

PALOMAR ENGINEERS

1750 METER

AM TRANSMITTER

BUILT BY

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Popular Electronics®

WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE

DECEMBER 1980/95¢

License-Free Transmitter Kit



Palomar Engineers has introduced a new transmitter in kit form that operates on the license-free 1750-meter (160 to 190 kHz) experimenters' band. The main transmitter assembly contains active r-f circuits, power supply, and a control panel. An antenna tuner assembly mounts remotely at the base of the antenna. (FCC regulations limit total antenna length—including that of any transmission line used—to 15 meters.) Rated input power to the final active stage of the transmitter is one watt, the maximum allowed by FCC regulations. Difficult assembly and wiring steps, including the winding of Litz-wire inductors, are performed at the factory. Wiring the kit is said to take approximately one hour. Palomar Engineers designed the transmitter for CW op-

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position. The antenna-tuning assembly mounts at the base of the antenna. The transmitter is for CW operation but can easily be converted to AM. Wiring of the kit takes about an hour using simple tools. Complete assembly and operating instructions are included. Suggested retail price is \$145.—Palomar Engineers, Box 455, Escondido, CA 92025.

STORY**Carl,**

APRIL 13, 2015

Thank you thank you thank you!

I'm not sure why Palomar Engineers only has a blank spot on their support page. It's weird. But I suspect that they might have been ahead of the market -- the guy who ran the place was a crusty, funny old radio engineer, named Jack Althouse (K6NY), and he died September 2013.

Althous wrote a hilarious column in WorldRadio Magazine under the pseudonym "Kurt N. Sterba" (which I think is an antenna-related pun).

There's a compilation booklet titled "Kurt Speaks Out" in print now (and on e-Bay), and I was also able to get copies of his older booklet "Ariels II" on Amazon. I haven't gotten through them both yet, but I've learned a lot just trying to keep up with his jokes.

Anyway, things have changed a bit at Palomar. I think they've merged with another San Diego-based radio company, and their website doesn't seem to carry any of the radio kits and off-the-wall gadgets (like the 1750m transmitter). And their support page for old stuff is spotty.

Which is why I'm grateful for this .PDF -- since there's that crystal right on the outside, I figure I might have an easy time getting to several nearby LW frequencies. And then there's that troubling hum from the AC power-supply ...

Thanks again.**Regards/****XXXXXXXXXXXXXXXX**

1750 METER
TRANSMITTER KIT

OPERATOR'S
MANUAL

Palomar Engineers

Box 455, Escondido, CA. 92025 • Phone: [714] 747-3343

I - INTRODUCTION

The 1750 meter transmitter kit is a one watt crystal controlled cw transmitter for the 160-190 KHz band.

The main transmitter assembly installs at your operating position. It contains the 115-v ac power supply, power adjustment, crystal socket, key jack and connectors.

The active antenna matching network mounts at the base of your antenna. Coupling and tuning of the antenna are fully adjustable. .Prewound Litz wire coils assure the highest possible efficiency.

The transmitter, when constructed and tested according to directions, meets all F.C.C. requirements. It is for use in U.S.A. only. Not for Canada.

The transmitter is intended for cw operation which is the recommended communication method for the 1750 meter band. However, it can be AM modulated quite easily if desired.

The main transmitter assembly is wired and tested. Directions for constructing the active antenna matching network are given in part III of this manual.

In addition to the parts supplied with the kit you will need wire and coaxial cable to connect the two parts of the transmitter, a breadboard on which to mount the matching network, a plastic pail or other suitable covering to protect the network from the weather, and a good antenna and ground system.

II - PARTS LIST

Following is a complete parts list for the 1750 Meter Transmitter.

The small parts are all in a plastic bag. Before beginning construction of the transmitter please check the contents of the bag against the parts list to be sure you can identify each part and to be sure nothing is missing.

If you cannot identify all the parts, go ahead with the next section "Step-by-step assembly". As you follow the instructions, the identification of the parts may become clear.

If you complete the assembly and find that parts are missing write to:

MISSING PARTS
P.O. BOX 455
ESCONDIDO CA 92025

Be sure to give the part number of any missing part.

Each step in the assembly has a parenthesis () ahead of it. Put a checkmark in it when you complete the step. This will help to make sure that each part is put in correctly.

<u>Part No.</u>	<u>Quantity</u>	<u>Description</u>
RESISTORS		
12-15K	1	15,000 ohm $\frac{1}{4}$ -w (brown-green-orange-silver)
12-22	1	22 ohm $\frac{1}{4}$ watt (red-red-black-silver)
CAPACITORS		
34-1-35	1	1-mfd 35-v dipped tantalum
37-6800	4	6800-pf (.068 mfd) polystyrene tubular
37-2700	1	2700-pf polystyrene tubular
35-150	1	150 pf 1000-v disc
COILS - TUNING INSERT		
1486	1	Tank coil
1485	1	Loading coil
1547	1	Tuning insert
94-2.5	1	2.5 mh RF choke
CONNECTORS		
151-3	1	Phono socket with lug, washer, and nut
151-4	3	Phono plug
CIRCUIT BOARD - CRYSTAL		
1532	1	Circuit board with transistor mounted
126-5-5600	1	Crystal, 5600-KHz nominal
WIRE - SOLDER - RODS - BRACKET - SPACERS - PINS		
204-22	10"	#22 gage bare tinned wire
210-22	18"	#22 gage solder
1533	2	4" plastic rods
570-3/8	2	3/8" brass spacer
134-2	5	printed circuit pins
HARDWARE		
605-4-40x $\frac{3}{4}$	1	4-40 thread screw $\frac{3}{4}$ " length
640-4	1	#4 lock washer
630-4-40	1	4-40 nut
602-6-1	2	1" #6 round head wood screw
MAIN TRANSMITTER - MANUAL		
	1	1750 Meter Transmitter
	1	Instruction manual

III - STEP-BY-STEP ASSEMBLY OF THE
ACTIVE ANTENNA MATCHING NETWORK

There are eight small pads labeled A-B-C-D-E-F-G-H (Fig. 1). These pads will be used to hold the plastic rods in place.

- () Cut a 1" length of bare wire.
- () Poke the wire through hole A from the component side of the board. Solder it to the pad.
- () Place one of the plastic rods next to the wire on the component side of the board. The end of the rod should be $\frac{1}{4}$ " from the right side of the board (Fig. 2).
- () Wrap the free end of the bare wire over the rod and into hole B. Hold the end tightly with pliers so the wire holds the plastic rod firmly and solder the wire to the pad.
- () Install another 1" wire over the rod using holes C and D.
- () Mount the other plastic rod in the same way using two pieces of wire and holes E & F and G & H.
- () Insert the connector into the large hole from the component side. On the circuit side place the solder lug, flat washer, and nut. Tighten the nut.
- () Solder the lug to the square pad below it.
- () Run a bare wire from the connector terminal to pad I. Solder both ends.
- () Connect the 15,000 ohm resistor (brown-green-orange-silver) between pads J and K on the component side. Solder both ends. Cut off extra wire.
- () Connect the tantalum capacitor between pads L and M on the component side. Pad M is square. Longer capacitor lead (+ side of capacitor) must go in this hole. Cut off extra wire after soldering.
- () Place the leads of the five large tubular capacitors in their holes as shown in Fig. 2. Solder the leads and cut off the extra wire.

() Take the small coil (this is the TANK coil) and remove the wrapped insulation up to $\frac{1}{4}$ " from the main coil. Twist the ends of the multi-wire leads so they can be pushed through the circuit board holes.

() Pass the leads through holes N and O and position the coil so the leads to the circuit board are as short as possible. The coil will nest between the two plastic rods.

() Cut a 3" length of bare wire. Solder one end to pad P.

() Run the wire over the tank coil and into hole Q. Hold the end of the wire tightly with pliers and solder to the pad. Cut excess wire. The tank coil should be held firmly in place by the plastic rods and the wire.

() Solder the tank coil leads to pads N and O. The wire is made of many small insulated strands (called Litz wire). The insulation melts under a hot soldering iron. Be sure to hold the soldering iron on the wire long enough to melt the insulation of all the wire strands. This takes 10 seconds or so. Cut off excess wire.

() From the component side of the board insert pins into holes R-S-T-U and V. Solder each pin to its pad.

() Set the large coil on the plastic rods (this coil is the ANTENNA LOADING COIL). The leads from this coil go to pins R-S-T-U. The leads must be left long so that the coil can be moved along the plastic rods.

() Remove the wrapped insulation from the end of each loading coil lead for about $\frac{1}{4}$ ". Wrap the exposed wire ends around the pins and solder to the pins. See Fig. 2. Note that the center pins each get two wires.

() The active antenna matching network is now completely wired. Use the two spacers and wood screws to mount it to a breadboard or small cheeseboard. The two holes in the corners of the circuit board are for this purpose.

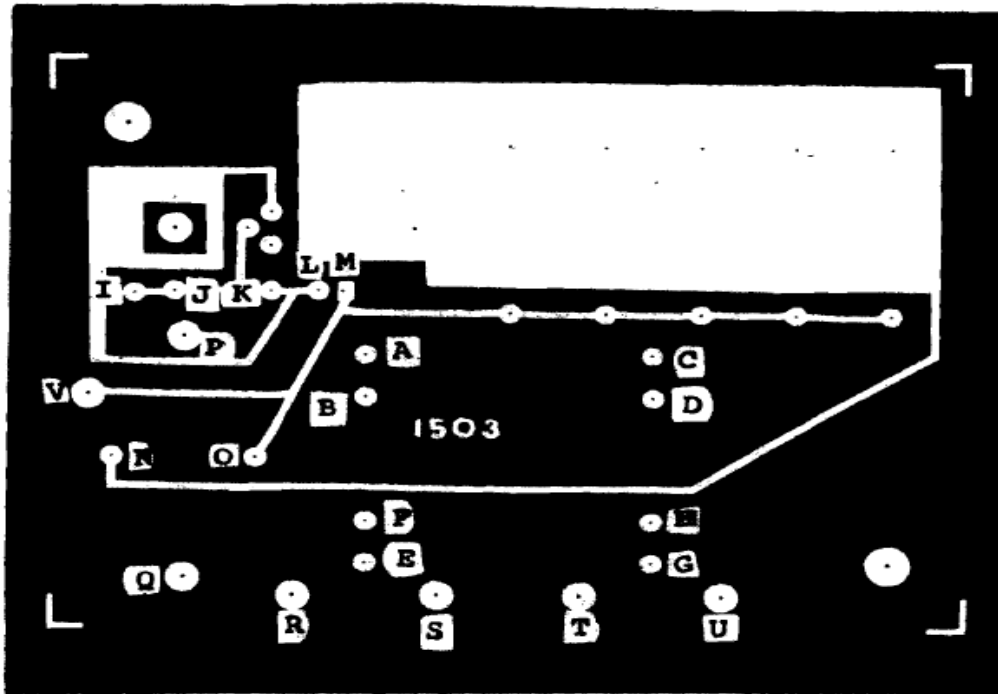


Fig. 1 Circuit side.

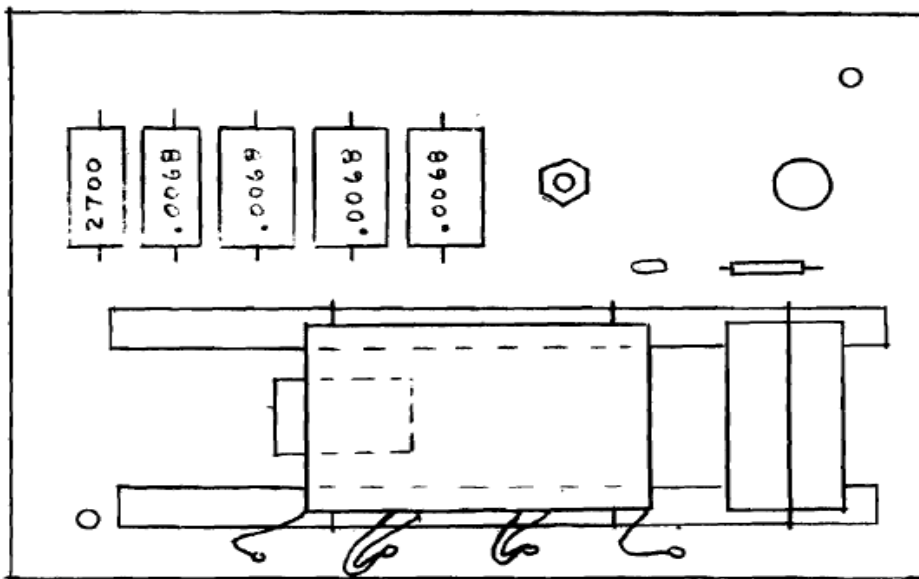


Fig. 2 Component side.

IV - TESTING THE TRANSMITTER

- () Plug the crystal into the crystal socket.
- () Connect the RF jack on the control panel to the matching network jack. Connectors are in the kit for making this shielded cable. Complete cables are available at Radio Shack stores or stereo supply houses.
- () Connect the + lead of a VOM or current meter (100-ma range) to the + terminal on the control panel. Connect the - lead to the pin near the tank coil.
- () Connect the 22 ohm resistor (red-red-black-silver) to one end pin of the loading coil. Connect the 150 pf capacitor to the other end pin. Connect together the free ends of the resistor and capacitor (series connection).
- () Turn the voltage control full counterclockwise. Connect a shorting plug to the KEY connector. Plug the line cord into a 115-v source. Turn switch to ON.
- () Watch the meter. It should read much less than 100 ma. Maybe 10 ma or so.
- () Move the loading coil so it is about $\frac{1}{2}$ " from the tank coil. Turn the voltage control clockwise until pointer is straight up.
- () Move the tuning inset through its range watching for an increase in current. There should be one position of the insert where the current rises to a peak and drops off on either side. Caution: If the tuning insert starts to enter the tank coil, the current will rise because the insert detunes the tank circuit. This is not a correct insert position.
- () If the peak is less than 100 ma, move the loading coil closer to the tank coil and reposition the tuning insert for peak.
- () Find the loading coil position that results in 100 ma current at peak. The power input now is about one watt. The output is about $\frac{1}{2}$ watt and the 22 ohm resistor should run warm.

V - INSTALLATION AND FINAL TEST

- () Put the main transmitter at your operating position. Put the active antenna matching network at the base of your antenna. A 50' vertical antenna with ground radials is the preferred antenna. A shorter antenna with horizontal wires at the top (T or inverted L antennas) will also work well. Cage verticals are good. The maximum height allowed is 50'. Do not use a horizontal antenna; results will be poor.
- () Make or procure a coaxial cable of proper length to connect the RF connector on the control panel to the matching network. RG-58/U is a suitable cable; do not use audio cables if the distance is more than five feet or so.
- () Run an insulated wire from the + terminal of the control panel to the pin near the tank coil. And another insulated wire from the GND terminal to the square pad under the connector on the matching network circuit board. Use #18 wire or similar size. A two wire cable can be used or two insulated wires can be twisted together to make a cable.
- () Put the current meter in series with the + wire at the antenna end.
- () Test the transmitter again as described in section IV so as to make sure your cables are alright.
- () Remove the 22 ohm resistor and the 150 pf capacitor from the matching network. Connect your antenna to one end of the loading coil and your ground to the other. Look for a current peak while adjusting the

tuning slug.

() If you don't find one, remove the connection from the pin most distant from the tank coil and connect it to one of the middle pins.

() After you find the peak, adjust the loading coil position and the insert slug until the peak is about 100 ma.

() Remove the current meter. Connect the + wire to one end of the RF choke. Connect the other end of the choke to the pin on the circuit board.

() Listen to the transmitter with a receiver located at least 200' from the antenna but close enough that the signal is strong.

() A calibrated signal strength meter is required. This can be a receiver with an "S" meter. One "S" unit is 5 db. Observe and record the signal strength.

() Now listen on twice the signal frequency. Then on three times, four times, and five times the signal frequency. It is required that these signals be at least 20 db weaker than the fundamental transmitter signal (four "S" points). You will probably find the second harmonic down 35 db, the third harmonic 50 db down.

() Record the readings you get along with a sketch or note showing where the equipment was located with respect to the antenna. Record the model number of the receiver or any other equipment you use. Keep this on file.

() Sign and date the notice of compliance with part 15 of the F.C.C. rules and affix this notice to the transmitter.

() Connect a voltmeter from the + terminal to the GND terminal. The voltage will be about 10 volts with the control knob pointer straight up. At full clockwise you will read about 22 volts. You can measure current by placing your current meter in series with the + wire.

() Adjust the voltage control so that the product of voltage x current is 100 or less (voltage in volts, current in milliamperes). This is one watt input, the maximum permitted by F.C.C. regulation.

() Remove the shorting plug from the key jack. Connect a key to the jack and you are ready to communicate on the 1750 meter band.

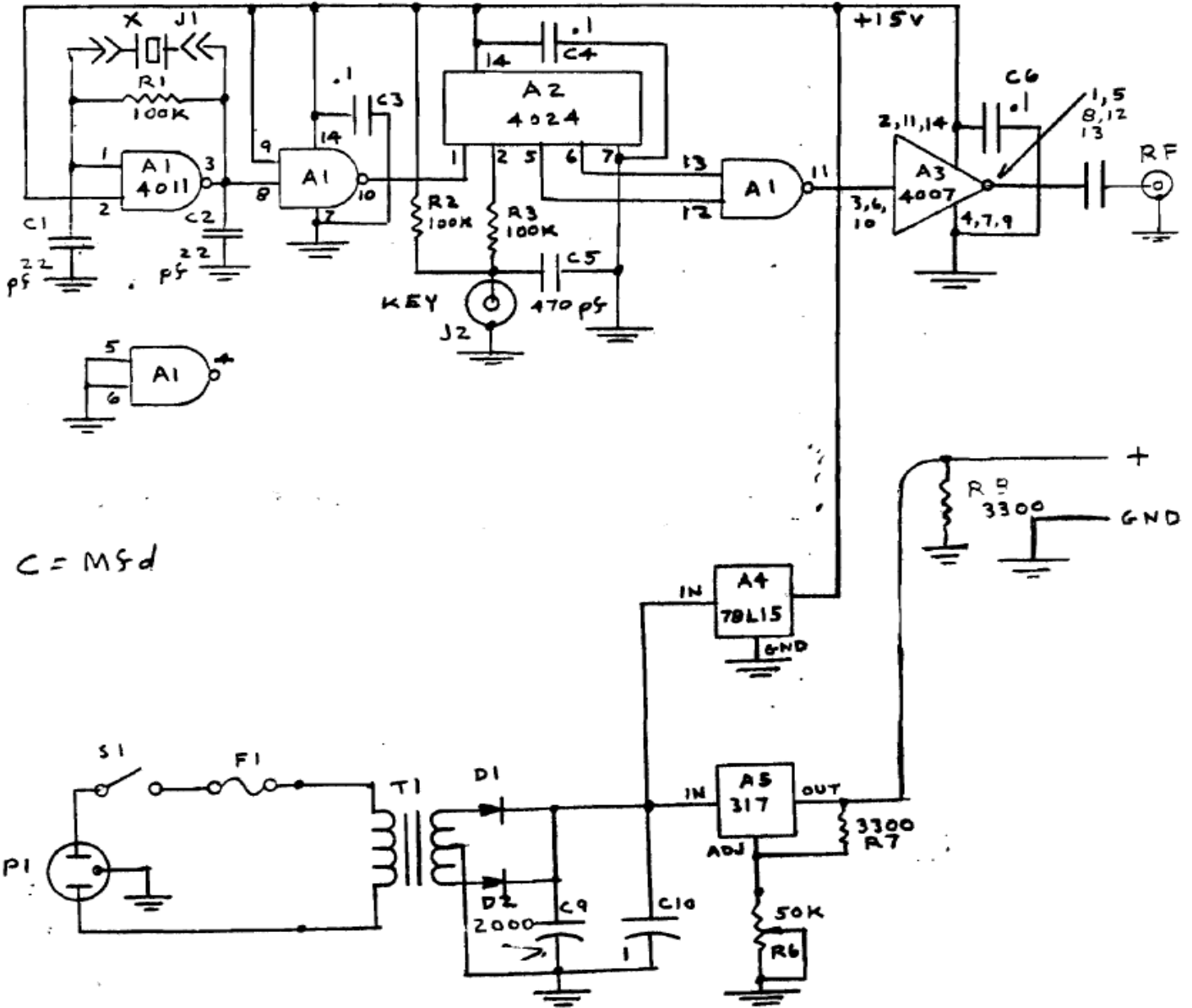
VI - FCC PART 15 LABEL

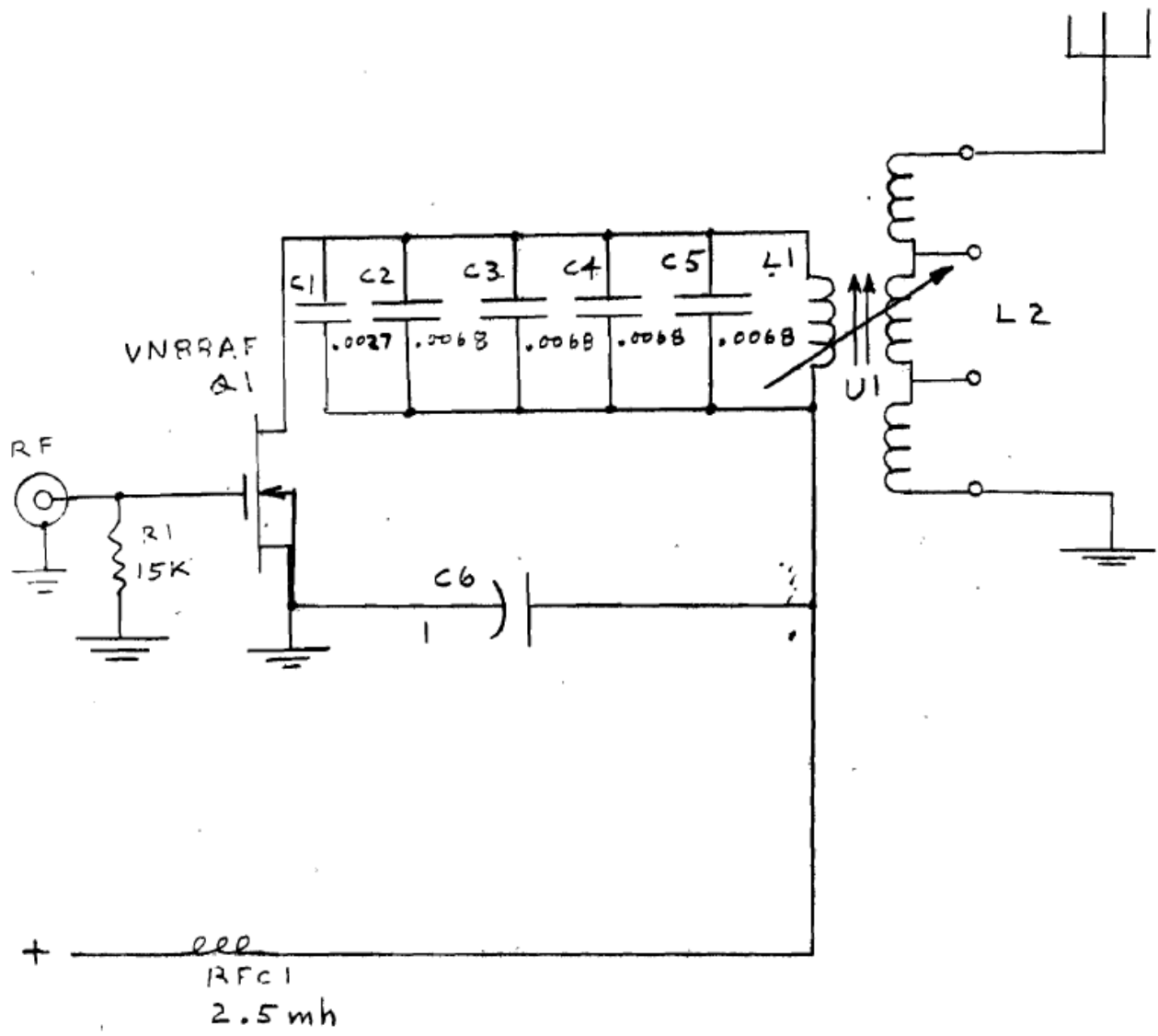
I have constructed this device for my own use. I have tested it and certify that it complies with the applicable regulations of FCC Rules Part 15. A copy of my measurements is in my possession and is available for inspection.

(Signature)

(Date)

VII - SCHEMATIC DIAGRAM





VIII - OPERATING THE TRANSMITTER

TRANSMITTER FREQUENCY

The frequency of the transmitter is controlled by the plug-in crystal. The crystal is the popular and inexpensive FT-243 type oscillating at 32 times the transmitter output frequency. The following table shows band edge and band center frequencies:

<u>Transmitter KHz</u>	<u>Crystal KHz</u>
160	5120
175	5600
190	6080

The crystal supplied with the transmitter is on or near 5600 KHz. The transmitter tank circuit is resonant on this frequency (175-KHz).

A supplier of FT-243 crystals is: JAN Crystals, 2400 Crystal Drive, Fort Meyers FL 33907.

Frequency changes of a KHz or so can be made just by plugging in new crystals. For larger changes you will observe that the current drops off. This is because the tuned circuit made up of the antenna, the loading coil, and the tuning insert is quite sharp in tuning. As you change frequency you will have to retune this circuit by adjusting the tuning insert.

The tank circuit can be operated over the entire band without retuning because, when the loading coil is peaked, the tank circuit is broad in tuning. However, as you move away from the center of the band, the off-peak current increases so it is difficult to follow the usual tuning procedure. If you plan to mostly operate toward the high or the low end of the band, you may want to change the tank circuit resonant frequency.

To do this, you need to add or remove polystyrene capacitors. To resonate the tank circuit at 160 KHz you must add 6000-pf. To resonate at 190 KHz you must remove 5000 pf. Removing the 2700 pf capacitor shifts resonance to 184 KHz.

AM MODULATION

To AM modulate the transmitter connect the + terminal of a 10 mfd 25 volt capacitor to the green wire at the voltage control potentiometer. Connect the modulating signal between the - side of the capacitor and ground (the bare wire lead at the potentiometer).

The carrier level should be set at 1 watt input. An audio signal of 20 volts peak-to-peak is required. The impedance level is about 1000 ohms.

USEFUL INFORMATION

Helpful information on receiving, transmitting, antennas, experimentation, and F.C.C. regulations is in Ken Cornell's "Low and Medium Frequency Scrapbook". Write Ham Radio Bookstore, Greenville NH 03048.

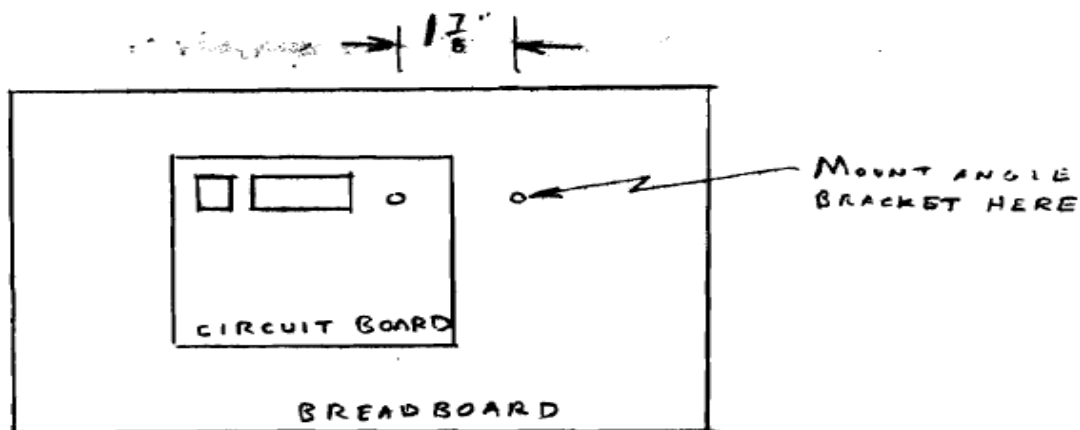
A monthly publication, The Lowdown, puts you in touch with activity on the long waves. For information send a self addressed stamped envelope to: Longwave Club of America, Box 33188, Granada Hills CA 91344.

IMPROVED TUNING

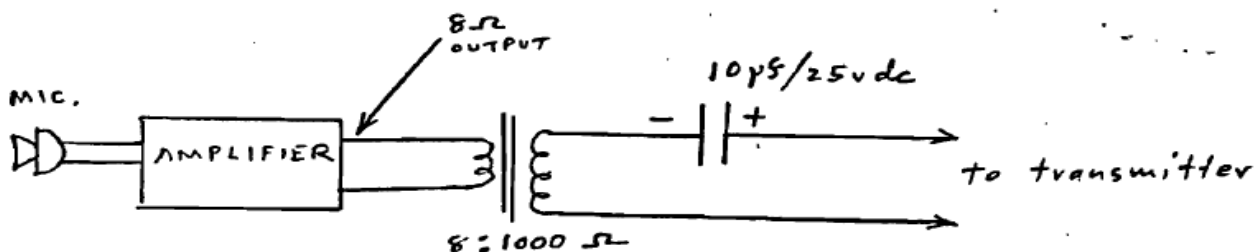
The loading coil must be tuned with the ferrite insert (the 1-7/8" plain black slug).

To make the tuning easier an iron powder insert with a threaded stud has been enclosed. The ferrite insert can be affixed to the iron powder insert using epoxy or other adhesive.

Then, using the angle bracket supplied, screwdriver adjustable tuning can be arranged. A suggested method is shown in the drawing below. The circuit board is mounted on a wooden breadboard. Then, the angle bracket is mounted on the breadboard a distance of 1-7/8" from the unused hole in the circuit board. The composite insert is threaded into the bracket. A 6-32 nut on each side of the bracket can be used to lock the insert in place.



AM MODULATION FOR THE 1750 METER TRANSMITTER

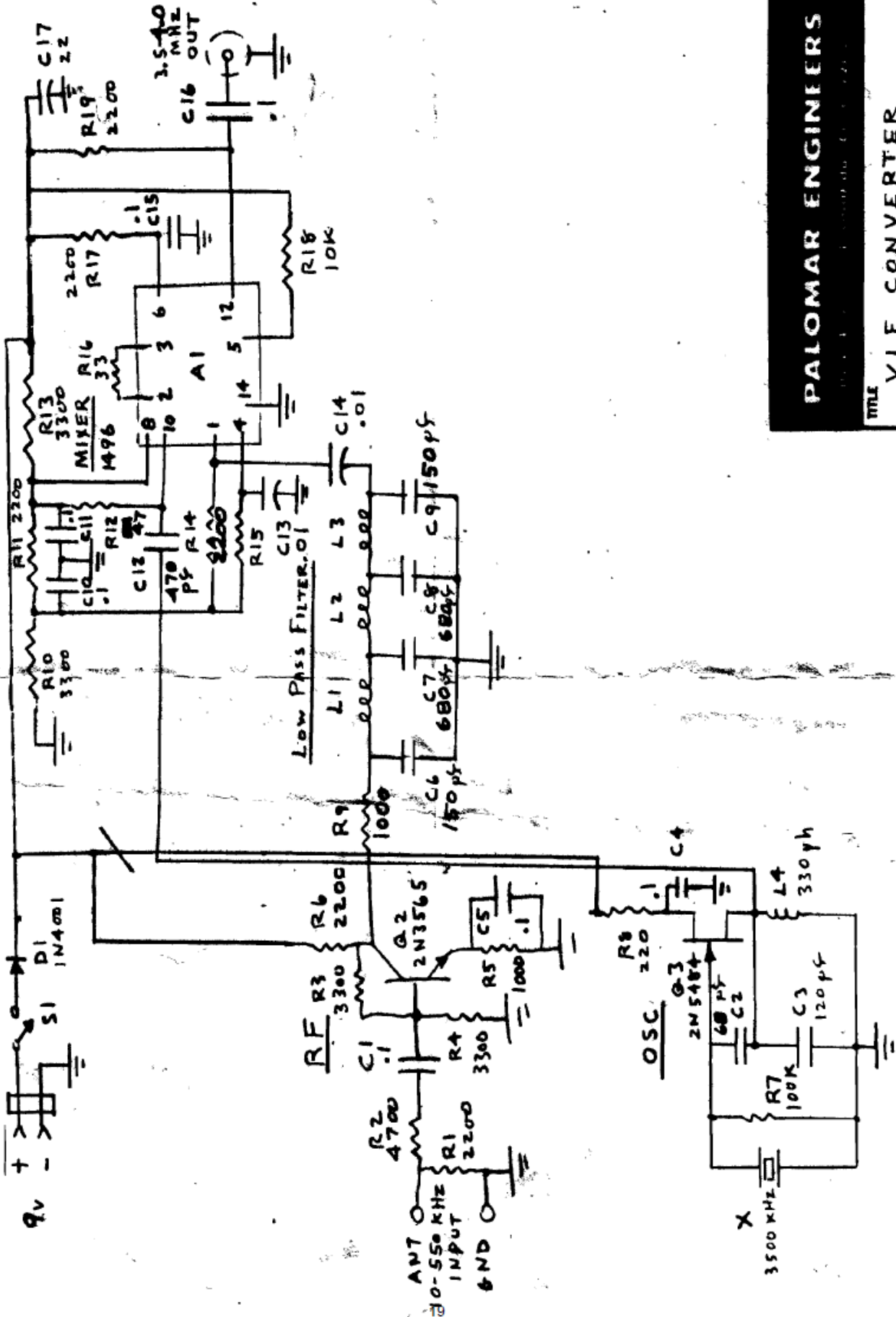


To AM modulate the transmitter use a small mono or stereo amplifier. Or use the output from a tape recorder "earphone" jack. These outputs are at about 8 ohms impedance and have adequate power. However, it is necessary to increase the audio voltage to get 20 volts peak-to-peak.

Use a transistor transformer 8 ohms to 1000 ohms or something close to this (8 to 500, 8 to 700, 8 to 1200). Connect the 8 ohm winding to the amplifier; connect the 1000 ohm winding through a 10 mfd 25-v capacitor to the transmitter. See page 8-2 of the instruction manual for the connecting points. The transformer lead connects to the transmitter chassis ground and the 10 mfd capacitor drives the "ADJ" terminal of voltage regulator A5.

The high frequency response will be greatly improved if you replace the 1 mfd bypass capacitor on the antenna matching network circuit board with a .068 mfd. Tantalum, paper, or mylar can be used with 25-v or more voltage rating.

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PALOMAR ENGINEERS

TITLE VLF CONVERTER

DATE 3-78 MODEL A SIZE DRAWING NO. 1348 SHEET 19 OF 19

VLF Converter - Operator's Instructions

Installation. Connect an antenna to the "10-500 KHz Antenna" connector. Connect a shielded cable from the "3.5-4 MHz Out" connector to a receiver that tunes 3500-4000 KHz. Clip a 9-volt transistor battery to the leads on the rear of the converter and slip the battery into the holder. Turn the switch to "On".

Tune the receiver to 3500 KHz where a strong carrier should be heard - this is the converter local oscillator. If the receiver has a dial set control, set it so the oscillator is exactly 3500 KHz on the dial.

Operation. The receiver should be set for CW reception - BFO on, AGC off - because most VLF signals are unmodulated. Turn the RF gain down far enough to keep the receiver from being overloaded.

Tune the receiver up from 3500 KHz. The VLF signals heard will be at the dial reading less 3500 KHz. 10-KHz signals will be heard at a dial reading of 3510; signals at 100-KHz will be heard at 3600, etc.

The frequency band 10-160 KHz contains standard frequency, long range navigation, radioteletype, and other signals. The band 160-190 KHz is a license-free band with power limited to one watt and antenna length to 50 feet. European broadcasters use 150-280 KHz with high power. 410-500 KHz is used by coastal ships. From 190-410 KHz there are a large number of radiobeacons. Most identify themselves by call letters sent in code. Some have AM modulation with weather reports and other information. Here are some examples:

Frequency	Call	Location
192 KHz	SPI	Petaluma CA
233	LG	Long Beach CA
236	GNI	Grand Isle LA
263	MFR	Medford OR
280	IPA	Easter Island
344	ZIY	Grand Cayman BWI
365	LEO	Leon, Mexico
397	ZBB	Bimini, Bahamas

Antennas. A long horizontal wire with its end brought to the center pin of the converter connector or a vertical antenna with its downlead connected to the center pin can be used. The connector shell should be grounded. The exact length of the antenna is not important - any practical antenna will be short as compared to the wavelength - a resonant antenna is not required for good signal pickup.

Loop antennas are effective at VLF and can be used to null out interference.

Interference. The converter is designed to minimize feedthrough of 80 meter signals and crossmodulation from standard broadcast signals. But if the receiver or the cable to it is not well shielded 80 meter signals may be heard. To test, turn off the converter. A VLF signal will disappear.

If a standard broadcast station is heard in the VLF band crossmodulation is present. To eliminate it try a shorter antenna, an attenuator between antenna and converter, a series tuned trap at the station's frequency, or a tuned circuit at VLF.

VIEW, FRONT



FRONT WITH SIDE



VIEW, BACK



VIEW, BOTTOM

