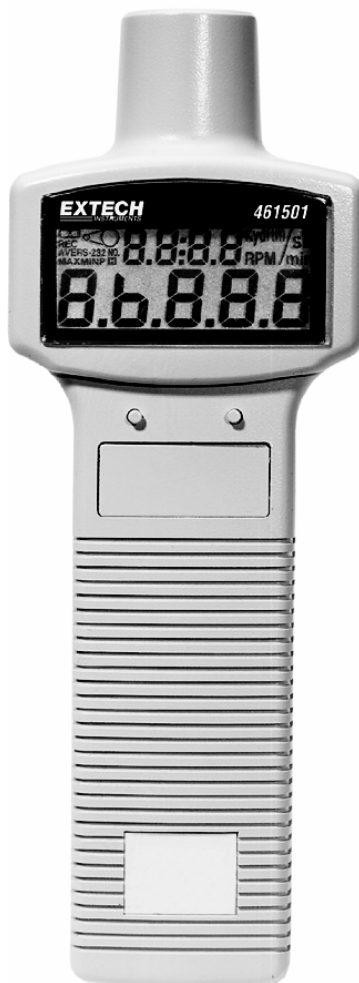


User's Manual



Photo Tachometer / Counter

MODEL 461501



WARRANTY

EXTECH INSTRUMENTS CORPORATION warrants the basic instrument to be free of defects in parts and workmanship for one year from date of shipment (a six month limited warranty applies on sensors and cables). If it should become necessary to return the instrument for service during or beyond the warranty period, contact the Customer Service Department at (781) 890-7440 for authorization. **A Return Authorization (RA) number must be issued before any product is returned to Extech.** The sender is responsible for shipping charges, freight, insurance and proper packaging to prevent damage in transit. This warranty does not apply to defects resulting from action of the user such as misuse, improper wiring, operation outside of specification, improper maintenance or repair, or unauthorized modification. Extech specifically disclaims any implied warranties or merchantability or fitness for a specific purpose and will not be liable for any direct, indirect, incidental or consequential damages. Extech's total liability is limited to repair or replacement of the product. The warranty set forth above is inclusive and no other warranty, whether written or oral, is expressed or implied.

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461501 V1.4 8/00

Introduction

Congratulations on your purchase of Extech's 461501 Photo Tachometer / Elapsed Timer-Counter. This device measures rotational speed (non-contact measurement) or linear speed (contact measurement) using the optional mechanical adapter. This meter offers an RS-232 interface for PC connection, MIN/MAX/AVG readings, Data Hold, Counter, Elapsed Timer, Digital IN/OUT, and Auto Power OFF. Proper use and care of this meter will yield years of reliable service.

Safety

1. Ensure that the four AA 1.5V batteries are inserted correctly in the rear battery compartment (secured with one Phillips head screw).
2. Remove the batteries from the meter if the meter is to be stored for long periods.
3. Always keep fingers, articles of clothing, etc. from coming into contact with moving fans, blades, belts, etc. when testing.
4. Do not look directly at the light beam or point the beam toward anyone's eyes.

Specifications

	Range	Resolution	Accuracy
Non-Contact Speed Measurements			
RPM	10.00 – 99999	0.01 / 0.1 / 1	±(0.1% rdg ±2d)
Hz (rotations per sec)	0.200 – 2000.0	0.001 / 0.01 / .1	
Contact Speed Measurements			
RPM	20.00 – 29999	0.01 / 0.1 / 1	±(0.04% rdg ±2d)
M/min	1.000 – 2999.9	0.001 / 0.01 / .1	
Ft/min	3.00 – 10000	0.01 / 0.1 / 1	
Yard/min	1.00 – 3000		
	Range	Max. input frequency	
Counter	0 – 99999	10kHz with 5% duty cycle	

Display	Dual 5-digit (99999 count) multifunction LCD
Display update rate	0.7 seconds (for 60 RPM)
Time base	4MHz Oscillator (quartz crystal)
Measuring distance	2 to 11.8" (50 to 300mm)
Power supply	Four 1.5V AA Batteries
Power consumption	35mA
Range selection	Automatic ranging
Auto Power OFF	After 30 minutes (can be deactivated)
Operating temperature	32 to 122F (0°C to 50°C)
Dimensions	6.8 x 2.5 x 1.5" (172 x 63 x 36mm)
Weight	6.7 oz. (190g)

Meter Description

1. Photo light source and lens
2. Multifunction LCD dual display
 - * Upper display: Elapsed Timer
 - * Lower display: Measurement/Counter
3. START key: Power, Measure, Data Hold
4. UNITS key and Auto OFF defeat key
5. MIN / MAX / AVG key



Note: The tripod mount and battery compartment are located on the rear of the meter. The RS-232 DB-9 PC Interface port is located on the bottom of the meter.

Display Symbols and Units of Measure

Max	Maximum reading display
Min	Minimum reading display
Ave	Average reading display
RPM	Revolutions per minute in Non-Contact measurement mode
RPM /	Revolutions per minute in Contact measurement mode
	NOTE: Contact measurements can only be made with the optional mechanical adapter
Ft/min	Feet per minute (for contact measurements only)
M/min	Meters per minute (for contact measurements only)
Yd/min	Yards per minute (for contact measurements only)
R/S	Rotations per second (Hz)
No.	(Number of Counts) Counter Function
H	Display HOLD active
^	Photo Light Beam is ON
X	Replace battery

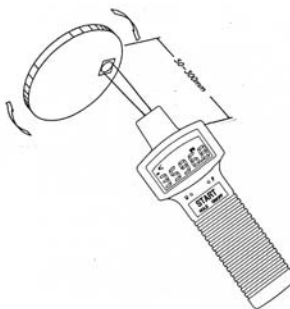
Preparing and affixing reflective tape

1. Cut off a small piece of the supplied reflective tape. The optimal size is 1.0 x ¼ cm or 0.1 x 0.5 in.
2. On the device under test, clean the area where the reflective tape is to be affixed. Ensure that no oil or other material, which could hinder the adhesiveness or reflectivity of the tape, is present.
3. Affix tape to the clean area of the device under test. Make sure that the tape is placed as close to the outer edge of the object under test as possible.

Non-Contact Photo Tachometer Measurements

1. Press the START key to power the Tachometer.
2. Press START again to activate the Photo light beam. Point the Photo light beam toward the object under test. The reflecting surface must be perpendicular to the light beam source. The optimum distance from light source to object under test is 2 to 12 in. (50 to 300mm). See Fig.1.
3. Read the RPM measurement data on the lower line of the LCD and the Elapsed Time on the upper LCD line.
4. Note that if only minutes are displayed on the Elapsed Timer, the tachometer is in the Auto Power OFF mode (meter powers down after 30 mins. of non-use). To disable Auto Power OFF refer to the Section "Auto Power Shut OFF". If the Elapsed Timer shows hours and minutes, then the Auto Power OFF feature has been disabled.
5. For rotational speeds less than 60 RPM, 1 to 6 seconds is required for the reading to stabilize (60 RPM = 1 second; 10 RPM = 6 seconds).
6. For DATA HOLD, press the START key while measuring. The data display will freeze and the 'H' icon will appear on the LCD to alert the user that DATA HOLD is activated. Press the START key again to resume measurement.
7. To power the meter down, press and hold the START key until the LCD reads OFF and then goes blank.

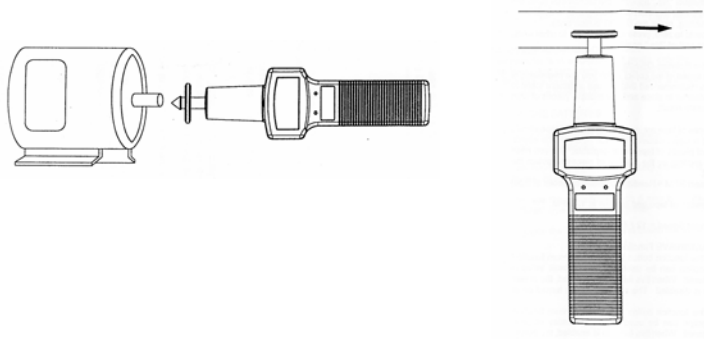
Fig.1 - Non-Contact Measurements



Contact Measurements using optional Mechanical Adapter

1. Select the appropriate rubber head to suit the application at hand. To affix the rubber head you must insert it partially into the adapter and then, while turning it as if it were a knob, push the rubber head into the adapter.
2. Affix the mechanical adapter over the tachometer sensor and snap it firmly in place.
3. Press the START key to power the Tachometer.
4. Press the Units key (at left) to select "RPM /", ft/min, m/min, yards/min, or r/s (rotations per second or Hz). Note that for contact RPM measurements use the "RPM/" instead of the "RPM" unit (the forward slash after RPM indicates that the reading is a contact measurement rather than a non-contact measurement)
5. Press START again to start measurement. Press the rubber head against the device under test (moving belt, escalator, etc.). Do not press too firmly against moving device. See Fig.2 below.
6. Read the measurement on the lower LCD line. The Elapsed Time appears on the upper LCD line. Do not exceed 29999 RPM with the mechanical adapter.
7. For DATA HOLD, press the START key again (while measuring). The data display will freeze and the 'H' icon will appear on the LCD to alert the user that DATA HOLD is activated. Press the START key again to resume measurement.
8. To power the meter down, press and hold the START key until the LCD reads OFF and then goes blank. Auto Power Off will power the meter down after 30 mins. of non-use. To defeat Auto Power Off refer to section "Auto Power Shut OFF".

Fig. 2 - Contact Measurement examples



Slow Speed Measurement Considerations

If the speed of a rotating object is slow, the use of a tripod is highly recommended. A tripod will hold the meter in place with minimum movement providing more accurate readings. Also, use additional pieces of reflective tape if possible.

If multiple pieces of tape are used, each piece of tape should be placed equidistant. Any number of pieces can be used but you must divide the reading by the number of pieces to obtain the correct result. Use this equation:

$$\text{Correct RPM} = \text{Reading} / \text{No. of tape pieces.}$$

In the example for Fig. 3, four pieces of tape are used. If the meter reading is 12 RPM, the equation becomes: $\text{RPM} = 12 / 4$; therefore the Correct RPM is 3.

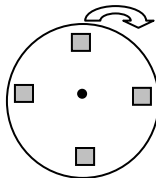


Fig. 3 – Rotating device with 4 pieces of reflective tape

Maximum, Maximum, and Average Readings

This feature permits the user to analyze the stability of a device under test with regard to rotational speed. This is achieved by comparing maximum, minimum, and average readings over time.

1. To display the Max, Min, and Avg readings while measuring, first press the Function key (located above and to the right of the START key). The MAX display icon will appear on the left side of the LCD along with the reading which indicates the highest reading since measurement began.
2. Press the Function key again and the MIN indicator along with the lowest reading will display.
3. Press the Function key again and the Average reading will display. The average function is a True Average (refer to equation below). If the summation of average values overflows ($n=65535$) then the last average RPM will be used as an initial value for successive calculations (n will be reset to 1).

$$RPM_{ave} = \frac{1}{n} \sum (rpm)_n; \sum (rpm) < 2^{32}; n < 65535$$

4. When the START key is pressed, the Max/Min/Ave values begin to be calculated and recorded. Users can then press the Function key (at right) to review the stored values.
5. To exit this mode, press and hold the Function key for approx. 3 seconds until the MAX, MIN, and AVE indicators disappear. When this mode is exited, the stored data is reset (cleared).

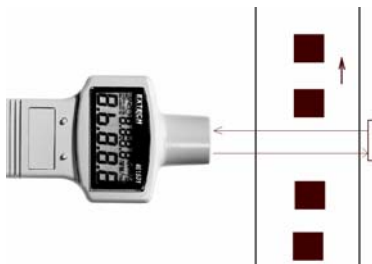
Data Hold

Press the START key while measuring to freeze the display. The "H" icon will appear on the LCD to indicate that the Data Hold mode is activated. Press the START key again to exit the Data Hold mode and return to normal operation.

Counter Function

This meter permits the counting of objects as they pass through its light beam (on a conveyor belt, for example). As shown in the diagram below, the Photo tachometer sends out a beam of light that is reflected back. Each time a product breaks the beam another count takes place and the display is updated. In addition, the top line displays elapsed time. The user must tripod-mount the meter and also provide a reflective surface as shown in Fig.4 below.

Fig. 4 – Product Counting



Press the Unit key (at left) repeatedly until “No.” appears on the left side of the LCD. The Counter display (lower, main LCD line) will be set to zero. Press START key again to begin counting pulses. Each object that breaks the light beam will be counted (in this mode Auto Power OFF is disabled). To pause counting (DATA HOLD), press the START key once, to resume counting press START again. To reset the Counter (zero), press the Function key (right). Elapsed Time is shown on the top line of the display in HR:MN format. Note that when the counter is reset, the Elapsed Timer does not return to zero. To reset the Elapsed Timer the meter power has to be cycled.

Counting with the Digital Input Feature

This tachometer accepts a DC voltage input through its RS-232 port (pin 8 for signal input with pin 5 as signal ground). A HIGH input is in the range of 4.5V and a LOW input is in the range of 0V. Each input pulse sensed by the tachometer is counted and the display is updated. Cover the light beam lens while using the Digital Input feature to avoid display errors. To set up the tachometer as a counter, follow the instructions above in the section entitled “Counter Function”.

Digital Output Feature

This tachometer outputs a square wave from its RS-232 port (pin 8 and pin 5 as signal ground) to an oscilloscope or other device. The 5V digital pulse (square wave) changes frequency proportionately to the measured RPM.

Auto Power Shut Off

This Tachometer is equipped with an Automatic Power OFF feature. After approx. 30 minutes, if no keys are pressed, the meter shuts down. This helps to conserve battery life.

To defeat this feature press and hold the Units key (at left) with meter powered until both the hours *and* minutes fields are displayed on the Elapsed Timer LCD line (top) instead of only the minutes field.

When only the minutes field is displayed on the Elapsed Timer, the Auto Power OFF feature is activated. When both the hours *and* minutes fields are displayed on the Elapsed Timer, the Auto Power OFF feature is defeated.

PC Interface via RS-232 Port

Communications Protocol

Ten bytes are output through the DB-9 RS-232 port (located on meter bottom). The protocol is presented below:

Byte 1: Leading byte 0x0D

Byte2: Decimal point (LCD)

bit0: dp1 (0000.0)

bit1: dp2 (000.00)

bit2: dp3 (00.000)

Byte3: Status Flags

bit0: low battery

bit1: Maximum reading feature over range

bit2: Counter over range

bit3: Auto power off disabled

bit4: Minimum reading feature over range

bit5: Average reading feature over range

Byte4: Units

bit0: RPM

bit1: m/min

bit2: ft/min

bit3: yr/min

bit4: rps

bit5: not used

bit6: counter mode

Byte5: Function

bit0: Normal mode of operation

bit1: Maximum reading mode

bit2: Minimum reading mode

bit3: Average reading mode

Byte6: Overload and Data Hold Status Flags

bit4: LCD reading overload (OL)

bit7: Data Hold Mode

Byte7: Least significant byte of reading (binary format)

Byte8: 2nd byte of reading (binary)

Byte9: 3rd byte of reading (binary)

Byte10: Most significant byte of reading (binary)

Hardware Connection

The tachometer's RS-232 DB-9 serial communications port is located on the meter bottom. Use the supplied cable to connect the meter's port to the PC serial COM port. A 25- to 9-pin adapter is included in the event that the PC in question has a 25-pin COM port only.

Windows™ Tachometer Software Installation

For Windows™ 3.1

Start Windows™

Insert Program Disk into Floppy Drive

From Program Manager, select FILE menu and choose RUN.

Type a:\setup (or b:\setup) and press ENTER

For Windows™ 95/98

Start Windows™ 95/98

Insert Program Disk in Floppy Drive

Press START key and then select RUN

Type a:\setup (or b:\setup) and press ENTER

Main Software Window

When the tachometer software is executed, the program checks for a connected tachometer or for an available serial COM port. If no serial port is available or if the meter is not connected correctly, the message "NO COM" is displayed on the lower right hand side of the Main Software Window (shown below).

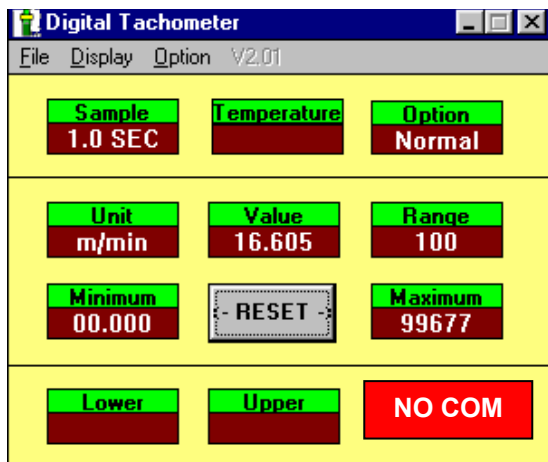


Fig. 5 - Main Software Window

Main Software Window Fields

Sample:	Sample rate (interval of time between recorded readings). The Sample rate is user-selectable from 1 to 32,767 seconds. Double click on this field or select Sample Rate from the OPTION menu to select sample rate.
Option:	The operational mode of the tachometer (Normal, Max, Min, or Avg)
Units:	Units of measure [RPM, RPM/, m/min/ ft/min, yd/min, R/S (Hz), and No. (counter)]. The units can only be selected from the meter front panel using the Units key (key on left).
Value:	Tachometer's measurement reading
Range:	Tachometer measurement range
Minimum:	The lowest reading recorded
Maximum:	The highest reading recorded
Reset:	Clear Minimum and Maximum reading. Press RESET to clear.
Lower:	User selectable Low Alarm (Window flashes UNDER if measurement falls below this user-defined limit).
Upper:	User selectable High Alarm (Window flashes OVER if measurement rises above this user-defined limit).

Main Software Window Menu Items

FILE

Name: User selected data file name

Start Recording: Select to begin recording data to file

End Recording: Select to cease data recording.

View File: Open the data file for viewing and printing. See List illustration in Fig. 6 below. The FILE heading in the VIEW FILE window permits the user to check the number of data blocks, records, or characters read

Print Data: Prints stored measurement data.

Exit: Closes the datalogging program.

DISPLAY

Refer to Fig. 6 below for the four display types. You can open each display type using the DISPLAY menu from the Main Software Window or you can use the following keyboard shortcuts.

Keyboard shortcuts

CTRL+D: Opens Digital Display

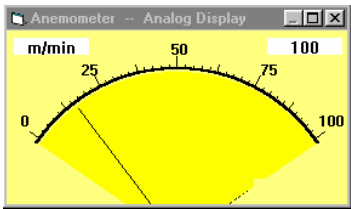
CTRL+A: Opens Analog Display

CTRL+L: Opens List Display

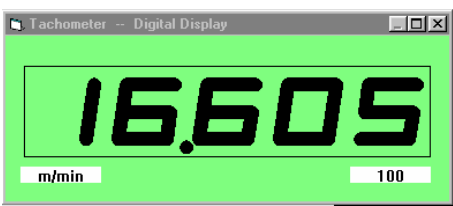
CTRL+G: Opens Graph Display

Fig. 6 – Display Types

Analog Display Mode



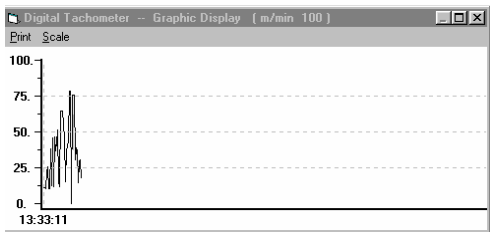
Digital Display Mode



List Display Mode

Time	Function	Range	Data	U/Area
13:33:34.0	m/min	100:	38.284	Normal
13:33:35.0	m/min	100:	39.129	Normal
13:33:36.0	m/min	100:	45.179	Normal
13:33:37.0	m/min	100:	78.303	Normal
13:33:37.9	m/min	100:	78.303	Normal
13:33:39.0	m/min	100:	00.000	Normal
13:33:40.0	m/min	100:	75.996	Normal
13:33:41.0	m/min	100:	75.996	Normal
13:33:42.0	m/min	100:	75.996	Normal
13:33:43.0	m/min	100:	30.540	Normal
13:33:44.0	m/min	100:	39.071	Normal
13:33:45.0	m/min	100:	37.240	Normal
13:33:46.0	m/min	100:	14.591	Normal
13:33:47.0	m/min	100:	29.658	Normal
13:33:48.0	m/min	100:	30.320	Normal
13:33:49.0	m/min	100:	17.223	Normal
13:33:32.0	m/min	100:	45.785	Normal

Graph Display Mode



OPTION

When **OPTION** is selected in the Main Software Window, the following items appear:

- SAMPLE RATE** Enter the rate at which data is recorded.
- UPPER LIMIT:** Enter a high measurement limit. If this limit is exceeded the OVER message will appear in the software window.
- LOWER LIMIT:** Enter a low measurement limit. If this limit is exceeded the UNDER message will appear on the software window.
- GRAPHIC MODE:** Select the way you desire the graph to display (Dots or bars)
- BAUD RATE** 9600 bps (fixed).

NOTE: There are two menu items in Graph Mode:

- a. **PRINT:** Allows the user to print the graph.
- b. **SCALE:** Permits the user to select the Min/Max units for the Y axis

Maintenance

Battery Replacement

When the low battery symbol appears on the LCD, replace the meter's four 1.5V AA batteries.

1. Remove the rear battery compartment screw and open the battery compartment.
2. Replace the batteries observing correct polarity, and replace the compartment cover and rear screw.

Repair and Calibration Services

Extech offers complete repair and calibration services for all of the products we sell. For periodic calibration, NIST certification or repair of any Extech product, call customer service for details on services available. Extech recommends that calibration be performed on an annual basis to insure calibration integrity.

NOTES: