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Tone Decoder Improvements

—another step toward perfection

With a signal conditioner and valid-digit recognizer, you can't go wrong.

Rick Swenton WA1LMV
19 Allen Street
Bristol CT 06010

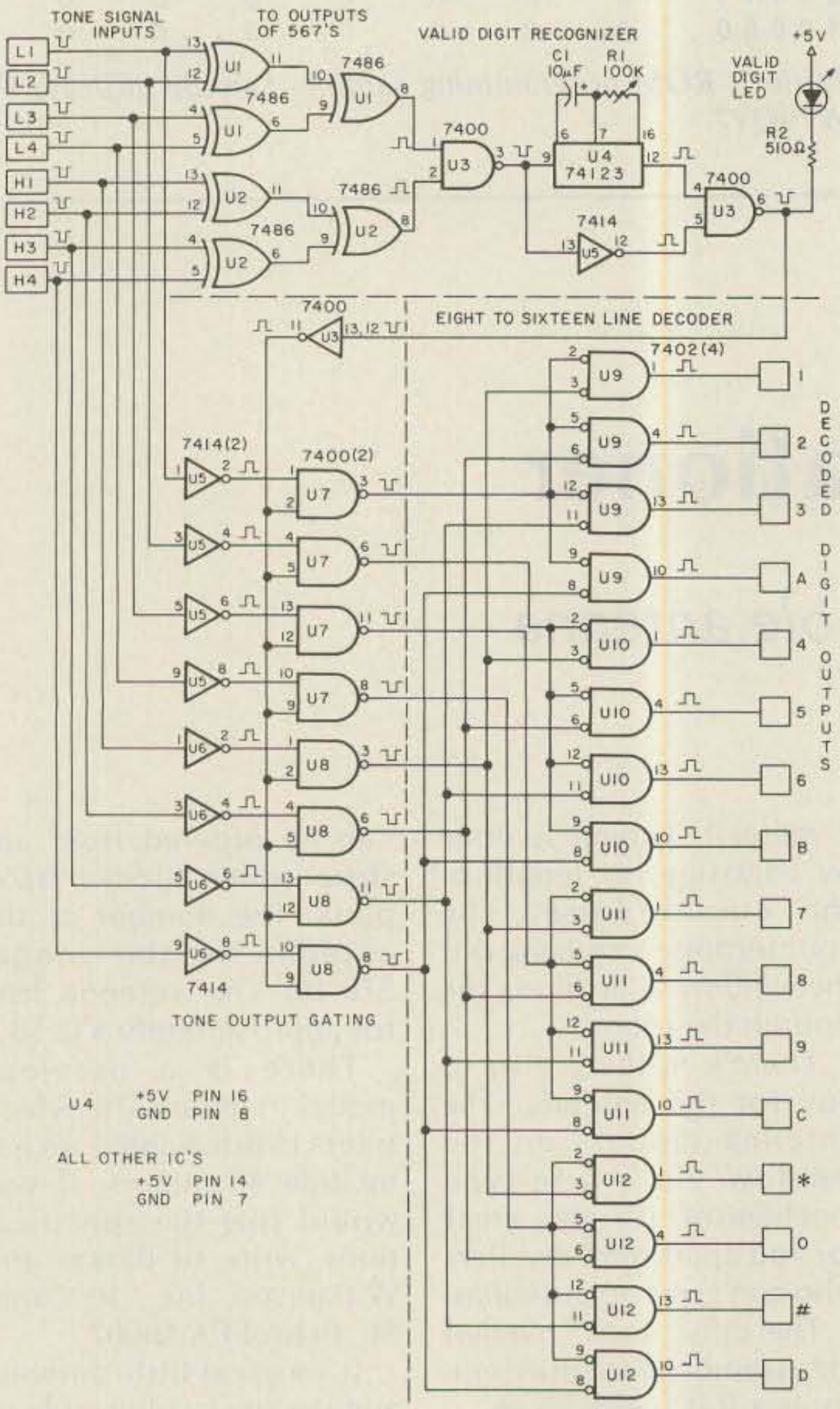

Fig. 1. Decoding system schematic.

The Signetics NE567 is my favorite toy. I'll never give it up. After working on several old telephone company decoders, I realized that they definitely leave something to be desired—especially if you were to attempt to build one from scratch! Also, after experiencing several commercial-quality state-of-the-art DTMF decoders, I realized that while they are terrific decoders, their price is out of sight. That leaves the NE567.

Mr. Everhart* described the limitations of the 567 in a very thorough presentation. However, its limitations can be worked around to yield a high quality, superior performing decoder. The 567 cannot stand alone without conditioning its output. The circuitry presented here is a sophisticated signal conditioner and valid-digit recognizer. It is an improved alternative to separate delay networks on the outputs of all eight 567s. (See Fig. 7 in referenced article.)

The block diagram of this system is in Fig. 2. It consists of two bandpass filters, one for the low-group tones, and one for the high-group tones, two limiters, eight frequency decoders, a valid-digit recognizer/signal conditioner, and an eight-to-sixteen-line decoder. To build your decoder, see Everhart's article for information on building the bandpass filters, limiters, and 567 decoders. The outputs of the eight 567 decoders are then fed into the valid-digit recognizer, Fig. 1. The valid-digit recognizer consists of U1 and U2 (7486 exclusive OR gates), U3 (7400 quad two-input NAND gate), U5 (7414 hex inverter), and U4 (74123 monostable multivibrator).

The function of U1 and U2 is to determine if the 567 decoders are sending only one low-tone signal and only one high-tone signal. The outputs of U1 and U2 are ANDed together by U3 so that the output of U3 (pin 3) goes low only when the following conditions are met: You

*J. H. Everhart WA3VXH, "Toward a More Perfect Touchtone Decoder," *73 Magazine*, November, 1976, pages 178-181.

must have only *one* low tone *and* only *one* high tone.

The next section of the valid-digit recognizer is the delay circuit consisting of U3, U4, and U5. R1 and C1 determine the time delay. The output of the valid-digit recognizer circuitry is U3, pin 3. Pin 3 of U3 goes low only when one low tone AND only one high tone are present and they must remain uninterrupted for the time duration set by R1 and C1. Optimum setting of R1 is from 0.25 to 0.5 seconds. This setting may vary for your particular setup. As a rule of thumb, set R1 to be fast enough for your signaling requirements, but slow enough to reject erratic pulsing. Remember that a condition could exist where a certain voice may be decoded as two tones which happen to be two touchtone™ frequencies. This would meet the requirements of only one low and only one high tone, but would not be decoded if R1 were set correctly.

Next, we use the output of the valid-digit recognizer to gate the outputs of the 567s into the eight-to-sixteen-line decoder. U5 and U6 are 7414 Schmitt triggers. They will further condition the outputs of the 567s and shape the output waveform. U7 and U8 (7400 NAND gates) provide the gating of the 567s to the sixteen-line decoder. Thus, no tone decoding can take place without valid-digit recognition because the outputs of the 567s are not being applied to the sixteen-line decoder unless valid-digit recognition has occurred. The outputs of the sixteen-line decoder, U9-U12 (7402s), are normally low and go high when the digit is decoded.

The system described here is in use at three repeaters in the Hartford CT area (WR1ABM: .28/.88 and 442.85-447.85 and WR1AFU: .75/.15) as autopatch and control decoders and are working well without any problems. With a 0.5-second response time, there has never been a false activation of any function. ■

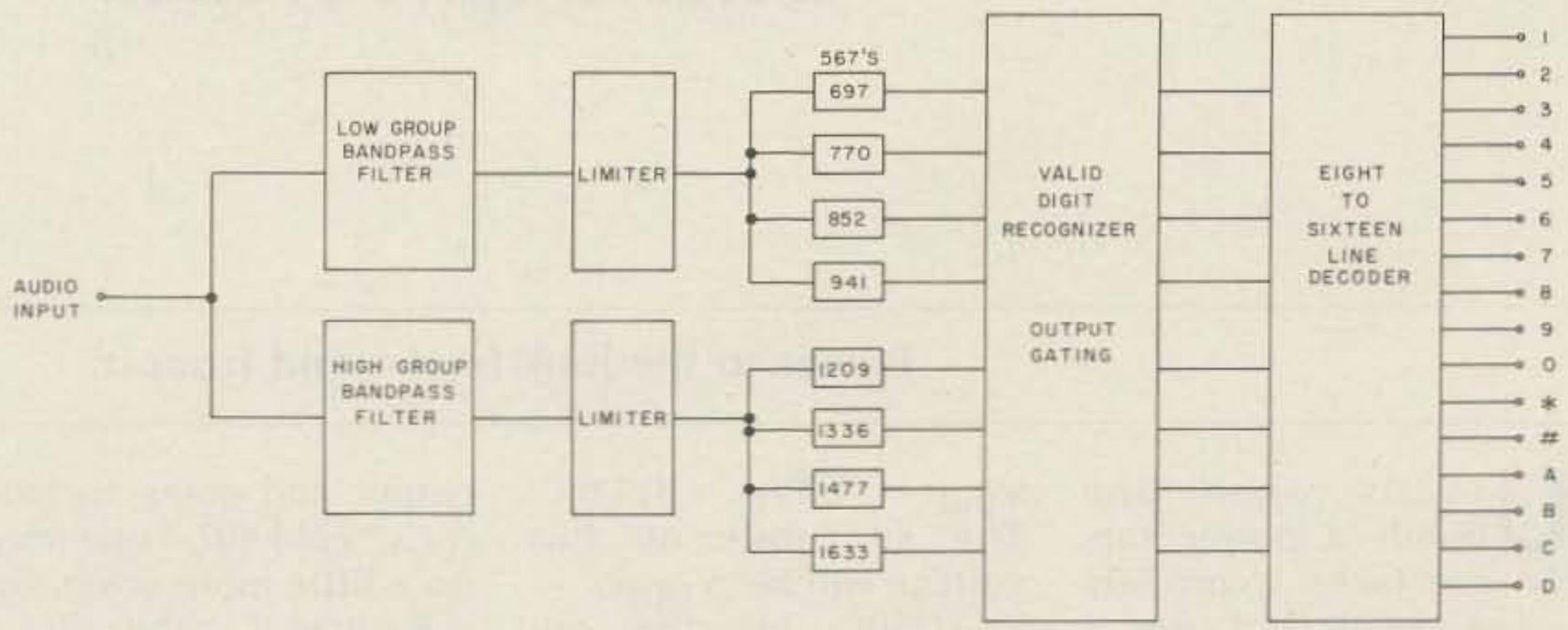

Fig. 2. Block diagram of decoding system.

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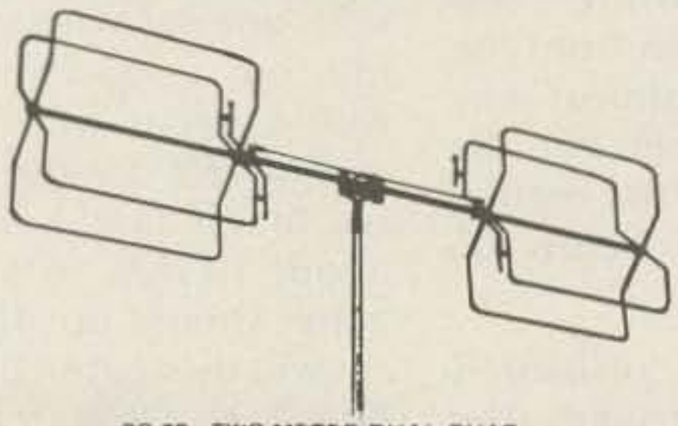

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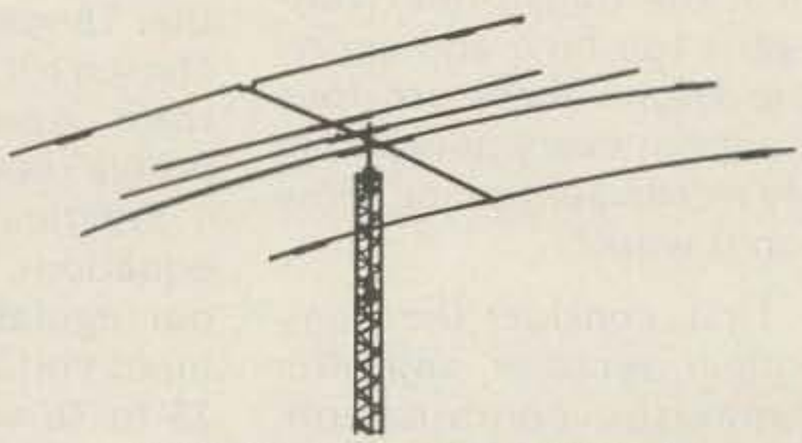

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