weak and is filled with static.
Solution:
a) Fine tune the "AM" radio to be sure it is set at 1610 KHZ.
b) Make sure the Radio DJ Studio gray antenna wire is fully extended. Elevate the antenna wire (as vertical as possible) until the red LED is illuminated. Do not drape the antenna over a metal object or hold in your hand.
c) Check the "DJ" ground wire connection. If .not connected, clip to a metal object such as a table or chair. If your furniture is not metal, connecting the ground wire to a cookie sheet works well.
d) Re-position the "AM" radio in order to re-direct its internal antenna.
e) Check to see that both the Radio DJ Studio and "AM" radio have fresh batteries.

Description:
My "AM" radio is emitting a loud squealing noise.
Solution:
a) This is known as feedback . Move the "AM" radio further away from the Radio DJ Studio and lower its volume until the sound ceases.
b) Lower the Radio DJ Studio microphone volume.

Description:
I have fast forwarded my tape in order to hear the other side, but the FF button remains pushed in.
Solution:
This tape deck does not have fast-forward auto shutoff. After the tape has stopped, simply push the stop button and remove tape.

Description:
My CD player isn't broadcasting. It seems to have stopped playing.
Solution:
a) Check all electrical connections. Specifically, be sure that the patch cord is plugged into both the Radio DJ Studio and the CD player.
b) Check to see that the Radio DJ Studio ground wire (black) is clipped to a metal object such as table or chair. if your furniture is not metal, connecting the ground wire to a cookie sheet works well.
c) Position your CD player away from the antenna.

Description:
I can't seem to shut the cassette door after the tape has been inserted.
Solution:
a) check to see that the tape is positioned within the door brackets and not jammed. Push the tape in until it stops, and shut the cassette door firmly.
b) Check to see that the play button is not pushed in. If it is, push the stop button to return the play head to the normal position.

Description:
The red LED doesn't light up when the ground wire is connected.
Solution:
Try connecting the ground wire to a smaller metal object.

FLYER

Be a Real Radio DJ– introduce and broadcast your favorite tunes, report the news, or rap to the beat!

RADIO DJ™

Radio Broadcast Microphone & Tape Player

#70034	Closed Box	Ages 6 and up

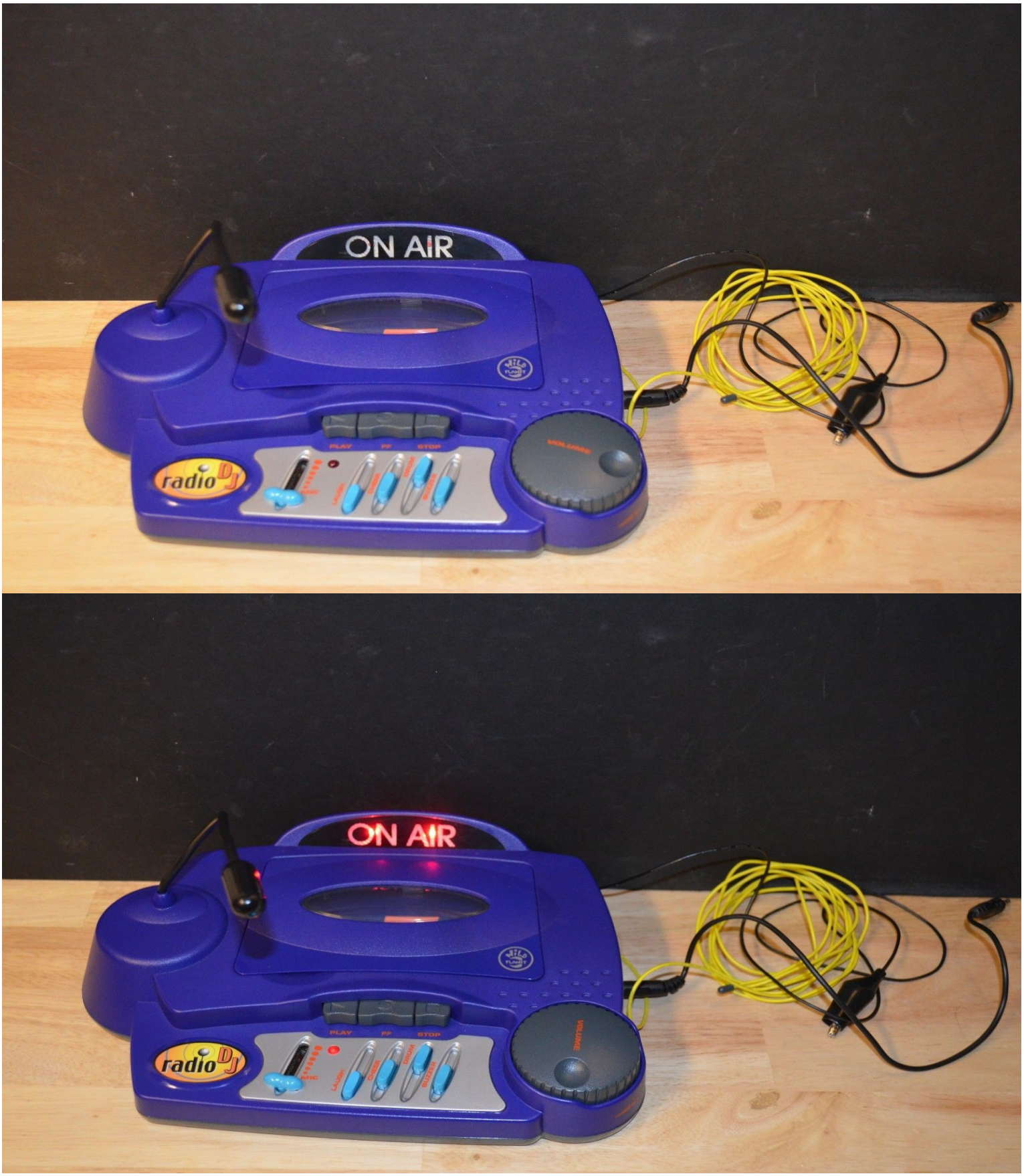
- Broadcasts your voice to any AM radio up to 30 feet away
- Real DJ microphone and fade-in controls let you mix your voice with music
- Button controls add sound effects over your voice or music
- Built-in tape deck let's you play your favorite songs "On Air"
- "On Air" sign lights up like a real radio station
- Can also be used as a sing-along karaoke machine, or to record a copy of your "broadcast" on the receiving radio
- Features plug-in jack for CD player (not included)

Built-in tape deck let's you broadcast your favorite songs over the radio

VIEW, FRONT PACKAGE

VIEW, BACK PACKAGE

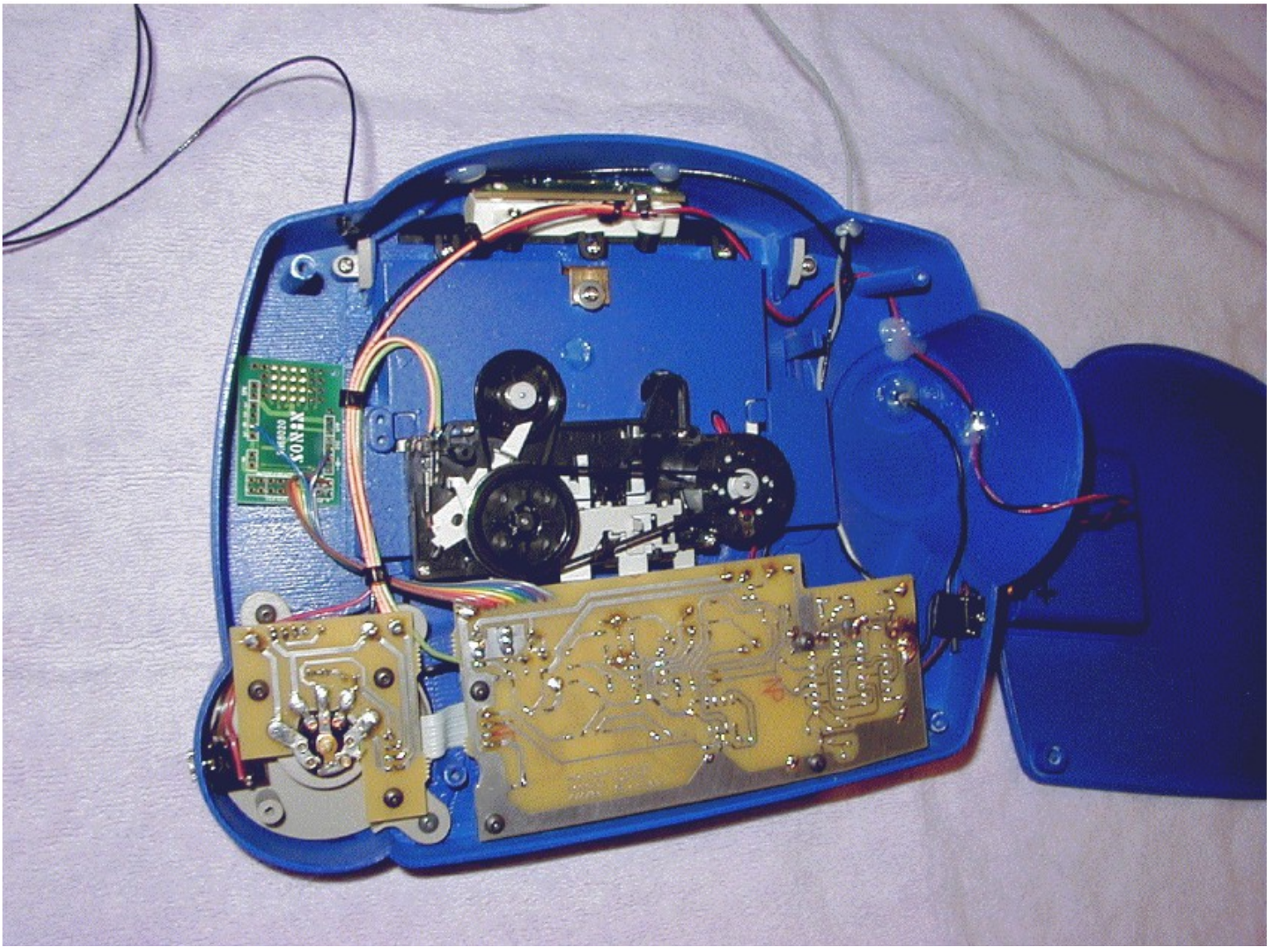
VIEW, FRONT UNIT



VIEW, BOTTOM UNIT & FCC LABEL

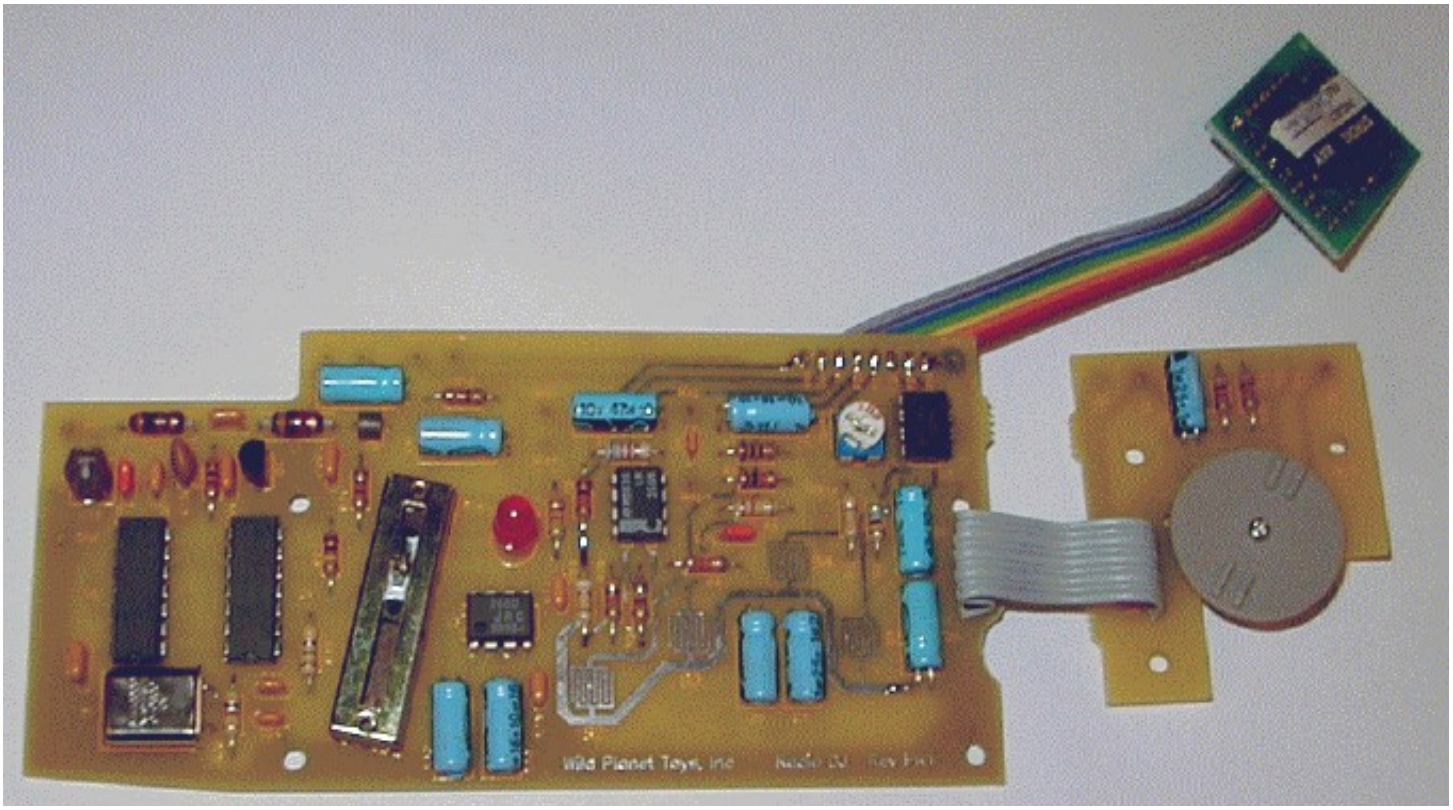
Wild Planet Toys Incorporated
FCC ID: N3ERADIODJ70034
ISC: XXX XXXX
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

VIEW, BOTTOM INSIDE LAYOUT

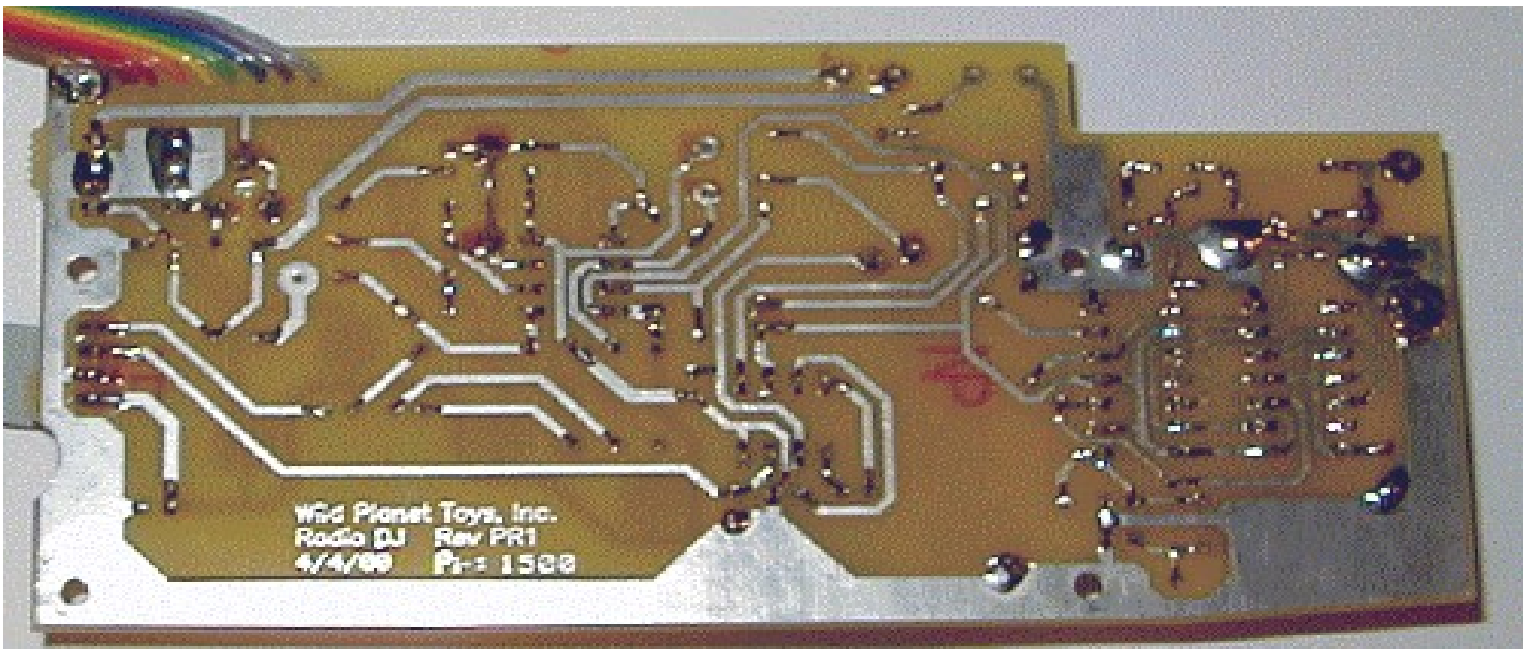


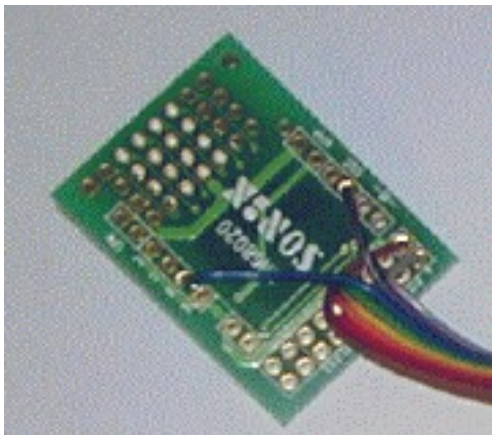
VIEW, TOP PCB

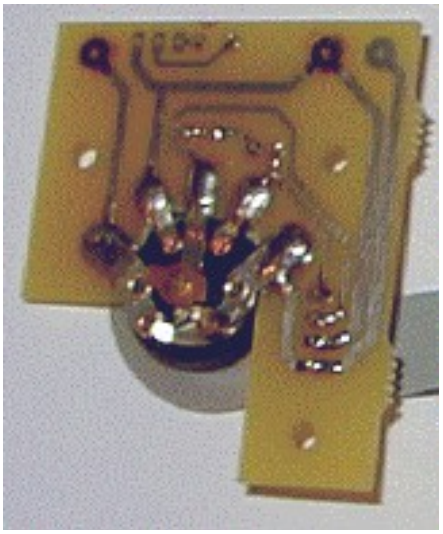

SPK
M+
M-
MIC-
MIC+
L-
L+
T+
LM386
74HC74
74HC00
VOL1
Wild Planet Toys,Inc.
Radio Dj Rev PR


Wild Planet Toys, Inc

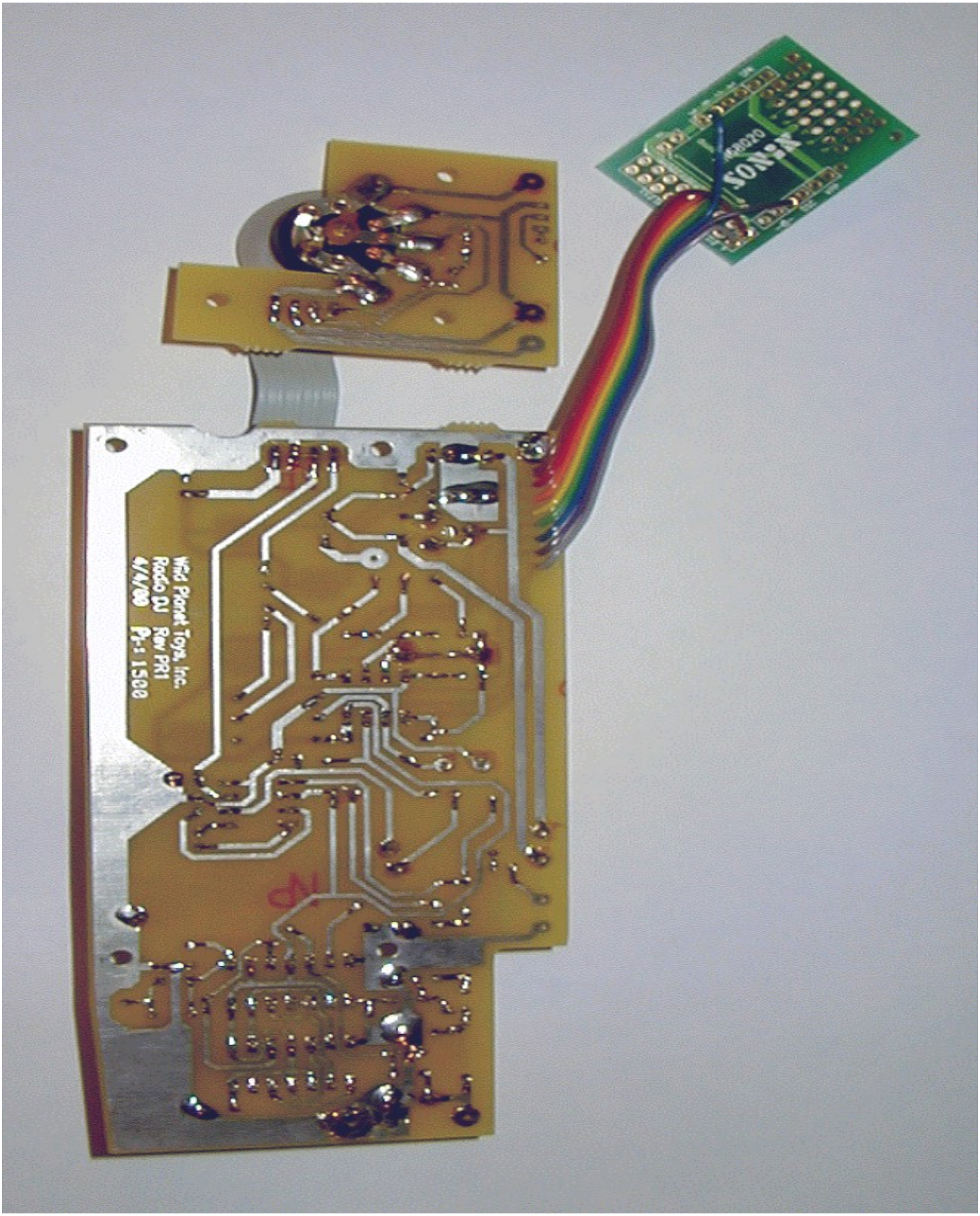
VIEW 1, BOTTOM PCB SECTIONS



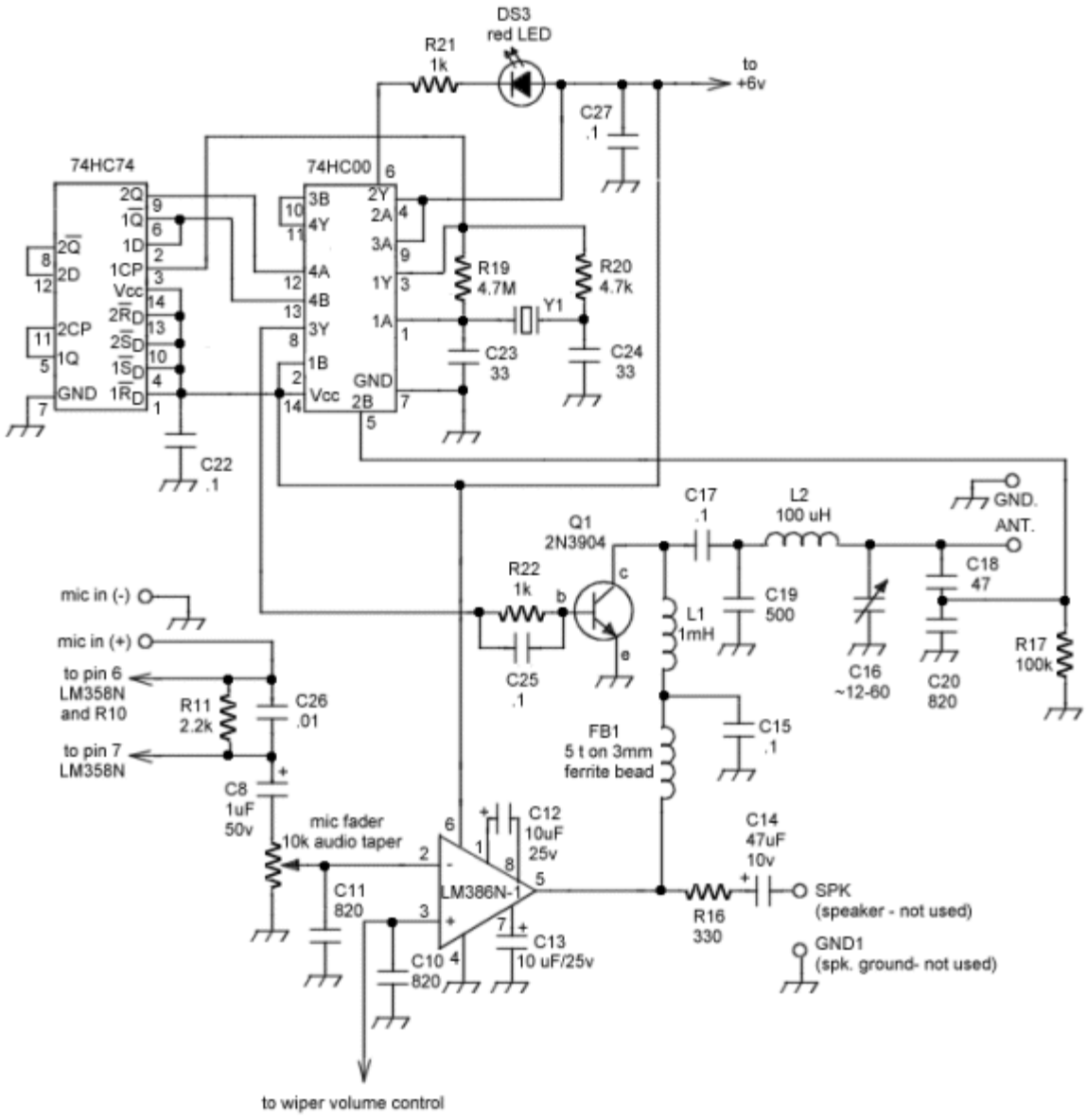




VIEW 2, BOTTOM COMPLETE PCB

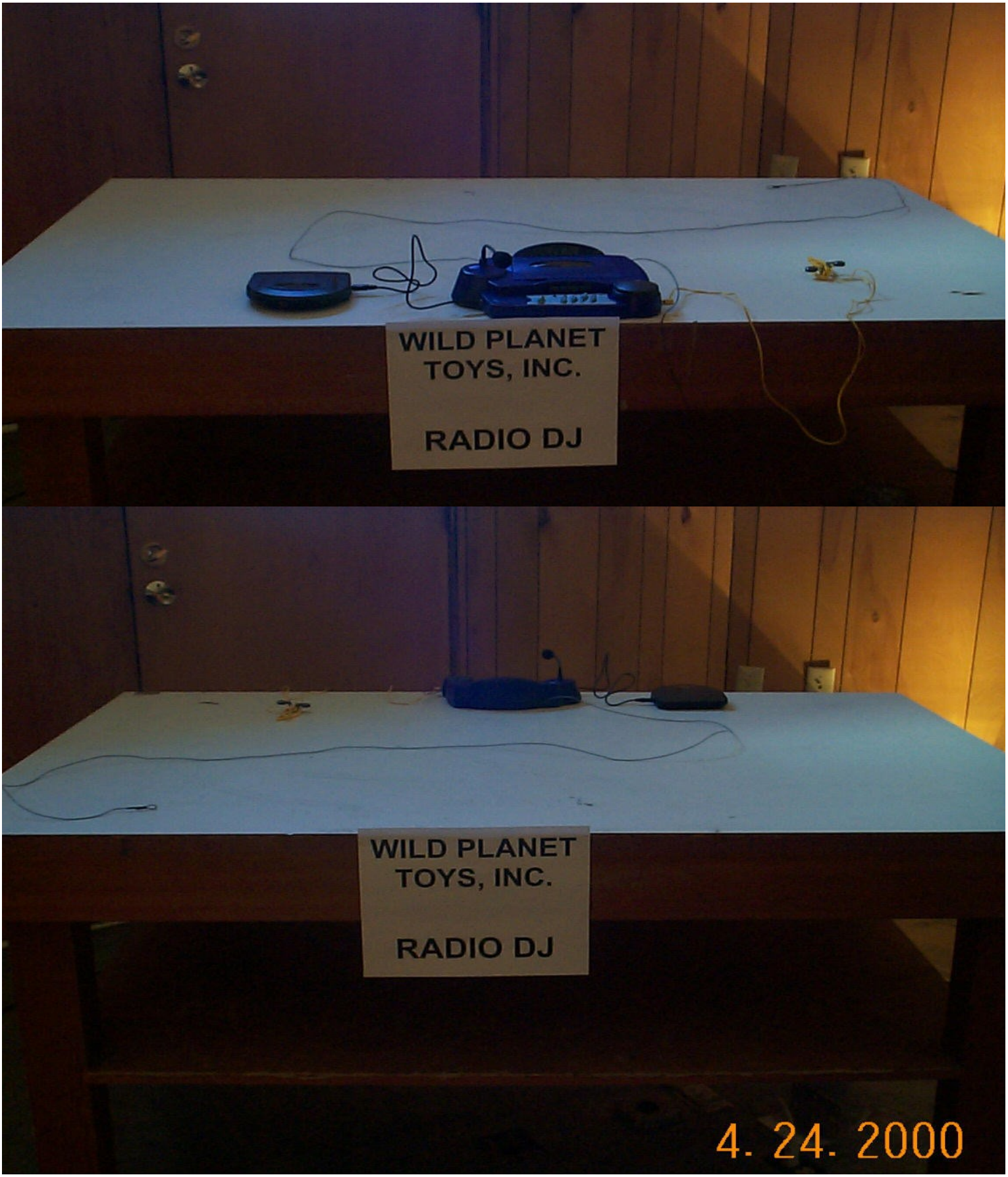


SCHEMATIC, RF & MODULATION SECTION



Wild Planet Radio DJ® Schematic
RF Section and Modulator

FCC TEST SETUP



FCC GRANT OF EQUIPMENT AUTHORIZATION CERTIFICATION

COPY

FEDERAL COMMUNICATIONS
COMMISSION
WASHINGTON, D.C. 20554

COPY

GRANT OF EQUIPMENT
AUTHORIZATION

Certification

Wild Planet Entertainment, Inc.
225 Bush Street Suite 1300
San Francisco, CA 94104
United States

Date of Grant: 06/14/2000

Application Dated: 05/08/2000

Attention: Shannon Bruzelius , Product Integrity Manager

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER:	N3ERADIODJ70034
Name of Grantee:	Wild Planet Entertainment, Inc.
Equipment Class:	Part 15 Low Power Transmitter Below 1705 kHz
Notes:	
Modular Type:	Does not apply

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	15C	0.161 - 0.161			A3E

Mail To:

EA97533

Hardware Hacking: Modding and Hot-Rodding the Wild Planet Toys ®"Radio DJ"™

~UNDER CONSTRUCTION~

DISCLAIMER: READ NOW!!!!!!!!!!

Modification of the device discussed on this page may void the FCC Certification and the owner's/user's authority to operate it. Any modifications made to this unit are done AT YOUR OWN RISK; in addition to possible violation of FCC rules, in hacking this unit you may damage/blow something, destroy personal or public property, start a fire, harm, maim or kill someone, create a rupture in the space-time continuum thus sucking in and crushing the entire earth, or other such follies. The author/creator of this site, the site host(s) and any third parties including but not limited to Wild Planet Toys, Inc. cannot be held liable nor responsible for any consequences or damages to any party resulting from the use, misuse or abuse of information contained herein. In other words, don't come crying to me if you connect a power supply backwards and the thing makes a sound and light show of a magnitude that it was not intended to produce, or if "They" kick down your door in the middle of the night and confiscate your Radio DJ at gunpoint! :-) The information presented on this page is for educational purposes only. By performing any of the modifications detailed in this site you and any subsequent owners/users of your modified Wild Planet Toys "Radio DJ" agree to hold the author/creator and host(s) of this site and any third parties harmless and free from all liability. Wild Planet Toys, "Radio DJ" and the original circuit and design of the latter are the property of Wild Planet Toys Inc. which owns all rights. No infringement of copyright, patent or other rights is intended, and there is no pecuniary interest, direct or indirect, associated with this site. Other trademarks and service marks are the authorized intellectual properties of their respective companies. No endorsements are expressed or implied.

Some Background on the WPRDJ

The Wild Planet "Radio DJ" (WPRDJ for short) is an FCC Certified Part 15 toy AM broadcaster, which includes a built-in tape player, sound effects generator, microphone with slide fader, functional "On Air" light, external jack for audio input (such as a CD player), antenna and ground wire and volume (modulation) control all in one compact molded plastic "console" chassis. The FCC ID number is **N3ERADIODJ 70034**. The frequency of operation is fixed at 1610 kHz and is crystal-controlled. The WPRDJ runs on 4 AA batteries. This page currently discusses only the fluorescent-blue cased "Radio DJ" model and not the newly introduced "Radio DJ Studio" model which has a white or cream plastic chassis. The main PCB of the sample investigated by the author has a designation of Revision PR6, but others may be different; as long as the model itself is the correct one the majority of the information presented here should be for the most part accurate across earlier revisions. The WPRDJ is a well-made, solid-feeling rig especially for the price (normally retailing for about $20, it sometimes can be found on sale for around $10). The audio quality is very good, but the range is limited, being on average about 30 feet (perhaps more if the unit is placed in a high location and provided with an optimum ground). According to Paul Walker Jr., who consulted with an engineer at WP Toys, the RF output is 1.3 mW. It is believed that the unit is certified under Part 15.209 which permits a maximum field strength at 30 meters of 24,000/F(kHz) microvolts per meter, which at the unit's fixed frequency of 1610 kHz works out to 14.9 μV/m. This is about the sensitivity of a very good car radio on AM with the typical auto whip antenna which is just shy of 1 meter, so the maximum range of the unmodified unit, on such a receiver or something of similar parameters would be approx. 30 meters or about 98 feet, assuming low noise conditions and no interference. As tested by the author, with the unit located on the first floor of a residence, the antenna simply strung up at a 45 degree angle to a nearby curtain rod and an oven drip pan used as the "ground", a usable signal was provided to a sensitive pocket receiver (the Radio Shack 12-201a, discontinued) about 20 feet outside of the residence, totaling about 50 feet from the antenna. This is through building walls - in the clear with no attenuating obstructions, with the antenna held vertical and a decent ground, greater range is quite likely.

However, many people have expressed a desire for the kind of range which can be obtained under Section 15.219 of FCC rules which allows a maximum final RF stage input power of 100 milliwatts (0.1 watt) and a maximum combined antenna/feedline/ground lead length of 3 meters (9.84 ft.) Useful transmission range of such apparatus can be up to 1 mile or more under the right conditions. The focus of this article will be, among other things, to modify the WPRDJ to comply with this section of the FCC rules rather than the one for which it was likely certified, thus permitting increased transmission range. However, as noted in the

disclaimer, the FCC Certification will probably be voided in the process, although since the unit would still be Part 15 compliant (just not under the original rule part) it *should* be okay to use it (note that this is *not* an official legal opinion). It could in theory be considered "homebrew" (permitted under Part 15 rules) since much of the modifications will of necessity be homebuilt, and considerable changes and/or additions may be made to the RF section of the unit. One could think of it as more of a "chassis" or "primed canvas" for the hardware hacker's "artwork". :-) Worst case, enough information is provided here so that someone could make a pure homebrew copy (incorporating the desired modifications) and then there should be no question of legality as long as the rules are adhered to.

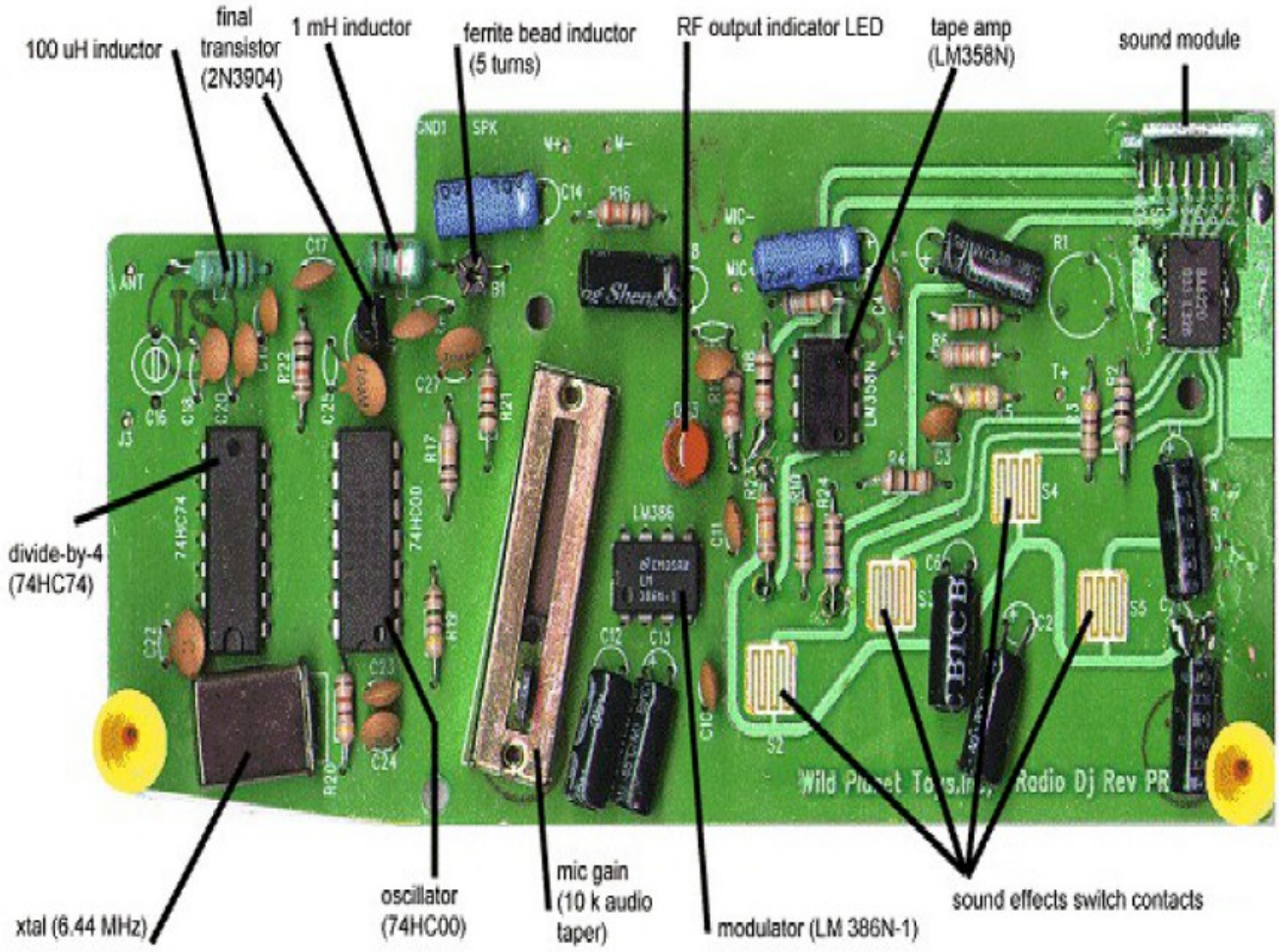
Opening It Up

This is probably the most difficult part of working with the rig; it obviously wasn't designed to give easy access to its innards. Place the unit upside-down so its "On Air" light is facing upward (microphone to the right). Remove the (8) screws on the back with a small Philips screwdriver. Note that two of these screws are hidden under the two top rubber feet, so these must be pried off to reveal the holes underneath into which the screwdriver can be inserted. Remove the back (bottom) cover of the chassis and set it aside. Remove and set aside the (4) switch buttons for the sound effects, making sure not to lose the little conductive rubber plungers loosely attached to each.

To access the main PCB (the largest board, facing towards you), you will then need to remove the microphone fader knob and the (4) screws holding the PCB in place. These screws require one size smaller Philips screwdriver than the case screws did. The microphone fader knob is the tough part - it's glued on and must be pried off with considerable force. Likely you will destroy both the fader pot and knob (as the author did) in the process of attempting removal of the latter. No problem, it's easily replaced. If you are attempting modifications to this rig in the first place it's assumed you are handy with a soldering iron, and for those so skilled it will be a trivial task to replace the fader should it be necessary. Any 10 kΩ audio taper slide pot of the same dimensions will do. Sometimes, even Radio Shack potentiometer and trimmer "bargain packs" may contain a suitable replacement. A new knob will probably be needed as well. The new slider knob, by the way, should NOT be glued onto the fader shaft otherwise you will not be able to remove the board without having to go through the whole "destroy, replace" process all over again! Luckily, this is the only "clinker" in the whole disassembly process, and everything else is proverbial cake after this.

After removal of the screws holding the board, and of the fader knob (and possibly the fader itself along with it :-), the board can be lifted up to inspect the balance of the components which are located on the flip side. Some parts, it will be noted, are located on the "foil" or solder side (facing up when the unit is belly-up for dissection), including the antenna trimmer capacitor and the micro-pot which is used to adjust tape player motor speed.

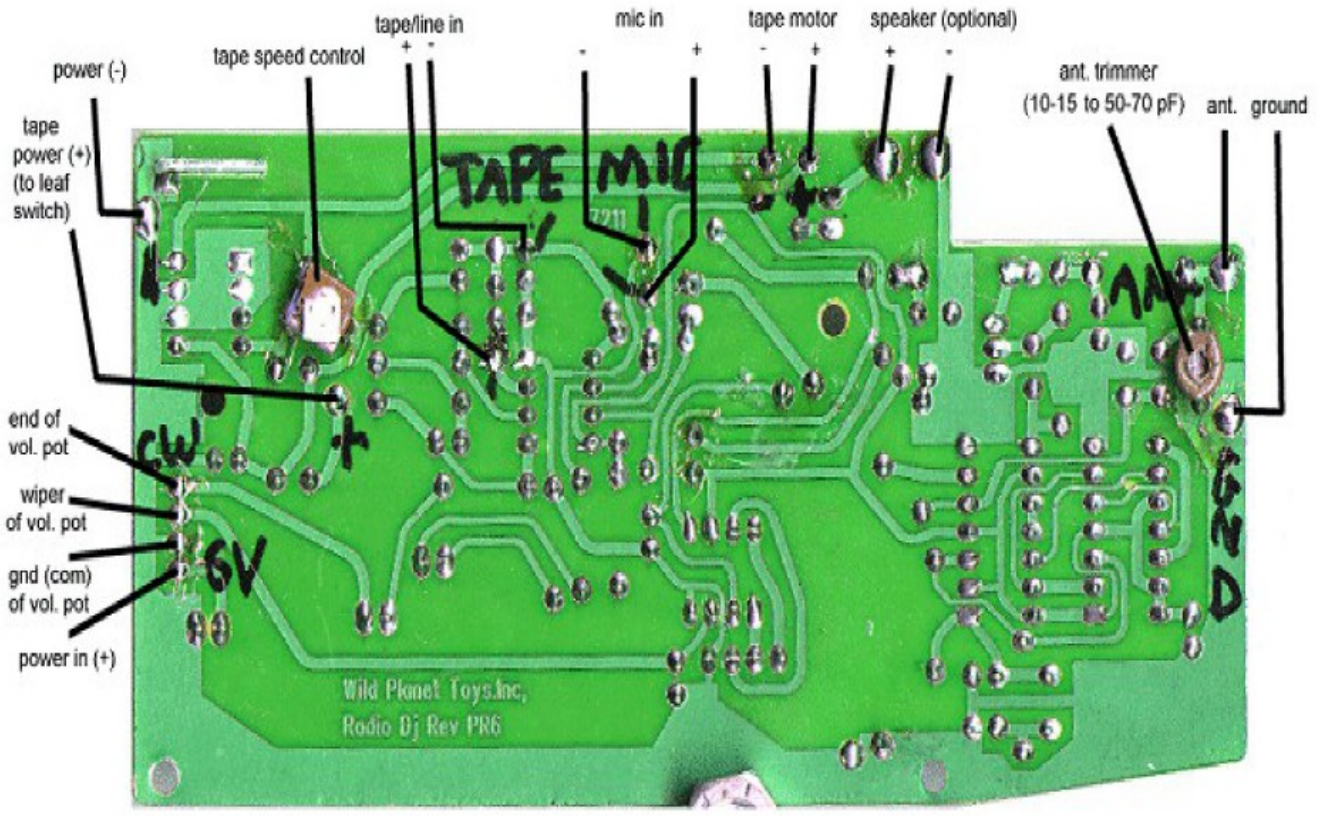
The Main Board



Above is the component side of the main PCB in the WPRDJ. Pretty much everything to the right of a vertical line drawn top to bottom through the output indicator LED is the tape and sound effects circuitry; everything to the left of that line is the modulator and RF stages. This is pretty cool because it means in theory one could snap the board in half if the tape and sound effects components were not needed. At the very least, it means that for our purposes, the right side of the board can be ignored as most of the "goodies" we are concerned with are on the left. The yellow objects at the two bottom corners are wire-nuts used as "props" to make the board level for scanning and are not part of it.

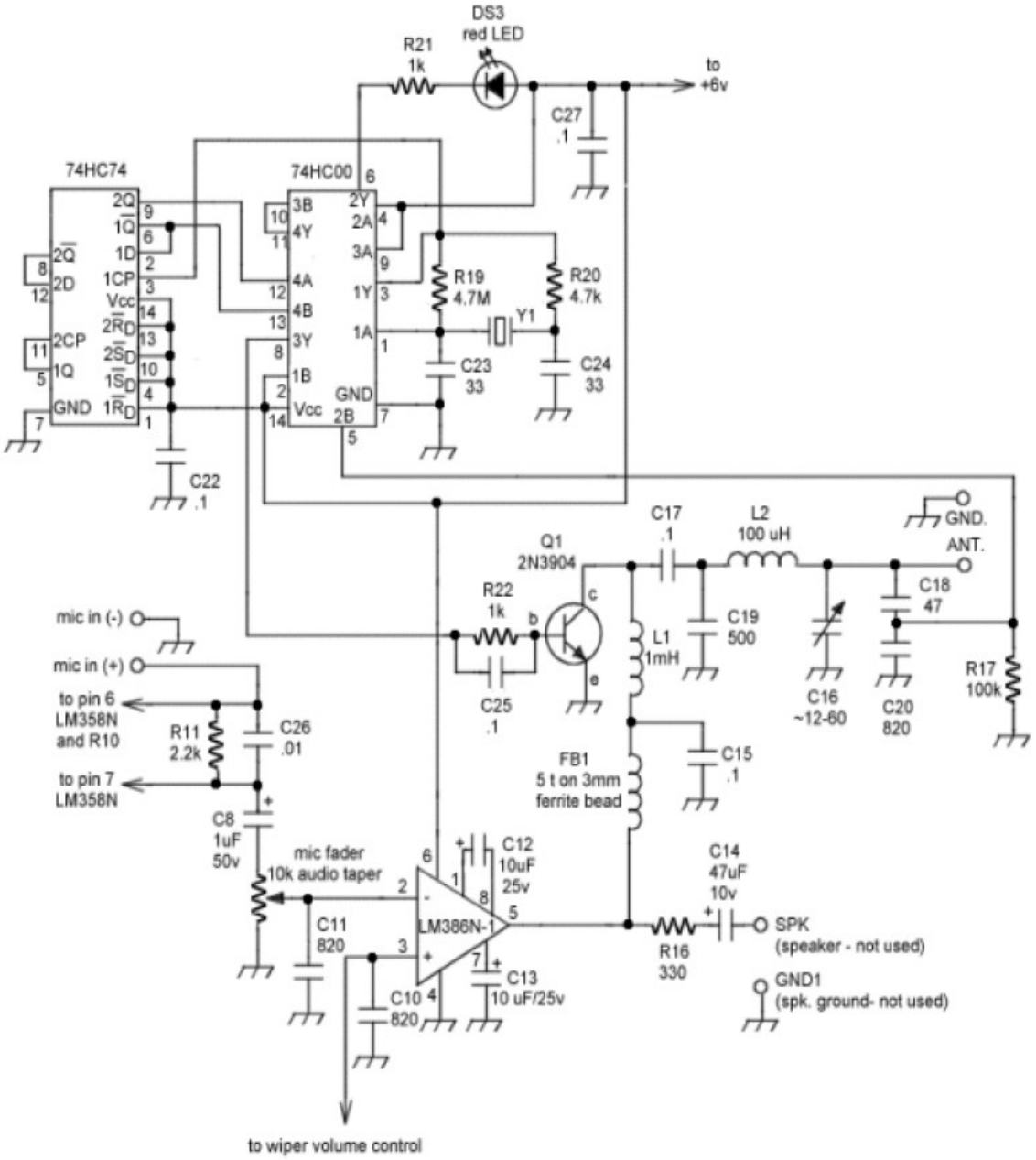
VIEW, BOTTOM PCB BOARD

Below is the foil or solder side of the main board, as it will appear when opening up the rig as recommended above. The wiring is shown roughly as it will be laid out (it was disconnected for photography purposes). The row of solder pads on the mid-lower left marked "CW" and "6V" connect to a ribbon cable going to a sub-board on the back of the main volume control; all the other wires are individual leads. Note that two components are located on this side; one, the antenna trimmer, is something we will want to mess with (or even remove); the other, the tape player motor speed control, should not be disturbed. The markings shown on the board were made by the author, and the silvery object just visible on the bottom center is another prop (a nut) used for scanning and can be ignored.



RF/Modulator Section Schematic

Below is the schematic for the RF section (including oscillator and freq. divider) and modulator of the WPRDJ. The tape amplifier (LM358N) and sound effects generator (BA6220 and sound module) sections are not shown, as most experimenters are not likely to want to modify them.



Wild Planet Radio DJ® Schematic
RF Section and Modulator

As can be seen, the oscillator is a 74HC00 high-speed CMOS quad 2-input NAND gate, with a 6.44 MHz crystal Y1. This IC also serves as the rectifier/amp for actuating the RF output/tuning indicator LED DS3. Output from the '00 is fed to a 74HC74 CMOS dual D-type flip-flop which is configured to work with the former as a divide-by-four, such that the output frequency fed to Q1, the final amplifier, will be 1/4th of the crystal frequency, in this case, 1610 kHz for the 6.44 MHz crystal. This permits easy changing of the frequency of the WPRDJ by simply changing the crystal Y1 to one of 4 times the desired frequency. More c this later.

The final RF stage (where much of our modifications will be performed) is a straightforward Class C bipola amplifier with pi-network output. Q1 is the final RF amp and is a 2N3904 NPN transistor. L1 and FB1 serv as the collector RF chokes, keeping RF out of the modulator but permitting audio and DC to pass. L2 is the pi-net inductor and tunes the tank to resonance with C19 and C16. The latter can be adjusted for up to 6 dB (4x) additional RF output beyond factory specs. as discovered by fellow "hacker" Pat Ryan, making this perhaps the simplest "modification" to increase performance. This however will still not bring the unit up to the capability of a full power 15.219 rig, nor does it address the problem of low modulation (according to Pat, 65-70% maximum) from which this unit suffers. C18 and C20 form a capacitive voltage divider which along with R17 sample a small amount of the RF output to actuate the output/tuning indicator DS3 via the 74HC00.

One modification which would improve efficiency of the finals would be to use a MOSFET instead of a bipolar transistor. The CMOS should be able to deliver enough drive for it (up to 5 v) and there are TO-92 plastic cased MOSFETs made by Zetex such as the ZVNL110A which would probably work great here, and fit in the same holes on the board as the original transistor (in the case of the aforementioned part, the pinou is identical to the original 2N3904).

Another idea is to change the pi-net output into a series-tuned ckt. using a loading coil wound on a former with a ferrite rod which can slide in and out for tuning. Yet another idea might be to use a toroid RF transformer, but that would have to be tapped for coarse tuning and thus would require a separate board to b installed into the rig. Such an arrangement would give good performance for sure. If this latter suggestion is undertaken, replace C16 with a 10 pF unit for use as a shunt "fine tuner". Finally, the circuit can be used to drive coax for an outboard 100 mW linear amplifier by changing the values of pi-net components C19, C16 and L2. Actually, in many cases these values as-is will be close enough except for the value of C16. To match 50 ohms, a much larger capacitor will be needed (it was designed to match to a short wire antenna which has high impedance), although it isn't too critical so a fixed cap close to the calculated value can be used as variables are probably going to be hard or impossible to find in the large value likely required. Som linear amps which have pi-net input may not even need that much; just remove the pi-tank parts and feed between ground foil and C17. To calculate the proper value cap for C16 at 50 ohms, first determine the collector load impedance:

For Class C operation, collector load impedance = $Vcc^2/2PO$ where,

Vcc is the DC voltage on the final collector with no modulation,

and

PO is power output (use 1.3 mW).

Then, one can use the following Java tool (saves a lot of time!) to find the proper pi-net values: http://www.qsl.net/wa2whv/radiocalcs.shtml . While it was designed for tube amplifiers it works well with solid state as long as you plug in correct data. You would plug in your calculated load impedance, an output impedance of 50 ohms (assuming 50-ohm coax to your amp); your desired frequency, and select a Q of 10 or less. Use the "air variable caps" selection although it makes only a small difference and is non-critical for our purposes (even if fixed caps are used). More details on these mods will be posted as time permits, but there should be enough here to get the experimenter started.

The LM 386N-1 is the 6-volt (nominal) version of this IC (denoted by the "-1" suffix) and is configured as a series modulator with a total gain of 200 as set by the 10 uF capacitor between pins 1 and 8. The optional speaker output connections are not used in this model of the WPRDJ although provided on the board. Audio and DC is coupled to the collector of Q1 through L1 and FB1. The '386 is set up so that it can accept audio input from an external source via the main "volume" control pot, or audio from the sound effects generator, microphone or tape.

A modification which immediately comes to mind is to change to transformer (or choke) modulation of the final rather than series, so the LM386 can do the full job it's capable of. Normally, series mod. is simpler and gives great sound and full modulation but using the '386 to do it is probably not the best way. Transformer/choke mod. for this rig on the other hand, can be easily done with a miniature "Hi-Q" audio unit from Mouser Electronics, and there is just enough room on the board between the mic fader, C8 and R16 to fit one in. Also, such a change will net more output from the final as the Vcc will be increased. More details to come.

Pat Ryan's Increased Range and Modulation Mod:

Fellow WPRDJ hacker Pat Ryan discovered that by adding emitter bias to the final stage with the addition of 3 components, and the removal of an existing one, modulation can be increased to 100% with good linearity and AF response. The transmission range was also reputedly substantially increased. In tests conducted by the author, range was increased under conditions of good grounding and with full modulation thus implying the increase is likely due more to the higher modulation level than greater RF efficiency (which can be addressed with other mods). This is a simple modification and is a good "starter" mod for the novice. To follow is a step-by-step description showing how to perform it.

Parts and Tools Needed:

(1) 33 or 47 ohm, 1/4 watt resistor

(1) .001 uF ceramic disc or monolithic dip capacitor, voltage rating not critical

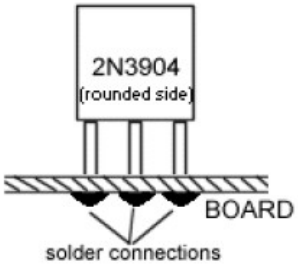
(1) 220 uF 16 volt electrolytic capacitor

Fine needlenose pliers

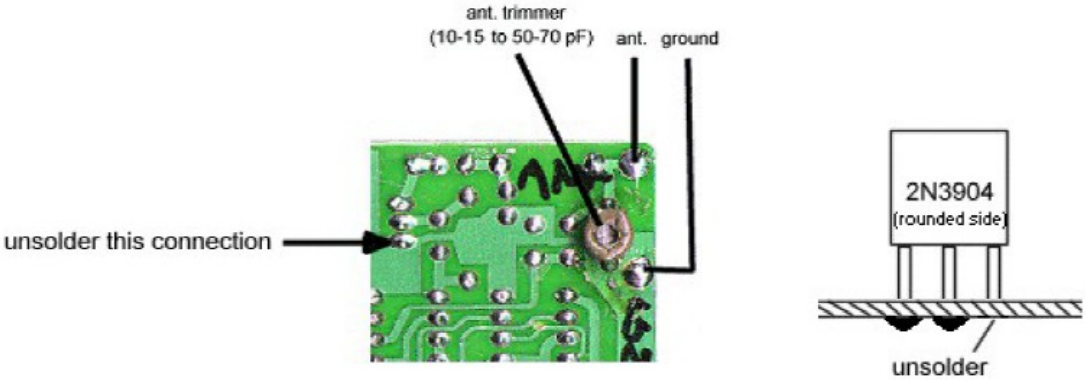
Solder sucker

Rosin core 60/40 solder, fine tipped 30-40 watt soldering iron, etc.

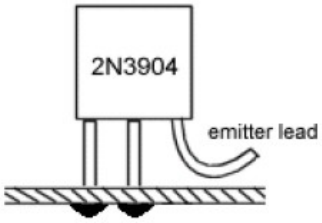
First, with the main board removed from the chassis, and held component side up as shown in the component side photograph above, note the location of the 2N3904 final transistor as shown in that picture. Turn the board so that the end with this part and the associated components faces towards you, and note the arrangement of the pins of the 2N3904 as shown below.



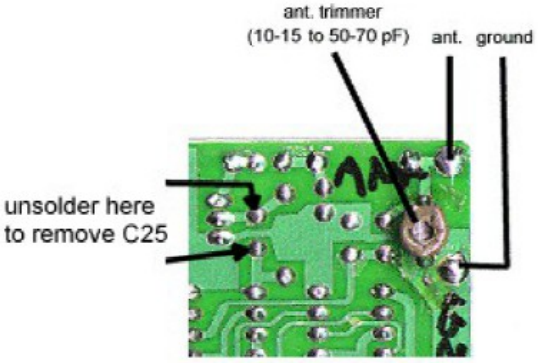
Next, locate the emitter lead of the 2N3904 and unsolder it from the foil (solder side of the board). See the figure below. A solder sucker (available at your local Radio Shack, or elsewhere) is a big help for this (or for any electronics project, for that matter!)



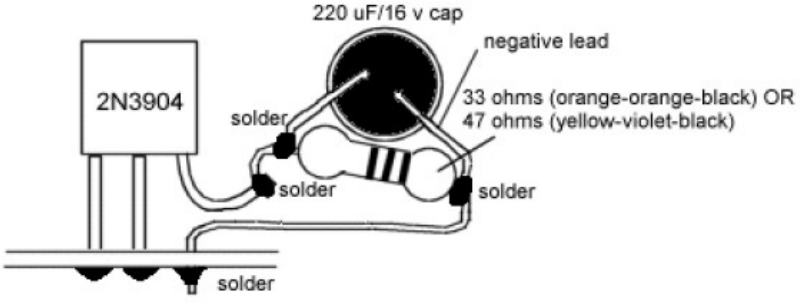
Now, using fine-tipped needlenose pliers, carefully pull/bend up the emitter lead through the hole in the board until it is free on the top side of the board and bend it up as depicted in the image below. If it does not come freely, make certain *all* solder is removed; do not force it. Make sure not to bend other leads on the transistor as they might break or short. If the emitter lead should break off, or other damage is incurred to the transistor, a replacement can be easily obtained from any Radio Shack. It may be called a "PN3904" or "2N3904" but they are both the same (the true generic number is with the 2N**** prefix, the PN**** prefix simply denotes a plastic package, as the original 2N**** parts had a metal case). Install the new part making certain the leads are in the proper position (the rounded side of the package should face to your left when viewed from the component side of the board, with the RF area on your left). Leave the emitter lead bent up for access, do not solder this lead into the board. If the lead bending is done carefully, with the right tool, replacement of the transistor should not be necessary, although it may in fact be desirable in any case as you can then leave longer leads for easier access to them for the remainder of this mod.



The next step is to remove C25. Unsolder C25 as shown below, and remove from the board.



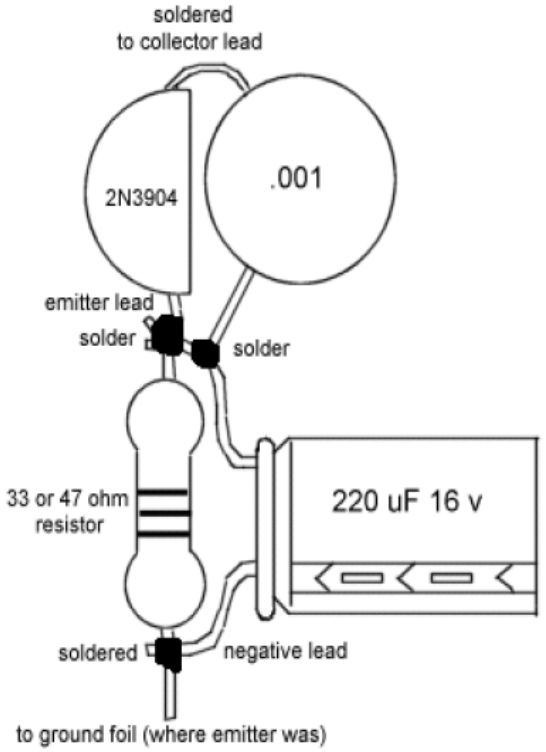
Take the 220 uF capacitor and solder it across the 33 or 47 ohm resistor. The leads of the capacitor should be twisted once tightly around the resistor's leads to make a mechanical connection prior to soldering. *Be certain* that the negative lead of the 220 uF capacitor is soldered to the side of the resistor (whichever you choose that to be) that will go to ground - in other words, where the emitter lead formerly was. The capacitor's negative lead is denoted by a vertical stripe of different color on the case, with arrows and/or a (-) symbol inside it. Now, take this resistor/capacitor assembly and push one lead of it (the one with the *negative* capacitor lead) down through the hole formerly occupied by the emitter lead of the transistor. Carefully twist the other free lead once around the bent-up emitter lead. Make sure nothing touches or shorts to anything else that it shouldn't, but keep lead lengths as short as possible. Solder in the leads of this assembly, and clip off excess length under the board. See the figure below.



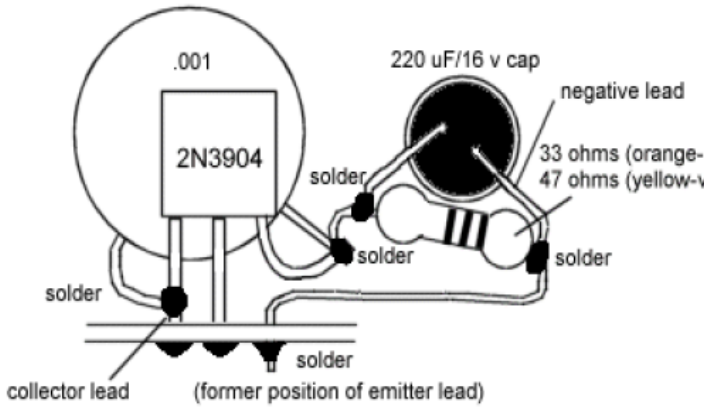
The last step is to install the .001 uF (1000 pF) capacitor from the emitter to the collector leads of the 2N3904. Unlike with the electrolytic cap, there is no polarity on either ceramic disc or monolithic caps, so

"which way around" it goes does not matter. Carefully solder one lead of this capacitor to the collector lead. Solder the other lead to the junction of the bent-up emitter lead of the transistor and the resistor/capacitor assembly you just installed. See the figure below, which illustrates the complete mod as it will look from both top and side.

TOP (COMPONENT SIDE) VIEW



SIDE VIEW



You are now finished and ready to test the mod. Reinstall the board but do not close the case (you'll need access to the antenna trimmer). Set up the unit with the antenna fully extended and held vertical, and with a proper ground such as a cold water pipe or ground rod, or an outlet/switchplate screw on a grounded circuit. Apply power, and carefully adjust the antenna trimmer for maximum brightness of the tuning indicator LED. With a program source playing, slowly increase the "volume" pot until the sound begins to distort, then back it down until it just cleans up again. This should correspond to 100% modulation, or close to it (of course, if you have an oscilloscope on hand you can and should use it to check). Note that after performing this mod the LED may pulsate if you overmodulate, which can be a useful indicator of same. The modulation should now be "louder" than it was "pre-mod" thus giving you greater range as a result of more "punch" in your audio.

Connecting An External DC Power Source

Sometimes, one may want to use the WPRDJ long-term, without constantly having to replace batteries; in that case, some form of external power supply must be used. The easiest way to do this is to use a regulated 6 VDC "wall wart" power supply. Make absolutely certain the unit chosen is *DC* and *regulated*; the WPRDJ cannot rectify/filter AC and unregulated supplies will have much higher voltage at no or light load than specified, which may damage the rig as it was designed to operate from 4 AA batteries which do not exceed 6 volts. As it is, the CMOS are maxed out at 6 volts, normally they would be operated at 5 v. Another method of powering the unit externally is to make your own regulated 6 VDC supply; instructions for doing so will follow. *CAUTION:* When using an external supply, the batteries *MUST* be removed, unless a switching type DC power jack is installed to automatically disconnect them. Failure to do so may charge the batteries, damaging them, the power supply, or both, and can be a fire, explosion and leakage hazard.

Regardless of whether a homebrew or commercial power supply is used, a means of feeding the power to the unit is needed; while one can simply solder leads across the battery contacts, a neater, more versatile job can be done by installing a coaxial DC power jack on the unit. The power supply is then equipped with the matching plug. On the side or rear of the unit, drill a small hole in the top shell of the chassis to accommodate the jack; the type chosen should match the plug provided with the wall-wart; if a homebrew power supply is used, the type of jack (and plug) is left up to the builder. Radio Shack carries a vast array of DC plugs and jacks. The thing to look for in jacks is the switching type; this can be connected to automatically disconnect the batteries when the external power supply plug is inserted, and reconnect them when it is removed. Thus, the batteries need not be removed to prevent unintentional charging as per the caveat to that effect above.

Changing The Frequency

Many people will not have a clear channel at 1610 kHz where they live most likely due to local TIS/HAR activity, so this can be an important modification to enable operation at a clear frequency without causing (or receiving) interference. As well, this is perhaps one of the easiest modifications of all. All that need be done is to unsolder the 6.440 MHz crystal (which is divided by 4 to give 1610 kHz) and solder in a new crystal having a frequency range from 6.800 MHz (for 1700 kHz) down to probably 4.800 MHz for 1200 kHz (the unit may/may not go lower and/or may not even go this low so the lower limit is for now, a guesstimate. More experimentation will be needed to determine it.) The oscillator will probably work a wide range of rocks but the limiting factor will be the final stage pi-network tank, whose component values, with the possible exception of C16, would need changing for anything more than a couple 10's of kHz either side of 1610. If only a small excursion of frequency is made and the pi-net components were not changed, the antenna trimmer C16 should still be peaked.

The one problem is that using stock values of 'microprocessor' crystals (the cheapest, most readily-available type, and the type used in this rig originally), there are few choices of frequency. In fact, a perusal of the major mail order electronics parts catalogs shows that even the original 6.44 MHz rock is hard to find. Making things more difficult is the fact that of those choices, few will come out to even 10 kHz channels (for example, 1610, 1620, etc.); many will end up on split or fractional channels, e.g, 1638.4 kHz (of course, this is no good for broadcasting, but perfectly okay for experimental use such as a 'MedFER' beacon.) Of the commonly available choices, those which may be useful for broadcasting applications on standard 10 kHz channels are listed below.

Crystal Frequency, MHz	Resulting frequency in kHz after division by 4
4.800	1200
5.000	1250
5.120	1280
6.000	1500