A License Free Low Frequency Transmitter

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Describing a transmitter before the receiver may sound a lot like putting the cart ahead of the horse. In this case, however, it's not that bad at all. Many of the receivers available today already have low frequency coverage, often as low as 150 kHz. Others have low frequency converters that make reception of the 160 to 190 kHz band possible.

What you probably *don't* have is a low frequency transmitter. And what you quite possibly don't know, is that you don't need a license to operate one. Sound good? Wait -- there's more.

Inexpensive Xmitter

As many monitors are well aware, communications equipment can cost a hefty buck. That's not the case when it comes to a lowfer transmitter. This one can be built, from scratch, for under $25.00, not including the power supply. Power supply circuitry can be found in innumerable books and publications.

Over the seventeen years I've been experimenting on the low frequency bands, I've constructed countless tube and solid state circuits. This transmitter, however, is one of the simplest, most fool-proof I've ever had the pleasure to construct.

The transmitter exciter is shown in figure one. It uses two I.C.s. The oscillator uses crystals in the 5120 to 6080 kHz range. (It's a CD4011BCN.) This is followed by a CD4024BCN that divides the crystal frequency by 32, producing an output between 160 and 190 kHz.

Easy-to-Get Parts

The final amplifier uses the relatively new high-powered FETs known as VMOSs and HEXFETs. These devices are extremely easy to drive and require only a gate bias resistor, several bypass capacitors and a tank antenna coil in the circuitry. They are also readily available and cost less than $2.00 each. See figure two for the circuit.

Seasoned experimenters can use their favorite construction methods but for the novice, I recommend that parts be assembled on perforated boards that have holes spaced at .100" x .100". Parts are mounted on top of the boards and the wiring underneath. I also suggest that sockets be used for the solid state devices as they can be easily damaged in soldering. Since we are dealing with LF, simple point-to-point wiring will suffice.

A cheeseboard measuring 8" x 5.5" x .75" thick was used as a baseboard on which to attach the assemblies. The perf boards were mounted on the cheese board with short stand offs. Three binding posts were mounted at the edge of the board for the power supply connections and grounding. See figure three for the transmitter layout.

The Tank/Antenna Coil

The most difficult and time consuming part of the project is the tank/antenna coil. Use a twelve inch length of 1 1/4 inch PVC pipe (1-5/8" o.d.) for the coil form. A PVC pipe cap is used to mount the coil vertically to the cheeseboard.

Fit one end of the pipe into the pipe cap and just clear of the cap flange, drill two small holes side by side to hold the start of the winding. From these holes, measure 10.5 inches to the other end and drill two more small holes side by side to secure the other end of the winding.

Next, measure 1 3/8" from the start and make a mark on the form for the final amplifier drain tap (100 turns). From the other end, place four marks, spaced 1" apart for the antenna taps. The winding will consist of a 10 1/2" length of close wound #28 enameled copper magnet wire. This is about 730 turns or 330 feet.

Gumming and Gluing

Keep a supply of gummed tape strips

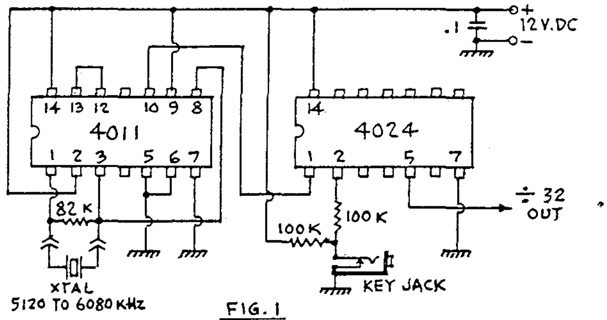


FIG. 1 EXCITER

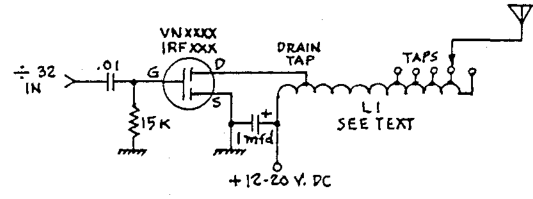
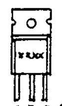


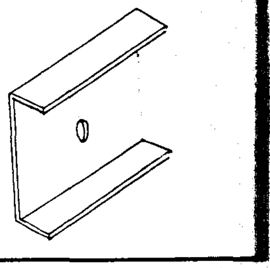
FIG. 2 FINAL AMPLIFIER



G D S (IRF)
S G D (VN)
TERMINAL PINS

All resistors can be 1/4 watt. Capacitors should have a 50 volt minimum rating. A standard transistor socket can be used for the final amplifier.

For continuous use, I suggest that a heat sink be used on the VMOS or HEXFET amplifier. Cut a several square inch rectangle out of sheet copper or aluminum and form into a channel shape as shown. Drill a hole in same and bolt to the back side of the drain tab.



handy to secure the winding when interrupted. Also, after every inch or so of winding, add some Duco cement to secure the wire. Let it dry before continuing. To make a tap, form a loop and then tightly twist them for two or three turns. Use long nose pliers and press the base of the twisted wires to align them for continuation of winding. After the coil is finished, the loop can be cut and the wires twisted tighter and then soldered.

When wiring up the various assemblies, test each device stage by stage. First, check out the 4011 crystal oscillator. Tune your receiver in CW mode to the crystal fundamental frequency. Clip about three feet of wire to pin #10 on the 4011 to act as an antenna. Apply 12 volts.

You should be able to hear the beat note in the receiver. Next, clip the short antenna wire on to pin #5 on the 4024 and tune to the crystal frequency divided by 32 that falls into the 160 to 190 kHz band, and again, you should hear the beat note. If you hear no signal, recheck your wiring and solder connections.

To test the final amplifier (and the whole transmitter) I suggest that you use the dummy antenna described in figure four. It consists simply of a noninductive 27 ohm resistor in series with a 365 pf variable capacitor. Connect the dummy antenna to the antenna coil using the full winding. Apply about 12 to 15 volts to the amplifier, tune the receiver to the frequency and note the "S" meter. Now set the variable capacitor to about 1/3rd mesh and try the antenna tap for maximum reading on the "S" meter. (You may need a short antenna on the transmitter for an effective reading.) When this point is found, retune the capacitor for maximum strength.

It should be noted that all antennas have a capacity to their ground system and the dummy's capacitor will duplicate this capacity. See figure five where the capacity, "Cx", which is the antenna's capacity to ground, is illustrated.

Final Tune Up

The final tune up will require the transmitter to be connected to its operational antenna. This will require a means for "fine tuning" the tank/antenna coil. Changes in weather and moving the operational frequency will require retuning. I use a ferrite rod that can be moved up or down within the coil field at the top and then clamped in the desired position. As the ferrite rod penetrates the coil field, it increases the coil's inductance. Another scheme is to use a variable capacitor connected between the antenna and ground.

Set-Up

Before selecting your operating frequency, a thorough study of the band should be made to locate the quietest one for you location. This should be done over a period of time. Take notes for accuracy and ease of reference.

The transmitting antenna should command considerable attention. First, it must be vertical. The FCC limits the length to 15 meters (49.2 feet). But even a much shorter vertical antenna will out-perform a 15 meter horizontal. The antenna will, in any case, carry high RF voltage, so excellent insulation from all supports is most important. Keep the antenna clear from trees and structures that could absorb RF radiated energy.

The ideal location for the transmitter would be to locate it in a weathertight housing at the base of the vertical antenna. Since we're dealing with low power, providing power and keying by cable from the operating position would be no problem.

Remember that the FCC limits the power input to the final amplifier to one watt. Therefore, after tuning up the transmitter, the drain voltage and current should be metered and set at one watt. Section 15.113 states that a certification label to this effect be placed on home-built devices and it must read:

I have constructed this device for my own use. I have tested it and certify that it complies to applicable regulations of the FFC Rules, Part 15. A copy of my measurements is in my possession and is available for inspection.

Signed ____________________

Date ____________________

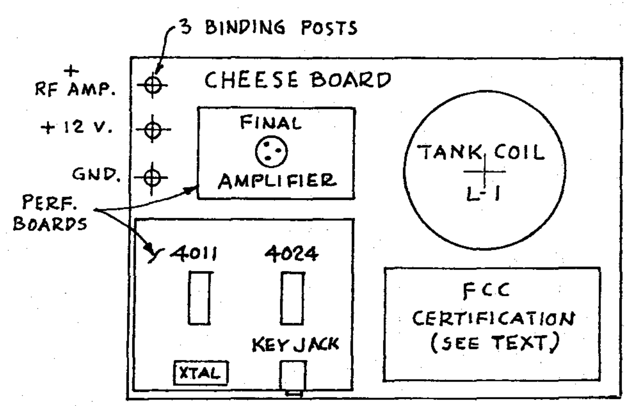


FIG. 3
TRANSMITTER LAYOUT
1/2 SIZE

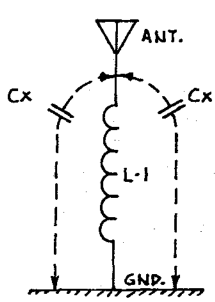


FIG.
ANTENNA CAPACITY
TO GROUND

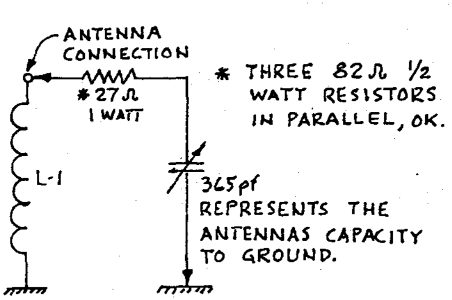


FIG. 4
DUMMY ANTENNA