TEST INSTRUMENT SAFETY

WARNING

Normal use of this instrument exposes you to a certain amount of danger from electrical shock because measurements must sometimes be taken in equipment that contains high voltage. An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Voltage as low as 35 volts dc or ac rms should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Higher voltage poses an even greater threat because it can more easily produce a lethal current. Your normal work habits should include all accepted practices that will prevent contact with exposed high voltage, and that will steer current away from your heart in case of accidental contact with a high voltage. You will significantly reduce the risk factor if you know and observe the following safety precautions:

1. Measurements should never be made at circuit points that exceed the maximum input voltages to the frequency counter as listed in the SPECIFICATIONS, or damage to the instrument may occur. Even when measurements are made at low voltage points, be careful to avoid touching any high voltage point.
2. If possible, familiarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.
3. Use the time-proven "one hand in the pocket" technique while handling an instrument probe. Be particularly careful to avoid contacting a nearby metal object that could provide a good ground return path.
4. Use an insulated floor material or a large, insulated floor mat to stand on, and an insulated work surface on which to place equipment; and make certain such surfaces are not damp or wet. Where insulated floor surface is not available, wear heavy gloves.
5. Connect the frequency counter's ac power cord only to a 3-wire outlet to assure that the instrument's chassis, connectors, and the probe ground lead are at earth ground.
6. Many equipments with 2-wire ac power cords are transformerless "hot chassis" powered, where one side of the ac power line connects directly to the chassis. If such equipment does not have a polarized power plug to prevent insertion the "wrong" way, a serious shock hazard exists if the chassis is touched. Also, damage to the frequency counter or the equipment under test may occur from connecting the ground lead of the probe to a "hot" chassis. To make measurements in such equipment, always

(Continued on inside of rear cover)

INSTRUCTION MANUAL FOR MODEL 1820

80 MHz UNIVERSAL COUNTER

B+K PRECISION DYNASCAN CORPORATION

6460 West Cortland Street
Chicago, Illinois 60635

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INTRODUCTION

The **B & K-PRECISION** Model 1820, 80 MHz Universal Counter is a high quality, lightweight, autoranging frequency counter. It measures frequencies in the range of 5 Hz to 80 MHz. In addition, the Model 1820 is capable of measuring the period required for one cycle to occur, accumulated cycles and time. The functions of the counter are selected by the four FUNCTION pushbutton switches on the front panel. When the ACCU (accumulate) or TIME function is selected, the display may be reset to ZERO by momentarily depressing the RESET pushbutton.

The AUTO/1 SEC (100 period average) switch selects either a one-second preset gate interval or the "AUTO" range. When the switch is in the "AUTO" position (out) the gate interval or period average that allows maximum resolution without overranging is automatically determined and the appropriate frequency/time unit indicator for either KHz/μS or MHz/mS is illuminated. When the AUTO/1 SEC pushbutton is in the 1 SEC (depressed) position, the display indicates frequency to the closest hertz or period to the nearest nanosecond even if the most significant digit (MSD) is beyond the display range.

When the X1/X10 pushbutton is in the X1 position (out), the input signal is applied to the counter circuits without attenuation. However, when the switch is depressed, the input signal is routed through an X10 attenuator before being applied to the counter circuitry.

When a function switch is pressed the first time, it locks in the "in" position. When another function pushbutton is pressed, all other function pushbuttons return to the "out" position.

The RESET pushbutton is a spring-loaded momentary contact switch that is independent of all other pushbuttons.

The standard input impedance of one megohm in conjunction with a ten-to-one scope probe makes this instrument ideal for use in applications where source loading must be kept to a minimum.

The display consists of six seven-segment light emitting diode (LED) numerical display units and three LED's to indicate KHz/μS, MHz/mS and OVER (overrange).

The internal 10MHz time base is generated by a crystal controlled oscillator. However, it may be desirable to use an external time base for certain counter applications. Consequently, the EXTERNAL TIME BASE INPUT connector has been included. This female BNC jack, on the rear panel, provides a convenient means of connecting the external time base to the counter. In addition, the TIME BASE SELECT switch, also on the rear panel, allows the user to select either the internal or external time base.

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The optional Temperature Compensated Crystal Oscillator (TCXO) is available for use as an internal time base with the Model 1820. The TCXO is a highly stable crystal-controlled oscillator that produces a closely controlled time base frequency over a wide temperature range. When the TCXO is used with the counter, the TCXO replaces the original time base generator in the 1820. The TCXO may be installed by the user.

The exceptional accuracy of the counter makes it an extremely valuable instrument to the scientist, engineer and experimenter. Its ruggedness and compactness make it practical for use by the hobbyist or in the field by service technicians. The low power consumption of less than 15 watts makes it practical to power the counter by a DC-to-AC power converter.

SPECIFICATIONS

FREQUENCY CHARACTERISTICS

Range	5 Hz to 80 MHz, FUNCTION switch selects KHz or AUTO display reading.
Gate Time, AUTO	10 mS (MHz reading) 100 mS and 1 SEC (KHz reading), automatically determined by counter circuitry.
Gate Time, 1 SEC	1 second (KHz reading – 1Hz resolution).
Accuracy	± Time base accuracy, ±1 count.
Resolution	±.0001% (1 PPM on 6 digit scale on all ranges). 1Hz resolution when 1 SEC gate is used.
Display	Input signal frequency with decimal point positioned automatically. Units of measurement (KHz, MHz) indicated on front panel by LED indicator.

PERIOD CHARACTERISTICS

Period Average, AUTO	1 period average (mS), 10 and 100 period average (μS).
Period Average, 1 SEC	100 period average (μSEC reading with 1 nS resolution).
Internal Frequency Counted	10 MHz.
Minimum Period Pulse Width	200 nS or greater pulse width required to trigger period counting circuitry.
Accuracy	$\frac{\text{Trigger Uncertainty} \pm \text{Time Base Accuracy}}{\text{Periods Average}} \pm 1\,\text{LSD}$
Display	Input signal period with automatically positioned decimal point. Units of measurement (mSEC or μSEC) displayed on front panel by LED indicators.
Overrange	Flashing OVER indicator.

INPUT CHARACTERISTICS

Impedance	1 megohm resistance shunted by 25 pF capacitance.
Connector	BNC on front panel.
Coupling	AC.
Sinewave Sensitivity	30 mV RMS, 5 Hz to 40 MHz. 50 mV at 80 MHz (see Fig. 2).
Maximum Input	200V (DC+peak AC), DC to 500 Hz, decreasing linearly to 100V (DC+peak AC) at 1 KHz. 100V (DC+peak AC), 1 KHz to 5 MHz, decreasing linearly to 30V (DC+peak AC) at 80 MHz, See Fig. 1.
Attenuator	X1/X10 switch-selectable.

INTERNAL TIME BASE CHARACTERISTICS (REFERENCED TO 25°C AFTER HALF-HOUR WARMUP)

Type	Crystal oscillator.
Frequency	10 MHz.
Setability	±.1 PPM (±1 Hz).
Line Voltage Stability	Less than ±1 PPM with ±10% line voltage variation.
Temperature Stability	Less than ±0.001% (±10 PPM from 0°C to 50°C ambient).
Maximum Aging Rate	±10 PPM/YR; ±1 PPM/MO.
External Input	TTL Level: 2.5V P-P, switch-selectable.

ACCUMULATE CHARACTERISTICS

Capacity	0 to 999999 plus overflow.
Control	Manual reset to 0. Provision included for conversion to remote reset by user.

ELAPSED TIME

Range	.01 SEC to 9999.99 SEC. = 166.66 minutes = 2.777 hours, plus overrange.
Display	Positioned decimal point.
Accuracy	± Time base accuracy, ± trigger error ±1 count.
Trigger Input	Rear panel connector compatible with either TTL or contact closure, trigger is activated on rising or falling edge of signal.
Reset	Manual RESET switch on front panel.

DISPLAY CHARACTERISTICS

Visual Display	6 digits with overflow. KHz/μS, MHz/mS indicator. Leading zero blanking, decimal point automatically positioned.
Overrange Indication	Flashing LED indicates that counter range is exceeded.
Display Time	Fixed at 200 mS plus gate interval.

GENERAL

Power Requirements	105V to 130V or 210V to 260V with internal, transformer jumpers, 50/60 Hz AC. Factory wired 210-260V version available.
Dimensions (HWD)	3.25" x 11.57" x 7.5". (8.25 cm x 29.4 cm x 19 cm.)
Weight	1.2 lbs. (2.6 Kg.)
Handle	Four positions, integral part of case.
Accessories Supplied	BNC to clip lead test cable. Timer control cable.
Optional Accessories Available	Model LC-50 carrying case. Model SA-10 Signal Tap.

Model PR-32 Demodulator Probe.

PR-36 10:1 and 1:1 Compensated Oscilloscope Probe.

PR-37 10:1 and 1:1 Compensated Oscilloscope Probe.

TCX-20 TCXO Kit ($\pm$ 1PPM).

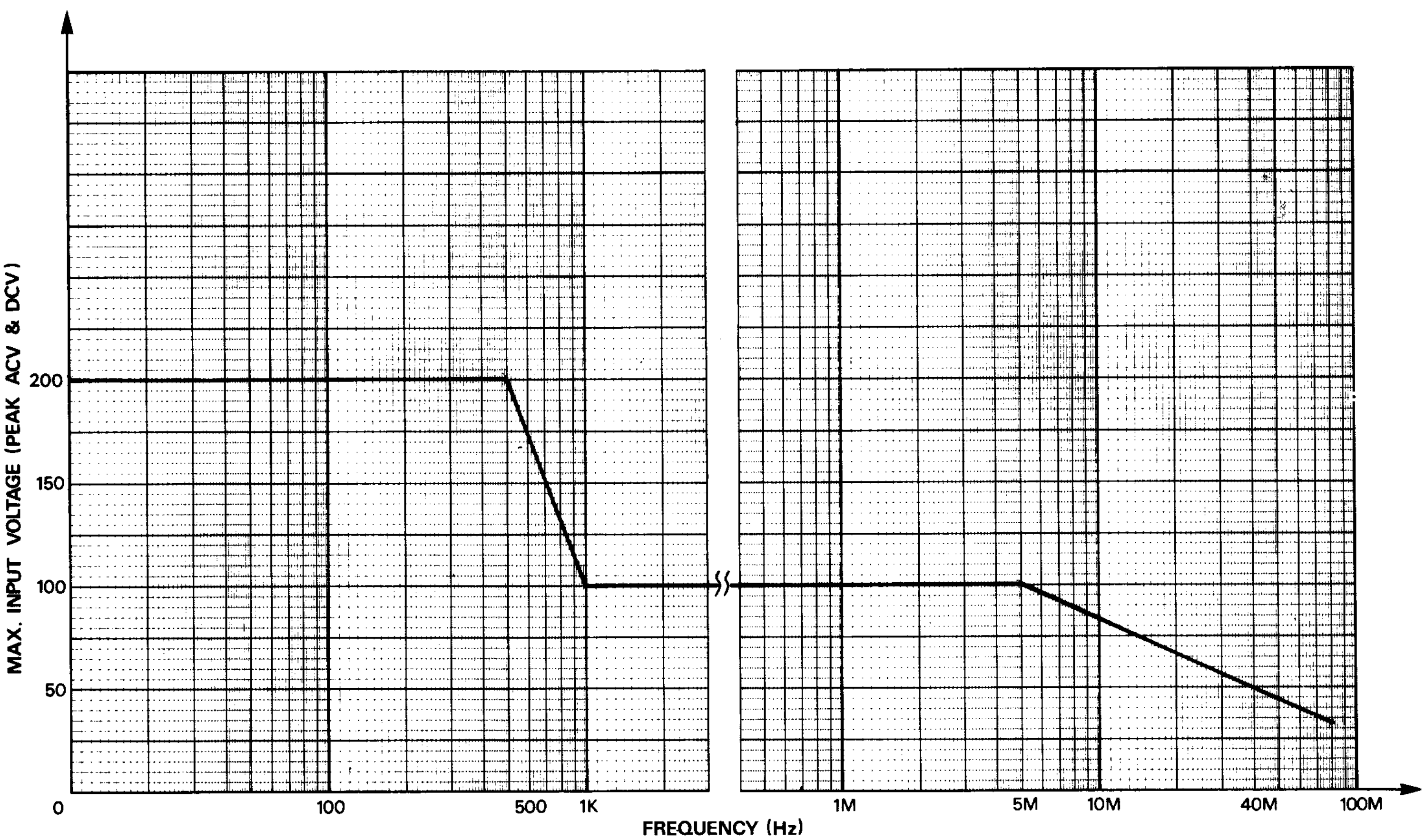

Fig. 1. Maximum input protection derating curve.

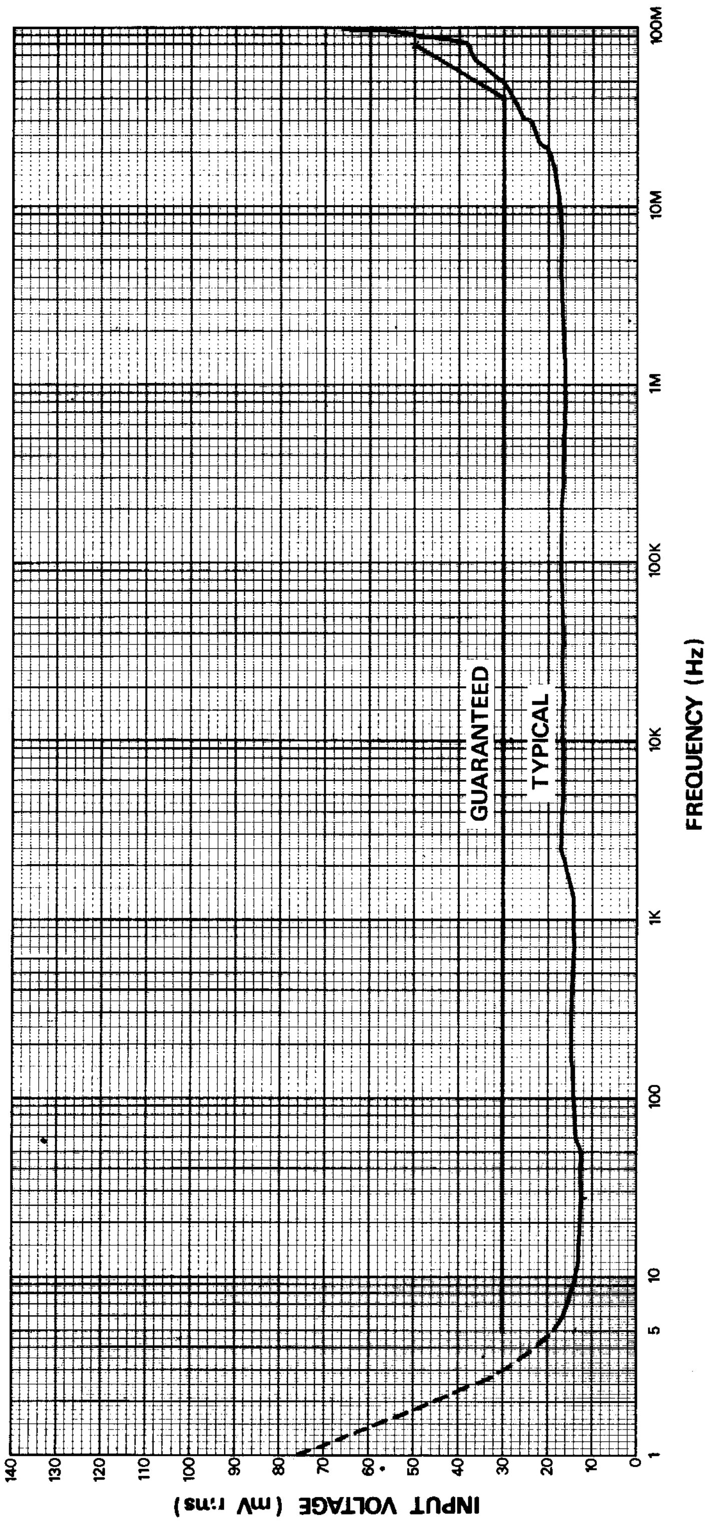

Fig. 2. Input sensitivity curve.

OPERATION

A. CONTROLS AND FEATURES (See Fig. 3 and 4)

1. **POWER.** When this pushbutton is depressed, primary power is applied to the frequency counter. To turn off the unit, depress power switch again. The switch is in the secondary circuit of the transformer.

2. **FREQ (Frequency).** Selects the frequency-counting function of the counter. When this pushbutton is depressed, the counter is capable of counting any frequency between 5 Hz and 80 MHz. The unit of measurement of the input frequency is indicated by the KHz/µS or MHz/mS LED as KHz or MHz, as appropriate.

3. **PERIOD.** Depress this pushbutton when it is desired to determine the period of one cycle of the signal under test. When the Model 1820 measures low frequencies directly, the last count is uncertain. Therefore, when it is necessary to determine a low frequency with a higher degree of accuracy, use of the PERIOD function may be desirable. The last count is uncertain in the PERIOD function also; however, the percentage of error is smaller. The KHz/µS or MHz/mS LED indicates the time units of the period of the cycle in microseconds or milliseconds, as appropriate.

   Frequency is determined by calculating the reciprocal of the measured period. Refer to APPENDIX frequency tables for popular low frequencies and their corresponding PERIODS.

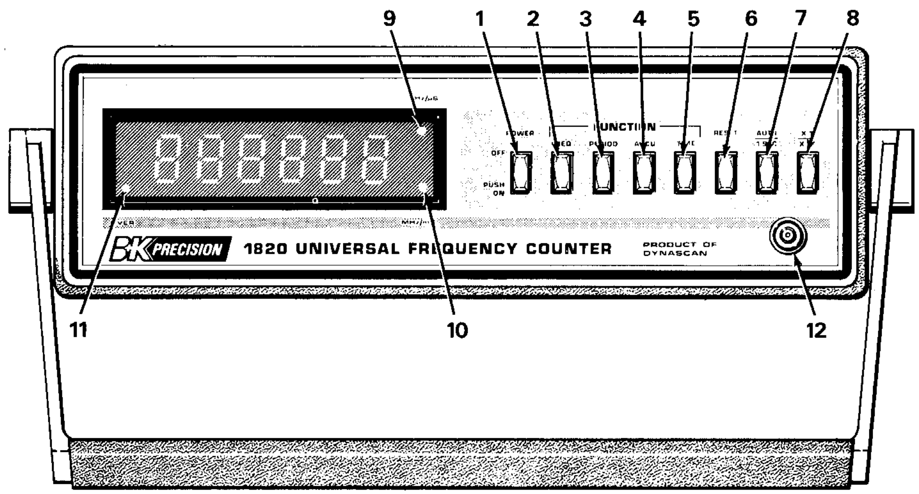

Fig. 3. Model 1820 front panel.

4. **ACCU (Accumulate).** Depress this pushbutton when it is desired to determine the total number of cycles or events that occur during a specific time period.

   The operation of the ACCU function is similar to that of the FREQUENCY function, except that the operator has control over the duration of the measurement.

5. **TIME.** Pressing this pushbutton allows the counter to time the interval between two events. An external timing signal is required to enable and then disable the counter at the beginning and end of the interval.

6. **RESET.** This control is a spring-loaded pushbutton switch which resets the numerical display to zero when the counter is operating in the ACCU or TIME function. This control does not reset the numerical display if the counter is in the FREQ or PERIOD function.

7. **AUTO/1 SEC (100 period average).** When this switch is in the AUTO (out) position, the gate length is automatically controlled by the frequency under test. In the PERIOD function, the 1, 10 or 100 period average is automatically selected. The AUTO position will always select a range that will try to fill all six digits without overranging. Pushing this switch in (1 SEC), causes the counter to produce a constant gate length of one second. This allows the counter to display the least significant digit. When the PERIOD function is in use and the AUTO/1 SEC switch is depressed, the counter displays a 100 period average.

8. **X1/X10.** This switch controls the built-in attenuator in the counter. If the switch is in the out position (X1), the input is applied to the counter circuitry without attenuation. Pressing the switch in (X10), switches an X10 attenuator in series with the input signal. The attenuator limiter prevents the counter logic circuitry from mis-counting when noisy or improperly terminated high-amplitude signals are applied to the counter. Signal voltage greater than 30 volts may damage the first stage (see Fig. 1).

9. **KHz/μS INDICATOR.** If this indicator is illuminated while either the FREQ or PERIOD function is in use, the indicator denotes that the frequency displayed is in kilohertz or the period is in microseconds. This indicator does NOT light when the ACCU or TIME functions are in use.

10. **MHz/mS INDICATOR.** If this indicator is illuminated while the counter is in the FREQ or PERIOD function, the frequency displayed is in megahertz, or the period is in milliseconds. The indicator is NOT lit in the ACCU or TIME function.

11. **OVER.** Flashes rapidly when the range of the display is exceeded.

12. **INPUT JACK.** This is a female BNC connector terminated in a 1 megohm input impedance. This allows the use of ÷10 frequency-compensated scope probe to reduce loading on the source of the signal under test. If a compensated probe is not used, high-frequency measurement sensitivity is limited.

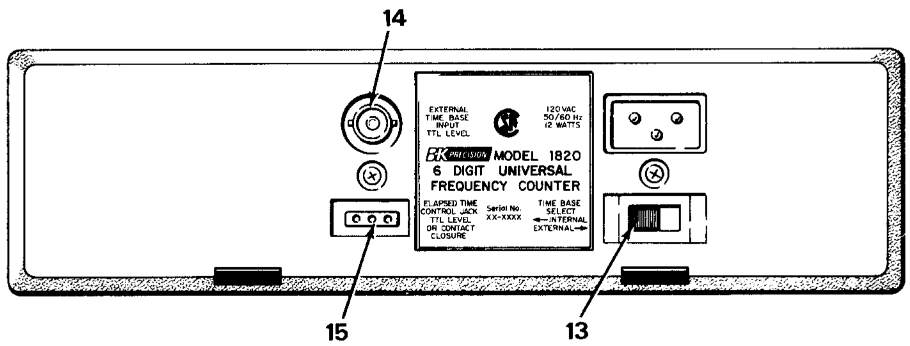

Fig. 4. Model 1820 rear panel.

13. **TIME BASE SELECT Switch.** This switch is on the rear of the Model 1820 and is shown in Fig. 4. It is set to the INT position when the counter is operating on its own internal 10 MHz time base generator. Set the switch to EXT position if it is desired to operate the counter from an external 10 MHz time base. The input from the external time base is applied to the counter through the BNC jack on the rear of the counter.

CAUTION

If the TIME BASE SELECT switch is set to the EXT position with no external time base applied to the counter, all or part of any one of the LED display units may be intensely illuminated. This may damage the display unit. Therefore, NEVER set the TIME BASE SELECT switch to EXT position – unless an external time base signal is applied to the EXTERNAL TIME BASE INPUT jack.

14. **EXTERNAL TIME BASE INPUT Jack.** This female BNC jack provides a convenient means of connecting an external time base to the counter.

15. **ELAPSED TIME CONTROL Jack.** When the counter is set to the TIME function, it is capable of measuring the time interval between two events. However, in order to measure the time interval, an external timing signal must be applied to the counter. When the external timing signal stops the counter from counting, the time interval is displayed until the RESET button is pressed. Pressing the RESET button resets the display to zero.

The ELAPSED TIME CONTROL jack provides a convenient means of applying this signal to the counter. The internal counter circuitry connected to this jack is compatible with TTL or contact closure circuits.

If no external timing signal is applied to the counter, the circuitry is still capable of measuring time. However, the counter counts continuously until the RESET button is pressed.

B. INTERPRETATION OF DISPLAY

Fig. 5 illustrates an example of a display of numerals on the front panel of the counter. As indicated in the figure, the numeral "6", at the extreme left of the display, is the most significant digit; "1" is the least significant digit.

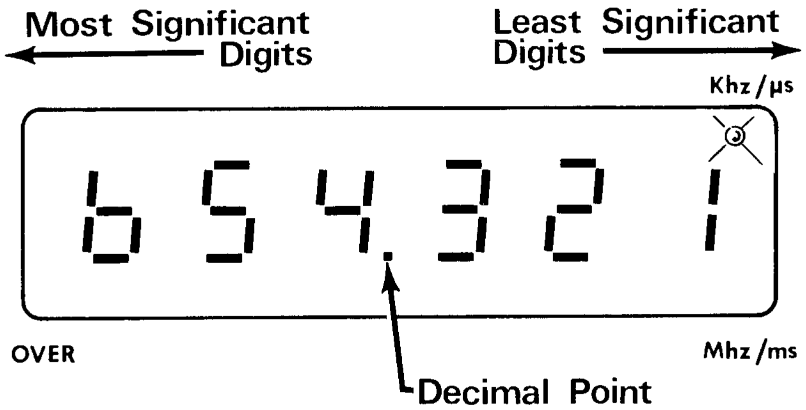

Fig. 5.

The three LED indicators, KHz/μS, MHz/mS and OVER, are also shown in the figure. In this example, the KHz/μS indicator is lit, as indicated by the small circle.

If the display is as shown in Fig. 5 when the counter is operating in the FREQ function, the frequency of the signal under test is 654.321 KHz, or 654,321 Hz. If the PERIOD function is in use and the display is as shown in Fig. 5, the time required for one cycle to occur is 654.321 microseconds (100 period average).

Whenever the PERIOD function is in use, always interpret the counter display in microseconds or milliseconds, whichever is appropriate.

Fig. 6 illustrates a display of .321 KHz (321 Hz). Note that the decimal point remains in the same position as in Fig. 5, and that the three LED units to the left of the decimal point are blank.

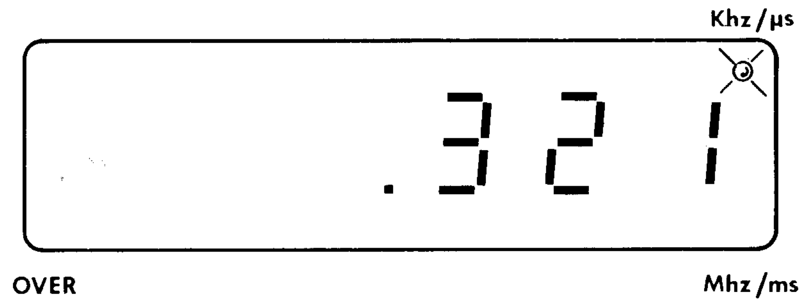

Fig. 6.

A frequency of less than 100 Hz is displayed as shown in Fig. 7. The counter is displaying .021 KHz(21 Hz).

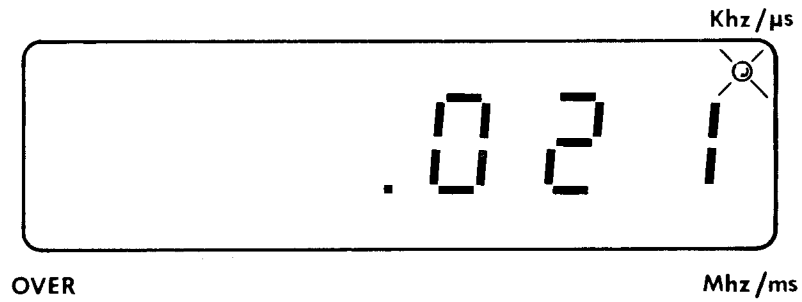

Fig. 7.

All the digits to the left of the decimal point are blank. As the number of digits displayed by the counter decreases, the accuracy of the measurement also decreases. This is because the last count is uncertain. Therefore, the frequency displayed may actually be .020, .021, or .022 KHz.

The accuracy of the counter display is enhanced at these low frequencies when the PERIOD function is used. For example, when the counter is displaying .200 KHz (200 Hz), the actual input frequency may be 199 Hz, 200 Hz or 201 Hz. This is because the last count is uncertain. As a result, the display may be in error by 0.5%. In many situations a higher degree of accuracy may be required. When the PERIOD function is activated, the counter displays the time required for one cycle of the input frequency to occur. One cycle of 200 Hz occurs in 5000 μSEC. This is displayed by the counter as 5000.00. The last count is uncertain in this display also. However, the uncertainty of error is only .0002%. As a result, the actual period could be 4999.99 μSEC, 5000.00 μSEC, or 5000.01 μSEC. By using the formula, F=1/P, the frequency that corresponds to each period can be calculated. If the period is 4999.99 μSEC, its corresponding frequency is 200.004 Hz; if the period is

5000.01 μSEC; its corresponding frequency 199.996 Hz. Consequently, it can be concluded that the percentage of error in the PERIOD function is much smaller than in the FREQ function.

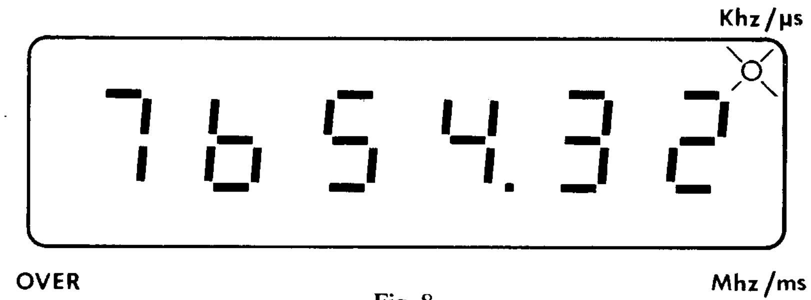

Fig. 8.

Fig. 8 illustrates a display of 7654.32 KHz with the AUTO/1 SEC switch in the AUTO (out) position. As indicated by the position of the decimal point, the least significant digit displayed is the tens digit. As a result, the reading may be in error by as much as 10 Hz (.01 μSEC in the PERIOD function) because of the uncertainty of the last digit.

If the AUTO/1 SEC switch is set to the 1 SEC (in) position while the same input frequency is applied, the display could appear as shown in Fig. 9. In this display, the least significant digit shown is the units (ones) digit as indicated by the decimal point position. Consequently, the accuracy of this measurement is improved because the uncertainty of the last digit is 1 Hz instead of 10 Hz. However, note the most significant digit (7) in Fig. 8 is not displayed in Fig. 9. This is indicated by the OVER indicator flashing on and off.

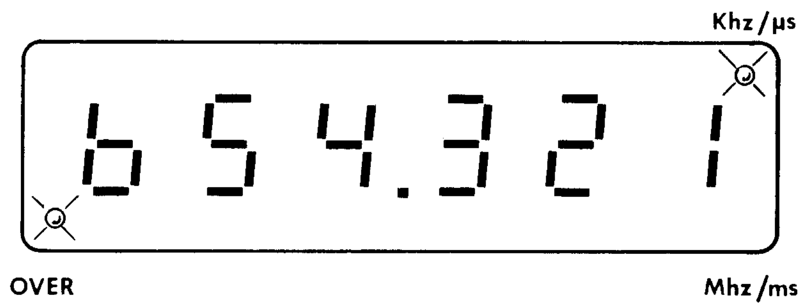

Fig. 9.

Maximum resolution to the nearest Hz (or nearest nanosecond in the PERIOD function) is obtained when the AUTO/1 SEC (100 period average) switch is set to the 1 SEC position. This is because the least significant digit is displayed. However, the most significant digit cannot be determined when the switch is in the 1 SEC (100 period average) position.

Therefore, it may be desirable to first read the counter with the AUTO/1 SEC switch in the AUTO position and then switch to the 1 SEC position and read the counter again.

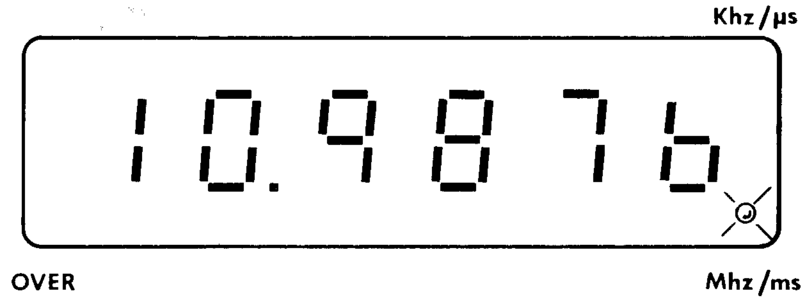

Fig. 10.

Fig. 10 illustrates a display of 10.9876 MHz (or 10.9876 mSEC in the PERIOD function) with the AUTO/1 SEC switch set to the AUTO (out) position. Notice that the two least significant digits are not displayed. However, the two most significant digits (1 and 0) are displayed and the OVER LED is not lit.

If it is desired to improve the resolution of the measurement shown in Fig. 10, set the AUTO/1 SEC switch to the 1 SEC (in) position. If the PERIOD function is in use, and the AUTO/1 SEC switch is in the 1 SEC position, the reading is a 100 period average.

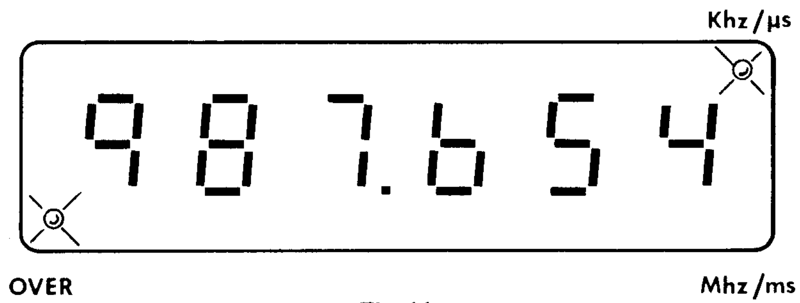

Fig. 11.

An example of how the display could appear is shown in Fig. 11. The two most significant digits are not displayed and the OVER LED is flashing to indicate that the frequency or period being measured is greater than that displayed.

The least significant digits of a frequency or period measurement may change as the display is observed. The amount of change is related to the stability of the signal source. If the output frequency of an LC oscillator is being measured, the counter display will probably change frequently. However, the output of a crystal oscillator is much more stable. Therefore, the counter display will be nearly constant.

C. HOW TO OPERATE THE MODEL 1820

CAUTION

Application of signals having voltage levels in excess of those listed in the SPECIFICATIONS in this manual may damage the counter. Therefore, before applying any signal to the counter input, always insure that the voltage of the input signal does not exceed the maximum allowable input listed in the SPECIFICATIONS.

The X10 setting of the X1/X10 switch does NOT protect the input limiter circuitry against voltages in excess of those listed in the SPECIFICATIONS. Therefore, NEVER apply voltages whose peaks exceed the specified capacity of the frequency counter. If necessary, connect an attenuator between the signal source and the counter input.

NOTES

1. Standing waves are usually present on a transmission line that is not terminated in its characteristic impedance. These standing waves may cause damage to the signal source or produce inaccurate frequency measurements. Therefore, when measuring radio frequencies, terminate the transmission line connecting the counter to the signal course in the characteristic impedance of the signal source. For example, terminate 50 ohm coaxial cable into a 50 ohm resistive load. Use a dc blocking capacitor in situations where bias voltage or other DC voltages could be affected by the termination resistor.

2. When counting signals with amplitudes less than 300 mV RMS, a 10:1 frequency compensated probe cannot be used, since less than 30 mV RMS signal is present at the counter (see SPECIFICATIONS).

3. When counting low-frequency signals, it may be necessary to add a 100KΩ resistor in series between the signal source and the 1:1 probe or direct frequency counter input. This resistor will attenuate any high-frequency noise that may cause the counter to display an erratic count.

4. It is not necessary to use a line termination if a compensated, high-impedance probe is used. The following high-impedance, compensated signal probes are suitable for use with the Model 1820 counter and are available as options from Dynascan:

   a. **B & K-PRECISION** Model PR-36 10:1 and 1:1 compensated oscilloscope probe.

   b. **B & K-PRECISION** Model PR-37 10:1 and 1:1 compensated oscilloscope probe.

   The loading effect of the PR-36 probe is 1 megohm with 120 picofarads of shunt capacitance at the point of measurement, when used in the X1 mode. The loading effect is 10 megohms with 15 pF of shunt capacitance, when used in the X10 mode. The loading effect of the PR-37 is 1 megohm and 60 pF direct and 10 megohms and 11 pF in the X10 mode.

5. If it is desired to assemble additional test cable, use 50-ohm coaxial cable, such as RG-58 A/U. The longer the test cable is, the greater the amount of undesirable shunt capacitance the cable introduces at the point being measured. In addition, the effect of standing waves becomes more pronounced as the cable length approaches one-quarter wavelength of high frequencies. This is especially true if the cable is not terminated in its characteristic impedance. Therefore, to keep shunt capacitance and standing waves within tolerable limits, it is recommended that the cable be no longer than 3 feet (90 cm).

FREQUENCY MEASUREMENTS

1. Turn on the power to the 1820 by fully depressing the POWER switch.

2. Fully depress the FREQ pushbutton.

3. Make sure the AUTO/1 SEC switch is in the AUTO (out) position.

4. If necessary, set the X1/X10 switch to the X10 (in) position and/or add on external attenuator (refer to SPECIFICATIONS).

5. Apply the signal frequency to be measured in the input jack.

6. If it is desired to improve the resolution of the frequency count on the display, set the AUTO/1 SEC switch to the 1 SEC position by fully depressing the switch. For example, if a frequency of 10.654321 MHz is applied to the counter while the AUTO/1 SEC switch is in the AUTO (out) position, the counter will display 10.6543 MHz. However, after the AUTO/1 SEC switch is set to 1 SEC (in) the counter will display 654.321 KHz while the OVER indicator flashes.

PERIOD MEASUREMENTS (Frequency range of 5 Hz to 1 MHz only)

1. Apply power to the counter.
2. Depress the PERIOD pushbutton switch fully.
3. Set the AUTO/1 SEC switch to AUTO (out).
4. If necessary set the X1/X10 switch to the X10 (in) position and/or add an external attenuator (refer to SPECIFICATIONS).
5. Apply the signal whose period is to be measured to the counter input jack.
6. The counter display will now indicate the number of milliseconds or microseconds required for one cycle.
7. If a higher degree of resolution at frequencies less than 1 KHz is desired, set the AUTO/1 SEC switch to the 1 SEC (100 period average) position.

   When measuring the period of a signal having a frequency less than 20 Hz, it may be necessary to wait for as long as 15 seconds before a usable reading is displayed.
8. The exact frequency can be determined by calculating the reciprocal of the measured period. Refer to APPENDIX for popular frequencies that have been already calculated.

ACCUMULATED CYCLE MEASUREMENTS

1. Apply power to the counter.
2. Depress the ACCU pushbutton.
3. Depress the RESET switch to "Zero" the display.
4. If necessary, set the X1/X10 switch to the X10 (in) position and add external attenuator (refer to SPECIFICATIONS).
5. Apply the signal to be counted to the input jack.
6. The display will show the total events accumulated up to a total of 999,999. The OVER indicator will light when this total is exceeded, and the count will continue to be updated.
7. When the input signal source is interrupted or disabled, the display will show the events accumulated. The display can be reset to zero by depressing the RESET button any time during or after the count.

TIME MEASUREMENTS

The counter will display elapsed time continuously, up to 9999.99 seconds (2.777 hours), and it will automatically display the time duration of a specific count.

1. **Elapsed Time.** Can be displayed without any connection or signal input.
   a. Turn on the counter.
   b. Depress the TIME pushbutton firmly and release. The display will immediately display time in seconds with resolution of 1/100 second.
   c. The display can be reset to zero at any time by depressing the RESET button. The reading will not be retained.

2. **Electronic Stop Watch.** When it is desired to measure an elapsed time interval and retain the reading, proceed as follows:
   a. Connect the Timer Control Cable to the ELAPSED TIME CONTROL jack at the rear of the unit. The tinned lead is ground, and the copper lead is the signal lead.
   b. Connect the normally closed contacts of a pushbutton switch to the Timer Control Cable leads.
   c. Depress the TIME button. The counter may display a random count.
   d. The display is reset to zero by depressing the RESET button.
   e. To start the count, depress the pushbutton switch (contacts open connected to the Timer Control Cable, and hold for the desired time.
   f. When the pushbutton is released (contacts closed), the count will stop and the elapsed time display will be retained.
   g. To reset the display to zero, depress the RESET button.
   h. The count will not start again until the pushbutton switch on the control cable is again actuated.

3. **Measuring the Time Duration of an Event.** The ELAPSED TIME CONTROL jack and the Timer Control Cable are used for this function. The tinned lead is ground and the copper lead is the signal lead. Either a contact opening or a positive-going voltage will start the elapsed time count (input signal level must not exceed 6 volts). A contact closure or zero potential across the cable leads will stop the elapsed time count. Proceed as follows:

   a. Connect the Timer Control Cable to the ELAPSED TIME CONTROL jack at the rear of the unit.

   b. Connect the cable to the actuating signal source. No front panel input to the counter is required.

   c. Depress the RESET button firmly and release. If the control cable leads are shorted, or if the applied signal is in the low state, the display reading will remain at zero.

   d. When the short is removed from the control cable leads (contact opening), or an electrical low-to-high transition occurs, the count will start, and will continue until a contact closure or high-to-low transition occurs.

   e. The reading at the end of the count will be retained until the RESET button is depressed.

NOTE

The reliability of operation when using mechanical switching depends on the bounce characteristics of the switch used. A good toggle or microswitch generally provides good contact closure. Refer to the APPENDIX for de-bouncing information.

D. APPLICATION NOTES

1. Radio Transmitter Frequency Measurement.

   Fig. 12 illustrates a typical test setup for measuring the frequency of the RF output from the radio transmitter having an output power of 100 watts or less.

   a. A 50-ohm termination, such as the BIRD 6154, may be used to terminate the output of the transmitter. However, if a termination of this type is not available, use a 50-ohm, non-inductive resistor as a dummy load. The power rating of the resistor must be adequate for the application.

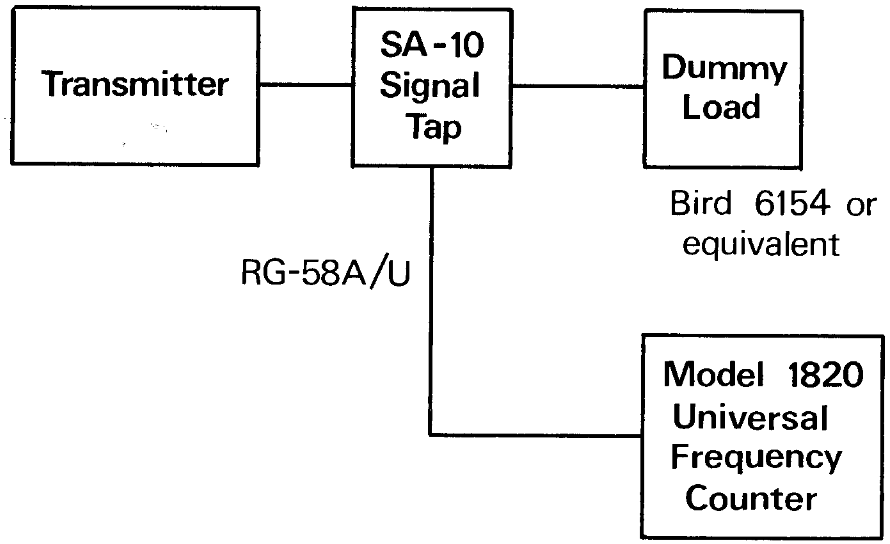

Fig. 12. Measuring transmitter frequency.

   b. The optional SA-10 Signal Tap protects the output stage of the transmitter against a severe mismatch. The signal tap also protects the counter input circuitry against excessive signal voltage.

2. Amplitude-Modulated Signals.

   A high percentage of amplitude modulation may cause the counter to display an erroneous frequency. This is because the carrier amplitude periodically drops to near zero. If this signal is applied through a signal tap to the counter, the carrier level at the counter will be even lower. Consequently, the counter will not count through the entire gate interval.

   As a result, the frequency displayed on the counter would be erratic and unreliable. Therefore, if it is desired to measure the frequency of the carrier, remove the modulation from the carrier.

   If it is desired to measure the frequency of the modulation on an RF carrier, use a detector with a low pass filter or a demodulation probe such as the **B & K-PRECISION** PR-32.

3. Square Wave or Pulse Train Measurement.

   False counts frequently occur when the frequency of square waves or a pulse train are measured, particularly when an unterminated input cable is used. The false counting is the result of overshooting (ringing) in the unterminated input cable. Ringing can be eliminated if a damping resistor of the proper value is added in series with the transmission line. Refer to the APPENDIX for the formula needed to calculate the value of the damping resistor. If a short cable is used with a terminating resistor at the counter input, the results are almost invariably satisfactory. The value of the terminating resistor must match the output impedance of the signal source.

4. UHF Frequency Measurement.

The Model 1820 Universal Counter is compatible with all commercially available prescalers to extend the frequency range up to UHF (with 100:1 or 10:1 prescaling). When any prescaler is used, the display on the counter must be multiplied by the scaling factor to determine the true frequency.

5. External Time Base

If desired, the Model 1820 can be operated from an external time base. Apply the external time base to the EXTERNAL TIME BASE INPUT jack on the rear panel of the unit and set the INT/EXT switch, also on the rear panel, to the EXT position.

6. Time.

The Trigger Gate Logic circuitry in the counter cannot withstand voltages in excess of 6 volts peak. Therefore, be sure that the circuitry used to generate the timing signal does not apply more than 6 volts to the ELAPSED TIME CONTROL jack.

A high from the TTL circuit or an open switch contact allows the counter to count. Conversely, a low from the TTL, or a short to ground caused by a closed switch contact, stops the count.

A low-to-high transition of the external timing signal causes the counter to start counting the time interval, and when the external triggering circuit applies a high-to-low transition to the ELAPSED TIME CONTROL jack, the count ceases, and the counter displays the duration of the interval in seconds. When the RESET button is pressed, the counter display is reset to zero. The counter will not count again until a low-to-high transition is applied to the ELAPSED TIME CONTROL jack.

7. Accumulate.

The ACCU function can be used to count the total number of events that occur during an indefinite time period. This function is especially useful if the event to be counted occurs at an irregular rate. However, the ACCU function also can be used to count events that occur at *regular* rate.

If an electrical event is to be counted, it can be applied directly to the counter input, provided that its peak voltage does not exceed the counter input specifications. In addition, the rise or fall time of the waveform must be faster than 100 milliseconds.

If a non-electrical event is to be counted, the event must be converted to an electrical signal. To do this, use an appropriate transducer, such as a photocell or microswitch, to trigger a TTL device or other de-bounced circuit. The output of this circuit can then be used to drive the 1820.

8. Line Frequency

WARNING

Use caution if measuring the line frequency of an AC outlet. Using the probe tip only, measure both sides of the line. The ground side will give a zero reading and the hot side will provide the desired measurement. *Do not use the "ground" lead of the probe.* Remember that the chassis of the frequency counter and the "ground" lead of the probe are already at earth ground (via the 3-wire power cord of the instrument). Touching the "ground" lead to the "hot" side of the line would place a direct short on the power line through the probe cable, resulting in possible injury and damage to the probe cable.

THEORY OF OPERATION

When reading the following paragraphs, refer to the Model 1820 block diagram shown in Fig. 13.

Input Circuit

Limits the voltages of the input signal to 1.4 volts peak-to-peak to protect the counter circuitry. The input circuit also amplifies the limited signal before applying it to the Schmitt Trigger.

Schmitt Trigger

Shapes the signal to the wave form required to drive the counter logic circuitry.

Steering Circuit And Counter

All counter functions are performed by the counters, IC7, IC8 and IC11. The steering circuit applies the input signal to the appropriate input of IC11 or IC7 so that the function selected by the operator can be accomplished.

BCD To 7 Segment Decoder-Driver

This circuit converts the BCD output of IC11 to the type of signal required to drive the seven segment LED display units.

Strobing Buffers

Interface the counter strobing output with the display.

LED Select Circuit

Controls the illumination of the decimal point LED's on the display. In addition, this circuit also controls the illumination of the KHz/µS and MHz/mS indicators.

Time Base Generator

This printed circuit board produces the 10 MHz time base frequency required for the operation of the counter.

TCXO Time Base (Optional)

When the optional TXCO (temperature-compensated crystal oscillator) is installed in the Model 1820, it replaces the Time Base Generator. The TCXO produces a very accurate and stable 10 MHz time base that improves the accuracy of the counter by a factor of 10.

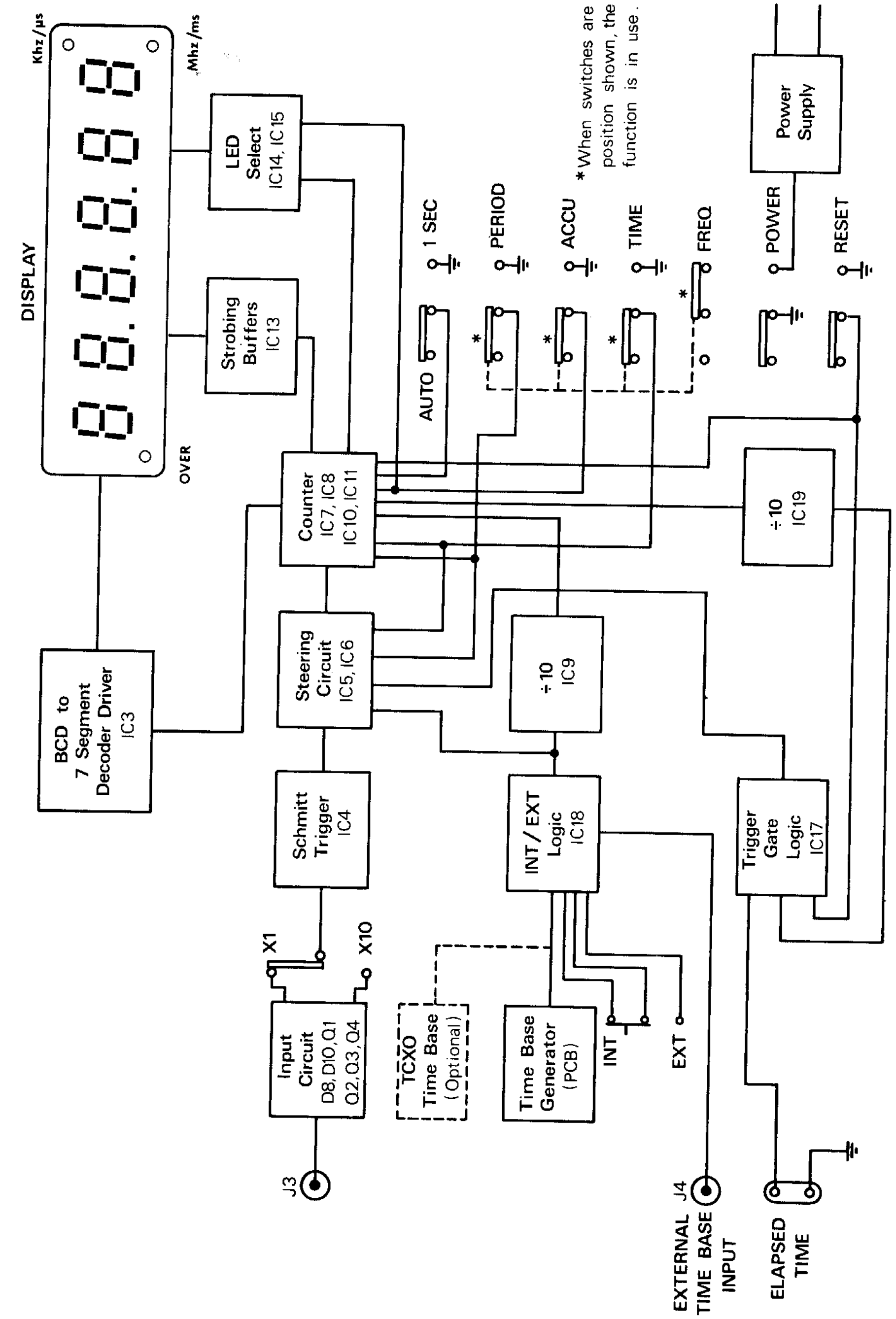

Fig. 13. Model 1820 block diagram.

Internal/External Logic Circuitry

When the TIME BASE SELECT switch on the rear panel of the counter is in the INTERNAL position, the internal/external logic circuitry applies the internal time base frequency to the steering circuit. If the switch is set to EXT, the logic circuitry applies the output of an external time base to the steering circuit.

÷10 (IC9)

This circuit divides the time base frequency by 10 and applies it to the counter.

Trigger Gate Logic

This is used in the TIME function only. The trigger gate logic accepts an external trigger and applies a timing signal from IC11 to the steering circuit to begin a timing interval. When another trigger is applied, the logic turns the timing signal off to complete the timing interval.

÷10(IC19)

This circuit generates an accurate .01 second clock that is used in the TIME function.

Power Supply

This provides +5 VDC and +10 VDC operating voltage for the operation of the counter circuitry.

RECALIBRATION AND MAINTENANCE
(Refer to Fig. 14)

WARNING

1. The following instructions are for use by qualified personnel only. To avoid electric shock, do not perform servicing other than contained in the operating instructions unless you are qualified to do so.
2. AC line voltage is present on the fuse, jumpers, and power transformer circuits whenever the line cord is plugged into an AC outlet, even if the POWER switch is off.

Your Model 1820 counter was carefully checked and calibrated at the factory prior to shipment. There is only one adjustment in all the circuitry, so recalibration is exceptionally simple, if it is ever required.

Calibration of this instrument should not be attempted unless you are experienced and qualified in the use of precision laboratory equipment. Should any difficulty occur during repair or calibration, refer to the warranty service instructions at the rear of this manual for information or technical assistance.

The time base oscillator frequency adjustment point (C202) is located at the right rear of the counter (adjustment hole provided in case) on the vertical printed circuit board.

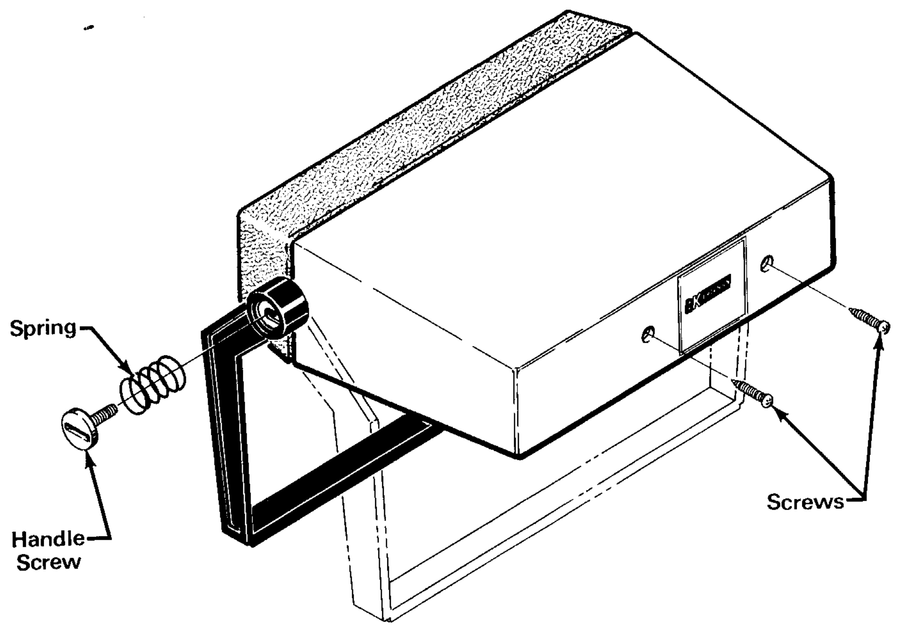

Fig. 14. Removal of rear case from Model 1820.

A. To calibrate the oscillator, a 10 MHz standard with accuracy of at least ±1 part in 10^8 is required to set the oscillator ±1 Hz of 10 MHz (a 1 MHz standard can be used to set the oscillator ±10 HZ of 10 MHz).

Procedure:

1. Allow the counter to warm up for at least 1 hour. Unit must be fully cased.

2. Connect the standard frequency source to front panel input.

3. Depress the FREQ and AUTO/1 SEC switches.

NOTE

The instrument will overrange and thus the MSD will be lost.

4. With a non-metallic alignment tool, adjust C202 (through hole in case) for a display equal to the standard frequency ±1 count.

B. To remove the rear case from the counter, proceed as follows:

1. Use a coin (a quarter works best) to remove the two screws that hold the handle to the case. Use caution to avoid losing the springs beneath the screws that hold the handle on the case. Remove handle.

2. Remove the two Phillips head screws from the rear case.

3. Slide the rear case from the counter.

4. To re-install the rear case on the counter, follow the above procedure in reverse. When re-installing the rear case, be sure the printed circuit board properly engages the slots inside the case.

C. Basic trouble-shooting check-list.

Should your 1820 not operate, be sure to make the following basic checks before assuming there is a defective component, etc.:

1. Is unit plugged into a "live" AC outlet?

2. Is the unit turned ON (POWER switch depressed)?

3. Is the fuse OK? (If blown, replace with same type fuse.)

4. Is line cord OK?

5. Is the TIME BASE SELECT switch (rear of unit) in the INT Position?

APPENDIX

A. DAMPING RESISTOR CALCULATION (Refer to Fig. 15 and 16)

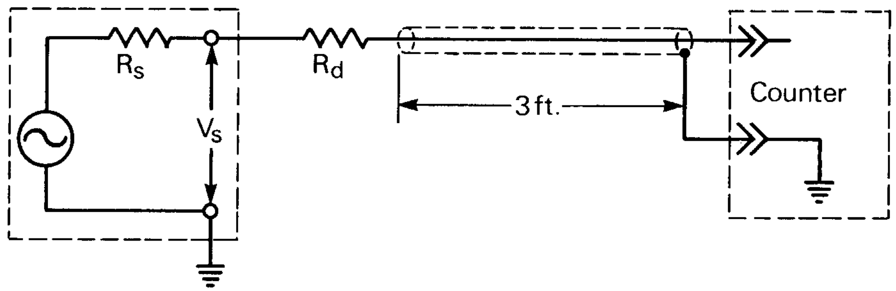

Fig. 15. Use of damping resistor when performing frequency measurements.

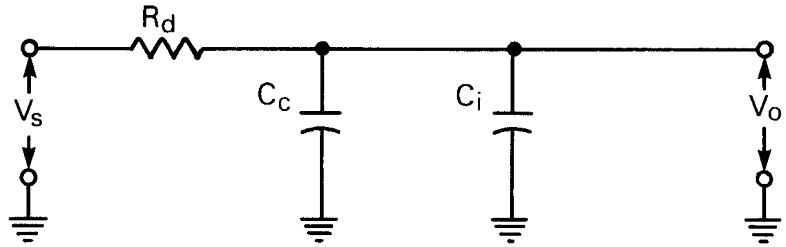

Fig. 16. Equivalent circuit.

Fig. 15 illustrates the use of a damping resistor when performing frequency measurements. As shown in Fig. 16, the cable capacitance, C_c, and the counter input capacitance, C_i form a voltage divider when a damping resistor, R_d, is added in series. In order for the damping resistor to have the optimum damping effect on ringing and overshoot, the value of R_d must be calculated. In order to calculate the value of R_d, the signal amplitude and frequency must be known. However, the frequency is usually unknown before the frequency measurement. Therefore, only the approximate value of R_d can be determined by estimating the source frequency. To maintain a minimum voltage of 30 mV RMS at the counter input (V_o), calculate the value of R_d using the following formula:

$$Rd = \frac{Vs\text{-}Vo}{Vo} \; Xc \quad \text{WHERE}$$

(a) $X_c = \frac{1}{2\pi f_1 C}$ = capacitor impedance at frequency f_1

(b) $C = C_c + C_i$; WHERE

C_c=87 pF (typical) for three feet of RG-58/U coaxial cable.
and C_i = 20 pF (typical);
and V_o = 30 mV RMS (counter sensitivity);
and V_s = signal amplitude at the source, in volts;
and f_1 = the estimated square wave or pulse train repetition frequency.
Choose a lower value for R_d if the duty cycle is low.

B. CONTACT DE-BOUNCING (Refer to Fig. 17)

For certain applications when a TTL interface circuit is not available at a timing signal source, a contact closure may be used to control the length of the time interval. This contact closure may consist of either switch contacts or relay contacts. The opening and closing of contacts may cause noise to be applied to the counter, preventing the Trigger Gate Logic circuitry from operating properly. As a result, slide switches are *not* recommended as a source of manual time interval control because they are extremely noisy. Pushbutton switches and toggle switches produce less noise because of their quick action. The decreased noise produced by these switches can be further reduced by connecting a 0.22 μF to 0.47 μF non-polarized capacitor across the switch contacts. If a relay is used, connect the capacitor across the relay contacts. This is sufficient for the proper operation of the Trigger Gate Logic circuitry most of the time. If a greater degree of reliability is required, a TTL circuit must be used. Several examples are shown below in Fig. 17.

C. FREQUENCY PERIOD TABLES

The tables in this section of the APPENDIX provide listings of standard audio frequencies in common use in the electronics industry. In each Table the frequency and the period are given. Frequency is the reciprocal of period. When using a calculator, divide the period reading into 1 to get frequency.

NOTE: 1 mSEC = .001 SEC and 1 μSEC = .000001 SEC.

1. **Telephone "Touch-Tone" Frequencies.** Each of the pushbuttons on a telephone touch-tone pad activates a pair of frequencies. These tones are used to activate the telephone terminal equipment. The digits on a telephone "Touch-Tone" pad and their respective frequency pairs are listed in Table I.

"Touch-Tone" is a registered trademark of A.T. & T.

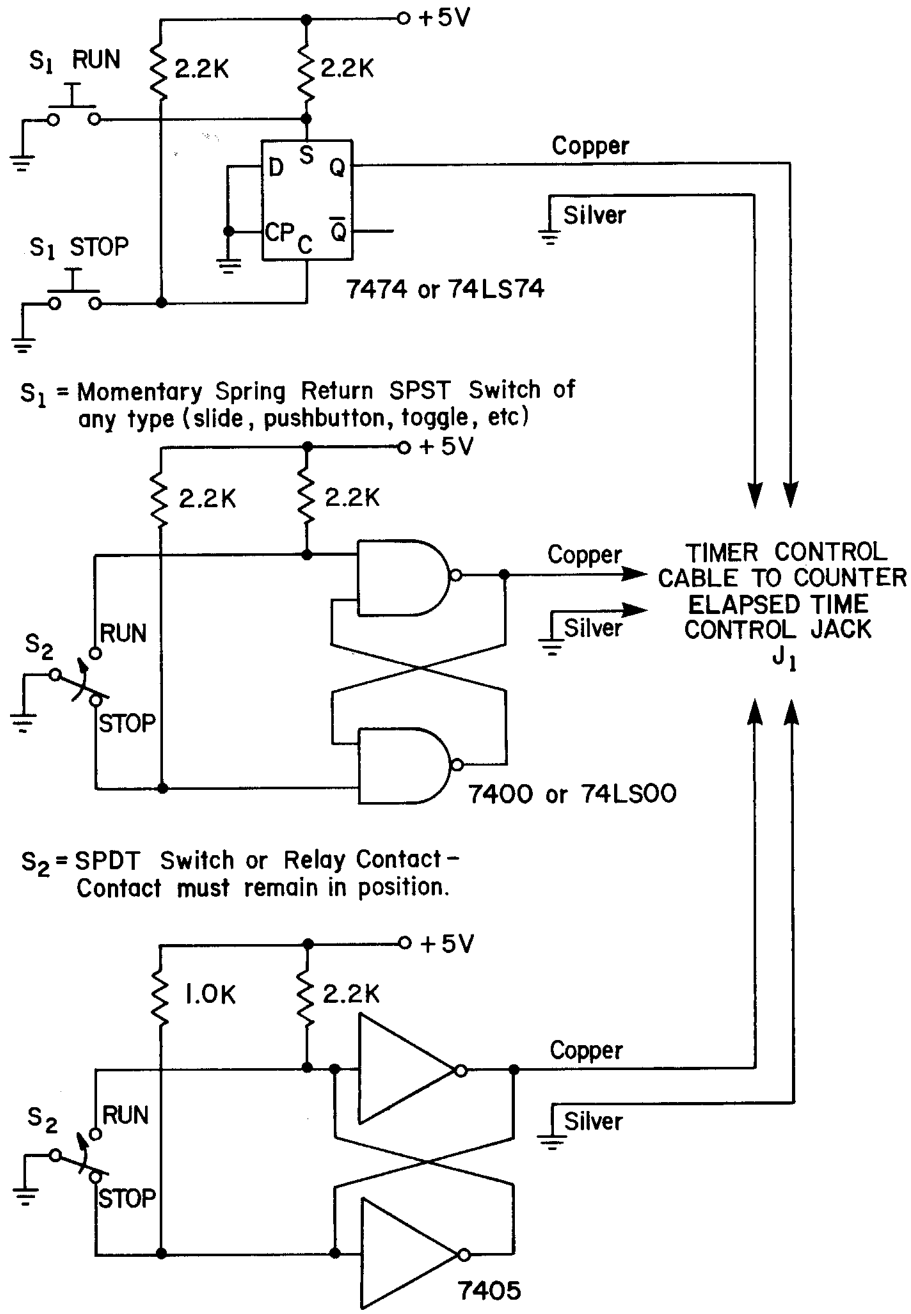

Fig. 17. De-Bounce circuits.

DIGIT (SYMBOL)	FREQUENCIES (PERIODS)
1	697 Hz (1434.72 μS) 1209 Hz (827.130 μS)
2	697 Hz (1434.72 μS) 1336 Hz (748.503 μS)
3	697 Hz (1434.72 μS) 1477 Hz (677.948 μS)
4	770 Hz (1298.70 μS) 1209 Hz (827.130 μS)
5	770 Hz (1298.70 μS) 1336 Hz (748.503 μS)
6	770 Hz (1298.70 μS) 1477 Hz (677.048 μS)
7	852 Hz (1173.71 μS) 1209 Hz (827.130 μS)
8	852 Hz (1173.71 μS) 1336 Hz (748.503 μS)
9	852 Hz (1173.71 μS) 1477 Hz (677.048 μS)
0	941 Hz (1062.69 μS) 1336 Hz (748.503 μS)
*	941 Hz (1062.69 μS) 1209 Hz (827.130 μS)
#	941 Hz (1062.69 μS) 1477 Hz (677.048 μS)

Table I. Telephone "Touch-Tone" pad digits and frequency pairs.

2. **Modem Frequencies.** There are two sets of standard audio frequencies used for data communications:

   a. U.S. Standards.

   b. The Consultative Committee on International Telephone and Telegraph (CCITT).

   These frequencies, their periods and corresponding bit pairs are listed in Table II.

U.S. STANDARD FREQUENCY (PERIOD)	BIT PAIR	CCITT FREQUENCY (PERIOD)
1270 Hz (787.402 μS)	00	980 Hz (1020.41 μS)
1070 Hz (934.579 μS)	01	1180 Hz (847.458 μS)
2225 Hz 449.438 μS)	10	1650 Hz (606.061 μS)
2025 Hz (493.827 μS)	11	1850 Hz (540.540 μS)

Table II. Modem frequencies.

3. **Scale of Equal Temperament (Table III).** This scale is included as a source of reference information for the frequency and period of musical notes. This table will be useful when the counter is being used to tune electronic musical instruments.

NOTE/FREQ.	C_{00}/16.351 Hz	$C^{\#}_{00}$/17.324 Hz	D_{00}/18.354 Hz	$D^{\#}_{00}$/19.445 Hz	E_{00}/20.602 Hz	F_{00}/21.826 Hz	$F^{\#}_{00}$/23.125 Hz	G_{00}/24.499 Hz	$G^{\#}_{00}$/25.956 Hz	A_{00}/27.500 Hz	$A^{\#}_{00}$/29.135 Hz	B_{00}/30.867 Hz
PERIOD	61.1583 mS	57.7234 mS	54.4840 mS	51.4271 mS	48.5390 mS	45.8169 mS	43.2432 mS	40.8179 mS	38.5267 mS	36.3636 mS	34.3230 mS	32.3971 mS
NOTE/FREQ.	C_{0}/32.703 Hz	$C^{\#}_{0}$/34.647 Hz	D_{0}/36.708 Hz	$D^{\#}_{0}$/38.890 Hz	E_{0}/41.203 Hz	F_{0}/43.653 Hz	$F^{\#}_{0}$46.249 Hz	G_{0}/48.999 Hz	$G^{\#}_{0}$/51.913 Hz	A_{0}/55.000 Hz	$A^{\#}_{0}$/58.270 Hz	B_{0}/61.735 Hz
PERIOD	30.5782 mS	28.8625 mS	27.2420 mS	25.7136 mS	24.2701 mS	22.9709 mS	21.6221 mS	20.4086 mS	19.2630 mS	18.1818 mS	17.1615 mS	16.1983 mS
NOTE/FREQ.	C_{1}/65.406 Hz	$C^{\#}_{1}$/69.295 Hz	$D^{\#}_{1}$/73.416 Hz	$D^{\#}_{1}$/77.781 Hz	E_{1}/82.406 Hz	F_{1}/87.307 Hz	$F^{\#}_{1}$/92.498 Hz	G_{1}/97.998 Hz	$G^{\#}_{1}$/103.826 Hz	A_{1}/110.00 Hz	$A^{\#}_{1}$/116.540 Hz	B_{1}/123.470 Hz
PERIOD	15.2891 mS	14.4310 mS	13.6210 mS	12.8566 mS	12.1350 mS	11.4538 mS	10.8110 mS	10.2053 mS	9631.50 µS	9090.91 µS	8580.74 µS	8099.13 µS
NOTE/FREQ.	C_{2}/130.812 Hz	$C^{\#}_{2}$/138.591 Hz	D_{2}/146.832 Hz	$D^{\#}_{2}$/155.563 Hz	E_{2}/164.813 Hz	F_{2}/174.614 Hz	$F^{\#}_{2}$/184.997 Hz	G_{2}/195.997 Hz	$G^{\#}_{2}$/207.652 Hz	A_{2}/220.000 Hz	$A^{\#}_{2}$/233.081 Hz	B_{2}/246.941 Hz
PERIOD	7644.56 µS	7215.48 µS	6810.50 µS	6428.36 µS	6067.48 µS	5726.92 µS	5405.49 µS	5102.12 µS	4815.75 µS	4545.45 µS	4290.35 µS	4049.55 µS
NOTE/FREQ.	C_{3}/261.625 Hz	$C^{\#}_{3}$/277.183 Hz	D_{3}/293.664 Hz	$D^{\#}_{3}$/311.126 Hz	E_{3}/329.627 Hz	F_{3}/349.228 Hz	$F^{\#}_{3}$/369.994 Hz	G_{3}/391.995 Hz	$G^{\#}_{3}$/415.304 Hz	A_{3}/440.000 Hz	$A^{\#}_{3}$/466.163 Hz	B_{3}/493.883 Hz
PERIOD	3822.26 µS	3607.72 µS	3405.25 µS	3214.13 µS	3033.73 µS	2863.45 µS	2702.75 µS	2551.05 µS	2407.87 µS	2272.72 µS	2145.17 µS	2024.77 µS
NOTE/FREQ.	C_{4}/523.251 Hz	$C^{\#}_{4}$/554.365 Hz	D_{4}/587.329 Hz	$D^{\#}_{4}$/622.253 Hz	E_{4}/659.255 Hz	F_{4}/698.456 Hz	$F^{\#}_{4}$/739.988 Hz	G_{4}/783.991 Hz	$G^{\#}_{4}$/830.609 Hz	A_{4}/880.000 Hz	$A^{\#}_{4}$/932.327 Hz	B_{4}/987.766 Hz
PERIOD	1911.13 µS	1803.86 µS	1702.62 µS	1607.06 µS	1516.86 µS	1431.73 µS	1351.35 µS	1275.52 µS	1203.94 µS	1136.36 µS	1072.59 µS	1012.39 µS
NOTE/FREQ.	C_{5}/1046.502 Hz	$C^{\#}_{5}$/1108.730 Hz	D_{5}/1174.659 Hz	$D^{\#}_{5}$/1244.507 Hz	E_{5}/1318.510 Hz	F_{5}/1396.912 Hz	$F^{\#}_{5}$/1479.976 Hz	G_{5}/1567.982 Hz	$G^{\#}_{5}$/1661.218 Hz	A_{5}/1760.000 Hz	$A^{\#}_{5}$/1864.654 Hz	B_{5}/1975.532 Hz
PERIOD	955.564 µS	901.933 µS	851.311 µS	803.531 µS	758.432 µS	715.865 µS	675.687 µS	637.762 µS	601.968 µS	568.182 µS	536.293 µS	506.193 µS
NOTE/FREQ.	C_{6}/2093.004 Hz	$C^{\#}_{6}$/2217.460 Hz	$D^{\#}_{6}$/2349.318 Hz	$D^{\#}_{6}$/2489.014 Hz	E_{6}/2637.020 Hz	F_{6}/2793.824 Hz	$F^{\#}_{6}$/2959.952 Hz	G_{6}/3135.964 Hz	$G^{\#}_{6}$/3322.436 Hz	A_{6}/3520.00 Hz	$A^{\#}_{6}$/3729.308 Hz	B_{6}/3951.064 Hz
PERIOD	477.782 µS	450.966 µS	425.655 µS	401.766 µS	379.216 µS	357.932 µS	337.843 µS	318.881 µS	300.984 µS	284.091 µS	268.146 µS	253.096 µS
NOTE/FREQ.	C_{7}/4186.008 Hz	$C^{\#}_{7}$/4434.920 Hz	D_{7}/4699.636 Hz	$D^{\#}_{7}$/4978.028 Hz	E_{7}/5274.040 Hz	F_{7}/5587.648 Hz	$F^{\#}_{7}$/5919.904 Hz	G_{7}/6271.928 Hz	$G^{\#}_{7}$/6664.812 Hz	A_{7}/7040.000 Hz	$A^{\#}_{7}$/7458.616 Hz	B_{7}/7902.128 Hz
PERIOD	238.891 µS	225.483 µS	212.782 µS	200.883 µS	189.608 µS	178.966 µS	168.922 µS	159.441 µS	150.493 µS	142.046 µS	134.073 µS	126.548 µS

Table III. Scale of equal temperament.

4. **Continuous Tone-Controlled Squelch System Frequencies (CTCSS).** The CTCSS code frequencies are used to code two-way radio communications on shared channels. Two code groups are used and are shown in Table IV.

GROUP A		GROUP B	
FREQUENCY (Hz)	PERIOD	FREQUENCY (Hz)	PERIOD
67.0	14.9254 mS	71.9	13.9081 mS
77.0	12.9870 mS	87.5	12.1212 mS
88.5	11.2994 mS	94.8	10.5485 mS
100.00	10.0000 mS	103.5	9661.84 µS
107.2	9328.36 µS	110.9	9017.13 µS
114.8	8710.80 µS	118.8	8417.51 µS
123.0	8130.08 µS	127.3	7855.46 µS
131.8	7587.25 µS	136.5	7326.01 µS
141.3	7077.14 µS	146.2	6839.95 µS
151.4	6605.02 µS	156.7	6381.62 µS
162.2	6165.23 µS	167.9	5955.93 µS
173.8	5753.74 µS	179.9	5558.64 µS
186.2	5370.57 µS	192.8	5186.72 µS
203.5	4914.00 µS	210.7	4746.08 µS
233.6	4280.82 µS	241.8	4135.65 µS
250.3	3995.21 µS		

Table IV. Continuous tone-controlled squelch system frequencies (CTCSS).

5. **Miscellaneous Frequencies Encountered.** See Table V.

USE/FUNCTION	FREQUENCY	PERIOD
TV horizontal	15734.26 Hz	63.556 μS
Stereo FM pilot carrier	19,000 Hz	52.631 μS
Test tone	400 Hz	2500.00 μS
Power line frequencies	60 Hz	16.6667 mS
	50 Hz	20.0000 mS
Kansas City standard cassette interface		
"Space"	1200 Hz	833.333 μS
"Mark"	2400 Hz	416.667 μS
16x Clock	4800 Hz	208.333 μS
Amateur RTTY		
"Mark"	2125 Hz	470.588 μS
170 Hz Shift "Space"	2295 Hz	435.730 μS
850 Hz Shift "Space"	2975 Hz	336.134 μS
Amateur slow-scan TV		
Sync	1200 Hz	833.333 μS
Black	1500 Hz	666.667 μS
White	2300 Hz	434.783 μS

Table V. Miscellaneous frequencies encountered.

D. LINE VOLTAGE CONVERSION

WARNING

1. The following instructions are for use by qualified personnel only. To avoid electric shock, do not perform servicing other than contained in the operating instructions unless you are qualified to do so.

2. AC line voltage is present on the fuse, jumpers, and power transformer circuits whenever the line cord is plugged into an AC outlet, even if the POWER switch is off.

The standard Model 1820 is factory-wired for use with 105-130V, 50/60 Hz AC power, but can be converted for operation from 210-260 VAC, 50/60 Hz power. The European Model 1820 is factory wired for 210-160 VAC, 50/60 Hz operation and can be converted for 105-130 VAC, 50/60 Hz operation. The European version also uses a fixed power cord rather than the detachable type. The following line voltage conversion procedure is for converting 105-130V to 210-260V operation. For 210-260V to 105-130V conversion, reverse the procedure.

The Model 1820 is factory-wired for use with 120V, 50/60 Hz AC lines. To operate the unit on 240V, 50/60 Hz, the internal connections must be changed. To convert the 1820 for 240 VAC operation, proceed as follows:

1. Remove the rear case of the counter as described in par. 2 of the RECALIBRATION AND MAINTENANCE section of this manual.

2. Remove the jumper wire connecting holes L3 and L4 on the printed circuit board.

3. Remove the jumper wire connecting holes L2 and L5 on the p. c. board.

4. Connect a jumper wire between holes L4 and L5 on the p. c. board. This jumper may be placed on the component side or the bottom side of the circuit board: L4 and L5 are adjacent to each other.

5. Remove the 1/8-ampere Type 3AG slo-blo fuse from the fuseholder at F1. Replace with 1/16-ampere Type 3AG slo-blo fuse.

6. Make a notation of the change near the fuse label on the transformer bracket.

7. Re-assemble the rear case of the counter as described in Par. 2 of the RECALIBRATION AND MAINTENANCE section of this manual.

8. The wires of the power cord are color-coded according to the European DIN standard.

E. TCXO INSTALLATION

1. **Material Required**

   TCX-20 TCXO Kit.

2. **Procedure (Refer to Fig. 18).**

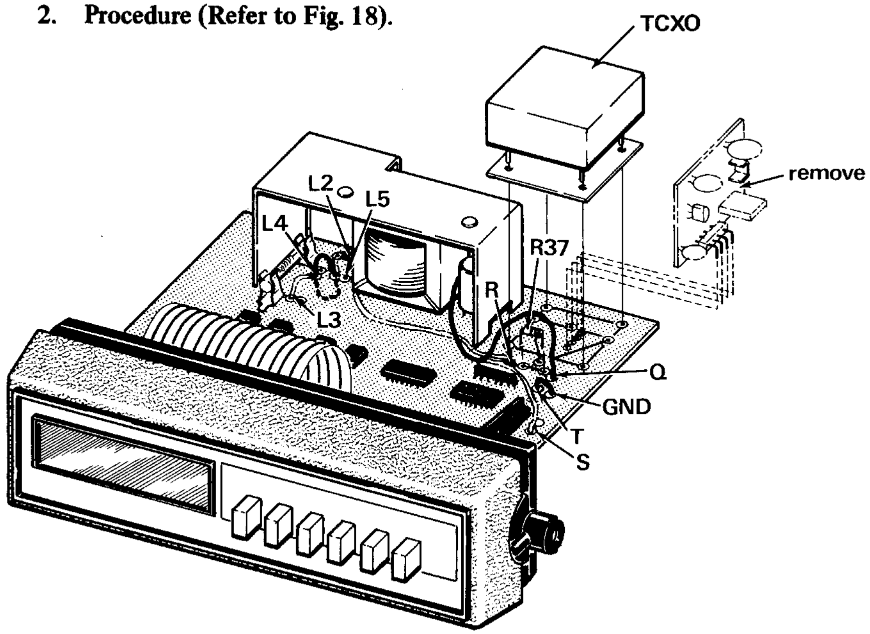

Fig. 18. TCXO installation.

a. Disassemble rear case. Refer to RECALIBRATION AND MAINTENANCE for instructions.

b. Remove the blue-yellow wire from S and insert wire into hole Q (with unit facing you, all reference locations are on the upper right hand side of the board).

c. Add R37 at the location labeled on the printed circuit board.

d. Remove the green-black wire connecting hole R with the TIME BASE SELECT switch.

e. Remove the green-yellow wire connecting hole T with the TIME BASE SELECT switch.

f. Connect a half-inch length of bare wire from hole T to ground (the hole immediately to the right of hole T).

g. De-solder the four pins that connect the TIME BASE GENERATOR to the main circuit board. Separate the TIME BASE GENERATOR from the main circuit board. Use CAUTION to avoid damaging the main circuit board.

h. Carefully clean out the holes in the main circuit board with a solder sucker or a stainless steel tool to accept the TCXO.

i. Insert the pins of the TCXO into the appropriate holes of the solder shield and install the TCXO on the main circuit board with the screw facing the rear of the unit.

j. Solder the four TCXO pins to the main circuit board.

k. Check all solder connections for shorts, etc., before applying power to the counter.

l. The installation of the TCXO is now complete. No further adjustments are necessary. The output frequency of the TCXO is available at the EXTERNAL TIME BASE INPUT jack if it is desired to connect an external counter. The TCXO signal can also be used as a test signal. The TIME BASE SELECT switch is now inoperative. Reassemble the counter case. Refer to RECALIBRATION AND MAINTENANCE.

SPECIFICATIONS

(REFERENCED TO 25 °C)

Type	Crystal oscillator.
Frequency	10 MHz.
Setability	±.1 PPM (± Hz).
Line Voltage Stability	Less than ±.1 PPM with ±10% line voltage variation.
Temperature Stability	Less than ±0.0001% (±1 PPM from 0 °C to 50 °C ambient).
Maximum Aging Rate	±1 PPM/YR.