ANODE

Inside this issue:

Editor's Comments

April 2006
Volume 6 Issue 9

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Switch Mode power supply noise

[A subject close to our hearts these days. It will be a subject of a Ham-Comp meeting in the near future. JB]

From: "Jason Reilly" < j a z o n . reillySTOP@optuznet. com.auJUNK>
Subject: **Switch mode supply noise elimination?**
Date: 23 March 2006 22:43

Hi all,
I recently purchased a Jaycar MP3090 switch mode power supply for running the shack. Despite being very careful before buying with respect to noise, I'm a touch disappointed - the power supply is responsible for little S5 signals popping up all over 80 metres (and probably other bands, I've not checked)

I looked at the power supply, found that it appears to have quite good filters on the mains input. Never the less, I still can (using a sniffer loop) detect some of the noise at the mains input and DC output. Disconnecting all leads and load from the DC side reduces the noise on the sniffer loop as you'd expect.

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Reverse BPL - A World First!

OM John, like the majority of Radio Amateurs in SA, lives in a "Retirement Village".

The 'body corporate' does not allow for antennas above rooftop height. You can have as many DSTV dishes as you want but no H.F. aerials.

When reading about BPL, John was inspired by to try 'Reverse BPL' for his antenna system. Fortunately his QTH is placed roughly central in the complex. He built a Rhombic using the mains wiring of the complex. He says, "Why not? We used the fence surrounding the RAF camp for an aerial long ago."

His experience in high-power transmitters, H. F. and medium wave aerials gave him some design pointers. He

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Special points of interest:

- Contact details on back page (updated)
- New email address for Anode and ZS6WR. See back page

Editors Comments & News

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A couple of 100pF disc ceramics and 0.1uF polyesters on the DC output did nothing to quieten it. Likewise, some clamp on ferrites did nothing to help on either DC output or AC input.

Does anyone have any practical pointers or tips to quietening these beasts? My next move was to install a filtered IEC mains input plug and directly ground the case of the supply to my 'RF earth' (unless someone tells me that's a bad idea... earth loops and all that...)

Ta - Jason VK7ZJA

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To reply directly from this news group message, please remove the STOP and JUNK and change all 'z' to 's' in my email identity shown here.

On Fri, 24 Mar 2006 07:43:24 +1100, "Jason Reilly" <jazon.reillySTOP@optuznet.com.auJUNK> wrote:

Did you tell the merchant your intended purpose, and that low noise was very important? If you did, and he sold it to you, you have an implied warranty of fitness for purpose and you are entitled to a full refund if it is not fit for purpose. You may have that entitlement without having discussed your purpose... but it is clearer if you did.

Having said that, I have two of those supplies and they are very quiet, so I can't comment on whether yours is faulty, or the design has changed, or there is just variability from unit to unit.

Owen

--
I know this doesn't help much - I bought a nice big linear supply to prevent noise and it's great. Then I added a 10/100 4 port hub to my computers and it creates S9+ spurs every 60khz through the HF Spectrum! Ha, it's all a game of snakes and ladders.

Brad.

On Fri, 24 Mar 2006 13:34:31 +1100, "Jason Reilly" <jazon.reillySTOP@optuznet.com.auJUNK> wrote:

Thanks for the replies Bob & Owen,

Bob, your description should be enough for me to give this a try on my supply. Those measures make sense, so I'll give them a go. Owen, I researched the MP3090 before buying (I think there'd still be a usenet message asking for opinions here somewhere) and saw one in action in person before buying. And then I purchased an 'as new, second hand' unit. So I won't go down that path. It could also be exacerbated by my situation, as the shack is directly below the feed point of my unbalanced antenna (OCF dipole) - proximity to the antenna might be showing up this minor problem.

Ok, well keep in mind that some are quieter. If you want to embark on resolving the problem, check that all the earthing of boards, filter units and the case parts (which are coated with a shielding compound) are effective. If I run a sniffer loop over my ones, noise can be heard with the loop near the digital display, otherwise, the input and output leads and everywhere else on the case is clean.

Don't forget that the problem could be exacerbated by a lack of DC filtering in the radio (ie does it come in the aerial lead, or is it arriving on the DC lead). Have you tried an external DC filter such as those that shipped with some of the Icoms (eg 7400), check your earthing scheme... I can't recall if the power supply outputs are floating, often the case.

I saw your original post, and didn't have any contra info for you.

I would add now, that the ball bearing fans can be noisy (as ball bearing fans are) and I have replaced one with a ceramic bush fan as a trial (should have long life, and it is 10dB quieter although it moves more air). Also, blow the dust out of it from time to time as needed, especially around the HV circuitry where is will form carbon tracks. Otherwise, I have been

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Editors Comments & News

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happy with mine.

I think the advice to anyone contemplating a SMPS, buy one on appro (see my earlier post re implied warranty of fitness for purpose), and check it suits your intended use. They can be fine, lightweight, good regulation, low noise etc... and they can be the opposite.

Owen
--
On 23 Mar 2006 19:14:12 -0800, "bradvk2qq" <bradvk2qq@w6ir.com> wrote:

I know this doesn't help much - I bought a nice big linear supply to prevent noise and it's great. Then I added a 10/100 4 port hub to my computers and it creates S9+ spurs every 60khz through the HF Spectrum! Ha, it's all a game of snakes and ladders.

But is it the hub (probably a switch actually) or is it its power supply (sound like it at 60KHz). A lot of those nasty little SMPS plug packs are just that, nasty. try another power source.

Owen
--
Thanks for the replies Bob & Owen,

Bob, your description should be enough for me to give this a try on my supply. Those measures make sense, so I'll give them a go.

Owen, I researched the MP3090 before buying (I think there'd still be a usenet message asking for opinions here somewhere) and saw one in action in person before buying. And then I purchased an 'as new, second hand' unit. So I won't go down that path. It could also be exacerbated by my situation, as the shack is directly below the feedpoint of my unbalanced antenna (OCF dipole) - proximity to the antenna might be showing up this minor problem.

Ta - Jason

Hi Jason

I purchased a Samlex SMPS device some months ago that has a standard mod for RFI suppression. It consists of 8 FB73-2401 ferrite toroids/beads in each DC lead followed by 2x 0.1uf caps each pos to neg, pos to gnd and neg to gnd. I had a URL but cant find it now. (I downloaded a PDF instead if you want it)

Cheers Bob W5/VK2YQA

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Return Loss Bridge Accuracy Questions

I have just built an HF return loss bridge according to the info in "Solid State design for the Radio Amateur". While it works ok, I was hoping for a bit better performance. Clearly the "balun" doesn't have enough inductance to operate well below 10 MHz or so (10 turns bifilar #30 AWG enamelled wire on Amidon T23-43, as specified in the book - twisted pair, which isn't specified one way or the other in the book).

This can probably be largely fixed by using a larger ferrite core (T37-43's available in junkbox). I am interested primarily in the 1.8-50 MHz range, though I wouldn't complain if it worked on 2m too.

But even at 30 MHz a reasonably good microwave 50 ohm load gives only about 28 dB apparent return loss...Not bad, but I might have expected a bit more.

And an open and short give about 2 dB different signal levels at 30MHz. That is with big pads (>20 dB attenuation) on both the signal generator and detector. The detector is an HF receiver with a step attenuator used to maintain a constant S-meter reading.

The circuit is built on a small PC board using construction techniques typical for the UHF or low microwave range (except that the test port connector is an SO-239), and is enclosed in a shielded box. Each of the three 50 ohm resistors is made of two 100 ohm 1206 chip resistors in parallel and measures between 50.0 and 50.3 ohms at DC.

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Has anyone with experience with this circuit any suggestions for how to tweak it for best performance ? What accuracy level have you achieved? Do you know where I might find an error analysis for this circuit ? Or if I am to think about errors myself, does anyone know how to model the balun in SPICE ?

73,
Steve VE3SMA

My first guess is leakage around the test fixture. Incidental radiation and coupling around the bridge can be a source of errors.

The test for that is to use a well shielded RF source and minimal RF and run the tests with less detector (RX) gain.

For a lot of tests getting better than 20db return loss is adequate accuracy.

Allison

Directivity plays a large part in the accuracy of return-loss measurements. Do some research on how to determine the directivity of the bridge. If the directivity is less than 30 dB, the return-loss accuracy will be impacted substantially.

Bob, w6nbi

Wes Stewart wrote:
> the minute you say "SO-239", all bets are off.

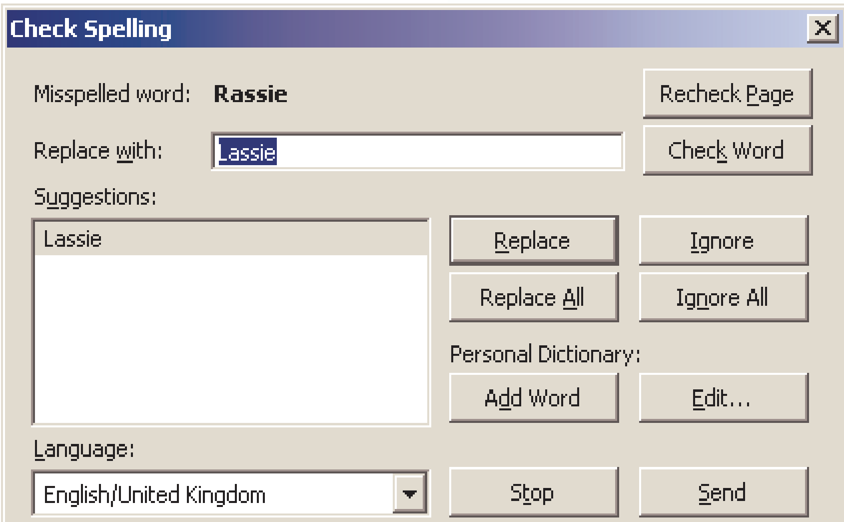
I did some SPICE modelling of an ideal bridge (with resistive detector) and came to the same conclusions....that the higher-than-50 ohm-impedance UHF connector and adapter may be a limiting factor in the performance on a good SMA- or N- connected load. It has virtually no effect on the difference in level between open and short terminations though.

> I have a link to a must read paper at:
http://www.k6mhe.com/n7ws/

Note No. 11.
Make particular note of the part, "The Curse of Adapters."

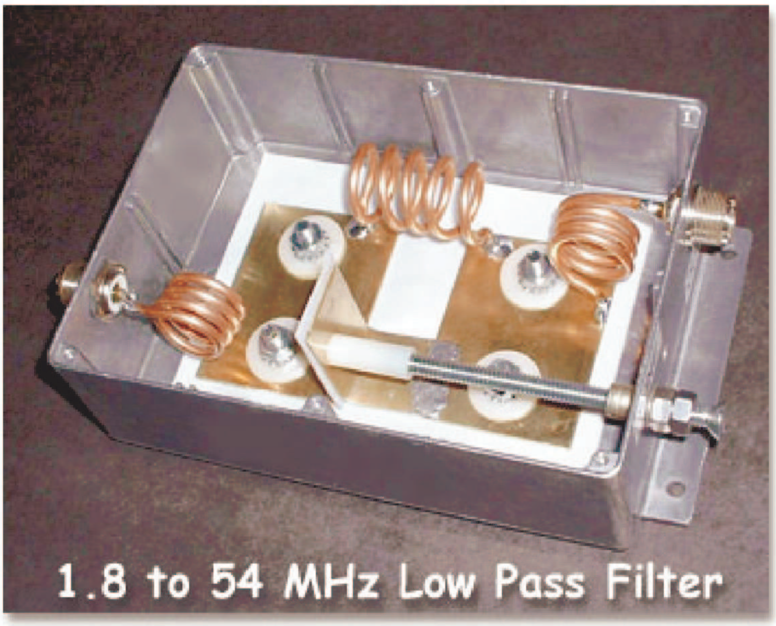
Thanks...the original Wiltron app note has been a favourite of mine for many years, but have never seen the updated version.

Don't you just love spell checkers that correct names?



JB - April 2006

A 54MHz Low Pass Filter (Power design)



- Designed with software available to radio amateurs at no cost
- Low cost - most parts available at hardware stores
- Easily constructed with common hand tools
- High performance, high power - uses low self inductance Teflon capacitors
- Works on all amateur bands from 1.8 MHz through 54 MHz.

A transmitter low pass filter design project was started with goals of low insertion loss, broad SWR bandwidth, mechanical simplicity, easy construction, and operation on all HF amateur bands including six-meters. This filter easily handles legal limit amateur power levels. It was originally built as an accessory filter for the 1500 Watt Six-meter Amplifier described on this site.

The FCC (and ICASA) requires good harmonic attenuation for VHF transmitters. This filter is useful in reducing harmonic radiation in the VHF and higher frequency bands, and is made at home with low cost commonly available parts. No complicated test equipment is necessary for practical alignment. Primarily intended for coverage of the six-meter band, this filter has low insertion loss and presents excellent SWR characteristics for all HF bands.

Although harmonic attenuation at low VHF frequencies near TV channels 2, 3 and 4 does not compare to filters designed only for HF operation, the use of this filter on HF is a bonus to six-meter operators that also use the regular HF bands. Six-meter operators may easily tune this filter for low insertion loss and SWR in any favourite band segment, including the higher frequency FM portion of the band.

Electrical Design

The use of low self-inductance capacitors with Teflon dielectric easily allows legal limit high power operation and aids in the ultimate stop band attenuation of this filter. Capacitors with essentially zero lead length will not introduce significant series inductance that upsets filter operation. This filter also uses an adjustable LC choke that greatly attenuates second harmonic frequencies of the six-meter band. A suitable software tool to design this low pass filter is named Elsie. Jim Tonne, WB6BLD of Trinity Software has made ELSIE filter design software available in a student/demo version at no charge. The program is a professional design tool aimed at engineers/technicians involved in filter design/ network analysis. The student/ demo version is limited to 7 stages. This limitation does not affect the usefulness of this program for many amateur radio filter requirements. In addition, there is no time limit on how long this student version will remain active on your computer.

This program may be downloaded from his site.
Program documentation and example data files are included.

The data filename for this filter is DC54.lct

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A 54MHz Low Pass Filter (Power design)

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The Elsie menu options and intuitive program design make it relatively easy to get started. The user has a choice of manual filter design or design assisted by the computer. I used a low pass filter design with inductor input and having five poles. After making other filter choices like design frequency, the program can calculate all performance parameters and display the predicted filter response. You can use keyboard arrow keys to select an item, tune it, and immediately see the result. A variety of program options are available for fine-tuning the initial design to allow specific design goals to be realized. The data files may be exported into other applications like Touchstone or PSpice. The Elsie software has auxiliary tools that help in filter design. These tools run within the program, and do not require exiting the software and then restarting again. I found that my existing external scientific graphing software could take advantage of Elsie standard two-column format export option for all charts. This helps when adding an Elsie chart into a document already using a standardized plotting format. For most uses, the Elsie internal video screen and hard copy printer outputs are fine.

Component Values Table

L2 --- 235.68 nH Wind with 1/8" OD soft copper tubing, 5 turns, .75" dia form, 1.75 inches long, ¼ inch lead length for soldering.

L1,L3 --- 178.9 nH Wind with 1/8" OD soft copper tubing, 3.5 turns, .75" dia form, .625 inches long, ¼ inch lead length for soldering to brass plate, other lead length to RF connector as required.

C1,C2 --- 74.1pF 2" by 2.65" brass plate sandwiched with .03125" thick Teflon sheet. The metal enclosure is the remaining grounded terminal of this capacitor.

Mechanical Design, Assembly, and Construction

Download the detailed mechanical drawing of this filter. One design goal of this filter was easy tuning with modest home test equipment. To realize this, build the coils carefully according to the component values table. The homemade coils solder directly to the top surface of the brass capacitor plates. The capacitors are made using a brass to Teflon to aluminium case sandwich. An easy to make variable capacitor is made from two pieces of .032-inch thick brass plate and a Teflon insulator. The filter inductors are mounted at right angles to each other to help maintain good stop band attenuation.

One Elsie software tool will calculate the details of each inductor. Coils L1 and L3 are designed with a half turn winding. This allows short connections to the brass capacitor plate and the RF connectors mounted on the enclosure walls. The coils are physically spaced with ¼ inch lead lengths, and then soldered to the brass plates.

Many of the parts required to make this filter are available at hardware stores. In particular, the one and two inch wide brass strips (sold as Hobby or Miniature brass), 1/8 inch diameter soft copper tubing, nuts, bolts, and nylon spacers and washers are commonly available at low cost. It is important that the specified .03125-inch thickness of Teflon be used since another size will result in a different capacitor value. If you have another Teflon thickness available, you will need to calculate the specific capacitor values depending upon the new thickness and brass plate sizes. The opaque white colour Teflon used here has a dielectric constant of 2.1. The clear varieties of Teflon typically have values less than this, and will result in different capacitor values for the same size brass plates.

The capacitance will decrease if the assembly bolts are loose, so be sure to have the bolts tightened. Make sure to use the .064 inch thick brass plate for the bolted down capacitors. When under compression, the thinner brass size used for the variable capacitor tends to flex more and doesn't fit as flat to the Teflon.

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A 54MHz Low Pass Filter (Power design)

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A separate Teflon sheet is also used in the variable capacitor, and is glued to the stationary vertical capacitor plate. This insulator is used to prevent a short circuit in case the tuning screw is tightened too much. Teflon is extremely slick, and doesn't glue well unless chemically prepared. One way to get acceptable glue joint performance between the brass support plate and the insulator is to scuff the Teflon and brass surfaces very well with 240 grit sandpaper. The intention is to increase the available surface area as much as possible, and provide more places for the glue to fasten to. Glue the Teflon in place with a bead of RTV or epoxy. After drying, the Teflon sheet can be intentionally peeled from the brass plate, but it appears to hold reasonably well. Special Teflon that has been treated to allow good adhesion is available, but the expense isn't justified for this simple application. This Teflon variable capacitor insulator sheet measures 1.5 inches wide by 1.75 inches tall and is larger than the two brass plates. This gives an outside edge insulation safety margin.

Calculating the capacitance of the plates.

The .064-inch thick brass capacitor plates have two .5-inch holes in them for the mounting bolts. The surface area of each hole is PI R squared, so the two holes combined have a total surface area of .3925 square inches. The brass plate size is 2 inches by 2.65 inches. This equals 5.3 square inches of surface area. Subtracting the area of the two holes gives a total surface area of 4.9 square inches. The formula for capacitance1 is:

Where:
C=capacitance in pF
k=dielectric constant of Teflon®
A=surface area of one plate in square inches
d=thickness of insulator

The dielectric constant of the Teflon used here is 2.1, and the thickness used is .03125 inches. The calculated capacitance of each plate equals 74.1 pF. Measured values agree closely with this number. When built as described, the capacitor plates measured between 2% and 2.5% of the calculated value. This is acceptable for a practical filter. The brass sheet material acts like a large heat sink, so an adequate soldering iron is required. A large chisel point 125-watt iron will work well. The soldering heat does not affect the Teflon material. However, beware of the temptation to use a small propane torch. Two bolts in each capacitor hold the Teflon sheet and brass plates firmly together. The bolts are insulated from the brass plates by nylon spacers the same thickness as the brass. The nylon plunger for the tuning capacitor needs to be drilled and tapped to accept the 1/4 x 20 thread of the adjustment bolt. A threaded insert or PEM nut in the enclosure provides support for the tuning screw.

Tuning Capacitor and Input SWR Adjustment

The small variable capacitor is shunted across coil # two. This coil and capacitor combination acts like a tuneable trap for second harmonic frequencies when operating in the six-meter band. After soldering into place, the flexible tuning plate of this capacitor is simply bent towards the adjustment screw. Brass of this thickness has a definite spring effect. Just bend the plate well towards the tuning screw, and then tighten the tuning bolt inward. This will result in a stable variable capacitor.

Six-meter alignment procedure.

If you are not concerned with six-meter operation, ignore this procedure. Simply set the variable capacitor plates .1-inches apart and disregard the following steps. If you wish to use this filter on the HF amateur bands from 1.8 to 30 MHz only, the adjustable tuning capacitor adjustment is not critical at all, and does not affect HF SWR performance. However, don't eliminate the capacitor entirely. The software predicts degraded VHF response with it missing. For

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A 54MHz Low Pass Filter (Power design)

(Continued from page 7)

use on the HF bands only, the tuning screw and associated nylon plunger may be omitted. Normally, tuning this filter would be an aggravating experience since three variables (with two interacting) are involved (L1, L2, and the variable capacitor). I realized that the Elsie software "Tune" mode held the answer. After studying what the software predicted, I generated this tuning procedure. My very first attempt to exactly tune this filter was successful, and was completed in just a few minutes. This method was predicted by software and then confirmed in practice. A common variable SWR analyzer is required. These steps may seem complicated, but are actually pretty straight forward once you get a feel for it. Read first before you start adjusting.

Step One: After the filter is constructed, adjust the variable capacitor until the top plate spacing is about .1 inches apart. Using a variable SWR analyzer, sweep the six-meter band area, searching for a very low SWR null anywhere in the vicinity of about 45 to 60 MHz or so. If a low SWR value (near 1:1 ratio) can be found, even though the frequency of the low SWR isn't where you want it, proceed to Step Two. Otherwise, adjust the input coil L1 by expanding or compressing the turns until a low SWR can be obtained anywhere in the range of about 45 to 60 MHz, then go to Step Two.

Step Two: If you can't measure the notch response at 100.2 MHz, proceed to Step Three. Now apply 100.2 MHz to the filter input. Adjust the variable capacitor until the six meter second harmonic at 100.2 MHz is nulled on the filter output. Then, hook up the SWR analyzer again, and sweep the six-meter band with the SWR analyzer. If the low SWR location is too low in frequency for you, adjust middle coil L2 for less inductance (expand turns apart), and then readjust the variable capacitor to bring the notch back on frequency. Continue these iterations until the SWR null is where you want, and the notch frequency is correctly set at 100.2 MHz..

Alternately, if the desired SWR low spot is too high in frequency for you, adjust L2 for more inductance (compress the coil turns), and then readjust the variable capacitor for the second harmonic notch. Continue this until both the low SWR frequency location and the notch null are set where you want. You may need to unsolder one end of coil L2 to allow the adjustment for a longer or shorter coil length as you expand or compress turns. Just solder the end again after you make your length correction.

Note that you will probably need to install the enclosure lid during the very final tuning steps. I was able to reduce the second harmonic into the noise floor of an IFR-1200S spectrum display, but the lid needed to be installed. The lid also interacts some with the variable capacitor. Once the SWR and the notch frequency are set, the tuning process is complete and the filter is optimally adjusted. Do not perform Step Three below.

Step Three: This step is only performed if you don't have a way to generate the 100.2 MHz input signal, and then detect a null on the filter's output terminal. The variable capacitor will become your SWR adjustment to move the SWR null spot to the portion of the six-meter band you desire. If you run out of adjustment range on the variable capacitor (turned all the way in), just compress the L2 coil turns together, and try again. Alternately, if the variable capacitor is backed completely off, just expand the L2 coil turns, and try again. After your SWR is set, you are finished. Although the second harmonic notch probably isn't exactly on frequency, you will still have good (but not optimum) suppression since the notch is very deep.

Parts list

1 ea Miniature brass strip, 1" wide, 12" length .032" thick (variable tuning cap)
1 ea Miniature brass strip, 2" wide, 12" length .064" thick (main filter capacitors)
5 feet length of 1/8" diameter soft copper tubing
4 ea ¼ x 20 x ½ inch long hex head bolt

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A 54MHz Low Pass Filter (Power design)

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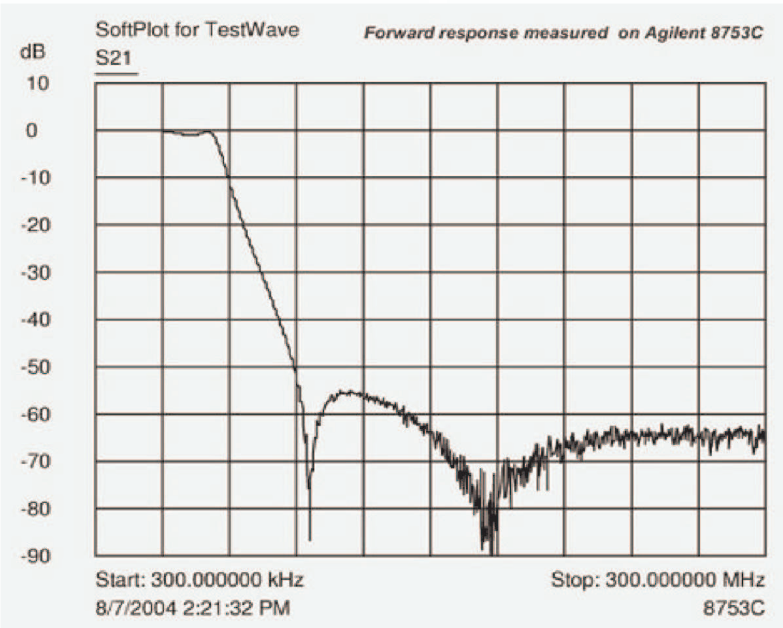
4 ea nylon washer, .5" OD, .25" ID, .062" thick; Mouser 561-D2562 or equivalent
6 ea ¼ x 20 hex nut with integral tooth lock washer
1 ea ¼ x 20 x 4" long bolt
1 ea ¼ x 20 threaded nut insert, PEM nut, or "Nutsert"
1 ea 1" long x .375" dia. Nylon spacer. ID to be smaller than .25".(used for variable capacitor plunger)
4 ea nylon spacer, .875" OD, .25 to .34" ID, approximately .065" or greater thickness (used to attach brass capacitor plates.)

Aluminium die cast enclosure is available from Jameco Electronics as their part number 11973. The box dimensions are 7.5" x 4.3" x 2.4".

The .03125" thick Teflon sheet is available from McMaster-Carr Supply Co. Item # 8545K21 is available as a 12" x 12" sheet.



Performance Graphs Discussion

Assuming the six-meter SWR is set to a low value for a favourite part of the band, the worst case calculated forward filter loss is about .18 dB. The forward loss is better in the HF bands, with a calculated loss of only .05 dB from 1.8 through 30 MHz.

The filter cut-off frequency is about 56 MHz, and the filter response drops sharply above this. There are parasitic capacitors on coils L1 and L3. These are also included in this filter analysis. The calculated self-capacity of each coil is almost one pF even. These small capacitors are included on the schematic and are also included in the software for the model. These capacitors occur naturally, so do not solder a one-pF capacitor across each of the end coils in this filter. The capacitors have the effect of placing additional notches somewhere in the UHF region. The calculated self-resonant frequency of L1 and L3 is about 365 MHz.

Refer to the graph showing calculated filter response from 1 to 1000 MHz. The impressive notch in the 365 MHz vicinity is because of these inherent stray capacitances across each of the coils. Slight variations in each coil will make slightly different tuned traps. This will introduce a stagger-tuned effect that results in a broader notch width. These exact capacitance values are hard to predict because of variations in home made coil dimensions and exact placement of each coil inside the enclosure. The best way to determine their effect is to physically measure the UHF response of this filter. Using low self-inductance capacitors in a VHF filter helps to take advantage of predicted filter attenuation at extended frequencies.

The SWR across the HF bands and six-meters is shown in the graph showing SWR response from 1 to 55 MHz. A more detailed graph showing only the six-meter band SWR is also shown.

Calculated return loss of the filter across 1 to 200 MHz is shown in a separate graph. Notice that the ten-meter region has particularly good return loss. Component values in this filter were adjusted so that this return loss spike was moved from about 40 MHz to the vicinity of the 28-30 MHz amateur

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Reverse BPL - A World First!

(Continued from page 1)
modelled his design on a personal computer using 'dumbNEC'. Careful placing of traps to earth stakes gives the antenna a performance figure of 6dbws(*). Shown below is 'aerial view' (pun intended).

He can be heard regularly on 7,070kHz +/- 50Hz.

(*) referred to wet string.

[I hope you enjoyed this article. It received no comment from any reader. So I can conclude either you all believed it, noone read it or we don't have any readers. JB]

A 54MHz Low Pass Filter (Power design)

(Continued from page 9)
band.

Conclusion

This filter meets the original design objectives. Since I use six-meters as well as the regular HF bands, this project has produced a doubly useful station accessory. Low insertion loss on six-meters makes this filter useful for receiving applications also. The ELSIE filter software tool made the electrical design portion of this project fun.

Thanks to Jim Tonne, WB6BLD for the Elsie design software and for his informal consultation and helpful comments about this filter. Jim suggested this filter topology and offered component values to consider.

Thanks to Steve Hageman for measuring the actual filter characteristics on an Agilent 8753C network analyzer.

Notes

1. The ARRL Handbook, 72 Edition (Newington:ARRL, 1995), pg 6.9.

Last Updated: Sat, 05 Nov 2005 22:5

The West Rand Amateur Radio Club
26.14122 South - 27.91870 East

P.O. Box 562
Roodepoort
1725

Phone: +27 11 475 0566
Email: **zs6wrmail@mweb.co.za**
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Bulletins (Sundays at …)
11h15 Start call in of stations
11h30 Main bulletin start

Frequencies
439.000MHz 7.6MHz split
(West Rand Repeater)
145,625 MHz (West Rand Repeater)
10,135 MHz (HF Relay)

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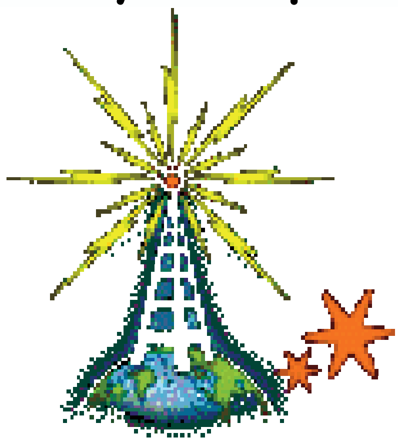
Vice Chairman	Keith	ZS6AGF	675 1604 (H)	Mwbronie@iafrica.com
Secretary	John	ZS6FJ	672 4359 (A/H)	
Digital Communications	Stuart	ZS6OUN	082 573 3359	sbaynes@iafrica.com
Technical	Phillip	ZS6PVT	083 267 3835	phillipvt@sse.co.za
Member	Craig	ZR6CRW	795 1550 (H)	craig.woods@absamail.co.za

West Rand members - we need your input!

To make this the best ham radio magazine in South Africa we need your input. Please submit articles, comments, suggestions etc.

Please send plain text with no formatting to the email address below.

In July 2003, we re-published an Anode Compendium on CD. It has the issues from July 2000 until June 2005. This included the new Adobe reader. It has been updated, check with the chairman for details.



We need your input! Email us articles, comments and suggestions please. John_brock@telkomsa.net