Building and Operating:

The Morse Dial Timer kit
from Jackson Harbor Press

Introduction:

A previous kit, the 10 Minute Timer, worked fine as a dedicated timer for 3 defined periods. But it wasn't easy to change the timer duration. This kit, the Morse Dial Timer, makes changing the duration between 1 and 99 minutes easy with two rotary switches. Regular "egg timers" require both a visual display and the need to press buttons multiple times to set a delay. At first other approaches were tried including a single dial using a pot (not exact enough), two pots (requires calibration), detented pots (most have 11 detents for some reason, I blame the movie: "This is Spinal Tap"). Two 10 position switches were found to be best.

The timing is fairly accurate using a 32.768 kHz watch crystal. The kit is low power and doesn't require a power switch although it will work fine with a switch since all settings are kept in non-volatile EEPROM memory and won't be lost if the power is removed.

An attempt was made to limit menu complexity. The code speed and command speed are set on the **SET** switch menu using the dials. Turning the keying on and off as well as the keying polarity are set on the **START** switch menu. The **BOTH** switch menu can enter a new message using the dials.

General notes on building the Morse Dial Timer:

The integrated circuits (U1-3) and the output transistor (Q1) are MOS 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 these parts.

The components should be inserted a few at a time, soldered in place and then clip the leads. The pads and traces are small and delicate - a small tipped, low power (25 watts or less) soldering iron should be used.

Building the Morse Dial Timer:

Step 0) *Please do NOT solder the three momentary switches until step 3u below. Soldering them too soon may result in problems fitting the board to the front panel.*

Step 1) All of the board mounted components and parts for the case have been supplied. But feel free to substitute or modify the kit to suit your needs. One thing I did was to use a 10 cell AA holder for the battery instead of the normal 9V battery. This resulted in a louder tone.

Step 2) Identify and orient the components: Most of the components should be fairly easy to identify and place - see the parts list and the parts placement diagram for descriptions. The diodes are the small glass axial components - the band indicates the cathode end of the diode.

Step 3) Place and solder the components on the main circuit board: Use the board photo doc for information on the placement and orientation of the parts. Clip the leads after soldering. Here is a suggested sequence for installing the parts:

a) R10 to R18 - brown, black, black, red, brown – 10 k ohm blue 1% resistors above right rotary switch

b) R23 – yellow-violet-red-gold – 4.7 k ohm 5% resistor, to the right of Q1

c) R19,20,24,25 – brown-black-orange-gold – 10 k ohm 5% resistors, top left area of board

d) R1 to R9 - brown, black, black, red, brown – 10 k ohm blue 1% resistors above left rotary switch

e) R21 – brown-black-green-gold 1 megohm 5% resistor located to left of U3 socket

f) R22 – brown-black-yellow-gold 100 k ohm 5% resistor located to right of U3 socket

g) D3 - glass diode - located between SW1 and SW2, banded end towards the bottom edge of the board

h) D2 - glass diode - located between SW2 and BOTH, banded end towards the bottom edge of the board

i) C6 - marked 104 - located above U1 socket

j) C5 - marked 104 - located below U2

k) C1 - marked 104 - located above U3 socket

l) 14 pin DIP sockets - each should be inserted with the notch towards the top edge of the board

m) C2 - marked 12 - located to the left of U1 socket

n) C3 - marked 12 - located below C2

o) X1 - cylinder crystal - located to the right of C2 and C3

p) C4 – 2.2 uF Tantalum polarized capacitor, marked 2u2, located below U2, plus sign + bumped out side towards LEFT edge of board

q) Q1 - marked 2n7000 - located at the top edge middle of the board, flat side towards the right edge of the board

r) U2 - marked S812 C30A - located at the top edge right of the board, flat side towards the bottom edge of the board

s) D1 – either a BAT42 or a 1N581x Schottky diode, located at the upper right of the board, install with the cathode (banded end) towards the bottom of the board

t) fit the two rotary switches to the board, don't solder them yet, it should be a fairly tight fit

u) next fit the three momentary switches to the board with the C (common) to the left, they may be loose, don't solder them yet

v) thread on a hex nut to each of the three 8121 momentary switches, thread it down until it's about the same height above the board as the top of the rotary switches (the idea is to have them all in the same plane for the front panel to rest on.

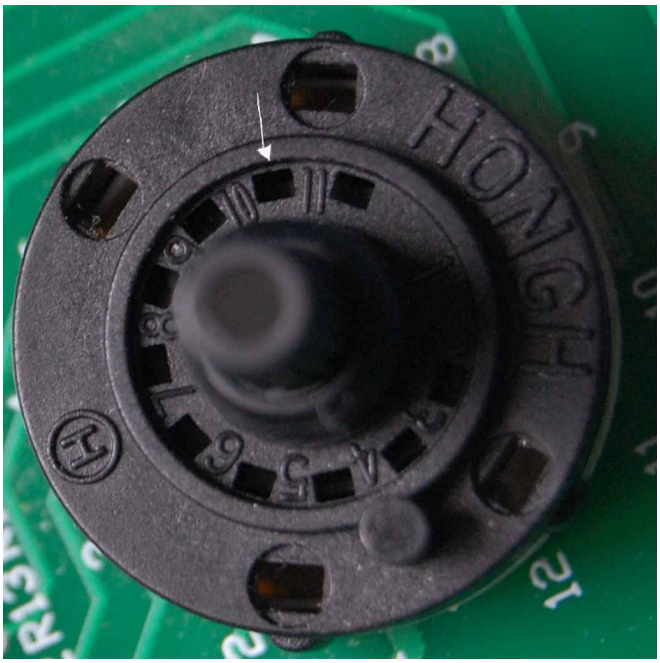
w) fit the front panel to the rotary and momentary switches and secure them snugly (they don't have to be crazy tight since they will be removed during further construction) with the hex nuts

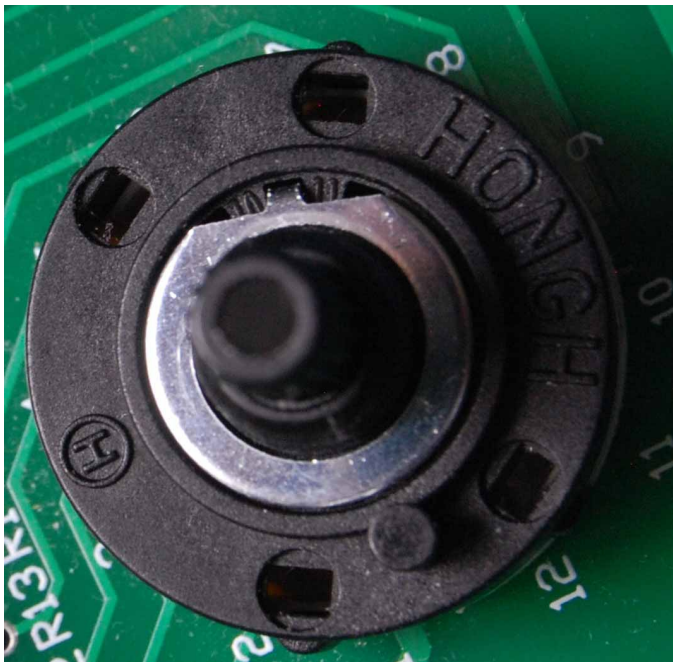
x) after making sure that the panel is roughly parallel with the board, solder the switches to the board, I did NOT trim the leads

y) remove the front panel. The piezo, 3.5mm jack and cable tie (for the 9V battery) can now be installed on the front panel per the enclosure diagram

Step 4) Check the board: 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 to see these problems. Also, double check the orientation of the critical components such as the MOSFET. After you are convinced that the board is OK, form the leads of IC U1 and U3 to fit in the sockets, insert the IC into the socket, being sure to follow the board photo doc for proper orientation (pin 1 indicated by a notch or dimple should be towards the top edge of the board). Also be sure to install the three jumpers for the x10, retrigger and tick options – I used pin sockets with solid wire to make the jumper connections. It would also be possible to solder square .1” spacing headers on the back of the board to allow using Arduino style jumpers to make the connections.

Step 5) the rotary switches have a tabbed washer each, the washer should be rotated until the tab goes in the 10 slot, this restricts the 12 position switch to 10 positions. If the numbers on the switch are mangled here are a couple of photographs that may help, the white arrow points to the correct slot, second from fully clockwise: The star washer can then be put on top of the tabbed washer.





Step 6) Re-install the board onto the front panel with the hex nuts. Solder connecting wires from the board to the piezo, output jack and battery holder (I use pin sockets with solid wire to make these connections easily removable). Powerup the Morse Dial Timer by plugging the 9V battery into the snap. The Morse Dial Timer should respond with an FB played through the piezo. If the FB is not heard, power should be removed immediately and all the connections should be re-checked. Soldering problems are the main source of most problems with kits.

Step 7) The black caps can now be installed on the momentary switches. The knobs can also be installed on the rotary switches, make sure that the pointer goes to the correct number. Finally the front panel can be attached to the enclosure using the 4 black 6-32 screws.

Operation:

First set the timer duration by setting the **TENS** and **ONES** switches to the desired delay. Start the timer by a Press And Release (PAR) of the **START** button. The seconds will start to tick (if the tick pin is pulled up high) through the piezo speaker. When the delay is complete, the recorded message will play. PAR **BOTH** during a count down to stop the timer, the ticking will cease and the letter S (for stop) will be sent via the sidetone. PAR **START** during the count down to send the elapsed time in minutes and seconds via the sidetone.

Random notes on operation:

PAR **SET** to send the currently set (via the rotary switches) time delay via the sidetone. But the operator does NOT have to PAR **SET** before starting a delay with **START**. The state of the rotary switches is read when **START** is PAR.

Note that if both rotary switches are set to 0 the message will immediately be sent via the sidetone with a PAR of **START**.

PAR **SET** during a delay to send the remaining whole minutes via the sidetone.

Note that all switch presses will be ignored during the last minute of a delay. This was done to prevent timing problems at the end of a delay.

A 10 will be sent as the timer reaches 10 minutes left in the delay. Similarly a 5 will be sent at 5 minutes left in the delay.

The on the second tick will be skipped on both the 29th and 59th seconds of a minute. A double click will be heard at the start of the next minute.

Jumpers:
Instead of having menu items, three parameters are changed using hardware jumpers, I make the connections either to ground or to the p/u (pullup) terminals.

X10 multiplies the time period set by 10 (10 to 990 minutes), if **SET** is PAR an X will be sent after the delay to remind the user of the jumper setting. Ground X10 to turn it off, pullup X10 (high) to turn it on.

Retrigger allows the delay to be automatically retriggered at the end of a timing. Ground Retrigger to turn it off, pullup Retrigger to turn it on. The term ***retrigger*** refers to repeating the message as a beacon would.

Tick allows the tick/tock through the piezo to be turned on or off. Ground Tick to turn it on, pullup Tick to turn it off (yes, this seems backwards but the defaults I usually use are grounded).

The user can also make the connections using panel mounted switches, for example a toggle switch could be mounted in the front panel hole for the output jack to control X10.

Menus:

The various timer parameters can all be changed using one of the three menus (one menu per button). Enter the menu with a Press And Hold (PAH) of the desired button. After about 2 seconds the timer will respond with the first menu item.

SET menu

SET button Menu item	PAR **SET** button	PAR **START** button	Default
SP – Morse code SPeed	Advances to CS menu item	Sets code speed to left dial setting	20
CS – Command Speed	Exits the menu	Sets command speed to left dial setting	18
DONE			

SP - if the **SET** button is PAH, after 2 seconds the Morse Dial Timer will send SP and then it will send the current setting for the Morse code speed of the timer. This number sent is the speed in words per minute. PAR **START** to change the SP to the left dial setting. The user can select any speed from 10 to 35 wpm in an 8 step sequence (10, 12, 15, 18, 20, 25, 30 and 35 wpm):

speed	**TENS** dial setting
10	0
12	1
15	2
18	3
20	4
25	5
30	6
35	7

Skip to the next menu item with a PAR of the **SET** button. Exit the menu with a PAH of the **SET** button (DONE will be sent after 2 seconds).

CS? - PAR **SET** button after SP to advance to the CS menu item. The Morse Dial Timer will send CS and then it will send the current setting for the Morse command code speed of the timer. This number sent is the speed in words per minute. PAR **START** to change the CS to the left dial setting. As with the SP menu item, the user can select any command speed from 10 to 35 wpm in an 8 step sequence (10, 12, 15, 18, 20, 25, 30 and 35 wpm) using the **TENS** dial setting. PAR **SET** to exit the menu. The Command Speed affects only the non-message Morse sent by the timer. The message speed is controlled by the SP menu item.

START menu

START Menu item	PAR **START**	PAR **BOTH**	Default
KEY output keying on/off	turns on output keying	turns off output keying	ON
POL output polarity	output ON (low) during delay	output OFF (high) during delay	OFF
DONE			

KEY? - if the **START** button is PAH for 2 seconds the Morse Dial Timer will send KEY? and then it will send the current setting (on or off) of the Output keying mode. When KEY is on, the timer will key the output in time to the message being sent through the sidetone. When KEY is off, the timer will just go key down (or up, depending on the state of POL?) during the message send. This can be useful for actuating a PTT type of arrangement when feeding audio tones into a transmitter. PAR **START** to toggle the keying from ON to OFF or from OFF to ON. PAR **SET** to advance to the next menu item.

POL – PAR **SET** to advance to the next menu item, POL. The Morse Dial Timer will send POL and then it will send the current setting (ON or OFF) of the timer output polarity. When POL is on, the timer will turn on the output during the delay. When POL is off, the timer will turn off the output during the delay. PAR **START** to toggle the polarity from ON to OFF or from OFF to ON. PAR **SET** to exit the menu.

BOTH menu

BOTH button Menu item	PAR **SET** button	PAR **START** button	PAR **BOTH** button
MSG set the message	moves up through the message	Reads the dial setting	Moves back through the message
DONE			

MSG – after the **BOTH** button has been pressed for 2 seconds the Morse Dial Timer will send MSG and then it will wait for one of the buttons to be pressed:

PAR **SET** to exit the menu without changing the message.
PAR **START** to enter the message set routine. The first character of the message will be sent.

Then PAR **START** to select the character as set by the dial setting. Note that the dials shouldn't be set higher than 42 or an ERR message will be sent. Use this table to select the correct character (it may help to write out the message and then write down the dial settings for each character, space and punctuation mark):

dials	character	
00	0	
01	1	
02	2	
03	3	
04	4	
05	5	
06	6	
07	7	
08	8	
09	9	
10	.	period
11	,	comma
12	END	special character for the end of memory, the characters END are run together: di-da-di-da-di-dit
13	BT	double slash aka da-di-di-di-dah, the characters BT are run together
14	/	slash (or portable) symbol: dah-di-di-da-dit
15	?	question mark: di-di-da-da-di-dit
16	SP	special character for a space in memory, the characters SP are run together: di-di-di-di-da-da-dit
17	A	
18	B	
19	C	
20	D	
21	E	
22	F	
23	G	
24	H	
25	I	
26	J	
27	K	
28	L	
29	M	
30	N	
31	O	
32	P	
33	Q	
34	R	
35	S	
36	T	
37	U	
38	V	
39	W	
40	X	
41	Y	
42	Z	

PAR **BOTH** to backup one character in the message.

The sidetone will increase slightly in frequency during this menu item.

PAR **SET** to skip to the next character.

PAH **SET** to exit the menu (DONE will be sent after 2 seconds). The message can be up to 60 characters long.

Notes:

The Morse Dial Timer can be reset to the defaults using this procedure:
1) turn off the power (take out the battery)
2) PAH **SET**
3) turn on the power with **SET** still held (re-attach the battery)
4) release **SET** when FB is sent via the sidetone

Please feel free to email with any questions, comments, suggestion or problems with this kit. My email address is:

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Thanks for choosing the Morse Dial Timer kit
and
Best Regards,

Chuck Olson, WB9KZY

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List of parts included with the Morse Dial Timer kit

Ref	marking	Description
C1	.1M or 104	.1 uf multilayer ceramic capacitor
C2	12J	12 pF disc ceramic capacitor
C3	12J	12 pF disc ceramic capacitor
C4	225 or 2u2	2.2 uf tantalum capacitor
C5	.1M or 104	.1 uf multilayer ceramic capacitor
C6	.1M or 104	.1 uf multilayer ceramic capacitor
D1	BAT42 or 1n581x	BAT42 Schottky diode or 1N581x diode
D2	1n4148	1n4148 switching diode
D3	1n4148	1n4148 switching diode
R1-R18	brown black black red brown	10 k ohms 1% blue resistor
R19	brown-black-orange-gold	10 k ohms 5%
R20	brown-black-orange-gold	10 k ohms 5%
R21	brown-black-green-gold	1 megohm resistor 5%
R22	brown-black-yellow-gold	100 k ohm resistor 5%
R23	yellow-violet-red-gold	4.7 k ohms 5%
R24	brown-black-orange-gold	10 k ohms 5%
R25	brown-black-orange-gold	10 k ohms 5%
Q1	2n7000	2n7000 n channel MOSFET transistor
U1	PIC16F676	14 pin DIP,programmed PIC microcontroller
U2	S812 C30A	3 volt LDO voltage regulator, TO-92
U3	CD4007	14 pin DIP CMOS inverter / transistor array
X1	unmarked cylinder	32 kHz watch crystal
		14 pin machined pin sockets (for U1 and U3)
		circuit board
		3 x 8121 momentary switches with hardware / caps
		2 x rotary switches with splined knobs
		aluminum, silk screened front panel
		6-32 hardware for piezo, 9V snap and front panel
		cable ties for use as 9V battery holders
		9V battery snap connector
		black phenolic case
		piezo speaker
		3.5mm output jack

Builder needs to provide solder and wire to complete the Morse Dial Timer kit.