BEEP THAT TAPE: AN INEXPENSIVE AUDIO-OSCILLATOR FOR THE LANGUAGE LABORATORY

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Introduction

The coding of audio tapes with low-frequency tones to delineate segments of an instructional sequence and help the user find his place on the tape, has been recommended by Krones et al. (1964), and more recently by Smith (1972). Krones and his associates spoke of the value of "audio cues" for language practice tapes recorded under the open-reel format while Smith, commenting upon the lack of cue-sensitive hardware[1] for cassette equipment, urged extending the same coding technique to audio-tutorial lessons. Both authors reviewed three methods to mark the beginning and end of an audio exercise, or segments thereof, so that when the tape is cycled in fast forward or rewind, the low-frequency tones are heard as "beeps." Briefly, the methods described included: 1) recording low-frequency signals from an audio-oscillator via the microphone input before each principal division of the lesson tape; 2) duplicating auditory cues, tape-to-tape, between exercises during the recording process; and 3) splicing-in prerecorded toned segments or leader-tape in order to audio-visually separate the major portions of an auditory sequence.

An increasing number of the publishers' recordings which accompany beginning and intermediate-level textbooks for foreign-language instruction have incorporated low-frequency auditory cues as a normal extension of their reel-to-reel format. Generally speaking, correlated textbook recordings present few problems for the consumer, for the toned cues already exist between principal parts of the practice exercise materials when the master tapes are borrowed or purchased; the "beeps" denoting subsegments of the tapes are transferred automatically and electronically to each and every copy—open reel or cassette—as duplicates are made for student use.

Tapes that the teacher makes himself, both practice-exercise or audio-tutorial, present quite another problem when it comes to delineating with audio cues the major portions of the recording, for the three methods described above each have one or more drawbacks. For example, duplicating tones from a prerecorded tape, one at a time, between parts of an exercise or lecture can be very time-con-

[1]Cue-sensitive equipment is defined as tape recorders whose playback head remains close to the tape and can "hear" the audio program when the recording is cycled in fast-forward or rewind.

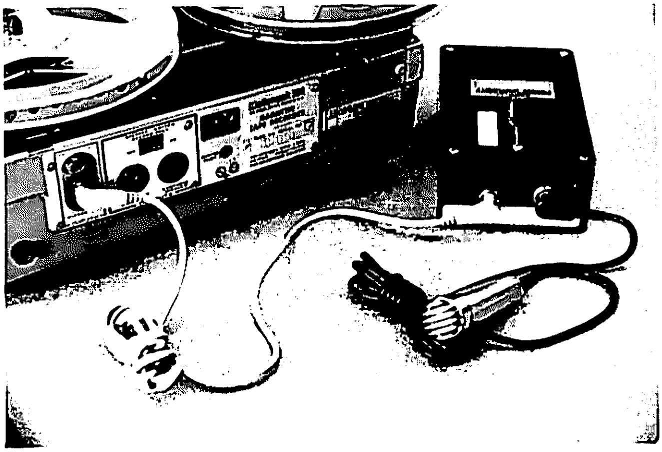
suming considering that duplication must be carried out at the same speed as the original recording. Too, the tape-to-tape process requires two recorders at the outset, one on which the the master tape is made and another from which to "patch-in" the prerecorded tones. Segments of a toned tape can be physically spliced in between dialogues, pattern drills, or similar exercises but this is tedious work with open-reel tapes; with cassettes, it is practically impossible. Finally, most teachers simply don't have access to a tone generator—a piece of equipment that can be very expensive—nor are they schooled in how one can be used to their advantage to code tapes electronically.

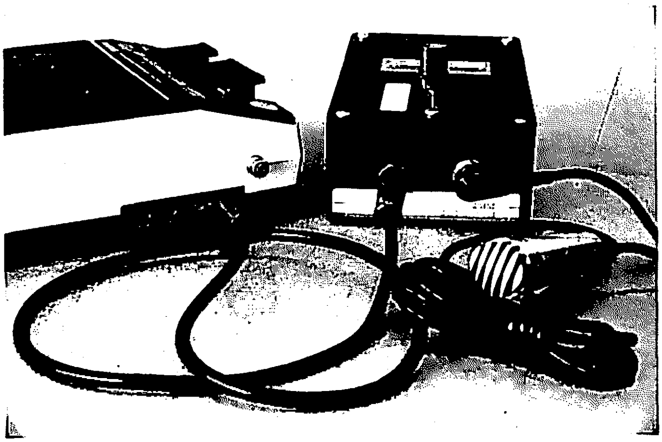
The purpose of this paper is to describe an easily operable, inexpensive, portable, audio-oscillator for the language laboratory and language classroom developed by the Department of Modern Languages at Purdue University to code its audio-tutorial lessons and tape library. The device is not limited exclusively to the technology of teaching a second language, however; it is immediately applicable in *all* disciplines where students receive instruction via audio tape. It is especially useful where teacher-made tutorial lessons are a fundamental part of the curriculum.

The Audio Oscillator

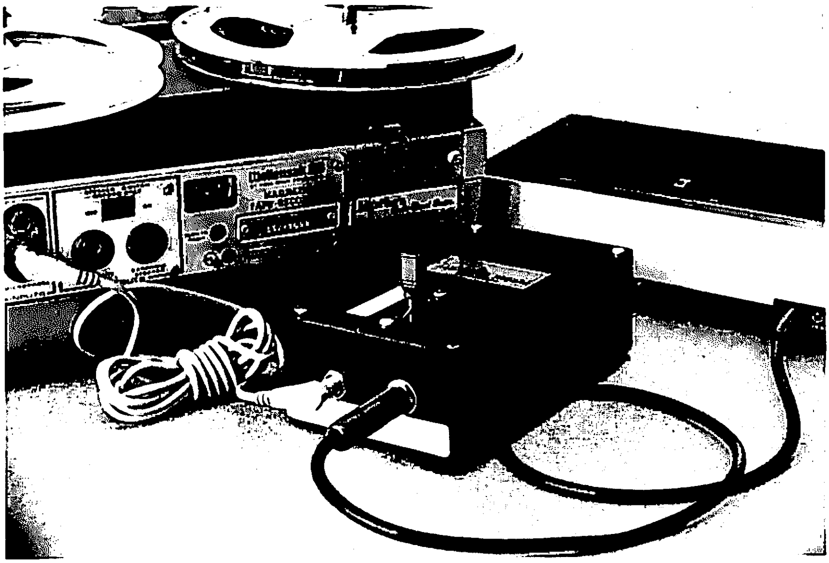
This compact, lightweight, battery-operated, tone generator permits anyone making an original recording—via microphone, tape—or even disc-to-tape duplication—to code the master tapes with low-frequency tones merely by depressing a switch. The oscillator functions equally well with cassettes or with reel-to-reel recorders and is relatively inexpensive and facile to build. Perhaps its most notable characteristic is the ease with which it can be used in the classroom, the laboratory, or at home. The teacher is able to "tone" the tape at will while reading from a prepared script or speaking extemporaneously. One simply plugs the oscillator into the input of the tape recorder and joins the microphone to the tone generator, linking all three (pictures 1 and 2). After setting the volume on the tape recorder to an appropriate VU level (or switching on the automatic volume control), one proceeds recording as usual. The recorder need not be started and stopped each time the tape is toned; rather with the tape running, one simply depresses the tone switch prior to announcing the content of each succeeding portion of the lesson.

Toning a master tape simultaneously while copying from one or several other recordings works essentially in the same fashion. The tone generator is patched into the input of the slave machine and to the output of the master recorder (picture 3). To create a newly-toned master tape, one copies the lesson, tape-to-tape, and intersperses codes by depressing the toning switch at appropriate points in the





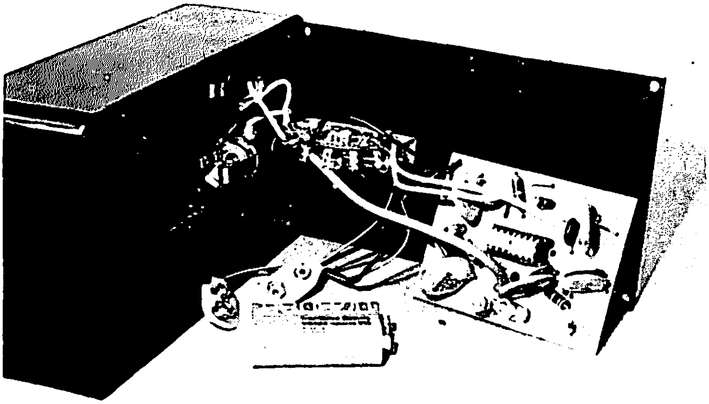
recording, taking care not to superimpose tones on voice. Finally, by simultaneously using the pause lever on the master machine and the tone switch on the oscillator—the former to stop the tape momentarily creating a pause on the copy, the latter recording a tone in that pause—one can break a previously uninterrupted sequence into several coded parts, each marked for easy access. Whatever the case, when the tutorial or practice tape is played at normal speed, the low-frequency tones are, for all practical purposes, inaudible. Cycled in fast-forward or rewind on a cue-sensitive recorder, the tones will be heard as "beeps" as the tape is wound past the playback heads at high speed. The user simply listens for and counts the "beeps" to locate his place on the tape.



The length of the tone, that is, the length of time one depresses the "toning switch" must be determined empirically. It is important to remember that the tones are heard as pauses when a coded tape is played at normal speed; the longer the tone, the longer the pause. If the tone is too long, the "pauses" thus recorded between exercises may be annoying to the student when he listens to the tape. On the other hand, bursts of tones which are too short will be all but inaudible on machines with a great deal of torque in the search modes. Where reel-to-reel tapes are to be used exclusively, the tones on the master tapes should be about three seconds long. With cassettes, the tone will need to be a bit longer. The consumer will need to "match" the length of the audio-cues to the characteristics peculiar to his play-back equipment. Finally, care must be exercised when recording so as not to "beep" the tape and speak at the same time, for the combination of the two, tone on voice, makes the latter unintelligible.

Dual Tones

The amplitude and frequency of the tones are as important as their length. Krones, Sawyer, and Grosjean (1964) recommended using forty cycles/second to code reel-to-reel tapes and Smith (1972)



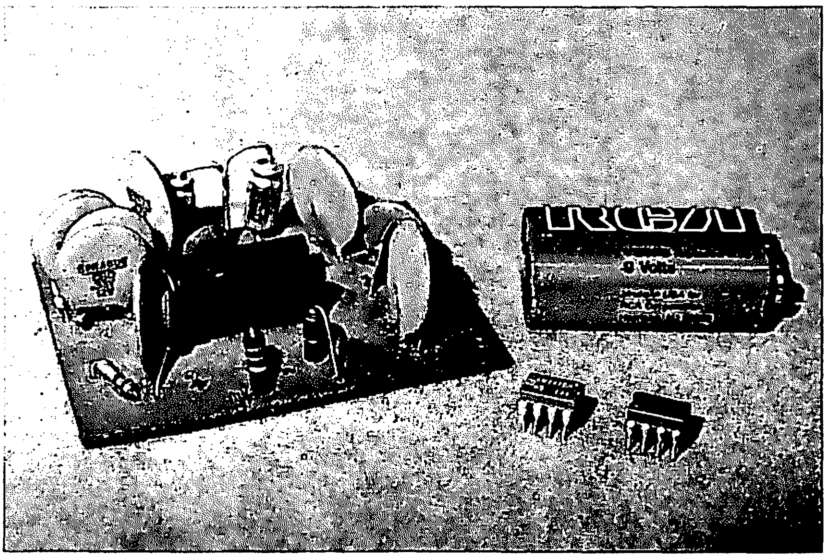
suggested using the same frequency for toning cassettes. In practice, however, the forty-cycle tone has been found to be not *low* enough for some cassette machines, notably those whose running speed is so great in the search modes that the "beeps" are generated at frequencies too high to be heard by the human ear. One could overcome this problem by reducing the velocity of the fast-forward and rewind functions of the tapedeck; similarly, one could use tones lower than forty cycles for the codes. Actually, a combination of two frequencies, ten and forty cycles, beating against one another seems to provide the best results and, in addition, generates a very distinctive "beep". In this fashion, the same "tone" can be used to code tapes of either format—for reels in the event the recordings are to be used primarily with reel-to-reel equipment, or for cassettes where playback equipment of this kind will be used by students.

Building the Device

Construction of the tone generator is straightforward. It is composed of five major parts (picture 4): 1) a rectangular Bakelite Box; 2) a three-gang momentary switch; 3) internal circuitry and electronics; 4) a power source—two 9 volt RCA batteries; 5) input and output jacks. Two patch cords—one with a standard phone-plug at either extreme, the second with a phone-plug on one and an RCA plug on the other—complement the device and allow the user to patch it into a variety of equipment. A specific list of parts is given in Appendix A. Total cost of the parts is estimated at fifteen dollars; total time to construct it, including etching, drilling and soldering is four to five hours.

For the technician wishing to build the device, the following explanation and Figure 1-3 will be instructive. The dual tones for the "beeper" are generated by two oscillators running at 10 cps and 40 cps with their respective outputs capacitively coupled.[2] The basic overall oscillator requires an inexpensive integrated circuit called an Operational Amplifier (No. SN 741 of figure 2). Using the amplifier as an oscillator necessitates a positive 9 volts and a negative 9 volts at points A and B, respectively, in Figure 1.

The electronics and circuitry linking the oscillators can be constructed on a printed-circuit board or by using a section of Designers Phonelic Board of equal size (picture 5). Since the integrated circuits are sensitive to and easily damaged by heat, rather than being soldered directly to the board, they should be inserted into a corresponding IC socket. Pin numbers (2, 3, 4, 6, and 7) for the amplifier in Figure 2 are valid for an eight pin, dual, in-line integrated circuit called a "mini-dip". Two of these "mini-dips" fit end-to-end in the single sixteen-pin socket, the terminals of which can bè seen in the center portion of the printed circuit reproduced full-size in Figure 3, which, incidentally, may be photocopied and used as a guide for wiring the device.



[2]Large capacitive coupling is required in the output circuit as a result of the relatively low frequencies chosen.

The three-gang momentary switch performs several important but independent functions when activated: 1) it interrupts the incoming program line, 2) it connects the combined oscillator outputs to the program line, 3) it turns on the power. A spring-loaded, momentary leaf-switch was used, but any three-gang switch can be substituted in its place. The spring-loaded, momentary feature is recommended however, for it causes the switch to return to "neutral" once a tone has been recorded and, thus prevents the possibility of erroneously leaving the tone generator in an "on position" during subsequent recording or copying of materials. The Bakelite experimenter's box is available in most electronics or radio supply stores. The switch mounts on the removable cover; the female phone-jacks are placed on one end. The power source and the circuitry fit snuggly within the box and are well-protected.

Because the tolerance of manufactured electronics parts may vary some ten percent, the values of R2 and R5 (see Figure 1) may have to be adjusted to obtain the proper wave form of the oscillators. After completing construction of the circuit, an oscilloscope may be connected to the output of the device. Remove integrated circuit number 2 (labeled IC2 on the schematic) from its socket. The value of R2 may be increased or decreased to produce a good sine wave at 40 cps. Next, remove IC1 and replace IC2; remove R5 and correct its value until the sine wave at 10 cps is similarly isomorphic.

Application

In addition to coding major divisions of language practice tapes or marking entry points for various subsections of an audio-tutorial lesson, one of the more useful applications of the audio oscillator is to code *each* segment of all of the listening comprehension exercises—conversations, narrations, radio broadcasts, interviews, etc.—which form part of a school's listening library. It is a simple matter to cut new master tapes from older and fundamental holdings, interjecting tones as "codes" during reduplication, while noting the corresponding subject-matter on an index card. Once coded and indexed, these tapes afford teachers an efficient means to locate and organize a large variety of related subject-matter from among several different sets of materials. Correspondingly, tones save the student time as he seeks and works with a given assignment on tape. Second, connected between a disc-playback and a tape recorder, and usually without stopping the phonograph at all, tones can efficiently and easily be placed between vocal or musical selections in the brief pauses which separate bands on the disc. Third, a tone placed at the beginning of a test tape allows the teacher to rapidly cue it up without unintentionally revealing the first portion of the examination. Fourth, entry codes

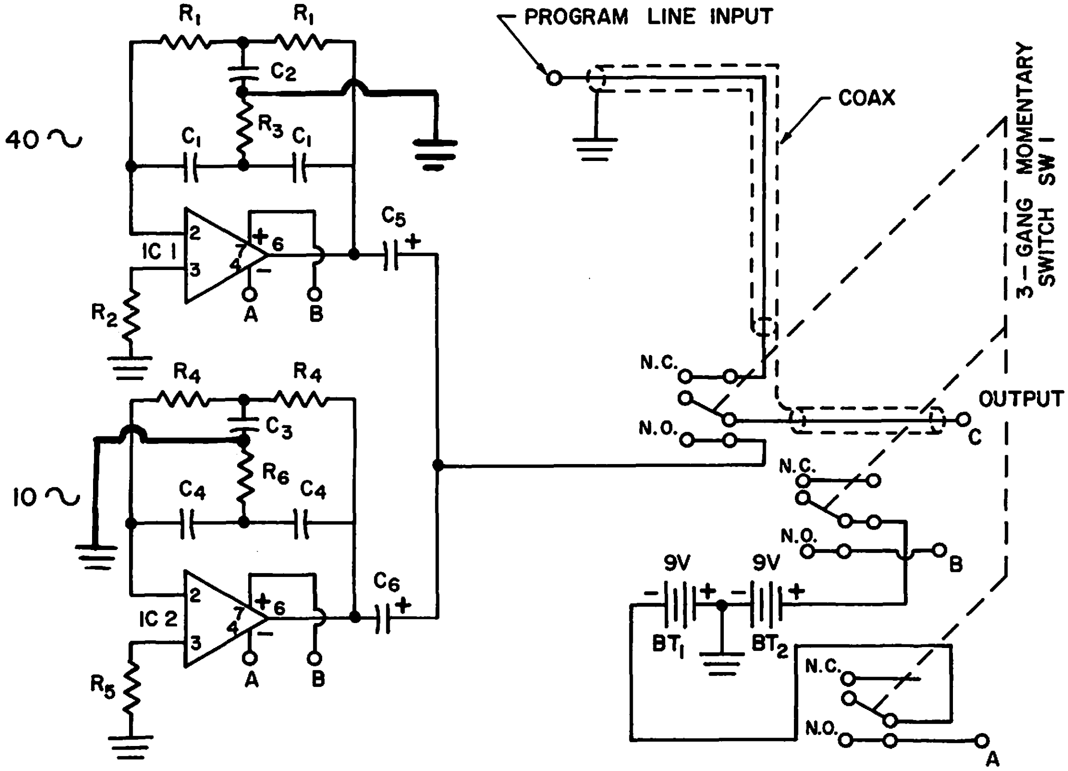


FIGURE 1. SCHEMATIC DIAGRAM OF THE TONE GENERATOR

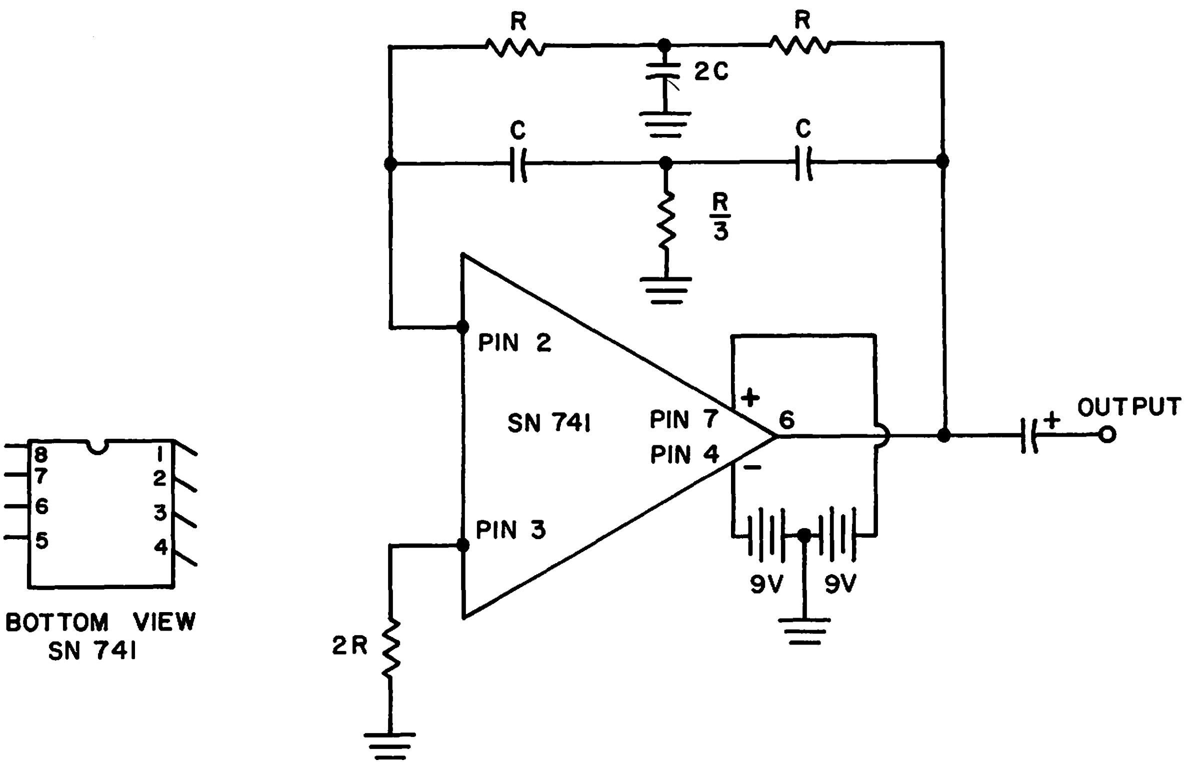


FIGURE 2. BASIC SCHEMATIC OF THE OSCILLATORS

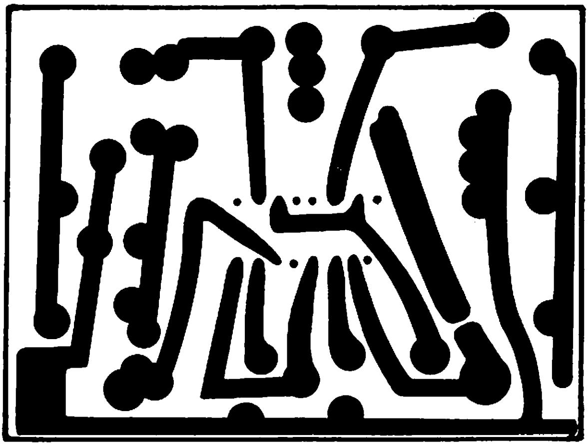


FIGURE 3. PRINTED CIRCUIT BOARD

placed at the begining and end of materials recorded sequentially over a period of time—for example, dictations or listening comprehension exercises by the teacher, a first-of-semester and end-of-semester reading by a student—make future use of the same material a much easier task, for one does not have to rely upon hunt-and-seek methods to locate a given sequence on the tape. Finally, by recording two short tones, one just after the other in rapid sequence, major divisions of a tape can be distinguished from subsegments coded with but one. Principal entry points into a lesson will thus be perceived as a "double beep", exercises within these diversions will be offset by just one when the tape is cycled on a cue-sensitive machine.

Conclusion

Audio tapes coded with low-frequency tones so that one can easily locate portions of their content remain a fundamental necessity when tape recordings are a basic vehicle by which the learner acquires information. Until now, the classroom teacher has had little recourse to inexpensive and easily operable equipment which would enable him to efficiently tone segments of recordings that he makes himself or to code tapes which form part of a school's listening library. The audio-oscillator for the language laboratory and language classroom provides a solution to this problem. What remains is for the practitioner to make toned tapes a routine extension of the use of media in teaching.

APPENDIX A
Parts List: AUDIO-OSCILLATOR

I General

Quantity	Name and Number
2	BT1 RCA VS 323, 9 volt battery, NEDA No. N216
2	BC-945 battery connector clips
1	CRL 1455 central lab 3 gang momentary switch
2	IC1 integrated circuit operational amplifiers Texas Instruments, SN 741N (mini dip)
1	Bakelite box, Calectro No. J4-726 (6" x 3½" x 1 7/8" or equivalent).

II From Figure 1

Resistors[3]		Capacitors	
R1	8200 ohms	C1	.5 uf, 10 WV/DC, disc
R2	1500 ohms	C2	1 uf disc
R3	2800 ohms	C3	1.42 uf disc (or 4.33 uf capacitor in parallel
R4	20K ohms	C4	.91 uf (a .47 uf and two .22 uf caps all in parallel)
R5	27K ohms		
R6	900 ohms	C5 & C6	2 uf electrolytic capacitors

[3] All resistors are ½ watt and all capacitors are 10 working volts.

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