Building and Operating: Morse Clock/timer kit
                                             from Jackson Harbor Press

Introduction:

The Morse Clock / Timer kit provides a fun way to know the time while also providing a large number of timers which can be used to switch external loads and notify the operator of the end of a delay.

General notes on building the Morse Clock / Timer kit

The integrated circuits (U1and U2) are 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 these parts.

One decision the builder should make before starting construction of the Morse Clock / Timer kit is how the project will be mounted in the enclosure and what kind of connector is required to connect the relay output to the load.. The circuit board can be mounted to the case with 4-40 (1/8 inch) sized hardware.

The Morse Clock / Timer is built on a "universal" board for the 12F6xx PIC microcontrollers. There are several components that are not used in this circuit for which there are positions on the universal board.

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 Clock / Timer kit

Step 1) Get the parts together: All of the board mounted components have been supplied but you will still have to provide off-board items to fully implement the kit. These items include:

mounting hardware, 4-40 sized
two momentary contact switches
piezo transducer, external drive type
9V or other battery connector
relay output connector

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.

step 3) Place and solder the components on the main circuit board: Use the parts placement diagram 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) DIP socket - should be inserted with the notch towards the top of the board
b) C4 - marked 104 - located on the top-left edge of the board
c) U2 - marked S812C50A - located on the top edge of the board, the flat side towards the top edge of the board
d) C5 - marked 2u2 16 - located on the top-center edge of the board with the positive (bumped out) side to the left
e) C1 - marked 104 - located on the left edge of the board near the top
f) C2 - marked 15 - located on the left edge of the board below C1
g) C3 - marked 15 - located on the left edge of the board below C2
g) X1 - cylinder crystal - located to the right of C3
h) R1 - brown, black, orange, gold - located just to the left of the 8 pin socket
I) Latching relay - 10 pin DIP- located to the right of U1, with the white stripe oriented to the left.
  Note that the two pins located closest to the right side of the board don't need to be soldered as they
  aren't connected internally. Also, for the same reason, an 8 pin socket can be used for the relay if desired.

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 C5 and U2. After you are convinced that the board is OK, form the leads of IC U1 to fit in the socket, insert the IC the socket, being sure to follow the parts placement diagram for proper orientation (pin 1 indicated by a notch or dimple should be towards the contact area of the board.

Step 5) Solder connecting wires from the board to the piezo, switches and power/ground. Powerup the Morse Clock / Timer , it should respond with an HOUR? played through the piezo. If the HOUR? 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.

Operation:

The Morse Clock / Timer kit will power up by sending: HOUR?. The operator can then set the current hour by a PAR (Press And Release) of the UP switch. The first PAR of UP will send the current HOUR setting (0), subsequent PARs will advance the hour setting by 1. The Morse Clock / Timer reports in 24 hour mode only, no AM / PM setting is possible. The HOUR setting will wraparound to 0 hours when advancing past 23 hours. If the UP switch is PAH (Pressed And Held), the operator will hear a rapid series of clicks, as the HOUR setting is quickly incremented. When the UP switch is released, the current HOUR setting will be sent in full. Exit the HOUR setting with a PAR of the SWITCH.

The Morse Clock / Timer kit will then send MIN?. The operator can then set the MINUTE (to the next minute)with a PAR (Press And Release) of the UP switch. The first PAR of UP will send the current MINUTE setting (0), subsequent PARs will advance the MINUTE setting by 1. The MINUTE setting will wraparound to 0 minutes when advancing past 59 minutes. If the UP switch is PAH (Pressed And Held), the operator will hear a rapid series of clicks, as the MINUTE setting is quickly incremented. When the UP switch is released, the current MINUTE setting will be sent in full. Exit the MINUTE setting with a PAR of the SWITCH at the start of the minute as determined by listening to WWV, CHU or by using another clock accurate to the second.

The Morse Clock / Timer kit will then start clicking the piezo at every second. A PAR of the SWITCH will send the current time as HOUR then MINUTE (no seconds). The Morse Clock / Timer kit will skip clicking on the 29th and 59th seconds. Zero seconds is distinguished with a double click. The clicking can be turned on and off with the TT? menu item.

The Morse Clock / Timer kit has a sleep timer built in. PAH the UP switch, after 1/2 second, the relay will be turned on and the current sleep timer delay will be sent. If the UP switch is released during the send, the relay will stay on for the duration just sent. If the UP switch is held after the send, the sleep duration will be increased through the sequence: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 40, 50, 60 minutes. The sleep timer will be set to the delay time last sent. To turn the relay off before the end of the sleep timer delay, just PAR the UP switch. Any subsequent PAH of the UP switch will turn on the sleep timer for the delay previously selected

The Morse Clock / Timer kit also has a delay timer built in. This is accessed in the same way as the sleep timer, except that at the end of the delay, the relay will be turned on and dits will start being sent. When the operator does a PAR of the UP switch, the relay will be turned off and the dits will stop. The delay timer must be turned on (taking the place of the sleep timer) with the TON? TOFF? menu item at the end of the SWITCH menu.

The Morse Clock / Timer kit has a stop watch, too. PAR both the UP and SWITCH to start the stop watch. PAR both the UP and SWITCH again to stop the timing and readout the timed period in hours/minutes/seconds. The easiest way to simulpress both the UP and SWITCH at the same time is to use the diode circuit mentioned in MOD number 1 at the end of this manual. Note that this stop watch isn't super precise, the ticks of the clock are counted but it should be good enough for many routine timing tasks.

The Morse Clock / Timer kit has up to 17 alarm registers (0 to 16). Alarm register 0 is used to set the time. Registers 1 to 16 are associated with 16 different pairs of timers. The first timer of the pair is used to set the start time of the timed interval. The second timer is used to set the stop time of the interval, either an actual time OR a duration. Each alarm can be a normal, once a day event (10:55) OR a relative, every hour of the day event (such as 55 minutes past the hour). Each of the 16 alarms can be turned ON and OFF.

The SWITCH menu:

SWITCH menu item	PAR UP
TT? - Tick Tock toggle on and off	toggles the on the second tick on or off, exits menu
SF? - Set Fast (use when clock is fast)	resets the seconds to zero, exits menu

SS? - Set Slow (use when clock slow)	sets seconds to zero, advances minutes by 1, exits menu
SP? - SPeed set	sends current speed, more UP PARs advance speed thru: 12, 15, 18, 20, 25, 30 wpm
TON? / TOFF? - turn delay timer on/off	toggles the delay timer ON or OFF

Enter the SWITCH menu with a PAH of the SWITCH, after two seconds the first menu item will be entered:

TT? will be played through the piezo, release the SWITCH when it starts to play. To proceed to the next menu item, PAR the SWITCH. PAR the UP switch to turn the "on the second" tick on and off. If the tick is on, it will be turned off. If the tick is off, it will be turned on. The menu item will then be exited.

SF? will be played through the piezo if a SWITCH PAR is done in TT?. Proceed to the next menu item with another SWITCH PAR. A PAR of UP in the SF? menu item (Set Fast) will reset the current second count to zero and then exit the menu. This is useful in case the clock has gained time (less than 1 minute). The UP switch should be pressed when WWV, CHU or a accurate clock has turned over from 59 to 0 seconds.

SS? will be played through the piezo if a SWITCH PAR is done in SP?. Proceed to the next menu item with another SWITCH PAR. A PAR of UP in the SS? menu item (Set Slow) will reset the current second count to zero, advance the minute count by 1 and then exit the menu. This is useful in case the clock has lost time (less than 1 minute). The UP switch should be pressed when WWV, CHU or a accurate clock has turned over from 59 to 0 seconds.

SP? will be played through the piezo if a SWITCH PAR is done in SS?. Proceed to the next menu item with another SWITCH PAR. An UP PAR in the SP? menu item (SPeed set) will allow the operator to determine the current Morse code speed setting and then increase (or decrease) the speed if required. There are 6 speeds to choose from: 12, 15, 18, 20, 25 and 30 WPM. The first PAR of UP will send the current speed through the piezo. Additional PARs of UP will increase the speed by one step. The speed will wraparound at 30 WPM down to 12 WPM. Exit the menu with a SWITCH PAR, the current time will be played through the piezo.

Either TON? or TOFF? will be played through the piezo if a SWITCH PAR is done in SP?. Exit the menu item with another SWITCH PAR. A PAR of UP in the TON? / TOFF? menu item (Tone ON or Tone OFF) will allow the operator to turn the delay timer on or off. If TON? is sent, the delay timer is currently on which means that during normal operation (not this menu) when the UP switch is PAR for 1/2 second and then released the current delay timer setting (in minutes) is sent, the delay is started. At the end of the delay, the relay will be turned on and a series of dits will be sent until the UP is PAR. This will turn off the dits and the relay. If TOFF? is sent, the timer is in sleep timer mode. When the sleep timer is actuated with the PAR of UP, the relay will turn on. After the delay period is over, the relay will turn off - no dits will be sent. Note that the TON/TOFF selection also applies to the 16 stored alarms, they will all either have dits sent at the end of the timing depending on this menu item setting.

The both UP and SWITCH menu with alarm set to 0: (enter by pressing both UP and SWITCH, PAR SWITCH to advance to next menu item)

both UP and SWITCH menu item	PAR UP
ALRM? - select the Alarm: 0	sends current alarm set, more UP PARs advance alarm to next setting, 0 is time set
HOUR? - time (hour) setting	sends current hour setting, more UP PARs increase hour by 1
MIN? - time (minute) setting	sends current minute setting, more UP PARs increase minute by 1

Enter the both UP and SWITCH menu with a PAH of the UP and SWITCH (note: I usually press the SWITCH first then tap the UP), after two seconds the first menu item will be entered:

ALRM? will be played through the piezo, release the UP and SWITCH when it starts to play. To proceed to the next menu item, PAR the SWITCH. PAR the UP switch to hear the current alarm setting (0 to 16). 0 refers to the clock, if left at 0, the next menu items (HOUR? and MIN?) will set the time. 1 to 16 are each alarms with various parameters (alarm ON or OFF, on time, off time (or duration) etc). PAR UP to increase the current alarm setting by one. When 16 is reached, the next UP PAR

will wraparound the alarm to 0. If UP is PAH, the operator will hear a rapid series of clicks, as the alarm setting is quickly incremented. When the UP switch is released, the current alarm setting will be sent in full.

HOUR? will be played through the piezo if a SWITCH PAR is done during ALRM?. The operator can then set the current hour by a PAR (Press And Release) of the UP switch. The first PAR of UP will send the current HOUR setting (0), subsequent PARs will advance the hour setting by 1. The Morse Clock / Timer reports in 24 hour mode only, no AM / PM setting is possible. The HOUR setting will wraparound to 0 hours when advancing past 23 hours. If the UP switch is PAH (Pressed And Held), the operator will hear a rapid series of clicks, as the HOUR setting is quickly incremented. When the UP switch is released, the current HOUR setting will be sent in full. Exit the HOUR setting with a PAR of the SWITCH.

 MIN? will be played through the piezo if a SWITCH PAR is done during HOUR?. The operator can then set the MINUTE (the next minute) with a PAR (Press And Release) of the UP switch. The first PAR of UP will send the current MINUTE setting (0), subsequent PARs will advance the MINUTE setting by 1. The MINUTE setting will wraparound to 0 minutes when advancing past 59 minutes. If the UP switch is PAH (Pressed And Held), the operator will hear a rapid series of clicks, as the MINUTE setting is quickly incremented. When the UP switch is released, the current MINUTE setting will be sent in full. Exit the MINUTE setting with a PAR of the SWITCH at the start of the minute as determined by listening to WWV, CHU or by using another clock accurate to the second. The menu will be exited and the current time will then be sent.

The both UP and SWITCH menu with alarm set to 1 to 16: (enter by pressing both UP and SWITCH, PAR SWITCH to advance to next menu item)

both UP and SWITCH menu item	PAR UP
ALRM? - select the Alarm: 1-16	sends current alarm set, more UP PARs advance alarm to next setting, 0 is time set
ON? OFF? - alarm on/off setting	toggles the alarm ON? or OFF?
HOUR? - hour setting	sends current hour ON setting, more UP PARs increase hour by 1
EVHR? NOR? - alarm normal / hourly	toggles the alarm between EVHR (every hour) and NOR (normal, single alarm time)
MIN? - minute setting	sends current minute ON setting, more UP PARs increase minute by 1
DUR? NOR? - alarm duration /normal	toggles the alarm between DUR (duration) and NOR (normal, off time)
HOUR? - alarm hour off/duration set	sends current hour OFF or duration setting, more UP PARs increase hour by 1
MIN? - alarm minute off/duration set	sends current minute OFF or duration setting, more UP PARs increase minute by 1

Enter the both UP and SWITCH menu with a PAH of the UP and SWITCH (note: I usually press the SWITCH first then tap the UP), after two seconds the first menu item will be entered:

ALRM? will be played through the piezo, release the UP and SWITCH when it starts to play. To proceed to the next menu item, PAR the SWITCH. PAR the UP switch to hear the current alarm setting (0 to 16). 0 refers to the clock, if left at 0, the next menu items (HOUR? and MIN?) will set the time. 1 to 16 are each alarms with various parameters (alarm ON or OFF, on time, off time (or duration) etc). PAR UP to increase the current alarm setting by one. When 16 is reached, the next UP PAR will wraparound the alarm to 0. If UP is PAH, the operator will hear a rapid series of clicks, as the alarm setting is quickly incremented. When the UP switch is released, the current alarm setting will be sent in full.

Either ON? or OFF? will be played through the piezo if a SWITCH PAR is done in ALRM? (with alarm from 1 to 16). Proceed to the next menu item with another SWITCH PAR. A PAR of UP in the ON? / OFF? menu item (alarm ON or OFF) will allow the operator to turn the current alarm on or off. If ON? is sent, the alarm currently specified by the previous ALRM? menu item is turned on. If OFF? is sent, the alarm is turned off which means that all the other settings (hour, min etc. are ignored).

HOUR? will be played through the piezo if a SWITCH PAR is done during ON? / OFF?. The operator can then set the current alarm hour on time by a PAR (Press And Release) of the UP switch. The first PAR of UP will send the current HOUR setting (0), subsequent PARs will advance the hour setting by 1. The Morse Clock / Timer reports in 24 hour mode only, no AM / PM setting is possible. The HOUR setting will wraparound to 0 hours when advancing past 23 hours. If the UP switch is PAH (Pressed And Held), the operator will hear a rapid series of clicks, as the HOUR setting is quickly incremented. When the UP switch is released, the current HOUR setting will be sent in full. Procced to the next menu item with a PAR of the SWITCH.

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Either EVHR? or NOR? will be played through the piezo if a SWITCH PAR is done in HOUR? (with alarm from 1 to 16). Proceed to the next menu item with another SWITCH PAR. A PAR of UP in the EVHR? / NOR? menu item (alarm EVery HourR or NORmal alarm) will allow the operator to turn the current alarm into either one that operates every hour of the day or a normal one time alarm. If EVHR? is sent, the alarm currently specified by the previous ALRM? menu item is active every one of the 24 hours. If NOR? is sent, the alarm is normal which means that the alarm is only active at one time during the 24 hours.

I use this EVHR? setting for what I call the 25/55 timer. A radio station that I listen to broadcasts the stock market report at 25 and 55 minutes past the hour, usually for 2 minutes. I have two EVHR? alarms, one set for 0 hours, 25 minutes, duration 2 minutes and the other for 0 hours, 55 minutes, 2 minute duration. I hook the relay in series between the radio audio output and the speaker (the other pole could be used for a load resistor). Then at all the hours I am listening to the radio, the timer will turn the speaker on at 25 and 55 minutes past the hour, I don't have to listen to a lot of other info that I'm not interested in. If the report is late, I can extend the time on by using the sleep timer set to 1 minute. If the report is short, I can turn off the radio with a PAR of the UP switch. Another way to do this would be to program two duration alarms for each hour of the day which would eliminate the relay going on and off all around the clock (since the radio is off, it doesn't matter to me if the relay is clicked on and off around the clock although it does waste the battery a little. There is also a special one time report at 5 after 12 noon for 2 minutes that I program in a third alarm as a NORmal alarm rather than EVHR?.

 MIN? will be played through the piezo if a SWITCH PAR is done during EVHR? / NOR?. The operator can then set the alarm minute on time with a PAR (Press And Release) of the UP switch. The first PAR of UP will send the current MINUTE setting (0), subsequent PARs will advance the MINUTE setting by 1. The MINUTE setting will wraparound to 0 minutes when advancing past 59 minutes. If the UP switch is PAH (Pressed And Held), the operator will hear a rapid series of clicks, as the MINUTE setting is quickly incremented. When the UP switch is released, the current MINUTE setting will be sent in full. Exit to the next menu item with a PAR of the SWITCH.

Either DUR? or NOR? will be played through the piezo if a SWITCH PAR is done in MIN? (with alarm from 1 to 16). Proceed to the next menu item with another SWITCH PAR. A PAR of UP in the DUR? / NOR? menu item (DURation alarm or NORmal alarm) will allow the operator to turn the current alarm into either one that has a start time and a duration time OR a normal alarm with a start time and and off time. If DUR? is sent, the alarm currently specified by the previous ALRM? menu item is is a duration alarm, so the next HOUR? and MIN? menu items will set that duration length - the alarm will turn on the relay at the start time and keep it on for the duration length. If NOR? is sent, the alarm is normal which means that the next HOUR? and MIN? menu items specify an off time for the alarm.

HOUR? will be played through the piezo if a SWITCH PAR is done during DUR? / NOR?. The operator can then set the current alarm hour off time (or the duration hour length) by a PAR (Press And Release) of the UP switch. The first PAR of UP will send the current HOUR setting (0), subsequent PARs will advance the hour setting by 1. The Morse Clock / Timer reports in 24 hour mode only, no AM / PM setting is possible. The HOUR setting will wraparound to 0 hours when advancing past 23 hours. If the UP switch is PAH (Pressed And Held), the operator will hear a rapid series of clicks, as the HOUR setting is quickly incremented. When the UP switch is released, the current HOUR setting will be sent in full. Procced to the next menu item with a PAR of the SWITCH.

 MIN? will be played through the piezo if a SWITCH PAR is done during HOUR?. The operator can then set the alarm minute off time (or the duration minute length) with a PAR (Press And Release) of the UP switch. The first PAR of UP will send the current MINUTE setting (0), subsequent PARs will advance the MINUTE setting by 1. The MINUTE setting will wraparound to 0 minutes when advancing past 59 minutes. If the UP switch is PAH (Pressed And Held), the operator will hear a rapid series of clicks, as the MINUTE setting is quickly incremented. When the UP switch is released, the current MINUTE setting will be sent in full. PAR the SWITCH to exit the menu, four dits will be sent as the new data is written to eeprom memory.

Mods:

1) use 2 diodes and another momentary switch to allow an easy simulpress of the UP and SWITCH buttons. See the schematic and parts placement diagram of the 10 minute timer kit (the DOWN switch is wired this way) for more details.

Notes:

The Morse Clock / Timer can be reset to the default alarm settings if power is removed, then PAH the SWITCH, then restore power and release the SWITCH when HOUR? is played.

The Morse Clock / Timer relay is rated at 1A at 30 Volts DC and 0.5 A at 125 Volts AC. Note that while the contacts are in-effect doubled since both poles of the relay are connected in parallel, be sure to keep the load size small. Also, be sure to use a series fuse of appropriate size to prevent damage to the relay in extreme load conditions.

Please feel free to email with any questions, comments, suggestion or problems with this kit. My email address is:
     wb9kzy@wb9kzy.com

Thanks for choosing the Morse Clock / Timer kit and Best Regards,

Chuck Olson, WB9KZY

List of parts included with the Morse Clock / Timer kit

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Ref    marking                      Description
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C1     104                          .1 uf yellow multilayer ceramic capacitor
C2     15J                          15 pF disc ceramic capacitor
C3     15J                          15 pF disc ceramic capacitor
C4     104                          .1 uf yellow multilayer ceramic capacitor
C5     2u2 16                       2.2 uf yellow Tantalum capacitor
R1     brown black orange-gold      10 k ohms 1/4 watt resistor
U1     PIC12F629                    8 pin DIP,programmed PIC microcontroller
U2     S812C50A                     TO-92 5 volt regulator IC
X1     unmarked metal cylinder      32 kHz crystal
                                    8 pin machined pin socket (for  U1)
                                    circuit board
                                    5V, single coil latching relay

Items you'll need to provide to complete the Morse Clock / Timer kit
     4-40 sized (1/8 inch) mounting hardware
     two momentary contact normally open SPST switches
     piezo speaker, external drive type
     9V battery or other battery connector
     connector to relay output load
     solder, wire

Optional items for the 'both' mod:
     2 1n4148 diodes
     third momentary switch
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