MicroSet Watch Timer Pro
Table of Contents

How this booklet is organized
The Quick Start section will provide very simplified step-by-step instructions for the basic operations of the MicroSet Watch Timer Pro to help you get started.

After this, an in-depth description of each function with more detail about some of the background issues will be presented. We strongly recommend that you read this section, at least a little at a time, to understand the full features of the timer.

A short summary of each command will be found inside the back cover. A flow chart of operations will be found on the back cover.

If you have a question about some aspect of MicroSet, first look to the Table of Contents. You should also feel free to call or email us at Mumford Micro Systems to ask questions about issues that are not clear to you.

Phone: (805) 687-5116
Email: info@bmumford.com
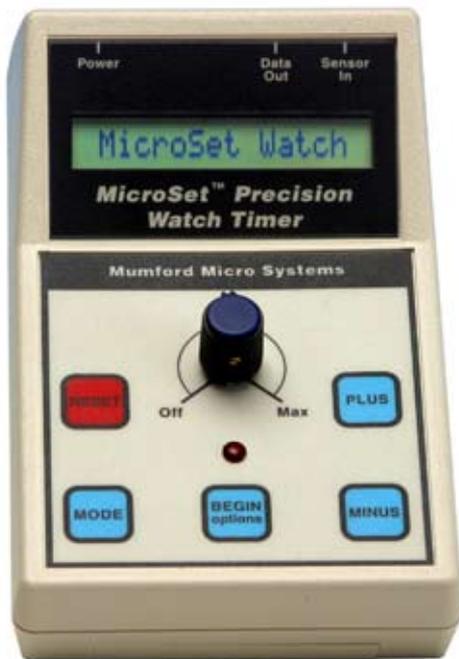
MicroSet Watch Timer Pro

Features

The MicroSet Watch Timer Pro incorporates many unique features. These include:

- MicroSet is a small, portable, battery-operated unit that takes up little room on the workbench and can be easily taken into the field.
- It has a resolution of one part per million which means an accuracy of one second per week. A temperature compensated timebase (TCXO) is available as an option.
- It will display watch rate as "Beats Per Hour", "Seconds Per Beat", or seconds of error per day and is not limited to a programmed set of train times.
- The most common watch rates are automatically recognized.
- A Running Average feature will display the total accumulated rate of a watch for as long as you let it run. This produces rate readings that are remarkably stable and much more accurate.
- A "Blanking Window" feature allows MicroSet to ignore sounds that occur at intervals other than the expected beat time. This greatly reduces false readings.
- The Beat Error Mode displays beat error to a tenth of a millisecond..
- The Accutron Mode will measure the rate of tuning fork watches as frequency of oscillation or error per day (optional sensor required).
- MicroSet will produce paper tape charts of watch performance when used with an inexpensive label printer (printer is optional).
- The Windows interface software allows more sophisticated analysis of watch performance. It allows you to see how a watch varies over time, and to evaluate trends in these fluctuations that can help you diagnose problems and understand erratic behavior.
- The software will simulate a traditional paper tape printer on the computer screen.
- The software will display an oscillogram of each tick on the computer screen and calculate the balance wheel amplitude.
- A variety of optional sensors are available for clocks and watches.
- An optional memory module can be added to capture watch data "in the field" for later analysis on a personal computer.
- Optional temperature and barometric sensors allow you to analyze compensation in watches.
- By adding appropriate sensors the MicroSet Watch Timer can also be used to measure clocks.

Quick Start - The Timer

For people who want to get started, and don't want to bother with explanations or background, we will start with a simple description of how to use the hand-held MicroSet timer without the computer. This will let you get acquainted with the timer hardware.

First, measure the beat error
The **Beat Error Mode** is used to get the watch adjusted so both halves of the beat are of equal duration.

> Plug the watch sensor into the jack labeled "Sensor In".
> Mount the watch in the sensor. Be sure the watch is wound and running!
> Turn MicroSet on with the LEVEL control. The LCD screen will say:
>> **MicroSet Watch Timer Pro**

Set the Level Control to the 9 o'clock position.

Press the MODE button once. The LCD screen will say "**Beat Error...**"

If the LED on MicroSet is not blinking, turn the Level control up until the LED blinks once on each beat.

Press the BEGIN button.

The LED should now be blinking with each beat.

The LCD screen should now display the beat error of the watch. The readings should be consistent, but they may not be identical every time. For example, it might say "**Error: 8.5**". This means the beat error was 8.5 milliseconds.

If the beat error varies wildly, the Level control may not be set to the optimum level. Slowly turn the Level control up to find a setting where the beat error readings are the most stable.

It's beyond the scope of these instructions to tell you how to adjust the beat error in a watch. MicroSet's job is just to measure it.
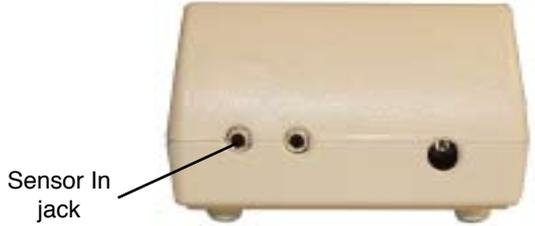
Measure the rate
Once you have measured the beat error and set the Level control, use the **Time Mode** to get see what rate the watch is running at. MicroSet will measure a number of beats, then tell you the average rate for each beat.

> Assuming MicroSet is still measuring beat error, press the MODE button once. The LCD screen should say:
>> **Beat Error ...**

> Press the MODE button a second time. The LCD screen should say something similar to:
>> **Time 10...**

> The LEVEL control should already be correctly adjusted from the Beat Error mode.

> You can now choose how many beats of the watch to average before you get an answer. The default setting is 10 beats. To change this, press the PLUS or MINUS buttons (or hold them down) until the number of beats you want to average is shown on the LCD screen. A value of "10" will get you a quick answer. The most accurate number to use is twice the number of teeth on the escape wheel.

The LCD screen now says "**Time 10...**" (or the number you set)

Press the BEGIN button.

The LCD screen says "**Rate:**" and the LED blinks each time the watch ticks. MicroSet will measure the watch for the number of beats you specified. At the end of this time, MicroSet will give you the average rate of the watch. For example, it might say "**Rate: 18001.10**". This means the average rate was 18010.10 *Beats Per Hour*. It might also say something like "**Rate: .200010**". This means the average rate was .200010 *Seconds Per Beat*. You can configure MicroSet to display answers in either Beats Per Hour or Seconds Per Beat. Refer to the section titled "**Configuration - Display mode**" for more details on these two choices.

You can also set MicroSet to display how fast or slow the watch is in seconds per day. To do this, press the BEGIN button while MicroSet is measuring the rate. The LCD screen will say:

Show error/day?

To say "Yes" (you want to see error per day) press the PLUS key.

MicroSet will now show you what it thinks the "Target Rate" is for this watch. In other words, MicroSet will guess what the correct rate is supposed to be. You must know what the correct rate for this watch is. If MicroSet has guessed correctly, press the BEGIN key again.

If MicroSet did not guess correctly, you can manually set the correct "Target" rate. To do this, press the MINUS key. MicroSet will now display the last reading that it made on the watch. Use the PLUS and MINUS keys to adjust the proposed value until it is the correct rate for this watch. Then press BEGIN.

MicroSet now measures the rate of the watch and shows you how many seconds per day it is fast or slow.

Blanking Window

MicroSet uses an important technique to reduce interference and make more accurate readings. This is called the "Blanking Window". It causes MicroSet to stop listening to the watch for a short while after each tick. By not listening until the next tick is due, MicroSet can ignore noise that's not a real tick. But if MicroSet waits too long, it can miss a real tick. So the Blanking Window should be set to a correct value for the watch you're using. If you're measuring a fast beat watch (28,800 or 36,000 BPH) and MicroSet reads the rate as near 14,400 or 18,000 BPH, the Blanking Window is too long. Refer to the section titled "**Configuration - Blanking Window**" for more details on setting the Blanking Window.

Running Average

There is a very useful feature built into MicroSet that will keep a running average of all readings. This reduces the fluctuation between individual readings and gives you a more accurate average rate for the watch. To turn on the running average display, press the BEGIN button while MicroSet is measuring the rate. The LCD screen will say:

Show error/day?

We don't care about this now, so press BEGIN again. The LCD screen will say:

Average: Off

To turn on the Average function, press the PLUS key. The LCD screen will say:

Average: On

Press MODE to begin measuring the watch again. Now the watch rate will be displayed as the accumulated average. A number at the left edge of the display will indicate how many readings have been incorporated in the current average. The rate readings will be much more stable because variations will be a small fraction of the total.

Quick Start - Windows Software

We'll now describe the basic operations of the Windows software that comes with the MicroSet Watch Timer Pro.

Installing the software
The MicroSet Watch Timer Pro software is provided on a CD. Put this into your computer and find the "Install" folder on it. There will be a program called "Setup.exe" within this folder that will install the Watch Timer program on your computer. Run the Setup.exe file and follow the directions to install the software on your computer. After you have installed the software, the program "MicroSet Watch Timer Pro" should appear in your list of Programs under the Start Menu.

There is also a folder called "Support" on the CD. This folder contains the Watch Timer Pro software that can be dragged to your hard disk and run without an installer, if you have any problems installing the software.

Plug in the timer
A serial data cable is provided with the Watch Timer. Plug the small end of this cable into the jack labeled "Data Out" on the watch timer box. Plug the large end into the serial port of your computer.

If your computer doesn't have a serial port but has a USB port, you will need to acquire a USB to serial adaptor. These are widely available, or one can be ordered from Mumford Micro Systems. If you install a USB to serial adaptor, it may come with software of it's own that needs to be installed.

AC adaptor
jack

Sensor In
jack

Computer interface jack

Running the software
Run the Watch Timer Pro program on your computer. The first time you run MicroSet it will try to connect with the timer on the serial port known as "COM1". If you will be using the timer with serial port COM1, no adjustment will be necessary. But if COM1 is not available, a Setup window will appear where you can select the COM port you'll be using. The Setup window is shown below.
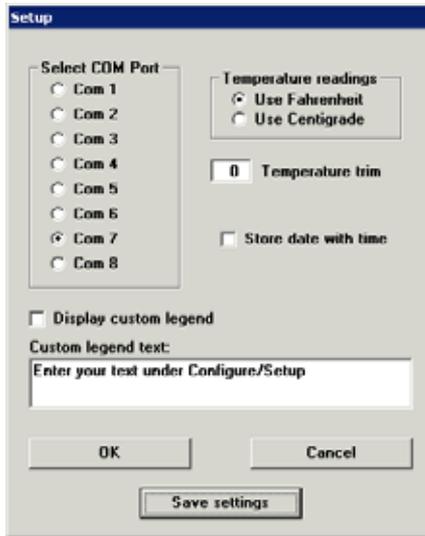
The Setup Window

There are several parameters in the Setup window, but the only one that matters to us now is the COM port number. You must select the COM port that the timer is plugged in to.

If you're using a USB to serial adaptor, you will have to look at the Windows "Device Manager" to see which COM port was created by your USB adaptor. To see the Device Manager, right click on the "My Computer" icon, then select "Properties". In the window that appears, select the "Hardware" tab. Then click the "Device Manager" button. In the list of devices that appears, find "Ports (COM & LPT)" and open it to see the ports that are in use. The COM port created by your USB to serial adaptor should be visible. Select this COM port number in the MicroSet Setup window.

After you have selected the correct COM port in the Setup window, you may click on "Save Settings". This will store the current settings to be used the next time you run the program. If you don't want to store the settings yet, just click on "OK". If you get an error message, the COM port you have selected is not available.

After this the main Watch TImer window will appear. It will be similar to the one shown on the following page. Details about the various commands and functions will be given later. For now, pay attention to the grid of buttons near the top right corner of the screen, as seen here:
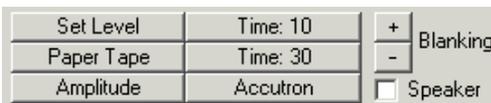
Remote control buttons

These are the primary control buttons for communicating with the watch timer. Each of these buttons will command the timer hardware to go to one mode or another and configure the Windows program to show you the data.
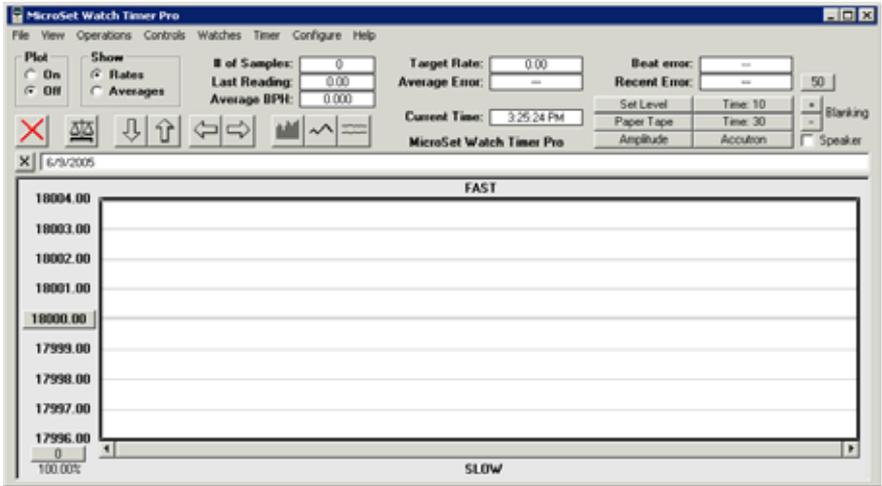
The main computer screen

Set the Target Rate

Before you measure a watch you need to tell the software what the correct rate for the watch is. This is something you'll just have to know about the watch. If you aren't sure, you can do a rough measurement to see what common value it's close to. For now, let's suppose the watch is known to beat at 18,000 Beats Per Hour. To set the software to this value, select "Set Target Rate" under the "Controls" menu. A new window will open where you can enter the correct "Target Rate" for this watch. This window lets you enter a numeric value, like "18000.00", or click on a button to set one of the most common rates. Choose 18000 (or the rate that's correct for your watch) and click on "OK".
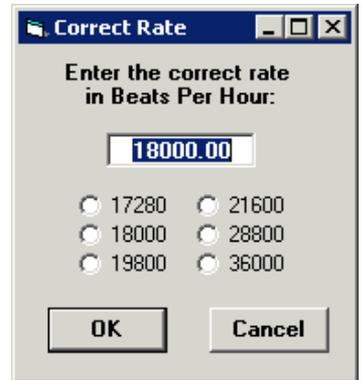
Enter the Target Rate

Make sure that the watch sensor is plugged into the timer, that a watch is mounted in the sensor, and that the watch is fully wound and running.

Set the Level

The next thing we must do is set the Level knob on the timer to the correct position. If it's too low the timer won't hear every tick completely. If too high, noise will be introduced and the readings will be wrong.

We'll use the "remote control" button at the top of the computer screen labeled "Set Level" to configure both the software and the timer for the proper settings to adjust the Level control.

Page 9
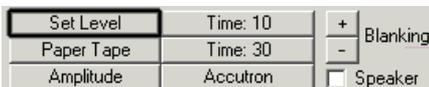
But before you click on the "Set Level" button at the top of the screen, reset the timer to be sure it's available. To reset the timer, press the red "RESET" button on the keypad.

Then click on the "Set Level" button. The LCD screen on the timer should show the word "Rate" followed by some rapidly changing numbers. Data lines should appear in the graph area on the computer screen.

If the LCD screen on the Watch Timer does not change to show the word "Rate", you may need to click on "Set Level" again. When you first run the program, you may have to issue the first command twice.

After 5 or 10 lines have appeared in the graph, choose "Autoscale" under the Controls Menu to get the data centered on the screen.

The goal now is to adjust the Level control on the timer so the data is uniform. When you use the "Set Level" button, the MicroSet timer is configured to read every beat of the watch. On the graph, one beat will be tall and the next one short. This shows the beat error of the watch. If the Level control is set well, the alternating pattern of tall and short will be regular because the beat error will be consistent. If the Level control is set poorly, the pattern of tall and short will be irregular because the timer will be triggering on different parts of the tick on different beats.

In the graph below, the data is inconsistent. The Level control needs to be adjusted.
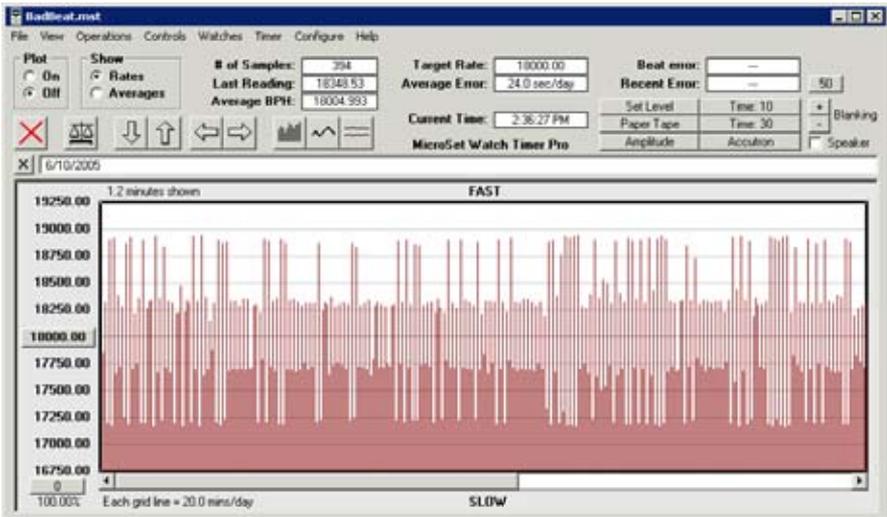
Inadequate setting of the Level control

In the next graph, the data is consistent. The Level control is fine.

Of course it's also possible for the watch to need service and have an irregular beat error. In this case you will be unable to get a regular display by adjusting the Level control.
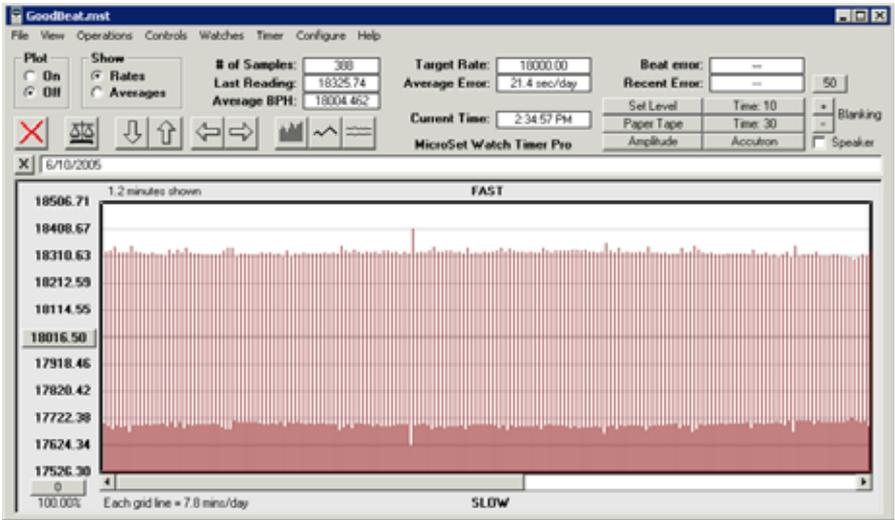
Good setting of the Level control

Paper Tape Simulation

The next software operation we'll cover is the simulation of a paper tape printer on the computer screen. To see this, click on the "Paper Tape" button at the top of the screen.
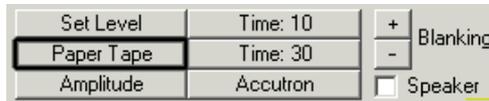
This will put the timer in the Time Mode to measure every beat, and it will configure the Windows software to show the paper tape simulation. An example of this display can be seen below.

The graph shows a display similar to a conventional paper tape except that the tape runs horizontally instead of vertically.

Unlike a traditional paper tape timer, you don't have to interpret the rate from the slope of the lines. You can read it directly at the top of the screen. The box labeled "Total Error" shows the rate of the watch in seconds per day of error. The box labeled "Average BPH" shows the average rate of the watch in Beats Per Hour. The box labeled "Recent Error" shows the error in seconds per day of the last 50 readings. Also shown is the recent Beat Error value.

MicroSet allows several unique manipulations of this data, but that will be covered later. This is the "Quick Start" section!
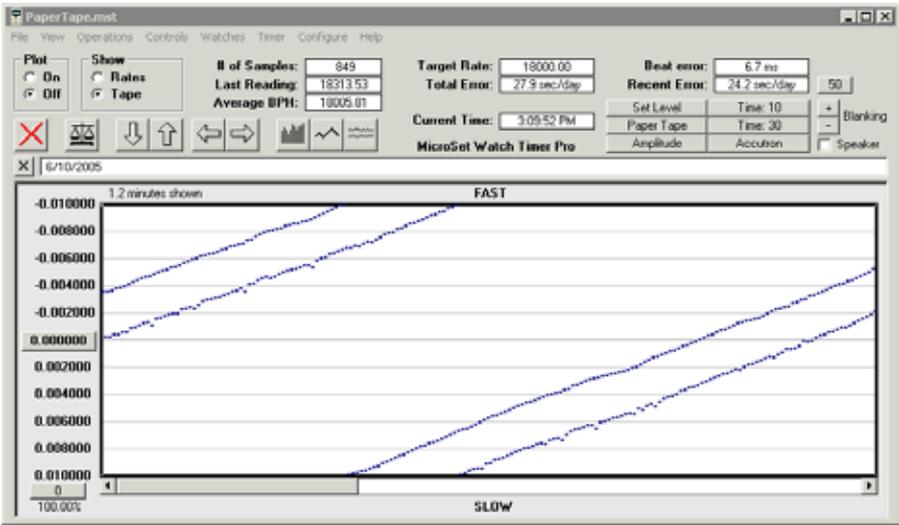
The paper tape simulation

Balance Wheel Amplitude
The next function we'll cover is balance wheel amplitude. The MicroSet Watch Timer Pro can display a very accurate oscillogram of the tick and measure the amplitude of oscillation from it. To see this display, click on the "Amplitude" button at the top of the screen.

This will put the timer in the Balance Wheel Amplitude Mode and configure the Windows software to display the result. An example of this display can be seen below.
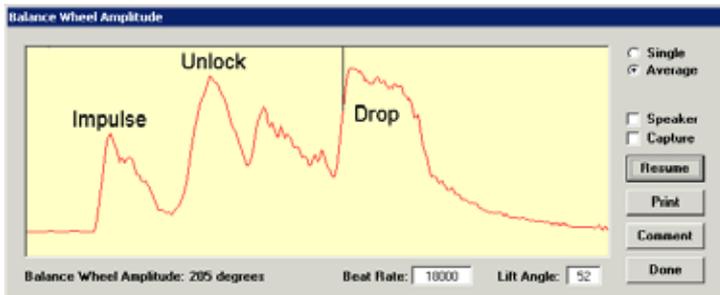
Balance wheel amplitude

You can see the sound envelope of a single watch tick. The three major sounds are the impulse, the unlocking, and the drop. This watch shows additional sounds between the unlocking and the drop.

Page 12

The balance wheel amplitude calculation depends on the beat rate and the lift angle of the watch, and these parameters can be changed in the window. MicroSet shows the amplitude of this watch to be 205 degrees.

MicroSet allows additional manipulations of this data, but that will be covered later in these instructions. This is the "Quick Start" section.

Measuring longer intervals

MicroSet will also measure the average rate of the watch over longer intervals of time. This will reveal the longer term average rate of the watch, and may also display cycles in the rate that indicate flaws in the movement. Two buttons are provided in the remote control area for longer averages: "Time 10" and "Time 30". The first will configure the timer to display a reading after every ten beats. The other will display a reading after every 30 beats.

An example of such a graph is shown below. This data can be manipulated in many useful ways, which will be explained in detail under the software section. Briefly, what can be seen here is that the rate is generally stable over the 12 minutes shown, but it was inconsistent over short time intervals. The watch speeds up and slows down by about 12 seconds per day on alternate readings. To see the actual average rate, an interval longer than ten beats must be used, or the software can average the oscillation.
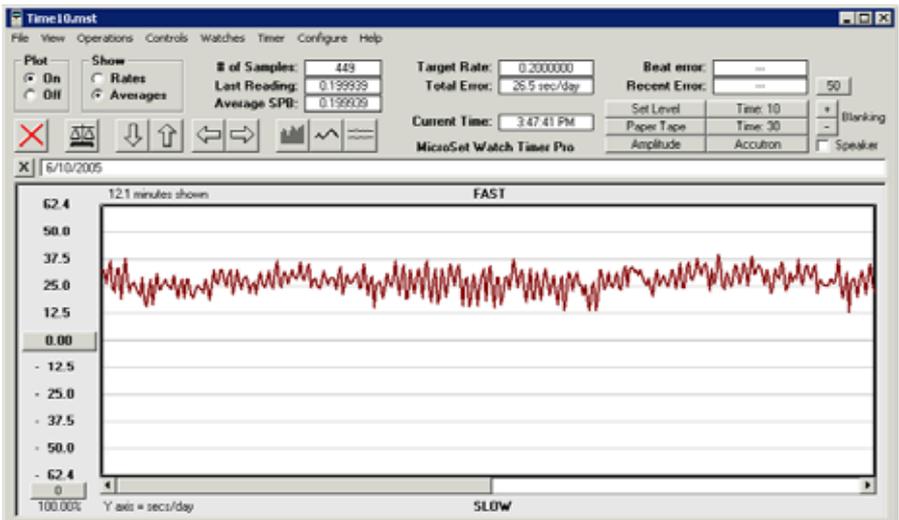
Measuring longer intervals -- Time: 10

Measuring Accutron Watches

The MicroSet Watch Timer Pro can also be used to measure Accutron watches. This requires an optionsl sensor that will pick up the Accutron tuning fork. This sensor can also be used to measure analog quartz watches.

The final remote control link at the top of the screen is for Accutron watches. If you have the special sensor, put an Accutron on the sensor and turn the MicroSet Level control fully clockwise. Click on the Accutron button at the top of the screen.

Set Level	Time: 10	+	Blanking
Paper Tape	Time: 30	−	
Amplitude	Accutron	☐ Speaker	

An example of an Accutron rate is shown below. We can see short term variation in the rate that may be an artifact of measurement. But there is also a very distinct speedup and slow down over this 21 minute interval. Two humps can easily be seen.
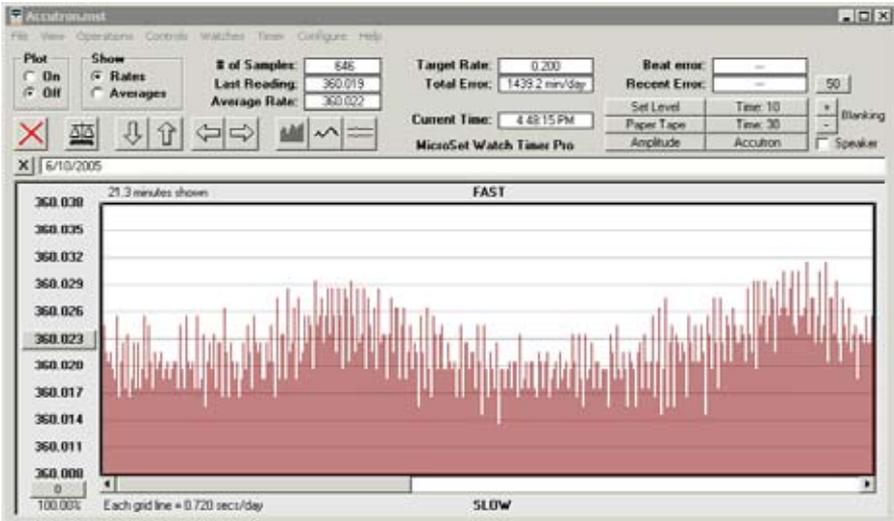
Measuring an Accutron watch

The Help System
We have just gone over the basic operations of the Windows Interface Software. There is also a Help sequence built into the Watch Timer software to help you learn these operations. The Help system is located under the Help Menu and has the title "Step-by-step". This will open a sequence of windows at the right side of the graph to help you learn the software without referring to these printed instructions. Be sure to take a look at this.

Using MicroSet in Depth

The following instructions document the operations of the MicroSet timer in greater detail. We strongly encourage you to read these descriptions to learn the details of each function.

The keypad
In general, you use the MODE button to select the various functions of MicroSet. If you press the MODE button over and over, MicroSet will cycle through the functions that are available in your timer. If you go past the function you want, keep pressing MODE and you'll come back to it.

When the mode you want is displayed on the LCD screen, press the BEGIN button to enter that mode. After you enter a mode you can usually press the MODE button again to get out of it.

The PLUS and MINUS keys are used to enter numbers and make other choices. One press will advance the count by one. If you hold down the PLUS or MINUS buttons they will "repeat" after a short while and make more entries very quickly. In places where there are "Yes/No" questions, use PLUS for "Yes" and MINUS for "No".

A flow chart of the MicroSet functions can be found on the back cover of this instruction book.

Power source
MicroSet will operate on a 9 volt battery or an AC wall adaptor. The battery is contained inside a door on the bottom of the unit. The AC adaptor plugs into a jack on the top end. AC operation is recommended when you have easy access to it. You can leave the battery in when the unit is plugged in to the AC adaptor and, if the AC goes off, MicroSet will keep running on the battery. If you lose your AC adaptor you can use any one that provides 7 to 15 volts DC at 100 milliamps. The plug is a 2.1 mm coaxial barrel plug, with center positive polarity.

Turning it on
The round knob in the center of the keypad is the power switch and sensitivity control. Turn it clockwise to turn it on. MicroSet should beep twice to indicate it is waking up. It will then display "**MicroSet Watch Timer Pro** on the LCD screen. If this does not happen as expected (or any time you want to re-initialize MicroSet) press the red RESET button.

Watch sensors
There are several different sensors you could use with the MicroSet Watch Timer. The "Clamping Watch Sensor", provided with the Watch Timer Pro, is the best watch sensor we make. Its spring-loaded arm will hold the watch in place against the sensor insuring good contact for tick transmission. Also, it has six flat sides so you can take measurements of the watch in different positions.

The watch sensor made by Witschi in Switzerland is very good, and has the advantage that you can rotate the watch to various positions without picking it up. It has the disadvantage of being very expensive. If you wish to use the Witschi watch holder we can probably get one for you and provide an interface to adapt it to MicroSet. Contact Mumford Micro for more information.

You may have a watch sensor from an earlier watch timer, like Vibrograph or Tick-O-Print. These sensors cannot be used with MicroSet. However, we may be able to update your old sensor with a new cable and sensing element to be compatible with MicroSet. Contact Mumford Micro for more information.

Clamping Watch Sensor

The Beat Error Mode

The first mode in MicroSet is the Beat Error Mode. It will measure, in milliseconds, the difference between the even and odd beats of a watch. If the watch were perfectly in beat, the beat error would be 0.0 milliseconds.

Plug your watch sensor into the jack labeled "Sensor In" at the top end of the timer. Mount the watch in your sensor and be sure it's wound and running.

Turn MicroSet on with the LEVEL control. The LCD screen will say:
> **MicroSet Watch Time Pro**

Set the Level Control to the 9 o'clock position. Press the MODE button once. The screen says
> **Beat Error...**

If the LED on MicroSet is not blinking, turn the Level control up until the LED blinks once on each beat. Then press the BEGIN button.

The LCD screen should now display the beat error of the watch. The readings should be consistent, but they may not be identical every time. If the beat error varies wildly, the Level control may not be set to the optimum level. Slowly turn the Level control up to find a setting where the beat error readings are the most stable.

The Beat Error Mode is the best way to set the Level control to the optimum position. Getting the Level control set correctly is critical to getting accurate readings. The graph here shows what a watch tick looks like on an oscilloscope. The tick is made up of several component sounds. To get accurate readings with a watch timer, it must trigger on the same component of the watch tick on every beat. If it doesn't, the readings will jump around as the timer measures different intervals on different beats.
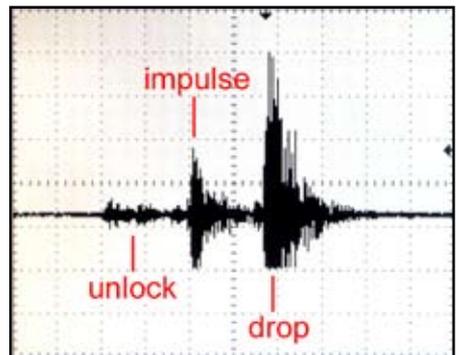
A watch tick

Another way to get the Level control set properly is to use the MicroSet Windows Interface Software. This computer program allows you to see changes in rate over time, and evaluate what those changes mean. If you configure MicroSet to measure every single beat of a watch, the numbers change too quickly on the built-in LCD screen to make sense of them. But if these readings are plotted on a computer screen, you can quickly see when the readings are measuring each beat accurately. Accurate readings will alternate between a tall one and a short one. The differences will be very consistent.

The graph below shows a watch with the Level control set too low. The readings are irregular because some beats are measured at different parts of the tick sound. This setup will produce jumpy, inaccurate readings in MicroSet.
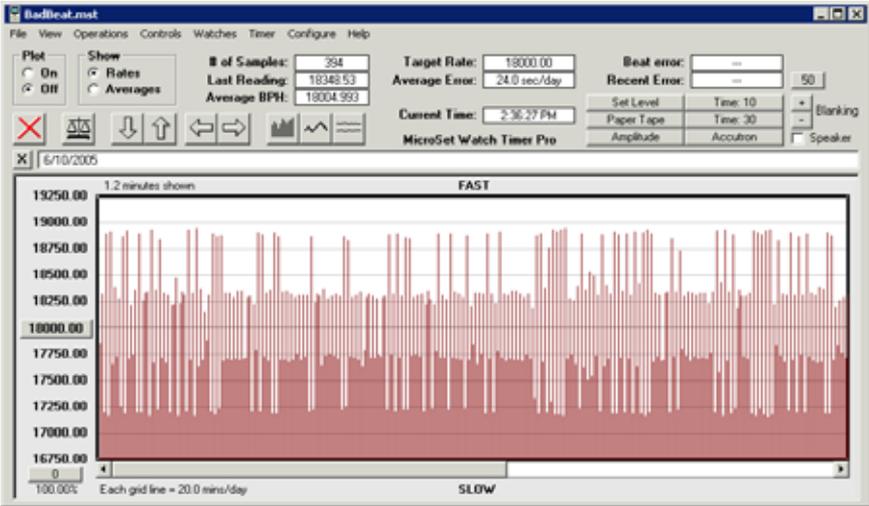
Erratic readings -- Level control set poorly

The next graph shows a watch that's measuring accurately. Notice how each reading alternates consistently. This setup will produce accurate readings on the MicroSet LCD screen.
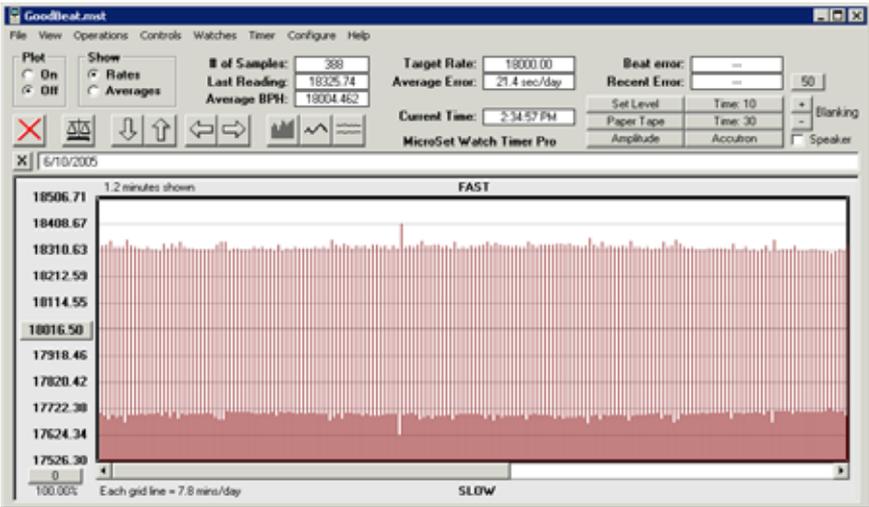
Consistent readings -- Level control set well

Even when the Level control is set correctly the Beat Error value may not be the same every time. There will often be some variation. But the variation should be small if the Level control is set properly. Of course flaws in the watch will also produce erratic beat error readings. The beat error will also change if the watch is measured in different positions.

To terminate the Beat Error Mode you can press the MODE button or the RESET button.

The Time Mode

The second mode in the MicroSet Watch Timer Pro is the Time Mode. It's used to measure the rate of the watch. Press the MODE button until the LCD screen says:

> **Time 10...**

This means MicroSet is in the mode to measure beat times, and is set to measure 10 beats.

Mount the watch in the sensor and be sure the watch is wound and running. If you have not yet measured the beat error of the watch, do that first because the Beat Error Mode is used to properly set the Level control.

Select the beat count

You can set the number of beats MicroSet will measure before giving you the rate. Press the PLUS button to increase the beat count. Press the MINUS button to decrease the beat count. The beat count is displayed on the LCD screen. For example, when set to measure 20 beats, the display will show:

> **Time 20...**

If you hold the PLUS or MINUS buttons down continuously, the beat count will increase or decrease rapidly.

If you measure a small number of beats you'll get a reading more quickly. But you'll get more accurate readings by measuring more beats. The ideal number of beats to measure is twice the number of teeth on the escape wheel. You may prefer to read fewer beats at first to get quick answers, and more beats later to get more accurate answers.

But you should always read an even number of beats. If you were to "Time" 11 beats, or 21, you would incorporate the beat error into the reading and get erratic results. One possible exception to this rule is when you might want to read just one beat (Time: 1), to display beat error on the computer screen. Below the value "1" is another odd choice, called "Time: 1 (skip)". This measures every other beat. Such a measurement measures the same pallet striking each tooth of the escape wheel one after another.

Reading the results

When you have the Time Mode configured with the beat count you want to use, press the BEGIN button to start measuring the watch. MicroSet will say:

> **Rate:**

as it measures the first period. The beat LED should blink and, after the selected number of beats have occurred, MicroSet will divide the total amount of time that has elapsed by the number of beats you selected and display the average length of each beat in one of two possible formats: Beats Per Hour or Seconds Per Beat. The format shown depends on how your timer is presently configured. For example, you might see **one** (not both) of the following displays:

> **Rate: .200015**
> **Rate: 18010.34**

The first line is the average beat time displayed in Seconds Per Beat. The second line is the rate of the watch displayed in Beats Per Hour. You can select which format MicroSet will use. See the "**Configuration - Display mode**" section in these instructions to change the current setting.

You can also display rates as seconds of error per day. This feature is explained under "**Time Mode Options**" (see below).

To restart the Time Mode you can press the MODE button, or press the RESET button to reset the timer.

Beep on completion
If the total period being measured is longer than about 10 seconds, you can instruct MicroSet to produce an audible beep whenever a reading is complete. This way the display doesn't need to be watched constantly to see when a new reading is ready. See the "**Configuration - Beep tone**" section in these instructions to turn the beep on or off.

Blanking Window
MicroSet will ignore any sounds that occur at a time that is outside a "window" of when the correct beat is likely to occur. This reduces false triggering on noisy watches. It can also prevent a false reading if you drop a screwdriver on the table or the sensor cable gets bumped. The Blanking Window can greatly reduce these sources of inaccurate readings and is an important feature that you should become familiar with.

The Blanking Window has a default value that's specified in the Configuration Mode. The setting of the Blanking Window should be matched to the watch you're working on. If the window is too long, MicroSet will not be able to measure fast beat watches because it will ignore every other beat. If it's shorter than it needs to be, MicroSet will be more susceptible to noise.

For measuring watches with a beat time of 18,000 BPH to 21,600 BPH, a Blanking Window of "8" can be used. If you're working on watches with beat times of 28,800 to 36,000 BPH, you can set the Blanking Window to "4".

You can tell if the Blanking Window is set correctly for the watch you're working on. The red LED on the front of MicroSet blinks on every beat. The LED is on while the Blanking Window is active, and goes off when MicroSet begins to listen for the next tick. The feature will be most effective if the LED is off for a very short time before it comes on again. This indicates that MicroSet is ignoring sound most of the time, then begins to listen just before the next tick arrives. If the LED seems to blink half as fast as the watch beats, it's an indication that the Blanking Window is too big and you're missing every other beat.

To program a default value for the Blanking Window, see "**Configuration - Minimum blanking**" for details.

You can also change the size of the Blanking Window "on the fly" as you measure a watch. Every time MicroSet finishes a reading, if the PLUS key is down, the Blanking Window gets longer by one count. If the MINUS key is held down, the Blanking Window gets shorter by one count.

If you hold down the PLUS key while MicroSet is measuring a watch, you'll see that the LED stays on for an increasingly longer time and blinks off for a shorter time. If you set MicroSet to measurre a short beat count, like "Time: 4", the change will happen more quickly. In this way you can increase the Blanking Window to the optimum value for the watch you're working on. Try to reach a point where the LED goes off for a short short time. This is the maximum setting. If you pass this point, the LED will begin to blink half as fast as the watch ticks because you're skipping every other beat. If this happens, hold down the MINUS key to reduce the Blanking Window by one or more counts.

MicroSet will keep this value of the Blanking Window until you turn it off or press the RESET key. Then it will revert to the default value that was specified with the Configuration Mode.

Time Mode Options

Once MicroSet is running in the Time Mode you can access several Time Mode Options. These are additional functions that are related to the measurement of rate. Some of them are extra cost options. If you wish to add an option you don't have, give us a call.

To access the Time Mode Options, press the BEGIN button while the Time Mode is running. You can step through the different Time Mode Options that may be in your timer by pressing BEGIN several times.

Show Error Per Day
The first Time Mode Option allows MicroSet to display rate readings as seconds of error per day rather than as Beats Per Hour or Seconds Per Beat.

To activate the Error Per Day option you should be running in the Time Mode. You should have already displayed one or more rate readings, and the reading should be close to the correct rate for the watch you're working on. If the reading is not close to the correct rate, the error will be too great to display as seconds per day.

Enter the Time Mode Options by pressing BEGIN. The LCD screen will say:
> **Show error/day?**

To answer "Yes", press the PLUS key. If you wish to answer "No", press the Minus key. Assuming you answered "yes", MicroSet will then guess the correct rate for the watch based on the last reading that was taken. MicroSet is programmed to recognize the most common watch rates. For example, MicroSet might say:
> **Target: 18000.00**

This means that MicroSet has guessed that the correct rate (the "target" rate) for this watch is 18000 BPH. If this is correct, just hit the BEGIN key and MicroSet will return to measuring the rate of the watch, but now the rate will be displayed as seconds of error per day. In other words, MicroSet will now tell you how fast or slow the watch is. If the value shown is positive, the watch is fast. If the value is negative, the watch is slow.

If the rate MicroSet guesses is not correct for the watch, you can manually adjust the target rate. To do this, press the MINUS key (for "No") when MicroSet guesses the wrong rate. MicroSet will then show you the last reading it made on your watch.

Let's say you were working on a watch, and the last reading taken in the Time Mode was 20946.55 Beats Per Hour. MicroSet would show this value on the LCD screen:
> **Target: 20946.55**

MicroSet needs to know the correct rate for the watch before it can calculate the error between the correct rate and the current rate. You need to know the correct rate for the watch. In this case, the correct rate might be 20944.44 BPH. You can adjust the proposed number with the PLUS and MINUS keys. To make the value larger, press (or hold) the PLUS key. To make it smaller, press (or hold) the MINUS key. When you press PLUS or MINUS the proposed rate will change by a small amount. If you hold the key down, the value will change rapidly. If you hold the key down even longer, the value will change even more quickly.

In this example, use the PLUS and MINUS keys to change the proposed Target rate from 20946.55 to 20944.44. The LCD screen will say:

Target: 20944.44

To enter this value and begin timing the watch again, press the BEGIN key. MicroSet will now show you the rate of the watch in terms of seconds per day of error.

As you enter the target rate in this way, if MicroSet has been displaying the rate as Beats Per Hour, the PLUS and MINUS keys will change the proposed rate by an odd value (.09 BPH). This is normal. If you cannot get MicroSet to display the exact rate you want, choose the closest value. The rate that MicroSet gives you will still be more accurate than a tenth of a second per day.

If you want to turn off the Error Per Day display mode, press the BEGIN key to access the Time Mode Options. Press BEGIN until the LCD screen says:

Show error/day?

To answer "No", press the MINUS key. MicroSet will return to the previous display mode, whether it was Seconds Per Beat or Beats Per Hour.

Running Average

The Running Average option is one of the most useful functions in MicroSet. When the Running Average function is turned on, MicroSet will accumulate a running average of every rate reading it has taken and display the average rate of the watch over any length of time you wish to let it run. This will cause rate readings to settle down to very stable and accurate values that change only in small fractions after just a few minutes.

To activate the Running Average option you must be running in the Time Mode. Press the BEGIN key to access the Time Mode Options. Press BEGIN again until the LCD screen says:

Average: Off

To turn on the Running Average function, press the PLUS key. The LCD screen will say:

Average: On

Now hit the MODE button to return to the Time Mode. As new readings are shown on the LCD screen, they will appear in the following format:

1: 18000.00

The first digit is the number of samples that have been taken. The number after the colon is the Running Average rate. In the example shown, the rate is displayed as Beats Per Hour, but the Running Average function also works if you have MicroSet configured to show Seconds Per Beat or Error Per Day.

Each time a new reading comes in, the number to the left of the colon will increase by one to show you how many readings have been taken, and the average rate will be calculated and displayed. The difference between subsequent readings will get smaller and smaller. As time goes on you get an increasingly accurate reading of the average rate of the watch.

To turn off the Running Average mode, enter the Time Mode Options and press BEGIN until the LCD screen says:

Average: On

Press the MINUS button to change it to "Average: Off" and then press MODE to return to the Time Mode.

If you wish to reset the running average value, enter the Time Mode Options and press BEGIN until the LCD screen says:

Average: On

Press MODE to return to the Time Mode. The running average value will be reset and a new average will be calculated.

If you're using the Running Average feature and a bad reading comes in, it will throw off the whole average because the bad value becomes incorporated with every reading. For this reason, take special care to get clean readings in the Running Average mode. In typical operation, the Running Average rate will become more and more stable over time. The readings might grow and shrink a little, but the amount of change should get smaller and smaller with each reading. If you notice that the rate just keeps getting bigger and bigger, or smaller and smaller, it may mean you have a bad sample that has thrown off the running average. In this case you may wish to re-reset the Running Average mode to reset the average and start over.

Normally we recommend using a relatively large number of beats for the Time Mode. For example, if you set MicroSet to "Time: 2", you'll get less accurate and more erratic answers than if you set it to "Time: 30". This seems to be much less important with the Running Average mode. You can get accurate readings with smaller beat counts with the Running Average and get answers more quickly.

Speaker On/Off

The MicroSet Watch Timer Pro includes a built-in beat amplifier. To turn it on, press BEGIN while the Time Mode is running. Press BEGIN until the LCD screen says:

Speaker: Off

Press the PLUS key to turn the speaker on. If it's already on, press the MINUS key to turn it off. You can now return to the Time Mode by pressing MODE and the speaker will stay as you set it.

The volume of the speaker is controlled by the existing LEVEL control. To make it louder, turn the LEVEL control clockwise.

MicroSet will continue to take readings while the speaker is on. You may notice that there is a slight hissing sound when MicroSet displays a new value on the LCD screen. This sound is not a flaw in the watch, it's an amplification of the electronics inside the timer. Also, if you have MicroSet plugged into a personal computer, you may hear an extra sound when data is sent to the computer. Don't be fooled by these sounds and think they're coming from your watch. If they bother you, reenter the Time Mode Options by pressing the BEGIN key. This will stop MicroSet from taking readings and you'll only hear the watch.

The speaker is mounted to the back of MicroSet, where it faces the work table. The rubber feet on MicroSet hold the timer off the table and let the sound out. In fact, the speaker is louder when MicroSet is sitting on a work table than it is if you turn it over and face the speaker towards you. However, the speaker will be loudest when sitting on a hard, reflective surface. The sound will be muffled if you set it on a padded or carpeted surface.

Data Capture
The next Time Mode Option is Data Capture. This is an extra cost option. If you didn't purchase Data Capture, the option will not be available. When Data Capture is turned on, rate readings taken by the timer are stored in memory within the timer as they are displayed on the LCD screen. At some later time you can connect MicroSet to a personal computer and "dump" the data that has been captured into the Windows Interface Program. This allows you to capture data for the computer even though the watch you're working on is not near a computer.

This feature will be useful if you have a computer in your office but not in the watch shop. Or perhaps there is a watch you're interested in buying at a local store, and you'd like to examine its performance before you commit to purchase. Assuming the shop keeper will allow it, you can capture the behavior of the watch in the shop and examine it later on your computer.

To use Data Capture, MicroSet must be in the Time Mode and taking readings. Press the BEGIN key to access the Time Mode Options. Press BEGIN until the LCD screen says:
>   **Capture: Off**
The default condition is for Data Capture to be off. To begin capturing your readings, you must turn it on. Do this by pressing the PLUS key. The LCD screen will then say:
>   **Capture: 1**
The number "1" means that MicroSet will capture every reading in memory. You can press the PLUS key again and the number "1" can be increased up to 250. The number that you select is the number of readings that will occur before one is stored in the Capture memory. For example, if you set the LCD screen to show:
>   **Capture: 10**
MicroSet will store one reading for every ten that occur.

When we say "readings" we don't mean "beats". If MicroSet is configured to measure 30 beats with "Time: 30", each reading of 30 beats is the "reading" that's captured with Data Capture.

The reason for saving fewer than every reading is that the Capture memory can hold no more than 8,125 readings. This is quite a lot, but there may be times when you would prefer to capture over a longer period of time. By skipping some readings your Capture time is increased.

After setting the Data Capture count value, you can go back to the Time Mode and begin capturing readings. Do this by pressing the MODE key.

MicroSet will now resume taking readings from the watch under study. Every new reading that's displayed on the LCD screen will be followed by the letter "C", to indicate that they are being captured. The readings will be stored in memory inside the timer until the memory storage is filled. If you fill the Capture memory, the Capture function will be turned off and the letter "C" will no longer appear after each rate reading.

Here are some typical kinds of measurements and the length of time you can capture with a Capture count of "1". If you enter a number larger than "1", multiply the duration shown by the number you entered for the Capture count:
- Pocket watch, "Time: 60" (one reading every 12 seconds)
    Will capture for 27 hours
- Pocket watch, "Time: 1" (capture every beat)
    Will capture for 27 minutes

When you have captured all the data you want, you should turn off the Capture function. Press the BEGIN key to access the Time Mode Options. Press BEGIN again until the LCD screen shows:

Capture: 1 (or some other number)

Press the MINUS button until the LCD screen says:

Capture: Off

This indicates that the Capture function has been turned off and new readings will no longer be stored.

When you turn Capture off, MicroSet stores a marker in the data to indicate where the end is. This allows you to turn the timer off and still be able to Dump the data at a later date. The data is stored in nonvolatile memory, and you can leave MicroSet off for an hour, or a month, and still get the data out. However, if you turn Data Capture "On" again, it will start a new data session and any previous data will be erased.

You can capture more than one "session" of data with the Capture function. You can stop the Time Mode (or use any other function of MicroSet), or set up on a different watch, and then Capture more data. If you wish to do this, do NOT turn the Data Capture off. As long as Data Capture is left on, the data will go into memory and it can be dumped to a PC later. If you turn off the Capture function you cannot add any more data.

Dumping captured data

When you're ready to transfer your captured data to the PC, plug MicroSet into the serial port of your Windows computer with the cable provided. To Dump the data, put MicroSet in the Time Mode and press the BEGIN button to access the Time Mode Options. Press BEGIN until the LCD screen says:

Dump?

Be sure the Windows Interface Program is ready to accept data (the "Plot: On" button is selected) and press PLUS on the timer. This will start the data dump. Every reading stored in the timer will come flying out of MicroSet. The numbers will appear on the LCD screen so fast that they will be illegible. New data points will appear on the computer screen as fast as your computer is able to display them. When the dump is complete, the timer will return to the Time Mode. You can dump the data as many times as you like; it will stay in memory until you turn Data Capture "On" again, which resets the storage area and begins a new capture.

Here are some things to keep in mind about the Capture process.

1) You can use Data Capture whether MicroSet is configured to display Seconds Per Beat or Beats Per Hour. But the data captured will always be saved as Seconds Per Beat. When you dump the data to the PC, even though MicroSet may have been displaying Beats Per Hour, you will dump Seconds Per Beat. You can see Beats Per Hour on the computer screen if you configure it to show Beats Per Hour.

2) Normally, when you capture readings from the timer on the computer, the computer stores the time of day that each reading was taken. When you examine the data on the PC screen, you can tell when each sample was taken because it has a "time stamp". When you dump data from the timer's Capture function, it all comes in very quickly, even though it may have taken days to collect it. The time stamp associated with each sample will be the instant it transferred to the computer, not the actual time it was captured. The Windows Interface Program has a command to correct the time stamps. It's called "Change timestamps" and can be found under the Operations menu. To correct the timestamps you must know the time that the first reading was captured and the number of beats

between each captured reading. For example, if MicroSet was set to Time 30 beats, there were 30 beats between each reading. But if you set the Capture count to "Capture: 10", there would be 300 beats between each captured reading. If you wish to correct the timestamps, you must make a note of the start time and counter values of your capture data when you start Data Capture.

3) The data will be saved in the timer for as long as you like, but if you turn Capture "On", any stored data will be lost. If you wish to capture more than one watch, you must do so without turning off the timer and without turning off the Capture function between watches.

4) Remember to "close" the Data Capture by turning "Off" the Capture function when you are through. If you turn off the timer without turning off the Capture function, the timer will not know where the end of the data is when you Dump it. However, as long as you do not turn off the timer, you can Dump the data without "closing" the Data Capture. The Dump command keeps track of the current end of data as long as the timer is left on. This allows you to Dump the data in the middle of a capture and then continue to capture more.

Paper tape output
The last Time Mode Option is Paper Tape. It allows MicroSet to print traditional paper tape charts (like a Vibrograph or Tickoprint produces) on an inexpensive label printer. The paper tape printer is an optional accessory. Call or write for price and availability.

We prefer to use the Windows Interface Software to display a simulation of a paper tape printer instead of using an actual paper tape printer. The simulation allows additional features a real printer can't reproduce, and requires no paper.

To use the paper tape printer, plug the special data cable (available from us) into the MicroSet Data Out jack at the end of the timer. This is the jack normally used by the computer interface. MicroSet must be in the Time Mode and generating readings. Press the BEGIN key to access the Time Mode Options, and press BEGIN as many times as necessary to reach the Paper Tape option. The LCD screen will say:
> **Paper tape?**

Answer "Yes" by pressing the PLUS button. MicroSet will then display the last reading that was taken in the Time Mode. MicroSet must know the correct rate for the watch in order to calculate the paper tape data. MicroSet will guess the correct rate, just as it does when you set MicroSet to display Error Per Day. If the proposed rate is correct you can accept it by pressing the BEGIN button, or manually adjust it by pressing the MINUS button. For more detail on selecting the Target rate, refer to the instructions for configuring Error Per Day earlier in these instructions.

When the proposed Target rate is correct, press the BEGIN key. The LCD screen will then say:
> **Paper tape: 1x**

and the printer should begin to print. To stop printing, press the MODE button. A short sample of the paper tape is shown below.
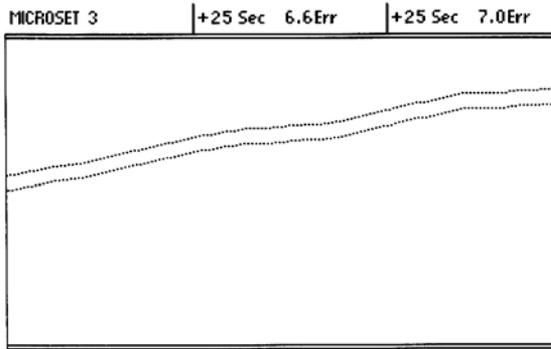
Paper tape strip

As the tape runs, a black dot will be printed on the tape for each beat of the watch. The position of the dot depends on the rate and beat error of the watch. If the watch is fast, the lines will wander off the top of the tape. If the watch is slow, the lines will wander off the bottom. If the watch is running at exactly the correct rate, the lines will be horizontal. After 100 beats, MicroSet will print the current rate of the watch at the top of the tape. In this example, it printed "+25 Sec", which means the watch is 25 seconds per day fast.

In the sample strip, there are two lines. This is because the watch is not in perfect beat. The difference between these two times is the "beat error". Larger beat errors appear as more separation between the two lines. Every 100 beats MicroSet prints the last beat error at the top of the tape, after the current rate. In this example, the beat error was 6.6 milliseconds.

If you do not see two clean rows of dots like the sample shown, your watch may be very dirty or the level may not be set correctly. Start with the level control of MicroSet set to maximum. Adjust it downward if you don't get clean results.

While the tape is running you can rotate the watch to different positions to evaluate the effect. It is beyond the scope of these instructions to teach you how to read the many possible variations in the printed pattern, and what they all mean. Much has been written on this subject, and many people have learned how to read the output of Vibrograph, Tickoprint, and WatchMaster timers. A listing of several common faults and the tapes they produce can be seen at the end of these instructions.

There are several controls on the paper tape display that exceed the abilities of the original paper tape timers. MicroSet will allow you to magnify the beat error to see finer detail. To do this, press the PLUS button while MicroSet is printing a tape. The LCD screen will say:
Paper tape: 2x
and the printed tape will be magnified two times. The beat error will appear twice as large in the pattern of dots, but the value printed at the tape edge will be correct. You can press the PLUS button again for a scale of "4x", and a third time for a scale of "8x". To return to lesser magnifications, press the MINUS key. The LCD screen will always tell you what magnification is in use.

If the rows of dots are running at the edge of the tape and you would like to center them, press the BEGIN button. This will start a new reading and re-center the dots to the middle of the tape. You can also use this button if you've moved the watch or otherwise disturbed the current reading and wish to start a clean measurement of the next 100 beats.

It's difficult to see the details of the individual beats when the overall rate is fast or slow, because the dots run off the edge of the tape. This was unavoidable with traditional paper tape timers. But because MicroSet allows you to specify any arbitrary rate as the correct rate, you can get the lines to run straight simply by telling MicroSet that the current rate is the correct rate. In other words, when you first enter the Paper Tape Mode, simply accept the last rate reading without adjusting it to be the known correct rate. In this case, the lines will be straight, the beat errors will be easy to see, and any fluctuation in rate will be easily seen as a divergence from straight lines.

The Accutron Mode

The MicroSet Watch Timer includes a special mode for measuring tuning fork watches (like Accutron) that use a tuning fork motor to drive the movement. These tuning forks run at a variety of frequencies, with 360 cycles per second (or "Hertz") being the most common. MicroSet will automatically detect the correct rate of any of the following frequencies:

    300
    341 1/3
    360
    440
    480

The Accutron mode requires a special, optional, inductive sensor. This sensor will also trigger on the motor impulse of quartz watches and clocks, and you can measure them with MicroSet too.

To use the Accutron mode, press the MODE button until the LCD screen says:
    Accutron...
Set a watch on the inductive sensor. The tuning fork in the watch is near the 12 o'clock position. Place the watch so the tuning fork is at the center of the sensor. Turn the MicroSet level control all the way up and the LED should come on and stay on. This means the watch is running and MicroSet can sense the tuning fork. Press the BEGIN button and MicroSet will say:
    Blocks: 5...
This allows you to choose how many cycles to measure before a rate reading is returned. If you select "5 blocks" you'll get a reading about once every two seconds, depending on the frequency of the watch you are measuring. This is usually an adequate interval to get an accurate reading. If you prefer to get fewer readings over longer periods, press the PLUS button to increase the "Block" count. When ready to start measuring, press the BEGIN button. MicroSet will say:
    Rate:
When the first reading is ready, it will appear after the word "Rate". MicroSet will automatically adjust to the rate of the tuning fork and read out the rate as seconds per day of error.

You can also display the actual frequency of the tuning fork. To see this, press and release the MINUS button. The display will change to frequency of the fork. To return to error per day, press and release the PLUS button.

If you have the Windows Interface Program for MicroSet, you can capture Accutron watch rate over time on the computer. MicroSet must be configured to output Accutron rates as frequency. These rates will be displayed as a graph on the computer, and you can see the effect of temperature or position on the frequency of the tuning fork.

Balance Wheel Amplitude Mode

The Balance Wheel Amplitude Mode allows the Windows software to display an accurate view of the tick sound and calculate the balance wheel amplitude. Instructions for using the Balance Wheel Amplitude Mode will be found under the instructions for the Windows interface software, which is the next section.

The Balance Wheel Amplitude Mode

The Computer Interface in Depth

With the MicroSet Windows Interface Software you can record readings from the Watch Timer on a computer. This is a very powerful feature with great benefit to the watchmaker. You can view a simulation of a paper tape watch timer, measure balance wheel amplitude, or log the average rate of the watch over minutes or hours. You will find that, in most watches, the rate will change from one reading to the next. This happens for many reasons. With a personal computer connected to MicroSet, you can see how the rate changes over time and get a feeling for the range and stability of the watch you're working with. You can capture rate data for as long as you like and plot the changes to reveal the effects of positional error, spring tension, wheel errors, temperature change, and many other factors. The software presents live charts and running averages of rate changes, all of which can be saved on disk or printed on paper for later reference or to give to customers.

Installing the software

The MicroSet Watch Timer Pro software will work with versions of Windows from 95 to XP. The screen size must be at least 850 pixels wide to see the full window.

The MicroSet Watch Timer Pro software is provided on a CD. Put this into your computer and open the "Install" folder on it. There will be a program called "Setup.exe" within this folder. Run the Setup.exe file and follow the directions to install the software on your computer. After you have installed the software, the program "MicroSet Watch TImer Pro" should appear in your list of Programs under the Start Menu.

There is also a folder called "Support" on the CD. This folder contains the Watch Timer Pro software that can be dragged to your hard disk and run without an installer, if you have any problems installing the software.

Plug in the timer

A serial data cable is provided with the Watch Timer. Plug the small end of this cable into the jack labeled "Data Out" on the watch timer box. Plug the large end into the serial port of your computer. If your computer doesn't have a serial port but has a USB port, you will need to acquire a USB to serial adaptor. These are widely available, or one can be ordered from Mumford Micro Systems. If you install a USB to serial adaptor, it may come with software of it's own that needs to be installed.

Startup

Select "MicroSet Watch Timer Pro" from the list of Programs under the Start Menu. The first time you run MicroSet it will try to connect with the timer on the serial port known as "COM1". If you will be using the timer with serial port COM1, no adjustment will be necessary. But if COM1 is not available, a Setup window will appear where you can select the COM port you'll be using. The Setup window is shown below.

There are several parameters in the Setup window, but the only one that matters to us now is the COM port number. You must select the COM port that the timer is plugged in to.

If you're using a USB to serial adaptor, you may have to look at the Windows "Device Manager" to see which COM port was created by your USB adaptor. To see the Device Manager, right click on the "My Computer" icon, then select "Properties". In the window that appears, select the "Hardware" tab. Then click the "Device Manager" button. In the list of devices that appears, find "Ports (COM & LPT)" and open it to see the ports that

are in use. The COM port created by your USB to serial adaptor should be visible. Select this COM port number in the MicroSet Setup window.

After you have selected the correct COM port in the Setup window, you may click on "Save Settings". This will store the current settings to be used the next time you run the program. If you don't want to store the settings yet, just click on "OK".

If you selected a port that's not available, you'll get a warning message. To see what COM ports are available in your computer, use the Device Manager.
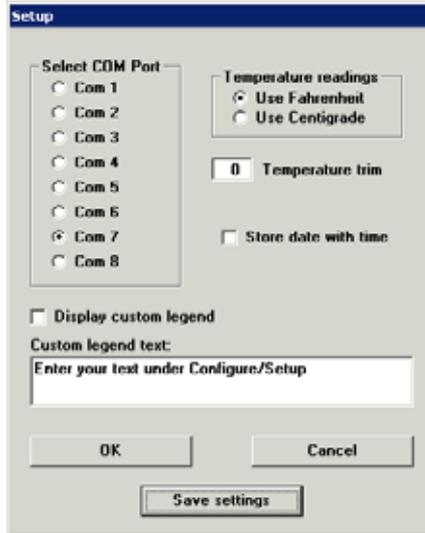
The Setup window

Getting ready to view watch data on the computer
There are several ways to see watch data on the computer. You can view average rate over time, you can view a simulation of a paper tape timer, and you can view an oscillogram of a single tick to analyze the balance wheel amplitude. We will cover each mode one after the other.

In general, to view watch data on the computer, you need to:
   1) plug the timer into the computer
   2) put the timer in one of the measurement modes
   3) tell the computer to start capturing the data

Near the top left corner of the computer screen is an area labeled "Plot" with two settings: On and Off. To tell the computer to start capturing data, you must click on the "Plot: On" button.

You can choose different modes of the MicroSet Watch Timer by pressing the keypad buttons on the timer.

With the Watch Timer Pro, you can also turn on the "Plot" and select different modes in the timer by clicking on a button in the remote control area at the top of the screen.
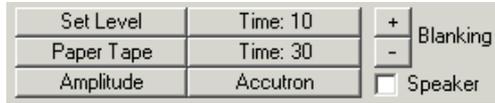
View the average watch rate
To view the average rate of a watch, use the MODE button to put the MicroSet Watch Timer in the Time Mode. You can also choose how many beats to measure. "Time: 10" will measure every ten beats, for example. You can also click on the "Time: 10" or "Time: 30" buttons in the remote control area of the computer screen.

The LED on the timer should blink with each beat, and new readings should appear on the LCD screen of the timer. The computer should now capture every new reading that appears on the MicroSet LCD screen, and the area on the computer screen labeled "# of samples" should start counting up.

You may not see the readings in the graph area if the scale is not correct for the rate of the watch you're measuring. Wait until there are at least three readings in the "# of samples" and then choose "Autoscale" from the Controls Menu, or click on the "Autoscale" button shown below. This will reset the Y axis to the proper scale so the current samples will fit the display area.

There are many controls with which to manipulate the way the data is displayed. You can change the type of graph or the scale of the readings. You can compute averages and show trends. The various tools available will be described later when the Menu commands are enumerated.

Learning to use the software
We have provided a sample file for you to use as we describe all of the functions in the program. You could also use live data captured from your own watch, but the sample file will make some explanations easier. Our explanation of the program will be a step-by-step explanation of each command. If you have questions, don't hesitate to call or send us an email.

Open the sample file
When the program starts up you will see the main screen of the program. An example of this is shown below. For the purpose of illustration we'll open a sample data file. Use the FILE menu to open the file "Time10.mst". This file was provided with the installation and should be in the same directory as the program itself. The extension "MST" stands for "MicroSet Timer".
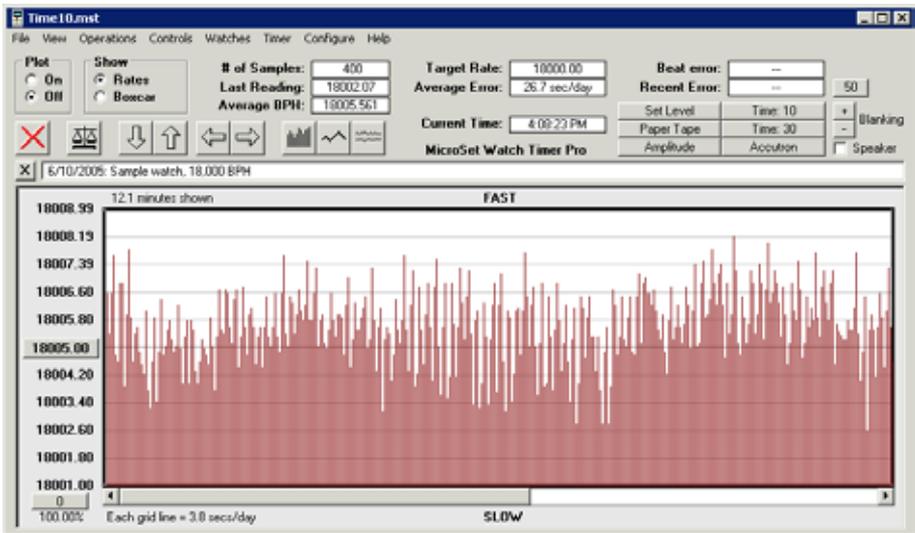
The basic display

Basic display
The sample data should appear in the graph on your screen (your screen may not be exactly identical to the example because of differences in screen sizes and types). The sample file was captured from an 18,000 BPH watch movement. Each reading represents ten beats of the watch (MicroSet was set to "Time: 10").

At the left edge of the graph you will see labels indicating the beat times in "Beats per Hour". The MIDPOINT of the graph is set at 18,005.00 BPH. This number appears in a button in the middle of the Y axis, at the left side of the screen

At the top of the screen you will see that the program currently holds 400 "Samples". This means it stores 400 different readings from the MicroSet timer. You can also see that the last reading it received was 1802.07 BPH, and the accumulated average rate of this watch over the entire 400 samples was 1805.561 BPH. This number is very significant. Though the watch rate is always changing, the watch hands show the accumulated average rate.

Set the midpoint
Look again at the button in the middle of the Y axis. This shows you the MIDPOINT of the graph is at 18005.00 BPH. If you look near the top of the screen, you'll see that the "Target Rate" for this watch has been specified as "18000.00". The target rate is the correct rate for the watch. To see how the data in the graph relates to the correct rate for this watch, click on the button in the middle of the Y axis. A dialog will appear on the screen and let you manually enter new values for the graph parameters. You will be able to specify a new MIDPOINT for the graph, automatically set the midpoint to the current average, or set the midpoint to the "target" rate for this watch. You will also be able to specify a "step size" for the grid lines. If the step size is made smaller you will, in effect, "zoom in" on more subtle rate changes. If the step size is made larger you will "zoom out" on rate changes. You can also zoom in and out with the up and down arrow buttons at the top of the screen or with the up and down arrow keys.

For now, click on "Lock midpoint to target rate". The graph will be redrawn with the target rate at the midpoint. But now the data fills the screen and you can't see the top of it. It's too big for the current screen settings. Press the down arrow key once, and the tops of the data lines will come into view. We have "zoomed out" to see the data range.

In the graph, each vertical line represents one reading. The beat times change quite a bit in this graph, which is not uncommon. Better watches will have a more consistent rate, and the rate will appear more consistent if we were to measure more than ten beats.

At the lower left corner of the graph you'll see a label that tells you how much rate change is represented by each horizontal grid line. In this example the value is 7.7 seconds per day. The variation in line height spans about two grid lines. So the watch may speed up and slows down by about 15 seconds per day between each reading. This is not a fault in the timer. This is how the watch runs.

At the top left corner of the graph you'll see the message "13.3 minutes shown". This tells you that the data visible in this graph required 13.3 minutes to gather.

The Comment line

Directly above the graph is a framed rectangle with text in it. You can use this area to record your notes about what the data in the file represents. To enter text in this area, just point at it with the mouse and click. You can then enter your text. On new data files the program automatically puts today's date in this field. You can then add the name of the watch that was studied or any other conditions you might want to remember (like type of watch, the number of beats per reading, or the particular issue you were looking at). Any information you enter in this rectangle will be recorded on disk with the data so you can see it any time you open this file.

You can quickly erase the contents of this comment line by clicking in the "X" to the left of it.

You can make this comment area larger by selecting "Large Comment Window" from the View Menu.

The Icon Controls

Above the comment line is a row of icons. These are shortcut commands to manipulate the graph and the data it shows. Each icon is an active button that will change the graph in some way.

Reset

The first icon has a red "X" in it. This is to RESET the graph. If you click on this icon all the data will be erased. If you want to try this, go ahead. Then load the sample file again from the FILE menu.

Autoscale

The second icon looks like a "balance" or "scale". This is used to automatically scale the Y axis values so the current beat times fit nicely in the window.

Vertical scale

Next to the autoscale icon are two icons that look like up and down arrows. The down arrow reduces the vertical resolution of the graph and allows bigger (taller) values to fit. This has the effect of "zooming out". The up arrow increases the vertical resolution to reveal more subtle changes in rate times. This has the effect of "zooming in". Click on the UP icon. The beat times seem to get bigger. This is because the step size between grid lines has become smaller and we are more sensitive to rate changes. You can also select these functions by typing the up or down arrow keys on the keyboard.

Click on the AUTOSCALE icon to re-scale the data in the sample file to fit the screen. Now click the DOWN icon four times, until it looks like the rate doesn't change very much in this watch. When viewed this way, the rate of the watch looks pretty good. To get a frame of reference for what kind of scale the graph represents, look at the bottom left corner of the graph where the scale of each grid line is shown. With the data "zoomed out" so it looks like the watch is more accurate, you'll find that each grid line might represent a very big rate change.

Hit the UP ARROW icon a few times to zoom in on the data. Watch the message at the lower left corner of the graph, and zoom in until you get just a couple of seconds per day in rate change for each grid line. In this watch, the graph will completely fill the screen.

When you look at a graph, you must pay attention to the scale. Any watch will look good viewed at a coarse scale, and any watch will look terrible when viewed on a very fine scale.

Horizontal scale

The next two icons look like left and right arrows. They're used to expand or compress the data graph horizontally. At the very lower left corner of the screen you will see a scale factor. Normally this is "100%". If you click on the LEFT ARROW icon, the horizontal scale will compress and this number will get smaller, indicating that not every data point is displayed. If you click on the RIGHT ARROW icon the horizontal scale will expand to show the entire data set. If you expand beyond 100% the data lines will get fatter. This can make it easier to see individual items. You can also select these functions by typing the left or right arrow keys on the keyboard.

In addition to these controls, there are commands under the View Menu to quickly compress the horizontal scale so all data points fit on the screen or expand the scale to 100% so every sample is visible (even though they may not all fit on the screen).

Graph type

The next icons let you select which type of graph is used to display the data. The first type uses vertical bars to represent each sample. The advantage of the vertical bars is that they make it easy to see how many readings occurred between different peaks or

troughs in the data. The second graph type shows one wandering line that follows the rate. The third graph type generates a simulation of traditional paper tape watch timer.

Plot On/Off

Above the icon controls, at the left side of the screen, is an area labeled "Plot" with two buttons under it: "On" and "Off". This is how you tell the program to start collecting new data from your watch.

The MicroSet timer can be configured to read out in either "Seconds Per Beat" or "Beats Per Hour". No matter how you have MicroSet configured, it will always send data to the computer as Seconds Per Beat. If you prefer to use Beats Per Hour, you can tell the Windows program to convert the Seconds readings from the timer into Beats Per Hour (look under the View Menu for this command).

If your watch bench is far from your computer you can use an extension cable for stereo headphones to extend the reach of your data cable. They both use 1/8" stereo phone plugs.

Before you start recording new data, hit the RESET icon to clear out any previous data. Be sure the horizontal scale is set to 100%. Otherwise, you might be fooled because not all new readings will be displayed in the compressed modes. You may even want to "fatten up" the plot lines with the RIGHT ARROW icon to make the first few data points easier to see.

Set the timer to the Time Mode. You may set it to any number of readings you like, from 1 to 254. Smaller numbers will give you results more quickly, larger numbers will give you more accurate readings. But don't use an odd number unless you have a specific reason to. Odd numbers of beats will appear jumpy because of beat error. So use "Time: 10" or "Time: 30" and don't use "Time: 15" or "Time: 31". The most accurate number to use is twice the number of teeth on the escape wheel.

Hit the BEGIN button on the timer to start sampling. Click the "On" button in the "Plot" area of the computer screen. As each new rate value appears on the LCD screen of the timer, it should also appear in the data graph on the computer. The "# of samples" at the top of the screen should increase with each reading. To stop capturing data you can either click on the "Plot: Off" button on the computer screen or hit the "MODE" button on the timer.

The computer interface will make it easy to see that the timer readings are more accurate when the timer is set to measure more beats (Time: 60 will be more accurate than Time: 4). If you set the timer to measure 4 beats, the graph will be jumpy. If you set the timer to measure 60 beats, the graph will be more consistent.

The program will currently store 90,000 samples before it gets full. When it gets full, the "Plot: On" setting will change to "Plot: Off". If you take a reading from an 18,000 BPH watch every 30 beats, you will be able to capture data for more than six days before the program fills up.

Show averages or rates

To the right of the "Plot On/Off" area is an area labeled "Show" with buttons for "Rates" and "Averages". It's possible to calculate and display two different kinds of averages and several other manipulations on the data set. (These calculations are available under the Operations Menu and will be described in more detail when the MENU commands are covered.)

Storage for the alternate calculations is kept separate from the main data, and you can switch back and forth between AVERAGE results and RATES by clicking on one of the "Show" buttons. When original Rate times are displayed the graph will be in dark red. When Averages are displayed the graph will be in blue. You can select which data set is displayed (rates or averages) with the buttons in the Show area. Note that, when a file is saved on disk, only the RATES data (the red data) is saved.

If "Averages" are selected while new data is coming in from the timer, the current average type will be displayed for each new reading. For example, if you have selected "Running Average", the software will display the running average rate of a watch over long periods of time. If you have selected "Boxcar Average", the boxcar value will be calculated for each new reading.

File Statistics

# of Samples:	400	Target Rate:	18000.00	Beat error:	---
Last Reading:	18002.07	Average Error:	26.7 sec/day	Recent Error:	---
Average BPH:	18005.561				

To the right of the "Show: Rates/Averages" area are several statistics about the data currently captured in the computer. First shown is the "# of Samples". In the sample file provided there are 400 samples. This means that the timer completed 400 separate readings and reported them to the computer..

The "Last Reading" shows the last value that was returned from the timer unit.

The "Average BPH" shows the total accumulated average rate of the watch over the study period. This value is calculated by adding all of the rate times together and dividing by the number of samples. This reading tells you actual accumulated rate of the watch — which is what the hands show you.

The "Target Rate" is the correct rate for the watch under study. The program does not calculate this value — you must enter it yourself. If you know what the correct rate for the watch is, you can enter it by clicking on the value shown for the "Target Rate". A dialog will appear to let you enter a new value. Once the program knows what the correct rate for the watch is, it can calculate the average error.

Below the "Target Rate" is a box called "Average Error". It will display the amount of error in the current data set by comparing the current average rate with the target rate you have entered. This will show you how many seconds of error per day there are in the current data set. A positive number indicates the watch is fast, a negative number means it's slow. If the Target Rate is not known you should set it to zero, and the Average Error cannot be calculated.

Below the Average Error value is the "Current time" of day. It's handy to have this reminder on screen because the system clock in the computer may be inaccurate and need correction. The MicroSet program records the time of day when each sample comes in. This information is useful because you might want to correlate rate changes to things that happen at specific times. For example, you might want to correlate the rate readings with the position of the watch hands. Keep an eye on the time of day shown and, when it's wrong, correct the system clock in your computer.

In the last column are labels for Beat Error and Recent Error. These functions are active only in the paper tape simulation, which we will describe later.

Remote control

Set Level	Time: 10	+	Blanking
Paper Tape	Time: 30	-	
Amplitude	Accutron	☐ Speaker	

Below the Beat Error and Recent Error boxes are the "Remote Control" buttons. These buttons communicate directly with the MicroSet Watch Timer Pro and allow you to use a single button click to configure both the Windows software and the timer hardware to use a particular function.

Set Level is used to adjust the Level control of the timer for optimum rate and paper tape readings.

Paper Tape initiates the paper tape simulation.

Amplitude initiates the measurement of balance wheel amplitude.

Time 10 initiates a rate measurement of every ten beats of the watch.

Time 30 initiates a rate measurement of every thirty beats of the watch.

Accutron initiates the measurement of Accutron watches.

The Plus and Minus buttons by the word "Blanking" allow you to increase or decrease the size of the Blanking Window in the MicroSet timer.

The "Speaker" check box allows you to turn the built-in beat amplifier on or off from the computer screen.

Manipulations on the data points in the graph area

Seeing individual data points
It's possible to display the values associated with individual data points. When the mouse pointer is over the graph window, it takes on the shape of a cross hair. If you position this cross hair over a particular data line and click the left mouse button, a line of text will appear at the top left corner of the graph which identifies that sample number, the value of that sample, and the time and date that sample was acquired. You can drag the crosshair through the data and see different data points.

Changing individual values
If you position the cursor over a data point in the graph and click the right mouse button, you will be given an opportunity to change the value stored for that sample. This allows you to correct erroneous readings. You can either enter a new value manually, let the

program automatically calculate the average of the two adjoining points, or delete the sample.

Measuring a range
If you hold down the left mouse button, then drag from one data point to another and release the mouse button, the text display at the top of the graph will show you the number of samples that were spanned by your selection, the amount of change from beginning to end, the average value of the samples you spanned, and the time difference between them. This allows you to identify the time intervals that produce visual effects in the data graph.

Delete a sample
Once you have specified a single data point by clicking on it with the left mouse button, or a range of points by dragging over them, you can delete them by hitting the DELETE key.

Arrow keys
The arrow keys on the keyboard have the same effect as the arrow icons to expand or compress the horizontal and vertical scales of the graph.

If you hold down the **CONTROL** key when you press the up or down arrow keys, the midpoint of the graph will change rather than the vertical scale. This has the effect of letting you see data that's above or below the top and bottom edges of the graph.

Normally, when you press the left or right arrow keys, the horizontal scale of the graph will expand or compress by a factor of two. If you hold down the **SHIFT** key when you press the right or left arrow keys, you can expand or compress the horizontal scale of the graph in smaller increments.

If you hold down the **CONTROL** key when you press the right or left arrow keys, the display will scroll right or left by the size of one screen width.

If the screen is in a compressed horizontal scale, the indicator at the bottom left corner will say something less than 100%. You can automatically expand the scale to 100% and set the left border by holding the **CONTROL** key down and clicking on any data point. That data point will be placed at the left border of the graph.

Setting the left viewing margin
There is a small button in the lower left corner of the screen, just below the labels on the Y axis. This button normally has the number "0" in it. This is the left margin of the samples you can view. MicroSet can capture up to 90,000 samples, but Windows will not let a scroll bar manipulate more than 32,767 samples. If you capture a huge data file (larger than 32,767 samples) you can click on this Left Margin Button and set the left margin to an offset. For example, if you set the left margin to 10,000, you'll be able to view and scroll through samples 10,000 to 42,767.

Redraw the screen
You can redraw the current data by clicking on the text box which shows the current number of samples.

The MENU Commands

The FILE Menu

The File Menu lets you store and retrieve data files.

Open lets you open a data file that has been previously saved on disk.

Save lets you save current data file on disk.

Save As lets you save current data file on disk with a new name.

Save A Subset As

This command lets you save a subset of the current data file on disk with a new name. The purpose of this command is to reduce the size of a data file. For example, suppose you captured a data file with a new sample every ten seconds. Let's further suppose that, when you examine the data, you find that one sample each minute would have been adequate. This command will let you save a file with only one sample per minute.

When you select Save A Subset As you will be asked to enter the number of samples you wish to skip for every sample saved. For example, to save one sample every minute from a file of one sample every ten seconds, you would enter 5 -- for every 6 samples, one will be saved. The smaller file is saved under the name you give it. The file in memory is not changed. If you wish to see the smaller file, you must open it with the OPEN command.

Print lets you print an image of the current graph on your printer.

Exit terminates the program and returns to Windows.

The View Menu

The View Menu gives you several commands that manipulate the graph.

Fit in window
This will compress the horizontal scale as necessary so that the entire duration of the current file will fit on the screen. This lets you step back and look at the overall result of the entire sample period.

Expand to 100%
This will expand the horizontal scale to 100% and lets you see every data point that will fit within the screen width.

Show temperature
This selection will allow you to display temperature and rate simultaneously if you have added a temperature sensor to your timer. This allows you to see how changes in temperature affects a watch.

When you select Show Temperature a new Y axis will be added to the right side of the graph to show temperature readings. The middle point of these values has a button around it, and if you click on this button, a control window will open. This window will let you enter ranges for the temperature display and whether to use a line graph or columns for the temperature data. The temperature data is shown in green. If you have captured temperature data, it must be showing when you save the file if you want to save the temperature data. If you turn off the temperature display (under the View Menu) you can save a file without temperature values so it will be compatible with people who don't have this feature. **The temperature data must be visible on screen when you save the file, or the temperature data will not be saved.**

Show/Hide gridlines
The next selection under the View Menu is "Show/Hide gridlines". You may find that the gray gridlines become distracting. You can turn the gridlines on or off with this menu item.

Large comment window
This selection will enlarge the size of the comment area, so you can enter a longer description of the data you are viewing.

Display custom legend
This selection will allow you to add a custom message to your screen display. People use this to display their shop name on each graph as a sales tool when they give customers a printout. You can specify what text to use in the Setup window (under the Configure Menu).

Show seconds per beat
This command will configure the graph to display rate data in the form of Seconds Per Beat. For example, a watch that beats 18,000 Beats Per Hour would have a beat time of .200000 Seconds Per Beat. The Y axis is labeled to six decimal places.

Show beats per hour
This command will configure the graph to display rate data in the form of Beats Per Hour.

Show error per day
This command will label the Y axis in terms of error in seconds per day. To perform this calculation you must have entered a "Target Rate" at the top of the screen. When showing error per day, the midpoint of the graph will be set to the target rate but displayed as zero. Each grid line will be labeled as error in seconds per day from the specified target rate. If the error is too great to be reasonable, the program will not enter this mode.

The Operations Menu

This menu provides several commands to alter either the data stored in memory or the way the data is gathered.

Running average

The Running Average is the accumulated average rate of the watch at each sample point. This is, in effect, what the watch hands show you. When you select this command, the program will go through the data and calculate the accumulated average. The average results are stored in the "alternate" (blue) data area. You can switch between the Running Average and actual Rates by clicking on the "Show Rates" or "Show Averages" buttons at the top left corner of the screen. When the average values are shown the color of the graph changes from red to blue and the "Averages" button in the "Show" area at the top left corner of the screen is selected.
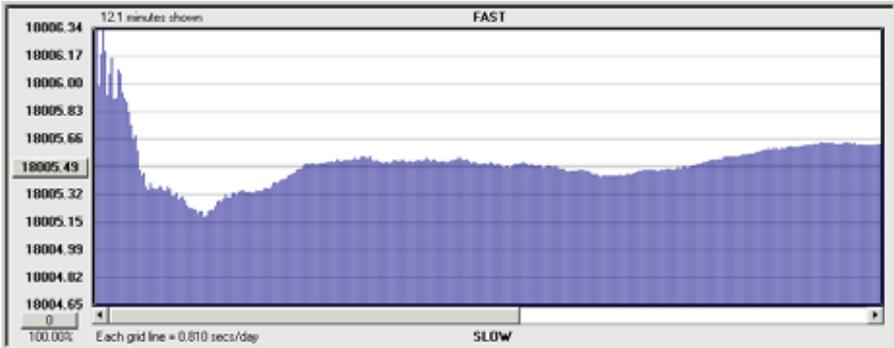
Running average

The hands of a watch show the accumulated average rate. We have seen that individual samples from a watch will vary over time, and that higher settings of the MicroSet Time Mode produce more consistent readings (you get more accurate results if you set MicroSet to "Time: 60" than if you set it to "Time: 2"). For similar reasons, if you record the watch with the average mode for ten minutes you'll get a better idea of what the rate of that watch really is, because the fluctuations of rate that occur over shorter periods are averaged out.

For a demonstration of this, load the sample file Time10.mst. You see that the rate changes continuously. Now select "Running Average" from the OPERATIONS menu. You will see that the rate quickly forms a gradual slope that reaches an average rate. This is really how this watch runs. Each reading is very different from it's neighbors, but over time these changes average out to a "flat" rate. But the rate is never truly flat. There are always changes happening in the movement to produce irregularities.

Once you set the software to show the running average you can leave it alone, and all new readings will automatically be averaged before they are plotted. In this way you can just let a watch run for as long as you like and you'll be able to easily see when the average rate has become stable.

Boxcar average

This is also known as a "moving" average. When you select this command, a window will appear and ask you for the "boxcar" size. Enter a number, and after you click on OK, the program will go through the data and calculate an average of the "boxcar" number of

samples through the whole data file. For example, if you enter a boxcar size of 10, the tenth sample will be set to the average of samples one through ten. The eleventh sample will be set to the average of samples two through eleven, and so on. The average results are stored in the "alternate" (blue) data area and the original readings are preserved in the main (red) data area, so you can perform the boxcar calculation over and over with a different boxcar size to see different results.

You can view either Rates or Boxcar Averages by clicking on the "Show Rates" or "Show Boxcar" buttons at the top left corner of the screen. When the Boxcar Average values are shown the color of the graph changes from red to blue, the label "Averages" changes to "Boxcar", and the "Averages" button in the "Show" area at the top left corner of the screen is selected.

The effect of the Boxcar Average is to reduce short term fluctuations of rate. This is also called a "low pass filter". The Boxcar Average will smooth out the jumpiness of each reading, but will allow you to see when the rate is generally speeding up or slowing down over longer periods of time. By choosing increasingly large boxcar sizes, you increasingly reduce the effect of short term fluctuations and increasingly reveal longer term fluctuations that might otherwise be hidden in the data.
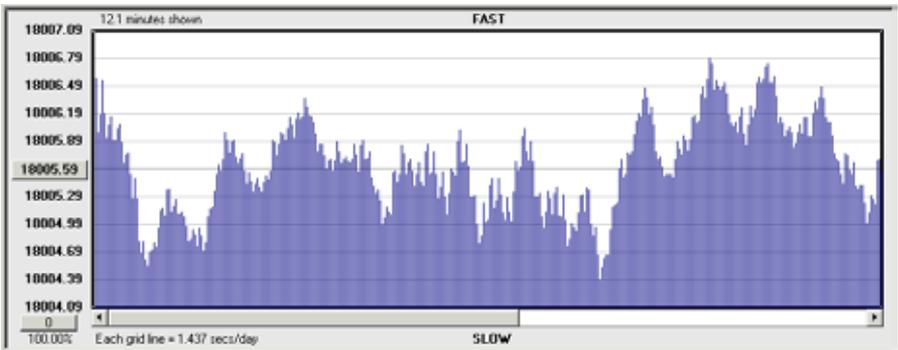
Boxcar average

To see for yourself, open the Time10.mst sample file. Now choose "Boxcar average" from the OPERATIONS menu and enter a boxcar size of 10. This result will appear less jumpy than the original data. In addition, we begin to see some cycles in the data. Click on the Autoscale icon to maximize the scale. The result is shown above. You can see several peaks in the data. If you move the cursor to one of the peaks, hold down the left mouse button, drag to the next peak, and release the mouse button, you will see that the interval between peaks is about one minute. This watch speeds up and slows down every minute, no doubt because of some issue with the wheelwork or hands. This may be a clue for servicing.

There is also a longer period oscillation in this data. Choose Boxcar Average again, and enter the number 60. Then click on the Autoscale icon again. Now the frequent peaks are gone, and you can see two humps with a period of about 6.8 minutes. This was caused by some other component of the movement.

The Boxcar Average reveals changes in rate that are masked by jumpy readings.

Difference / Rate of change

This command will examine the data and show you the difference between each subsequent reading. It gives you a way of analyzing how a watch is changing as opposed to what it's absolute rate is.

When you select this function the data graph will turn blue to indicate that you're looking at the "alternate" data area. The raw rate information is undisturbed in the red (main) data area. The midpoint of the graph is set to zero, and each reading is displayed as the difference between it and the preceding sample. Values are shown as seconds to six decimal places.

Percentage change

This command is very similar to the previous one, but it shows you the readings as a percentage of change from the previous value rather than as absolute fractions of a second.

Gain/Loss

This command will convert the rate of a watch into the absolute gain or loss in seconds of time. Up to now we've been viewing the data in terms of how fast or slow each beat is. This command shows us how fast or slow the whole watch is over time. The midpoint of the graph is set to zero, and each reading is displayed as how fast or slow the watch is at that instant. In other words, if the watch has lost a second by sample 150, sample 150 will have a value of 1.0. Positive numbers indicate loss, negative numbers indicate gain.
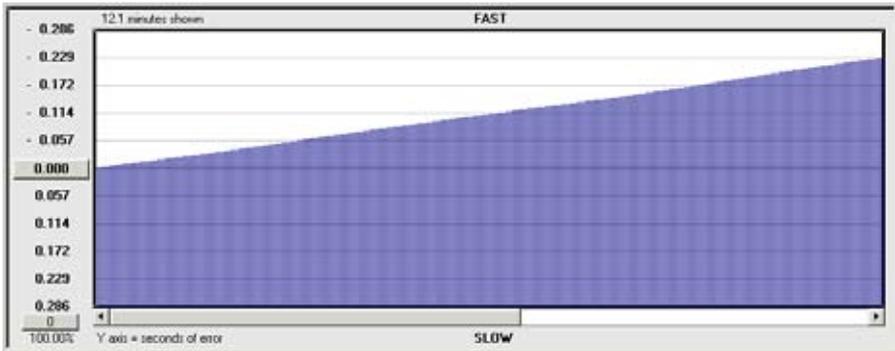
Gain/Loss

In our sample file, the Gain/Loss function shows that the watch is generally gaining and has gained about .229 seconds in 12 minutes.

One way in which this function could be useful is as follows. Suppose you have a watch that doesn't keep time. Suppose you've used MicroSet to adjust the rate, but the watch still loses time. The problem could be that the hands are slipping even though the watch is beating correctly. If you set the watch to the correct time and let it run for a few hours or longer, you can compare the amount of time the hands show have been gained or lost with the amount of time that the computer tells you have been gained or lost. The computer will give you the answer according to the beating of the watch . The watch will give you an answer according to the motion of the hnads. If the results are not the same, there may be a problem in the hands.

Remove noise
This command will eliminate samples that are so far out of scale with the other readings that they can only be attributed to "noise". To use this command, scale the data on screen so all the legitimate samples easily fit between the top and bottom boundaries of the screen, and the flawed data points extend off the screen. When you select "Remove noise", any data point that is outside the range of the maximum and minimum values on the Y axis will be set to the average of the two neighboring points.

Use this function with care. Don't be too quick to judge that a data point just CAN'T be real. Sometimes these outliers are real, and evidence of unexpected behavior.

Pre-average new data
This command will average several readings internally before it plots a new value on the screen. It was added to facilitate certain kinds of experimental work. It's basic operation allows you to take readings for much longer periods of time. When you select this command, a dialog will appear and ask you to enter the number of samples you want to pre-average. Let's say you enter 60. The software will then take 60 readings from the timer, average them together, and plot the result. If the timer had also been set to "Time: 60", you would get one data point in the graph for every 3600 beats of the watch. In this way you can multiply the Time Mode setting of MicroSet and get readings over intervals much longer than the usual limit of "Time: 254". This lets you capture data for very long periods of time without collecting a large number of samples. It's easy to forget that the pre-average is on, however, so be sure to remember when you use it. To disable pre-averaging, set the value to zero.

Skip samples
This command is similar to "Pre-average new data", except that it simply skips a specified number of samples rather than averaging them together before they're recorded. In most cases, you'll want to "pre-average" readings rather than skip them because you care about what the watch is doing between readings.

Modify datasets
This command will allow you to modify the data stored in the program. There are a couple of uses for this function. For example, let's suppose you have gathered several hours worth of rate data on a very accurate watch and the watch is running fast by 10 microseconds per beat. Perhaps you'd like to evaluate variations in the watch performance as if it were running exactly to rate. You can simulate this adjustment by adding 10 microseconds (.000010) to every rate reading. The result will represent how the watch rate would look if it were possible to correct the average rate without disturbing the watch whatsoever. The inherent fluctuations will still occur, we simply adjust the balance "mathematically" as opposed to actually.

There are two data areas in MicroSet -- the "main" data area and the "alternate" data area. The main data area appears red, the alternate data area appears blue. When new data is captured it is stored in the main data area. When you save a file, it is the main data area that gets saved. The alternate data area is used for some of the calculations, like "Boxcar average" or "Running average". The alternate data area also stores the results of the "Modify datasets" command.

The "Modify datasets" command brings up a dialog where you can select several options. Two buttons let you choose to modify the main dataset or the alternate dataset. Which dataset you modify depends on what you want to do. If you modify the main dataset, the results of your modification will be stored in the alternate data area so your original

data will not be lost. If you modify the alternate dataset, the results will be stored back into the alternate data area and overwrite the data you operated on.
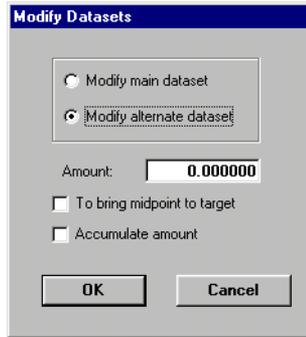
Modify datasets dialog

A text box lets you enter the Amount by which to adjust the dataset. The number you enter will be added to every value in the dataset. To subtract a value, enter a negative number.

A check box lets you choose to have the program automatically enter the amount of correction needed to bring the current midpoint of the graph to the specified target rate. This is useful if you have rate data captured for a watch that's not running exactly on time. Set the midpoint of the graph to the current average rate. Be sure the correct rate of the watch has been entered in the "Target Rate" area. If you check the box "To bring midpoint to target", the value needed to bring the average rate to the target rate will be calculated and entered in the AMOUNT field.

A check box lets you choose whether or not to have the AMOUNT "accumulate". If you click on "Accumulate amount", the amount you enter will be added to the first data element, twice that amount will be added to the second data element, three times that amount will be added to the third data element, and so on.

When you have the MODIFY DATASETS dialog configured the way you want, click on "OK". The operation will be performed and the results will be shown to you in the alternate data area (the blue dataset). If you modified the main dataset, you can do it again, as many times as you like with different values, because the main data area is left unchanged. If you modified the alternate dataset, you will have overwritten the previous values in the alternate data area.

Exchange data sets
This command will let you exchange the normal (red) data set with the alternate (blue) data set. When you save a file in MicroSet, only the normal (red) data area is saved. If you want to store the result of some operation that has put data in the blue data area, you will need to exchange the data sets to put the values in the red data area so you can save the.

Keep in mind that, if you exchange data sets and then save the file, your raw original data will not be stored on disk. If you wish to preserve the original data, be sure to save it on disk before you exchange it for the result of some calculation.

Change time stamps

Every time a reading is captured by the Windows interface program and stored, the time of day is recorded for that sample. This allows you to go back later and correlate changes in the data with motion of the watch hands, the temperature in the room, etc. If the clock in your computer is set correctly, the time stamp will usually be correct. If you notice that your computer clock was wrong after you've collected some data, this command will let you correct the time stamps in your data file. Or, if you have purchased the optional Data Capture memory for MicroSet (which allows you to capture readings while you're away from a computer), you will need to reset the time stamps of the captured readings.
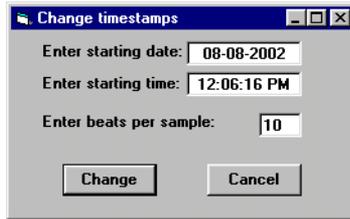
Change timestamps

When you select this function, a dialog will appear that lets you enter the conditions for time stamp calculation. You must enter the date of the first sample, the time of day of the first sample, and the number of beats between each sample. This last number may require a little thought.

If you had MicroSet to "Time: 30" then there would be 30 beats between each sample **unless** you also had the Windows Interface Program set to pre-average or skip some samples.

If you're using the MicroSet Data Capture memory, you may also need to think about how many beats per sample there are. If you had MicroSet configured to "Time: 30" beats and had the Data Capture set to "10", you would capture one reading after 30 beats and you would not capture the next "9 times 30" beats. In other words, there were 300 beats per sample.

After entering the correct parameters, click on the "Change" button and the timestamps in the file will be changed. You will see no outward effect, but the time stamps can be viewed by clicking the left mouse button when the cursor is over a data sample.

The Controls Menu

This menu makes many of the commands that are usually accessed with mouse clicks available as menu items. This is a convenience for people who prefer to use the keyboard rather than the mouse.

Plot On
  Starts capturing readings from the timer.
Plot Off
  Stops capturing readings from the timer.
Show Rates
  Displays the main data area (the red data).
Show Averages
  Displays the alternate data area (the blue data).
Refresh display
  Redraws the graph
Recalculate average
  Recalculates the Average Rate value
Set Target Rate
  Sets the "target rate" (the correct rate) for the watch under study
Delete all data
  Empties the graph. Same as clicking on the red "X" icon.
Autoscale
  Scales the data to fit on the screen. Same as clicking on the red autoscale icon.
Reduce vertical scale
  Compresses the vertical scale. Same as clicking on the down arrow icon.
Move down
  Moves the data lower on the vertical scale.
Increase vertical scale
  Expands the vertical scale. Same as clicking on the up arrow icon.
Move up
  Moves the data higher on the vertical scale.
Halve horizontal scale
  Compresses the horizontal scale by half. Same as clicking on the left arrow icon.
Reduce horizontal scale
  Compresses the horizontal scale by a small amount.
Double horizontal scale
  Doubles the horizontal scale. Same as clicking on the right arrow icon.
Expand horizontal scale
  Expands the horizontal scale by a small amount.
Bar graph
  Displays the data in column format. Same as clicking on the bar graph icon.
Line graph
  Displays the data in line format. Same as clicking on the line graph icon.

The Watches Menu

This menu accesses several watch related functions.

Get watch data

The MicroSet Watch Timer Pro comes with a data file that contains beat times and lift angles used by many watch manufacturers. You can refer to this data file to get an idea of the likely specifications for a watch you're working on.

When you choose "Get watch data" a dialog will let you open the file. The file will be stored on your hard disk in the same location as the MicroSet program is stored. The name of the file is "WatchDataFile.txt". When you open this file, a window will show you all the watches it contains.

Watch data file

You can click on any entry visible in the window, or scroll down to see more listings. If you identify a watch you want to use, click on its entry in the window and then click on the Choose button, or just double-click the item. This will set the Target Rate and Lift Angle in the MicroSet software to the specified value. It will also enter these values in the comment line at the top of the graph.

Paper tape simulation

This remarkable features allows MicroSet to simulate an traditional paper tape style of watch timing machine, like Vibrograph and Tickoprint. These machines print a dot on a paper tape for each beat of the watch. You can tell if the watch is fast or slow, and many other things, by analyzing the pattern of dots. Many people have become skilled in the use of these machines. MicroSet will allow you to perform the same kinds of analyses on the computer screen but with much greater accuracy, flexibility, and more quietly. Examples of some paper tape patterns associated with different problems can be seen in the back of this instruction manual.

After you select "Paper tape simulation" from the Watches Menu you must put the MicroSet timer in the mode to read a single beat: "Time: 1". On the LCD screen you will see individual beat times changing very quickly with each beat of the watch. Be sure the "Plot: On" button is selected.

If you click on the "Paper Tape" button in the remote control area, everything should be set up for you.

If a Target Rate has not already been set, MicroSet will ask you for the correct rate of the watch. Enter this value and MicroSet will display the paper tape simulation. MicroSet will now show you each beat of the watch as a dot on the screen. If the watch is running close to rate and with little beat error, you will see two nearly parallel lines similar to the sample shown below.

You may need to adjust the Level control on MicroSet to get the best result. There are three primary components to a watch tick. If the Level is not high enough you may trigger on the second or third sound rather than the first. You want to find a setting where the two rows of dots are closest together and most stable.
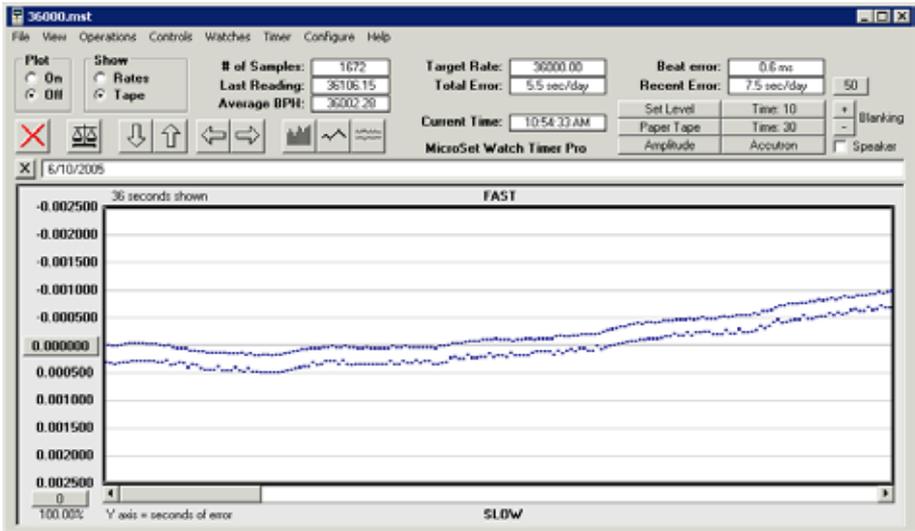
Paper tape simulation

Each row of dots is one side of the beat (one pallet). If the watch is very fast or very slow, the slope of the lines may be so extreme that you don't see them as simple parallel lines. In this case, click on the "down arrow" icon to reduce the vertical scale of the display until you can see two lines at some slope.

If the two lines are very close together you can easily "zoom in" on them to more accurately see the dot pattern. Just click on the "up arrow" icon or type the up arrow key to increase the vertical resolution until you can easily see the separation between the two lines.

With conventional paper tape timers you would use a protractor to measure the slope of the lines to derive the amount of error per day. With MicroSet we can view this value much more easily by simply looking at the top of the screen where the Total Error is

displayed. As long as the Target Rate was entered correctly, the Total Error will correctly show you the total error per day of the watch.

To the right of this is a box labeled "Beat Error". This displays the current beat error of the watch in milliseconds.

Below this is a box labeled "Recent Error". This is the recent rate error of the watch, as opposed to the Total Error. To the right of the Recent Error value is a number in a box. This shows you how many beats were used to calculate the Recent Error. The default value is "50". In this case, the Recent Error is the rate of the watch over the last 50 beats. You can change the number of beats used by clicking on the number "50".

The Recent Error value is useful if you're working on the watch. For example, if you change the position of the watch, you can simply wait for 50 beats to go by and read the rate in the new position.

The Total Error shows you the rate over the whole time the software has been measuring the watch. You may wish to let the software record the watch rate for a long time. The Total Error will show you what the overall total rate for the watch is. The Recent Error will show you if the rate the watch is CURRENTLY running at is different than the combined total rate.

Manipulations of the paper tape
As with a paper tape timer, if the data lines wander off the edge of the "tape", they will wrap back on at the other side. If the slope is very steep it can be difficult to evaluate fluctuations in the rate because they can be "swamped" by the slope of a rate error. The computer makes it easy for us to eliminate this problem. If you click on the "Autoscale" icon, MicroSet will automatically change the Target Rate to be equal to the current Average Rate. The effect of this is to remove the slope of the lines caused by rate error, because there is now, at least theoretically, no rate error at all. The lines will lose their slope and become roughly horizontal, and you can see irregularities in them much more easily.

Paper tape machines had no choice but to display single dots for each beat. With the MicroSet software, when a watch is erratic and the dots are not arranged in nice parallel lines, you may be able to view the data more easily by clicking on the "vertical lines" graph style icon. The information displayed is still the same, but you can more easily see how an "outlying dot" relates to the dots around it. To return to the conventional paper tape display, click on the "Paper Tape" graph style icon.


Of course you can also zoom in and out of the paper tape display with the up and down arrow icons or the keyboard.

If you wish to leave the paper tape mode, click on the "Show: Rates" button at the top left corner of the screen. This will revert to a vertical line graph of each beat.

The vertical line display mode is a good way of being sure you have the Level control adjusted properly for the Paper Tape Mode. Every other line should be higher or lower than it's neighbor in a perfectly regular pattern. In the sample below you can see an example of this display. The first half of the data was captured with the Level control set too low. The beat readings are erratic. The second half shows the same watch with the

level control set correctly. Now the beat readings are perfectly regular. It's a good idea to set the Level control this way before you use the paper tape display. To automatically go to this display mode, click on the "Set Level" button in the remote control area of the Windows program.
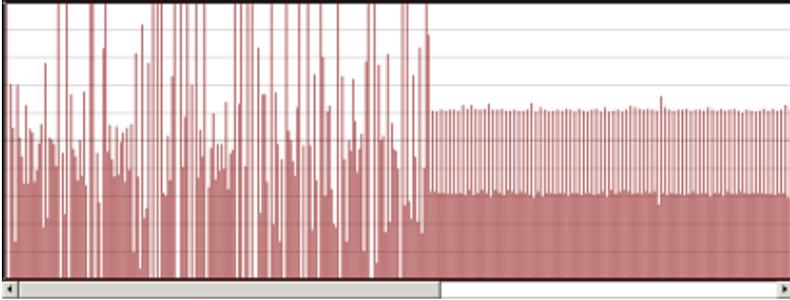
Adjusting the Level control

Accutron Rate
The next item under the Watches Menu allows you to capture the rate of Accutron and other tuning fork watches on the computer. Plug the optional Accutron sensor into the timer's Sensor In jack. Set a tuning fork watch on the sensor so the 12 o'clock position is near the center of the sensor. Press the MODE button on the timer until the LCD screen says "Accutron..." and press BEGIN. The LED on the front of the timer should come on to indicate that it's getting a signal.

When the timer is set up and measuring a watch, select "Accutron rate" from the Watches Menu. MicroSet will change it's display mode to show numbers with three decimal places, which is the resolution of frequency readings from the timer. If you have clicked "Plot: On" to begin taking readings, you should see the "# of Samples" increasing, but you may not see any data on the computer screen. This is because the values are very high and are usually off scale. Click on the "Autoscale" icon to set the Y axis values so the Accutron frequency rate will be on the screen. You should now see a new reading from the timer about once every second.

If you wish to have the program show you the error per day, simply set the Target Rate to the correct frequency for the watch. The most common value is 360 (cycles per second). The "Total Error" box will then display the error per day.

You will find that the fork frequency of Accutron watches varies with temperature and position. There's even a little wobble to the rate as the minute hand passes the 12 each hour.

Balance wheel amplitude
This function will show you a high resolution graphical representation (an "oscillogram") of a watch tick and automatically calculate the balance wheel amplitude.

When we hear a watch tick, we hear it as a single sound. But when examined "microscopically", there are actually several sounds happening one after another. The primary sounds are the unlocking, the impulse, and the drop. The primary use of the relationship between these sounds is to divine the amplitude of balance wheel oscillation.

Page 54

Put a watch on the sensor and set the Level control to about the 9 o'clock position. On the computer, choose "Balance Wheel Amplitude" from the Watches Menu. On the timer, choose the "BW Amplitude" mode. (You could also simply choose the "Amplitude" button in the remote control area on the computer.) You will see a new window similar to the one shown below.
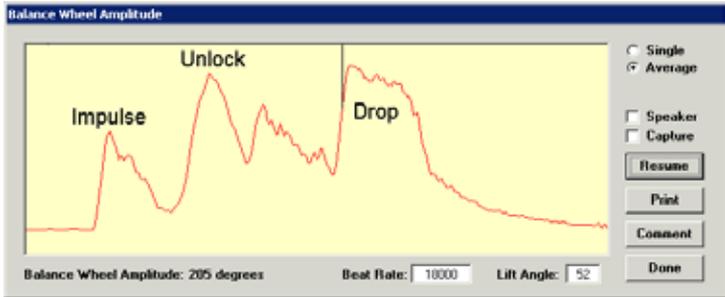
Balance Wheel Amplitude

The tick sounds are displayed in the main window. The sounds are displayed as a red line. If the sound is loud, the red line will move towards the top of the graphing area. If the sound is quiet, the red line will move towards the bottom of the area. Adjust the Level control slowly until you can see three main bursts of sound. The first burst begins the wave at the left edge of the graph. The second burst will be a smaller hump in the signal. The third burst should be the tallest hump. The highest burst should go near the top of the yellow graphing area.

The setting of the Level control will be lower for this function than you usually use with MicroSet. If the Level is not high enough, the tall burst will appear to jump left and right and not hold position. Raise the Level control a little farther so the display is generally stable. There may be a little fluctuation from one beat to the next.

If you raise the Level control too far you won't get any display at all. Turn it back down and start up again slowly. If your computer is slow, it may not keep up with the display and the tick shown may lag the watch a little bit.

A good quality watch that is running well will have at least three distinct sound pulses. The Balance Wheel Amplitude display will allow you to evaluate subtleties of operation of the watch escapement after you have become familiar with it. Some watches will have three clean sounds, others will reveal four or more distinct sounds. Refer to a book on watch escapements for more information on these sounds.

Reading the balance wheel amplitude
MicroSet calculates the amplitude of the balance wheel from the position of the sounds within the tick. Simply put, the distance of the third sound (the drop) from the beginning of the first sound (the unlocking) indicates the amplitude. The point MicroSet is using is indicated by a thin black line that drops down from the top of the window. Sometimes there may be an earlier sound that's louder than the drop, and MicroSet will read a false amplitude. If this happens you can turn down the Level control on the timer so the third main sound is the loudest one. The measured amplitude is printed at the bottom of the window.

The balance wheel amplitude calculation depends on the geometry of the watch. Specifically, we must know the Beat Time and the Lift Angle. The default values are a Beat Time of 18000 BPH and a Lift Angle of 52 degrees. You can change these if your watch is different. It's easy to know the correct Beat Time of a watch, because you can measure it. You should also know the Lift Angle of your movement to get an accurate reading of balance wheel amplitude. This value is commonly 52 degrees for wrist watches and 36 degrees for pocket watches. Many values of lift angle are included in the Watch Data File we discussed earlier as an item under the Watches Menu.

A new watch may have a specified lift angle, but after the watch is worked on the angle can change. A very small adjustment on the banking pins and/or pallet stone setting could dramatically change the lift angle. For this reason you may wish to measure the lift angle on the watch you're working on. Master watchmaker Wit Jarochowski suggests the following procedure:

With the balance wheel at rest, place a tiny black mark on the balance wheel with a non-permanent marker. It's important that you use a non-permanent marker, because you must remove the mark when you are through. It is unprofessional to leave a mark on the balance wheel. Make this mark 180 degrees away from you or 180 degrees from any easily visible solid point on the movement.

If you have no erasable marker, make note of the location of one balance wheel arm so you can see when it has reached 180 degrees (half a turn) of motion.

Wind the movement a little and wait for the balance wheel to stabilize. With increased winding, bring the oscillations to 180 degrees. You will be able to recognize a short stop at the point of maximum rotation.

If you're watching the balance wheel arms, and the balance wheel has 3 arms, bring the oscillation to 220 degrees. This is the point at which one balance arm will make 2/3 of a rotation and appear to stop for an instant.

Now measure the amplitude with the MicroSet Watch Timer. Set the correct BPH of the watch and the expected lift angle. Confirm that the amplitude shown by the computer is 180 degrees (or 220 degrees in the case of a three arm wheel). If it's not, change the setting of the lift angle until the program shows the correct amplitude. The setting of the lift angle that shows 180 (or 220) degrees is the correct value for the watch.

Single / Average
Usually you get more accurate readings of the amplitude if you average several beats together. This is the default setting of the program. The important sounds of the escapement become enhanced and the background noise is reduced. But you can use a radio button at the right side of the window to display the beats one at a time if you wish. This can give you some insight into what the different beats look like.

Speaker On / Off
A check box labeled "Speaker" will allow you to turn the beat amplifier in the timer on or off.

Capture
A check box labeled "Capture" will allow you to capture a history of amplitude readings over time in the normal graph area of the program. This feature is unique in the world of watch timers and allows you to see how the amplitude of oscillation changes over time.

Pause / Resume

You can also stop the display to examine a reading more closely with the "Pause" button. This button changes to "Resume" when the display is stopped. Slow computers may not be able to display the watch data as fast as it comes in. If this happens, the data you see may not be exactly current. If you click on Pause and then Resume, you'll discard unread data.

Print

The "Print" button will print the current tick display on your printer. Usually you'll use the Pause button to stop the display before you print it.

Comment

The "Comment" button will automatically insert the current reading of the amplitude in the comment line at the top of the normal graph window.

Done

When you have finished with the "Balance Wheel Amplitude" function, click on the "Done" button.

The Timer Menu

This menu lets you send remote commands to the MicroSet Watch Timer Pro hardware. It's similar to the remote control buttons above the graph area.

Time 1 configures the timer to read single beats.

Time 10 configures the timer to measure every ten beats.

Time 30 configures the timer to measure every thirty beats.

Balance Wheel Amplitude puts the timer in the "BW Amplitude" mode.

Measure Accutron Watches puts the timer in the "Accutron" mode.

Speaker On turns the built-in beat amplifier on or off.

Increase Blanking Window increases the size of the Blanking Window.

Decrease Blanking Window decreases the size of the Blanking Window.

The Configure Menu

Autosave
This command will allow you to automatically save the current data at specified intervals. This will help insure that you will not loose data if the power goes off or the computer crashes when you aren't around.

When you select "Autosave" a dialog will allow you to enter the number of samples to wait before saving the data. If you're using the "Pre-average" or "Skip" functions, the number you enter refers to the number of readings actually stored in the graph, not any of the readings that are skipped or averaged.

Let's suppose you were measuring an 18,000 BPH watch with a 30 beat average. This means that a new value would come out of the timer every six seconds. If you tell the "Autosave" dialog to save after 300 samples, you will write the current data to disk every 30 minutes.

After you enter the number of samples, click on "Start Auto Save" and you will be asked to enter the name of the file to save under.

To turn off Autosave, click on "Stop auto save".

Setup
This selection let's you configure the software for several settings that you may wish to preserve. All of these settings can be memorized by the program so it will always use your configuration.
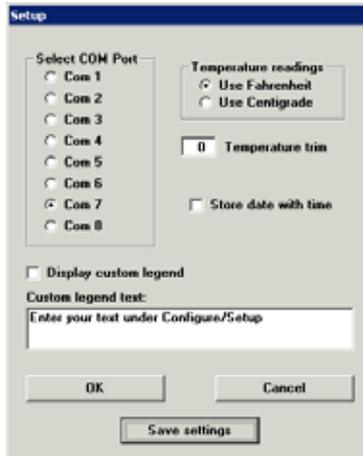
The Setup window

The most important setup is the COM port number the timer is plugged in to. To select a COM port, click on the radio button that corresponds to that port. MicroSet only works through serial ports. If your computer has no serial ports and only has USB ports, you can use a USB to serial converter to create a virtual serial port. To see which serial ports are available on your machine, use the Device Manager to display them.

If you have the optional temperature sensor, you can choose to have the software display temperatures as Fahrenheit or Centigrade. You can also enter a "trim" value to be added to each temperature reading if you have some way of calibrating the temperature sensor more accurately. Use a negative number to subtract a value.

There's a check box to "Store date with time." If you set this, the time stamps saved in the computer files will record the date as well as the time of day.

There is a check box to enable a "custom legend". This is a line of text that's displayed above the graph and can be used to show your business name on every graph that you print for customers. Enter the text of your message in the area provided.

Once you've made your selections you can click on the "OK" button. The program will try to accept your selections and go back to work. If the serial port you selected is nonexistent or already in use by some other program, you'll get a warning message. Otherwise, the program will resume operation with the new settings.

If you can't get the computer to accept a COM port number, you can continue to run the program and open saved files by clicking on "Cancel". You will not be able to capture any new data, however.

If you want the program to remember the settings you've selected, you must click on "Save settings". This will save the selections on your hard disk for the next time you run the program.

Window size
This command will let you specify the size of the program's window as a specific number of pixels. You can always re-size the window in the usual way, by dragging a corner or side. But it is sometimes helpful to have the window be a specific, known size. We often do this before capturing an image of the program window for printing or posting on the Internet.

To capture an image of the program screen, press the PRT SCR key on the computer's keyboard. This will place a copy of what's on the computer screen in the computer's "scratchpad". You can now paste this image into an image editing program like Paint or PhotoShop.

The Help Menu

The first item under the Help Menu initiates a tutorial in the operation of the program. This sequence will remind you of the sequence of operations to measure a watch, and is always available on screen.

If your screen is not tall enough to show the bottom of the Help windows, you can drag them higher. If your screen is still not tall enough to see the buttons at the bottom, you can hit the ENTER key to close the window and terminate the Help sequence.
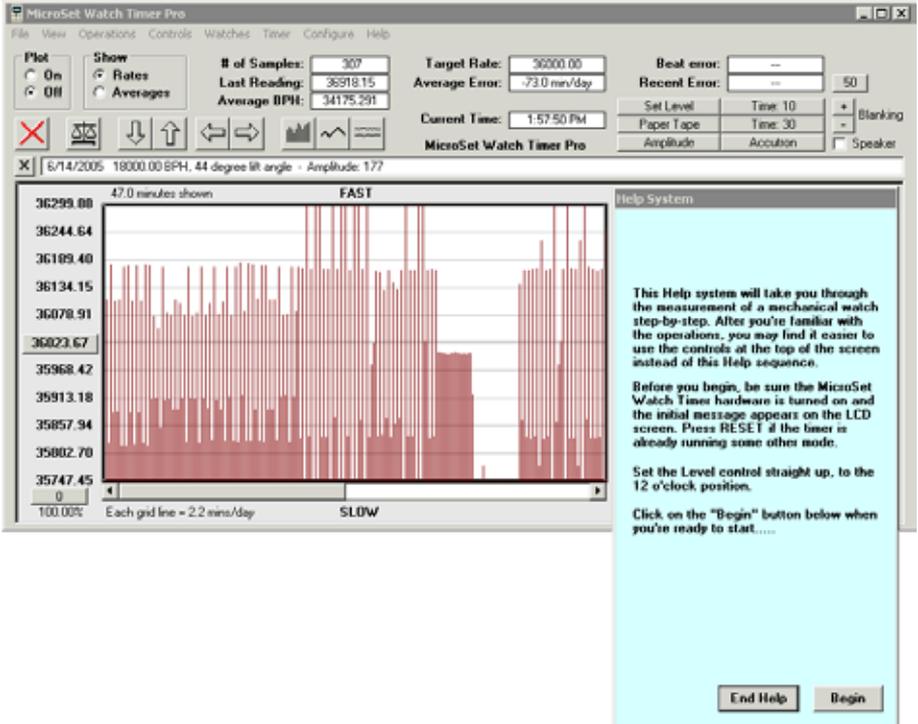
The second item under the Help Menu will display information about the software and the revision date of your copy.

Configuration of the MicroSet timer

There are a several settings that are available to configure the behavior of your MicroSet Watch Timer. These settings are remembered from one day to the next, even when MicroSet is turned off. To enter the Configuration mode, do the following:
  • Be sure MicroSet is turned off
  • Hold down the MODE button
  • Turn on the timer and wait until the words "BEEP ON" or "BEEP OFF" appear on the LCD screen.
You can cycle through the different Configuration settings by pressing the MODE key.

Beep On/Off
You can configure MicroSet to beep every time a Time Mode measurement that takes longer than about 10 seconds is complete. When you first enter the Configuration mode, the display will show either "**Beep On**" or "**Beep Off**". To turn the beep on, press the PLUS button. To turn the beep off press the MINUS button.

If you're through with configuration after turning the BEEP on or off, hit the RESET button. To continue with the next configuration setting, press the MODE button.

Time mode beats
This setting lets you store the default number of beats to be measured in the Time Mode. When you use the Time Mode, you specify the number of beats to measure before the average rate is given. This configuration setting lets you select a starting value that suits your work style. You might prefer to start with a low number, like "10", so you can get a result quickly. Or you may prefer to start with a higher beat count to get more accurate results. Whatever value you choose, it should be an even number or "1". An odd number, like "11" or "33" will incorporate the beat error in every reading and the readings will be very irregular.

When MicroSet is at this Configuration setting the LCD screen will say something like:
  Time beats: 10
To increase the number, press the PLUS key. To decrease the number, press the MINUS key. When the number you'd like to use is showing you can hit the RESET button to exit the Configuration Mode. Or, to continue with the next configuration setting, press the MODE button.

Blanking Window size
This setting lets you store the default duration of the Blanking Window. The Blanking Window is the feature in MicroSet that allows it to ignore sounds that occur between proper ticks. Because MicroSet can measure watches as fast as 36,000 BPH and clocks as slow as 30 seconds per beat, there is no one setting for the Blanking Window that will serve all timepieces perfectly.

When MicroSet is at this Configuration setting, the LCD screen will say something like:
  Blanking: 4
To increase the number, press the PLUS key. To decrease the number, press the MINUS key. The following values for the Blanking Window can be used for the beat times shown:

<div align="center">
18,000 BPH -- use 11
21,600 BPH -- use 9
28,800 BPH -- use 6
36,000 BPH -- use 4
</div>

If you want to pick one number to use for all watches, use "4".

When the number you'd like to use is showing you can hit the RESET button to exit the Configuration Mode. Or, to continue with the next configuration setting, press the MODE button.

Time Mode display format

You can configure MicroSet to display the results of its Time Mode measurements in Seconds Per Beat or in Beats Per Hour. When you enter this configuration setting the display will show either

Units: Secs

or

Units: BPH

To have MicroSet display Time Mode measurements in Seconds Per Beat, press the PLUS key and the display will show "**Units: Secs**". To have MicroSet display time measurements in Beats Per Hour press the MINUS key and the display will show "**Units: BPH**".

MicroSet can also display rate as seconds of error per day. This setting is made with the Time Mode Options.

If you're through with configuration after this setting, hit the RESET button. To continue with the next configuration setting, press the MODE button.

Oscillator calibration

The final setting in the Configuration Mode allows you to enter a "trim" value that is used to correct for errors in the quartz crystal time base. This unique feature allows us to recalibrate your MicroSet timer with software if the accuracy of the quartz crystal changes over time. Don't change this setting unless you know what you're doing and have a good reason to change it. You may want to record the factory setting for this value inside the back cover of this instruction manual. If anything goes wrong and the trim value gets changed, you can re-enter the original value. You (or we) can make adjustments to this setting as the unit ages, and it allows us to recalibrate MicroSet without making any changes to the hardware.

When you enter the Trim Mode, the display will show something like the following:

Trim: 0

The range of values is +99 to -99, but our assembly procedure is so accurate that the value rarely needs to be greater than plus or minus "2". To increase the trim value, press the PLUS button. To decrease the trim value, press the MINUS button. When the value you want is displayed, you must press the BEGIN button if you want MicroSet to memorize it. (This extra key press helps to insure that the trim value will not be changed accidentally.) When you do, the LCD screen will show "OK!" and the trim value will be stored in permanent memory for future use.

The units of Trim are "parts per million". If the Trim value is "+1", it means the crystal oscillator is accurate to one part per million, and the remaining one part per million error is corrected with the software Trim value. The final error of the timer is always zero parts per million when it's at the same temperature it was when it was calibrated.

Experience has shown that MicroSet does not lose much accuracy over time. We have gotten several units back for upgrades after more than a year, and the trim value has always been within two or three parts per million of correct. Often the timebase has not drifted at all after a year. A change of 1.65 parts per million is a change of one second per week. Your timer is not likely to be off by more than this in a year's time.

To exit the calibration mode press the MODE key.

Technical Functions

There are several "technical functions" built into MicroSet that are not necessarily related to timing watches. These functions are put in as utilities to help the experimenter, or to extend the usefulness of the timer. Not all timers will have all functions. To access the technical functions, hold down the BEGIN button when you turn on the timer. To move from one technical function to the next, press the MODE key.

Temperature
If you purchased the temperature sensor for MicroSet, the first technical function will display the temperature once per second. This reading is also sent to the computer interface, so you can record the temperature when you aren't measuring a watch.

Width
This function probably has no use for the watchmaker. It will display the amount of time a sensor is triggered. For example, if you're using an optical sensor on a clock pendulum, it will measure how long the sensor is blocked each time the pendulum passes. With watches, it measures the time the acoustic sensor is active at each watch tick. This reading is sent to the computer interface.

Dark / Light
This function probably has no use for the watchmaker. It will display the amount of time a sensor is triggered, followed by the amount of time the sensor is NOT triggered. This reading is sent to the computer interface.

Tachometer
This function will display the RPM of a spinning tool like a lathe or mill. To use it, you need to arrange an optical or magnetic sensor to trigger once on each rotation of the tool. The best way is probably to get a magnetic sensor from Mumford Micro and use epoxy to hold the magnet to some part of the tool where you can mount the sensor. This is an easy way to add a tachometer to your watchmaker's lathe or other tool used in watchmaking.

Accessories

There are many accessories available to extend the capabilities of the MicroSet timer. Some of these are listed below. Contact us for further details.

- A padded carrying case
- Optional watch sensors
- Accutron watch sensor
- Temperature sensor

Hardware Options

There are several optional features that can be added to the MicroSet hardware. These are listed below. Contact us for further details.

- Temperature sensor
- Data Capture Memory
- Temperature compensated (TCXO) timebase

**The most current information about MicroSet features and
accessories is available on the Internet.
Go to www.WatchTimer.com**

Typical errors as revealed by paper tape printer
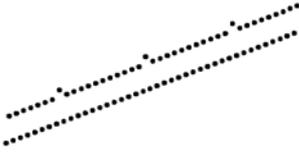
A damaged tooth on the escape wheel

Irregular transmission or dirty escapement

Balance is isochronous but not in poise when watch is turned

Balance is not isochronous when watch is turned

Faulty escapement or damaged pallet stone

Balance is knocking

Escape wheel is out of round
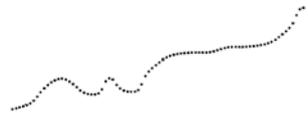
Excessive sideshake on pallet-staff or balance pivots, or defective train

Variation in balance amplitude

Variation in running of balance, poor transmission, or loss of amplitude

Summary of Operations

Beat Error Mode - measure beat error

Press BEGIN to start measuring. The number of milliseconds of beat error will be shown.

Time Mode - measure the rate a watch

Press PLUS or MINUS to set the number of beats to measure.

Press BEGIN to start measuring.

Blanking Window - to make the timer immune to other sounds

To maximize it, hold PLUS until the LED stays on.

To minimize it, hold MINUS until the LED stays off.

You can adjust the default setting of OFF with the Configuration Mode.

Time Mode Options

Press BEGIN to access the options available in your timer.

Show error/day: Press PLUS to enter the correct rate of the timepiece or press MINUS to disengage Error Per Day calculation. MicroSet will guess the correct Target Rate. If it's right, press BEGIN. If it's not right, press MINUS to display the last value measured, then press PLUS or MINUS to adjust it.

Average On/Off: Press PLUS to turn it on, MINUS to turn it off

Speaker On/Off: Press PLUS to turn it on, MINUS to turn it off

Data Capture: Press PLUS to begin data capture. The number shown will be the number of readings taken before one is saved. Set the number to zero to stop capture.

Dump: Press PLUS to dump the captured data to a personal computer.

Paper tape: Press PLUS to begin paper tape output. After the current rate is shown, press PLUS or MINUS to adjust it. Select the correct rate for a rate reading, or just accept the current rate for a flat tape. Press BEGIN to start printing. Press PLUS to zoom in, MINUS to zoom out. Press BEGIN to restart a reading at the center of the tape. Press MODE to terminate paper tape printing.

Accutron Mode - show the rate of tuning fork watches

Press BEGIN and select the number of "blocks" to measure (the time before a reading appears).

Press BEGIN to start measuring.

Press PLUS to see the rate as Error Per Day.

Press MINUS to see the rate as frequency of the fork.

Balance Wheel Amplitude Mode - measure balance wheel amplitude

Press BEGIN to start sending data to the PC.

Configuration Mode - to set various parameters of operation

Hold down MODE when you turn on the timer to enter the Configuration Mode.

Beep: Press PLUS to turn the beeper ON, press MINUS to turn it OFF.

Time beats: Press PLUS or MINUS to set the default number of beats for the Time Mode.

Blanking: Press PLUS or MINUS to set the value of the Blanking Window when it is turned off. Use 8 for most cases. Use 5 if you measure fast beat watches.

Units: Press PLUS to see rates as Seconds Per Day, press MINUS to see rates as Beats Per Hour.

Trim: Oscillator calibration. Do not change this. Press MODE to exit.