System performance deteriorates in two respects as the frequency is increased beyond 500 MHz. First the on–off isolation ratio of the modulator decreases at the rate of 6 dB/octave because of the diode capacitance ($\sim$1 pF). Second the triggering jitter of the synchronizer becomes an increasingly significant fraction of the signal period and leads to incoherence between the rf signal and the modulation pulse. Consequently the upper frequency limit for satisfactory operation of the system, in the form presented here, is 1 GHz.

A Relay Control to Improve Operation of AISI-Type Automatic Air Samplers

L. Todd Reynolds
Colorado Department of Health, Denver, Colorado 80220

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AIR sampling machines of the AISI type,[1] using edge-punched filter paper tapes, are extensively used in air quality studies. The tape advance drive motor in typical models[2,3] of this device is controlled by two spst-no switches in parallel. A timer mechanism closes one switch for 1–4 sec duration at the end of sampling intervals. The second switch is then closed by contact with the moving tape, remaining closed until a punched indexing hole passes under the switch feeler. This tape advance mechanism functions properly when new, but may develop intermittent problems with age which cannot be corrected by readjustments.

First, when the take-up reel is nearly empty, the timer switch may let the tape drive motor run too short a time to take up tape slack. The tape is then not pulled far enough to close the hole sensing switch and continue the tape advance to a fresh segment of tape. More than one time interval is then sampled through the same spot on the tape. Second, as the take-up reel fills with tape and the linear tape velocity increases, a whole segment of tape may be pulled beyond the hole sensing feeler before the timer switch releases control to the hole sensing switch. Segments of tape are thus skipped and may erroneously be interpreted as periods of perfectly clean conditions.

When the timer pulse duration is changed to relieve one problem, the other problem is accentuated. Either malfunction leads to defective synchronization of tape segments with the time intervals of sampling. This defect cannot be tolerated when the exact time intervals in which high pollutant levels occur must be correlated with wind data and other synoptic measurements.

Both problems are readily corrected by installation of a simple relay control within the case of the AISI-type sampler. The circuit diagram for this electrical tape advance escapement is shown in Fig. 1. The relay logic circuit allows the tape to advance one and only one segment each time a new signal pulse is received from the timer switch. An incidental advantage is that switching loads for the tape release solenoid are carried by a relay, giving longer life to the controlling switches. Further, a timing signal pulse can be introduced at connection 4 from an external source, allowing the tape advance to be actuated by other equipment.

Tape synchronization errors totaling 1–20 h/week had been noted in 80% of tapes run with four 7-year-old samplers. Without any further readjustments of the mechanisms, relay controls were installed in these samplers. Accelerated testing for 25 000 tape advances, from −20 to 50°C, and with empty and overfilled reels, showed perfect synchronization throughout full 30 m rolls of tape. Field experience has confirmed the excellent synchronization performance of these modified samplers. This relay control can thus be recommended as a valuable accessory for older AISI-type samplers.

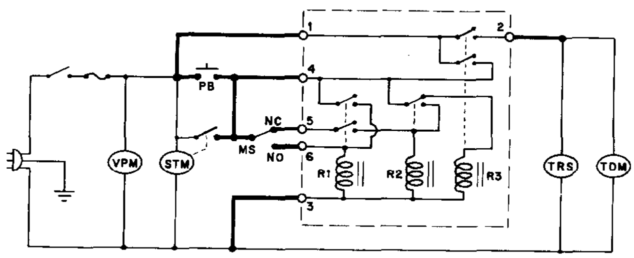

Fig. 1. Wiring diagram for AISI-type sampler with relay control unit. Heavy lines denote new connections to retained portions of original circuit. MS—Hole sensing switch, rewired spst; PB—pushbutton switch, tape advance, added to panel; STM—synchronous timer motor; TDM—tape drive motor; TRS—tape release solenoid; VPM—vacuum pump motor; R1–R3—relays (Guardian 1200-2C-120A) in Bud CU-3004A box; connections 1–6 via Belden 8446 cable to Jones 140-6 terminal block mounted on back of panel.[3]

[1] ASTM test method D1704.
[2] Research Appliance Company, models F-1 and F-2.
[3] Mention of company or product name does not constitute endorsement by the Colorado Department of Health.

A Versatile Pulse Amplifier*

M. Lampton and J. H. Primbsch
Space Sciences Laboratory and Department of Physics, University of California, Berkeley, California 94720

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WHEN counting charged particles or photons with scintillation counters, surface barrier detectors, proportional counters, or channel electron multipliers, one must amplify the detector's anode signal (-10^{-14} to -10^{-10} C) to bring it up to the level of several volts

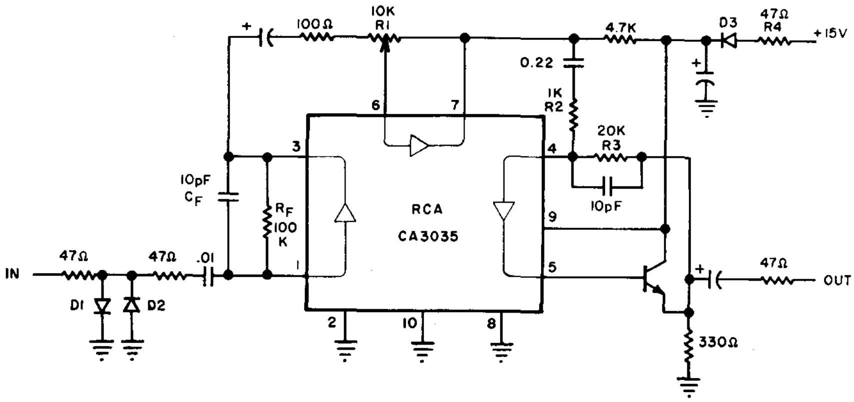

FIG. 1. Schematic diagram of the amplifier. Diodes are 1N914A or equivalent. Polarized capacitors are 3.3 μF, 15 V tantalum. The transistor is a 2N3904 or equivalent.

compatible with discriminator and pulse height analyzer inputs. This note describes a pulse amplifier suited for these applications which combines the features of simplicity, low power consumption, wide gain range, and low cost.

The pulse amplifier is diagramed in Fig. 1. The design is based on the RCA integrated circuit CA 3035 which consists of three inverting amplifiers. One of these is employed as the charge sensitive input amplifier. Its feedback capacitor C_F determines the charge amplification of this stage, and the feedback resistor sets the decay time R_FC_F of the amplified pulses. The second feedback loop is a variable gain stage whose amplification is $-X(1-X)$; X represents the fractional setting of the gain control R1. The third feedback loop has a fixed gain of -20 and is provided with an emitter follower for improved drive in 50 Ω systems. The shunt diodes D1 and D2 protect the amplifier from possible high voltage breakdown in the detector, and D3 prevents damage from a reversed power supply connection. The electrical current consumption is 10 mA from a +12 to +15 V power supply. For operation from +28 V, change R4 to 1200 Ω.

With the values shown, the amplifier has rise- and fall-times of 0.3 and 1.0 μsec. By varying R1 the gain can be adjusted from -10^{11} to -10^{14} V/C. For use near maximum gain, care must be exercised to maintain spurious input to output wiring capacity below 10^{-14} F. The amplifier's noise level is approximately 10^{-15} C rms. Output signals to 7 V peak can be obtained without clipping. The design has been proven in several laboratory and space flight applications.

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Erratum

Magnetic Susceptibilities of Some Materials Which May Be Used in Cryogenic Apparatus

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D. M. GINSBERG

Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801

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TABLE I and its footnotes should indicate that resin 3170 with catalyst 7133 is an epoxy adhesive; resin 7343 with catalyst 7139 is a modified polyurethane adhesive.