A PROM for the Accu-Keyer

The Accu-PROM . . . a device that doesn't lose its memory when power is removed.

By David L. Madison,* K3ACN

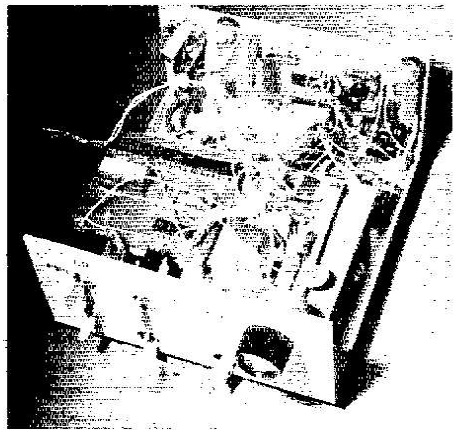
The Accu-Keyer[1] has all of the qualities of a classic amateur design: relative simplicity, fool-proof operation, and low cost. The popularity of the Accu-Keyer is reflected by periodic reports in *QST* of the number of circuit boards shipped by Mr. Garrett.

In a more recent paper, an Accu-Keyer with memory is described.[2] The heart of the Accu-Memory is a metal-oxide-semiconductor (MOS) memory device which can be programmed and erased repeatedly. The Accu-Memory will undoubtedly be built and used by large numbers of contest operators and cw enthusiasts.

For the occasional cw operator, the Accu-Memory may entail more complexity and expense than desired. A simpler alternative is possible through the use of a programmable read-only memory (PROM). The system to be described converts the Accu-Keyer to a message generator, or Accu-PROM. The modifications to the Accu-Keyer are minor and have no effect on keyer operation when a message is not being sent. Perhaps the best feature is the cost, which can be kept to about seven dollars if surplus ICs are used.

*264 Heartwood Court, Glen Burnie, MD 21061

[1] This and succeeding references may be found on page 24.



The author's version of the Accu-PROM is installed in his Accu-Keyer cabinet. The pc board on the back panel is the original Accu-Keyer circuitry. The white IC on the left of the pc board in the foreground is a programmable read-only memory (PROM) with 1024 bits of memory.

There are a couple of trade-offs, of course. The type of PROM used here cannot be erased once it is programmed. Several PROMs can be programmed though, for calling CQ, for contests or Field Day, and so on. The other disadvantage is that some circuitry must be constructed to program the PROM. The programming device can be bread-boarded from readily available parts, however, and can be used to program any number of PROMs, making the Accu-PROM a good club project.

Operation of the PROM

A type N82S129 PROM is used to provide 1024 bits of memory, organized as 256 words at 4 bits per word. In some respects this type of PROM is an IC version of the diode matrices used in earlier message generators.[3] In those circuits, the presence or absence of a diode at a particular location in the matrix represented a logic 0 or 1. The N82S129 is effectively a matrix of 1024 diodes, each in series with a miniature nichrome link. Prior to programming, the entire memory is in the logic 0 state. The chip is programmed by electrically fusing the appropriate nichrome links, thereby changing the corresponding bits to the logic 1 state.

The chip also contains all of the required address decoding and output buffering, and is fully compatible with TTL ICs. Eight of the sixteen pins on the N82S129 are used to specify the desired word. The address of the first word is 00000000, and the 256th word is 11111111. If the two chip-enable pins are grounded, the contents of the addressed word will appear on four of the pins.

Logic Description

Four instructions are required to control the Accu-Keyer: Send a dot,

Table 1

Word Address							Contents of Word						
IC PIN													
5	*6*	*7*	*4*	*3*	*2*	*1*	*15*	*11*	*12*	*	*9*	*10*	*
0	0	0	0	0	0	0	0	0	1	—	1	0	.
0	0	0	0	0	0	0	1	0	1	—	1	0	.
0	0	0	0	0	0	1	0	0	0	space	0	1	—
0	0	0	0	0	0	1	1	0	1	—	1	0	.
0	0	0	0	0	1	0	0	0	1	—	0	0	space
0	0	0	0	0	1	0	1	0	0	space	0	0	space
0	0	0	0	0	1	1	0	0	1	—	1	0	.
0	0	0	0	0	1	1	1	0	1	—	1	0	.
0	0	0	0	1	0	0	0	0	0	space	0	1	—
0	0	0	0	1	0	0	1	0	1	—	1	0	.
0	0	0	0	1	0	1	0	0	1	—	0	0	space

Sample message coding for the Accu-PROM. Each word contains two instructions. Pins 11 and 12 contain the first instruction of a word, and pins 9 and 10 contain the second instruction. A space is represented by 00, a dot by 10, a dash by 01, and halt (not shown) is 11. The first eleven words of a 3 X 3 CQ are given.
*Instruction

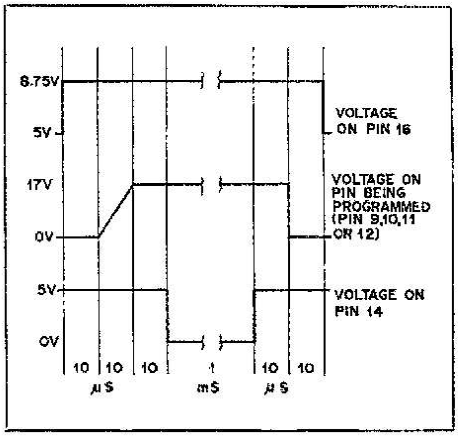


Fig. 2 — Timing diagram for the programming sequence of the N82S129 PROM. The above pulses will change the bit being programmed from the logic 0 to the logic 1 state.

send a dash, send a space, and stop or halt. A space is coded in the PROM by 00, a dot by 10, a dash by 01, and halt by 11. Since the PROM used here is organized in the 256 X 4 configuration, each word will contain two instructions.

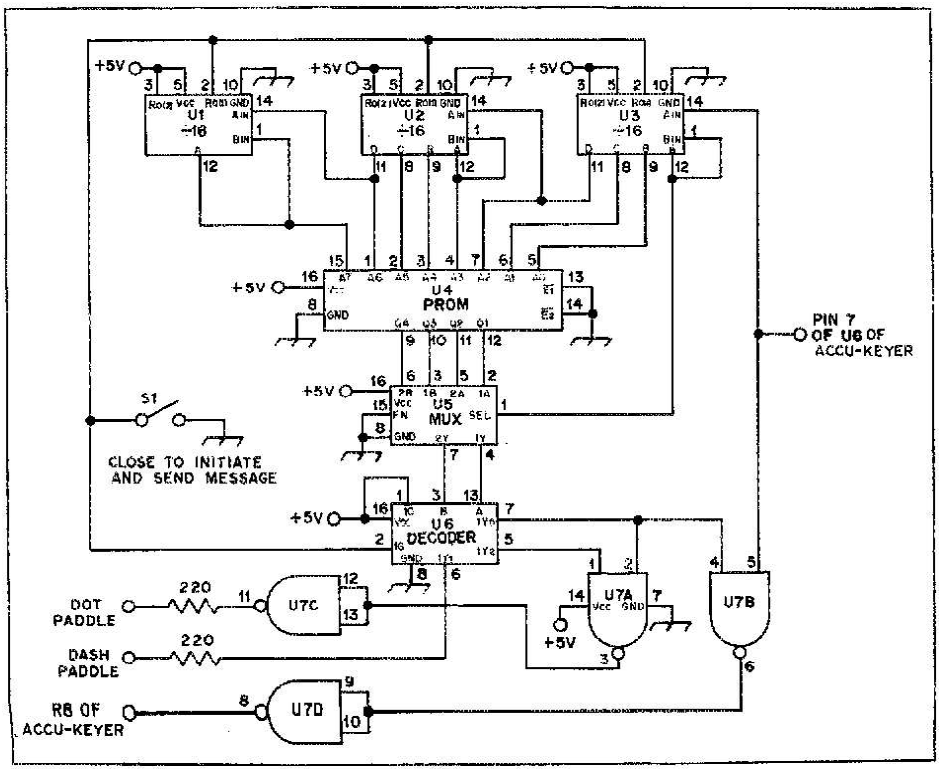
As shown in Fig. 1, U1, U2, and U3 form a binary counter. When S1 is open, pin 2 of each 7493 is high, holding the count to zero. When the switch is closed, the 7493s are enabled to count. The least significant bit of the count, available at pin 12 of U3, is used by U5 (a 2-input multiplexer) to select the "left" two bits of a word (pins 11 and 12 of U4), or the "right" two bits (pins 9 and 10 of U4). The next most significant 8 bits of the counter specify which of the 256 words is required.

The output of U5, on pins 7 and 4, represents one coded instruction. It is decoded by U6 into the four possible instructions. If the instruction is halt, pins 5, 6, and 7 are high and nothing further happens. If a dot is to be sent, pin 5 goes low, causing pin 3 of U7A to go high. After inversion by U7C, this condition causes the dot-paddle contact to go low as though it had been tapped manually. If a dash is to be sent, pin 6 of U6 goes low, effectively grounding the dash paddle. A space is sent in the same manner as a dot, but U7B prevents the output of the Accu-Keyer (pin 7 of U6) from reaching R8. The Accu-Keyer is thereby "faked" into sending a space by sending a dot but suppressing the output. This allows any number of spaces to be sent sequentially without having the Accu-Keyer clock stop. Pin 7 of U6 in the Accu-Keyer is also tied to pin 14 of U3 in the Accu-PROM. The falling edge of the pulse generated by a keyer dot, dash, or space advances the binary counter by one, allowing the next instruction to be decoded.

During manual operation, S1 is open and pin 2 of U6 is high. This holds pins 5, 6, and 7 high regardless of the inputs to pins 3 and 13; therefore, the paddle contacts are high unless they are manually keyed. The 220-Ω resistors are included to prevent damage to U7 when the paddles are closed. When S1 is open, pin 4 of U7B is high, and the Accu-Keyer output from pin 7 of U6 is routed to R8 essentially unaltered.

Fig. 1 — Diagram of the Accu-PROM. There are 256 words of memory, each containing 4 bits, provided by U4, the N82S129 programmable read-only memory.

S1 — Spst toggle.
U1-U3, incl. — TTL 4-bit binary counter, type 7493.
U4 — Programmable read-only memory, Signetics type N82S129.
U5 — TTL quad 2-input multiplexer, type 74157.
U6 — TTL dual 2-line to 4-line decoder, type 74155.
U7 — TTL quad 2-input NAND gate, type 7400.



Programming the PROM

The first step in programming the PROM is to construct a table of the required state (*logic 1 or 0*) of each bit of each word. Table 1 shows how the

first two CQs of a message are coded. The halt instruction can be omitted; if it is not included, the Accu-PROM will consider the unused portion of the PROM to be filled with spaces, and the message will eventually repeat unless S1 is opened first.

Fig. 2 shows the timing diagram of the pulses used to program the N82S129. Fig. 3 is a circuit which will generate the required pulses; it is similar to the circuit recommended by Signetics. Slide switches S6 through S13 are used to set the address of the word being programmed. As previously mentioned, only the bits requiring a 1 are programmed. To program a bit, hold down S2, S3, S4, or S5 (corresponding to the required bit) and momentarily depress S1. The programming must be done carefully, since a bit that has been programmed to a logic 1 cannot be changed back to a logic 0. Also, after each bit is programmed, it is wise to check the status of the pin with a voltmeter. A pin voltage of at least 2.4 V indicates that the bit has been successfully programmed.

Building and Using the Accu-PROM

The Accu-PROM circuit is simple enough that it can easily be wired on a small piece of perforated board, or, if preferred, a pc board can be etched. It is suggested that an IC socket be used for the PROM so that the message can be changed by replacing the IC. The only modification to the Accu-Keyer board involves breaking the connection between R8 and pin 7 of U6 and bringing leads from those points to the Accu-PROM board as indicated in Fig. 1. If the Accu-Keyer was constructed with the simple Zener-diode-regulated supply, better voltage regulation may be required to power the Accu-PROM. It is suggested that an LM309 5-V regulator to be used in lieu of the Zener diode.

Using the Accu-PROM is easy. Closing S1 initiates and sends the message, and opening S1 stops the message at any point and reverts the keyer to normal operation. The message rate is determined by the Accu-Keyer speed control.

Several variations of the Accu-PROM are possible. If the capability to send one of several messages is required, the messages can be programmed on separate PROMs. If the corresponding pins of each PROM are wired in parallel, with the exception of pin 14, one PROM can be addressed by using a rotary switch to ground pin 14 on the desired chip. Another possible variation is the addition of a dpst switch to break the connections to pin 14 of U3 and pin 2 of U6. This switch, when open, would cause the Accu-PROM to pause during a message so that code (e.g., RST) could be inserted manually.

References

1. Garrett, "The WB4VVF Accu-Keyer," *QST*, August, 1973.
2. Garrett, and Contini, "The Accu-Memory," *QST*, August, 1975.
3. Hall, "A Digital Morse-Code Message Generator," *QST*, June, 1970.

Fig. 3 — Schematic diagram of the programming device for the N82S129 PROM. The word address is entered with S6 through S13. A logic 1 is programmed by holding either S2, S3, S4, or S5 closed, as required, and momentarily pressing S1. U5 is wired as a current regulator.

Q1-Q4, incl. — Silicon npn 250-mW switching transistor.
S1-S5, incl. — Normally open push-button switch.
S6-S13, incl. — Spdt slide or toggle switch.
U1 — Monostable multivibrator, type 74121.
U2, U3 — Retriggerable monostable multivibrator, type 74123.
U4, U5 — 5-volt regulator, type LM309.