A Reprogrammable ID

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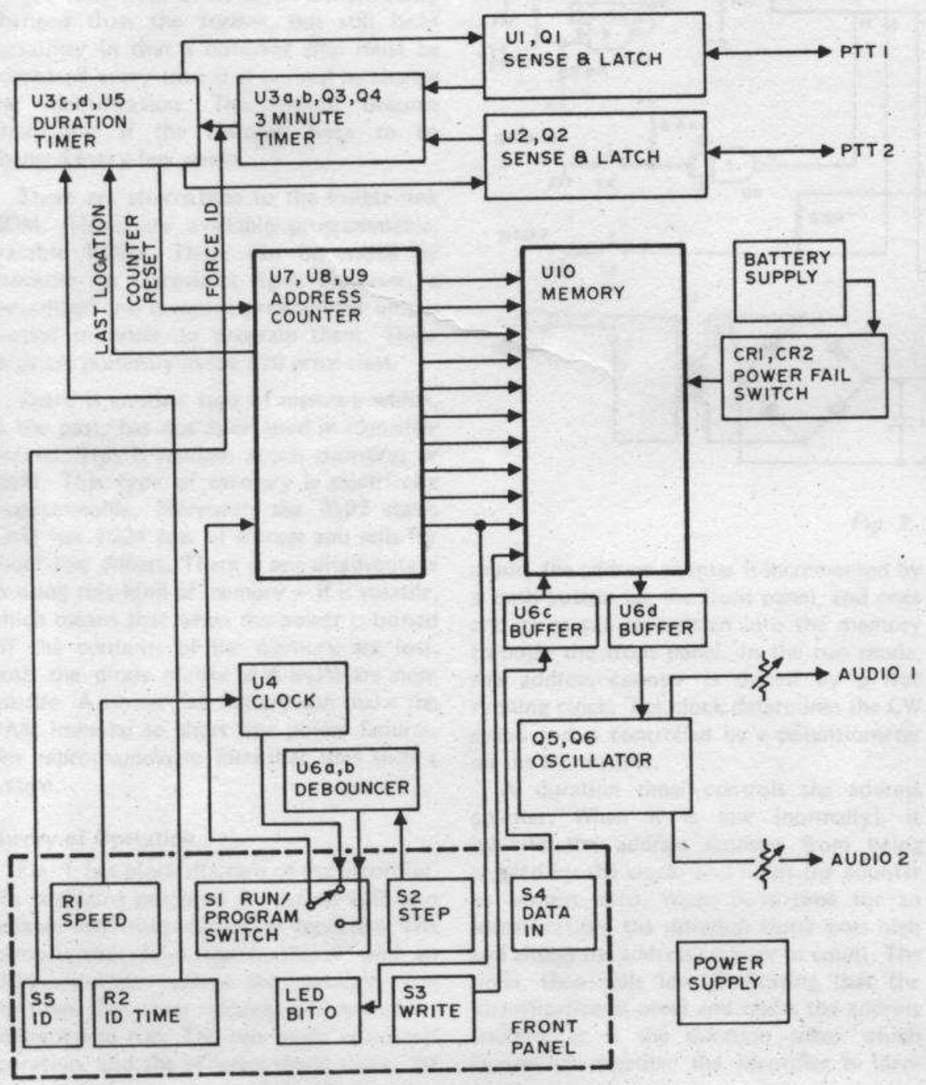

Fig. 1. Block diagram.

There are a large number of repeaters on the air these days, and most have CW identifiers. The CW operator who takes a sojourn into the repeater bands is inundated with repeater callsigns. After a day or two on the same repeaters, listening to the dull but prevalent "DE WR3ABQ" type of repeater identification becomes rather boring. Being an avid CW operator as well as repeater user, I decided that a more interesting type of repeater identifier could easily be built. It was decided that the identifier should:

1. Be easily reprogrammable (without opening the case).
2. Have capacity for long messages.
3. Retain its memory during power failures.
4. Service two repeaters.
5. Be relatively inexpensive (under $40).

The identifier was to be used at a site where two repeaters are located with the same callsign (150 and 450) — hence the fourth point.

An identifier was designed and constructed which satisfied the above requirements. It is programmed from switches on the front panel, has a 1024 bit non-volatile memory, identifies two repeaters, and costs about $30 to $40 to build (with new parts).

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Other Identifiers

The distinguishing feature of identifiers is the memory. Identifiers may be classified according to the type of memory they use. There are basically two kinds of electronic identifiers in use today. The first and older of the two uses a diode matrix for memory. The identifier is programmed by soldering diodes in a matrix. The disadvantages of this system are that large memory units become cumbersome, and that reprogramming entails opening the unit and physically moving diodes around.

The other type of identifier uses read only memory (ROM). These are fairly new devices and can store more in less space than a diode matrix. Typically, fusible link ROMs are used because these are the most inexpensive. The fusible link ROM is programmed by selectively melting fusible links inside the integrated circuit chip. Naturally once a link is melted there is no way to put it back. Generally a ROM of this type can be programmed only once. However, to change the identification in this type of identifier it is only necessary to reprogram another ROM chip and replace the old ROM with the new one.

The latter type of identifier is more easily changed than the former, but still lacks versatility in that a different chip must be purchased every time it is desired to change the identification. This would become impractical if the memory were to be changed every few weeks.

There are alternatives to the fusible link ROM. There are available programmable, erasable ROMs. These can be erased by exposure to ultraviolet light. However, a specialized and complex programmer unit is needed in order to program them. These chips are presently in the $20 price class.

There is another type of memory which, in the past, has not been used in identifier circuits. This is random access memory, or RAM. This type of memory is electrically programmable. Moreover, the 2102 static RAM has 1024 bits of storage and sells for about five dollars. There is one disadvantage to using this kind of memory – it is volatile, which means that when the power is turned off the contents of the memory are lost. Both the diode matrix and ROM are non-volatile. A power fail battery can make the RAM immune to short line power failures. The reprogrammable identifier uses such a system.

Theory of Operation

Fig. 1 is a block diagram of the identifier. The oscillator generates a sidetone with two variable level outputs for the repeaters. The memory unit keys the oscillator, and an address counter drives the memory. The identifier has two modes of operation: program and run. The run mode is normal operation, and the program mode allows the memory to be programmed. In the program

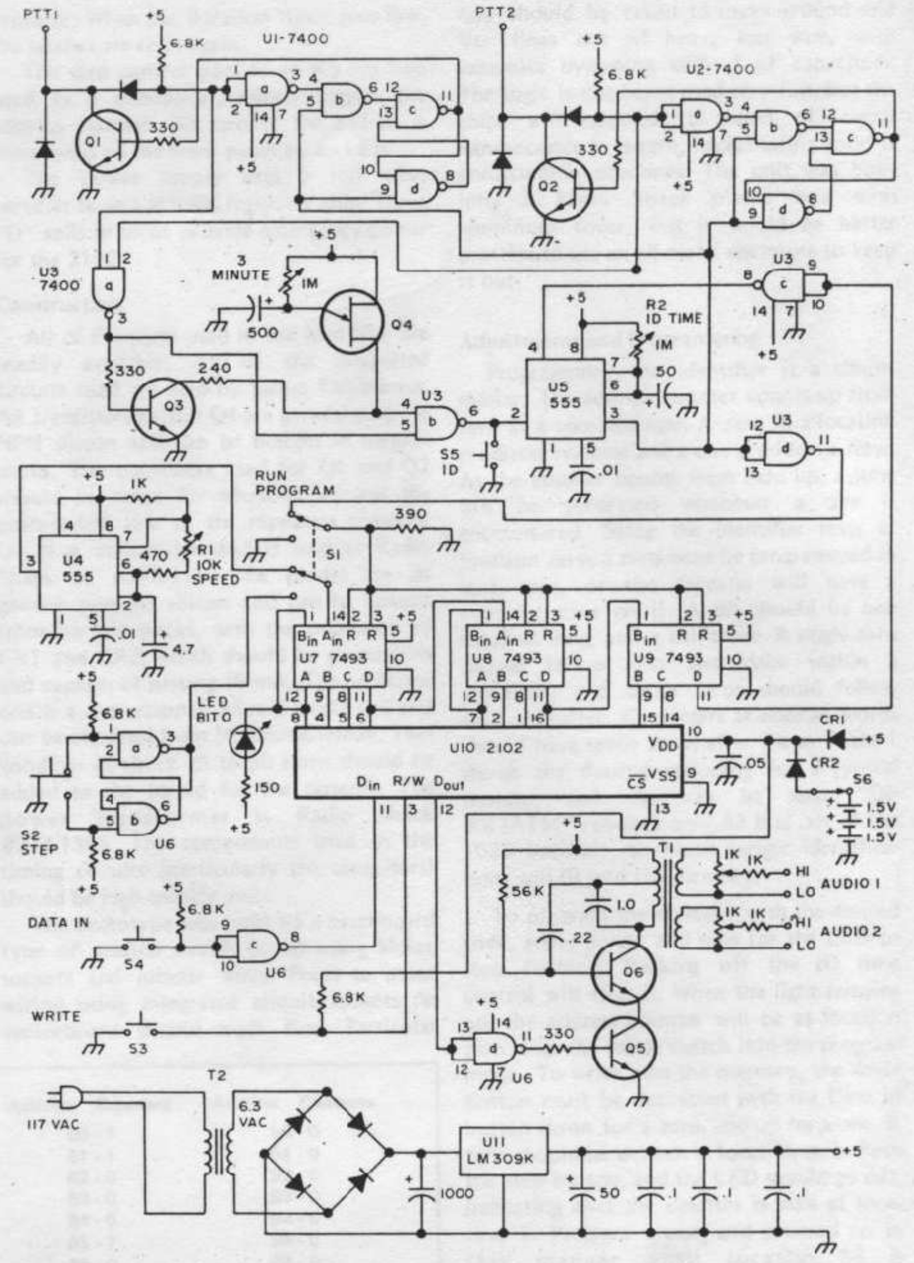

Fig. 2. Schematic.

mode, the address counter is incremented by a push-button on the front panel, and ones and zeros can be written into the memory through the front panel. In the run mode, the address counter is driven by a free running clock. The clock determines the CW speed and is controlled by a potentiometer on the front panel.

A duration timer controls the address counter. When it is low (normally), it inhibits the address counter from being toggled by the clock, and holds the counter at address zero. When it is time for an identification, the duration timer goes high and allows the address counter to count. The timer then falls low (indicating that the identification is over) and resets the address counter. It is the duration timer which determines whether the identifier is identifying or not.

The duration timer is controlled by a three minute timer. This timer does two things: If the repeaters have not been used for three minutes, upon key-up the timer will send a pulse to the duration timer to initiate an identification. Additionally, if the repeater remains on the air, the timer pulses the duration timer every three minutes.

The three minute timer is controlled by two identical sense and latch circuits. The sense and latch circuits go to the push-to-talk lines of the two repeaters. If either of the push-to-talk lines is grounded, the three minute timer is activated. If the duration timer is high when a push-to-talk line is low, the latch on the respective sense and latch circuit is set, which grounds that push-to-talk line to keep the repeater on the air. When the duration timer goes low the latch is reset, letting the repeater drop.

A power supply feeds the electronics, but when power is lost, the memory is switched to internal batteries.

The schematic of the identifier is shown in Fig. 2. The memory consists of a 2102 RAM.. The 2102 is an nMOS integrated circuit and has TTL compatible inputs and output. The chip has ten address lines necessary to access 1024 bits. When a particular address is selected, whatever is present at the D_{in} terminal is stored in that location when the read/write (R/W) line goes low. When the R/W is high, whatever was previously stored will be present at the D_{out} terminal when that address is again selected.

The oscillator utilizes an 88 mH toroid coil with two secondary windings. The audio outputs of the identifier are low impedance. With the component values specified, the tone is 1 kHz.

The address counter consists of three 7493 four-bit binary counter chips. The reset lines are tied together and go to the complement of the duration timer.

The clock is a 555 square wave generator. Another 555 is used as a monostable multivibrator for the duration timer. When the input is pulsed, the output is a pulse of predetermined width (5 to 60 seconds).

A unijunction transistor is used as the three minute timer in conjunction with Q3 and part of U3.

The latches are RS flip flops. The reset lines go to the duration timer's output, so the latch outputs are held low until the duration timer goes high, whereupon the set line may go low if the push-to-talk line is low. When the latches are set, Q1 or Q2 is turned on and holds up the respective repeater. When the duration timer goes low, the latches are reset again.

The step control goes to an RS flip flop used as a debouncer, which toggles the address counter. Bit zero of the address is monitored on the front panel by an LED.

The power supply uses a full wave rectifier to an LM309K regulator chip. Three "D" cells in series provide emergency power for the 2102.

Construction

All of the parts used in the identifier are readily available. All of the integrated circuits used are sold by James Electronics. All transistors except Q4 are general purpose NPN silicon and can be bought in bargain packs. The transistors used for Q1 and Q2 should be rated for whatever current the push-to-talk line of the repeaters requires. Q4 is a unijunction and is sold at Radio Shack as #276-111. The diodes are all general purpose silicon and can be bought from bargain packs, with the exception of CR1 and CR2, which should be germanium and capable of passing 70 mA. The oscillator coil is a centertapped 88 mH toroid coil and can be obtained from M. Weinschenker. Two windings of about 25 to 50 turns should be added to the toroid for the outputs. The power transformer is Radio Shack #273-1384. The components used in the timing circuits (particularly the capacitors) should be high quality units.

The prototype was built on a patchboard type of printed circuit board using Molex sockets and jumper wires. Point to point wiring using integrated circuit sockets on vectorboard should work fine. Particular care should be taken to make ground and Vcc lines out of heavy bus wire, with extensive bypassing with .1 uF capacitors. The logic is not being used very fast, but the chips will respond to pulses of several nanoseconds in length, necessitating good rf construction practices. The unit was built into a Radio Shack plastic box with aluminum cover, but it would be better practice to use an all metal enclosure to keep rf out.

Adjustments and Programming

Programming the identifier is a simple matter. The address counter counts up from zero at a constant rate. A zero in a location produces no tone and a one produces a tone. As the counter counts from zero up, a tone will be generated whenever a one is encountered. Since the identifier rests at location zero, a zero must be programmed in that spot, or the repeater will have a constant tone on it. A dit should be one location long, and a dah three. A single zero should follow dits and dahs within a character, and three zeros should follow each character. Characters at ends of words should have seven zeros after them. Table 1 shows the desired encoding for a typical repeater call. As can be seen, "DE WR3AFM" requires only 83 bits out of the 1023 available, so much longer identifications will fit into the memory.

To program the memory with the desired code, apply power and wait for the LED to stop flashing. Backing off the ID time control will stop it. When the light remains on, the address counter will be at location zero. Flip the mode switch into the program mode. To write into the memory, the write button must be depressed with the Data In button down for a zero, and up for a one. A zero should be written in location zero. Push the step button, and the LED should go out, indicating that the counter is now at location 1. Program a one, and proceed on in this manner until location 83 is programmed. It should be noted that there is no way to go back a count, so if a mistake is made the procedure should be started over. A number of zeros should always be placed after the message to give leeway to the duration timer. Put the mode switch back to run and push the ID button. Set the speed control for the desired speed, and then adjust the ID time control so that the counter resets about five seconds after the ID is done. If a mistake is noticed, hit the ID button again, but place the mode switch into program just before the location where the mistake is located. This makes it unnecessary to step through the entire ID when a mistake is near the end. The counter remains where it was before it is placed into the program mode. After programming a message, tie a push-to-talk line low, and measure the time between identifications. Adjust the 1 megohm trimpot for the desired time — nominally three minutes.

Address Contents	Address Contents	Address Contents	Address Contents
0 - 0	30 - 0	60 - 1	90 - 0
1 - 1	31 - 1	61 - 1	91 - 0
2 - 1	32 - 0	62 - 0	92 - 0
3 - 1	33 - 1	63 - 0	93 - 0
4 - 0	34 - 1	64 - 0	94 - 0
5 - 1	35 - 1	65 - 1	95 - 0
6 - 0	36 - 0	66 - 0	96 - 0
7 - 1	37 - 1	67 - 1	97 - 0
8 - 0	38 - 0	68 - 0	98 - 0
9 - 0	39 - 0	69 - 1	99 - 0
10 - 0	40 - 0	70 - 1	100 - 0
11 - 1	41 - 1	71 - 1	101 - 0
12 - 0	42 - 0	72 - 0	102 - 0
13 - 0	43 - 1	73 - 1	103 - 0
14 - 0	44 - 0	74 - 0	104 - 0
15 - 0	45 - 1	75 - 0	105 - 0
16 - 0	46 - 0	76 - 0	106 - 0
17 - 0	47 - 1	77 - 1	107 - 0
18 - 0	48 - 1	78 - 1	108 - 0
19 - 1	49 - 1	79 - 1	109 - 0
20 - 0	50 - 0	80 - 0	110 - 0
21 - 1	51 - 1	81 - 1	111 - 0
22 - 1	52 - 1	82 - 1	112 - 0
23 - 1	53 - 1	83 - 1	113 - 0
24 - 0	54 - 0	84 - 0	114 - 0
25 - 1	55 - 0	85 - 0	115 - 0
26 - 1	56 - 0	86 - 0	116 - 0
27 - 1	57 - 1	87 - 0	117 - 0
28 - 0	58 - 0	88 - 0	118 - 0
29 - 0	59 - 1	89 - 0	119 - 0

Table 1. Example of programming a typical ID: "DE WR3AFM."

Results

After wiring, the only problem encountered was one of the Vcc lines being too small and poorly organized. After remedying this problem, the identifier had no other problems. After the unit was in operation about a month the speed began to slowly vary. Replacement of the components in the clock circuit fixed this problem. The identifier is located in the bottom of a 450 MHz repeater cabinet, next to a 150 MHz repeater, in a building with dozens of 150 MHz and 450 MHz repeaters. There has been no problem with rf getting into the identifier, even though it is constructed in a plastic case. The identifier has been installed for several months and has been working continuously on the Baltimore Amateur Radio Club's 146.07/146.67 and 444.35/449.35 repeaters. The batteries have not been replaced, and they have been successful in retaining the memory when power failures have occurred. It generally takes between five and fifteen minutes to program the identifier. BARC repeater users have been listening to the CW as it spouts notices and comments. If nothing else, this type of identifier makes users cognizant of the fact that the tones actually say something, and are not something to be constantly ignored, as is the case with too many repeaters across the country. ■

Parts List

CR1, CR2 – germanium diodes, 70 mA
Q1, Q2, Q3, Q5, Q6 – general purpose NPN silicon (2N3904)
Q4 – unijunction (Radio Shack #276-111)
R1 – 10k potentiometer with switch
R2 – 1M potentiometer
S1 – DPDT toggle switch
S2 – momentary push-button SPDT
S3, S4, S5 – momentary push-button SPST
S6 – SPST mounted on R1
T1 – 88 mH centertapped toroid coil with two 50 turn windings added
T2 – 6.3 volt power transformer (Radio Shack #273-1384)
U1, U2, U3, U6 – 7400 quad NAND gate
U4, U5 – NE555 timer
U7, U8, U9 – 7493 four bit binary counter
U10 – 2102 1k static RAM memory
U11 – LM309K voltage regulator