

Dealing with Router Hash – From a Ham's Perspective

by

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As a licensed Amateur Radio Operator (ham), I have been involved with many facets of this hobby for the 30+ years that I have been licensed. Currently, I am playing around with Phase Shift Key (PSK) modulation and weak signals. Much of this endeavor over the past few years has been with the [PropNET™ Project](#).

In the spare bedroom (ham/computer shack), my wife and I have 3 wired computers, a wired/wireless all-in-one printer plus a wired/wireless laptop at our disposal and all have to be able to access the internet for various reasons. In order to share the one incoming internet connection from the Internet Service Provider (ISP), we need to install some type of router that will perform the necessary Network Address Translation (NAT) and provide a basic firewall to protect the computers.

The original Linksys, basic router, that I had for a number of years bit the bullet a while back. It was about that same time that my Daughter and her husband got into the Apple thing and wanted WiFi Access when visiting. (Note to self: MOVE!!!). The first wireless router I had was a Linksys, and it functioned quite well and was free of any type of Radio Frequency Interference (RFI) across the HF frequencies I use. But, its administration ability was useless for anything other than the basic routing. I have a Linux Box that is running a couple of servers and I needed to be able to do some port forwarding to make all of this happen and this particular unit was unsuitable for that.

So I donated that hunk of junk to a garage sale and purchased a D-Link DIR 615. This was a much better router in that I had much more control over the administration than I had with the Linksys. It fit the bill, BUT, when it came to RFI, this thing was noisier than the Gas Turbine Compressor and Auxiliary Power Unit (GTC/APU) on a C-130 Transport Aircraft!!!! (I spent 25 years up close and personal to these puppies and can still hear the damn things in my sleep!!!)

It was a few months after I installed the D-Link that I started searching for the tremendous noise that I had encountered on the 10 Meter Band around 28.118 MHz. See Figure 1

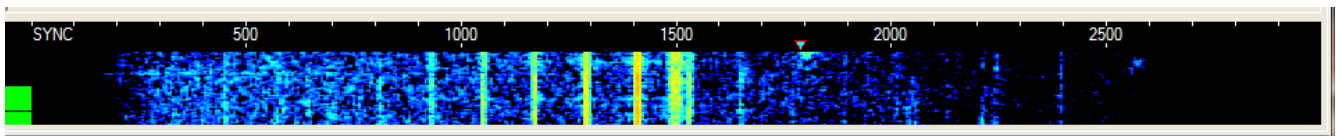


Figure 1

You will see 7 vertical bars between 950 Hz and 1600 Hz. At the top of those bars, you will notice some additional horizontal deflection from the vertical bar. That is data – probably my wife's computer downloading something from the Pogo Game site. The arrow at 1800 Hz is the beginning of a pretty strong PSK31 signal.

Needless to say, this router hash completely destroys the idea behind weak signal work. At first, I did not even consider the router as being the problem as the device says right on the placard that it complies with FCC part 15. I have seen this type of noise in the past and thought it might be a neighbor's touch lamp or a really dirty switching power supply.

So, I fired up my FT-857D, which is mounted in my truck and took a listen to the same frequency and sure enough it was quite audible sitting in the driveway. I then moved the truck in 100 foot increments, along the street from the driveway until I was able to get the noise to show some signs of decreasing in amplitude. So much luck. (I later deduced, after hooking up the laptop to the radio in the truck, that I was seeing various different noises and as one would decrease in amplitude, another would take its place. I can see 18 routers from my house as I write this!!!).

I resigned myself to the fact that this would be a long drawn out process trying to locate the source of the noise,

with the meager tools I had at my disposal.

About three months ago, I noticed that I had no noise in the waterfall and the PSK display was clean. This was quite perplexing as now I had no source to troubleshoot, but it sure was nice to start seeing more of the weak signals that I was accustomed to. But, the bubble was burst when my wife complained that she was unable to access her email account and the internet. After some basic troubleshooting, I discovered the router was not powered because her desk chair had accidentally pulled the power cord from the wall socket next to her desk. Plugged the cord back in and the immediate wife crisis is averted. But, the waterfall is again overloaded with the same noise in Figure 1.

Pulled the power from the router again, and the noise disappeared until I re-powered the router. I pulled the WAN cable from the ISP and it is still there. I even went as far as removing the wall-wart switching power cube and powered it from a linear supply, but no luck.

Unfortunately, by this time the device is out of warranty so I purchased a new router, a Netgear WNR2000v3 that was on sale. This device had a much better web administration interface and the throughput was much faster than the D-Link. But, this device was also problematic, although not as strong as the D-Link. Nonetheless, it was also unusable for weak signal PSK work. I took a swing through the amateur bands and found this device was all over the place between 3.5 MHz and 54 MHz. I also discovered that signals were stronger on the wire 7MHz Windom antenna that is almost 80 feet from the shack as opposed to the multi-band vertical I have that is only 25 feet from the shack!!!

Since this device is still under warranty, I contacted Netgear customer service and explained the problem and their obvious disregard for FCC Part 15. After 2 weeks of the Customer Service goat rope, I finally had to threaten that I would file a FCC Equipment Marketing Violation complaint and that got some action on their part. I will be sending this unit back for a warranty exchange on Monday, although I do not believe this is going to solve anything.

I still have the D-Link, but it is just as noisy as the Netgear. Purchasing another router is not the answer as I am sure that most of these routers being sold today are just as noisy, if not worse.

Since I have a Linux box here and most routers have a subset of Linux running them, I figure I should be able to use that computer as a router. Google is your friend, and I found a number of pages dealing with how to design a Linux Router. As this is for just home use, I did not feel that I needed a dedicated box to solve this problem. I have a number of dead computers in the garage so I was able to appropriate a 10/100 Ethernet card to add to the Linux box as that is what you need for a basic wired router. Here are some links you can use to show you how to setup a router and use a program called webmin to administer the whole ball of wax:

<http://ubuntulinuxhowto.blogspot.com/2006/06/setup-your-computer-to-be-router.html>

<https://help.ubuntu.com/community/Router>

<http://ubuntuforums.org/showthread.php?t=926001>

It took me a couple of hours of research, reading and configuration to get my Linux Box running as a router. I already had a 10/100 16-port Smart Switch so I did not have to invest in that additional piece of hardware. You will need to get a switch/hub that will support all the computers that will be on your home network. Additionally, if you want wireless support, you will need to have a wireless card that has native support in Linux. Those cards that are supported by the ndiswrapper and using the Microsoft Windows binary drivers, will not work for this specific application. I do not have a wireless card that is supported by Linux at the present time, so I do not have any wireless. (I guess the kids are SOL next time they come over !!!)

Figure 2 is a screen shot of the waterfall taken on 11 March 2012, 2252UTC with the Linux Box acting as the router.

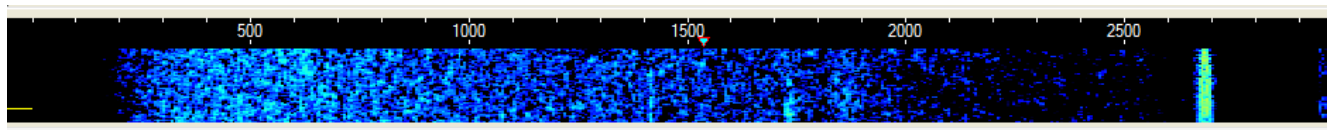


Figure 2

As you can see, the waterfall is quite clean of any interference and router hash, along with the lone PSK signal around 2700 Hz. I suspect the solar activity and the flares we've had this week would explain the absence of a lot of signals at 28.1189 at almost 3pm local time in Tucson, AZ. BUT – no more router hash!!!!

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11 March 2012

Update 27 March 2012

Netgear requested that I send the defective router back under an RMA for exchange. While I was awaiting the replacement unit to arrive, I decided to utilize the brand new Tektronix DPO3402 digital scope we have at work and take a look at the power cube that came with the unit.

According to the placard on the cube, it is rated at 12 VDC @ 1 amp. From the mere small size of this unit, I was a bit skeptical and figured this was a really cheap piece of junk switching power supply. But once I powered it up and started measuring the output I was further convinced that this was a real piece of junk. Unloaded it had an output of 15 volts, telling me this is far from being a regulated device. With no load on the device whatsoever, there was a lot of random noise on the output that I was unable to explain, other than a poor design of the device. Figure 3 is the no load output.

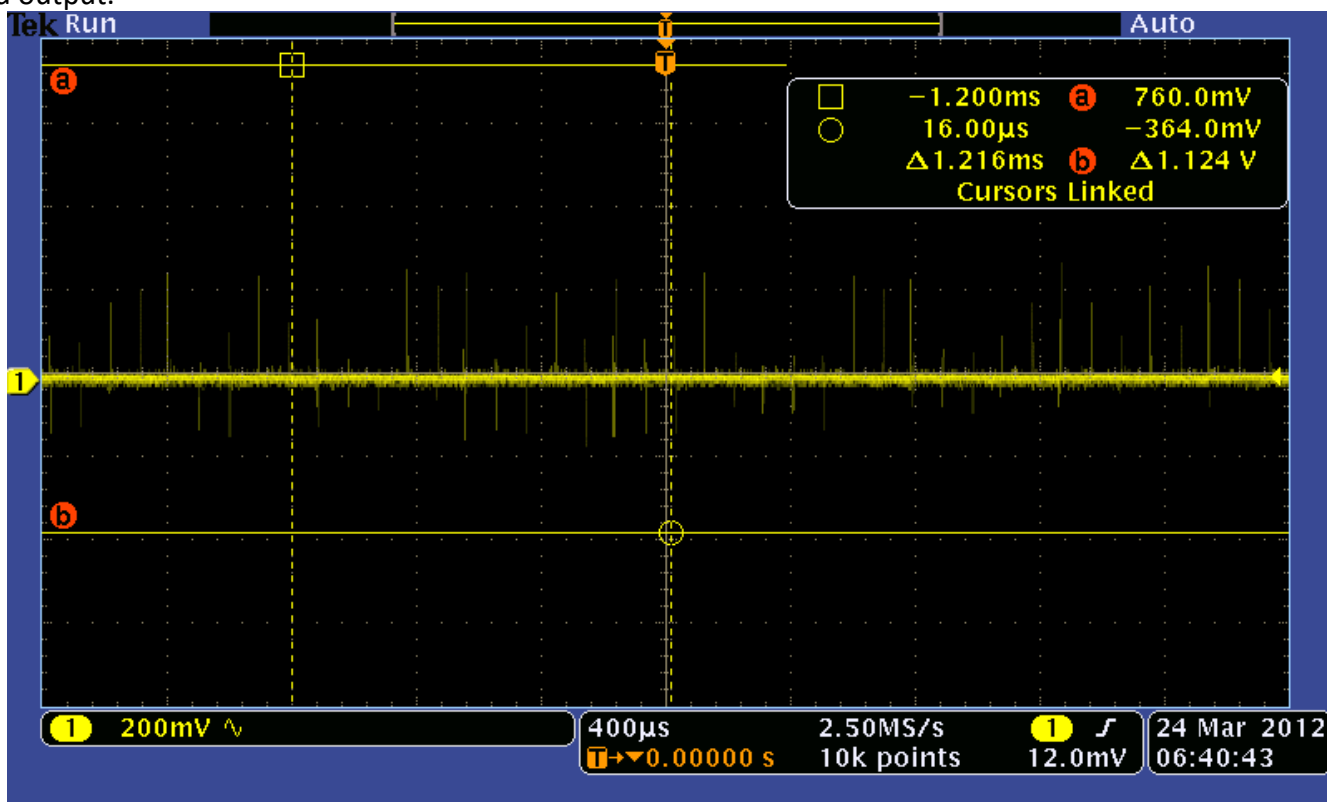
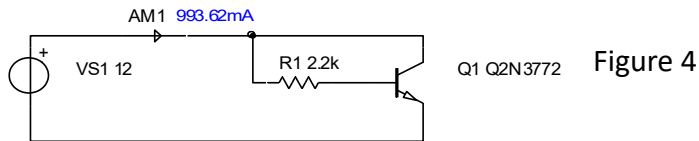


Figure 3.

At first I thought all of these random spikes might have been the florescent tubes in the office or possibly something from the FM broadcast radio also close by. But turning all of that off did not seem to change anything. (Note: after a couple of hours playing with the scope, I finally figure out how to increase the brightness of the back scale – it is a bit hard to see in these pictures.)

The first test was to see if I could load the device up to about 1 Amp and see where we are on regulation and ripple. I spent about 30 minutes rummaging through all of the stuff we have and I was unable to locate resistors that could provide 12 ohms at about 12 watts. So I resorted to my transistor theory from years ago. I had an abundant supply of 2N3772 power transistor that will dissipate 150 watts and carry a collector current of 10 amps. By adding the proper base resistor, I should be able to get this setup to draw close to 1 amp. And with a 2.2K resistor in the base I should be able to do just that. Figure 4 is the diagram and the predicted current via a Spice simulation.



Hooking this circuit up to the power cube yielded 0.991 amps on the DVM, with a loaded voltage of 11.7 volts. Not too shabby for something that is rated at 12 volts and 1 amp. Now, what does the scope have to offer in the ripple and noise department?

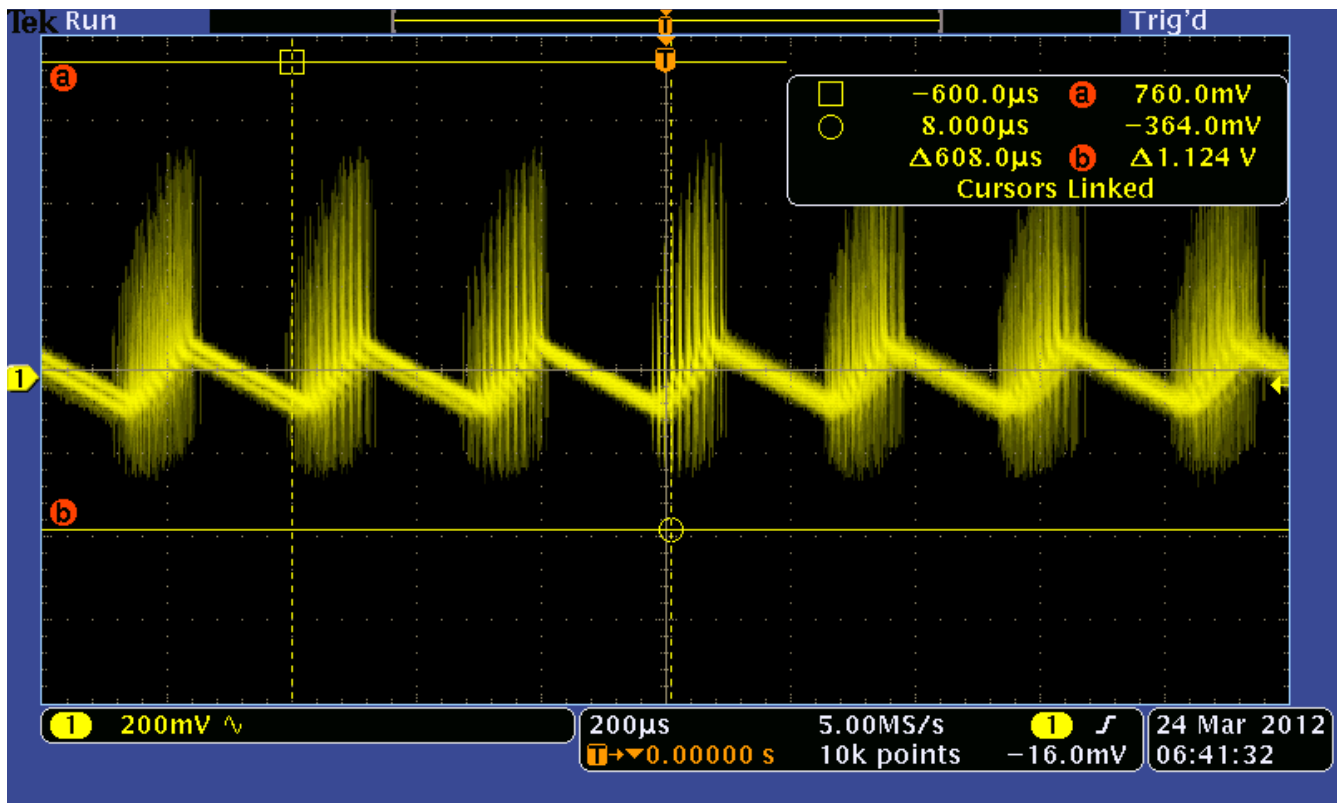


Figure 5.

That is a terrible looking ripple output!!!. This infact does tell me it's a really cheap switching power supply. The ripple frequency is about 3.3 KHz ($f = 1/t$ or $1/300\mu s$). The time difference between the vertical cursors is 600 μs for two full waveforms. The output filter capacitor is way to small for the 1 amp load, but what is more interesting is the high frequency noise you see on the up-rise of the sawtooth wave.

In a nutshell, it's a crappy power supply. To be more realistic, the router itself only draws about 150 mA so this was a worst case test for the power supply. But, this is a very good reason to be extremely careful when selecting a switching power supply, especially if you are going to run the thing close to it's maximum load potential.

The next series of scope shots are with the router connected and going through it's normal power on sequence, running the boot-up software, turning on the WiFi radio and attempting to get an IP address through its DHCP request. Since I did not have a WAN to connect to the router, I left that port disconnected and let the router keep trying to get an outside connection.

Figure 6 below shows the ripple right after power on. With the 150 mA load, the output voltage of the supply is a bit higher at 12.6 volts.

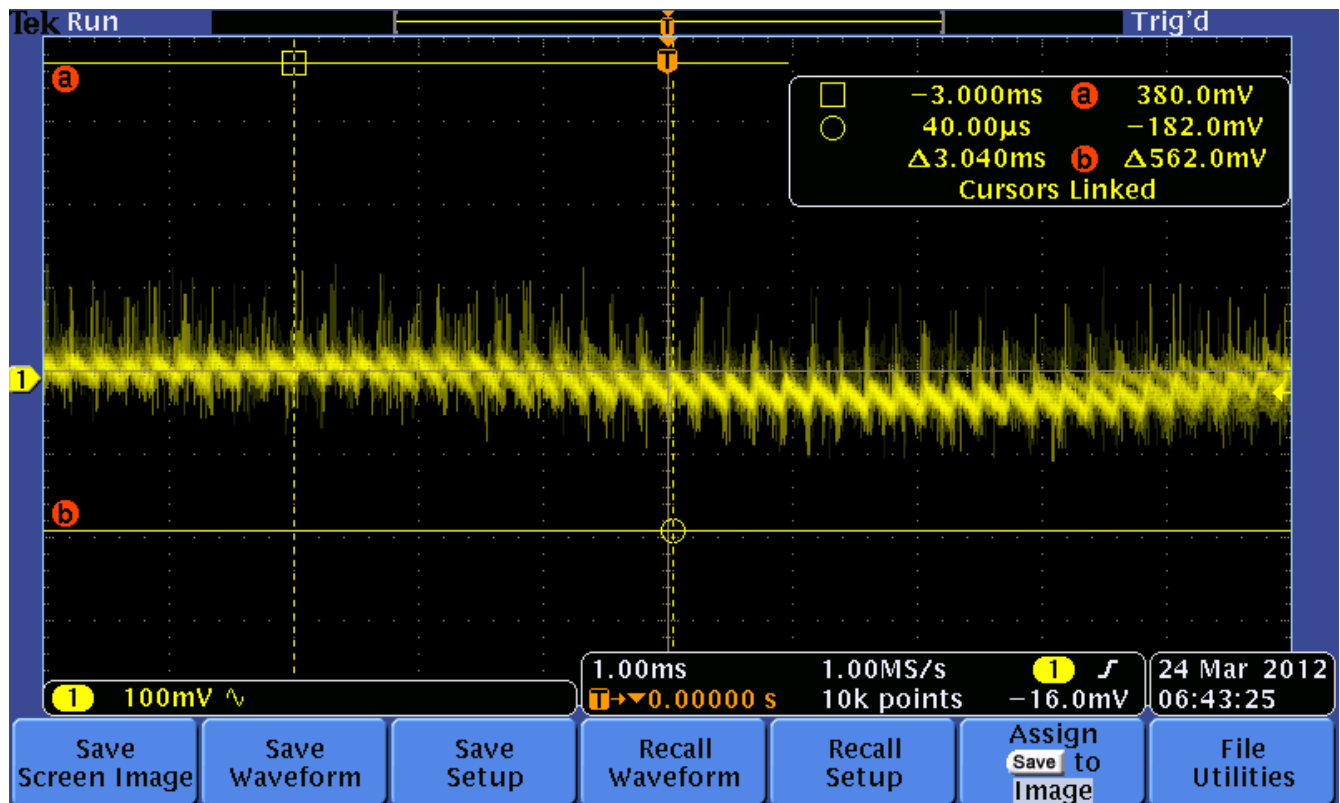


Figure 6

I change the time base on this to 1 ms to get a better look at what is happening during the boot up process. Not too bad until you zero in on the right side of the scope. I'm not sure exactly what started to take place at this point in time, but I think this was about the time the WiFi radio started to come alive. (And yes, that is 6:43 AM on a Saturday Morning!!!)

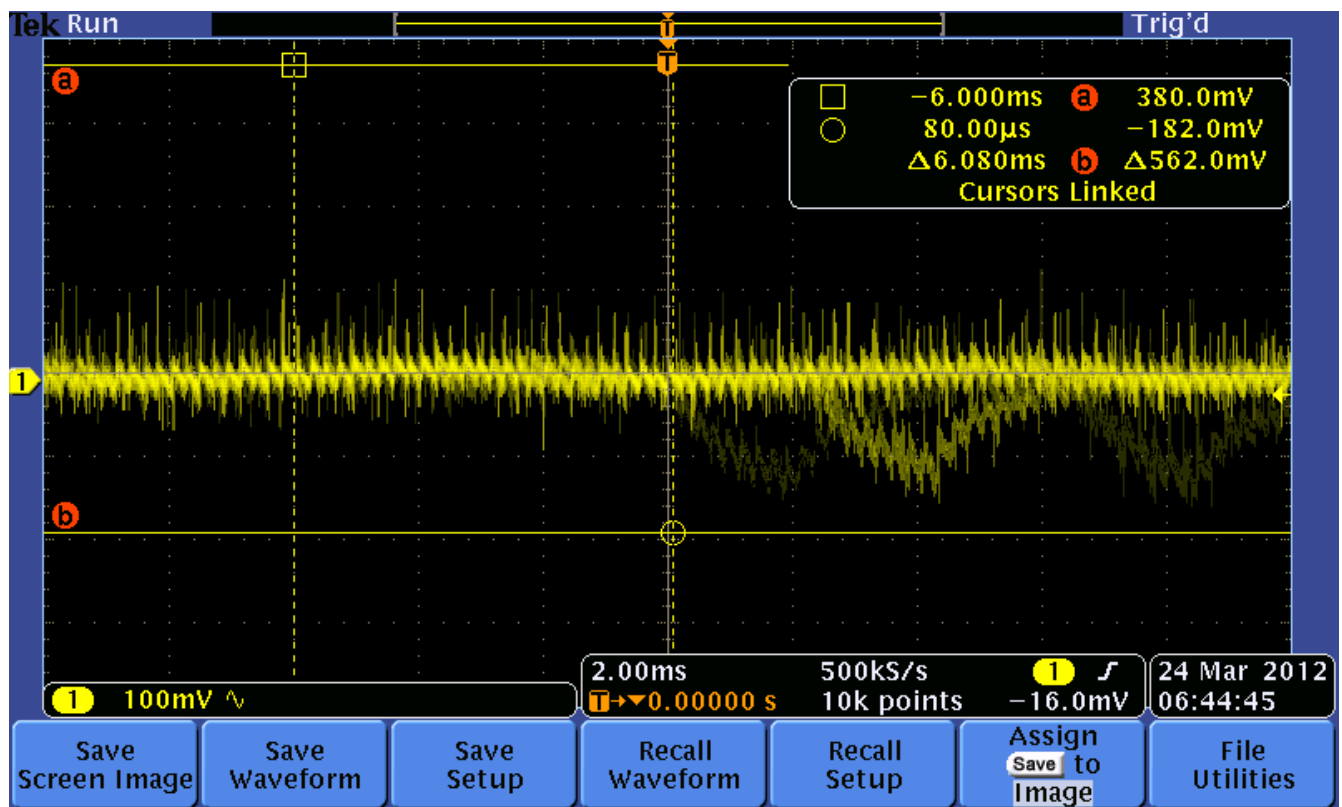


Figure 7

This is a really interesting capture. The negative going noise pulse superimposed was intermittent and would appear at different positions along the wave form. We didn't buy the MPEG option, otherwise I'd have recorded a minute or two of this.

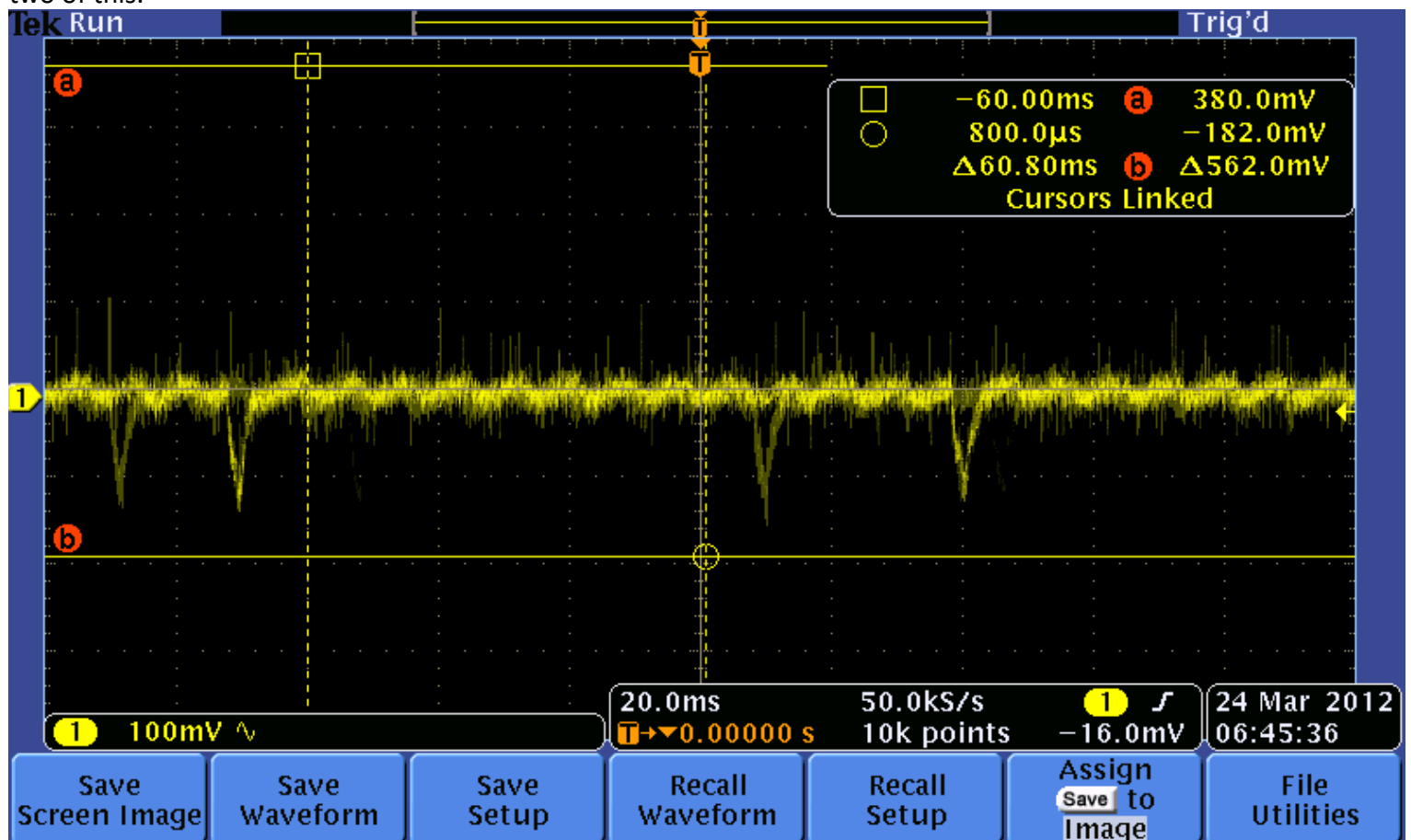


Figure 8

Figure 8 is after the complete boot-up and the Wifi is completely active. Those negative going pulses I believe are each time the router tries to connect with the WAN, even though it can't find one.

The replacement router arrived earlier in the week, and I finally got a chance to put it in line this past Sunday. There was no change from what I had displayed in part 1 of this rant. Not surprisingly though, this router was WORSE than the one I sent back. Reference Figure 1 above, double the amount of vertical traces and triple the amplitude.

The ball is now in Netgears court so we'll see what happens.