



OPERATOR'S MANUAL

Model FC130A  
Frequency Counter

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OPERATOR'S MANUAL

# Model FC130A Frequency Counter

**Wavetek Corporation**

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San Diego, CA 92123

**European Distribution and Service Center**

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Hurricane Way, Norwich, NR6 6JB  
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## ONE YEAR LIMITED WARRANTY

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Model FC130A Frequency Counters are warranted against defects in parts, material and workmanship within a period of one (1) year following the date of purchase of the Frequency Counter by the original buyer. This warranty is extended by Wavetek Corporation only to the original buyer or original user of the instrument, who must present proof of purchase at the time of warranty service.

In the United States any instrument claimed to be defective during the warranty period should be returned with proof of purchase to Wavetek Corporation Instrument Repair Department. For warranty repair outside the United States, contact your local Wavetek Corporation dealer or distributor where your Frequency Counter was purchased, or return it to Wavetek Corporation Instrument Repair Department.

ANY IMPLIED WARRANTIES ARISING OUT OF THE SALE OF AN FC130A FREQUENCY COUNTER, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO THE ABOVE STATED ONE (1) YEAR PERIOD. MANUFACTURER SHALL NOT BE LIABLE FOR LOSS OF USE OF THE FREQUENCY COUNTER OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES OR ECONOMIC LOSS.

Some states do not allow limitations on how long implied warranties last or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

### CERTIFICATION

Wavetek Corporation certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when shipped from the factory.

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## Section One INTRODUCTION

This instrument is a microprocessor-based frequency counter. It measures frequency, period and rate per minute (RPM) over a range of 0.01Hz to 120MHz on channel A, and from 50MHz to 1.3GHz on channel B. Special features include high resolution and sensitivity.

## Section Two SPECIFICATIONS AND FEATURES

### Channel A:

Range:	Coupling	AC	DC
	FREQ A	30Hz to 120MHz	0.01Hz to 120MHz
	PER A	8ns to 30ms	8ns to 100s
	RPM	1800 RPM to 7200 million RPM	0.6 RPM to 7200 million RPM
Sensitivity:	20mVrms TYP. 50mVrms sine wave MAX to 10kHz. 10mVrms TYP. 30mVrms sine wave MAX to 80MHz. 30mVrms TYP. 40mVrms sine wave MAX to 110MHz. (Sensitivity figures are for 4 stable digits of reading following adjustment of "TRIG LEVEL" control, at 10kHz and below.)		
Coupling:	AC or DC switchable.		
Filter:	Low pass, switchable in or out of channel A. 3dB point nominally 100kHz.		
Impedance:	1M $\Omega$ nominal shunted by less than 40pF.		
Attenuator:	x1 or x20 nominal.		
Trigger level:	Variable between +2.5VDC and -2.5VDC.		
Damage level:	x1: 250Vpp (AC+DC). x20: 500Vpp (AC+DC).		

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## CHANNEL B:

Range: 50MHz to 1.3GHz.

Sensitivity: 15mVrms TYP. 25mVrms MAX to 80MHz.  
10mVrms TYP. 15mVrms MAX to 700MHz.  
15mVrms TYP. 25mVrms MAX to 1GHz.  
30mVrms TYP. 50mVrms MAX to 1.3GHz.

Coupling: AC.

Impedance: 50 $\Omega$  nominal.

Max. input level: 3Vrms sinewave.

## GENERAL:

### Resolution:

At least 7 digits for 1 second, 6 digits for 100ms, and 5 digits for 60ms gate times.

The maximum resolution for frequency measurement is 10nHz for 1Hz and 1Hz for 100MHz inputs.

Maximum resolution for period measurement is 100ns for 1Hz and 10<sup>-15</sup>s for 100MHz inputs.



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Time base:           Frequency:    10MHz.  
                          Aging rate:   1ppm per month.  
                          Temperature:  5ppm, 23°C±5°C.  
                          Line voltage: ±0.005ppm for 10% variation.

Gate time:           Continuously variable from 60ms to 10s or 1 period of the input,  
                          whichever is greater.

Display:             8 digits with exponent and overflow indicators.

Operating  
temperature:         0°C to + 40°C, 10 to 80% RH.

Power  
requirement:         117/234V, 50/60Hz (factory set).  
                          Power consumption is 15VA.

Weight:              Approximately 2.0kg (4.4 lb) net

Dimensions:         22.8 (W) x 8 (H) x 32.9 (D) in centimeters  
                          9 (W) x 3.13 (H) x 13 (D) in inches  
                          Exclusive of handle.

Accessories:         Instruction manual  
                          Power cord  
                          2 Coaxial test leads  
                          2 Fuses

## Section Three

### FRONT PANEL DESCRIPTION

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**Note:** Refer to figure 3-1 for details. Numbers in circles on Figure 3-1 reference the items described below.

1. PWR  
Supplies power to counter when pressed.
2. RESET  
Resets counter to zero, then restarts counting.
3. FREQ A  
Selects frequency mode of operation for Channel A.
4. PER A  
Selects period mode of operation for Channel A.
5. FREQ B  
Selects frequency mode of operation for Channel B.
6. RPM  
Selects RPM mode of operation for Channel A.
7. GATE TIME (LED)  
Gate light (when on), indicates the counter's gate circuit is open and a measurement is in progress.

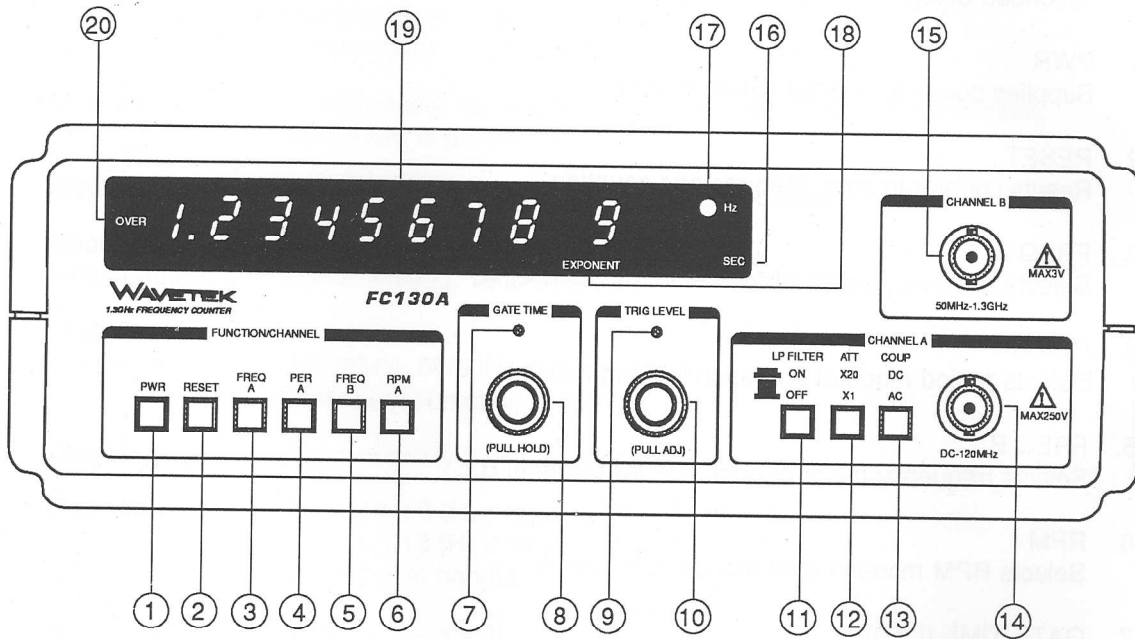


Figure 3.1

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8. GATE TIME (KNOB)  
Provides continuously variable measurement time from, nominally, 60ms to 10s (minimum = 1 period of the input signal). When pulled, the displayed value will hold until the knob is pushed back in.
  9. TRIG LEVEL (LED)  
Blinks when triggering.  
ON or OFF indicates the input signal is above or below the trigger level setting.
  10. TRIG LEVEL (KNOB)  
When pulled, the Trigger Level control is variable over a  $\pm 2.5V \times ATT$  setting.  
When pushed, the Trigger Level is automatically set.
  11. FILTER  
Inserts a 100kHz low pass filter into Channel A.
  12. ATT  
Selects attenuation for input to Channel A:  
x1 position connects input signal directly to input amplifiers.  
x20 position attenuates input signal by a factor of 20.
  13. COUP  
Selects DC or AC coupling for Channel A.
  14. CHANNEL A  
Input BNC connector for Channel A.

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- 15. CHANNEL B  
Input BNC connector for Channel B.
  - 16. SEC  
Seconds indicator shows that the displayed data is in seconds.
  - 17. Hz  
Hertz indicator shows that the displayed data is in hertz.

**Note:** When both SEC and Hz LED are OFF in the RPM mode, units of cycles/minute are displayed.

- 18. EXPONENT  
Displays the value of the exponent of the measurement.  
For example, when 6 is displayed, it represents  $10^6$ .
- 19. DISPLAY  
8-digit red LED display.
- 20. OVER  
Over (Overflow) indicator shows that one or more of the most significant digits are not displayed.

### 1. Display Check Feature

When the power is first applied, the FC130A self-tests all display functions in sequence. Table 4-1 on the following page shows what appears in the display during self-test. Upon completion of the tests the instrument is ready to make measurements.

### 2. Signal Measurements

Use Channel A for measuring frequencies in the 0.01Hz to 120MHz range.

- Press the **FREQ A** button, then connect the input signal to the **CHANNEL A** input connector.

For low frequency signal measurement in the 0.01Hz to 30Hz range, select DC coupling by pressing in the **COUP** button.

Either AC or DC coupling may be selected for frequencies above 30Hz.

- Adjust the **GATE TIME** control for the desired sampling rate and resolution, then read the frequency value from the display, adding the exponent value to it.

For example, a reading of 3.57955+6 indicates 3.57955MHz, or a reading of 10,000.0+3 indicates 10,000.0kHz.

**Note:** If the signal level is too low to trigger the counter, make certain the **ATT** switch is released for X1 attenuation. For manual trigger level adjustment, pull out the **TRIG LEVEL** knob and adjust it until there is a reading in the display, or until the LED indicator above the knob blinks. Maximum trigger sensitivity occurs when the **TRIG LEVEL** knob is set to the 12 o'clock position.

## DISPLAY CHECK CYCLE

ALL DISPLAYS	OVFL	Hz	S	*dp <sub>1</sub>	*dp <sub>2</sub>	*dp <sub>3</sub>
00000000 -0		●		●		
11111111 -1		●		●		
22222222 -2		●		●		
33333333 -3			●		●	
44444444 -4			●		●	
55555555 -5			●		●	
66666666 -6						●
77777777 -7						●
88888888 -8						●
99999999 -9	●					
0.00 0		X	X	●		

\* dp = decimal point

Table 4-1

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Use Channel B for measuring frequencies in the 50MHz to 1.3GHz range.

- Press the **FREQ B** button, and connect the input signal to the **CHANNEL B** input connector.
- Adjust the **GATE TIME** control for the desired sampling rate and resolution, then read the frequency value from the display, adding the exponent value to it.

For example, a reading of 450.960+6 indicates 450.960MHz.

**Note:** Channel B does not use the **LP FILTER**, **ATT**, and **COUP** buttons. Also the **TRIG LEVEL** knob and **LED** indicator are inoperative on Channel B.

<b>NOTICE</b>
The Channel B input circuitry is very sensitive and may generate apparently random readings with no signal present on the CHANNEL B input connector. This is normal and is not an indication of a failure within the instrument. Upon application of a suitable signal, the random readings will be replaced with the correct reading.

Period measurements may be made with Channel A.

- Press the **PER A** button and connect the signal to be measured to the **CHANNEL A** input connector.
- Adjust the **GATE TIME** control as required to give the desired sampling rate and resolution then read the value from the **LED** display.



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**Note:** When measuring periods of frequencies in the 0.01Hz to 30Hz range, push in the LP FILTER and COUP buttons. This often gives more stable readings.

RPM is measured on the Channel A input.

- Press the RPM A button and connect the signal to be measured to the CHANNEL A input connector.
- Adjust the GATE TIME control as required to give the desired sampling rate and resolution, then read the value from the display.

### 3. Gate Time Settings

The FC130A features continuously adjustable gate time selection, from 60ms to 10 seconds or one period of input, whichever is longer. Adjustment of the GATE TIME control affects the sampling rate and therefore the resolution of the reading.

- Turn the knob counterclockwise for faster reading updates, or turn it clockwise for more resolution (number of digits displayed).
- Pulling out the GATE TIME knob freezes the last displayed reading, so that it can be written down. Pushing the knob IN returns the counter to normal operation.

The LED indicator above the GATE TIME knob lights to indicate that the instrument is making a measurement. In normal operation it will blink at a rate dependent upon the setting of the GATE TIME knob.

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#### 4. Trigger Level Adjustment

Greater sensitivity to low-level signals may be obtained by pulling out the TRIG LEVEL knob and adjusting it until the counter triggers on the signal.

Maximum sensitivity is obtained when the knob is pointing in the 12 o'clock position.

Note that the LED indicator above the knob blinks rapidly when the counter triggers on the signal.

#### 5. LP Filter

Noise on low frequency signals measured on Channel A often causes unstable readings.

The LP Filter minimizes high frequency noise, permitting the counter to measure only the desired low frequency component.

Pushing in the LP FILTER button inserts a 100kHz low pass filter into the Channel A input circuitry for more stable readings.

#### 6. Attenuator

An attenuator is provided in the Channel A input circuit for measuring large signals and for providing additional overload protection.

Pushing in the ATT button reduces the input signal by 20 times. It is recommended when measuring signals of unknown amplitude that this button should be pushed in for protection. If the amplitude is too low, the button may be released for greater sensitivity.

## Section Five CALIBRATION

**Note:** Refer to Figure 5-1 on the following page for details.

1. Connect a DMM (3 1/2 digits) to TP2 and adjust SVR104 for  $+5\text{VDC} \pm 0.05\text{V}$ .
2. Connect a DMM to TP3 and adjust SVR103 for  $-5.2\text{VDC} \pm 0.05\text{V}$ .
3. Input Offset Voltage adjustment
  - Connect a 10MHz sine wave to channel A input BNC.
  - Set the Trigger Level knob to auto with the control fully clockwise.
  - Adjust SVR102 and decrease amplitude of 10MHz sine wave to the minimum allowable to maintain display. SVR102 is under the metal shielding at the front, right hand side of the PC board. It can be reached through the hole closest to the edge of the board.
4. Time Base Amplitude Adjustment
  - Connect an oscilloscope (20MHz or greater) to TP4.
  - Adjust SVR101 for 50 - 50 duty cycle of the oscilloscope display.
5. Standard Oscillator Adjustment
  - Connect a standard reference frequency (10MHz, temperature stability  $< 1\text{ppm}$ ) to channel A input.
  - Adjust the gate time control for 8 digit display.
  - Adjust SVC101 for the most accurate display of the reference frequency.

**Note:** The unit should be on at least 30 minutes before performing any calibration.

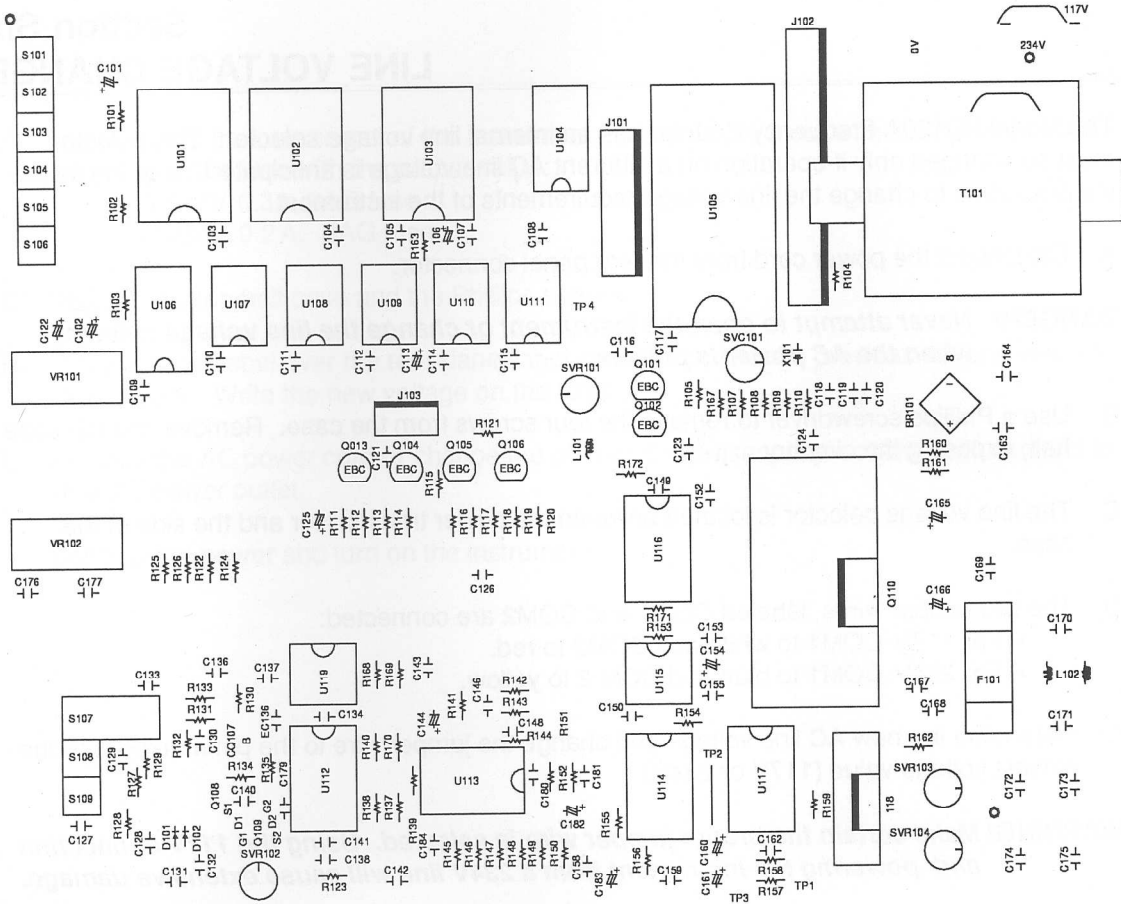


Figure 5.1

## Section Six LINE VOLTAGE CHANGE

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The Model FC130A Frequency Counter has an internal line voltage selector. This selector must be changed only if operation on a different AC line voltage is anticipated. Use the following procedure to change the line voltage requirements of the instrument:

A. Disconnect the power cord from the rear panel connector.

**DANGER!** *Never attempt to open the instrument or change the line voltage selector when the AC power is present.*

B. Use a Phillips screwdriver to remove the four screws from the case. Remove the top case half, exposing the circuitry.

C. The line voltage selector is located between the power transformer and the side of the case.

D. The two jumper wires, labeled COM1 and COM2 are connected:

- For 117V: COM1 to white and COM2 to red.
- For 234V: COM1 to blue and COM 2 to yellow.

E. Determine the new AC line voltage and change the jumper wire to the pin marked with the closest voltage value (117V or 234V).

**WARNING!** *Make certain the proper jumper wire is selected. Using the 117V connection and powering the instrument from a 234V line will cause extensive damage.*

- 
- F. The fuse is in the rear corner of the instrument. Carefully pry it out with a screwdriver and replace it with a fuse with the proper value:
- For 117V:0.3A, 3AG fuse
  - For 234V:0.2 A, 3AG fuse.
- G. Replace the top half case and the Phillips screws.
- H. Place a paper label over the rear panel label so that it covers the previous AC line voltage requirement. Write the new voltage on the label.
- I. Replace the AC power cord or change the plug on the present one so that it will connect to your AC power outlet.

Connect the power and turn on the instrument.

Section Seven  
**SERVICE INFORMATION**

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**Factory Service**

Read the warranty located at the front of this manual before requesting warranty or non-warranty repairs.

**Shipping Instructions**

For in- and out-of-warranty repairs in the United States, we recommend shipping your Frequency Counter to the factory for repair. Our factory service center features 24-hour turnaround time under normal circumstances, with a maximum of 48 hours guaranteed. Combined with low flat rate charges and fast turnaround time, the factory service center provides your best overall service alternative. A Frequency Counter, returned for calibration or repair, should be shipped with the following: your company name (if applicable), your name, address, telephone number, proof of purchase (for warranty repairs), and any test leads used with the meter.

In addition, make sure to **include a written description of the problem encountered or service required. For minimum turn-around time on out-of-warranty repairs please phone in advance for service-charge rates. Ship the Frequency Counter in original packaging or a sturdy box to the following address and marked *Attention: Instrument Repair/Service:***

**For U.S.A.:**  
Wavetek Corp.  
9045 Balboa Ave.  
San Diego, CA 92123  
Tel: (619) 279-2200, ext. 670  
Fax: (619) 495-3296

**For U.K.:**  
Wavetek Ltd  
Hurricane Way  
Norwich, NR6 6JB, U.K.  
Tel: 011-44-603-404824  
Fax: 011-44-603-483670

**Other:**  
Contact either Factory Service Center for the name of a local authorized service center.

The Frequency Counter will be returned with the shipping charge paid by Wavetek Corp.  
For questions in North America, contact the Instrument Repair & Service Department at (619) 279-2200, ext. 670.

EDITOR'S

Model

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