

## The TICK-4

### Kit Building and Operations Manual

Version 1.0

Congratulations on your purchase of the Tiny CMOS Keyer 4 kit. The TICK-4 features include lambic modes A and B, adjustable speed control, tune function, paddle select, sidetone on/off, straight key mode, (2) 50 character message memories, and beacon mode. The TICK-4 utilizes the latest in RISC-based microcontroller technology. This kit includes all board-mounted parts; the user simply adds a power source and enclosure. Although we believe this kit to be easy to build, we recommend following the steps as listed below, in order to insure a working unit in the shortest period of time.

#### Building the TICK-4 Kit

The first step is to inventory all the parts contained in the kit against Table 1. Be sure to check each component, and it will be helpful to tape each component to a piece of paper along with its designation and value. Be extra careful with U1, the PIC microcontroller, as it is susceptible to static damage if mishandled. Be sure to ground yourself before handling U1 by touching a metal object which you know is grounded.

Table 1

C1, C2	Tantalum capacitor	1 uF	1.0
C3	capacitor - axial	.001 uF	102
C4, C5	capacitor - axial	.1uF	104
J1	stereo paddle jack		
J3	mono keyline jack		
R1	resistor - 1/4w	4.7K	yellow-violet-red
R2	resistor - 1/4w	27K	red-violet-orange
R3	resistor - 1/4w	1 Meg ohms	Brown-black-green
P1	piezo audio transducer		
Q1	transistor		PN2222
S1	momentary switch		
U1	PIC microcontroller		PIC12CE674
U2	5v voltage regulator	5v +	78L05
8 PIN SOCKET			
PC BOARD			TICK-1

Now that you have verified the parts, you can prepare to solder the parts on the board. You'll need a small-to-medium soldering iron, something in the 15-40 watt range. Use rosin core solder, a 60/40 mix of lead/tin is recommended. Radio Shack stores carry all the soldering supplies you would need to build this kit. Before starting the actual soldering, take a few minutes to look at these assembly instructions.

(1). Install the 8 pin socket which U1 will use. Notice that one end of the socket has a concave tab, which denotes the pin 1 end. Make sure the tab on the socket matches the silk screen overlay on the circuit board. Solder the socket onto the board, being careful not to apply too much heat and melting the socket. Do not install U1 at this time... it will be installed last.

(2). Install capacitor C3. Do not install the other capacitors, they will be dealt with later.

(3). Install resistor R1. Do not install the other resistors, they will be dealt with later.

(4). Install Q1, the keyline transistor.

(5). Beginning with this instruction, there are parts that will be optional, depending on the application you intend for the TICK-4. Take a few minutes to read and consider these instructions before continuing.

(6). Voltage Source: Embedded or Stand alone application

**12V:** If you want to power the TICK-4 from a 12v DC supply, the parts necessary for 12v-to-5v regulation must be added; this is done with U2 (78L05 voltage regulator), C1, and C2. **NOTE:** C1 and C2 must be installed with respect to their polarity! The "+" lead is identified by a marking on the body of the cap, as well as the "+" lead is the longer of the two! The

voltage input is at J2, with the POSITIVE pad located closer to the center of the board, and GROUND pad closer to the edge of the board. **MAKE SURE THAT YOU DO NOT USE THE J4 BATTERY INPUT IF YOU ARE USING THE REGULATED SUPPLY INPUT!**

**REGULATED 3-5V source:** If your rig already has an internal regulated source, or you want to run off of a battery source for a stand alone application, then you may want to take advantage of this. The input for this regulated voltage is J4. If you decide on this option to power the unit, you do not need the following components: C1, C2 and U2.

(7). Audio feedback/sidetone:

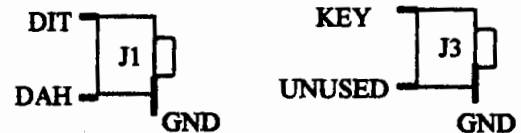
**Piezo Method:** We wanted to make the TICK-4 kit as simple as possible, so we decided to provide a method of audio feedback and/or sidetone that would not require a connection to the radio audio chain. The way this is done is by providing an output for a piezo transducer to connect to. The piezo transducer connects between the two pins of J6. Polarity is not necessary. You will have to place a jumper for R3, and C4 and **NOT POPULATE** R2 or C5. Using two small pieces of resistor lead can do this. Bend the leads in a "U" and solder in place of R3 and C4. This jumpers pin 3 of the TICK-4 to J6 pin 1. There should be continuity between pin 3 of the TICK-4 and pin 1 of J6. This method allows for the easiest implementation of embedding a keyer into your rig. The **ONLY** connection required between the keyer and the rig is the keyline of the keyer (J3) to the keyline of your rig. This could be as simple as connecting to the front (or rear) panel key input of the rig.

**Internal Audio Chain Method:** We also decided to make it possible to experiment with adding the TICK-4 to a radio and integrating it in the audio chain. We have set up the typical arrangement required to integrate the keyer into many rigs. This involves removing the current sidetone circuitry that is generated by your rig, and inputting the sidetone and feedback from the keyer (pin 3 TICK-4). We included the following components to reduce the output voltage and couple it to the rig's audio chain: R2, R3, C4, and C5. For the Norcal-40A, we have been told that the value for R2 is 27K, and R3 is 1Meg, but we have not tried this implementation. We leave this up to the experimenter to determine values for the rig in question.

**BUT REMEMBER, IF YOU DONT WANT TO MAKE THIS COMPLICATED, JUST USE THE PIEZO!**

- (8). Now that the components have been placed and soldered on the board, the final wiring can take place. First jacks to be wired are paddle input (J1) and keyline output (J3). Both these jacks look identical, except that the keyline jack (J3) has a small spring inside it.

J1 and Paddle Input wires: requires 3 wires of equal length. The exact length should be sufficient to connect from the board to your choice of location for J1. J1 is the stereo, paddle input jack.



J3 and the keyline output wires: requires 2 wires of equal length. The exact length should be sufficient to connect from the board to your choice of location for J3.

J5 and S1: requires 2 wires of equal length. The exact length should be sufficient to connect from the board to your choice of location for S1.

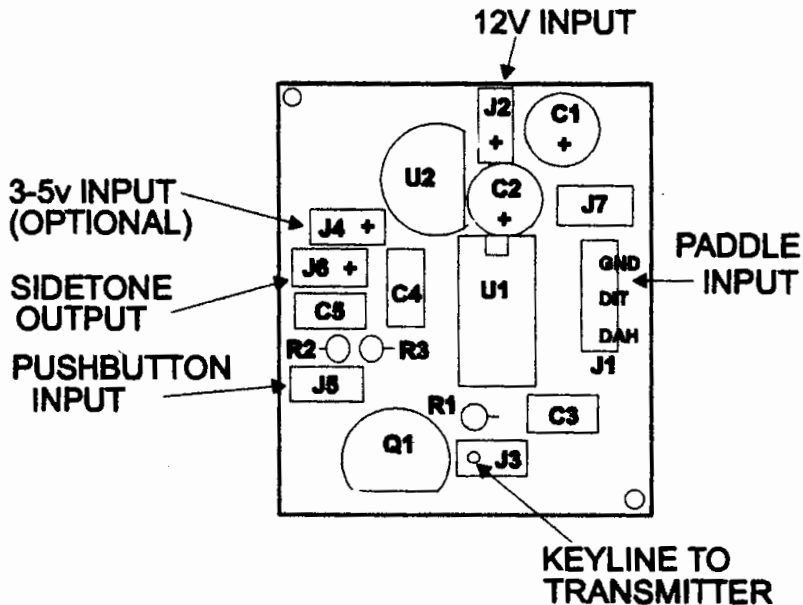
- (9). Install U1, the PIC microcontroller. Be careful to discharge yourself of any static electricity before handling the chip. Make sure the tab on the chip matches the location on the silk-screen, thus insuring correct orientation of the chip.
- (10). At this point, hook up your paddles and supply power to the unit. When first powered up, the TICK-4 will send "ST" (dit-dit-dit, dah) through its sidetone output. If there is no audio output on the piezo, go back and check for the following:

**Solder Bridges** - The most common mistake made. Check the bottom of the board for solder blobs, which serve to bridge two unconnected points. Use a magnifier and bright light if possible. Check for unsoldered pins and cold solder joints (these appear dull and somewhat rough).

**Parts Placement** - Go over the instructions and insure that each part is in its correct position on the board. Something as simple as an incorrectly placed resistor may cause the unit to malfunction. Verify that the microcontroller is oriented correctly, with respect to the tab on its end.

**Silk Screen and Parts Placement Diagram**

Below is a silk-screen of the Circuit Board, with additional details for construction.



**Appendix 1: Advanced TICK-4 Construction**

**Making the TICK-4 Consume Even Less!**

The TiCK-4 consumes very little power, but there is always room for improvement. These methods will reduce the TiCK-4's current consumption even further.

Replacement of the 78L05 with a LP2950 as suggested in QRP Power<sup>1</sup>. This will reduce the quiescent current consumption of the regulation circuit. This part is available from Digi-Key for \$2.07. Part Number LP2950CZ-5.0-ND.

Also, using a bipolar transistor requires drive current. Even with a 4.7K base resistor, and operating at 5V this is about one milliamp, and considering that this will only be key down current, it is very minimal. But you can reduce it further by jumpering R1 and replacing Q1 with an N channel FET.

We have not experimented with different FETs, but there are many out here that will probably work fine.

**Reviews and Articles:**

The TiCK keyers have been described and reviewed in many amateur radio journals, among them:

- August 97 issue of CQ (TiCK-1 keyer)

- September 97 issue of CQ (TiCK-2 keyer & Surface Mount TiCKs)
- August 97 issue of Mobile Ham (Japanese Magazine, TiCK keyers)
- October 97 issue of World Radio (TiCK keyers)
- October 97 issue of QST (TiCK keyers)
- Fall 97 issue of QRPp (Surface Mount TiCK-2)
- 1999 ARRL Amateur Radio Handbook (TiCK Keyers)

**Questions:**

If you should have any questions or comments regarding the TiCK-4 or if you would like to submit rig modifications for embedding the TiCK-4 into your favorite rig, contact us via the following:

USMail: Embedded Research  
PO Box 92492  
Rochester, NY 14692

Internet: <http://www.frontiernet.net/~embres>  
Email: [embres@frontiernet.net](mailto:embres@frontiernet.net)

<sup>1</sup> QRP Power, compiled by Joel Kleinman (N1BKE) and Zack Lau (KH6CP/1), American Radio Relay League (ARRL), Newington CT, 1996.

## The TiCK-4 DATASHEET

Congratulations on your purchase of the Tiny CMOS Keyer 4. The TiCK-4 features lambic modes A and B, adjustable speed control, tune function, paddle select, sidetone on/off, and straight key mode. In addition, the TiCK-4 offers (2) 50 character message memories, plus single button access to memory, a Beacon mode, and non-volatile parameter storage. The TiCK-4 utilizes the latest in RISC-based microcontroller technology. The TiCK-4 chip can be made operational with as few as four (4) external components!

### TICK-4 User Interface

The Single Button Interface (SBI) makes the TiCK-4 simple to use. The general idea is that as long as the user holds the pushbutton down, the TiCK-4 will allow sequential access to its various functions. After the code for the desired function is output through the sidetone, the user simply releases the button to access that particular function. Once the function is completed, via paddle or possibly pushbutton input, the user is returned to operational or "keyer" mode.

### User Interface Description

ACTION	TICK RESPONSE	FUNCTION
Hold Pushbutton Down MOMENTARILY	NONE	PLAYS back message #1 (assuming message #1 has been entered into the TiCK-4's memory).
Hold Pushbutton Down	DIT	PLAYS back message #2 (assuming message #2 has been entered into the TiCK-4's memory).
Hold Pushbutton Down	"S" (dit-dit-dit)	SPEED Adjust: press dit to decrease, dah to increase speed
Hold Pushbutton Down	"T" (dah)	TUNE: to unkey rig, press either paddle or pushbutton
Hold Pushbutton Down	"A" (dit-dah)	ADMIN mode: this allows the user to access various setup parameters of the TiCK-4 chips.
Hold Pushbutton Down MOMENTARILY	"I" (dit-dit)	INPUT mode: allows the user to enter message input mode.
Hold Pushbutton Down	"1" (dit-dah-dah-dah-dah)	MSG #1 INPUT: allows the user to enter message #1
Hold Pushbutton Down	"2" (dit-dah-dah-dah-dah)	MSG #2 INPUT: allows the user to enter message #2
Hold Pushbutton Down	"P" (dit-dah-dah-dit)	PADDLE select: press paddle you want to designate as DIT paddle
Hold Pushbutton Down	"A" (dit-dah)	AUDIO select: press DIT to enable sidetone, DAH to disable. Default: enabled.
Hold Pushbutton Down	"SK" (dit-dit-dit, dah-dit-dah)	STRAIGHT KEY select: pressing either paddle toggles the TiCK to/from Straight Key/Keyer Mode. Default: Keyer Mode.
Hold Pushbutton Down	"M" (dah-dah)	MODE select: pressing the DIT paddle puts the TiCK into lambic Mode A, DAH lambic Mode B (default).
Hold Pushbutton Down	"B" (dah-dit-dit-dit)	BEACON select: pressing either paddle toggles the TiCK to/from Beacon/No-Beacon Mode. Default: No-Beacon Mode.
Hold Pushbutton Down	"K" (dah-dit-dah)	KEYER mode. If the user releases the pushbutton, keyer returns to normal operation.
Hold Pushbutton Down	"S" (dit-dit-dit)	Cycle repeats with MEMORY PLAYBACK, SPEED adjust, etc.

**Functions:** If the user holds the pushbutton down continuously, the keyer will rotate through the functions listed. If the user releases the pushbutton after entering ADMIN mode, then pushing the button will allow access to the ADMIN functions: memory input, paddle select, audio select, straight key mode, and mode select. Completing any function within ADMIN mode returns the user to normal KEYER mode. Upon power-up, the TiCK-4 will send "dit-dit-dit-dit, dah" ("4") through the audio pin, and is identified by a YELLOW dot.

**Speed adjust:** speed adjust continues as long as paddle is pressed; when paddle is released, speed is set at that point. Once the initial paddle is pressed, pressing the opposite paddle will cause the speed change to occur more quickly.

**Memory Message -** the TiCK-4 supports (2) 50 character message memories. The TiCK-4 starts consuming memory with the first element entered. Memory consumption ceases when either the user has pressed the pushbutton, or memory is totally consumed. When you have completed entering the message, hit the pushbutton to end input mode. Between the last element input and the press of the pushbutton, the TiCK-4 is entering spaces into memory (possibly a useful feature in Beacon Mode!).

**Message Playback:** This option is not available, unless there is at least one message in memory. If message #1 is in memory, a single momentary press of the pushbutton will play it back. If message #2 is desired, then the pushbutton is pressed until a single "dit" is heard.

**Straight Key Mode:** in order for straight key mode to function with a straight key, a mono (two wire) jack needs to be wired in parallel with the stereo (3 wire) paddle input jack. It is vital that one wire from the mono jack go to the ground jack on the paddle input; the other wire will work with either the dit or dah input.

**Keyer Parameters:** the TiCK-4 uses its own internal Random Access Memory (RAM) to store its operating parameters such as speed, dit/dah paddles, lambic mode, memory, etc. When power to the TiCK-4 is cycled, the values in RAM are lost and upon powerup the TiCK-4 uses its default values.

**Audio Sidetone -** if you elect to use a piezo audio device with the sidetone, it is to your benefit to power the TiCK-4 with as close to 5V DC as possible, in order to obtain the highest volume. Attach one piezo lead to PIN 3, the other to GROUND.

**Beacon Mode -** the TiCK-4 can be put into Beacon mode. In this mode, when the memory message is played, it will play and repeat until one of the paddles

is hit. To repeat a given message, just play the message like you would if the TiCK-4 was not in Beacon mode.

**Pushbutton -** it is important that a Normally Open (NO) switch be used for input on PIN 4.

**Current Usage -** the TiCK-4, when not receiving input from the pushbutton or paddle inputs, will immediately go into "sleep" mode. In this state, the device draws about one microamp of current.

**Parameters -** the TiCK-4 utilizes EEPROM memory for storing operating parameters. This means that you can power off the chip, and upon power-up, it will "remember" its parameters: speed, mode, paddle select, audio on/off. Note: memory messages are NOT stored in EEPROM memory, and will be lost when the power is turned off.

A schematic has also been supplied with this data sheet. It demonstrates an example circuit that we have built and tested. You may find the information helpful in building up the TiCK-4 into a working circuit. The TiCK-4 PC board supports this schematic. Please note that the voltage divider and capacitors on PIN 3 (Audio) may vary depending on the rig you're interfacing to.

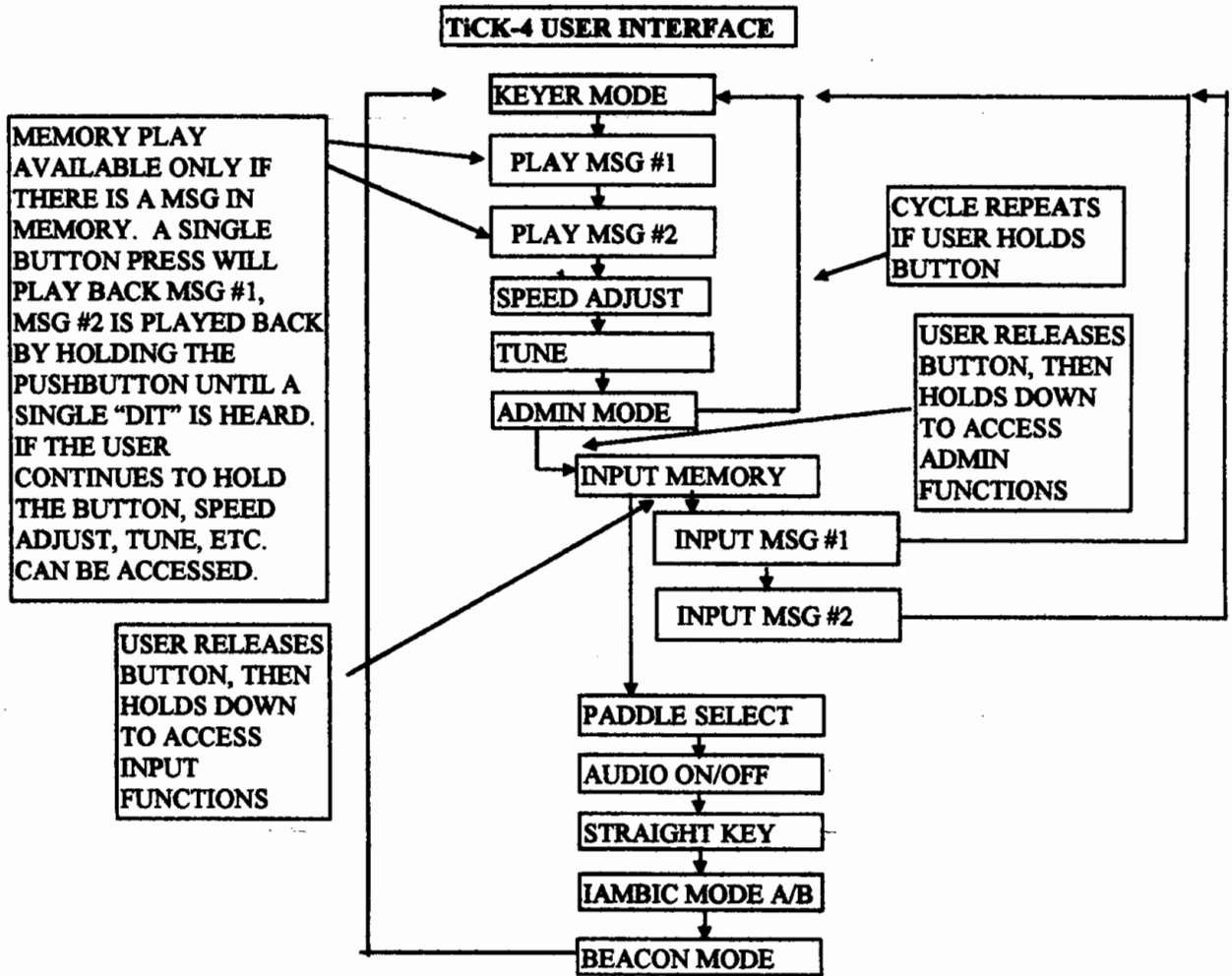
One last thing: the TiCK-4 has a built-in timer to prevent it from loitering in the parameter setting menu. After approximately 8-10 seconds, the TiCK-4 will send a "K" and automatically exit the menu and go back to normal operating mode.

In addition to offering the TiCK-4 chips, we also offer full TiCK kits that include all board mounted parts, keyline and paddle jacks, piezo audio transducer, pushbutton, and PC board.

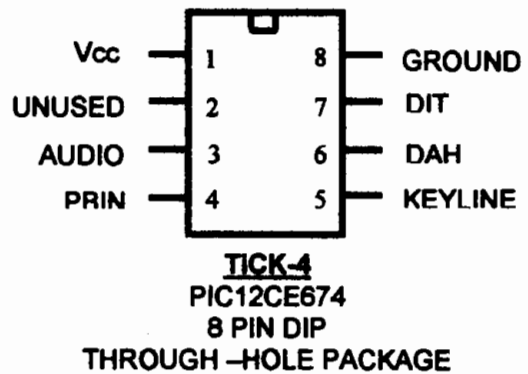
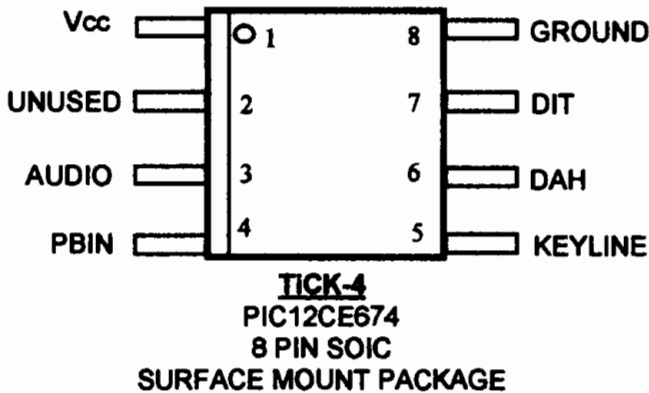
We're happy to provide you with products utilizing the latest in microcontroller technology for your Amateur Radio station. If you have any comments or ideas for current or future products, please contact us! We welcome you to visit our webpage to view our variety of accessories for your amateur radio needs.

Embedded Research  
PO Box 92492  
Rochester, NY 14692

embres@frontiernet.net  
<http://www.frontiernet.net/~embres>



PIN	DESCRIPTION	PIN	DESCRIPTION
1	VCC - 3-5 VDC	5	KEYLINE - LOGIC HIGH = KEYED, LOGIC LOW = UNKEYED
2	UNUSED	6	DAH - INPUT
3	AUDIO - 625Hz NOMINAL	7	DIT - INPUT
4	PBIN - N.O. PUSHBUTTON INPUT	8	GROUND



## Operating Scenarios

### 1. Entering a message into Memory #1

Press and hold pushbutton until "A" (Admin Mode) is heard, then release.

Press and hold pushbutton until "I" (Input Mode) is heard, then release.

Press and hold pushbutton until "1" (Msg #1) is heard, then release.

Now with the first character you enter on the paddles, the TiCK-4 begins entering the message into memory. The TiCK-4 will allow you to enter characters until memory is full. If your message is less than 50 characters, momentarily press the pushbutton when you are done entering the message. This will have two effects: first, it will keep the TiCK-4 from entering spaces at the end of your message. Second, it will signal the exit of input mode, and will play the message back for you to hear through the audio output (pin 3).

**Helpful hints:** let the TiCK-4 add spaces to the end of your message, if your aim is to use it in Beacon mode. Then when you play back the message, there will be a space between message playbacks. If you entered an incorrect message, you will need to go back into memory input mode as described above. If you do not want to hear your entire message played back, you can hit either paddle to interrupt the TiCK-4. This puts you back into normal keyer mode, and you will follow the above procedure to get back into memory input mode. One more hint: if you get into memory input mode, but do not wish to alter the message, simply press the pushbutton momentarily. This will have the effect of merely playing the message back out through the audio output (pin 3), and will not change the message.

### 2. Entering a message into Memory #2

Press and hold pushbutton until "A" (Admin Mode) is heard, then release.

Press and hold pushbutton until "I" (Input Mode) is heard, then release.

Press and hold pushbutton until "1" (Msg #1) is heard, and KEEP holding the pushbutton down until "2" is heard, then release.

Now enter message #2; when done, press the pushbutton momentarily to end message #2 input and return to normal keyer mode.

### 3. Playing back a message

Playing back message #1 requires only a momentary press of the pushbutton. Playing back message #2 requires pressing the pushbutton and holding it until a single "dit" is heard. If the user continues holding the pushbutton down, then he will access speed adjust, tune, etc.

If there are messages in memory, then the above user interface is in effect. If there are no messages in memory, then pressing (and holding) the pushbutton will lead the user first to speed adjust, tune, etc.

When playing back a message, hitting either paddle will interrupt the outgoing message. This is helpful when you continue calling "CQ" and someone answers while your re-sending.

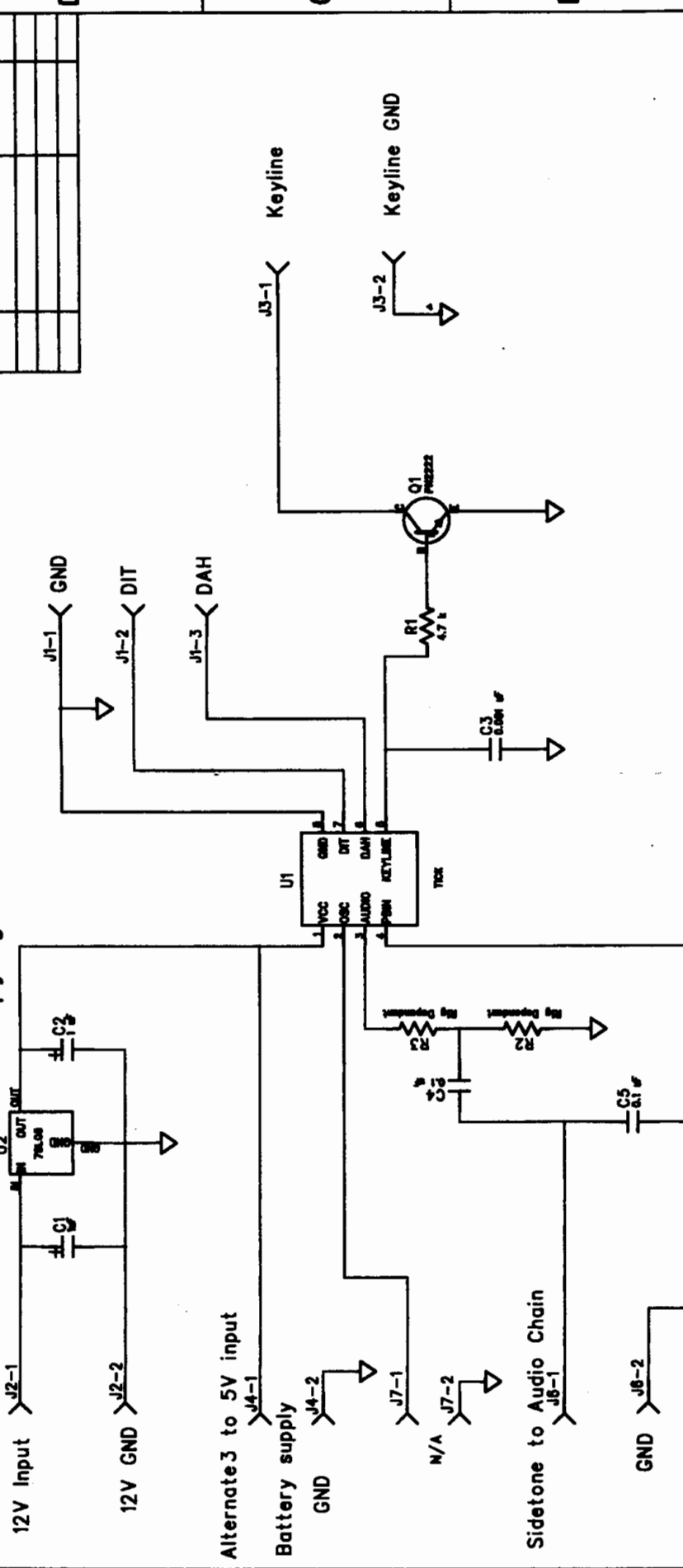
### 4. Resetting EEPROM Parameters to factory settings

Should you need to reset the TiCK's operating parameters, you can power off the TiCK and power it on with the pushbutton depressed. Once you hear the TiCK's power-up sequence ("dit-dit-dit-dit-dah"), you can release the pushbutton – your parameters are now set, as they were when you first received the TiCK!

1 2 3 4 5 6

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REVISION RECORD	
LTR	ECO NO: APPROVEMENT:



COMPANY: EMBEDDED RESEARCH	
TITLE: TICK 1/2/2B/3/4	
DRAWN: RSM	DATED: 1/25/96
CHECKED: GMDSR	DATED: 1/25/96
RELEASED: GMDSR	DATED: 1/25/96
CODE: SIZE:B	DRAWING NO: REV 1.2
SCALE: 1:1	SHEET: 1 OF 1

- Notes:
- To use Pico Amps R3 and C4 and do not use R2 and C5
  - Pico output would be at J1-1 & 2
  - If you use the 3-8 Volt input, do not use C2,C3 and U2
  - If you use the 5V input, you must have a J4 hooked to a supply
  - For IC-40 & 40A IC-50g and IC-50K