

SMOG-1 Reception

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1 Antenna of minimal configuration

Anybody can receive SMOG-1 1-PQ class satellite with e.g. RTL-SDR R820T2 & TCXO with:

1. hand-held 6-element Yagi-Uda antenna - Fig. 1 or
2. quarter-wavelength ground-plane antenna or
3. half-wavelength dipole antenna or
4. quadrifilar-helix antenna.

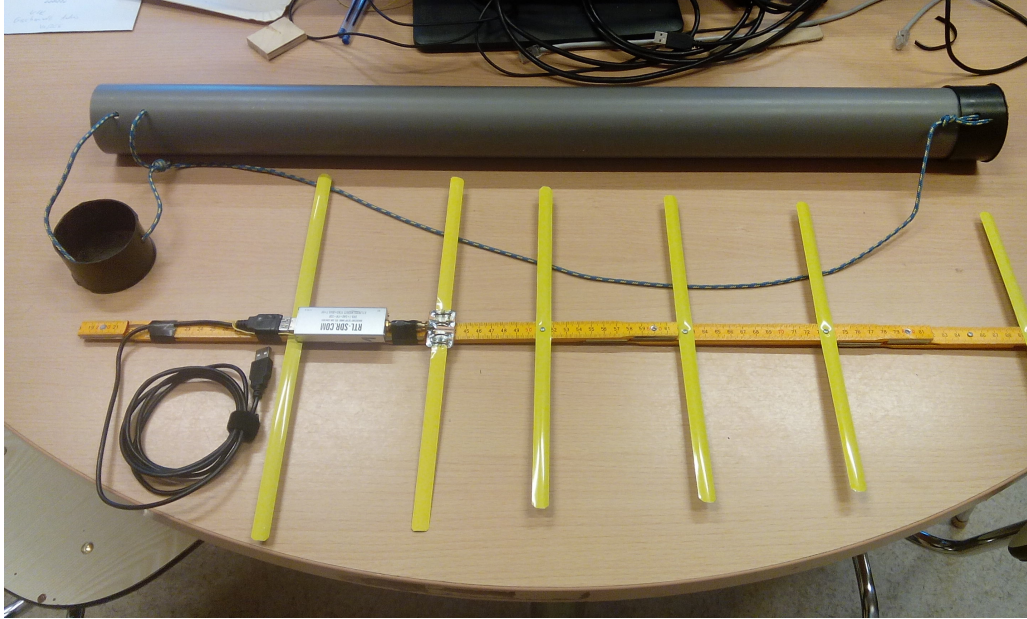


Figure 1: 6 element Yagi

Table 1. contains the length and position of antenna elements: antenna elements are made of 13 mm wide (space-qualified - Masat-1) measuring tape and antenna boom is made of measuring rod.

Type	Length [mm]	Position [mm]
Director 4	260	25
Director 3	275	185
Director 2	290	297
Director 1	300	410
Dipole	323	490
Reflector	342	606

Table 1: 6-element Yagi antenna

RTL-SDR R820T2 with TCXO is connected directly to the dipole element of the Yagi antenna: shielding and center point of the SMA connector must be connected to the two half of the dipole.

If you use omni-directional antenna, Low Noise RF Amplifier is required type e.g. PSA-4 or similar. RTL-SDR can supply the LNA with +5V DC via its integrated bias-tee - Fig. 2. - use `./smog1_rtl_rx` program with `-T` switch.

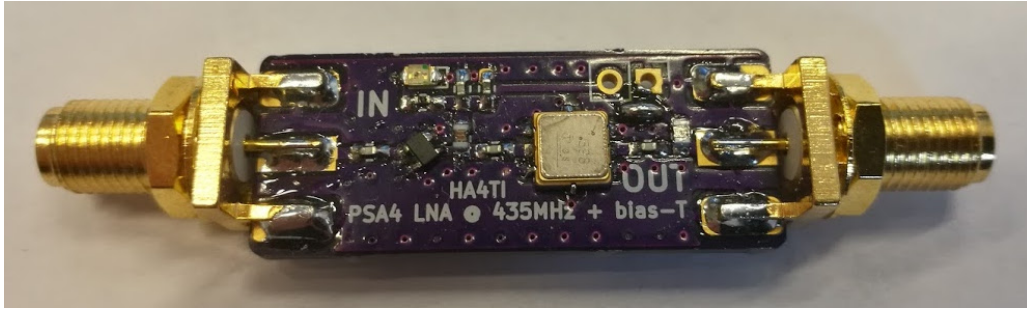


Figure 2: LNA with SAW filter

The receiver chain is the following (optional): antenna - (LNA) - (coaxial cable) - RTL-SDR - (USB cable) - Raspberry Pi-3

2 smogcli2 software on R-Pi-3

1. Buy a Raspberry Pi-3 (R-Pi-3), SD-card, RTL-SDR v3 and 5V power supply.
2. Insert pre-installed Raspbian SD-card into R-Pi-3.
3. Connect RTL-SDR to the USB of R-Pi-3.
4. Power up your R-Pi-3.
5. Open terminal with Ctrl + Alt + T.
6. Follow these instructions:

- Configure the R-Pi-3:

```
sudo raspi-config
```

- Change password.
- Set hostname.
- Set wireless LAN.
- Set localisation options.
- Enable SSH in Interfacing Options.
- Finish and Reboot the R-Pi-3.

- You should have Internet connection on R-Pi-3.

```
sudo apt update -y
sudo apt install libusb-1.0-0-dev libusb-1.0-0 -y
sudo apt install librtlsdr-dev libcurl4-gnutls-dev -y
sudo apt install cmake git libfftw3-dev libjsoncpp-dev libiio-dev -y
git clone https://gitlab.com/phorvath/smogcli2.git
cd smogcli2
mkdir build
cd build
cmake -DCMAKE_TOOLCHAIN_FILE=cmake/arm_cortex_a53-native.cmake ..
make
sudo make install
sudo ldconfig
```

- If your RTL-SDR is connected, you can see RTL2838 DVB-T string after "lsusb" command.

```
cp ../qthfile.txt .
```

- Modify qthfile with "nano qthfile.txt" - callsign, latitude, negative longitude, altitude, username and password.

```
./smog1_rtl_rx --help
```

- OpenWebRX install:

```
wget 152.66.80.46/smog1/receivesmogpat11/openwebrx.zip
unzip openwebrx.zip
cd openwebrx
cd csdr
make clean
sudo make install
sudo ldconfig
cd ..
cat cron
```

Copy content of cron file to crontab (last line) with nano:

```
crontab -e
```

- Install tmux, ncat (nmap):

```
sudo apt install tmux net-tools nmap -y
```

- "nano cli.sh" edit shell script:

```
http://152.66.80.46/smog1/receivesmogpat11/cli.sh
```

```
#!/bin/bash
cd /home/pi/smogcli2/build

echo stopping
bash stop.sh
sleep 3

cf="cf32.fifo"
rm $cf
mkfifo $cf

echo true > cli.txt
c=$(cat cli.txt)
while $c
do
    echo test smog1_decode
    pidof smog1_decode
    if [ $? -ne 0 ]
    then
        echo decode
        stdbuf -o0 ./smog1_decode $cf 2>>decode.err 1>>packets.log &
        sleep 1
    fi

    echo test smog1_rtl_rx
    pidof smog1_rtl_rx
    if [ $? -ne 0 ]
```

```

then
  echo rtl_rx

  # Without openwebrx
  ./smog1_rtl_rx -k -a -g 30 -T -i 47964 -O 2>>rx.err 1>>$cf &

  # With openwebrx
  ./smog1_rtl_rx -k -a -g 30 -T -i 47964 -O 2>>rx.err 1| tee $cf | nc
  localhost 12345 &

  sleep 1
fi

sleep 3
c=$(cat cli.txt)
done

```

cli.sh

- "nano stop.sh" edit shell script:

<http://152.66.80.46/smog1/receivesmogpat11/stop.sh>

```

#!/bin/bash
cd /home/pi/smogcli2/build
echo false > cli.txt
sudo killall -s9 smog1_rtl_rx
sudo killall -s9 smog1_decode
sudo killall -s9 smog1_packets

```

stop.sh

- "crontab -e" edit crontab file (with nano):

```

@reboot bash /home/pi/smogcli2/build/cli.sh > /dev/null &
0 0 * * * sudo reboot

```

- After reboot:

```

cd smogcli2/build

```

7. Connect your antenna to RTL-SDR.

- You can track the satellite according to its azimuth and elevation angles in time with "tail".

```

tail -f /home/pi/smogcli2/build/*.err

```

- You can see the received packets:

```

tail -f /home/pi/smogcli2/build/*.log

```

- You can see the telemetry data with:

```

cd /home/pi/smogcli2/build
./smog1_packets *.pkts

```

(* is the pkts file name or all pkts files) or

```

./smog1_packets packets.log

```

8. OpenWebRX - you can see the incoming signal on waterfall diagram with browser and hear the demodulated sound:

```
firefox localhost:8073
```