Mini-Kits®

Mini 1250MHz FM Video Transmitter VK5EME36

Specifications:	Tx Freq	Freerunning VCO 900 to 1330MHz
	Output Power	50mW (+ 17dBm) Using a MAV11 MMIC 10mW (+ 10dBm) MAR4 only Version
	Pre-emphasis Video	CCIR standard NORM - 405 - 1
	Video I/P	1v P-P 75 ohms
	Audio I/P	Optional 5.5MHz subcarrier input

TRANSMITTER DESCRIPTION: The complete 1250MHz FM Video transmitter is built on a single 80 x 35mm size PC board & takes around 1 Hour to build. The circuitry consists of a freerunning oscillator tuned to 1250MHz, with a two stage RF amplifier giving up to 50mW (+17dBm) output. Alternatively the second MAV11 amplifier stage can be left out to give around 10mW (+10dBm) output from the MAR4 stage, for driving an optional Power Amplifier. The design is based on previous designs, but is now a basic building block with which other option kits can be added at a later stage. The circuitry has been greatly simplified by not using a PLL, (Phase Locked Loop) as in previous designs. Because of the wide bandwidth used with FM ATV, a freerunning VCO, (Voltage Controlled Oscillator) was found to bave ample stability (+/ - 1MHz) maximum. A FM receiver not using AFC, (Automatic Frequency Control) was found to quite easily cope with the minimal drift of the transmitters oscillator, which can quite easily be monitored on a frequency counter, or a satellite receiver. Also by not using a PLL & video buffer stages, the transmitter had a much better high frequency response by driving the VCO direct with the video signal. Too much capacitance across the oscillators varicap diode, lowers the high frequency response of the transmitter. If audio is required then a 5.5MHz audio/subcarrier Kit (VK5EME38) can be simply added to the Video transmitter.

VIDEO PROCESS: Refer to the circuit diagram. The video process circuitry has been greatly simplified to a minimum required to get the best possible high frequency response from the transmitter. A 1v p-p Video signal is fed into the Video input through a standard CCIR 405 pre-emphasis network. The video signal is then adjusted for level through the deviation trimpot & is applied through a 1kohm resistor to the BB405B varicap diode in the VCO.

TRANSMITTER: Refer to the circuit diagram. The basis of the FM modulator is a freerunning (Voltage Controlled Oscillator), VCO, using a BFG96 transistor at 1250MHz. The frequency is determined by the stripline inductor L2 & a 5pF high temperature trimmer capacitor, & is able to be fine tuned (+/- 5MHz) by adjusting the DC voltage to the varicap diode, by the fine tune trimpot in a simple voltage divider cct. The FM modulated signal is then buffered and amplified by MAR4 and MAV11 MMIC's to 50mW output.

CONSTRUCTION:

1. The PC board supplied is a professionally made plated through hole board, which makes it easier to construct the kit & gives the finished project a professional appearance. The boards component spacings & drilled hole sizes were designed around the components that are used in the kit, so no drilling or modifications to the PC board should be required. The single earth pad connections on the bottom of the PC hoard are plated through holes & only have to be soldered on the track side of the board.

2. If you are building the Mini transmitter to drive a 2 Watt M67715 Mitsubishi PA, you only require 5-10mW of RF drive from the transmitter. You can either build the complete 50mW transmitter & use a 8-10dB attenuator pad on the output, or build the transmitter without the MAV11 & associated components, & use just the MAR4 which will give a maximum power output of 10mW.

3. Follow the PC hoard overlay diagrams and circuits carefully, by checking the components and placing them onto the PCB. All component leads should be kept as short as possible, using good UHF construction techniques. This is especially important around the 1250MHz VCO where chip components are used in critical areas to minimize lead inductance. The oscillator may not be able to reach 1250MHz if the components leads are too long. The chip capacitors, MMIC amplifiers, & the BFG96 transistor are all mounted on the track side of the PCB. Cut one of the BFG96 emitter legs off as both are not required. To solder in the chip capacitors a pair of tweezers are used to hold the capacitors in place, soldering one side first then the other side. The 1pF chip capacitor is soldered diagonally across the collector-emitter legs of the BFG96 transistor. When soldering in the MMIC amplifiers, the earth connections are bent 90 degrees & passed through the mounting hole in the PCB & bent out on the other side, & soldered to the groundplane. When soldering in the trimpots allow for a slight gap between the wide part of the trimpots legs & the top groundplane of the PCB, this will stop any potential shorts. All coils should be wound carefully as per the instructions in the parts list.

CONNECTIONS & BOX MOUNTING:

1. Either a RF socket connector, or a direct coax connection can be used on the output of the transmitter. To use a socket on the output, either use a **BNC or SMA flange mount socket**, as these are the only recommended types to use. The PCB may have to be filed on the end to butt the socket hard up against the board, & to mate the center pin of the socket against the stripline. The outer of the socket is soldered directly to the top groundplane of the PCB.

2. Connections from the transmitter to either an antenna socket or to & from a Power Amplifier should all be made using miniature RG-178 50ohm Teflon coax, DSE part No W2088 with good termination's each end. Poor 50ohm termination's cause SWR reflections, & will cause instability problems with the transmitter. When preparing the end of the coax keep the center core & earth braid connections very short. Pigtails, (Long lead lengths & twisting of the earth braid) is not a good UHF practice & causes a very poor 50ohm termination. To prepare the end of length of coax, cut 10mm of insulation off of the end of the coax so that 10mm in length of the earth braid is now showing. Then cut off 5mm of the earth braid by cutting around it carefully with a sharp pair of side cutters leaving 5mm of braid, & 5mm of insulated center core now showing. Heat the earth braid with a soldering iron & flow some solder evenly into the braid. Now cut off 3.5mm of the insulation that is around the center inner core of the cable with side cutters so that you have a 3.5mm length of the inner wire core now showing. Twist the center core of the coax & apply a small amount of solder to keep the twists in place.

3. For a good direct coax connection to the PCB, it is suggested that a 0.7mm hole is drilled through the stripline & PCB. The drill hole position is shown on the PCB overlay diagram for either the MAV11 or (MAR4 only) version. Recess the drilled hole with a slightly larger drill bit & pass the center core of the coax through the hole on the top groundplane side of the PCB & solder it to the stripline. The coax is positioned horizontal to the PCB, & the earth braid of the coax is then soldered directly to the top of the PCB. If a connector needs to be put on the end of the coax, then the same preparation of the coax that is used in section 2 is recommended as it is for all the RF connections to & from the boards. e.g. when connecting the coax to an antenna output socket, the center pin should be cut very short, just allowing enough length to solder the center core of the coax. Solder the coax to the sockets center pin & then position the coax so that the earth braid can be soldered directly to the outer of the socket, & as close as possible to the center insulator. This with give a good 50ohm termination without using an expensive & specialized connector. Don't use a solder lug bolted to one of the sockets mounting holes for the coax earth connection, this is only acceptable on HF & VHF.

4. Check your construction carefully, that you have no shorts, solder dags etc as they are a lot more difficult to repair later on when the PCB is mounted in a box.

5. When deciding on what box you are going to mount the transmitter in, make sure that you get one that is big enough to allow for ample clearance around the board. If you are mounting a Power Amplifier in the same box you will have to shield the transmitter board from the Power Amplifier section, & use feedthrough capacitors for the power wiring between the boards. A suitable box for a complete 2W transmitter using the VK5EME36, VK5EME38, & VK5EME01 kits, is at Extruded Aluminium Heatsink box from DSE, part No H-3002. The transmitter board will need to be cut a bit shorter to fit it all in the box, this is done by cutting away the MAV11 section which is not required anyway when using the Mitsubishi 2W PA. Fabricate an aluminium shield to mount down the center of the box for RF shielding between the transmitter & PA sections. All PC boards are mounted horizontally to the bottom of the box using 10-15mm high metal M3 spacers. The PA board is mounted on the LHS of the box, with the Mitsubishi M67715 module bolted vertically to the heatsink area on the LHS of the box. A 4 bolt N connector socket is mounted to the LHS rear of the box. The transmitter & audio boards are mounted inline on the RHS of the box.

MODIFICATIONS:

1. When using the transmitter on a radio controlled model, the transmitter can be modified to run on a battery supply down to 7volts minimum. For a 7.2volt battery the 180ohm bias resistor on the MAR4 should be changed to 56ohms, & the 150ohm bias resistor on the MAV11 should be changed to 39ohms.

ALIGNMENT:

1. You should now be at a stage that you are ready to turn on the Transmitter. First make sure that there are no shorts across the power rail to earth with a multimeter. Connect a 50ohm dummy load on the transmitters output socket and an Ammeter in line with the power cable. Turn on the Transmitter briefly and ensure that it draws close to 130mA.

2. Loosely couple a frequency counter onto the output of the transmitter and set the fine tune trimpot to it's center position and adjust the 5pF Trimmer capacitor with an insulated adjusting tool for a frequency close to 1250MHz, (+/- 1MHz).

3. Connect a 1 volt p-p Video signal to the Video input on the PCB & adjust the Deviation trimpot for correct brightness on a suitable 1250MHz receiver. **The approximate setting of the trimpot looking at the PC board with the lettering the correct way up is at approx 3 to 4 o'clock.** This is a very approximate way of achieving around + / - 3.5MHz deviation out of the transmitter. On a 1250MHz FM receiver the deviation can be turned up until the picture shows signs of black noise streaks horizontally, then just back it off slightly. If the picture looks too bright or dark after setting the deviation, the video O/P level control in the receivers FM I/F might need adjusting.

4. Connect a RF diode probe to the output of the transmitter and check that the output is close to 50mW (+17dBm).

PARTS LIST:

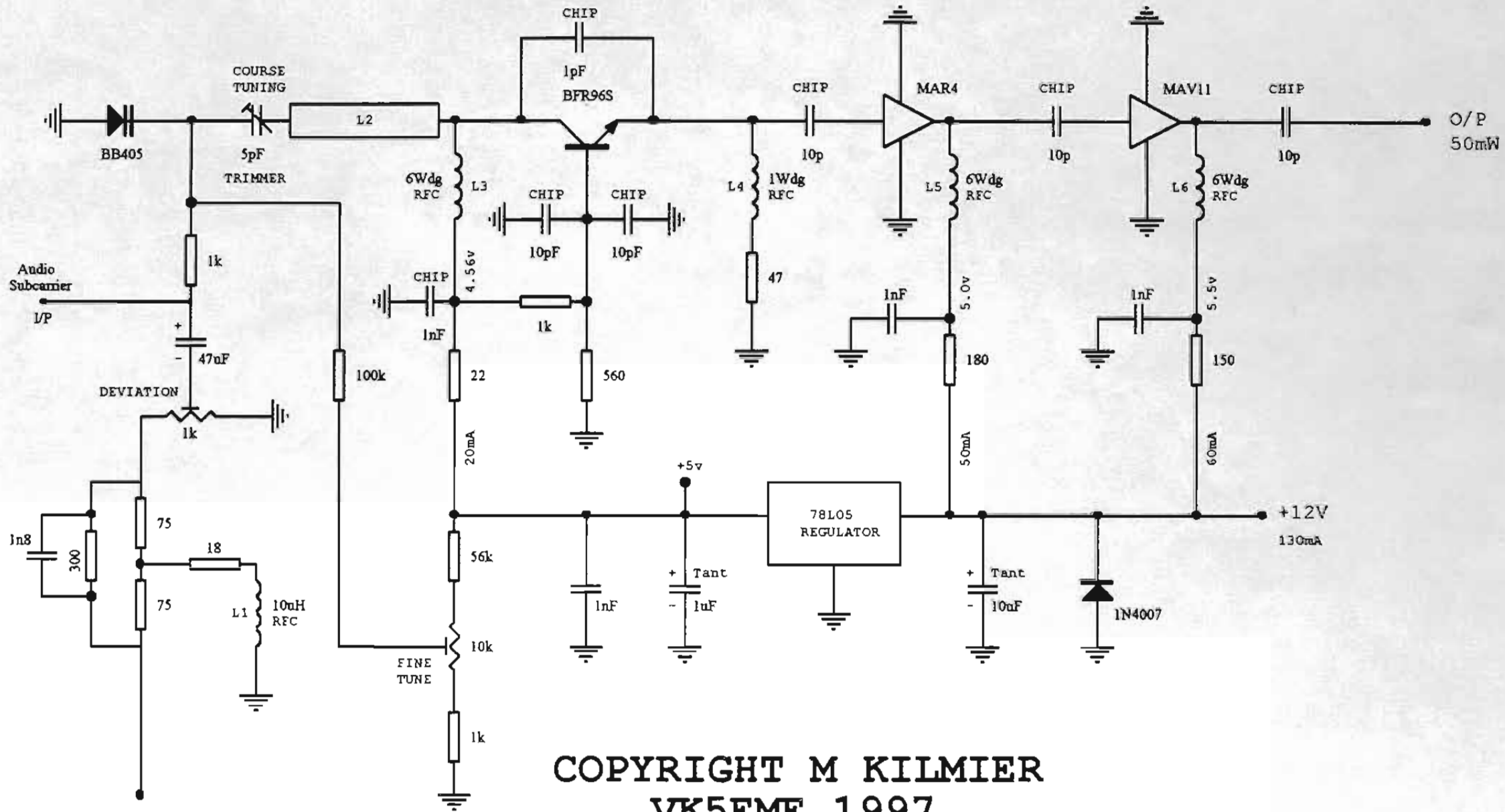
1 x BB405B UHF Varicap Diodes (Black \ White Band)
1 x 1N4007 Diode (Black \ Silver band)
1 x 78L05 Regulator
1 x BFG96 Transistor
1 x MAR4 MMIC (White dot input)
1 x MAV11 MMIC (Raised dot output)
1 x 10uH Choke (Brown Black Black)
1 x VK5EME36.PCB board
1 x Instructions

Trim Pots: 1kohm, 10kohm
Resistors: 18ohm, 22ohm, 47ohm, 2x75ohm, 150ohm, 180ohm 300ohm, 560ohm, 3x1kohm, 56kohm, 100kohm
Chip Capacitors: 1x 1pF, 1x 4p7, 4x 10pF, 1x 1nF 0805
Ceramic Capacitors: 3x1nF, 1n8 (5.01mm Spacing)
Electrolytic Capacitors: 47uF 25v
Tantalum Capacitors: 1uF, 10uF 25v
Trimmer Capacitors: 5pF Philips orange square
1x 20cm 0.4mm ECW
3x 1mm PCB Pins

Coils: L3 / L5 / L 6, 6 Turns of 0.4mm ECW wound on a 3mm dia, air spaced closewound

L4, 1 Turn of 0.4mm ECW wound on a 3mm dia, air spaced

1250MHz VCO



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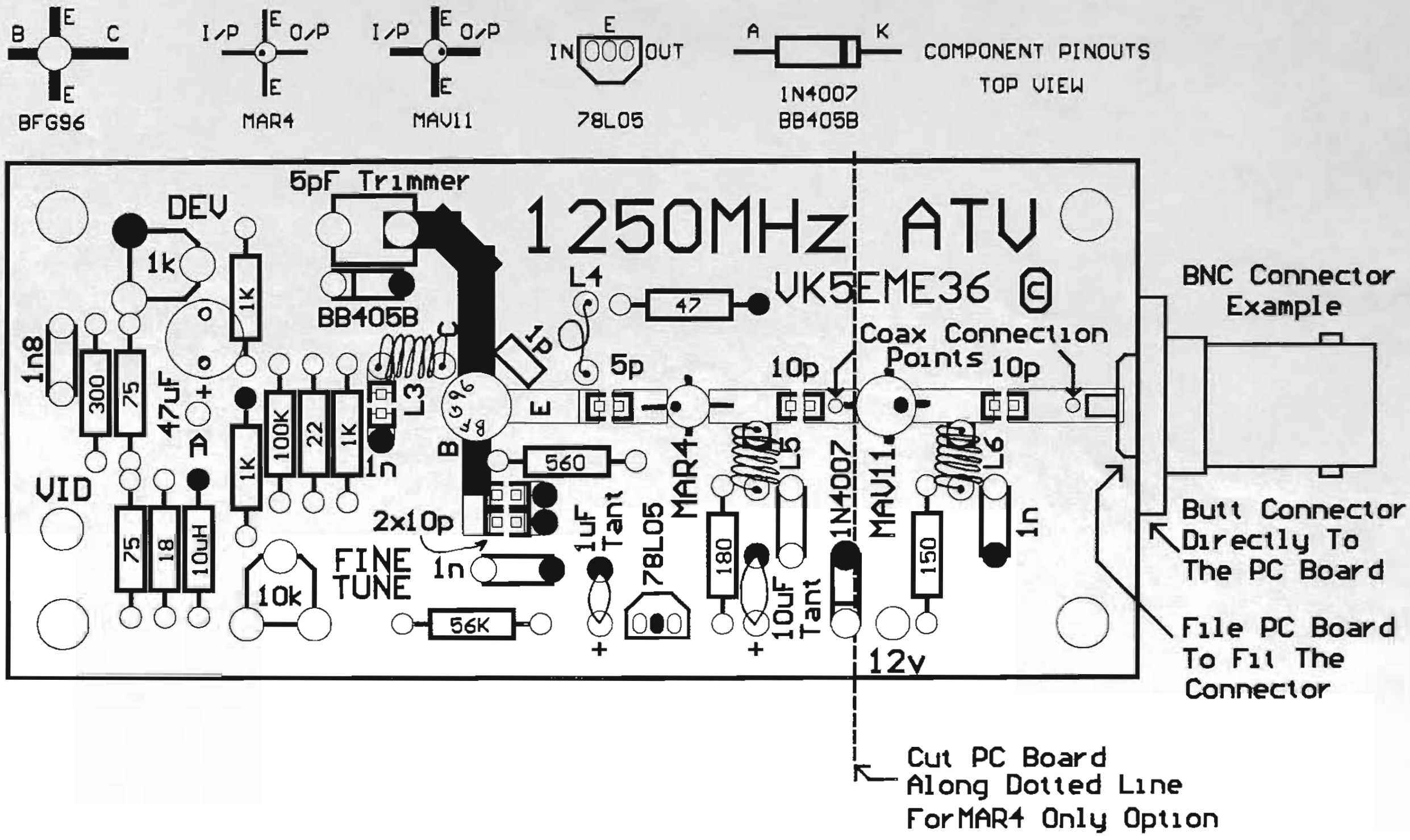
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I/P E O/P E
MAR4
I/P E O/P E
MAV11
E
IN OUT
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A K
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COMPONENT PINOUTS
TOP VIEW
1250MHz ATV
VK5EME36 ©
5pF Trimmer
DEV
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BB405B
1P
L4
47
5p
10p
Coax Connection
Points
10p
BNC Connector
Example
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75
47uF
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BFG96
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MAR4
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MAV11
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1n
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180
10uF
Tant
150
75
18
10uH
10k
FINE
TUNE
1n
56K
12v
Butt Connector
Directly To
The PC Board
File PC Board
To Fit The
Connector
Cut PC Board
Along Dotted Line
ForMAR4 Only Option