CIRCUITS

60-Hz TIMEBASE

Here's a one-IC timebase generator that's both accurate and flexible.

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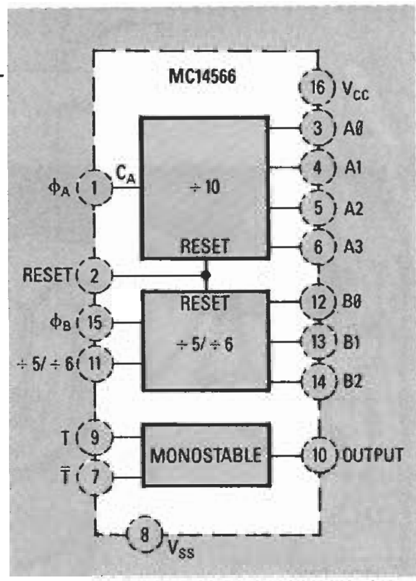

FIG. 1—PINOUT AND BLOCK DIAGRAM of the Motorola MC14566B, or the equivalent 4566, timebase generator.

WHILE A STABLE REFERENCE FREQUENCY is often needed when doing electronics experimentation, generating one can present some problems. Usually, a reference frequency is generated using either a crystal timebase or some form of line-frequency divider. But crystal timebases are fairly expensive and line-frequency dividers usually require two or three IC's to get a usable 1 or 10 Hz frequency from a 60-Hz line. There is, however, a relatively obscure CMOS IC that can do the job inexpensively.

That IC, the Motorola MC14566B (and the equivalent 4566), carries the imposing title of "Industrial Timebase Generator," which is probably a large part of the reason it isn't commonly used. However, the device can be used anywhere an experimenter or hobbyist needs an inexpensive reference frequency: in clocks, frequency meters, period counters, etc.

Being a CMOS device, the MC14566B can operate with any supply between 5 and 15 volts. And, being CMOS, it draws only about 10 mA of supply current across that voltage range.

Inside the MC14566B

As Fig. 1 shows, the MC14566B contains three independent function blocks: a BCD (*B*inary *C*oded *D*ecimal)-output divide-by-10 counter, a BCD-output divide-by-5 or -6 counter, and a monostable multivibrator. The two counters share a common reset, which is tied to ground for normal operation and brought high to reset both counters to zero.

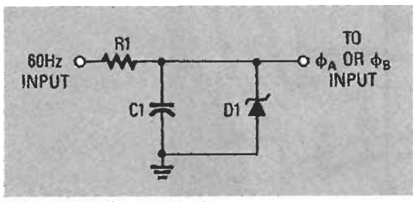

FIG. 2—THIS RESISTOR-CAPACITOR-ZENER network allows the MC14566B to take its clock signal from either end of the transformer that powers the circuit.

Both counters are clocked by the falling or negative edge of the clock pulse, and both have pulse-shaping networks on their clock inputs (ϕ_A and ϕ_B) that allow them to be directly driven by a low-voltage sinewave signal via a resistor-capacitor-Zener network like the one shown in Fig. 2. The source for the sinewave is the transformer that powers the circuit; the input of the network may be connected to either end of the winding that powers the MC14566B circuit. The Zener should be a ½- or 1-in watt unit, and have a voltage rating that's within 10% of the supply voltage. With such a Zener in place, the AC peak-to-peak voltage (V_{PP}) can be from 70–200% of the circuit's DC supply.

TABLE 1

OUTPUT	DIVISION RATIO	DUTY CYCLE (%)
A0	2	50
A1	4	40*
A2	10	40
A3	10	20
B0	2(2.5)	50(40*)
B1	6(5)	33(40)
B2	6(5)	33(20)

*PULSES IRREGULARLY SPACED
FIGURES IN ( ) FOR ÷5 MODE

Although the counters have standard BCD outputs, we have little need for that format for our application. Therefore, it is more practical to regard them as division-ratio outputs. Table 1 shows the output-division ratios and the accompanying duty cycles for each counter's outputs.

Using the IC

Figure 3 shows the most common set-up for using the MC14566B as a frequency standard. With the 60-Hz signal from the transformer applied to ϕ_B, the B2 output will provide a 10-Hz frequency. If that signal is used to drive ϕ_A, the A3 output will provide a 1-Hz signal.

Many other output frequencies can be obtained from the IC. The actual output depends upon which output of the first counter is used to clock the second, and which of the seven outputs is then used. Through various combinations, some 12 different frequencies should be available, with duty cycles of 20, 40, and 50 percent.

The third section of the MC14566B is a simple monostable multivibrator with a fixed pulse-width output, positive- and negative-edge triggering, and a normally-low output. With

continued on page 77

60-Hz TIMEBASE

continued from page 56

T input tied to the power supply, a falling edge at the $\overline{T}$ input will trigger an output pulse. See Fig. 4-*a*. On the other hand, if the $\overline{T}$ input is tied to ground, a rising edge at the T input will generate a pulse. See Fig. 4-*b*. The output pulse width is short, fixed, and somewhat dependent on the supply voltage.

If desired, any of the counter outputs can be routed to the monostable to get a pulse output with the same frequency and a duty cycle of less than 1%. With the dual RC network shown in Fig. 5, the monostable becomes a dual-edge detector or frequency doubler, generating a pulse on each incoming edge, thus synthesizing an output frequency that's twice the input. That doubled frequency (with a sub-1% duty cycle) can be used directly or used to clock the second counter. Note that any unused inputs must be tied to ground.

Finally, pin 11 ($\div 5/\overline{\div 6}$) allows use with 60- or 50-Hz line frequencies. Ground the pin for 60-Hz operation: tie it high for 50-Hz. **R-E**

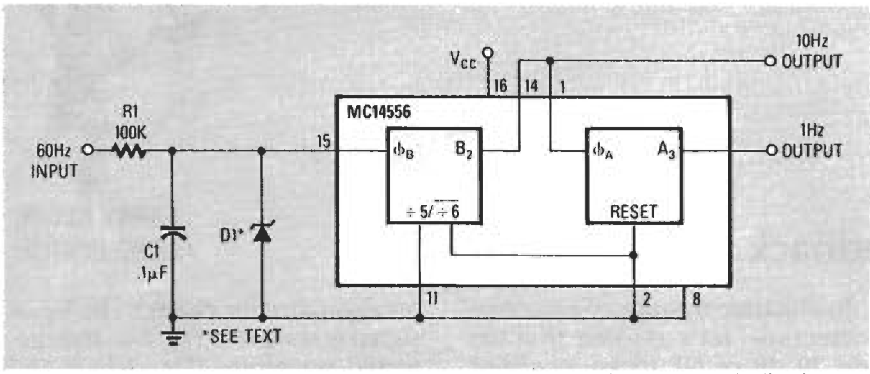

FIG. 3—THIS CONFIGURATION will deliver 1- and 10-Hz signals from either 50- or 60-Hz line frequencies. Note that the outputs do not have 50% duty cycles.

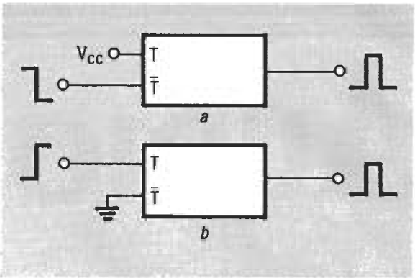

FIG. 4—THE MONOSTABLE can be configured to respond to either a rising or falling edge.

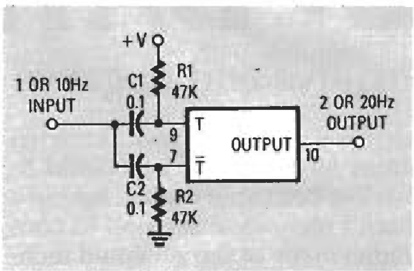

FIG. 5—USING A DUAL RC network, the monostable becomes a frequency doubler with an output duty cycle of less than 1%.

AUDIO SCRAMBLER

continued from page 55

scrambled tapes, or between a tape recorder and its output to decode them.

The device can also be used to scramble and descramble two-way telephone conversations. For instance, a single scrambler/descrambler unit can be used in a half-duplex mode, which means only one person can speak at a time because the unit must be switched between connections. A mechanical TX/RX switch can be used to do the switching. A much better approach is a full-duplex set-up. Figure 9 shows how two scrambler/descrambler units are connected for full-duplex, meaning that no switching is necessary. (The conventional telephone is full-duplex.) Other than merely eliminating the RX/TX PUSH-TO-TALK switch needed in the half-duplex configuration, the full-duplex application offers a more secure environment. A would-be eavesdropper would have to descramble both sides of the conversation, a difficult task because each transmitting scrambler unit would, of course, be tuned to a slightly different frequency by the users.

The device can also be used to provide computer data transmission security. For that you can connect the full-duplex configuration to a 300-baud computer modem. **R-E**

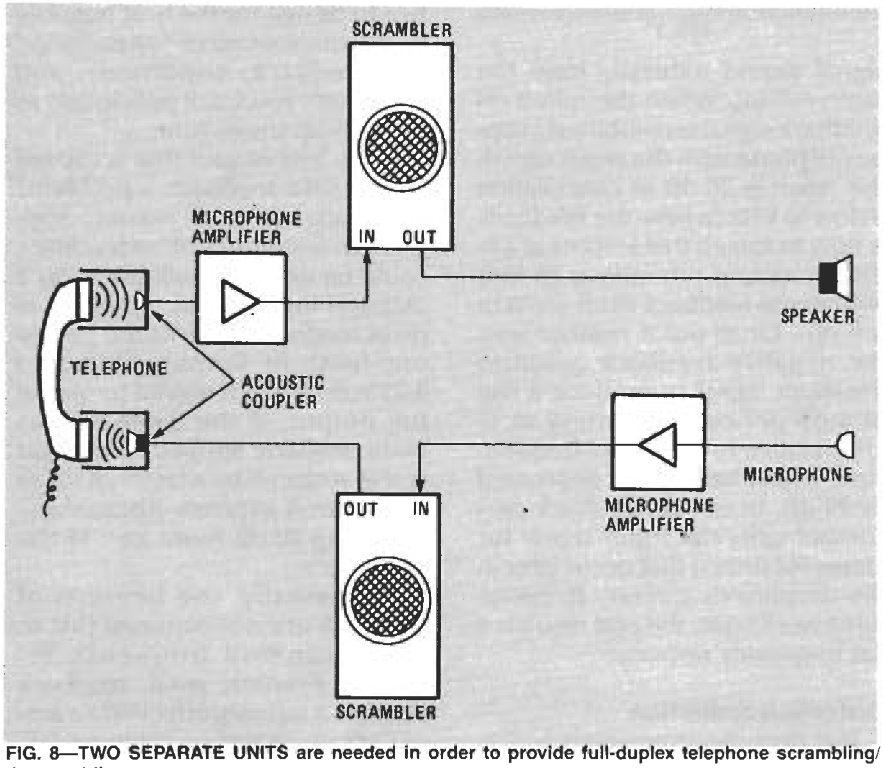

FIG. 8—TWO SEPARATE UNITS are needed in order to provide full-duplex telephone scrambling/descrambling.