EME79 1250MHz FM ATV TRANSMITTER

Ver1.0

SPECIFICATIONS:	Tuning Range	Adj Range VCO 900 to 1330MHz
	Output Power	10mW (+10dBm) Attenuator Fitted 50mW (+17dBm) No Attenuator
	Video Pre-emphasis	CCIR standard NORM – 405 –1
	Video Input	1v P-P 75ohms
	Audio Input	Optional Subcarrier Input
	Power Supply	12volts @ 130mA

DESCRIPTION: The complete 1250MHz FM Video transmitter is built on a single 75 x 35mm size PC board & takes around 2 Hours to construct. The circuitry consists of a freerunning oscillator tuned to 1250MHz, with a single stage RF amplifier giving up to 50mW (+17dBm) output. A 7dB pad can be added to the board to attenuate the output to give 10mW (+10dBm) output suitable for driving a Mitsubishi M67715 2Watt module. The transmitter is also able to be used freerunning without a PLL, (Phase Locked Loop) as in the previous design. Because of the wide bandwidth used with FM ATV, a freerunning VCO, (Voltage Controlled Oscillator) was found to have ample frequency stability, (+/ - 1MHz) maximum drift. 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. If audio is required then a EME75 audio/subcarrier Kit can be simply added to the Video transmitter.

TRANSMITTER: Refer to the circuit diagram. The basis of the FM modulator is a freerunning VCO, (Voltage Controlled Oscillator), using a BFR93 transistor at 1250MHz. The frequency is determined by the stripline inductor L2 & a 4p7 chip capacitor, & is able to be fine tuned (+/- 5MHz), by adjusting the DC voltage to the varicap diode with a simple fine tune trimpot. The FM modulated signal from the BFR93 is around 10mW & is then attenuated by a 10dB pad to isolate the oscillator from the ERA-5 RF amplifier. The signal at the input of the ERA-5 is around 1.3mW & is amplified by the ERA-5 to around 50mW before being attenuated 7dB by another pad to produce 10mW output. The attenuator pads provide good isolation to the oscillator stopping frequency pulling when different loads are connected to the output of the transmitter. For 50mW output the 7dB attenuator is left out of circuit.

VIDEO PROCESS: Refer to the circuit diagram. 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 amplified by a NE592 amplifier IC, & adjusted for level with the deviation trimpot & is applied through a 4k7ohm resistor to the BB405B varicap diode in the VCO. An optional 47pF capacitor can be placed across the 4k7 resistor to give some high frequency boost, but should not normally be required.

PLL OPTION: The design is similar to previous designs, but now includes circuitry on the PCB to connect a PLL directly to the transmitter for frequency control. It is only recently that the problems of poor frequency response of some PLL FM ATV transmitters was found. The common symptoms are colour noise, colour dropout, & poor vertical hold, (jumping pictures). The main cause is the loop filter used on the output of the PLL for filtering the error voltage. The frequency response of the network must be slow, <40Hz so that it doesn't see the Video Modulation & interpret it as frequency drift & try & correct it. Fast PLLs like the SP5070 cause low frequency tilt or distorted field syncs. No degradation of the video signal was seen when using a TSA5511 type PLL on the transmitter.

CONSTRUCTION:

1. The PCB supplied is a professional plated through hole board that makes construction easier. Plated through holes are used to earth connections to the top groundplane of the board.
2. If you are building the transmitter to drive a 2 Watt M67715 Mitsubishi PA, then you only require around 5-10mW of drive from the transmitter. The 7dB pad on the output of the ERA-5 amplifier will give around 10mW output

3. The ERA5 bias resistors have been selected for a 12volt rail only. If you decide to either use the transmitter on 13.8 or a lower voltage, then you will have to recalculate the resistor values to suit the ERA5s 65mA 5volt requirement. Two SMD resistors have been used in the design for power dissipation. A standard 1/2 Watt resistor can be used as a substitute.
4. The 5k Tune trimpot should not be fitted if a Phase Locked Loop is going to be used on the transmitter.

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5. Follow the PCB overlay diagram and circuit carefully, by checking the components and placing them onto the board. All components are mounted on the top track side of the board. Most components are SMD, which makes it easy to build the transmitter without having to make sure that leads on components are kept short as with conventional components. The construction is especially important around the 1250MHz VCO where chip components are used in critical areas to minimize lead inductance. The position of the 4p7 chip cap to inductor L2 will affect the output frequency of the oscillator. To solder in the chip resistors & capacitors, a pair of tweezers are used to hold the component in place, soldering one side first then the other side. When soldering in the ERA-5 amplifier, 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. The earth legs must be kept as short & direct to the groundplane as possible.

6. Cut a short length of 0.7mm wire so it can be used as a shorting link on the oscillators tuned circuit. solder it into its initial position as indicated on the PCB overlay diagram. Moving this link up & down the tuned lines is used to adjust the oscillators frequency.

RF CONNECTIONS:

1. Direct Coax Connection: The connection point either A or B on the PCB overlay diagram will depend on whether you are using the 7dB pad after the ERA5. All connections to either an antenna socket or to & from a Power Amplifier can be made using miniature RG-178 50ohm Teflon coax, DSE part No W2088 with good termination's each end. When preparing the ends 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. Poor 50ohm terminations can cause transmitter instability, & intermittent power output problems. 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. Depending on which connection point you are using, either A or B, drill a small 0.8mm hole through the PCB. Recess the hole on the groundplane side with a small drill bit. Pass the center of the coax through the hole from the groudplane side of the PCB & solder it to the stripline. Now bring the coax parallel to the PCB in the direction that you want it to go, & solder the braid to the groundplane. Connection to an antenna socket should be made by bringing the coax in at right angles to the center pin of the connector. Cut & file the center pin of the connector so that it is just 2mm long. File some of the plating on the earth of the connector to make it easier to solder the coax braid to, & solder the braid directly to the connector as close as possible to the connectors plastic insulation.

2. Using RF Connectors: Makes it easier to disconnect the transmitter board for testing etc. To use a socket directly on the board, you can either use one of the small SMA or SMB types or a good quality BNC flange mount socket, as these give a good 50ohm match on 1200MHz. The SMA is small & can be easily soldered directly to the board. If you use a BNC type then you will have to cut & file the end of the board to make it fit. Butt the socket hard up against the board, & to mate the center pin of the socket against the stripline, then tack solder it to the board. The outer of the socket is then soldered directly to the bottom groundplane of the PCB.

BOX MOUNTING:

1. The basic FM Video transmitter can be mounted in practically any box, plastic or metal. But if you have decided that you are going to add an audio/subcarrier board, Phase Locked Loop, LCD display, & possibly a Mitsubishi poweramplifier then, you are going to need a metal box that is big enough to fit all the extra boards, & heatsinking for the poweramplifier. A suitable box for a complete 2Watt FM ATV transmitter is a DSE Part No H 3100 which will make your project look very professional. When using a Mitsubishi M67715 PA it will have to be shielded from the Video transmitter board to stop RF feedback, (instability). The 2W PA PCB can be cut down & fitted inside a DSE Part No H2231 dicast box that is mounted to the rear of the H 3100 box & heatsink. The front of the box can be cut out for the LCD display, switches, & controls etc. Switches like the DSE Part No P7552/7550/7540 are suggested for frequency up/down & power etc. Feedthrough capacitors etc should be used for running power etc through the shielding. If you are planing on using a higher powered 16Watt Mitsubishi M68719 amplifier module, it should not be put in the same box as the rest of the transmitter. These modules need a large heatsink area & a cooling fan when being used for FM ATV.

2. If an external Potentiometer is used for the deviation adjustment, make sure that a 4k7 to 5k is used so that the Video gain range of the NE592 remains the same. The 5k trimpot used for the Tune adjustment is not too critical & can be anything from 1k to 10k. Connections for external Pots can be soldered directly onto the pads on the board.

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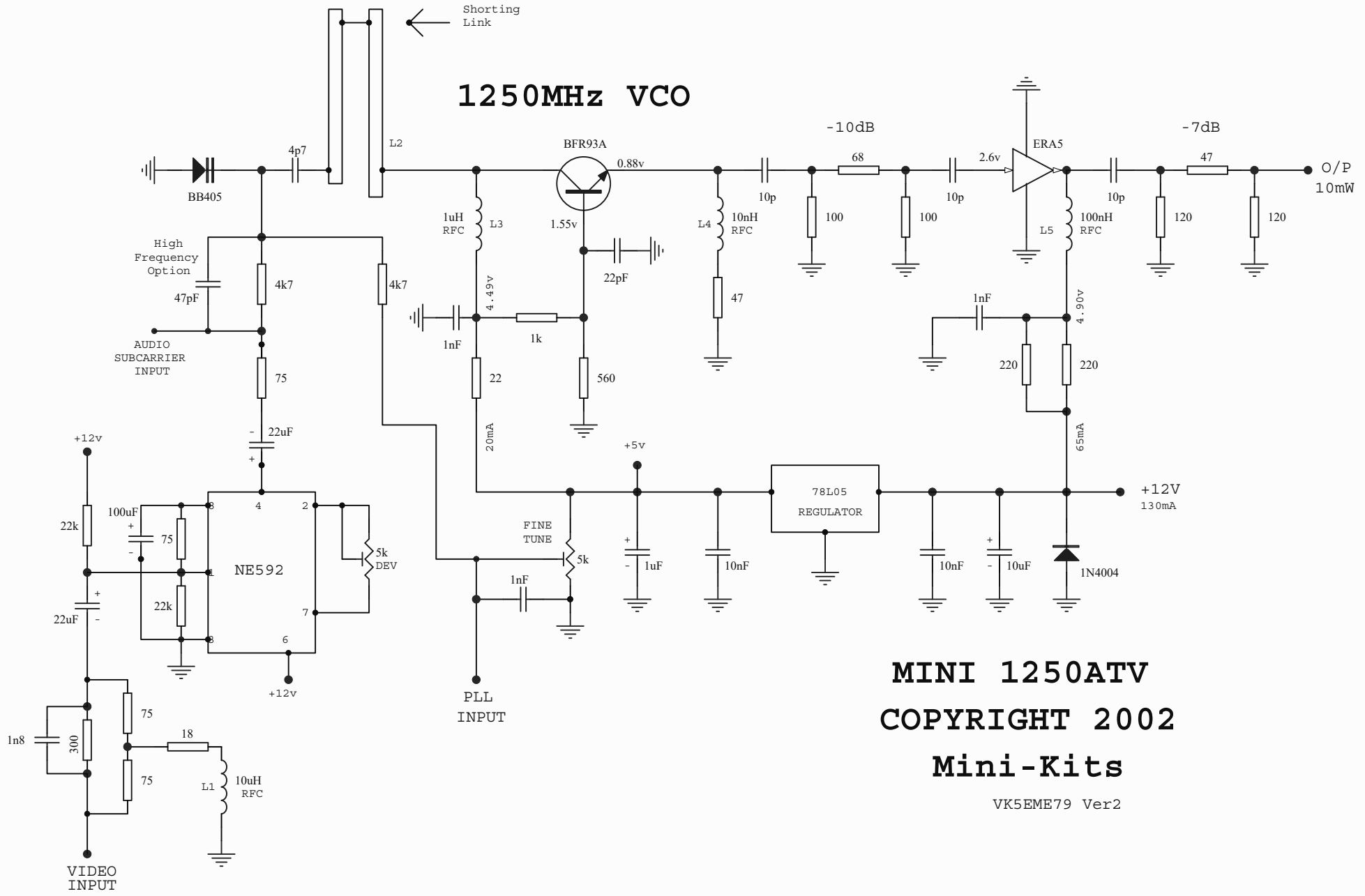
1250MHz VCO
Shorting Link
BB405
4p7
L2
BFR93A
0.88v
1.55v
-10dB
-7dB
ERA5
2.6v
O/P
10mW
High Frequency Option
47pF
4k7
4k7
AUDIO SUBCARRIER INPUT
75
22uF
1uH RFC
L3
4.49v
1nF
1k
22
560
22pF
20mA
L4
10nH RFC
47
10p
68
100
100
10p
10p
L5
100nH RFC
1nF
4.90v
220
220
65mA
47
120
120
+12v
22k
100uF
75
22k
22uF
NE592
5k DEV
+12v
FINE TUNE
5k
1nF
PLL INPUT
+5v
1uF
10nF
78L05 REGULATOR
10nF
10uF
1N4004
+12V
130mA
1n8
300
75
75
18
L1
10uH RFC
VIDEO INPUT
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VK5EME79 Ver2

1250MHz FM VIDEO TRANSMITTER EME79

TUNEUP & TESTING:

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, & 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 Tune trimpot to it's center position, and adjust the shorting link using a soldering iron to move the wire up & down the tuned oscillator lines for a frequency close to 1250MHz, (+/- 1MHz). If you are using a PLL on the transmitter then the 5k Tune trimpot should be taken off of the board. Set the PLL frequency to 1250MHz & adjust the shorting link until the PLL is locked, around 3volts dc measured on the PLL Input on the transmitter board.

3. Power output can be measured with either a schottky diode RF probe, microwave powermeter, or spectrum analyzer.

4. 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.

NOTE: Chip components crack easily so if you have problems getting the kit going properly, check for broken chip capacitors throughout the signal paths.

PARTS LIST:

RESISTORS

1 x 18R	SMD 1206 Resistor
1 x 22R	SMD 1206 Resistor
2 x 47R	SMD 1206 Resistor
1 x 68R	SMD 1206 Resistor
4 x 75R	SMD 1206 Resistor
2 x 100R	SMD 1206 Resistor
2 x 120R	SMD 1206 Resistor
2 x 220R	SMD 1206 Resistor
1 x 300R	SMD 1206 Resistor
1 x 560R	SMD 1206 Resistor
1 x 1k	SMD 1206 Resistor
2 x 4k7	SMD 1206 Resistor
2 x 22k	SMD 1206 Resistor
2 x 5k	SMD Trimpot

CAPACITORS

1 x 4p7	SMD 0805 Chip Capacitor
1 x 22pF	SMD 0805 Chip Capacitor
3 x 10pF	SMD 0805 Chip Capacitor
4 x 1nF	SMD 0805 Chip Capacitor
1 x 1n8	SMD 1206 Chip Capacitor
2 x 10nF	SMD 0805 Chip Capacitor

CAPACITORS

1 x 1uF	Miniature Electro Capacitor
1 x 10uF	Miniature Electro Capacitor
2 x 22uF	Miniature Electro Capacitor
1 x 100uF	Miniature Electro Capacitor

INDUCTORS, RF CHOKES, FILTERS

1 x 10nH	SMD Inductor (100)
1 x 100nH	SMD Inductor (101)
1 x 10uH	SMD Inductor (100k)
1 x 1uH	SMD Inductor (102)

SEMICONDUCTORS

1 x 1N4004	SMD Power Diode
1 x 78L05	SMD Regulator 5volt
1 x BB405B	UHF Varicap Diode
1 x BFR93	Transistor UHF NPN
1 x ERA-5	Mini-Circuits Amplifier
1 x NE592	SMD Video Amplifier IC

MISCELLANEOUS

1 x PC Board	EME79
1 x Instructions	EME79
1 x 10cm 0.7mm TCW	

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