# NASA TECH BRIEF

*Lewis Research Center*

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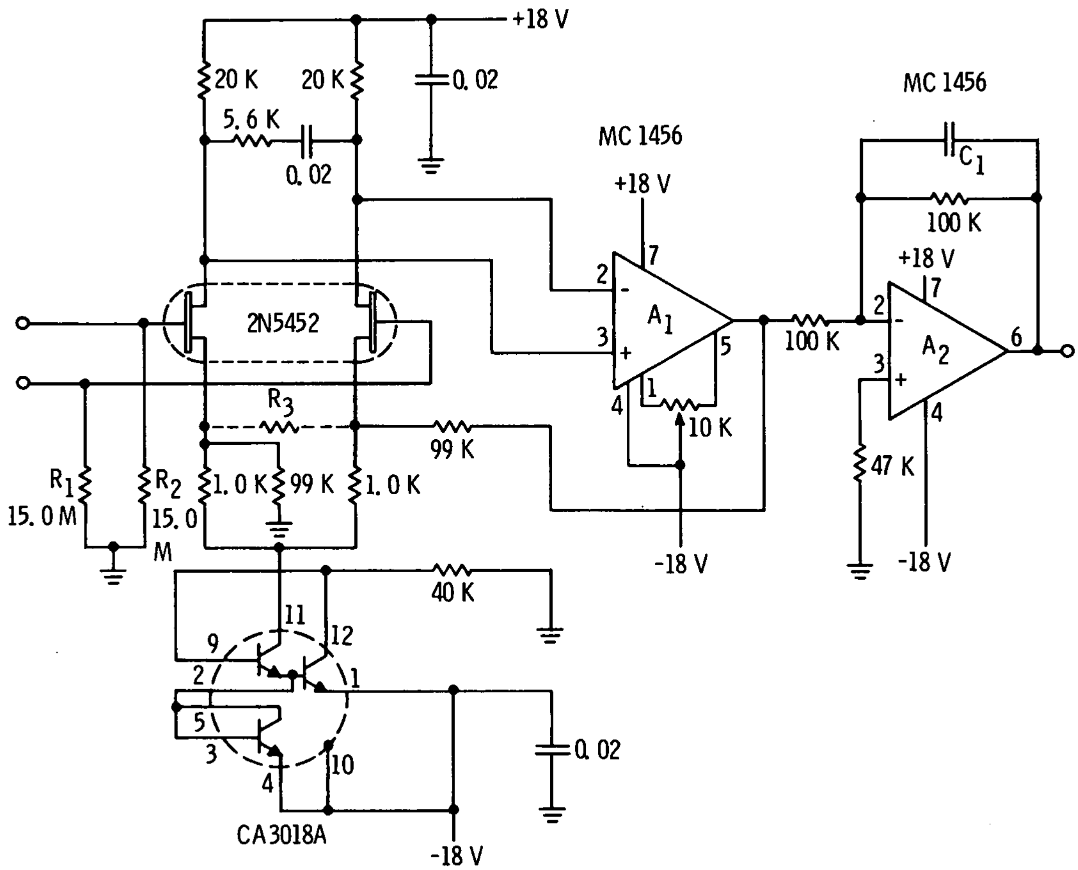
## Low Cost Instrumentation Amplifier




### The Problem:

In instrumentation and other applications, it is often necessary to amplify small signals in the presence of unwanted common mode signals or noise. Too often the solution to this problem is to use a high quality instrumentation amplifier, at considerable cost, even if its high precision is not required.

### The Solution:

An inexpensive amplifier that can be used for many applications requiring high input impedance and common mode rejection, low drift, and gain accuracy on the order of one percent.

### How It's Done:

As shown in the figure, the amplifier consists basically of two stages. The first, comprising the dual FET and operational amplifier A1, determines most of the amplifier's characteristics. The first stage gain is 100 and is as accurate as the ratios of the resistors used. Variable gain can be provided by adding a potentiometer at R3. A moderate gain change in this fashion will not alter the performance of the amplifier, particularly the input characteristics.

Input impedance of the amplifier is determined almost entirely by resistors $R_1$ and $R_2$. Their only function is to

(continued overleaf)

provide a ground return for true floating inputs. For inputs that provide a conduction path to ground, these two resistors can be eliminated to provide the highest possible input impedance.

The second stage provides a means of tailoring the gain, bandwidth, and output power to meet many possible requirements. Gain changes or bandwidth limiting using capacitor $C_1$ may be easily implemented without affecting the first stage. The second stage could even be used as an active filter to provide a sharp low pass characteristic. Use of a higher power operational amplifier for $A_2$ could provide sufficient output power for line or galvanometer driver applications.

Performance of this amplifier approaches that of some commercial instrumentation amplifiers in many specifications. DC drift is below 10 $\mu$V/°C, input noise is very low, and common mode rejection ratio of greater than 70 db holds to beyond 1 KHz. If not intentionally limited, the bandwidth is at least 10 KHz.

## Notes:

1. Applications requiring many amplifiers may be operated from common power supplies further reducing the system cost.
2. The addition of a modified second stage would provide hi-pass, band-pass, or low-pass filter characteristics for special applications. Replacement of the output stage integrated circuit with a higher power type would extend its use to galvanometer driver, line driver, and other high power applications.
3. Possible applications for this low-cost amplifier are: (1) signal conditioning for any type dc transducer, (2) input buffering of instruments; i.e., recorders, scopes, and computers, (3) line isolation, (4) impedance transformation, (5) elimination of common mode noise, (6) measuring signals from very high impedance sources such as crystal transducers, and (7) medical electronics (small signal pickups and amplification).
4. No additional documentation is available. Specific technical questions, however, may be directed to:

    Technology Utilization Officer
    Lewis Research Center
    21000 Brookpark Road
    Cleveland, Ohio 44135
    Reference: B74-10015

## Patent Status:

NASA has decided not to apply for a patent.

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