INSTRUCTION MANUAL

B+K PRECISION **1801**

6-DIGIT, AUTORANGING

FREQUENCY COUNTER

B+K PRECISION

A Product of DYNASCAN CORPORATION • 6460 W. Cortland St. • Chicago, Illinois 60635

PRICE $2.00

INSTRUCTION MANUAL

FOR

B & K-PRECISION

MODEL 1801
6-DIGIT, AUTORANGING
FREQUENCY COUNTER

DIVISION OF DYNASCAN CORPORATION
6460 W. Cortland Street
Chicago, Illinois 60635

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INTRODUCTION

The B & K Model 1801 is a high-quality, lightweight, autoranging counter designed for frequency measurement in the range from 20 Hz to 40 MHz. A front panel function switch selects "1 SEC" preset gate interval or "AUTO" range. In the AUTO position, the correct gate interval for maximum resolution without overranging the instrument is automatically determined and proper frequency unit indicators for KHz or MHz turned on. In the "1 SEC" position, the display will indicate frequency to the closest Hz even if the leading most significant digit (MSD) is beyond the display range. The input impedance of 1 megohm is ideal for use with a divide-by-10 probe for measurements where the source loading is critical.

The display consists of six 7-segment, solid state, numerical display units and three LED's (light-emitting diodes) for units and overrange indication.

An internal time base of 10 MHz is generated by a crystal-controlled oscillator. Provision has been made for the user to convert the instrument to operate from an external time base when extreme accuracy is desired. Consult our Customer Service Department for conversion instructions.

Rugged, compact design and exceptional accuracy combine to make this counter a valuable tool for the scientist, engineer, experimenter, hobbyist, and service technician. It not only is an excellent instrument for the laboratory, but also is rugged enough for use in the field. Low power consumption of under 25 watts facilitates its use with DC-to-AC power inverter.

SPECIFICATIONS

1. FREQUENCY CHARACTERISTICS

Range	20Hz to 40 MHz (guaranteed); 10 Hz to over 60 MHz (typical). Function switch selects kHz or AUTO display reading
Gate Time, Auto	10 mSEC or 100 mSEC (MHz reading), or 1 SEC (kHz reading), chosen automatically
Gate Time, Manual	1 SEC (kHz reading, 1 Hz resolution).
Accuracy	± time base accuracy, ± 1 count.
Resolution	1 Hz
Display	Frequency of input signal with automatically positioned decimal point. Units of measurement (kHz, MHz) displayed in front panel by illuminated indicator.

2. INPUT CHARACTERISTICS

Impedance	1 megohm, shunted by 20 pF.
Protection	Diode-protected.
Connector	BNC (Front Panel)
Coupling	AC
Sinewave Sensitivity	30 mV rms (guaranteed); 15 mV rms (typical); 20 Hz to 40 MHz.
Maximum Input	200 V (peak AC + DC) to 500 Hz; derate linearly to 100 V (peak AC + DC) at 1 kHz. 100 V (peak AC + DC) 1 kHz to 5 MHz; derate linearly to 50 V (peak AC + DC) at 40 MHz.

3. INTERNAL TIME BASE CHARACTERISTICS (REFERENCED TO 25° C. AFTER 30-MINUTE WARM-UP)

Type	Crystal oscillator
Frequency	10 MHz
Setability	±0.1 PPM (±1 Hz)
Line Voltage Stability	Better than ±1 PPM for ±10% line voltage variation.
Temperature Stability	Better than ±0.001% (i.e. ±10 PPM) from 0-50° C. ambient.
Maximum Aging Rate	10 PPM/Year, 1 PPM/ Month.

4. DISPLAY CHARACTERISTICS

Visual Display	6 digits with overflow, kHz and MHz indicators.
Overflow Indication	Flashing light indicates display range is exceeded.
Display Refresh Interval	Fixed; 200 mSEC plus gate interval.

5. GENERAL

Power Requirements	105 to 130V, 117V nominal, 60 Hz; 25 watts maximum.
Dimensions	3-5/16" H x 8-11/16" W x 10-1/2" D.
Shipping Weight	5-1/2 lbs.
Handle	Combination "Kick Stand" and handle attached to bottom of unit.

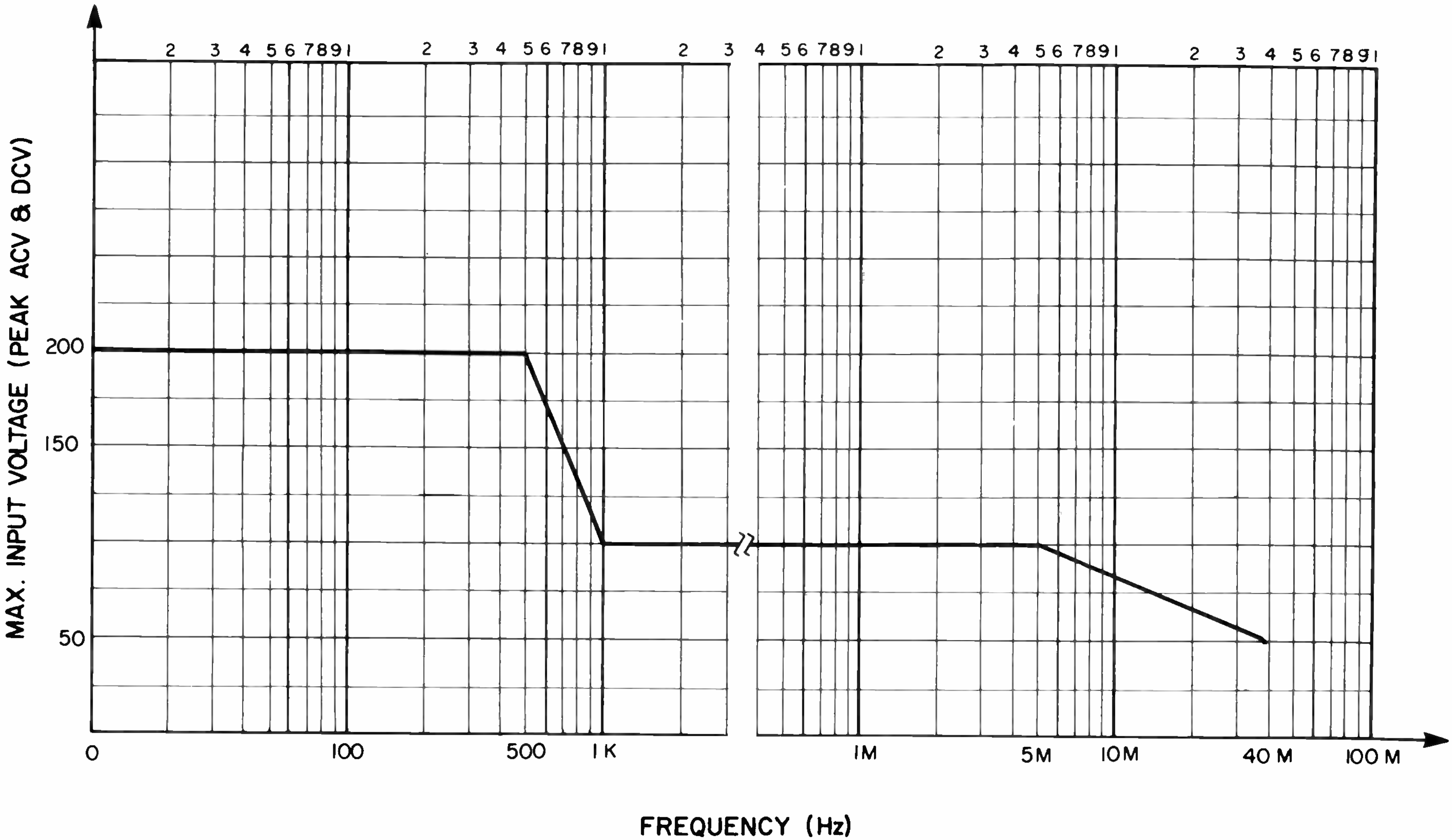

Fig. 1. Maximum input protection derating curve.

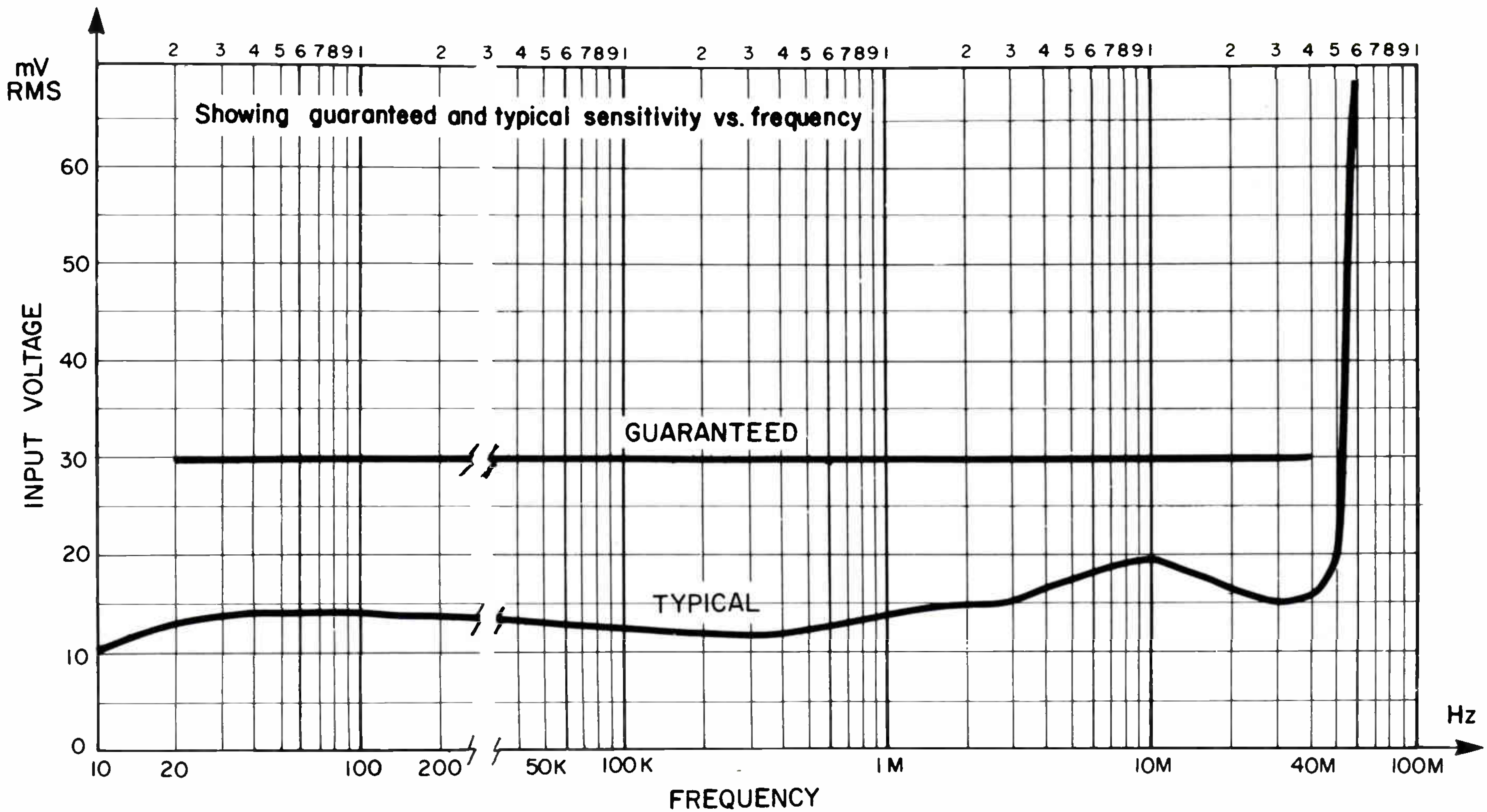

Fig. 2. Input sensitivity curve.

OPERATING PROCEDURE

A. CONTROLS AND FEATURES

1. FUNCTION SWITCH. Turns instrument on and selects preset (1 SEC.) or AUTO counting range. In the AUTO range mode, proper gate interval is automatically selected by the instrument to fill all six digits, starting with the most significant digit, without overflow (also referred to as "overrange").
2. INPUT JACK. BNC type jack. 1 megohm impedance allows the use of a standard 10:1 frequency-compensated probe which reduces the loading effect on the signal source. Use of a non-compensated probe will limit the measurement sensitivity at high frequencies.
3. kHz FREQUENCY UNIT INDICATOR. Indicates that the decimal point is placed to read measured frequency in kHz. This indicator is always on when the function switch is in the 1 SEC position, and the decimal point is as shown in Fig. 3.
4. MHz FREQUENCY UNIT INDICATOR. Indicates that decimal point is placed to read measured frequency in MHz.
5. NUMERICAL DISPLAY. Indicates frequency of the input signal.
6. OVERRANGE INDICATOR. Flashes when the frequency is beyond the selected display range.
7. STAND. Can be pushed against chassis so that the unit will sit on its feet, or can be pulled out to tilt the unit at a convenient viewing angle.

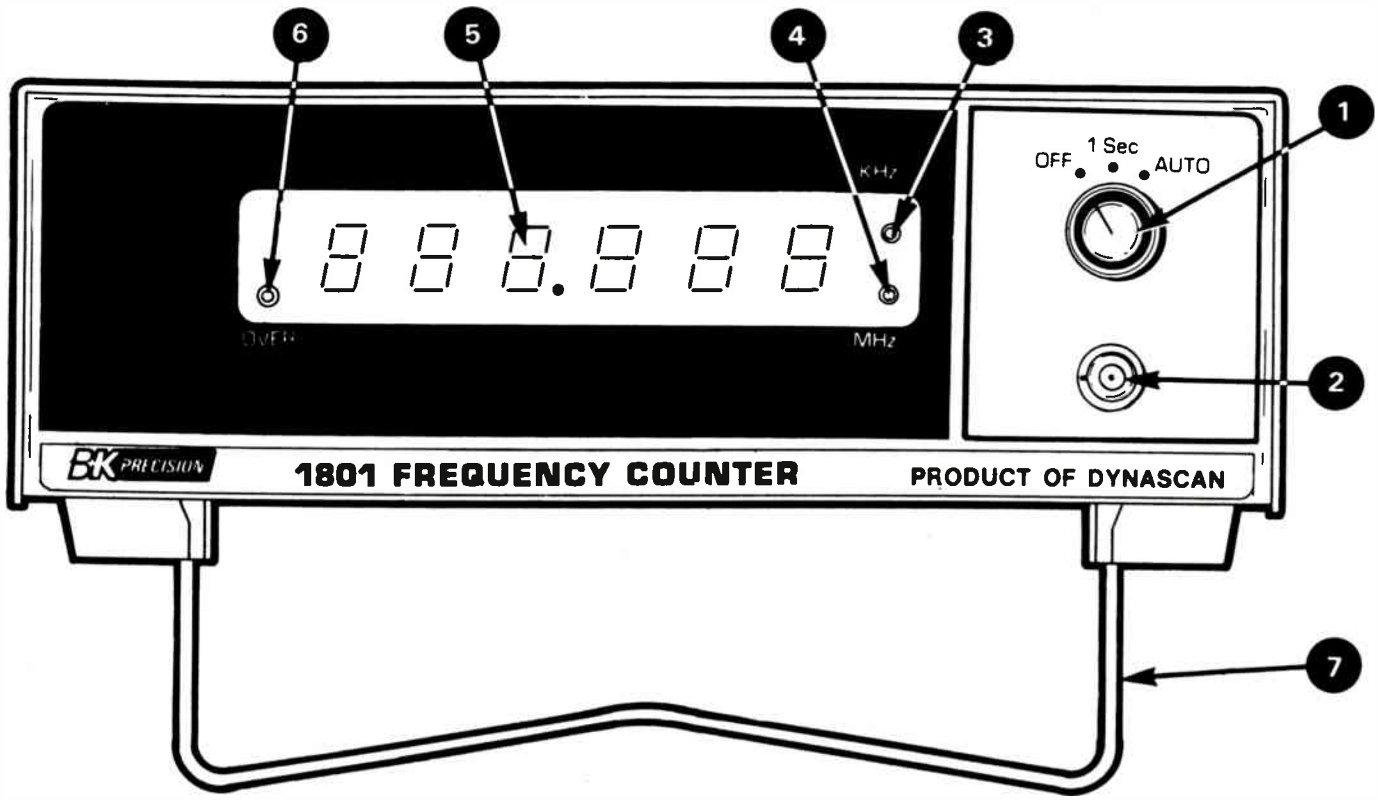

Fig. 3. Controls and features.

B. INTERPRETATION OF DISPLAY READINGS

For purposes of identification, the six display digits of the counter will be identified numerically as shown in the display drawing of Fig. 4.

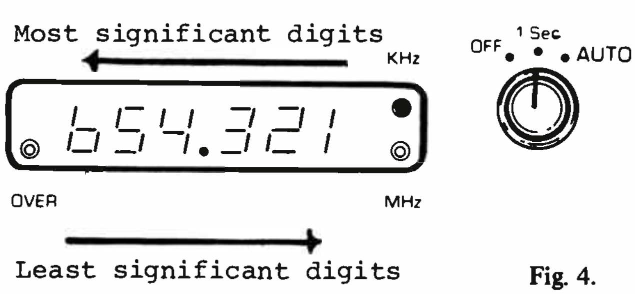

Fig. 4.

Digit #1 is to the extreme right and digit #6 is to the extreme left. In addition, the most significant digits (MSD) and least significant digits (LSD) are indicated.

Three indicator lights are shown in Fig. 4. If, in the following discussion, a particular indicator is lit, it will be shown as a solid circle. If it is not lit, it will be shown as in Fig. 4.

When the function switch is in the 1 SEC position, the decimal point is located as shown in Fig. 4 and the kHz lamp is lit. All readings are then indicated in kiloHertz. For example, if a frequency of 654,321 Hz is to be measured, the display would be as shown in Fig 5. With the function switch still in the 1 SEC position, a measurement of 321 Hz would be displayed as shown in

Fig. 6. Note that the unused digits register as zeros and the decimal point is retained in the kiloHertz position. The reading is displayed as 000.321 kHz, which is actually 321 Hz.

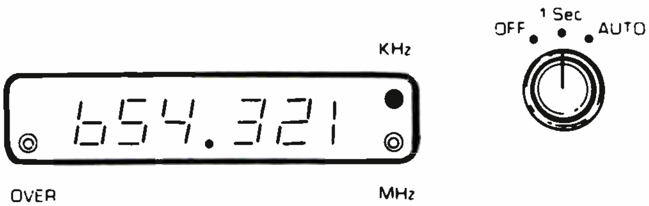

Fig. 5.

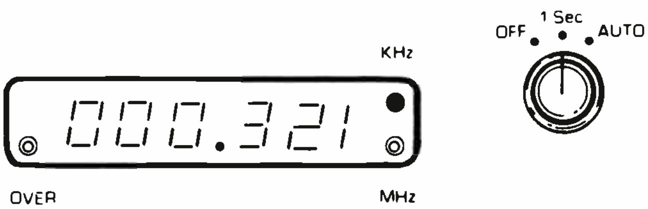

Fig. 6.

If a frequency of 21 Hz is measured, the display would read as shown in Fig. 7, which is 000.021 kHz. It should be noted here that as fewer digits are displayed, the accuracy of the reading decreases, because of the uncertainty of the last digit. With a tolerance of ±1 count on the reading displayed, a frequency of 21 Hz may actually be displayed as 20, 21 or 22 Hz.

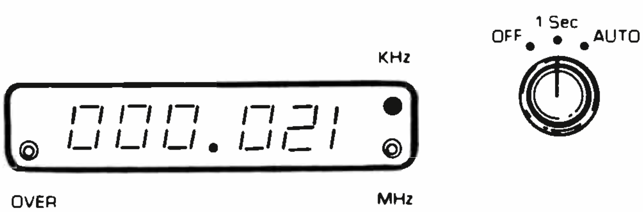

Fig. 7.

With the function switch in the 1 SEC. position, and with the reading greater than 1 MHz (for example, 1,654,321 Hz) only the last six digits of the frequency being measured will be indicated, as shown in Fig. 8. Note that the kHz lamp is lit and that the OVER lamp is flashing. This indicates that the most significant digit is not being displayed in the frequency count.

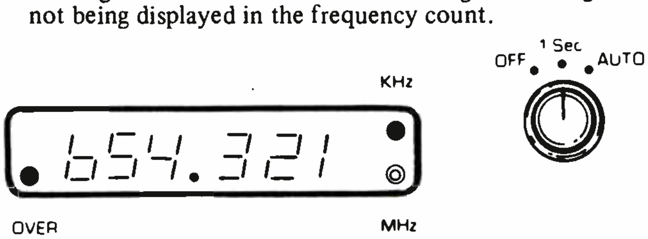

Fig. 8.

Maximum resolution to the Hz is obtained under these conditions because the least significant digit is displayed; however, the first and most significant digit cannot be determined.

When the condition described above occurs, the function switch should be placed in the AUTO position. The display corresponding to measurement of the frequency 1,654,321 Hz would then appear as shown in Fig. 9.

Fig. 9.

Note that the MHz lamp is now lit and that the least significant digit (1) is no longer being displayed at the right end of the display, and the most significant digit (1) has been added at the left end of the display. When the most significant digit is displayed, the OVER lamp is off.

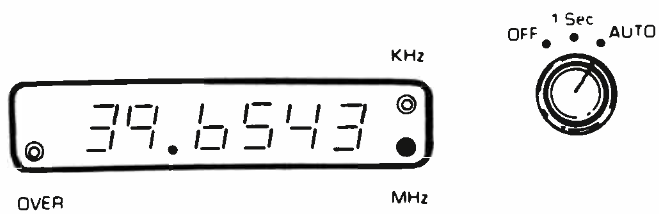

Fig. 10.

Now consider the case in which a measurement is to be performed at 39.654321 MHz. With the function switch in the AUTO position, the frequency reading will be displayed as shown in Fig. 10. Notice that the two least significant digits (2 and 1) have been deleted. Also, the MHz lamp is lit, indicating the reading is displayed in MegaHertz. Because the most significant digits (3 and 9) are displayed, the OVER light is not lit. If it is desired to obtain maximum resolution of the frequency being measured (in other words, down to the Hertz), the function switch must be placed in the 1 SEC position. The reading will be displayed as shown in Fig. 11.

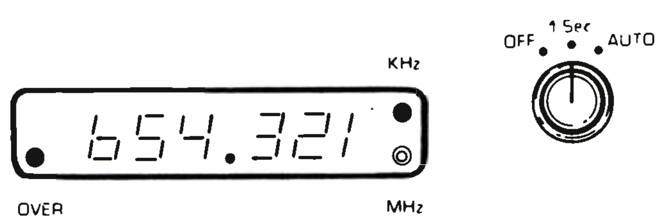

Fig. 11.

Notice that the least significant digits (2 and 1) are displayed and that the most significant digits (3 and 9) are not displayed. Because the most significant digits are not displayed, the OVER lamp will flash, indicating that the actual frequency being measured is greater than that displayed.

Remember that with the function switch in the AUTO position, the most significant digits are *always* displayed and the kHz or MHz light will be on as required to identify the units of measurement. For example, with the function switch in the AUTO position, and with a measurement of 321 Hertz, the display of Fig. 6 is automatically obtained. With a measurement of a frequency of 654,321 Hz, the display of Fig. 5 is obtained.

For maximum convenience of operation, the AUTO position of the function switch should be used. However, when it is desired to have the maximum resolution of the reading (to the Hertz) the 1 SEC position is selected.

Bear in mind that the least significant digits of the measured frequency display will *change as the reading is being observed,* the amount depending on the frequency stability of the frequency source being measured. An oscillator with the inductance and capacitance as frequency-determining elements may have a rather fast rate of change, while a crystal-controlled oscillator will provide a much more stable frequency reading.

C. OPERATION

CAUTION

Before you proceed with this section, carefully read the specifications. Damage to the instrument can result if excessive voltage is applied to the input. Be sure the signal is within the parameters specified for this instrument.

NOTES

At high frequencies, always terminate the transmission line in its characteristic impedance (e.g. 50 ohm coaxial cable should be terminated into a 50 ohm resistive load). This will eliminate reflections along the line which could damage the equipment under test, or produce inaccurate readings. A DC blocking capacitor is required in the cases where the circuit DC bias might be affected by the termination resistor. To avoid the requirement for use of a terminated transmission line, a compensated high-impedance 10:1 probe can be used instead.

Signal cables available from Dynascan are:

a. 10:1 and 1:1 compensated counter probe PR-25 or
b. 10:1 and 1:1 oscilloscope probe, PR-24

These present a loading effect of 10 megohms and approximately 15 picofarads at the point of measurement. When using the oscilloscope probes with the counter, a BNC male-to-UHF female adapter is required.

To make your own signal cable, 50-ohm coaxial cable (RG-58A), no longer than 3 ft., is recommended. Remember, each foot of coaxial cable adds about 30 picofarads of shunt capacitance to the point of measurement. In addition, at higher frequencies, standing wave effects become significant as the cable length approaches a quarter wavelength of the frequency measured, if the cable is not properly terminated.

Proceed as follows:

1. Turn on the 1801 by rotating the function switch clockwise and select either "1 SEC" or "AUTO" range.
2. Connect the signal to be counted to the input jack.
3. If the display overranges in the "1 SEC" range, switch to "AUTO" and read the frequency directly in MHz. When in the AUTO mode, allow the unit enough time to select the proper range and display the frequency. For frequencies below 1 MHz, the AUTO mode will select the 1 second time base and the frequency readings will be displayed in kHz.

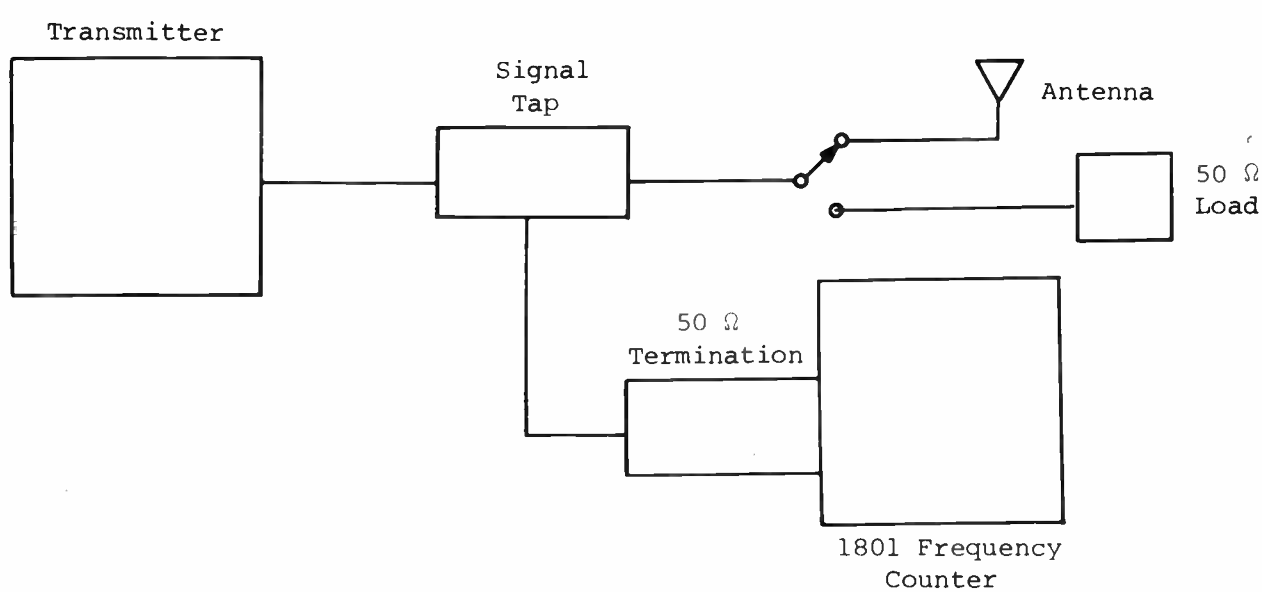

Fig. 12. Measuring transmitter frequency.

4. In the "1 SEC" range, the display shows the reading to Hertz (least significant digit, LSD), even though the most significant digits (MSD) may be beyond the display reading (overrange indicator flashes).
   Example: If measuring frequency of 10.654321 MHz, the counter will display 10.6543 MHz if it is in "AUTO" mode, and display "Over 654.321 kHz" if it is in "1 SEC" range.

D. APPLICATIONS:

1. **Radio Transmitter Frequency Measurement**
   Four watts output power is chosen as example. Refer to Fig. 12 for details.

   a. If a commercial 50-ohm termination, such as the Bird Model 6154, is not available, use a 5W, 50-ohm non-inductive resistor at the transmitter output as a dummy load in order to protect the output stage.

   b. A resistive or capacitive voltage divider is used in a 50-ohm coaxial cable signal tap to protect the transmitter output stage from load mismatch and to protect the counter input stage from excessive signal voltage (10:1 probe is also usable). To determine the peak voltage of an RF carrier when the power and load are known, use the relationship:

   $E\ PEAK = 1.4\sqrt{PR}$ where

   P is power output in watts,

   R is load resistance in ohms.

   Using a 4-watt output into 50 ohms,

   $$E\ PEAK = 1.4\sqrt{4 \times 50}$$
   $$= 20 \text{ volts}$$

   If we consider that this value can almost double with 100 percent modulation and can be multiplied several times again by severe load mismatches, the importance of minimizing the voltage to the counter becomes obvious.

   A convenient method of paralleling the load and the divider is shown in Fig. 12; details on construction of signal taps and termination shown in Fig. 13 and 14 are available from

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   B&K-PRECISION
   DIVISION OF DYNASCAN CORPORATION
   2815 Irving Park Road
   Chicago, Illinois 60618

   c. A 50-ohm termination resistor is required at the counter input if a 50-ohm coaxial cable is used to prevent erratic counting caused by ringing and reflections. Refer to Fig. 14.

2. **Amplitude-Modulated Signals**
   Erroneous frequency readings may be obtained if carrier frequency measurements are performed with a high percentage of amplitude modulation present. This is caused by the fact that the carrier level periodically decreases to a near zero amplitude at 100% modulation. If this modulated signal is applied to the frequency counter through a voltage divider as outlined earlier, the possibility of the carrier level dropping to a value lower than the counter sensitivity must be considered. When this occurs, the counter does not count during the entire interval and an erratic and inaccurate reading results. For more reliable results, the amplitude modulation should be removed when carrier frequency measurements are performed.

   The frequency of the modulating signal, if in the audio range, can be measured if a suitable detector with low-pass filter or a demodulator probe (such as B&K-PRECISION'S PR-23 with adapter cable) is used between the signal test point and counter.

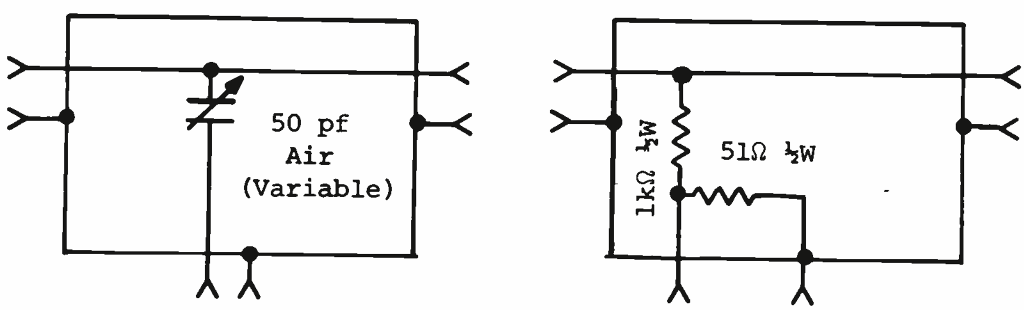

Fig. 13. Signal taps.

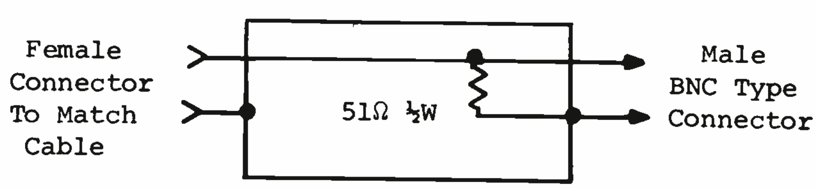

Fig. 14. Termination for counter.

3. **Square Wave or Pulse Train Measurement**

   In some cases, miscounts can occur when measuring the frequency of square waves or a pulse train, particularly if an unterminated input cable is used. That error is caused by "ringing" or overshooting in the unterminated transmission cable. The proper value of damping resistor in series with the cable signal line can eliminate this effect. (Refer to Appendix for the damping resistor calculation.) In practically all cases where the output of a pulse or square wave generator is being measured, satisfactory results are obtained if a short cable is used with a terminating resistor at the counter input which matches the generator impedance.

4. **VHF/UHF Frequency Measurement**

   The 1801 Frequency Counter is compatible with all commercially available prescalers to extend the frequency range up to the UHF range (with 100:1 prescaling).

   When any such device is used, of course, the reading on the counter must be multiplied by the scaling factor to obtain the true frequency.

5. **Line Frequency Measurement**

   NOTE

   Using the line frequency as a check of counter accuracy or using the counter to verify the power line frequency is not recommended if accuracy is required. The counter reading obtained is accurate to ±1 digit. At 60 Hertz this represents a reading error of ±1.7%, which is much greater than the allowable power line frequency deviation. The following are provided as safety guidelines in the event that line frequency measurements are performed.

   AC Outlet:

   a. If the instrument is operated from a grounded outlet (which is highly recommended), only the *center conductor* of the input cable should be connected to the power line. Otherwise, a short circuit might result. If a reading is not obtained at one terminal, try the other.

   b. If the instrument is operated from an ungrounded (two conductor) outlet, or if an ungrounded two-pronged adapter is used, ground the chassis to earth ground and proceed as above. The counter can be connected directly to the line if it is a 120 volt line. For higher line voltages, a voltage divider should be used to avoid exceeding the input voltage rating of the counter.

E. MODIFICATIONS

1. Use of external time base: If greater measurement accuracy is required than afforded by the internal time base, the instrument can be modified for use with a higher precision external time base. Modification instructions include provision for a switch to select either the internal or external time base.
2. Internal time base output: If it is desired to use the internal time base of the 1801 for other purposes, such as a secondary frequency reference, the unit can be modified to make the internal reference frequency (10 MHz) available at the rear panel.
3. Use of the counter as an accumulator or an event counter for machine operations is possible by defeating the gating function.

   Information regarding any modifications can be obtained by writing to

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B&K-PRECISION
DIVISION OF DYNASCAN CORPORATION
2815 W. Irving Park Road
Chicago, Illinois 60618

THEORY OF OPERATION

The Model 1801 Frequency Counter consists of an input section, time base and control circuit, counter section, display, auto-ranging circuit, and power supply.

1. **INPUT**

   The input circuit consists of a protected high-impedance FET/Bipolar pair amplifier (Q1, Q2), two stages of signal conditioner, a threshold detector (third amplifier of IC1), an ECL to TTL level translator (Q3, Q4), and a counting control gate (Q5).

2. **TIME BASE AND CONTROL**

   A precision 10 MHz oscillator serves as a timing control center from which different function control pulses are derived (refer to Timing Diagram in Fig. 16). It determines the counting interval, updates the display information, resets the counter and drives the display multiplexing circuit.

3. **COUNTER SECTION**

   A decade counter, a memory and multiplex-controlled gates are provided for each digit. The overrange indicator is driven by the last decade counter of the chain.

4. **DISPLAY**

   Multiplexed BCD signals from counter chain are fed into a decoder device (IC301) which drives 7-segment solid state displays. Two frequency units (kHz, MHz) indicators and three decimal points are automatically selected by auto-ranging circuit.

   If the count per unit time exceeds the capacity of the display, the spillover from MSD will trigger the overrange circuit and flash the overrange light.

5. **AUTO-RANGING CIRCUIT**

   This part of the circuit consists of an underrange detector, overrange detector, binary counter and demultiplexer.

   In auto-range mode, one of the three different length counting periods is selected. The demultiplexer will select the shortest period (10 mSEC) while the binary counter is in its lower two states. The counter will accept a time base update pulse which is generated by IC26B at the end of the previous counting period and moves to its third state; the demultiplexer selects a decade longer period (100 mSEC) if the underrange detector detects "zero" in MSD (IC21).

   This cycle will repeat until the MSD begins to count or the demultiplexer reaches the 1 SEC time base.

   If the incoming signal is increased in frequency and the instrument is overranged, the binary counter is reset and a new auto-ranging sequence is initiated.

   Since the gates of IC27 are open collector, the function switch will override their output in the "1 SEC" position, and force the demultiplexer into the 1 SEC time base.

6. **POWER SUPPLY**

   The power supply operates from 120V, 60 Hz line to supply regulated +15 volts and +5 volts DC for all circuitry. The +5 volt output employs a closed loop feedback regulator for good load regulation.

RECALIBRATION AND MAINTENANCE

Your 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 on technical assistance.

The adjustment point (C202) is located at the left front side of the counter on the vertical printed circuit board.

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 20 minutes.
2. Connect the standard frequency source to front panel input.
3. Set function switch to "1 SEC" position.

   NOTE: The instrument will overrange and thus the MSD will be lost.
4. With a non-metallic alignment tool, adjust C202, through the hole in the side of the cover, for a display equal to the standard frequency ±1 count.

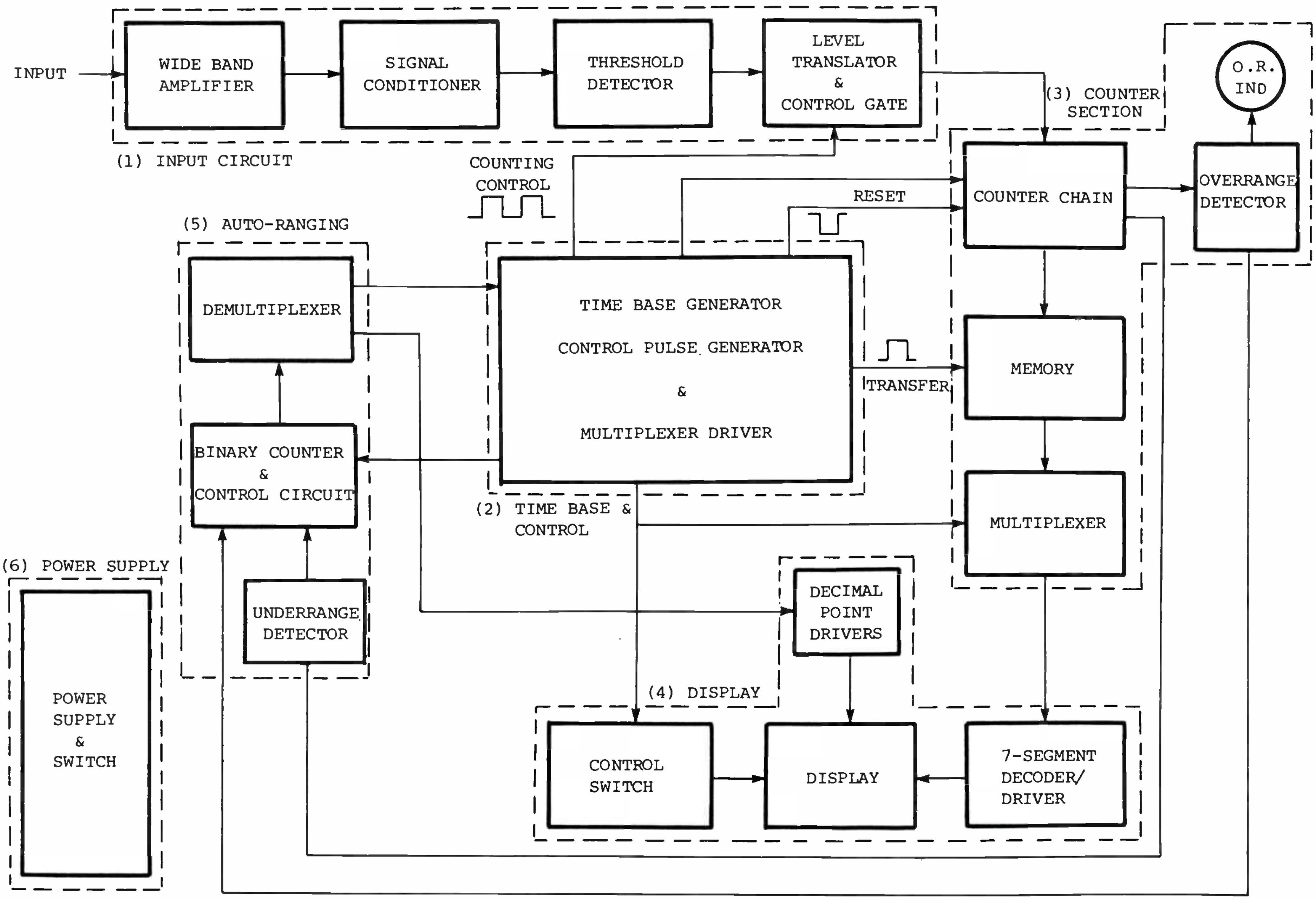


Fig. 15. System block diagram.

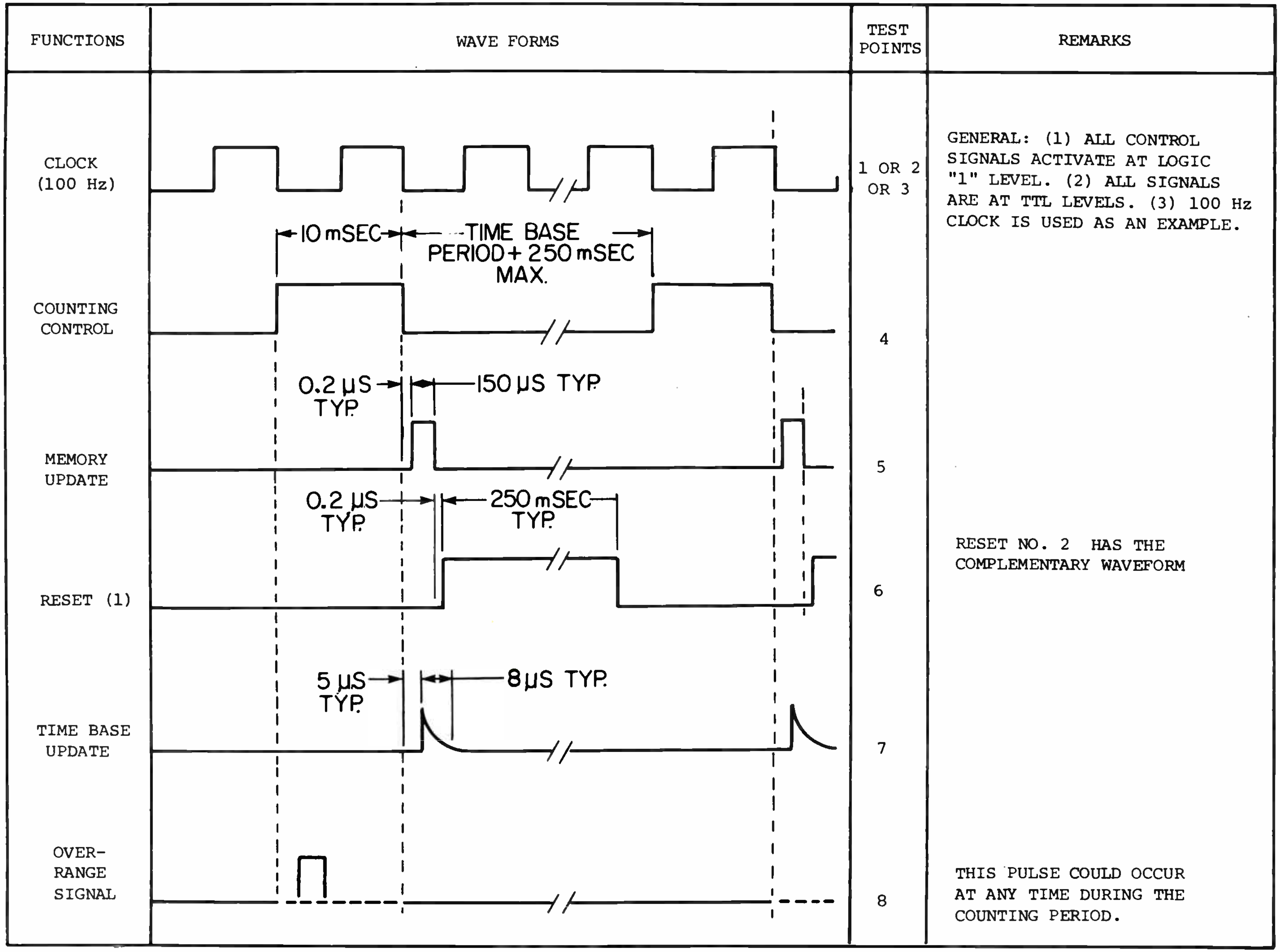
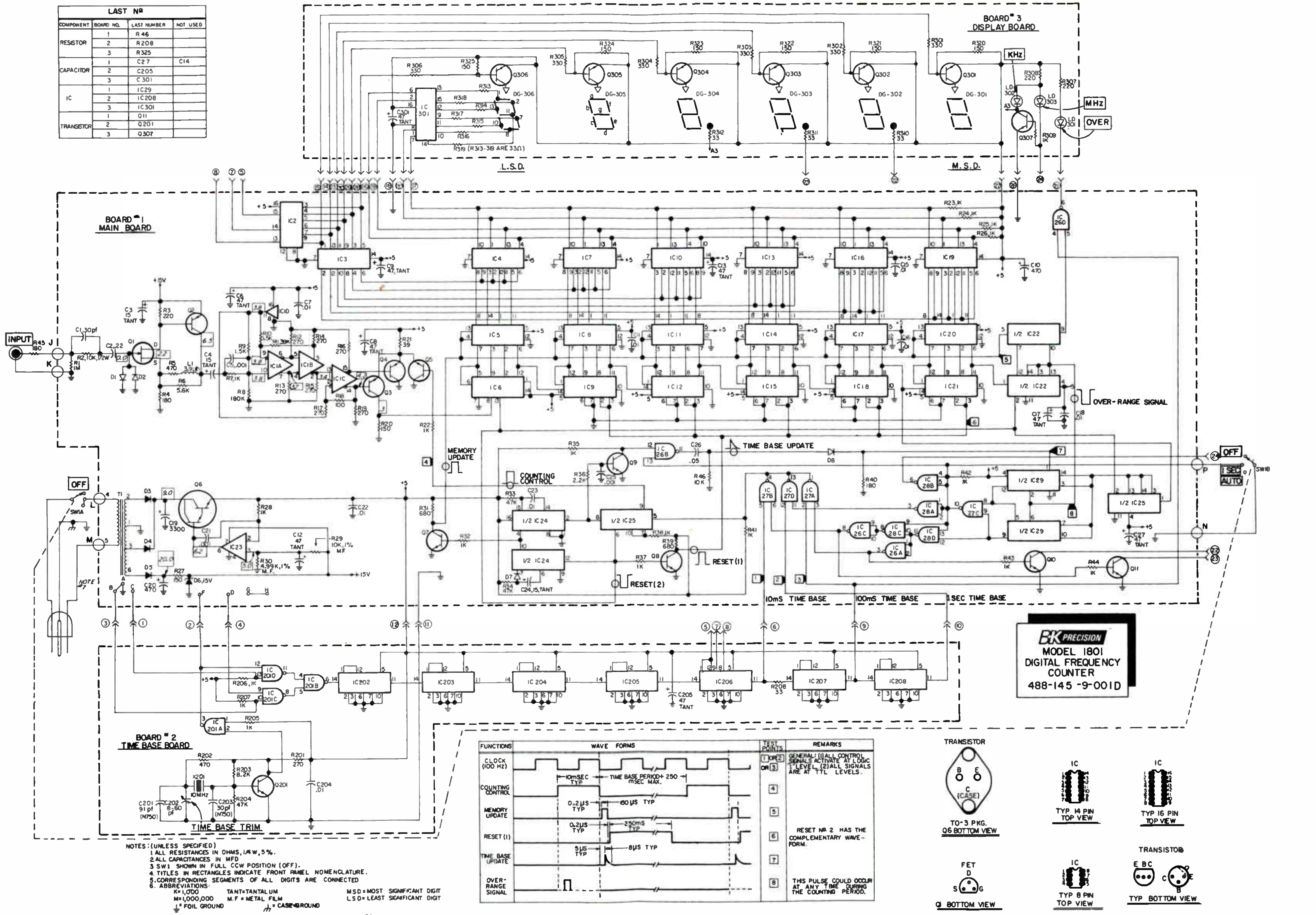


Fig. 16. Timing diagram.

LAST Nº			
COMPONENT	BOARD NO.	LAST NUMBER	NOT USED
RESISTOR	1	R 46	
	2	R208	
	3	R325	
CAPACITOR	1	C27	C14
	2	C205	
	3	C 301	
IC	1	IC29	
	2	IC208	
	3	IC301	
TRANSISTOR	1	Q11	
	2	Q201	
	3	Q307	



NOTES: (UNLESS SPECIFIED)

1. ALL RESISTANCES IN OHMS, 1/4 W, 5%.
2. ALL CAPACITANCES IN MFD
3. SW1 SHOWN IN FULL CCW POSITION (OFF).
4. TITLES IN RECTANGLES INDICATE FRONT PANEL NOMENCLATURE.
5. CORRESPONDING SEGMENTS OF ALL DIGITS ARE CONNECTED
6. ABBREVIATIONS:
   - K = 1,000
   - M = 1,000,000
   - TANT = TANTALUM
   - M.F = METAL FILM
   - MSD = MOST SIGNIFICANT DIGIT
   - LSD = LEAST SIGNIFICANT DIGIT
   - = FOIL GROUND
   - = CASE GROUND
7. RIBBED WIRE IS NEUTRAL, DIRECTLY CONNECTED TO TRANSFORMER.
8. ALL THE DC VOLTAGES SHOWN (ITALICS ON SQUARES) ARE TYPICAL VALUES IN VOLTS, MEASURED WITH NO SIGNAL INPUT.

B & K-PRECISION MODEL 1801 PARTS LIST

488-145-9-002E

RESISTORS

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART NUMBER
R29	10kΩ ± 1% 1/2W P.F. Metal Film	011-020-9-001
R30	4.99kΩ ± 1% 1/2W P.F. Metal Film	011-071-9-001

CAPACITORS

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART NUMBER
C1,203	30 pF, ± 5% N750 Pin Lead Ceramic Disc	020-135-9-001
C2	.22μf, 200V, 10% Polyester	025-028-9-001
C3,4,24	15μf, 20V Tantalum	027-006-9-003
C5,21,25	.001μf, 500V Ceramic Disc	020-072-9-001
C6,8,9,12, 13,17, 27,205, 301	47μf, 6.3V Tantalum Capacitor	027-006-9-004
C7,11,15, 16,18,22, 23,204	.01μf, 25V Ceramic Disc	020-104-9-001
C10	470μf, 16V Electrolytic	022-100-9-001
C19	3300μf, 16V Electrolytic	022-124-9-001
C20	470μf, 25V Electrolytic	022-095-9-001
C26	.05μf, 100V Ceramic Disc	020-102-9-001
C201	91 pF, N750 Ceramic Disc	020-136-9-001
C202	8-60 pF Trimmer	028-001-9-004

CRYSTAL AND INDUCTOR

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART NUMBER
X201	10 MHz Crystal	132-010-9-001
L1	3.9μH 5% Inductor	041-065-9-001

DIODES

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART NUMBER
D1,2,7	1N4148 Silicon	151-038-9-001
D3,4,5	1A, 600V Rectifier	151-050-9-001
D6	15V, 3%, 1/2W Zener	152-060-9-001
D8	1N60 Germanium	150-001-9-005

TRANSISTORS

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART NUMBER
Q1	2N5950 J-FET	182-031-9-001
Q2,3,4,5	MPS 3640 PNP Switching Transistor	177-014-9-001
Q6	2N6383 Power Darlington Transistor	172-021-9-001
Q7,8,9, 10,11, 201,307	MPS 2369 NPN Switching Transistor	176-049-9-001
Q301,302, 303,304, 305,306	PNP Signal Transistor	177-017-9-001

COMPOSITE
499-072-9-001E

INTEGRATED CIRCUITS

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART NUMBER
IC1	10116 ECL Triple Line Receiver	307-056-9-001
IC2	7442 BCD-to-Decimal Decoder	307-053-9-001
IC3	7404 Hex Inverter	307-039-9-001
IC4,7,10, 13,16, 19,27	7401 Quadruple 2-Input NAND Gates with Open-Collector Output	307-055-9-001
IC5,8,11, 14,17, 20	7475 Quadruple Latch	307-013-9-001
IC6	74196 High-Speed Counter	307-048-9-001
IC9,12, 15,18, 21,202, 203,204, 205,206, 207,208	7490 Decade Counter	307-012-9-001
IC22,25, 29	7473 Dual J-K Flip-Flop	307-010-9-001
IC23	741 Operational Amplifier	307-016-9-001
IC24	74123 Dual Multivibrator	307-054-9-001
IC26,28, 201	7400 Quadruple 2-Input NAND Gate	307-015-9-001
IC301	7447 BCD to 7-Segment Decoder	307-049-9-001

SWITCH

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART NUMBER
S1	Rotary	083-171-9-001

MISCELLANEOUS

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART NUMBER
LD301, 302,303	HP5082-4484 Light-Emitting-Diode (LED)	158-004-9-001
DG301, 302,303, 304,305, 306	HP5082-7750 Solid State 7-Segment Displays	238-007-9-001
T1	Power Transformer	065-106-9-001
	Bus Bar	757-018-9-001
	Line Cord, 3-Wire with Molded Plug	420-010-9-001
	Standoff, Square	759-059-9-001
	Knob	751-116-9-001
	Stand, Wire Form	804-005-9-001
	Foot, Front	381-059-9-001
	Foot, Rear	381-061-9-001
	Instruction Manual	480-161-9-001

NOTE: Standard value resistors are not listed. Values may be obtained from schematic diagram. Minimum charge $5.00 per invoice. Orders will be shipped C.O.D. unless previous open account arrangements have been made or remittance accompanies order. Advance remittance must cover postage or express charges. Specify serial number when ordering replacement parts.

B & K Division of DYNASCAN CORPORATION
2815 W. Irving Park Rd., Chicago, Illinois 60618
Phone: 312/583-4360
Factory Authorized Parts & Service Centers
492 - 036 - 0 - 776

The following will handle any parts and/or service problems, either in or out of warranty. Your nearest service center has been selected for quality and prompt attention to your needs. Please take advantage of this service facility established for your benefit. This list is subject to change without notice. Please contact service center before forwarding equipment for repair.

TEST EQUIPMENT

ALABAMA
Arnold's Instrument Service
2116 Dauphin Island Pkwy.
Mobile, AL 36605
205/478-3230

B & C Instruments, Inc.
803 Fackler St. S.W.
Huntsville, AL 35801
205/539-2739

ALASKA
Yukon Radio Supply, Inc.
3222 Commercial Dr.
Anchorage, AK 99504
907/277-1497

ARIZONA
Arizona Electric Standard Lab.
4430 N. 19th Ave.
Phoenix, AZ 85015
602/264-9351

ARKANSAS
Electric Sales & Service
7515 Geyer Springs Rd.
Little Rock, AR 72209
501/565-0774

CALIFORNIA
Electronic Services Co.
8128 Orion Ave.
Van Nuys, CA 91406
213/780-3071

Guaranteed Electronics
5822 Mission St.
San Francisco, CA 94112
415/334-5900

CANADA
Atlas Electronics Limited
50 Wingold Ave.
Toronto, Ont., Canada M6B 1P7
416/781-6174

COLORADO
House of TV Repair
1445 Florence St.
Aurora, CO 80010
303/366-1581

Clyde N. Still Electronics
2630 W. Kiowa
Colorado Springs. CO 80904
303/633-8404

CONNECTICUT
L & L Electronics
186 N. Main St.
Branford, CT 06405
203/488-4814

DISTRICT OF COLUMBIA
Electronic Maintenance
308 Carroll St. N.W.
Washington, D.C. 20012
202/882-2333

FLORIDA
Azalea Park Appliance, Inc.
1201 W. Pine St.
Orlando, FL 32805
305/ 425-1440

Elecon Corp.
4981 72nd Ave. North
Pinellas Park, FL 33565
813/541-3021

IDAHO
Idaho Instrument Service
410 Elm St. N.
Twin Falls, ID 83301
208/733-5636

ILLINOIS
Dynascan Corporation
2815 W. Irving Park Rd.
Chicago, IL 60618
312/583-4360

INDIANA
Electro-Lab Services, Inc.
510 Williams Rd.
Evansville, IN 47712
812/423-5211

KANSAS
Main Electronics, Inc.
225 Ida
Wichita, KS 67211
316/267-3581

KENTUCKY
Louisville Meter Service
2829 Dell Brooke Ave.
Louisville, KY 40220
502/454-3432

MARYLAND
Q-Tronics
1237 Queen Anne Ave.
Odenton, MD 21113
301/672-1127

MASSACHUSETTS
Electric Service Center
39 Hollis St.
E. Pepperell, MA 01437
617/433-6940

MICHIGAN
Electro Instrument Repair
Div. Instrument Specialties, Inc.
1024 West 14 Mile Rd.
Clawson, MI 48017
313/435-3311

Main Electronics
5558 S. Pennsylvania Ave.
Lansing, MI 48910
517/882-5035

MISSOURI
Kermit Shetley Repair
2613 Marvin
Cape Girardeau, MO 63701
314/334-2055

Sherrer Instruments
7170 Manchester Ave.
St. Louis, MO 63143
314/644-5362

NEBRASKA
Alpha-Omega Applied Electronics, Inc.
2208 Franklin St.
Belevue, NB 68005
402/291-2200

NEW JERSEY
Hosica Laboratories
715 Main St.
Little Falls, N.J. 07425
201/256-7724

NEW MEXICO
dba Electronics Systems, Inc.
6344 Linn Ave. NE
Albuquerque, NM 87108
505/268-1744

NEW YORK
Altair Electronics Service, Inc.
474 Thurston Rd.
Rochester, N.Y. 14619
716/235-1470

Circle Tele-Tronics, Inc.
1008 Utica Ave.
Brooklyn, N.Y. 11203
212/345-5656

NORTH CAROLINA
Speed Instrument Div.
Owen-Barbot, Inc.
Hwy. #401 North, Box 11456
Raleigh, N.C. 27604
919/876-4919

OHIO
Pioneer Cleveland Div.
Pioneer Standard Electronics, Inc.
4800 E. 131st St.
Cleveland, OH 44105
216/587-3600

OKLAHOMA
Stark's Avionics & Comm. Service
1604 NE Woodlands
Ponca City Airport
Ponca City, OK 74601
405/765-8264

OREGON
Westcom
1910 N. Killingsworth St.
Portland, OR 97217
503/285-6629

PENNSYLVANIA
American Instrument Service, Inc.
441-45 N. Fifth St.
Philadelphia, PA 19123
215/923-6760

Dynatronics, Inc.
Route #611
Tannersville, PA 18372
717/629-0050

SOUTH AMERICA
Teleroman CIA LTDA
10 de Agosto 614 y Boyaca
Guayaquil, Ecudator S.A.
513-525 Casilla 3906

SOUTH CAROLINA
Kings's
114 S. Main St.
Bishopville, S.C. 29010
803/484-5482

TENNESSEE
Instrument Repair Service
1374 Overton Park Ave.
Memphis, TN 38104
901/278-0762

TEXAS
Border Electronic Services, Inc.
1704 E. Paisano
P.O. Box 3804
E1 Paso, TX 79923
915/532-2524

Whitlock Instrument
1306 North Texas St.
Odessa, TX 79762
915/337-3412

WASHINGTON
B & F Repair
East 17405 Boone
Greenacres, WA 99016
509/926-9037

Eicher-Richards Co.
2727 NE Blakeley St.
Seattle, WA 98105
206/523-7888

Sutherlands, Inc.
South Annex, Boeing Field
Seattle, WA 98108
206/763-2491

Tomahawk Corp.
6900 220 S.W.
Mountlake Terrace, Wa 98403
206/776-7598

Dynascan Corporation — 6460 W. Cortland — Chicago, Illinois 60635
Printed in U.S.A.

APPENDIX

DETERMINATION OF APPROXIMATE DAMPING RESISTOR

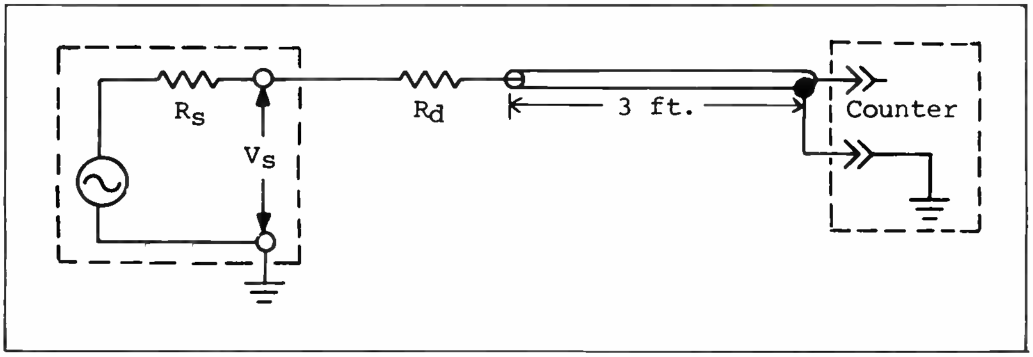


Fig. A-1. Use of damping resistor in frequency measurements.

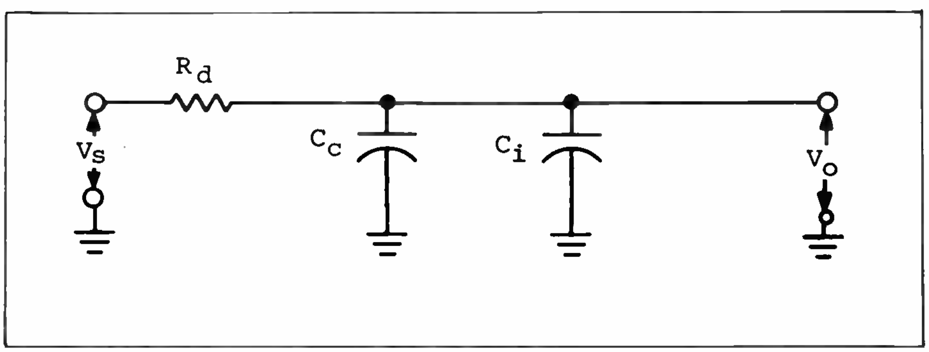


Fig. A-2. Equivalent circuit of counter input.

Because of cable capacitance C_c and the counter's input capacitance C_i a voltage divider is formed after a series damping resistor R_d has been added. The value of R_d is determined by the signal source frequency and amplitude, and because the frequency is usually unknown before the measurement, only an approximate value for R_d can be obtained by guessing the source frequency. In order to maintain a minimum voltage of 30 mV RMS at the divider output, value of R_d can be determined by the following relations:

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

(2) $C = C_i + C_c$

(3) $R_d = \frac{Vs - Vo}{Vo} X_c$

where C_i = 20 pF (typical)

C_c = 87 pF (typical) for RG-58 coaxial cable, which has a capacitance of 28.5–29.5 pF/ft.

V_o = 30mV RMS (counter sensitivity)

f_1 = estimated square wave or pulse train repetition frequency.

When the duty cycle of the pulse signal is low, a lower value of R_d should be chosen.

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the maintenance section of the instruction manual for adjustments that may be applicable.
2. Defective parts removed from units which are within the warranty period should be sent to the factory prepaid with model and serial number of product from which removed and date of product purchase. These parts will be exchanged at no charge.
3. If the above-mentioned procedures do not correct the difficulty, pack the product securely (preferably in original carton or double-packed). A detailed list of troubles encountered must be enclosed as well as your name and address. Forward prepaid (express preferred) to the nearest B & K-Precision authorized service agency.

Contact your local B & K-Precision Distributor for the name and location of your nearest service agency, or write to

Service Department

B & K-Precision Product Group
DYNASCAN CORPORATION
2815 West Irving Park Road
Chicago, Illinois 60618

ONE YEAR LIMITED WARRANTY

DYNASCAN warrants that each product manufactured by it will be free from defects in material and workmanship under conditions of normal use and service for a period of one (1) year from the date of purchase from an authorized DYNASCAN distributor. DYNASCAN will, at its option, repair or replace any product or component not conforming with the foregoing warranty and which is returned, transportation prepaid, to our factory or our authorized service contractor. *DYNASCAN shall not otherwise be liable for any damages, consequential or otherwise.* DYNASCAN makes no other express warranties. *Any implied warranties (including any warranty of merchantability) are limited in duration to (1) one year from the date of purchase.* This warranty does not apply to (i) damage resulting from unauthorized alterations and repairs, misuse, negligency or accident; or (ii) damage resulting from improper installation, connection or adjustment otherwise than in accordance with DYNASCAN's authorized Instruction Manual. This warranty is void if the serial number has been altered, defaced or removed. DYNASCAN reserves the right to discontinue any model at any time or change specifications or design without notice and without incurring any obligation. To register this warranty, the enclosed DYNASCAN warranty registration card should be completed and mailed to DYNASCAN CORP., 6460 W. Cortland Street, Chicago, Illinois 60635, within ten (10) days after date of purchase.

B+K PRECISION

DIVISION OF DYNASCAN CORPORATION

6460 W. Cortland Street

Chicago, Illinois 60635

480-161-9-001C