

# BITX40 with Raduino - tips and mods

Also check out hfsigs blogspot <http://bitxhacks.blogspot.co.uk/>

## IMPORTANT NOTE

**DO NOT** let the final pa transistor tag touch ground. Any heatsink used **must** be isolated from the transistor.

## Two very good aids to fault finding

There are two pdf files in the Files section of groups.io bitx20. One is receive signal path, the other is transmit signal path. They are by Randy - K7AGE

Link <https://groups.io/g/BITX20/files/K7AGE>

The official circuit diagrams are here [http://www.hfsigs.com/bitx40v3\\_circuit.html](http://www.hfsigs.com/bitx40v3_circuit.html)

## Trouble shooting the final stages.

Measured these voltages without any modulation, unplug microphone  
Power supply exact 12V, PTT pressed/shorted

Predriver Q13 drawing 30mA

C=11.6

B=3.66

E=3.0

Driver Q14 drawing 41mA

C=11.85

B=1.0

E=0.415

Final Q15 drawing 150mA

C=12

G=4V

E=0

### Clicks during tuning

I assume you are talking about the Raduino clicking as you tune. I'm not having that problem, but others are. One solution is to bypass both the input and output of the 7805 regulator with some 100nf caps. Apparently not all of the Arduino Nano clones are from the same manufacturer and some have better bypassing onboard than others, so all you need to do is filter the power supply to the Raduino so the clicks can't get back into the main 12v power rail.

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I completely removed TUNING CLICKS by adding 2X 10mfd caps on the input and outputs of the 7805 volt reg, it also made tuning more stable

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I was able to silence the tuning "tick" by inserting a 22 ohm, 2 watt resistor in series with the Raduino power wire and connecting a 470 uF capacitor from each end of the resistor to ground (One resistor, two capacitors.). You can easily do this right on the back of the volume control/power switch. This indicates that it is a power filtering issue. Lower values of resistor and capacitors will work but I have not determined the optimum values. Some serious bypass treatment on both input and output of the Raduino's 7805 regulator should help.

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Try 10nf + 100nf + 1µf + 10 - 22µF on both input and output of the voltage regulator with the shortest possible leads to earth (centre pin of the regulator).

High value electrolytics have too much inductance to effectively bypass high frequency pulses.

If possible put the capacitors directly between the input and output pins of the regulator itself.

### Extra Features in code - Wiring

If I remember correctly, the Raduino can be configured for dual VFO's or receive RIT. How is that accomplished? I want to operate CW with the BitX40 and RIT would be helpful.

There is code for dual vfo, rit, cw tx/rx.

It's already in the code but commented out in the " loop() ". You need to uncomment them and reprogram the Nano.

It uses a pushbutton on A3 pin to select using tap, press, double tap method.

Wiring colours used are

Brown = CW Key

Red = Calibrate and CW tone when in CW

Orange = Pushbutton to select Dual vfo's, RIT, CW

Blue = PTT Sense

Black = LPF Select – not catered for yet

### Audio hiss

I just made up a tone control with a 100n and a 10k preset across the AF gain and twiddled to suit.

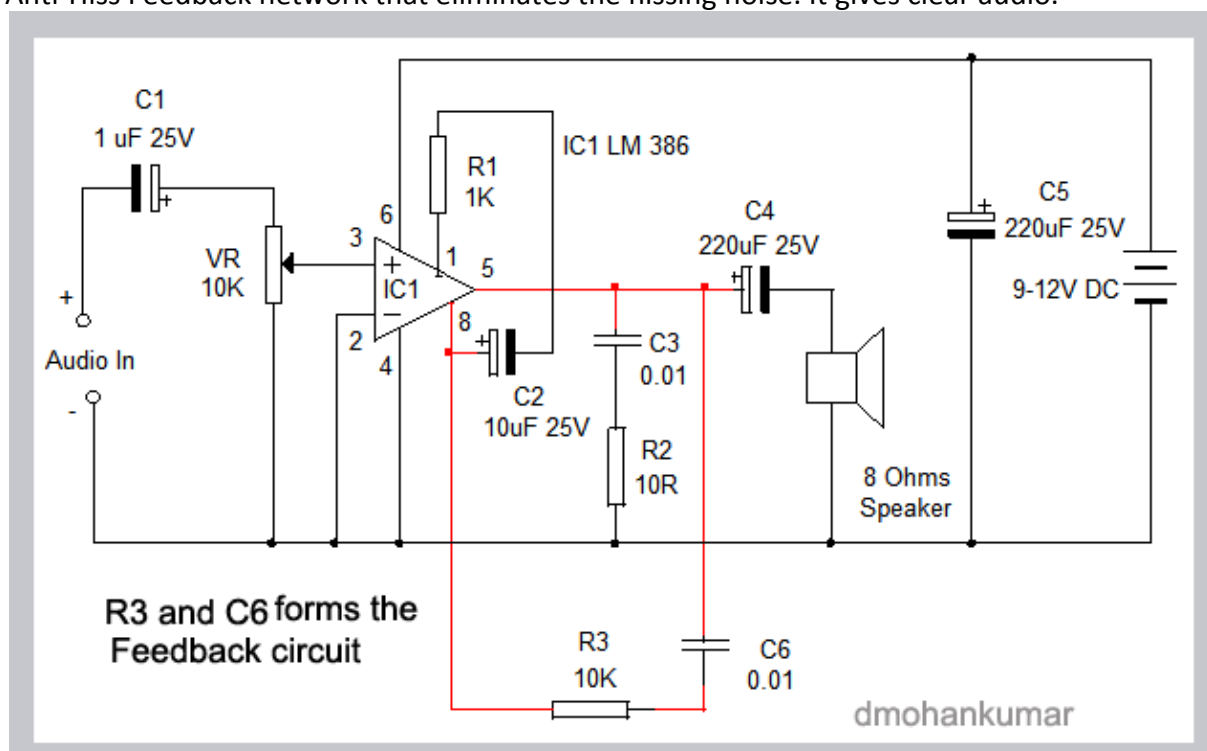
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The Q16 collector voltage is a bit low to handle loud signals. I changed R114 to 180K and added another 180K from Base to Emitter. This increases the collector voltage from around 1 Volt to about 3V. The hiss reduces a bit due to the change in time constant of R114 and C118. You can add a parallel cap of another 100 or 150pf to roll off highs above 3 KHz.

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**NOTE:** NOT Bitx40 schematic parts designations.

The Hissing noise is eliminated by adding a Feedback network from the output to its pin8 ( Gain pin ). This Filter feedback using a 0.01 capacitor (C6) and a 10K resistor (R3) acts as an Anti-Hiss Feedback network that eliminates the hissing noise. It gives clear audio.



### **Click on transmit, keying of mike**

Farhan mentioned this during his interview with Tom, [W5KUB video](#).

He felt it was due to the cap C114 around the audio preamp Q16, holding the amp on for a bit when that rig is switched into transmit. I wouldn't be surprised that C110 might also be holding U1 on as well.

He thought about placing a transistor across the cap to discharge it when going into transmit. Drive the transistor from the xmit voltage.

### **Relays not working with PA power disconnected and display goes blank.**

Was bad ground on regular power and display. Ground on PA PWR was good.

OK, I repaired power socket. Relays are functional. I think the PA PWR had a good ground and the regular power and display didn't. The board only had a good ground when PA PWR was connected.

### **Shrill noise on power up !!**

Solved it by interchanging the 10k pots brown & red wires...!!

### **LED for transmit indication**

Looking at the schematic looks like an easy place to add a LED would be across the relay coil. Along with a current limiting resistor in series with the LED.

A 12 V LED, which would have an internal current limiting resistor, can be connected directly across the relay.

Most red LED's have a forward voltage of about 1.65v, so at 12V that would be anywhere between 1K to 1.2K series resistor for about 11ma current flow through the LED. If you want it brighter you could drop that value to 800-900 ohms for about 20-25ma. I wouldn't go much lower or you'll toast your LED.

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Here's what I did - I tapped the TX / RX +12 points from the relay closest to the Power Connector.

This will give you +12 on RX, then on PTT, RX goes to zero (or nearly) and TX goes +12.

This way, you can use a Red / Green Bi-Color LED.  
Green for 'ON / RX'

Red for 'PTT / TX'

In fact, there's a convenient spot near that relay, toward the corner, where you can glue or hot-glue a 3-pin connector (just like the ones on-board), but flush with the bottom of the PCB. Now you have a convenient plug-in point for your Red/Green LED.

Since both LEDs won't be on at the same time, they can share a single current limiting resistor in the 'common' or 'ground' leg of the connector headed out to the Bi-Color LED.

I think current draw for Red and Green are slightly different, but I just picked a resistor which would give me the most even light from each. Current draw is probably under 10 ma. for these LEDs, but it is a nice feature. You can tell if PTT is working.

### **More RF output power**

Using 24v to feed the final amplifier stage can significantly increase output power. Additional power jack to feed in 24v to the power amp. It's on a switch so i can run it with 12 volts off one supply also. Oh, and bigger heatsink when I did the higher voltage mod.

### **Gain reduction**

Can also try gain reduction at IF stage instead of connecting agc at audio try connecting the collector of AGC transistor to the base of Q3 in series with a 10nF-100nF cap.

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the other thing to do is reduce the rf amp gain. you could try removing or increasing the 10 ohm in the emitter bypass of the rf amp.

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The bitx transceivers have more than necessary gain. The strong signals tend to distort with the lack of AGC. Here is a simple hack to reduce the gain slightly. All you do is remove the 1uf capacitor between pins 1 and 8 of the LM386. Don't worry it will not affect the sensitivity of the transceiver at all!

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A switch between R15 and R16 will act like a 20 dB attenuator. Or insert a 10 K variable resistor there for continuous control from zero to 17 dB.

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The mod that made the biggest improvement for me was an RF Gain knob. I added a 10k ohm variable resistor (potentiometer) in series with R16, so I now have an RF Gain control on my radio. It certainly improves the user experience when listening to high power signals. Remove R16, solder two wires to the pads, connect them to a potentiometer with a 220 ohm resistor in series. I used a 10k pot, but a 5k or even a 1k would probably also work, I use less than 10% of the turning angle. I can turn down the high power signals and listen to

them without damage to my ears, or I can turn down the noise while monitoring a frequency, and turn it back up when I hear something interesting. The receiver as delivered is seriously loud in headphones, hopefully this will reduce my future hearing aid bills.

### **Punchier TX audio**

I did this mod and I believe it helps but I have not heard my signal yet, so can't confirm that: <https://www.youtube.com/watch?v=IELJwapv5gs> I paralleled a 22pf capacitor and a 5pf cap in the same method as the vk3ye video. Audio sounds more punchy. It also helps to speak loud with the mike right next to your mouth. I had some faint signal qso's where they couldn't hear me until I very clearly and loudly barked out my call. The power meter jumps higher the louder you speak.

### **Increase frequency coverage**

Change the varactor to one that has higher capacitance tune ratio or  
Alternatively, add an MV209 or 2109 in parallel with the one on the PCB  
The tuning range will increase.  
You may need to tweak the trimmer and maybe change some turns on  
the yellow VFO toroid.

You will probably find that it will take only a few pF to achieve your goal.  
I easily changed my range by changing the variable capacitor C93 from 22 pF to 33 pF.

If your C93 is set to minimum capacitance, and the high end of the frequency range is still not enough, then remove a turn or two from the inductor, L4.

If your capacitor C93 is set somewhere above the minimum, then decrease it to raise frequency high end, and increase it to lower it.

First add parallel varactors and see what range you get.

Changing C96 from 100pf to sat 330 or 470 will improve the range as it is. Use NPO/COG for all

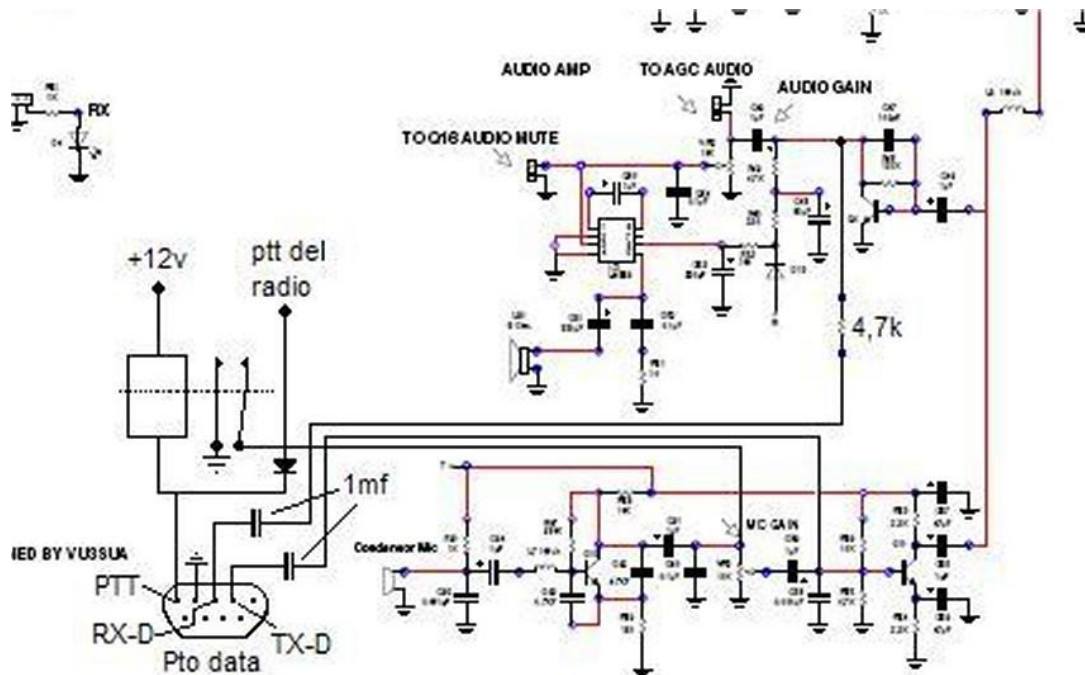
caps in the VFO. My board is very stable drifts only 10-20Hz and 50Hz in the long term.

At the moment I have 3 in parallel with 6uH and 150pf extra and get 200Khz but stabler VFO.

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I see here that you are suggesting what is right for a normal designs but this one is opposite 12Mhz - VFO, so you need to make the VFO go lower for the range to go higher.

## Digimode Connections



## CW MODE

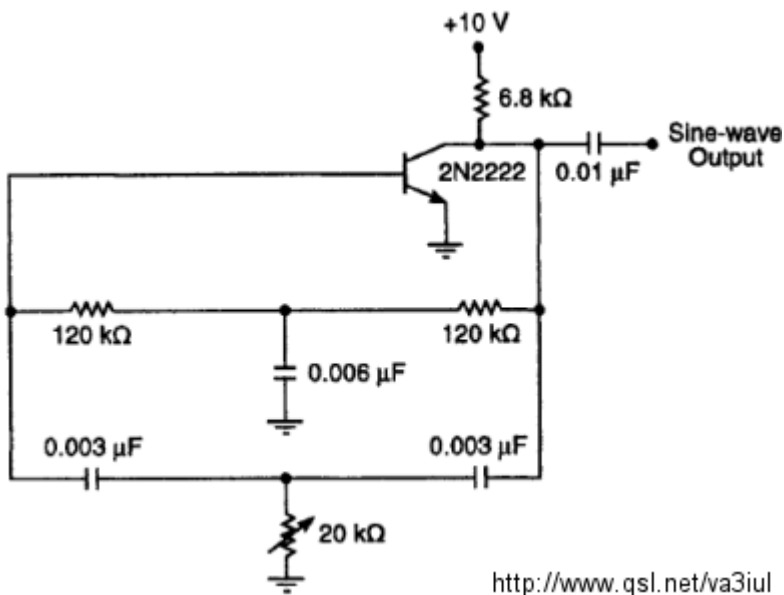
The Raduino could use a counter-timer to approximate a properly shaped audio sine wave using pulse-width-modulation, RC filtered before injecting into the mic input.

Easier and possibly cleaner would be to inject DC via a diode into the top of C107 to unbalance the modulator during a dot or dash, have the Si5351 driven BFO centered on the crystal filter passband during CW transmissions. That DC can come from a Raduino digital output, goes through an RC filter to avoiding key clicks. Shut down the mic amp when operating CW, or maybe just unplug the mic.

Disclaimer: I've never done any of this.

Jerry, KE7ER

## CW on BitX



Here is the (VA3IUL) circuit I used for testing my BITX80v3 . It is injected directly into the mic input .

VE7BEE

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Try the above circuit , it works. The signal seems clean and it is small . I have not tried it on 40M yet as I am converting a BITX40v3 to 80 M . Tested it tonight , I get full output on CW on 80 M . I have the AF adjusted to approx 1k audio note via the 20 k pot . I am also going to put an adjustment pot in the sine wave output so as not to overdrive the TX .

MODS : I changed the 2 - .003 uf to .002 as that is all I had in my junk box . Since I am running 12 V input , I changed the 6.8 k to 10 k and it still works on the bench hooked up to the BITX. The circuit is stupidly simple and seems very stable. I just installed the key in series with the sine wave output to the mic connection . Going to install a DPDT switch to disconnect mike and connect audio generator for CW . Simple and it works . 73s Buzz

## Another CW suggestion

Perhaps somebody out there would be kind enough to try my pet scheme for transmitting CW. Involves 3 resistors, a cap, and a straight key.

First off we have to move the BFO down in frequency by a khz or so, such that it is in the crystal filter passband.

I assume the boards out now don't have C103 stuffed.

So install a small variable cap at C103, likely needs well under 100pf, Set it for minimum capacitance, then tune in a CW station.

Find a setting for C103 such that you can tune that station through zero-beat and still hear it as it starts going up the other side.



(I suspect the next board rev of the Bitx40 will use the 3<sup>rd</sup> Si5351 channel for the BFO, allowing these BFO adjustments to be done with just Raduino code. Reduces part count, and also gives us USB/LSB selection. Or could borrow that MV209 from the analog VFO so you can adjust the analog BFO with a DC voltage from a pot or switched resistor network.)

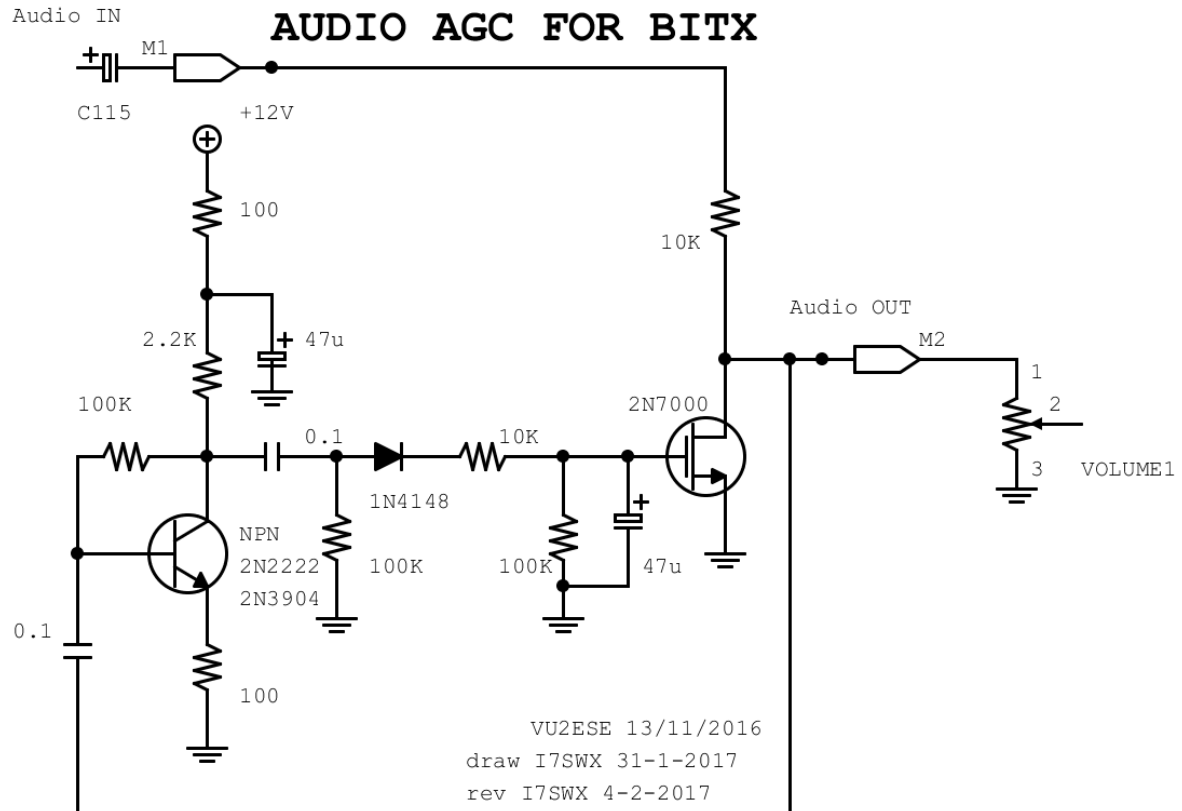
Now take a 10k pot, a 1k resistor, and a 50 ohm resistor, string them up in series. Wire the top of the 10k pot to TX 12v, the bottom of the 50 ohm resistor to ground. Run a wire from the junction between the 1k and 50 ohm resistors to one terminal of a straight key. Run a wire from the other terminal of the straight key to the top of C107 near the balanced modulator. When the straight key is pressed, a DC voltage of about 0.57v max will be given to the top of C107. If you care about key clicks, maybe put a 4.7uf cap between the top of C107 and ground. (You could add a stereo phone jack, with tip to TX 12v, ring wired to the top of C107, and sleeve to ground. Then the 3 resistors and 4.7uf cap can all be out there on the straight key, and when you pull the phone plug this is set back up for SSB operation.)

Set the 10k pot to maximum resistance, remove the microphone, and have some way of measuring the transmit power. Turn on the rig, put a jumper across push-to-talk so it is always transmitting. There should be no output to your power meter, because the balanced modulator is still balanced and thus suppressing the carrier from the BFO. Now press the straight key and slowly advance that 10k pot until you see 5 watts out (make sure that IRF510 isn't getting hot).

OK. Did you see 5 Watts? What is the voltage at C107 when you do? Once we know that, we can get rid of the pot and just have two resistors.

If you zero beat a received signal, pressing the key should transmit on exactly that frequency, which is handy. But normally when receiving CW we'll prefer the BFO at the LSB position for single signal reception. I have a one transistor circuit simulated in LT Spice that allows C107 to be keyed with a clean trapezoid from a Raduino digital pin. But I'll wait to see if the above works before dragging that out.

## This is Ashhar Farhans AGC circuit



## DuWayne Schmidkofer KV4QB AGC with pcb in Eagle

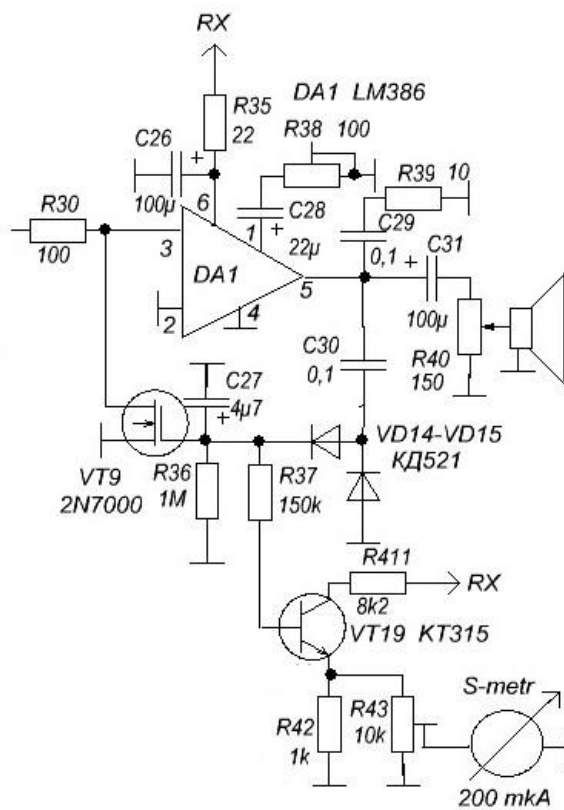
I built the AGC board a while ago and it worked quite well, except the audio level was a little low. I had previously removed the cap from pins 1 to 8 on the LM386. I ended up putting a 10uF between 1 and 8 to get the audio up where it had been. I made a small circuit board for the build. It is laid out so you could mostly SMD components or leaded in the 'Muppet' style. I have the Eagle files and a PDF that can be used to make your own using toner transfer. They are available at

[https://www.dropbox.com/sh/pg3otf9cwtekkoo/AADGvAfmP\\_E96njuNP5UX\\_Y9a?dl=0](https://www.dropbox.com/sh/pg3otf9cwtekkoo/AADGvAfmP_E96njuNP5UX_Y9a?dl=0)

The blog entry with this and a couple other changes I made at

<http://kv4qb.blogspot.com/2016/11/bitx-40p-building-part-1.html>

## AGC and S Meter – from Russia with love



By resistor R42 we calibrate indications of S-meter, as which it is possible to apply the milliammeter with a current of arrow full deflexion up to 200-300mA. At feeding of 50mV on antenna input of the transceiver, the arrow of S-meter must show 9 points.