# FORTOP LTD

Manufacturers & Suppliers of Radio Equipment


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## THE TVT437 TELEVISION TRANSMITTER KIT.

This is new product from FORTOP LTD represents a departure from our normal products in that it is the first of a new range of products we are producing as kits. For quite a long time now people have been coming to us and asking 'when will we be able to buy your products in kit form', and we have always replied that we had not intended to do so. However the demand has been so great that we have desided to produce a range of low cost modules that will enable the user to 'customise' his own TV transmitter / receiver system. This then is the first product in the range.

The TVT437 TV TRANSMITTER incorporates the FORTOP SYNC-PULSE CLAMP circuit originaly designed for our ready-made transmitters, indeed this circuit is fast becoming the 'STANDARD' for high performance amateur TV transmitters (at least one manufacturer has incorporated OUR circuit into THERE transmitter!). The unit was designed to give the flexability that amateurs require. For example it is a simple task to change the oscillator circuit into a buffer and feed in the oscillator from a different source (multi-frequency). The unit need not be built in the die-cast box provided, you might like to fit front panel controls for VR1 & VR2 and mount the board along with a linear amplifier and a power supply into a larger box. There is nothing to stop the enthusiastic amongst you from changing the oscillator into a buffer, running the unit without the modulator, and using it as a frequency multiplier & power amplifier for a low-power 24cms exciter (you need a tripler on the output though). The flexibility of the unit is only limited by the constructor.

## THE TVT437 TV TRANSMITTER.

RF OUTPUT POWER.....250mW PSP min
VIDEO INPUT LEVEL.....1.0V TO 2.5V P-P (terminated)
FREQUENCY.....CRYSTAL CONTROLED AT 437MHz
(435.5MHz available)
POWER CONSUMPTION.....11V TO 13.8V, @ 250mA max
CONTROLS.....BLACK-LEVEL AND VIDEO-GAIN
PCB SIZE.....95mm X 50mm

The kit is supplied complete with all parts and instructions to build this high-quality TV transmitter in approx 3 hrs, using a minimum of home made test equipment. A die-cast box suitable for housing the completed pcb is supplied with the kit.


Directors: S. J. Mitchell S. J. Whalley (Secretary)
Registered in England No. 1554751 Registered Office: Victoria Chambers, 48 The Boulevard, Tunstall, Stoke-on-Trent

# ASSEMBLY INSTRUCTIONS

1) Fit all 1mm pins. Fit from track side of pcb and push into board with hot soldering iron.

2) Fit all resistors EXCEPT R15,R16,R20,R24 & R28.

3) Fit D1,D2 & D3. Check polarity.

4) Fit VR1 & VR2.

5) Fit all capacitors EXCEPT C9 & C10. Caution should be excersised when fitting trimmers as they have a tendency to melt. Check polarity of electrolytic capacitors.

6) Fit all transistors EXCEPT TR5 & TR10. Solder tab of TR9 to top of board. Do not use excesive heat as the transistors are easily damaged.

7) Fit L1,L2.L3,L4,L5.

8) Cut leads on TR10 and place into pcb. Solder ONLY the emitters.

9) Fit L7,L8,R15,R16 & C10. Solder on top and bottom of pcb. Solder collector and base of TR10 as well.

10) Fit L9.

11) Fit C9.

12) Fit TR5. Mount on plastic spacer and fit heatsink.

13) Check that all the components that require soldering on the top side of the PCB have been solderd.

14) CHECK FOR SOLDER SHORTS ON THE UNDER SIDE OF THE PCB. Pay particular attention to the transistor connections as they are very close together and shorts may not be obvious.

The transmitter should work first time if care is taken when assembling thekit.

CIRCUIT DESCRIPTION

Tr6 forms a crystal controled oscillator running at 109.25 MHz. A fifth overtone crystal is used to ensure good spectral purity. The oscillator has been chosen to run in the range 109 MHz to ensure that no harmonics of the crystal fall anywhere near 144 MHz. The output of the oscillator is coupled into the first doubler stage by C26. L2 is tuned to resonance at 218.5 MHz by C22. The output of the first doubler is coupled to the next by C21. The output of the second doubler is arranged as a bandpass filter at 437 MHz. This effectively removes most of the harmonics of the drive source and ensures a clean RF drive to the output stage. A printed, series matching element is used to match the output impedance of the filter to the input impedance of TR10. Modulation is applied to the collector of TR10 via an RF choke with a small amount of decoupling. If the decoupling capacitors were of a larger value, then the effective bandwidth of the transmitted signal would be seriously affected. Two capacitors are used in parallel rather than a single one of larger value to reduce the effect of inductive reactance.

The video input is buffered by the emitter follower TR1 and fed to the video gain control VR1. A small amount of the signal is also fed to TR2. TR2 is configured as a sync-pulse separator which 'clips off' the video and produces positive going sync-pulses at it's collector. These pulses are used to clamp the output of the modulator. TR3 is actualy an emitter follower which clamps the collector of TR4 (base of TR5) to the positive rail for the duration of the sync-pulse. When the sync pulse is not present the output of the sync-pulse separator is at approx 0V. This reverse biases the base emitter junction of TR3 because it's emitter is at a higher potential (collector of TR4) then it's base. Tr4 is actualy the video amplifier, it's function is to increace the level of the video signal to that required to modulate the RF outut stage. The gain of this stage is set by the ratio of R11 to R12, the lower the value of R12 the higher the gain. To control the level of the video output, we control the video input level using VR1. The video signal at the collector of TR4 is a full composite signal but the sync level has been reduced by the limiting that occures in the stage. The reason for this is that it is extreamly difficult, if not impossible, to amplify up a signal to 12 volts peak-peak when, the supply is only 12 volts! For this reason the sync-pulse clamp was developed. The processed syncs are gated onto the output of TR4 thus achieving maximum voltage out on syncs, IRRESPECTIVE of video gain or black level control settings. The output from the collector is current amplified by TR5 and fed to the RF output stage. This then is the FORTOP SYNC-PULSE CLAMP.

# ASSEMBLY INSTRUCTIONS

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2) Fit all resistors EXCEPT R15,R16,R20,R24 & R28.

3) Fit D1,D2 & D3. Check polarity.

4) Fit VR1 & VR2.

5) Fit all capacitors EXCEPT C9 & C10. Caution should be excersised when fitting trimmers as they have a tendency to melt. Check polarity of electrolytic capacitors.

6) Fit all transistors EXCEPT TR5 & TR10. Solder tab of TR9 to top of board. Do not use excesive heat as the transistors are easily damaged.

7) Fit L1,L2,L3,L4,L5.

8) Cut leads on TR10 and place into pcb. Solder ONLY the emitters.

9) Fit L7,L8,R15,R16 & C10. Solder on top and bottom of pcb. Solder collector and base of TR10 as well.

10) Fit L9.

11) Fit C9.

12) Fit TR5. Mount on plastic spacer and fit heatsink.

13) Check that all the components that require soldering on the top side of the PCB have been solderd.

14) CHECK FOR SOLDER SHORTS ON THE UNDER SIDE OF THE PCB. Pay particular attention to the transistor connections as they are very close together and shorts may not be obvious.

The transmitter should work first time if care is taken when assembling thekit.

## ALIGNMENT

Alignment is straight forward and may be accomplished using only a small amount of equipment. (see detail at the end of this section).

Connect the 50 ohm load onto the RF output. Supply power and check that the unit is not drawing more than 250mA, if it is then SWITCH OFF and check for shorts (top and bottom side) on the pcb. Using the RF sniffer described, trim L1 until the oscillator starts. Ensure that the oscillator starts every time by switching the supply on and off a few times. If it fails to start trim L1 a small amount. Place the coupling probe near to L2 and trim C22 for maximum reading on the meter.(L2 is tuned to 218.5 MHz). Place the probe near L3 and trim C18 for maximum.(L3 is tuned to 437 MHz). Connect meter to the output of the load circuit and set to give a reading on scale (3V scale). Tune all trimmer capacitors for a maximum reading on the meter. If a spectrum analyser is available (I imagine it usualy won't be) then set up the transmitter to give maximum output with minimum spurious outputs. Test show that tuning up the transmitter without the aid of an analyser results in a typical spurious output level of -40dbC.

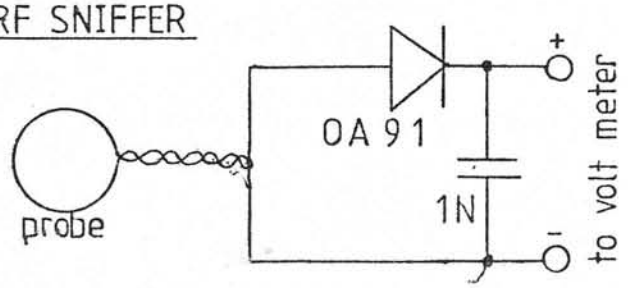
After the RF tests have been completed apply video to the transmitter. If an oscilloscope is available check that the output from the modulator (test pin 1) is a good video waveform, and that the sync-pulses are clamped to approx +11V irrespective of the setting of VR1 or VR2. If this is not the case then check the waveform at the collector of TR2, it should be very large positive going sync-pulses. The input buffer TR1 will produce, at it's emitter, a video waveform the same level as that of the input, however it will be at a DC level of approx +8V. VR1 sets the VIDEO GAIN while VR2 sets the BLACK LEVEL.

If an oscilloscope is not available then the modulator can be checked in the following way. With no video input the RF output from the transmitter should not alter very much with adjustment of VR2. If it does vary then the sync-pulse clamp is not working. Check the collector voltage of TR2, it should be approx +11V, if not then check the polarity of C2 and TR2. Assuming that the output does not vary then apply video. Set VR1 fully anticlockwise, then adjust VR2 and monitor the RF output level. The RF output should vary considerably, if no change is observed than check the sync-pulse clamp circuit. If conciderable change is noted then the modulator is proberbly functioning correctly.

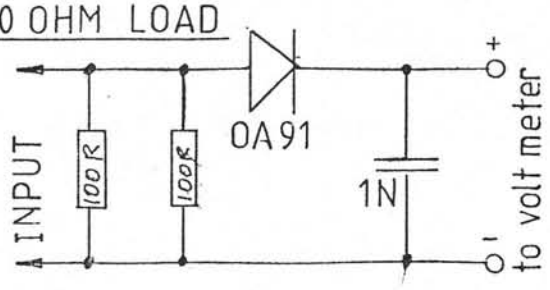
The average RF output from the transmitter will drop to approx 125mW when the unit is fully modulated. To set up VIDEO GAIN and BLACK LEVEL an oscilloscope is the best tool (using a detector probe in the output of the transmitter), however setup can be achieved without the aid of a 'scope using the following method.

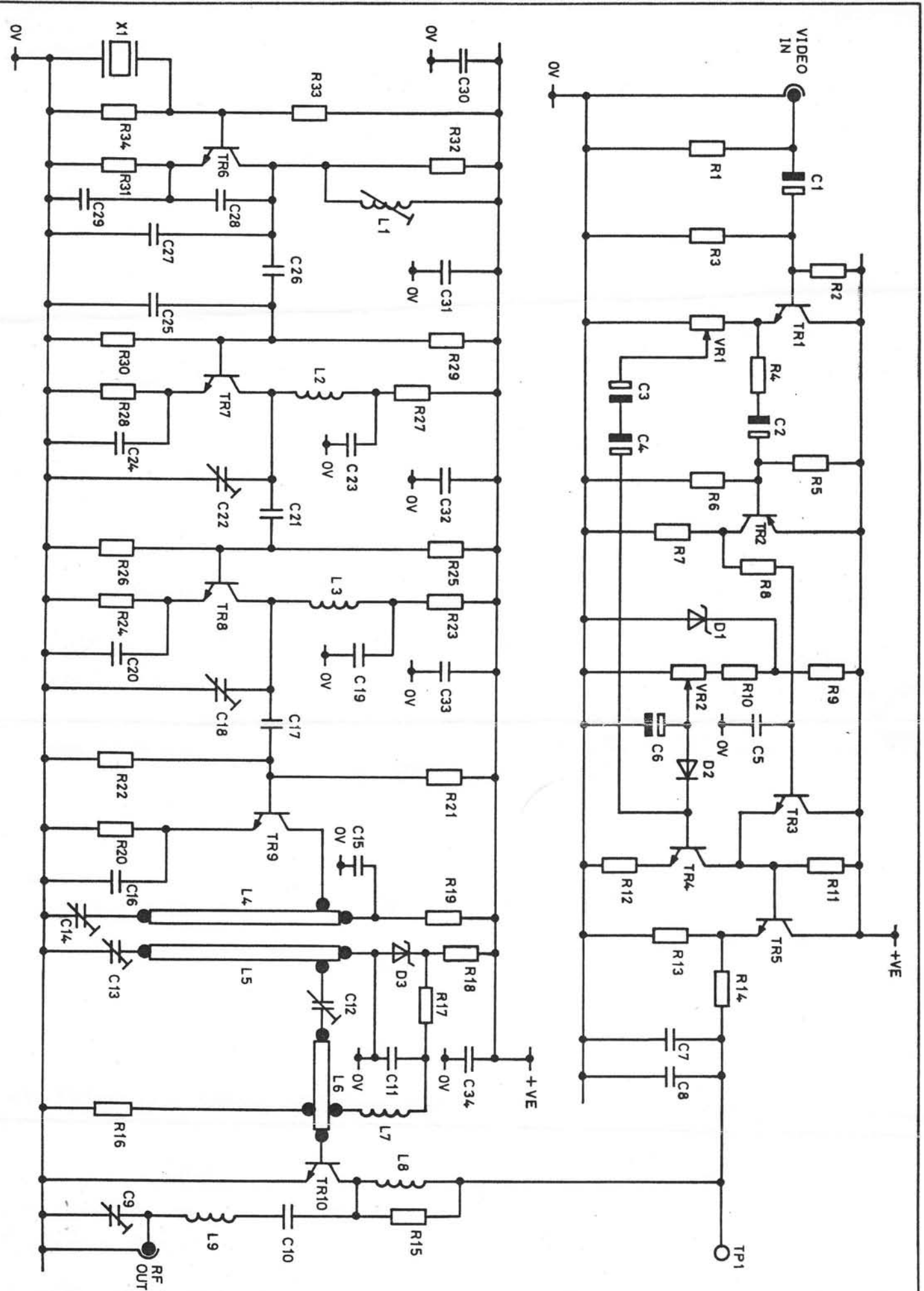
Set VR1 to 75% clockwise and VR2 to mid-travel. Monitor the output of the transmitter on a receiver, ensure that the receiver is not being overloaded. Adjust the BLACK-LEVEL control (VR2) anticlockwise until any vertical lines in the scene start to bend, back off slightly from this point. Set the VIDEO-GAIN (VR1) for normal contrast without 'peaking' on whites,(loss of contrast on high brightness areas of the scene.

RF SNIFFER




50 OHM LOAD



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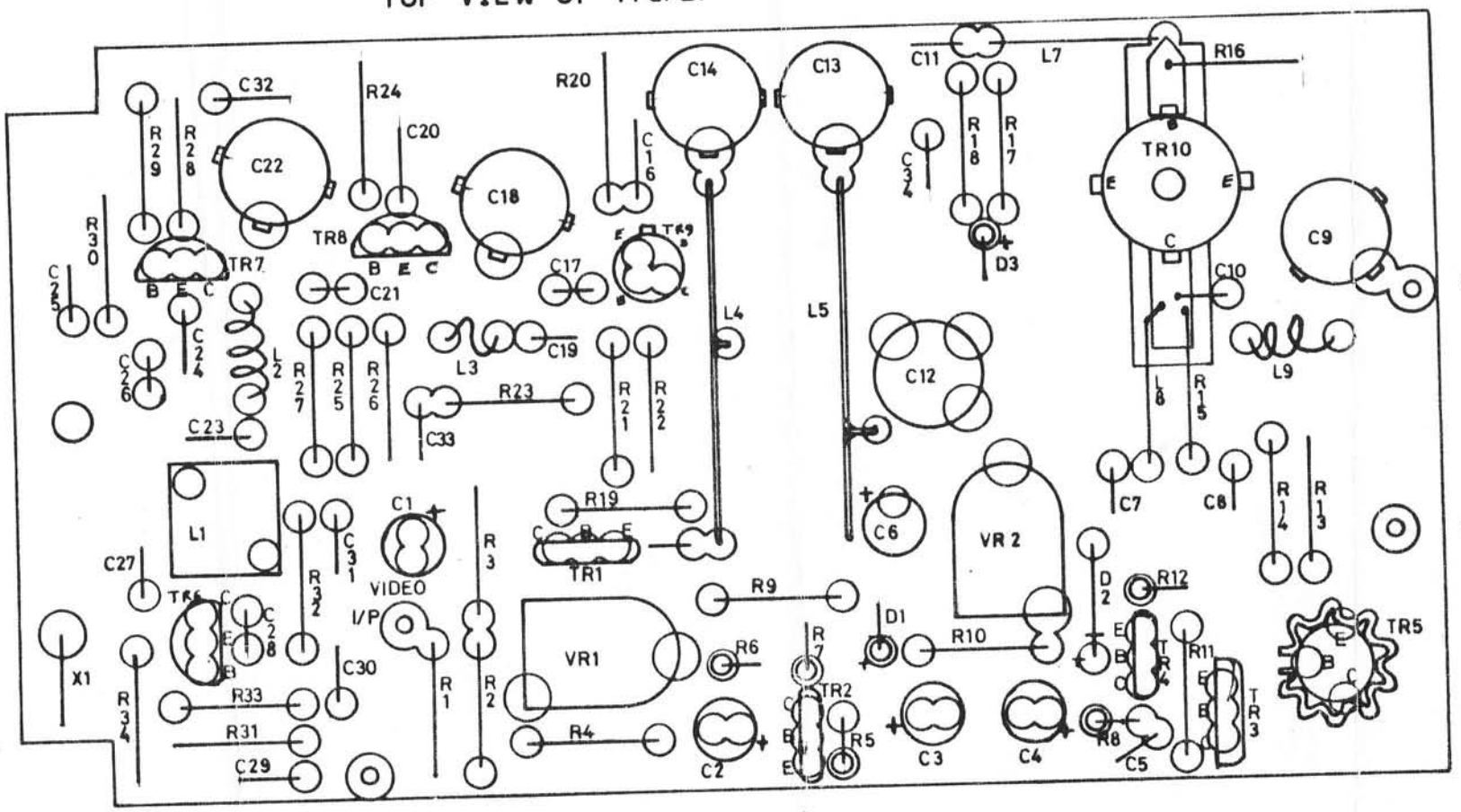
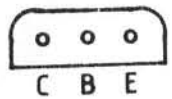
|---|---|---|---|---|
| FORTOP LTD | Drawn by S.A.B. | Eng SJM | Contract | Sheet 1 of 1 |
| | Date 30_10_83 | Approved SJM | Part No. TVT437 | Scale — |
| | Title TVT 437/1 SCHEMATIC DIAGRAM | | | |

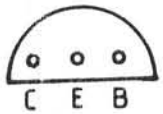
# TOP VIEW OF P.C.B.



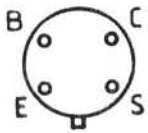

PIN VIEW



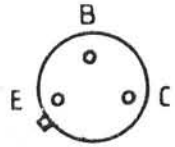

TR1, 2, 3, 4




TR6, 7, 8




TR9




TR5

| | | | |
|---|---|---|---|
| FORTOP LTD | Drawn: S.A.B. | Contract: | Sheet 1 of 1 |
| | Date: 30-10-83 | Approved: SJM | Part No: TVT437 |
| | Title: TVT437 ASSEMBLY DETAIL | SJM | Scale: — |

# PARTS LIST TVT437/1

| | |
|---|---|
| R1- 82R | C1- 22mF 16v |
| R2- 6K8 | C2- 2.2mF 16v |
| R3- 12K | C3- 22mF 16v |
| R4- 10R | C4- 22mF 16v |
| R5- 33K | C5- 47pF |
| R6- 330K | C6- 22mF 16v |
| R7- 4K7 | C7- 47pF |
| R8- 2K2 | C8- 47pF |
| R9- 220R | C9- 2-10pF (YELLOW TRIMMER) |
| R10- 2K2 | C10- 470pF |
| R11- 1K | C11- 470pF |
| R12- 82R | C12- 1-5pF (GREY TRIMMER) |
| R13- 2K2 | C13- 2-10pF (YELLOW TRIMMER) |
| R14- 10R | C14- 2-10pF (YELLOW TRIMMER) |
| R15- 220R | C15- 470pF |
| R16- 220R | C16- 470pF |
| R17- 2K2 | C17- 2.2pF |
| R18- 220R | C18- 2-10pF (YELLOW TRIMMER) |
| R19- 100R | C19- 470pF |
| R20- 220R | C20- 470pF |
| R21- 4K7 | C21- 4.7pF |
| R22- 1K | C22- 2-22pF (GREEN TRIMMER) |
| R23- 220R | C23- 470pF |
| R24- 390R | C24- 470pF |
| R25- 33K | C25- 10pF |
| R26- 15K | C26- 4.7pF |
| R27- 220R | C27- 10pF |
| R28- 390R | C28- 2.2pF |
| R29- 33K | C29- 10pF |
| R30- 15K | C30- 470pF |
| R31- 680R | C31- 470pF |
| R32- 3K3 | C32- 470pF |
| R33- 12K | C33- 470pF |
| R34- 3K3 | C34- 470pF |

VR1- 1K HORIZONTAL
VR2- 1K HORIZONTAL

PARTS LIST TVT437/1 cont'

TR1- ZTX109
TR2- ZTX214
TR3- ZTX109
TR4- ZTX109
TR5- BFY52
TR6- BF375
TR7- BF375
TR8- BF375
TR9- BFY90
TR10- PT4642

D1- BZY885v6 (5.6v ZENER)
D2- 1N4148
D3- BZY885v6 (5.6v ZENER)

X1- 109.25 MHz CRYSTAL (HC18/U)

8 off- 1mm PINS
1 off- TO5 INSULATING SPACER
1 off- TO5 HEATSINK
2 off- NUTS FOR TR10 (use one as spacer)
1 off- PCB TVT437/1
1 off- TRIMMING TOOL (COIL WINDING FORMER)

LLS

L1.....PRE-WOUND COIL ( orange former )

L2.....3 turns 4mm diameter, spaced out to 7mm length, mounted 1mm above the PCB.

L3.....1 turn 4mm diameter, spaced out to 3.5mm length, mounted 1mm above the PCB.

L4.....Wire line as drawing, mounted 5mm above the PCB, with tap.

L5.....Same as L4.

L6.....Printed line. Printed as part of PCB.

L7.....0.22 uH ( or 0.33 uH ) pre-wound choke.

L8.....Same as L7

L9.....2 turns 7mm diameter, spaced out to 6.5mm length, mounted 1mm above PCB.

IE

The trimming tool supplied is the correct diameter for the winding of L2,L3 and L9. The sheilded end of the trimmer for L2 and L3 , and the main handle for L9.

TAIL OF L4 & L5