

## **Build notes copied and pasted into 1 running pdf file. Circa September 2012**

Todd -

While going thru my documentation earlier I came across something that MAY be useful to you later.

At one point I was getting annoyed by being able to see the sweep retrace on faster sweeps on the analog scope. It was dim but it was there. The fleeting retrace, slightly visible, was showing up in scope display photos when taken on my analog scope. Adjusting the intensity could mitigate this annoyance but that was an inconvenience, so I added a small circuit/mod to address this particular.

I'm attaching a .pdf to share this with you. I suggest this is a simple addition / tweak that can be used if you need to - I don't know how your scope will treat this issue. I'd say to finish up the path you are presently on, try things out when you actually have some things to sweep, and then decide if this might be beneficial. In my case I was actually able to add this right on the involved front panel switches as in the photo.

Bob

---

Hi Again Todd -

OK - I think I've unraveled the mystery of the missing stuff.

At the dates shown on the various drawings the USG was "evolving" and I was tweaking drawings for the benefit of John who was trying to duplicate what I had done. Appreciate that my original USG was getting a bit "messy and battered" as it was getting tweaked and refined over time.

Because of this messy activity I re-drew some drawings for John including the holeboard layout drawings. (My USG circuitry was built on Radio Shack holeboard and John was trying to duplicate that.)

For John's sake I included a convenience network on his board layout for use in USG test/tune - that's what the mystery paragraph refers to and it did not wind up on dwgs. I sent you. But it's pretty simple:

There is a 500 ohm trimmer with two matched 10 k resistors on each side of it i.e. the trimmer is "in the middle" of this 3-resistor string. The resistors are simply ohmmeter matched close enough to allow the 500 ohm trimmer to find the exact center of this divider - thus it becomes "a

precision divider" used as a convenient network as described in the test / tune procedure. (I recall having this network off-board i.e. on the bench when I was doing my own USG.)

In the process of searching out the answer to your question, I note that there is a typo on page 2 of the schematic regarding IC4c - namely pins 8 and 10 labels are swapped. Thus the inputs to this op amp 10 and 9 and the output is pin 8. I believe the test / tune text is properly written.

Hopefully I've covered all but please don't hesitate to get in touch should any further question / confusion pop up - I will not let you down!

And hey - you've come a long way and are just about done. You can be proud of what you've done - I can imagine where doing the USG ugly is really a massive, messy undertaking - and you only had one tiny solder short - fantastic!

Bob

----- Original Message -----

**From:** Todd to bob **Sent:** Wednesday, September 19, 2012 12:41 AM

**Subject:** cal question please

Hi Bob :

I don't see the built-on-the-board precision convenience divider. I made the op-amp comparator... but don't see the divider Please clarify.  
Thanks Todd

**...This is accomplished by utilizing an otherwise dormant section of IC4 quad op amp as a comparator and the built-on-the-board precision convenience divider.**

FROM

UTILITY SWEEP GENERATOR TEST AND ALIGNMENT PRODEDURE

DRAFT ONE

file: USG\_TAP\_1.wps 11/25/08

Todd -

While going thru my documentation earlier I came across something that MAY be useful to you later.

At one point I was getting annoyed by being able to see the sweep retrace on faster sweeps on the analog scope. It was dim but it was there. The fleeting retrace, slightly visible, was showing up in scope display photos when taken on my analog scope. Adjusting the intensity could mitigate this annoyance but that was an inconvenience, so I added a small circuit/mod to address this particular.

I'm attaching a .pdf to share this with you. I suggest this is a simple addition / tweak that can be used if you need to - I don't know how your scope will treat this issue. I'd say to finish up the path you are presently on, try things out when you actually have some things to sweep, and then decide if this might be beneficial. In my case I was actually able to add this right on the involved front panel switches as in the photo.

Bob

---

**Hi Todd et al -**

**Sorry for this long delay in responding.**

**Todd - I appear to have a mis-file in my emails to you but right now I can't pin down what I may have already sent you drawing-wise for the Utility Sweep Generator (ramp generator). Since you are referring to specific parts of the design I can see where I must have sent some stuff - but I don't remember what that was and if it included all the info. Please tell me what it is you already have (use file names) and I'll see if I have more stuff to add.**

**Meanwhile, IC1 is a 555C timer. MAKE SURE it is a CMOS version no matter the vendor. IC's 2,3,4,5 are LM324 quad op amps.**

**S/S is "start / stop", CW is just that, and dF is delta freq. around some chosen center freq. As it turns out, I very nearly always use S/S wherein the start and stop freqs are easily independently settable and non-interactive for a properly tuned up ramp gen. The 2, 4, 6 volt lines ARE VERY SIGNIFICANT and require ACCURATE settings during tune up / calibration. It's this precision that permits that independant and non-interactive freq setting above.**

**(Do you have the text on how to tune up the ramp gen.?)**

**The circuitry associated with the transformer is that of a very simplistic multivibrator based low power, power converter providing low current bias to the panel DVM (10V) and some op amp circuitry (IC4). The latter allows some negative going (i.e. swing below ground) waveforms. The transformer is Mouser 42TM028.**

**I don't understand your question 4.**

The "-10 volts" is not "minus 10". The (~) is an "approximate" symbol - and it is hard to clearly see / read. Same for the 3V line. These are unregulated voltages where "approximate" is just fine. As above, the nominal 10V powers the DVM panel meter.

My ramp gen current drain is 69 mA with no external load on the 15V utility output. (I use the latter to power the two RF sweep gens I use with the ramp gen.)

I DO NOT recommend installing an AC power transformer in the ramp gen case. I've not done so and can imagine all kinds of hum issues with an internal transformer. I use an external simple DC wall wart supply.

Hope this is of some help. I understand there is a ways to go - for sure - but I'll stay with you throughout.

Regards,  
Bob, K3NHI

Hi Todd -

OK - now I understand the confusion. The "read-volts set" switch on the schematic is badly titled - should be labeled "AVG" - as explained in the texts. It is a simple SP3TCO toggle. The 4P3T rotary switch is actually also very simple and cheap - Mouser 105-SR2511F-43FN @ \$2.77.

I need to compile an assortment of pix and dwgs for you. My problem in doing this is a somewhat less-than-the-best-organized pile of stuff that includes updates and mods and probably some "misses" and therein is confusing - even to me now looking back. HOWEVER - I do know "it works" because John, K5IRK, did it - lack of dwg organization notwithstanding! (John - please jump in if you feel so inclined!) I need some time - and "head scratching" - to better backtrack and sort things out. I may have to do some re-drawing. Glad you are not in a hurry!

---

Hi Todd et al -

Per your request, I'm attaching the basic info for subject RF sweep generator. John has duplicated this although in a different enclosure - as I recall.

This is sort of an "Erector Set" circuit in that the internal adjustments and settings can tailor the operation to the job at hand i.e. it allows one to easily "build" the source needed. It's "all in the box". Thus the center freq and freq span are all adjustable / settable when used in conjunction with the USG ramp source. So far I've not found a desired sweep condition that I could not effect with this box - all the variables appear to "overlap" as was the original idea.

Keep in mind it is a "narrow band" generator. Also, the resulting frequency sweep will likely always have some non-linearity given the tuning varactor behavior but I've never found this to be a limitation probably because the subject filters are all rather narrow.

Given the above, it should be clear that there is plenty of room for personalization - it's more the "idea" here (along with the USG) than the exact specifics that matter, I feel.

As I'm gathering this info I note there is a resistor value missing from the schematic: the trimmer R in the J310 source is 2K. As before please feel free to ask re: any questions.

John - do you have anything to add?

Bob

---

Good morning to all of you.....A couple of things on Bob's little sweeper.....first in the upper right hand corner of the schematic, there is a R between the .1 and the 10uf/16V caps not labeled....I have it marked as 120 ohms. In addition, I have the schematic relabeled with MV209's (which I used) rather than MV109's. Bob if I remember correctly the 109's was a typo.....

Mine is a Xerox copy of Bob's in layout and box size, etc.....I tried to duplicate mine in every way as this was the first project of his that I did with the oscillator circuitry that he used, including his layout ideas for the switch and stacking the T cores which was all new to me. I wanted to simply eliminate any problems associated with the layout, if there were any....Finally, Bob, you might want to give Todd, at the appropriate time, some tips on the voltages used during the sweeps.....recall I got mine too low during some measurement sweeps when we were doing some comparisons in the beginning.

Bob, it was the 0-100 mHz sweeper I built later that I used a larger box than the one you used....Hope this helps, hope all of you have a good weekend...John

---

Hi guys,

My take on this is that I can't really see how it could possibly work. It's just not ugly enough!

Todd, for what it's worth, the sweeps that I get with my VNA and the ones that Bob generates are really together. There have been a couple of crystal filters that have made it across the country and back and have been measured with both systems.

73, Wes

---

Hi Todd, Wes, and John -

Thanks all for the various communications re subject - please keep 'em coming. Frankly I've been wondering what's been happening with this stuff and now I'm happy to find there is activity - and results! Way to go Todd!

Todd, I don't remember for sure, but I have a nagging suspicion that I may have failed to respond to some much-earlier inquiry on your part (??) but if so please be assured such oversight would have been nothing personal. If this actually happened it is NOT due "abandonment" on my part but rather reflects my inability to do a good job at it at the time. Be assured I'm most anxious for your success with any of my stuff you venture to try. Just your willingness to try stuff is a "feel good" for me and of course your success is like whipping cream!

I do acknowledge the USG has lots of knobs and that it does take a bit of practice to get full benefit of the available variables. I also admit there are some I rarely use. But with so many tools in the box I've yet to find an application it could not accomodate!

I don't recall what you are using for a detector (such as in following a filter). John and I are using my expanded version of Wes' 8307 power meter. As you might suspect, our's have more knobs - relatively speaking! These variables coupled with appropriate settings on the 'scope permit a very expanded view of a filter nose, for example. So, it is easy to display a nose at 1 or 2 dB/grid. I know I have some photos of such a display but they are downstairs on my desktop (harder to get to) and right now I'm using a laptop in my living room. I'll try to send some examples in the near future. Anyway, at 1 or 2 dB/grid it's easy to watch the passband flatness or those little wiggles shift around as one tweaks filter C's.

Here's wishing all a Happy New Year. Do be safe this holiday weekend and do keep snortin' solder smoke ....

Bob, K3NHI

---

Hi Todd,

Great on getting the sweeper built and working. It will, I predict, become a real workhorse tool for you. It looks great.

Two things: First, in looking at the sweep result, I was a bit perplexed by the "squiggles" on the upper frequency side. I don't think this is natural. I would wonder if you are not sweeping too fast. These ripples are common when you sweep a narrow filter too fast. So try slowing down the sweep speed and see what you get. Bob is not an operator and certainly not a CW op. So he does not relate to a 400 Hz BW. A Gaussian to 6 dB filter can probably be swept faster than many other shapes, but there are limits.

Item 2: I hope that you have been keeping Bob and John up to speed with this work. I'm sure

they will be excited and pleased with your results. I bet poor Bob is presently under quite a bit of snow.

Have a good New Year's celebration.

73, Wes

-----  
Hi Todd,

Great. The 50 MHz RX front end looks great. That should be a great RF amp.

Attached is the stuff to get you started with Bob's sweeping system. The first is a sketch I did just to show an overall view of what he is doing. He has lots of boxes, which is the same approach I often take to measurements. One box is a bunch of analog electronics that generates the VCO ramp, plus a ramp to drive the scope. It's just like a SA time base. You will note the 555 based sweep is much like the time base for that single conversion analyzer. I lifted the circuitry from Bob. Frankly, it works a bit better than the sweep for my analyzer. I think the sweep generated with a constant current into a cap is lower noise than the integrator I use. The block is "k3nhi sweeper system.png."

The control in this comes from the "timing module." This is Bob's sweepstuff 001. Then sweepstuff 002 shows a couple of the modules.

Next comes a text file that is just a collection of emails between Bob and me, with John Lawson (k5irk) on the side. Then come the schematic files that Bob has generated. The timing module is in three parts.

Bob has lots of photos. I'm going to CC him (and John) with this note to give you their email addresses. Both are great about sharing their efforts and helping out. Bob has been able to get amazing results with his system.

Not shown is the power meter. You can use one like mine, or you can build up Bob's version. It is documented in QEX and further on the EMRFD Yahoo group in the files section. Essentially, Bob took the power meter that Larkin and I did and added a digital panel meter to it. That meter had a 100 mV range with 100 uV or so resolution. So with some analog circuitry, Bob was able to set it up to read out directly in dBm to a tenth of a dB. He also has offsets built in to really enhance the performance. By juggling the sensitivity of the scope and the offsets, he can get whatever he wants for output results. He uses an Owen DSO that has four colors available, so he gets some wonderful data. You can of course use your Rigol or the HP. The display on the HP is so wonderful. Can you do two or more traces with different colors on screen? That's what Bob does to get the super data that he gets.

The final photo is of Bob and me when I visited him in PA a couple of years ago. That was a fun trip.

Anyway, this will get your started.

73, Wes

---

Hi Todd -

OK - now I understand the confusion. The "read-volts set" switch on the schematic is badly titled - should be labeled "AVG" - as explained in the texts. It is a simple SP3TCO toggle. The 4P3T rotary switch is actually also very simple and cheap - Mouser 105-SR2511F-43FN @ \$2.77.

I need to compile an assortment of pix and dwgs for you. My problem in doing this is a somewhat less-than-the-best-organized pile of stuff that includes updates and mods and probably some "misses" and therein is confusing - even to me now looking back. HOWEVER - I do know "it works" because John, K5IRK, did it - lack of dwg organization notwithstanding! (John - please jump in if you feel so inclined!) I need some time - and "head scratching" - to better backtrack and sort things out. I may have to do some re-drawing. Glad you are not in a hurry!

Meanwhile, I'm attaching some texts that are essentially correct but even here need some updating. They should convey much of the basic ideas involved, however. Like I said, this stuff was never treated as "for publication"!

Keep the questions coming.

Bob

-----

Hi Todd et al -

Sorry for this long delay in responding.

Todd - I appear to have a mis-file in my emails to you but right now I can't pin down what I may have already sent you drawing-wise for the Utility Sweep Generator (ramp generator). Since you are referring to specific parts of the design I can see where I must have sent some stuff - but I don't remember what that was and if it included all the info. Please tell me what it is you already have (use file names) and I'll see if I have more stuff to add.

Meanwhile, IC1 is a 555C timer. MAKE SURE it is a CMOS version no matter the vendor. IC's 2,3,4,5 are LM324 quad op amps.

S/S is "start / stop", CW is just that, and dF is delta freq. around some chosen center freq. As it turns out, I very nearly always use S/S wherein the start and stop freqs are easily independently settable and non-interactive for a properly tuned up ramp gen. The 2, 4, 6 volt lines ARE VERY



SIGNIFICANT and require ACCURATE settings during tune up / calibration. It's this precision that permits that independent and non-interactive freq setting above.

(Do you have the text on how to tune up the ramp gen.?)

The circuitry associated with the transformer is that of a very simplistic multivibrator based low power, power converter providing low current bias to the panel DVM (10V) and some op amp circuitry (IC4). The latter allows some negative going (i.e. swing below ground) waveforms. The transformer is Mouser 42TM028.

I don't understand your question 4.

The "-10 volts" is not "minus 10". The (~) is an "approximate" symbol - and it is hard to clearly see / read. Same for the 3V line. These are unregulated voltages where "approximate" is just fine. As above, the nominal 10V powers the DVM panel meter.

My ramp gen current drain is 69 mA with no external load on the 15V utility output. (I use the latter to power the two RF sweep gens I use with the ramp gen.)

I DO NOT recommend installing an AC power transformer in the ramp gen case. I've not done so and can imagine all kinds of hum issues with an internal transformer. I use an external simple DC wall wart supply.

Hope this is of some help. I understand there is a ways to go - for sure - but I'll stay with you throughout.

Regards,  
Bob, K3NHI

---

4/5/2012

Hi Bob,

Hey, I got a note from a Canadian buddy, VE7BPO, where Todd was looking for a sweep generator. He was starting to talk about a VNA, but I convinced him that he really didn't need a VNA, for he was not really in need of phase or complex impedance. Rather, he wanted to sweep filters. Anyway, I told him about the 100 MHz sweeper that you build and he really lit up. So he ask if you had a detailed write up about this variation and if you would be willing to share it.

I looked under Kopski in the regen rx and the emrfd Yahoo groups but didn't find that one. I didn't think that you had posted any of that there, although I found the 50 MHz generator. I thought that I had info on the sweeper in my old EMRFD2 folder, but I could not find it.

The really simple thing to do would be to build up a VCO (or buy a MiniCircuits) and then build the STG. I have variations of the DC sweep module, a.k.a. ramp generator. I know that John has built the 100 MHz sweeper.

Anyway, anything that you could offer would be greatly appreciated.

I have not updated my stuff on the extended range RLB because I'm waiting to get over to BC's house to do more measurements. But his wife's sisters are arriving today for a few day's visit, so it's an especially bad time for me to go over there. Bob tells me that indeed he may be over here. I guess it can get pretty intense with three gals yaking at each other in Chinese, but they do have a good time.

Anyway, hope that you are getting out for some flying. The temperature has been low in the 40s here and have not been out much. I may head out in a while though, for the sun is presently shinning. It was raining an hour ago.

Many thanks.

73, Wes

=====

10:23 AM 4/6/2012

Hi Wes -

I have been using what is by now some rather evolved sweep stuff for several years and you have seen many examples of resulting traces over time. The attached show the associated boxes, and John has successfully duplicated them all. I acknowledge it did take a lot of back-and-forth emails but it did work out FB. None of this stuff has been published or posted and I have only limited associated text notes but I do have the schematics.

One box - Utility Sweep Generator (USG) might be better named utility (voltage) ramp generator for that is what it really is. The USG is used to ramp the other RF sweeper boxes in the photo as well as Mini Circuits VCO's and any other swept oscillator things I've played with over the years (many!). It is indeed "utility" with plenty of variables and I've not found anything so far I can't sweep with it. This stand-alone voltage ramp source eliminates having to build dedicated "local" ramps for every project that comes along.

The most often associated boxes are the "Narrow Band RF Sweep Generator" and the "~1 to 100 MHz RF Sweep Generator". The first is basically a VFO with switchable caps and L's plus the necessary varactors - all in that box. It covers about 3 to 15 MHz in smaller segments depending on the C and L selection and then sweeps within that chosen segment. This box works well with Xtal filters and even stuff like the Q Mult / regen things I was playing with. It derives both power and the fully adjustable ramp signal from the USG.

The other most used box is the 100 MHz one and it too derives from the USG. Having this wide freq range it is not useful for sweeping narrow stuff and of course that is not the intent anyway.

BTW - I have used all this stuff with regular analog scopes but more recently with the DSO which allows the capture of slower and more numerous comparative displays. As you know, really narrow filters are hard to sweep / see on regular scopes.

I'd be happy to share the info with your friend noting that the total of the above is quite a bit of building - as I'm sure John would attest! I'm also pretty sure he would attest to its working well! (What do you say John -- :- ) Originally I felt it might be candidate for consideration in II but then I did see VNAs beginning to dominate. Anyway, please feel free to have your friend email me and you are also welcome to stay in the loop - if one happens!

Have a nice holiday weekend guyz - I thought maybe your grand kids would like to see the attached "newbies" photo.

Bob

=====

10:23 AM 4/6/2012

John Lawson

7:35 AM (2 hours ago)

to Bob, me

Hi to both of you...Bob you mentioned for me to chime in, so here's a short note....

Wes, as Bob mentioned there needs to be some dedicated time allowed for the building....I'm guessing I spent 9 months or so in ordering parts, physical building and emails back and forth on the tune ups, etc. I built the PM, the USG, the Narrow Sweep Xtal Filter sweeper and the 0-100 MHz sweeper.

Was it worth it? The answer is definitively a BIG TIME YES! I would have never had the capabilities it provides without building everything including that 110 MHz sweeper that came later to sweep that filter in the SA ....As far as my PM and 0-100 MHz sweeper were concerned I'm sure Bob will attest that only the change in the 15 to 10 pf cap at the input of the PM and very very minor tweaking was necessary when he got his hands on my stuff.....I found them very reproducible with what Bob provided me with. If Todd decides to build any or all of these Boxes, I'm sure he will be very happy he did....I know he's got that DSO, so he'll use it for sure with Bob's stuff.....Happy Easter to all.....John

=====

10:37 AM 4/6/2012

Hi Bob,

Could you perhaps send the pdfs that have the schematics for these things? I have a bunch of stuff and I'm not sure which is the most up to date. Then I'll ship them off to Todd.

There is a difficulty here in that the instrument you have is extremely versatile. That makes it really useful and makes it closer to the state of the art. But at the same time, it makes it hard to duplicate. This is the same dilemma that I've fought. We have kicked this one around more than once, and I've had some discussions with some of my old Tektronix colleagues over the same issue. In any case, I don't want to overwhelm poor ole Todd.

Many thanks!

73, Wes

---

2:57 PM 4/6/2012

Hi Wes and John -

It's been some years but I think I've gathered the latest files for the stuff I described previously. I understand your not wanting to overwhelm your friend but if in fact all this is not so intimidating to him I'll be happy to support / assist. I do have photos and some text description that would be helpful or at least guideline should he want to go forward.

BTW - I don't think you described what he's interested in doing - perhaps some of this can be "reduced" for more specific applications - just let me know and I'll do my best. Aside from the Narrow Band (Xtal) Sweeper and 100 MHz RF sweeper, I've made many simple one-off or dedicated VFO circuits up thru VHF and UHF for limited uses and drove them with the USG - which is a really good utility box for this sort of thing.

Bob

Included were a pile of files.

=====

Hi Todd and all -

I can't speak to the effects of varied inductor choices since I (and K5IRK) primarily used small chokes from Mouser (Fastron, cat 434-22-R\_\_ series). The purpose of these inductors is to widen the bandwidth of each amplifier stage for an overall wider flatter amplifier response. Originally I chose the chokes while sweeping the 3 stages each (with another source) and choosing the values from that exercise. Actually the three values were then tweaked a bit when sweeping the overall three stage amplifier and that's why the values vary from stage to stage in this application. I am natured to make circuit functions "as good as I can" but realize of course that this HB sweeper has a leveling loop and so "perfection" in this regard is not a mandate.

The influence of the inductor in a single stage is illustrated in an attachment and it is clear the flatness is essentially fully corrected to about 160 MHz with the inductor I used in this particular assy. I can't say what it would be with an alternative component. I originally purchased a series

of inductor values from the Mouser catalog series so I had choices. This is where I generally resort to a "To Measure Is To Know" (TMITK) approach - hi!

BTW - the attachment is not necessarily from a stage from the HB sweeper but rather from a single stage assy. built for other uses - same generalized thing, however.

Best of Luck going forward -

---

Hi Todd plus Bob and John,

It should not make any difference at all what the inductor type is picked. After all, you have trashed the Q with the insertion of the 330 resistor. So about anything that is small and also handy will do the job. The inductor is, as Bob showed, just for high frequency peaking. You might get more gain peaking with more inductance. This is a wonderful experiment to do once you get the sweeper working. Perhaps you do?

I'm surprised at the poor S11 and S22 that you have at 100 MHz. I would have thought that they would have been better, even at 100. The 9.1 dB gain sounds just about correct. What power level are you using for your measurements? Bob, have you done any reflection measurements on your amplifier?

The 15M band seemed pretty hot this morning. The signals were not strong, but there were quite a few of them. I worked a couple of Russians plus 9K2/SP4R in Kuwait. The last one is a new one for me. Some other good ones I've snagged in the last few days include Cyprus, Gibraltar, and New Caledonia. None were new, but were still fun. So John, ya ought to get that antenna up and throw some RF at it!

Anyway, catch you guys later.

73, Wes

---

---

Hi All -

Attachment WBamp2RL2.JPG is the RL info I have on this amplifier version.

Other attachments show a Darlington variation having all-around improvement though I can't say there is any merit to retrofitting this (later) variant into the (earlier) HB sweep gen. circuitry. I deemed it not worth the trouble since the generator works great for my purposes. In any case all data is with the earlier "unimproved" RLB (i.e. no "L"). Maybe someday ... :-)

References to amplifier #9 is for circuitry just like #2. References to #11 are for the Darlington implementation. (I built a LOT of amplifiers!!!) Do take note of the variations in the "x" axis scales when making comparisons - they aren't all the same span.

Hey John - have you used your 100 MHz swp. gen. for any data on similar amps? If so which RLB did you use?

<<Bob, in reference to your question, the only sweeps I've basically done is the amps in the STG, STG Jr and of course the amp experiments we did together about a month ago....that's all right now.....John>>

RE: the inductor. OK - sounds FB. However, I was always uneasy about "allowing" any kind of inductor choice when asked - not feeling comfortable about e.g. possible self resonance effects on amplifier performance. (When I find something that works well I tend not to mess with it, or, "if it ain't broke, don't fix it.")

Bob

=====

Hi guys, (May 1, 2012)

Very interesting and generally what we might expect.

Bob, I don't think it makes much difference which bridge you might have used, for you had a reference for all cases. You were always well away from the reference, so your measurements were all pretty good. We are looking for measurements close to 50 Ohms here, so we are well away from the open or short circuit cases. Hence, it is the directivity that is important for these measurements. The very first case you had displayed, WBamp2RL2, had an S22 that was only a bit over 10 dB at 100 MHz. All the rest looked much better, if I read the curves right and remembered the data, hi.

Yea, you did build a lot of amplifiers. I just built RLB #25 today and I'm getting a bit rummy with the results.

Anyway, more later. No more DX today other than a group in Scotland.

73, Wes

=====

STUFF FROM JOHN – Late Oct, 2012

Todd, I'll try to help to get you started...Bob is a little under the weather.....

However I need to know what you are trying to do...sweep a LC filter, or what? Also are you using a SA or a Power Meter's output to drive the DSO? By knowing what equipment is in use in the line, and what you are trying to do, I think I can get you started.....Keep in mind that you can use either the DSO's internal Trig system OR the Trig output of the USG.....If you use the DSO's Internal trig....set it and the Sec/Div on the USG the same.....most of the the time I use .5

sec/div unless there is a bunch on noise on the trace, then I use a slower setting on the USG, etc to get rid of the noise on the trace.....

Let me know and I'll try to give you a hand...Bob, of course chime in for sure, John

Todd, if you can send me a picture...it would help as well as further details as to what equipment is in the line....settings, etc....I'm hitting the sack and will look at it first thing in the morning....I've been up since very very early this morning having to do some outside work in prep for the hurricane,,,,which didn't live up to the Weatherman's expectations, yet....John

On Thu, Oct 25, 2012 at 9:02 PM, Todd wrote:

Thanks John

Todd In addition, a couple of other things quickly....The DSO's channel settings are set for a 1X probe and DC. On your scope's trigger menu use Normal mode of horizontal operation, not Auto for triggering....also Rising slope, DC coupling, In addition we have on our OWON scopes a "set to 50%" and a "set to zero" button which is also pushed for the setup..... At times the Trig level control knob has to be adjusted....finally be sure that the DSO's Source trig setting matches the X channel that is in use (Channel 1 or 2).....Bob and I use an Channel 2 for the X setting and/or external triggering from the USG and Channel 1 is reserved for the Y input Therefore the the Trig source has to be set for Channel 2...Hope this will give you some additional things to check out also....Looking forward to the photo and additional info tomorrow....John

More.....

Hi Todd....I had a few minutes to do this sweep and get it off to you....it's not as clean as I would like it on the horizontal spacing...it's a little under 1kHz per horizontal grid and if I was going to do a careful measurement I would have made it so that it would be EXACTLY 1kHz/ horizontal grid.....This is a sweep of the 10 Rock crystal filter...I used it because all the settings were there when I put everything thing up....however.....it should give you a good guidance on how to do it with an LC filter also.....with the USG you use a 5 V Pk setting for the LC filter and a 16 V Pk setting for the crystal filter...other than than that everything is pretty much the same.....attached is the trace.....first I set up a reference line at 0 dBm so I can then see the IL of the filter....see the horizontal magenta line....next you see a purple trace of the trig from the X out of the USG fed into Ch2...normally it will be turned off...however **it is at 500 mv which is the exact setting on the USG also**...they should match. Finally the green trace is that of the filter.....which is really 2.8kHz at the 3 dB down point on the skirts if I had been careful at setting up the start/stop voltages of the USG and used the Freq counter to do the settings on the nose....

Now for the full settings.: First the DSO Trig settings from the OWON scope.....Type=Edge, Source=Ch2 (that's the X out from the USG), Slope=rising, Mode=Normal, Coupling=DC, Hold Off=100 ms, set to 50% button pushed, Set to Zero button pushed..

Ch 1 is the Y output from the PM....Ch2 is the X output from the USG, The USG was set for a S/S sweep setting which is what I and Bob use most of the time. The Ch1 is set for 100 mv (10

dB/Vert Grid) and Channel 2 is set to 500 mv same as the USG's setting. The USG's trig output not used as the X output is used instead.

The DSO's Channel 1 and 2's settings are as follows: DC Coupling, Probe=1X, Inverted=OFF, and both of the Channels are turned on.....normally when I do the traces, I will turn on Channel 2 to line up the trig trace properly and then turn it off....in addition the Sec/Div of the DSO is set for 50 ms to give the full screen trace from left to right. See the Purple trace for the Start and Stop lined up on the extreme left and right edges.

Finally for the Start/Stop frequencies I would set the Lo in manual mode, adjust the Lo starting voltage and read the Freq on the counter until I got what I wanted, then set the Hi stopping voltage in manual mode and adjust the voltage there for the stop frequency that I wanted....Once that is down, then I'll set them back to auto so the sweep will work...There may be some interaction between the Lo and Hi settings and you will have to diddle with both to get them back and forth some to get them just right..

Bob told me early on the stuff is like an erector set, just setting everything up to do what you want to do....once you get the hang of it,,,then things are much easier to set up and measure.....BTW...Bob is going to be basically QRT for a while from an email I got from him this morning until he is feeling better, so I will do the best I can to help you.....

I'm curious on what you are doing with the PM you say you have under construction...Features, etc :-)

Hope all of this makes sense...let me hear from you when it's convenient and if there are questions, please ask.....John

--→ file called usg-operation rtf

Hi Todd, and Bob and Wes.....Todd attached is a write-up Bob sent to me when I first got my USG going....If you don't have it, I think it would be helpful...

If I recall correctly you may (?) have the Lo and Hi settings reversed so that the trace will be reversed also...that may be what happened with your trace being reversed compared to the GPLA.....I would have to get my toys out and experiment to see if I'm correct....see the attachment.....in addition, on Bob's PM wait until Bob gets in touch with you.....If you decide to build it, I would strongly ask you to consider building it with the Panel meter and the DVM. I have found them very helpful and use those two features often in my measurements, particularly the DVM for dBm readings..I believe that Bob designed his PM for a 10 mV output for compatibility with his DSO, etc, But he would have to confirm that.

Finally I'll dig around in some more of Bob's old helpful emails to see if I can find additional info that may be of help to you.....It takes some patience to learn how to get the USG setup right while learning how to use it, but when you do, you'll be good to go....Guess you could just call it



a learning curve.....BTW, on the USG voltage setting, Bob had me use the 5 volt Pk setting for the 0-100 MHz sweeper, and the 16 volt Pk setting for the xtal filter sweeper.....

Hey Bob....the news down hear is telling us that Sandy my visit you and NY before it's over with.....have to wait and see.....today will be the worst day with some wind and rain, then it will clear out and the weather will improve noticeably tomorrow afternoon.....Todd more to come.... Hope everyone has a good day.....John

---

Injecting a cal signal

Hi again Todd....well I guess my old brain is on tilt with math late at night....the formula is wrong in my reply email to you for conversion from Pk Pk voltage to dBm as you will quickly see....realized it after I had gone to bed....should have been Pk Pk volts squared times 2.5, then take the log of that answer times 10 = dBm.....No wonder I didn't do good on math tests the next day in school when I studied all night,,,Hi.....Hope you have a good day.....sorry John

Hi Todd, Great on your traces....your getting there FB.....

Let me explain further what I did when I cal'd mine.....I think this might be what you are looking for.....in reference to the reference signal

I have a xtal Osc at 10 MHz that gives a very clean output of 0 dBm.....I have a 5 element low pass filter at it's output.....I had previously used the SA to verify how far down the 2nd and 3rd, etc harmonics were from the fundamental so I knew it was a clean signal. With the use of the DSO and a 50 ohm termination at it's input, I noted the Pk Pk voltage of the Osc's output, then I did the math to turn that into the dBm output of that Osc.....recall the formula 2.5 times Pk Pk times Log times 10 = dBm....That's how I came up with it's power output.

I then used that Osc with it's known output to cal the meter to read 0 dBm.....then to see how the meter responded to different power levels, I used my 0-50 dB attenuator with 5, 10, 15 20 steps. (All the steps are within 1% accuracy).....I inserted it in the line between the Osc and the input to the PM. Once again it read 0 dBm with the straight through no attenuation ...then I progressively switched in the 5, 10, 15, and 20 dB attenuation and it tracked beautifully on the PM's voltmeter with the correct dBm reading....so I knew I was good to go and the meter circuitry was working FB.....Is that what you were referring to with your question for clarification? If not, please help this old buzzard understand.....

BTW you could measure the dBm output of your 0-100 MHz sweeper at one manually chosen frequency (no USG sweeping it) at say 10 MHz or whatever your choice may be while it was driving the input of your DSO terminated with that 50 ohm terminator then doing the math to change the Pk Pk reading into dBm and then use it as a reference signal to cal the PM.....OR a different Osc you have on hand that you know it's output in dBm.....You could use Bob's -10 dBm Osc for the initial calibration, but then would have to switch to a different Osc to do the remaining check(s). Recall the 8307 doesn't like square waves below about -20 dBm....I would

just make sure the signal is clean from the other Oscillators I used during the calibration process if you use Bob's little Osc to do the initial cal.

I think you made a 1% 10 dB attenuator when you built your previous PM and cal'd it.....therefore you have a second measurement you can make an additional 10 dB down from a known Osc's output (excluding Bob's) and that would tell you that your PM is working....the other attenuation measurements you chose to do further down would give you a nice warm feeling on how the PM performs.....Hope this helps ....If I'm still not clear...let me know and I'll give it another go.....Best of luck....John

On Thu, Nov 1, 2012 at 12:03 AM, Todd > wrote:

Hi John:

**Thanks** for your great comments. Of course, you're correct – I need to add the DVM measurement options!!

Aside, this tweaked power meter with the DC offset sure works great.

Take a look:

W2 is the 7 MHz filter now

W3 = the top ~6 dB from the tip of the sweep – awesome resolution.

I won't need the filters, although they look intriguing. My 'scope has a pile of FB digital filters that work just super: band-pass, low-pass, high-pass, you name it.

---

EPT 2/2013----

Hi Jay and Todd with John on the side ... Jay, taking your comment/query in order:

The 4P3T switch in the schematic is shown in the "Stop Start" (SS) position. I followed your parts/connections numbering and all seems well.

The "fairly high frequency distorted square wave ..." is ALL WRONG! :-( Of course I don't have a "hands on" so you will have to do some tracing. So - is this instability present with both output ramp voltage ranges or just one? If it's both, then look at IC3a pin 1 and IC3b pin 7 for any evidence of instability, When in "SS" these points should have some ramp waveform / some DC values depending on the settings of the STOP and START controls - but NO indication of instability.

BTW - SOMETIMES the 324 op amps will display instability when loaded with "enough" capacitive load - like with longer lengths of cable. That's what the 100 ohm resistors are for on the op amp outputs - to help suppress this tendency. BUT different vendor's parts behave differently in this regard.

Anyway the test is easy - if you have cable in place to your scope change it out for a 10X scope probe temporarily and see what happens - let me know either way.

It appears you have got just about everything FB but for this nuisance instability but this should be quite "fixable". (While on the subject of "IC4", note a labeling error on the un-used IC4c on the schematic - pins 8 and 10 are labeled interchanged.) Good catch on the "Install IC2 and IC3 typo.". You are correct - it should read 3 and 4. (Hey John - how did we miss this one???)

Yea - the 10T pots are as you call 'em.

With the "hi V - AVG - lo V" switch in the center position (AVG) you will get X axis ramp output of +- 1V swing (when cal'ed). In the extreme positions you should get either +1V or -1V DC out of the X-axis output port (when cal'ed).

OK RE: using the enhanced version of the PM. I have two in use. These are great as detectors as well and I use 'em to "read" filter and other circuit output sweeps. I port the PM SIG OUT to a scope verticle input. It's easy to change display resolution by simply changing the scope vertical attenuator - I routinely use the 100 mV/grid setting for 10 dB/grid but I can switch down to 10, 20, or 50 mV/grid and tweak the OFFSET to place the trace as desired. This way I can easily see the top of a filter at e.g. 1 dB/grid no matter how deep the skirts go!

OK - I think I covered everything but if I missed anything or if you have additional needs please just feel free to inquire!

Cordially, Bob, K3NHI

-----

Jay wrote On 9/2/2013 8:50 AM, Bob Kopski wrote: Gentlemen - Thanks for copying me - the attached is quite a barrage of back-and-forth and it does bring back some memories! Jay - Thank You for your interest in the USG. I'm confident you will find it a "new best friend"10:23 AM

Jay Cox Bob Kopski and Todd

Monday, September 02, 2013 10:23 AM

On 9/2/2013 8:50 AM, Bob Kopski wrote:

> Gentlemen - Thanks for copying me - the attached is quite a barrage of back-and-forth and it does bring back some memories!

Jay - Thank You for your interest in the USG. I'm confident you will find it a "new best friend" if you are inclined to mess with filters, > amplifiers, and such, and also have associated RF generators in the bands of interest.

To the best of my knowledge the schematics I sent Todd and others are without error - strongly evidenced by the fact that John, K5IRK and Todd successfully duplicated the circuitry as in the schematic. Of course I'm not able to pin down what might be the question with the 4P3T rotary without some "hands on" but I do know it does work as drawn - so don't give up! There is no question this box is pretty dense with stuff and inter-wiring so some assembly error or oversight is really easy to creep in (I KNOW THIS!) but in the end all should be well - schematically. I do hope your custom boards are FB otherwise I can appreciate the agony that might follow!

Please feel free to query me going forward and I'll do my best to help with any questions. And please do let me know how this all works out. Cordially, Bob, K3NHI

Hi Bob,

Many thanks for your quick reply. I didn't mean to imply that your schematic was wrong, rather to ask Todd if he had had any difficulty with the 4p3t switch. I would appreciate knowing if the switch, as drawn on page 2 of the (early, I think, with few part numbers) schematic on Todd's website is in the Start Stop position...then I can work from there.

I have numbered the contacts on the schematic from top to bottom 1-12, the poles 13-16 and the 2 sliders on the 10k 10t pots 17 and 18. On the switch, I hooked up 1 and 12, 3 and 9, 4,5,10 and 11. then, pins 1 and 12 go to IC3-8, which has a good waveform. Contacts 3 and 9 go to the 4V line. Contacts 4,5,10 and 11 go to the 6V line. Contact 6 goes to IC3-14, which also has a good, although opposite waveform. Contacts 7 and 8 go to the 2V line, so as far as I can tell only 5 wires go to the pcb. Poles 13 and 14 go to top and bottom of one 10k10t pot and poles 15 and 16 go to the other. Sliders 17 and 18 go to IC3-3 and 5.

I am getting a fairly high frequency distorted square wave at the sweep out. In the first part of the USG setup, everything is fine, and X-axis output is fine, though not yet calibrated. All voltage lines are correct. Knowing that the switch IS drawn correctly is a big help and knowing that the switch is/is not in the start/stop position would also help. In the setup instructions I have downloaded from Todd's site, marked Draft 1, in the X-axis output signal-preliminary it says "Install IC2 and IC3". This should read "Install IC3 and IC4"...IC2 is already installed and there will be no X-axis output without IC4d.

I presume the set LO-V and set HI-V controls are the 10 turn pots. The set HI-V--AVG---set LO-V 3 position switch ONLY works on the AVG position...the other positions kill the X-axis waveform...is this correct behavior at this preliminary stage of setup or do I have a problem. Once again, Bob, thanks. this looks like a terrific piece of gear. BTW I have been using your augmented version of Wes' Power Meter for several years now. ATB Jay

-----

Hi Jay ---thanks for your email.

Greetings Bob -- hope all is well --- please read Jay's question(s) below. The switch proved a little difficult to understand, however, wired as shown -- it works fine, Bob is the king of applying DC voltages to op-amp circuits and getting everything to line up correctly. I've copied author Bob on this one -- Bob's the expert on his gear. I've attached some random build notes from my folder -- they may or may not help

you; so delete at will Jay. I employed Ugly Construction with a few Manhattan pads ----- so mine looks like a mess -- despite all the wire , it calibrated and works FB. Best to you

Todd

-----