# 5 - 8 Watt Valve AM Medium-Wave Transmitter


These AM Transmitters operate between 900KHz and 1750KHz on the Medium Waveband (AM Band) and beyond.
These heritage transmitters are based on a design which I built back in the mid 1970's and is from a design which was published in 'Short-Wave Magazine' in the 1950's which was called 'Top-Band Transmitter', although the original had a Crystal or VFO valve front end.
This Transmitter circuit design employs a CMOS Phase Locked Loop oscillator circuit for accuracy and ease of frequency selection. A binary code is created by the 8 position DIP switch. It is also very stable and therefore does not drift off frequency. The Phase Lock circuit provides selection in either 9KHz steps for UK/European Union or 10KHz steps for USA. A suitable Crystal is used for either is selected at time of ordering.
This oscillator feeds the RF driver stage which uses an EF91 Pentode which then feeds the 5763 (QV03-10) Beam Tetrode output valve which can produce about 10Watts RF at this frequency.
The modulator in the transmitter uses 2 valves, an ECC83 double triode as 2 stage pre-amplifier which then feeds a 6BW6 beam tetrode, whose forerunner was the ubiquitous 6V6. This modulates the RF stage via a HT choke in the anode supply.
Hence anode modulation of the PA Amplifier. Audio input on the rear is via Phono sockets, left and right which are mixed together, so a CD player, mixer, PC etc can be used to feed the transmitter.

Audio/modulation level can be adjusted internally by the pre-set potentiometer, see details later.

This model is housed in a Steel box with ABS front and rear. A current meter is fitted in the Anode supply to the PA valve. A Pi-tank is utilised for Aerial matching.

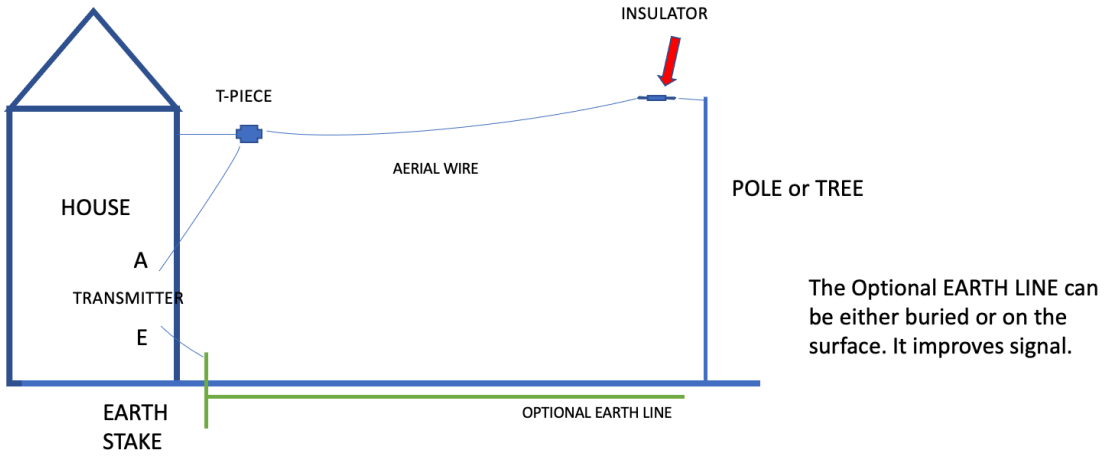
It would be advantageous if you have used a valve rig before, but it isn't essential.
Valve rigs are fairly forgiving. They don't blow-up like transistors!
For the transmitter to operate correctly, the TUNE control must be 'In-DIP', as seen on the current meter. (Or to be exact, slightly out of dip by a few percent)
The dip should be around 25mA. Do not operate the transmitter out of dip, as excessive current will be drawn through the output valve which will shorten the life of the output valve.


# Setup and Operation

1. Select the operating frequency by setting the 8-way switch to desired setting.
2. Connect up Aerial and Earth (Earth if available) together with Audio 'L and R' RCAs
3. Connect AC Mains supply and turn on unit with front panel power switch
4. Allow the transmitter to heat up, the current meter will start to climb.
5. Once there is current on the meter, quickly adjust 'anode tune' for a 'dip'.
6. Adjust aerial tune knob for maximum signal on a Field Strength Meter.
7. Re-adjust the 'Anode Tune' for dip once again. Correct reading is about 25 mA

# Advanced setup and troubleshooting

Internally, there is a 'tank coil', which is used to match the output valve with the aerial. The tank coil is situated between the two variable Capacitors. The transmitter can match various lengths of long-wire aerial etc, by adjustment of 3 components, the anode 'Tune', the 'Load' and the Pi tank Coil.
A picture of these components is shown further below.
The transmitter has been set up to operate around 1500KHz using a 10-metre-long wire. But by altering the tapping on the tank coil other frequencies and aerial lengths can be tuned. See further pics below.
It would be necessary to use a soldering iron (and a bit of experimentation) to get this part right. The copper wire used for the tank coil is enamel covered, so you will need to scrape the copper with a knife in order to solder to it.




AERIAL ARRANGEMENT

A longer aerial wire can be used with the transmitter and will give a better range. Excellent results have been obtained using a single long wire of approximately 10 metres long, 3 metres high as shown in the diagram. For example, this arrangement on 1500KHz gives around 1 mile radius range. The aerial is essentially the length of the back garden, using insulators that radio hams use. Roof top is the end of the wire, suspended via a tree at the other end. Also, the use of a good Earth helps with signal efficiency and distance. A copper stake in the ground is a good start. Search the Internet for further advice.
NOTE- DO NOT USE COAXIAL CABLE ON THE AERIAL FEED. The output is high impedance and coax will load the output and produce less RF signal. Use separate wires for Aerial and Earth. Maximise the signal level with the tuning control, whilst observing the signal on a Field Strength Meter display. A Field Strength Meter, which are readily available on eBay.

# IMPORTANT

SAFETY NOTICE

Dangerous voltages lurk inside. There is a risk of Death by touching the DC supply rail. High Voltage is present on the circuit board and meter terminals.
Ensure that the power is disconnected, and time is given for the DC supply to dissipate. (Say around 2 minutes)
Should you need to change any valves, please pay attention to the top of the circuit board shorting out on the power supply body. There should be a gap between them.
If you are in any doubt, or hesitant, then STOP and don't go inside the unit.

POWER SUPPLY

Power is derived from an internally fitted 'Switch-mode' power supply. This provides 260V DC HT and 6.3V Heater supply. A separate step-up invertor is used to supply 12V DC for the Phase-locked loop oscillator from the 6.3V heater voltage.

BLUETOOTH CONNECTIVITY

Top Tip: A Bluetooth audio adapter can be used to feed the audio into this transmitter.

Frequency setting

## Setting frequency using dip switches

There are 2 versions, EU or USA spacing as controlled by different crystals to obtain either 9KHz or 10KHz channel spacing. EU channels are in Blue, USA in Red in the tables.
At the rear of the transmitter there are a set of dip switched numbered 1 to 8.
Using the frequency table set the switches to the desired frequency.
For example, if your desired frequency is 1368Khz (1520KHz for USA crystal), look it up in the table and you will see its binary setting to the left.
As we can see the binary position is: 1 0 0 1 0 1 1 1

1530 1700 10010111

The switch positions are up for 0 and down for 1. So therefore, starting from the left-most switch and working our way to the right we get the following:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Binary number | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| Switch position | on | off | off | on | off | on | on | on |

It looks like this:


**Frequency Set Switches**

1st digit bottom, last digit at the top

These DIP switches on the rear determine the operating frequency.

## Binary switch positions

Frequency Setting on S1 (kHz) Blue=UK/EU. Red=USA

| Pre-set | S1 S2 S3 S4 S5 S6 S7 S8 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| UK-EU | USA | | | | | | | |
| 477 | 540 | 00110101 | 594 | 660 | 01000001 | 702 | 780 | 01001101 |
| 495 | 550 | 00110110 | 603 | 670 | 01000010 | 711 | 790 | 01001110 |
| 504 | 560 | 00110111 | 612 | 680 | 01000011 | 720 | 800 | 01001111 |
| 513 | 570 | 00111000. | 621 | 690 | 01000100 | 729 | 810 | 01010000 |
| 522 | 580 | 00111001 | 630 | 700 | 01000101 | 738 | 820 | 01010001 |
| 531 | 590 | 00111010 | 639 | 710 | 01000110 | 747 | 830 | 01010010 |
| 540 | 600 | 00111011 | 648 | 720 | 01000111 | 756 | 840 | 01010011 |
| 549 | 610 | 00111100 | 657 | 730 | 01001000 | 765 | 850 | 01011100 |
| 558 | 620 | 00111101 | 666 | 740 | 01001001 | 774 | 860 | 01010101 |
| 567 | 630 | 00111110 | 675 | 750 | 01001010 | 783 | 870 | 01010110 |
| 576 | 640 | 00111111 | 684 | 760 | 01001011 | 792 | 880 | 01010111 |
| 585 | 650 | 01000000 | 693 | 770 | 01001100 | 801 | 890 | 01011000 |
| | | | | | | | | |
| 810 | 900 | 01011001 | 918 | 1020 | 01100101 | 1026 | 1140 | 01110001 |
| 819 | 910 | 01011010 | 927 | 1030 | 01100110 | 1035 | 1150 | 01110010 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 828 | 920 | 01011011 | 936 | 1040 | 01100111 | 1044 | 1160 | 01110011 |
| 837 | 930 | 01011100 | 945 | 1050 | 01101000 | 1053 | 1170 | 01110100 |
| 846 | 940 | 01011101 | 954 | 1060 | 01101001 | 1062 | 1180 | 01110101 |
| 855 | 950 | 01011110 | 963 | 1070 | 01101010 | 1071 | 1190 | 01110110 |
| 864 | 960 | 01011111 | 972 | 1080 | 01101011 | 1080 | 1200 | 01110111 |
| 873 | 970 | 01100000 | 981 | 1090 | 01101100 | 1089 | 1210 | 01111000 |
| 882 | 980 | 01100001 | 990 | 1100 | 01101101 | 1098 | 1220 | 01111001 |
| 891 | 990 | 01100010 | 999 | 1110 | 01101110 | 1107 | 1230 | 01111010 |
| 900 | 1000 | 01100011 | 1008 | 1120 | 01101111 | 1116 | 1240 | 01111011 |
| 909 | 1010 | 01100100 | 1017 | 1130 | 01110000 | 1125 | 1250 | 01111100 |
| 1134 | 1260 | 01111101 | 1242 | 1380 | 10001001 | 1350 | 1500 | 10010101 |
| 1143 | 1270 | 01111110 | 1251 | 1390 | 10001010 | 1359 | 1510 | 10010110 |
| 1152 | 1280 | 01111111 | 1260 | 1400 | 10001011 | 1368 | 1520 | 10010111 |
| 1161 | 1290 | 10000000 | 1269 | 1410 | 10001100 | 1377 | 1530 | 10011000 |
| 1170 | 1300 | 10000001 | 1278 | 1420 | 10001101 | 1386 | 1540 | 10011001 |
| 1179 | 1310 | 10000010 | 1287 | 1430 | 10001110 | 1395 | 1550 | 10011010 |
| 1188 | 1320 | 10000011 | 1296 | 1440 | 10011111 | 1404 | 1560 | 10011011 |
| 1197 | 1330 | 10000100 | 1305 | 1450 | 10010000 | 1413 | 1570 | 10011100 |
| 1206 | 1340 | 10000101 | 1314 | 1460 | 10010001 | 1422 | 1580 | 10011101 |
| 1215 | 1350 | 10000110 | 1323 | 1470 | 10010010 | 1431 | 1590 | 10011110 |
| 1224 | 1360 | 10000111 | 1332 | 1480 | 10010011 | 1440 | 1600 | 11001111 |
| 1233 | 1370 | 10001000 | 1341 | 1490 | 10010100 | 1449 | 1610 | 1010000 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1458 | 1620 | 10100001 | 1521 | 1690 | 10101000 | 1584 | 1760 | 10111111 |
| 1467 | 1630 | 10100010 | 1530 | 1700 | 10101001 | 1593 | 1770 | 10110000 |
| 1476 | 1640 | 10100011 | 1539 | 1710 | 10101010 | 1602 | 1780 | 10110001 |
| 1485 | 1650 | 10100100 | 1548 | 1720 | 10101011 | 1611 | 1790 | 10110010 |
| 1494 | 1660 | 10100101 | 1557 | 1730 | 10101100 | 1620 | 1800 | 10110011 |
| 1503 | 1670 | 10100110 | 1566 | 1740 | 10101101 | 1629 | | 10110100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1512 | 1680 | 10100111 | 1575 | 1750 | 10101110 | 1638 | | 10110101 |

Adjustment and alignment.

The only adjustments that need to be done other than frequency setting are those on the output of the transmitter by way of Anode Tune and Aerial Load. The Pi Tank Coil as already mentioned, may need re-tapped by adjusting the turns on the coil.

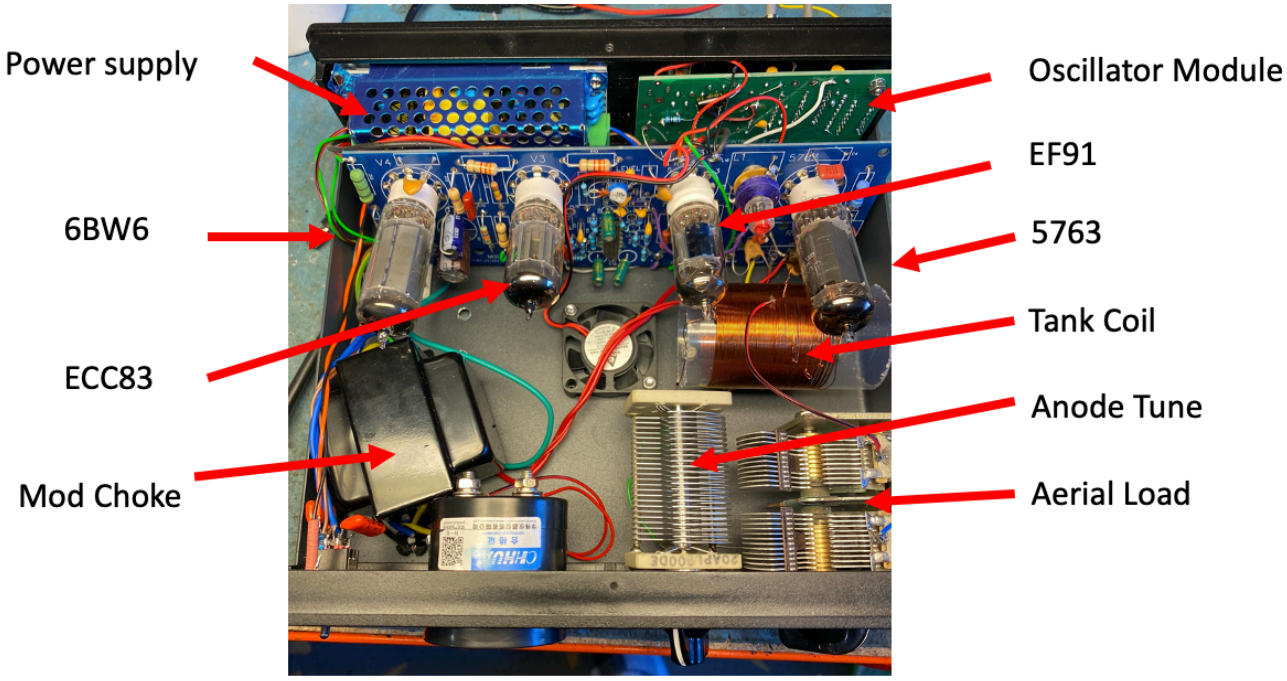
RF Drive

There is a tuning slug on L1. It should not be necessary to adjust this.

Audio Level

Adjust pre-set VR1 for maximum modulation, or best sound audio as monitored by receiver.

# Inside the Transmitter



## Technical Specifications

Size - 220mm wide, 240mm depth, 80mm high
Weight. - 3Kg
Power requirement - AC Mains 110-240V
Operating Frequency – 900 to 1700KHz
Audio input – RCA Phono sockets, left and right audio 775mV RMS
Audio Bandwidth (+ −3dB) - 80Hz to 5KHz
Modulation level – up to 100%
RF Output level – 5 to 8 Watts Average (or more depending on Aerial Match)
RF Output Capacitor – 500pF variable
RF connection – M3 screw terminal
Display - Final Amplifier Anode Current (50mA FSD)
Ventilation – passive convection plus 2 small fans.

*Do not use Coaxial Cable. Output is high impedance and Coax will swamp out the voltage