SLAC-PUB-987
(EXPI)
November 1971

A LOW COST PHOTOTUBE AMPLIFIER*

E. Cisneros

Stanford Linear Accelerator Center
Stanford University, Stanford, California 94305

ABSTRACT

Described in this note are two 8-channel amplifier modules particularly suited to multidetector systems where low cost and high packaging density are of particular importance. The circuit is discussed and all parameters of interest are included along with photos showing physical layouts.

(Submitted to Nucl. Instr. and Methods.)

*Work supported by the U. S. Atomic Energy Commission.

Introduction

The SLAC 135-098-01 and the SLAC 135-098-02 are two versions of a high speed amplifier designed primarily for use as a phototube amplifier. These low cost amplifiers feature excellent rise time, typical 1.7 nsec for the SLAC 135-098-01, and continuously variable gain from 5-90. Both versions of this amplifier have been instrumented in single width NIM modules. There are 8 amplifiers per module. The two versions are very similar in performance, the difference being in power supply requirements. The SLAC 135-098-01 requires ± 12 V at 320 mA. As many as 6 of these modules may be operated in a NIM manifold with the standard power supplies. The SLAC 135-098-02, with slightly less desirable performance, requires ± 6 V at 320 mA, but has the advantage of 12 module operation in a NIM manifold with a single piggy-back ± 6 V at 5 A power supply.

Circuit Description

Schematics for the SLAC 135-098-01 and SLAC 135-098-02 are shown in Figs. 1 and 2 respectively. The circuit consists of two feedback stages in cascade. Gain adjustment is facilitated by a 50 Ω trimpot R1, which is accessible from the front panel of the module. Diodes CR1 and CR2 prevent damage to Q1 in the event of high level transients on the input. The gain of each stage is determined by the ratios of R5 to R3, in the first stage, and by the ratio of R14 to R11 in the output stage. Total gain of both stages is

$$A_V \approx \frac{R5R14}{R3R11} .$$

C2 and C11 are selected for optimum high frequency compensation in test. The complementary output stage, consisting of Q4 and Q5, provides bipolar output driving capability.

Conclusion

The amplifiers described are primarily intended for use with photubes used in scintillation counting at low average counting rates. Since the circuit is ac coupled, performance is limited by base line shifts at high continuous rates.

Acknowledgement

The writer is indebted to Ray Larsen for his helpful comments and to George Burgueno for his efforts in breadboarding, layout, and testing.

SPECIFICATIONS, SLAC 135-098-01

General

Gain:	5-90 continuously variable, non-inverting
Linearity:	Better than 2%
Rise Time:	1.7 nsec 10% - 90% at $A_v = 90$
Delay:	3 ns
Noise:	50 μv referred to input
Feedthrough:	220 μv equivalent input from adjacent channel at 1.5 v out

Input Characteristics

Impedance:	50 Ω
Input Protection:	Input diode limited to $\pm$ .7v
Quiescent Voltage:	0 v

Output Characteristics

Output Impedance:	$\approx 8\Omega$
Maximum Output:	$\pm$ 3 v
Overshoot:	Less than 5% for 1 ns input risetime

Power Requirements

+ 12 v at 320 mA

- 12 v at 320 mA

SPECIFICATIONS, SLAC 135-098-02

General

Gain:	5-90 continuously variable, non-inverting
Linearity:	Better than 2%
Rise Time:	2.3 ns 10%-90% at A_V = 90
Delay:	3 ns
Noise:	Less than 50 μv referred to input
Feedthrough:	220 μv equivalent input from adjacent channel at 1.5 v out

Input Characteristics

Impedance:	50 Ω
Input Protection:	Input diode limited to ± .7v
Quiescent Voltage:	0 v

Output Characteristics

Output Impedance:	$\approx$ 8 Ω
Maximum Amplitude:	± 1.5 v
Overshoot:	Less than 5% for 1 ns input risetime

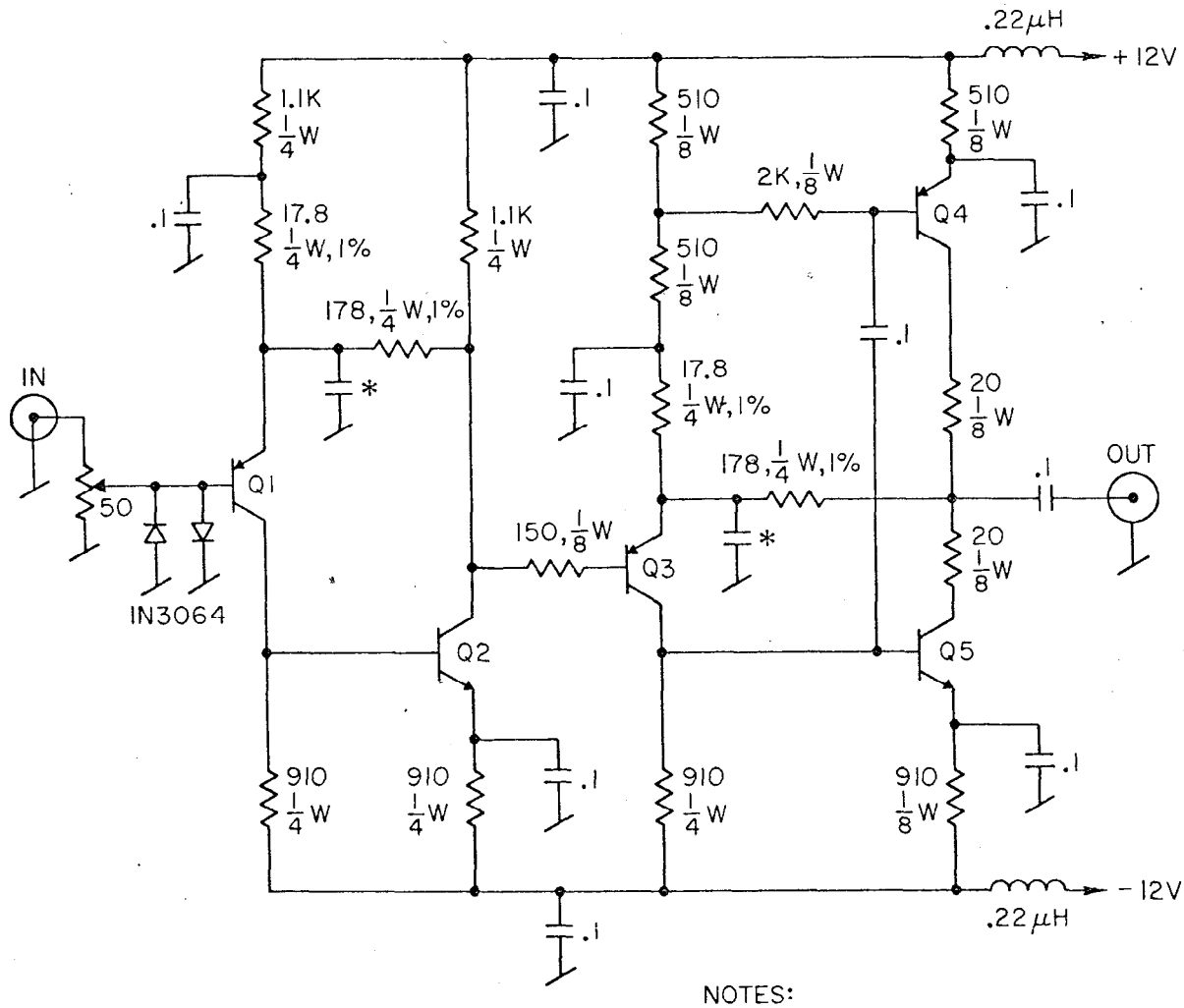
Power Requirements

+ 6 v at 320 mA

- 6 v at 320 mA

FIGURE CAPTIONS

1. Schematic Diagram, 135-098-01
2. Schematic Diagram, 135-098-02
3. Output Waveform of Circuit Shown in Fig. 1 with 1 ns Input Risetime
4. Output Waveform of Circuit Shown in Fig. 2 with 1 ns Input Risetime
5. Front View of 135-098-02 Module
6. Side View of 135-098-02 Module
7. Side View of 135-098-02 Module



NOTES:

Q1,Q3,Q4 SAB4113
Q2,Q5 SE3005

ALL RESISTORS IN OHMS AND CAPACITORS IN μF UNLESS OTHERWISE SPECIFIED.

* SELECT Ag MICA IN TEST

SLAC 135-098-01

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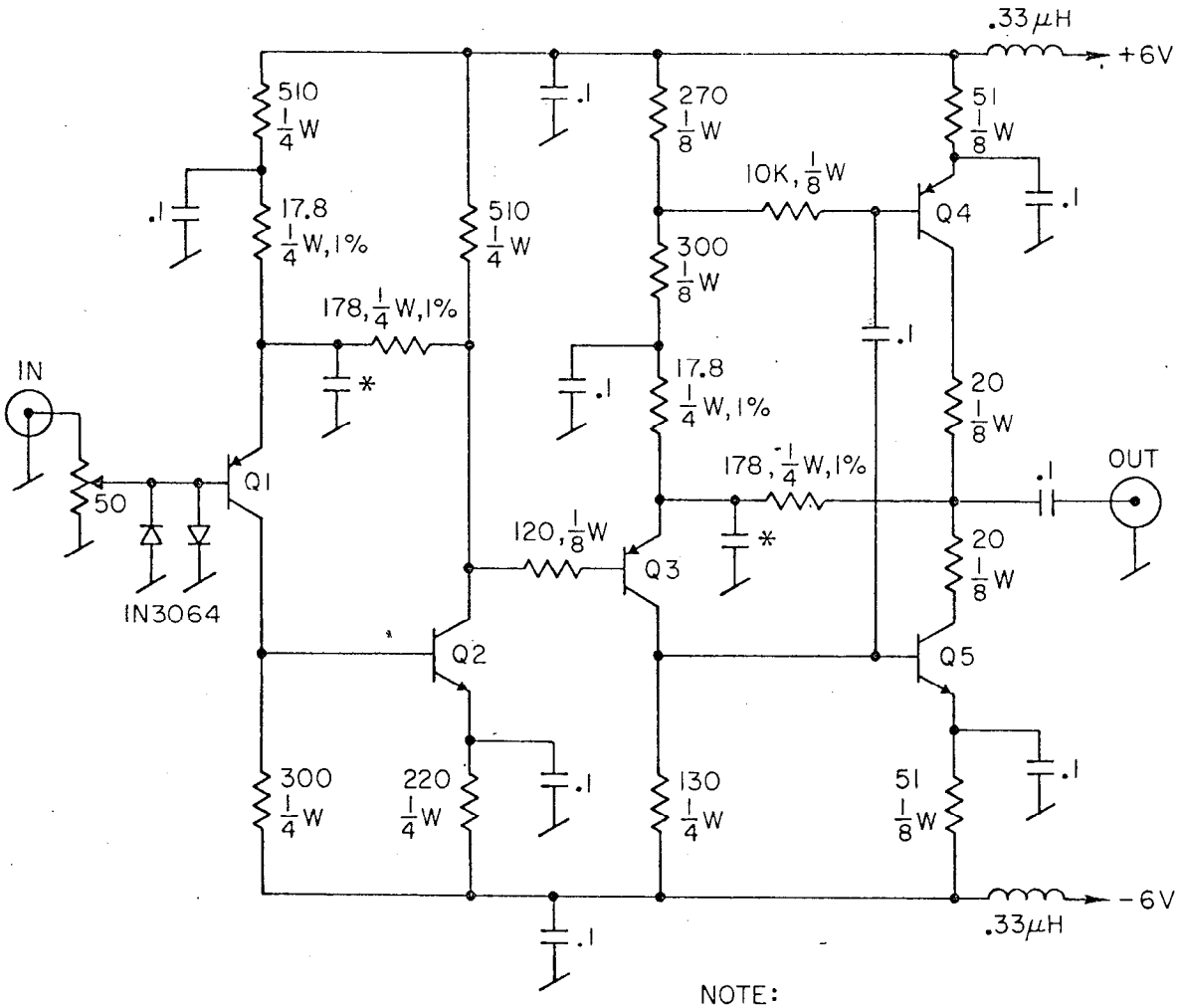
Fig. 1



NOTE:

Q1,Q3,Q4 SAB4113
Q2,Q5 SE3005
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SLAC 135-098-02

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Fig. 2