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COMMON ANTENNA PREAMPLIFIER-ISOLATOR
FOR VLF-LF RECEIVERS

An improved high impedance preamplifier circuit provides outputs to drive an Omega-VLF receiver and an ADF-LF receiver from a common antenna such as the ADF sense antenna on general aviation aircraft. The preamplifier has been evaluated with fixed ground station receivers and is anticipated for use in the second generation prototype Ohio University Omega receiver design.

by

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PREFACE

This short report has been submitted to ELECTRONICS magazine for possible publication in their Designer's Casebook series.

I. INTRODUCTION

The previously reported RF front end circuitry and preamplifier for Omega receivers (R. W. Burhans, "Phase-Difference Method Offers Low-Cost Navigation Receivers", *ELECTRONICS* 47, No. 18, pp. 98-105, September 5, 1974) has been used for several flight tests of simplified digital VLF navigation sensor methods for general aviation users. (R. W. Lilley, "Binary Processing Concepts for Low-Cost Omega Receivers", Proc. 2nd Omega Symposium, pp. 160-167, ION, Washington, D. C., November 7, 1974) One of the problems in field use with small general aviation aircraft is the desirability of using a common antenna such as the ADF sense whip for both the Omega navigation and ADF receivers. Another problem with the previous VLF preamplifier has been occasional burn out of the first stage MOSFET in the presence of strong local spherics activity (very close lightning discharges).

II. IMPROVED PREAMPLIFIER CIRCUIT

A solution to both of these problems is presented in the circuit of Figure 1. The MOSFET is replaced with a low-cost junction FET which provides a gain of 2 or 3 and adequately low noise performance over the frequency range from 5 KHz to 1500 KHz. The expensive wideband line isolating transformer used in the original preamplifier is eliminated and a simple resistor divider string (R_1 , R_2) results in multiplexing of the power to the preamplifier and signal output to the Omega receiver over the same cable. A small resistor in the collector lead of the output emitter follower (2N5139) provides a unity gain buffer output for driving an ADF or broadcast band receiver from the same preamplifier at a low impedance level through a separate cable. Good isolation

between the VLF receiver (10 - 100 KHz) and the ADF-BC band receiver (200 - 1500 KHz) is achieved with this circuit which will drive two separate 100 foot lengths of low-impedance cable to the respective receivers from a single wire antenna.

The 2N3819 JFET is much less prone to burn out with static charges and the NE-2 neon bulb gives gross protection for high level short duration burst interference. The atmospheric noise level in the 5 KHz to 1500 KHz region usually is the limiting factor in high input impedance preamplifiers of this sort and an ultra-low noise MOSFET is not required.

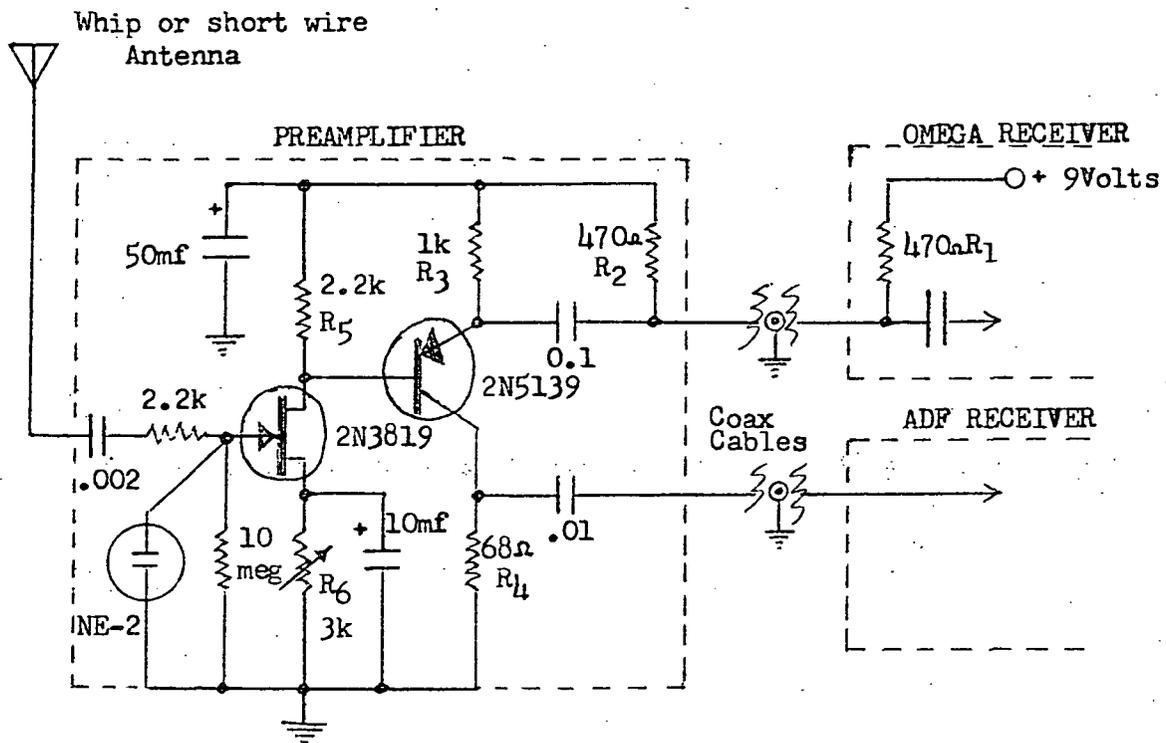
III. CIRCUIT ADJUSTMENTS

A source bias resistor (R_6) is adjusted to compensate for slight difference among 2N3819 JFET's to center the operating point for about equal positive and negative peak clipping on large signals. The circuit shown will handle input signal levels up to 100,000 microvolts rms before round-off distortion of the output waveform begins. The ratio of R_4/R_3 is adjusted to approximately $= B \times A$ (where $B =$ current gain of the 2N5139 stage, and $A =$ gain of the 2N3819 stage) to provide unity gain at the LF output terminal. A higher gain of 2 or 3 at the VLF output is desirable to drive the additional filters and limiting amplifiers in the Omega receiver. The isolating preamplifier may also be used in ground station monitors with a single wire antenna driving two receivers such as: WWVB 60 KHz time reference with 100 KHz Loran C, Omega with Loran C, Loran C with ADF, Omega with ADF, Omega with BC band, etc. One of the receivers must supply power to the preamplifier as shown in the example of Figure 1. An upper frequency of 1500 KHz is limited by the performance of typical low-cost JFET's.

Somewhat higher frequency performance might be achieved with similar circuits using JFET's such as the 2N4416.

IV. ACKNOWLEDGEMENT

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PREAMPLIFIER - ISOLATOR

FIGURE 1.