tuner: will there be further development?

#antijunxiantennatuner

Date

Jul 11 #10698

Glenn

Sorry Jim and the Group.....

Don't know why I wrote that. Brain totally out of gear.....Of course, my PCB interpretation of the K3NG ATU is un-balanced only.

Glenn
vk3pe

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Jul 10 #10697

Jim Ratcliffe

Hi Glenn,

Apologies for the delayed reply, and sorry if I came across the wrong way...

I thought for unbalanced, coax, operation, you'd only need one set of L&C boards, not two?
My manual tuner at the minute, MFJ-945E, only has the inductor and capacitors connected between the centre contacts, the outer is grounded through the chassis of the tuner...

Kind regards,

Jim.

More

Jun 10 #10693
Edited Jul 11

Glenn

Jim, I make no claim to having designed the ATU. The schematic and original firmware is by K3NG.

There are a few pictures in the files group of the L&C pcb I designed to build the project for myself. I built a couple of versions of the controller board. One using the LCD that K3NG and one for an OLED display, although a serial display could be used on that version also. K3NG's sketch does not cover the OLED. There's also a few more pictures and description here
http://www.carrut.info/K3NG_ATU/K3NG_Arduino_based_ATU_2.htm
There are some BOM's, schematics and PCB overlays on that page. That's about as far as the documentation goes. It assumes some construction knowledge. I may have the odd PCB available, I would have to see whats left.

As for what SWR it will tune, I don't know. Included provisions are measurements. K3NG would be the better person to ask for this, of his his original build at least. My QRP version seems to bring my EFHW SWR under ~1.5 : 1 on 30M band. I haven't checked any other bands.
K3NG's software has provision for CAT control. Having no interest in it, I never tried it. Like most of his software projects, there are a number of options that can be enabled in **#define statements**. You would have to see if the code when compiled would fit in the NANO. Otherwise a change of Arduino might be needed.

Correction 11th July 2019, it should read,
My PCB's do not cater for *balanced* operation. The control board would be the same but one would have to duplicate the L&C boards and probably make other changes if you wanted balanced operation.

NOTE:-

My PCB's do not cater for un-balanced operation. The control board would be the same but one would have to duplicate the L&C boards and probably make other changes.

Glenn
vk3pe

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Jun 10 #10692

Jim Ratcliffe

Hi,

Is it possible to get the PCB blueprints and full BOM's to order the parts, and PCB's, to build the tuner designed and built by VK3PE?

I'm also interested in seeing if it's possible to modify the tuner to create a CAT pass-through feature for Yaesu radios, similar to LDG's auto tuners, as I use a US-Link for interfacing between my 897 and laptop.

Lastly, what are the SWR ranges for the tuner?, can it handle high SWR, >9, and bring it down below 2:1?

Many thanks and king regards,

Jim de 2E0URD.

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Feb 16 #9756

Mark Elliot

Hello all
Ask this what is the new p.c.b. for I have not been on in some weeks thank you
Markm6wzw@...

Sent from my Samsung Galaxy smartphone.

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Feb 15 #9754

Daniel Marks

So the circuit I'm using for phase actually has quite a bit of dynamic range. I wanted to make sure you could tune with only 1 watt, and I tuning with 1 watt will work. But with 60 dB of dynamic range probably the AD8302 will do better. The problem is that the chips are $20 unless you go to Chinese sources, which I am not sure I want to rely on.

The phase detection circuit I am using can work with signals as small as +/- 0.2 V. The reason why is the circuit on page 2 of the supplied schematic, in the upper left corner (look at XFlex). I first put the signals through 1N4148 and 1N5711 pairs to clip the signal, first to +/- 0.7 V and then to +/- 0.4 V. I do it in two stages because the Schottky diodes only clip effectively with low current. This is input to a common collector stage which provide strong current sourcing for the clipped signal. This is input to a common emitter stage so it basically the common collector stage is moving the emitter voltage up and down by hundreds of millivolts, turning it on or shutting it off quickly. The resistor between the base and collector of the emitter follower biases the transistor into being well into the linear operating range where it is most sensitive about halfway between the positive and negative supply. This circuit is very effective at amplifying small signals to be turned into a square wave using the Schmitt trigger. The Schmitt trigger is necessary because using the output of the common emitter directly would put the output signal in between high and low most of the time where most logic gates don't operate properly except the Schmitt trigger. The circuit is so sensitive that it picks up distant lightning strikes which are registered as counts in the frequency counter sometimes. A similar circuit is used often for LNAs. I use the 74HC393 counter so that the processor is only woken up if a certain number of counts occur (128), so that when the processor wakes up it can actively check the signal magnitude to see if power is really coming, or if it is a false alarm, otherwise the counter is reset and the processor goes back to sleep. The counter is also used to divide the frequency so that it can be counted by the STM32 timer.

I have the antenna tuner built up with HK141FH relays which have been used in the MFJ-998 and are only $1 a piece. I have tested with the VNA and have measured about 4000 ohms of impedance at 30 MHz between the coil and pole, vs. 600 ohms for the ice cube relay, so I think its much more likely the HK141FH relay will work well, and I will be able to ground the coil of the relay without unbalancing the L network or burning the capacitors.

Dan

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ControlerSchematic.pdf

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Feb 15 #9750

K9HZ

Well there certainly are a lot of good things here. I'm a fan of the phase-amplitude approach to tuning too… has roots in the old military RF-601 tuner. For tuning, it's much easier to see progression on a smith chart than just random searches.

A couple of things though. The phase detector you had designed works ok, but the AD8302 will have a higher dynamic range. No difference if you constantly use the same 100 watts to tune, but becomes problematic once you hit the limits of detection with your circuit. Your phase sign discrimination being a delay is similar to the technique I've used… add in a delay element (capacitor of known value). Therefore the control circuitry with the proper algorithms to calculate transform (and therefore appropriate inductance and capacitance) to match the presented impedance back to 50 ohms real should work quite well.

The RF problems I remember you having… Usually means there is either a ground issue (which I know you've chased extensively) or something else in the transmission section is not right (the transmission line has become part of the antenna). Nothing some shielding, good ground planes, and a couple of chokes shouldn't fix.

I'm following what you are doing. It's the wave of the future in tuners for sure.

Dr. William J. Schmidt - K9HZ ,J68HZ &P6HK ZF2HZ PJ4/K9HZ VP5/K9HZ PJ2/K9HZ

Moderator – North American QRO Group at Groups.IO.

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Feb 15 #9749

Daniel Marks

I am currently working on an antenna tuner. I have proposed solutions to some of these problems. The current state of the project is that I haven't worked on it for four months but I hope to get back to it soon. Meanwhile I design and built a vector network analyzer. The github for the project is at

https://github.com/profdc9/ModularTuner

and that of the Vector Network Analyzer

https://github.com/profdc9/VNA

The VNA is in a working, useful state. Where I left off on the antenna tuner project is that I was trying to solve two problems which are related:

1. The grounding is difficult because when the relay coils are grounded, this badly detunes the L network. If I don't ground the relay coils, the RF finds it way to the controller board and causes the microcontroller to crash. I included provisions in the design now to basically control all aspects of grounding, so that all grounds can be connected (or not) to the chassis ground through capacitors. All cables also have alternating grounds in the wires to help shield RF from the control signals. Adding these features let me figure out the second problem....
2. The relays. The problem is that relays that look similar can have wildly different RF characteristics. I built the VNA in part (not only to learn about VNAs) but now I have really good measurements of the parasitics of the relays with the VNA I built. Ordinarily, one is most concerned about the isolation of the two ports of the relay. However, the coil and pole of the relay can have significant capacitance between them. I tried to use common relays because they have supposedly been used in other amateur radio projects, but I do not know how those other projects succeeded with those relays, because when I measure the coil-pole capacitance of these relays I have a very high value which virtually ensures that if the coils are grounded to prevent RF leakage, the network will not be able to match the load.

I think I have both of these problems solved. I really liked the aspect of Anthony K3NG's design that he used the I2C control of the relays, because if I am going to go to the trouble to make an antenna tuner, I would like it to be modular so that all of the bits can be recycled into other new designs, for example, incorporating tunable elements into antennas. I have all of the antenna tuning units attached to a bus so that one can control up to possible 10 sets of adjustable inductors or capacitor banks using the controller board five ports, two sets per port). I think that a major motivation to develop an open design is so that it can be both a working example and can serve as a means for incorporation into experimental devices, something that is hard to do with an antenna tuner you buy.

I use the STM32F103C8T6 rather than the Arduino because it has a lot more processing power and is just as cheap, and also has the STM32duino development platform on the Arduino IDE. I think the extra processing power, RAM, and USB support is a big help.

I have a phase detector in the design based on mixing square waves with a 74HC86 XOR gave. This is very similar to how a detector such as the AD8302 works, it just that for HF signal frequencies, the 74HC86 is sufficient. I built a tandem coupler, and then sample the forward and reflected signals from the tandem coupler with a peak detector to measure the power. To get the phase, I sample the forward and reflected signals and put them into a circuit based on two ZN3904 that amplifies the signal. I then use a 74HC14 schmitt trigger to turn them into square waves and a 74HC86 to mix the signals. I use a slightly delayed signal so I can disambiguate phase. A 74HC393 counter is used so I can measure frequency using the square wave signals as well.

I also added a third signal besides the forward and reflected power because I would like to do phase detection directly on the current in the antenna element (after the matching network) so I can sense the phase of the signal being radiated relative to the forward signal, as well as the sign of the load when its being matched (inductive/capacitive).

I think at the lower bands right now I am getting about 3 degrees of phase accuracy up to about the 15 m band, and maybe 10 degrees of accuracy at the 10 m band.

Anyways if you check out the project there are several parts: the controller board with the SWR bridge, microcontroller, and bus signals, and relay controller and relay boards. The relay boards can be configured with jumpers for either series or parallel connection of the elements for inductor or capacitor banks. There are also relays on each board to switch the input/output to different ports, for example, so that an L network can be configured between low and high impedance, and/or to swap around the elements of a pi or tee network.

I just have to make sure the grounding problem is solved well enough so that I can give someone idiot proof instructions on how to ground the boards. I think the way to do this is just to have a metal sheet under the boards, and connect all of the boards to the sheet grounded through brass standoffs.

73,
Dan
KI4VTI

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Feb 15 #9747

Gerry Kavanagh

There are some "relatively" simple circuits that will read vector impedance of a DUT. It might be possible to use one of these to determine if the reactance of the load is +ve or -ve and apply the appropriate capacitance/inductance to bring to resonance.
/ Gerry

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Feb 13 #9739

DL1AKP OM Andy

Hi Goody,

Thanks a lot for that detailed information.
So I will definitley stay tuned to the tuner project. In the meantime I can experiment with the existing version.
There is an allready functioning code for ICOM CI-V to monitor the the serial bus and extract frequency information.
That workes great - I have included that code part in a project at myown. Otcourse with the allowance of IK3PWC.
I don't understand, what is going on in that code, but is not very much and so I think is not very complicated for a profesional programmer.

The advantage of I2C (or even RS485) is that there are only 2 wires necessary. Very usefull, if the rf unit is remote from the main unit in the shack.

73, Andy

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Feb 12 #9736

K9HZ

I think I pretty much have that Intelligent Tuning problem solved… I need to just run a few more experiments (finding the corners of failure of course). So when you are ready…

Dr. William J. Schmidt - K9HZ ,J68HZ &P6HK ZF2HZ PJ4/K9HZ VP5/K9HZ PJ2/K9HZ

Moderator – QRO Group at Groups.IO.

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Feb 12 #9735

Anthony Good

There will be development in the future. I'm not sure when, but I will eventually get back into this project and take it further. I do not own any Icom gear, but if someone wants to buy me an IC-9700 I'll have the tuner interface to Icom rigs quickly :-)

I'm not sure how fast you can go with the rig interface. When I wrote the antenna tuner code I was using an Arduino Uno, which has only one native serial port. That port was taken for computer USB interfacing and the command line interface. In order to get a secondary serial port I used SoftwareSerial which emulates in software additional serial ports using ordinary I/O pins. This works, but SoftwareSerial in general has been buggy. You will need to experiment to see how fast you can go, but I expect you'll run into issues with higher speeds. There's just no substitute for a real hardware serial port with a UART.

The next iteration of the tuner will require a Mega and it will use native serial ports, and SoftwareSerial will be eliminated. Using the I2C multiplexers to drive all the relays was fun, but Megas are so darn cheap and have plenty of I/O lines to avoid the whole multiplexing complexity. I plan to drive all the relays with I/O pins, but I'll likely leave all the I/O multiplexer code in there.

I really want to also offer an intelligent impedance measurement based tuning option, as has been discussed here before, as a better alternative to the "spray and pray" tuning methodology.

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Feb 12 #9731

DL1AKP OM Andy

Hello Goody,

will there be some further development on the tuner project?
Means especially ICOM rig interface?

Which max speed does the YAESU / kenwood CAT works with?

Thanks, Andy, DL1AKP

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