TIMETRAX Timing Machines

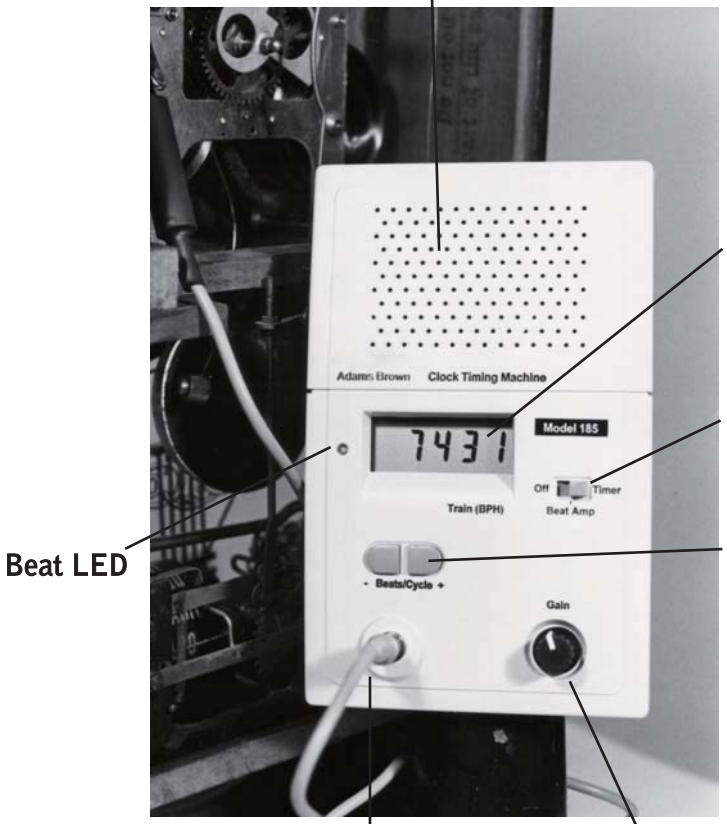
Instruction Manual

MODEL 185

MODEL 1000

Adams Brown Company
www.adamsbrown.com

Controls and Indicators



Quick Start - Operation Summary

1. Install 4pcs fresh AA alkaline batteries
2. Plug the Model 20 sensor into the front panel sensor jack.
3. For timer operation: Slide power switch to TIMER position
   For beat amp operation: Slide switch to AMP position
4. Clip sensor to clock movement. Winding arbor usually works well.
5. Adjust GAIN control for a steady even flashing of BEAT LED.
6. Read display and compare to correct value obtained from tables or from calculation. Take several readings to allow movement to stabilize.
7. For finest adjustment use UP and DOWN cursors to set twice the escape wheel teeth.
8. Adjust clock (platform or pendulum) to match correct rate.
9. To save battery life, turn off the timer when finished.

How it works

Each tick of a clock is a mechanical vibration which is converted to an electrical signal by the Model 20 sensor. These electrical signals are amplified inside the timer. The amount of amplification is controlled with a Gain adjustment, located on the front panel of the unit.

With the power switch in the TIMER position, the amplified sounds are converted to a stream of digital pulses, with one pulse per tick. An advanced microprocessor groups pulses together for measurement. The number of ticks that are grouped together is called the Preset Average. A precision quartz crystal time-base is used as a timing reference for all measurements.

After a series of mathematical calculations the result of a complete group of ticks is displayed on the direct reading liquid crystal display (LCD). Each time the Preset Average number of ticks have been processed, the display is updated with a new reading. For example, with a Preset Average of 30, the display is updated every 30 ticks.

Double-Rate Update

Model 185 Plus incorporates a unique feature called Double-Rate Update, designed to save time for the professional repairman. In the example above, with a Preset Average of 30, the display is updated every 15 ticks! The result is still based on the previous 30 ticks, so accuracy is not diminished. This powerful feature becomes especially useful when taking readings over a full revolution of the escape wheel, probably 30 or more ticks.

Note, To maintain full accuracy the very first reading only must time over the full interval. So, with a Preset Average=30, the display updates after 30 ticks, then 15 ticks, 15 ticks, 15 ticks...

Thinking in terms of train

Timetrax instruments 'listen' to the ticking sounds of a mechanical clock and compute the present train, or number of beats per hour, at which the timepiece is running. The train information is displayed directly on a large LCD display.

Most horologists are familiar with the concept of train. The train of a timepiece is simply the number of times it beats (ticks) in one hour. A movement with an 18,000 train is designed to beat 18,000 times in one hour. The same timepiece running at 18,001 gains time at the rate of one beat per hour, or 24 beats per day. Since each beat is equal, in this case, to 0.200 seconds, the clock will gain a total of 4.8 seconds per day. Similarly, the same timepiece running at 17,998 will lose 9.6 seconds per day. The following equation may be applied to find the seconds per day gained or lost for each +1 beat per hour error.

SECONDS = 86,400 / (CORRECT TRAIN)

Connecting the Sensor

A model 20 clip-on sensor is included with your timer. The sensor converts the vibrations of a ticking mechanical timepiece to electrical signals. To use the sensor, simply plug it in to the front panel of the timer and clip the other end onto the clock. It is best to choose a location on the movement itself and not on the case. Use care as the clip is made of steel, and may scratch softer materials such as brass. A winding arbor is generally an excellent location for the clip-on sensor. When using the instrument as a beat amplifier, the sensor should be connected as closely as possible to the components being monitored.

Using the Timetrax 185 as a Beat Amplifier

The beat amplifier is generally helpful to anyone attempting to repair or diagnose mechanical clock movements. The experienced repairman can tell a great deal about a clock just by listening to the sounds it makes. The beat amplifier also simplifies the task of putting a clock in beat.

To use the Timetrax 185 as a beat amplifier, simply slide the power switch to the center position, marked 'AMP', connect a sensor, and set the gain to a comfortable listening level. Note that none of the timing functions operate in this mode. The display will remain blank, and the LED will remain unlit.

The beat amplifier mode requires more power from the battery than the timing mode. A weak battery will cause a loud 'whine' from the speaker, the first indication that a replacement battery is needed.

Using the Timetrax 185 as a Timing Machine

Your new timer will function as a full featured timing machine with the power switch in the far right 'TIMER' position. The unit will provide readings with almost any settings, but for best results and ultimate satisfaction you should understand the effects of the various adjustments and modes available to you. The sections that follow detail each separately, and includes instructions for regulating a movement.

Setting the GAIN

The Model 185 is designed to be universally applicable to all mechanical clocks. A GAIN control is provided to compensate for the wide diversity of sound complexes these timepieces can produce. Gain is actually an electrical engineering term that refers to the amount of amplification. To the left of the display is a red LED which aids in proper gain adjustment. Each time a tick is detected the LED blinks on for about 1/10 of a second. Setting the gain is a simple matter of rotating the Gain control until the LED flashes exactly once for each and every tick. Clockwise rotation results in higher gain and higher susceptibility to stray noise. Counterclockwise rotation provides less gain and more chance that you could miss a weak tick. For most clocks the final setting will be near the low end of the gain adjustment range.

Because the pickup is actually a specialized vibration sensor, timing should be performed in a quiet, vibration-free environment. If possible, the movement should be acoustically isolated from it's surroundings. For example, a clock on a wooden bench may pick up vibration produced by moving a chair along the floor. A felt pad between the bench and the clock would greatly reduce the potential problem.

Setting the Preset Average

The Preset Average is the number of ticks that the timer groups together in train calculations. For example, with a Preset Average of 30, the timer bases it's calculations on groups of 30 ticks. Preset Average is an important timing parameter which must be applied properly for accurate results. When setting Preset Average there are three basic factors to consider.

The first is cyclic variation due to the irregularity of escape wheel teeth. No mechanical part is absolutely perfect, and the escape wheel of a clock is no exception. There will be variations in both tooth size and spacing, especially on older clocks. These cyclic errors can be eliminated timing over exactly one (or more) complete revolutions of the escape wheel. Since each tooth produces two beats, one as it enters the verge and another as it exits, choose a Preset Average that is an integral multiple of twice the number of teeth on the escape wheel. For example, if a clock has an escape wheel of 15 teeth, then the best numbers for the Preset Average would be 30, 60, or 90, representing 1, 2, or 3 complete revolutions of the escape wheel.

The second factor to consider is random variation associated with all things. While this cannot be eliminated, the effect can be reduced by taking several readings, or, equivalently, by timing over longer intervals. Timing over 60 beats results in the average of two 30 beat readings.

The third factor in the selection of Preset Average is the time required to get results. The higher the Preset Average, the longer it takes to get a reading, since the timer must wait to gather enough data before calculating and displaying train information. You will find that low Preset Averages are best for quick, coarse measurements, while the longer intervals, particularly twice the escape wheel teeth, are best for final adjustments. Model 185 with Double-Rate Update displays accurate readings twice as often, which can save you nearly half the time.

The amount of variation will be evident by the displayed results and depends mostly on the clock being regulated. You should place the most confidence in stable, repeating numbers. When fine tuning, always take several readings to insure accuracy.

To view or change the Preset Average you must first enter the Preset Average Mode. This is accomplished by pressing either the UP or DOWN cursor just once. The current Preset Average is immediately displayed, but not changed. If you do nothing the timer will automatically return to the normal timing mode after two seconds, leaving the Preset Average un-changed. To change the Preset Average, use the UP or DOWN cursor to move to the desired number. Once the new number is set, allow the timer two seconds to return to the normal timing mode. The number you selected is used for all subsequent timing, or until the timer is turned off. The default preset average is 2, which is set each time the unit is turned on.

Auto-ranging

To make the most of the available 4 1/2 digit display the Model 185 will automatically select one of two available timing ranges. Most clocks have trains in the normal range, extending from 2000 to 19,999 beats per hour. For trains below 2000, the unit will switch to the long timing range, with an extra decimal point of resolution. No operator intervention is required, when you see the decimal point you will know that the unit has changed ranges.

Any time a movement is detected that is outside the range of timer (i.e. more than 19,999 beats per hour) the display will show E-or, indicating Error-out of range.

Timing Range Summary

RATE	<60	60.0 to 1999.9	2000 to 19.999	>20.000
RANGE	out of range			out of range
DISPLAY	----	decimal point	no decimal point	E-or

Balance Mode

Before timing a clock it should be put 'in balance' or 'in beat'. A movement is said to be in balance when the time between ticks is equal, giving it a steady, even beat. Traditionally the adjustment has been made by ear. Now, Timetrax timers feature a balance mode that allows precise beat setting. In balance mode the timer provides accurate digital beat timing.

Balance should be roughly set by ear before proceeding. Connect the clip-on sensor and set the gain in the usual manner. To put the timer in balance mode, use the cursor keys as if you were selecting a Preset Average. As the display wraps from 130 to 2, or vice versa, there will be a display of BAL, indicating Balance mode. Upon stopping on BAL the unit will begin to function in the balance mode.

In the balance mode the timer makes a comparative measurement, relating the time intervals between ticks. Consider, for example, three sequential ticks. The first interval begins at the first tick and ends at the second. The second interval begins at the second tick and ends at the third. At the end of each interval a number is displayed, the magnitude of which indicates the relative difference of the two most previous intervals. If the second interval is the shorter the number is preceded by a minus sign.

A new number, positive or negative, will be displayed each time a tick is detected. The clock is in balance when the magnitude of the numbers is minimized. The timer provides a very fine reading of balance, so it is practically impossible to get many zeroes. Values under twenty should be considered excellent.

Regulating a Movement

With a sensor in place, and the gain and Preset Average properly set, the unit will begin timing. Initially the LCD shows a series of dashes, indicating that no computations have been made. No numbers will be displayed until a number of ticks (equal to the Preset Average) have been detected. At that point the timer will begin to display readings directly in units of beats per hour.

The display will continue to update as long as stable data is available. As previously described, the update rate is dependent on the value of Preset Average. If you have a problem getting stable data you should recheck the setting of the gain control and connection of the sensor to the timepiece. Look also for mechanical problems in the movement or other sources of extraneous noise. Be sure that you have a steady, even flashing of the LED.

The basic idea behind timing is simple; adjust the present rate of the timepiece until it matches the correct rate. This assumes the repairman knows the correct rate, either from tables or by direct calculation. A booklet of train tables and sample calculations is provided with your timer.

If neither of these methods is satisfactory there is an alternative originally described to us by Laurie Penman in Clockmakers Newsletter (203 John Glenn Ave., Reading, PA, Mr. Steven G. Conover, Editor). First measure and record the present train. Allow the clock to run for 24 hours, and record the error in seconds. The correct train may then be calculated with the following formula:

CORRECT TRAIN = PRESENT TRAIN /(1 + ERROR/86400)

Begin timing with a low Preset Average, increasing it as the numbers get close to the ideal value. Final readings should always be made with a Preset Average equal to a multiple of twice the escape wheel teeth. Example: with a 15 tooth escape wheel, make the final measurements using a Preset Average of 30. Even with a high Preset Average there will still be some variation in the displayed results, so take several reading reading and confirm consistent results.

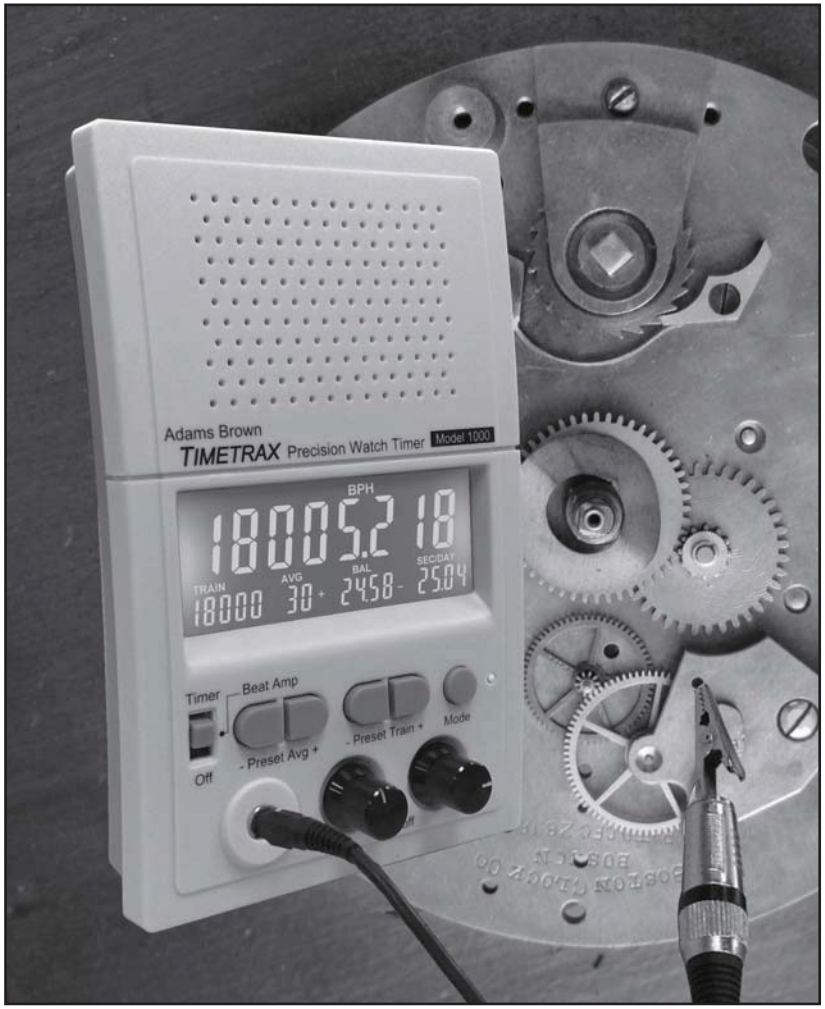
Technical Specifications: Timetrax Model 185 Timer

Display:	4 1/2 digit high contrast Liquid Crystal Display
Power Source:	4 PCS AA alkaline batteries
Monitor, visual:	bright flashing LED with each tick detected
Monitor, audio:	built in beat amplifier
Speaker:	2 1/4 inch wide range dynamic, Alnico magnet
Amplifier:	High impedance wide range, 100:1 variable gain
Processor:	8 bit CMOS
Internal Resolution:	1 microsecond (10 E-06 second)
Timebase, type:	quartz crystal, factory adjustable
Timebase, stability:	+/- 20ppm 0 to 50 degrees C
Timing:	Double-Rate(two equal spaced readings per cycle)
Timing Ranges:	normal range:2000 to 19.999 BPH
	low range: 60.0 to 1999.9 BPH
Balance Mode:	relative reading of beat error
Preset Average:	2 to 130 in steps of 2
Warranty:	1 year, parts and labor

Specifications: Timetrax Model 20 Clip-on Sensor

Type:	passive
impedance:	7000 pF
Weight:	1.5 ounces
Cable:	72 inches w/3.5 mm(1/8") mini plug

All specifications, including price, subject to change at any time without notice.



Timetrax Model 1000

How it works

Each tick of a timepiece is a mechanical vibration convert to an electrical signal by a transducer. In this case the transducer is a specialized microphone, either a Model 20 Clip-on Sensor or a Model 100 Watch Sensor. The small electrical signals are directly coupled to the instrument through a six-foot shielded cable.

Inside the timer, circuitry can be roughly divided into two parts; an analog and a digital section. Signals from the transducer enter the analog section where they are amplified and converted to a stream of digital pulses. Operation of the analog section is controlled with the GAIN and HOLDOFF controls located on the front panel. When the controls are properly set, the analog electronics will produce exactly one pulse for each incoming tick. The operator can monitor these pulses by observing the flashing Light Emitting Diode (LED) located to the left of the display, and/or by listening to the small tick produced with pulse. It is important to note that correct gain setting is crucial for good results. The user is strongly advised to read the 'Setting the Gain' section located later in this guide.

The digital portion of the instrument includes a CMOS microprocessor, Liquid Crystal Display (LCD), and a precision timebase. Digital pulses from the analog electronics are precisely timed and stored in groups. A complete group may consist of from 2 to 130 ticks. The actual number, which we will call the Preset Average, is set by the user. Control of the Preset Average is a powerful feature because it allows timing over exactly one revolution of the escape wheel for any timepiece. (If the importance of this is not apparent now, it will be soon). After a series of mathematical calculations the result is displayed directly on LCD.

By default, readings are displayed in units of Beats per Hour (BPH). Timetrax timers can also compute a rate error, in Seconds per Day, for many standard trains. A third mode, Balance, computes the time difference between subsequent ticks. Balance mode is useful for precisely setting the balance of a timepiece. Although all three modes were available in previous machines, they have all been improved with autoranging and enhanced resolution. Preset Average now applies to all three modes.

Super-Rate Update

Model 1000 is the only Timetrax timer to include a unique feature called Super-Rate Update, designed to save time for the professional repairman. The advantage of this feature is best realized when timing over one or more complete escape wheel revolutions, probably 30 or more ticks. Consider the example of a railroad watch with a 15 tooth escape wheel and an 18000 train; The Preset Average is correctly set at 30, and one would expect to get a new reading every 30 ticks. With Super-Rate Update, however, the display will update every 4 ticks (0.8 seconds). Every reading is still correctly based on the previous 30 ticks, so accuracy is not diminished. Several readings are required to establish the rate of a timepiece, with Super-Rate Update these can be taken quickly and accurately. As a rule of thumb, the update rate is approximately ten times per Preset Average number of ticks. For low Preset Average the update occurs on every tick.

Note; To maintain full accuracy the very first reading only must time over the full interval. So, with a Preset Average=30, the display updates after 30 ticks, then 4 ticks, 4 ticks, 4 ticks...

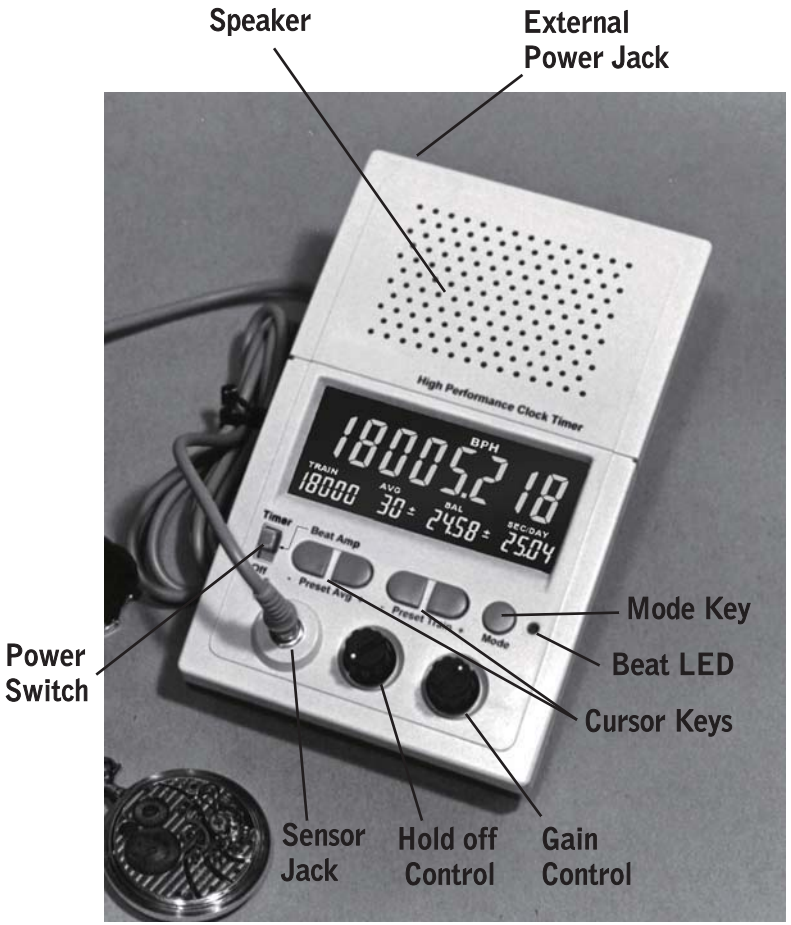
Thinking in terms of train

Timetrax instruments 'listen' to the ticking sounds of a mechanical clock and compute the present train, or number of beats per hour, at which the timepiece is running. The train information is displayed directly in units of beats per hour on an LCD.

Most horologists are familiar with the concept of train. The train of a timepiece is simply the number of times it beats (ticks) in one hour, A movement with an 18,000 train is designed to beat 18,000 times in one hour. The same timepiece running at 18,001 gains time at the rate of one beat per hour, or 24 beats per day. Since each beat is equal, in this case, to 0,200 seconds, the clock will gain a total of 4.8 seconds per day. Similarly, the same timepiece running at 17,998 will lose 9.6 seconds per day. The following equation may be applied to find the seconds per day gained or lost for each +1 beat per hour error:

SECONDS + 86,400 / (CORRECT TRAIN)

Controls and Indicators



Connecting Power

Timetrax Model 1000 operates on 6 to 10 volts DC, supplied by either an internal battery, or an external supply. For battery operation install 4pcs fresh AA alkaline. When not in use, power should be switched to the far left 'OFF' position to conserve battery life. Always try fresh batteries before sending the unit in for repair.

Units sold for use in the United States include an AC adapter (wall transformer) suitable for 120 volt AC operation. The Model 1000 will automatically switch between line and battery power.

Timetrax timers will not operate below 4 volts. Timing is suspended while the display shows a Lo Batt message. Install a fresh battery or connect external power to restore operation.

Set The Display Clock

Move the slide switch to OFF or BEAT AMP Position. Now you will see a real time clock display.

To set the time, press and hold Mode button and the hour digits will start blinking. Press MODE button again will switch to Minutes set Mode and the Minutes digits will blink, Press again MODE will switch to seconds setting. At HOUR & MINUTES setting modes. Use Cursor buttons of "PRESET TRAIN" to set desired time. At SECONDS Set Mode press these Cursor buttons will reset seconds to zero. Affer setting time press MODE Again will return the display to normal display mode.

Using the Model 20 Clip-On Sensor

A model 20 clip-on sensor is included with your timer. The sensor converts the vibrations of a ticking mechanical timepiece to electrical signals. To use the sensor, simply plug it in to the front panel of the timer and clip the other end onto the clock. It is best to choose a location on the movement itself and not on the case. Use care as the clip is made of steel, and may scratch softer materials like brass. A winding arbor is generally an excellent location for the clip-on sensor. When using the instrument as a beat amplifier, the sensor should be connected as closely as possible to the components being monitored

Using the optional Model 100 Watch Sensor

The Model 100 consists of a sensor (with cable) and a special watch holder. Assemble the unit by sliding the two dowel pins on the sensor into holes on the watch holder. Watches by then be mounted in the usual manner. Tighten enough to hold the watch snuggly against the small silver contact pin on the sensor. It is important that the watch makes mechanical contact with the sensor pin. Place the watch/sensor where it will not be disturbed. A solid table with a soft covering works well to isolate external vibration.

Using the Built-in Beat Amplifier

The beat amplifier is generally helpful to anyone attempting to repair or diagnose mechanical movements. The experienced repairman can tell a great deal about a timepiece just by listening to the sounds it makes. The beat amplifier also simplifies the task of putting a timepiece in beat.

To use the Timetrax as a beat amplifier:

- Position the gain to the minimum setting by rotating the knob counter-clockwise until a stop is reached.
- Connect a sensor as previously described.
- Slide the power switch to the center position, marked 'AMP'
- Slowly increase the gain to a comfortable listening level. Excessive gain will result in feedback, a loud squeal. Lower the gain to eliminate any feedback that occurs.

When operated as a beat amplifier none of the timing functions are active. The display remains blank, and the LED will remain unlit. The HOLD OFF control has no effect, nor do any of the five pushbuttons.

The beat amplifier mode requires significant power from the battery. A weak battery will cause a loud 'whine' from the speaker, even with the sensor disconnected. The battery can be checked with the slide switch in the 'Timer' position.

Timing Machine Operation

Your new timer will function as a full featured timing machine with the power switch in the far right 'TIMER' position. The unit will provide readings with almost any settings, but for best results and ultimate satisfaction you should understand the effects of the various adjustments and modes available to you. The sections that follow detail each separately, including instructions for regulating a movement.

Setting the GAIN

Timetrax timers are designed to be universally applicable to almost all mechanical timepieces. A GAIN control is provided to compensate for the wide diversity of sound complexes these mechanisms can produce. To the left of the display is a red Light Emitting Diode (LED) to aid in gain adjustment. The LED flashes each time a tick is detected.

Because the pickup is actually a specialized vibration sensor, timing should be performed in a quiet, vibration-free environment. If possible, the movement should be acoustically isolated from it's surroundings. For example, a clock on a wooden bench may pick up vibration produced by moving a chair along the floor. A felt pad between the bench and the clock would greatly reduce the potential problem.

Figure 1a shows an amplified signal sampled from a Brewster & Ingraham steeple clock connected to a Model 20 Clip-on sensor The figure is a graph of voltage, on the vertical axis, versus time, on the horizontal. Signal voltages large enough to cross a threshold (depicted as a horizontal dashed line) will be detected as ticks. The gain control in figure 1a is correctly set, ticks are large enough to be detected, while noise is not. Compare this to figure 1b, which shows the same situation, but with a lower gain setting. Some ticks will probably be missed because they don't cross the threshold. Finally, figure 1c shows the effect of too much gain, which results in noise detected as ticks. Setting the gain is a matter of rotating the Gain control until the LED flashes exactly once for each and every tick. Clockwise rotation results in higher

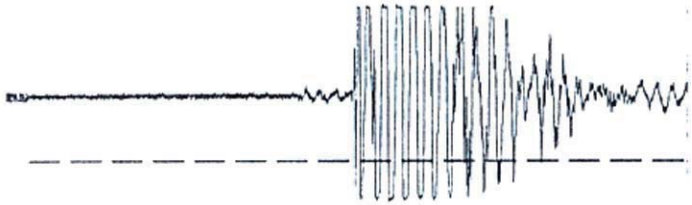


figure Ia:
Gain set correctly

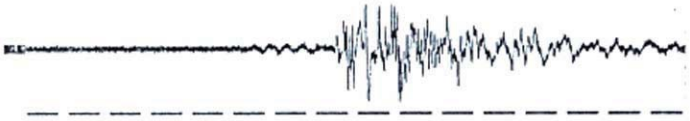


figure Ib:
Gain too low

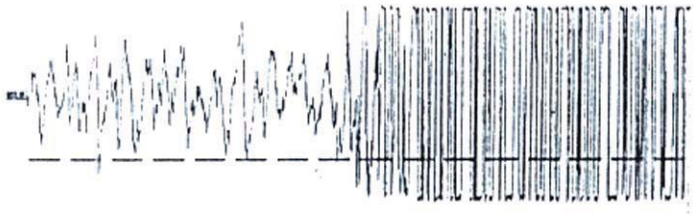


figure Ic:
Gain too high

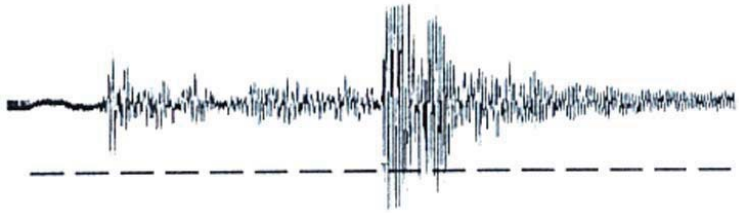


figure 2:
A.W.W.Co.17 jewel pocket watch

gain and higher susceptibility to stray noise, manifested as extra ticks. Counterclockwise rotation provides less gain and more chance that you could miss a weak tick. For most clocks the final setting will be near the low end of the gain adjustment range.

In some cases proper gain adjustment can be tricky. Figure 2 is the voltage vs. time graph of a signal obtained from an American Waltham Watch Co. Model 1899 pocket watch. While the clock waveforms in the previous example are mostly characterized by the escape wheel striking the pallet fork, the watch movement in this example is more complex. The largest portion of the watch signal is still generated by the escape wheel striking a pallet jewel. With the watch, however, there are other significant sounds that can be detected as ticks, depending on the gain setting. It is common, with higher gain, to detect the very earliest portions of the tick, which occur several milliseconds prior to the main portion. The potential problem is further complicated by the normal amplitude variation from tick to tick.

It is clearly desirable to trigger on the same portion of the waveform for each and every tick, resulting in the most accurate and stable measurements. Consider that a one millisecond error on the 18,000 train described above is equivalent to a train error of about 90 beats per hour. Then consider that in the same example the spacing between the earliest portion and the main portion of the tick is approximately 15 milliseconds, which could lead to a single tick error of nearly 1500 beats per hour. Fortunately, Timetrax timers are very good at detecting ticks. Averaging over many ticks also helps, as described in the "Setting the Preset Average" section. Gain setting is the other very important factor.

Two gain setting strategies are available when regulating a watch. In the first, the gain is slowly increased from a minimum, to a point at which every tick is detected. This works well if the main portion of the tick is predominant. The alternate approach is to further increase the gain to just below the point that noise begins to be detected, in an effort to sufficiently amplify the very earliest watch sounds. There is no way of telling which approach will work for a given watch, but you will know when you are successful by the stability and repeatability of results.

Setting the Hold off

While gain control alone is sufficient for tick detection, additional benefit is sometimes realized with the addition of an adjustable hold off control. Hold off works by blocking tick detection until such time that a tick is expected. As an example, consider a tall case clock with a train of 3600 beats per hour, or one beat per second. Once a tick occurs, another will not be expected for a full second. In this case the hold off control would be properly set to block tick detection for approximately 90 seconds.

Minimum hold off is 80 milliseconds, set with the hold off control in its most counter-clockwise position. Clockwise rotation results in increased hold off which can be monitored by observing the flashing red LED. The LED remains lit for the entire hold off duration. Excessive hold off duration acts to block actual ticks, resulting in very low readings. Hold off is quite useful for clocks, but is of lesser value for watches, which have much higher rates.

Setting the Preset Average

The Preset Average is the number of ticks that the Timetrax timer groups together in train calculations. For example, with a Preset Average of 30, the timer bases each measurement on the 30 previous ticks. Like gain, Preset Average is an important parameter which must be applied properly for accurate results. When setting Preset Average there are three basic factors to consider.

The first is cyclic variation due to the irregularity of escape wheel teeth. No mechanical part is absolutely perfect, and the escape wheel of a clock is no exception. Expect variations in both tooth size and spacing, especially on poorly made or badly worn timepieces. These cyclic errors can be virtually eliminated by timing over exactly one (or more) complete revolutions of the escape wheel. Since each tooth produces two beats, one as it enters the verge and another as it exits, choose a Preset Average that is an integral multiple of twice the number of teeth on the escape wheel. For example, if a clock or watch has an escape wheel of 15 teeth, then the absolute best numbers for the Preset Average would be 30, 60, or 90, representing 1, 2, or 3 complete revolutions. This is the most important consideration when setting Preset Average.

The second factor to consider is random variation associated with all things. While this cannot be eliminated, the effect can be reduced by taking several readings or equivalently, by timing over longer intervals. Timing over 60 beats results in the average of two 30 beat readings. Very high Preset Averages are best applied to very fine adjustments or observations, after the gain has been established and the timepiece stabilized.

The third factor in the selection of Preset Average is the time required to get results. The higher the Preset Average, the longer it takes to get a reading. You will find that low Preset Averages are best for quick, coarse measurements while the longer intervals, particularly twice the escape wheel teeth, are best for final adjustments. Furthermore, very long readings are more prone to corruption by noise or a missed tick.

To view or change the Preset Average you must first enter the Preset Average Mode by pressing either preset Average cursor just once. The Preset Average is immediately displayed, but not changed. If you do nothing the timer will automatically return to the normal timing mode after two seconds, leaving the Preset Average unchanged. To change the Preset Average use the UP (+) or DOWN (-) cursor to move to the desired number. Once the new number is set, allow the timer two seconds to return to the normal timing mode. The number you selected is used for all subsequent timing, or until the timer is turned off. The default preset average is 2, which is set each time the unit is turned on. Preset Average (and Preset Train) keys will auto-repeat if held down.

Selecting Timing Modes - The MODE Key

A single pushbutton is used to select one of three timing modes: Beats per Hour, Seconds per Day, or Balance. Press the mode key once to see the present mode, or use it to scroll to the desired mode. The mode key does not auto repeat. The default mode is BPH, which is set whenever the timer is powered up. Pressing the Mode button allows you to display the timing information as BPH, BPM, SEC, & MSEC. This allows you to regulate a mechanism in terms of the rate or the time between ticks.

Timing Modes - BPH

Beats per Hour (BPH) is the default timing mode, with the display calibrated directly in beats per hour. BPH is also the most widely applicable mode, providing useful information for any timepiece within range of the timer. BPH mode is selected with the MODE key. Note that Preset Train has no effect, and need not be set, for BPH measurements.

Pressing the Mode button allows you to select the display of timing information as a Beat Rate (BPM or BPH), or a time interval (SEC, MSEC). Where BPM means Beats per Minute, BPH means Beats per Hour, Time Interval SEC means Seconds expressed as a decimal, and MSEC means Milliseconds expressed as a decimal. 1 MSEC = 1/1000th of a SEC.

Timing Modes - SEC/DAY

Seconds per day rate error calculations can be performed on many standard trains. These are pre-programmed, and selected using the Preset Train cursors. You choose the desired train by scrolling through the Preset Train list, just like choosing a Preset Average. Seconds per Day (SEC) mode is displayed in all timing Modes - BPH, BPM, SEC, MSEC in the lower right of the display. It is important to realize that seconds per day provides an

extremely fine measurement, especially since the timer will display down to 1/100th of one second per day. The results will be widely scattered unless every setting is correct. Seconds per day measurements are intended for better grade timepieces.

Always use a Preset Average of one (or more) complete escape wheel revolutions. Be sure the gain and Preset Train are properly set. In the SEC/DAY mode readings are calibrated in seconds per day gained or lost, based on the preset rate. Timepieces running too slowly (losing time) show readings preceded with a minus sign on the display.

Timing Modes - BAL

Before timing a clock it should be put 'in balance' or 'in beat'. A movement is said to be in balance when the time between ticks is equal, giving it a steady, even beat. Traditionally the adjustment has been made by ear. Now, Timetrax timers feature a balance mode that allows precise beat timing.

Balance should be roughly set by ear before proceeding. Connect a sensor and set the gain in the usual manner, use the MODE key to select BAL. Start with a Preset Average of 2.

In the balance mode the timer makes a comparative measurement, relating the time intervals between ticks. The first interval begins at the first tick and ends at the second. The second interval begins at the second tick and ends at the third. At the end of each interval a number is displayed, the magnitude of which indicates the relative difference of the two most previous ticks. A minus sign is displayed if the second interval is shorter.

A new numbed, Positive or negative, will be displayed each time a tick is counted. The clock is in balance when the magnitude of the numbers is minimized. Timtrax timers provide a very fine measure of balance, so it is practically impossible to get many zeroes.

A new feature of Models 1000 is the application of Preset Average to balance measurements. Average balance is measured by setting the Preset Average to twice the number of escape wheel teeth. The magnitude of the resulting number is the magnitude of the average balance. With low Preset Averages updates occur every tick, and the minus sign will toggle on and off. As Preset Average is increased above 12 the display updates less frequently and the minus sign no longer toggles.

Timing Range Summary for the 3 Timing Modes

BPH:	60.00 to 39.999 Beats per Hour
SEC:	+/- 0.00 to 9999 Seconds per Day

Tips for Regulating a Movement

The basic idea behind timing is simple; adjust the present rate of the timepiece until it matches the correct rate. This assumes the repairman knows the correct rate, either from tables or by direct calculation. A booklet of train tables and sample calculations is provided with your timer.

If neither of these methods is satisfactory there is an alternative originally described to us by Laurie Penman in Clockmakers Newsletter (203 John Glenn Ave., Reading, PA, Mr. Steven G. Conover, Editor)

First measure and record the present train. Allow the clock to run for 24 hours, and record the error in seconds. The correct train may then be calculated with the following formula:

CORRECT TRAIN =PRESENT TRAIN / (1+ERROR / 86400)

For coarse initial measurements choose a low Preset Average, 10 or less. Select BPH mode. Connect a sensor and set the gain as previously described, the unit will begin timing. A series of four dashes is displayed as data are gathered. When a number of ticks (equal to the Preset Average) have been detected the LCD will begin to show readings directly in units of beats per hour. With the low Preset Average you will get a new reading every tick. The readings will vary from tick to tick, but you can quickly estimate the present train.

For finer measurements set the Preset Average to twice the number of escape wheel teeth. Some variation will still be evident, the actual amount depends mostly on the clock being regulated. Place the most confidence in stable, repeating numbers. Observe carefully the flashing LED, making certain there is exactly one flash for each beat of the timepiece. You may need to fine tune the gain or hold off settings at this point. If an extra tick, or missed tick occurs the displayed number will show a large shift until the error 'falls out of the buffer' after the Preset Average number of ticks. Observe several readings to establish the overall rate.

If you have a problem getting stable data you should recheck the setting of the gain control and connection of the sensor to the timepiece. Look also for mechanical problems in the movement or other sources of extraneous noise. Do not get carried away trying to get perfect readings; most timepieces will vary as they run.

Use seconds per day mode for the finest possible resolution. A model 1000 with built in TCXO time-base is best suited for such measurements. Remember that seconds per day readings are many times more sensitive than train readings.

Begin timing with a low Preset Average, increasing it as the numbers get close to the ideal value. Final readings should always be made with a Preset Average equal to a multiple of twice the escape wheel teeth. Example: with a 15 tooth escape wheel, make the final measurements using a Preset Average of 30. Even with a high Preset Average there will still be some variation in the displayed results, so take several reading and confirm consistent results.

Experience Counts. If you've never worked with a timing machine, start with a known timepiece, running at a known rate. Observe the effects of the various controls, and try to gain an understanding of the effect of each.

WARRANTY

All TIMETRAX timers are guaranteed for a period of 1 year from the date of purchase. Adams Brown Company, Inc. will repair or replace, at their option, any defective parts without charge for parts or labor. Simply pack and ship your timer to Adams Brown Company prepaid to the address below. Include a short note that describes the problem along with a copy of your receipt of purchase.

Out of Warranty Service, Repair, Recalibration:
There are no user serviceable parts inside the Timetrax unit. If your unit has failed, do NOT attempt to repair it. Timers may be returned to Adams Brown Company, Inc. for Repair and Recalibration. Please return the unit postage prepaid along with a check for $70 payable to Adams Brown Company in the amount of $ 70 USD. We will repair your timer and ship it back to you via USPS Priority Mail.

Adams Brown Company

Box 357

Cranbury NJ 08512

Note:

Adams Brown Company, Inc. manufactures only the Timetrax instruments and sensors, and NOT the clocks, watches, chronometers, mechanical movements, or other devices used with timetrax instruments or sensors. Adams Brown Company, Inc. is not responsible for, and this warranty does not cover the clocks, watches, chronometers, mechanical movements, or other devices used with Timetrax instruments and/or sensors, or any loss, damage, or injury arising out of the Timetrax instruments or sensors.

Technical Specifications: Timetrax Model 1000 Timer

Display:	8 larger digits in Main Display line
	18 smaller digits in Sub Display line
Power Source:	4pcs AA Alkaline batteries
	AC line power adapter (wall pack)
Monitor, visual:	Negative display white digits in blue background with bright white backlight
Monitor Audio:	Built in Beat amplifier
Speaker:	2 ¼ inch wide range dynamic, Alnico magnet
Amplifier:	High impedance wide range, 100:1 variable gain
Processor:	8 Bit CMOS MCU
Internal Resolution:	1 micro second
Timebase type:	Quartz Crystal TCXO
Stability:	+/-3ppm from 0C to 50C
Timing Ranges:	BPH: 60.00000 - 40000.000
	SEC : 0.000000 - 10000.000
	MSEC: 0.000000 - 10000000
	BPM: 1.000000 - 667.00000
Balance Mode:	Relative reading on beat error
Preset average:	2 to 254 in steps of 2
Warranty:	One year Parts and labour
Specifications:	Timetrax Model 20 Clip-on Sensor
Type:	Passive
Impedance:	7000pF
Weight:	1.5 ounces
Cable:	72inch with 1/8" (3.5mm) mini plug

All specification, including price, subject to change at anytime without notice

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.