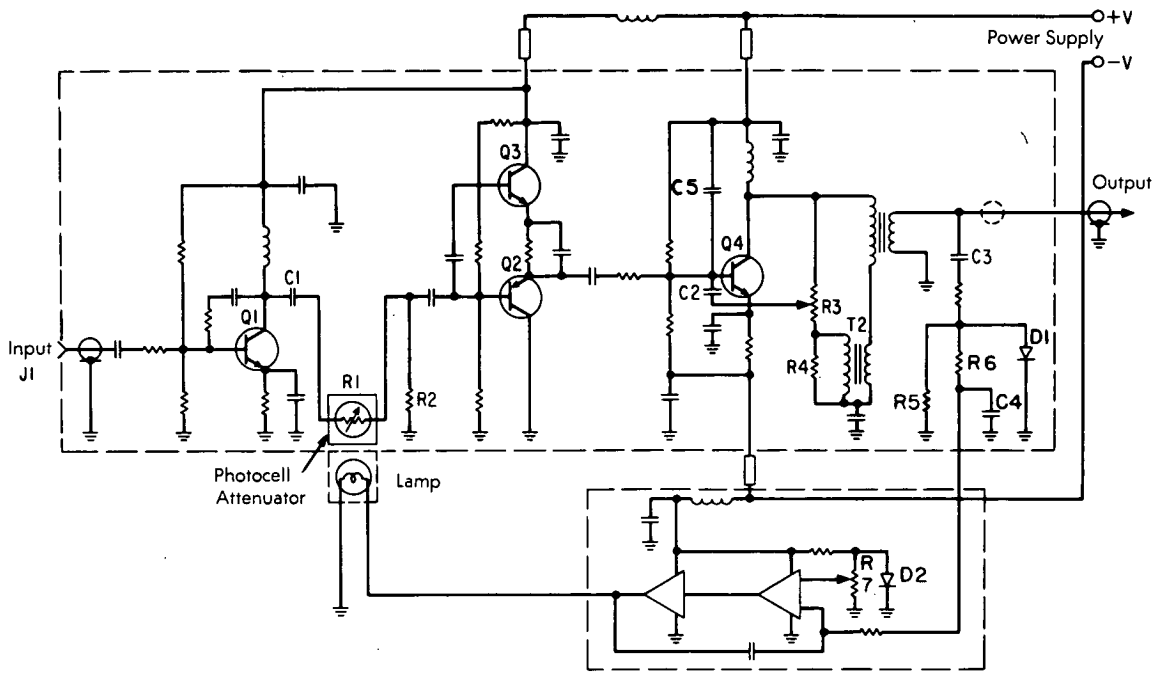
NASA TECH BRIEF

NASA Pasadena Office

Broadband RF-Distribution Amplifier



The problem:

To design an RF-amplifier which distributes reference frequencies to various places in communication systems and provides 10 db of automatic gain control (AGC) with low phase distortion (+3 to +13 dbm input power); the output amplifier stage also must supply 180 milliwatts into 50 ohms at an output impedance of 50 ohms resistive.

The solution:

Utilize a photocell in a variable attenuator configuration to obtain low phase shift with AGC; broadband transformers are used in a feedback network to obtain a variable output impedance with low power loss over a wide frequency range.

How it's done:

The first stage of the amplifier shown in the diagram consists of Q1 and associated components, and serves to isolate the photocell attenuator and the AGC lamp from the input; it also provides a 50-ohm input impedance at the input (J1). The first stage is followed by the variable attenuator which is a photocell in an L network consisting basically of C1, R1, and R2.

The second stage (Q2, Q3) is a simple amplifier

(continued overleaf)

that provides isolation between the attenuator R1 and the output stage Q4; this stage reduces the reactance at the output of the attenuator R1 and helps reduce phase shift as it is varied by the AGC power dissipated in the lamp.

The output stage Q4 is a power amplifier which supplies 180 milliwatts. Two types of feedback are provided by the transformer configuration at the output of Q4. The feedback from the collector of Q4 to its base, through R3 and C2, lowers the output impedance of Q4 while the feedback from the transformer T2 developed across R4 and coupled to the base raises the output impedance. The potentiometer (R3) between these two points can be used to provide a variety of adjustments between the two kinds of feedback. The output impedance can be varied from about 10 ohms to about 100 ohms, thus making it possible for the novel distribution amplifier to accommodate a wide range of loading. In the present application, the adjustment is made for 50 ±2 ohms. The capacitor C5 is in a lead network which cancels the reactive component on the output of the amplifier.

The RF output level also passes through C3 into a detector (R5, R6, C4, and D1) which generates a DC voltage proportional to the RF level. The DC voltage is compared to an adjustable reference voltage (D2; R7) and the difference is then amplified and phased properly to drive the lamp. The intensity of light falling on the photocell attenuator (R1) controls the input of the RF output; the desired output level is set by R7.

The amplifier was used to drive a passive hybrid power divider which split the power eight ways and provided eight outputs at 20 milliwatts (1 volt rms) each. Phase noise is so small that it cannot be measured accurately with instrumentation ordinarily available in development laboratories.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
NASA Pasadena Office
4800 Oak Grove Drive
Pasadena, California 91103
Reference: TSP 72-10245

Patent status:

No patent action is contemplated by NASA.

Source: George F. Lutes, Jr. of
Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-11401)