TIC Cuckoo Clock User Guide

The TIC software is a cuckoo clock that runs on the TAPR/AMSAT DSP-93 hardware platform that sets the time using off the air signals from WWV shortwave broadcasts.

Features:

- AGC function on input samples.
- 1000Hz and 100Hz FIR Bandpass filters used to recover WWV time signals.
- Bit by bit data integration method extracts time information from WWV signal
- ASCII time string output in 12 or 24 hour format from DSP-93 UART.
- Hourly gongs or cuckoo's and bells at 15, 30, and 45 minutes past hour.
- Sound effects produced using FM synthesis methods.
- Automatic Daylight savings time adjustment except for GMT output.
- Assembly options for various time zones, sound options, radio port, etc.
- Automatic internal clock compensation for stand alone timekeeping.
- DOS clock viewer program included for displaying UART time string.

DSP-93 TIC Cuckoo clock Front Panel LED Usage:

During time acquisition period:

LED1 is Seconds timing.
LED2 is Second position locked.
LED3 is Minute position locked.
LED4 is Minutes units digit locked.
LED5 is Minutes 10's digit locked.
LED6 is Input is in AGC range.
LED7 is Input level too high
LED8 is Power

After time acquisition, the LED's form a pendulum swing with LED4 indicating that the internal clock has been compensated and maximum accuracy is achieved.

Radio Port Setup

The TIC clock can use either radio port depending on how the code is assembled. Please follow the instructions carefully for attaching radios with transmit capability to the DSP-93 using the procedures called out in the DSP-93 Operations Manual. ***Pay particular attention to the pin strapping of the TNC connector for selecting the proper PTT polarity***. Failure to do so could turn on your transmitter unexpectedly. It might be a good idea to disable your transmitter PTT or use a dummy load until you have checked out all the connections and signals from the DSP-93.

Customizing TIC Software

The TIC software can be customized by assembling with various command line controls and/or by modifying the source code default settings.

The following source files are needed to assemble this code-
"ticmain.asm"
"ticinput.asm"
"ticsound.asm"
"tictime.asm"
"ticuart.asm"
"ticdata.tbl"

The following include files from TAPR are needed to assemble this code-
"REGS.INC"
"PORTS.INC"
"MONITOR.INC"
"SERIAL.INC"

Several things can be customized by assembly commands:

- Radio port. Either port 1(default) or port 2 can be specified with the following assembly invocation:
  tasm -3225 -g0 -dRx ticmain.asm
  where Rx is the radio port (R1=port1 R2=port2)

- Input gain. Seven different gains can be selected. The default gain is G2. These can be specified with the following assembly invocation:
  tasm -3225 -g0 -dGx ticmain.asm
  where Gx is the input gain (G1=1, G2=2, G4=4, G8=8, G16=16, G32=32, G64=64)

- Local time zone. Five different time zones are defined:. The default zone is EST. These can be specified with the following assembly invocation:
  tasm -3225 -g0 -dXXX ticmain.asm
  where XXX is GMT,EST, CST, MST, PST

- 12 or 24 hour format. The default is 12 hour. This can be specified with the following assembly invocation:
  tasm -3225 -g0 -dHxx ticmain.asm
  where xx is 12 or 24

- Hour sound. Either Cuckoo's(default) or tubular bell gongs can be specified with the following assembly invocation:
  tasm -3225 -g0 -dXXXX ticmain.asm
  where XXXX is either GONG or CUCKOO

Example of using radio port 2 with a gain of 8, CST, 12 hour mode, and GONG sounds:

tasm -3225 -g0 -dR2 -dG8 -dCST -dH12 -dGONG ticmain.asm

Example of using radio port 1 with gain of 16, PST, 24 hour mode, and CUCKOO sounds:

tasm -3225 -g0 -dR1 -dG16 -dPST -dH24 -dCUCKOO main.asm

Example of using radio port 1 with gain of 2, EST, 12 Hour mode, and CUCKOO sounds:

tasm -3225 -g0 ticmain.asm (note all defaults are used)

In order to change the time output serial port baud rate one must modify one line of code in the TICMAIN.ASM file.

BAUDRATE .equ BAUD9600

Possible values are BAUD2400, BAUD4800, BAUD9600, BAUD19200, BAUD38400, and BAUD76800.

Loading TIC Software

After the TIC clock software is configured by assembling it to your requirements, the TIC software must be loaded into the DSP-93 using the normal dspload.exe program from DOS or the D93WE program from within Windows. Refer to the DSP-93 Operations Manual for a thorough description of file loading and configuration.

First reset the DSP-93 box so that LED1 and LED8 are on. This places the unit in the monitor mode and allows program loading.

If in DOS make sure the proper com port is selected in the DSPLOAD.CFG file then Type→ DSPLOAD TICMAIN

If using D93WE in Windows, select the TICMAIN.OBJ file for downloading.

LED1 should briefly flicker and then the file download begins. The download process will take 10 seconds or more. When the downloading is complete, LED1 will blink at a 1 second rate. LED6 or LED7 may be active depending on what signals are present. The hourly gongs should also sound a one hour mark. This is useful for adjusting the speaker output level. Afterwards, a “tic-tock” sound should occur at every second interval.

Setting Receiver Audio Level

With the DSP-93 connected radio tuned to WWV on 2.5, 5.0, 10.0, 15.0, or 20.0MHz, adjust either the volume control if you are using the speaker output, and/or R215/R216(port1/port2) inside the DSP-93 until LED6 is on and LED7 is off. If the incoming signal is very strong or there is very little noise, LED6 may not turn on. Wait until WWV is broadcasting a steady tone and then adjust the pot until LED6 is on. If the input signal seems too strong or weak for the normal range of the pots, there is a way to increase or decrease the overall gain of the DSP-93 by re-assembling using different gain values.

The pot setting is not critical. Just keep LED7 from flickering(signal too strong) and try to keep LED6 on(AGC is active) when there is fairly continuous noise or signal present.

Monitoring Time Acquisition

The TIC software initially starts up trying to acquire the time signal. The progression of this task can be monitored by observing the LED's.

LED1 should always be blinking at a one second rate.

LED2 should begin blinking within a few seconds of receiving the WWV signal indicating that the seconds position is phase locked.

LED3 begins to blink when the minutes position is determined. This may take several minutes depending on signal quality. Once LED3 is blinking, time data capture begins.

LED4 starts to blink when the minute unit digit is acquired.

LED5 blinks when the minutes 10's digit is determined.

Finally when the hours digits are determined, the LED's begin flashing back and forth in pendulum fashion. This indicates that time information is now correct. If the WWV signal is received adequately for 30 minutes or more, LED4 will flash in the pendulum swing. This indicates that the internal clock has been compensated and you can remove the WWV signal and the clock should keep fairly accurate time on it's own. Your mileage may vary as signal quality, temperature variations, etc. can all affect the internal DSP-93 compensated oscillator stability.

Hourly cuckoo's or gongs should now occur as well as 1, 2, or 3 bell sounds at the 15, 30, and 45 minute past the hour marks.

The time required to lock onto the time varies with the signal quality and may take as little as 10 minutes to an hour or so. Try using the higher WWV frequencies during the day and lower ones at night. If noise or interference is real bad, one can try SSB using either LSB or USB. The narrower filters may allow the signal to get through. Tuning is critical if using SSB modes. One way to adjust the receiver frequency is to wait until WWV is sending the steady background tone and then flip between LSB and USB while adjusting the frequency knob until the tones sound the same pitch in either LSB or USB.

The TIC program also outputs time acquisition information by outputting status data in ASCII format over the UART link. Four 2 digit numbers separated by comma's are used to indicate the progression of minute, 10 minute, and hour digit bit energy levels and the number of minutes into acquisition.

Once time is acquired, the time is output in either 12 or 24 hour format depending on how the program was assembled.

DOSCLOCK.EXE

A simple DOS application is included with this package that will display the status and time data coming from the DSP-93 UART when the TIC software is running. It simply takes the ASCII data and places it on the screen in large characters.

After the TIC software is loaded and running on the DSP-93, from the DOS command line type the following to invoke DOSCLOCK:

Type→ DOSCLOCK -1

or

Type→ DOSCLOCK -2

The -1 or -2 specifies which serial com port to use. The baud rate is fixed at 19200bps.

If only question marks are displayed, then no data is being received. Make sure the TIC program is running on the DSP-93, check for correct com port or cables. The data should update each second.

Another simple program "TERM.EXE" is also included which can also be used with the DSP-93 to display data in HEX or ASCII format and send serial data to the DSP-93.

Known Problems

- The program does not receive WWVH signals from Hawaii. They use a different frequency for the seconds and minute markers that are out of the passband of the detector. (maybe if you live on Kauai the signals are strong enough to still get through. I'd be happy to have someone send me there for a few months to investigate!)

- Daylight Savings mode is changed at 0 GMT not at 2AM local time. I was too lazy to decode the extra bits and add the logic for something that happens twice a year. Same is true for leap seconds. The clock will just be off by one second until the next time acquisition cycle.

- Without battery backup, any power interruption will cause all program operation and time keeping to stop. This makes the DSP-93 not the kind of clock to set on the mantel. However if your DSP-93 is just sitting around idle gathering dust, maybe this is a good use for it.