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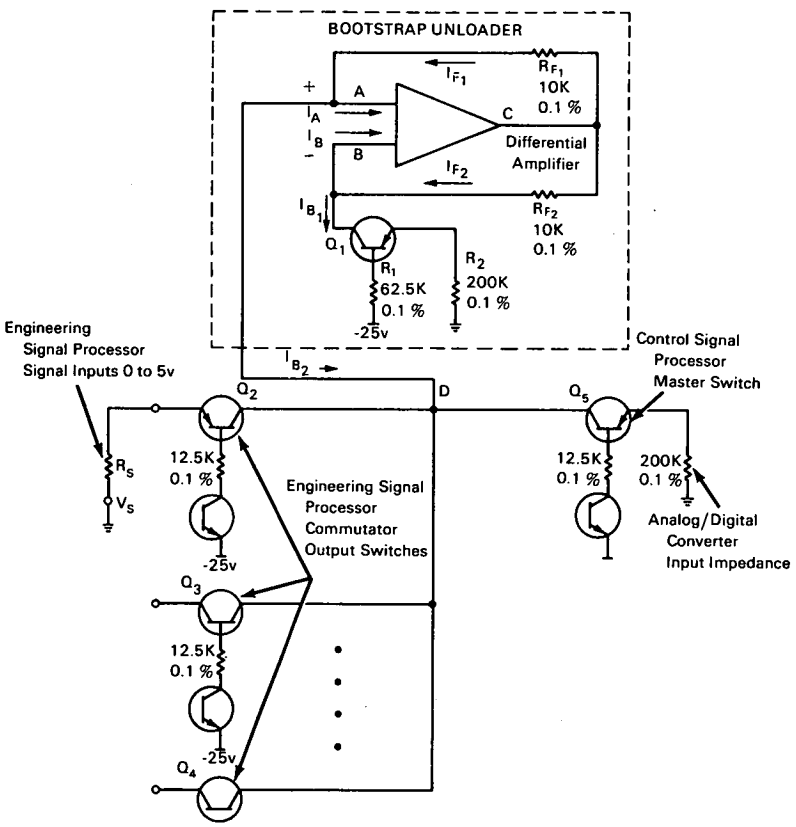
NASA TECH BRIEF

Bootstrap Unloader



A circuit has been invented that can sample a number of transducers in sequence without drawing current from them. Novelty in the invention consists in the use of a differential amplifier with one input connected to a circuit which is the equivalent of the circuit to be unloaded. In this configuration, the other input delivers the proper unloading currents.

The bootstrap unloader is shown together with a diagram of the engineering signal processor (ESP) commutator output switches and a partial diagram of the control signal processor (CSP) master switch. At any one time during an ESP telemetery frame, both ESP commutator output switch Q_2 and CSP master switch Q_5 will be on. Without a bootstrap unloader, Q_2 and Q_5 base current must be supplied by the ESP signal input voltage through the signal input impedance. This has the effect of introducing an appreciable ESP measurement error owing to the voltage drop

(continued overleaf)

across R_s. The error will vary from channel input to channel input since the current supplied to the base resistors will vary as the value (0 to 5 v.) of the input voltage to be measured varies.

The purpose, then, of the bootstrap unloader is to supply the required base current to Q_2 and Q_5 by unloading the signal input. The bootstrap unloader will thus appear as a negative resistance on the ESP commutator output line, which always supplies the correct amount of current for Q_2 and Q_5 base resistors as the input voltage varies from 0 to 5 v.

The following description of bootstrap unloader operation neglects commutator switch offset and saturation voltages.

If the commutator input voltage is V_s (0 to 5 v.), inputs A and B will be exactly V_sv. Voltage ac will equal BC; then I_{F1} and I_{F2} will be equal. Since I_A is equal to I_B in the steady state, I_{B2} will equal I_{B1} or

$$I_{B1} = \frac{V_s + 25}{62.5K} + \frac{V_s}{200K} = I_{B2} = \frac{V_s + 25}{125/2} + \frac{V_s}{200K}$$

where I_{B2} is the current input required at point D to unload the ESP signal source. If the commutated voltage is $V_s + \triangle V$, the sensed increase at A will cause the voltage at C to increase in order to supply extra current ($\triangle V/62{,}5K + \triangle V/200K$). If the magnitude of ESP -25v supply decreases or increases, the bootstrap unloader will sense the decrease in I_{B1}, which causes I_B to increase, which, in turn, causes the voltage at C to decrease, hence reducing I_{B2} to only that current required by the commutator and master switch base resistances. Thus the bootstrap unloader, rather than the ESP signal source, always supplies the exact amount of current required by Q_2 and Q_5 regardless of input signal or power supply voltage variations.

Notes:

1. This bootstrap unloader requires no elaborate module calibration procedure involving carefully handpicked components. It is also free of oscillation problems.
2. Documentation is available from:

   Clearinghouse for Federal Scientific and Technical Information
   Springfield, Virginia 22151
   Price $3.00
   Reference: TSP69-10120

Patent status:

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