Here's a simple add-on feature that will go a long way to improve what you hear on 2 plus being a test device.

An Easy To Build 2 Meter Preamp and Gated Noise Source

BY JOHN C. REED*, W6IOJ

This preamp project resulted from my desire to participate in the Phase III Satellite activity. My sick 2 meter receiver failed to receive signals from the satellite and obviously needed a low-noise preamp having moderate gain. Following the preamp installation, the satellite activity sounded like that of a low-frequency DX band—many of the signals from Europe. The amplifier with a 30 dB gain is easy to build, and all parts can be purchased from Radio Shack.

The description also includes a gated noise source. This simple test device having a variable noise output of up to 15 dB above receiver threshold noise level is invaluable when used to optimize the receiver S/N. It essentially is a poor man's laboratory signal generator.

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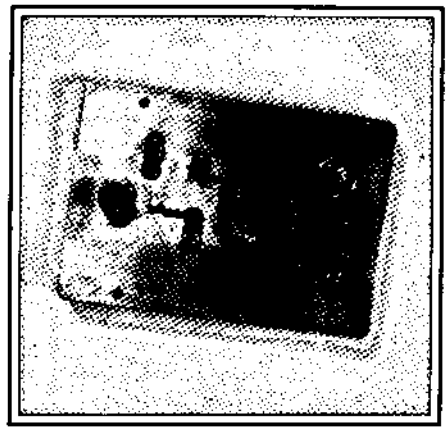
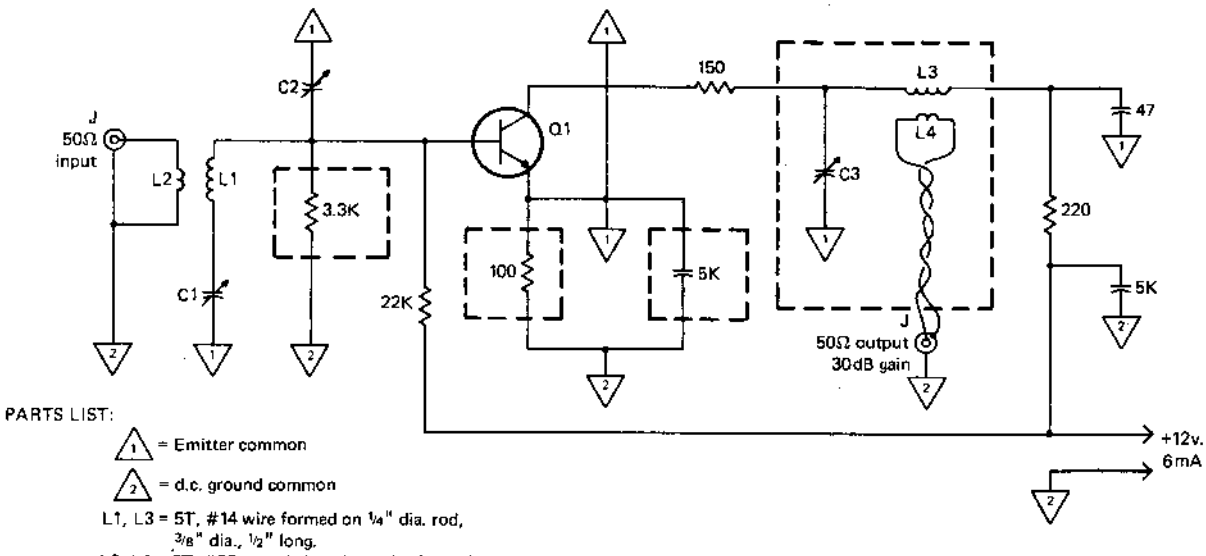
Preamp Circuit Description

The MRF901 was chosen as the active element primarily because of availability and cost. It is not a bad compromise when considering that the indicated noise figure of 1.5 dB at 150 MHz is only about 1 dB greater than the best GaAs units. Other than being inexpensive, the MRF901 is rugged and it has excellent gain characteristics.

Referring to the circuit diagram (fig. 1),



The preamp as seen from the d.c. ground common side.



PARTS LIST:

1 = Emitter common

2 = d.c. ground common

L1, L3 = 5T, #14 wire formed on ¼" dia. rod, ⅜" dia., ½" long.

L2, L4 = 2T, #22 stranded hookup wire formed on L1/L3 end.

Q1 = MRF901 (276-2044)

C1, C2, C3 = 5-60pF (272-1340)

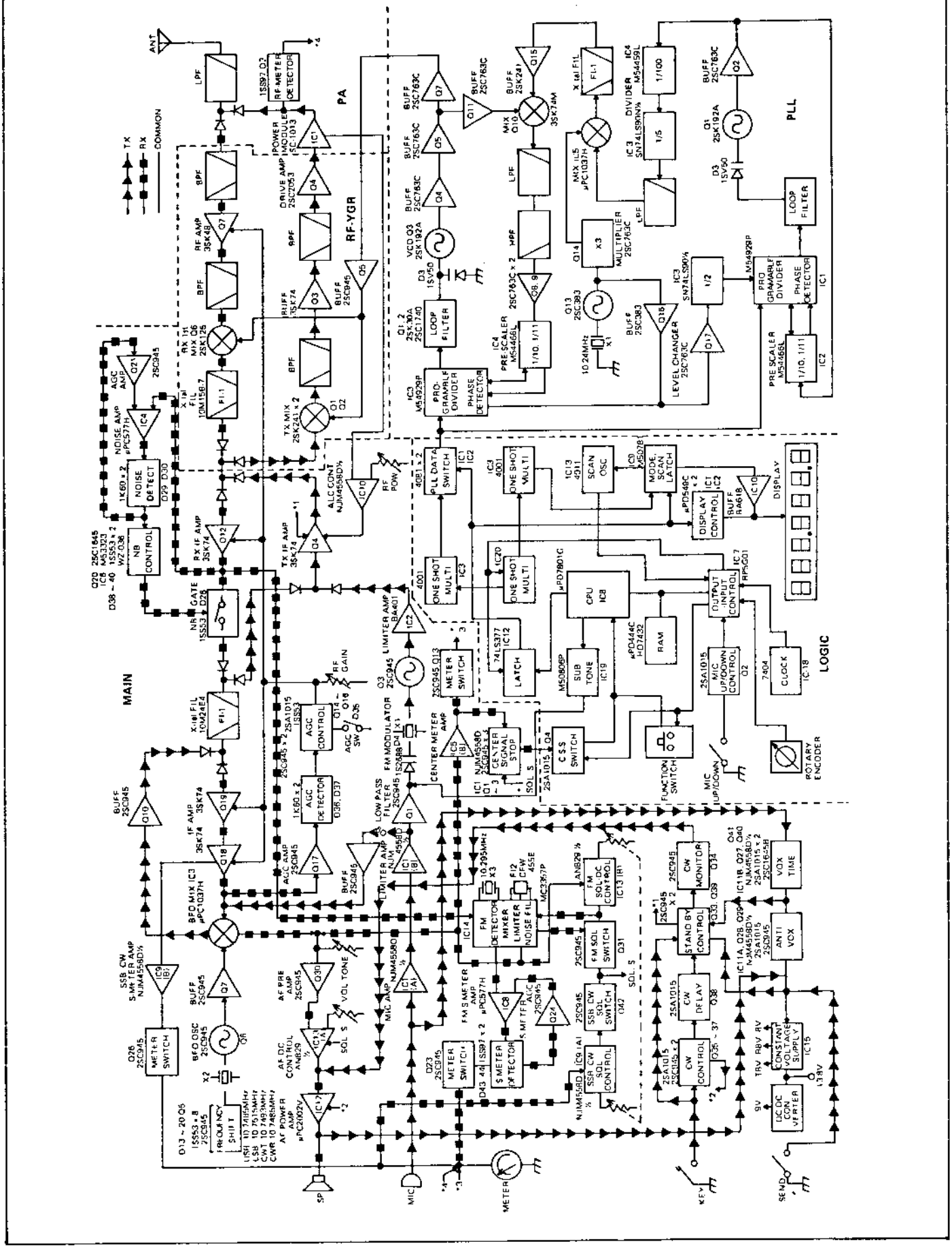
J = BNC chassis connectors (278-105)

All fixed capacitors = pF/50v. disc ceramic.

All resistors = ¼w., 5% (Radio Shack catalog numbers)

Fig. 1– The 2 meter preamp circuit diagram. See text for explanation of components within broken lines.

Fig. 2– Full block diagram of the ICOM IC-271A. Note legend in the upper right-hand corner. A detailed discussion is presented in the text.



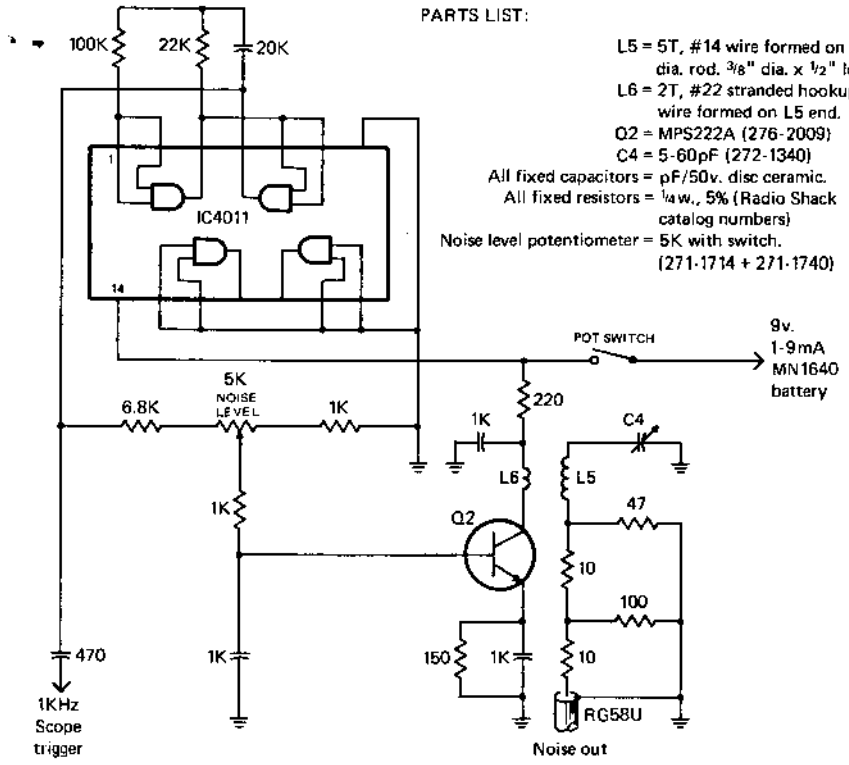
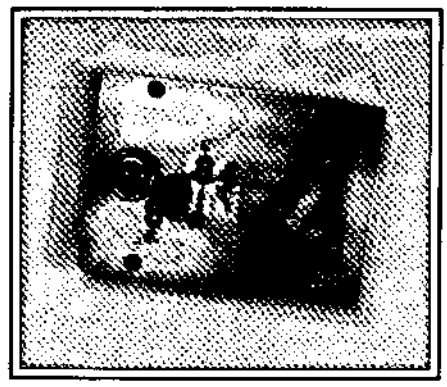
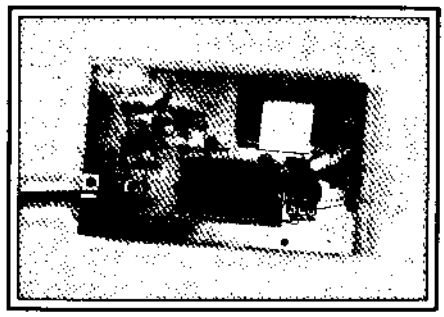


Fig. 2– Schematic for the gated noise source.



The preamp as seen from the emitter common side.



The gated noise source.

you will note there are two commons: one is the emitter common and the other is the d.c. ground common. The two are accommodated in the assembly by using a double-sided PC board; the foil on each side is used as a different common. This method minimizes stray inductance between the emitter and related input/output circuitry while avoiding the use of low-inductance-type feed-through capacitors. The input circuit is simple pi-network, the 5–60 pF C1-C2 capacitors providing the desired adjustment capability for antenna matching. When optimized, C1 is near minimum and C2 is near maximum capacity. Inductive coupling is used to d.c. isolate the antenna from the emitter common.

The MRF901, primarily a microwave device, requires special stability considerations when it is used at lower frequencies. This characteristic is accommodated in the circuit by using a degenerative resistor between the collector and the output circuit, with the resistor soldered directly to the transistor collector tab for minimizing stray capacitance. The parallel tuned output circuit is conventional except for the 47 pF by-pass capacitor. This minimal-value capacitor provides additional degeneration at lower frequencies. Using these precautions, the amplifier is stable under all operating conditions even without the use of external shielding.

Preamp Fabrication

Parts are mounted on a 4" × 2¾" circuit board, the layout approximately as indicated in the fig. 1 circuit diagram. All parts are mounted on the common emitter side of the board except for those indicated in fig. 1 by dotted lines. These are primarily the output circuit components and are mounted on the common ground side. The layout maximizes input/output circuit isolation. Parts are mounted using push-in terminals, removing ¼ inch diameter foil around the terminal for insulation (in some cases the terminal is soldered directly to the foil). The mount for the MRF901 is made by bending over the push-in terminal wire connecting end to form a flat mounting tab for the base and two emitter connections. The collector is soldered directly to the 150 ohm series resistor. The BNC chassis-type input/output connectors are insulated from the common emitter foil by removing ¾ inch diameter foil.

Gated Noise Source Description

This gated noise source is essentially a noisy r.f. amplifier having no input tuned circuit. Referring to fig. 2, the MPS222A noise source is link-coupled to a 150 MHz tuned circuit. The tuned circuit load resistor is followed by a 4 dB pad to assure a 50 ohm source impedance. The MPS222A is base-gated using a pair of NAND gates in a QUAD NAND Gate 4011 CMOS integrated circuit. The CMOS device was chosen to minimize power drain by the gating function. Although CMOS devices are subject to static discharge damage, the 4011 is diode-protected to minimize this problem. The square-wave generator is a conventional NAND gate oscillator, with components selected to make a 1 kHz square wave. The assembly is powered by a self-contained MN1604 9 volt battery.

Gated Noise Source Fabrication

The assembly is on a 5½" × 3½" single-sided PC board. The noise source components are mounted on the PC board with push-in terminals as in the preamplifier, and the NAND-gate oscillator components are mounted on a small perfboard assembly supported above the PC board by standoffs.

Operation

Gated noise source develops incoherent noise, and therefore will not function properly when used with f.m. or s.s.b. detectors that depend upon coherent information. The receiver must be in the a.m. mode of operation. When the receiver is in the a.m. mode, the gated noise will be apparent as 1 kHz audio that can be evaluated by ear, 1 kHz filter/peak-diode detector, or oscilloscope. I personally like to look at wide-band noise, and I built a special i.f. amplifier/detector to serve this function.

Aligning the preamplifer is simply noise peaking beginning with C3, then C1, and then peaking the noise gate frequency C4. The gated noise should be apparent at this stage. Optimizing the NF is accomplished by varying the ratios of C1 and C2 for maximum gated noise.