FREQUENCY COUNTER MODELS

8007-S / 8010-S / 8013-S

OWNERS MANUAL

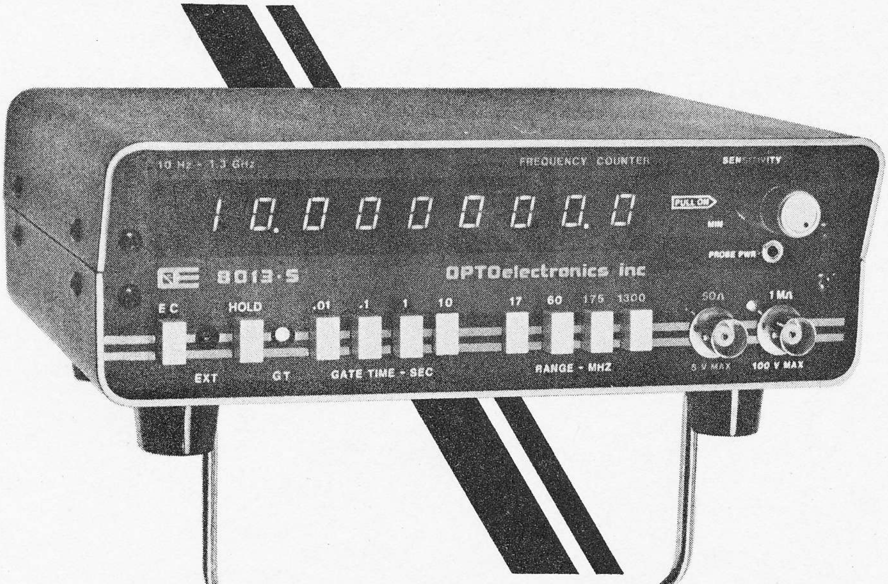

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TABLE OF CONTENTS

GENERAL DESCRIPTION

The 8007-S, 8010-S and 8013-S series frequency counters are high performance general purpose instruments capable of measuring frequencies from 10 Hz to 700 MHz, 1000 MHz and 1300 MHz respectively. 80XX-S series counters employ state of the art instrument design. Modular construction and use of large scale integrated circuits and thin film hybrid circuitry provide maximum reliability and minimum maintenance. Low power consumption and the use of a remote plug transformer ensure relatively cool counter operating temperatures. The rugged aluminum cabinet provides RF shielding and minimizes RFI. Compact size, 13.5 V DC operation and an optional internal Ni-Cad battery pack make the 80XX-S series counters ideally suited for portable as well as bench use. Nine LED digits provide a highly visible display with automatic lead zero supression and automatic decimal point positioning at the "MHz" and "Hz" positions.

The standard time base is a precision 10 MHz TCXO (temperature compensated crystal oscillator) which features low drift, low power consumption and almost instant warm-up time. The standard TCXO has temperature stability to better than ± 1 ppm from 20° to 40° C.

The TCXO-80 option offers a temperature stability of ± .1 ppm from 20° to 40° C with the same low power consumption and rapid warm-up as the standard TCXO. The TCXO-80 provides an order of magnitude increase in stability without sacrificing power consumption (battery life) or warm-up time.

For better temperature stability over a wider temperature range a ± .05 ppm oven controlled crystal oscillator (OCXO) is available. The OCXO is a compact low power design featuring proportional temperature regulation. The OCXO temperature stability is better than ± .05 ppm from 10° to 45° C.

Both TCXOs and the OCXO feature state of the art design and are of metal shielded, sealed modular construction. 10 turn frequency adjust trimmers are accessible from the instrument's rear panel for precise calibration.

The 80XX-S series counters are supported by a broad range of accessories such as probes, carrying case, antenna, and a broadband pre-amp to further enhance their usefulness.

SPECIFICATIONS

FREQUENCY RANGE

	8007-S	8010-S	8013-S
Overall:	10 Hz to 700 MHz	10 Hz to 1000 MHz	10 Hz to 1300 MHz
1 Megohm Input			
Range I:	10 Hz to 17 MHz	10 Hz to 17 MHz	10 Hz to 17 MHz
Range II:	1 MHz to 60 MHz	1 MHz to 60 MHz	1 MHz to 60 MHz
50 Ohm Input			
Range III:	10 MHz to 175 MHz	50 MHz to 175 MHz	50 MHz to 175 MHz
Range IV:	10 MHz to 700 MHz	50 MHz to 1000 MHz	50 MHz to 1300 MHz

INPUT CHARACTERISTICS

1 MEGOHM INPUT
Coupling: AC
Impedance: 1 Megohm & 20 pF
Max. Input Signal: 100 V rms
Connector Type: BNC

50 OHM INPUT
Coupling: AC
Impedance: 50 Ohm (Nominal)
Max. Input Signal: 5 V rms
Connector Type: BNC

GATE TIMES

.01 second
.1 second
1 second
10 second

AVERAGE SENSITIVITY

Below 500 MHz 10 mV rms (-27 dBM)
Above 500 MHz 20 mV rms (-21 dBM)
Above 1000 MHz 50 mv rms (-13 dBM)

RESOLUTION
(Max. at 10 sec. gate)

Range I:	.1 Hz to 17 MHz
Range II:	1 Hz to 60 MHz
Range III	1 Hz to 175 MHz
Range IV	10 Hz to 700/1000/1300 MHz

ACCURACY: ± 1 count + time base error

STANDARD TIME BASE
10 MHz TCXO (Temperature Compensated Xtal Oscillator)
±1 ppm 20° - 40° C (68° - 104° F) at Temp. equilibrium
Less than ± 0.1 ppm/month aging

OPTIONAL TIME BASE, # TCXO-80
10 MHz TCXO
± 0.1 ppm 20° - 40° C (68° - 104° F) at Temp. equilibrium
Less than ±0.1 ppm/month aging

OPTIONAL TIME BASE, #OCXO-80
10 MHz OCXO (Oven Controlled Xtal Oscillator)
±0.05 ppm 10° - 45° C (50° - 113° F) after warm-up.
Less than ±0.1 ppm/month aging typ.
Proportional oven control circuitry.

DISPLAY

9 Red LED Digits. Auto Zero blanking above decimal point. Decimal point will indicate at Hz and MHz positions.

ENVIRONMENTAL TEMPERATURE

Operational: 0° to 45° C (32° to 113° F)
Storage: -5° to 65° C (23° to 149° F)

POWER REQUIREMENTS

Voltage: 12 V AC or 13.5 V DC ±10%
Current: 700 mA typ.

115 V AC adaptor supplied standard.
Cord with mating plug supplied for optional power source.
Optional internal Ni-Cad Battery Pack available (#Ni-Cad-86)
Check with Factory or your Distributor for 220-250 V AC 50 Hz operation.

CABINET

3-1/4" H x 7-1/4" W x 6-3/4" D (83 mm H x 184 mm W x 172 mm D) Black aluminum with tilt bail.

WEIGHT

2 lbs./.91 kg.
2.75 lbs./1.25 kg. with Ni-Cad Battery Pack.

EXTERNAL CLOCK INPUT/INTERNAL CLOCK OUTPUT

Input/Output frequency: 10 MHz
Input/Output signal: TTL compatable

Ni-Cad BATTERY PACK (OPTION #Ni-Cad-86)

Charging: Automatic charging when power is connected to rear panel. Counter automatically switches to internal battery when external power is interrupted. Charging current is regulated. Maximum charging time from completely discharged state: 14 hours.

PROBE PWR OUTPUT JACK

Accessory power outlet supplying 10V DC at 60 M.A. (will power preamp #AP-8015-A) receives standard 2.5 MM plug.

CONTROLS, CONNECTORS AND INDICATORS

FRONT PANEL

EC

Activates external clock input on rear panel. LED indicator lights when button is depressed. Counter will not operate unless a 10 MHz signal is connected to the external clock input when the EC button is depressed.

NOTE: A misoperation will occur if NO external clock signal is coupled to rear panel input and the "EC" button is depressed. A single digit or no digit display may result.

GT

LED indicator lights during the gate or sample period and is not lighted between gate periods. a 1 second gate will cause the light to be on for 1 second and off for .2 second.

GATE TIME/SEC.

The four gate time select buttons are interlocked so that when one is depressed the others return to the out position.

.01 — Selects .01 second gate period.

.1 — Selects .1 second gate period.

1 — Selects 1 second gate period.

10 — Selects 10 second gate period.

RANGE-MHz

17 — Signals between 10 Hz and 17 MHz connected to the 1 Megohm input may be counted.

60 — Signals between 1 MHz and 60 MHz connected to the 1 Megohm input may be counted.

175 — Signals between 50 MHz and 175 MHz connected to the 50 Ohm input may be counted.

700, 1000, 1300 — Signals between 50 MHz and 700 MHz (1000 MHz or 1300 MHz) connected to the 50 Ohm input may be counted.

HOLD

When depressed the current display information is held until the button is released.

1 MEGOHM INPUT

BNC input connector for signals between 10 Hz and 60 MHz. This input is active only when the 17 MHz or 60 MHz range switch is depressed and the associated LED indicator is illuminated.

50 OHM INPUT

BNC connector for signals between 50 MHz and 700 MHz, 1000 MHz or 1300 MHz. This input is active only when the 175 or 700/1000/1300 MHz range switch is depressed and the associated indicator LED is illuminated.

SENSITIVITY

Control adjusts sensitivity for both inputs. Maximum sensitivity is full clockwise and minimum sensitivity is full counterclockwise. Normally set to maximum.

PULL ON

Pull knob out to power on counter. Push knob in to remove power.

PROBE PWR

Accessory probe power jack for use with active probes such as the model AP-8015-A Preamp.

OVEN LIGHT

When # OCXO-80 option is installed, the decimal point to right of least significant digit lights during oven warm-up or when ever OCXO is below operating temperature. Frequency measurements made while oven light is illuminated may be inaccurate because the OCXO is not up to temperature.

REAR PANEL

POWER

The power input jack mates with the hollow pin plug from the wall plug transformer supplied. 12 V AC or 13.5 V DC may also be used to power the counter. An accessory power cable with mating plug is included with the counter for alternate power sources. Because the 8007-S, 8010-S and 8013-S have full wave bridge input circuitry, polarity need not be observed. Maximum current consumption should be less than 1 Amp.

10 MHz CLOCK

BNC connector has 10 MHz timebase output frequency when the front panel "EC" button is in the out position. When the "EC" button is depressed a 10 MHz TTL compatable signal must be connected to the BNC connector for the counter to operate.

OSCILLATOR ADJUST

Access hole in rear panel for TCXO/OCXO Oscillator adjustment.

Ni-Cad BATTERY OPERATION

The Ni-Cad battery pack supplied with the #Ni-Cad-86 battery option is a high quality commercial grade and should provide years of trouble free service without maintenance. The #Ni-Cad-86 option fits completely within the counter and is easily field installable using a #1 phillips screw driver. This option consists of a pre-assembled Ni-Cad battery pack (containing 12 AA cells) that installs in the bottom of the instrument and a PC board containing a relay and charging circuitry that plugs into the main counter PC board.

The battery pack is charged automatically whenever power from the AC adaptor or from a 13.5 V DC source is connected via the power input jack, with instrument operating or off. If external power is interrupted, the battery pack is automatically switched in line to power the counter.

The Ni-Cad pack is charged by a constant current charging circuit at a level that is safe for continuous battery charging. After repetative periods of charging and discharging to a nearly identical depth of charge, an apparent loss of capacity may result. This condition is characteristic of Ni-Cads (sometimes called "memory effect") and full capacity can be restored by deep cycling. Deep cycling is accomplished by completely discharging and then recharging the batteries several times.

The length of time a counter will operate from a fully charged Ni-Cad battery pack depends upon the exact model (8007-S,, 8010-S, 8013-S), the time base (OCXO or TCXO), the range selected, and the number of display segments illuminated, etc. An 8007-S with TCXO installed will operated for over two hours reading a 14 MHz signal. An 8013-S with OCXO-80 time base will read 1300 MHz for approximately 45 minutes with one warm-up cycle at room temperature. The discharge cycle times reported here are approximate and are intended only as a guide for using 80XX-S series counters under battery power.

OVEN TIME BASE OPERATION - OCXO-80 OPTION

The OCXO-80 is an oven controlled crystal oscillator which features low power consumption, proportional temperature control circuitry and rapid warm-up. The crystal oscillator circuit is enclosed in an oven with temperature precisely maintained over a wide ambient range (10° to 45° C). The proportional control circuitry compares the oven temperature sensor voltage to a preset reference and supplies the precise amount of heater current necessary to maintain the oven temperature. During warm-up, the maximum heater current is applied until the preset oven temperature is reached. When up to temperature the heater current is reduced to a level which exactly balances the heat loss out of the oven. During warm-up the LED decimal point to the right of the least significant digit in the display is illuminated. After the oven reaches temperature the LED will be extinguished. The LED is used to indicate that the oven is operating, that it is not yet up to temperature, and frequency measurements taken while the LED is illuminated may have excessive error. The oven oscillator may not reach maximum stability until several minutes after the operating temperature is reached. Actual oven warm-up times will vary from less than 5 minutes at room temperature to about 10 minutes at 10° C.

For bench use the 80XX-S counter may be left powered up continuously for best oscillator stability and to allow precision frequency measurements without waiting for oven warm-up. For battery operation, whenever possible the counter can be operated from the AC adaptor or 13.5 V DC during warm-up to maximize battery discharge time. Because oven current consumption is proportional to ambient temperature, battery discharge cycle time will be reduced in cold temperatures.

CALCULATING FREQUENCY MEASUREMENT ERROR

Frequency measurement accuracy is specified as ±1 count plus time base error. The 1 count uncertainty is due to frequency counter time base not being synchronized with the signal being counted. The ±1 count uncertainty is referred to as a **quantization error** and is inherent in digital counters. When measuring 1 KHz the quantization error allows the following uncertainty:

1001 Hz
1000 Hz (17 MHz range, 1 sec gate)
999 Hz

Thus at 1 KHz the ±1 count equates to ±.1% error. At 100 MHz this error will be ±10 Hz (175 MHz range, 1 second gate) or ±.00001%. As the frequency increases the quantization error becomes less significant. The ±1 count error is minimized by using the longest possible gate time.

The time base error is the combination of **aging** of and **temperature change** on the OCXO or TCXO. The aging rate of both TCXOs and the OCXO is specified as ±.1 ppm/month. A recently calibrated counter time base error would be due to temperature effects. Time base error is proportional to the frequency being counted. The higher the frequency of the input signal the greater the contribution of the time base error. To determine the magnitude of the time base error, use the following formula:

± Time base error in parts per million x Frequency being counted in MHz = ± Error in Hz.

Maximum measurement error of a 150 MHz frequency indicated on a recently calibrated counter with a **Standard TCXO** time base (175 MHz range, 1 second gate, and standard time base) should be:

± (1 x 150 + 10) = **±160 Hz**

With the **#TCXO-80** optional TCXO time base installed, maximum measurement error should be:

± (.1 x 150 + 10) = **± 25 Hz**

With the **#OCXO-80** optional proportional oven time base installed, maximum measurement error should be:

± (.05 x 150 + 10) = **±17.5 Hz**

Temperature compensated crystal oscillators (TCXOs) and oven controlled crystal oscillators (OCXOs) are used in the counters. The temperature stability, given in the specifications, assumes the counter and oscillator have reached thermal equilibrium with the ambient temperature. The oscillator components require a finite amount of time to change temperature, which depends upon the magnitude and speed of the change in ambient temperature. Oscillator error larger than the specified temperature stability may occur during rapid temperature transitions. For maximum accuracy, allow the counter to come to thermal equilibrium with its environment.

TABLE 1
COUNTER ACCESSORY APPLICATIONS

COUNTER INPUTS AND RANGES

ACCESSORIES	1 MEGOHM INPUT	50 OHM INPUT	17 MHZ RANGE	60 MHZ RANGE	175 MHZ RANGE	700/1000/1300 MHZ RANGE
P-100 DC PROBE	●	●	●	●	●	●
P-101 LOW-PASS PROBE	●	X	●	X	X	X
P-102 HI-Z PROBE	●	X	●	●	X	X
BNC-PC PATCH CABLE	●	●	●	●	●	●
TA-100 ANTENNA	O	●	X	O	●	●
AP-8015 PREAMP	●	●	●	●	●	●
LFM: 1110 LOW FREQ. MULTIPLIER	●	X	●	O	X	X

Recommended for use: ●
Reduced Performance: O
Misapplication: X

FREQUENCY COUNTING TECHNIQUES

Frequency counters perform well when measuring pure and stable sine wave outputs from signal generators. In many instances, however, there is a requirement to measure the frequency of more complex electrical signals. In general, a signal may have an irregular, nonsymmetrical wave form and contain noise or harmonics. Difficulty occurs because the counter triggers whenever the input signal transits the hysteresis band without regard to noise or harmonics.

Incorrect counter triggering is one of the most common difficulties encountered when using a frequency counter, however, in most instances, it is easily remedied by using proper signal coupling technique.

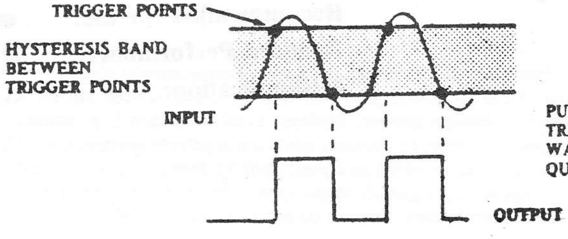
Misapplication errors can occur when an attempt is made to use the counter outside its frequency range or when attemping to count signals either too large or too weak in amplitude. Signals slightly below the input sensitivity threshold or otherwise deficient in some way may cause the counter display to become extremely erratic. In some instances a stable yet incorrect reading can result from attempting to measure a frequency within the counters overall frequency range but outside the range of the input amplifier or counter range selected. Counter probes and accessories may be limited to specific ranges and input amplifiers. Check Table 1 for specific application information on probes and accessories.

There are some signals which may not be directly countable due to the fact they are not continuous or because of the type of modulation employed. Some types of not directly countable signals include single sideband or suppressed carrier RF emissions and digital or pulse width modulated signals used in some radio controlled or remote control applications. In general, if a piece of equipment requires a frequency measurement, contact the manufacturer or refer to the service manual for recommended procedure.

SIGNAL COUPLING CONSIDERDATIONS TO AVOID TRIGGERING ERRORS

Fig. A shows the correct operation of a frequency counter's Schmitt Trigger Circuit. After amplification the signal is applied to the tigger input and whenever the signal crosses the predetermined trigger levels the output changes state from low to high or from high to low very quickly. The trigger's output square wave is at the proper logic levels to be counted.

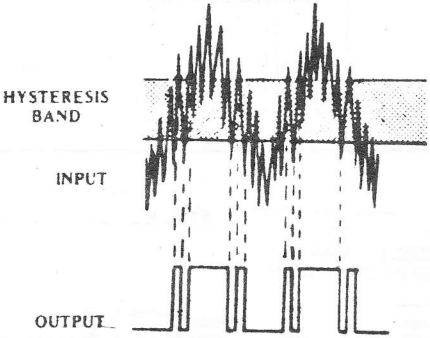
FIG. A



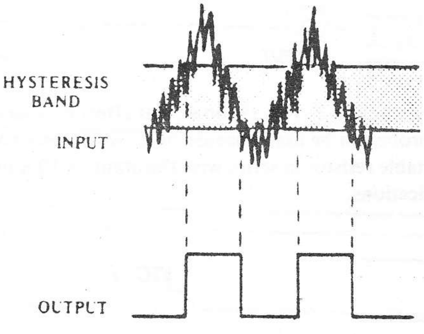
PURE SINE WAVE INPUT CROSSES TRIGGER LEVELS, GIVING SQUARE WAVE OUTPUT OF CORRECT FREQUENCY.

Fig. B shows the false triggering that occurs when a noisy input signal is counted. The false triggering is caused when noise spikes transit the hysteresis band. When the signal is attenuated, (Fig. C) the noise spikes become smaller in relationship to the hysteresis band. A 10X oscilloscipe probe is useful for attenuation and has the added advantage of reducing the circuit loading. A 10 megohm pot in series with the counter's high impedance input will allow continuously variable attenuation from 1X to 100X.

FIG. B



NOISY SIGNAL CROSSES HYSTERESIS BAND SEVERAL TIMES DURING PERIOD, CAUSING FALSE TRIGGERING, GIVING INCORRECT SQUARE WAVE FREQUENCY OUTPUT.



ATTENUATION OF NOISY SIGNAL REDUCES SIZE OF NOISE COMPARED TO HYSTERESIS BAND CORRECT TRIGGERING NOW OCCURES, GIVING SQUARE WAVE OUTPUT OF CORRECT FREQUENCY.

Harmonic distortion in the signal in Fig. D causes double counting. Increased signal amplitude prevents the double counting as shown in Fig. C.

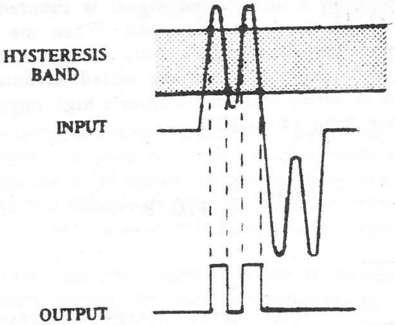


FIG. D

FIRST HARMONIC CONTENT CAUSES DOUBLE COUNTING.

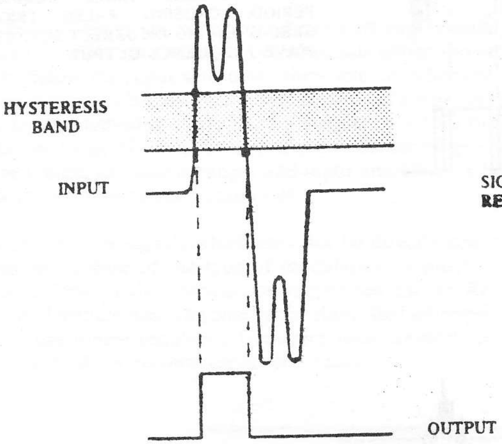


FIG. E

SIGNAL AMPLITUDE INCREASED TO REMOVE DOUBLE COUNTING.

Ringing can cause false triggering as shown in Fig. F. Fig. G shows that effect of a series damping resistor. The HI-Z frequency counter probe can be used because of its series resistance or the DC (50 OHM) probe can be used with a suitable resistor in series with the input. A 10 K ohm series damping resistor works well in many applications.

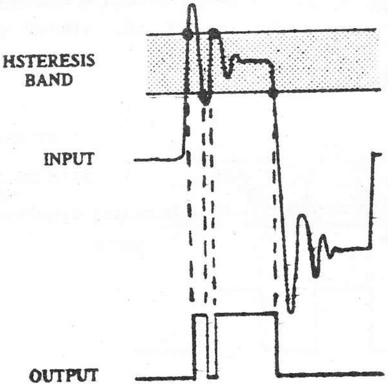


FIG. F

"RINGING" CAUSES FALSE TRIGGERING.

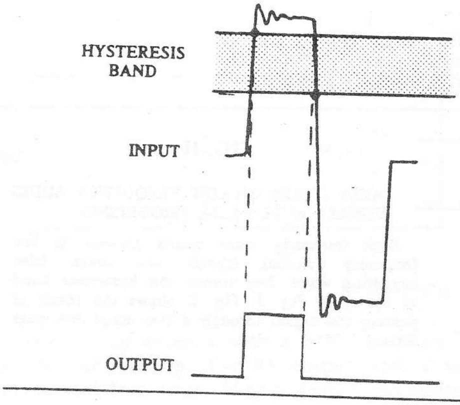
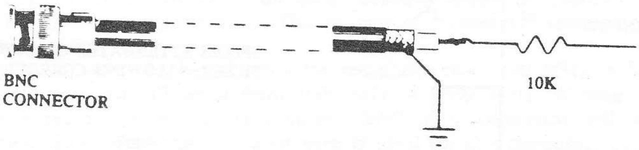


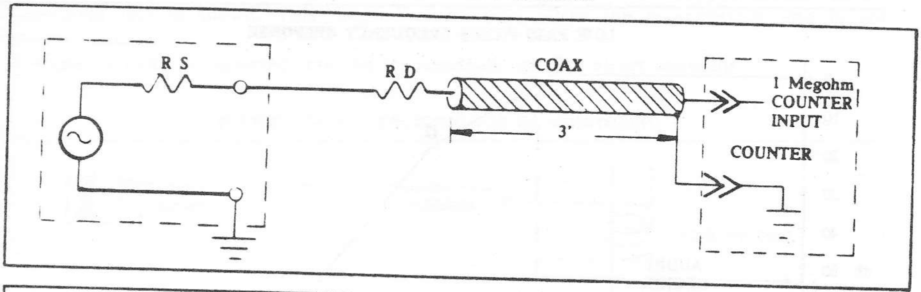
FIG. G

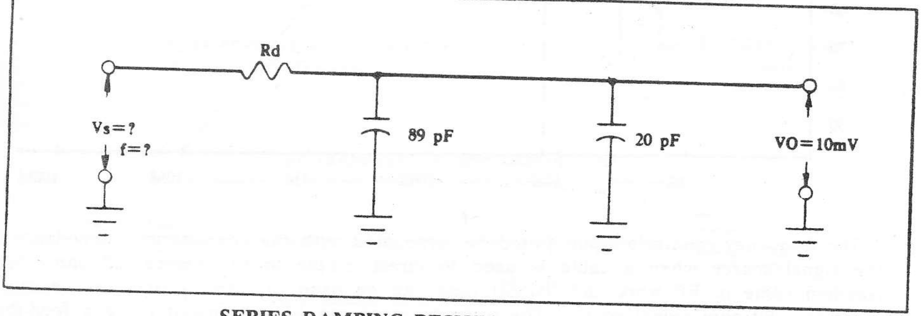
USE OF SERIES DAMPING RESISTOR REDUCES RINGING.

BASIC COUNTER PROBE WITH SERIES DAMPING RESISTOR



USE OF SERIES DAMPING RESISTOR





SERIES DAMPING RESISTOR CALCULATIONS

A voltage divider is formed by Rd and the parallel combination of the coax capacitance and the counters input capacitance. To maintain 10 mV at the counters input, the maximum value for Rd can be computed as follows:

$$R_d = \frac{V_s - V_o}{V_o} \; X_{c\;coax} + C_{Input}$$

$$\text{Where } X_{c\;coax} + C_{Input} = \frac{1}{2\pi f \cdot 8.9 \times 10^{-11}} + \frac{1}{2\pi f \cdot 2 \times 10^{-11}}$$

An estimation will have to be made for the values of f and Vs.

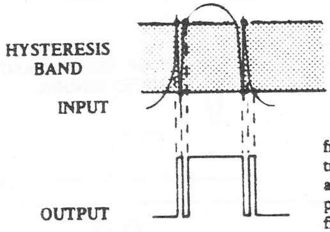


FIG. H

NOISE SPIKES ON LOW FREQUENCY AUDIO SIGNAL CAUSE FALSE TRIGGERING.

High frequency noise spikes present in low frequency (Audio) signals can cause false triggering when they transit the hysteresis band as hsown in Fig. J. Fig. K shows the result of passing the signal through a two stage low pass filter.

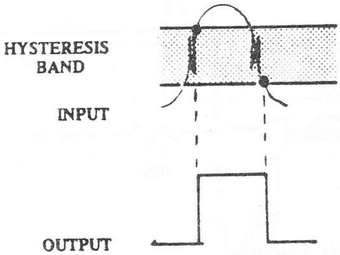
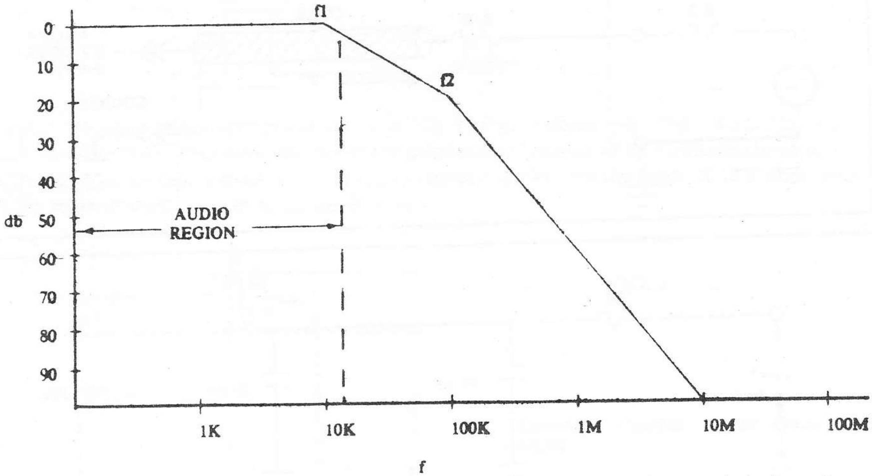


FIG. I

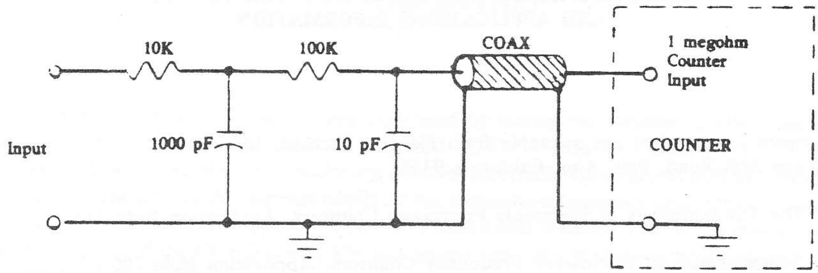
SPIKES ATTENUATED BY LOW PASS FILTER, ALLOWING CORRECT TRIGGERING.

LOW PASS FILTER FREQUENCY RESPONSE



The frequency counter's input should be terminated with the characteristic impedance of the signal source when a cable is used to direct couple to the source. 50 ohms is a common value in RF work and RG58U coax can be used to direct couple the counter's input to a 50 ohm signal source. The counters input can be terminated using a feed-thru terminator such as the Heath SU511500 or Hewlett Packard 10100C. A 51 ohm carbon resistor can also be placed across the input for a 50 ohm termination at low frequencies. Proper termination prevents ringing or oscillation due to impedance miss match.

LOW PASS PROBE SCHEMATIC



RF PICK UP

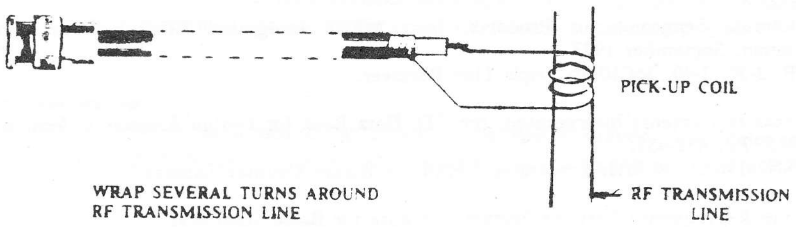
A telescoping antenna with a BNC connector can be mounted directly on the counter's input for RF pick-up. The RF output from a small (.1 watt) transmitter can be counted from several feet away. Higher power transmitters can, of course, be counted from much greater distances. For weak signals the antenna's length can be adjusted for reasonance (quarter wave length) at the particular frequency. It can be observed that signal minimums occur at regular distance intervals (distance depends upon frequency) between the counter's and the transmitter's antennas. The counter or transmitter should be moved until the most stable counting is observed.

The telescoping antenna can be adjusted for resonance from 140 MHz to 500 MHz and can be used with reduced efficiency from 100 MHz to 1300 MHz. A long wire antenna inserted into the center contact of the counter's BNC input connector will work well for lower frequencies. Small diameter insulated wire is ideal for this purpose.

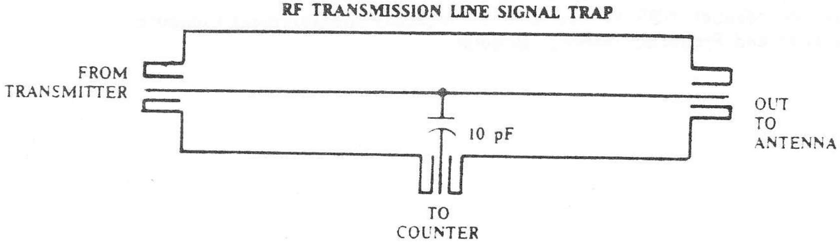
An inductive pick-up consisting of several turns of hook-up wire wrapped around an RF transmission line is shown. This method works best when the transmission line is not perfectly matched.

A signal tap can be inserted into the transmission line for direct coupling.

POSSIBLE SIGNAL COUPLING FOR RF MONITORING



RF TRANSMISSION LINE SIGNAL TRAP



BIBLIOGRAPHY OF FREQUENCY COUNTER THEORY AND APPLICATIONS INFORMATION

The following phamplets are available from Hewlett Packard, Inc.
1501 Page Mill Road, Palo Alto, California 94304

"The Fundamentals of Electronic Frequency Counters, Application Note 172"

"Fundamentals of Microwave Frequency Counters. Application Note 200-1"

Straight Talk on Frequency Counters in Communications Applications"

Coombs, Clyde Ed., Basic Electronic Instrument Handbook, McGraw Hill, 1972.

Stein, Robert, S., "Understanding and Using Frequency Counters"
Ham Radio Magazine, February, 1978.

Meyers, Lee, "Understanding Preclsion Crystal Timebases", Electronics August 17, 1978.

Van der Winat, Jan. and Ericson, Jan. "Making Accurate Measurements with Counters and Timers."
Electronics, March 30, 1978.

The following is available from: Intersil Inc.,
10710 N. Tantau Ave., Cupertino, Ca. 95014
"Intersil Data Book", July 1979 PP. 6-56 through 6-71

The following data sheet is available from: Fairchild Semiconductor Components Group.
Fairchild Camera & Instrument Corp.,
464 Ellis Street, Mountain View, Ca. 94042

Motorola Semiconductor Products, Inc., MECL Integrated Circuits Data Book, Third Edition, September 1973.
PP. 3-30, 3-40, MC10116 Triple Line Receiver.

Texas Instruments Incorporated, the TTL Data Book for Design Engineers, First Edition. 1973, PP. 451-455,
"SN74196 50/30-MHz Presetable Decade or Binary Counter/Latches".

Time & Frequency Services Section, Institute for Basic Standards,
National Bureau of Standards, Boulder Colorado 80302

New Frequency Calibration Service
Instruction Manual: NBS TV System 358 Frequency Measurement Computer
NBS Time and Frequency Services Bulletin

CALIBRATION

Series 80XX-S frequency counters are calibrated by setting the counter timebase oscillator to precisely 10 MHz. On models with the standard TCXO or with the optional TCXO-80, this requires the adjustment of a single multiturn trimmer accessable via an access hole in the instrument rear panel. The OCXO-80 timebase oscillator has a multiturn frequency adjust trimmer accessable through the instrument rear panel and may also have a coarse adjust trimmer accessable through a hole in the top of the OCXO cover. The instrument top cover must be removed to gain access to the OCXO coarse adjustment.

1. WWV "zero beat"

Tune in the highest frequency transmission of station WWV which can be received on a HF communications receiver (2.5, 5, 10, 15, 20 MHz). Place one end of a piece of hook-up wire in the center of the external clock BNC connector and the other end on the receiver antenna or antenna lead in. The exact positioning of the wire and antenna may have to be changed several times until a beat can be heard through the receiver's speaker. Adjust the counter timebase frequency adjust trimmer until a zero beat is obtained.

2. Calibration with a known frequency.

Allow the counter to count an accurately known signal (from a frequency standard or other source) and using the 10 sec. gate and appropriate range to obtain maximum resolution, adjust the trimmer until the correct frequency is displayed.

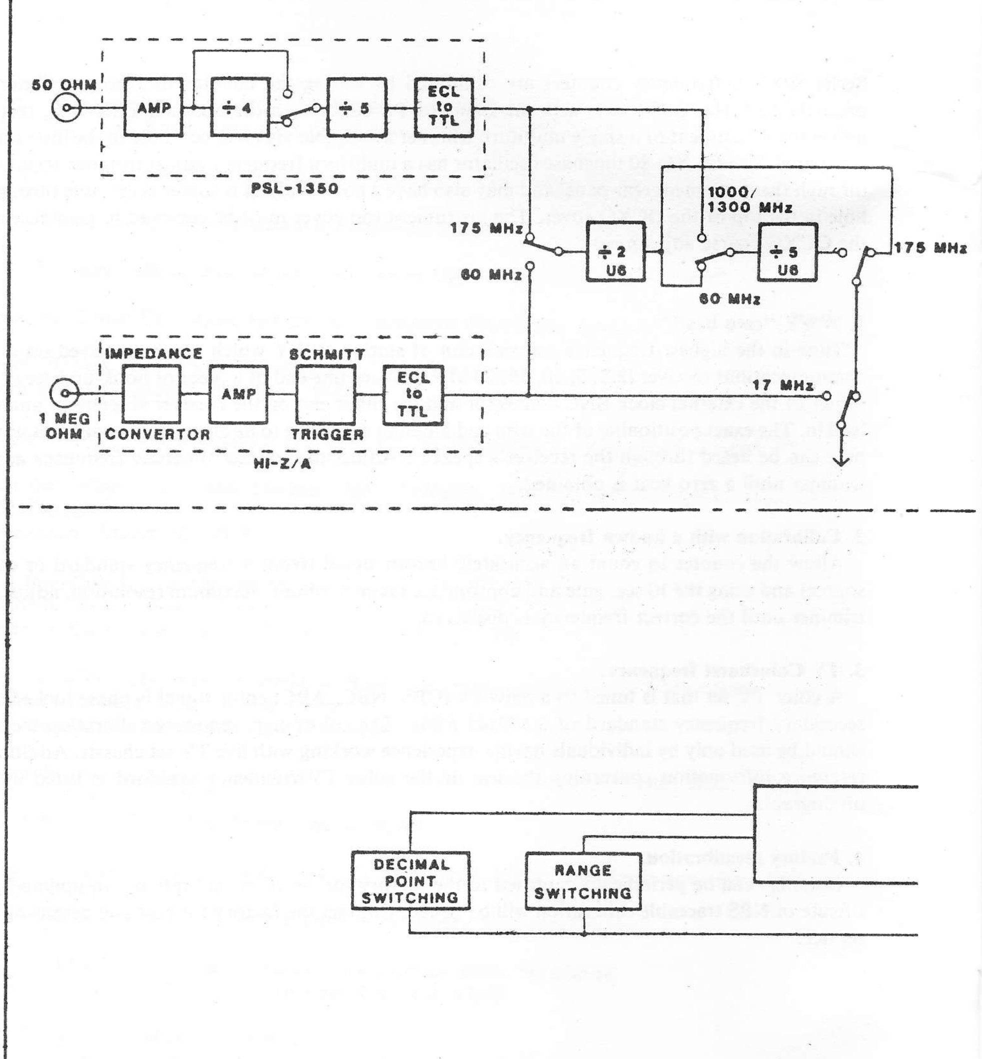
3. TV Colorburst frequency.

A color TV set that is tuned to a network (CBS, NBC, ABC) color signal is phase locked to a secondary frequency standard of 3.579545 MHz. The colorburst frequency calibration method should be used only by individuals having experience working with live TV set chassis. Additional reference information concerning the use of the color TV frequency standard is listed in the bibliography.

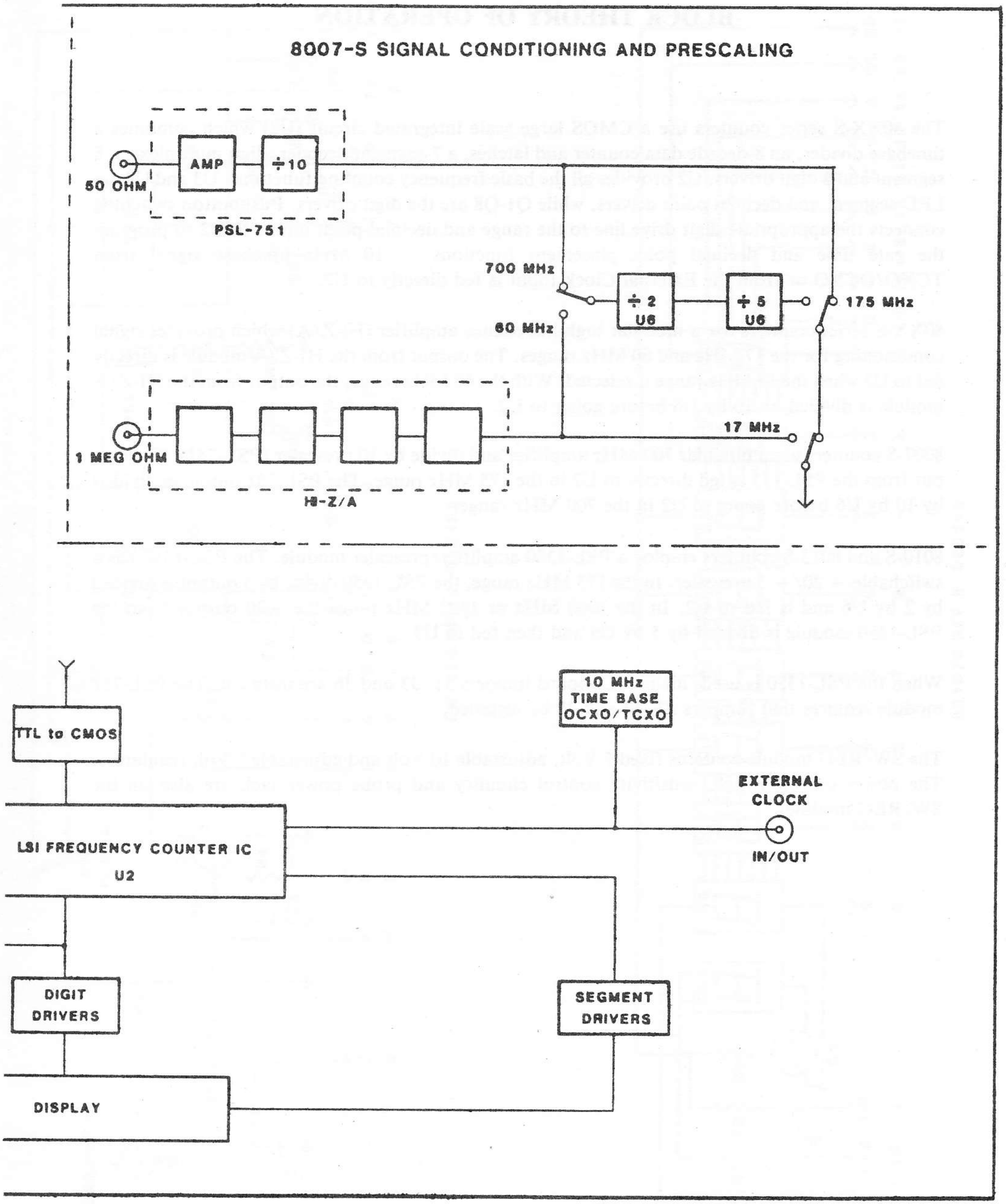
4. Factory recalibration.

Counters can be periodically returned to the factory for certified calibration. An updated certificate of NBS traceable calibration will be issued. Contact the factory for cost and details of this service.

8010-S/8013-S SIGNAL CONDITIONING AND PRESCALING



80XX-S SERIES FREQUENCY COUNTER
BLOCK DIAGRAM
060183


8007-S SIGNAL CONDITIONING AND PRESCALING
AMP
÷10
50 OHM
PSL-751
700 MHz
60 MHz
÷2
U6
÷5
U6
175 MHz
1 MEG OHM
HI-Z/A
17 MHz
TTL to CMOS
10 MHz
TIME BASE
OCXO/TCXO
EXTERNAL
CLOCK
IN/OUT
LSI FREQUENCY COUNTER IC
U2
DIGIT
DRIVERS
SEGMENT
DRIVERS
DISPLAY

BLOCK THEORY OF OPERATION

The 80XX-S series counters use a CMOS large scale integrated circuit (U2) which combines a timebase divider, an 8-decade data counter and latches, a 7-segment decoder, digit multiplexers, 8 segment and 8 digit drivers. U2 provides all the basic frequency counting functions. U3 and U4 are LED segment and decimal point drivers, while Q1-Q8 are the digit drivers. Pushbutton switching connects the appropriate digit drive line to the range and decimal point inputs to U2 to program the gate time and decimal point placement functions. A 10 MHz timebase signal from TCXO/OCXO or from the External Clock Input is fed directly to U2.

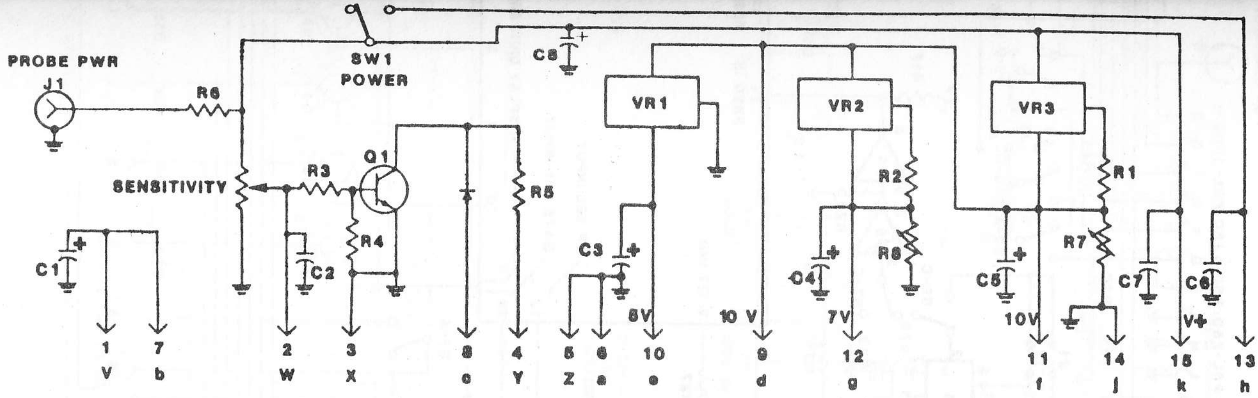
80XX-S series counters use a modular high impedance amplifier (Hi-Z/A) which provides signal conditioning for the 17 MHz and 60 MHz ranges. The output from the HI-Z/A module is directly fed to U2 when the 17 MHz range is selected. With the 60 MHz range, the output from the HI-Z/A module is divided by 10 by U6 before going to U2.

8007-S counters use a modular 700 MHz amplifier and divide by 10 prescaler (PSL-751). The output from the PSL-751 is fed directly to U2 in the 175 MHz range. The PSL-751 output is divided by 10 by U6 before going to U2 in the 700 MHz range.

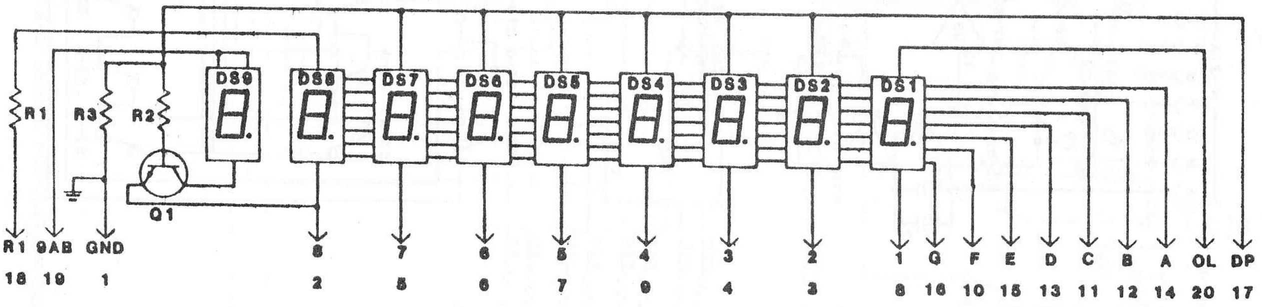
8010-S and 8013-S counters employ a PSL-1350 amplifier/prescaler module. The PSL-1350 has a switchable ÷ 20/ ÷ 5 prescaler. In the 175 MHz range, the PSL-1350 divide by 5 output is divided by 2 by U6 and is fed to U2. In the 1000 MHz or 1300 MHz range the ÷20 output from the PSL-1350 module is divided by 5 by U6 and then fed to U3.

When the PSL-1350 is used, main P.C. board jumpers J1, J3 and J6 are installed. The PSL-751 module requires that jumpers J2, J4 and J5 be installed.

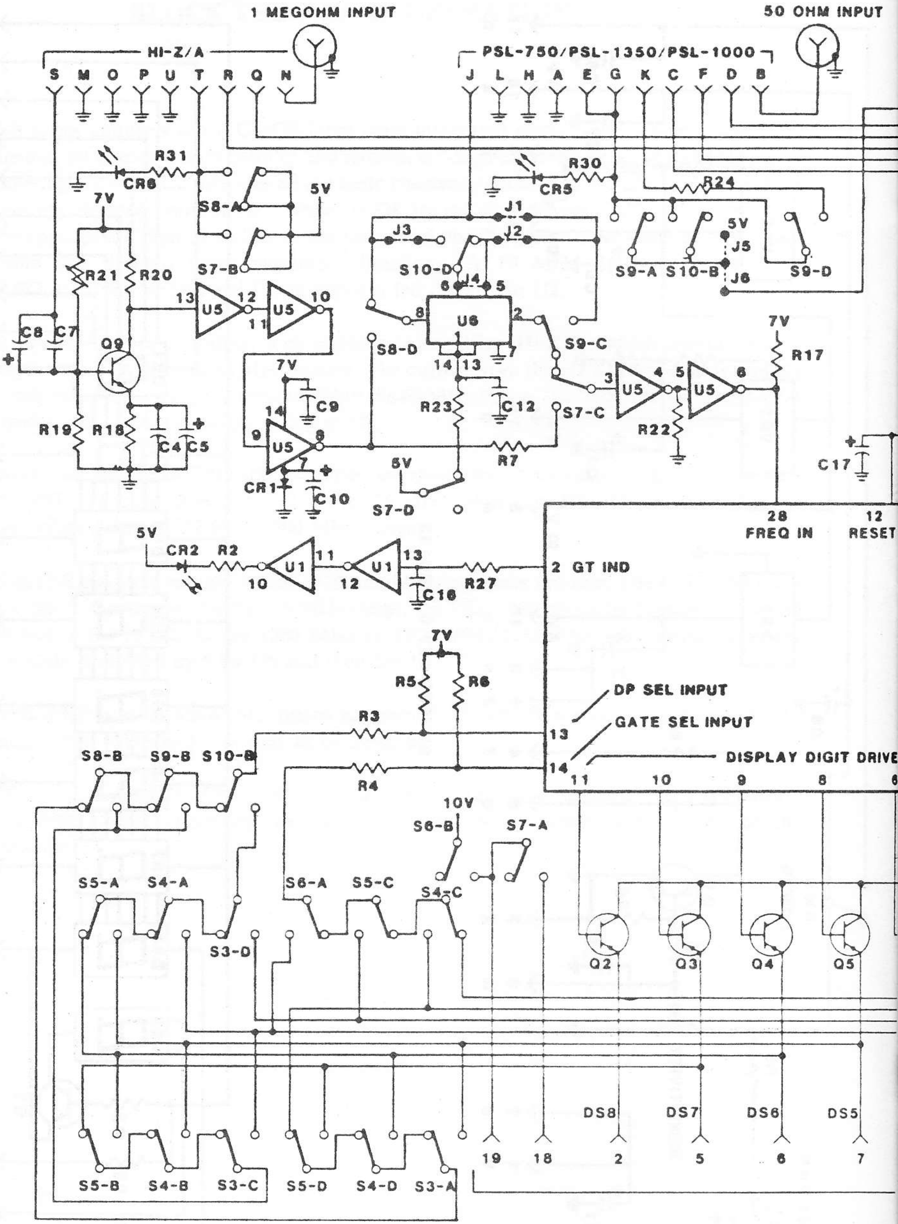
The SW/REG module contains fixed 5 Volt, adjustable 10 Volt and adjustable 7 Volt regulators. The power off/on switch, sensitivity control circuitry and probe power jack are also on the SW/REG module.



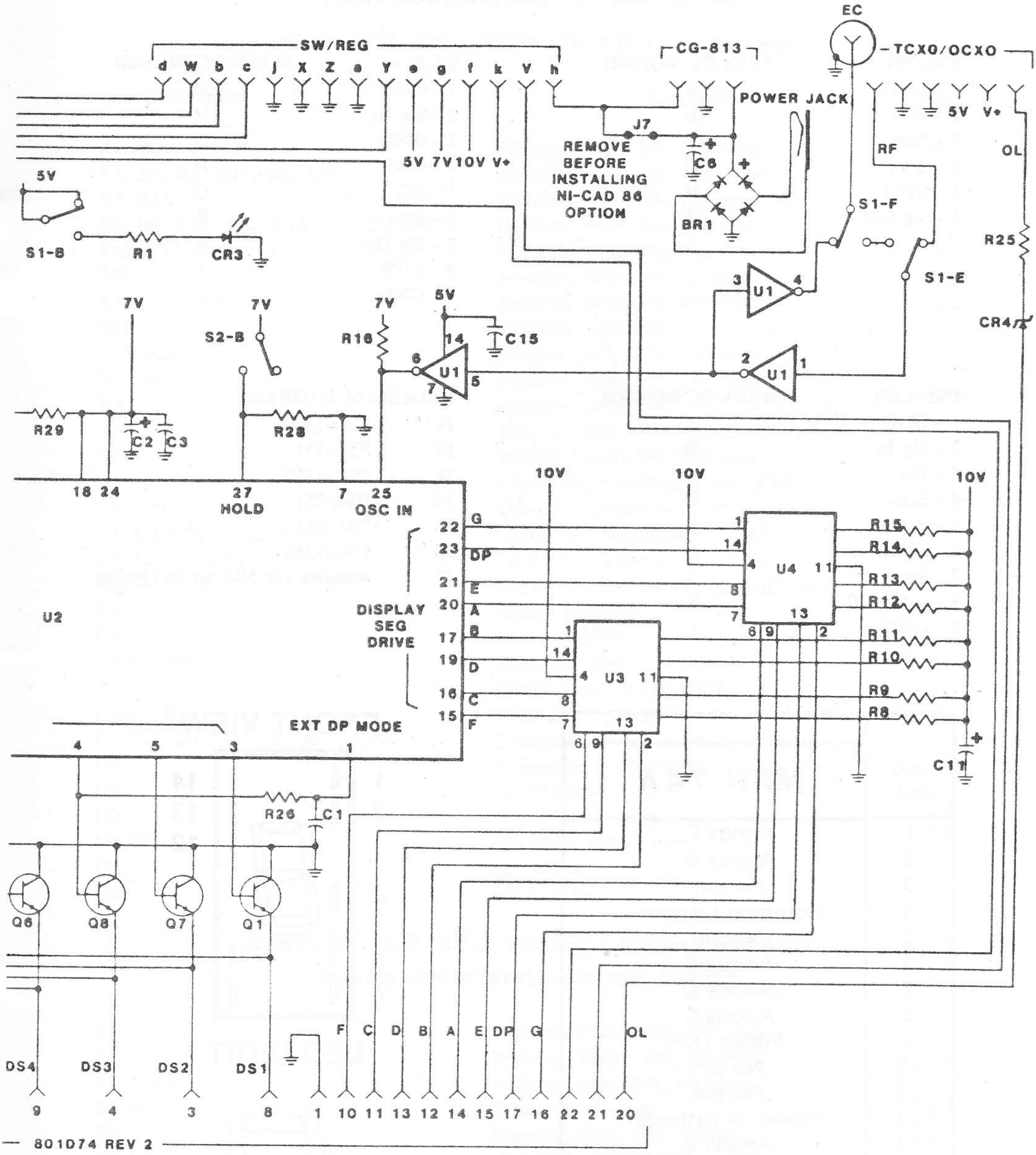
SW/REG REV 0 060183



801D74 REV 2 060183



1 MEGOHM INPUT
50 OHM INPUT
HI-Z/A
PSL-750/PSL-1350/PSL-1000
S M O P U T R Q N
J L H A E G K C F D B
R31
CR6
R30
CR5
R24
7V
5V
S8-A
S7-B
J1
J2
J3
J4
J5
J6
S10-D
S9-A S10-B
S9-D
R21
R20
U5
U6
C8 C7
Q9
S8-D
S9-C
7V
R17
C9
R23
C12
S7-C
R22
R19
R18
C4 C5
R7
C17
CR1
C10
S7-D
28
FREQ IN
12
RESET
CR2
R2
U1
C16
R27
2 GT IND
R5
R6
R3
R4
DP SEL INPUT
GATE SEL INPUT
DISPLAY DIGIT DRIVE
S8-B
S9-B
S10-B
10V
S6-B
S7-A
S5-A
S4-A
S6-A
S5-C
S4-C
S3-D
Q2
Q3
Q4
Q5
DS8
DS7
DS6
DS5
19 18 2 5 6 7
S5-B S4-B S3-C S5-D S4-D S3-A



80XX-S SERIES FREQUENCY COUNTER
SCHEMATIC
060183

MODULE PIN IDENTIFICATION

PSL-751	MAIN PC BOARD
1 - GND	A
2 - ±5V	E
3 - Sens	F
4 - ±5V	G
5 - GND	H
6 - Sig Out	J

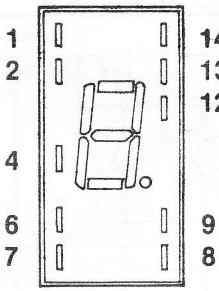
HI-Z/A	MAIN PC BOARD
1 - GND	M
2 - Sig In	N
3 - GND	O
4 - GND	P
5 - BG	Q
6 - Sens	R
7 - Sig Out	S
8 - ±5V	T
9 - GND	U

PSL-1350	MAIN PC BOARD
1 - GND	A
2 - Sig In	B
3 - BG	C
4 - Sens	D
5 - ±10V	E
6 - GND	H
7 - Sig Out	J
8 - ÷5/÷20	K
9 - GND	L

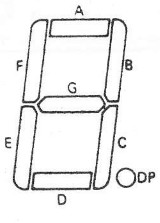
PROGRAM JUMPERS	
J1	PSL-1350
J2	PSL-751
J3	PSL-1350
J4	PSL-751
J5	PSL-751
J6	PSL-1350
J7	Remove for Ni-Cad-86 Option

PIN NO.	MAN 74A
1	Anode F
2	Anode G
3	No pin
4	Common cathode
5	No pin
6	Anode E
7	Anode D
8	Anode C
9	Anode D.P.
10	No pin
11	No pin
12	Common cathode
13	Anode B
14	Anode A

FRONT VIEW



LED DIGIT



LIST OF REPLACEABLE ELECTRONIC PARTS

ASSY. NO. 801S, MAIN COUNTER P.C. BOARD

Ref. Designation	Description	Qty.
R1, R2	Resistor, ¼W, 5%, 270 ohm	2
R3, R4, R5, R6, R26, R29	Resistor, ¼W, 5%, 10K ohm	6
R7, R23	Resistor, ¼W, 5%, 5.1 ohm	2
R8, R9, R10, R11, R12, R13, R14, R15	Resistor, ½W, 2%, 220 ohm	8
R16, R17, R19	Resistor, ¼W, 5%, 1K ohm	3
R18	Resistor, ¼W, 5%, 27 ohm	1
R20	Resistor, ¼W, 5%, 470 ohm	1
R21	Trimmer, 10K ohm	1
R22, R24	Resistor, ¼W, 5%, 100 ohm	2
R25, R27	Resistor, ¼W, 5%, 330 ohm	2
R30	Resistor, ¼W, 5%, 510 ohm (8007-S)	1
R30	Resistor, ¼W, 5%, 1K ohm (8010-S, 8013-S)	1
R31	Resistor, ¼W, 5%, 510 ohm	1
C1	Capacitor, monolythic, 100 pOF	1
C2, C11	Capacitor, electrolytic, 10uF, 16V	2
C3, C4, C7, C9, C12, C15, C16	Capacitor, monolythic, .1 uOF	7
C5, C8, C10, C17	Capacitor, tantalum, 47 uF, 6.3 V	4
C6	Capacitor, electrolytic, 2200 uF 16V	1
BR1	Bridge Rectifier	1
CR1	Diode 1N4002	1
CR2, CR3	LED, .2" Red	2
CR4	Diode, zener, 5.1V, 1N751	1
CR5, CR6	LED, .125", Red	2
Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8	Transistor, PNP, PN3638A (#0141)	8
Q9	Transistor, NPN, 2N2857	1
U1	IC, 74LSO4	1
U2	IC, ICM7216DIPI	1
U3, U4	IC, 75491 (#491, #501)	2
U5	IC, 74F04	1
U6	IC, 74S196	1

ASSY. NO. SW/REG, VOLTAGE REGULATOR AND POWER/SENSITIVITY CONTROL BOARD

Ref. Designation	Description	Qty.
R1	Resistor, RN55, 1%, 475 ohm	1
R2	Resistor, RN55, 1%, 243 ohm	1
R3, R4, R5	Resistor, ¼W, 5%, 1K ohm	3
R6, R7	Trimmer, 5K ohm	2
R8	Resistor, ¼W, 5%, 1.6 ohm	1
C1, C2, C6, C7	Capacitor, monolythic, .1 uF	4
C3, C4, C5	Capacitor, tantalum, 1 uF, 35V	3
C8	Capacitor, electrolytic, 220 uF, 25V	1
VR1	Voltage regulator, fixed, 7805	1
VR2, VR3	Voltage regulator, adjustable, LM317T	2
SW1	Switch, sensitivity control	1
J1	Jack, probe power	1

801D74 REV. 2 DISPLAY ASSEMBLY

Ref. Designation	Description	Qty.
R1	Resistor, ¼W, 5%, 270 ohm	1
R2, R3	Resistor, ¼W, 5%, 10K ohm	2
Q1	Transistor, NPN, PN2222	1
DS1-DS9	LED Digits, MAN 74A	9

REPLACEABLE ELECTRONIC MODULES

PSL-751-7	700 MHz amplifier/prescaler module
PSL-1350-10	1000 MHz amplifier/prescaler module
PSL-1350-13	1300 MHz amplifier/prescaler module
HI-Z/A	High impedance amplifier module
TCXO-STD	± 1 PPM Temperature compensated Xtal oscillator
TCXO-80	±0.1 PPM Temperature compensated Xtal oscillator (Option #TCXO-80)
OCXO-80	± .05 PPM Oven controlled Xtal oscillator (Option #OCXO-80)
CG-813	Battery charge/relay module (Part of Option #Ni-Cad-86)

FREQUENCY COUNTER
SERVICE AND WARRANTY INFORMATION

WARRANTY SERVICE

OPTOelectronics, Inc. Frequency Counters are warranted for one year from date of purchase to the **original purchaser** against defects in workmanship or failure of circuitry, provided no unauthorized repairs or modifications have been attempted or performed and unit has not been subjected to misuse or abuse.

The original purchaser should fill out and mail in the warranty registration card as soon as possible to establish the factory warranty protection period.

Defective units covered by this warranty must be returned to factory, with transportation charges prepaid. The factory warranty provides for **100% parts and labor** costs. U.S. and Canadian customers include $5.00 per warranty service for return shipping expenses; outside U.S. and Canada actual shipping and insurance costs must be paid by the customer.

NON WARRANTY SERVICE

OPTOelectronics, Inc. will only provide service for its own products. Instruments not covered by warranty, requiring factory repair may receive service on a time and materials basis. Instruments may be returned for a repair estimate before any work is begun. Two-way transportation costs to be borne by the customer in all cases. Our service department will provide a rapid repair turn-around. Do not cause delays - enclose complete information.

No prior return authorization is required for service returns.

ALL RETURNS SHOULD INCLUDE:

(1) Copy of sales receipt (readable) if covered by warranty.

(2) Detailed description of problem/s.

(3) Complete return address and phone number (U.P.S. street address for U.S.A.)

(4) Proper packaging (insurance recommended). Note: Carriers will not pay for damage if items are not properly packaged. Return via U.P.S. if possible.

(5) Proper remittance (Visa or Master Card numbers, company purchase order, etc.).

Address all items to: **OPTOelectronics, INC.**
Service Department
5821 N.E. 14th Avenue
Ft. Lauderdale, Florida 33334

All rates or prices stated are in effect as of your date of purchase but are subject to change without notice. If in question please consult factory for current information.

No other warranties are expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. OPTOelectronics, Inc. is not liable for consequential damages.