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| **Specifications:** | Output Power | 5Watts @ 1dB Compression ( MGF0906B ) |
| | Input Power | 30mW |
| | Gain | 23dB |
| | Bandwidth | 100MHz |
| | Power | 11 – 15Volts 1.5A |

**DESIGN:** The design is based on an article that appeared in VHF Communications magazine 3/94. CalTechs PUFF CAD software package has been used to redesign the 2300MHz amplifier for use on 2400MHz. A Teflon PC board has been used to keep losses to a minimum guaranteeing the gain & output power of the amplifier. The amplifier uses the readily available low cost Mitsubishi 0900 series GasFETs. Much of the amplifier construction is mechanical work, requiring taping of holes for bolts & mounting on an heatsink. A milled aluminium plate is supplied for mounting of the PC board & GasFET devices.

**DESCRIPTION:** The RF Amplifier stages are constructed on a 120 x 50mm Teflon PC board. Earlier in the design stage it was decided that the amplifiers powersupply would be built on a separate board to make construction & testing easier. The EME100, GasFET bias Kit is used to supply 9.5volts & -ve bias volts to the amplifier. Both boards are mounted onto a milled 120 x 80mm x 10mm thick aluminium plate along with the input & output RF connectors. Two GasFETs have been used to produce >5Watts output with 50mW input. The predriver uses a Mitsubishi MGF0904A for its 13dB gain & 28dBm ( 630mW ) 1dB compression output. The output uses a MGF0906B for its 37dBm ( 5W ) 1dB compression output. A MGF0905A could be used in place of the 0906B for slightly lower than 5watts 1dB compression output. The MGF0906B is more suitable for ATV use due to the larger ceramic package for continuous operation. The MGF0906B is around twice the cost of a MGF0905A but can supply around 7Watts saturated output, compared with 5Watts for ATV use. The efficiency of the devices is around 40% so a relatively large heatsink is required to dissipate the heat. The GasFET devices use –ve bias on the gate to control the drain current. **Shorting of the gate connection to gnd causes excessive drain current that can destroy the devices instantly.**

**CONSTRUCTION:**

**1**. The Teflon PCB supplied is not a plated through hole board, so some connections need to be soldered to the groundplane side of the board with 0.7mm TCW. Due to these connections needing to be soldered underneath the board, they with protrude enough requiring the aluminium plate to have to be countersunk for clearance to allow the board to sit down flat. These connections are shown as black dots on the PCB overlay diagram & should be left until the rest of the components are mounted onto the board to allow the plate to be marked for countersinking clearance.

**2**. With a sharp scalpel, carefully cut the two marked cutouts on the board for the GasFETs. **Teflon board cuts very easily so be very careful. If drilling any holes in the board, use a blunt drill bit by hand with light pressure . Sharp bits & or a power drill will tear the board & you will probably have to throw it away**

**3. An antistatic strap should be used when handling the GasFETs, & should be kept to a minimum.** Next line up the board on top of the aluminium plate aligning the milled sections for the GasFETs. The board & RF connectors are mounted off center, around 6mm from the edge of the aluminium plate allowing for around 25mm of the opposite side for mounting of the Bias board. Make sure that the GasFETs fit correctly into the cutouts in the board & milled sections. Remove the board & drill 6 x 3mm holes for the mounting bolts in the board as shown on the diagram. Line the board up onto the aluminium plate & mark position of the 6 holes into the aluminium plate for drilling. 6 x 3mm Taptite bolts are used for mounting the board to the plate, & either require a 3mm tap, or 2.7mm drill bit. Some patience is needed to drill & tap the holes without breaking taps or bolts. Taptites are self tapping & are ideal if you use the correct size drill bit in the aluminium.

**4.** Next mount all the components excluding the GasFETs to the board as shown in the diagram. Remember to not solder any GND connections including two of the SKY trimmers through the board until the aluminium plate has been countersunk to clear the soldered connections. **When mounting the SKY trimmers, all leads are bent 90 degrees horizontal except the connections on two of the trimmers that are kept straight & pass through the board for earthing. Some of the trimmers leads will have to be cut shorter to fit them onto the board correctly.** Bolt the board to the plate & drill all the GND holes shown as black dots with a 0.7mm drill bit, also drilling slightly into the aluminium to mark the area for countersinking.

**5.** Remove the board from the plate & countersink the markings in the plate with a 5mm drill bit. Next solder all Gnd wires through the board including the connections on two of the SKY trimmers, & then check that the board sits flat onto the plate. Redrill any countersunk holes wider for more clearance if required.

**7.** Remount the board to the aluminium plate, a position the GasFETs into place. Mark the position for the mounting holes

for the GasFETs & remove the board from the plate for drilling.

**8.** 2mm nuts & bolts are used for mounting the GasFETs to the aluminum plate. 2.5mm holes are drilled through the aluminium where they are marked. Countersink the underside of the plate large enough to allow each nut enough clearance to fit the bolt.

**9.** Check the board for anything that might have been missed before mounting it in its final position on the aluminium plate. Fit the board to the plate along with the GasFETs. **The GasFETs input Gate leads have a bevel cut for indication.** A thin smear of heatsink compound must be used underneath each GasFET. Silver Epoxy is normally suggested in microwave amplifier construction for gluing the board to the heatsink for earthing, but was not found to be necessary.

**10.** Next mark & drill holes to bolt the SMA & N connectors to the aluminium plate.

**11.** Fabricate an aluminium cover to fit over the board & plate for shielding. The cover should be at least 30 to 40mm high above the board as to not cause RF coupling. Mount the complete aluminium plate on a large heatsink of at least 120 x 120 x 40mm. For continuous operation a small fan might be required.

**CONNECTIONS:**

**1.** Bias board is now ready to be connected to a GasFET poweramplifier. All filter capacitors & bias resistors are normally fitted on the poweramplifier board, so it should just be a matter of hooking up the connections on the bias board to the respective connections on the poweramplifier. **It is assumed that you have tested the GasFET bias board, EME100 before connecting it to the Power Amplifier board.**

**TESTING & BIAS ADJUSTMENT:**

**1.** The bias required will depend on the devices that have been used in the poweramplifier. The bias is set by measuring the current through each GasFETs drain bias resistor. A multimeter is connected across each bias resistor, & used to measure the voltage drop across it. Knowing the required voltage Vds, ( Volts Drain to Source ) & Id, ( Drain Current ) for each GasFET, & supply voltage 9.5V, calculate the voltage drop across the bias resistor for the bias current for each device. **If you are unsure about how to do this, then ask someone who knows how to work it out. Recommended Volts Vds for the 0904 is 8v, 0905 is 8v, & 0906 is 9v. Id current for 0904 is 200mA, 0905 is 800mA, & 0906 is 1.2A**

**2.** Terminate the Amplifiers input & outputs with a 50ohm load. Initially set both 5kohm bias trimpots fully clockwise. Turn on the power to the amplifier & bias board, & adjust each trimpot for the required bias current to each device.

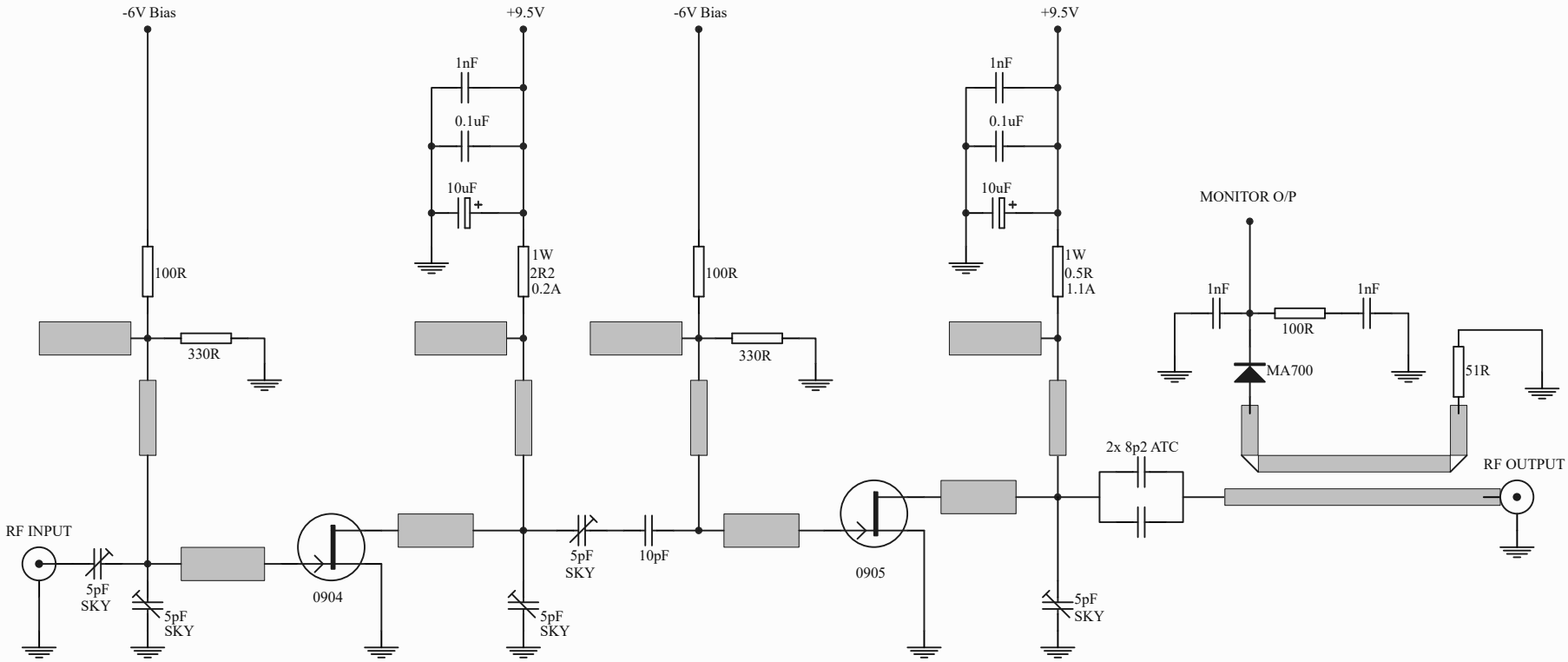
**3.** Connect a suitable powermeter to the output of the Amplifier. A 1200MHz SWR meter will work but its readings will be lower than on the meter scale. The monitor output is really only for indication purposes but can aid in tune up. Apply RF to the input, approx 10mW & adjust the 5 SKY trimmers for maximum output. These are a bit interactive & touchy to tune. Then apply full input power up to 100mW & retune the trimmers for maximum. Snowflaking of the RF stages should not be required, but extra output may be obtained by adding a bit of copper on the output of the 0906.

**PARTS LIST:**

1 x EME99 Teflon PC board
1 x MA700 Schottky Diode
1 x MGF0904A GasFET
1 x MGF0906, or ( 0905A ) GasFET
1 x Instructions

Resistors 1W: 2.2ohm, 0.5ohm
Resistors 1206 SMD: 51ohm, 3x 100ohm, 2x 330ohm,
Capacitors 0805 SMD: 2x 8p2 ATC, 10pF, 4x 1nF, 2x 0.1uF
Capacitors Tantalum: 2x 10uF 25v
Capacitors Trimmer: 5x 0.5-5pF SKY
Capacitors Feedthrough 1x 2n2

1 x Hardware Kit: Machined Aluminium Plate, Screws.
1 x Connector Kit: SMA & N, Both 4 Bolt Flange Types.






# 2400MHz POWER AMPLIFIER