GUITAR AND BASS TUNER

Build this "electronic pitch-pipe" and you'll be able to tune your guitar or bass without disturbing your audience or other performers...and without having them disturb you.

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ONE OF THE GREATEST PROBLEMS encountered by guitar and bass players—especially when performing before an audience—is tuning up. Most musicians in bands or combos use a piano or organ as a pitch reference. If there is no keyboard player, its members usually just tune up against one-another, and hope they wind up in close to the right key.

This tuner has a pitch reference for each string of a standard six-string guitar: E (high), B, G, D, A, and E (low). The unit accepts regular stereo headphones, and the pitch-reference signal is heard in one channel. The instrument being tuned is also plugged into the device, and its amplified output drives the other channel.

Volume controls are provided for both the instrument and the pitch reference, and can be adjusted to override the noise in any room, while the headphones isolate the audience from the tuning-up process. There's also a STEREO/MONO switch. When in the STEREO position, the device operates as described above. However, in the MONO position, the pitch reference and instrument signals are mixed and heard in both channels.

Because of the low frequencies involved, an electric bass is more difficult for most musicians to tune than is a standard guitar. Many times the bassist prefers to tune to a chord, rather than a single-note pitch reference. The tuner provides him with major-triad chords for each bass string: E, A, D, and G. The E (low), A, D, and G guitar-pitches can be used for single-note references.

Circuit description

The heart of the circuit, whose schematic shown in Fig. 1, is IC2, a 50240 top-octave generator. That device uses a single input-frequency to generate all twelve notes of the musical scale. The input signal is provided by IC1, a 4001 quad 2-input NOR gate. Two sections of that IC are used to form an oscillator that runs at approximately 2 MHz. The frequency can be adjusted by trimmer potentiometer R2.

Dual D flip-flops, IC3-IC7, are used as frequency dividers. They divide down the upper-octave frequencies from IC2, thus generating the lower-frequency notes required for the pitch references.

The chords for the bass pitch-references are composed of three notes each. Those notes are taken from various outputs of IC2-IC7 through isolation diodes D1-D12.

All signals are routed to the TONE switch, S3. The wiper arm of that switch is connected through R7 to the input of audio power-amplifier IC8, an LM386. The resistor acts as a volume control for the pitch reference. Another LM386, IC9, serves as an amplifier for the instrument being tuned, with R10 acting as its volume control. The outputs of IC8 and IC9 are coupled, through C5 and C12 respectively, to the headphone jack, J1. Switch S2 STEREO/MONO is used to mix the reference and instrument signals at IC9 for mono operation. Power is supplied by eight "AA" cells connected in series.

Construction

A single-sided PC board (see Fig. 2) was used in the author's prototype. The layout, however, is not critical and other methods of construction, such as wire-wrap, can be used. Sockets should be used for the IC's to eliminate the hazards sometimes encountered when working with CMOS.

The component layout is shown in Fig. 3. Be careful not to use too much heat when soldering the components, and observe the polarities of the electrolytic capacitors and diodes. After all other components have been installed, insert the IC's in their sockets, being sure that they are oriented correctly.

The amplifiers should be shielded from the frequency dividers to prevent extraneous signals from getting into the audio section. The shield can be made from one-inch-wide tin, as shown in Fig. 4.

A drilling guide for the metal case is shown in Fig. 5. Note that all holes are ⅜-inch in diameter except for the ¼-inch hole for the STEREO/MONO switch, S2, on the rear panel. The other hole on the rear panel is for the pitch-reference output jack, J3. Rotary switch S3 is mounted in the center hole on the front panel. All labelling is done using rub-on dry-transfer letters, which should be protected by a thin coat of lacquer. The completed unit is shown in Fig. 6.

Adjustment and operation

Use R2 to calibrate the device, using a recently-tuned piano or a tuning fork as a

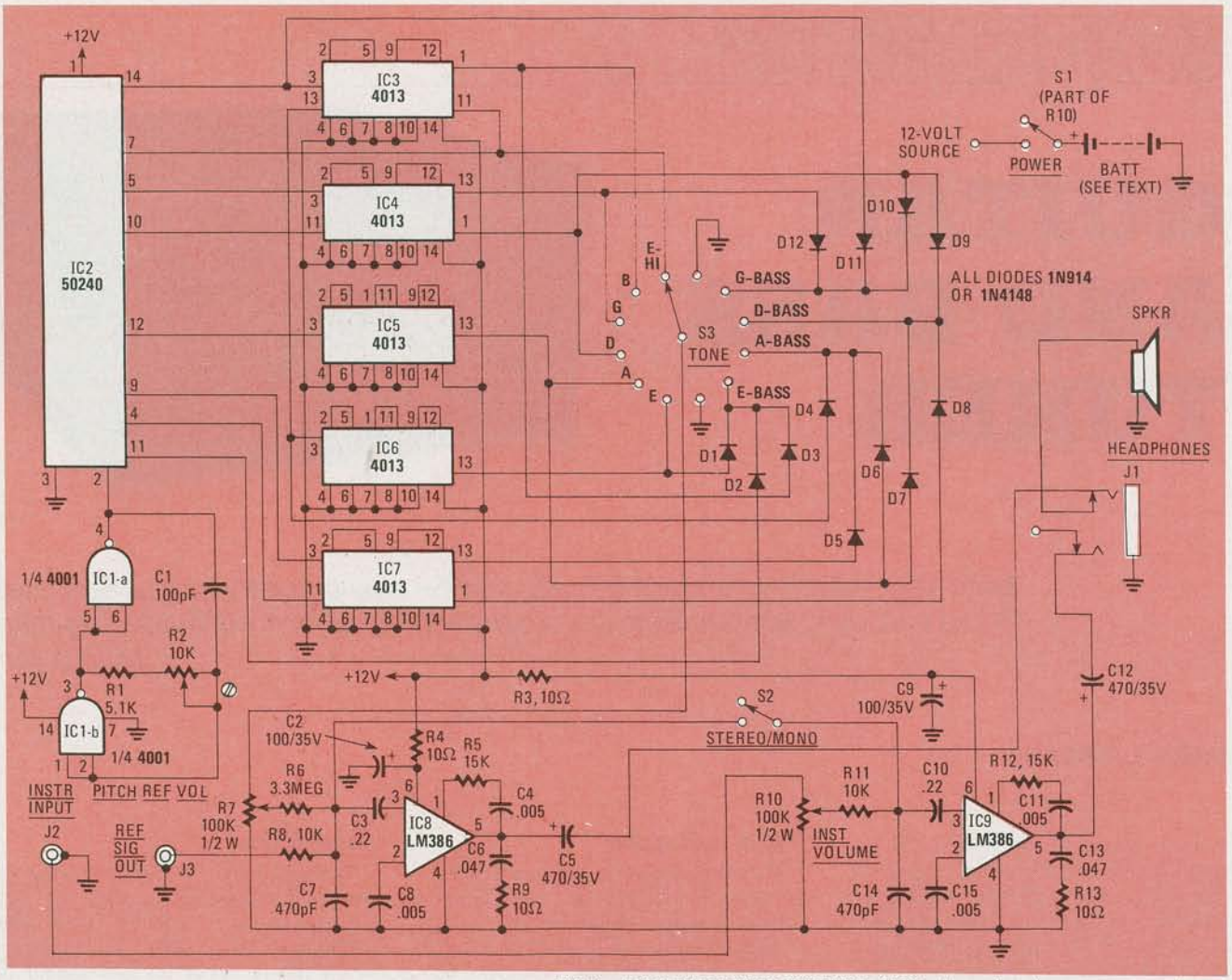


FIG. 1—HIGH-FREQUENCY OUTPUTS of IC2, a top-octave frequency generator, are divided down to frequencies used for instrument tuning by IC3-IC7.

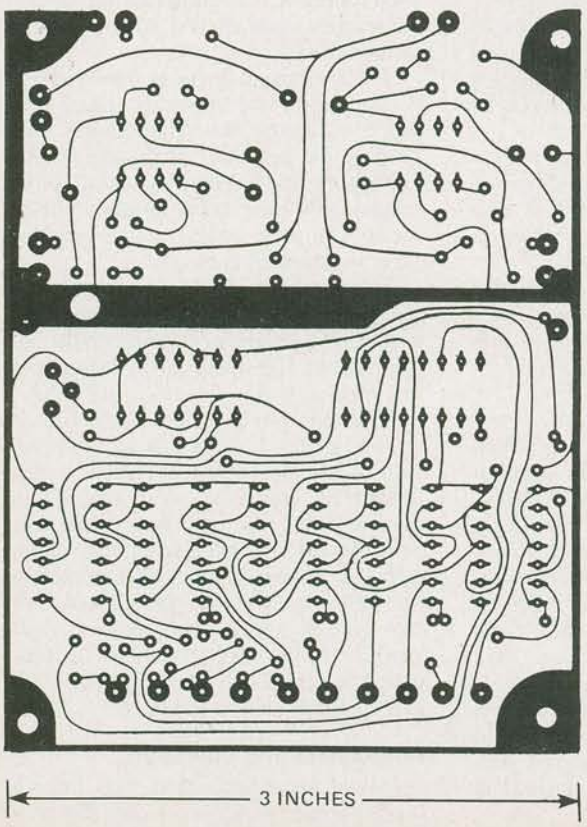


FIG. 2—WHILE TUNER CAN BE HAND-WIRED, a printed-circuit board (left) will make for neater construction.

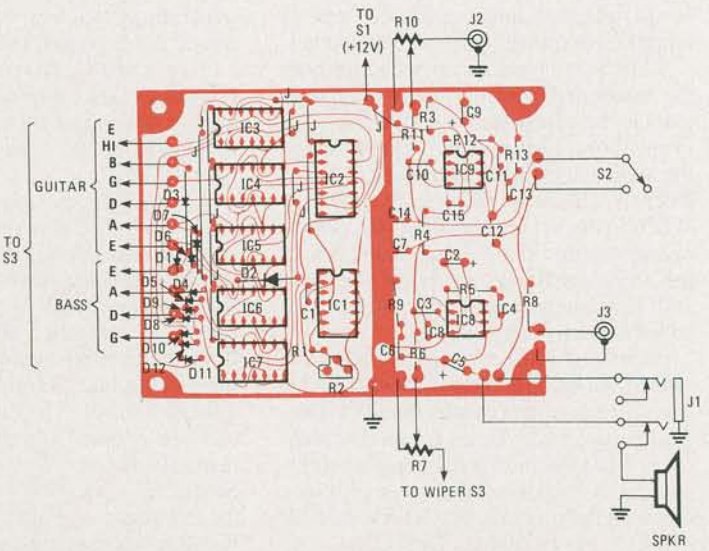


FIG. 3—DO NOT FORGET to install the 11 jumper wires on the component side of the board.

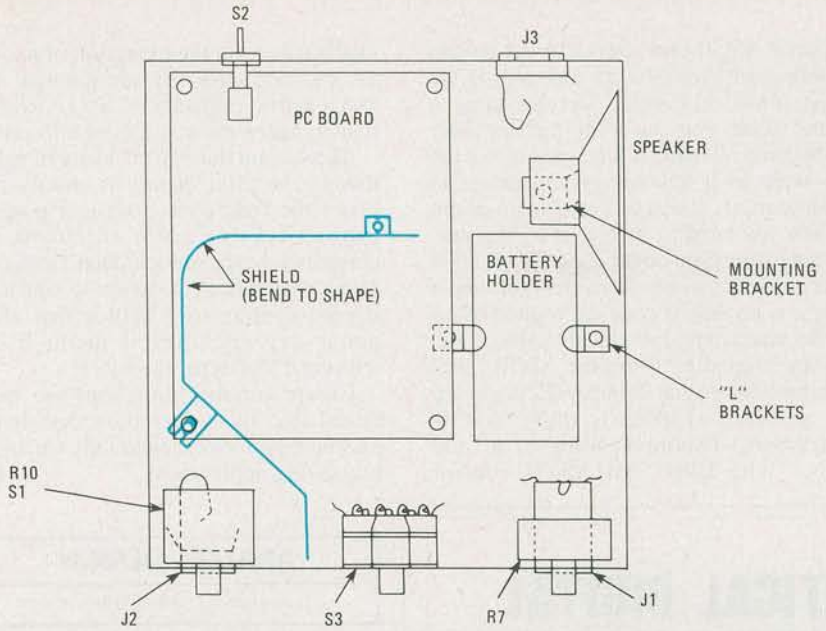
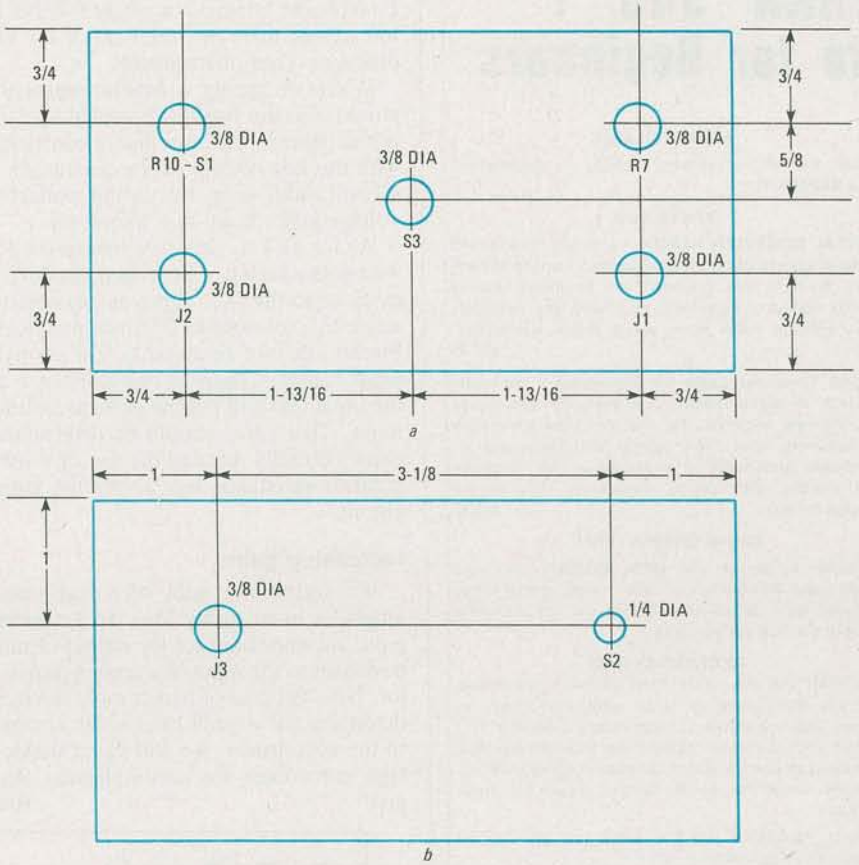


FIG. 4—MOUNTING LOCATIONS for off-the-board parts. Note shield, made of one-inch-wide tin, that keeps noise out of amplifier circuits.



ALL DIMENSIONS IN INCHES

FIG. 5—DRILLING TEMPLATES for front of enclosure (*a*) and rear (*b*). All holes are ⅜-inch in diameter except for the ¼-inch one for S2.

reference. Any of the single notes selected by S3 can be used for calibration, and all the other pitch-reference notes will fall into place. No further adjustment is necessary.

To use the tuner, plug a set of stereo headphones into J1. Next, insert the plug from the guitar or bass into J2. Place S2 in the STEREO position, and adjust volume controls R7 and R11 so the volume of the instrument is about the same as that of the pitch reference. You should be able to hear the beat signal produced by the difference in frequencies between the two. Tune the string until the beat note just disappears.

FIG. 6—AMPLIFIER SHIELD is clearly visible in photo of completed unit. Also note battery pack and vertical mounting of some diodes and resistors.

PARTS LIST

All resistors ¼-watt, 5%, unless otherwise specified
R1—5100 ohms
R2—10,000 ohms, trimmer potentiometer
R3, R4, R9, R13—10 ohms
R5, R12—15,000 ohms
R6—3.3 megohms
R7, R10—100,000 ohms, ½-watt, panel-mount potentiometer, audio taper (S1 is part of R10)
R8, R11—10,000 ohms
Capacitors
C1—100 pF, 50 volts, ceramic disc
C2, C9—100 μF, 35 volts, electrolytic
C3, C10—.22 μF, ceramic disc
C4, C8, C11, C15—.005 μF, ceramic disc
C5, C12—470 μF, 35 volts, electrolytic
C6, C13—.047 μF, ceramic disc
C7, C14—470 pF, ceramic disc
Semiconductors
IC1—4001 quad 2-input NOR Gate
IC2—50240 top-octave generator
IC3–IC7—4013 dual D flip-flop
IC8, IC9—LM386 low-voltage amplifier
D1–12—1N914 or 1N4148
S1—SPST switch (part of R10)
S2—SPST miniature toggle switch
S3—single pole, 12-position, rotary switch (Radio Shack 275-1385 or equivalent)
J1—3-conductor N.C. ¼-inch stereo phone-jack
J2, J3—2-conductor N.O. ¼-inch phone jack
SPKR—8-ohms, 2-inch diameter
BATT—8 "AA" cells in series
Miscellaneous: PC board (optional), IC sockets, battery holder, sheet tin, enclosure, knobs, wire, etc.

If the beat is difficult to hear, try listening for it with S2 in the MONO position. If that is done, both signals—pitch reference and instrument—will be heard from each earpiece.

Old strings on an instrument may also cause the beat signal to be difficult to hear. In that case, simply tune until the two tones sound close or—better still—get a new set of strings.

The beat signal is much more difficult to hear with a bass guitar; however, that instrument can be tuned very accurately using the chords selectable by S3. **R-E**