The TiCK-EMB-4

The TiCK-4 Keyer with Enhanced board & Memory Backup

Building and Operations Manual

Version 1.3

Congratulations on your purchase of the Tiny CMOS Keyer-EMB (Enhanced board & Memory Backup) kit. This kit includes the TiCK-4, which features Iambic modes A and B, adjustable speed control, tune function, paddle select, sidetone on/off, straight key mode, (2) 50 character message memories, beacon mode, and non-volatile parameter memory. 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. The product was designed to run off a DC source of 7-25V DC, and uses a board mounted 3V lithium battery to power the TiCK when the main power is shut off. In this manner, the TiCK's parameter settings and memory message will stay active. Since the TiCK only draws a few microamps, the lithium cell will last a long time. Finally, 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-EMB

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 it's 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 that you know is grounded.

Table 1

DESIGNATION	TYPE	VALUE	MARKED AS:
B1	Lithium Battery	3v	CR1225
C2	Tantalum capacitor	1 uF	1.0
C3, C4	capacitor – axial	.1 uF	104
C5, C6, C7, C8	capacitor – axial	.001uF	102
D1	Shottky Diode	1N5817	1N5817
P1, P2	stereo paddle jack		
R1	resistor - 1/4w	4.7K	yellow-violet-red
R2	resistor - 1/4w	27K	red-violet-orange
R3	resistor - 1/4w	1 Meg	brown-black-green
R4, R5, R6	resistor - 1/4w	100	brown-black-brown
Q1	Transistor		PN2222
S1	momentary switch		
U1	PIC microcontroller		PIC12CE674
U2	LDO voltage regulator	+5v	LT1121CZ-5
8 PIN SOCKET			
PC BOARD			EMB-1
PIEZO			AT-12
BATTERY CLIP	9v battery clip		
BATTERY HOLDER	3v lithium cell holder		

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. Make sure to wear safety glasses, and to wash your hands with hot soapy water after handling the solder.

(1). Install the 8-pin socket that 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 the lithium battery holder. Be sure to solder the holder in so that it is sitting flush on the surface of the board.

(3). Install P1 and P2, the board mounted stereo jacks used for paddle input and keyline output, respectively. Be sure to solder these in so that they are sitting flush on the surface of the board, and that the edge of the jack is flush with the board. You may have to adjust them into position, BEFORE soldering.

(4). Install S1, the momentary, board mounted pushbutton switch. Be sure to press the switch to the board so that it is sitting flush on the board, and even with the edge as in the step above.

(5). Install capacitor C2. **Note**: C1 is **NOT** used. These tantalum caps are polarity sensitive, and MUST BE INSERTED CORRECTLY. The longer leg of the cap is the POSITIVE leg, and should be inserted as shown on the silkscreen. **Note: be sure to orient the positive lead of C2 toward the socket for U1.**

(6). Install capacitors C5, C6, C7, and C8. Do not install the other capacitors, they will be dealt with later.

(7). Install resistors R1, R4, R5, and R6. Do not install the other resistors, they will be dealt with later.

(8). Install Q1, the keyline transistor. Make sure the flat side is oriented correctly.

(9). Install D1, the Schottky diode. Note that one end of the diode has a band on it. Position this band as shown on the board's silkscreen.

(10). Install U2, the 5v regulator. Make sure that the regulator is positioned with its flat surface, as shown on the board's silkscreen.

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

(12) Audio feedback/sidetone:

Piezo Method: We wanted to make the TiCK-EMB 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 J2. Polarity is not necessary. You will have to place a jumper for R2 and C3, and **NOT POPULATE** R3 or C4. This can be done by using a two small pieces of resistor lead. Bend the leads in a "U" and solder in place of R2 and C3. This jumpers pin 3 of the TiCK to J2 pin 1. There should be continuity between pin 3 of the TiCK and pin 1 of J2. This method allows for the easiest implementation of embedding a keyer into your rig.

Internal Audio Chain Method: We also decided to make it possible to experiment with adding the TiCK-EMB 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). We included the following components to reduce the output voltage and couple it to the rig's audio chain: R2, R3, C3, C4. For the Norcal -40&A 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 DON'T WANT TO MAKE THIS COMPLICATED, JUST USE THE PIEZO!

13). Now that the components have been placed and soldered on the board, the final wiring can take place.

(13a). Cut two equal length pieces of wire, to use for connecting a 7-25V DC power source to the TiCK-EMB board. It is customary to use RED for the positive lead, and BLACK for the negative (ground) lead. Solder the wires into J1, making sure that the RED wire goes to hole marked with a "+".

(14). 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.

(15). Install the lithium battery into B1, the battery holder. Note that the battery should be inserted so that the "+" on it's surface is facing **UP**. At this point, you should hear the letter "B" in Morse code (if you are using the piezo).

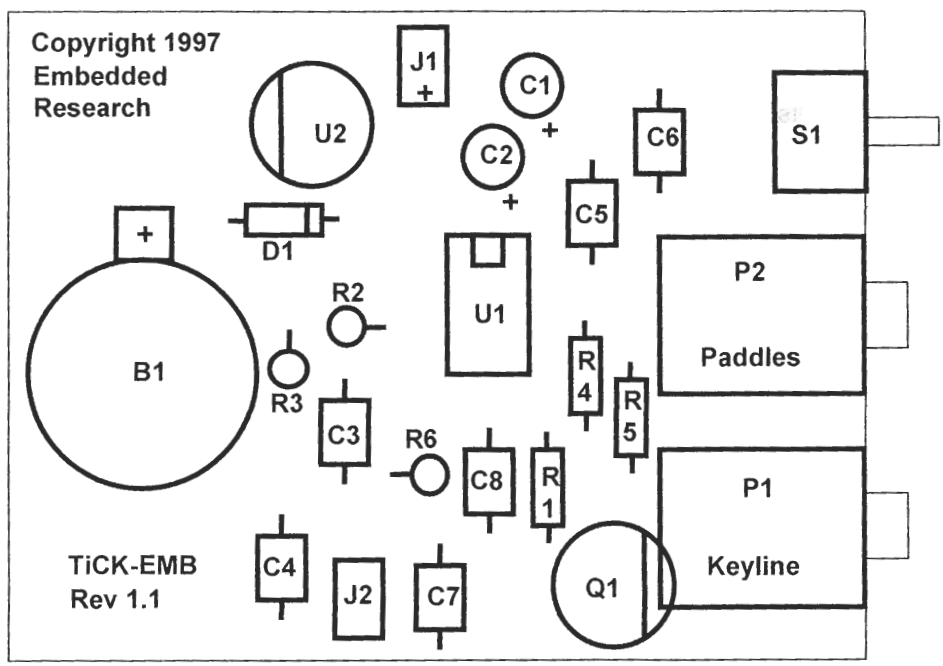
(16). Now plug your paddles into the paddle jack (P2) and supply power (7-25v DC) to the unit. When the paddles are actuated, you should hear the dits/dahs at the piezo. If there is no audio output at the piezo, go back and check for the following:

Solder Bridges - Easily the most common mistake made. Check the bottom of the board for solder blobs that serve to bridge two unconnected points. Use a magnifier and bright light if possible. Also 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 it's end.

Silk Screen and Parts Placement Diagram

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



[1]Notes:

Keyer Parameters: the TiCK-4 uses internal EEPROM (Electrically Erasable Programmable Read-Only Memory) to store its operating parameters such as speed, dit/dah paddles, Iambic mode, sidetone on/off, etc. The message memories are stored in RAM, and unlike the parameters described above, will be lost when the keyer is not powered ON. The 3v lithium battery keeps the TiCK powered, even when the main power supply is cycled off, which sustains the TiCK's message memory. **IT IS NOT RECOMMENDED THAT THE TiCK BE POWERED FROM THE ON-BOARD LITHIUM CELL AS THE PRIMARY BATTERY.**

Power-Up : upon power up, you should hear the TiCK's start-up audio signal, per the TiCK data sheet. Note that this only occurs when the TiCK is powered up, which includes insertion of the 3v battery.

Current Usage: when not receiving input from the pushbutton or paddle inputs, the TiCK will immediately go into "sleep" mode. In this state, the device draws about five microamps of current from the 3v lithium cell. Current is only drawn from the 3v cell when the primary power is not connected.

When the primary source of DC is connected, the TiCK-EMB will draw about 35 microamps from it. So if you use a standard 9v battery to power the 'EMB, it will last a long time! You may even decide to forego an ON/OFF switch!

Construction notes:

The TiCK-EMB was designed to mount inside an enclosure just using its front panel jacks. In addition, or alternatively, you may wish to use the (2)) holes provided on the circuit board for mounting with 4/40 screws and standoffs. We offer an EMB Enclosure kit, specifically made for it. Mail us, or visit our webpage for more information.

The TiCK-EMB was designed to be powered with a primary DC supply of 7-25v DC. The 3v lithium battery is optional, and is used to maintain the TiCK's memory and parameters when the primary DC power supply is off.

The voltage regulator used in the TiCK-EMB is a Low Drop Out (LDO), low quiescent current design. Unlike the 78L05 regulator, this one uses MUCH less current when the rig is powered up. Although more costly than the 78L05, we believe these features to be important to those utilizing batteries.

Do not operate the TiCK-EMB without the main power supplied. This will greatly reduced the 3V battery life. The 3V battery's main purpose is to preserve the TiCK's message memory when changing batteries, and when the main power is shutdown. As long as the TiCK is in sleep mode, the 3V lithium battery will keep the TiCK powered for several months, without need for a primary power source.

If you intend to keep a 9v battery attached to the TiCK-EMB all the time, then there is no need to put a switch between the battery and the 'EMB. In this case, the 9v battery will power the 'EMB and the 3v cell will not be utilized. Only when changing batteries will the 3v cell be called upon to power the TiCK and maintain its message memory; the operating parameters, stored in EEPROM, will NOT be effected by power up/down cycles.

When removing the main power source, make sure that you are in normal keying mode, and not in one of the menus. Not doing so will greatly reduce the life of the lithium battery. The TiCK only goes to sleep when it is in normal, operational mode. While inside the menus the TiCK is awake and looking for input. Again, when it is normal operational mode, if there is no input from the paddles or pushbutton, then the TiCK goes to sleep and only draws 5 uA.

Questions:

If you should have any questions or comments regarding the TiCK-EMB or if you would like to submit rig modifications for embedding the TiCK-EMB 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

The TiCK-4
DATASHEET

Congratulations on your purchase of the **Ti**ny **C**MOS **K**eyer 4. The TiCK-4 features Iambic 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 Iambic Mode A, DAH Iambic 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, Iambic 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.

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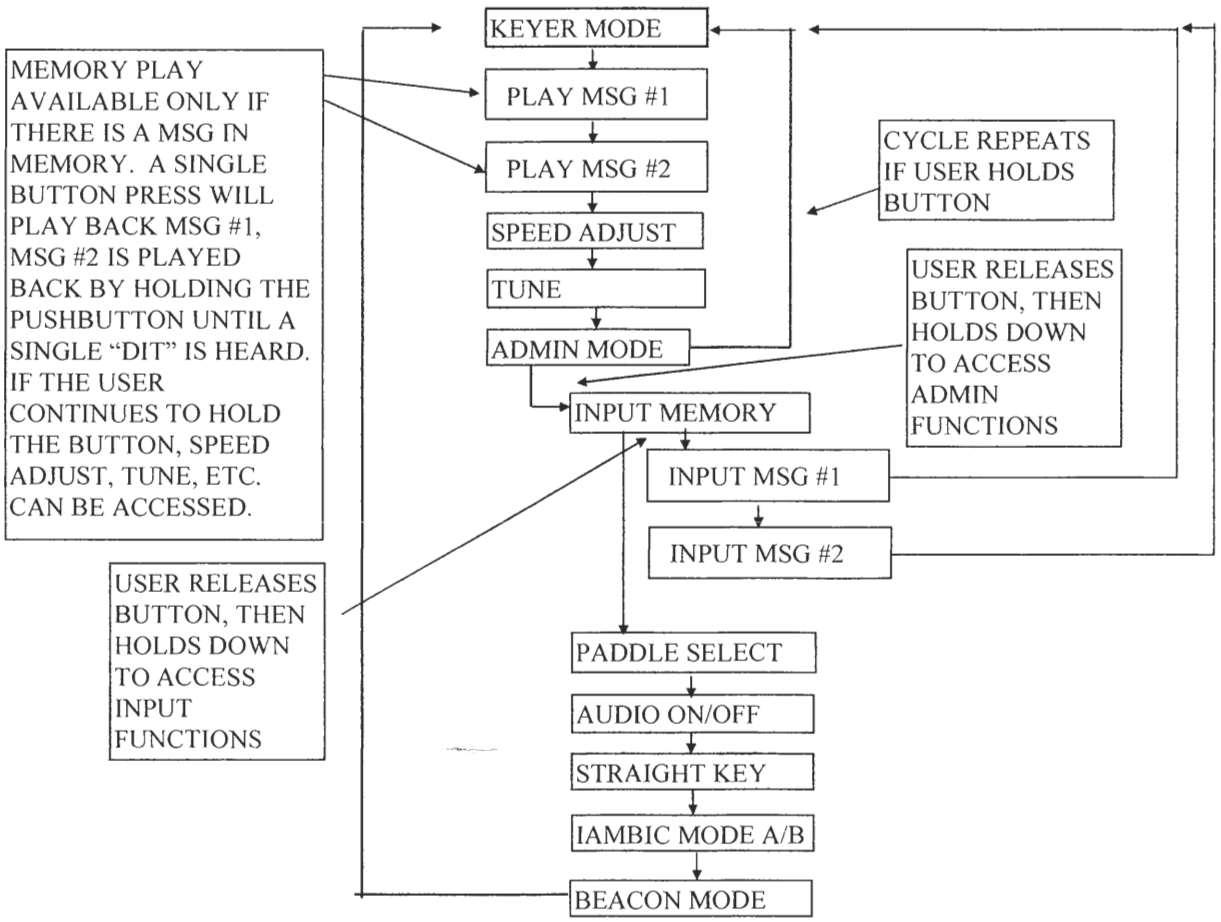
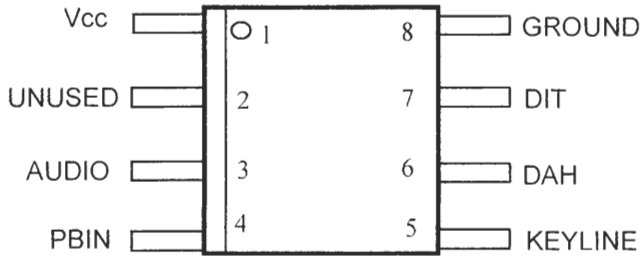
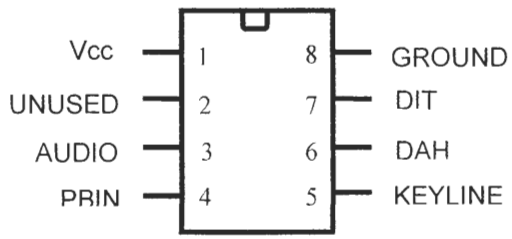
TiCK-4 USER INTERFACE



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



TiCK-4
PIC12CE674
8 PIN SOIC
SURFACE MOUNT PACKAGE



TiCK-4
PIC12CE674
8 PIN DIP
THROUGH –HOLE PACKAGE

Operating Scenarios

1. Entering a message into Memory #1

Press and hold pushbutton until "**A**" (**A**dmin Mode) is heard, then release.
Press and hold pushbutton until "**I**" (**I**nput 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**" (**A**dmin Mode) is heard, then release.
Press and hold pushbutton until "**I**" (**I**nput 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!