

RF Sniffer

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FSM (Field Strength Meter) is the device that should be present on any amateur radio station. As for me, I have been using MFJ- 801 FSM for a long time. I use this device on all HF bands as well successfully tried it on the 145 and 430- MHz band. I used to the MFJ- 801 in the field under rain and snow and, of course, at home without problem from this one. However I've decided add to my radio station a simple RF Sniffer that may sniff the radio waves up to 3000 MHz i.e. that device should react on to cell phones and internet routers.

Experimental RF Sniffer

In the past times I made lots of different FSM so it was no problem to draw a schematic for my experimental Sniffer. The RF Sniffer was intended to sniff 2.4- GHz Band.

Figure 1 shows the schematic. It is a usual radio detector. L1 is a loop of wire with perimeter in 12- cm length. Diameter of the wire is 1 mm. Actually L1 is a resonant antenna that could catch waves around of 12- cm band or near frequencies 2.4- GHz. I took the length because WiFi routers, microwave ovens, wireless devices like mouse and keyboard work in the 2.4 GHz band. The loop is not optimal for Canadian cell phones that are working in 850/1900 MHz band but due high power radiated by the cell phones the RF Sniffer (I believe) should sniff the devices. D1 is a UHF diode, R1, D2 and D3 protect M1 from overload by power RF signal.

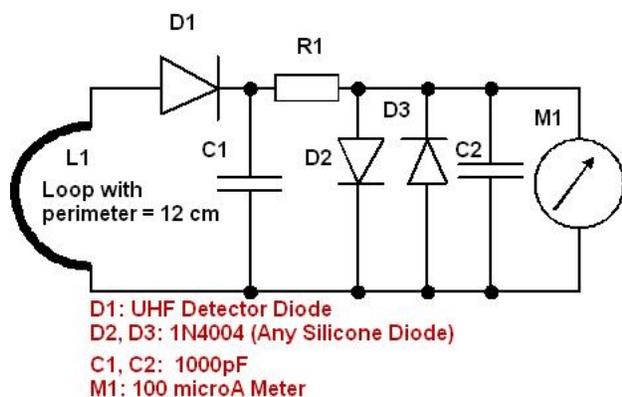


Figure 1 RF Sniffer

At first deal I decided make the RF Sniffer on a breadboard and try different version of the schematic. Some time ago I have bought at ham flea market real 1N21 (microwave mixer S- X Band diode) and 1N35 (matched pair of 1N34), both of the parts made by SYLVANIA in USA, so I impatiently would like to try those old legendary diodes.



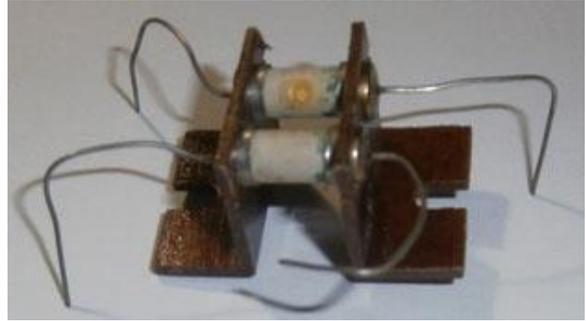
MFJ - 801 and Curious Cat

However, real test of 1N35 was disappointed for me. The diode worked fine up to 430 MHz but higher the sensitivity drop to zero. 1N21 was fine diode for my RF Sniffer. It worked fine on 2.4 GHz. The diode could catch radiation from cell phones, routers and wireless mouse. But... at one of my experiment with a cell phone the diode was burned out. I had just one such diode and next ham flea market where I could buy such stuff was months away... on E- Bay such diode costs pretty money... So, I decided give up old stuff and use to modern UHF diodes in the RF Sniffer.



1N21. Made in USA, SYLVANIA

Again E- Bay was the source of the diodes. I found there 50 each excellent UHF TOSHIBA 1SS315 type diodes for 5 USD shipping included. It was small SMT parts but in recent times almost every electronic part comes in SMT package. **Table 1** shows main parameters for the diode. Forward voltage for the diode is only 0.25 V (Forward voltage for Silicone diode is 0.7 V, for germanium is 0.3 V), so the diode could catch low level RF voltages that would be present on the antenna- inductor L1. Total capacitance for the diode is 0.6 pF, so the diode may work in my FSM on frequencies up to 3-GHz.



1N35. Made in USA, SYLVANIA

Table 1 Electrical Characteristics of 1SS315

Electrical Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Forward voltage	V_F	$I_F = 2 \text{ mA}$	—	0.25	—	V
Forward current	I_F	$V_F = 0.5 \text{ V}$	30	—	—	mA
Reverse current:	I_R	$V_R = 0.5 \text{ V}$	—	—	25	μA
Total capacitance	C_T	$V_R = 0.2 \text{ V}, f = 1 \text{ MHz}$	—	0.6	—	pF

1SS315 diode showed very good result during my experiments. After that I made finished design of the device. But... the finished design means a breadboard PCB attached to the internal contact screw of the 100-micro- ampere meter. Newer any cabinet there was around. Such design allows me do different experiments with the RF Sniffer. I changed length of L1 (length of wire of the L1 should be equal to wavelength of the signal to be catch) for different frequencies, I may remove board with loop antenna from the meter and place antenna in some hard accessed places to catch RF. I install RF choke with whip antenna instead of L1 to turn the device to sniff HF (1.8- 50.0- MHz) and VHF- UHF (145 and 430- MHz). **Figure 2** shows modified RF Sniffer.

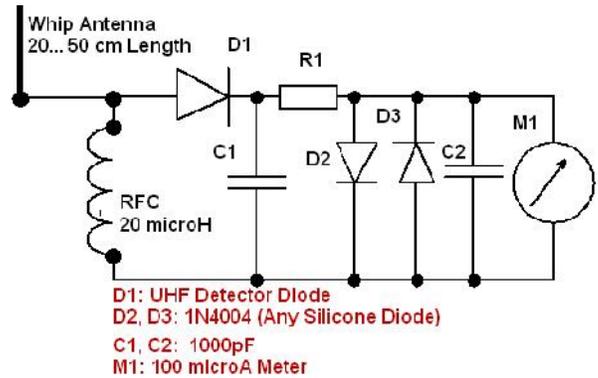
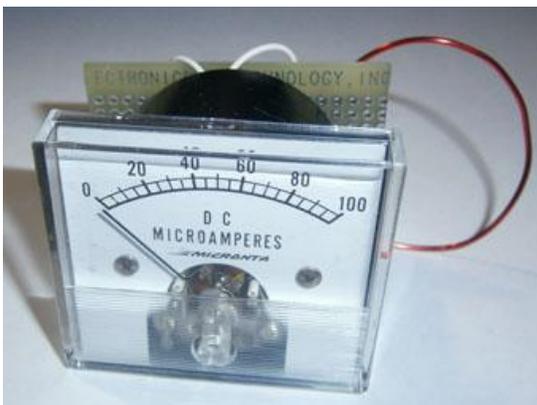
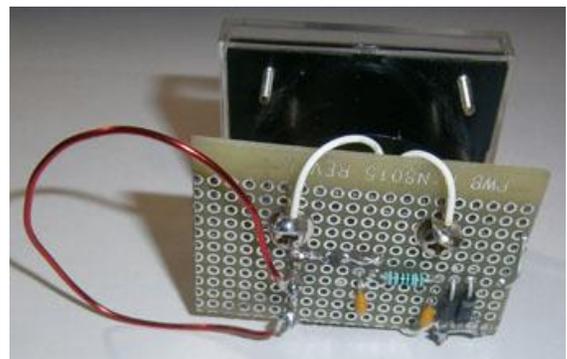


Figure 2 Modified RF Sniffer



RF Sniffer: Front View

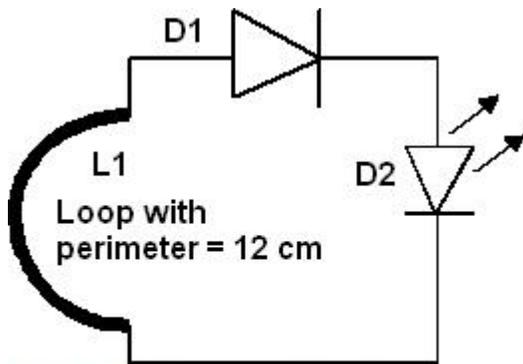


RF Sniffer: Rear View

FSM with 1SS315 diode could successfully catch cell phone – needle of the meter flapping at the edge of the meter, router and notebook WiFi - almost 100 percent of the scale, mouse and keyboard docking station- near 20 percent of the scale, microwave oven- near 20 percent of the scale. It was just interesting to meter and compare. The RF Sniffer allows find where is installed an antenna in those devices. When I have played enough with the RF catcher I decided make a small brother of the RF Sniffer- simple Sniffer with LED instead of the meter.

Simple RF Sniffer

Figure 3 shows simple RF Sniffer with LED as the RF indicator. It is a very simple circuit. It consists of inductor (or RF receiver- antenna), RF diode and LED. The LED is very important part for the simple RF Sniffer. This LED should have as low as possible forward voltage and current for lighting. Before going to E- Bay to find a suitable one I went to garage to check old toy box belonged to my son. The modern toys are contained lots electronics parts so I time to time use the old toys to harvest some parts needed to me. Again I was lucky because I found several low voltage (1.7-V forward) low current (2.5- mA) LEDs. Simple calculation shows that at 2 V RF on the inductor the LED should be glow (0.25- V on detector diode plus 1.7-V on LED).



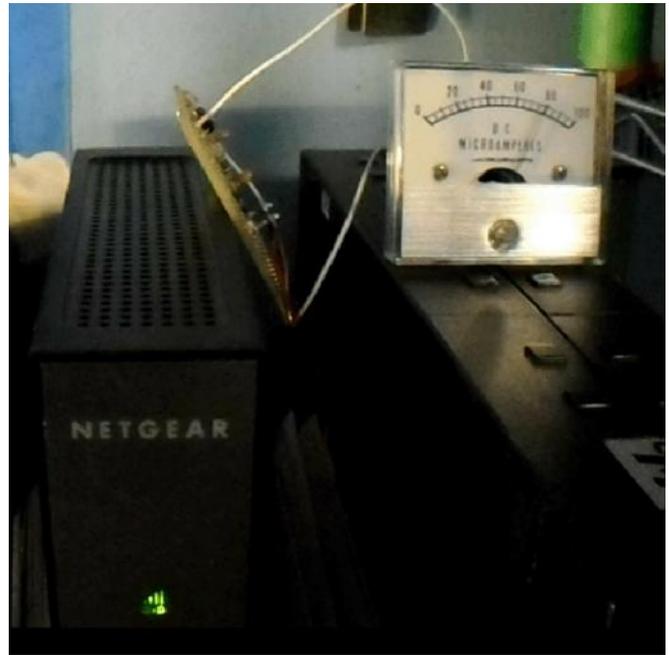
D1: UHF Detector Diode

D2: Low Power LED

Figure 3 Simple RF Sniffer with LED as RF Indicator

The first version of the LED RF Sniffer was made to catch RF from cell phone. L1 is a loop of wire in 12- cm length. Diameter of the wire is 1 mm. When the Sniffer was placed at antenna location on the cell phone the LED glows up very bright according to transmitting. However, I could not found any useful application for the device...

So I decided to do LED RF Sniffer for something useful. For me it was usual HF FSM and RF current meter.



Breadboard of the RF Sniffer near Antenna of WiFi Router



Breadboard of the RF Sniffer near Antenna of Cell phone



LED RF Sniffer

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For this case I made the second version of the LED RF Sniffer that was differed from the first one only by L1. L1 was air wounded, had 9 turns of 1- mm wire (18- AWG), length of winding was 40- mm and OD of the L1 was 28- mm. Small whiskers in 28- mm length were connected to the ends of the inductor. **Figure 4** shows the schematic of the modified RF Sniffer.

Now it was universal RF Sniffer. It may catch RF from cell phone when the whiskers were near the antenna. To catch usual HF RF the whiskers should have length 1 meter and more- it depends on power of the transmitter and location of the transmitting antenna outside the shack and location of the LED HF RF Sniffer in the shack.

However, the most interest for me was to check the RF current on the outer braid of the antenna coaxial cable. When the RF Sniffer was inserted into RF Choke that was wound by the coaxial cable (the choke was placed near my transceiver) the LED was glow (when key was pressed) on the band where SWR was more the 1.5:1. It allowed me visually control transmission and took attention of my Cat to the blinking toy (he often try steal it when the LED is blinking). The RF Choke contained 5 turns and had ID 30- mm. So the L1 perfect fit the RF Choke.

Oh, yes, you may ask me why the PCB of the LED RF Sniffers had such strange form. It is simple. I would like made a perfect design and place the LED RF Sniffer into cabinet. For UHF RF Sniffer I want to use an empty box from SUPER WICK. For HF RF Sniffer I want to use an empty container from medical pills. But... then I leave things like it is...

73! Igor, VA3ZNW



SUPER WICK

RF Sniffer

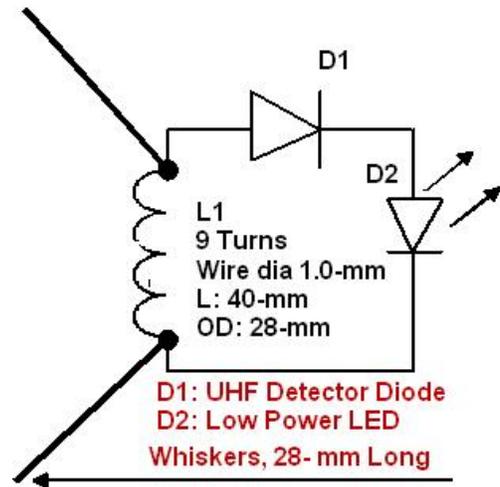
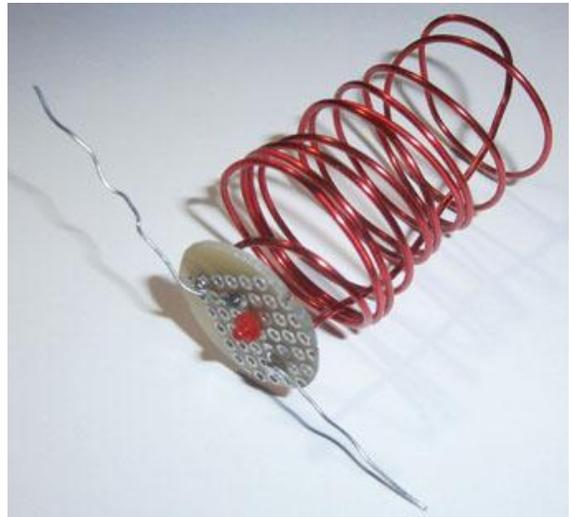


Figure 4 Modified RF Sniffer with LED as RF Indicator



LED HF RF Sniffer



HF RF Sniffer Inside of RF Choke