SPECIAL FEATURE–COMMUNICATIONS 1975

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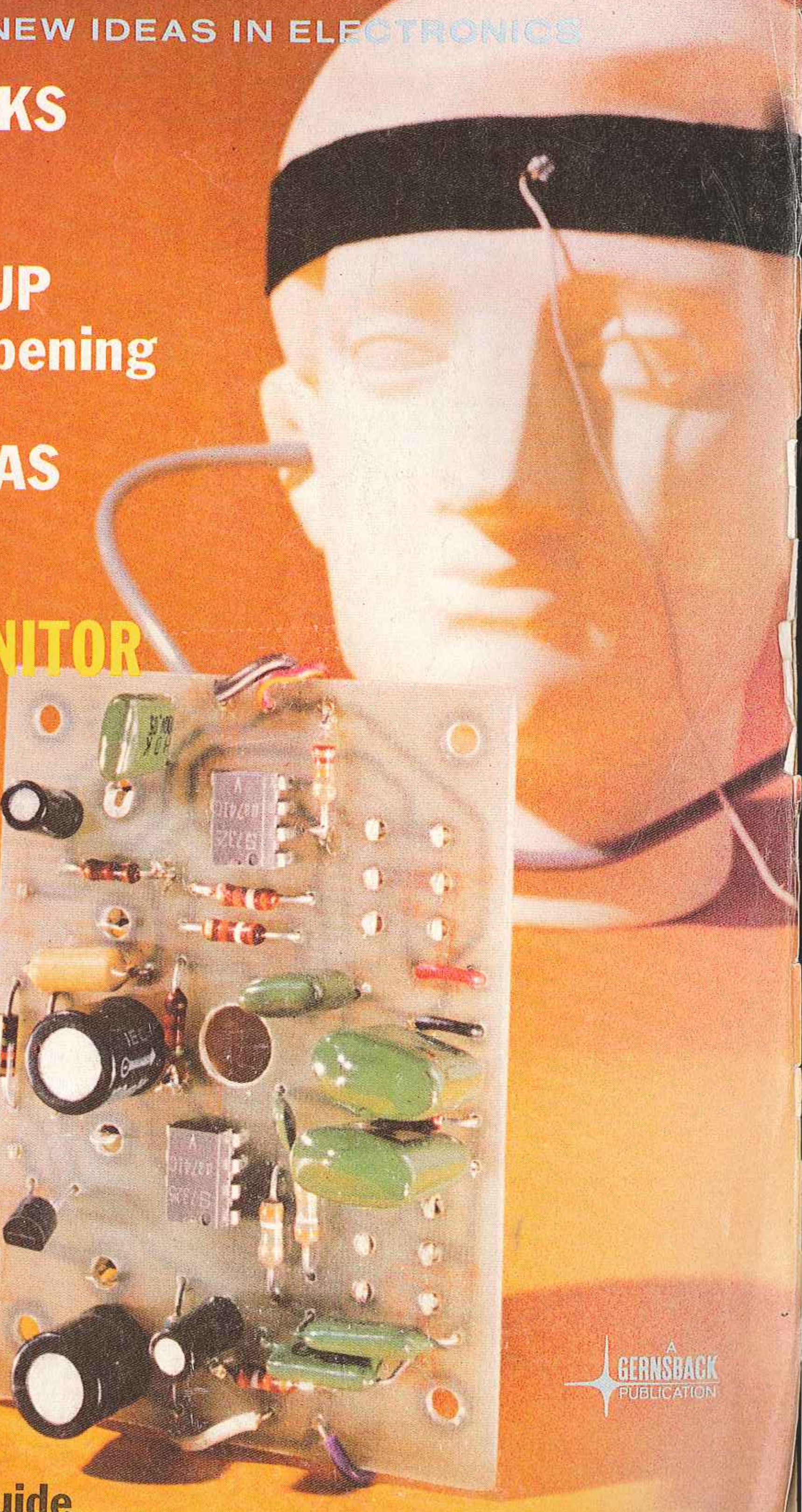
Radio-Electronics

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS



3 UNIQUE DIGITAL CLOCKS
You Can Build Them All

CB EQUIPMENT ROUNDUP
What's New–What's Happening

INSTALLING CB ANTENNAS
In RV Vehicles

BUILD A BRAINWAVE MONITOR
And Tune-Up Your Mind

NEW CB RULES
How They Affect You

STATE-OF-SOLID-STATE
New Developments
And Applications

COSMOS PROJECTS

R-E's Replacement Transistor Guide
Step-By-Step Troubleshooting Charts

A GERNSBACK PUBLICATION

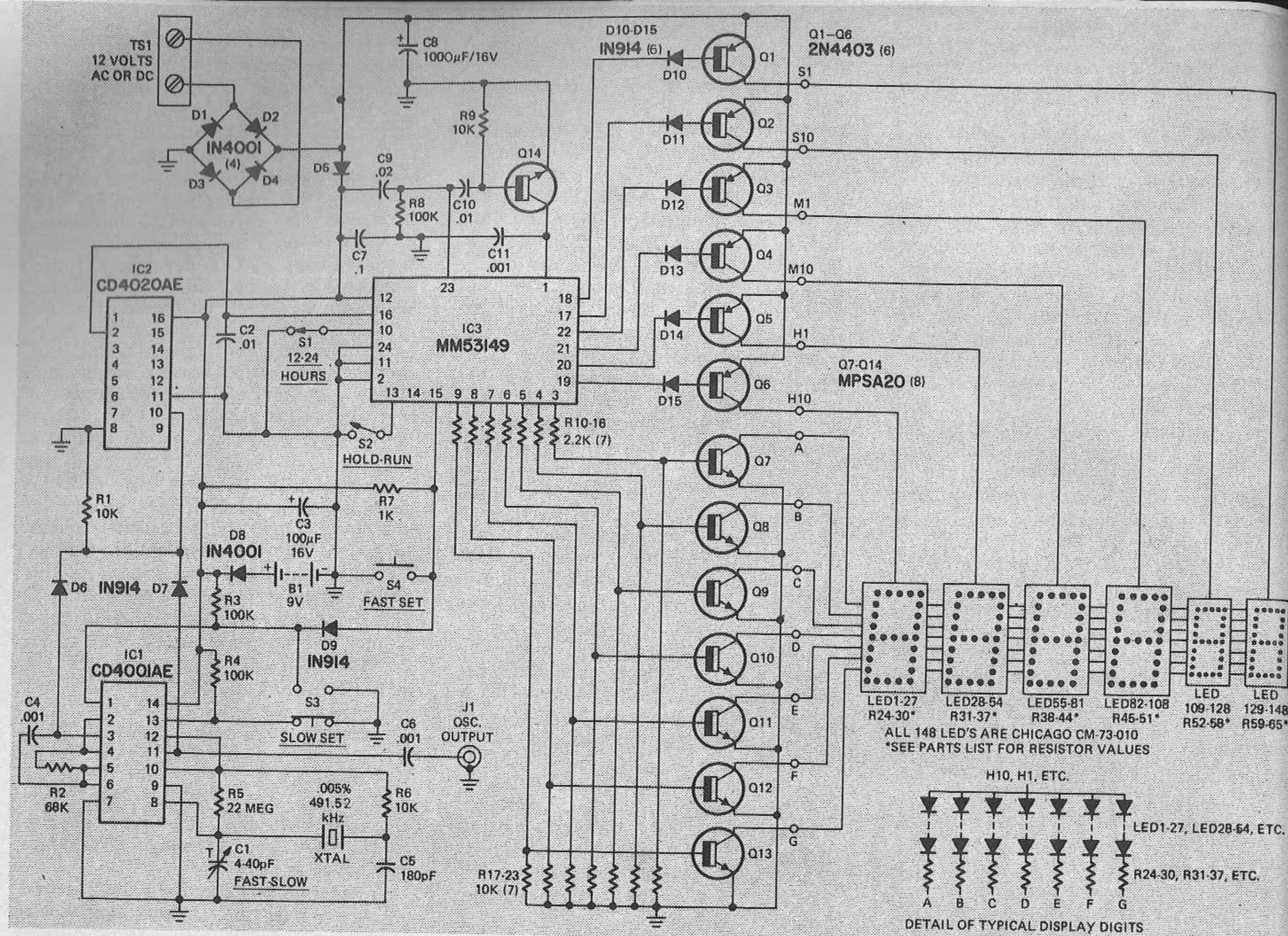


FIG. 8—SCHEMATIC OF THE WALL CLOCK. S1 selects 12 or 24-hour time. S2 is the HOLD-RUN switch. S3 is the SLOW SET pushbutton and cycles the minutes only. S4 is the FAST SET pushbutton and cycles the hours and minutes. The seconds readouts have a 4×7 format.

B1—9-volt (Eveready 216 or equal)
C1—4 to 40-pF trimmer (Arco 403 or equal)
C2, C10—0.01-μF disc ceramic
C3—100-μF, 16-volt, PC-type electrolytic
C4, C6, C11—0.001-μF disc ceramic
C5—180-pF, N2200 negative temperature coefficient, disc ceramic (Sprague 10TCY-T18 or equal)
C7—0.1-μF disc ceramic
C8—1000 or 2200-μF, 16-volt electrolytic
C9—0.02-μF disc ceramic
D1 to D5, D8—1N4001
D6, D7, D9 to D15—1N914
D16 to D20—not used (see text)
IC1—CD4001AE (RCA) CMOS Quad NOR gate
IC2—CD4020AE (RCA) CMOS 14-Stage Binary Counter/Divider
IC3—MM53149 (National) MOS Digital Clock
J1—Phono jack
LED1 to LED148—Light-emitting diode (Chicago Miniature Lamp CM-73-010 or equal) selected for 3:1 light-intensity range and chip centering, (see text)
Q1 to Q6—2N4403 pnp
Q7 to Q14—MPSA20 npn
R1, R6, R9, R17 to R23—10,000 ohms, 10%, ½ watt
R2—68,000 ohms, 10%, ½ watt
R3, R4, R8—100,000 ohms, 10%, ½ watt
R5—22 megohms, 10%, ½ watt
R7—1000 ohms, 10%, ½ watt
R10 to R16—2200 ohms, 10%, ½ watt
R24, R27, R28, R31, R34, R35, R38, R41, R42, R45, R48, R49, R52, R55, R56, R59, R62, R63—150 ohms, 10%, ½ watt
R25, R30, R32, R37, R39, R44, R46, R51, R53, R58, R60, R65—56 ohms, 10%, ½ watt
R26, R29, R33, R36, R40, R43, R47, R50, R54, R57, R61, R64—100 ohms, 10% ½ watt
S1, S2—spst slide switch
S3, S4—spdt pushbutton switch
TS1—2-lug terminal strip
XTAL—491.520-kHz crystal, HC/6 holder, 0.005% tolerance at room temperature
MISC—Printed circuit boards, suitable cabinet, solder, wire, etc.

NOTE—The following are available from Caringella Electronics, Inc., P.O. Box 327, Upland CA 91786: PC board, etched and drilled, No. MDC-1-1, at $7.95 postpaid; PC board, etched and drilled, No. DWC-1A, at $14.95 postpaid; Set of 148 selected LED's for display panel at $60.00 postpaid; Complete kit of all parts including cabinet, hardware, UL approved plug-in stepdown transformer No. LVT-1, wire, solder, step-by-step instructions, etc., No. DWC-1 KIT at $159.95 plus $3.50 handling and shipping. California residents add 6% sales tax on all items.

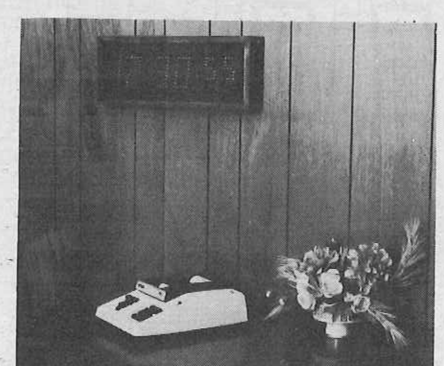


FIG. 7—JUMBO-SIZED DIGITS, measuring 3½-inches high, make the 6-digit wall clock particularly impressive, and well suited for office, school, factory, and many other applications. This large wall clock is housed in a simulated-walnut cabinet and has a red sheet-acrylic clock "window".

the two desk clocks. However, most of the remaining circuitry is unique to the wall clock.

The 60-Hz time base is generated internally, making the timekeeping accuracy independent of the power-line frequency or power-line failures! This also allows for operation from an external *12-volt dc* power source.

One gate of a CMOS quad 2-input NOR gate, IC1, is used as a crystal-controlled oscillator. A 491.520-kHz crystal is used. A second gate amplifies and buffers this signal, to provide an output through J1, located on the back panel, to a frequency counter. Trimmer capacitor C1 sets the quartz-crystal frequency precisely. This frequency can be varied over a limited range, to compensate for seasonal temperature changes that can affect the operating frequency of the crystal. Access to C1 is shown as

(continued on page 85)

40 PROJECTS Using COSMOS Digital IC's

This is the final part in a series of articles describing COSMOS IC applications, the latest in solid-state technology. The series concludes with oscillator, alarm generator and alarm circuits.

by R. M. MARSTON

LAST MONTH WE EXPLORED WAYS OF USING the CD4001 in lamp flasher, time-delay, oscillator and alarm generators. This final article in the series will conclude with alarm generators and electronic alarm projects.

Figure 41 shows how the CD4001 can be wired up as a one-shot alarm generator, which starts to generate a monotone alarm signal as soon as pushbutton switch S1 is momentarily closed, but stops generating automatically after a pre-set period. The period can be varied from a fraction of a second to more than 15 minutes by selecting the value for C1.

The operation of this circuit is quite simple. Gates 1 and 2 are wired as a gated monostable or one-shot multivibrator which is triggered by momentarily closing S1, and gates 3 and 4 are wired as a gated astable multivibrator that operates at 800 Hz. The output of the monostable turns the astable circuit on and off, and the output of the astable is fed to the speaker via Q1. Thus, the alarm is normally off, but turns on as soon as S1 is closed, and then turns off again automatically after a pre-set period. The period is roughly equal to 1 second per μF of C1 value. C1 must be a low-leakage capacitor in this application.

Finally, Fig. 42 shows how the CD4001 can be wired as a self-latching alarm generator. Here, gates 1 and 2 are wired as a manually-triggered bistable multivibrator, and gates 3 and 4 are wired as a gated astable multivibrator. The output of the bistable is used to turn the astable on and off, and the output of the astable is fed to the speaker via Q1. The action of the circuit is such that the alarm turns on and self-latches as soon as S1 is briefly operated. The alarm then remains on until S2 is pushed at which point the alarm resets and self-latches off.

Note that the circuits of Figs. 40 to 42 are designed to give only a low output power level, as in the case of Fig. 37. These circuits can be modified to give medium or high output power levels by altering their output stages to conform to Figs. 38 or 39. (Figures 37 through 40 can be found in the December 1974 issue.)

Electronic alarm circuits

The versatility and near-zero standby current of the CD4001 makes it suitable for use in a variety of electronic alarm applications. Figure 43 shows how the IC can be used in a break-to-operate self-latching low-power alarm circuit.

Here, gates 1 and 2 are wired as an electronically-triggered bistable multivibrator, and gates 3 and 4 are wired as a 800-Hz gated astable multivibrator. The output of the bistable provides the gating signal to the astable circuit, and the output of the astable is fed to the speaker through Q1. The action of the circuit is such that the alarm turns on and self-latches as soon as S1 is momentarily opened or broken. The alarm then remains on until S2 is momentarily closed, at which point the circuit resets and self-latches into the OFF state, and the quies-

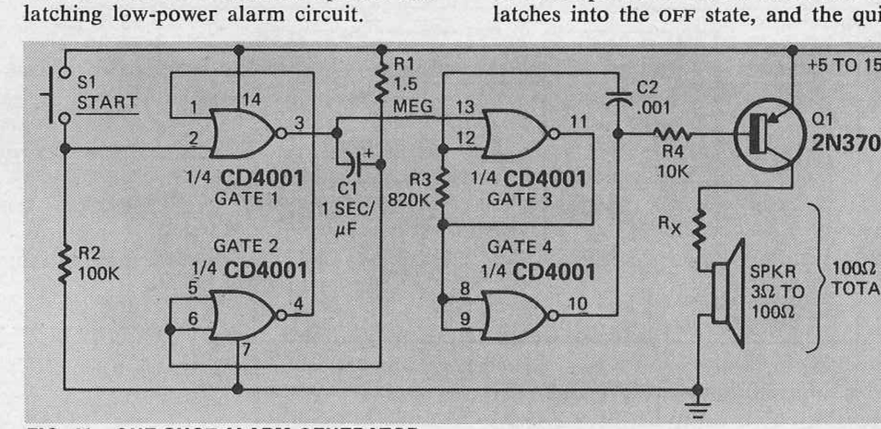


FIG. 41—ONE-SHOT ALARM GENERATOR.

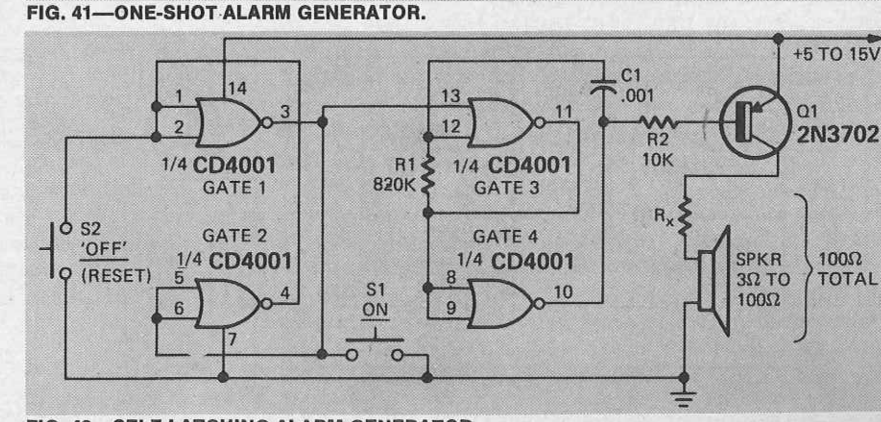


FIG. 42—SELF-LATCHING ALARM GENERATOR.

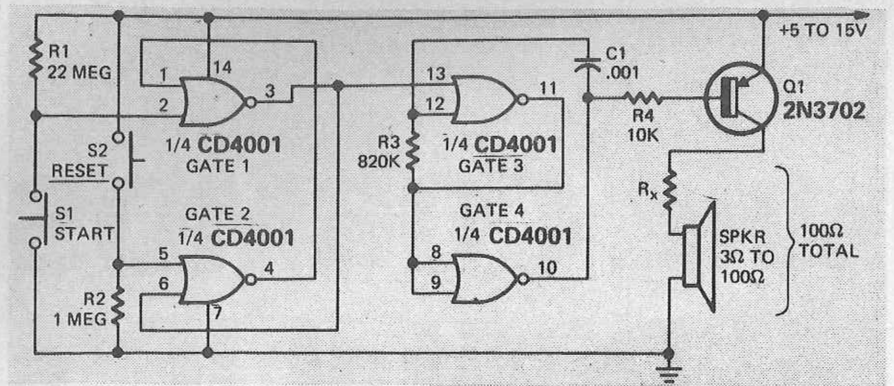


FIG. 43—BREAK-TO-OPERATE self-latching low-power alarm.

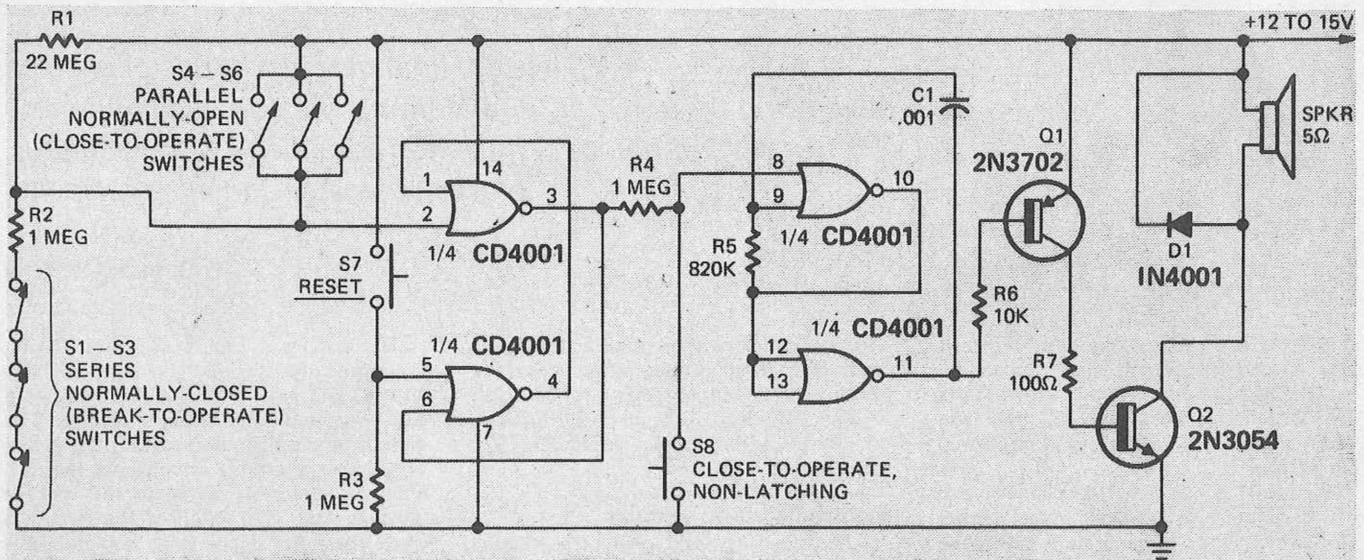


FIG. 44—MULTI-INPUT BURGLAR ALARM (gives approximately 10 watts output.

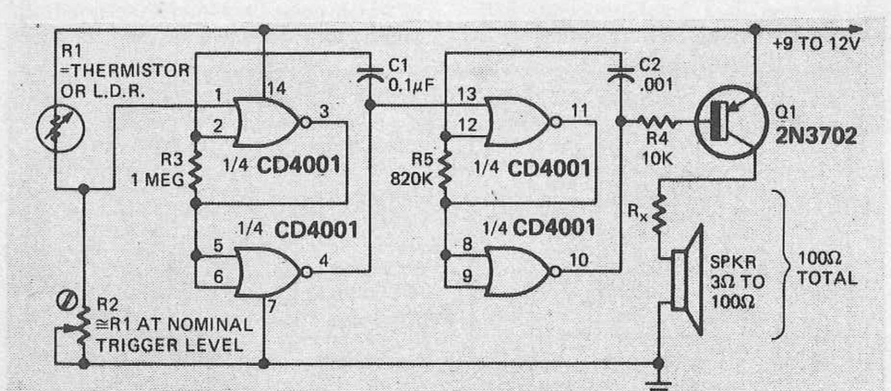


FIG. 45—PULSED-OUTPUT WATER-ACTIVATED ALARM.

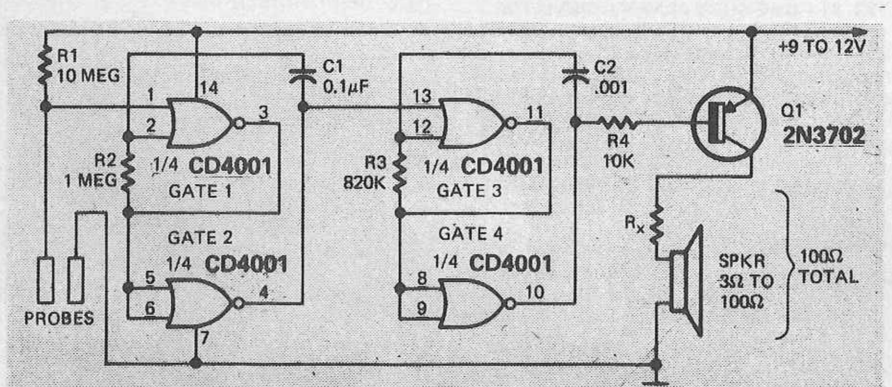


FIG. 46—PULSED-OUTPUT UNDER-TEMPERATURE or light-activated alarm.

cent current falls to near-zero.

Figure 44 shows how the circuit in Fig. 43 can be modified for use as a multi-input burglar alarm. The circuit is basically similar to Fig. 43, except that the input circuitry is modified, the output of the bistable multivibrator is coupled to the input of the astable via 1-megohm resistor R4, and the output of the astable is fed to the speaker via Q1 and Q2. The circuit is designed for operation from a 12 to 15-volt supply, and gives an output of about 10 watts into a 15-ohm speaker.

The action of the circuit is such that the alarm turns on and self-latches as soon as any of series-connected switches S1 to S3 are momentarily operated or broken, or as soon as any of parallel-connected switches S4 to S6 are momentarily closed. The alarm then remains on until S7 is momentarily closed, at which point the circuit resets and self-latches into the OFF state, and the quiescent current falls to a value of about 10 μA.

Note that any number of additional normally-closed switches can be wired in series with S1—S3, and any number of normally-open switches can be wired in parallel with S4—S6, so there is no limit to the number of input trigger switches that can be used with the circuit. Also note that normally-open switch S8 can be used to operate the alarm in the non-latching mode, and that any number of additional normally-open switches can be wired in parallel with this switch. S8 can be used simply to test the functioning of the alarm, as a "panic button" or to activate it via sensing circuitry that does not require the alarm to be operated in the self-latching mode. Finally, note that a standing current of about 0.65 μA flows in resistors R1 and R2 when the circuit is in the standby mode, and that this current is insignificant relative to the normal leakage current of about 10 μA of output transistor Q2.

Figure 45 shows how the CD4001 can be used as a pulsed-output water-activated alarm. Here, gates 1 and 2 are connected as a gated 6-Hz astable multivibrator, and gates 3 and 4 are connected as a gated 800-Hz astable. The 800-Hz

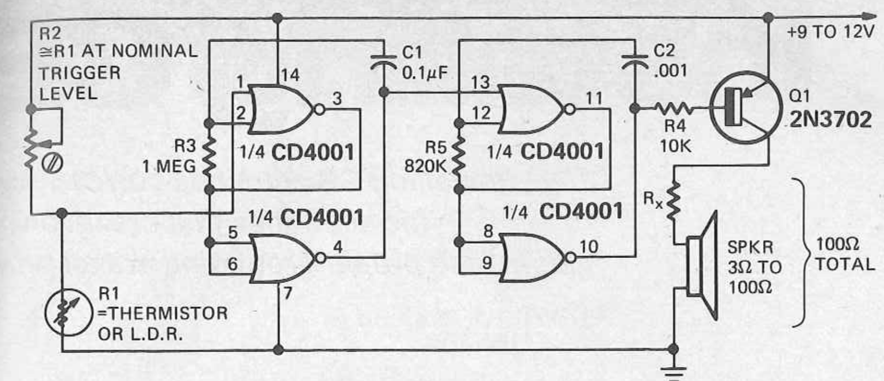


FIG. 47—PULSED-OUTPUT OVER-TEMPERATURE or dark-activated alarm.

multivibrator controls the 6-Hz astable, and its output feeds to the speaker via Q1. The 6-Hz astable is gated via the resistance appearing between a pair of metal probes.

Normally, the two probes are open circuit, and under this condition both multivibrators are disabled and the circuit passes near-zero quiescent current. When a resistance is placed across the probes, a voltage divider action takes place between that resistance and R1, and some fraction of the supply voltage is applied to the input terminal of gate 1. When this voltage falls below the transfer voltage of the gate, the two astable multivibrators become enabled, and a pulsed alarm signal is generated. COSMOS I.C's have nominal transition voltage values of 50% of the supply voltage: Consequently, the circuit in Fig. 45 is activated when the probe resistance is reduced below a nominal value of 10 megohms. Water (in common with many other liquids) has a fairly low resistivity, so the alarm circuit can be turned on by simply placing both probes simultaneously into water. The circuit thus acts as a water activiated alarm, and gives a low-level pulsed output. The circuit can be used to indicate flooding in cellars or basements, the overflowing of cisterns or water tanks, or simply to give an announcement when the bath water has reached a given level.

Finally, Figs. 46 and 47 show how the circuit in Fig. 45 can be modified for use as a pulsed-output temperature or light-activated alarm. In the explanation of circuit operation given above, it was pointed out that the alarm turns on as soon as the input voltage falls below the transfer voltage value of the IC. This transfer voltage is reasonably stable, and the turn-on action of the alarm is quite sharp. Consequently, the alarm can readily and reliably be activated via a light or temperature-sensitive potential divider wired across the supply lines.

Figure 46 shows the connections for making an under-temperature or light-activated alarm, which turns on when the temperature of a thermistor falls below a pre-set level, or when the illumination of a light-dependent resistor rises above a pre-set level. The light or temperature-sensing element (R1) forms the upper arm of the potential divider, and sensitivity control R2 forms the lower arm.

The action of this circuit can be reversed, so that it acts as an over-temperature or dark-activated alarm that turns on when the temperature rises above a pre-set level or when the illumination falls below a pre-set level, by simply transposing the positions of R1 and R2, as shown in Fig. 47. In either case, any negative-temperature-coefficient thermistor can be used as the temperature-sensing element, or any cadmium sulphide photocell can be used as the light-sensing element: Ideally, however, these elements should have large resistance values at their nominal operating values, so that the quiescent current consumption of the circuits are kept to reasonably low levels. R2 is a pre-set resistor, and should be adjusted to give a value roughly equal to that of the sensing element at the nominal light or temperature triggering level. This resistor acts as a sensitivity control. **R-E**

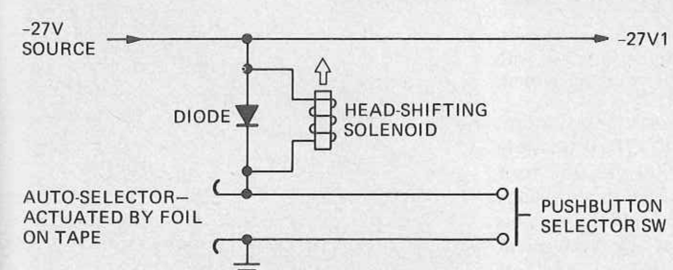
service questions

NO TRACK CHANGE

The channel selector doesn't work in this Mayfair 888 stereo tape player. Everything else is fine. Can't find a schematic listed on this anywhere. The selector and cam are OK, but nothing happens when I push the button.—C.K. Cheektowaga, NY.

Look in Sams Home Tape Player Manual, Vol. HTP-9, pp. 61-70. You'll find it listed there.

Channel or track selector: if the cam and selector unit



are free, check the solenoid coil. Also make sure that the dc voltage is getting to the solenoid. Last check; if an ammeter shows a sudden pulse of current when the track-selector button is pushed, but nothing happens, check that transient-suppressor *diode*. It is connected across the solenoid. If it's shorted, nothing will work.

PULL-IN AT SIDES

The brightness goes way down, (high-voltage drops) and the raster pulls in at the sides, in this RCA CTC-22AD. This is intermittent, of course. I think it's somewhere in the brightness limiter stage. Dc voltages up to the 11HM7 video output seem to be OK. Any ideas?—J.R., Tucson, AR.

Check that 11HM7 tube. If all dc voltages are within tolerance *up to that point*, there could be some kind of problem here; an intermittent short in the tube, etc. The brightness limiter, like the regular brightness control, works through the 11HM7 video output to react on the picture tube cathode circuits.

UNBELIEVABLE

The syncs (both horizontal and vertical) went completely out, on this RCA CTC-19. Scope on the first video grid showed a mess, with a big hum-component. Pull the horizontal output tube, and the video signal looked OK. Now comes the weird part.

I turned on a small black-and-white portable very near by. Worked fine. Then, for one more check, I turned on the CTC-19. Out went the syncs ON THE PORTABLE. Turn the -19 off, normal sync. Sound not affected.

There was a weird sound that seemed to be coming from the high-voltage cage of the -19. As nearly as I could tell, it came from the vicinity of the 6BK4 high-voltage Regulator. I pulled this tube, and lo! Normal picture. Both sets. New 6BK4 cleared up the whole thing. Evidently the 6BK4 was radiating some kind of hash that was killing the sync. Would you believe that?—W.A., Los Angeles, CA.

Yes. **R-E**