

# P103050 – P-1000 INSTALLATION & INSTRUCTION MANUAL



## REVISION PAGE

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P103050 Rev. A	P103050 Rev. B	04/24/91	tjkll	Added Graphics
P103050 Rev. B	P103050 Rev. C	09/16/91	tjkll	Updated for STC Release
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This Document has been modified for the Fort Myers Flying Club. Only the highlighted sections are included.



# INTRODUCTION

Thank You for purchasing the Horizon Instruments' P-1000 Digital Aircraft Tachometer. Many features have been incorporated into the design of the P-1000 insuring simple operation and long life. The P-1000 represents the state-of-the-art in applying computer technology to aircraft engine control and will prove to be invaluable in the reliable and safe operation of your aircraft.

The P-1000 functions as two fully independent digital tachometers that monitor the signals received from the primary circuits of the aircraft's magnetos. The internal right and left tachometers independently determine engine RPM, which is then average and displayed for the pilot. The superior reliability of the tachometer design is due to the use of two separate magneto signals to generate two identical RPM readings. If either magneto fails, the tachometer will continue to display RPM from the remaining functional magneto. No external probes or sensors are required to be installed in the harsh engine environment, further reducing the possibility of failure, and simplifying installation.

Easy installation is facilitated by wiring the P-1000 to the P-Leads of the ignition switch. In most cases, no additional wires need be run into the engine compartment.

To be sure of obtaining the best possible performance from the P-1000 please be sure to read this Instruction Manual carefully and become thoroughly familiar with the operation of the P-1000 before starting its use.

**KEEP THIS MANUAL HANDY FOR FUTURE REFERENCE.**

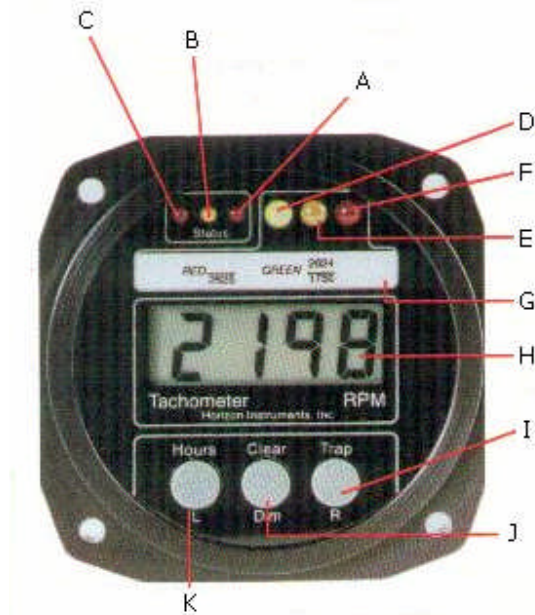


Figure 1, P-1000 Features

- A Right Magneto Signal Status Indicator. Turns on with the Loss of Signal from the Right Magneto. Flashes when the Right Internal Tachometer is Disabled.
  - B Magneto Error Indicator. Illuminates to indicate that there is a difference in RPM reported from each Magneto.
  - C Left Magneto Signal Status Indicator. Turns on with the Loss of Signal from the Left Magneto. Flashes when the Left Internal Tachometer is Disabled.
  - D Green, "Normal Operating" Range Indicator. Illuminates when the Engine RPM is within its specified normal operating ranges.
  - E Yellow, "Warning, Cautionary or Transient" Range Indicator. Illuminates when Engine RPM is within its specified Cautionary or Transient Operating Ranges.
  - F Red, "Restricted Operating" Range Indicator. Illuminates when the Engine RPM is within its specified Restricted Operating Ranges.
- UP TO FIVE SEPARATE RPM RANGES MAY BE FACTORY PROGRAMMED.**
- G Placard Area
  - H Full 4 Digit High Visibility Back-Lit ½" Liquid Crystal Display
  - I RPM Overspeed Trap Recall Button/Right Tachometer Enable/Disable.
  - J RPM Overspeed Trap Clear Button/Indicator Dimmer.
  - K Engine Hours Recall Button/Left Internal Tachometer Disable. **ENGINE HOUR METER CAN BE FACTORY PRE-SET TO START WHERE THE REPLACED TACHOMETER STOPPED.**

Two fully independent tachometers in one panel-mounted instrument increase tachometer reliability in case of either magneto's failure. Tachometer monitors both magneto P-Leads for redundant RPM sensing and magneto performance comparisons. Non-Volatile memory won't forget engine hours or factory pre-sets, no battery required. Eliminates tachometer cables, oil seal problems and accuracy problems associated with mechanical tachometers. Light weight, sturdy construction, easy to install.

Long term stability due to the use of all digital techniques, accuracy better than 1 RPM. Vibration, temperature, and electromagnetic interference, do not affect accuracy. Detection of RPM differences between magnetos and possible magneto failure. Automatic display of "MAG-DROP" RPM when a magneto pre-flight is performed. Visual indication of possible "HOT-MAG" or shorted magneto conditions. Operates with any number of engine cylinders.

## THEORY OF OPERATION

The P-1000 operates by timing the alternating electrical signals generated by an operating magneto, see Figure 2, and made available on the magneto's "P" or grounding leads. Because reciprocating engine aircraft have two magnetos on each engine (See Figure 3), the P-1000 provides two terminals for connection to these "P" leads of the right and left magnetos of the engine. These "P" lead signals are generally only a few hundred volts as compared to the secondary output of the magneto, which may generate tens of thousands of volts used to create sparks at the spark plugs.

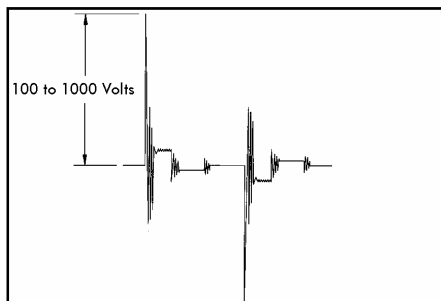


Figure 3, Typical Magneto Electrical Installation, With P-1000

RPM is derived from the repetition rate of the signals received from the magnetos, and not the amplitude or shape of these signals. This rate corresponds to the firing of the engine's spark plugs, and thus, the turning of the engine.

The Microprocessor functions as two internal tachometers. It has the ability to compare and store the RPM of each tachometer. A difference of RPM reported from the two magnetos of the same engine indicates that one of the magnetos may be failing (i.e. Mis-firing, severe fouling, sticking or floating points, etc.).

The RPM displayed on the LCD is the average of the right and left tachometer's RPM. Thus, if either tachometer begins to fluctuate or act erratically, due to failure in its ignition system, the error will show in the display. Mechanisms are provided to mask these erroneous RPM values and allow operation from the signal of the functional magneto.

Loss of a signal from either magneto is detected by the corresponding internal tachometer and a signal status indicator is turned on to indicate the error. Short term (< 1/2 second) differences between the right and left tachometers are also indicated to the pilot with a yellow status indicator.

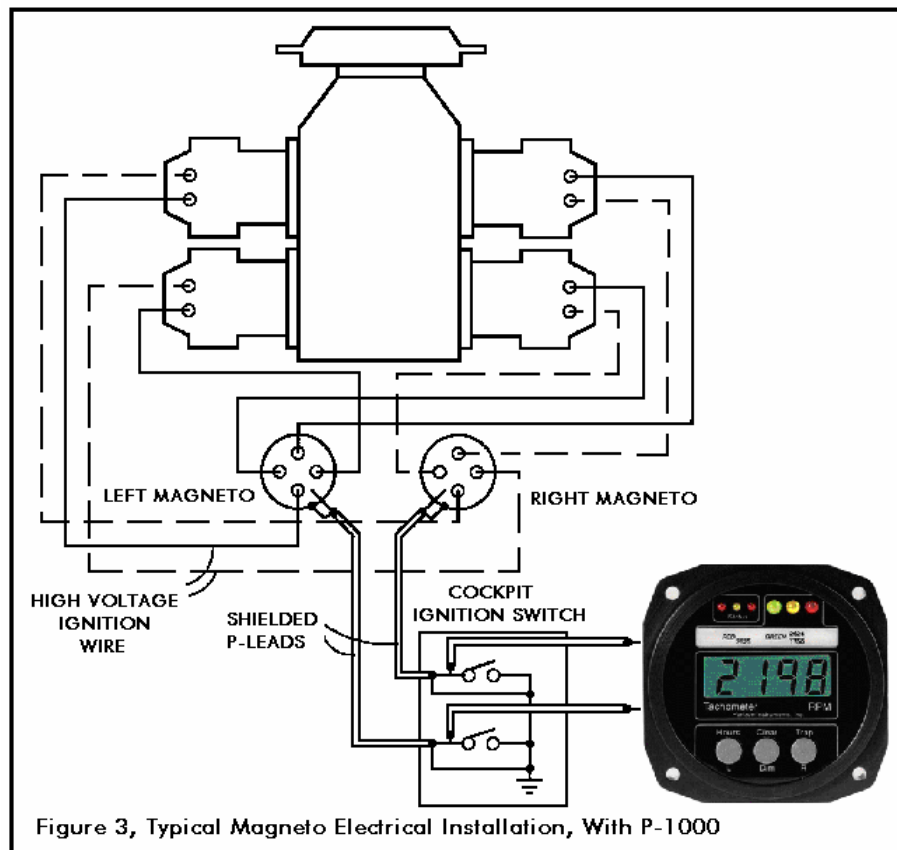


Figure 3, Typical Magneto Electrical Installation, With P-1000

Engine hours are recorded in real time beginning when the engine is assumed to be able to sustain combustion, at or above 800 RPM. A high accuracy engine clock yields true TBO times (engines are rated in real hours, not RPM-hours) and more accurate fuel consumption calculations.

Using the internal microprocessor to compare RPMs from each internal tachometer against a previously known highest RPM, and storing the new highest RPM creates the "Overspeed Trap" feature. Provisions are made to clear this trap at any time. The Overspeed Trap is saved when the P-1000 is turned off.

### DISPLAY FEATURES

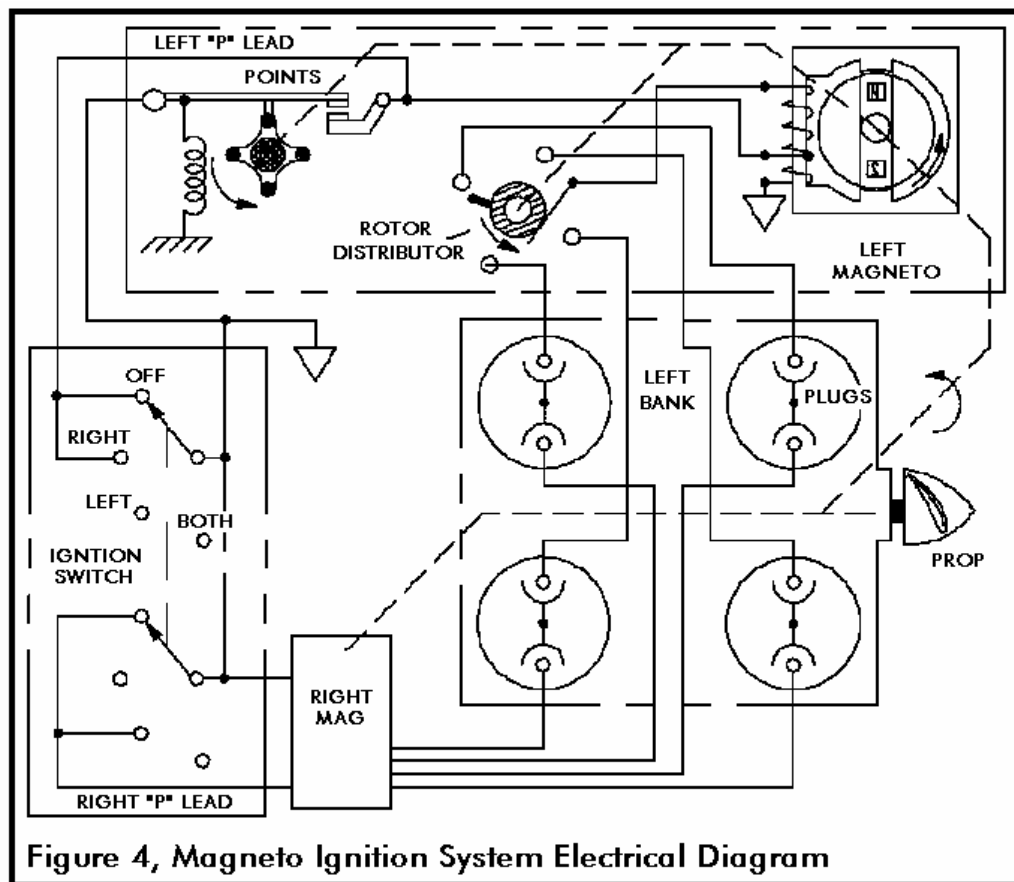
#### LIQUID CRYSTAL DISPLAY

The P-1000 provides easy to read ½ inch high characters on a liquid crystal display (LCD). A "straight line" (displayed using hyphens) is displayed on the LCD when the P-1000 is not receiving a signal from either magneto. This is generally noticeable when the P-1000 is turned on and the engine is not started.

#### STATUS INDICATORS

When no signal is received from either the right magneto or left magneto (See Figure 1), the P-1000 will turn on a corresponding right or left red magneto signal "Status" indicator. The status indicators are located on the upper left of the tachometer face and can indicate a hot magneto (open circuit) or grounded magneto (breached insulation or broken ignition switch) condition. The indicators turn on after ½ second passes without receiving a pulse from a magneto, and will turn off when the signal is restored.

Another status indicator is located between the red magneto signal indicators. This yellow indicator is a warning that the P-1000 has detected different RPM from the signals provided by each magneto. This is typical of a failing set of points or an intermittent wiring problem. The yellow status indicator may be accompanied by a red magneto signal status indicator, but under some conditions, may appear by itself. See the Troubleshooting section for more information. This indicator operates as a threshold set at the maximum allowable difference between the mag-drop readings of each magneto.



**Figure 4, Magneto Ignition System Electrical Diagram**

## **RPM ARC INDICATORS**

Three large LED type indicators are provided at the upper right corner of the P-1000 face to indicate the RPM operating range of the engine (See Figure 1). A "Normal Operating " green, "Caution" yellow, and "RED-LINE" red LED are provided. The RPM settings at which these indicators activate are presettable at the factory. Five separate RPM arcs can be factory programmed into the P-1000.

## **MAG-DROP DISPLAY MODE**

Loss of either magneto signal causes the P-1000 to turn the appropriate status indicator, remember the engine RPM at the time the signal was lost, and display the drop in engine RPM that resulted from the loss of the magneto. When this feature is used in conjunction with the ignition switch, pre-flight magneto performance tests, or "Mag-Drop", can be easily and accurately performed. During this mode of operation, the LCD should show a small RPM number, normally preceded by a minus sign ("-") indicating that the engine slowed down. A display without a minus sign indicates an engine that has increased in speed. If the loss of signal remains for more than fifteen seconds, the P-100 will revert back to displaying the engine RPM, determined from the remaining functioning magneto.

## **OPERATION**

Three buttons on the face of the P-1000 control the information being displayed to the pilot. These buttons have two modes of operation: press-and-hold, and press-and-release. The press-and-hold operation is used to control information displayed on the liquid crystal display. Each button must be pressed and held for one second to change the display. Pressing and holding the right button causes the Overspeed trap to be displayed. This function is denoted on the P-1000 face by the word "TRAP" above the button. Pressing and holding the center button for one second will cause a zero to be displayed. This causes the Overspeed trap to be cleared, and the button is marked with the word "CLEAR". Pressing and holding the left button for one second will cause the engine hours to be displayed. While the button is being held, the integer portion of the engine hours is displayed. Upon release of the button, the fractional portion of the engine hours is displayed for five seconds, then the display reverts back to displaying RPM. This function is marked on the P-1000 by the word "HOURS" above the left button. Press-and-release operations modify the operation of the internal tachometers and control display characteristics. The press-and-release operation must occur within one second to distinguish the operation from the press-and-hold operations described above.

## **LED DIMMING**

A press-and-release operation on the center button causes the LED indicators (except for the red LEDs) to be dimmed. Pressing the button again restores the LEDs to full intensity. This feature is handy for night flying because an LED bright enough to overcome sunlight washout may be annoyingly bright at night. This function is marked "DIM" on the P-1000 face under the center button. The red RPM range indicator is not dimmable.



## **TACHOMETER CONTROL**

Because a bad or failing magneto may affect the RPM displayed on the liquid crystal display (see Theory section), a mechanism is provided to mask the erroneous RPM information from the display. An Erroneous or erratic RPM display may be accompanied by one or more of the status LEDs illuminating.

Press-and-release operation of the right and left buttons causes the right and/or left tachometers to be alternately masked and un-masked from the display. This is a toggle type feature: a masked tachometer will be un-masked, or allowed to affect the display, when the button is pressed, or an un-masked tachometer will be prevented from affecting the display when the button is pressed.

When the RPM displayed on the P-100 is suspected to be wrong, is jittery or erratic, does not track the engine properly, or one or more of the status indicators are turned on or are flickering, it is likely that one of the ignition systems has a problem.

The procedure to find the bad ignition system is to isolate the RPM from each internal tachometer can check the results. Mask each tachometer, one at a time, starting with the tachometer corresponding with any flickering red status LED to try to stabilize the RPM on the display. A tachometer that appears to be varying wildly or not properly tracking the engine is the culprit and should be masked from the display to allow normal operation of the P-1000 on the remaining good magneto.

A tachometer that is masked is indicated by the corresponding status LED flashing regularly at a one second rate. Care should be taken not to interpret this indication as a loss of signal condition. The yellow status indicator is inhibited when either tachometer is masked.

## **ENGINE CLOCK**

Your tachometer may have been pre-programmed at the factory for other than zero engine hours. When ordering your P-1000, a review of your logs may have been necessary to determine the correct time for the tachometer display. Any correction or change in time must be recorded in the appropriate log book.

Recording tachometer, such as the P-1000, are considered by the FAA to record engine hours, not airframe hours. Thus, the tachometer should be ordered with zero hours if being installed with a zero time engine. Allowing the tachometer to run past engine changes in hopes to accumulate total "Time In Service" is not proper, as the engine operates long before the aircraft leaves the ground, see FAR 1.0.

Also, Horizon Instruments, Inc. provides a service to zero or correct your engine hours when engines are changed, or to adjust a tachometer display for the proper engine hours reading.

## **RESET**

The computer within the P-1000 may be manually reset if it is suspected that it is not operating properly. To accomplish the reset, simultaneously press the center and right buttons. The P-1000 should proceed through its self-check tests and resume full operation.

## TROUBLE-SHOOTING

The following is a brief chart of some of the different ways the P-1000 will behave under certain circumstances. It is assumed that the P-1000 is properly installed.

### **BEHAVIOR:**

RPM drop during pre-flight magneto test is excessive.

P-1000 continuously indicated excessive RPM difference for right and left magnetos (Greater than allowed for this aircraft).

P-1000 continuously displays "Mag-Drop" indication with unstable displayed information.

Erratic or non-stable RPM readings on the P-1000.

RPM becomes unstable at higher engine speeds.

No engine RPM reduction when magneto is grounded by ignition switch.

P-1000 indicated no RPM. Engine runs and ignition switch is not shorting magneto.

RPM becomes unstable or inaccurate as engine warms up.

Red or Yellow Status LEDs flicker.

Yellow Status LED is on without either RED LED.

### **PROBABLE CAUSE:**

Failing ignition system. Probable weak magneto or high-voltage components (ignition wires, plugs, etc.).

This is a common indication of degradation of one of the two ignition systems. The ignition system with the lesser RPM may be mis-firing.

P-1000 has an intermittent connection to a magneto (missing signals at P-1000).

Low magneto power output, bad connection, or bad magneto points.

Suspect point floating or possible ignition coil failure.

Possible hot magneto condition, P-Lead signal is not grounded. Possible open P-Lead wire or non-functional ignition switch.

P-Lead wires may be "open" or broken. Magneto signal is not arriving at switch connection. Power buss ground is floated from magneto, or P-100 has no connection to magneto ground.

Probable bad magneto points, bad bearing.

Intermittent connection in P-Lead or possible grounding of P-Lead. Check for loose connection at magneto, bad ignition switch, and breached insulation on P-Lead wire. Possible bad magneto.

Indicates that the magnetos are not supplying the same number of pulses (i.e. One for each cylinder). This generally indicates bad points or an intermittent connection.

## BEHAVIOR:

Red status LED flashed regularly.

## PROBABLE CAUSE:

Check to see that the tachometer has not been accidentally shut down. Quickly press and release the corresponding right or left tachometer control buttons to see if the condition clears.

## COMMON FAILURES OF IGNITION SYSTEM

Loose connection at magneto.	Vibration of the engine can loosen the nuts/fittings where the P-lead terminates at the magneto.
Breached/Broken Insulation	Heating/Cooling can deteriorate insulation on old wire, vibration can cause object to wear through the insulation (the firewall is a likely location).
Broken Ignition Switch	Wafers/wipers inside the switch become loose or worn, debris (dust and dirt also) causes accidental shorts.