

7261A

Universal Counter/Timer

Instruction Manual



NOTE

This manual documents the Model 7261A and its assemblies at the revision levels shown in Appendix 7A. If your instrument contains assemblies with different revision letters, it will be necessary for you to either update or backdate this manual. Refer to the supplemental change/errata sheet for newer assemblies, or to the backdating sheet in Appendix 7A for older assemblies.

7261A

Universal Counter/Timer

Instruction Manual

P/N 487512
January 1979
Rev. 1 9/80
Rev. 2 2/81

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SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

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The JOHN FLUKE MFG. CO., INC., will be happy to answer all applications or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX C9090, EVERETT, WASHINGTON 98206, ATTN: Sales Dept. For European Customers: Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands.

*For European customers, Air Freight prepaid.

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, Washington 98206

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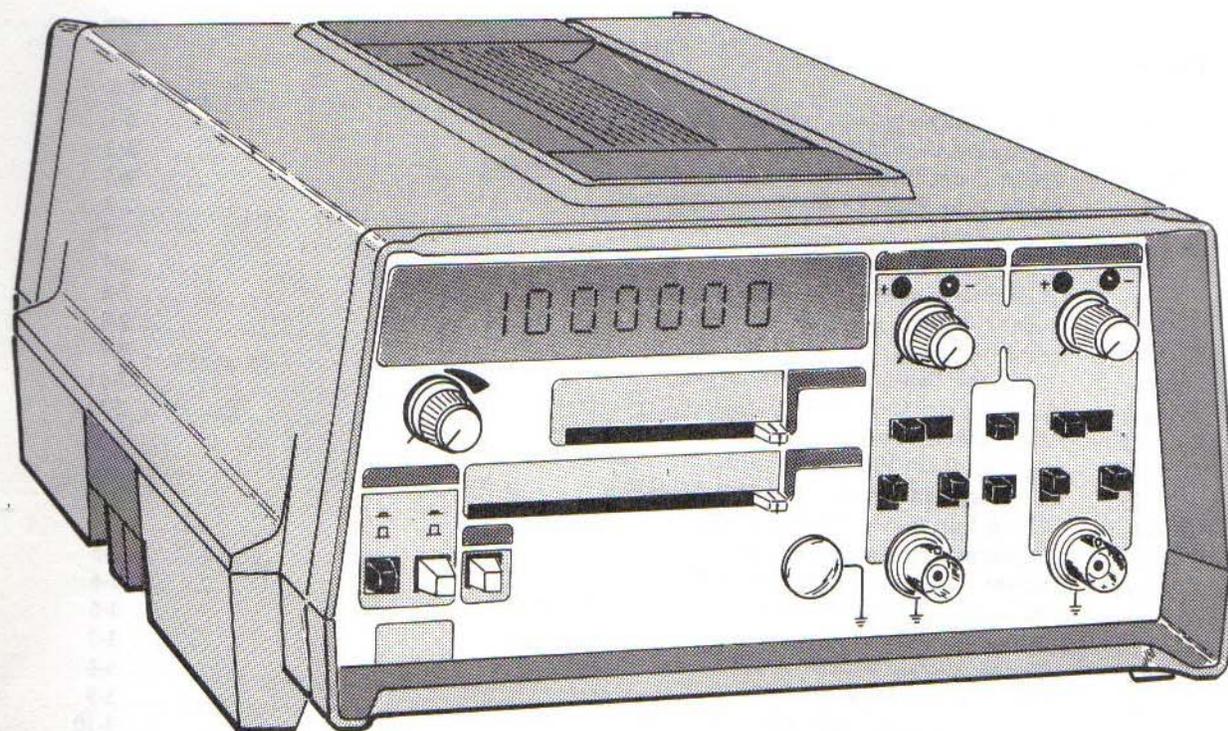
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7261A Universal Counter/Timer

Section 1**Introduction & Specifications****1-1. INTRODUCTION**

1-2. The John Fluke Model 7261A is a bench-type, portable Universal Timer/Counter. A self check mode of operation is provided to verify overall instrument performance. The instrument can make four types of measurements.

1. Frequency, both standard and normalized.
 - a. Standard frequency measurements can be made up to 125 MHz (the optional Channel C allows measurements of higher frequencies).
 - b. CPM frequency measurements are normalized into units of 100 Counts Per Minute of the frequency input on Channel A.
2. Time measurements of both the period of an input frequency and the time interval between any two events with averaging functions for both to improve accuracy and resolution of the measurements. Period averaging allows a maximum resolution of 0.1 psec or about the length of time it takes light to travel about one ten-thousandth of an inch. Time interval averaging allows a maximum resolution of about 31 psec or about the length of time it takes light to travel about 3 1/2 inches.
3. Ratio measurements of one frequency to another.
4. Totalized count measurements.

1-3. Both Channel A and B have an input impedance of 1 M Ω . Both channels have trigger level controls, trigger status lights, \pm slope selection, 3 position attenuator switches, AC/DC coupling select controls, 100 kHz low pass filter select switches, analog trigger level outputs and the capability of being electrically connected together. A marker output is available when either the TI A-B or the TIA A-B function is selected. The optional Channel C has an input impedance of 50 Ω and is ac-coupled. This channel is used for frequency measurements only and has no Front Panel controls.

1-4. Measured data is displayed via an 8-digit LED readout on the front panel. This display has leading zero suppression and automatic decimal point positioning. Annunciators are provided to indicate Gate, Overflow, Oven and display units. All displayed information is also available, in serial BCD format, at a rear panel connector when the unit is equipped with an optional Data Output Unit (DOU).

1-5. Power requirements are 100V, 120V, 220V or 240V at 47-63 Hz. The -010 Battery Option allows operation of the instrument away from ac power sources.

1-6. OPTIONS AND ACCESSORIES

1-7. The options and accessories available for use with the 7261A are described in Section 6. Table 1-1 lists these options and accessories.

1-8. SPECIFICATIONS

1-9. Table 1-2 lists the specifications of the 7261A.

Table 1-1. 7261A Options and Accessories

OPTION/ MODEL NO.	DESCRIPTION	OPTION/ MODEL NO.	DESCRIPTION
	OPTIONS		ACCESSORIES
7261A-190	Jittered Time Base	Y2014	C Size Single Unit Offset Rack Mount
72XXA-010	Battery	Y2015	C Size Dual Rack Mount
72XXA-112	2 ppm Time Base	Y2020	C Size Panel Mount
72XXA-131	Low Power Oven Time Base	Y7201	Attenuator/Low Pass Filter
72XXA-132	Superior Low Power Oven Time Base	Y7203	2 Foot Ribbon Cable Assembly
72XXA-310	520 MHz, Direct	Y7204	5 Foot Ribbon Cable Assembly
72XXA-521	Data Output Unit		
72XXA-529	IEEE Interface Option		

Table 1-2. 7261A Specifications

FUNCTIONS
(See Footnotes for definition of terms)

Frequency A

Range: 0-125 MHz
 Resolution: .1 Hz-10 kHz in decade steps
 Accuracy: ± 1 count \pm time base errors
 Display: kHz or MHz with decimal point

CPM X100A

Range: 0-125 MHz
 Resolution: 100 CPM, fixed
 Accuracy: ± 1 count \pm time base errors
 Display: no decimal point or annunciators

Frequency C**Option -310**

Range: 50-520 MHz
 Resolution: .1 Hz-10 kHz in decade steps
 Accuracy: ± 1 count \pm time base errors
 Display: kHz or MHz with decimal point

Ratio A/B

Range: A: 0-125 MHz
 B: 0-2 MHz
 Resolution: $\frac{\text{Freq B}}{\text{Freq A} \times N}$
 Accuracy: $\frac{\text{Freq B}}{\text{Freq A} \times N} \pm \frac{\text{Freq B} \times \text{Trig Error B}}{N}$
 Display: decimal point without annunciator

Period A

Range: 10 ns - 99,999,999 sec
 Resolution: 10 ns-1 ms in decade steps
 Accuracy: +1 count, \pm time base error, \pm trigger errors
 Frequency Range: 0-2 MHz, Sinewave
 Min. Pulse: 500 ns 0Hz 100 kHz
 250 ns 100 kHz-2 MHz
 Display: μ sec, msec or sec with decimal point

Period Average A

Range: 0.1 ps - 999,999.99 μ s
 Resolution: 0.1 ps-10 ns in decade steps
 Accuracy: $\frac{10 \text{ ns}}{N} \pm$ time base errors $\pm \frac{\text{Trigger error}}{N}$
 Frequency Range: 0-2 MHz, Sinewave
 Min. Pulse: 500ns: 0Hz-10kHz
 250ns: 100kHz-2MHz
 Display: μ sec, msec or sec with decimal point

Time Interval

Range: 10ns-99,999,999 sec
 Resolution: 10 ns-1 ms in decade steps
 Frequency Range: 0Hz-5MHz, Sinewave
 Accuracy: \pm count \pm time base error \pm Trigger errors
 Min. Pulse: 10 ns
 Display: μ sec, msec or sec with decimal point

Time Interval Average

Range: 0.1ns-999,999.99 μ s
 Resolution: $\frac{10 \text{ ns}}{\sqrt{N}}$, $N = 1-10^5$ in decade steps
 Accuracy: $\frac{10 \text{ ns}}{\sqrt{N}} \pm 2 \text{ ns}^* \pm$ time base errors $\pm \frac{\text{Trigger error}}{\sqrt{N}}$
 Min. Pulse: 10 ns

Dead Time: 4 μ s (see Footnote #4)
 Display: μ sec or msec with decimal point
 Frequency Range: 0-5 MHz

* Degrades to 4 ns when operating on batteries.

Totalize A-B

Range: A: 0-125 MHz
 B: 0-2 MHz
 Count Capacity: 0-99999999
 Display: no decimal point or annunciator

Time Interval Holdoff

Range: 20 μ sec-20 msec
 continuously adjustable

Table 1-2. Specifications (cont)

SIGNAL INPUTS

Channel A & B

Range: 0-125 MHz (DC coupled)

5 Hz -125 MHz (AC coupled)

Sensitivity: 10 mV rms, 0-50 MHz

15 mV rms, 50-100 MHz

35 mV rms, 100-125 MHz

Min. Pulse: 10 ns and 50 mV peak

Linear Operating Range: +2.5V to -2.5V

Trigger Level Range: +1.5V to -1.5V

Input Impedance: 1 M Ω shunted by 55 pf, nominal

Coupling: AC or DC, switchable

Attenuator: X1, X10, X100

Slope: + or -, switchable

Channel Input: separate or common A, switchable

Filter (3 dB point): 100 kHz low pass, nominal

Channel C

Range: 50 MHz-520 MHz (Option -310)

Sensitivity: 10 mV rms

Impedance: 50 Ω , 2.5:1 VSWR

Max Input Voltage: 5V rms, fused

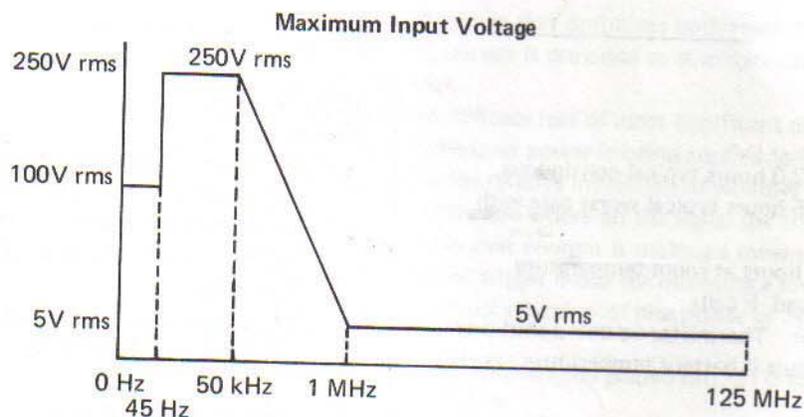
External Time Base

Input Frequency: 10 MHz, AC coupled

Sensitivity: 300 mV rms

Impedance: 1 k Ω shunted by 30 pF nominal

Max Input Voltage: 3V rms



TIME BASES

Standard

Frequency: 10 MHz

Aging Rate: $\pm 5 \times 10^{-7}$ /monTemperature Stability: $\pm 5 \times 10^{-6}$, 0°-40°CLine Voltage ($\pm 10\%$): $\pm 1 \times 10^{-7}$ Battery: $\pm 1 \times 10^{-7}$

Table 1-2. Specifications (cont)

OPTIONS			
	-112	-131	-132
Frequency	10 MHz	10 MHz	10 MHz
Aging Rate (constant temperature)	$\pm 3 \times 10^{-7}/\text{mo}$ ($\pm 1 \times 10^{-6}/\text{yr}$)	$\pm 1 \times 10^{-7}/\text{mo}^*$	$\pm 3 \times 10^{-9}/\text{day}^*$ ($\pm 5 \times 10^{-8}/\text{mo}$) [*]
**Temperature Accuracy (0-40°C)	$\pm 2 \times 10^{-6}$	$\pm 1 \times 10^{-7}$	$\pm 3 \times 10^{-8}$
Line Voltage ($\pm 10\%$ change)	$\pm 2 \times 10^{-8}$	$\pm 2 \times 10^{-8}$	$\pm 4 \times 10^{-9}$
Battery	$\pm 2 \times 10^{-8}$	$\pm 5 \times 10^{-8}$	$\pm 1 \times 10^{-8}$
*** Warmup	10 min	$\pm 5 \times 10^{-7}$	$\pm 5 \times 10^{-7}$
	20 min	$\pm 3 \times 10^{-8}$	$\pm 3 \times 10^{-8}$

* After 5 days continuous operation.

** Accuracy with temperature specification includes errors caused by temperature variations during operation as well as all calibration errors when calibrated per procedure in the instrument service manual.

*** Compared to frequency. 24 hours after turn on.

Battery Pack

Option -010

Operating Time: 2.0 hours typical continuous.
Decreases to 1.5 hours typical worst case with option.

Charge Time: 16 hours at room temperature

Battery Type: Nicad, F cells

Charge Protection: Thermistor actuated shut down of charging circuit if battery temperature exceeds 65°C.

Discharge Protection: Automatic low-voltage shut down to prevent over-discharge.

Printer Interface

Option -521

Description: Serial BCD output of all digits and annunciator

Levels: TTL, "1" state low

IEEE Interface

Option -529

Description: Option for interfacing 7261A to IEEE-488 via the Fluke 1120A IEEE Translator. Provides full measurement output capability as well as remote selection of all functions and ranges.

IEEE Repertoire: SH1, AH1, TEØ, L4, LEØ, SR1, RL2, PPO, DC1, DT1, CØ

Time Base Phase Modulation

Option -190

Description: Option for insuring valid time interval averaging of clock synchronous signals by phase modulating internal time base.

520 MHz Channel C

Option -310

Description: Provides a third input channel for measuring frequencies from 50 MHz to 520 MHz

Sensitivity: 10 mV rms

Input Impedance: 50Ω, VSWR 2.5:1

Max Input Voltage: 5V rms, fuse protected

Table 1-2. Specifications (cont)

GENERAL	
See Figure 1-1 for dimensions.	
Display:	8 digit, LED with leading zero suppression, decimal point and annunciators
Cycle Rate:	Fixed, 250 ms between readings
Reset:	Reset button clears display, lights all display segments and, on release, activates a new measurement.
Self Check:	Uses internal 10 MHz signal to check digital circuits.
Time Base Output:	Buffered, TTL compatible, 10 MHz signal derived from crystal time base VOUT ≥ 500 mV into 50Ω
Storage Temperature:	-40°C to +70°C.
Operating Temperature:	0° to 40°C.
Power:	47-63 Hz; 100V/120V/200V/220V ±10%, 32 VA max.
Marker Output:	TTL compatible output, positive going edge indicates A channel trigger, negative going edge indicates B channel trigger. 30 ns delay, typical, from time signal triggers input amplifier to the time marker changes level at rear panel.
Trigger Level Output:	±1.5V level. Indicates DC trigger level set on either Channel A or Channel B, switch selectable.
Autoranging:	Automatically selects range that optimizes both resolution and measurement time. 20% ranging hysteresis is provided to eliminate unnecessary ranging on signals near range edge.
Overflow Indicator:	LED is illuminated to indicate loss of most significant digit information.
Oven Indicator:	LED is illuminated whenever power is being applied to internal oven oscillator.
Trigger Status Indicators:	Two per channel. Provide relative indication of whether the input signal is triggering input amplifier and where on the signal the trigger occurs.
Gate Light:	LED is illuminated whenever counter is making a measurement.
Cont/Trig Mode:	Switch activates external trigger mode for initiating a measurement.
Battery/Line Switch:	Switch provides for manual selection of line power or optional battery power.
EMI:	Internal metal RFI shield (tested and passed MIL-STD-461 notice 3) contact factory for test data.
Weight:	3.1 kg (6 lbs, 14 oz)
Dimensions:	Standard type "C" PTI case (see figure 1-1)
PROTECTION CLASS:	CLASS 1 (As defined in IEC 348).
FOOTNOTES:	
1.	$N = 10^0$ to 10^5 in decade steps, set by resolution switch. Indicates the number of periods averaged in Period Average mode, the number of cycles of B averaged in Ration mode, and the number of intervals averaged in Time Interval Average mode.
2.	Time base error is the sum of all errors specified in the time base section for the particular time base.
3.	Trigger error is the measurement error caused by noise on the input signal tiggering the input amplifier too early or too late. If is calculated as follows:
	$\text{Trigger Error} = \pm \frac{2X \text{ peak noise voltage}}{\text{signal slew rate at trig point } V/\mu\text{s}} \quad \mu\text{s}$
4.	The counter will ignore time intervals occuring during the dead time.

Section 2

Operating Instructions

2-1. INTRODUCTION

2-2. Installation and operation of the 7261A Universal Counter/Timer are explained in this section. Read this information before attempting to operate the unit. Should any difficulties arise, contact your nearest Fluke Sales Representative (listed in Section 7), or the John Fluke Mfg. Co., Inc. (P.O. Box 43210, Mountlake Terrace, WA., 98043; Telephone 206 774-2211).

2-3. SHIPPING INFORMATION

2-4. The 7261A is packaged and shipped in a foam-packed container. An Instruction Manual and any accessories ordered will be included with the instrument. Upon receipt of the instrument, make a thorough inspection for proper contents and possible shipping damage. Special instructions for inspection and claims are included with the shipping container. If reshipment is necessary, use the original container. If the original container is not available, a new container can be obtained from the John Fluke Mfg. Co., Inc. Please reference the instrument model number when requesting a new shipping container.

2-5. INSTALLATION

2-6. Input Power

2-7. The 7261A can be operated with an input line voltage of 100, 120, 220, or 240V ac ($\pm 10\%$). Line frequency may vary between 47 and 63 Hz. Before connecting the power cord, verify that line voltage switches (located inside the instrument) are properly set and that an appropriate line fuse is installed. Refer to Section 4 of this manual for proper verification procedures (see "Line Voltage Selection" and "Fuse Replacement").

2-8. Instrument Case Mating

2-9. The 7261A is contained in a molded instrument case with non-marring feet, a tilt-down bail, and a latching arrangement. This instrument may be stacked and latched together with other Fluke instruments employing this type of case.

2-10. Use the following procedure when attaching these molded cases together:

1. For the top instrument, pull out latches found on either side (refer to Figure 2-1).
2. Nestle top and bottom instruments together.
3. Push latches in to secure instruments together.

CAUTION

Instrument stacks should be limited to a total height of three feet and a total weight of 40 pounds.

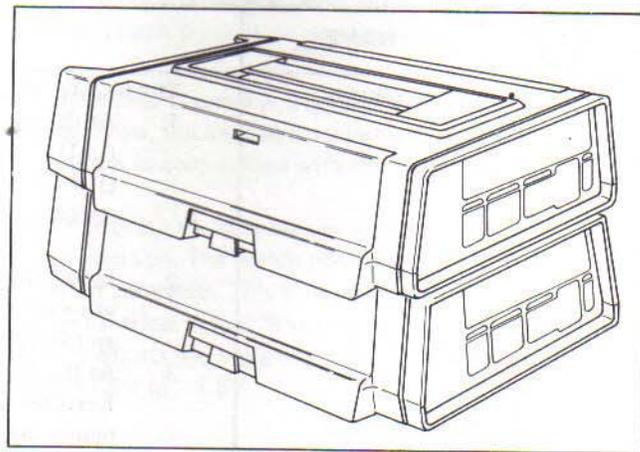


Figure 2-1. Instrument Case Mating

2-11. Tilt-Down Bail

2-12. When used as a separate instrument, the 7261A may be tilted up, or down, with the aid of the tilt bail. When extended, the bail may be locked in place by firmly pressing the legs into slots provided in the bottom panel. When retracted, the bail lies flush with the instrument's bottom panel and does not interfere with case mating. This bail will normally be mounted toward the front of the instrument's bottom panel. To remove the bail, compress either of its legs toward the center of the case and pull out. Installation may then be made in identical mounts at the rear of the bottom panel.

2-13. Rack Installation

2-14. The 7261A may be installed in a standard 19-inch

equipment rack or a DIN panel mount. Mounting kits for these accessories are described in Section 6 of this manual. A list of all available accessories and options is presented in Section 1.

2-15. OPERATING FEATURES

2-16. The location of front panel controls, indicators and connectors is shown in Figure 2-2. Referenced by number, these items are briefly described in Table 2-1. Rear panel controls and connectors are covered in a similar fashion in Figure 2-3 and Table 2-2. It is suggested that the operator become acquainted with this information before operating the instrument.

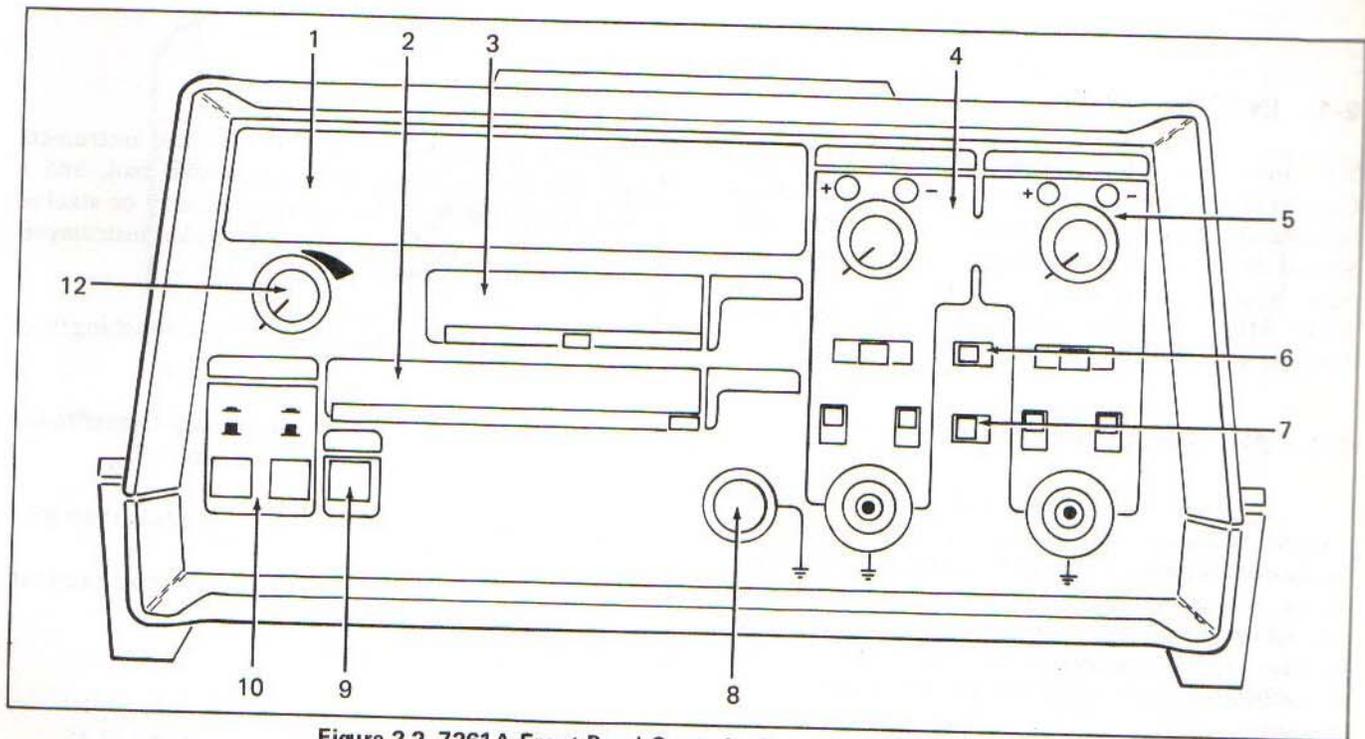


Figure 2-2. 7261A Front Panel Controls, Connectors and Indicators

Table 2-1. 7261A Front Panel Controls, Connectors and Indicators

REF NO.	NAME	FUNCTIONS
1	Display	<p>The display has three sections:</p> <ol style="list-style-type: none"> At the left end, the instrument status annunciators: <ul style="list-style-type: none"> GATE Indicates that the instrument is sampling the input signal. OVFL Indicates that the capacity of the display has been exceeded. OVEN If one of the oven time base options is installed, indicates that the oven is receiving power. In the center, the eight LED digits. These digits present the measured value of the unknown input. The value may range between 00000000 and 99999999. At the right end, the display units annunciators. For all instrument functions except CPMX100A, RATIO A/B and TOT A·B, the LED beside the appropriate unit of measurement will be illuminated.

Table 2-1. 7261A Front Panel Controls, Connectors and Indicators (cont)

REF NO.	NAME	FUNCTIONS
2	FUNCTION	<p>A ten position slide switch that determines what measurement function the instrument will perform. Changing the position of the Function Switch automatically resets the instrument. The basic instrument function for each position of the Function Switch is:</p> <p>FREQ A Measures the frequency of signals applied to Channel A. Can measure signals from 0-125 MHz.</p> <p>CPM X100A Measures the frequency of the signal applied to Channel A and automatically displays the value in Counts Per Minute times 100. Range is 0-125 MHz.</p> <p>FREQ C Measures the frequency of signals applied to the optional Channel C. 72XXA-310 Option has a range of 50-512 MHz.</p> <p>RATIO A/B Measures the ratio of the frequency of the signal applied to Channel A to the frequency of the signal applied to Channel B. Apply the signal with the higher frequency to Channel A. Range of the channels: Channel A: 0-125 MHz Channel B: 5 Hz-2 MHz</p> <p>PER A Measures the period of signals from 0-2 MHz applied to Channel A.</p> <p>PER AVG A Measures the period of a predetermined number of cycles of the signal applied to Channel A and displays the average value of these periods. The range in frequency of the signal is 0-2 MHz.</p> <p>TI A-B Measures the interval in time between the arrival of a signal applied to Channel A and the arrival of a signal applied to Channel B. Dead time (time between one STOP pulse and the next START pulse) must be greater than 200 ns.</p> <p>TIA A-B Measures a predetermined number of Time Intervals (as defined above) and displays the average value of these periods. Minimum dead time is 200 ns.</p> <p>TOT A-B Counts the total number of events occurring on Channel A that are gated by events occurring on Channel B.</p> <p>CHK This is an internal self test of the instrument. It provides a confidence check of all but the input circuits and time base. The frequency displayed should be 10 MHz.</p>
3	RESOLUTION	<p>A seven position slide switch that determines the resolution (range) of the display. Generally, the further right the Resolution Switch position, the longer the instrument's Gate Time. Changing the position of the Resolution Switch automatically resets the instrument. Except for the AUTO position, the position of the Resolution Switch determines the position of the decimal point in the display for all instrument functions except CPM X100A (resolution permanently set at 100 Counts Per Minute).</p>
4	CHANNEL A	<ol style="list-style-type: none"> 1. \pmTrigger Status Indicators. Each time Channel A triggers, the appropriate indicators blink. At high frequencies, the indicators will appear to be lit continuously. The indicators work in conjunction with the Trigger Level Control. 2. Trigger Level Control. This control is a variable resistor with a switch in the extreme counterclockwise position. The switch position is PRESET. PRESET selects a trigger level of zero volts. This is the most sensitive trigger level for ac-coupled symmetrical inputs. When the control is rotated out of the PRESET position, it adjusts the triggering point of Channel A about zero volts in a range of +1.5V to -1.5V.

Table 2-1. 7261A Front Panel Controls, Connectors and Indicators (cont)

REF NO.	NAME	FUNCTIONS
		<p>3. ATTEN is a three position slide switch used to reduce high amplitude input signals so that they fall within the dynamic range of the input amplifier. The input signal is attenuated by the factor indicated above the switch positions.</p> <p>4. AC/DC is a two position slide switch that selects the type of signal coupling used. DC coupling is used to maintain a consistent trigger point on input signals down to a frequency of zero. AC coupling is used when measuring a signal with a large DC offset. (When AC coupling is selected, the trigger point changes with both the input frequency and duty cycle.)</p> <p>5. +/- is a two position slide switch that selects which slope (positive or negative) of the input signal Channel A will trigger on.</p> <p>6. BNC connector used to apply input signal to Channel A. Impedance at this terminal is 1 MΩ for connecting directly across an input signal with minimum input waveform distortion. (Important for all time measurement functions, i.e., period, time interval, time interval averaging, etc.). The amplitude of signals applied to this input should not be below 10 mV rms or above the levels shown in Table 2-3. The input circuit is fuse protected.</p>
5	CHANNEL B	<p>This outlined position of the front panel contains the controls, indicators and connector for Channel B inputs. Item locations and functions correspond directly with those of Channel A.</p>
6	SEP/COM	<p>A two position slide switch that determines whether the inputs of Channel A and Channel B are tied together (COM) or separate (SEP). For most types of measurements, this switch will be in the SEP position but the COM position is useful for measurements made on a single signal from a single input cable. (Such as rise time and fall time.)</p>
7	FILTER OUT/IN	<p>A two position slide switch that effectively places a 100 kHz low pass filter in series with the input signals on Channels A and B (the IN position) or allows the input signals to pass with no filtering (the OUT position).</p>
8	CH C	<p>BNC connector for the optional Channel C. Only the frequency of Channel C inputs may be measured. The range of the -310 Option is 50-512 MHz. The input impedance is 50Ω to provide proper impedance matching for 50Ω cables to minimize reflected waves. Maximum input is 5V rms. The input circuit is fuse protected.</p>
9	RESET	<p>The RESET control is a momentary contact pushbutton that provides the capability to manually reset the instrument. When the RESET control is depressed, the display will be all 8's. With this character displayed, each segment of every digit of the display may be checked. Decimal point position will depend on the position of the Resolution Switch.</p>
10	POWER	<p>Both of these controls are two position push-push switches (do not attempt to pull either switch to the out position). The ON/STBY switch in the ON position connects the outputs of the power supplies to the instrument circuitry. If the ON/STBY switch is in the STBY position the outputs of the power supplies are not connected to the instrument circuitry. If an oven time base option is installed, the oven receives power when the ON/STBY switch is in the STBY position and the Rear Panel REF switch is in the INT position. The BAT/LINE switch is bypassed on instruments that do not have the -010 Battery Option installed. If the option is installed, refer to the Operating Instructions for the -010 Option in Section 6.</p>
11	TI HOLDOFF	<p>This control is a potentiometer. It provides continuously variable time delay before the STOP pulse can be generated in the TI A-B and TIA A-B functions.</p>

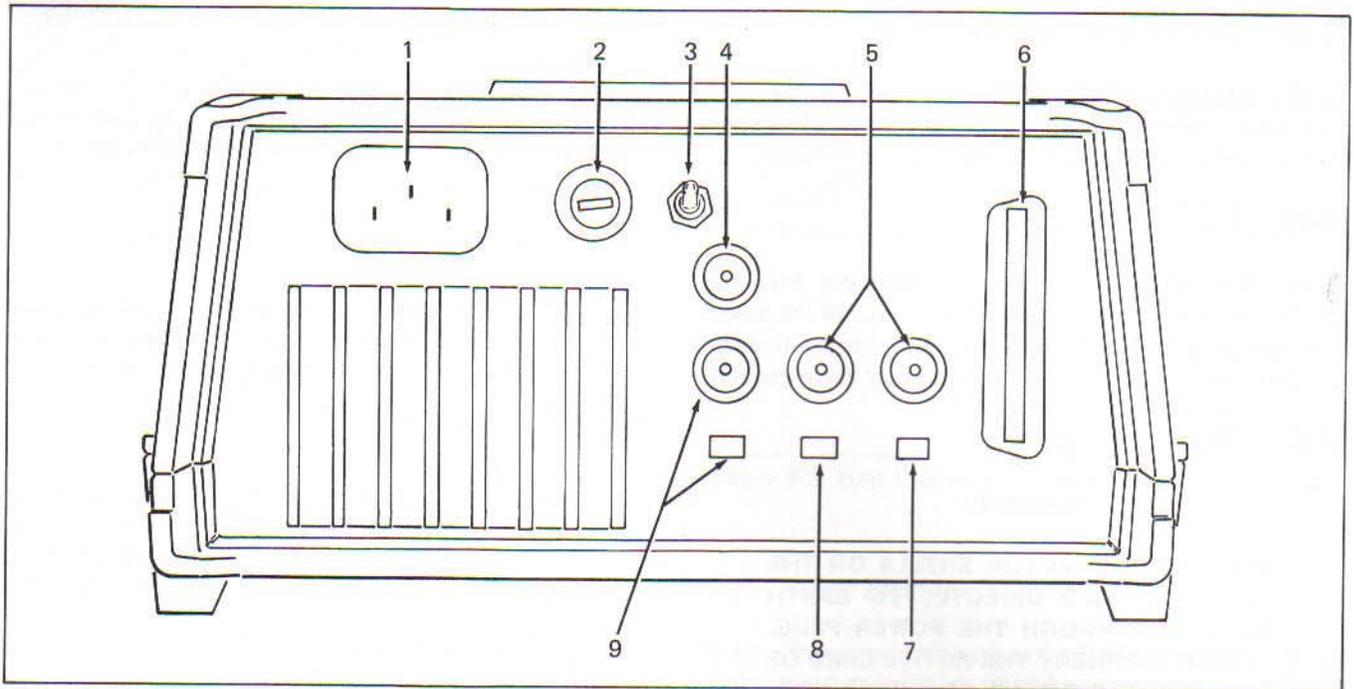


Figure 2-3. 7261A Rear Panel Controls and Connectors

Table 2-2. 7261A Rear Panel Controls and Connectors

REF NO.	NAME	FUNCTIONS
1	POWER RECEPTACLE	Polarized, 3-prong connector for line power input.
2	F1	Main Power Fuse.
3	AC POWER	Connects (ON) or disconnects (OFF) line power to the primary side of the Main Power Transformer.
4	MARKER OUT	Marker pulse output during TI A-B and TIA A-B functions to assist in operator in setting the Trigger Levels.
5	10 MHz REF IN OUT	BNC terminal allows connection of an external time base. BNC terminal that has 10 MHz time base signal used by the instrument.
6	DATA I/O	Connector for DOU Option (-521).
7	REF	Two position slide switch to select time base used by the instrument. INT position selects installed time base. EXT position selects external time base connected to the 10 MHz IN terminal.
<i>NOTE</i>		
<i>If either oven time base option is installed in the instrument, the EXT position of the REF switch removes oven power, allowing the internal time base to cool.</i>		
8	MODE	Two position slide switch determines triggering mode of the instrument. CONT position selects continuous triggering. TRIG position selects single triggering.
9	TRIGGER LEVEL CHA/CHB OUT	Two position slide switch determines whether the trigger level voltage of Channel A or Channel B is connected to the Trigger Level Out terminal. BNC connector with the trigger level of the channel selected by the Trigger Level control.

2-17. OPERATING NOTES

2-18. The following paragraphs describe various conditions and information which should be considered before operating the Model 7261A Counter/Timer.

2-19. AC Line Connection

2-20. The input power cord is a three-pin polarized connector which permits connection to any of the power voltages described in INPUT POWER. Ensure that the ground pin is connected to a high quality earth ground.

2-21. Maximum Inputs

WARNING

ALL BNC CONNECTOR SHELLS ON THE 7261A ARE TIED DIRECTLY TO EARTH GROUND THROUGH THE POWER PLUG. DO NOT CONNECT THE ACTIVE LEAD OF THE INPUT SIGNALS TO THE SHELL. IRREPARABLE DAMAGE TO THE INSTRUMENT OR THE SIGNAL SOURCE MAY RESULT.

2-22. Table 2-3 defines the maximum allowable signal level input for each input terminal. Channels A and B are fuse protected (250 mA). Refer to Section 4 of this manual for fuse replacement instructions.

Table 2-3. Overload Protection

INPUT TERMINAL	MAXIMUM INPUT
Channel A Channel B	100V rms from 0 to 45 Hz, 250V rms from 45 Hz to 50 KHz, then the maximum decreases linearly to 5V rms at 1 MHz and remains at 5V rms above 1 MHz.
Channel C	5V rms
REF, EXT	3V rms

2-23. Counter/Timer Terminology

2-24. The following definitions are useful in understanding how and when to use the 7261A's controls.

2-25. ATTENUATION

2-26. Attenuation is used to limit the input signal within the input amplifier's dynamic range. On the 7261A, an attenuation control is provided to limit the input amplifier's gain. The ATTEN control allows selection factors: X1, X10 and X100.

2-27. CYCLE RATE

2-28. This term refers to the minimum time necessary for the instrument to process and display a measurement. It does not include the actual measurement time. In the 7261A, each cycle time is 250 ms.

2-29. DISTORTION

2-30. Distortion refers to an unwanted change in the input waveform. It may occur at equally spaced (harmonic) or random (non-harmonic) intervals.

2-31. DUTY CYCLE

2-32. Duty cycle specifies the ratio of signal on time to off time. The greater the percentage of off time, the lower the duty cycle. Measure low duty cycle signals with dc-coupling selected (AC/DC switch in the DC position).

2-33. EVENT COUNTING

2-34. The accumulation of a number of events over a period of time is termed event counting. Several 7261A functions perform this operation. The **FREQ A** mode counts events for a specific length of time to determine the Channel A input frequency. In the **CPM** mode, the Channel A input frequency is counted in the same manner then a conversion factor is used to normalize the frequency (counts per second) into counts per minute. In **TOT A·B** mode, a continuously updated count of events on Channel A gated by events on Channel B is displayed. Finally, in **RATIO A/B** mode, the 7261A will count events on Channel A during a gate time determined by the signal on Channel B. The instrument can measure events generated by a wide variety of sources. For example, the **FREQ A** function can be used to measure the precision frequency output of a signal synthesizer, and the **CPM** function can be used to determine the rotational speed of a conveyor belt spindle.

2-35. When using any function that counts events, the instrument must trigger once, and only once for each event. Use of the front panel controls must be directed toward this end. Noise must be filtered or attenuated to prevent false triggering, and the input signal must be kept within the dynamic range of the instrument.

2-36. EVENT TIMING

2-37. During event timing functions, an internal oscillator frequency is counted for a period determined by the input signal. In the 7261A, two types of event timing measurements can be made; period and time interval. Period measurement (**PER A** or **PER AVG A**) determines the period, or inverse of frequency, of a repetitive signal. The instrument measures period by counting an internal oscillator's frequency for single

(PER A) or multiple (PER AVG A) cycles of the input. Time interval measurements (TI A-B) can be made to determine the period of time between any two events, repetitive or not. Average time interval measurements (TIA A-B) can be made on signals with repetitive time intervals. For either type of event timing, separate start and stop signals must be generated from the input (refer to Figure 2-4).

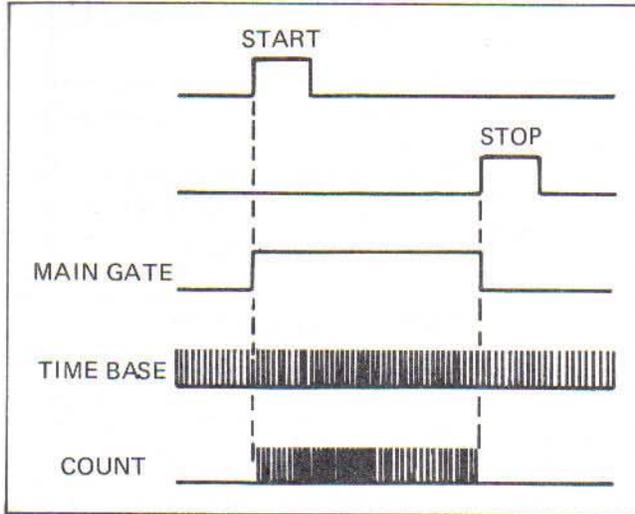


Figure 2-4. Event Timing

2-38. SYNCHRONOUS VERSUS ASYNCHRONOUS TIME INTERVAL REPETITION RATES

2-39. Time Interval Averaging is a statistical reduction of both the time base and trigger errors. Like all true statistical functions, Time Interval Averaging depends upon random sampling. If the repetition rate of the time interval is synchronous with the clock used, time interval averaging may not give the increase in accuracy and resolution expected. In worst case situation of a synchronous repetition rate, Time Interval Averaging will decrease accuracy and resolution. The repetition rate is synchronous with the clock if the time interval always starts in the same place with respect to the clock. As Figure 2-5 shows, asynchronous repetition rates can start anywhere, but synchronous repetition rates have a fixed relationship to clock. The -190 Jittered Time Base Option can be used to ensure asynchronous operation. This option introduces a phase noise "jitter" on the 100 MHz clock frequency to insure asynchronous measurements.

2-40. GATE TIME

2-41. Gate time refers to the length of time during which a frequency is being counted for display. The frequency counted may be derived from the input signal or from the instrument's internal time base. With longer gate times, more counts are accumulated and measurement resolution improves.

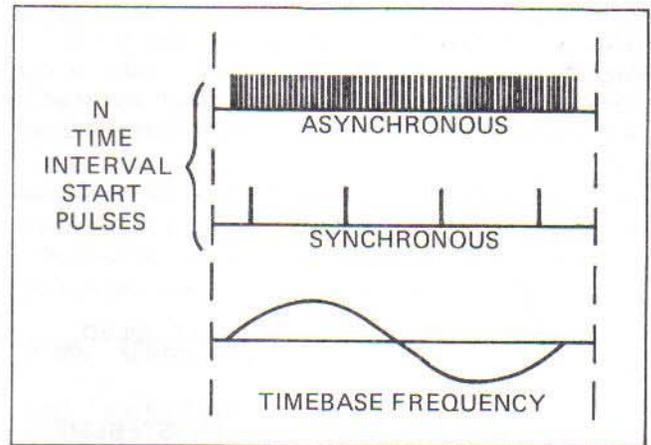


Figure 2-5. Time Interval Repetition Rate versus Time Base

2-42. HYSTERESIS

2-43. In instruments such as the 7261A, proper counting and timing requires a pulsed output from the input circuitry. To form this pulse, each input waveform (regardless of its shape) triggers the input circuitry on or off at predetermined triggering, or hysteresis levels. An input waveform must pass through both of these hysteresis levels for the input circuitry to generate a pulse. The voltage difference between the two levels is termed the hysteresis window; the minimum signal that can trigger both levels therefore defines the instrument's sensitivity. Generation of the hysteresis window is illustrated in Figure 2-6.

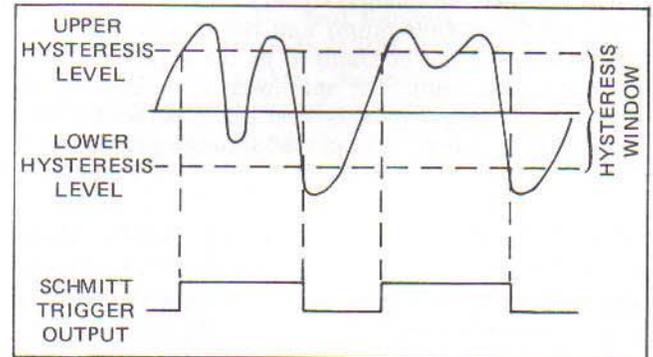


Figure 2-6. Hysteresis Window

2-44. INPUT COUPLING

2-45. Either ac or dc coupling may be used to transfer the input signal to the input conditioning circuitry. If the input signal is riding on a dc level, it may not lie within the range of the hysteresis window. The instrument cannot measure the signal. The top waveform in Figure 2-7 shows such a dc-coupled waveform. The lower waveform shows the same waveform ac-coupled. With ac-coupling the signal can be measured. AC-coupling causes no problems for repetitive signals of a fixed frequency but the trigger

point will shift with a change in frequency or duty cycle. This is not important in event counting but is very important to event timing. Pulse inputs with low duty cycles should not be ac-coupled as the coupling capacitor will not charge high enough for proper triggering.

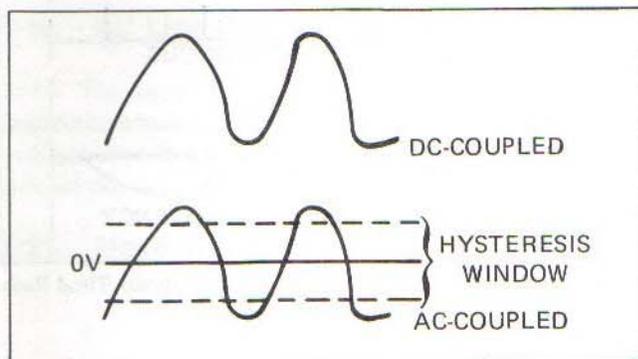


Figure 2-7. Input Coupling

2-46. INPUT IMPEDANCE

2-47. The input impedance defines the impedance seen by a signal source. Input impedance of Channels A and B is $1\text{ M}\Omega$ shunted by 45 pF . The optional Channel C input impedance is 50Ω .

2-48. LINEAR OPERATING RANGE

2-49. The linear operating range refers to the excursions of the input signal that can reliably trigger the input amplifier without distortion. The 7261A's linear range varies between the smallest signal level acceptable by the input amplifier (minimum) and the largest attenuated signal that will not be clamped by the amplifier's input circuits (maximum). The minimum is defined by the instrument's sensitivity specifications. Operation within maximum levels may be ensured through proper use of the ATTENUATION controls.

2-50. NOISE

2-51. Noise is defined as spurious signals riding on the input waveform. Unlike distortion, the waveform is not changed. Noise of sufficient amplitude can, however, cause false triggering, resulting in inaccurate measurements during event timing functions. The 7261A input amplifiers (signal conditioners) exhibit very low noise. The signal applied to these amplifiers may, however, be plagued with noise from the signal source, the electrical environment or from improper signal transfer to the 7261A.

2-52. ± 1 COUNT ERROR

2-53. The one count ambiguity, inherent in any gate and counter type of frequency meter, results from an out-of-phase relationship between the input signal and the internal oscillator signal. The effect is demonstrated in

Figure 2-8. During a one second gate time, the top 9.5 Hz signal accumulates a count of ten; during the same gate time, the phase-shifted bottom signal accumulates only nine counts. The ambiguity amounts to one displayed count.

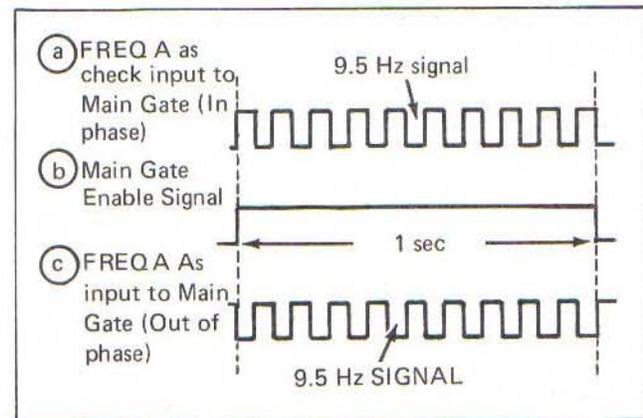


Figure 2-8. ± 1 Count Error

2-54. RESOLUTION

2-55. This term defines the value of the smallest displayed unit in a measurement. In the 7261A, this unit (the least significant digit, or LSD) is defined by each combined setting of the FUNCTION and RESOLUTION controls.

2-56. SENSITIVITY

2-57. Sensitivity defines the smallest signal amplitude capable of triggering the instrument. This specification corresponds to an rms value of the peak-to-peak difference between hysteresis levels (the hysteresis window). Note that the waveform must pass both hysteresis levels before a count is generated from the input circuitry; false triggering from noise or distortion on the input signal is thereby minimized.

2-58. TIME BASE ERROR

2-59. Time base error stems from crystal aging, temperature variation, and line voltage fluctuation. The 7261A may be fitted with one of several available time base oscillators; specifications for each are included in Section I of this manual.

2-60. TRIGGER ERROR

2-61. Input signal irregularities (noise, distortion, etc.) may cause premature or delayed triggering at the input circuitry's hysteresis levels. During event counting functions, this error is significant only when extra pulses are generated by the input circuitry. In event timing functions triggering error may be significant; improper triggering translates into inaccurate counting of the

internal oscillator frequency. Figure 2-9 illustrates possible trigger errors.

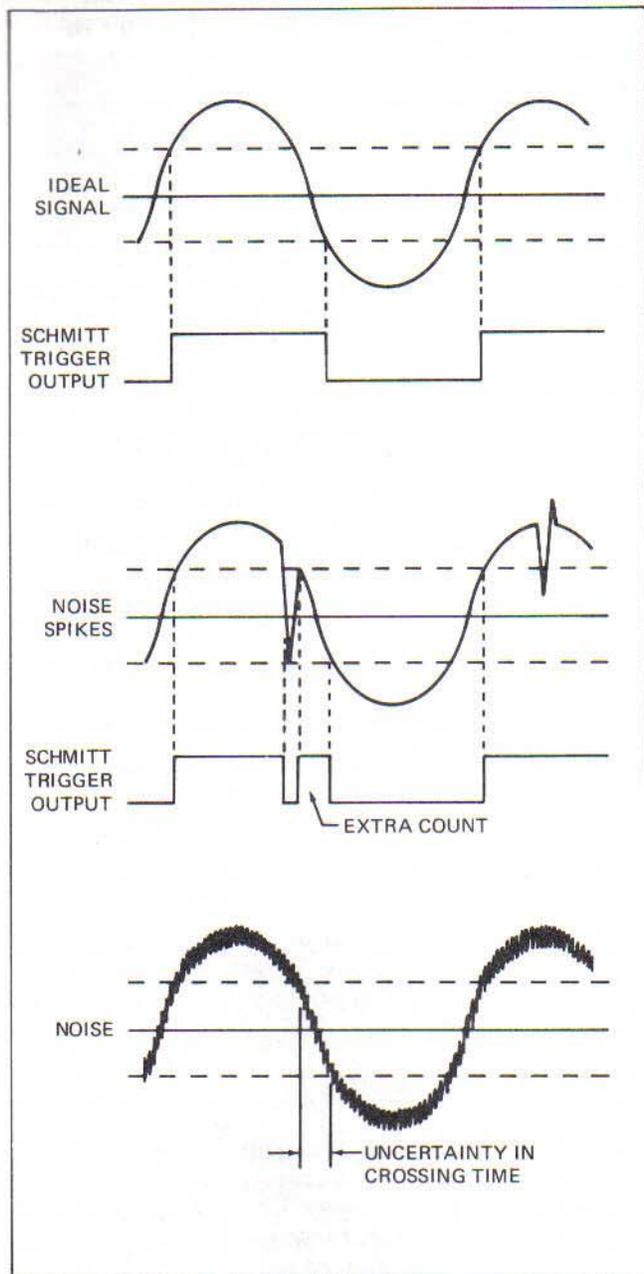


Figure 2-9. Noise and Distortion Effects

2-62. TRIGGERING

2-63. Signal conditioning circuits ideally provide a pulse train output representative of the input signal. These pulses should occur at the same frequency in Event Counting functions. The pulses are the Start or Stop times in Event Timing functions and must have the same time relationship as the input signals. Each pulse is triggered on and off at the specified upper and lower hysteresis levels for the instrument.

2-64. TRIGGER LEVEL

2-65. The voltage level nominally halfway between upper and lower hysteresis levels is termed the trigger level. On the 7261A, the ATTN control reduces the input signal within the dynamic range or the input amplifier. Then the TRIGGER LEVEL and slope (\pm) controls select the trigger level. Trigger Level for Channels A and B are available as analog voltages on a rear panel terminal.

2-66. Controls

2-67. FUNCTION CONTROL

2-68. The FUNCTION slide switch determines the type of measurement that the instrument will make. Each change of the switch position generates an internal reset. OPERATING DIRECTIONS provide descriptions, operating limits, and specific procedures for each function.

2-69. RESOLUTION CONTROL

2-70. The front panel RESOLUTION control selects autoranging or one of six manual ranges. Each of these settings is defined by three function-related scales. The scale used with **FREQ A**, **PER A**, **PER AVG A**, **RATIO A/B**, **CHK** or **TI A-B** is discussed with the appropriate OPERATING DIRECTIONS in this section.

2-71. The RESOLUTION control will have no effect in two functions. For totalizing measurements (**TOT A-B**), resolution is set at the least significant integer. On the counts per minute mode (**CPM X100A**), resolution is determined by dividing the number of counts per revolution by the number of minutes. If a 100 count-per-revolution input is used, resolution will translate directly to one RPM.

2-72. When placed in **AUTO**, the 7261A will automatically step through a predetermined series of resolution settings. The settings available for each function are defined in Table 2-4. When autoranging, the instrument seeks the greatest resolution possible, without overflow, for the function selected and the signal being measured. As an example, with **FREQ A** selected, the 7261A will step through the first four resolutions to maximize its display capacity when measuring a frequency of 1.2 MHz: the reading will be "1200.000 kHz". If a 1200 Hz is measured, maximum resolution allowable will again be found at the last step, but the reading will be "1.200 kHz".

NOTE

During autoranging in the PER A mode, the GATE LED may flash more than once for each display update.

Table 2-4. Autoranging

	10 ⁰	10 ¹	10 ²	10 ³	10 ⁴	10 ⁵
	10 ns 10 kHz	100 ns 1 kHz	1 μs 100 Hz	10 μs 10 Hz	100 μs 1 Hz	1 ms 0.1 Hz
FREQ A	→					
RATIO A/B	→					
PER A		←				
PER AVG A	→					
TI A-B		←				
TIA A-B	→					
CHK	→					
(Autoranging not used in TOT A·B or CPM X100A)						

2-73. SEPARATE/Common CONTROL

2-74. The SEP/COM control is used to select the input to the Channel B amplifier. In SEP, the Channel B input connector is tied to the Channel B amplifier. In the COM position, the Channel A input connector is tied to both the Channel A and B Amplifiers; the Channel A ATTN and AC/DC controls now influence the signal to both amplifiers. All other Channel B controls affect Channel B signals as usual.

NOTE

In COM, the Channel B input is not connected.

2-75. ATTENUATION CONTROLS

2-76. The ATTN control is a three position switch that can limit instrument input circuit gain by factors of X1, X10 and X100. Large signals causing distortion or non-linear operation can therefore be reduced to within the instrument's dynamic range. This dynamic range, or area between the hysteresis level and the overload point, varies with frequency. Increased attenuation may also be used to compensate for noise on the input signal; use of ATTENUATION in this case can prevent the noise from crossing one or both of the hysteresis levels.

2-77. SLOPE CONTROL

2-78. The slope (\pm) control determines instrument triggering order; the initial trigger may occur on a negative going signal (-position) or on a positive going signal (+position).

2-79. FILTER CONTROL

2-80. The position of the Filter IN/OUT switch determines whether or not frequencies above 100 kHz are removed from the input signal. When the control is at the IN position, the upper bandpass limit of the input amplifier on the Preamplifier is lowered from 125 MHz to 100 kHz. If high frequency noise is a problem with a low frequency signal, the 100 kHz low pass filter may be used to advantage.

2-81. TRIGGER LEVEL CONTROL

2-82. Trigger level is selected by the Trigger Level Control. The Trigger Level Control is continuously adjustable between +1.5V and -1.5V. The \pm trigger indicators provide the operator with a coarse indication of trigger setting. (The exact level of trigger setting can be measured from the Rear Panel Trigger Level Out Terminal.) The PRESET position of the control selects the zero volts position. The position of the \pm switch

determines whether the instrument is set up to trigger on the positive or the negative slope of the waveform Figure 2-10 shows the effects of this control. Use of both the Trigger level and \pm (slope) controls will be discussed later in this section under Triggering.

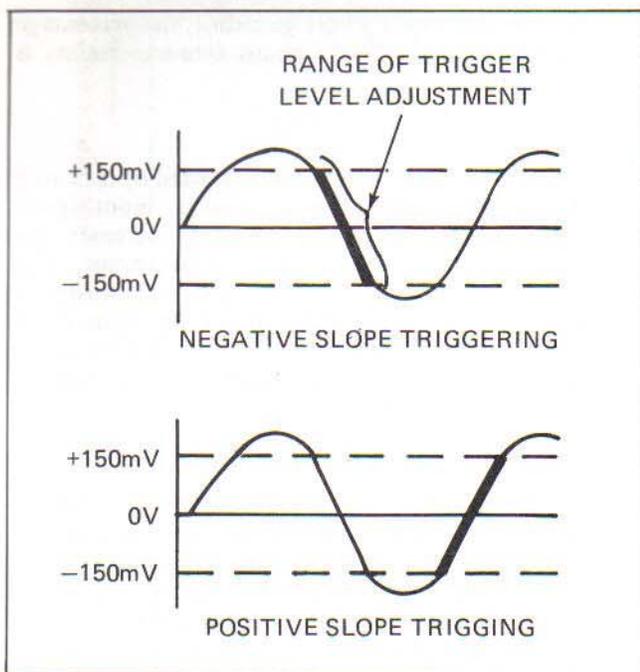


Figure 2-10. Trigger Level Control

2-83. TI HOLDOFF

2-84. The TI Holdoff control provides a continuously adjustable time delay in generating the STOP pulse. The time delay begins from the START pulse. This allows the operator to accurately measure the time interval of some extremely noisy signals. Figure 2-11 shows the waveform of a signal generated by relay contact closure. The noise from contact bounce is so great that without TI Holdoff the STOP signal would occur almost immediately after the START pulse. The time interval measurement would be grossly inaccurate. But the TI Holdoff signal prevents the output of the Channel B signal conditioner from generating the STOP pulse. After the end of the TI Holdoff period, the next pulse out of the Channel B signal conditioner will generate the STOP pulse. The time interval of the signal has been accurately measured.

2-85. MODE CONTROL

2-86. The rear panel trigger MODE control positioned to CONT, the instrument's internal logic will automatically cycle through repetitive measurement routines. When placed in TRIG, a measurement on Channel A can be initiated by using the Channel B signal as a trigger. If the 7261A is in TRIG during remote control operations with the DATA I/O Option -521 installed, refer to Section 6 for special instructions.

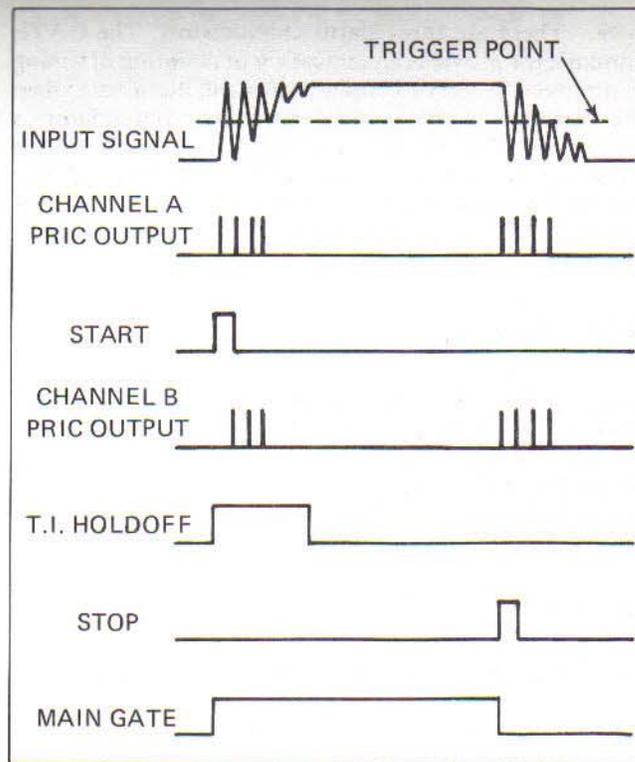


Figure 2-11. T.I. Holdoff

2-87. Display

2-88. The 7261A display presents an eight-digit LED readout with leading zero suppression. Measurement unit annunciators of MHz or kHz will be activated in FREQ A or CHK modes. For PER A, PER AVG A, or TI A-B, annunciators for μ sec, msec, or sec will illuminate. There will be no units annunciation in RATIO A/B, TOT A-B, or CPM X100A modes. Decimal point placement is determined by RESOLUTION and FUNCTION settings, as defined by Figure 2-12.

FUNCTION	RESOLUTION					
	10^0	10^1	10^2	10^3	10^4	10^5
	10ns 10kHz	100ns 1kHz	1 μ s 100Hz	10 μ s 10Hz	100 μ s 1Hz	1ms 0.1Hz
FREQ A	D2	D3	D4	D2	D3	D4
*CPMX100 A	DOESN'T USE DECIMAL POINT					
FREQ C	D2	D3	D4	D2	D3	D4
RATIO A/B	—	D1	D2	D3	D4	D5
PER A	D2	D4	D3	D2	D4	D3
PER AVG A	D5	D6	D4	D5	D6	D7
T.I. A-B	D2	D4	D3	D2	D4	D3
T.I.A. A-B	D5	D6	D4	D5	D6	D7
TOT A-B	DOESN'T USE DECIMAL POINT					
CHK	D2	D3	D4	D2	D5	D4

Figure 2-12. Decimal Point Placement

2-89. There are three status annunciators. The GATE annunciator provides an indication of counting or timing in progress. The OVFL annunciator will illuminate when the capacity of the internal 8-decade accumulator is exceeded. The OVEN annunciator should be on whenever an oven oscillator (Option -131 or -132) is installed, the instrument is connected to line or battery power (STBY or ON); and the Rear Panel REF switch is in the INT position.

2-90. Accuracy

2-91. Techniques are available for improving the accuracy of any measurement. Even with the controls set for optimum performance, three error factors may degrade accuracy. These errors (one count error, trigger error, and time base error) relate to each function as defined in the following accuracy statement:

1. FREQ A, FREQ C

± 1 count \pm time base error

2. CPM X100A

± 1 count \pm time base error

3. RATIO A/B

$$\pm \frac{\pm \text{FREQ B}}{\text{FREQ A} \times \text{N}} \pm \frac{\text{FREQ B} \times \text{TRIGGER ERROR B}}{\text{N}}$$

4. PER A

± 1 count clock \pm trigger error \pm time base error

5. PER AVG A

$$\frac{10 \text{ nS}}{\text{N}} \pm \text{timebase error} \pm \frac{\pm \text{trigger error}}{\text{N}}$$

6. TI A-B

± 1 count clock \pm trigger error \pm time base error

7. TIA A-B

$$\pm \frac{10 \text{ nS}}{\sqrt{\text{N}}} \pm 4 \text{ nS} \pm \text{timebase} \pm \frac{\pm \text{trigger error}}{\sqrt{\text{N}}}$$

2-92. Dealing with ± 1 Count Error

2-93. There are several methods available for reducing the effect of one count error. The following considerations may be useful:

1. By selecting a longer gate time, the percentage error caused by the ± 1 count gate uncertainty is decreased.

2. The accuracy of functions affected by ± 1 count A depends upon the frequency of the input signal. As frequency increases, accuracy increases. As frequency decreases, accuracy decreases. The sloped line (± 1 count A), in Figure 2-13, illustrates this concept. With a higher frequency input, more counts will be made per gate time, and ± 1 count error will become less significant. The percentage error is thereby reduced.

3. The accuracy of functions, affected by the ± 1 count clock depends upon the frequency of the clock used. Since the clocks are all based on the precision time base, accuracy is a constant for each clock and is completely independent of the frequency of the input signal. The straight line (± 1 count clock) that intersects the ± 1 count A line at clock frequency in Figure 2-13 illustrates this function. Any noise or distortion on the input signal will degrade the accuracy level.

4. FREQ A and PER A functions can be used selectively to maximize accuracy of frequency measurements over the range of Channel A. The relationship between the two measurement functions is shown in Figure 2-13. The following can be drawn by this function comparison.
 - a. FREQ A provides the best measurement accuracy if the input signal is higher in frequency than the instrument time base oscillator (10 MHz).
 - b. PER A provides the best measurement accuracy if the input signal is lower in frequency than the instrument time base oscillator.

5. When using these guidelines, the operator must exercise discretion. In a high noise environment, or where a great deal of non-harmonic distortion might be expected, gate time errors due to improper triggering may be significant; FREQ A might be the better choice regardless of the input signal frequency.

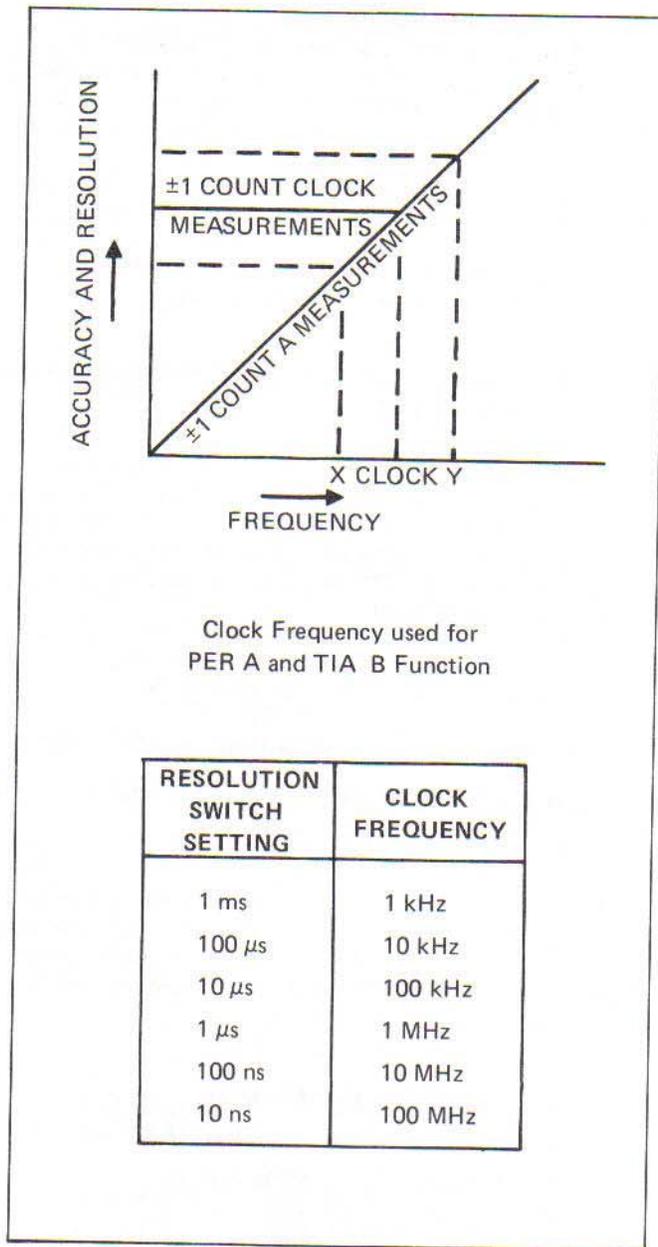


Figure 2-13. Accuracy and Resolution versus Frequency

2-94. DEALING WITH TIME BASE ERROR

2-95. Some of the effects of crystal related time base errors can be reduced. If the temperature of the instrument environment is maintained at a constant value, temperature error is minimized. If tight control of the instrument environment fails to produce the accuracy desired, the time base crystal related error can be reduced through recalibration or by substituting a time base with smaller errors. This time base may either be one of the optional internal time bases described in Section 6, or an external 10 MHz reference connected to the instrument via the rear panel.

2-96. DEALING WITH TRIGGER ERROR

2-97. Improperly triggered hysteresis levels can cause error when using any function. When using ratio or event timing functions, trigger errors produce gate time errors, resulting in inaccurate counts. Proper use of ATTENUATION and FILTER controls, along with other noise reduction techniques, will help solve this problem. In addition, the following considerations should be kept in mind:

1. Period measurements use Channel A for both START and STOP pulses; triggering errors are from one channel only. Trigger error will be caused by noise on the input signal. The period averaging function will reduce the effect of the triggering error by a factor of $1/N$.
2. Time interval measurements use both Channel A and channel B for the START and STOP pulses; the trigger error may arise from either or both channels. The averaging function will reduce the effect of the triggering error by a factor of $1/\sqrt{N}$.
3. In the ratio mode, the counts of Channel B trigger error increase as the frequency of the Channel A input signal increases.
4. A pulse input signal, with faster rise times, will exhibit less trigger error than a sine wave input.

2-98. REDUCING ERRORS DUE TO NOISE ON THE INPUT SIGNAL

2-99. The following techniques may also be used to ensure noise rejection:

1. Use an oscilloscope to identify the presence of noise.
2. Use the X10 ATTEN control to limit noise levels while maintaining sufficient signal levels for triggering.
3. Use an oscilloscope probe (X10) as the input cable when measuring high impedance circuits.
4. Use a low pass filter/attenuator. The front panel FILTER control can be utilized to attenuate signals above 100 kHz. Alternately, the Fluke Model Y7201 Filter/Attenuator, attached to the front panel input connector, can be used to suppress unwanted noise. This accessory is described in Section 6 of this manual.

2-100. SUMMARY

2-101. Some of the errors that affect accuracy are inherent and cannot be much improved without substituting different components (time base error). Accuracy can be improved by using the proper techniques

(triggering error) or by selecting the correct function (PER A versus FREQ A). The accuracy of the event timing functions can be improved by using the appropriate averaging function. And, sometimes, the technique that decreases the effect of one error source increases the effect of another error source. Noise and distortion on the input signal or signals also affect the accuracy of measurement. The operator has to be aware of all facets of the error sources and exercise discretion in using the instrument to make precise measurements.

2-102. OPERATING DIRECTIONS

2-103. Operation of the 7261A for each function is described in the following paragraphs. Function capabilities, as well as useful operating hints, are also presented here.

2-104. Initial Procedure

2-105. The following procedural checks should be performed prior to using any of the function operating directions.

1. Check that the instrument has been connected to appropriate line power.
2. Ensure that the rear panel EXT-INT select switch is set to INT.
3. Press power to ON.
4. Ensure adequate time for instrument warmup, especially if an optional oven time base is installed (typically 10 minutes).

2-106. Frequency Measurements (FREQ A)

2-107. Frequencies on Channel A from 0 - 125 MHz can be counted and directly displayed using this function. The gate times available range from 0.1 ms through 10s in six decade steps selectable with the RESOLUTION control (respective markings of the 10 kHz through 0.1 Hz). Input amplitudes should not exceed 250V rms from 45 Hz to 50 kHz, lowering to 5V rms at 1 MHz and above). Use the following procedure when making frequency measurements:

1. Set front panel controls as follows:

FUNCTION	- FREQ A
RESOLUTION	- as required, or AUTO
ATTENUATION	- X100
TRIGGER LEVEL	- PRESET
SEP/COM	- SEP
FILTER	- Out

2. Connect the signal to be measured to the CHANNEL A input connector.
3. Adjust the ATTEN and TRIGGER LEVEL controls for a stable display.

4. Set the RESOLUTION control to obtain desired resolution of the displayed frequency. The OVFL annunciator will light if the display's capacity is exceeded.

NOTE

When dealing with low frequencies, period measurements yield greater accuracy.

2-108. Counts per Minute Measurements (CPM X100A)

2-109. The 7261A can be used as a tachometer to read out revolutions per minute. The input to Channel A in this function must be from a 100 pulse per revolution transducer. For transducers having other pulse per revolution rates, the 7261A readout can be converted to RPM with the formula:

$$\text{Correct RPM} = \frac{100 \text{ Displayed RPM}}{N}$$

Where N = the number of pulses per minute of the transducer.

When the CPM X100A function is selected, gate time is set to 0.6s, the RESOLUTION control is disabled, and the display will not indicate a decimal point or units annunciator. Use the following procedure when making counts per minute measurements:

1. Set front panel controls to:

FUNCTION	- CPM X100A
SEP/COM	- SEP
FILTER	- Out

2. Connect the transducer output to the CHANNEL A input terminal.
3. Adjust the ATTEN and TRIGGER LEVEL controls to ensure proper triggering.

NOTE

The output voltage from magnetic transducers will vary with speed of revolution. The ATTEN and TRIGGER LEVEL control settings may, in such cases, need to be changed. Alternately, a photo-electric transducer will provide an output level not dependent on frequency.

2-110. Frequency Measurements (FREQ C)

2-111. Frequency measurements can be made above the range of FREQ A measurements using this optional function. Direct frequency measurements can be made in the range 50-520 MHz with the -310 Option installed. This option is discussed in detail in Section 6. Assuming the option is installed:

1. Set the Front Panel controls as follows:

FUNCTION - FREQ C
RESOLUTION - as required

2. Connect the signal to be measured to the Channel C input connector.

3. Set the RESOLUTION control to obtain maximum resolution of the displayed frequency. The OVFL annunciator will illuminate if the display capacity is exceeded.

2-112. Ratio Measurement (RATIO A/B)

2-113. The ratio function can be used to measure the numeric ratio of two input signals. The input on CHANNEL A is divided by that on CHANNEL B. The result is displayed without measurement unit annunciation. The RESOLUTION control influences the display resolution in the normal manner. Use the following procedure when making ratio measurements.

1. Set front panel controls as follows:

FUNCTION - RATIO A/B
RESOLUTION - set to optimize displayed resolution
SEP/COM - SEP
FILTER - Out (both channels)

2. Connect the higher of the two frequencies to CHANNEL A input connector.

3. Connect the lower of the two frequencies to CHANNEL B input connector (5 Hz through 2 MHz).

4. Adjust the ATTEN and TRIGGER LEVEL controls on both channels for proper triggering. (GATE LED flashing.) Gating is derived from the CHANNEL B signal when in the Ratio function; generally, the greater the level of the signal on CHANNEL B, the greater the accuracy of the Ratio measurement will be.

NOTE

It may be necessary to check each signal separately in FREQ A or PER A to verify correct levels.

5. Set the RESOLUTION control to obtain maximum resolution of the ratio measurement.

2-114. Period Measurements (PER A)

2-115. This function can be used to measure the period of an input signal with frequencies from 5 Hz through 2 MHz.

2-116. The period function provides a great improvement in both accuracy and resolution of measurements made on low frequency signals. To make period measurements, the instrument measures the time interval between two consecutive cycles of a repetitive signal; Channel A is used to generate start and stop pulses. The RESOLUTION control is used to specify the value of the least significant digit (10.0 ns-1.0 ms). Use the following procedure when making period measurements:

1. Set the front panel controls as follows:

FUNCTION - PER A
RESOLUTION - as required, or AUTO
SEP/COM - SEP

2. Connect the signal to be measured to the CHANNEL A input connector.

3. Adjust the ATTEN and TRIGGER LEVEL controls (Channel A) until a stable display is seen.

2-117. Period Averaging Measurements (PER AVG A)

2-118. Multiple periods of frequencies between 5 Hz and 1 MHz may be averaged to obtain greater resolution and accuracy than with Period measurements. For example, with a Period measurement of a 1 kHz signal, the display would read "1000.00 μ s"; the maximum resolution of the Least Significant Digit is 10 ns. In period Averaging, the same signal would be maximum at a display of "1000.0000 μ s"; the resolution has increased to .1 ns with a sample of 100 periods (RESOLUTION control 10² position). Use the following procedure when making period measurements:

1. Set the front panel controls as follows:

FUNCTION - PER AVG A
RESOLUTION - as desired, or AUTO
SEP/COM - SEP

2. Connect the signal to be measured to the CHANNEL A input connector.

3. Adjust the ATTEN and TRIGGER LEVEL controls to ensure proper triggering.

2-119. Time Interval Measurements (TI A-B)

2-120. The elapsed time between events common or separate to CHANNEL A and B can be accurately measured and displayed using the Time Interval function. CHANNEL A is used to provide a start signal, and CHANNEL B provides the stop signal. Dead time is 4 μ s (the counter will ignore time intervals occurring during the dead time). Use the following procedure when making time interval measurements.

1. Set front panel controls as follows:

FUNCTION - TI A-B
 RESOLUTION - as desired, or AUTO
 SEP/COM - SEP if the start and stop signals are from separate sources. COM if the start and stop signals are from the same source.

2. For separate input signals, connect the start signal to CHANNEL A input connector and the stop signal to CHANNEL B. For common inputs, connect the signal to Channel A.
3. Use the information presented earlier in this section to ensure proper triggering.

2-121. Time Interval Averaging Measurements (TIA A-B)

2-122. Multiple time intervals can be averaged to obtain greater resolution and accuracy than with Time Interval measurements. Use the following procedure when making Time Interval Averaging measurements:

1. Set the Front Panel controls as follows:

FUNCTION - TIA A-B
 ATTENUATION - X100
 TRIGGER LEVEL - PRESET

2. Set all other instrument controls as necessary for the application at hand.
3. For input from separate sources, connect the start signal to Channel A input terminal and set the SEP/COM switch to the SEP position. For inputs from a single source, connect the signals to the Channel A input terminal and set the SEP/COM switch to the COM position.
4. Adjust the instrument controls as described in the Operating Notes earlier in this section to insure stable display triggering at the proper points.

2-123. Totalizing Measurements (TOT A-B)

2-124. In the totalize mode, the 7261A can be used to continuously count and display the number of events occurring on Channel A during each event on Channel B. Only a reset will reinitialize the count. Use the following procedure for totalize measurements:

1. Set front panel controls as follows:

FUNCTION - TOT A
 RESOLUTION - not used
 SEP/COM - SEP

2. Connect signal to be totalized to CHANNEL A input connector.
3. Adjust the ATTEN and TRIGGER LEVEL controls (Channel A) to ensure proper triggering.
4. Observe that the display counts up, stops, continues the count, stops, continues the count, etc.

NOTE

Should just a totalized count of Channel A input signal be desired, set the Channel A \pm switch to the + position and adjust the Channel A TRIGGER LEVEL control until the + trigger status indicator goes out.

2-125. Self-Check (CHK)

2-126. The self-check function can be used to verify the digital operation of the 7261A. Each setting of the RESOLUTION control will provide a predictable display of the 10 MHz reference frequency. To self-check the 7261A, use the following procedure:

1. Press the power switch to ON.
2. Set the FUNCTION control to CHK.
3. Momentarily press the RESET control; the display should read "88888888" while RESET is depressed.
4. Set the RESOLUTION control to AUTO; the display should read "10000.00 kHz".
5. Verify correct display for each of the remaining six RESOLUTION settings as defined in Table 2-5.

Table 2-5. CHK Function Display

RESOLUTION SWITCH SETTING	DISPLAY
0.1 Hz	*0000.0000 kHz
1 Hz	10000.000 kHz
10 Hz	10000.00 kHz
100 Hz	10.0000 MHz
1 kHz	10.000 MHz
10 kHz	10.00 MHz
* Overflow annunciator should be illuminated.	

2-127. REMOTE OPERATION

2-128. The 7261A can both Talk and Listen to remote stations. The remote station programming can duplicate the use of the FUNCTION, RESOLUTION, FILT, \pm (slope) and RESET, Front Panel controls. The 7261A will provide measured value data, strobos, decimal point,

GATE, OVFL, and Unit's Annunciators, and command functions. The 7261A must be interfaced through the JF 1120A. The PCB installed in the 7261A is the 72XXA-521 Option which is part of the total interface 72XXA-529 Option. Detailed operation is described under these options in Section 6.

Section 4 Maintenance

WARNING

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

4-1. INTRODUCTION

4-2. This section of the manual provides information concerning warranty, general maintenance, performance tests, calibration and troubleshooting for the 7261A

Universal Counter/Timer. Test equipment recommended for performance tests, calibration, and troubleshooting is listed in Table 4-1. If the recommended equipment is not available, equipment with equivalent specifications may be used.

Table 4-1. Required Test Equipment

EQUIPMENT TYPE	REQUIRED SPECIFICATIONS	RECOMMENDED TYPE
Oscilloscope	Dual trace, DC-200 MHz wide band	Tektronix 475
High Frequency Signal Generator	125 MHz at a level of 1V rms. Time Base 1×10^{-8} per day.	John Fluke 6160B with -02 Option
Low Frequency Signal Generator (2)	Up to 10 MHz at a level of 1V rms. Time base 1×10^{-8} per day.	John Fluke 6011A
50 Ω Termination (3) BNC Tee	Impedance match the UUT.	GR874
Digital Multimeter	AC volts up to 250V ac. DC volts to 1V ± 0.01 V rms. Resistance - 0 to infinity.	John Fluke 8012A
RF Voltmeter	10 mV rms to 5V rms.	Boonton 92-BD
50 Ω Adapter	Impedance match UUT to RF Voltmeter	Boonton 91-8B
Oscilloscope Probe	X10, DC to 125 MHz.	Tektronix P6054A
Variable AC Power Supply	Variable Voltage from 0-250V ac	Variac
Frequency and Time Standard	Aging rate of 5×10^{-10} /day or less.	HP5061A
RF Attenuator	0-120 dB in 10 dB steps.	HP255D
3-way splitter	50 Ω	HP11667A

4-3. In some parts of the text of this section, referring to the Model 7261A by instrument number or by names such as "instrument" may lead to confusion. Therefore, the instrument may sometimes be referred to as the UUT (Unit Under Test).

4-4. SERVICE INFORMATION

4-5. The instrument is warranted for a period of 1 year upon delivery to the original purchaser. The WARRANTY is located on the back of the title page of this manual.

4-6. Factory authorized calibration and service for each Fluke product is available at various worldwide locations. A complete list of these service centers is included in Section 7 of this manual. If requested, an estimate will be provided to the customer before any work is begun on instruments that are beyond the warranty period.

4-7. GENERAL MAINTENANCE

NOTE

To avoid contaminating the pcbs with oil from the fingers, handle the pcbs by their edges or wear gloves. If a pcb does become contaminated, refer to the cleaning procedure.

4-8. Disassembly

4-9. To disassemble the instrument, use the following procedure:

1. Press the power switch to STBY, and remove the line power cord.
2. On the case bottom, remove the six securing screws. Two of these screws will be found in the middle of the case, under the latches. To access either middle screw, as shown in Figure 4-1, alternately push the two latching rails away from the triangular stop. Pull the latch out far enough to reveal the screws.
3. The top half of the case may now be separated from the bottom.

NOTE

Do not hold the case bottom while lifting off the case top. Damage to the Main PCB could otherwise result.

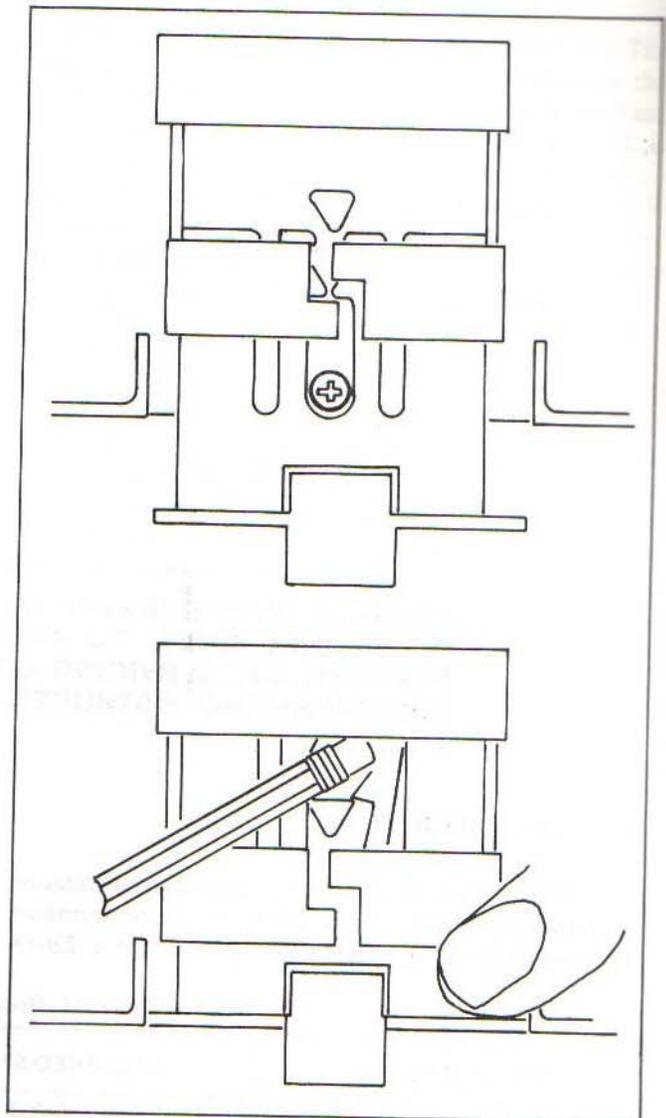


Figure 4-1. Disassembly Screw Access

Alternating between front and back panels, pry the case top free of the rest of the instrument. In the front, press down on the BNC input connectors, while gently pulling up on the case top lip. In the rear, press down on the External Reference BNC connector, while pulling up on the top case lip.

NOTE

For most test and calibration procedures, stop at this step.

4. Remove the single screw at the middle of the Main PCB, and separate the case bottom.
5. Remove the Signal Conditioner Assemblies (A3 and A4) from connectors on the Main PCB and the Front Panel PCB. Pry either assembly gently away from its Front Panel Connector until free. With a gentle rocking motion, now lift the assembly

out of its Main PCB connector. Avoid bending individual connector pins on the Signal Conditioners.

NOTE

The Signal Conditioners must not be interchanged. Each assembly is component matched to a hysteresis resistor on the Main PCB.

6. To remove the Front Panel Assembly (A2) from the Main PCB Assembly, first pull off the following switch buttons in the panel's lower left corner:

- a. ON - STBY (green)
- b. BAT - LINE (white)
- c. RESET (blue)

7. Gently pry the Front Panel Assembly away from its 40-pin connector (left) and guide pin (right). Avoid bending individual connector pins on the Main PCB.

8. Refer to Section 6 of this manual when removing any optional assemblies.

4-10. Reassembly

4-11. For reassembly, the disassembly procedures can generally be followed in reverse. Keep the following considerations in mind:

1. When reinstalling the Signal Conditioners or the Front Panel Assembly, care should be taken not to bend the connector pins.
2. When reconnecting the top and bottom case halves, ensure that the Front and Rear Panels fit into their appropriate grooves in the case top half. Slide the top half into place uniformly. Firmly squeeze top and bottom together (at front and rear), and reinstall the six securing screws.

NOTE

Proper RFI shielding depends on top and bottom case halves being securely mated.

4-12. Input Power

4-13. Input line power voltage is selected by positioning the two switches in the right rear corner of the Main PCB. Each switch (S4 and S5) shows a position identifying red or white dot. Line voltage settings identified by dot color are presented in Figure 4-2. Factory line voltage settings are identified on the instrument's rear panel; one of four (4) white dots will be darkened to signify 100, 120, 220 or 240V selection.

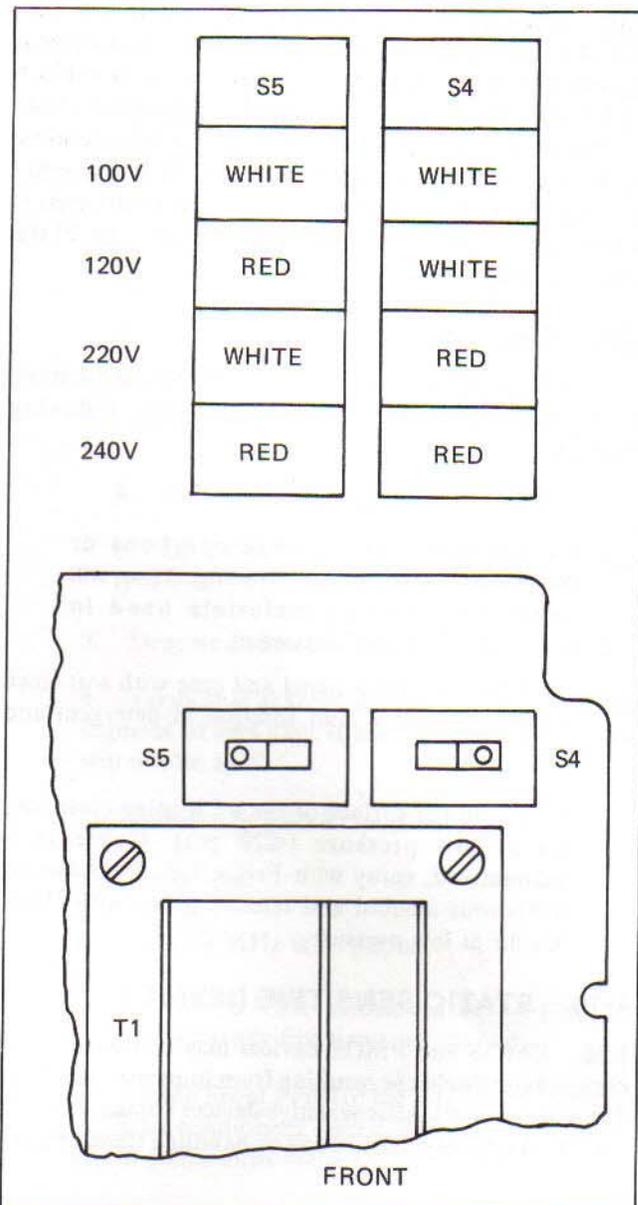


Figure 4-2. Line Voltage Selection

4-14. Fuse Replacement

WARNING

BEFORE ATTEMPTING FUSE REPLACEMENT, REMOVE LINE POWER FROM THE INSTRUMENT.

4-15. The 7261A line power fuse is accessible on the rear panel. Fuse requirements are a 3/8A MDL (slo-blo) for line inputs of 100V or 120V and a 3/16A MDL (slo-blo) for line inputs of 220V or 240V.

CAUTION

For continued fire protection always replace F1 with a 250V fuse of same type and rating.

4-16. Channel A and Channel B inputs are fuse protected for maximum inputs of 250 mA. Replacement of either of these fuses necessitates removal of the Main PCB Assembly and the Front Panel PCB Assembly; refer to Instrument Disassembly for removal instructions. Each fuse is soldered to the Front Panel PCB Assembly immediately below the respective BNC input connector. Replacement fuses should be ordered from John Fluke Mfg. Co., Inc.

4-17. Cleaning

4-18. Clean the instrument periodically to remove dust, grease and other contamination. Use the following procedure:

CAUTION

Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. They will react with plastic materials used in manufacture of the instrument.

1. Clean the front panel and case with soft cloth dampened with a mild solution of detergent and water.
2. Clean the surface of the PCB using clean, dry air at low pressure (≤ 20 psi). If grease is encountered, spray with Freon T.F. Degreaser or anhydrous alcohol and remove grime with clean, dry air at low pressure.

4-19. STATIC SENSITIVE DEVICES

4-20. CMOS and PMOS devices may be destroyed by electrostatic discharge resulting from improper handling. Table 4-2 lists the static sensitive devices contained in the 7261A. When working around or handling these devices,

use the procedures outlined on the yellow Static Awareness sheet located in this manual.

4-21. SOLDERING PRECAUTIONS

4-22. The Main and Front Panel PCBs are multilayer boards. Irreparable damage may be caused by careless removal or resoldering components. The following board repair procedures are recommended by the John Fluke Mfg. Co., Inc.

1. Restrict soldering iron tip temperatures to 700°.
2. Use a heat regulated soldering iron.
3. Use the compressed air driven vacuum type of desoldering tool.
4. Do not reheat the same pin or pad until it has been allowed to cool. Excessive heat build-up can cause board warpage and separation of inner layers as well as loss of pads and through-hole connections.
5. For IC removal, first cut all pins and gently remove the pins by heating the solder joint. Always work in one direction around the IC to allow previous pins and pads to cool. After the pins are removed, use the vacuum desolderer to remove the solder. Sometimes a small filip of solder will remain in the center of the hole and will not melt because not enough heat is carried to it by the copper plating. Resolder the hole, allow to cool, then desolder it. Enough heat must be applied to melt the solder all the way through before suction is applied.

Table 4-2. Static Sensitive Devices

	ASSEMBLY	REF. DES.	TYPE
Standard Instrument	Main PCB Assembly	U15	7031
		U34	4078B
		U46	14511
		U48	Custom
Options	Printer Interface PCB Assy	U1	MC 14503CP
-521		U2	MC 14013CP
		U3	MC 14011CP
		U5	4028AN
-010	Battery PCB Assy	U2	CD4001AE

4-23. PERFORMANCE CHECKS

4-24. The Performance Checks are used to compare the performance of the instrument with the Specifications given in Section 1. The Performance Checks are recommended for incoming inspection, preventative maintenance, evaluation after repair or as an aid in troubleshooting. All of the Performance Checks other than the Time Base Check should be performed quarterly. The Time Base Check should be performed monthly if operation within the Section 1 Specifications is desired. Should the instrument fail any portion of the Performance Checks, calibration and/or repair is indicated. Refer to Table 4-2 when specific test equipment is called for. Use the RF voltmeter to set up the programmed level of the HF synthesizer.

4-25. Initial Instrument Setup

4-26. Unless otherwise specified, it will be understood that the following controls will be in the indicated position before beginning any Performance Check:

1. On the Rear Panel of the UUT, set the controls to the following position:

ON/OFF	ON
INT/EXT	INT
CONT/TRIG	CONT

Line cord connected to line power.

2. On the Front Panel of the UUT, set the controls to the following position:

ON/STBY	ON
BAT/LINE	LINE
TI HOLDOFF	OFF
RESOLUTION	AUTO
SEP/COM	SEP
FILTER IN/OUT	OUT
TRIGGER LEVEL (A&B)	PRESET
ATTN (A&B)	XI
AC/DC (A&B)	AC
± (A&B)	-

4-27. Display Check

4-28. Use the following procedure to check the function of all segments of the eight display digits, decimal point positioning, all annunciators (except OVEN), and the RESET control.

1. On the Front Panel of the UUT:
 - a. Set the ON/STBY switch to the ON position.

- b. In the Channel B signal conditioner section:

- 1) Set the Trigger Level control maximum clockwise position.
- 2) Set the \pm control to the + position.

- c. Set the RESOLUTION control to the 10 kHz position.

- d. Set the FUNCTION control to the CHK position.

2. Verify that:

- a. 10.00 MHz is displayed.
- b. GATE annunciator is flashing approximately five times per second.

3. Depress and hold the RESET pushbutton.

4. Verify that 888888.88 MHz is displayed. If any segment of any digit is not functioning, that digit will not be an 8.

5. Release the RESET pushbutton.

6. Verify that:

- a. 10.00 MHz is displayed.
- b. The GATE annunciator is flashing approximately five times per second.

7. On the Front Panel of the UUT, in the Channel A signal conditioner section and in the Channel B signal conditioner section:

- a. Set the AC/DC switch to the AC position.
- b. Set the \pm switch to the + position.

8. Using Table 4-3 as a guide, set the Function to each of the positions indicated. At each of the Function Control positions, sequence the Resolution control to each of its settings. Verify that for each setting of the Function and Resolution control that the digits, decimal point positions and units annunciator all agree with the values given in Table 4-3.

NOTE

When performing this step, the OVFL annunciator illuminates when the Function control is set to the CHK position and the Resolution control is set to the .1 Hz position.

Table 4-3. Display Check

FUNCTION	RESOLUTION SWITCH	DIGIT DISPLAY	UNITS ANNUNCIATOR
FREQ A	10 kHz	0.00	MHz
	1 kHz	0.000	MHz
FREQ C	100 kHz	.0000	MHz
	10 Hz	0.00	kHz
	1 Hz	0.000	kHz
	.1 Hz	0.0000	kHz
	AUTO	0.000	kHz
CPM X100A	All settings	0	Blank
RATIO A/B	10 ⁰	0	Blank
	10 ¹	0.0	Blank
	10 ²	0.00	Blank
	10 ³	0.000	Blank
	10 ⁴	0.0000	Blank
	10 ⁵	0.00000	Blank
	AUTO	0	Blank
PER A	10 ns	0.00	μ sec
	100 ns	0.0000	msec
	1 μ s	0.000	msec
	10 μ s	0.00	msec
TI A-B	100 μ s	0.0000	sec
	1 ms	0.000	sec
	AUTO	0.00	msec
PER AVG A	10 ⁰	.00000	msec
	10 ¹	.000000	msec
	10 ²	.0000	μ sec
	10 ³	.00000	μ sec
	10 ⁴	.000000	μ sec
TIA A-B	10 ⁵	.0000000	μ sec
	AUTO	.00000	msec
TOT A-B	All settings	0	Blank
CHK	10 kHz	10.00	MHz
	1 kHz	10.000	MHz
	100 Hz	10.0000	MHz
	10 Hz	10000.00	kHz
	1 Hz	10000.000	kHz
	.1 Hz	*0000.0000	kHz
	AUTO	10000.000	kHz

*OVFL annunciator turns on after 10 sec gate time

4-29. Sensitivity Check, Channel A

4-30. Use the following procedure to verify that Channel A meets the sensitivity specifications listed in Table 1-2.

1. On the Front Panel of the UUT, set the controls to the following position:

FUNCTION -	FREQ A
RESOLUTION -	10 Hz
SEP/COM -	SEP
AC/DC, Channel A -	DC

2. On the Rear Panel of the UUT, set the REF switch to EXT.

3. Connect the equipment in the configuration shown in Figure 4-3, Part A.

4. Program the LF synthesizer for an output of 10 kHz at a level of 100 mV rms.

5. Verify the UUT display is 10.00 kHz ± 1 count.

6. Reduce the programmed output level of the LF synthesizer until the error is greater than ± 1 count. The programmed level should be less than 10 mV rms.

7. On the Front Panel of the UUT, set the Channel A ATTEN control to the X10 position.

8. Program the LF synthesizer for an output level 23 dB above the sensitivity level measured in step 6 above.

9. Verify that the UUT display is 10.00 kHz ± 1 count.

10. Program the LF synthesizer for an output level 17 dB above the sensitivity level measured in step 6 above.

11. Verify that the UUT display is either all zeros or no longer ± 1 count.

12. On the Front Panel of the UUT, set the Channel A ATTEN control to the X100 position.

13. Program the LF synthesizer for an output level 43 dB above the sensitivity level measured in step 6 above.

14. Verify that the UUT display is 10.00 kHz ± 1 count.

15. Program the LF synthesizer for an output level 37 dB above the sensitivity level measured in step 6 above.

16. Verify that the UUT display is either all zeros or no longer ± 1 count.

17. On the Front Panel of the UUT, set the Resolution control to the 1 Hz position.

18. Connect the equipment in the configuration shown in Figure 4-3, Part B.

19. Adjust the RF attenuator and program the HF synthesizer for an input to the UUT of 50 MHz at a level of 100 mV.

20. Verify that the UUT display is 500000.000 kHz ± 1 count.

21. Reduce the level input to the UUT until display is no longer ± 1 count.

22. Verify that the voltmeter reading is less than 10 mV.

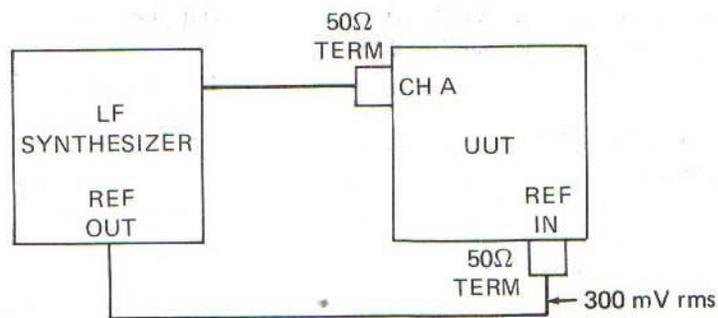
23. On the Front Panel of the UUT, set the Resolution control to the 10 Hz position.

24. Adjust the RF attenuator and program the HF synthesizer for an input to the UUT of 125 MHz at a level of 100 mV.

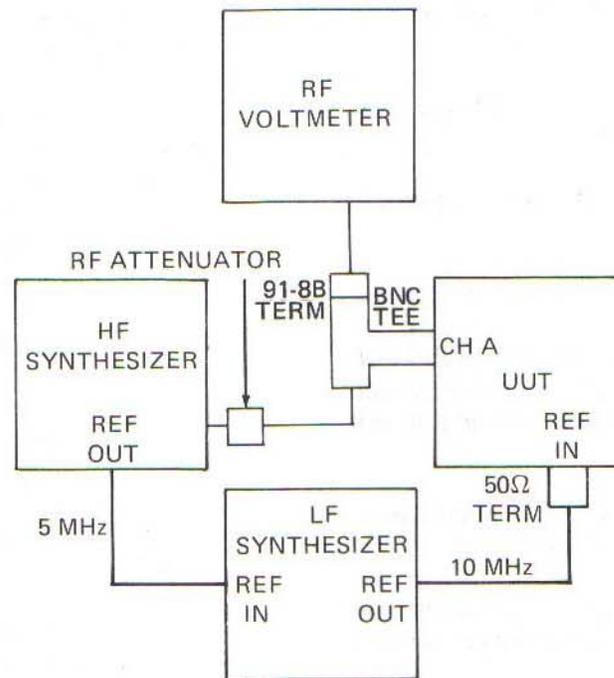
25. Verify that the UUT display is 125000.00 kHz ± 1 count \pm time base error.

26. Reduce the level of the UUT input until the error is greater than ± 1 count.

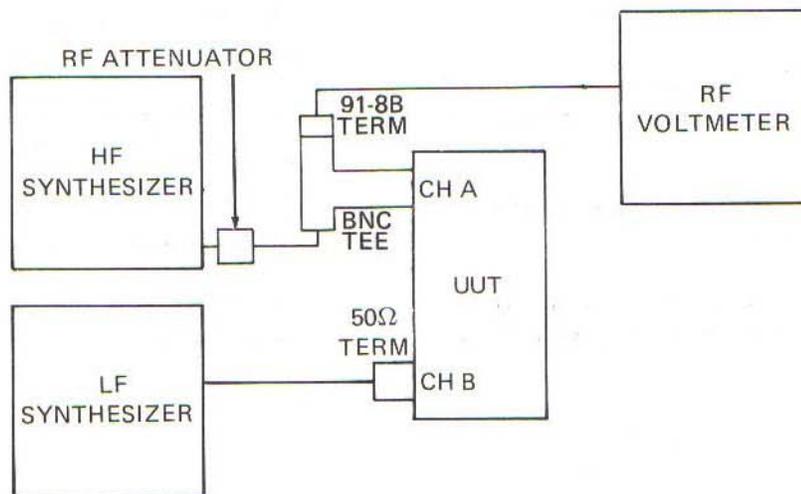
27. Verify that the voltmeter reading is less than 35 mV.



A.



B.



C.

Figure 4-3. FREQ A Check

4-31. Sensitivity Check, Channel B

4-32. Use the following procedure to verify that Channel B meets the sensitivity specifications listed in Table I-2.

1. On the Front Panel of the UUT, set the controls as follows:

FUNCTION -	RATIO A/B
RESOLUTION -	10 ⁰

2. Connect the equipment in the configuration shown in Figure 4-3, Part C.
3. Adjust the RF attenuator and program the HF synthesizer for an input to the UUT of 100 MHz at a level of 50 mV rms.
4. Program the LF synthesizer for an output of 100 kHz at a level of 50 mV rms.
5. Verify that the UUT display is 1000 ± 1 count.
6. Reduce the LF synthesizer programmed level until the UUT display has slightly more than ± 1 count error.
7. Verify that the LF synthesizer programmed level is less than 10 mV rms.
8. On the Front Panel of the UUT, set the Channel B ATTEN control to the X10 position.
9. Program the LF synthesizer for an output level 23 dB above the sensitivity level measured in step 6.
10. Verify that the UUT display is 1000 ± 1 count.
11. Program the LF synthesizer for an output level 17 dB above the sensitivity level measured in step 6.
12. Verify that the UUT display is either all zeros or greater than ± 1 count error.
13. On the Front Panel of the UUT, set the Channel B ATTEN control to the X100 position.
14. Program the LF synthesizer for an output level 43 dB above the sensitivity level measured in step 6.
15. Verify that the UUT display is 1000 ± 1 count.

16. Program the LF synthesizer for an output level 37 dB above the sensitivity level measured in step 6.

17. Verify that the UUT display is either all zeros or greater than ± 1 count.

18. On the Front Panel of the UUT, set the Channel B ATTEN control to the X1 position.

19. Program the LF synthesizer for an output of 2 MHz at a level of 50 mV rms.

20. Verify that the UUT display is 50 ± 1 count.

21. Program the LF synthesizer for an output of 2 MHz at a level of 10 mV rms.

22. Verify that the UUT display is 50 ± 1 count.

4-33. Time Base Check

4-34. Use the following procedure to check the accuracy of the time base and the operation of the REF OUT circuitry.

1. On the UUT, set the Front Panel controls as follows:

FUNCTION -	FREQ A
RESOLUTION -	.1 Hz
ON/STBY -	ON

2. Connect the LF synthesizer to the Channel A input terminal of the UUT via a 50 Ω termination and the shortest length of RG-58 possible.

3. Program the LF synthesizer for an output of 5 MHz at a level of 1V, OPEN.

4. Verify on the UUT that the display reading is 5 MHz \pm maximum allowable count error of ± 28.1 Hz. The maximum allowable count error can be computed for any input signal by multiplying the frequency of the input signal by the total time base accuracy ($\pm 56 \times 10^{-7}$) and then adding the ± 1 count to the product.

5. Connect the oscilloscope to the REF OUT terminal on the UUT through as short a length of RG-58 as possible. The oscilloscope end of the test cable must have a 50 Ω termination.

6. Verify that the waveform displayed on the oscilloscope is a 10 MHz square wave with the logic high greater than .5V.

4-35. Frequency A Function Check

4-36. Use the following procedure to check the FREQ A function of the instrument.

1. On the Front Panel of the UUT, set the controls to the following position:

ON/STBY -	ON
FUNCTION -	FREQ A
RESOLUTION -	10 kHz
AC/DC, CHANNEL A -	AC
SEP/COM -	SEP
ATTN CHANN A -	X 1
SLOPE, CHANN A -	—

2. On the Rear Panel of the UUT, set the REF switch to the EXT position.

3. Connect the HF synthesizer to the Channel A input terminal via a 50 Ω termination as shown in Figure 4-3, Part B.

4. Program the HF synthesizer for the UUT inputs shown in Table 4-4 for each position of the ATTENUATION switch on the UUT.

5. Verify that the UUT display agrees with the frequency programmed ± 1 count.

6. On the Front Panel of the UUT, set the Channel A \pm switch to +.

7. Repeat steps 3 and 4.

8. Disconnect the HF synthesizer and connect the LF synthesizer as shown in Figure 4-3, Part A.

9. On the Front Panel of the UUT, set the Resolution control to the positions indicated in Table 4-5. For each setting of the Resolution control, program the LF synthesizer for the indicated output frequency and level.

10. Verify that the UUT display is within ± 1 count of the frequency programmed in each step of Table 4-5.

11. On the Front Panel of the UUT, set the \pm switch in the - position.

12. Repeat steps 8 and 9.

Table 4-4. FREQ A Function Check - High Frequencies

HF SYNTHESIZER PROGRAMMED VALUES	
LEVEL (rms)	FREQUENCY (MHz)
10 mV	1
	10
	25
	50
15 mV	60
	70
	80
	90
	100
35 mV	110
	125

Table 4-5. FREQ A Function Check - Low Frequencies

RESOLUTION CONTROL	LF SYNTHESIZER PROGRAMMED FREQUENCY	
	FREQUENCY	LEVEL (rms)
		X1
1 Hz	10 Hz	10 mV
	100 Hz	
	1 kHz	
100 Hz	1 kHz	10 mV
	10 kHz	
	100 kHz	
	1 MHz	

4-37. CPM X100A Function Check

4-38. Use the following procedure to check the CPM X100A function of the instrument.

1. On the Front Panel of the UUT, set the controls to the following position:

FUNCTION -	CPM X100A
RESOLUTION -	0.1 Hz
FILTER -	IN
ON/STBY -	ON

2. Connect the LF synthesizer to the Channel A input of the UUT via a 50 Ω termination.

3. Program the LF synthesizer for an output of 5 kHz at a level of 100 mV rms.

4. Verify on the UUT that:
 - a. 3000 is displayed.
 - b. Decimal point is blank.
 - c. No units annunciator is illuminated.
5. On the Front Panel of the UUT, sequence the Resolution control to all of its positions.
6. Verify on the UUT that:
 - a. The display remains unchanged.
 - b. No decimal point is illuminated.
 - c. No units annunciator is illuminated.

4-39. Ratio A/B Function Check

4-40. Use the following procedure to check the Ratio A/B function of the UUT.

1. On the Front Panel of the UUT, set the controls to the following position:

FUNCTION -	RATIO
RESOLUTION -	10 kHz
+/-, Channels A & B -	+
AC/DC, Channels A & B -	DC

2. On the Rear Panel of the UUT, set the INT/EXT REFERENCE control to the EXT position.

3. Connect the equipment in the configuration shown in Figure 4-4.

4. Program the LF synthesizer for an output of 2.0 MHz at a level of 100 mV rms.

5. Program the HF synthesizer so that the UUT input is the frequencies listed in Table 4-6 at a level of 100 mV rms.

6. Verify that the UUT display agrees within ± 1 count with the value listed in Table 4-6 for each frequency programmed into the HF synthesizer.

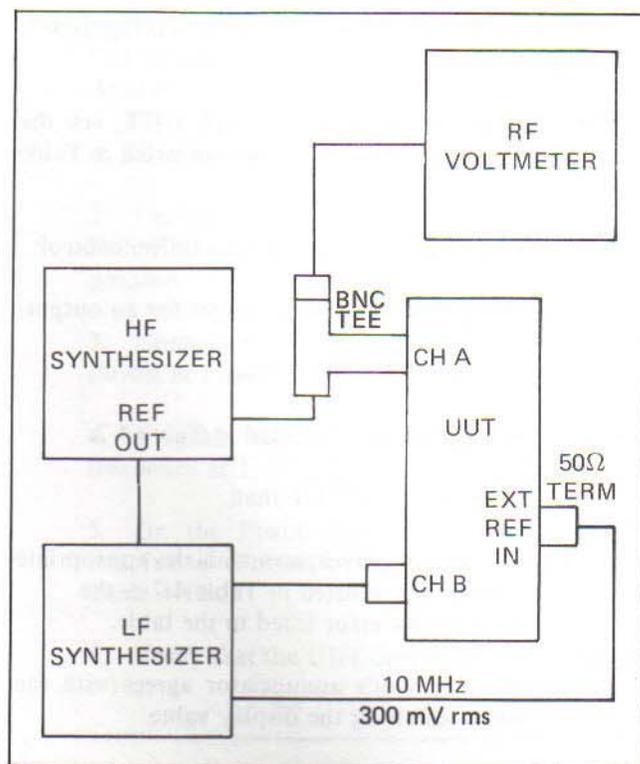


Figure 4-4. Ratio A/B Check

Table 4-6. RATIO A/B Function Check

HF SYNTHESIZER PROGRAMMED FREQUENCY (MHz)	UUT DISPLAY
10	5.00000
20	10.00000
50	25.00000
60	30.00000
70	35.00000
80	40.00000
90	45.00000
100	50.00000
110	55.00000
120	60.00000
130	65.00000
140	70.00000

4-41. Period A Function Check

4-42. Use the following procedure to check the Period A function of the UUT:

1. On the Front Panel of the UUT, set the Function control to the PER A position.
2. On the Rear Panel of the UUT, set the INT/EXT REFERENCE switch to the EXT position.

3. Connect the equipment as shown in Figure 4-3, Part A.
4. On the Front Panel of the UUT, set the Resolution control to the positions listed in Table 4-7.
5. For each position of the Resolution control:
 - a. Program the LF synthesizer for an output.
 - 1) Level of 100 mV rms.
 - 2) Frequency indicated in Table 4-7.
 - b. Verify on the UUT that:
 - 1) The display agrees with the appropriate Display value listed in Table 4-7 \pm the appropriate error listed in the table.
 - 2) The unit's annunciator agrees with the units following the display value.

Table 4-7. PER A Function Check

LF SYNTHESIZER FREQUENCY PROGRAMMED	UUT		
	RESOLUTION SWITCH	DISPLAY	ERROR(\pm COUNTS)
2 MHz	10 nsec	0.50 μ sec	± 1
100 kHz	10 nsec	10.00 μ sec	± 3
10 kHz	100 nsec	0.1000 μ sec	± 3
1 kHz	1 μ sec	1.000 msec	± 3
100 Hz	10 μ sec	10.00 msec	± 3
10 Hz	100 μ sec	0.1000 sec	± 3
1 Hz	1 msec	1.000 sec	± 3

4-43. PER AVG A Function Check

4-44. Use the following procedure to check the Period Averaging function of the UUT.

1. On the Front Panel of the UUT, set the Function control to the PER AVG A position.
2. On the Rear Panel of the UUT, set the INT/EXT REFERENCE control to the EXT position.
3. Connect the equipment in the configuration shown in Figure 4-3, Part A.
4. On the Front Panel of the UUT, set the Resolution control to the positions listed in Table 4-8.

5. Program the LF synthesizer for an output frequency of 100 kHz at a level of 100 mV rms.
6. On the Front Panel of the UUT, set the Resolution control to the positions listed in Table 4-8.
7. Verify on the UUT that for each position of the Resolution switch:
 - a. The display agrees with the value listed in Table 4-8.
 - b. The unit's annunciation agrees with the unit listed for that display reading in Table 4-8.

Table 4-8. PER AVG A Function Check

RESOLUTION	DISPLAY	ERROR (\pm COUNTS)
AUTO	10.00000 μ sec	± 1
10^5	0.0000000 μ sec*	± 1
10^4	10.000000 μ sec	± 1
10^3	10.00000 μ sec	± 1
10^2	10.0000 μ sec	± 1
10^1	0.010000 msec	± 1
10^0	0.01000 msec	± 3

*OVFL annunciator is illuminated

4-45. TI A-B Function Check

4-46. Use the following procedure to check the Time Interval A to B function of the UUT.

1. On the Front Panel of the UUT, set the controls as follows:

FUNCTION -	TI A-B
SEP/COM -	COM
AC-DC -	DC
\pm , CHANNEL A -	+
\pm , CHANNEL B -	-

2. On the Rear Panel of the UUT, set the INT/EXT REFERENCE switch to the EXT position.
3. Connect the equipment in the configuration shown in Figure 4-3, Part A.
4. On the Front Panel of the UUT, set the Resolution control to each of the positions listed in Table 4-9.
5. For each position of the Resolution control:
 - a. Program the LF synthesizer for an output:

- 1) Level of 2V rms.
- 2) Frequency indicated in Table 4-9 for that position of the Resolution control.

b. Verify on the UUT that:

- 1) The displayed value agrees within ± 1 count of the value listed under Display for the position of the Resolution control selected and the LF synthesizer frequency programmed.

- 2) The unit's annunciator agrees with the units for that Display value.

6. On the Front Panel of the UUT, set the controls to the following positions:

RESOLUTION - 10^1
 HOLDOFF - Maximum counter clockwise but not in OFF position

7. Program the LF synthesizer for an output of 2 MHz at a level of 2V rms.

8. Verify that the display is not greater than 0.01YY msec. (Y = don't care.)

9. On the Front Panel of the UUT, rotate the TI Holdoff control maximum clockwise.

10. Verify on the UUT, that the display reading is not less than 20.YYYY msec. (Y = don't care.)

Table 4-9. TI A-B Function Check

LF SYNTHESIZER	UUT	
	RESOLUTION CONTROL	DISPLAY
100 kHz	10 nsec	5.00 μ sec
10 kHz	100 nsec	.0500 msec
1 kHz	1 μ sec	0.500 msec
100 Hz	10 μ sec	5.00 msec
10 Hz	100 μ sec	.0500 sec
10 kHz	AUTO	.0500 msec

4-47. TIA A-B Function Check

4-48. Use the following procedure to check the Time Interval, A to B averaging function of the UUT.

1. On the Front Panel of the UUT, set the controls to the following positions:

FUNCTION - TIA A-B
 SEP/COM - SEP
 AC-DC - AC
 \pm , CHANNEL A - +
 \pm , CHANNEL B - -

2. On the Rear Panel of the UUT, set the INT/EXT REFERENCE switch to the EXT position.

3. Connect the equipment in the configuration shown in Figure 4-5.

4. Program the LF synthesizer for an output frequency at 1.12345 MHz at a level of 2V rms.

5. On the Front Panel of the UUT, set the Resolution control to the positions indicated in Table 4-10.

6. Verify that the UUT display agrees with Table 4-10.

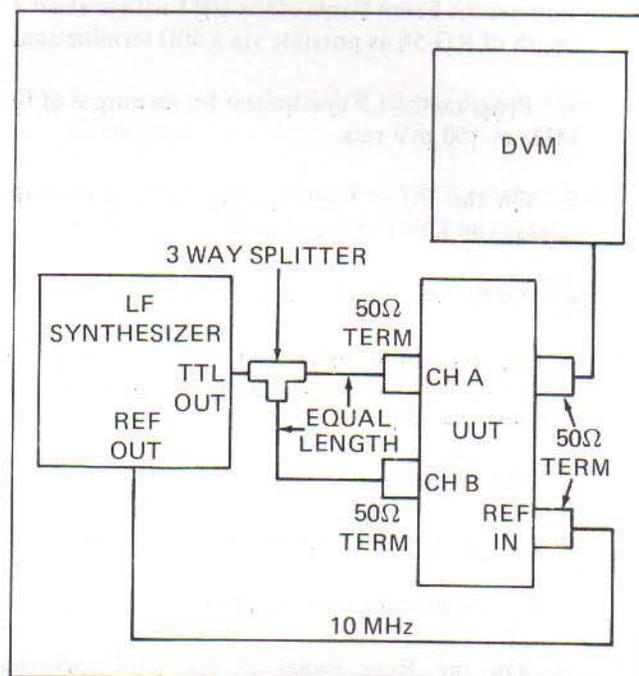


Figure 4-5. TIA A-B Check

Table 4-10. TIA A-B Function Check

RESOLUTION CONTROL	DISPLAY	JITTER (in COUNTS)	ERROR
10^0	.00044 msec	± 1	± 2 ns \pm Time Base Error Error (10 ns + Trig. Error) N +
10^1	.000445 msec	± 3	
10^2	.445 μ sec	± 10	
10^3	.4450 μ sec	± 33	
10^4	.44505 μ sec	± 100	
10^5	.445055 μ sec	± 330	

4-49. Continuous/Single Trigger Check

4-50. Use the following procedure to verify that the UUT performs properly when either continuous or single triggering is selected.

1. On the Front Panel of the UUT, set the controls to the following positions:

ON/STBY -	ON
FUNCTION -	FREQ A
RESOLUTION -	1 Hz
±, CHANNEL A -	+
±, CHANNEL B -	+
TRIGGER LEVEL, CHANNEL B -	Fully Clockwise
CHANNEL A	PRESET

2. On the Rear Panel of the UUT, set the MODE switch to the TRIG position.
3. Connect the LF synthesizer to the Channel A input on the Front Panel of the UUT with as short a length of RG-58 as possible via a 50Ω termination.
4. Program the LF synthesizer for an output of 10 MHz at 100 mV rms.
5. On the Front Panel of the UUT, press and release the RESET pushbutton.
6. Verify that the display is 0.000 kHz.
7. On the Front Panel of the UUT, rotate the Channel B Trigger Level control fully counterclockwise.
8. Verify that:
 - a. The GATE annunciator flashes once.
 - b. 10000.000 kHz is displayed.
9. On the Rear Panel of the UUT, set the CONT/TRIG switch to the CONT position.
10. Verify that:
 - a. The GATE annunciator is flashing.
 - b. 100000.000 kHz is displayed.

4-51. External Reference Input Check

4-52. Use the following procedure to check proper performance of the instrument with an external reference input used as time base.

NOTE

Both synthesizers used must be synchronous to a common reference.

1. On the Front Panel of the UUT, set the controls to the following positions:

ON/STBY -	ON
FUNCTION -	FREQ A
RESOLUTION -	10 Hz
AC/DC, Channels A & B -	DC
±, Channels A & B -	+

2. On the Rear Panel of the UUT, set the INT/EXT REFERENCE switch to the EXT position.
3. Connect the LF synthesizer to the EXT REF terminal on the Rear Panel of the UUT via a 50Ω termination.
4. Program the LF synthesizer for an output of 10 MHz at a level of 300 mV rms.
5. Connect the HF synthesizer to the Channel A input terminal of the Front Panel of the UUT.
6. Program the HF synthesizer for an input to the UUT of 100 MHz at a level of 100 mV rms.
7. Verify that the display of the UUT is 100000.00 kHz ±1 count.
8. Increase the programmed frequency of the HF synthesizer by 100 Hz.
9. Verify that the display of the UUT is 100000.10 kHz ±1 count.
10. Increase the programmed frequency of the HF synthesizer by 100 Hz.
11. Verify that the display of the UUT is 10000.20 kHz ±1 count.

4-53. Marker Check

4-54. Use the following procedure to check the MARKER output.

1. On the Front Panel of the UUT, set the controls in the following positions:

ON/STBY -	ON
FUNCTION -	RATIO A/B
RESOLUTION -	100
SEP/COM -	COM
AC/DC, Channels A & B -	DC

2. Connect the LF synthesizer and dual trace oscilloscope to the UUT as shown in Figure 4-6.
3. Program the LF synthesizer for an output of 1 kHz at a level of 1V rms.
4. On the Front Panel of the UUT, set the \pm controls to: Channel A, +; Channel B, -.
5. Verify that the waveform displayed on the oscilloscope is about the same as the waveform shown in Figure 4-7, Part A.
6. On the Front Panel of the UUT, set the \pm controls to: Channel A, -; Channel B, +.
7. Verify that the waveform displayed on the oscilloscope is about the same as the waveform shown in Figure 4-7, Part B.

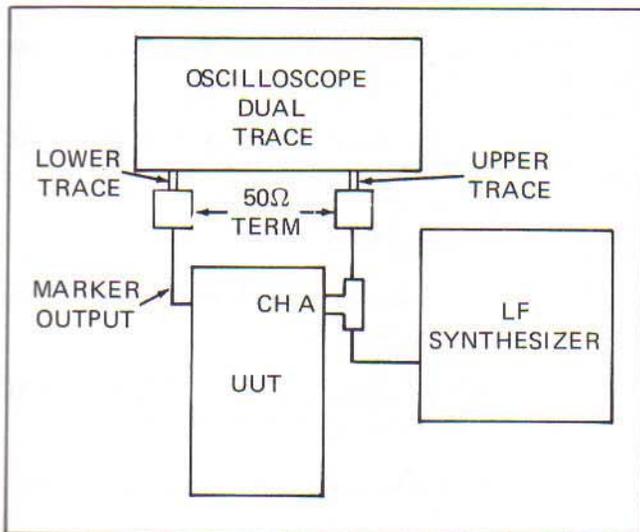


Figure 4-6. Marker Check

4-55. Filter Check

4-56. Use the following procedure to check the operation of the 100 kHz low pass filter on Channel A and Channel B of the UUT.

1. Set the Front Panel of the UUT, set the controls to the following position:

FUNCTION -	FREQ A
RESOLUTION -	1 kHz
FILTER -	OUT
ON/STBY -	ON
\pm , Channels A & B -	+
AC/DC, Channels A & B -	DC

2. On the Rear Panel of the UUT, set the REF switch to EXT.
3. Connect the equipment as shown in Figure 4-3A.
4. Program the LF synthesizer connected to Channel A for an output of 1.0 MHz at a level of 10 mV.
5. Verify on the UUT that, 1.000 MHz is displayed.
6. On the Front Panel of the UUT, set the Channel A FILTER switch to the IN position.
7. Verify on the UUT that, 0.000 MHz is displayed.

4-57. CALIBRATION ADJUSTMENTS

4-58. These procedures should be performed whenever the instrument has been repaired or fails to pass the Performance Checks.

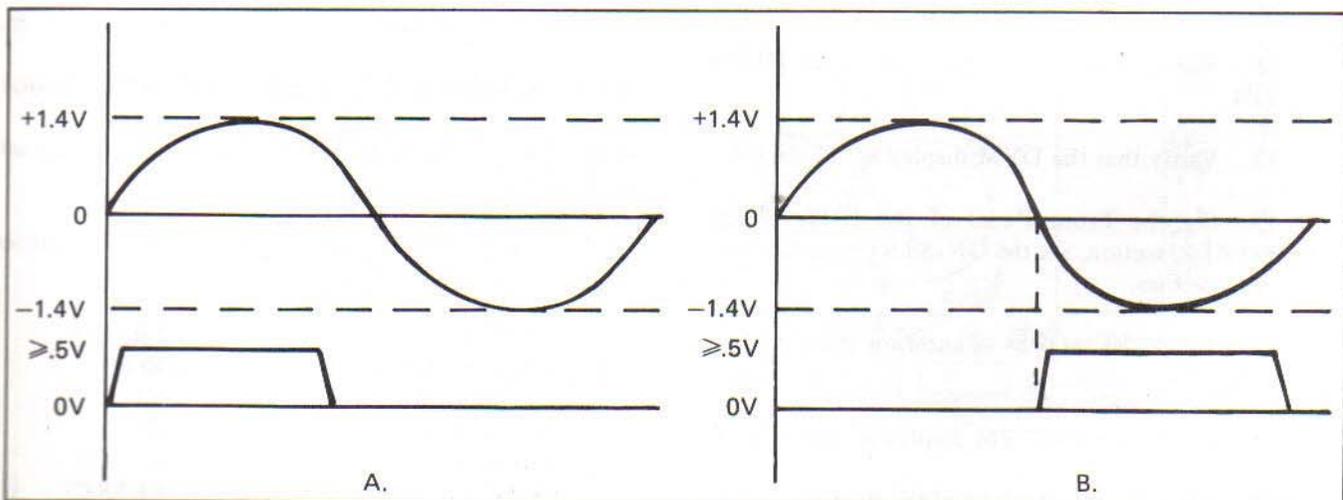


Figure 4-7. Marker Output Waveform

4-59. Power Supply Voltage Adjustments

4-60. Use the following procedure to adjust the power supply voltages in the UUT. Figure 4-8 shows the location of test point and adjustments.

1. Remove the top instrument case cover. (Use the disassembly procedure presented earlier in this section.)
2. Connect the instrument to line power through a Variac set to zero volts.
3. On the Front Panel of the UUT, in the POWER section, set the ON/STBY switch to the STBY position.
4. On the Rear Panel of the UUT, set the AC POWER switch to the ON position.
5. Using the line voltage selection guide presented earlier in this section, set S4 and S5 to the proper position to select local line voltage. If the instrument is to be used for areas with more than one line voltage, set S4 and S5 for the line voltage used most. (This voltage will be considered local line voltage for the remainder of this procedure.)
6. Set the Variac for an output voltage of 120V ac.
7. Connect the DVM to the UUT, + to TP1, - to E1 (or any other UUT common point). See Figure 4-8 for aid in locating test points or adjustments.
8. Adjust R4 for a DVM display of $+5.00 \pm 0.05V$.
9. Move the +DVM connection from TP1 to TP2.
10. Verify that the DVM display is $+12 \pm 0.6V$.
11. Move the DVM + connection from TP2 to TP4.
12. Verify that the DVM display is $-12 \pm 0.6V$.
13. On the Front Panel of the UUT, in the POWER section, set the ON/STBY switch to the ON position.
14. Move the +DVM connection from TP4 to TP3.
15. Verify that the DVM display is $-5.0 \pm 0.15V$.
16. Select the ac-coupled mode on the oscilloscope.

17. Connect the oscilloscope probe to TP1, then, in turn, TP2, TP3, and TP4.

18. Verify that at each test point the ripple voltage is less than 50 mV p-p.
19. Set the Variac output to local line voltage plus 10% of local line voltage.
20. Use the DVM to verify that the voltage present at TP1, TP2, TP3, and TP4 is within the range listed in steps 8, 10, 12 and 15.
21. Repeat steps 16 through 18.
22. Set the Variac output to local line voltage minus 10% of local line voltage.
23. Repeat step 20.
24. Repeat steps 16 through 18.
25. If the instrument is to be operated with other line power voltages:
 - a. On the Rear Panel of the UUT, set the AC POWER switch to the OFF position.
 - b. Set the Variac to zero volts.
 - c. Set S4 and S5 to the proper position for the line voltage desired.
 - d. On the Rear Panel of the UUT, set the AC POWER switch to the ON position.
 - e. Set the Variac to the desired line voltage.
 - f. Perform steps 16 through 18.
 - g. Repeat sub-steps a through f for each line voltage that the instrument will be powered on.

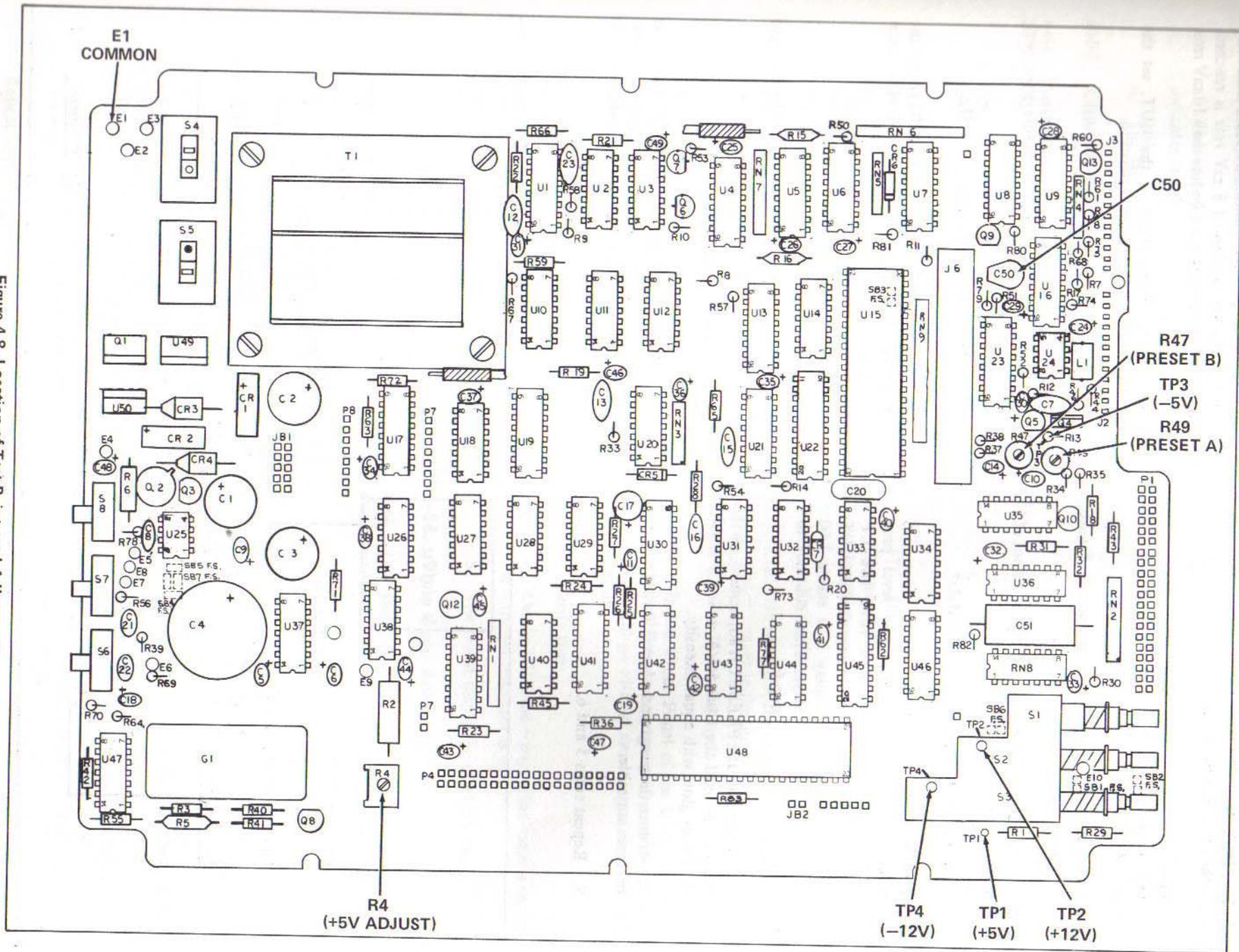
4-61. Channel A Trigger Level Adjustment

4-62. Use the following procedure to adjust the Channel A Trigger Level:

1. On the Front panel of the UUT, set the controls to the following position.

FUNCTION -	FREQ A
RESOLUTION -	10 kHz
ATTEN (CH A) -	X1
AC/DC (CH A) -	DC
\pm , (CH A) -	+
TRIGGER LEVEL (CH A) -	PRESET
SEP/COM -	SEP

Figure 4-8. Location of Test Points and Adjustments



2. On the Rear Panel of the UUT, set the controls to the following positions:

REF -	EXT
TRIGGER LEVEL -	CH A
AC POWER -	ON

3. Connect the equipment as shown in Figure 4-9A.

4. Program the LF synthesizer for an output of 1 MHz at a level of 10 mV rms.

5. Is the UUT display stable 1.00 MHz?

YES -	Go to step 6
NO -	Increase the level programmed into the LF synthesizer until the UUT display is a stable 1.00 MHz. Then continue to step 6.

6. Adjust R49, the PRESET A adjustment, on the Main PCB until the Channel A + and - trigger indicators glow with equal intensity.

7. Reduce the programmed level until the display becomes unstable.

8. Repeat steps 5 and 6.

9. Repeat steps 7 and 8 until maximum sensitivity or a programmed level of 8 mV rms is reached. maximum sensitivity must be less than 10 mV rms.

10. On the Front Panel of the UUT, set the Channel A \pm switch to the - position.

11. Verify that on the UUT:

a. The + and - trigger indicators glow with equal intensity.

b. The display is a stable 1.00 MHz.

12. On the Front Panel of the UUT, rotate the Channel A Trigger Level control maximum clockwise.

13. Verify that:

a. The - trigger indicator is on and the + trigger indicator is off.

b. The DVM display is $\leq -1.5V$.

14. On the Front Panel of the UUT, rotate the Channel A Trigger Level control counterclockwise as far as it will go without switching into the PRESET position.

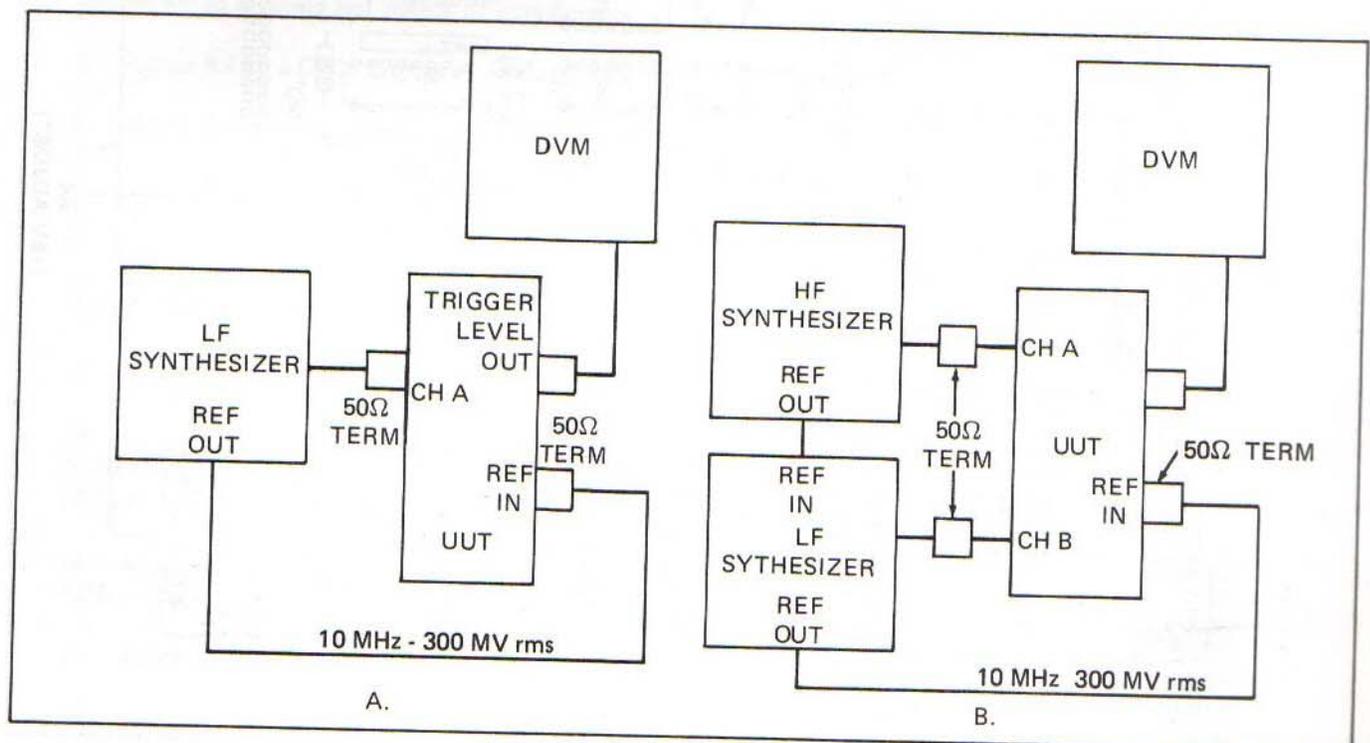


Figure 4-9. Trigger Level Adjustment

15. Verify that:

- The + trigger indicator is on and the - trigger indicator is off.
- The DVM display is $\geq +1.5V$ rms.

4-63. Channel B Trigger Level Adjustment

4-64. Use the following procedure to adjust the Channel B Trigger Level:

- On the Front Panel of the UUT, set the controls to the following positions:

FUNCTION -	RATIO A/B
RESOLUTION -	10^3
AC/DC (CH A&B) -	DC
\pm (CH A&B) -	+
SEP/COM -	SEP
TRIGGER LEVEL -	PRESET

- On the Rear Panel of the UUT, set the controls to the following position:

REF -	EXT
TRIGGER LEVEL -	CH B
AC POWER -	ON

- Connect the equipment as shown in Figure 4-9B.

- Program the LF synthesizer for an output of 1 MHz at a level of 10 mV rms.

- Program the HF synthesizer for an output of 1.0 MHz at a level of approximately 300 mV rms.

- On the UUT, is the GATE annunciator flashing and display stable 1.000 ± 1 ?

YES	Proceed to step 6.
NO	Increase the programmed level of the LF synthesizer until the GATE annunciator flashes and the display is a stable 1.000 ± 1 . Then proceed to step 6.

- Adjust R47, the PRESET B adjustment, on the Main PCB until the Channel B + and - trigger indicators glow with equal intensity.

- Reduce the programmed level until the display becomes unstable.

- Repeat steps 5 and 6.

- Repeat steps 7 and 8 until maximum sensitivity or a programmed level of 8 mV rms is reached. Maximum sensitivity must be less than 10 mV rms.

- On the Front Panel of the UUT, set the \pm switch to the - position.

- Verify that on the UUT:

- The + and - trigger indicators glow with equal intensity.
- The GATE annunciator is flashing.
- The display is a stable 1.000 ± 1 .

- On the Front Panel of the UUT, rotate the Channel B Trigger Level control maximum clockwise.

- Verify that:

- On the UUT, the - trigger indicator is on and the + trigger indicator is off.
- The DVM display is $\geq -1.5V$ rms.

- On the Front Panel of the UUT, rotate the Channel B Trigger Level control counterclockwise as far it will go without switching to the PRESET position.

- Verify that:

- On the UUT, the + trigger indicator is on the the - trigger indicator is off.
- The DVM display is $\leq +1.5V$ rms.

4-65. Time Base Adjustment

4-66. Use the following procedure to adjust the standard time base or any of the three optional time bases:

- Connect the instrument to line power through a Variac set to local line voltage.

- Allow the instrument to warmup at least 5 minutes with the case covers on. The longer the instrument has warmed up, the better.

- On the Front Panel of the UUT, set the controls to the following positions:

FUNCTION -	FREQ A
RESOLUTION -	1 Hz
TRIGGER LEVEL (CH A) -	PRESET
ATTEN (CH A) -	X1
AC/DC (CH A) -	DC
\pm (CH A) -	+

4. On the Rear Panel of the UUT, set the REF switch to the INT position.
5. Connect the LF synthesizer to the Channel A input terminal on the UUT via a 50Ω termination and as short a length of RG-58 as possible.
6. Program the LF synthesizer for an output of 10.0 MHz at a level of 100 mV rms.
7. Verify that the UUT display is stable and reads about 10000.000 kHz.
8. On the Front Panel of the UUT, set the RESOLUTION control to the .1 Hz position.
9. Verify that on the UUT display, the OVFL annunciator illuminates.
10. Use the JFD 258 tuning tool to adjust the time base adjustment so that the UUT displayed value is within 9999.9449 to 0000.0551*. Ideally, the display will be all zeros, indicating an exact alignment. Figure 4-10 shows the location of the time base adjustment hole in the bottom case cover off the UUT.

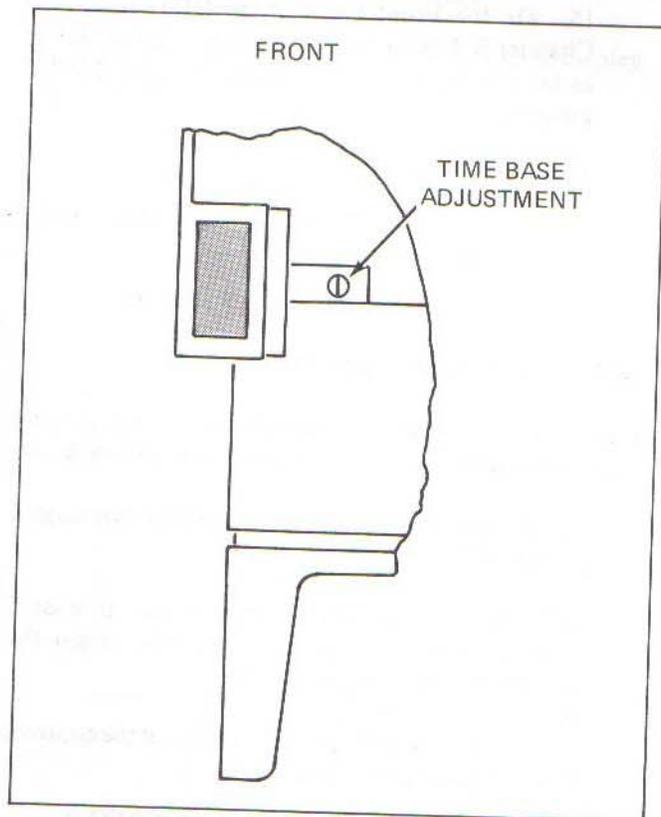


Figure 4-10. Time Base Adjustment Location

***NOTE**

The OVFL annunciator will illuminate every time the displayed value is 10000.0000 kHz or greater.

11. If the time base cannot be adjusted and is of the standard, free air type, remove the top case cover and look at the top of the time base pcb, perform the Coarse Time Base Adjustment procedure presented next in this section.

12. If the time base cannot be adjusted within specifications and is not of the type described in step 11, troubleshooting is indicated.

4-67. Coarse Time Base Adjustment

4-68. Some of the standard, free air, time bases have a coarse adjustment located on top of the A1A1 Time Base PCB. If the time base cannot be adjusted within proper limits using the previous time base calibration procedure, use the following procedure to coarse adjust the time base.

1. Connect the UUT to line power through a Variac set to the local line voltage.
2. Remove the top case cover (refer to the instrument access procedure presented earlier in this section).
3. On the Front Panel of the UUT, set the controls to the following positions:

FUNCTION -	FREQ A
RESOLUTION -	1 Hz
TRIGGER LEVEL (CH A) -	PRESET
ATTEN (CH A) -	X1
AC/DC (CH A) -	AC
\pm (CH A) -	+

4. On the Rear Panel of the UUT, set the REF switch to the INT position.
5. Use the JFD 258 tuning tool to adjust the fine time base adjustment to mid-range.
6. Connect the LF synthesizer to the Channel A input terminal of the UUT via a 50Ω termination.
7. Verify that the display is stable.
8. Using the JFD 258 tuning tool, adjust the coarse (top) time base adjustment until the display is as close as possible to 10000.000 kHz.
9. Connect the top case cover.
10. Wait at least 1/2 hour.
11. Perform the Time Base Adjustment procedure.

4-69. 100 MHz Time Base Adjustment

4-70. Use the following procedure for adjusting the 100 MHz time base on the 10-100 MHz Multiplier PCB. Figure 4-11 shows the location of the test points and adjustments. The test points are labeled on the land pattern side of the pcb.

1. On the UUT, set the controls to the following positions:

FUNCTION -	PER A
RESOLUTION -	10 ns
SEP/COM -	SEP
TRIGGER LEVEL -	PRESET
MODE -	CONT
REF -	EXT
± -	+

2. Remove the top case cover of the UUT.
3. Connect LF synthesizer as shown in Figure 4-3, Part A.
4. Program the LF synthesizer for an output of 10 MHz at a level of 300 mV.
5. Connect the DMM, + to TP1 on the 10-100 MHz PCB; - to common.

6. Adjust C19 (on the 10-100 MHz PCB) for a DMM display of $6.3 \pm 0.3V$.

7. Alter the LF synthesizer output to 9.7 and 10.3 MHz.

8. Verify that the DMM display goes to approximately 3V to 11V.

9. Disconnect the DMM.

10. Connect the oscilloscope through an X10 probe to U5-7 on the Main PCB.

11. Verify that the signal on the oscilloscope display is approximately 600 mV p-p on a dc offset of approximately 3.5V.

12. On the Front Panel of the UUT, set the FUNCTION and RESOLUTION controls to the positions shown in Table 4-11.

13. Verify that the 100 MHz signal is either present or absent from the oscilloscope display as listed in the table for each combination of control settings.

14. Perform the Time Base Adjustment procedure.

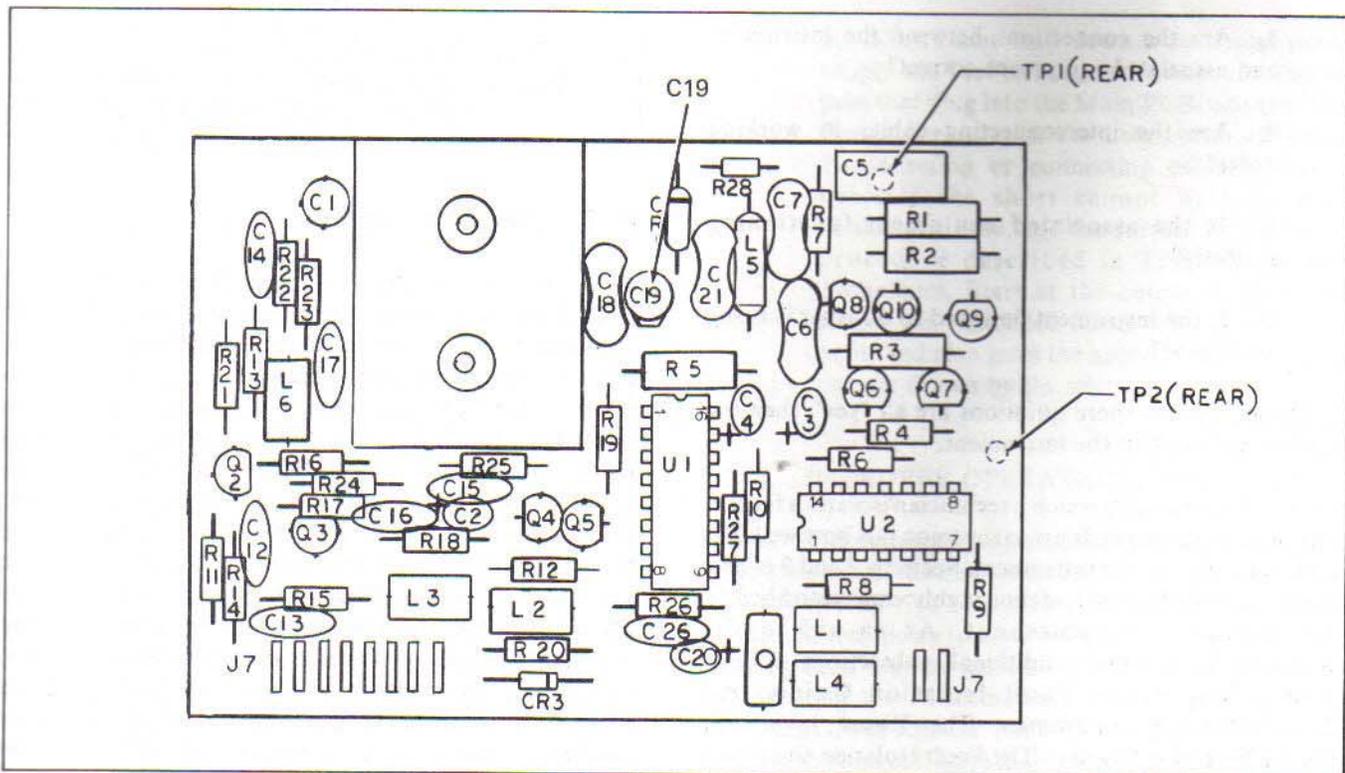


Figure 4-11. 10-100 MHz Multiplier PCB Adjustment and Test Point Location

Table 4-11. 100 MHz Time Base

FUNCTION CONTROL	RESOLUTION CONTROL	100 MHz SIGNAL	
		PRESENT	ABSENT
PER A	10 ns	X	
PER A	any but 10 ns		X
PER AVG A	any	X	
TI A-B	10 ns	X	
TI A-B	any but 10 ns		X
TIA A-B	any	X	

4-71. TROUBLESHOOTING

4-72. Introduction

4-73. The material in the remainder of this section is presented as a troubleshooting aid for the technician. If the instrument fails to perform as expected, select the CHK function. If the instrument display is incorrect, the fault is in the instrument. But, if the display is correct, the fault may not lie in the instrument. Ask the following questions:

1. Are the instrument controls set to the proper position?
2. Are the controls of associated equipment set to the proper positions?
3. Are the connections between the instrument and associated equipment correct?
4. Are the interconnecting cables in working order?
5. Is the associated equipment functioning properly?
6. Is the instrument designed to do what is being attempted?

If the answers to these questions are all "yes", then the fault is probably in the instrument.

4-74. The ease with which a technician isolates a fault in any instrument depends primarily upon just how well that technician knows the instrument. Sections 2 and 3 of this manual should be read and thoroughly understood before attempting to troubleshoot. As an aid to the troubleshooter, three additional subsections follow: Visual Inspection, Fault Isolation Guide, and Troubleshooting Techniques. The Visual Inspection should be performed first. The Fault Isolation Guide is a brief check of all instrument functions. The procedure

should enable the technician to isolate the fault to a circuit or circuits. Once a suspect circuit is identified, the Troubleshooting Techniques provide the technician with suggestions for troubleshooting IC technology circuits.

4-75. When working with the instrument, either to troubleshoot or to make repairs, observe the warning given at the beginning of this section dealing with handling techniques and preventing static discharge damage. In addition, care should be taken when soldering as hidden damage to the instrument can be caused as well as obvious damage.

4-76. The instrument uses three basic types of logic: ECL, TTL, and CMOS. The circuits handling the high frequency signals employ Emitter Coupled Logic (ECL) because of its faster switching capability. Positive ECL is used to reduce interfacing problems. On the schematics in Section 8, ECL logic terms are usually identified by a prime (') symbol immediately following the term. Circuitry using CMOS IC's work at CMOS logic levels. The remainder of the instrument employs Transistor-Transistor Logic (TTL). Table 4-12 lists the high and low logic levels for each of the three types of logic used in the instrument.

Table 4-12. Instrument Logic Levels

LOGIC TYPE	LOGIC 1	LOGIC 0
TTL	>2.5V	<0.6V
ECL	>4.1V	<3.2V
CMOS	>3.5V (>70% of supply)	<1.5V (<30% of supply)

4-77. Visual Inspection

4-78. Visual inspection can sometimes quickly locate instrument faults saving the technician the time usually consumed in extensive troubleshooting. Use the Disassembly procedure presented earlier in this section to remove the top case cover. Carefully inspect the instrument inside and out. Check for loose or broken wires and component leads, improperly seated plug-in assemblies, physically damaged component, discoloration due to arcing, etc. Shorted IC's usually have a small bubble or discoloration at the center of the package. Shorted capacitors or resistors in short paths are often discolored or burnt. Abusively high overloads may blow carbon composition resistors, glass diodes, ceramic capacitors, thermistors, etc into fragments. These symptoms or anything that looks suspect should be carefully checked before proceeding with involved troubleshooting.

4-79. Fault Isolation Guide

4-80. The Fault Isolation Guide is a simplified check of instrument performance. It is intended to direct the troubleshooter to the defective circuit or circuits. There are three basic cases of improper operation:

1. The instrument will not turn on. Use the Power Up procedure.
2. The instrument turns on but the problems seem to be spread throughout the instrument or erratic. This may be due to any of a number of power supply related problems. Use the Power Up procedure.
3. The instrument has a problem in one or more function or range. Use the Improper Operation procedure.

4-81. POWER UP PROCEDURE

CAUTION

Line power voltage is present from the power cord throughout the primary circuit or the main power transformer. Do not contact this voltage.

4-82. If the instrument cannot be turned on, the problem may lie in several areas: the line power used may not be present, the AC POWER switch may be in the OFF position, the main power fuse, F1, may be blown, or there may be a power supply problem. Power supply problems can be caused both by faults in the power supply circuitry and by shorts in the instrument loading the power supply down. Points to consider when attempting to isolate power problems are listed below. If the UUT will operate but the symptoms are erratic or widespread, seemingly disassociated then go directly to item number 6.

1. Insure that line power is present at the receptacle being used.
2. Insure that the Rear Panel AC POWER switch is in the ON position.
3. Check F1, the main power fuse.
4. Make continuity measurements between chassis common and the three pins of the power receptacle. The ground pin to common should be zero volts. The other two pins to common should be infinity.
5. Make the continuity measurement between the two non-ground pins of the Rear Panel power receptacle. (The AC POWER switch should be in the ON position.) There should be some slight resistance because the measurement is taken through the primary windings of the main power transformer.

6. Measure the power supply voltages at TP1, TP2, TP3 and TP4 with the Front Panel POWER ON/STBY switch in both positions. Use E1 for the common reference when making these measurements. If all voltages are within the limits listed in the Power Supply Voltage Adjustment procedure, proceed to item 7. If one or more voltage is incorrect when the POWER ON/STBY switch is in the STBY position, the problem is in the power supply, proceed to item 6, Part A. If one or more voltages is/are incorrect only when the POWER ON/STBY switch is in the ON position, the fault does not lie in the power supply, proceed to item 6, Part B.

a. Problems in the power supply can be tracked down using conventional methods, but remember that:

- 1) The -5V supply "tracks" the +5V supply so if the +5V supply has a problem, it will affect both power supplies.
- 2) The +5V supply "tracks" the +12V supply, so if the +12V supply has a problem, it will affect the +12V, +5V and -5V supplies.
- 3) The -12V supply, after the rectifier, CR1, is independent of the other supplies. Problem in all four power supplies indicates that the fault lies in the primary circuit, transformer, or CR1.

b. Shorts that load down a particular power supply can best be isolated by disconnecting the pcbs that plug into the Main PCB, one at a time. Remember to turn the instrument off before disconnecting or connecting cables, plugs or pcbs. If the short cannot be located by unplugging pcbs, use the current probe tracing procedure described in Troubleshooting Techniques. Start at the output of the power supply that is loaded down. This is the logical point and also gives the approximate amount of current drawn by the short.

4-83. IMPROPER OPERATION PROCEDURE

4-84. The Improper Operation Procedure is a simple dynamic test of the instrument. The procedure provides a speedy overall view that is interpreted by Table 4-13 to guide the technician to the most likely circuits. Additional information can be gained to aid troubleshooting by performing the Performance Checks indicated by the results of the procedure. The UUT can pass all parts of the procedure and still have faults. Should the UUT pass the procedure, do the Performance Checks. Use the following

steps to perform the Improper Performance Procedures. Perform the Improper Operation Procedure as follows:

1. Set the instrument controls as follows:

RESOLUTION -	1 kHz
SEP/COM -	SEP
FILTER -	OUT
CHANNEL A & B	
TRIGGER LEVEL -	PRESET
ATTEN -	X1
AC/DC -	DC
± -	+
REF -	INT

2. Connect the LF synthesizer to the Channel A input terminal of the UUT via a 50Ω termination.
3. Program the LF synthesizer for an output of 1 MHz at a level of 100 mV rms.
4. To check the FREQ A function:
 - a. Set the FUNCTION control to the FREQ A position.
 - b. Verify that the GATE annunciator is flashing and that the display is 1.000 MHz.
5. To check the CPM X100A function:
 - a. Set the FUNCTION control to the CPM X100A position.
 - b. Verify that the GATE annunciator is flashing and that the display is 600000.
6. To check the FREQ C function: Refer to Section 6.
7. To check the RATIO A/B function:
 - a. Set the FUNCTION control to the RATIO A/B position.
 - b. Set the SEP/COM switch to the COM position.
 - c. Verify that the GATE annunciator is flashing and that the display is 1.0.
 - d. Set the SEP/COM switch to the SEP position.
8. To check the PER A function:
 - a. Set the FUNCTION control to the PER A position.
 - b. Verify that the GATE annunciator is flashing and that the display is 0.0010 msec.
 - c. Set the RESOLUTION control to the 10 ns position.
 - d. Verify that the GATE annunciator is flashing and that the display is 1.00 μsec. (R0 check.)
9. To check the PER AVG A function:
 - a. Set the FUNCTION switch to the PER AVG A position.
 - b. Verify that the GATE annunciator is flashing and the display is 0.00100 msec.
10. To check the TI A-B function:
 - a. Set SEP/COM switch to COM and the FUNCTION control to the TI A-B position.
 - b. Set the Channel B ± control to the - position.
 - c. Verify that the GATE annunciator is flashing and that the display is 0.50 μsec.
 - d. Set the RESOLUTION control to the 100 ns position.
 - e. Verify that the GATE annunciator is flashing and that the display is 0.0005 msec.
11. To check the TIA A-B function:
 - a. Set the FUNCTION control to the TIA A-B position.
 - b. Verify that the GATE annunciator is flashing and that the display is 0.000500 msec.
12. To check the TOT A B function:
 - a. Set the SEP/COM switch to the SEP position.
 - b. Rotate the Channel B TRIGGER LEVEL control maximum counterclockwise.
 - c. Set the FUNCTION control to the TOT A B position.
 - d. Press and release the RESET button on the Front Panel of the UUT.
 - e. Verify that all zeros is displayed.
 - f. Rotate the Channel B TRIGGER LEVEL control maximum clockwise.
 - g. Verify that a count begins to accumulate in the display and the GATE annunciator is lit.

Table 4-13. Fault Isolation Guide Interpretation

FREQ A		F	F		F				
CPM X100A		F	F		F		F		
RATIO A/B		F	F		F	F			
PER A	F	F	F						
PER A (R0)		F	F						F
PER AVG A	F	F	F					F	F
TI A-B		F	F			F		F	
TI A-B (R0)		F	F			F		F	F
TIA A-B		F	F			F		F	F
TOT A-B		F	F		F	F			
CHK		F	F						

ANY ONE FUNCTION

TROUBLESHOOT CIRCUITRY BELOW:

100 MHz control, 10-100 MHz Mult. PCB
Control Logic U42
TIA Circuitry, Control Logic
CPM Control & Timing Circuitry
Channel B Input
Channel A Input, Control Circuitry
Decoding ROM'sm Control Circuitry
Time Base
Channel A Input
Control, Timing, Main Gate, Counter, Display
1. Display is 1/6 of correct value, U2 or U48. 2. Time Base or U26.

4-85. Troubleshooting Techniques

4-86. There are several techniques that can be used to isolate a fault in the instrument. The techniques are discussed below by type.

4-87. CURRENT TRACING

4-88. Current Tracer probes, such as the HP 547A, are usually the best way to locate shorts in the instrument. If the short is so bad that the power supply is loaded down, the Performance Checks or Fault Isolation Guide may not provide any help in isolating the faulty circuit. Starting at the output of the loaded power supply, logically move the Current Tracer through the instrument until the short is found. Sometimes the short is minor and is located between two or more logic gates as shown in Figure 4-12. The Current Tracer will glow brightest at the terminal of the shorted gate.

4-89. HEAT AND COLD

4-90. A fast and effective method of locating the faulty area in the instrument is by alternately heating and cooling areas in the instrument with a heat gun and freon spray. This check can be used on large areas or even individual components. IC's can open or short internally and this method of troubleshooting can be especially effective.

4-91. LOGIC CLIP

4-92. Logic clips, such as the John Fluke Testclip 200, provide the troubleshooter with visual indication of the logic levels in the instrument as the instrument operates. This test device is easier to use (it clips onto the IC) than such test equipment as an oscilloscope and allows all inputs and outputs to be observed simultaneously.

4-93. TEMPERATURE

4-94. Shorted components overheat. Temperature can be measured with the Fluke 80T-150 and any of its associated DMMs.

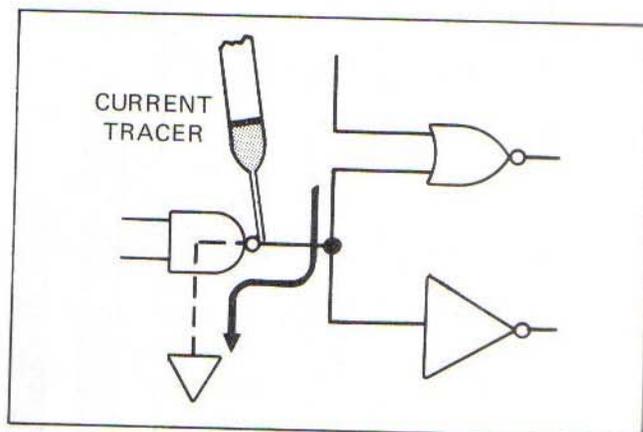


Figure 4-12. Current Tracing