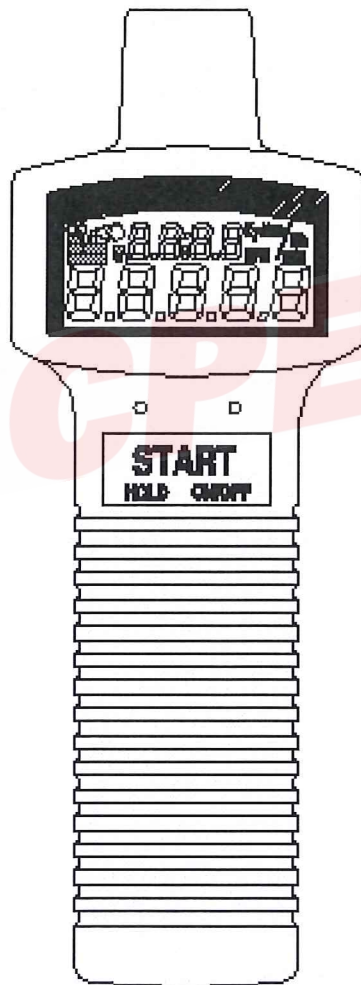


DIGITAL PHOTO TACHOMETER

MODEL: RM-1500/1501/1502

INSTRUCTION MANUAL



Thank you very much for your purchasing this new digital tachometer. In order to enjoy a long and correct usage of the tachometer, please read this instruction manual carefully. Then you shall understand its operation, appreciate all its features and get the most accurate results.

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1. SPECIFICATIONS

Speed (Non-contact):

	Range	Resolution	Accuracy
RPM	10.00 - 99999	0.01/0.1/1	0.04% ±2 dgts
rps(Hz)	0.200 - 2000.0	0.001/0.01/0.1	0.04% ±2 dgts

Speed (Contact)

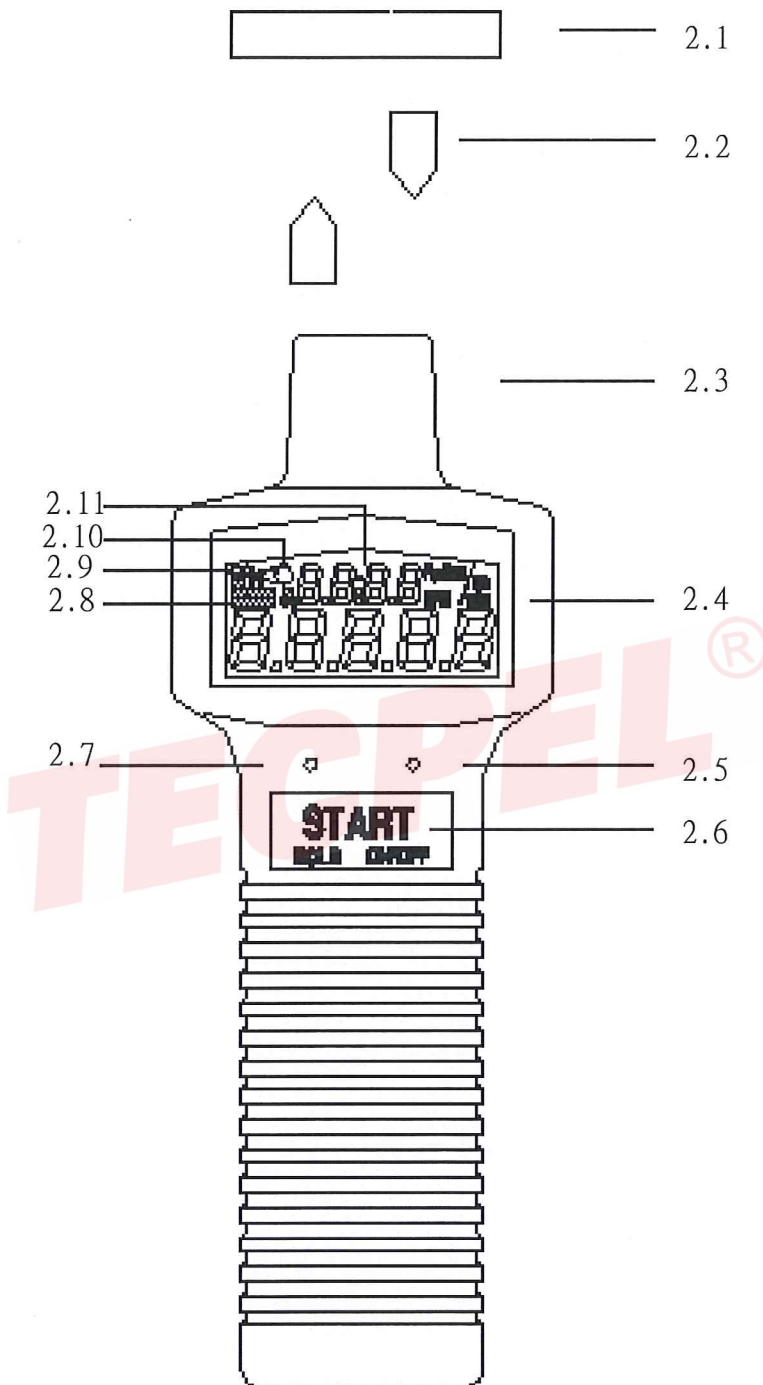
	Range	Resolution	Accuracy
RPM / (/ symoblizes "Contact")	20.00 - 29999	0.01/0.1/1	0.04% ±2 dgts
m/min	2.000 - 2999.9	0.001/0.01/0.1	0.04% ±2 dgts
ft/min	6.00 - 10000	0.01/0.1/1	0.04% ±2 dgts
yard/min	4.00 - 3000	0.01/0.1/1	0.04% ±2 dgts

Event Counter:

Range	Max. Input Frequency
0 - 99999	10KHz. with 5% duty cycle

External TTL Input	High > 4.5V (RM1501)
Display:	5 digits 99999 counts
Sampling Rate:	0.7 second (> 60 rpm) > 1 second (10 to 60 rpm)
Measuring Distance:	50 to 300 mm
Time Base:	4.0 MHz Quartz Crystal
Range Selection:	Automatic
Battery:	Four 1.5V batteries (AA, UM-3)
Power Consumption:	1.5mA (Idle) 5mA (1000.0 - 99999 rpm) 25mA (10.00 - 999.99 rpm) 25mA (Max, Min or Ave Enabled) 25mA (Event Counter)
Auto-Power-Off:	30 minutes.
Operating Temp.	0 to 50°C (32 to 122 °F)
Size:	172 mm x 63 mm x 36 mm (6.8" x 2.5" x 1.5")
Weight:	190 g(6.7 oz.) (including battery)
Accessories:	Carrying case x 1, Reflective tape x 1, Instruction Manual x 1

2. PANEL FUNCTIONS



2.1. Reflecting tape

Attach a reflecting tape to the surface of the unit to be measured

2.2. Reflecting signal light beam

It is recommended that the reflecting surface is perpendicular to the emitting/receiving unit for best measurement.

2.3. Emitting/Receiving Unit

The red light emits from the left side of the tachometer. And a receiving sensor is installed in the right side to receive light signal from the reflecting surface.

2.4. LCD

The lower row of the LCD is a 5 digit number to display RPM, m/min, ft/min, yd/min or counts.

The upper row of the LCD is a clock. If only the minutes is displayed, tachometer is in the auto-power off mode. Power will be turned off in 30 minutes. To disable auto-power-off mode, press and hold the unit button (left button) for 2 seconds. Then the hours will be displayed.

2.5. Function Button

Press the button to select MAX, MIN or AVE function. To return to normal mode, press and hold the button for 2 seconds.

2.6. Start/Hold/On/Off

When the power is turned off, press this button to turn the power on. If the power is on, press this button to start measurement. Press again to hold the data and stop measurement. To turn the power off, press and hold button until "OFF" is displayed in the LCD (about 2 seconds). Release the button, then the power will be turned off.

2.7. Unit Button

Press this button to select different units, such as RPM, RPM / (/ Symbolizes "contact"), m/min, ft/min, yd/min, rps (Hz) or No. of counts. To measurement speed in RPM /, m/min, ft/min or yd/min, the option RM1502 mechanical adaptor must be attached.

When the No. symbol is displayed in the LCD, the unit becomes an event counter. The clock will be reset to zero, and start counting. To stop counting, press the HOLD (START) button once. To reset counts, press the function button(right button).

2.8. MAX/MIN/AVE symbols

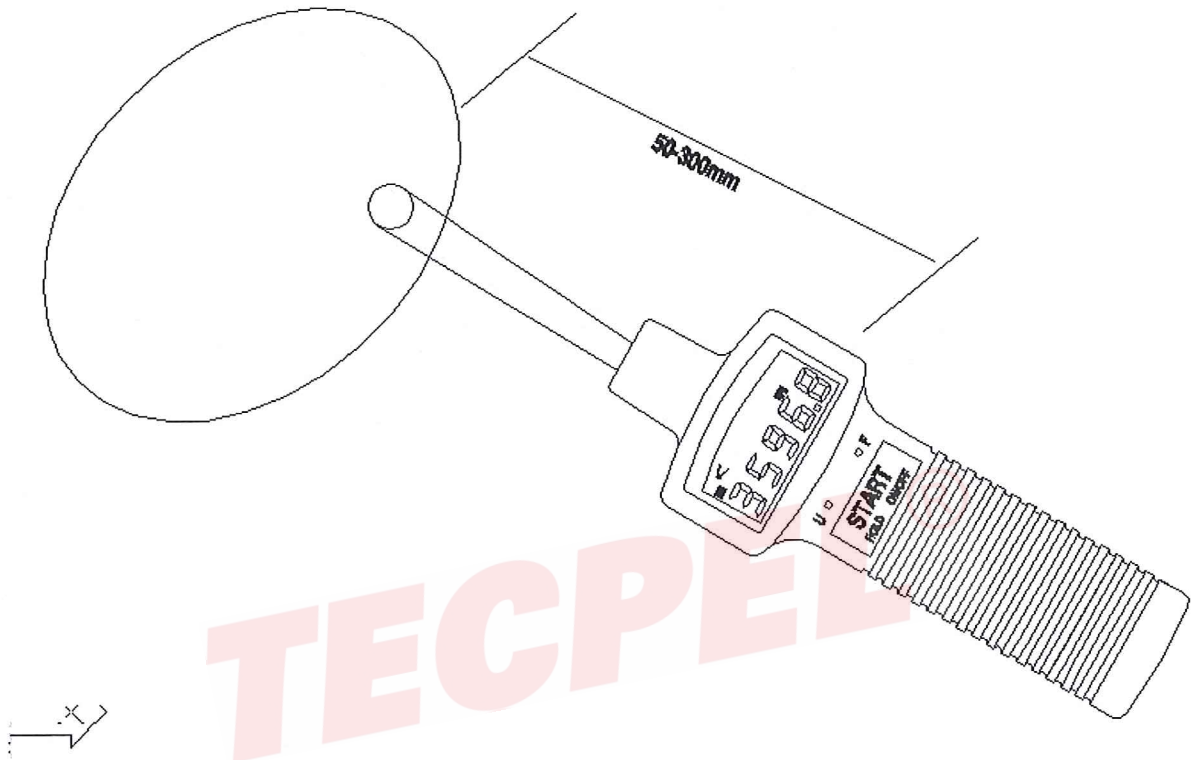
Symbols to indicate which of MAX, MIN or AVE function is enabled.

2.9. Low battery warning

2.10. Start Measurement Symbol

2.11. Hours:Minutes Clock

3. OPERATING INSTRUCTION

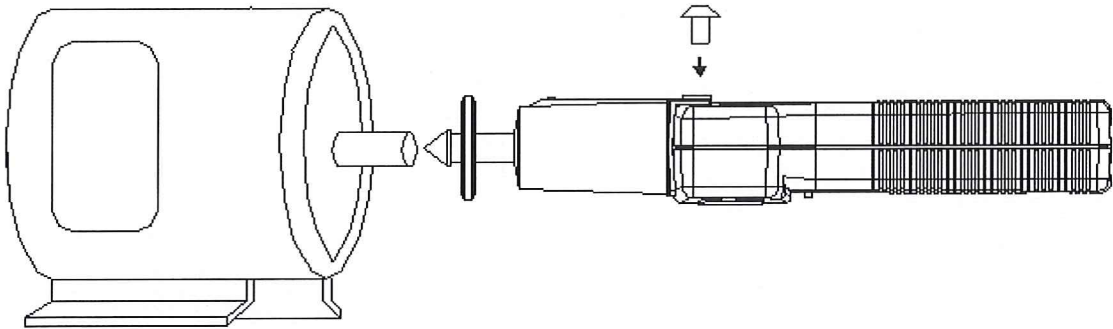


3.1. Normal Operation

- a. Install four 1.5V AA size batteries.
- b. Cut off a piece of reflective tape of size 1.0 cm x 1.4 cm (optimal size)
- c. Wipe off oil or stains from the surface where reflective tape will be adhered.
- d. Stick the self-adhesive reflective tape on the object whose rotational speed is to be measured. The reflective tape should be attached as close to the outer edge of the object to be measured as possible.
- e. Press the START button to turn on tachometer.
- f. Point the photoelectric probe at the object as Figure 2. Press the START button once and confirm that the red emitting LED lamp lights up. Then read the rotational speed on the LCD display.
- g. If the rotational speed is less than 60 rpm, it may take about 1 to 6 seconds to measure (60 rpm takes 1 second, and 10 rpm takes 6 seconds).
- h. The reading will be held for 6 seconds, if you aim the photoelectric probe at a 0 speed object right after one measurement.

Note: If the speed is less than 999.99 rpm, the red LED is turned on all the time to detect speed. If the speed is great than 999.99, the unit goes into power-saving mode. The LED is turned on for a very short period of time, then turned off for most of the time to save power.

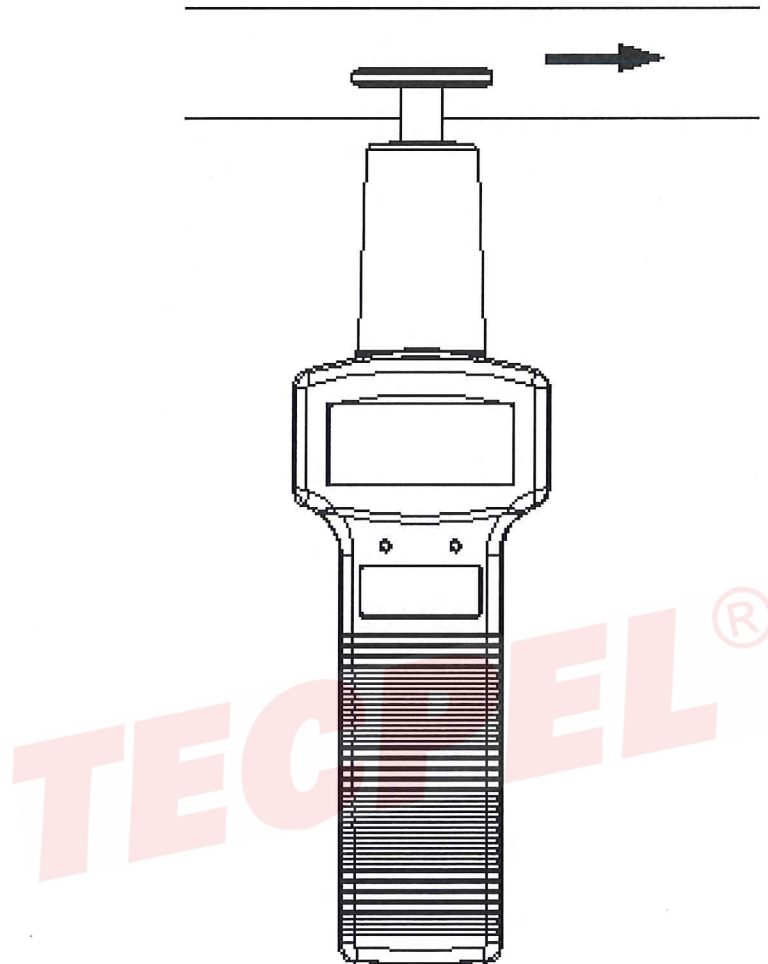
3.2. Using the Mechanical Adaptor (Option RM1502)



- TECPEL®**
- Select proper rubber head.
 - Attach the mechanical adaptor to the unit, **and fasten the screw.**
 - Press the unit button (left button) to select RPM / (instead of RPM only). The auxiliary LED will be turned on while the main LED will be turned off.
 - Press against the shaft of the object to be measured.
 - Do not press against the shaft too hard to avoid hazard.

WARNING: Do not exceed the speed limit of 29999 rpm when using mechanical adaptor.

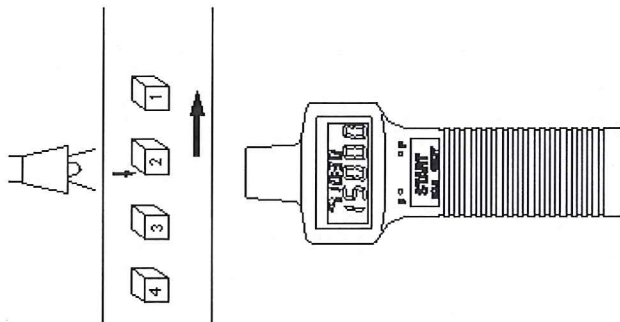
3.3. Measurement of Surface Speed(m/min, ft/min, or yd/min)



- Attach the mechanical adaptor (option RM-1502) to the unit.
- Press the unit button to select desired unit. The auxiliary LED will be turned on while the main LED will be turned off.
- Slightly touch against the surface to be measured.

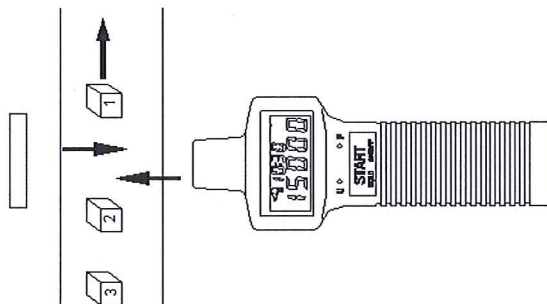
3.4. Use as an Event Counter with External Light Source

- a. Press the unit button several times to select the unit of "No. O" (counts). The "O" symbol is used to instruct users that external light source is required.
- b. When the symbol "No. O" appears, the tachometer reset the upper clock to 00:00 and start counting the pulses it detects. (Auto-power-off is automatically disabled)
- c. To stop counting, press the START button once.
- d. To reset counts to zero, press the function(right) button.



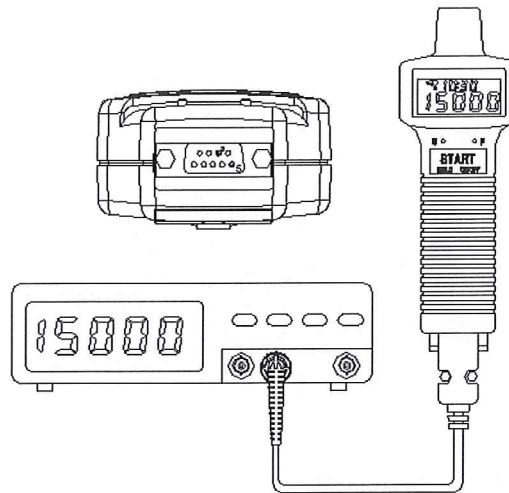
3.5. Use as an Event Counter with Internal Red LED

- a. Press the unit button several times to select the unit of "No. " (counts).
- b. When the symbol "No." appears, the tachometer reset the upper clock to 00:00 and start counting the pulses it detects (Auto-power-off is automatically disabled).
- c. To stop counting, press the START button once.
- d. To reset counts to zero, press the function(right) button.



3.6. External Signal(TTL) Input (RM1501)

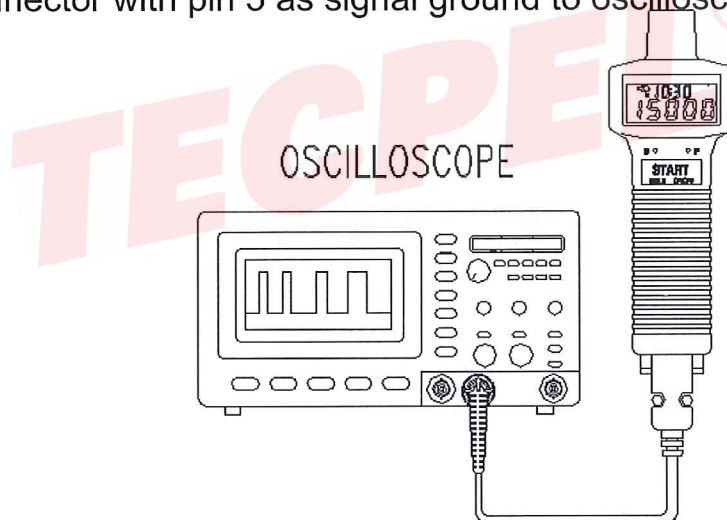
Instead of receiving signal from light source, users can input external TTL signal (High: > 4.5V, Low: 0V) through pin 8 of RS232C connector with pin 5 as signal ground.



NOTE: It is strongly recommended that the emitting/receiving unit be covered to avoid undesired light signal coming in.

3.7. Digital Pulse Signal Output (RM1501)

Users can output digital pulse signal through pin 8 of RS232C connector with pin 5 as signal ground to oscilloscope.



3.8. Measuring Slow Rotating Objects

If the rotating speed of the object which you are measuring is very slow, it is recommended that you use a tripod to hold the tachometer in place and use multiple pieces of tape for more accurate result.

If multiple pieces of tape are used, each piece of tape should be located at a equal distance to each other on the object. Any number of pieces of tape are acceptable. But you need to divide the reading by the number of pieces to obtain the correct result.

Correct RPM = Reading / (number of pieces of tape)

Example: 4 pieces of tape and reading is 12 RPM.

Correct Speed = $12 / 4 = 3$ rpm

3.9. Using the MAX/MIN/AVE Functions

These functions allow users to analyze the stability of rotational speed. These value are actually peak (MAX), valley(MIN), and true average(AVE) values.

MAX: Press the function button to select maximum function. The MAX function can be used to find the peak value of speeds measured.

MIN: Press the function button to select minimum function. The MIN function can be used to find the valley value of speeds measured.

AVE: Press the function button to select average function. The average function is a true average value.

Erreur !

If summation of average value overflow, or $n > 65535$, the last average RPM will be used as initial value for successive calculation. And n will be reset to 1.

When users press the HOLD button (same as START button), the max/min/ave values are still stored in memory. Users can press the function button (right button) to review the values. To return to normal mode, press and hold the function (right button) for 2 seconds, and the max/min/ave symbols will disappear in LCD.


3.10. Turning On/Off Tachometer

Press any button will turn on the power of tachometer. To turn off the power of tachometer, press and hold the START button until word "OFF" is displayed in LCD. Then release the START button.

3.11. Disable Auto-Power-Off Function

If tachometer is in auto-power-off mode, only the minutes will be displayed. And tachometer will be turned off in 30 minutes. To disable the auto-power-off function, press and hold the UNIT button (left button) for 2 seconds until the hours is displayed.

3.12.  REPLACING THE BATTERIES

- a. When the  symbol (low battery) appears in the LCD, it is time to replace the batteries.
- b. Remove the screw of the battery cover and remove the battery cover.
- c. Replace the old batteries with 4 new batteries. Do not mix different type of batteries together.
- d. Replace the battery cover and fasten the screw.

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4. Protocol of RS-232C Serial Interface (RM-1501)

Ten bytes are sent out through RS-232C connector to PC. The definitions of each byte are as followings:

- Byte 1: Leading byte 0x0D
- Byte 2: Decimal point of LCD display
 - bit0: dp1 (0000.0), if 1
 - bit1: dp2 (000.00), if 1
 - bit2: dp3 (00.000), if 1
- Byte 3: Flags for current status
 - bit0: low battery, if 1
 - bit1: Max. value overflow, if 1
 - bit2: Counter overflow, if 1
 - bit3: Auto-power-off disable, if 1
 - bit4: Min. value overflow, if 1
 - bit5: Ave. value overflow, if 1
- Byte 4: Unit
 - bit0: rpm, if 1
 - bit1: m/min, if 1
 - bit2: ft/min, if 1
 - bit3: yd/min, if 1
 - bit4: rps, if 1
 - bit5: counter with external light source, if 1
 - bit6: counter without external light source, if 1
- Byte 5: Function
 - bit0: normal, if 1
 - bit1: max, if 1
 - bit2: min, if 1
 - bit3: average, if 1
- Byte 6: Flags for current status
 - bit4: LCD reading over load (OL)
 - bit7: Hold
- Byte 7: Least significant byte of reading in binary format
- Byte 8: 2nd byte of reading in binary format
- Byte 9: 3rd byte of reading in binary format
- Byte 10: Most significant byte of reading in binary format

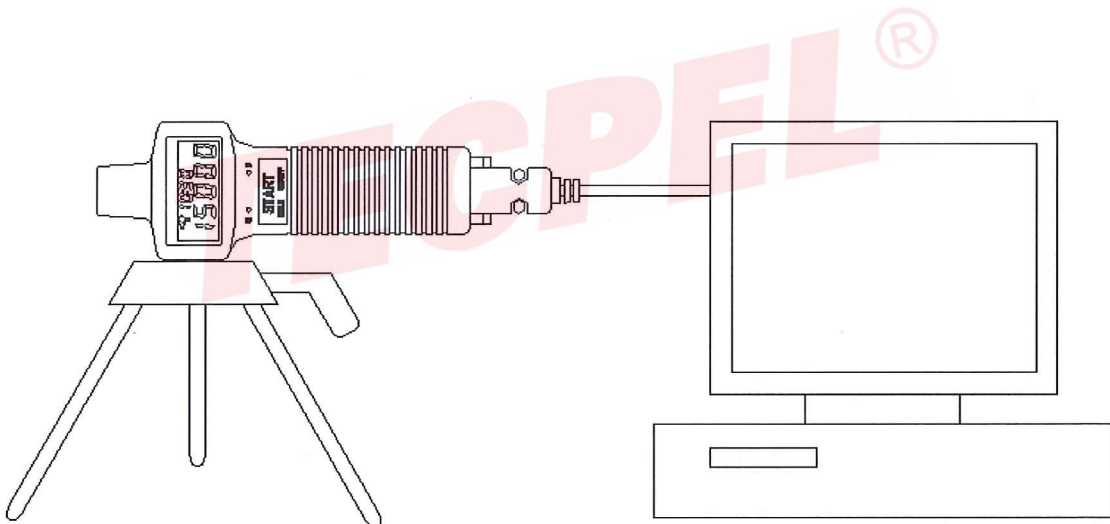
5. Installation of Window™ Application Software (RM-1501)

5.1. For Windows 3.1

- A. Start **Microsoft™ Windows™**
- B. Insert disk in drive A (or B)
- C. From **Program Manager**, select **File** menu and choose **Run**
- D. Type a:\setup (or b:\setup) and press **Enter** key

5.2. For Windows 95

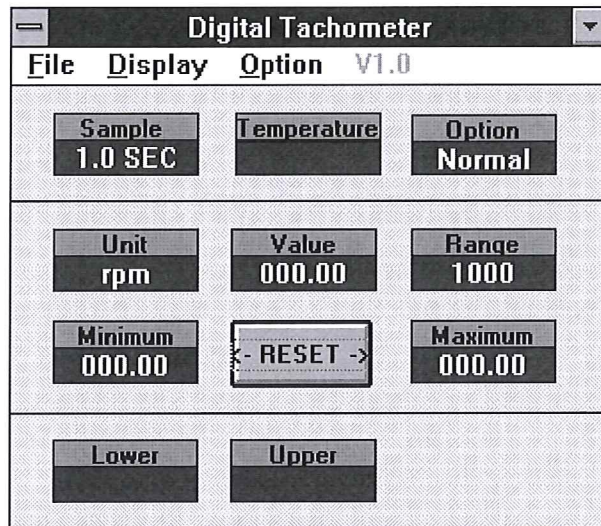
- A. Start **Windows™ 95**
- B. Insert disk in drive A (or B)
- C. Press **START** button, then select **Run**
- D. Type in a:\setup (or b:\setup) and press **Enter** key



6. Description of Windows™ Application Program (RM-1501)

Main Window:

When the program is executed, the program automatically search for connected tachometer or available serial port. If no serial port is available, then a message of "No communication port" will be displayed, and the program exits . Once communication port is setup, a main window will be displayed on the screen as below:



Sample: Sampling time.

Option: Display option of anemometer. Normal, MAX, MIN, AVE

Unit: rpm, m/min, ft/min, yard/min, counter 0, counter

Value: The value under VALUE is the reading from the tachometer

Range: The text displayed under RANGE is the range of the unit selected at the tachometer

Minimum: The minimum value ever recorded by PC.

Reset: Clear minimum and maximum value recorded.

Maximum: The maximum value ever recorded by PC.

Lower: The minimum value of the range specified.

Upper: The maximum value of the range specified.

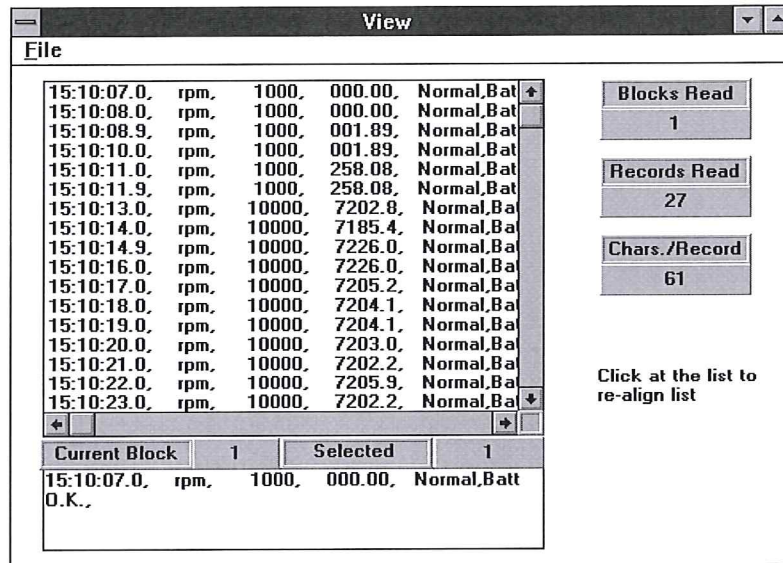
File: If you select File, a pull down menu will show six options: Name, Start Recording, End Recording, VIEW, Plot Data from File, and Exit.

Name: Enter file name to store data dispalyed in LCD at specified interval.

Start Recording: Start recording when selected

End Recording: End recroding when selected.

VIEW FILE:



If the View option under FILE in the Main Window is selected, a view window will be shown as above, and the users can review your ASCII data file. If a printer is connected to the PC, users can print out content selectively.

File: Open users data file by selecting this menu. Users will be asked to enter file name. After the name being entered, program will read in one block of data. Number of records in one block depends on the memory size of PC. The bigger memory, the more records in one block.

Blocks Read:

Indicate how many blocks of records have been read.

Records Read:

Indicate how many records have been read.

Chars./Record:

Indicate how many characters in one record.

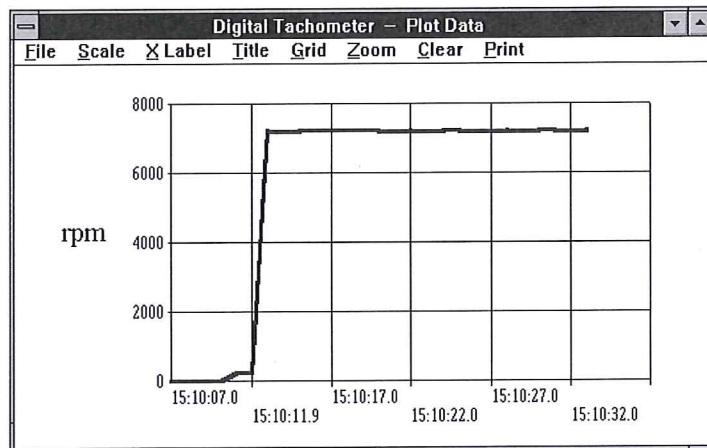
Current Block:

Indicate the current block number being reviewed.

Selected:

Indicate the current record number being selected.

Plotting Data from File



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If the "Plot Data from File" option under FILE is selected in the Main Window, a Plot Window will be shown, and the users can plot curve of your data file. If a printer is connected, users can print out the curve.

File: Open the file to plot data from

Scale: Set the scale of Y-axis.

X Label: Users can select sequence number(1,2,3,4,...) or time(12:00:01, 12:00:05, ...) as X-axis label.

Title: Enter the title for X-axis, Y-axis, or Graph.

Grid: Draw Horizontal, Vertical grids or both.

Zoom: Zoom into the graph. The zoom size is limited to 3600 points.

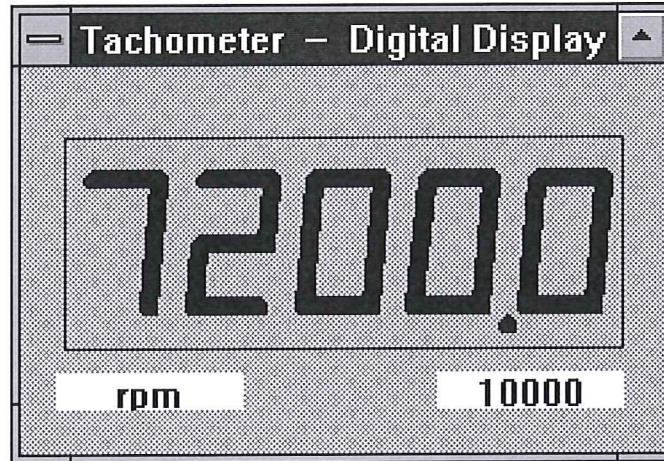
Statis: Statistics. This function allows users to plot average value, standard deviation, best fit over the curve. This function is valid only when the are less than 3600 data. If there are more than 3600 data, STATIS will be disabled.

Clear: Clear the graphic screen.

Print: Print out the curve if a printer is connected to PC.

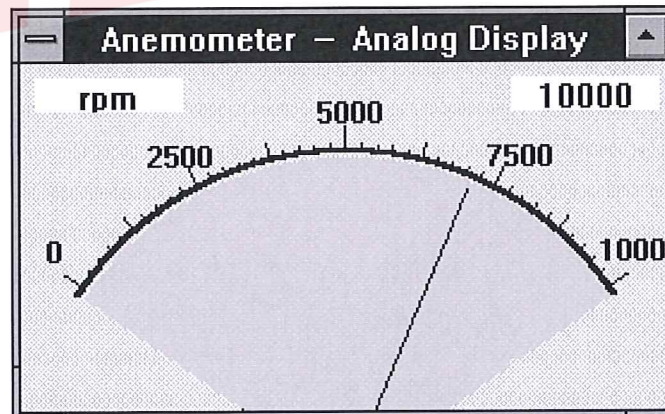
DISPLAY: DISPLAY menu has four options: DIGITAL, ANALOG, LIST, and GRAPHIC.

DIGITAL:



If this option is selected or CTRL+D is pressed, a window, which emulates multimeter's LCD display, shall appears on the screen.

ANALOG:



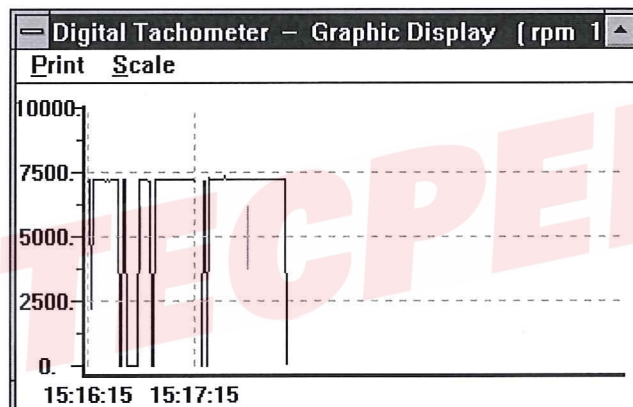
If this option is selected or CTRL+A is pressed, a window, which emulates an analog meter, shall appear on the screen.

LIST:

Digital Tachometer - List				
Time	Function	Range	Data	Area
15:26:01.9	rpm	10000:	7202.6	Normal
15:26:03.0	rpm	10000:	7202.6	Normal
15:26:04.0	rpm	10000:	0000.0	Normal
15:26:04.9	rpm	10000:	0000.0	Normal
15:26:06.0	rpm	10000:	7207.4	Normal
15:26:07.0	rpm	10000:	7229.3	Normal
15:26:07.9	rpm	10000:	7202.6	Normal
15:26:09.1	rpm	10000:	7205.0	Normal
15:26:10.0	rpm	10000:	7186.2	Normal
15:26:10.9	rpm	10000:	7201.8	Normal
15:26:12.0	rpm	10000:	7203.5	Normal
15:26:13.0	rpm	10000:	7199.4	Normal

If this option is selected or CTRL+L is pressed, a window, which lists the date, function, range, and value every sampling, shall appear on the screen.

GRAPHIC:



If this option is selected or CTRL+G is pressed, a window, which emulates strip chart recorder, shall appear on the screen. The graphic window has two menu, PRINT and SCALE. Select the PRINT menu, the graphics will be printed through any printer connected to the PC. The SCALE menu allows user to set the minimum and maximum value for the Y (vertical) axis.

Option: If you select Option, a pull down menu will show three options:
Sample Rate, Baud Rate.

Upper Limit: Enter upper limit. If upper limit is exceeded, a OVER message will be displayed in screen.

Lower Limit: Enter lower limit. If displayed value is less than lower limit, a UNDER message will be displayed in screen.

Graphic Mode: Select way of display in the graphic windows. Dot or BAR.

Sample Rate: Select this option to enter PC sampling time, or click at the SAMPLE on screen to enter sampling time.

Baud Rate: 9600.

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