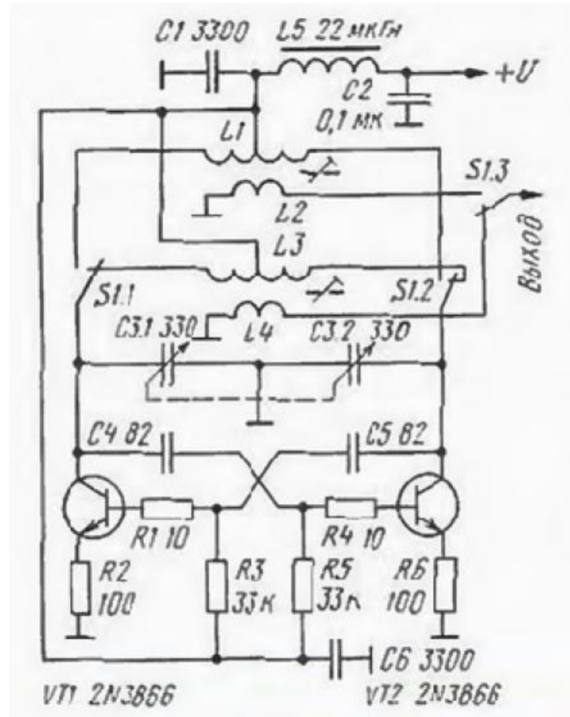
RF Generator for HF Bands 1.8- 30- MHz

By: Igor Grigorov, VA3ZNW

For antenna measurements I used to a home brew RF- Bridge (http://www.antentop.org/024/Simple%20RF-%20Bridge%20_024.htm).
It was very compact device that can be used in the roof and field. However, to test the antennas the RF- Bridge needs RF generator that provides at least 50- mW of RF power. For my field applications it should be compact, battery powered and stable source of RF energy. At first time I made RF generator from Reference 1. It was simple and enough powerful one. It provides near 50- mW of RF power and could be used with RF- Bridge.

However, the RF generator cannot provide good frequency stability and output power over the ranges. The frequency was varied while RF-Bridge was setting to null. As well it was for RF power which level varies while the load of the generator was varied. The generator was redesign to meet the requirements for antenna testing. Figure 1 shows schematic of the RF generator. If the schematic would be compared with Reference 1 it should be noted, that it is added a voltage linear regulator U1 (5V) that provide stable voltage to master oscillator on Q1 and Q2 while input voltage is changed from 12 to almost 6 volts, and power RF amplifier on Q3. The buffer power amplifier helps eliminate the influence of the load to the frequency and gain the output power. Stability of the RF generator is suitable for adjusting narrow-bandwidth antennas



Picture 1
RF- generator from **Reference 1**

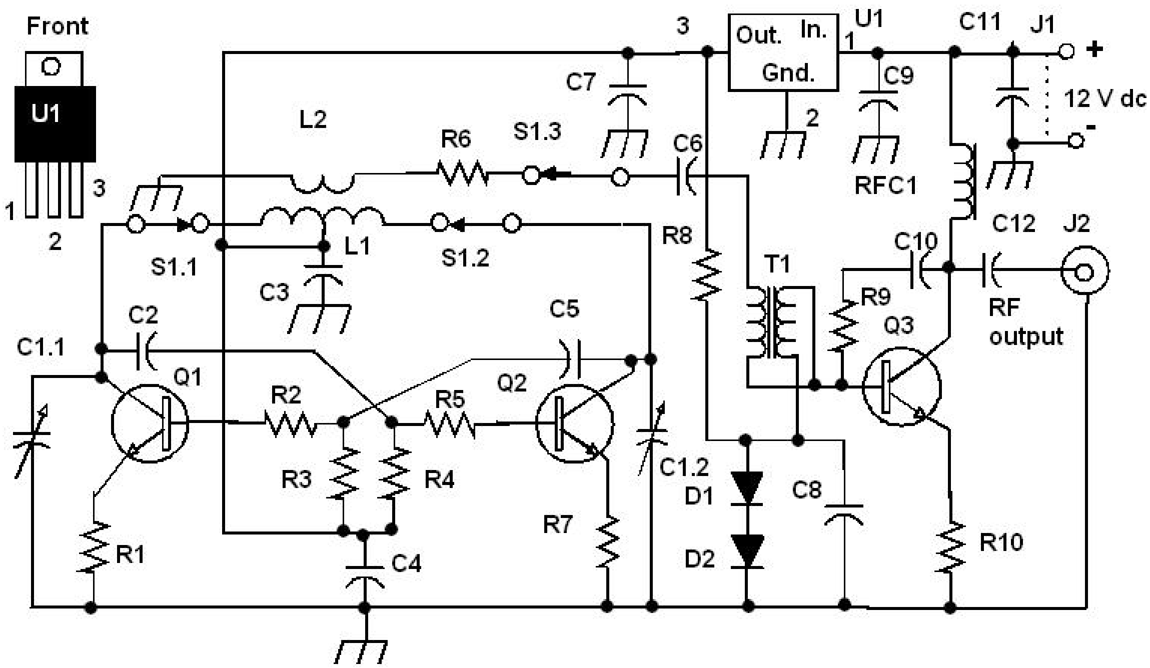


Figure 1 RF Generator

The master oscillator consisting of Q1 and Q2 is a typical, push-pull RF generator. The frequency range depends on coil L1 and variable capacitor C1. S1 switches the coils to change bands. For simplicity, the coil connection is not shown for all ranges in use. The generator has three switching coils that provides operation ranges 1.4 to 3.2 MHz, 3.2 to 8.0 MHz, and 8.0 to 30 MHz. Dial of the variable capacitor C1 was calibrate with frequency meter at each of the operation range.

In the lower operation range 1.4 to 3.2 MHz, the output power measured into a 50 ohm dummy load is no less than 400 mW. Output power in the middle range 3.2 to 8.0 MHz, is no less than 300 mW. In the high range 8.0 to 30 MHz, output power is 200 mW on 8 MHz and 150 mW on 30 MHz. When generator was connected to an RF- Bridge that is loaded by an antenna, the output frequency of this RF- generator varies no more than 5 kHz in the first range, 15 kHz in the second range and no more than 30 kHz in the highest range of operation.

The master oscillator is fed from the 5 V regulator chip U1, also the base network of Q3 feeds from the 5 V regulator. This stabilizes the oscillator against supply voltage variations between 6 V and a maximum of 12 V. Voltage regulator IC U1 is not mounted on a heat sink. If the Q3 is fed from the regulated 5V supply, the frequency stability will be increased even more, but the output power will be lowered at least in half. The regulator chip will have to be mounted on a heat sink if this is done. Transistor Q3 is installed on a heat sink with sizes 40x40x4 mm.

Adjustment of the RF Generator is not complicated. When it is soldered from right parts it should be work straight away. However, for best operation Q1 and Q2 must be identical -- a matched pair. It should be checked with oscilloscope or RF voltmeter. RF voltage on the collectors of the transistors should be almost identical. If there is a difference of 30 percent or more, it would be necessary to replace one or the other of the transistors. The resistors R1, R2, R5 and R7 assure a sine wave RF output on all of the operating ranges. R8 installed the bias of the Q3.

Without signals on the base Q3 (inductors are not connected to Q1 and Q2) the collector current of Q3 should be in the range of 100 to 150-mA. The value of R6 should be picked for each range. Increasing the resistance of R6 increases the frequency stability, but it also reduces the output power of the generator.

Table 1 shows data for inductors of the RF generator. **Figure 2** shows design of the inductors.
Set up of the frequency ranges of the master oscillator done by squeezing or stretching turns of the coil L1. The coil has Center Tap and it should be wound with best possible symmetry.

Figure 3 shows design of the RF transformer T1. Transformer T1 is wound on a ferrite ring with a permeability of 600 and OD of 10 mm. The winding consists of 10 turns of 0.3-mm wire (28 AWG).

There is parts list below

- **Capacitors**-

C1 - 12 to 500-pF, Air Variable Dual Capacitor
C2, C5 - 91 pF
C3, C4, C6, C8 - 0.1 UF
C7, C9, C10, C12 - 0.15 UF
C11 - 100 UF/16V

- **Resistors**-

R1, R7 - 100 Ohm, 0.25W
R2, R5 - 10 Ohm, 0.25W
R3, R4 - 30k Ohm, 0.25W
R6 - See **Table 1**
R8 - 360* Ohm, 0.5 W, must be selected, see text
R9 - 470 Ohm, 0.25 W
R10 - 2 Ohm, 0.5 W

- **Connectors** –

J1 – Any DC connector
J2 - BNC Female RF Connector

- **Diodes** –

D1, D2- Any Small Power Silicon Diode, 1N914, 1N4004

- **Transistors**-

Q1, Q2 - Any Small Power RF Transistors, 250 mW/300 MHz
Q3 - Any Middle Power RF Transistor, 5W/300 MHz

-**Integrated circuits**-

U1 - 7805

- **Switches**-

- S1 – Three Positional, Three Selected, Rotary Switch

- **Wire parts** –

RFC- RF choke, 20-UH/0.5 A

Figure 3 shows design of the RF transformer T1. Transformer T1 is wound on a ferrite ring with a permeability of 600 and OD of 10 mm. The winding consists of 10 turns of 0.3-mm wire (28 AWG). The wires are twisted together, at a rate of one twist per centimeter, and are wrapped equally around the entire core, with identical spacing between turns.

The RF Generator was assembled in cabinet with sizes 160x90x100-mm. The cabinet was made from two sided PCB. Generator was made by Manhattan style. Design should be compact and rigid as possible. The generator was fed from internal NiCad battery on 12V/800mA.

Reference

1. Radio, 1999, NR 5, p. 59

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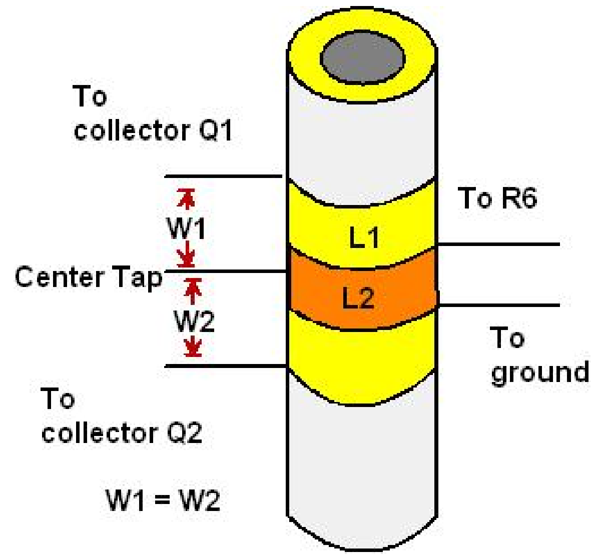

Figure 2
Design the Inductors of the RF Generator

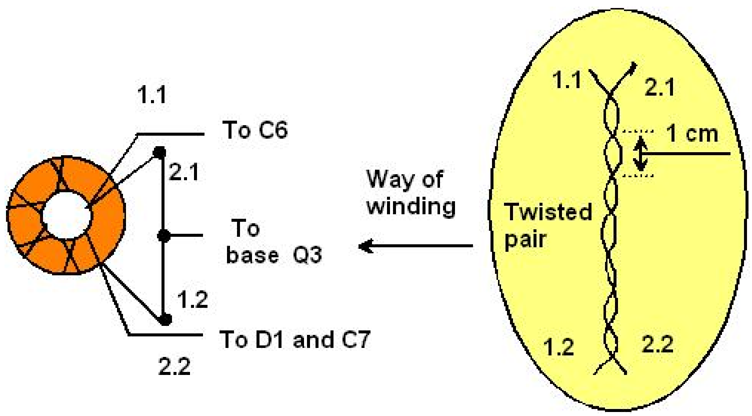

Figure 3 Design of the RF Transformer

Table 1 Data for Inductors of the RF Generator

Band, MHz	L1	L2	R6, Ohm
1.4 to 3.2	15+15 turns on diameter 42 mm, wire diameter 0.5mm (24 AWG); length of winding 10 mm	2 turn over CT L1; wire diameter 0.5mm (24 AWG)	75
3.2 to 8.0	12+12 turns on diameter 17 mm, wire diameter 0.5mm (24 AWG); turn to turn	3 turn over CT L1, wire diameter 0.5mm (24 AWG)	100
8.0 to 30.0	4+4 turns on diameter 8 mm, wire diameter 0.5mm (24 AWG): turn to turn	2 turn over CT L1; wire diameter 0.5mm (24 AWG)	120