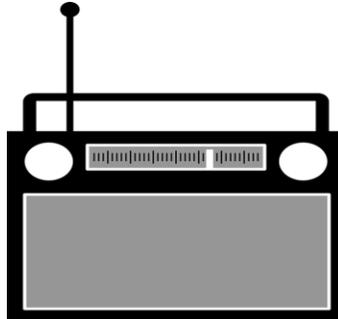


DESIGN OF A TV TUNER BASED RADIO SCANNER

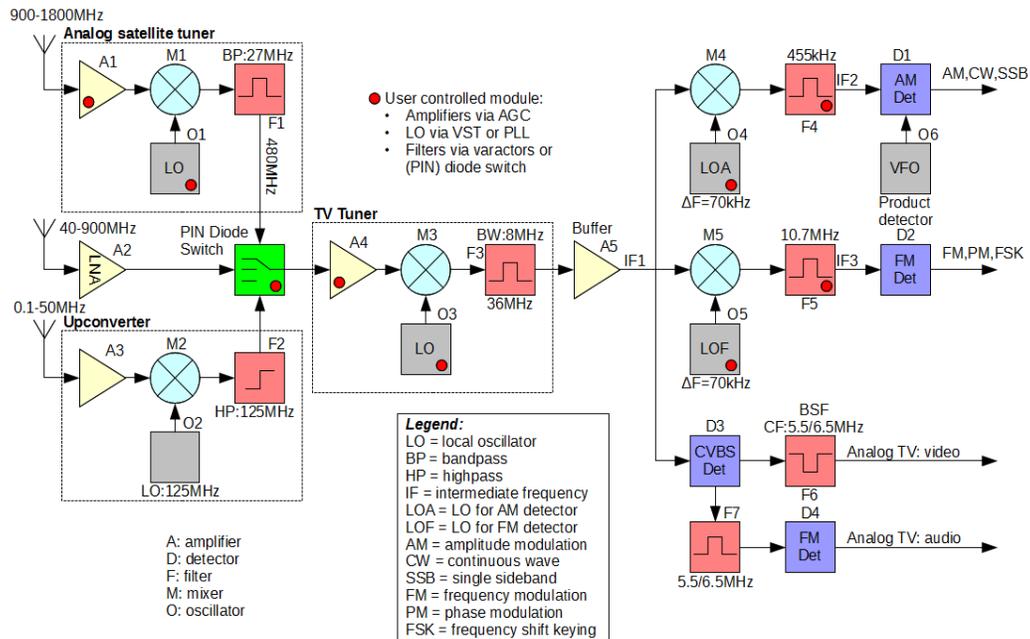


Building radio frequency devices becomes difficult starting from VHF band.

Moreover, tuning various stages is difficult without expensive electronics equipment. But a ready made unit can be used as the frontend of any radio receiver operating in the VHF – UHF band. That unit is the tuner coming from a TV, from a STB or from a PC card. It has the advantage of covering a wide spectrum of frequencies at a reasonable reception quality well above homemade radio receivers.

In order to build a TV tuner radio scanner you need, of course, a tuner. Also you must be able to build some detectors (demodulators) for the common analog modulation schemes. Some frequency mixers need to be built too. Although designed for analog modulation, the scanner is able to demodulate digital signals using the PC sound card as input. The whole constructional project is not difficult because it is modular and you don't have to build all modules to get it working with a specific RF signal.

Let's take a simple example: if you are interested in receiving broadcast FM radio stations, you only need a simple FM detector that can take as input the tuner's intermediary frequency. Of course, if you want to improve it you can add a stereo and RDS decoder. On the other hand, if you are interested in digital aviation signals, you'll need a detector with a tunable local oscillator to overcome tuner large frequency step and a tunable IF filter. To maintain the modular design of the project, you could make this from two modules: a frequency downconverter with the tunable oscillator and filter followed by a fixed frequency detector. In the end, the main point of building this is obtaining the same results as with Realtek SDR devices and SDR#. The functional schematic of the scanner is shown in the figure below.



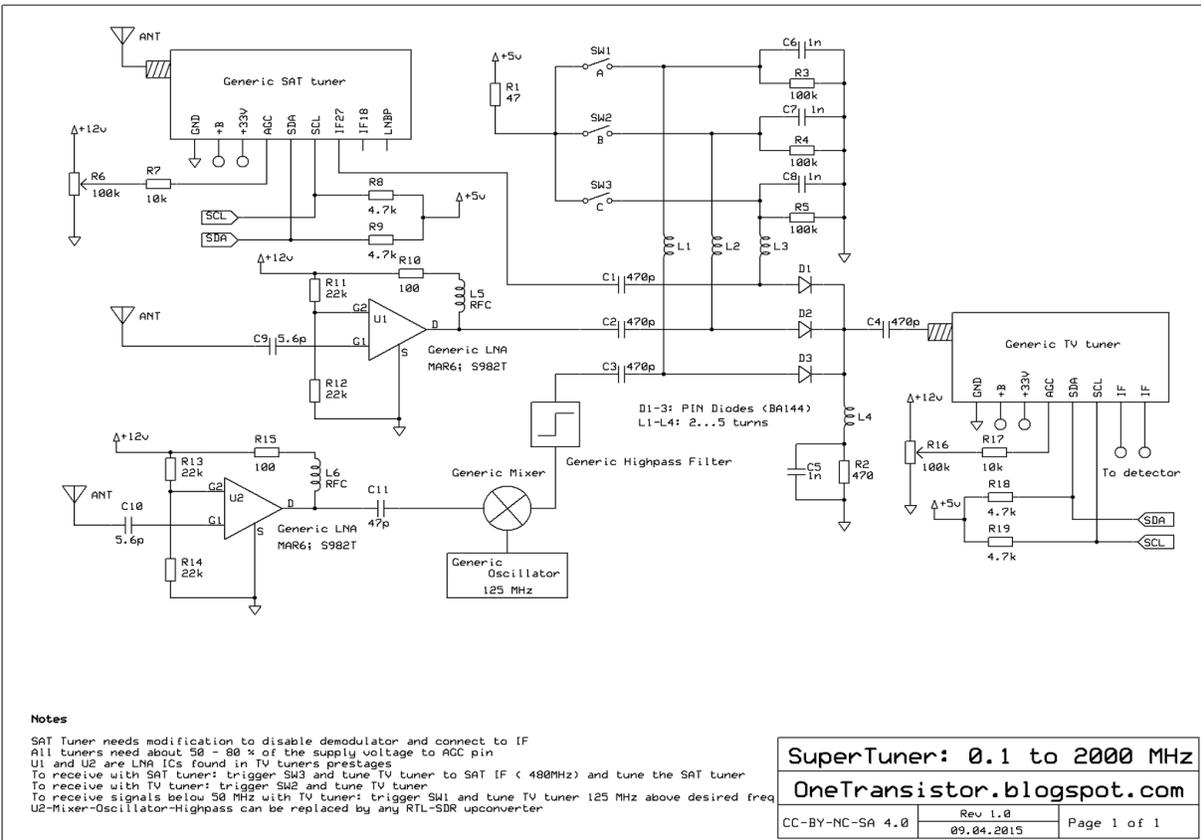
Functional schematic of the scanner. Don't worry, you don't have to build everything from scratch.

In order to make things simpler, the tuner frequency output which we'll call IF1 will be down converted to standard IF values used in radios. These values are 455 kHz and 10.7 MHz. The down converter must have a tunable oscillator in order to allow fine tuning between one frequency step of the tuner. Following the converter is an IF filter that must also be tunable to allow good reception of different bandwidth signals. The filter output is buffered before entering various detectors for AM and its variations (SSB, CW, DSSC) and FM. The detector output can be further processed by a computer or if it is an audio signal it can be amplified.

The tuner

The TV tuner can be used as-is. I2C controlled tuner is highly recommended. It's up to you to get the bus functional description from the tuner datasheet or the IC that controls PLL datasheet. Satellite tuner requires a bit of modification. Most of them include a demodulator IC which must be disabled. The RF input of this demodulator will be used as IF output from the tuner. You must also get a datasheet for the SAW filter in order to determine the IF center frequency. Zero-IF tuners are not suitable for this. A how-to for this is hard to write because it will be device-specific. I suggest reading *How to identify an unknown radio tuner*.

If you're interested in all available receiving range, you can connect the tuners as following. The schematic below is just a generic one. Use it to get an idea.

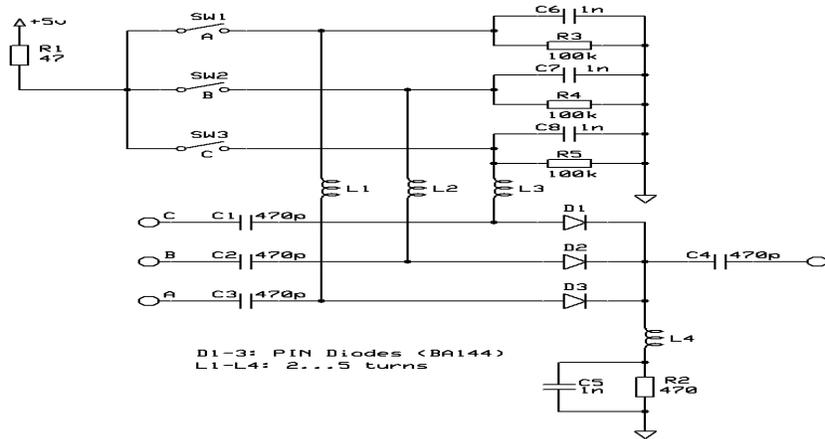


Building a supertuner

This schematic contains all the blocks from the left of A5 buffer (refer to the functional schematic).

The switch

The switch allows connecting multiple RF sources to the same tuner. One of them will be the output from the SAT tuner (acting here as a downconverter), which will be around 480 - 490 MHz. The other will be the upconverter output and the last one will be the direct antenna input, optionally through a LNA (low noise amplifier).



Antenna switch

The switch contacts (on the right side) can be used as TTL compatible inputs. L1 - L3 number of turns varies inversely with the frequency. Input capacitors C1 - C3 can also be decreased at higher frequencies. Adjust them for your configuration.

Following this project, we can say that branch A will pass 480 MHz, branch B will pass 40 - 900 MHz and branch C will pass 100 - 180 MHz.

References:

- Antenna selector circuit using PIN diodes
- RF Switch with Pin Diode

The SAW filter

Most of TV tuners do not include the IF filter (in the schematic: F3). You'll have to add it before the detector(s). There are mainly two types of SAW (surface acoustic wave) filters.

The older ones separate audio from video thus having a center frequency of about 38.9 MHz and a narrower bandwidth (the brown one from the picture). The other type has a center frequency of 36.15 MHz and a bandwidth of 8 MHz (the smaller black one).



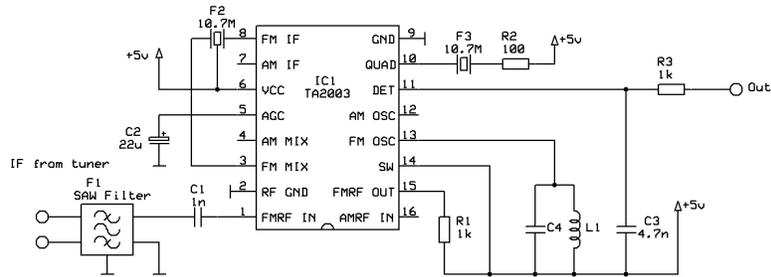
SAW filters

The black one has a balanced input at pins 1 and 2, GND at pin 3 and balanced output at pins 4 and 5. When using this filter, tune your detector to the center frequency of 36 MHz. The brown type has the input on the same pins 1 and 2. Pins 3, 8 and 10 are GND. Pins 4, 5 are the audio filtered IF output and pins 6, 7 are video IF output. When using this kind of filter, tune your detector to the video IF frequency, which is usually 38.9 MHz.

The FM detector

FM broadcast radio stations

The following detector is based on TA2003 and is suitable for reception of broadcast stations in the 88 - 108 MHz band and also analog TV sound in the VHF/UHF bands.



FM detector

The bandwidth of this detector is determined by F2 filter (SFE10.7). Common ceramic filters have around 150 - 200 kHz bandwidth which is suitable for stereo FM reception and preserves RDS data. The output can therefore be connected further to a stereo decoder and a RDS decoder. Using narrower filters, which are harder to find unfortunately, this detector can receive other FM signals, like NOAA APT.

F3 is a ceramic quad detector and can be replaced by a LC pair tuned to 10.7 MHz.

L1-C4 oscillator is tuned to a frequency 10.7 MHz lower than tuner IF

(considering standard IF of 36 MHz, the oscillator should be tuned to 25.3 MHz).

Due to the wide band characteristic, there is no need for a tunable local oscillator to overcome the tuner frequency step. All the parts (except SAW filter) can be found in cheap commercial available radios.

Looking at our main scanner blocks, this schematic includes the following (refer to the functional blocks schematic): F3, A5, M5, O5, F5, D2.

Source: <http://onetransistor.blogspot.in/2014/08/design-of-tv-tuner-based-radio.html>