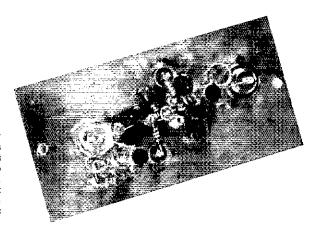
An Inexpen\$ive Low Noise Preamplifier

for

422 MHz

Simplicity of construction makes the preamplifier a short-term project. Small standoff insulators support most of the components. The transistor is upside down in the center of the board. Leads to be grounded are soldered direct to the copper foil. BNC connectors are used for input and output connections; input is on the left. Two feedthrough capacitors bring +9 V from the other side of the po



BY STEVEN A. MAAS,* K3WJQ

THIS AMPLIFIER was developed as part of a low cost 400-MHz radiotelescope, Although it does not represent the ultimate in low-noise operation, its performance is much better than many commercially made units, and the cost and simplicity are hard to beat. The circuit uses a 2N5652 transistor, although a 2N5651, 2N5650, or K6007 can be used for better noise performance. The author's unit has 12-dB gain and a noise figure of less than 2 dB - 1.5 dB has been obtained with a selected transistor.† The total cost can be less than \$20.

If greater gain is desired, the amplifier can be modified by changing the operating point of the transistor. According to the manufacturer of the 2N5652, a 5- to 8-dB increase is possible, and greater signal handling ability and linearity is achieved as a bonus. The cost of this gain improvement is an increased noise figure.

Circuit Description

The circuit is a basic common-emitter amplifier, with tuned input and output circuits. It has some

attractions that are not obvious from the schematic. Neither neutralization nor shielding are needed, in spite of the high frequency and high gain, because of the low input impedance of the transistor. The amplifier should be unconditionally stable, even when mistuned. Also, because the 50-ohm transmission line is in parallel with the input tuned circuit, wide-band response is obtained. In environments where interference is a problem, the input connection and transistor base may be tapped lower on L_1 , narrowing the bandwidth.

Power is supplied by a 9-volt source, preferably a small transistor radio battery. Current drain is only 3 mA. A 12-volt Zener diode is connected across the power connection to protect the transistor against excessive voltage and improper supply polarity. The maximum $V_{\rm ce}$ of the 2N5652 is only 20, and the device is not very forgiving.

To protect against lightning damage (if the unit is mounted at the antenna, as it should be) some means should be employed to ground the antenna. The old trick of connecting two diodes across the input will not protect the delicate base junction of the 2N5652, and will appreciably increase the amplifier noise figure.

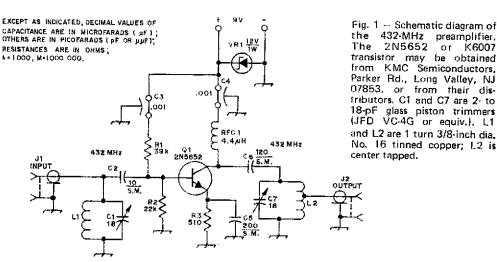
Construction

The amplifier is built on a 2×4 -inch (51 \times 102 mm) piece of copper-clad printed circuit board, using miniature ceramic insulated terminals. Holes

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^{†[}EDITOR'S NOTE: A representative of KMC Semiconductor was consulted about the noise figure obtained by the author. His opinion was that it is not impossible to have a 1.5 dB noise figure if using a selected 2N5652; most are capable of providing 2 dB. For consistent results a K6007 is recommended, which can produce a 1.6-dB figure.]



are drilled in the board for all mounted components; where ground connections are needed, the leads are simply soldered to the board. This type of construction results in the shortest possible lead length for all components, and is very simple to do. The amplifier may be fastened to the open side of an aluminum chassis to form a compact, well shielded unit.

The inductors should be installed so their leads are as short as possible, but keep the coil at least 1/4-inch from the copper surface or from other components. The transistor should be installed last and soldered carefully. Do not bend its leads close to the body, or they may break.

Adjustment

The amplifier is adjusted for maximum gain using a signal generator or a received signal. The collector current should be checked and set to the value which gives best noise figure; this will be very close to 3 mA. The collector current can be varied by changing the values of the base resistors, R_1 and R_2 or by varying the supply voltage by no more than ±2 volts.

It may be necessary to trim the inductors in order to achieve a smooth passband response. For best results, the input inductor should be connected from ground to the center pin of the input connector, and C_1 should be connected to the same point by a short wire. The bandwidth is also affected by the value of C_2 ; increasing this value by a few pF will broaden the frequency response.

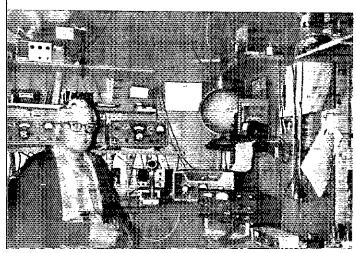
or K6007

If oscillation should occur, be sure the transistor leads, especially the emitter lead, are well soldered and as short as possible. Oscillation is usually caused by poor construction practices, bad grounds, or poor layout.

To improve the gain, at the cost of noise figure. the base resistors R_1 and R_2 should be changed, to increase the collector current to a maximum of about 10 mA, R₁ may be replaced by an rf choke with a small potentiometer connected in series, to make the bias point variable.

There is no reason why this circuit cannot be used at 220 or 144 MHz, with even better performance. All that would be needed is to change the input and output tuned circuits and increase the value of C2 slightly. Q5''---

Strays"



Every Monday WA71KZ sends text taken from QST at 5, 8, 10 and 15 wpm. He has helped about 40 Novices get licenses, having also conducted classes in the past. George was also a leading light in the KD7SPO show station at Spokane's Expo.

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