Constructing and Operating:

The Island Keyer

Construction:

General notes about building:

The components should be inserted a few at a time, soldered in place and then the leads are clipped. Note that all the leads for any particular pad should be inserted prior to soldering to prevent clogging the holes. The pads and traces are small and delicate - a small tipped, low power (25 watts or less) soldering iron should be used.

Also, machined pin SIP sockets (not supplied) can be used to provide the connection points to the off-board components, then the builder will be able to plug the wires from the components into the SIP sockets which simplifies moving the unit in and out of the enclosure. The builder might also consider using these sockets for the transistors and the voltage regulator. The machined pin sockets are available in snappable strips from most of the mail order surplus electronics parts suppliers.

Finally, the two DIP integrated circuits (ICs) are both CMOS devices. This means that they should be handled as little as possible to prevent static damage. The builder should use a grounding strap and anti-static mat if available or at the very least, work on a grounded metal surface and be sure to touch ground prior to touching the ICs.

Step 1: Get the parts together

All of the board mounted components have been supplied. You will still have to provide off-board items from the stocklist to fully implement the keyer including the enclosure, speed pot, switches, jacks and mounting hardware.

Step 2: Identify and orient the components

Most of the components should be fairly easy to identify and place except for the ceramic resonator and the ceramic bypass caps. The resonator is a small light blue OR white box with 3 leads. Orientation of the resonator isn't important.

The .1 uf and .01 uf capacitors appear similar. They are both very small yellow or blue parts with 2 radial leads spaced .1" apart. You may need a magnifying glass to see the markings on these parts. The .1 uf part is marked 104 OR .1M. The nine .01 uf caps are marked 103.

The orientation of the diodes is very important - the ring indicates the cathode lead of the diode. Note that if you use a VOM to check the resistance of diodes that the black lead of the VOM may actually be the positive lead.

The orientation of the SIP resistor network is also very important - the common lead, pin 1, is designated with a dot. This dot end of the network should be oriented towards the bottom of the circuit board as shown on the parts placement diagram.

Step 3: Determine how you will power the keyer

The keyer can be powered from 2 or 3 AA batteries (3 to 4.5 volts) or from 12 V using the supplied 78L05 regulator. If you do wish to the option of using either batteries or 12V, the Schottky diodes supplied with the kit will isolate and switch automatically between whichever power source has the highest voltage.

To prevent damage to the keyer, do **NOT** exceed 6 volts on the battery power input or 14 volts on the regulator power input.

Step 4: Mount and solder the components on the board

Use the parts placement diagram for the placement and orientation of the parts.

Start by inserting and soldering the 2 IC sockets.

Then insert the 8 yellow or blue bypass capacitors on the right side of the board. Then insert 10 wires of appropriate length in the holes to the left of the capacitors. Solder the connections and clip leads.

Form the leads of the eight 1N914 diodes for vertical insertion by bending one of the leads of the diode over. Insert the diodes (in the next set of holes to the left of the wires) with their banded end (cathode) to the left. Insert the 10 pin 10K ohm SIP next to the diodes making sure to orient the common lead (marked with a small dot or a vertical line) towards the bottom of the board. Note that resistor SIPs are somewhat fragile. Solder the connections and clip the leads.

Continue working to the left of the board by inserting and soldering the rest of the components and leads as shown on the placement diagram. Note the orientation of the transistors, Schottky diodes, voltage regulator and electrolytic cap as shown on the parts placement diagram. The electrolytic cap and D10 (schottky diode) are very closely positioned - the builder may want to leave the leads on the electrolytic cap long enough so that the cap can be bent to the left to make room for D10.

Step 5: Check your work

Before proceeding, take the time to check the bottom of the board for solder bridges. Use the Bottom view diagram as a guide to visually check for these shorts. It may help to clean the flux from the board and then use a strong light in conjunction with a magnifying glass too see these problems. Also, double check the orientation of the critical components such as the resistor SIP, diodes, electrolytic capacitor, transistors and voltage regulator. After you are convinced that the board is OK and after you have formed the leads of the ICs to fit in the sockets, insert the ICs into their sockets, being sure to follow the parts placement diagram for proper orientation.

Next, power up the board. An FB should be sent by the keyer at powerup through the sidetone if the keyer is functioning correctly. Note that you will only hear the FB if the

voltage across the 22 uf capacitor is fully discharged - since the keyer IC and EEPROM consume less than 10 ua of current in sleep mode it can take a long time before the capacitor is fully discharged UNLESS a key is pressed while the power is off. If you don't hear the FB, use a VOM to measure the current drawn. With a regulator, the idle current draw after powerup at 12 V should be about 2.5 ma. This will jump up to as much as 15 ma or so when the sidetone is engaged depending on the volume setting. Using batteries (without a regulator), the idle current draw after powerup at 3 V should be less than 6 ua. This will jump up to much higher levels when the unit is keyed.

If you see significantly higher currents, power down immediately and check again for shorts and/or opens. If the currents look reasonable, then power down and hook the unit up to the switches, speaker and pot and proceed to the Operation section.

Gotchas:

EEPROM erasures:

One problem I noted with the early versions of the keyer was that the EEPROM would occasionally be either erased or corrupted during power up. Serial EEPROMs are apparently very sensitive to power glitches - the keyer was being powered from the 12V accessory jack on my Argonaut. The fix involved adding C13, the 22 uf electrolytic capacitor, to the 5V output from the 78L05 regulator and removing the 1000 uf internal capacitor from the Argonaut 12V bus. No further erasures were noted after these changes were made. If you encounter phantom erasures of your messages, be certain that you are not encountering power-up glitches.

Speed Pot problems:

The leads to the speed pot should be kept as short as possible to prevent a wavering effect in the keying.

The speed pot (R10) and the timing cap (C11) may need to be selected to provide the full 7 to 48 WPM speed range. Some 1 meg pots have maximum values of less than 800 k ohms. Since the maximum resistance setting on the pot corresponds to the minimum keyer speed these low value pots can result in a higher minimum speed. Because of this, the value of C11 has been increased from the original nominal 500 pf value. If the resulting minimum speed with your pot isn't low enough, add a series resistance to the pot OR pad / change the timing cap.

This table shows the range of the speed reading for 10 samples of several different C11 values. The 220k and 330k values are shown so that you have an idea of the top speed of the keyer if a 220k or 330k resistor is connected in series with the speed pot. The data was taken at 5V, the speeds will increase at lower voltages.

WPM values at various combination of C11 and R10
R10 value (timing resistance)

C11 value	1.2M	1.1M	1.0M	900k	800k	330k	220k
470 pf	7	7-9	11-13	14-16	18-20	36	40
560	7	7	7	8-11	13-15	33-34	38-39
680 *	7	7	7	7	7-8	31	36-37

* The 680 pf capacitor is provided with your kit

Preventing latch-up:

IMPORTANT! - Do NOT connect a bypass capacitor on the interrupt pin of the processor (pin 19). A bypass capacitor seems to cause the processor to enter a condition called latch-up where excessive power supply current is drawn. This may cause destruction of the chip.

Notes:

I used a 330 ohm resistor in place of the sidetone volume pot - this provides a good volume level with a 5V supply.

The builder might consider adding a switch in series with the keying line to the transmitter. This will allow easy verification of memory contents or just practice with the keyer without keying the transmitter or having to unplug the keying line.

The simple keying circuit works well for most modern transmitters. **DO NOT** connect the Island Keyer directly to tube equipment with negative (grid block) keying or high positive (greater than 15V - cathode) keying or damage to the keyer may result. Contact Jackson Harbor Press for alternative keying circuits.

The keyer can be operated without the EEPROM - no messaging of course, but the idle current drawn will be much lower (<1 ua at 3V vs. <3 ua with the EEPROM). Note that if the keyer chip is used standalone (without the EEPROM) the FB message will ***NOT*** be sent at powerup.

The keyer will enter low power mode after about 1 second of inactivity. A keypress on any of the 8 switches will restart the processor and enter the main program loop.

If you are using batteries and the memories suddenly stop working, the battery voltage is probably too low for the EEPROM to function. The EEPROM is specified to work down to 2.5V.

Operation:

Adjusting and reading the code speed

The speed of the dits and dahs is adjusted by turning the speed pot (clockwise = faster). The approximate code speed can be determined by pressing the speed button. The code speed will be sent by the keyer through the internal sidetone only. The speed range is set in the program from a minimum of 7 WPM to a maximum of 48 WPM.

Setting the Sidetone frequency:

To set the sidetone frequency, first press and hold the speed button, the speed will be sent, then two question marks will start to be sent, then release the speed button immediately. Then press the Mem1 button to lower the sidetone one step. Press and hold the Mem1 button to continuously lower the sidetone frequency. Similarly, press the Mem2 button to raise the sidetone frequency. When you hear the desired sidetone frequency, hit the speed button again to save it in EEPROM memory and return to the normal keyer mode.

Note that the speed pot can be set to the highest speed to quicken the pace of adjustment. Also,
the sidetone will “wrap around” at the high and low tone limits (approximately 400 and 1200 Hz). If the frequency of the sidetone is increased above the high sidetone limit, the sidetone will jump down to the lowest tone possible.

Resetting the Sidetone frequency:

To reset the sidetone frequency, first press the INT / record key, then press and hold the speed button until the two question marks start to be sent, then immediately release the speed button. The sidetone will be reset to 750 Hz.

Programming the memories:

First, you may wish to disconnect the transmitter before recording to prevent accidentally sending your message over the air during the process.

To program a memory, first press the INT / record key, then press the button of the memory you want to program. A question mark will then be sent by the keyer. The message can now be recorded by using the paddles to "send" the message. After the message is complete, press the INT / record button to save it into the EEPROM. The message can then be played back by pressing the appropriate memory button to verify that it is correct.

If the keyer didn't recognize a character sent during the record routine, a low error tone will sound through the sidetone.

Automatic character and word spacing is used during the recording process, this can take some getting used to before you record exactly what you want.

11 special characters can be recorded in addition to the normal numbers and letters. These characters are:

?	..--..	question	,	--..--	comma	//	-...-	BT
.	.-.-.-	period	/	-..-.	slash	AR	.-.-.	
SK	...-.-		AS	.-...		KN	-.--.	

embedded pause is 7 or more dahs in a row
space 7 dit periods of nothing! (word space)

The embedded pause works as follows - if the user sends 7 or more Dahs in a row during the record process, a pause character will be placed into the message. During playback, the message will stop at the pause character. The user can then send something manually via the dit and dah paddles.. Message playback can then be resumed by pressing any of the memory keys. More than one pause can be inserted into a message. Note that the keyer will stay paused FOREVER at active power levels - be sure you have exited a pause if you are using batteries to power your keyer. Note that pressing the reset/kill switch will also exit an embedded pause. Also note that the speed and straight keys are inoperative while in a pause. Pauses are useful for messages where some of the message changes constantly (signal report, weather, temperature or serial number) and the rest is always the same:

message 1: UR RST IS <pause> // QTH IS GREEN BAY, WI

message 2: WX IS <pause> ES TEMP IS <pause> DEG F //

message 3: NR <pause> Q WB9KZY 72 WI

The capacity of the memories is:

memory 1: 123 characters
memory 2,3,4: 127 characters

Note that both word spaces and embedded pauses each count as a character.

If the memories are not long enough they can be run together by just continuing the recording process past the normal end point. Memory 1 can thus play up to a total of 507 characters, memory 2 - 383 characters, memory 3 - 255 characters.

Stopping a message after playback has started:

Press the Reset / kill button and the keyer will be reset - this can also be done when you want to exit the recording process.

You can also tap the dit or dah paddle and the message will stop playing after the character currently being sent.

Operations Notes:

Memory recording problems:

If you hit the INT / record button accidentally, hit a memory button and then hit the reset button. This will prevent accidental recording of a memory or reseting the sidetone frequency. You can also turn the keyer off after hitting the INT / record button by accident. I recessed the INT / record button on my prototype to prevent hitting it by accident.

The memories on this keyer are hard to load - I realize this fact but there just isn't much room to address it in this size device. Most of the recording problems are due to my design but some are just due to the human element - we make mistakes! I just can't imagine how some folks load these memory keyers with thousands of characters using a plain old paddle

and not record tons of mistakes.

The automatic character and word spacing in the keyer recording routine is needed to decode the operator input and store it into the EEPROM. However, the auto spacing also results in messages which don't really reflect what the operator thought he sent. Also, no editing of the messages is available.

I've addressed the memory loading problem with a QBASIC program called MEMLOAD2.BAS and minimal hardware to allow the operator to load the memories from a PC using the LPT1 port. This allows the operator to type in, edit, play back and then record a memory. **This program is available on our web site: http://home.att.net/~jacksonharbor OR will be sent to you via email on request (send an email to: jacksonharbor@worldnet.att.net).** The schematic for the interface hardware is printed on the back of the keyer schematic / parts placement diagram along with a circuit for a simple 555 based beacon timer.

Here are some tips I use to load the memories in my keyer from the keyer paddle.

1) Choose your most comfortable speed for sending - this may be obvious, but there is no need to record at any specific speed. Both speeds which are too high or too low will cause frustrating mistakes during the recording process.

2) Write out your copy ahead of time and practice sending it. You probably won't need this to enter the old 3x3 CQ but when entering other messages, any pauses or indecision may result in unwanted word spaces or malformed characters. You may wish to count the number of characters and spaces in your message to make sure that it will fit into the memory. Remember that the keyer will record over the boundary between memories without warning -- this is either a bug or feature, depending on how you look at it.

3) Exagerate your word spaces. The keyer will only record 1 word space in a row, so you can afford to wait extra time in between words that you WANT to separate with a word space.

Once you get the memories the way you want them, the EEPROM should store them indefinitely even when power has been disconnected for a long period. In fact, it would be possible to have multiple EEPROMs recorded with specific messages which could be plugged into the socket for specific need.

Speed switch accuracy:

The speed indicated by the speed switch is approximate -- sometimes it’s very approximate. When the speed switch reports 21 WPM the actual speed can vary from 20.43 WPM (750 Hz sidetone) to 20.46 WPM (highest sidetone) and finally to 20.79 WPM (lowest sidetone). However, at 48 WPM, the actual speed will be closer to 45 WPM. Note that the keyer generates dits and dahs and spaces using integral numbers of sidetone periods. To these sidetone periods are added whatever overhead is required by the program (including time to

measure the pot position). This and the mathematical imprecision of integer arithmetic account for a lot of the inaccuracy.

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Island Keyer Stocklist

Qty	Ref.	Part Name	Source, part #	Description
2	Q1-2	2N2222 or 2N3904	Various	EBC TO92 NPN Transistor
1	U1	68HC705J1A	Jackson Harbor Press	programmed microcontroller
1	U2	93LC66	Digikey, 93LC66/P	256 x 16 serial EEPROM
1	U3	78L05	Various	+5V LINEAR REGULATOR
9	C3-10,14	CAP, .01 uf	Hosfelt, 15-861	.1" lead space multi-layer radial
1	C12	CAP, .1 uf	Hosfelt, 15-860	.1" lead space multi-layer radial
1	C11	CAP, 680 pf	Digikey,1323PH	.25" lead space 5% ceramic disc
1	C13	CAP, 22 uf	Digikey, P6224	.079" lead space radial electrolytic
1	CERE1	CERES	Digikey, PX200	2 MHz ceramic resonator w/caps
8	D1-8	DIODE	Jameco, 36038	Axial 1N914 / 1N4148, glass switching diode, band = cathode
2	D10,11	DIODE	Various	Schottky diode, band = cathode 1N5817,18, 19 or BAT42
1	R1-9	10k SIP	Jameco,24643	10 pin, 9 resistor 10 K SIP
4	R11-14	R1/4W,1 K	Jameco, 29663	Axial 1/4 watt carbon film resistor brown, black, red
1	R16	R1/4W,750	Circuit Specialists	Axial 1/4 watt carbon film RA750 resistor violet, green, brown

Note: C1, C2 and D9 have been eliminated from the circuit.

The following items are not included in the kit:

1	R10	VRES	Jameco, 29065	1 M linear pot.
1	S1	SPEAKER	various	8 ohm speaker
7	SW1-7	SW-MOM	various	SPST normally-open,momentary
1	R15	VRES	various	1 k pot