OPERATING AND SERVICE MANUAL

HP 5359A
Time Synthesizer

SERIAL PREFIX: 2648A

This manual applies to Serial Prefix 2648A or below, unless accompanied by a Manual Change Sheet indicating otherwise.

MANUAL PART NUMBER 05359-90008
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HEWLETT PACKARD

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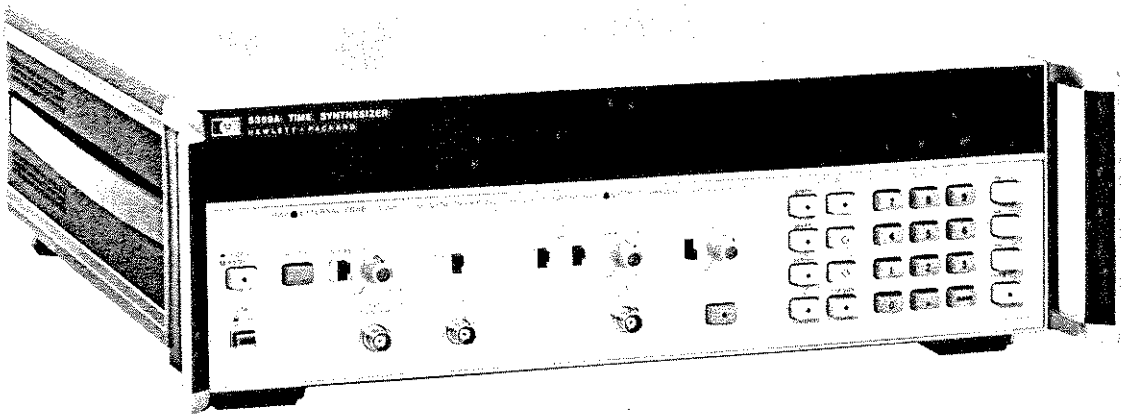
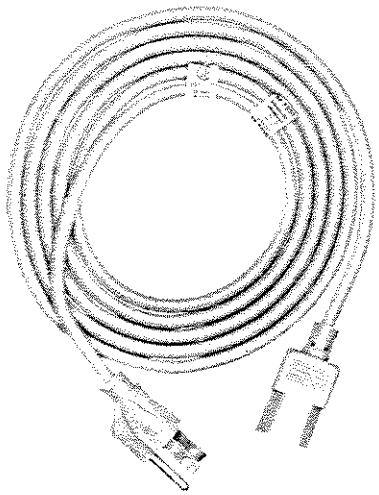


MODEL 5359A



LINE POWER CABLE

Figure 1-1. HP Model 5359A Time Synthesizer and Accessories Supplied

The supplement for this manual is keyed to the manual's print date and part number, both of which appear on the title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-12. For information concerning a serial number prefix not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-13. HP-IB INTERFACING AND PROGRAMMING INFORMATION

1-14. Section II of this manual contains instructions for interfacing the Model 5359A with the HP-IB. A brief description of the sequence of events comprising the transfer of data by the HP-IB is provided in Section III followed by programming information. Information concerning the design criteria of the bus is available in IEEE Standard 488-1975, titled *"IEEE Standard Digital Interface for Programmable Instrumentation"*.

1-15. INSTRUMENT AND MANUAL IDENTIFICATION

1-16. The instrument serial number is located on the rear panel. Hewlett-Packard uses a two-section serial number consisting of a four-digit prefix and a five-digit suffix. A letter between the prefix and suffix identifies the country in which the instrument was manufactured (A=USA, G=West Germany, J=Japan, U=United Kingdom). All correspondence with Hewlett-Packard concerning this instrument should include the complete serial number.

1-17. If the serial number of your instrument is lower than the serial number on the title page of this manual, you must modify your manual for agreement with your instrument. Refer to Section VII, MANUAL CHANGES, for the information that will adapt this manual to your instrument.

1-18. DESCRIPTION

1-19. The Hewlett-Packard Model 5359A Time Synthesizer is capable of generating digital delays from Ø to 160 ms in steps of less than 50 ps with <100 ps rms jitter typical. It uses a phase-startable-phase-lockable oscillator which allows the 5359A to commence digital time synthesis in synchronism with a randomly occurring external pulse. In addition, the time synthesizer can generate pulse trains with frequency or periods selectable to 10 MHz and with controllable pulse width.

1-20. OPTIONS

1-21. There are both equipment options and accessory options available for the 5359A. All options are designated by a three-digit number. The first digit of the option number identifies the option as either equipment or accessory. For an equipment option, the first digit is a zero and for an accessory option, the first digit is a nine. The following is a list of equipment and accessory options available with the 5359A:

Option	Description
001	High Stability Crystal Oven (10544A)

1-22. For more information concerning these options, contact your local HP Sales and Service Office. A list of HP Sales and Service offices is provided at the end of this manual.

1-23. ACCESSORIES SUPPLIED

1-24. The only accessory supplied with the HP Model 5359A is a power cord (HP Part Number 8120-1378) as shown in *Figure 1-1*.

1-25. EQUIPMENT AVAILABLE

1-26. A service accessory kit for the HP Model 5359A is available for troubleshooting and repairing the instrument. The service accessory kit contains seven extender boards and a service aid board. The accessory kit may be obtained from Hewlett-Packard by ordering Service Accessory Kit Model Number 10870A.

1-27. RECOMMENDED TEST EQUIPMENT

1-28. Equipment necessary to maintain the HP Model 5359A is listed in *Table 1-2*. Other equipment may be substituted if it meets or exceeds the critical specifications listed in the table.

Table 1-1. Specifications

MODES:
External Trigger Mode — "Delay" and output pulse width must both be selected. "Delay" is the time from the leading edge of the sync output to the leading edge of the output pulse.
Internal Trigger Mode — Period or frequency is selected and the width of the output pulse. "Delay" is not specified in this mode.

RANGE:

Delay	0 ns to 160 ms
Width	5 ns to 160 ms (width + delay ≤160 ms)
Period	Minimum 100 ns or width + 85 ns. Maximum 160 ms.
Frequency	Same as corresponding period

STEP SIZE:
50 ps minimum, keyboard selectable, for both "width" and "delay".

ABSOLUTE ACCURACY:
±1 ns ± time base error

INSERTION DELAY:
Less than 140 ns in preset. For "delays" greater than 100 ns, reduced to less than 40 ns in the auto position. Fixed in both cases.

JITTER:
Between external trigger or sync out, and the output pulse.
Standard time base
100 ps rms typical 200 ps rms max (delays 0 to 10 ms)
500 ps rms typical 1 ns rms max (delays 10 ms to 160 ms)
High stability time base (Option 001)
100 ps rms typical 200 ps rms max (delay 0—160 ms)

EXTERNAL TRIGGER INPUT:
Trigger level adjustable -2V to +2V. Slope selectable + or -.

MANUAL TRIGGER:
Pushbutton

SYNC OUTPUT:
1 volt positive pulse into 50Ω, from 200Ω source impedance.
Width 35 ns nominal. Rise/Fall times <5 ns.

OUTPUT PULSE:
Amplitude adjustable from 0.5V to 5V into 50Ω from 50Ω output impedance.
Offset adjustable from -1V to +1V, or OFF.
Normal or Complement Mode selectable; Rise/Fall times less than 5 ns; typical 3.5 ns.
Short circuit proof; external voltage must not be applied.
Offset and Amplitude may be displayed.

Table 1-1. Specifications (Cont'd)

REPETITION RATE:
Internal Trigger Mode
Maximum repetition rate 10 MHz
Period ≥ width +75 ns typical
External Trigger Mode
"Preset" Sync Delay
Maximum repetition rate 7.5 MHz typical
Period ≥ delay + width +75 ns typical
"Auto" Sync Delay
Maximum repetition rate 13 MHz typical
Period ≥ delay + width -30 ns typical
The "Auto" mode requires a delay of at least 100 ns. For delays of less than 100 ns, the same specifications as for "Preset" apply.

EDGE 1 OUTPUT: (rear panel)
Occurs with fixed time relationship to the leading edge of the output pulse. Specifications are the same as for SYNC OUT.

EDGE 2 OUTPUT: (rear panel)
Occurs with fixed time relationship to the end of the output pulse. Specifications are the same as for SYNC OUT.

EVENTS MODE:
Substitutes an external input for the internally counted clock. "Delay" and "Width" must both be specified in events.
Trigger Level: Adjustable -2V to +2V
Slope: Selectable + or -
Frequency: Up to 100 MHz
Delay from "Ext Trigger Input" to the first event counted is less than 50 ns
Range: "delay" 2 events to 16777215 events
"width" 1 event to 16777214 events
"width" + "delay" <16777216 events

FREQUENCY STANDARD (rear panel)
Input: 5 or 10 MHz >1.0V p-p into 1 KΩ. Maximum input 10V.
Output: 10 MHz. 1V p-p into 50Ω in sync with time base chosen (INT or EXT).

TIME BASE:
High Stability Time Base
Crystal Frequency 10 MHz
Stability:
Aging Rate: $<5 \times 10^{-10}$ per day
Short Term: $<1 \times 10^{-11}$ for 1 s average
Temperature: $<7 \times 10^{-9}$ 0°C to 55°C
Line Voltage: $<1 \times 10^{-10}$, ±10% from nominal

OPERATING TEMPERATURE: 0° to 50°C
WEIGHT: 14.55 kg (30 lbs).
DIMENSIONS:
Height: 133 mm (5¾")
Width: 426 mm (16¾")
Depth: 521 mm (20½")

Table 1-2. Recommended Test Equipment

Equipment	Required Characteristics	USED FOR			Recommended HP Model
		Oper. Verif.	Adjust.	Trouble-shooting	
Service Kit Consists of:			X	X	10870A
Service Board	No Substitute			X	05370-60014
Extender Board	15 Pin			X	5060-0049
Extender Board	22 Pin			X	5060-0630
Extender Board	For 5370A Use				05370-60074
Extender Board	For A7 Oscillator Power Supply			X	05370-60076
Extender Board	For Digital Section (A9 thru A23, except A16)			X	05370-60075
Extender Board	For A24 200 MHz (Multiplier Assembly)			X	05370-60077
Extender Board	For A16			X	05359-60078
Pulse Generator		X	X		8082A
Oscilloscope		X	X		1720A
Sampling Oscilloscope			X		140A
Sampling Plug-In			X		1410A
Spectrum Analyzer			X		141T/8552A/ 8554L
Active Probe			X	X	1120A
Probe P.S.			X	X	1122A
Signature Analyzer	No Substitute			X	5004A
DMM	$3\frac{1}{2}$ Digit with 0.1% Accuracy		X	X	3435A
Controller	HP-IB	X		X	9825A
Logic Probe				X	545A
Pulser				X	546A
Current Tracer				X	547A
9 Cables	4' BNC 50Ω Cables (2 matched length within $\frac{1}{2}$")	X	X	X	11170C
Tuning Wand	Ceramic		X		8730-0013
Tuning Wand	Long Plastic		X		8730-0011
Time Interval Probes	No Sutstitute	X			5363A
Universal Time Interval Counter			X		5370A

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section provides all information necessary to install the HP 5359A. Covered in this section are initial inspection, power requirements, line voltage selection, interconnection, circuit options, mounting, storage, and repackaging for shipment.

2-3. INITIAL INSPECTION

2-4. Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the shipment has been checked mechanically and electrically. The contents of the shipment should be as shown in *Figure 1-1*. Procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping material for the carrier's inspection.

2-5. PREPARATION FOR USE

2-6. Power Requirements

2-7. The HP 5359A requires a power source of 100, 120, 220, or 240 Vac, +5%, -10%, 48 to 66 Hz single phase. Power consumption is 220 VA maximum.

WARNING

IF THIS INSTRUMENT IS TO BE ENERGIZED VIA AN AUTO-TRANSFORMER FOR VOLTAGE REDUCTION, MAKE SURE THE COMMON TERMINAL IS CONNECTED TO THE EARTHED POLE OF THE POWER SOURCE.

2-8. Line Voltage Selection

CAUTION

BEFORE SWITCHING ON THIS INSTRUMENT, make sure the instrument is set to the voltage of the power source.

2-9. *Figure 2-1* provides instructions for line voltage and fuse selection. The line voltage selection card and the proper fuse are factory installed for 120V ac operation.

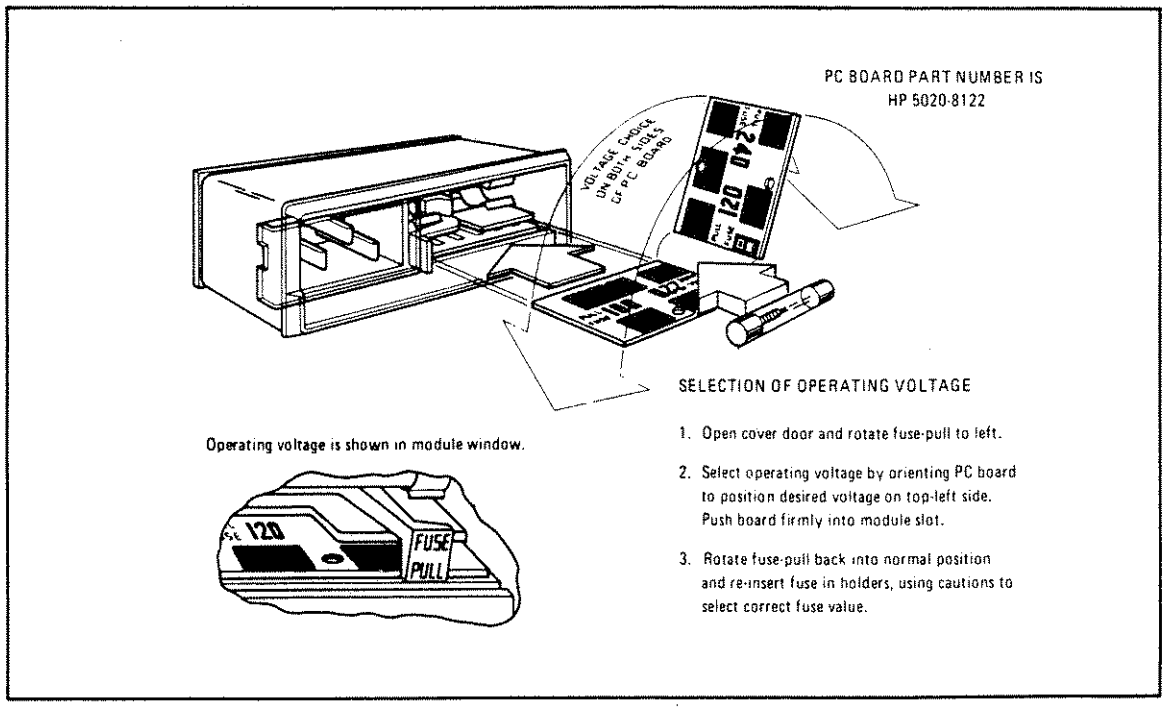


Figure 2-1. Line Voltage Selection

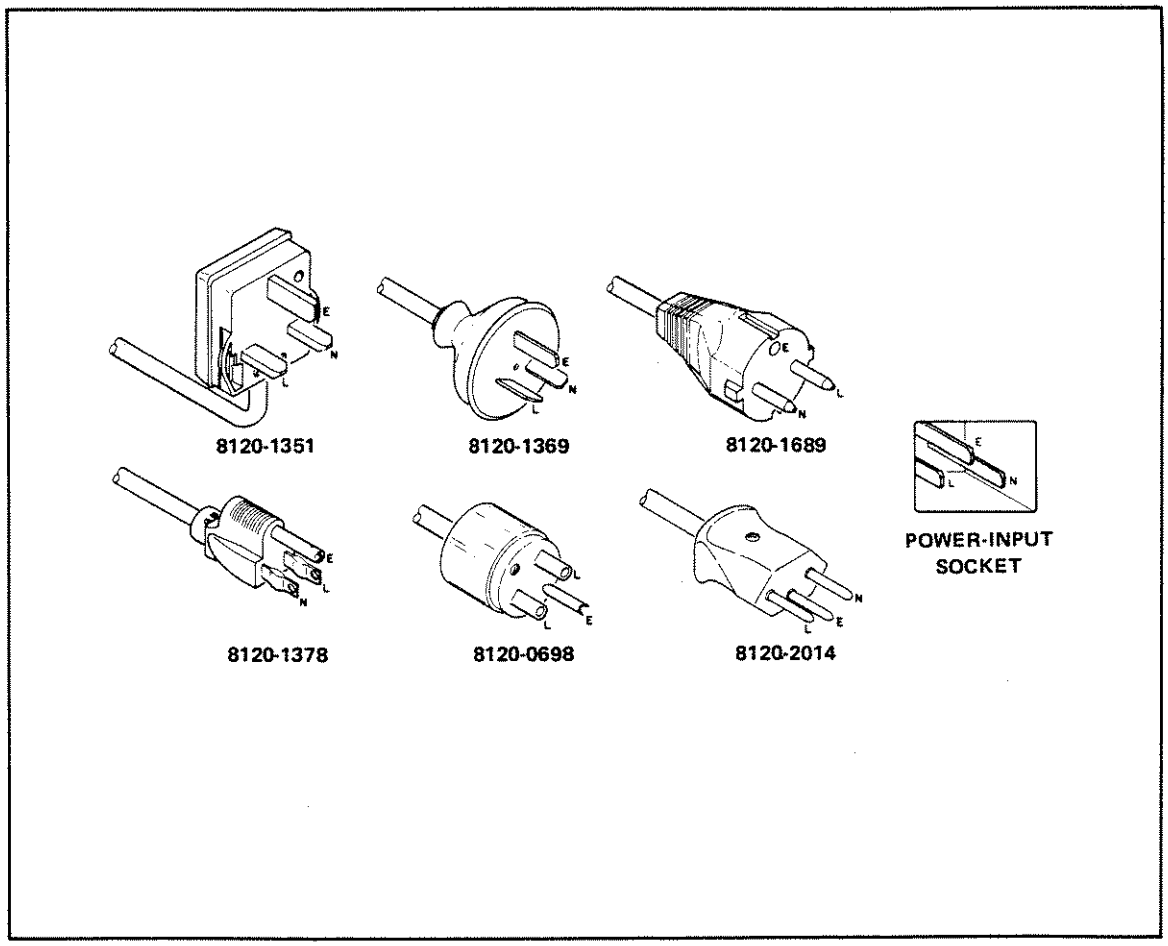


Figure 2-2. Power Cable HP Part Numbers versus Main Plugs Available

2-10. Power Cable

WARNING

BEFORE SWITCHING ON THIS INSTRUMENT, THE PROTECTIVE EARTH TERMINALS OF THIS INSTRUMENT MUST BE CONNECTED TO THE PROTECTIVE CONDUCTOR OF THE (MAINS) POWER CORD. THE MAINS PLUG SHALL ONLY BE INSERTED IN A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD (POWER CABLE) WITHOUT A PROTECTIVE CONDUCTOR (GROUNDING).

2-11. The 5359A is shipped with a three-wire power cable. When the cable is connected to an appropriate ac power source, the cable connects the chassis to earth ground. The type of power cable plug shipped with each instrument depends on the country of destination. Refer to *Figure 2-2* for the part numbers of the power cable and plug configurations available.

2-12. Interconnections

2-13. HEWLET-PACKARD INTERFACE BUS. Interconnection data concerning the rear panel HP-IB connector is provided in *Figure 2-3*. This connector is compatible with the HP 10631A/B/C/D HP-IB Cables. The HP-IB system allows interconnection of up to 15 (including the controller) HP-IB compatible instruments. The HP-IB cables have identical "piggy back" connectors on both ends so that several cables can be connected to a single source without special adapters or switch boxes. System components and devices may be connected in virtually any configuration desired. There must, of course, be a path from the calculator (or other controller) to every device operating on the bus. As a practical matter, avoid stacking more than three or four cables on any one connector. If the stack gets too large, the force on the stack produces great leverage which can damage the connector mounting. Be sure each connector is firmly (finger tight) screwed in place to keep it from working loose during use.

2-14. CABLE LENGTH RESTRICTIONS. To achieve design performance with the HP-IB, proper voltage levels and timing relationship must be maintained. If the system cable is too long, the lines cannot be driven properly and the system will fail to perform properly. Therefore, when interconnecting an HP-IB system, it is important to observe the following rules:

a. The total cable length for the system must be less than or equal to 20 metres (65 feet).

b. The total cable length for the system must be equal to or less than 2 metres (6.6 feet) times the total number of devices connected to the bus.

c. The total number of instruments connected to the bus must not exceed 15.

2-15. 5359A Listen Address

2-16. The 5359A contains a rear panel HP-IB Instrument address selection switch. There are five switches designated (5, 4, 3, 2, 1) which are used to select the address. Instructions for setting and changing the listen address are provided in Section III of this manual along with 5359A programming codes.

2-17. HP-IB Descriptions

2-18. A description of the HP-IB is provided in Section III of this manual. A study of this information is necessary if the user is not familiar with the HP-IB concept. Additional information

concerning the design criteria and operation of the bus is available in IEEE Standard 488-1975, titled *"IEEE Standard Digital Interface for Programmable Instrumentation"*.

2-19. OPERATING ENVIRONMENT

2-20. Operating and Storage Temperature

2-21. In order for the 5359A to meet the specifications listed in *Table 1-1*, the operating environment must be within the following limits:

Temperature	0° to +55°C
Humidity	<88% relative
Altitude	<15,000 feet

2-22. Cooling System

2-23. A forced air cooling system is used to maintain the operating temperature required by the instrument. The cooling fan is located on the left-side of the rear panel (while looking at the rear panel). When operating the 5359A, choose a location that provides at least 8 cm (3 in.) of clearance at the rear and at least 2 cm (1 in.) for each side. Failure to provide adequate air clearance will result in execessive temperature reducing instrument reliability. The clearances provided by the plastic feet in bench stacking and the filler strip in rack mounting allow air passage across the top and bottom cabinet surfaces.

CAUTION

The left side-cover (facing front of instrument) is perforated, the right side-cover is not. This provides proper instrument cooling. DO NOT transpose covers or perforate the cover on the right side, or excessive heat, potentially damaging to the instrument, may result.

2-24. Bench Operation

2-25. The instrument has plastic feet and a foldaway tilt stand for convenience in bench operation. The tilt stand raises the front of the instrument for easier viewing of the control panel and the plastic feet are shaped to make full width modular instruments self aligning when stacked.

2-26. STORAGE AND SHIPMENT

2-27. Environment

2-28. The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

Temperature	-40°C to +75°C
Humidity	<95% relative
Altitude	<50,000 feet

2-29. Packaging

2-30. ORIGINAL PACKAGING. Containers and materials equivalent to that used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, and full serial number. Aslo, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument model number and full serial number.

2-31. OTHER PACKAGING. The following general instructions should be used for repackaging with commercially available materials:

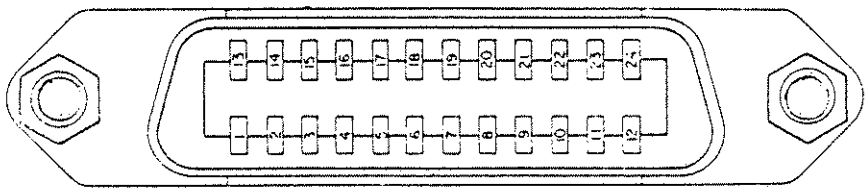
a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, attach a tag indicating the type of service required, return address, model number, and full serial number.)

b. Use a strong shipping container. A doublewall carton made of 250 pound test material is adequate.

c. Use enough shock-absorbing material (3- to 4-inch layer) around all sides of the instrument to provide firm cushion and prevent movement inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely.

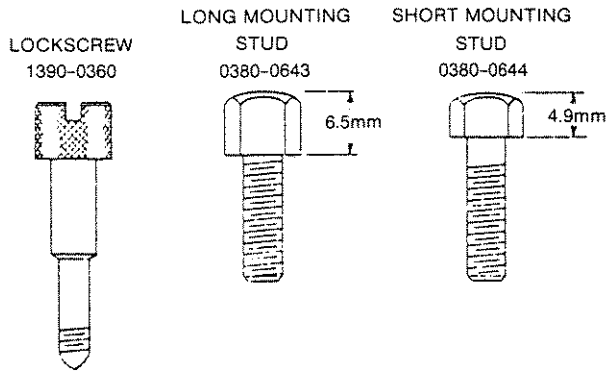
e. Mark the shipping container FRAGILE to assure careful handling.



PIN	LINE	
1	DIO1	
2	DIO2	
3	DIO3	
4	DIO4	
13	DIO5	
14	DIO6	
15	DIO7	
16	DIO8	
5	EOI	
17	REN	
6	DAV	
7	NRFD	
8	NDAC	
9	IFC	
10	SRQ	
11	ATN	
12	SHIELD-CHASSIS GROUND	
18	P/O TWISTED PAIR WITH PIN 6	THESE PINS ARE INTERNALLY GROUNDED
19	P/O TWISTED PAIR WITH PIN 7	
20	P/O TWISTED PAIR WITH PIN 8	
21	P/O TWISTED PAIR WITH PIN 9	
22	P/O TWISTED PAIR WITH PIN 10	
23	P/O TWISTED PAIR WITH PIN 11	
24	ISOLATED DIGITAL GROUND	

CAUTION

The 5359A contains metric threaded HP-IB cable mounting studs as opposed to English threads. Metric threaded HP 10631A, B, C, or D HP-IB cable lockscrews must be used to secure the cable to the instrument. Identification of the two types of mounting studs and lockscrews is made by their color. English threaded fasteners are colored silver and metric threaded fasteners are colored black. DO NOT mate silver and black fasteners to each other or the threads of either or both will be destroyed. Metric threaded HP-IB cable hardware illustrations and part numbers follow.



Logic Levels

The Hewlett-Packard Interface Bus logic levels are TTL compatible, i.e., the true (1) state is 0.0V dc to 0.4V dc and the false (0) state is +2.5V dc to +5.0V dc.

Programming and Output Data Format

Refer to Section III, Operation

Mating Connector

HP 1251-0293; Amphenol 57-30240.

Mating Cables Available

HP 10631A, 0.9 metres (3 ft.), HP 10631B, 1.8 metres (6 ft.)
HP 10631C, 3.7 metres (12 ft.)
HP 10631D, 0.5 metres (1.5 ft.)

Cabling Restrictions

1. A Hewlett-Packard Interface Bus System may contain no more than 1.8 metres (6 ft.) of connecting cable per instrument.
2. The maximum accumulative length of connecting cable for any Hewlett-Packard Interface Bus System is 20.0 metres (65.6 ft.).

Figure 2-3. Hewlett-Packard Interface Bus Connection

SECTION III
OPERATING AND PROGRAMMING

3-1. INTRODUCTION

3-2. This section provides complete operating and programming information for the HP Model 5359A Time Synthesizer. Included in this section are a description of all front and rear panel controls, connectors and indicators, manual and remote operating instructions, and operator's maintenance.

3-3. OPERATOR'S MAINTENANCE

3-4. The only operator maintenance is replacement of the primary power fuse located within the Line Module Assembly. For instructions on how to change the fuse, refer to Section II, Line Voltage Selection.

CAUTION

MAKE SURE THAT ONLY SLOW-BLOW TYPE FUSES WITH THE REQUIRED RATED CURRENT ARE USED FOR REPLACEMENT. THE USE OF REPAIRED FUSES AND THE SHORT-CIRCUITING OF FUSE-HOLDERS MUST BE AVOIDED.

3-5. POWER/WARM UP

3-6. The HP Model 5359A requires a power source of 100, 120, 220, or 240V ac, +5%, -10%, 48 to 66 Hz single phase. Selection of the line voltage and the input power fuse is described in Section II, Preparation for Use.

3-7. The 5359A has a two-position power switch, STBY and ON. For 5359A Option 001 only, it is important that the instrument remain connected to the power source and be in the STBY mode when not in use. This supplies the necessary power to the crystal oven to maintain a constant oven temperature and eliminates the need for a long warm-up period. When the STBY mode is not used or power has been disconnected from the instrument, allow 30 minutes in the ON mode for the instrument (crystal oven) to warm-up.

WARNING

POWER IS ALWAYS PRESENT AT THE LINE SWITCH AND POWER TRANSFORMER, AND UNREGULATED DC IS PRESENT WHENEVER THE LINE CORD IS ATTACHED. DISCONNECT THE POWER CORD TO REMOVE ALL POWER FROM THE INSTRUMENT.

3-8. PANEL FEATURES

3-9. Front panel controls, front panel indicators and rear panel features of the HP Model 5359A are described in *Figures 3-3, 3-4* and *3-5* respectively. These figures locate and describe all operator controls, connectors, and indicators.

3-10. OPERATOR'S CHECKS

3-11. A procedure for verifying the basic operation of the 5359A Time Synthesizer is provided in *Figure 3-6*. This check utilizes the instrument's self-calibration cycle and verification of front panel indicators. No additional equipment is required.

NOTE

This check is not intended to verify the output, accuracy or performance specifications of the instrument.

3-12. OPERATING INSTRUCTIONS

WARNING

BEFORE THE INSTRUMENT IS SWITCHED ON, ALL PROTECTIVE EARTH TERMINALS, EXTENSION CORDS, AUTOTRANSFORMERS AND DEVICES CONNECTED TO IT SHOULD BE CONNECTED TO A PROTECTIVE EARTH GROUNDED SOCKET. ANY INTERRUPTION OF THE PROTECTIVE EARTH GROUNDING WILL CAUSE A POTENTIAL SHOCK HAZARD THAT COULD RESULT IN PERSONAL INJURY.

WARNING

ONLY FUSES WITH THE REQUIRED RATED CURRENT AND SPECIFIED TYPE SHOULD BE USED. DO NOT USE REPAIRED FUSES OR SHORT CIRCUITED FUSE-HOLDERS. TO DO SO COULD CAUSE A SHOCK OR FIRE HAZARD.

CAUTION

BEFORE THE INSTRUMENT IS TURNED ON, IT MUST BE SET TO THE VOLTAGE OF THE POWER SOURCE, OR DAMAGE TO THE INSTRUMENT COULD RESULT.

3-13. Operating the 5359A Time Syntheiszer requires adjustment and programming of the front panel keys and controls. These keys and controls are arranged in four major groups. From left to right across the front panel the groups are:

a. EXTERNAL ENABLE

b. SYNC DELAY

c. OUTPUT

d. FUNCTION/DATA/UNITS

3-14. External Enable

3-15. The EXTERNAL ENABLE section contains the External Trigger input and the controls that affect it. The LEVEL control is adjustable from -2V to +2V and determines the trigger level of the external input. The setting of the SLOPE switch selects the enabled slope. The MAN TRIG key initiates one external trigger, independent of any external input, each time the key is pressed.

3-16. SYNC Delay

3-17. The SYNC DELAY section contains the output connector for the SYNC OUTPUT pulse, and the PRESET/AUTO select switch. Sync Delay is the amount of insertion delay between the external trigger and the Sync Output pulse. After an external trigger, the 5359A requires a minimum of about 140 ns to produce an output pulse. The SYNC Delay Preset mode inserts a fixed delay of about 140 ns between the external trigger and sync out. This provides the minimum processing time, while still allowing the 5359A to output with "zero" delay from sync output to output pulse.

3-18. In applications where specified pulse delays will be 100 ns or more, a sync delay mode of less than 40 ns may be selected. The fixed sync delay of about 40 ns combined with a 100 ns (minimum) pulse delay provides the minimum processing time. This combination shortens the total time from external trigger to the sync output pulse by about 100 ns. See *Figure 3-1.*

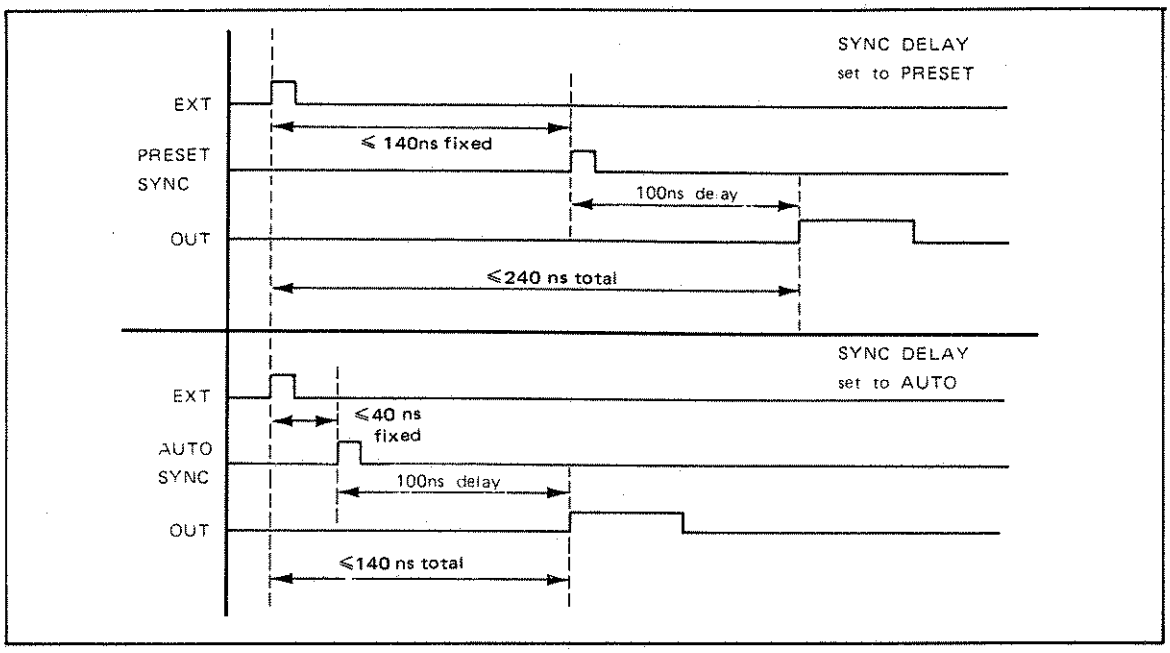


Figure 3-1. PRESET/AUTO Sync Delay

3-19. The PRESET/AUTO switch selects a fixed sync delay of less than 140 ns in PRESET. In AUTO, the sync delay may be either fixed at less than 40 ns or fixed at less than 140 ns, as determined by the programmed pulse delay. If a 100 ns (or greater) pulse delay is specified the sync delay is less than 40 ns. If a pulse delay of less than 100 ns is specified, the sync delay automatically resets to less than 140 ns (typical 135 ns). In the AUTO mode (with delay set to ≥100 ns) the SYNC OUT is simply a buffered version of the EXT TRIGGER. Therefore, if the EXT TRIGGER is at a frequency in excess of the capabilities of the 5359A, extra SYNC OUT pulses may occur.

3-20. Output

3-21. The OUTPUT section contains the output connector and output controls. The output pulse may be normal or complimented, positive polarity or negative polarity, as determined by the settings of the POLARITY switches. The output amplitude is adjustable from 0.5V to 5V with the AMPLITUDE control. The ON/OFF switch activates the OFFSET control. The output DC offset is adjustable from -1V to +1V when activated, and is preset to zero when off. The DISPLAY LEVELS key activates a continuous digital display of both amplitude and offset voltage levels.

3-22. Function/Data/Units

3-23. The FUNCTION keys control which operating parameter is displayed and precede the entry of new data. They also allow the stepped manipulation of entered data and initiation of a self calibration cycle.

3-24. The DATA keys, when preceded by a function key, are used to enter a new operating parameter. The new parameter entry is completed by selection of a UNITS key. The data entry is displayed as it is keyed in, and can be cleared and re-entered anytime prior to pressing a units key. Illegal or out of range entries result in an error message. However, the 5359A does retain the preceding parameters.

3-25. Stepping

3-26. A separate STEP SIZE parameter can be entered and stored for each of the four functions, Width, Delay, Period, and Frequency, by pressing the desired function followed by STEP SIZE 23, DATA 24, and UNITS 25, 26, 27, or 28.

3-27. CALIBRATION

3-28. The CAL 20 key causes calibration of six internal timing parameters. The routine should be performed after any change in the front panel Amplitude of Offset controls, or following a significant change in operating temperature. The calibration is performed to the 50% point of the rise/fall times of the output pulse, as determined by the Amplitude and Offset controls. During Calibration the 5359A Output is open circuited.

3-29. The calibration can be expanded beyond the 5359A signal BNC's with the 5363A Time Interval Probes, through an External Timing Compensation procedure outlined in Section IV.

3-30. TURN-ON CHARACTERISTICS

3-31. When the 5359A is turned on, a power-up reset and self-check/calibration cycle is automatically initiated. The sequence is as follows:

1. Initially, all segments, indicators, and annunciators on the front panel and display are blanked out.
2. Then, all segments, indicators, annunciators, and pushbutton key LEDs in the front panel are lighted, except for CLOCK 29. A self-calibration is performed at this time. If the calibration cannot be completed, the display returns with error message 8.n or 9.n. Refer to paragraph 3-36.
3. Finally, the display reads 100.00 ns WIDTH. The WIDTH function key LED and OUTPUT indicator LED are lighted.

3-32. Successful completion of the turn-on self-check cycle is indicated by a display of 100.00 ns WIDTH. During power-up, the microprocessor performs a checksum of the program ROM's and a checkerboard bit pattern is written into and read from RAM. Any ROM or RAM failure halts the cycle and displays an error message. Refer to Error Messages, paragraph 3-35.

3-33. After power-up and self-check, the 5359A assumes the following output parameters:

WIDTH	100.00 ns
PERIOD	1.00 μs
FREQUENCY	1.00 MHz
STEP SIZE	1.00 ns/1.000000000 kHz

3-34. Output polarity, amplitude, and offset are set by front panel controls.

NOTE

Perform the CAL whenever Output Amplitude or Level is changed to insure accurate timing.

3-35. Error Messages

3-36. Under certain conditions the 5359A will display an error message (number) or error indication (annunciator lite). There are nine numbered error messages in all. Errors 6.n and 7.n pertain to power-up only. Errors 4 through 7 and 9 generally indicate service related problems. Refer to Section VIII for additional information.

Error	Message
Err 1	Indicates an illegal remote command or an undefined function.
Err 2	Data out of range.
Err 3	Illegal key combination (local of HP-IB)
Err 4	Phase-locked-loop out of lock.
Err 5	Undefined key (hardware problem).
Err 6.n	RAM error
Err 7.n	ROM error
Err 7.9	ROM missing
Probe Err 8.n	Unable to calibrate using external probes.
Err 9.n	Calibrate error.

3-37. The 5359A may also indicate an error condition by flashing on and off the non-numbered error annunciator ERR (36). This display indicates that the last parameter entered is inconsistent with parameters previously entered. For example, the ERR annunciator will flash if an attempt is made to enter a pulse width of 2 ms after a period of 1 ms is specified. The new data is accepted, but the OUTPUT is disabled until the inconsistency is corrected (this permits the operator to enter new data in any order).

3-38. OPERATING CHARACTERISTICS

3-39. The following paragraphs describe the four general modes of operation for the 5359A Time Synthesizer. The modes of pulse generation are:

a. External Trigger/Delay

b. External Trigger/Events

c. Frequency/Period

d. Triggered Frequency

3-40. *Figures 3-7, 3-8, 3-9,* and *3-10* describe general operating instructions for the HP Model 5359A in each of four major modes of operation. The description control numbers correspond to the control locator illustration.

3-41. External Trigger/Delay

3-42. In this mode, the 5359A uses an external trigger input to generate an output pulse whose width and delay are selected by the user. Delay is defined as the time from the leading edge of the Sync Output to the leading edge of the Output pulse. The Sync Output is synchronized to the external trigger input with the amount of insertion delay fixed at either less than 40 ns or less than 140 ns. The output delay and width are selected over the following range:

Delay: 0 ns to 160 ms

Width: 5 ns to 160 ms

(Width + Delay $\leq$ 160 ms)

3-43. *Figure 3-2a* illustrates the timing relationships for the External Trigger/Delay mode of operation.

3-44. External Trigger/Events

3-45. The External Trigger/Events mode is similar to External Trigger/Delay mode previously described. An external trigger input is used to generate an output pulse whose width and delay are specified in terms of Events rather than time. An external Events input, up to 50 MHz, is substituted for the internally counted clock. The output delay and width are selectable over the following range:

Delay: 2 to 16777215 Events

Width: 1 to 16777214 Events

(Width + Delay ≤ 16777216 Events)

3-46. To prevent ambiguity as to the first event counted, the Events input pulses generally should not be present until about 50 ns following the EXT TRIGGER. Given this requirement, the Events signal may occur at up to a 100 MHz rate (50% duty cycle).

3-47. *Figure 3-2b* illustrates the timing relationships for the External Trigger/Events mode of operation.

3-48. Frequency/Period

3-49. The Frequency/Period mode is internally triggered and independent of any external inputs. The 5359A generates an output pulse train whose frequency (or period) and pulse width are selected by the user. Delay is not specified in this mode. The input frequency/period and pulse width are selectable over the following range:

Frequency: 6.25 Hz to 10 MHz.
Period: 100 ns to 160 ms
Width: 5 ns to 160 ms
(Period ≥ Width + 85 ns)

3-50. *Figure 3-2c* illustrates the timing relationships for the Frequency/Period mode of operation.

3-51. Triggered Frequency

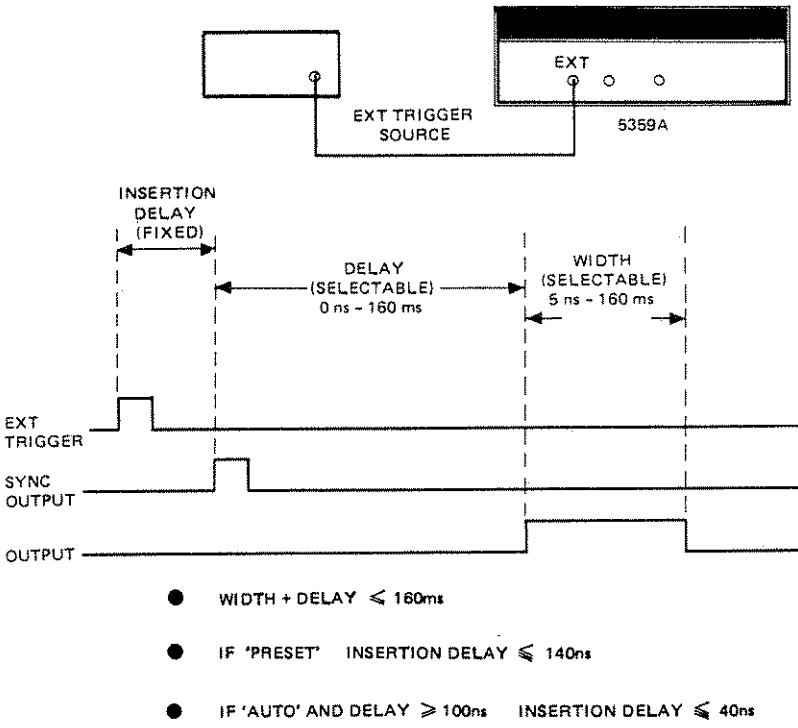
3-52. The Triggered Frequency mode generates a pulse train with frequency and pulse width specified, as in the Frequency/Period mode previously described. The output, however, is "gated" by an external trigger input. The user defines the duration of the gated "burst" of output pulses by selecting the slope and trigger level of the external input. Delay is not specified in this mode. The frequency/period and pulse width ranges are as specified in paragraph 3-49.

3-53. The delay from the EXT TRIGGER to the first pulse of the output burst is fixed for any given set of frequency/period and width parameters (i.e., the burst is synchronized to the EXT TRIGGER input). One sync output occurs for each EXT TRIGGER.

3-54. The Triggered Frequency mode is entered by pressing TRIG FREQ ㉘ key while in the Frequency/Period mode. Pressing this key again (while in the Triggered Frequency mode) restores operation to normal Frequency/Period mode of operation.

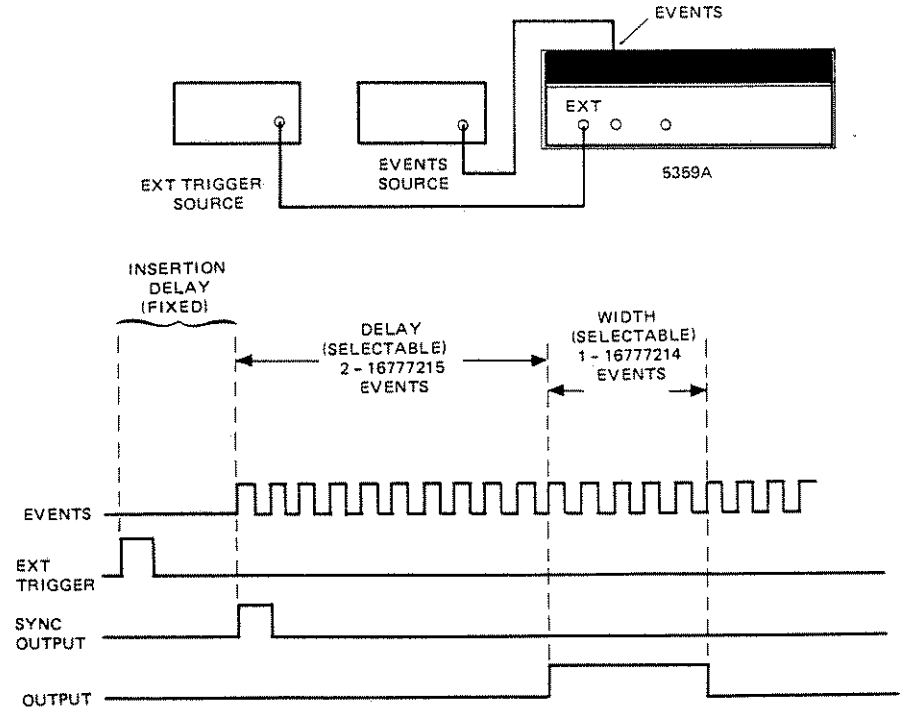
3-55. *Figure 3-2d* illustrates the timing relationships for the Triggered Frequency mode of operation.

5359A EXTERNAL TRIGGER/DELAY MODE



- WIDTH + DELAY ≤ 160ms
- IF 'PRESET' INSERTION DELAY ≤ 140ns
- IF 'AUTO' AND DELAY ≥ 100ns INSERTION DELAY ≤ 40ns

5359A EXTERNAL TRIGGER/EVENTS MODE

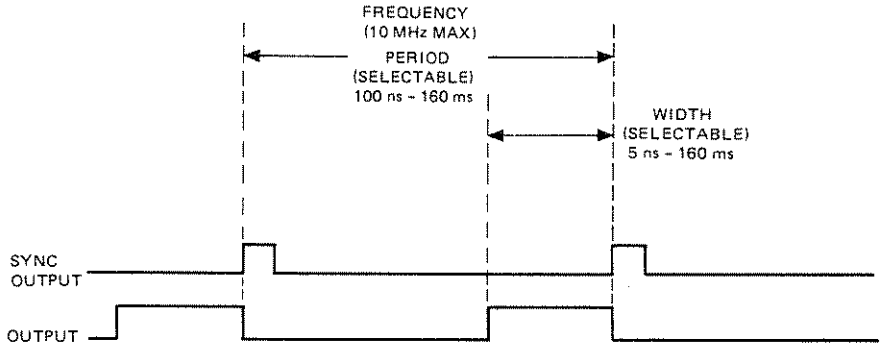


- WIDTH + DELAY ≤ 16777216 EVENTS

Figure 3-2. Modes of Operation

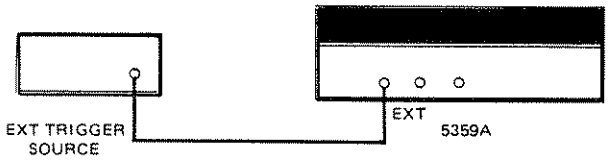
5359A FREQUENCY/PERIOD MODE

5359A



● PERIOD ≥ WIDTH + 85ns

5359A TRIGGERED FREQUENCY MODE



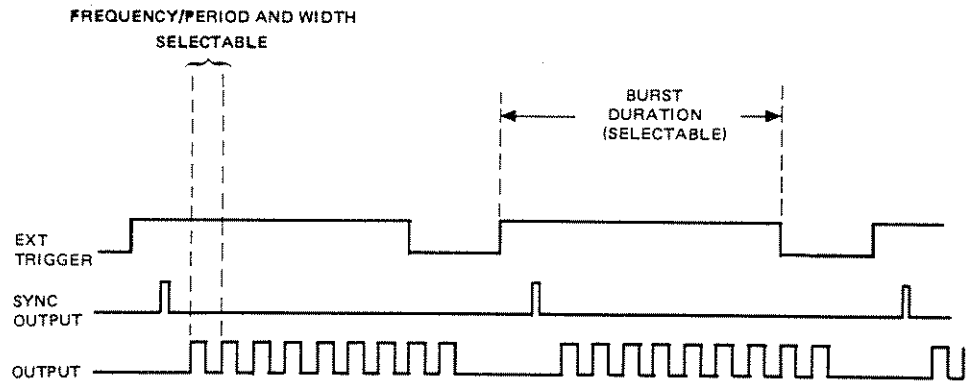
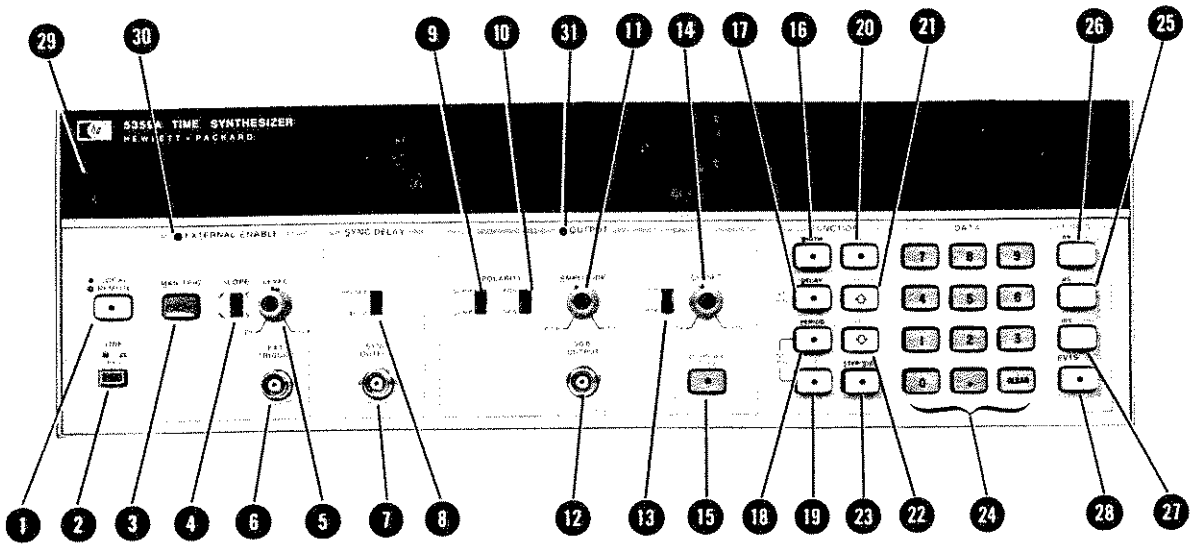
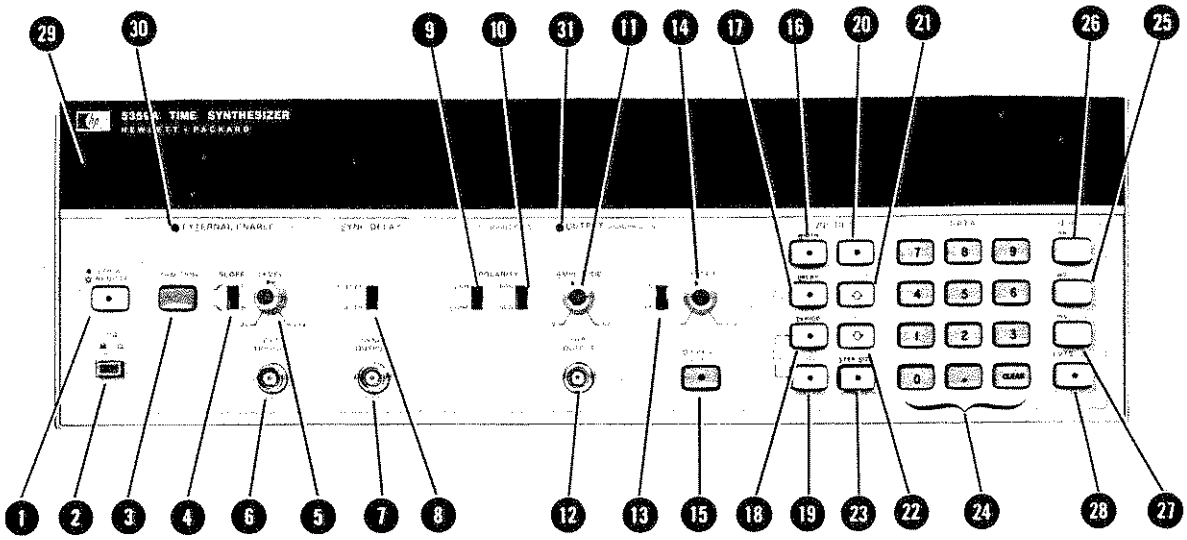


Figure 3–2. Modes of Operation (Cont'd)



1. Returns the instrument to local control when operated remotely and Local Lockout command has not been issued.
2. Supplies power to entire machine in the ON position. Supplies power only to the oscillator oven (Option 001 only) in the STBY (standby) position.
3. Manually triggers a single output pulse when in external enable mode.
4. Switch setting selects the slope of the EXT TRIGGER input that triggers the output.
5. Level control which sets the trigger level of the EXT TRIGGER input.
6. Input BNC connector for EXT TRIGGER input.
7. Output BNC connector for SYNC OUTPUT.
8. Switch setting selects insertion delay for sync output.
9. Switch setting selects either normal or complemented output pulse.
10. Switch setting selects either positive or negative polarity output pulse.
11. Level control which sets the amplitude voltage of the output pulse.
12. Output BNC connector for output pulse (50Ω output impedance).
13. Switch setting which enables adjustable offset voltage for output pulse. Off position selects zero volts offset.
14. Level control which sets the offset voltage of the output pulse.
15. Measures and continuously displays the amplitude and offset voltage of the output pulse.
16. WIDTH function displays current output pulse width while enabling keyboard entry of new width data.
17. DELAY function displays current output pulse delay parameter while enabling keyboard entry of new delay data.

Figure 3-3. Front Panel Controls



18 PERIOD function displays current pulse train period (reciprocal of frequency), while enabling keyboard entry of new frequency data.

19 FREQ function displays current pulse train frequency (reciprocal of period) while enabling keyboard entry of new frequency data.

20 CAL function initiates an automatic self-calibration cycle in which 6 internal timing parameters are calibrated. Should be pressed after changing Amplitude or Offset controls to recalibrate to the 50% point of the output rise/fall times.

21 Single (or continuous if pressed in and held) step up of Width, Delay, Period or Frequency selection in increment of selected step size.

22 Single (or continuous if pressed in and held) step down of Width, Delay, Period or Frequency selection in increments of selected step size.

23 STEP SIZE displays current step size of the enabled function mode and allows keyboard entry of new step size data.

24 Keyboard for the entry of Width, Delay, Period, Frequency, Events or Step Size data. CLEAR key aborts entered data (prior to pressing a UNITS key) and blanks the display.

25 Used in conjunction with DATA keyboard, executes entry of displayed number in units of nanoseconds or hertz as determined by the function mode.

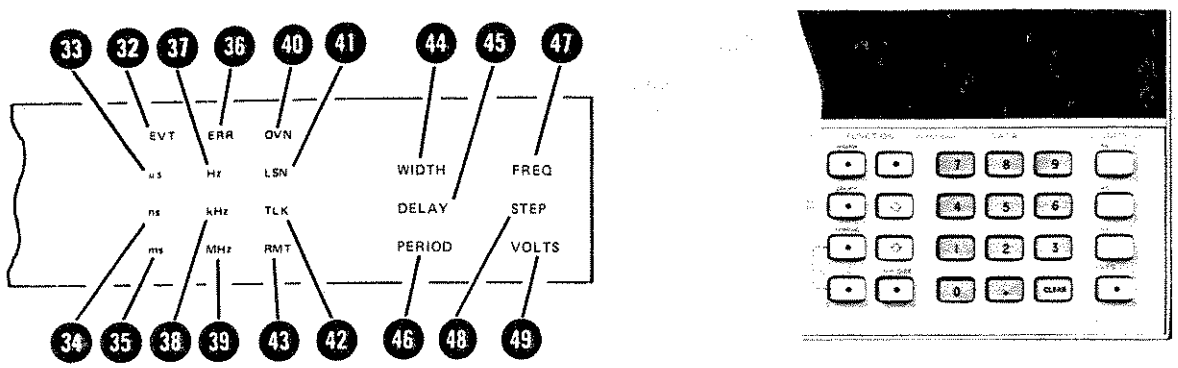
26 Used in conjunction with DATA keyboard, executes entry of displayed number in units of microseconds or kilohertz as determined by the function mode.

27 Used in conjunction with DATA keyboard, executes entry of displayed number in units of milliseconds or megahertz as determined by the function mode.

28 Events mode substitutes external input (EVENTS) for the internally counted clock. Output pulse delay and width specified in terms of external input events. Triggered Frequency mode outputs a keyboard selected frequency (period) burst with duration determined (gated) by the external trigger input.

29 CLOCK LOSS — When lit indicates no clock (internal or external) present.

Figure 3-3. Front Panel Controls (Cont'd)



30 EXTERNAL ENABLE — Indicates External Trigger required to produce output.

31 OUTPUT — Indicates output circuitry is active.

NOTE

This indication does not mean an output pulse is present. It does indicate that the programmed parameters are legal and the processor will allow an output.

32 EVT — output programmed in terms of Events.

33 μs — microseconds (10^{-6} seconds)

34 ns — nanoseconds (10^{-9} seconds)

35 ms — milliseconds (10^{-3} seconds)

36 ERR — Flashes indicate an error: last parameter entered inconsistent with parameters entered previously. Example: attempt to enter width of 2 ms after period is specified as 1 ms.

37 Hz — Hertz

38 kHz — kilohertz (10^{3} hertz)

39 MHz — Megahertz (10^{6} hertz)

40 OVN — Oven temperature indicator. When lit, crystal oscillator oven (option 001) is operating below required temperature.

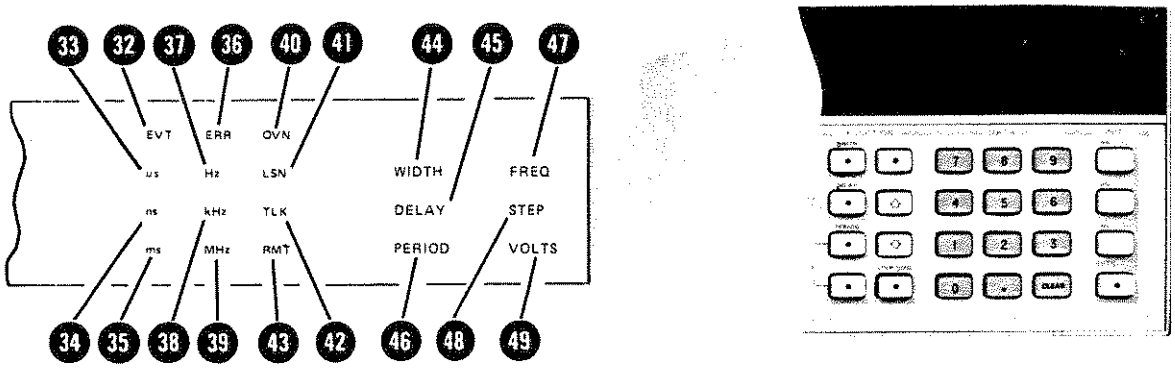
41 LSN — Listen indicates 5359A is remotely programmed to listen via HP-IB.

42 TLK — Talk indicates 5359A is remotely programmed to talk via HP-IB.

43 RMT — Remote indicates the 5359A is under remote control.

44 WIDTH — Indicates that the displayed data describes the output pulse width.

Figure 3–4. Front Panel Indicators



45 DELAY — Indicates that the displayed data describes the amount of delay from sync output to output pulse.

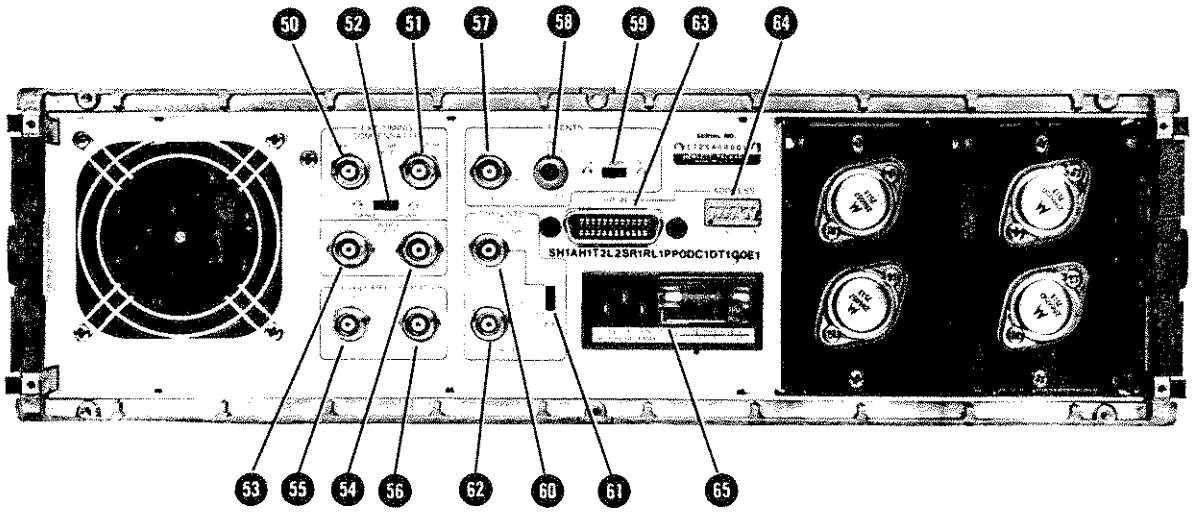
46 PERIOD — Indicates that the displayed data describes the period of the output.

47 FREQ — Indicates that the displayed data describes the frequency of the output.

48 STEP — Indicates that the displayed data describes the step size for the indicated function (the value which is added or subtracted by the STEP UP and STEP DOWN keys, respectively).

49 VOLTS — Indicates that the data displayed is in units of volts (pulse amplitude and offset).

Figure 3-4. Front Panel Indicators (Cont'd)



50 Start channel input BNC connector for HP 5363A Time Interval Probes.

51 Stop channel input BNC connector for HP 5363A Time Interval Probes.

52 Enable/Disable switch for HP 5363A probe inputs.

53 EXT X output BNC connector (to HP 5363A).

54 EXT Y output BNC connector (to HP 5363A).

55 EDGE 1 output BNC connector outputs auxiliary pulse (1 volt RMS into 50Ω) in sync with leading edge of output pulse.

56 EDGE 2 output BNC connector, outputs auxiliary pulse (1 volt RMS into 50Ω) in sync with trailing edge of output pulse.

57 EVENTS input BNC connector accepts asynchronous input up to 100 MHz to substitute for internal clock in Events mode.

58 TRIGGER LEVEL control adjusts ±2 volts to select trigger level of the Events input signal.

59 SLOPE switch selects the positive or negative slope of the Events input signal.

60 FREQ STD INPUT BNC connector allows synchronous operation with an external standard of either 5 or 10 megahertz (1 volt peak-to-peak into 1KΩ required. Maximum input 10V).

61 FREQ STD EXT/INT switch selects either internal (10 MHz) or external time base.

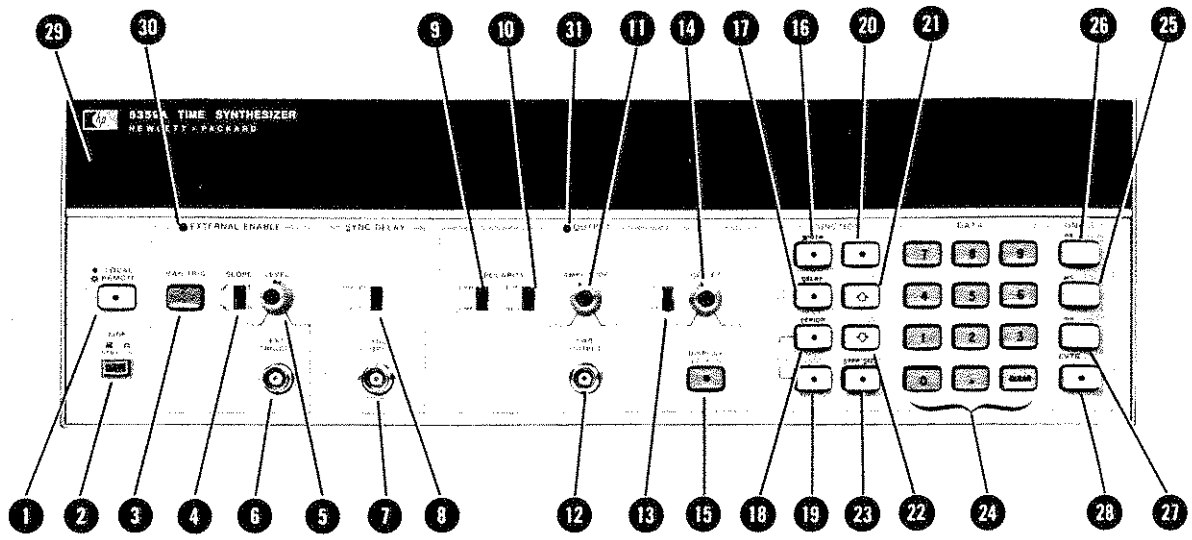
62 FREQ STD OUTPUT BNC connector provides 10 Megahertz in sync with time base chosen (EXT or INT). Amplitude is 1 volt peak-to-peak into 50Ω.

63 HP-IB Interface connector for remote operation via HP-IB.

64 HP-IB ADDRESS switch contains address switches A1 through A5. Switches A6 and A7 are not connected.

65 AC power input module permits 5359A operation from 100, 120, 220 or 240 volts AC. The number visible in the window indicates nominal line voltage to which instrument must be connected (see *Figure 2-1*). Protective grounding conductor connects to the instrument through this module.

Figure 3-5. Rear Panel Features



1. Before switching on the instrument, ensure that the power transformer primary is matched to the available line voltage, the correct fuse is installed, and that all safety precautions have been observed. See Power Requirements, Line Voltage Selection, Power Cables, and associated warnings and cautions in Section II of this manual. Description numbers below matched the numbers in *Figure 3-3.*

2. Preset the 5359A front panel controls as follows:

EXTERNAL SLOPE
- SLOPE 4 ..... ⨍
- LEVEL 5 ..... approximate center

SYNC DELAY
- PRESET/AUTO 8 ..... PRESET

OUTPUT
- POLARITY 9 10 ..... NORM, POS
- AMPLITUDE 11 ..... approximate center
- OFFSET 13 14 ..... OFF, approximate center

3. Preset the 5359A rear panel controls as follows:

EXTERNAL TIMING COMPENSATION
- ENABLE/DISABLE 52 ..... DISABLE

EVENTS
- TRIG LEVEL 58 ..... approximate center
- SLOPE 59 ..... ⨍

FREQ STD
- EXT/INT 61 ..... INT

4. Press LINE switch 2 to ON position and observe the self-calibration routine (see Paragraph 3-27). After calibration verify that the display indicates 100.00 ns WIDTH, and that the WIDTH FUNCTION key 16 and OUTPUT 30 LED indicators are lit.

NOTE

When the instrument is first turned on, the processor performs a self-check on the ROM's and RAM's and self-calibrates. If, during power-up or normal operation, an Error Messages is displayed, refer to Paragraph 3-35 ERROR MESSAGES in this section.

Figure 3-6. Operator's Checks

5. Press DISPLAY LEVELS (15) . Verify that there are two groups of three digits displayed. The left group indicates the output pulse amplitude and the right group indicates the DC offset of the pulse (volts). Change the POLARITY switches (9) , (10) to the COMP and NEG positions. Verify that the letter "c" and "–" (negative) sign precede the display groupings. Return the POLARITY switches to the NORM and POS positions. Vary the AMPLITUDE control (11) , and verify that the left-most digits vary from approximately 0.50 volts to 5.00 volts. Slide the OFFSET OFF/ON switch (13) to ON, and vary the OFFSET control (14) . Verify that the right-most digits vary from approximately –1.00 volts to 1.00 volts. Return the OFFSET ON/OFF switch to OFF. Verify that the displayed Offset voltage returns to 0.00 volts.

6. Press function keys WIDTH (16) , DELAY (17) , PERIOD (18) , and FREQ (19) in succession, and observe the recall of power-up parameters as follows:

WIDTH	100.00 ns
DELAY	— — — — — — ns
PERIOD	1.00000 μs
FREQ	1.00000 MHz

NOTE

When no parameter is entered, as in DELAY above, a series of eleven dashes (all display center segments) will be lit.

Verify that the displayed annunciator and function key LED correspond to the key pressed.

7. Press, in sequence, function key WIDTH (16) and STEP SIZE (23) . Verify that the predefined power-up STEP SIZE of 1.00 ns is displayed. Verify that the STEP SIZE key LED and the STEP and WIDTH annunciators are lit. Verify that the LED indicator on the associated function key (WIDTH) is flashing. Repeat the above procedure for the DELAY (17) , PERIOD (18) and FREQ (19) function keys (delay and period step size 1.00 ns and frequency step size 1.000 000 00 kHz).

8. Press function key WIDTH (16) . Verify that momentarily pressing the STEP UP key (21) increments the displayed WIDTH by 1.00 ns. Press and hold the STEP UP key (21) and verify that the displayed WIDTH is increasing in steps of 1 ns, at a rate of approximately 7 steps per second. Repeat the above procedure using the STEP DN (22) key.

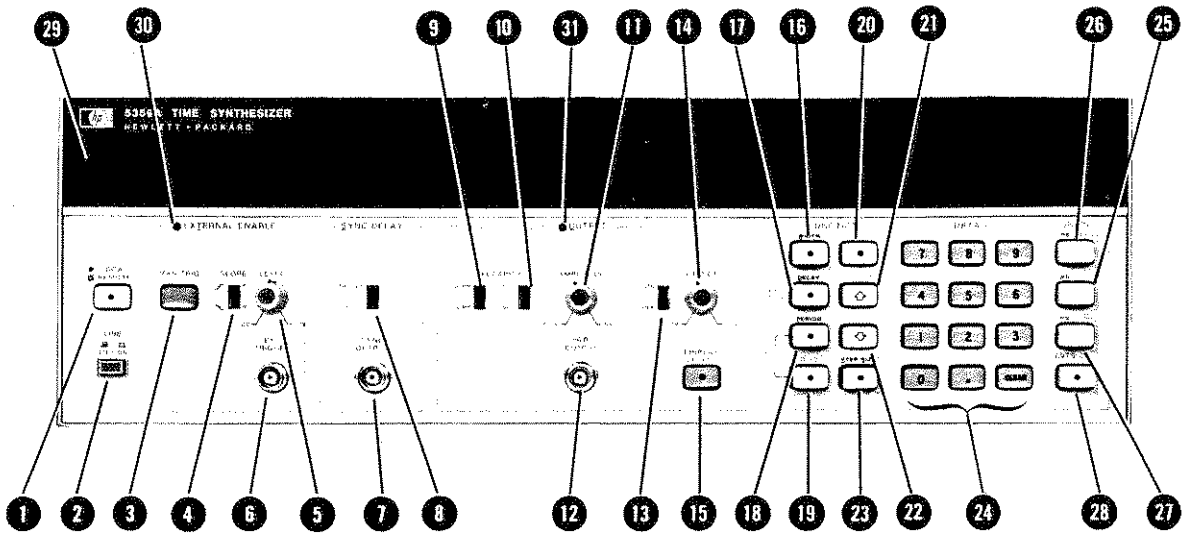
9. Press function key PERIOD (18) and verify a period of 1.000 00 μs. Press function key WIDTH (16) and observe a width of 100.00 ns (reenter these parameters if necessary). Attempt to enter an illegal width parameter (i.e. 2.0 μs) and verify the ERR annunciator (36) is flashing and the associated function key (PERIOD) LED is flashing. This display indicates that a 2.000 00 μs pulse WIDTH is inconsistent with the previously entered 1.000 00 PERIOD. The ERR may be cleared by entering a consistent parameter.

10. Press function key CAL (20) , and verify that the OUTPUT LED (31) and selected function key LED momentarily blank, while the CAL (self-calibration) is performed.

NOTE

The CAL routine can be initiated without affecting any currently programmed function mode or parameter.

Figure 3-6. Operator's Checks (Cont'd)



1. Set LINE switch ❷ to the ON position. The 5359A will perform self-calibration, and assume power up parameters (Paragraph 3-30).

2. Set SYNC DELAY ❽ and OUTPUT controls ❾ ❿ ⓭ ⓮ for desired output pulse. (If short insertion delay is not essential set ❽ to PRESET.)

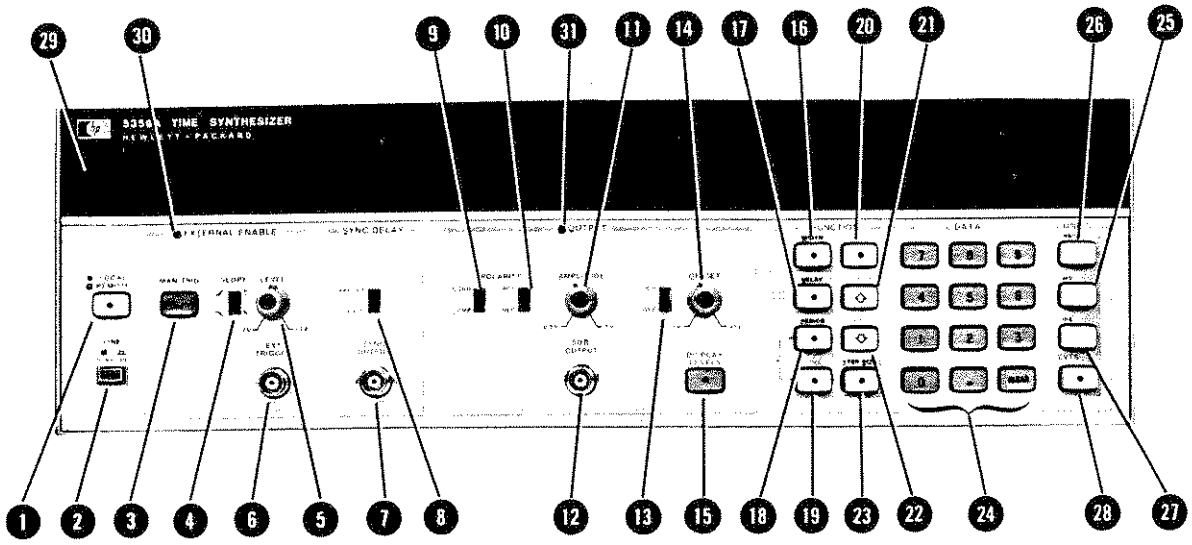
3. Connect external trigger signal to EXT TRIGGER input jack ❻ .

4. Set EXTERNAL ENABLE slope ❹ and LEVEL ❺ controls for desired trigger.

5. Select desired delay by pressing DELAY ⓱ , DATA ㉔ and UNITS ㉕ ㉖ ㉗ in sequence.

6. Select desired width by pressing WIDTH ⓰ , DATA ㉔ and UNITS ㉕ ㉖ ㉗ in sequence.

Figure 3-7. EXT TRIGGER/DELAY



1. Set LINE switch (2) to ON position. The 5359A will perform self-calibration and assume power-up parameters (Paragraph 3-30).

2. Set SYNC DELAY (8) and OUTPUT controls (9) (10) (11) (13) (14) for desired output pulse. (If short insertion delay is not essential set (8) to PRESET.)

3. Connect external trigger signal to EXT TRIGGER input jack (6) .

4. Set EXTERNAL ENABLE Slope (4) and Level (5) controls for desired trigger.

5. Connect events signal to EVENTS input jack (57) on rear panel.

6. Set EVENTS Slope (59) and Level (58) controls for desired trigger.

7. Select desired delay by pressing DELAY (17) DATA (24) and EVENTS (28) in sequence. Data entry is referenced to number of Events.

8. Select desired width by pressing WIDTH (16) , DATA (24) , and UNITS (28) in sequence.

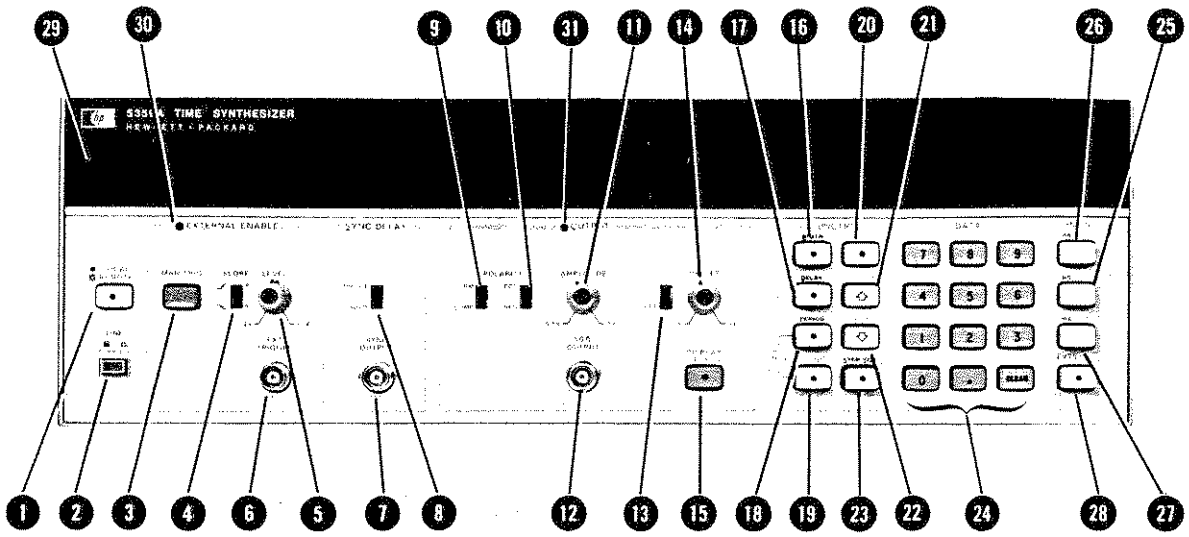
NOTE

Both Delay and Width must be specified as Events. If either value is not specified, a default value of 10 events is entered.

NOTE

The Events Level adjustment (58) (on rear panel) should be set to the approximate correct position prior to entering the Events mode. Failure to due so may result in attempting to count the noise or ripple pulses on the Events signal, causing an apparent "lock-up" in the 5359A (i.e., Output may cease). This condition may be cleared by pressing the EVT (28) key.

Figure 3-8. EXT TRIGGER/EVENTS



1. Set LINE switch ❷ to ON position. The 5359A will perform self-calibration and assume power-up parameters (Paragraph 3-30).

2. Set OUTPUT controls ❾ ❿ ⓫ ⓭ ⓮ for desired output pulse.

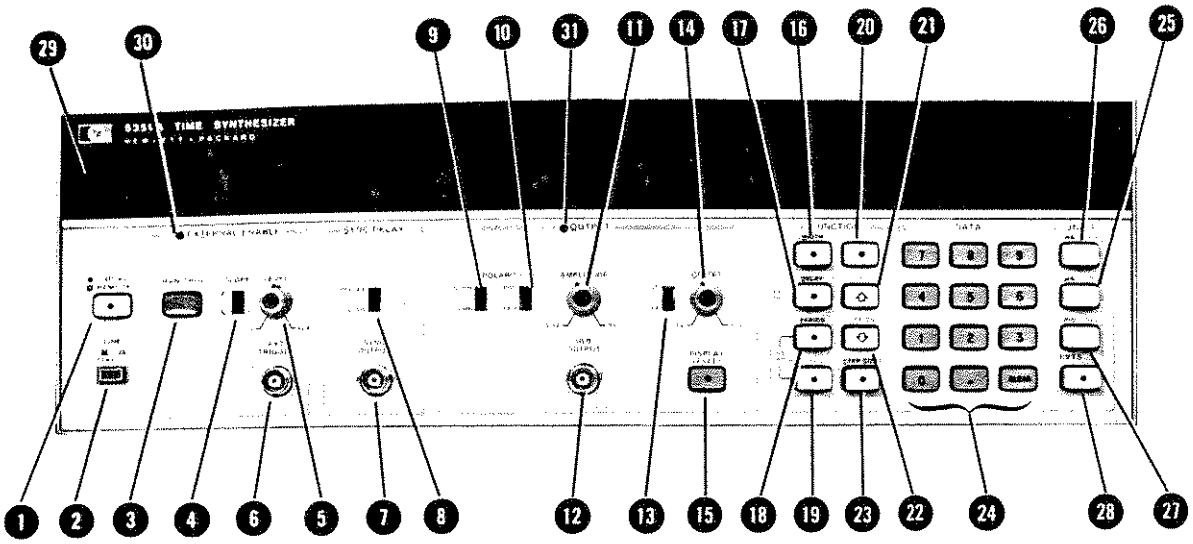
3. Select desired frequency (or period) by pressing FREQ ⓳ or PERIOD ⓲ , DATA ㉔ and UNITS ㉕ ㉖ ㉗ in sequence.

4. Select desired width by pressing WIDTH ⓰ , DATA ㉔ and UNITS ㉕ ㉖ ㉗ in sequence.

NOTE

The 5359A is a TIME SYNTHESIZER, rather than a Frequency Synthesizer. When data is entered, it is internally converted to the corresponding period, which is then synthesized. Since the accuracy of the instrument is stated in terms of absolute TIME (1 ns), the percentage frequency accuracy improves as frequency is lowered (i.e., 1 ns is 1% of a 10 MHz signal's period, but only 1×10^{-6}% of the 10 Hz signal's period).

Figure 3-9. FREQUENCY/PERIOD



1. Set LINE switch ❷ to ON position. The 5359A will perform self-calibration and assume power-up parameters (Paragraph 3–30).
2. Set OUTPUT controls ❾ ❿ ⓫ ⓭ ⓮ for desired output pulse.
3. Connect external trigger signal to EXT TRIGGER input jack ❻ .
4. Set EXTERNAL ENABLE Slope ❹ and Level ❺ controls for desired trigger.
5. Select desired frequency (or period) by pressing FREQ ⓳ or PERIOD ⓲ , DATA ㉔ and UNITS ㉕ ㉖ ㉗ in sequence.
6. Select desired width by pressing WIDTH ⓰ , DATA ㉔ and UNITS ㉕ ㉖ ㉗ in sequence.
7. Press TRIG FREQ ㉘ to enable the external trigger.
8. To return to normal Frequency/Period mode, press TRIG FREQ ㉘ again.

Figure 3–10. TRIGGERED FREQUENCY

3-56. PROGRAMMING

3-57. Introduction

3-58. The 5359A Time Synthesizer is fully compatible with the Hewlett-Packard Interface Bus (HP-IB). The bus capability is installed as standard equipment and allows the 5359A to respond to remote control instructions via the HP-IB.

NOTE

HP-IB is Hewlett-Packard's implementation of IEEE Std. 488-1975, "Standard Digital Interface for Programmable Instrumentation".

3-59. This section describes how to use the 5359A on the HP-IB. Before programming the 5359A, the operator must be familiar with the selected computing controller (e.g., the 9825A or 9830A calculator), the capabilities of the HP-IB, and the manual operation and capabilities of the 5359A. The following HP manuals provide useful background information:

HP-IB User Guide, 9830A, (P/N 59300-90002)
Hewlett-Packard 9825A Calculator General I/O Programming (P/N 09825-90024)
Hewlett-Packard 9825A Calculator Extended I/O Programming (P/N 09825-90025)
Condensed Description of the Hewlett-Packard Interface Bus (P/N 59401-90030)

3-60. Interface Function

3-61. The capability of a device connected to the HP-IB is specified by its interface functions. *Table 3-1* lists the interface functions of the 5359A using the terminology of the IEEE 488-1975 standard (Appendix C). The interface functions are also listed below the rear panel HP-IB connector. Interface functions provide the means for a device to receive, process, and send messages over the HP-IB.

Table 3-1. HP-IB Interface Capability

Interface Function Subset Identifier	Interface Function Description
SH1	Complete source handshake capability.
AH1	Complete acceptor handshake capability.
T2	Talker (basic talker, serial poll, no talk only mode, does not unaddress to talk if addressed to listen).
L2	Listener (basic listener, no listen only mode, does not unaddress to listen if addressed to talk).
SR1	Service request capability.
RL1	Complete remote/local capability.
PPØ	No parallel poll capability.
DC1	Device clear capability.
DT1	Devce trigger capability.
CØ	No controller capability.
E1	One unit load.

3-62. Bus Messages

3-63. Messages are the means by which devices exchange control and measurement information. There are 12 basic messages which can be sent over the interface. *Table 3-2* lists each bus message, a description of the message, how the 5359A uses that message, and examples of 9825A implementation of the messages.

Table 3-2. Bus Message Usage

Message	Description	5359A Use	Sample 9825A Statement
Data	Transfers device-dependent information from one device to one or more devices on the Bus.	Accepts program codes. See Table 3-4 for code set. Sends instrument state in "teach mode".	wrt 704, "F6e6"
Trigger	Causes a group of selected devices to simultaneously initiate a set of device-dependent actions.	Starts counting delay or period (same as pressing MANUAL TRIGGER when in local mode or sending the TM command when in remote).	trg 7 or trg 704
Clear	Causes an instrument to be set to a pre-defined state (a certain range, function, etc.).	Clears bits 5, 6 and 7 of status word. Clears Service Request.	clr 7 or clr 704
Remote	Permits selected devices to be set to remote operation, allowing parameters and device characteristics to be controlled by Bus Messages.	Goes to remote when REN true and listen or talk address sent. Locks out all controls except *.	rem 704
Local	Causes selected devices to return to local (front panel) operation.	Remain as currently configured and enable local control or all switches and controls.	lcl 704
Local Lockout	Disables local control of selected devices.	Disables LOCAL/REMOTE pushbutton.	llo 7
Clear Lockout and Local	Returns all devices to local (front panel) control and simultaneously clears the Local Lockout Message.	Same as Local Message and enable LOCAL/REMOTE pushbutton.	lcl 7
Require Service	Indicates a device's need for interaction with the controller.	Pulls on SRQ to indicate change in status byte or single cycle output completed. See status byte below.	rds (7) →A if bit (7, A) (bit 7 = 1 if SRQ true)
Status Byte	Presents status information of a particular device; one bit indicates whether or not the device currently requires service, the other 7 bits (optional) are used to indicate the type of service required.	See Table 3-5.	rds (704) →S (test bits in S)
Status Bit	A single bit of device-dependent status information which may be logically combined with status bit information from other devices by the controller.	Does Not Use	—
Pass Control	Passes bus controller responsibilities from the current controller to a device which can assume the Bus supervisory role.	Does Not Use	—
Abort	Unconditionally terminates Bus communications and returns control to the system controller.	Clears Talk, Listen, Serial Poll and Enable. Current configuration unchanged.	cli 7

**Trigger level control, amplitude control, offset control, events level control, internal/external time base switch, and local pushbutton (see Local Lockout below).*

3-64. Address Selection

3-65. To use the 5359A in an HP-IB system, set the rear panel address switches as shown in *Table 3-3*. The five right-hand switches, A5 through A1, set the talk and listen addresses of the 5359A. Switches A6 and A7 are not connected. The examples listed in this section assume an address setting of 00100, which is a 5-bit binary equivalent of decimal 04. This number is important when using an HP 9825A calcualtor, since the calculator addresses the 5359A to talk and listen using the address 704 (the "7" being the select code of the 98034A HP-IB Interface and the "04" being the 5359A address). The equivalent ASCII addresses are talk "D" and listen "$". The ASCII addresses are used when the computing controller is an HP 9830A Calculator.

3-66. Device Command Definitions

3-67. A device command is a sequence of one or more ASCII-coded bytes, sent to the 5359A over the HP-IB, that cause the 5359A to perform a specific function. Before discussing individual device commands, it is useful to classify these commands into three types: terse commands, decimal commands, and binary commands. Definitions and examples of each type follow:

Terse command: A specific sequence of one or more ASCII-coded bytes not followed by a decimal or binary number. For example, the character "C" causes the 5359A to execute a calibrate sequence. The characters "OC" cause the 5359A to output pulses in the complement polarity.

Decimal command: A sequence of one or more ASCII-coded bytes followed by a sequence of bytes representing a decimal number and a terminator. Numbers are explained below. A terminator is either a comma, carriage return or linefeed. For example, the sequence "F2.e6," causes the 5359A to output 2 MHz in the frequency mode.

Binary command: A sequence of one or more ASCII-coded bytes followed by a sequence of bytes representing a binary number. For example, the binary command:

LN (byte #1) (byte #2) . . . (byte #66) is the "learn" command.

For decimal commands, the number used must be of the form:

$$[+ \text{ or } -]\ X_0X_1 \ldots X_M\ [.]\ Y_0Y_1 \ldots Y_N\ [e \text{ or } E\ [+ \text{ or } -]\ Z_0 \text{ or } Z_0Z_1]$$

where:

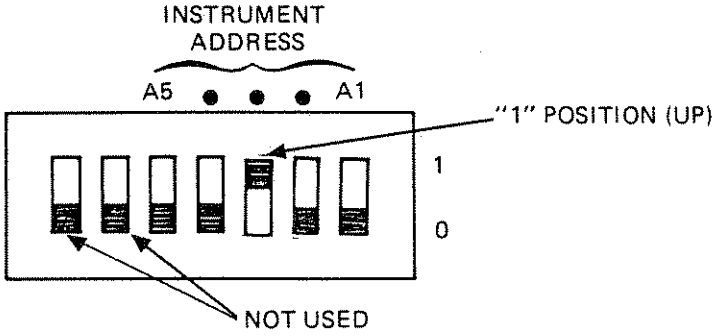
X_i = digit (i = 0 to M; M≥0)

Y_j = digit (j = 0 to N; N≥0; N+M≥1)

Z_k = digit (k = 0 to 1, one or two allowed)

[ ] = optional

Table 3-3. Address Selection



ASCII CODE CHARACTER		ADDRESS SWITCHES					DECIMAL EQUIV-LENT OF BINARY SWITCH SETTING
LISTEN	TALK	A_5	A_4	A_3	A_2	A_1	
SP	@	0	0	0	0	0	00
!	A	0	0	0	0	1	01
"	B	0	0	0	1	0	02
#	C	0	0	0	1	1	03
$	D	0	0	1	0	0	04
%	E	0	0	1	0	1	05
&	F	0	0	1	1	0	06
'	G	0	0	1	1	1	07
(	H	0	1	0	0	0	08
)	I	0	1	0	0	1	09
*	J	0	1	0	1	0	10
+	K	0	1	0	1	1	11
,	L	0	1	1	0	0	12
—	M	0	1	1	0	1	13
.	N	0	1	1	1	0	14
/	O	0	1	1	1	1	15
ø	P	1	0	0	0	0	16
1	Q	1	0	0	0	1	17
2	R	1	0	0	1	0	18
3	S	1	0	0	1	1	19
4	T	1	0	1	0	0	20
5	U	1	0	1	0	1	21 ← Normally Reserved for HP-IB Controller
6	V	1	0	1	1	0	22
7	W	1	0	1	1	1	23
8	X	1	1	0	0	0	24
9	Y	1	1	0	0	1	25
:	Z	1	1	0	1	0	26
;	[	1	1	0	1	1	27
<	\	1	1	1	0	0	28
=	]	1	1	1	0	1	29
>	~	1	1	1	1	0	30

The following are examples of valid numbers:

-123 or 123. or 123e0 or +123

+0.6e6 or .6E6 or 0.6e+6

27E-09 or 27E-9 or 27e-9

Thus, to command the 5359A to output 345 kHz use any of the following decimal commands:

F345000,

or F3.45e+5,

or F+.345E6 CR (CR = carriage return)

3-68. In the discussion that follows, each 5359A device command is classified as to type.

3-69. THE 5359A DEVICE COMMANDS

3-70. *Table 3-4* shows the complete set of 5359A device commands. The codes are organized into functional groups for ease of description and use. Each group of commands is discussed below in detail. The order in which the codes are listed and sent over the HP-IB is arbitrary. Each code is processed on an interrupt basis by the microprocessor and implemented immediately. For example, the decimal command "F9.9e6", is sent to the processor via the HP-IB interface card (05370-60015), character by character, until the "," is received. On receipt of the "," the processor causes the 5359A to immediately output 9 MHz. The 5359A powers up with a width set to 100 ns and a frequency set to 1 MHz. When the 5359A goes into remote, the current switch settings and controls are "memorized" and become the starting point for HP-IB operation. The only conditions not recorded are the current setting of the AMPLITUDE and OFFSET controls. These controls remain locally enabled when the 5359A goes into remote. Lastly, all ASCII letters may be sent over the HP-IB in either upper or lower case.

3-71. FUNCTION MODE. The decimal commands in this group duplicate the operation of the front panel WIDTH, DELAY, PERIOD, FREQ, DATA, and UNITS keys. Each decimal command must include a number and a terminator (comma, carriage return, or line feed). The numbers used for FREQ and PERIOD have units of hertz and seconds, respectively. The units for DELAY and WIDTH are events, if the numbers are equal to or greater than one, or seconds, if less than one.

Example: For delay of 25 ns send

D 25 e - 9, or

D.025 e - 6 LF (LF = Line Feed)

3-72. STEP MODE. The commands in this group duplicate the operation of the STEP SIZE (width, delay, period, or frequency steps), STEP UP, and STEP DOWN keys. To program a step size (a) send a step size prefix (F, P, D, or W for Frequency, Period, Delay, or Width), (b) SS)Step Size), (c) a number and (d) a terminator. The numbers used for FREQ and PERIOD STEP SIZES have units of hertz and seconds, respectively. The units for DELAY and WIDTH are events, if the numbers are equal to or greater than one, or seconds, if less than one.

Table 3-4. 5359A Device Commands

Command Group	Device Command	Description	Equivalent Key/Switch/Control	Command Type
Function Mode	F <num> <term>*	Frequency Mode (Hz)	FREQ (•) /DATA/UNITS	Decimal
	P <num> <term>	Period Mode (seconds)	PERIOD (•) /DATA/UNITS	Decimal
	D <num> <term>	Delay — Seconds, if Delay/Width less than 1. Events otherwise.	DELAY (•) DATA/UNITS	Decimal
	W <num> <term>	Width — Seconds, if Delay/Width less than 1. Events otherwise.	WIDTH (•) /DATA/UNITS	Decimal
Step Mode	<prefix> SS <num> <term>	Step Size (units correspond to the units of the prefix) <prefix> = F, P, D, or W	STEP SIZE (•) /DATA/UNITS	Decimal
	<prefix> SU	Step Up (single step)	STEP UP (▲)	Terse
	<prefix> SD	Step Down (single step)	STEP DOWN (▼)	Terse
Events Mode	EN	Events Slope Negative	EVENTS SLOPE 	Terse
	EP	Events Slope Positive	EVENTS SLOPE 	Terse
Trigger Mode	TP	External Trigger-Positive Slope	SLOPE 	Terse
	TN	External Trigger-Negative Slope	SLOPE 	Terse
	TM	Trigger Manual	MAN TRIG ( ) pressed once	Terse
	ID	Trigger Input Disable	Disconnect/connect EXT TRIGGER input	Terse
	IE	Trigger Input Enable		
	TF NF	Triggered Frequency On Normal Frequency (No trigger needed)	TRIG FREQ (•)	Terse

Table 3-4. 5359A Device Commands (Continued)

Command Group	Device Command	Description	Equivalent Key/Switch/Control	Command Type
Output Mode	ON	Output–Normal	POLARITY NORM COMP	Terse
	OC	Output–Complement	NORM COMP	Terse
			AMPLITUDE	Terse
	OA <num> <term>	Output Amplitude and Display Levels	0.5V 5V and DISPLAY LEVELS	Decimal
			OFFSET	
	OO <num> <term>	Output Offset and Display Levels	-1V +1V and DISPLAY LEVELS	Decimal
	OL	Output Local (Enable front panel OFFSET and AMPLITUDE controls)	DISPLAY LEVELS	Terse
	SC	Single Cycle	No equivalent	Terse
	RA	Rearm (initiate single cycle)	No equivalent	Terse
	NC	Normal Cycle (cancels SC)	No equivalent	Terse
	OD	Output Disable	No equivalent	Terse
	OE	Output Enabled	No equivalent	Terse
Sync Delay Mode	SP	Sync Delay–Preset	PRESET AUTO	Terse
	SA	Sync Delay-Auto	PRESET AUTO	Terse
Calibration Mode	C	Perform Calibration	CAL	Terse
	ECE	External Compensation Enable (Enable 5363A Probes)	EXT TIMING COMPENSATION	Terse
			ENABLE DISABLE	Terse
	ECD	External Compensation Disable (Disable 5363A Probes)	ENABLE DISABLE	
Teach/ Learn	TE	Teach	None	Terse
	LN	Learn	None	Binary

*<num> = *number*
<*term*> = *terminator (ASCII carriage return, line feed, or comma)*

3-73. After programming the step size, one step up or step down is accomplished by sending F, P, D, or W followed by SU (Step Up) or SD (Step Down).

Example:

(1) For width step size of 10 ns send WSS 10 e-9,

(2) To step up the width 30 ns, send WSUWSUWSU or WSUSUSU

3-74. EVENTS MODE. The terse commands EN and EP select the slope for events detection corresponding to Events Slope Negative or Events Slope Positive.

3-75. TRIGGER MODE. The terse commands in this group program various trigger modes. The external trigger slope is selected by sending either TP (Trigger-Postive Slope) or TN (Trigger-Negative Slope). A single trigger, equivalent to pressing MAN TRIG once, can be programmed by sending the terse command TM. The externally supplied trigger signal (or the internal self-trigger in FREQUENCY or PERIOD MODE) is effectively turned off and on by sending ID (Trigger Input Disabled) or IE (Trigger Input Enabled). ID is intended for temporarily disabling the input. In addition to IE, the input will be re-enabled by NC, C, new data, and certain other commands. The triggered frequency mode may be enabled and disabled by sending TF (Triggered Frequency mode) or NF (Normal Frequency mode).

3-76. OUTPUT MODE. The front panel OUTPUT NORM/COMP functions are programmed by sending the terse commands ON or OC, respectively. The AMPLITUDE and OFFSET controls can be operated locally by sending OL. Whenever the OL command is sent, the 5359A will automatically display the amplitude and offset control settings (equivalent to pressing DISPLAY LEVELS in local operation). Once the AMPLITUDE and OFFSET controls are adjusted as desired, the settings can be "read and saved" by programming the terse commands OA or OO. As an alternative, the decimal command OA and OO may be used to program a desired output amplitude and output offset. The numbers used for these decimal commands have units of volts and a resolution of 20 mV. As always, decimal commands are followed by a terminator: comma, carriage return or line feed. Sending either one of the decimal commands OA or OO results in disabling local operating of both controls.

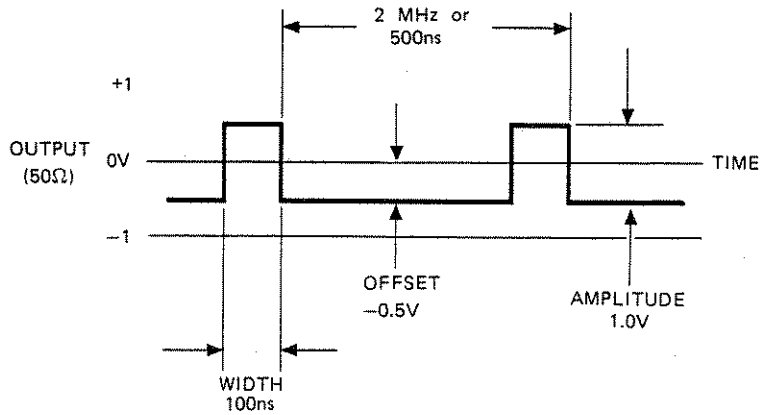
3-77. SYNC DELAY MODE. The codes SP (Sync Delay-Preset) and SA (Sync Delay-Auto) are completely analogous to the front panel SYNC DELAY PRESET/AUTO control setting.

Examples:

(1) f = 2 MHz

width = 100 ns

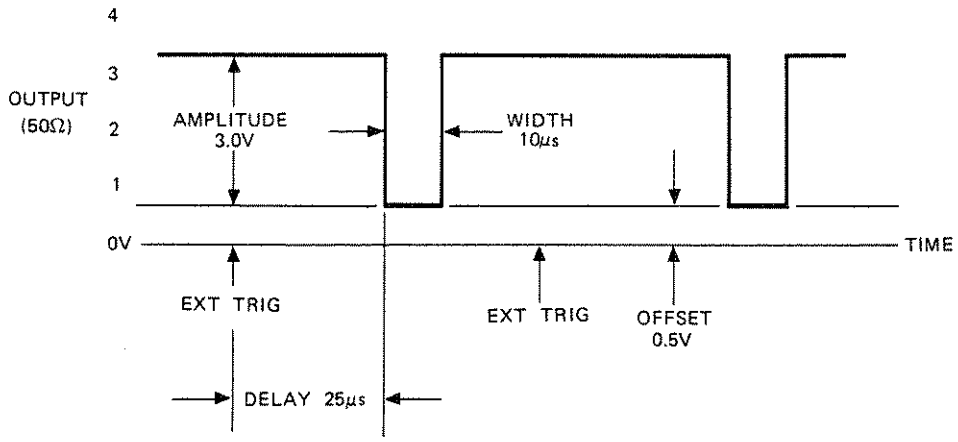
sending f2e6, w100e-9, oa1, OO -.5 LF



(2) delay = 25 μs

width = 10 μs

sending d25e-6, w10e-6, oc, oa3, OO +.5,



3-78. By using the SC (Single Cycle) terse command, one output pulse is produced for the first trigger pulse until an RA (Re-Arm) command is set. Upon receipt of the RA command, the occurrence of a trigger pulse will produce one more output pulse. While the single cycle mode is in effect, changing the pulse parameters also produces one output pulse. In this fashion, a sequence of individually tailored pulses (varying delays and widths) may be synthesized and controlled via the external trigger input. Sending NC (Normal Cycle) or C (Calibrate) cancels the single cycle mode of operation.

3-79. The command OD (output disable) turns off the output pulse and opens a relay that changes the OUTPUT impedance to a high state. This capability is useful when calibrating the 5359A with the 5363A Time Interval Probes. The 5363A should be calibrated with the probes either grounded or inserted into a 50Ω system with no signal applied. The command OE (output enable) reconnects the output pulse to the OUTPUT connector. OD is intended for temporarily disabling the output. In addition to OE, the output is reconnected by C, new data, or certain other commands.

3-80. CALIBRATION MODE. Sending the program code C is equivalent to pressing the front panel CAL button. The codes ECE (External Compensation Enable) and ECD (External Compensation Disable) remotely enable/disable calibration through the 5363A Time Interval Probes (C must be sent to actually perform the calibration after sending ECE or ECD).

3-81. TEACH AND LEARN. At any point in time, the complete state of the 5359A may be "taught" via HP-IB to the controller. Sixty-six 8-bit bytes are required to define the state of the 5359A. At a later time, the 66 bytes may be transferred back to the 5359A and the 5359A will return to the previous operational state. To exercise the teach and learn mode, proceed as follows:

a. With the 5359A in local mode, set the instrument controls, switches and functions as desired.

b. Address the 5359A to listen and send the terse command TE (teach).

c. Address the 5359A to talk. The 5359A then automatically sends 66 bytes to the controller.

d. Modify the state of the 5359A as desired either locally or via the HP-IB.

e. Address the 5359A to listen and send the terse command LN (learn).

f. Send the 66 bytes to the 5359A. When the 5359A receives the 66th byte, it will automatically calibrate and go to the defined state.

NOTE

When using the teach and learn commands, the state of the offset and amplitude controls will be recorded, i.e., if these controls are operable locally before the teach command is used, then they will be operable locally after the learn command has been set. If it is desired to "teach" manually set values for amplitude and offset, send either the OO terse command (output offset) or the OA terse command prior to sending the teach command.

3-82. Refer to Program Example 2 for a specific application of the teach and learn mode using the 9825A computing controller.

3-83. PROGRAMMING HINTS

1. The Terminator (comma, CR, LF) at the end of numerical data is essential. For example:

   wrt 704, "w 100e-9d100e-9" is incorrect

   This should be written as:

   wrt 704, "w 100e-9, d100 e-9"

   A CR LF (carriage return/linefeed) is inserted at the end of the line by the 9825A.

2. Extra Terminators may be used to synchronize the calculator to the 5359A. For example:

   a. wrt 704, "w 100 e-9" (CR LF automatic). The CR causes the 5359A to begin processing the number, however, the LF is accepted into the one byte command buffer and the calculator will proceed with the program while the 5359A is still processing the width data.

   b. wrt 704, "w 100 e-9," (CR LF automatic). In this example, the second comma starts the 5359A processing the number. The CR is accepted into the command buffer, but the linefeed cannot be sent until the CR is processed (and ignored). Therefore, the calculator must wait until the width is set as specified before continuing to the next line. The 5359A always processes commands in the order received.

3-84. SERVICE REQUEST MESSAGE AND STATUS BYTE

8-85. In general, service is requested (bus line SRQ set low) when certain status bits are set or cleared. *Table 3-5* gives the usage for each status bit and the effect of each bit on the service request message.

Table 3-5. Table of Status Bits and Effect on SRQ

Bit	Set to a "One" When	Set to a "Zero" When	Effect on SRQ
8	Entering debug monitor	Leaving debug monitor	None
7	Service Requested	Any legal device command received or change from remote to local or clear bus message received.	Generated when set to one. Cleared when set to zero or when serial polled.
6	Any error message except 8.4, 8.5, or 8.6 is displayed.	Clear bus message received.	Generated when conditions to set this bit occur.
5	Error messages 8.4, 8.5, or 8.6 are displayed.	Calibrate operation is performed (but may be set to one again if error occurs) or clear bus message received.	Generated when conditions to set this bit occur.
4	Time base set to EXT.	Time base set to INT.	Time base should not be changed while instrument is running.
3	Oven time base not up to temperature.	Oven up to temp or no oven installed.	Generated when any change in this bit.
2	Output disabled by a duty cycle* error.	No duty cycle error.	Generated when any change in this bit.
1	Cycle complete in single cycle mode.	Rearm command or new data received or leave single cycle mode.	Generated when this bit set to a one.

*Duty cycle error:
(1) Width too wide for period specified
(2) Delay plus width too large
(3) Delay too negative

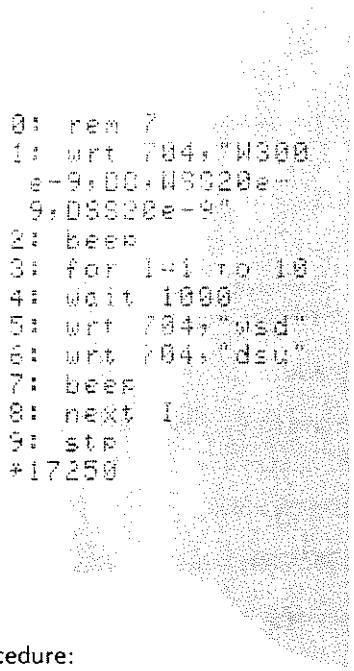
3-86. PROGRAMMING EXAMPLES

3-87. The following HP-IB programming examples are provided for information only. The sample program utilizes a 9825A Computing Controller and a 5359A address of decimal 4.

EXAMPLE 1

Goal: Program 5359A for a delay of Ø ns and a pulse width of 300 ns. Then once per second, increase the delay by 20 ns and decrease the width by 20 ns. This action keeps the trailing edge of the pulse fixed relative to the sync pulse (5359A address switches 00100).

9825A Computing
Controller Program



Line Ø: Insures that the REN bus line is set low (assertive).

Line 1: Program the 5359A for a width of 300 ns, a delay of 0 ns, a width step size of 20 ns and a delay step size of 20 ns.

Line 2: Beep.

Line 3: Set up loop for 10 delay and width changes.

Line 4: Wait 1 second.

Line 5: Step down width once (the 5359A responds identically to upper and lower case letters).

Line 6: Step up delay once.

Line 7: Beep.

Line 8: Increment the loop counter.

Line 9: Stop after 10 passes through the loop.

Procedure:

1. Power-up 5359A.
2. Manually enter a delay of 0 nsec. This step puts the 5359A in an external trigger mode.
3. Apply an appropriate trigger signal to EXT TRIGGER. Use a signal with a period of at least 300 ns (<3.3 MHz).
4. Monitor the 5359A SYNC OUTPUT and OUTPUT pulse with a dual channel oscilloscope. Use either a scope with 50Ω input impedance or 50Ω feed throughs.
5. Adjust the trigger LEVEL control until an output is produced.
6. Enter the above program into a 9825A calculator.
7. Press (RUN) on the 9825A. Verify proper operation by observing the SYNC OUTPUT and the OUTPUT pulse on the oscilloscope.

EXAMPLE 2

Goal: Demonstrate the teach and learn capability of the 5359A.

Procedure:

1. Power-up 5359A.
2. Manually alter the power-up state of the 5359A by entering an appropriate function, step-sizes, etc.
3. Enter the 9825A program shown below.
4. Press RUN on the 9825A. When the 9825A display returns with (5359A →→ 9825A), the 5359A has "taught" its operational state to the 9825A.
5. Turn 5359A power off then on (returns 5359A to its power-up state, i.e. width = 100 ns and period = 1 μs).
6. Press CONTINUE on the 9825A. When the 9825A display returns with (9825A →→ 5359A), the 5359A has "learned" the previous operational state stored in the 9825A.

```
0: dim A[100]
1: wtb 704,"te"
 red 704
2: for I=1 to 66
3: rdb(721)→A[I]
4: next I
5: beep:dsp "535
 9A →→ 9825A"
 stp
6: wtb 704,"lm"
7: for I=1 to 66
8: wtb 731,A[I]
9: next I
10: beep:dsp
 "9825A →→ 5359A
 "
11: end
*15369
```

Line 0: Dimension variable A.

Line 1: Send teach command to the 5359A and address the 5359A to talk.

Line 2: Set-up loop to read 66 bytes.

Line 3: Read byte from HP-IB interface.

Line 4: Loop until 66 bytes read.

Line 5: Beep, display message, stop.

Line 6: When CONTINUE, send learn command to 5359A (5359A addressed to listen).

Line 7: Set-up loop to output 66 bytes.

Line 8: Write byte to HP-IB interface.

Line 9: Loop until 66 bytes output.

Line 10: Beep, display message.

Line 11: End.

Note: If the amplitude and offset controls are operable locally before the teach/learn cycle is executed, then they will be locally operable after the cycle is completed. To include the amplitude and offset control settings in the teach/learn cycle, send the terse commands OO or OA before sending the TE (Teach) command.

SECTION IV
OPERATION VERIFICATION AND PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedures from page 4-1 through 4-15 verify all major functions, controls, inputs, and outputs of the 5359A, both locally and via the HP-IB. The complete procedure can be performed without access to the interior of the 5359A. This verification procedure can be used as an incoming inspection for comparison in periodic maintenance, troubleshooting, and after repairs, or adjustments. A complete performance test starts on page 4-16.

4-3. EQUIPMENT REQUIRED

4-4. Equipment required for the operation verification procedure is listed in *Table 1-2*. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

4-5. CALIBRATION CYCLE

4-6. The 5359A requires periodic verification of operation. Depending on the use and environment conditions, the 5359A should be checked using the operation verification procedure at least every 6 months.

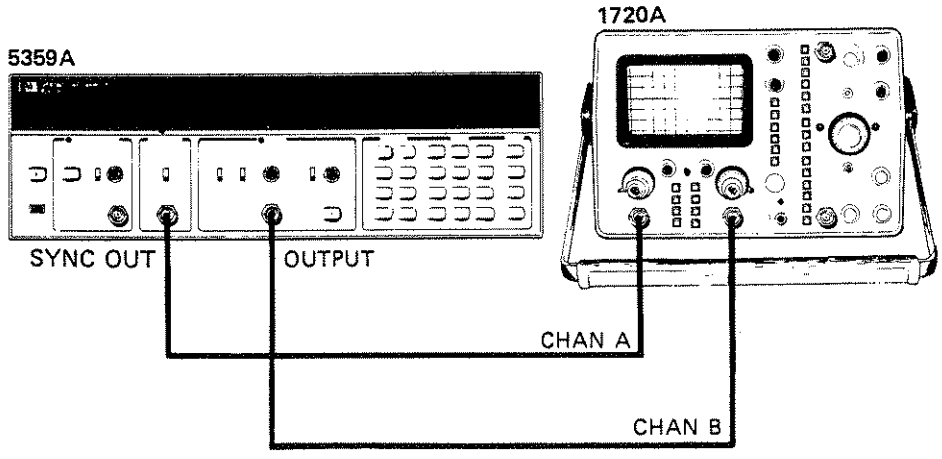
4-7. Successful completion of the Operation Verification procedure verifies the proper operation of the circuits in the HP 5359A Time Synthesizer.

4-8. LOCAL OPERATION VERIFICATION

4-9. Output Pulse, Controls, and Keyboard

1. Before switching on the instrument, ensure that the power transformer primary is matched to the available line voltage, the correct fuse is installed, and that all safety precautions have been observed. See Power Requirements, Line Voltage Selection, Power Cables, and associated warnings and cautions in Section II of this manual.

   Setup:



2. Preset the 5359A front panel controls as follows:

EXTERNAL SLOPE
SLOPE ..... ⨍
LEVEL ..... approximate center

SYNC DELAY
POLARITY ..... NORM, POS
AMPLITUDE ..... approximate center
OFFSET ..... OFF, approximate center

3. Preset the 5359A rear panel controls as follows:

EXTERNAL TIMING COMPENSATION
ENABLE/DISABLE ..... DISABLE
EVENTS
TRIG LEVEL ..... approximate center
SLOPE ..... ⨍
FREQ STD
EXT/INT ..... INT

4. Preset the 1720A Oscilloscope control as follows:

CHANNEL A ..... 1 volt/Div., 50Ω input Z
CHANNEL B ..... 1 Volt/Div., 50Ω input Z
HORZ DISPLAY ..... MAIN
VERT DISPLAY ..... ALT
INT TRIG ..... A
TIME/DIV ..... .2 μs

5. Press LINE switch ❷ to ON positon and observe the self-calibration routine (see Paragraph 3-27). After calibration verify that the display indicates 100.00 ns WIDTH, and that the WIDTH FUNCTION key ⓰ and OUTPUT ㉛ LED indicators are lit. Adjust oscilloscope Trigger Level for stable display of SYNC OUT and OUTPUT pulses.

NOTE

When the instrument is first turned on, the processor performs a self-check on the ROM's and RAM's and self-calibrates. If during power up or normal operation, an Error Message is displayed, refer to Paragraph 3-35 ERROR MESSAGES in Section III.

6. Press DISPLAY LEVELS and observe two groups of three digits displayed. The left group indicates the output pulse amplitude and the right group indicates the DC (volts) offset of the output pulse.

7. Vary the AMPLITUDE control and verify that the output pulse waveform is adjustable from approximately 0.50 volts to 5.00 volts and that the left-most grouping of digits continously corresponds to the output pulse level.

8. Slide the OFFSET OFF/ON switch to ON and vary the OFFSET control. Verify that the output pulse waveform DC offset is adjustable from approximately -1.00 volt to 1.00 volt and that the right-most grouping of digits continously corresponds to the output pulse DC offset. Return the OFFSET OFF/ON to OFF and verify that the waveform and level display return to 0.00 volts.

9. Change the NORM/COMP polarity switch to COMP and verify the output pulses with respect to the SYNC OUT, is now "complemented" and that the letter "c" precedes the display groupings. Return polarity switch to NORM.

10. Change the POS/NEG polarity switch to NEG and verify the output pulse with respect to the SYNC OUT, is now "negative going" and that a "-" (negative) sign precedes the display groupings. Return polarity switch to POS.

11. Press function keys WIDTH, DELAY, PERIOD, and FREQ in succession and verify parameters as follows:

WIDTH	100 ns
DELAY	--- --- --- --ns
PERIOD	1.000 00 μs
FREQ	1.000 00 MHz

NOTE

When no parameter is entered, as in DELAY above, a series of 11 dashes (all display center segments) will be lit.

Verify that the displayed annunciator and function key LED correspond to the key pressed.

12. Press, in sequence, function key WIDTH (16) and STEP SIZE (23). Verify that the predefined power-up STEP SIZE of 1.00 ns is displayed. Verify that the STEP SIZE key LED and the STEP and WIDTH annunciators are lit. Verify that the LED indicator on the associated function key (WIDTH) is flashing. Repeat the above procedure for the DELAY (17), PERIOD (18) and FREQ (19) function keys (delay and period step size 1.00 ns and frequency step size 1.000 000 00 kHz).

13. Enter a width step size of 10 ns, by pressing the WIDTH, STEP SIZE, 1, 0, and ns/Hz keys in succession. Refresh width display by pressing WIDTH key. Momentarily press STEP UP and verify that the displayed width increments up by 10 ns. Press and hold the STEP UP key and verify that the waveform and display value are increasing in steps of 10 ns, at a rate of approximately 7 steps per second. Press and hold STEP DN and verify the output pulse width waveform and display value decrement down in steps of 10 ns.

14. Press function key PERIOD (18) and verify a period of 1.000.00 μs. Press function key WIDTH (16) and observe a width of 100.00 ns (re-enter these parameters if necessary). Attempt to enter an illegal width parameter (i.e., 2.0 μs) and verify the ERR annunciator is flashing and the associated function key (PERIOD) LED is flashing. This display indicates that a 2.000 00 μs pulse WIDTH is inconsistent with the previously entered 1.000 00 PERIOD. The illegal parameter has been entered and the previous parameters are still active. The ERR may be cleared by entering a legal parameter.

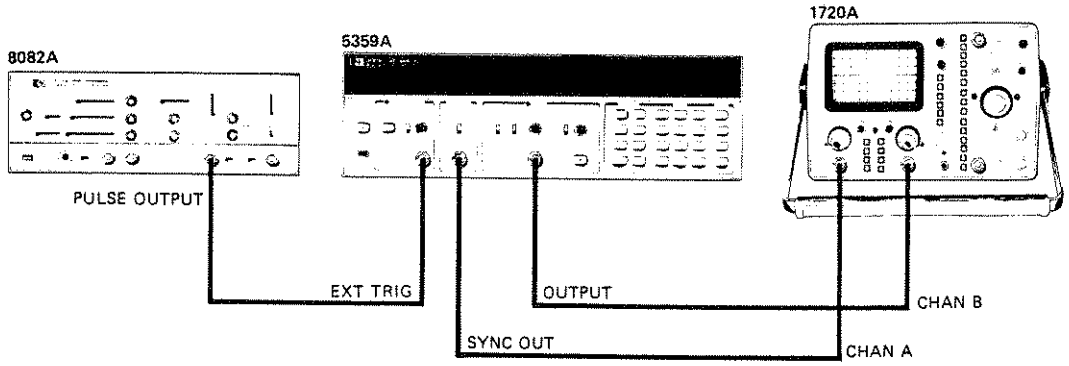
15. Press function key CAL (20), and verify that the OUTPUT LED, selected function key LED and both SYNC OUT and OUTPUT pulses momentarily blank, while the CAL (self-calibration) is performed.

NOTE

The CAL routine can be initiated without affecting any currently programmed function mode or parameter.

4-10. EXTERNAL TRIGGER

Setup:

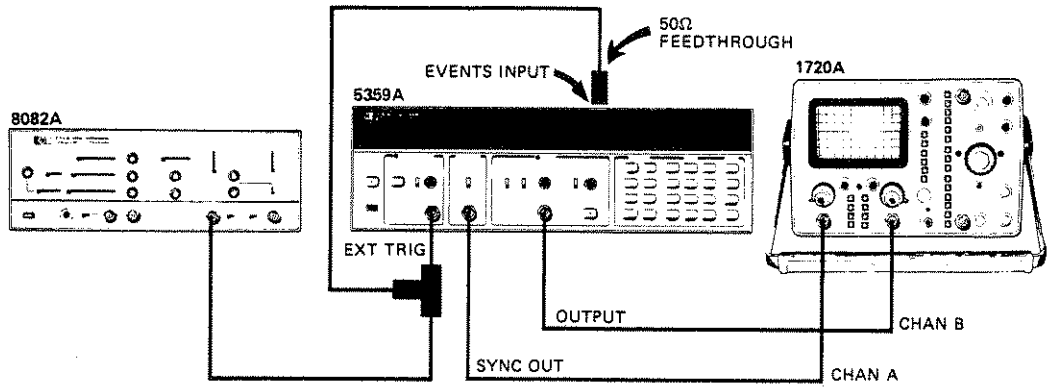


1. Preset the 8082A controls to produce a train of approximately 50 ns pulses, amplitude of 1-volt at a rate of approximately 1 Megahertz.

2. Program the 5359A for a Delay of 200 ns, by pressing the DELAY, 2, 0, 0, ns/Hz keys in succession. Verify that the EXTERNAL ENABLE LED is lighted. Adjust EXTERNAL ENABLE LEVEL control for stable oscilloscope display of Sync Out and Output pulses. Verify a 100 ns Output pulse occurring 200 ns after the Sync Out. Temporarily remove the EXT TRIG input (disconnect BNC cable) and verify that no Sync Out or Output pulses are present.

4-11. EVENTS INPUT

Setup:



1. Enter the Events mode by pressing the WIDTH, 2, EVTS, DELAY, 3, EVTS keys in succession

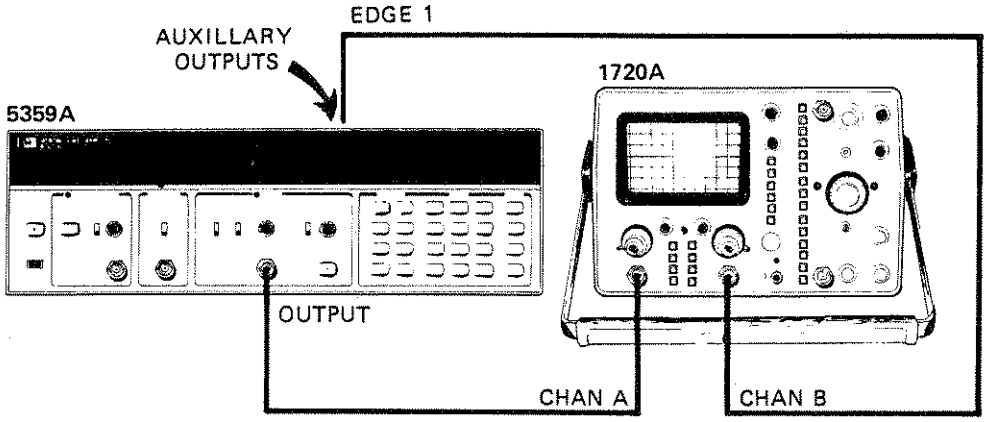
NOTE

In this mode of operation, both WIDTH and DELAY must be specified, in units of EVENTS.

2. Set the oscilloscope TIME/DIV to 1 μs and adjust the EVENTS TRIG LEVEL control on rear panel for stable oscilloscope display of Sync Out and Output pulses. (Readjust EXTERNAL ENABLE LEVEL if necessary.) Verify an approximate 2 μs Output pulse occurring approximately 3 μs after the Sync Out.

4-12. AUXILIARY OUTPUTS

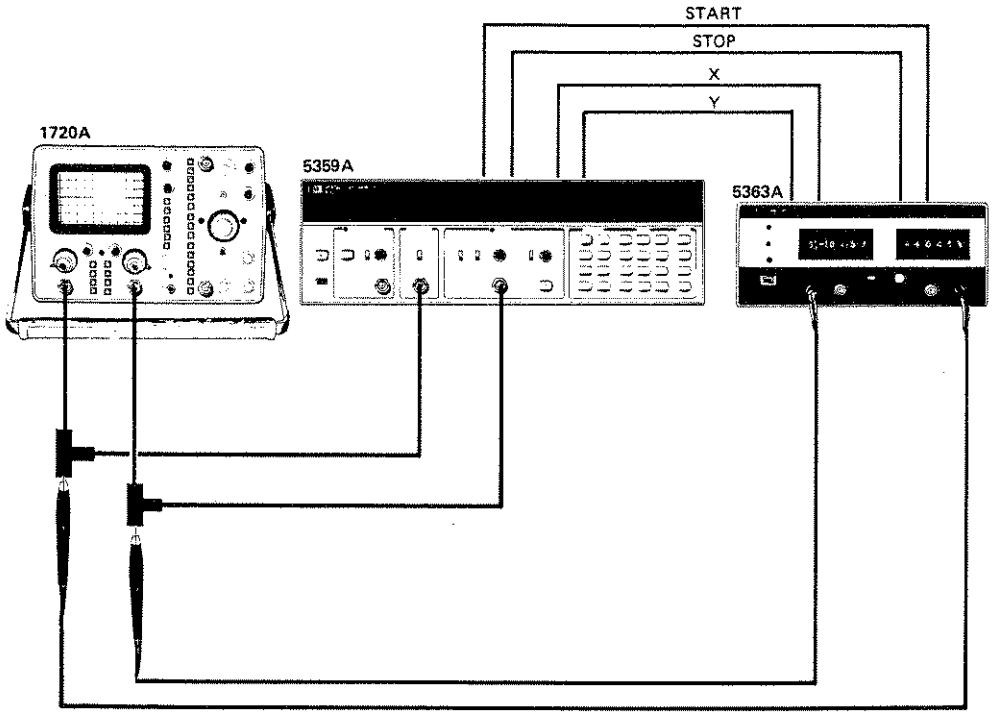
Setup:



1. Program the 5359A for a WIDTH of 100 ns and a FREQ of 1 MHz (through keyboard or power-down and power-up). Set the oscilloscope TIME/DIV to 0.1 μs and verify an EDGE 1 output pulse of approximately 35 ns in sync with the leading edge of the output pulse.
2. Reconnect Channel B oscilloscope input to EDGE 2 Output and verify an output pulse of approximately 35 ns in sync with the trailing edge of the output pulse.

4-13. EXTERNAL ENABLE COMPENSATION

Setup:



1. Preset the 5363A controls as follows:

START	A + 0.50 ⨍
STOP	B + 0.50 ⨍
PULL TO ADD	
10.00 nsec	IN

NOTE

Perform the self-calibrate routine on 5363A prior to configuration with 5359A.

2. Preset the 5359A controls as follows:

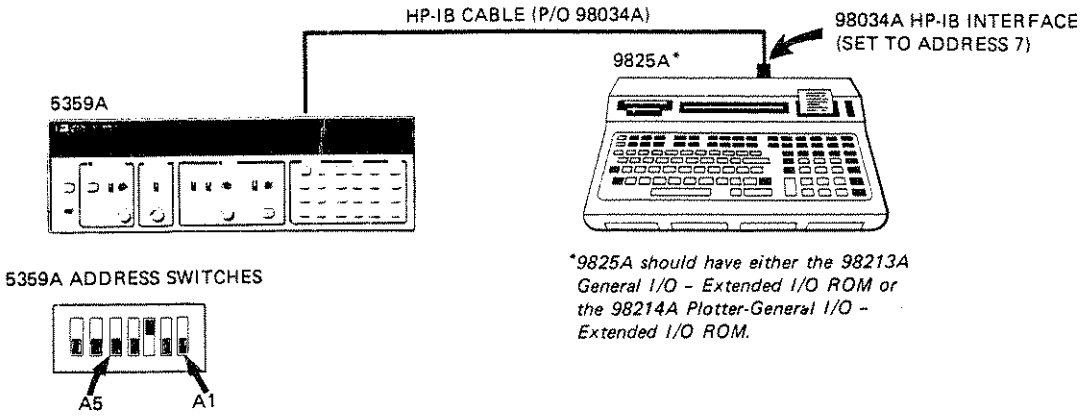
EXTERNAL ENABLE	≈ CENTERED, ⨍
SYNC DELAY	PRESET
POLARITY	NORM, POS
AMPLITUDE	≈ 1V
OFFSET	OFF
EXT TIMING COMPENSATION (REAR PANEL)	DISABLE

3. Press 5359A LINE switch to ON and observe the self-calibration routine (see paragraph 3-30). After calibration verify that the display indicates 100.00 ns WIDTH, and that the WIDTH FUNCTION key and OUTPUT LED indicators are lit.
4. Connect 5363A probe A to SYNC OUT and probe B to OUTPUT (via 10218A BNC to PROBE ADAPTORS). Place EXT TIMING COMPENSATION switch on rear panel to ENABLE.
5. Press 5359A CAL key, and verify a completed calibration (i.e., momentary blanking of display followed by the return of previous display of 100.00 ns WIDTH).
6. Remove 5363A probe B from OUTPUT BNC and press CAL key. Verify Probe Err 8.1.
7. Return EXT TIMING COMPENSATION switch to DISABLE. Press CAL key and verify a completed calibration (i.e., momentary blanking of display followed by the return of display of 100.00 ns WIDTH.

4-14. 5359A HP-IB VERIFICATION PROGRAM

4-15. The 9825A program listed in *Table 4-2* exercises the 5359A through various operating modes, described below, via its HP-IB Interface. If the 5359A successfully completes all phases of the verification program, then there is a high probability that the instrument is working properly. If the 5359A does not respond as described, refer to the overall troubleshooting in Section VIII.

4-16. To perform the verification, set up the 5359A as shown and set its rear panel address switch to Address Ø4.



Additional equipment required (connect to 5359A as directed by the program).

Dual-Channel Oscilloscope	1720A or equivalent
Pulse or Function Generator	3312A or equivalent
BNC Cables	4

4-17. Set the 5359A controls as follows:

FRONT

EXT TRIG SLOPE	⎍
LEVEL	≈ØV
SYNC DELAY	PRESET
POLARITY	NORM/POS
AMPLITUDE	midrange
OFFSET	ON/midrange

REAR

FREQ STD EXT/INT	INT
EXT TIMING COMPENSATION	DISABLE

4-18. The program listed in *Table 4-2* may be keyed into the 9825A or may be loaded from an HP-IB Verification Cassette, HP P/N 59300-10001 (Revision E or later), which also contains HP-IB verification program for other instruments. To run the program on the cassette, insert the cassette into the 9825A, load file Ø, and press RUN. Type 5359 CONTINUE when the instrument model number is requested. The 9825A will then load and run the 5359A verification program.

4-19. Apply power to the 5359A and verify that the time synthesizer powers up with a display of 100.00 ns width as per checkpoint 1 listed on the 9825A printer. Any other 5359A display (hieroglyphics, error messages, etc.) constitutes an instrument failure. Refer to Section VIII for troubleshooting.

4-20. The program goes through 21 checkpoints (tests) as described in *Table 4-1*. The information in *Table 4-1* tells what occurs during each test and gives the corresponding portion of the 9825A printer output produced as the program is run. The 9825A printer output tells what the condition of the 5359A should be at the end of the test. Checkpoints 9 through 18 require observation of the SYNC and OUTPUT signals using an oscilloscope. Connect the scope, when instructed to do so by the 9825A printer. Checkpoints 14 through 18 require an external trigger to be supplied to the 5359A. Connect a pulse or function generator when instructed to do so by the 9825A printer. At the conclusion of each test the 9825A stops and displays the current checkpoint. To advance to the next test, simply press CONTINUE. If it is desired to repeat a test, type cont "9" EXECUTE, for example, to repeat checkpoint 9.

Table 4-1. Model 9825A Program Description

Check Point	Test Name	9825A Printer Output/Comments
1	Set-up	CHECK POINT 1 5359A front panel set-up check. Verify: *ONLY KEYS LIT: * WIDTH *5359A DISPLAY: * 100.00 * ns * WIDTH *EXT ENABLE..off *OUTPUT.....on *Means that the operator checks for these conditions. When verified, press CONTINUE.
2	Listen Address	CHECK POINT 2 Program sends 5359A listen address. Verify: *ONLY KEYS LIT: * LOC/REM * WIDTH *5359A DISPLAY: * 100.00 * ns * WIDTH * LSN * RMT *EXT ENABLE..off *OUTPUT.....on
3	Talk Address	CHECK POINT 3 Program sends 5359A talk address. Verify: *ONLY KEYS LIT: * LOC/REM * WIDTH 5359A DISPLAY: * 100.00 * ns * WIDTH * TLK * RMT *EXT ENABLE..off *OUTPUT.....on

Table 4-1. Model 9825A Program Description (Continued)

Check Point	Test Name	9825A Printer Output/Comments
4	Remote/Local	CHECK POINT 4 Press LOC/REM on 5359A. Verify: *ONLY KEYS LIT: * WIDTH 5359A DISPLAY: * 100.00 * ns * WIDTH * TLK *EXT ENABLE..off *OUTPUT.....on Operator must press LOCAL on 5359A, then verify as indicated.
5	Local-Lockout	CHECK POINT 5 Program sends 5359A listen address & sets local-lockout. Press LOC/REM on the 5359A and verify as per CHK POINT 2. 5359A should have same indication as those listed for Checkpoint 2.
6	Calibrate	CHECK POINT 6 Press CONTINUE on the 9825A and observe 5359A CAL KEY LED. It should light as a CAL is done. 5359A front panel remains as per CHK POINT 2 after CAL done. CAL key LED turns on and OUTPUT LED turns off during calibrate cycle approximately 1 s.

Table 4-1. Model 9825A Program Description (Continued)

Check Point	Test Name	9825A Printer Output/Comments
7	External Timing Compensation	---------- CHECK POINT 7 Program sets EXT COMP ENABLE and CAL. Verify: *ONLY KEYS LIT: * LOC/REM * WIDTH *5359A DISPLAY: * ProbE * Err 8.1 * LSN * RMT * ns * WIDTH *EXT ENABLE..off *OUTPUT.....on Do not connect a 5363A for this test.
8	Display and Adjust Levels	---------- CHECK POINT 8 DISPLAY LEVELS Test. Verify: *AMP adjustable *from < 0.5 * to > 5.0 V *OFFSET adjusts *from < -1.0 * to > +1.0 V *ONLY KEYS LIT: * LOC/REM * DISP LVLS *5359A DISPLAY: * LSN * RMT * VOLTS *EXT ENABLE..off *OUTPUT.....on Leave AMP at 4.00 V and OFFSET at -1.00 Adjust AMPLITUDE and OFFSET controls and verify (5359A displays) these ranges. Display also has AMP OFFSET voltage displayed Convenient for the following scope observations.

Table 4-1. Model 9825A Program Description (Continued)

Check Point	Test Name	9825A Printer Output/Comments
9	SNYC and OUTPUT	---------- CHECK POINT 9 Connect SYNC and OUTPUT to scope (50 ohms): Set SYNC chan: 1 V/DIV Set OUTPUT chan: 2 V/DIV Set TIME/DIV to: 500 ns Trig on SYNC sig Verify OUTPUT: * 1 MHZ * Amp +4 V * Offset -1 V * Width 100 ns Verify SYNC: * Amp 1 V * Width 40 ns Trigger scope on channel with SYNC signal as input. Approximate value.
10	Normal/ Compliment	---------- CHECK POINT 10 OUTPUT NORM/COMP Test. Program switches from NORM to COMP 10 times. Press CONTINUE while observing the scope. See Section III if required, for a description of NORM/COMP Small "c" also present on the 5359A when OUTPUT in COMP mode.
11	Postive/ Negative	---------- CHECK POINT 11 OUTPUT POS/NEG Test. Program sets OFFSET to 0 and then switches from POS to NEG 5 times. Press CONTINUE while observing the scope. See Section III, if required, for a description of POS/NEG output. 5359A display will flash as data is input via HP-IB.

Table 4-1. Model 9825A Program Description (Continued)

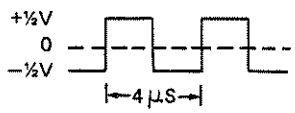
Check Point	Test Name	9825A Printer Output/Comments
12	Output Disable	---------- CHECK POINT 12 OUTPUT Disable Test. Program disables and enables the OUTPUT 5 times. Press CONTINUE while observing the scope. NOTE: OUTPUT LED does not flash.
13	External Trigger Delay Mode	---------- CHECK POINT 13 FREQ/PERIOD Test Program sets: Period.....2 us Width.....100 ns Width 99...20 ns Then it steps the width up to 1 us and back down to 100 ns. Press CONTINUE while observing the scope. } While stepping, the output turns off so that the scope display will flash. 5359A display indicates current width.
14	Frequency/ Period Mode	---------- CHECK POINT 14 EXT TRIGGER Test. Connect a pulse gen (pg) to EXT TRIGGER IN. Set pg rep rate to 250 KHZ. Set pg amp to 1 V sq wave 0 V offset. Replace SYNC to scope with pg signal } Approximately: 

Table 4-1. Model 9825A Program Description (Continued)

Check Point	Test Name	9825A Printer Output/Comments
		Program sets 5359A for: DELAY.....500 ns WIDTH.....50 ns Verify: *ONLY KEYS LIT: * LOC/REM * DELAY *5359A DISPLAY: * 500.00 * ns * DELAY * LSN * RMT *EXT ENABLE...on *OUTPUT.....on *SCOPE DISPLAY: *DELAY....640 ns *(EXT TRG - OUT) *WIDTH.....50 ns Measured from leading edge of the EXT TRIGGER signal to the leading edge of the OUTPUT signal, i.e., 640 ns = 140 ns (insertion delay) + 500 ns (Programmed delay). ---------- CHECK POINT 15 SYNC DELAY Test. Program sets SYNC DELAY AUTO to PRESET 10 times. Press CONTINUE while observing the scope. Delay between EXT TRIG and OUTPUT should alternate between 640 and 540 ns (approx.) 5359A OUTPUT LED flashes during SYNC delay switching.
15	SYNC Delay	
16	External Trigger Disable	---------- CHECK POINT 16 TRIG DISABLE Test. Program disables and enables EXT TRIG 10 times. Press CONTINUE while observing the scope. Output should alternate between on and off.

Table 4-1. Model 9825A Program Description (Continued)

Check Point	Test Name	9825A Printer Output/Comments
17	External Trigger Slope	---------- CHECK POINT 17 TRIG SLOPE Test. Program sets +/- slope 10 times. Press CONTINUE while observing the scope. } Output moves depending on which slope selected.
18	Triggered Frequency Mode	---------- CHECK POINT 18 TRIG FREQ Test. Program sets: WIDTH.....10 ns FREQ.....5 MHZ Verify: *ONLY KEYS LIT: * LOC/REM * FREQ * EVTS * (flashing) *5359A DISPLAY: * 5.0000 * MHZ * FREQ * LSN * RMT *EXT ENABLE..... *.....flashing *OUTPUT.....on *SCOPE DISPLAY * TRIG FREQ } Should be a burst of 11 Output pusles.
19	Teach/Learn	---------- CHECK POINT 19 TEACH/LEARN Test 5359A teaches current set-up to 9825A. Turn 5359A power off then ON. Press CONTINUE. Verify that the 5359A learns the mode per CHK POINT 18 } Before the program stops, the set-up as per check-point 18, is "taught" to the 9825A. } When power is turned OFF then ON, the 5359A returns to the normal power-up. 1 MHz/100 ns width. When CONTINUE is pressed, 5359A "learns" the set-up i.e., it should return to triggered frequency mode.

Table 4-1. Model 9825A Program Description (Continued)

Check Point	Test Name	9825A Printer Output/Comments
20	Error 1	---------- CHECK POINT 20 HP-IB Illegal Command Test. Program sends undefined HP-IB command. Verify: *5359A DISPLAY: * Err * 1 ----------
21	Service Request Duty Cycle Error	CHECK POINT 21 SERVICE REQUEST Test. Programs delay and width that gives a duty cycle error PERIOD.....1 us } Width too large for WIDTH.....3 us } specified period The program then checks for a service request; conducts a } A Duty cycle error serial poll & should cause a prints the Service Request. status byte in octal. Verify: *ONLY KEYS LIT: * LOC/REM * WIDTH * PERIOD } Due to duty cycle error. * (flashing) *5359A DISPLAY: * 3.00000 * US * WIDTH * RMT * ERR } Due to duty cycle error. * (flashing) *EXT ENABLE..off *OUTPUT.....off *STATUS BYTE: * 102 * 106 } Status byte should be one of these two values. * if cold oven Measured Status Byte = 102 } Actual received status byte is printed here. Should be 102 or 106. END OF TEST

4-21. PERFORMANCE TESTS

4-22. The following procedures can be used as the Performance Tests for the HP 5359A Time Synthesizer. Results of the Performance Tests may be tabulated on the HP5359A Performance Test Record at the end of this section.

4-23. The equipment needed to perform these tests are:

One HP 5370B Universal Time Interval Counter,
One HP 3312A Function Generator (or equivalent)
One HP 1725A 275 MHz Oscilloscope (or equivalent)
One 50Ω Feed-Through (HP part # 10100C)

4-24. *Table 4-2* lists a summary of the eight tests and the specifications tested:

Table 4-2. Summary of the HP 5359A Performance Tests

PARAGRAPH NUMBER	DESCRIPTION	SPECIFICATION
4-25	Delay	0nS to 160mS
4-28	Period	100nS to 160mS
4-31	Width	5nS to 160mS
4-34	Step Size	minimum 50pS
4-37	Jitter	200 pS rms max (Delays 0nS–10mS) 1nS rms max (Delays 10mS–160mS)
4-40	SYNC OUTPUT	1 volt positive pulse width 35nS nominal Rise/Fall time <5nS
4-43	OUTPUT PULSE	Amplitude adjustable 0.5V to 5v Offset adjustable -1V to +1V Rise/Fall times <5nS
4-46	Insertion Delay	<140nS in PRESET <40nS in AUTO

4-25. DELAY

4-26. Specification Tested: 0 nS delay and 160mS delay at various output amplitudes.

4-27. Equipment: HP 5370B, HP 3312A

1. Set the 5359A front panel controls as follows:

EXTERNAL ENABLE
  LEVEL ..... midrange
  SLOPE ..... +
SYNC DELAY ..... PRESET
OUTPUT
  POLARITY ..... NORM,POS
FUNCTION
  WIDTH 5nS

4-25. DELAY

4-26. Specification Tested: 0 nS delay and 160mS delay at various output amplitudes.

4-27. Equipment: HP 5370B, HP 3312A

1. Set the 5359A front panel controls as follows:

EXTERNAL ENABLE
  LEVEL ..... midrange
  SLOPE ..... +
SYNC DELAY ..... PRESET
OUTPUT
  POLARITY ..... NORM,POS
FUNCTION
  WIDTH 5nS

2. Set the 5370B front panel controls as follows:

FUNCTION ..... TI
STATISTICS ..... MEAN
SAMPLE SIZE 1
ARMING ..... ±TI
  PERIOD COMPLMNT ..... STOP
START
  TRIG LVL ..... 0.50V (mid range of SYNC pulse)
  SLOPE ..... +
STOP
  TRIG LVL ..... 0.50V (mid range of OUTPUT pulse)
  SLOPE ..... +
INPUTS ..... 50Ω, ÷1(both START and STOP)
START COM ..... SEP
COUPLING ..... DC

3. Set the HP 3312A for a 1 MHz, approximately 2Vp-p square wave with no offset.

4. Connect the 5359A, 3312A and 5370B as shown in *Figure 4-1.*

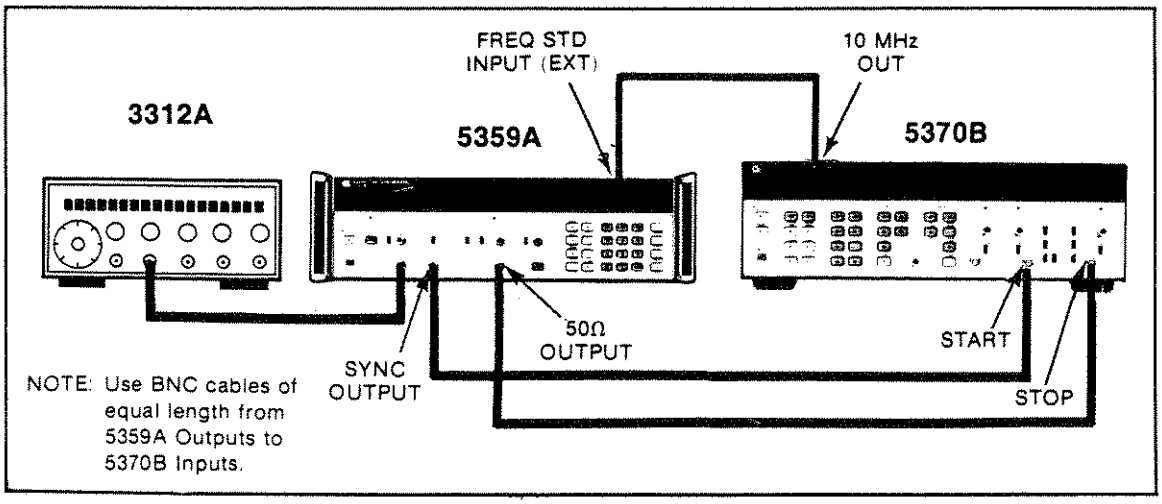


Figure 4-1. Setup for DELAY Performance Test

5. Modify the 5359A front panel (OUTPUT AMPLITUDE, OUTPUT OFFSET and FUNCTION DELAY) and the 5370B front panel (STOP TRIGGER LEVEL) to meet the first parameters shown in *Table 4-3.*

6. Press the CAL key — This sets the Internal delay constants to the midrange of the OUTPUT and SYNC OUT pulses.

7. Verify that the time interval measured on the 5370B meets the MEASURED DELAY specified for the appropriate line in *Table 4-3.*

8. Perform steps 5, 6, and 7 for all the lines in *Table 4-3.*

Table 4-3. Measurement Parameters for Individual RANGE Testing

OUTPUT AMPTD (5359A)	OUTPUT OFFSET (5359A)	FNCTN DELAY (5359A)	STOP TRG LVL (5370B)	MEASURED DELAY (5370B)
+1.00V	Off	0nS	+0.50V	±1nS
+3.00V	Off	0nS	+1.50V	±1nS
+4.00V	Off	0nS	+2.00V	±1nS
+1.00V	ON/+1V	0nS	+1.50V	±1nS
+1.00V	ON/-1V	0nS	-0.50V	±1nS
+1.00V	Off	160mS	+0.50V	160mS±1nS
+3.00V	Off	160mS	+1.50V	160mS±1nS
+4.00V	Off	160mS	+2.00V	160mS±1nS
+1.00V	ON/+1V	160mS	+1.50V	160mS±1nS
+1.00V	ON/-1V	160mS	-0.50V	160mS±1nS

4-28. PERIOD

4-29. Specification Tested: 100nS Period and 160mS period at various output amplitudes.

4-30. Equipment: 5370B

1. Set the 5359A front panel controls as follows:

OUTPUT
  POLARITY ..... NORM,POS
OFFSET ..... OFF
FUNCTION
  WIDTH 5nS

2. Set the 5370B front panel controls as follows:

FUNCTION ..... PERIOD
GATE 0.1S

3. Connect the 5359A and 5370B as shown in *Figure 4-2.*

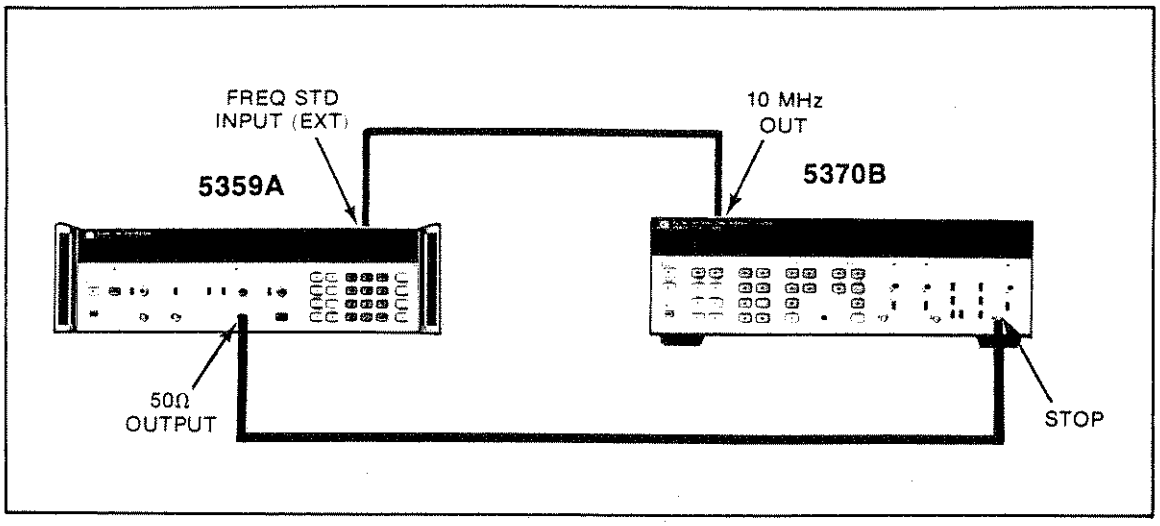


Figure 4-2. Setup for PERIOD Performance Test

4. Modify the 5359A front panel (OUTPUT AMPLITUDE, OUTPUT OFFSET, and FUNCTION PERIOD) and the 5370B front panel (STOP TRIG LVL) to meet the first parameters shown in *Table 4-4*.

5. Press the CAL key.

6. Verify that the PERIOD measured on the 5370B meets or exceeds the MEASURED PERIOD specified for the appropriate line in *Table 4-4*.

7. Perform steps 4, 5, and 6 for all the lines in *Table 4-4*.

Table 4-4. Measurement Parameters for Individual PERIOD Testing

OUTPUT AMPLITUDE (5359A)	OUTPUT OFFSET (5359A)	FUNCTION PERIOD (5359A)	STOP TRG LVL (5370B)	MEASURED PERIOD (5370B)
+1.00V	Off	100nS	+0.50V	100nS±1nS
+3.00V	Off	100nS	+1.50V	100nS±1nS
+4.00V	Off	100nS	+2.00V	100nS±1nS
+1.00V	ON/+1.00V	100nS	+1.50V	100nS±1nS
+1.00V	ON/-1.00V	100nS	-0.50V	100nS±1nS
+1.00V	Off	160mS	+0.50V	160mS±1nS
+3.00V	Off	160mS	+1.50V	160mS±1nS
+4.00V	Off	160mS	+2.00V	160mS±1nS
+1.00V	ON/+1.00V	160mS	+1.50V	160mS±1nS
+1.00V	ON/-1.00V	160mS	-0.50V	160mS±1nS

4-31. WIDTH

4-32. Specification Tested: 5nS width and 160mS width at various output amplitudes.

4-33. Equipment: HP 5370B and HP 3312A

1. Set the 5359A front panel controls as follows:

EXTERNAL ENABLE
  LEVEL ..... midrange
  SLOPE ..... +
SYNC DELAY ..... PRESET
OUTPUT
  POLARITY ..... NORM,POS
FUNCTION
  DELAY 0nS

2. Set the 5370B front panel controls as follows:

FUNCTION ..... TI
STATISTICS ..... MEAN
SAMPLE SIZE 1
ARMING ..... ±TI
  PERIOD COMPLMNT ..... STOP
INPUT
  START
    SLOPE ..... +
    IMPEDANCE 1MΩ
    ATTENUATION ..... ÷1
    COUPLING ..... DC
  STOP
    SLOPE ..... -
    IMPEDANCE 1MΩ
    ATTENUATION ..... ÷1
    COUPLING ..... DC
START COM ..... SEP

3. Set the HP 3312A for a 1 MHz, approximately 2Vp-p square wave with no offset.

4. Connect the 3312A, 5359A and 5370B as shown in *Figure 4-3.*

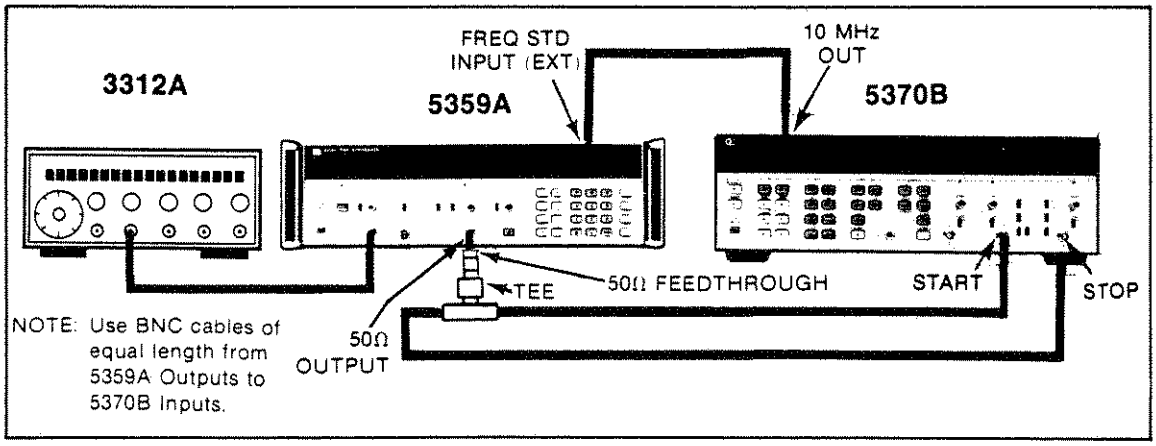


Figure 4-3. Setup for WIDTH Performance Test

5. Modify the 5359A front panel (OUTPUT AMPLITUDE, OUTPUT OFFSET and FUNCTION WIDTH) and the 5370B front panel (START/STOP TRIG LVL) to meet the first requirements shown in *Table 4-5.*

6. Press the CAL key.

7. Verify that the time interval measured for the pulse width meets the qualifications specified under MEASURED WIDTH for the appropriate line in *Table 4-5.*

8. Perform steps 5, 6 and 7 for all the lines in *Table 4-5.*

NOTE

If the WIDTH reading is slightly out of tolerance, make sure that the START and STOP Trigger Levels of the 5370B are set to the mid points of the signals.

Table 4-5. Measurement Parameters for Individual WIDTH Testing

OUTPUT AMPTD (5359A)	OUTPUT OFFSET (5359A)	FNCTN WIDTH (5359A)	STOP TRG LVL (5370B)	MEASURED WIDTH (5370B)
+1.00V	Off	5nS	+0.50V	5nS±1nS
+3.00V	Off	5nS	+1.50V	5nS±1nS
+4.00V	Off	5nS	+2.00V	5nS±1nS
+1.00V	ON/+1.00V	5nS	+1.50V	5nS±1nS
+1.00V	ON/-1.00V	5nS	-0.50V	5nS±1nS
+1.00V	Off	160mS	+0.50V	160mS±1nS
+3.00V	Off	160mS	+1.50V	160mS±1nS
+4.00V	Off	160mS	+2.00V	160mS±1nS
+1.00V	ON/+1.00V	160mS	+1.50V	160mS±1nS
+1.00V	ON/-1.00V	160mS	-0.50V	160mS±1nS

4-34. STEP SIZE

4-35. Specification Tested: 50pS minimum step size for width and delay functions. Other step sizes are also tested.

4-36. Equipment: HP 5370B and HP 3312A

1. WIDTH STEP SIZE

   a. Set the 5359A front panel controls as follows:

EXTERNAL ENABLE
  LEVEL ..... midrange
  SLOPE ..... +
SYNC DELAY ..... PRESET

OUTPUT
  POLARITY ..... NORM,POS
  AMPLITUDE ..... +1.00V
  OFFSET ..... OFF
FUNCTION
  DELAY 0nS
  WIDTH 5nS

b. Set the 5370B front panel controls as follows:

FUNCTION ..... TI
STATISTICS ..... MEAN
SAMPLE SIZE 1
ARMING ..... ±TI
  PERIOD COMPLMNT ..... STOP
START
  TRIG LVL ..... +0.50V
  SLOPE ..... +
  IMPEDANCE 1MΩ
  ATTENUATION ..... ÷1
  COUPLING ..... DC
STOP
  TRIG LVL ..... +0.50V
  SLOPE ..... -
  IMPEDANCE 1MΩ
  ATTENUATION ..... ÷1
  COUPLING ..... DC
START COM ..... SEP

c. Set the HP 3312A for a 1MHz, approximately 2.0Vp-p square wave with no offset.

d. Connect the 5359A and 5370B as shown in *Figure 4-3*.

e. Press the CAL key.

f. Verify that the value measured using the 5370B is 5nS ± 1nS.

g. Press the WIDTH key.

h. Enter the STEP SIZE from *Table 4-6*.

i. Press the STEP UP/DOWN key as indicated in *Table 4-6*.

j. Verify that the measured pulse width value from the 5370B meets the tolerance shown in *Table 4-6*.

k. Perform steps h, i, and j for all the lines in *Table 4-6*.

Table 4-6. Measurement Parameters for WIDTH STEP SIZE Testing

STEP SIZE (5359A)	STEP UP/DOWN (5359A)	MEASURED WIDTH (5370B)
.05nS	STEP UP	5.05nS±1nS
1nS	STEP UP	6.05nS±1nS
10nS	STEP UP	16.05nS±1nS
100nS	STEP UP	116.05nS±1nS
100nS	STEP DOWN	16.05nS±1nS
10nS	STEP DOWN	6.05nS±1nS
1nS	STEP DOWN	5.05nS.1nS
.05nS	STEP DOWN	5.00nS±1nS

2. DELAY STEP SIZE

   a. Set the 5359A front panel controls as follows:

EXTERNAL ENABLE
  LEVEL ..... midrange
  SLOPE ..... +
SYNC DELAY ..... PRESET
OUTPUT
  POLARITY ..... NORM,POS
  AMPLITUDE ..... +1.00V
  OFFSET ..... OFF
FUNCTION
  WIDTH 5nS
  DELAY 0nS

   b. Set the 5370B front panel controls as follows:

FUNCTION ..... TI
STATISTICS ..... MEAN
SAMPLE SIZE 1
ARMING ..... ±TI
  PERIOD COMPLMNT ..... STOP
START
  TRIG LVL ..... +0.50V
  SLOPE ..... +
  IMPEDANCE 1MΩ
  ATTENUATION ..... ÷1
  COUPLING ..... DC
STOP
  TRIG LVL ..... +0.50V
  SLOPE ..... +
  IMPEDANCE 1MΩ
  ATTENUATION ..... ÷1
  COUPLING ..... DC
START COM ..... SEP

   c. Set the HP 3312A for a 1MHz 2Vp-p square wave with no offset.

   d. Connect the 3312A, 5359A and 5370B as shown in *Figure 4-4.*

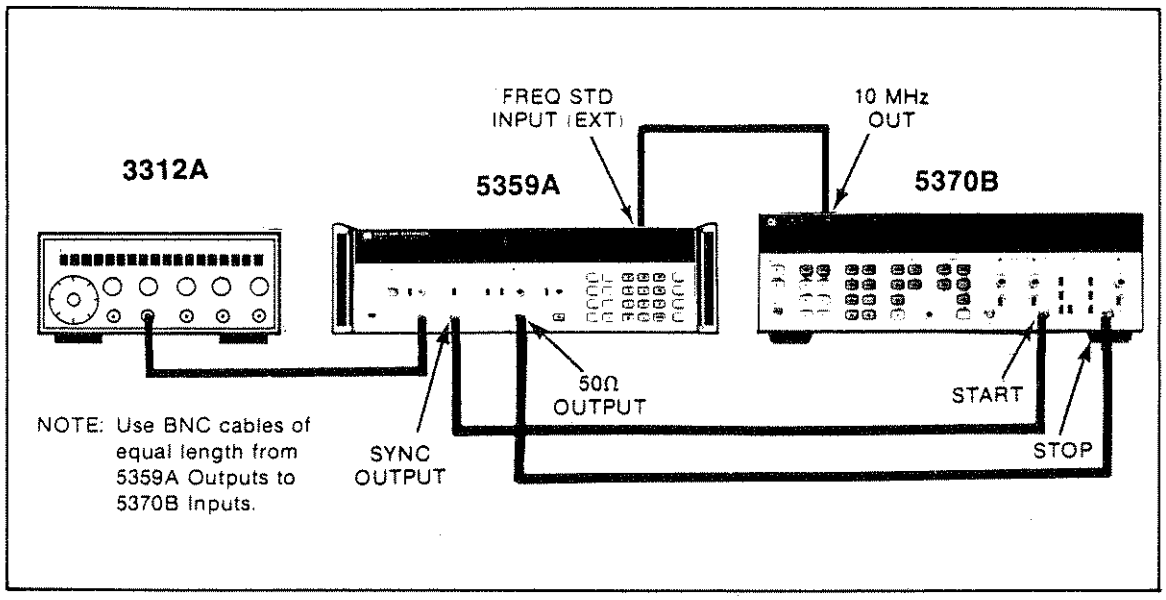


Figure 4-4. Setup for DELAY STEP SIZE Performance Test

e. Press the CAL key.

f. Verify that the DELAY time measured using the 5370B is between ±1nS.

g. Press the DELAY key.

h. Enter the STEP SIZE from *Table 4-7.*

i. Press the STEP UP/DOWN key as indicated in *Table 4-7.*

j. Press the CAL key.

k. Verify that the measured DELAY from the 5370B meets the tolerance shown in *Table 4-7.*

l. Perform steps i, j, and k for each line in *Table 4-7.*

Table 4-7. Measurement Parameters for DELAY STEP SIZE Testing

STEP SIZE (5359A)	STEP UP/DOWN (5359A)	MEASURED DELAY (5370B)
.05nS	STEP UP	.05nS±1nS
1nS	STEP UP	1.05nS±1nS
10nS	STEP UP	11.05nS±1nS
100nS	STEP UP	111.05nS±1nS
100nS	STEP DOWN	11.05nS±1nS
10nS	STEP DOWN	1.05nS±1nS
1nS	STEP DOWN	.05nS.1nS
.05nS	STEP DOWN	±1nS

4-37. JITTER

4-38. Specification Tested: Standard Timebase — 200pS rms max (delays 0nS to 10 mS), 1nS rms max (delays 10mS to 160mS); High Stability Timebase (Option 001) — 200pS rms max (delays 0nS through 160mS)

4-39. Equipment: HP 5370B, HP 3312A

1. Set the HP3312A for a 1MHz 2V p-p square wave with no offset.

2. Set the HP 5359A front panel controls as follows:

EXTERNAL ENABLE
  SLOPE ..... +
  LEVEL ..... midrange
SYNC DELAY ..... PRESET
OUTPUT
  POLARITY ..... NORM,POS
  AMPLITUDE ..... +1.00V
  OFFSET ..... OFF
FUNCTION
  WIDTH 5nS

3. Set the HP 5370B front panel controls as follows:

FUNCTION ..... TI
STATISTICS ..... STD DEV
SAMPLE SIZE 100
ARMING ..... ±TI
  PERIOD COMPLMNT ..... STOP
START
  TRIG LVL ..... +0.50V
  SLOPE ..... +
  IMPEDANCE 50Ω
  ATTENUATION ..... ÷1
  COUPLING ..... DC
STOP
  TRIG LVL ..... +0.50V
  SLOPE ..... +
  IMPEDANCE 50Ω
  ATTENUATION ..... ÷1
  COUPLING ..... DC
START COM ..... SEP

4. Connect the 5359A, 3312A, and 5370B as shown in *Figure 4-5.*

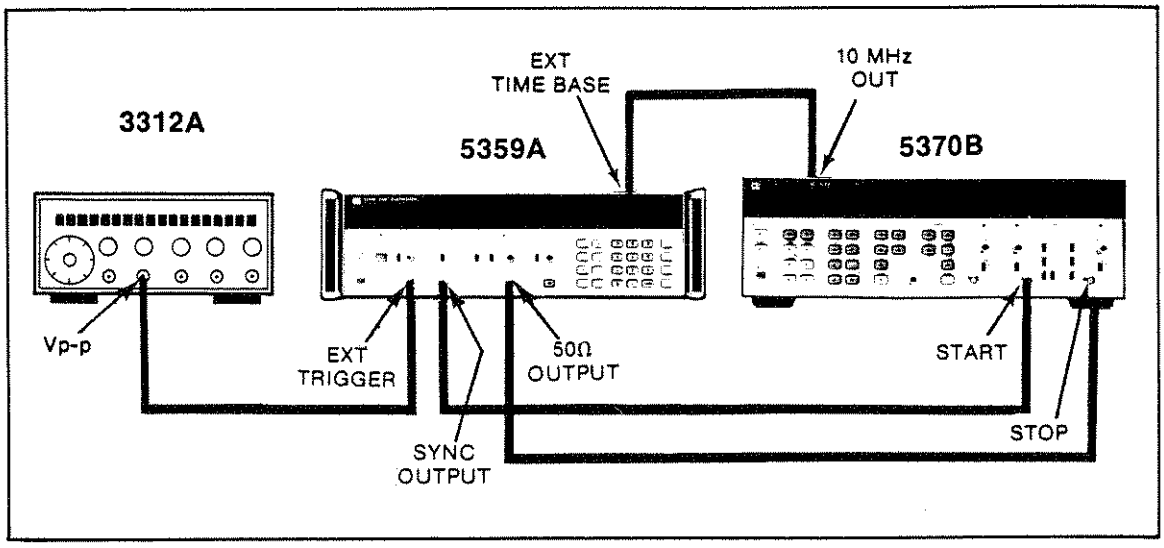


Figure 4-5. Setup For Jitter Performance Test

5. Set the DELAY to the first (or subsequent values) specified value from *Table 4-8.*

6. Verify that the Standard Deviation (Jitter) measured on the 5370B meets the tolerance shown in *Table 4-8.*

7. Perform steps 5 and 6 for each line in *Table 4-8.*

Table 4-8. Measurement Parameters for Individual JITTER Testing

DELAY (5359A)	MEASURED JITTER (Standard Deviation) (5370B)
0nS	<200pS rms
10mS*	<1nS rms (<200pS for Option 001 Instruments)
160mS*	<1nS rms (<200pS for Option 001 Instruments

*Note — For longer delays, the HP 5370B takes a longer time to complete the measurement.

4-40. SYNC OUTPUT

4-41. Specifications tested: SYNC Output Pulse Level: +1.00V ± 0.15V
SYNC Output Pulse Width: 40nS ± 15nS
SYNC Output Pulse Rise Time: < 5nS
SYNC Output Pulse Fall Time: < 5nS

4-42. Equipment: HP1725A (or equivalent)

1. Set the HP 5359A front panel controls as follows:

SYNC DELAY ..... PRESET
OUTPUT
  POLARITY ..... Norm/Pos
  AMPLITUDE ..... +1.00V
  OFFSET ..... Off
FUNCTION
  WIDTH 100nS
  Period 1.0μS

2. Set the HP 1725A front panel controls as follows:

Channel A Volts/Div	0.2(50Ω)
Vertical Display	A Channel (IN)
INT TRIG	A Channel (IN)
Main Sweep	0.01μS/Div
Horizontal Display	MAIN (IN)
All Other Buttons	OUT

3. Connect the 5359A, and 1725A as shown in *Figure 4-6.*

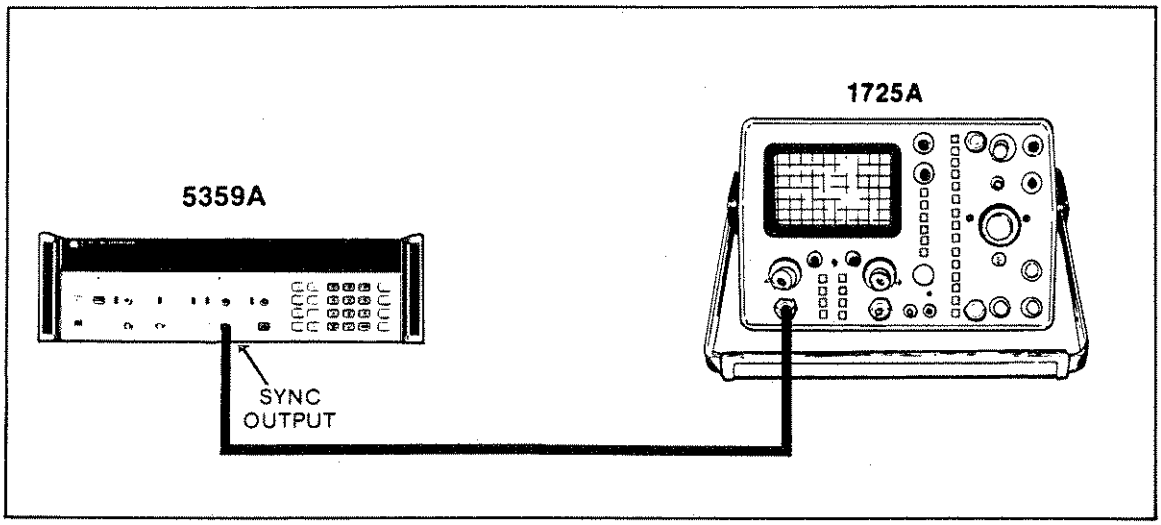


Figure 4-6. Setup for SYNC OUTPUT Performance Test

4. Using the HP1725A, verify that the SYNC Output Pulse Level is +1.00 V ±0.15V.

5. Using the HP 1725A, verify that the SYNC Output Pulse Width is 40nS ±15nS.

6. To measure the Rise/Fall Time of the SYNC Output Pulse perform steps a. through e.

   a. Press the HORIZ DISPLAY MAG X10 button in. (This gives the HP 1725A a horizontal scale of 1nS/Div.)

   b. Set the MAIN TRIGGERING ± button to ± (out).

   c. Using the HP 1725A, verify that the SYNC Output Pulse Rise Time is less than 5nS.

   d. Set the MAIN TRIGGERING ± button to – (in).

   e. Using the HP 1725A, verify that the SYNC Output Pulse Fall time is less than 5nS.

4-43. OUTPUT PULSE

4-44. Specifications Tested: OUTPUT Pulse Amplitude: Adjustable from 0.50V to 5V.
OUTPUT Pulse Offset: adjustable from -1V to +1V.
OUTPUT Pulse Rise Time: < 5nS
OUTPUT Pulse Fall Time: < 5nS

4-45. Equipment: HP 1725A, HP 3312A

1. Set the HP 5359A front panel controls as follows:

EXTERNAL ENABLE
SLOPE ..... +
LEVEL ..... midrange
SYNC DELAY ..... PRESET
OUTPUT
POLARITY ..... NORM,POS
OFFSET ..... OFF
FUNCTION
DELAY 0nS
WIDTH 100nS

2. Set the HP 1725A front panel controls as follows:

VERTICAL DISPLAY ..... A Channel (IN)
INT TRIG ..... A Channel (IN)
MAIN SWEEP 0.01μS/Div
HORIZONTAL DISPLAY ..... MAIN (IN)
All other buttons ..... OUT

3. Set the HP 3312A for a 1MHz 2Vp-p square wave with no offset.

4. Connect the 5359A, 3312A and 1725A as shown in *Figure 4-7.*

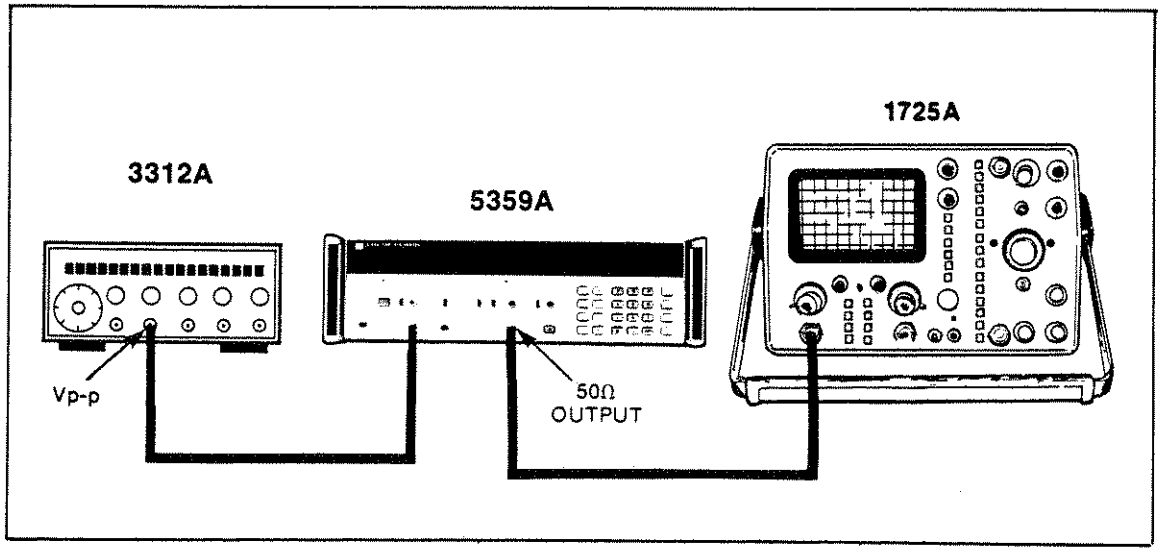


Figure 4-7. Setup for Testing Output Amplitude and Offset

5. **OUTPUT Pulse Amplitude**

   a. Set the 5359A OUTPUT AMPLITUDE to +0.50V.

   b. Using the HP 1725A, verify that the OUTPUT Pulse Amplitude is 0.50V ±0.03V.

   c. Set the HP 5359A OUTPUT AMPLITUDE to +5.00V.

   d. Using the HP 1725A, verify that the OUTPUT Pulse Amplitude is +5.00V ±0.03V.

6. **OUTPUT Pulse Offset**

   a. Make the following changes to the 5359A front panel controls:

   OUTPUT
   Amplitude ..... +2.00V
   Offset ON/–1.00V

   b. Using the HP 1725A, verify that the peak amplitude of the OUTPUT pulse is +1.00V ±0.003V. Verify the base amplitude is –1.00V ±0.15V.

   c. Set the OUTPUT OFFSET to +1.00V.

   d. Using the HP 1725A, verify that the peak amplitude of the OUTPUT pulse is +3.00V ±0.03V. Verify the base amplitude is +1.00V ±0.15V.

7. **OUTPUT Pulse Rise and Fall Time**

   a. Make the following changes to the 5359A front panel controls:

   OUTPUT
   Amplitude ..... +1.00V
   Offset ..... OFF

   b. Make the following changes to the 1725A front panel:

   HORIZONTAL DISPLAY ..... MAG X10 (IN)
   MAIN TRIGGERING ..... ± (OUT)

   c. Using the HP 1725A, verify that the OUTPUT Pulse Rise Time is less than 5nS.

   d. Set the MAIN TRIGGERING ± button to – (IN).

   e. Using the HP 1725A, verify that the OUTPUT PULSE Fall Time is less than 5nS.

4-46. INSERTION DELAY

4-47. Specifications Tested: <140nS (when in PRESET)
<40nS (when in AUTO)

4-48. Equipment: 5370B, 3312A

1. Set the 3312A for a 1MHz 2V p-p square wave with no offset.

2. Set the 5359A front panel controls as follows:

EXTERNAL ENABLE
  SLOPE ..... +
  LEVEL ..... midrange
  SYNC DELAY ..... PRESET
OUTPUT
  POLARITY ..... NORM,POS
  AMPLITUDE ..... +1.00V
  OFFSET ..... OFF
FUNCTION
  DELAY 200nS

3. Set the 5370B front panel controls as follows:

FUNCTION ..... TI
STATISTICS ..... MEAN
SAMPLE SIZE 1
ARMING ..... ±TI
  PERIOD COMPLMNT ..... STOP
START
  TRIG LVL ..... Preset
  SLOPE ..... +
  IMPEDANCE 50Ω
  ATTENUATION ..... ÷1
  COUPLING ..... DC
STOP
  TRIG LVL ..... +0.50V
  SLOPE ..... +
  IMPEDANCE 50Ω
  ATTENUATION ..... ÷1
  COUPLING ..... DC
START COM ..... SEP

4. Press the CAL key.

5. Connect the 5359A, 3312A, and 5370B as shown in *Figure 4-8.*

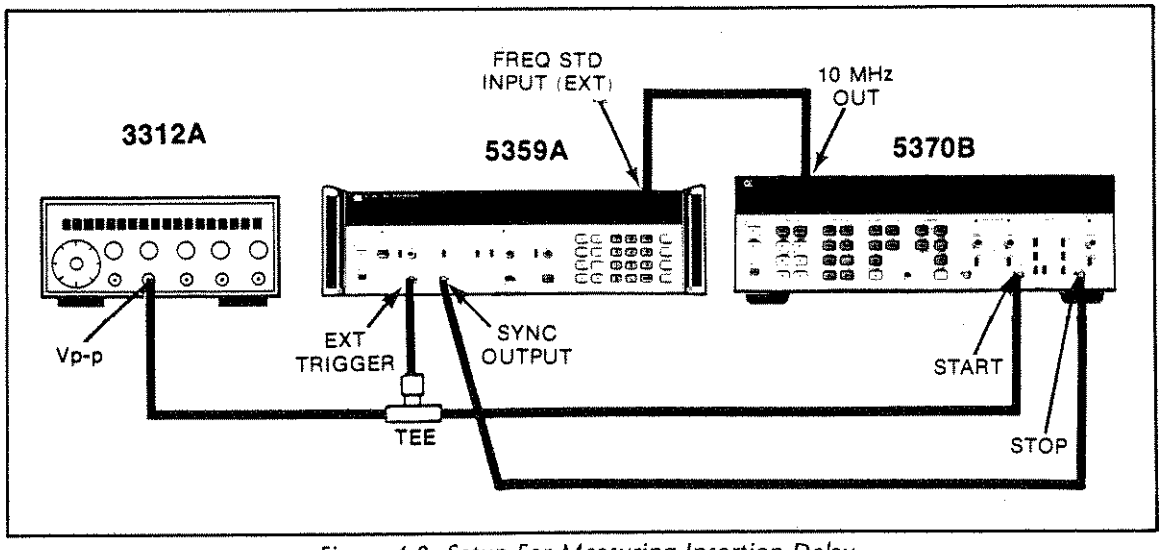


Figure 4-8. Setup For Measuring Insertion Delay

6. Verify that the value measured on the 5370B for insertion delay is less than or equal to 140nS.

7. Change the SYNC DELAY to AUTO.

8. Verify that the value measured on the 5370B for insertion delay is less than or equal to 40nS.

4-49. THE PERFORMANCE TEST FOR THE 5359A IS NOW COMPLETE.

PERFORMANCE TEST RECORD (Page 1 of 2)

HEWLETT-PACKARD MODEL 5359A
TIME SYNTHESIZER

Serial Number: _____
Test Performed By: _____
Date: _____
Notes: _____

Repair/Work Order No. _____
Temperature: _____
Relative Humidity: _____
Post Calibration Test: ☐
Pre Calibration Test: ☐

PARA. NO.	TEST			RESULTS MINIMUM	RESULTS ACTUAL	RESULTS MAXIMUM
4-25	**DELAY**					
	with Delay = 0 ns					
	Amplitude = +1.00V	Offset =	Off	-1ns	_____	+1ns
	+3.00V		Off	-1ns	_____	+1ns
	+4.00V		Off	-1ns	_____	+1ns
	+1.00V		On/+1.00V	-1ns	_____	+1ns
	+1.00V		On/-1.00V	-1ns	_____	+1ns
	with Delay = 160 ms					
	Amplitude = +1.00V	Offset =	Off	159.999999ms	_____	160.000001ms
	+3.00V		Off	159.999999ms	_____	160.000001ms
	+4.00V		Off	159.999999ms	_____	160.000001ms
	+1.00V		On/+1.00V	159.999999ms	_____	160.000001ms
	+1.00V		On/-1.00V	159.999999ms	_____	160.000001ms
4-28	**PERIOD**					
	with Period = 100ns					
	Amplitude = +1.00V	Offset =	Off	99ns	_____	101ns
	+3.00V		Off	99ns	_____	101ns
	+4.00V		Off	99ns	_____	101ns
	+1.00V		On/+1.00V	99ns	_____	101ns
	+1.00V		On/-1.00V	99ns	_____	101ns
	with Period = 160 ms					
	Amplitude = +1.00V	Offset =	Off	159.999999ms	_____	160.000001ms
	+3.00V		Off	159.999999ms	_____	160.000001ms
	+4.00V		Off	159.999999ms	_____	160.000001ms
	+1.00V		On/+1.00V	159.999999ms	_____	160.000001ms
	+1.00V		On/-1.00V	159.999999ms	_____	160.000001ms
4-31	**WIDTH**					
	with Width = 5 ns					
	Amplitude = +1.00V	Offset =	Off	4ns	_____	6ns
	+3.00V		Off	4ns	_____	6ns
	+4.00V		Off	4ns	_____	6ns
	+1.00V		On/+1.00V	4ns	_____	6ns
	+1.00V		On/-1.00V	4ns	_____	6ns
	with Width = 160 ms					
	Amplitude = +1.00V	Offset =	Off	159.999999ms	_____	160.000001ms
	+3.00V		Off	159.999999ms	_____	160.000001ms
	+4.00V		Off	159.999999ms	_____	160.000001ms
	+1.00V		On/+1.00V	159.999999ms	_____	160.000001ms
	+1.00V		On/-1.00V	159.999999ms	_____	160.000001ms

HP 5359A PERFORMANCE TEST RECORD (Page 2 of 2)

PARA. NO.	TEST	CORRECT DISPLAY	RESULTS MINIMUM	RESULTS ACTUAL	RESULTS MAXIMUM
4-34	**STEP SIZE**				
	Width Step Size (Width = 5ns)				
	Step Size = 0.05ns Up/Down =	Up	4.05ns	_____	6.05ns
	1ns	Up	5.05ns	_____	7.05ns
	10ns	Up	15.05ns	_____	17.05ns
	100ns	Up	115.05ns	_____	117.05ns
	100ns	Down	15.05ns	_____	17.05ns
	10ns	Down	5.05ns	_____	7.05ns
	1ns	Down	4.05ns	_____	6.05ns
	.05ns	Down	4.00ns	_____	6.00ns
	Delay Step Size (Width = 0ns)				
	Step Size = 0.05ns Up/Down =	Up	-950ps	_____	1.05ns
	1ns	Up	50ps	_____	2.05ns
	10ns	Up	10.05ns	_____	12.05ns
	100ns	Up	110.05ns	_____	112.05ns
	100ns	Down	10.05ns	_____	12.05ns
	10ns	Down	50ps	_____	2.05ns
	1ns	Down	-950ps	_____	1.05ns
	.05ns	Down	-1.00ns	_____	1.00ns
4-37	**JITTER**				
	with Delay = 0 ns		—	_____	200ps
	10ms		—	_____	1ns*
	160ms		—	_____	1ns*
4-40	**SYNC OUTPUT**				
	AMPLITUDE		0.85V	_____	1.15V
	WIDTH		25ns	_____	55ns
	RISE TIME		—	_____	5ns
	FALL TIME		—	_____	5ns
4-43	**50Ω OUTPUT**				
	AMPLITUDE				
	Amplitude = +0.5V Offset =	Off	+0.47V	_____	+0.53V
	+5.00V	Off	+4.97V	_____	+5.03V
	OFFSET				
	Amplitude = +2.00V Offset =	On/-1.00V	+0.97V	_____	+1.03V
	+2.00V	On/+1.00V	+2.97V	_____	+3.03V
	RISE TIME		—	_____	5ns
	FALL TIME		—	_____	5ns
4-46	**INSERTION DELAY**				
	PRESET		—	_____	140ns
	AUTO (DELAY = 200ns)		—	_____	40ns

* 200ps for Option 001 Instruments.

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section describes the adjustments which will return the 5359A to peak operating condition after repairs are completed or for periodic preventative maintenance. If the adjustments are to be considered valid, the 5359A must have a half-hour warm-up and the line voltage must be within +5 to -10% of nominal.

5-3. ORDER OF ADJUSTMENT

5-4. The following is a list of the adjustment procedures provided in the recommended order of adjustment. With the following exception, the actual order of adjustment is not critical, however, it is recommended that adjustments be performed only when necessary and only to the indicated assembly. The A17 and A16 adjustments are complementary procedures and both should be performed when either is indicated, and A17 must precede A16.

A22	Digital Timing
A24	200 MHz Multiplier
A23	Startable VCO
A19	Auto-Zero
A21	Analog Timing
A17	Output Reference
A16	Processor Interface
A27	10 MHz Crystal Oscillator

5-5. SAFETY CONSIDERATIONS

5-6. Although the HP Model 5359A has been designed in accordance with International Safety Standards, this manual contains information, cautions, and warnings which MUST be followed to ensure safe operation and to retain the 5359A in safe conditon (also see Sections II and III of this manual). Service and adjustments should be performed only by qualified personnel.

WARNING

ANY INTERRUPTION OF THE PROTECTIVE (GROUNDING) CON – DUCTOR (INSIDE OR OUTSIDE THE 5359A) OR DISCONNECTION OF THE PROTECTIVE EARTH TERMINAL IS LIKELY TO MAKE THE 5359A DANGEROUS. INTENTIONAL INTERRUPTION IS PROHIBITED.

5-7. Any adjustment, maintenance, or repair of the opened 5359A with voltage applied should be avoided as must as possible and, when inevitable, should be carried out by a skilled person who is aware of the hazard involved. Capacitors inside the 5359A may still be charged even if the 5359A has been disconnected from its source of supply.

5-8. Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided. Whenever it is likely that the protection offered by fuses has been impaired, the 5359A must be made in operative and secured against any unintended operator.

WARNING

ADJUSTMENTS DESCRIBED HEREIN ARE PERFORMED WITH POWER SUPPLIED TO THE 5359A WHILE PROTECTIVE COVERS ARE REMOVED. ENERGY AVAILABLE AT MANY POINTS MAY, IF CONTACTED, RESULT IN PERSONAL INJURY.

5-9. EQUIPMENT REQUIRED

5-10. The test equipment required for all of the adjustment procedures is listed in *Table 1-2*, Recommended Test Equipment. The test equipment required for the adjustment of each particular assembly is listed at the beginning of the adjustment procedure for that assembly. This listing is a duplicate of the listing in *Table 1-2* and is supplied as a quick reference. The critical specifications of the substitute test instruments must meet or exceed the standards listed in *Table 1-2* if the 5359A is to meet the specifications in *Table 1-1*.

5-11. ADJUSTMENT LOCATIONS

5-12. As an adjustment aid, locators are given for each assembly adjustment procedure and appear at the end of each adjustment procedure. These locators are simplified illustrations of the assembly showing variable resistors, variable capacitors, test points, etc., needed for adjustment of the assembly.

5-13. ASSEMBLY REMOVAL AND REPLACEMENT

5-14. All of the assemblies, with the exception of A11 and A16, can be easily removed by lifting up on the board extraction tabs and pulling the assembly straight up out of the motherboard connector. The right-angle ribbon cable connectors on A11 and A16 must be removed prior to extracting these assemblies.

A22 Digital Timing Assembly

Equipment:
HP 3435A DMM

Accessories:
Ceramic Tuning Wand

Setup:

1. Set the 3435A function to dc V and RANGE to AUTO.
2. Turn the power switch of the 5359A to ON and observe auto-calibrate and then display of 100.00 ns Width.
3. Connect the DMM between the "-3V" TP and "⏚" TP on A22.
4. Adjust A22 R61 for -3.00V ±0.02V.
5. This completes adjustment of A22.

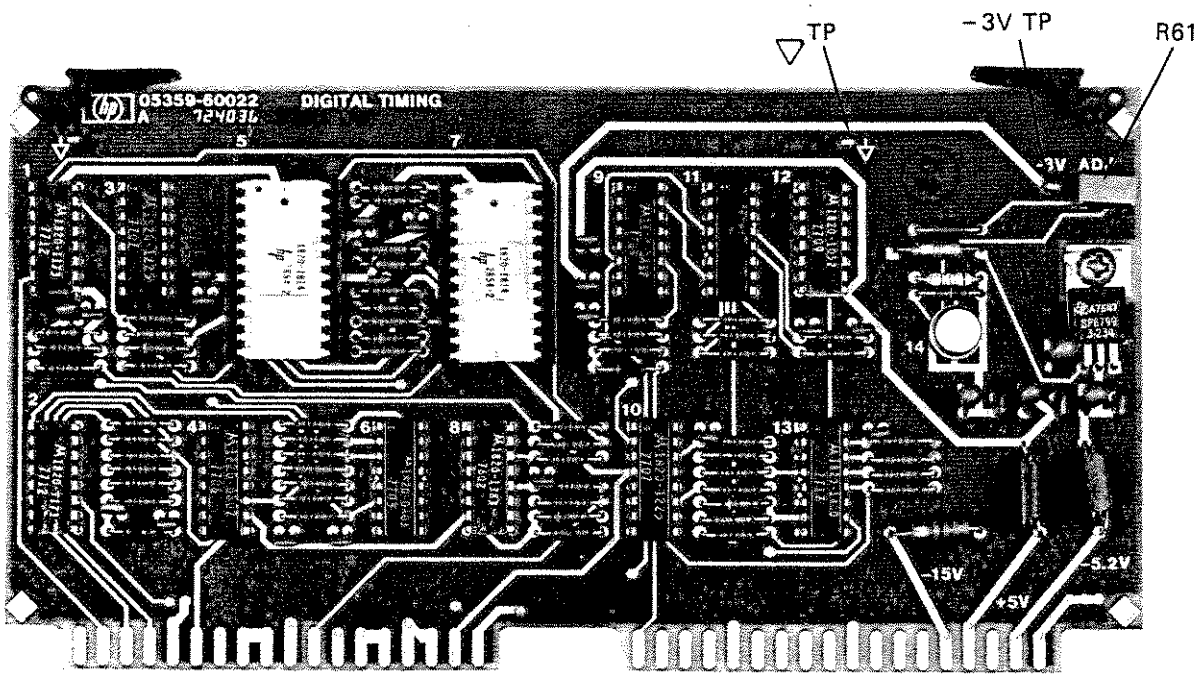


Figure 5-1. A22 Digital Timing Assembly Adjustments

A24 200 MHz Multiplier Assembly

Equipment:

HP 141T/8552A/8554L Spectrum Analyzer
HP 1120A Active Probe
HP 1122A Probe Power Supply

Accessories:

HP 1024A 10:1 Divider Tip
HP 5060-0474 Spanner Tip
HP 8710-0033 Ceramic Tuning Wand
12" Alligator Clip Lead

Setup:

1. Connect 10:1 divider tip and spanner tip to active probe. Connect probe to power supply.

CAUTION

Always set 5359A power to STBY before removing or inserting assembly boards.

2. Set 141T/8552A/8554L Spectrum Analyzer as follows:

STORAGE	STD
PERSISTANCE	MIN
BANDWIDTH	100 kHz
SCAN WIDTH	10 MHz PER DI
INPUT ATTENUATOR	10 dB
CENTER FREQUENCY	50 MHz
SCAN TIME	2 ms
LOG REF LEVEL DIAL	-10 dBm
LOG REF LEVEL VERNIER	Ø
LOG REF LEVEL SWITCH	LOG
VIDEO FILTER SWITCH	OFF
SCAN MODE SWITCH	INT
SCAN TRIGGER SWITCH	AUTO

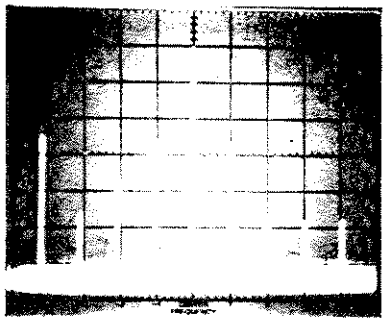
3. Connect 1120A Active Probe to spectrum analyzer RF INPUT.
4. Connect probe tip to A24 TP3.

NOTE

Make ALL the following adjustments with ceramic tuning wand only.

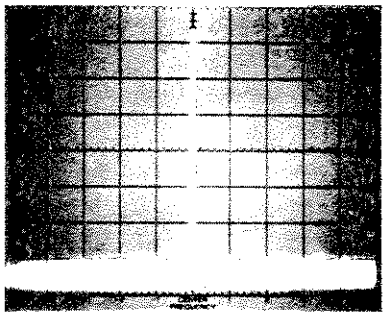
Figure 5-2. A24 200 MHz Multiplier Assembly Adjustments

5. Adjust A24C54 for equal amplitude for the 40 MHz and 60 MHz sidebands around the 50 MHz center frequency as shown. Do not readjust C54 during the remaining procedure.



50 MHz Center Frequency Signal

6. Set spectrum analyzer input attenuator to 20 dB and connect probe tip to A21TP2.
7. Adjust A24C52, C51, C46, C33, and C28 to minimize all sidebands around the 50 MHz signal as completely as possible. Repeat adjustment as necessary until sidebands are down 60 dB or more as shown.

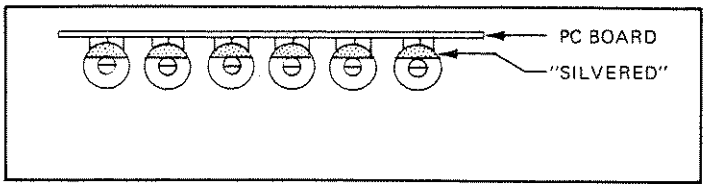


50 MHz Sidebands Adjustment Signal

8. Set spectrum analyzer as follows:

CENTER FREQUENCY	200 MHz
BANDWIDTH	300 kHz
SCAN WIDTH	50 MHz/DIV
LOG REF LEVEL DIAL	+10 dBm

9. Connect probe tip to A24TP1. The probe ground connection is critical. Poor ground will give excessive 10 MHz frequency components.
10. Adjust A24C20, C18, C12, C10, C6, and C2 to the prealignment position ("silvered" half of each capacitor adjacent to board ground plane) as shown.



Capacitor Prealignment Position

Figure 5-2. A24 200 MHz Multiplier Assembly Adjustments (Continued)

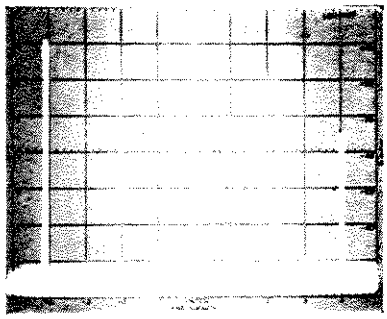
11. Adjust A24C20, C18, C12, C10, C6, and C2 to maximize the amplitude of the 200 MHz center frequency signal.

12. Readjust A24C20, C18, C12, C10, C6, and C2 to minimize all sidebands around the 200 MHz center frequency as completely as possible.

NOTE

Maintaining the maximum amplitude of the 200 MHz center frequency is not critical at this point and the amplitude of the second harmonic (400 MHz) is not critical.

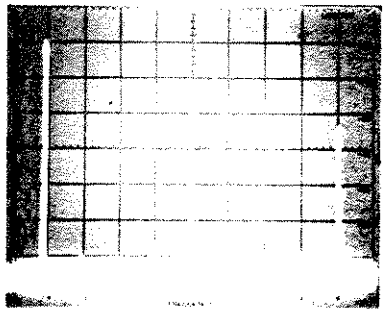
13. Repeat adjustment as necessary until sidebands are down 65 dB or more as shown.



200 MHz Sideband Adjustment Signal

14. Set spectrum analyzer LOG REF LEVEL VERNIER for 200 MHz center frequency at Ø dB log reference level on display screen.

15. Verify the following Test Limits.



200 MHz Test Limit Signal

Figure 5-2. A24 200 MHz Multiplier Assembly Adjustments (Continued)

TEST LIMIT

a) Connect probe tip to U1 pin 2 and observe 200 MHz signal amplitude down less than 30 dB.

b) Connect probe tip to U1 pin 14 and observe 200 MHz signal amplitude down less than 30 dB.

c) Connect probe tip to U2 pin 3 and observe 200 MHz signal amplitude down less than 30 dB.

d) This completes adjustments of A24.

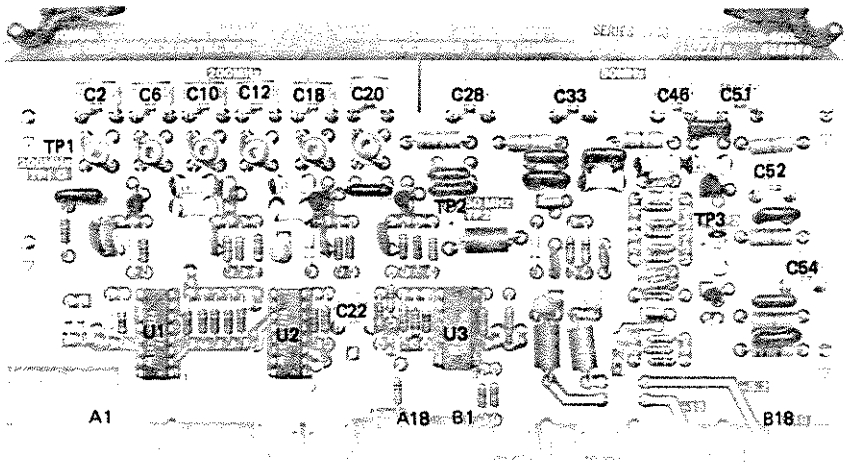


Figure 5-2. A24 200 MHz Multiplier Assembly Adjustments (Continued)

A23 Startable VCO Assembly

Equipment:
HP 1720A Oscilloscope
HP 10014A Scope Probes (2 each)

Setup:

1. Remove and reinstall the A23 assembly on extender board (05370-60075).
2. Connect Channel A and Channel B scope probes as follows:

CHANNEL A	A23 MIXER GATED TP (U7 pin 3)
CHANNEL B	A23 DIV GATED TP (U4 pin 6)
SCOPE PROBE GROUND CLIPS	A23 ⏚ (ground) TP

3. Set 1720A controls as follows:

CHANNELS A&B	DC (1 MΩ)
VOLTS/DIV	0.05
VERT DISPLAY	ALT
INT TRIG	"A"
TIME/DIV	10 ns/Div
MAIN TRIGGERING	"+"

4. Set 5359A controls as follows:

LINE	ON
DELAY	5 μs
EXT TRIGGER	REMOVE ALL CONNECTIONS

5. Adjust A23R8 BAL such that the leading edges of the scope signals A and B occur at the same time (as close as possible).
6. Remove power (LINE switch to STBY) and replace A23 assembly (without extender) into instrument.
7. Remove scope probe connections and reconnect Channel A scope probe to A23TP2, and probe ground to ⏚ TP.
8. Set 5359A controls as follows:

LINE	ON
DELAY	5 μs
EXT TRIGGER	REMOVE ALL CONNECTIONS

9. Set oscilloscope for 0.1 μs/Div.
10. Adjust A23 MIXER SYM, R19 for a 50% duty cycle.
11. This completes the A23 adjustments.

Figure 5-3. A23 Startable PLL Oscillator Assembly Adjustments

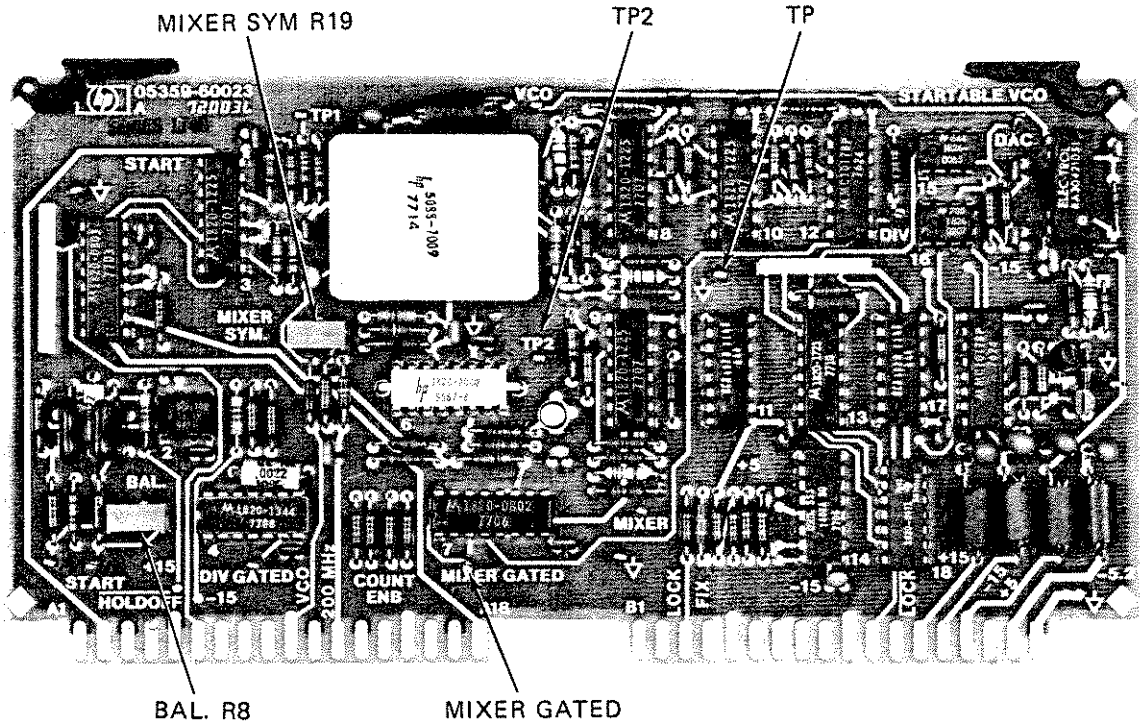


Figure 5-3. A23 Startable PLL Oscillator Assembly Adjustments (Continued)

A19/A21 Auto-Zero/Analog Timing Assemblies

NOTE

The adjustments on A19 and A21 may interact with each other. Alternate procedures back and forth to verify the specified outputs.

Equipment: None required

Setup:

1. Set 5359A controls as follows:

A16 "Debug" switches to	
A9 switches	
A18 switches	CKT
EXT TIMING COMPENSATION	DISABLE
FREQ STD	INT
EXT TRIG SLOPE	P
SYNC DELAY	PRESET
POLARITY	NORM/POS
OFFSET	OFF
EXT TRIG LEVEL	2 O'Clock
AMPLITUDE	12 O'Clock
LINE	ON

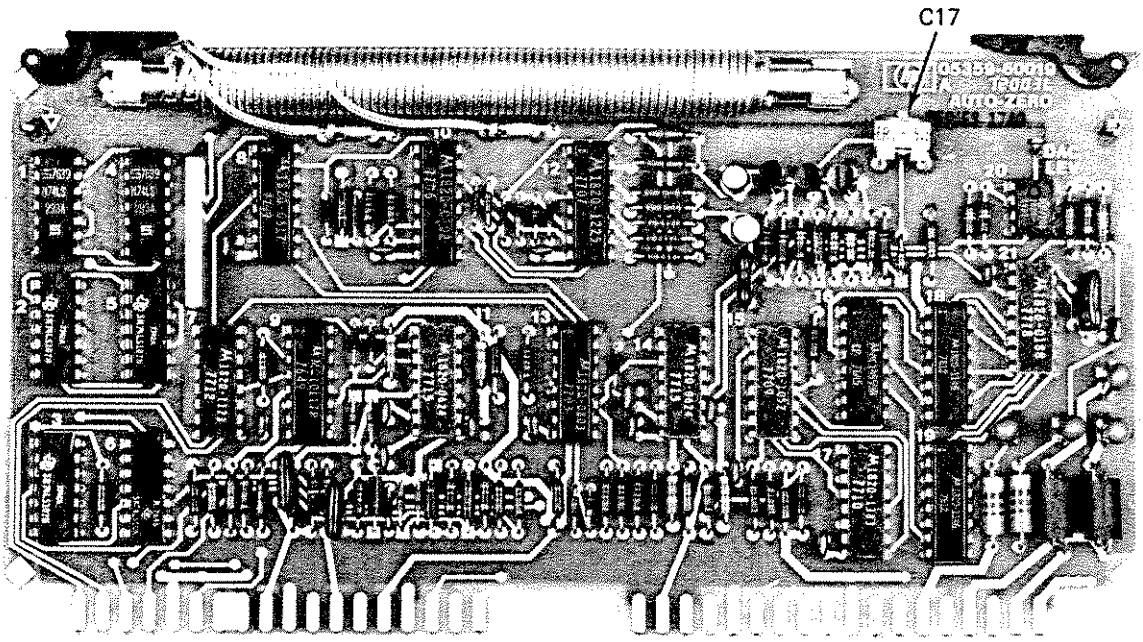
NOTE

The A16 switch setup has placed the microprocessor in a special service mode. The constants associated with analog step sizes (S_D and S_W) and precedence detector range are continuously measured and displayed in loops which are entered through front panel keys CAL, STEP UP and STEP DOWN, and exited by CLEAR.

2. Place LINE to STBY, remove and reinstall the A21 assembly on extender board (05370-60075), and return line switch to ON.
3. Push CAL and observe precedence displayed detector capture range. Adjust C17 on A19 for a display of 12.5 to 12.8 ns. A jitter of 0.2 ns is acceptable.
4. Push CLEAR and hold until display shows 100.00 ns width. This exits the loop.
5. Push STEP UP and observe displayed "S_D" (X1000) analog step size constant. Adjust A21, C24 (rear adjustable capacitor) for a display of 44 to 46 ns. A jitter of 0.6 ns is acceptable.
6. Push CLEAR and hold until display shows 100.00 ns WIDTH. This exits the loop.
7. Push STEP DOWN and observe displayed "S_W" (X1000) analog step size constant. Adjust A21, C20 (front adjustable capacitor) for a display of 44 to 46 ns. A jitter of 0.6 ns is acceptable.
8. Push CLEAR and hold until display shows 100.00 ns WIDTH. This exits the loop.
9. Remove power (LINE switch to STBY) and replace A21 assembly (without extender into instrument.
10. This completes the adjustments for the A19 and A21 assemblies. However, this service mode also allows the recall and display of the following calibration constants.

Figure 5-4. A19/A21 Auto-Zero/Analog Timing Assembly Adjustments

PUSH	CONSTANT DISPLAYED	NORMAL RANGE
WIDTH	C_W	-5 ns to +5 ns
DELAY	C_D	15 ns to 35 ns
PERIOD	C_P	-79 ns to -40 ns
FREQ	C_{DS}	-79 ns to -40 ns



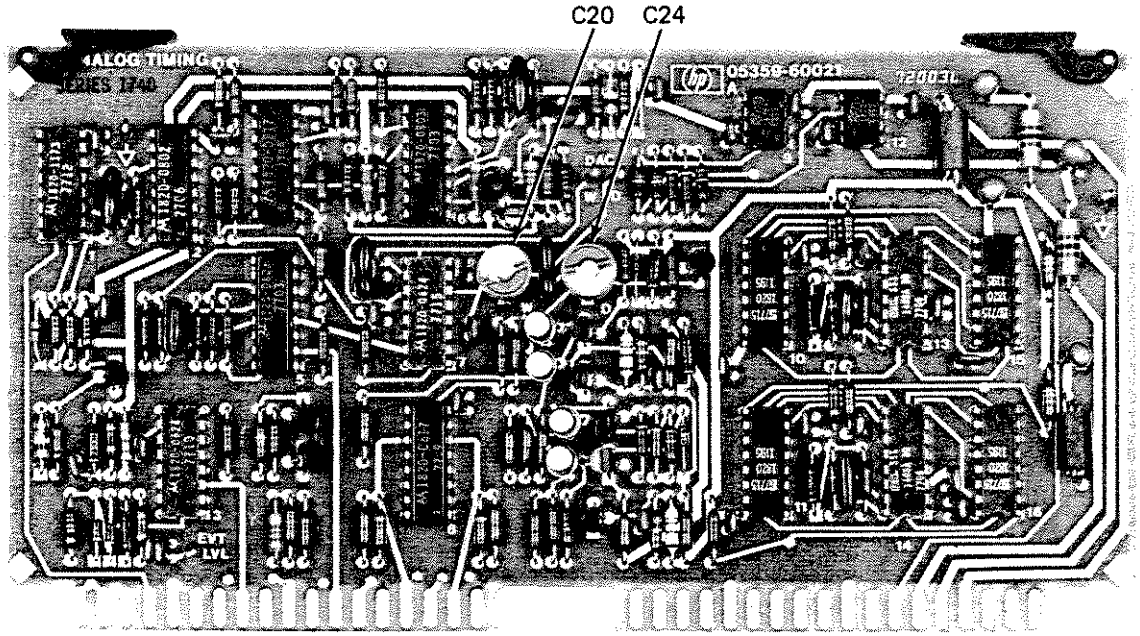


Figure 5-4. A19/21 Auto-Zero/Analog Timing Assembly Adjustments (Continued)

A17 Output Reference

Equipment:
HP 3435 DMM
HP 140A/1410A/1424A Sampling Scope

Accessories:
HP 8491A
20 dB Attenuator

Setup:

1. Set the 3435A function to dc V and RANGE to AUTO.
2. Turn the LINE switch on the 5359A to ON and observe auto-calibrate and then display of 100.00 ns width.
3. Connect the 50Ω OUTPUT to 3435A through a 50Ω feedthrough.
4. Remove any connections to the EXT TRIGGER input.
5. Enter DELAY of Ø ns.
6. Adjust A17 as per the following table.

Table 5-1. A17 Adjustments

Step	Polarity	Offset	Amplitude Control	Offset Control	Adjust
*1.	Comp/Neg	Off	ccw	—	Min Ampl (R1) for -0.40V ±0.01V
*2.	Comp/Pos	Off	ccw	—	BAL (R20) or +0.40V ±0.01V
3.	Norm/Pos	Off	cw	—	Verify reading -100 to +200 mV
4.	Norm/Pos	Off	cw	—	If reading not in range of Ø to +100 mV, readjust BAL slightly.
*5.	Comp/Neg	Off	cw	—	Max Ampl (R16) for -5.10V ±0.03V
*6.	Comp/Neg	Off	ccw	—	Min Ampl (R1) for -0.40V ±0.01V
7.	Norm/Neg	On	Midrange	ccw	Neg Offset (R18) for -1.10V ±0.02V
8.	Norm/Neg	On	Midrange	cw	Pos Offset (R9) for +1.10V ±0.02V

**Alternate adjustments until both readings are stable.*

7. Connect 50Ω OUTPUT to sampling scope input through 20 dB attenuator. Connect SYNC OUT to sampling scope trigger input.
8. Set the 5359A as follows:

POLARITY ..... NORM/POS
OFFSET ..... OFF
EXTERNAL TRIG ..... Connect external trigger to "EXT TRIGGER" input
LEVEL ..... for output pulse
DELAY ..... 10 ns
WIDTH ..... 20 ns

9. Set Amplitude control fully cw and adjust HI DRIVE (R56) for best rise time and fall time consistent with 10% maximum overshoot.

Figure 5-5. A17 Output Reference Assembly Adjustments

10. Set Amplitude control fully ccw and adjust LO DRIVE (R50) for best rise time and fall time consistent with 10% maximum overshoot.

11. Repeat instructions 3, 4, 5, and continue as per the following table.

Table 5-1. A17 Adjustments (Continued)

Step	Polarity	Offset	Amplitude Control	Offset Control	Adjust
9.	Comp/Neg	Off	cw	—	Verify reading of -5.1V ±0.05V. If not, return to step 1 and repeat procedure.
10.	Comp/Neg	Off	ccw	—	Verify reading of -0.37V to -0.45V

12. This completes the adjustments for A17.

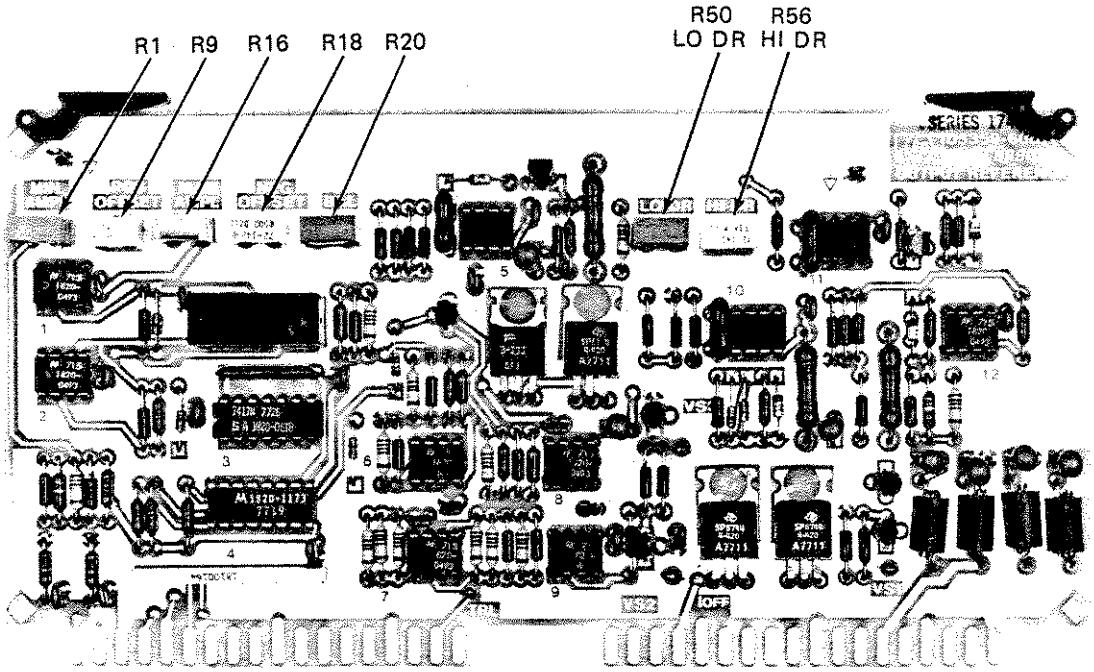


Figure 5-5. A17 Output Reference Assembly Adjustments (Continued)

A16 Processor Interface

NOTE

Complete adjustments on A17 before performing A16 procedure.

Equipment:
HP 3435 DMM
HP 9825 Calculator
HP 98034 Interface

Setup:

1. Connect 9825A calculator with 98034 Interface to 5359A, rear panel HP-IB connector, J14. Set 5359A HP-IB address switch A5S1 to  Address "4".
2. Set the 3435A function to dc V and RANGE to AUTO.
3. Turn the LINE switch on the 5359A to ON and observe auto-calibrate and then display of 100.00 ns width.
4. Connect the 50Ω OUTPUT to 3435A through a 50Ω feedthrough.
5. Remove any connections to the EXT TRIGGER input.
6. Enter DELAY of Ø ns.
7. Adjust A16 as per the following table:

Table 5-2. A16 Adjustments

Step	9825 Keyboard Command	A16 Adjust
*1	wrt 704, "OCOA 0.5, OOØ"	R11 for +0.50V ±0.01V
	EXECUTE	
*2	wrt 704, "OCOA 5, OOØ"	R17 for +5.00V ±0.03V
	EXECUTE	
*3	wrt 704, "ONOA 2.75, OO-1"	R14 for -1.00V ±0.02V
	EXECUTE	
*4	wrt 704, "ONOA 2.75, OO1"	R21 for +1.00V ±0.02V
	EXECUTE	

**Alternate adjustments until both readings are stable.*

8. This completes the adjustments for A16.

Figure 5-6. A16 Processor Interface Assembly Adjustments

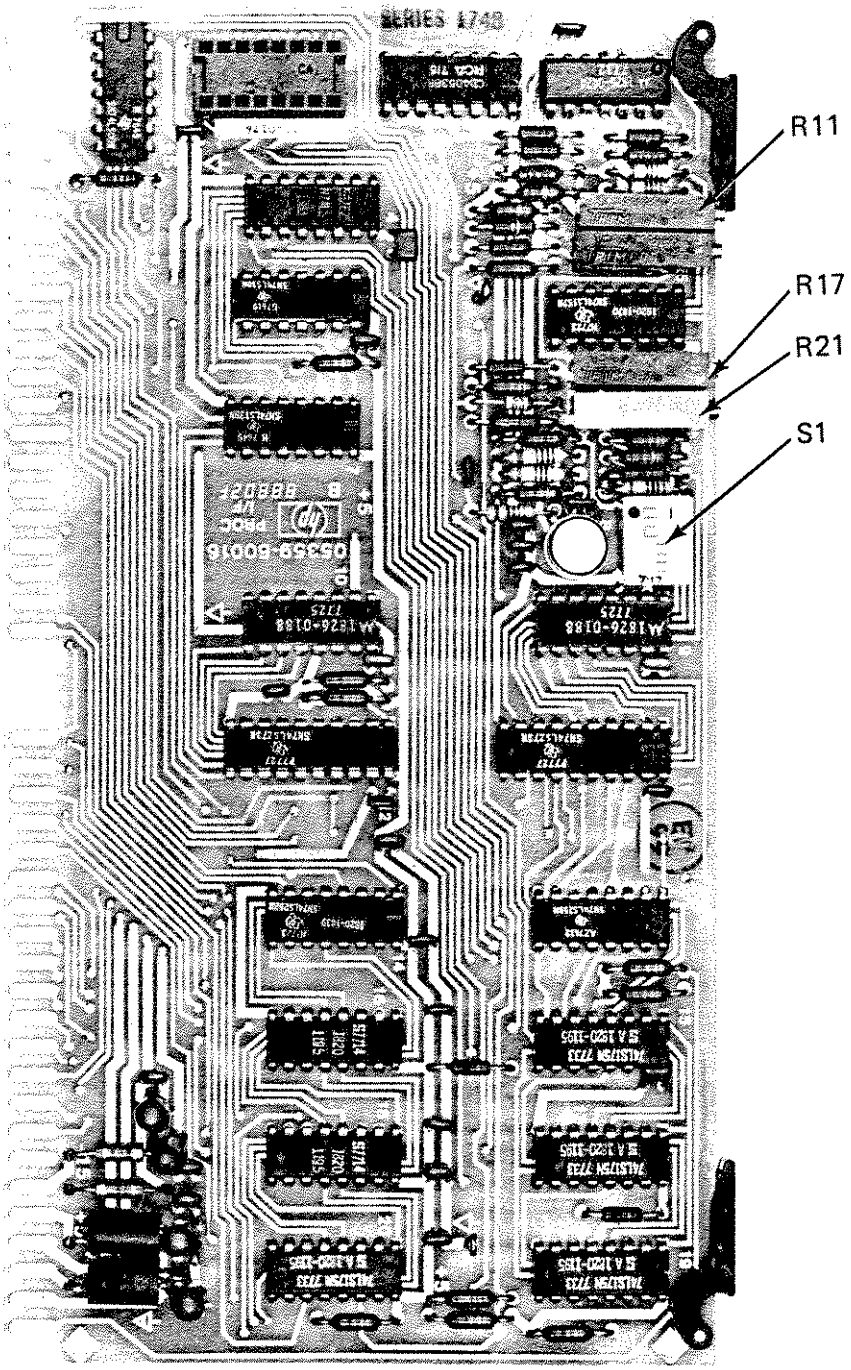


Figure 5-6. A16 Processor Interface Assembly Adjustments (Continued)

A27 Oscillator (Standard or Option 001)

Every few months, the oscillator should be checked to a house standard. When adjustment is required, use the oscilloscope method shown. Using the appropriate sweep speed, adjust the oscillator until the movement of the pattern is stopped.

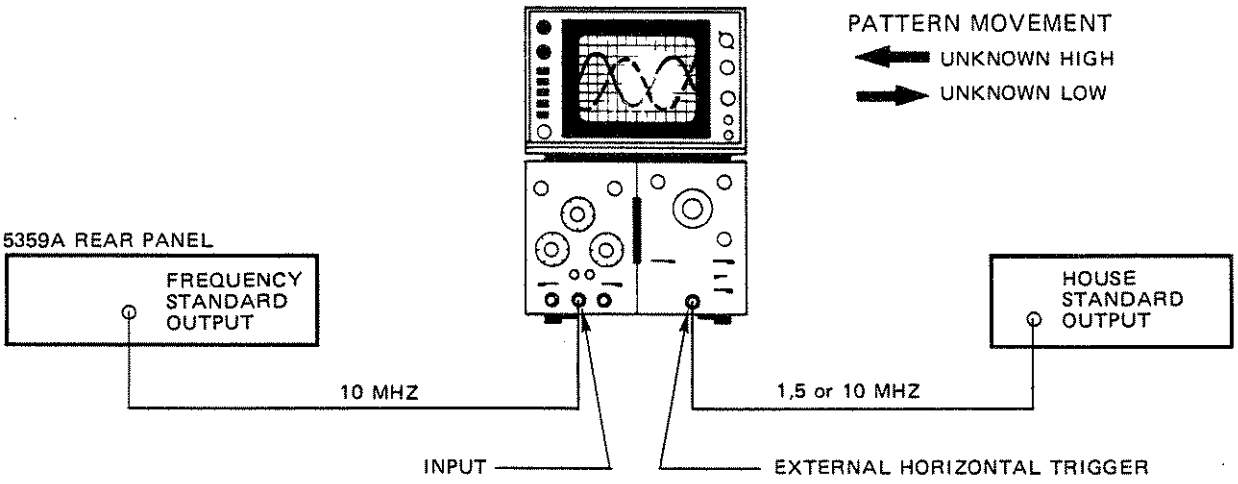


Table 5-3. Sweep Movement versus Calibration Accuracy

MOVEMENT	SWEEP SPEED			NOTES
	1 μsec/cm	0.1μsec/cm	0.01μsec/cm	
1 cm/sec	1×10^{-6}	1×10^{-7}	1×10^{-8}	Time scope trace movement with second hand of watch or clock
1 cm/10 sec	1×10^{-7}	1×10^{-8}	1×10^{-9}	
1 cm/100 sec	1×10^{-8}	1×10^{-9}	1×10^{-10}	

Adjustments for the A27 Oscillator Assembly are now complete.

Figure 5-7. A27 10 MHz Crystal Oscillator Assembly Adjustments

MANUAL UPDATING CHANGES **CHANGE DATE:** February 21, 1991

*** * * * MANUAL UPDATING COVERAGE* * * ***

This supplement adapts your manual to instruments with serial numbers prefixed through **2904A.**

*** * * * MANUAL IDENTIFICATION * * * ***

Instrument: HP 5359A Time Synthesizer Operating & Service Manual

Manual Part No: 05359-90008
Manual Microfiche: 05359-90009
Manual Print Date: April 1987

ABOUT THIS SUPPLEMENT

The information in this supplement is provided to correct manual errors and to adapt the manual to instruments containing changes after the manual print date.

Change and correction information in this supplement is itemized by page numbers corresponding to the original manual pages. The pages in this supplement are organized in numerical order by manual page number.

HOW TO USE THIS SUPPLEMENT

Insert this title page in front of the title page in your manual.

Perform all changes specified for "All Serials", and all changes through the Series Prefix of your instrument or board.

Insert any complete replacement pages provided into your manual in the proper location.

If your manual has been updated according to the last edition of this supplement, you need only perform those changes pertaining to the new series prefix. See List of Effective Pages on the reverse side of this page. New information affecting "All Serials" will be indicated by a "#" in front of the page number.

LIST OF EFFECTIVE PAGES

SERIAL PREFIX OR SERIAL NUMBER	PAGES
All Serials	Title Page, 1-1/1-2, 1-4, 3-2, 3-4, 4-16, 4-23, 4-29, 6-4/6-5, 6-8, 6-12/6-19, 6-21, 6-23, 6-25/6-26, 6-31/6-38, 8-5, 8-83, 8-89
2004A00261 and above	1-2, 8-119
2732A	6-10/6-12, 6-29/6-31, 8-83, 8-95, 8-113 The following Series 2732A instruments also include the changes for Series 2740A: 2732A01386 thru 2732A01405
2740A	6-29/6-31, 8-113
2740A01430 and below	6-13/6-16
2740A01431 and above	6-13/6-16, 8-99
2808A	6-7/6-8, 8-5, 8-89
2812A	6-36, 8-83
2904A	1-2, 6-36/6-38

PLEASE NOTE

This instrument incorporates a new method for tracking changes to its circuit boards. Starting July 1, 1988, all circuit boards will be labeled with a unique serial number. The SERIAL number will replace the previously used SERIES number, even though there may have been no change to the circuit board. Thus, if changes were made after July 1, 1988, they will be documented in this change sheet using the new circuit board SERIAL number. Changes made before that time are documented with the SERIES number.

Therefore, Circuit changes described in this change sheet may reference either the older SERIES number or the new SERIAL number. Using both numbers enables this change sheet to support both older and newer products. To determine which changes apply to your instrument, find the instrument's serial number prefix located on the rear panel, and make the manual changes indicated in this change sheet for that serial number prefix. For example, if the serial number is 2804A12345, make changes to the manual indicated for serial prefix 2804.

HEWLETT PACKARD

5. **OUTPUT Pulse Rise and Fall Time**

   a. Make the following changes to the 5359A front panel controls:

   OUTPUT
   Amplitude ..... +1.00V
   Offset ..... OFF

   b. Make the following changes to the 1725A front panel:

   HORIZONTAL DISPLAY .....MAG X10 (IN)
   MAIN TRIGGERING .....±(OUT)

   c. Using the HP 1725A, verify that the OUTPUT Pulse Rise Time is less than 5nS.

   d. Set the MAIN TRIGGERING ±BUTTON TO –(IN).

   e. Using the HP 1725A, verify that the OUTPUT PULSE Fall Time is less than 5nS.

6. **OUTPUT Pulse Amplitude**

   a. Connect the 50-ohm OUTPUT to the 3458A through a 50-ohm feedthrough.

   b. Remove any connections to the EXT TRIGGER input.

   c. Set the 5359A OUTPUT AMPLITUDE to +0.50V and POLARITY to COMP,POS.

   d. Using the HP 3458A, verify that the OUTPUT Pulse Amplitude is 0.50V ±0.03V.

   e. Set the HP 5359A OUTPUT AMPLITUDE to +5.00V.

   f. Using the HP 3458A, verify that the OUTPUT Pulse Amplitude is +5.00V ±0.03V.

7. **OUTPUT Pulse Offset**

   a. Make the following changes to the 5359A front panel controls:

   OUTPUT
   Amplitude ..... +2.00V
   Offset ON/–1.00

   b. Using the HP 3458A, verify that the peak amplitude of the OUTPUT pulse is +1.00V ±0.03V.

   c. Set the 5359A POLARITY to NORM, POS and verify the base amplitude is –1.00V ±0.15V.

   d. Set the OUTPUT OFFSET to +1.00V.

   e. Using the HP 3458A verify the base amplitude is +1.00V ±0.15V.

   f. Set the 5359A POLARITY to COMP, POS and verify that the peak amplitude of the OUTPUT pulse is +3.00V ±0.03V.

4-46. INSERTION DELAY

4-47. Specification Tested: <140nS (when in PRESET)
<40nS (when in AUTO)

4-48. Equipment: 5370B, 3312A

1. Set the 3312A for a 1MHz 2V p-p square wave with no offset.

SERIAL PREFIX OR SERIES NUMBER	CHANGES

PAGE 4-23. OPERATION VERIFICATION:

All Serials >Change IMPEDANCE from "1 M Ohm" to "50 Ohms" under START and STOP in step b.

PAGE 4-29. >Replace page 4-29 with page 4-29 in these manual changes.

PAGE 6-4, TABLE 6-2. A2 MAIN MOTHERBOARD ASSEMBLY REPLACEABLE PARTS:

All Serials >Change A2J1 from 1200-0519 to 1200-0482.

PAGES 6-4/6-5, TABLE 6-2. A6 POWER SUPPLY CONTROL BOARD REPLACEABLE PARTS:

All Serials
>Change A6 (05370-60081) Series from 1748 to 2716.
>Add Reference Designation A6MP1-MP3 to part number 5000-9043.
>Add Reference Designation A6MP4-MP6 to part number 5040-6843.
>Add A6Q5, 1853-0020 TRANSISTOR-PNP SI PD=300MW FT=150MHZ.
>Add A6Q6, 1854-0087 TRANSISTOR-NPN SI PD=360MW FT=75MHZ.
>Change A6R18, R21 from 0757-0438 (5.11K ohms) to 0757-0283 RESISTOR-FXD 2K 1% .12W F.

PAGES 6-7/6-8, TABLE 6-2. A9 PROCESSOR ASSEMBLY REPLACEABLE PARTS:

All Serials
>Change A9U5, U8, and U10 from 1818-0135 to 1818-0701 IC-NMOS 1024 (1K) STAT RAM 360-NS 3-S.
>Add A9MP1, MP2 0403-0189 EXTRACTOR-PC BD BLK POLYC.
>Add A9MP3, MP4 1480-0116 PIN-GRV .062-IN-DIA .25-IN-LG STL.

2808A
>Change A9 from 05359-60027 to 05359-60082, Series 2808.
>Change A9U3 from 05359-80003 to 05359-80004.
>Change A9XU3 from 1200-0565 (24-Pin) to 1200-0567 (28-PIN).

PAGES 6-9/6-10, TABLE 6-2. A11 DISPLAY INTERFACE REPLACEABLE PARTS:

>Add A11MP1/MP2 0403-0189 EXTRACTOR-PC BD BLK POLYC.
>Add A11MP3/MP4 1480-0116 PIN-GRV .062-IN-DIA .25-IN-LG STL.
>Add A11MP5 1400-0249 CABLE TIE .062 .625-DIA .091-WD NYL.

MANUAL CHANGES MODEL 5359A (05359-90008)

SERIAL PREFIX OR SERIES NUMBER	CHANGES

PAGES 6-10/6-12, TABLE 6-2. A15 HP-IB INTERFACE REPLACEABLE PARTS:

All Serials
>Change A15U29, U31/U32, and U34 from 1820-1689 to 1820-3329 IC-TTL XCVR BCD INSTRUMENT BUS MC3446.
>Delete A15XU23 and XU26 sockets.
>Add Reference Designation A15MP1/MP2 to part number 0403-0189; change quantity from 20 to 2.
>Add A15MP3/MP4, 1480-0116 pin-grv .062-IN-DIA .25-IN-LG STL.

2732A
>Change A15 (05370-60015) SERIES to 2732.
>Add A15C13, 0160-4832, CAPACITOR-FXD .01UF +-10% 100VDC CER.
>Add A15XU11, 1200-0473, SOCKET-IC 16-PIN DIP DIP-SLDR.

PAGES 6-12/6-13, TABLE 6-2. A16 PROCESSOR INTERFACE REPLACEABLE PARTS:

All Serials
>Change A16J1 from 1200-0519 to 1200-0482 SOCKET, IC 16-PIN DIP SLDR.
>Change A16TP1,TP2 from 0360-0535 to 0360-0124.
>Add Reference Designation A16MP1/MP2 to part number 0403-0189.
>Add Reference Designation A16MP3/MP4 to part number 1480-0116.

PAGES 6-13/6-16, TABLE 6-2. A17 OUTPUT REFERENCE ASSEMBLY REPLACEABLE PARTS:

All Serials
>Change A17Q1 from 1853-0233 to 1854-0394 TRANSISTOR-POWER PNP SI TO-220AB PD=40W.
>Change A17Q2, Q5, and Q6 from 1854-0420 to 1854-0701 TRANSISTOR, NPN SI DARL TO-220AB PD=70W.
>Change A17TP1/TP6 from 0360-0535 to 0360-0124.
>Change A17U4 from 1820-1173 to 1820-3124 IC XLTR ECL-TO-ECL QUAD.
>Add Reference Designation A17MP5/MP6 to part number 0403-0189.
>Add Reference Designation A17MP8/MP9 to part number 1480-0116.

NOTE

2740A01430 & below
If A17Q5 (1854-0420) is replaced with 1854-0701 then A17CR4 must be changed to 1901-0460, and A17CR5 must be replaced with A17R81 (8159-0005).

2740A01431 & above
>Change A17CR4 from 1901-0040 to 1901-0460, DIODE STABISTOR 30V 150MA DO-7.
>Delete A17CR5.
>Add A17R81, 8158-0005, RESISTOR-FXD 0 OHMS 22 AWG LEAD DIA.

PAGES 6-16/6-18, TABLE 6-2. A18 OUTPUT AMPLIFIER BOARD REPLACEABLE PARTS:

All Serials
>Change A18 TP1/TP12 from 0360-0535 to 0360-0124.

SERIAL PREFIX OR SERIES NUMBER	CHANGES

PAGES 6-18/6-19, TABLE 6-2. A19 AUTO-ZERO BOARD REPLACEABLE PARTS:

All Serials

>Change A19TP1/TP3 from 0360-0535 to 0360-0124.
>Change A19U15 from 1820-1052 to 1820-3125 IC-XLTR ECL ECL-TO-TTL QUAD 2-INP.
>Add Reference Designation A19MP3/MP4 to part number 0403-0189.
>Add Reference Designation A19MP5/MP6 to part number 1480-0116.

PAGES 6-20/6-21, TABLE 6-2. A20 TRIGGER AMPLIFIER BOARD REPLACEABLE PARTS:

All Serials

>Change A19MP1, MP2 and TP1, TP2 from 0360-0535 to 0360-0124.
>Change A20U2, U4 from 1820-1173 to 1820-3124 IC XLTR ECL-TO-ECL QUAD.
>Add Reference Designation A20MP3/MP4 to part number 0403-0189.
>Add Reference Designation A20MP5/MP6 to part number 1480-0116.

PAGES 6-22/6-23, TABLE 6-2. A21 ANALOG TIMING BOARD REPLACEABLE PARTS:

All Serials

>Change A21TP1/TP5 from 0360-0535 to 0360-0124.
>Change A21U1 from 1820-1173 to 1820-3124 IC XLTR ECL-TO-ECL QUAD.
>Add Reference Designation A21MP1/MP2 to part number 0403-0189.
>Add Reference Designation A21MP3/MP4 to part number 1480-0116.

PAGES 6-24/6-26, TABLE 6-2. A22 DIGITAL TIMING BOARD REPLACEABLE PARTS:

All Serials

>Change A22Q1 from 1853-0234 to 1853-0371 TRANSISTOR, POWER PNP 2N6107.
>Change A22U12 from 1820-1052 to 1820-3125 IC-XLTR ECL-TO-TTL QUAD.
>Change A22U1, U2 from 1820-1173 to 1820-3124 IC-XLTR ECL-TO-ECL QUAD.
>Add A22U5, U7, 1820-1814 IC-CNTR 24-BIT.
>Add Reference Designation A22MP1/MP2 to part number 0403-0189
>Add Reference Designation A22MP3/MP4 to part number 1480-0116.

PAGES 6-26/6-29, TABLE 6-2. A23 STARTABLE PLL OSCILLATOR REPLACEABLE PARTS:

All Serials

>Add A23H1, 2190-0124 WASHER-LK INTL T NO. 10 .195-IN-ID.
>Add A23H2, 2950-0078 NUT-HEX DBL-CHAM 10-32-THD .067 THK.

MANUAL CHANGES MODEL 5359A (05359-90008)

SERIAL PREFIX OR SERIAL NUMBER	CHANGES

TITLE PAGE:

All Serials >Change Serial Prefix to 2716A in two places.

PAGE 1-1. GENERAL INFORMATION:

All Serials >Delete Option 001 information, the High-Stability Crystal Oven is standard in the HP 5359A.

PAGE 1-2. GENERAL INFORMATION:

All Serials Add the following options to paragraph 1-21:

Option	Description	Part Number
908	Kit, Rack Mount Adapter With handles removed	5061-9677
909	Kit, Rack Handle and Flange	5061-9683
913	Kit, Rack Mount Adapter With handles attached	5061-9771

>Add Option W30 to paragraph 1-21:

Option	Description
W30	Extended Hardware Support - provides two additional years of return-to-HP hardware-service support. Option W30 is available only at time of purchase. Service contracts are available from Hewlett-Packard for instruments which did not include Option W30 at time of purchase. For more information, contact your nearest Hewlett-Packard Sales and Support office.

2004A >Delete reference to Option 001; Option 001, High-Stability Crystal Oven is standard in the HP 5359A.

2904A >Change Option 908 part number from 5061-9677 to 5062-3977.
>Change Option 909 part number from 5061-9683 to 5062-3983.
>Change Option 913 part number from 5061-9771 to 5062-4071.

SERIAL PREFIX OR SERIES NUMBER	CHANGES

PAGE 1-4, TABLE 1-1. SPECIFICATIONS (Cont'd):

All Serials **TIMEBASE:**

>Replace Aging Rate and Warmup specifications with the following:

Long Term (Aging Rate):

A. $<5 \times 10^{-10}$ per day after 24 hour warm-up when:

1. oscillator off-time was less than 24 hours.
2. oscillator aging rate was $<5 \times 10^{-10}$ per day prior to turn off.

B. $<5 \times 10^{-10}$ per day in less than 30 days of continuous operation for off-time greater than 24 hours.

C. $<1 \times 10^{-7}$ per year for continuous operation.

Warmup:

Within 5×10^{-9} of final value (see below) 10 min. after turn-on when:

1. oscillator is operated in a 25° C environment with 20 Vdc Oven Supply voltage applied.
2. oscillator off-time was less than 24 hours.
3. oscillator aging rate was $<5 \times 10^{-10}$ per day prior to turn-off.

Final value is defined as oscillator frequency 24 hours after turn-on.

PAGE 3-2. OPERATING AND PROGRAMMING:

All Serials >Change "Syntheiszer" to "Synthesizer" in first line of paragraph 3-13.

PAGE 3-4. OPERATING AND PROGRAMMING:

All Serials >Change "of" to "or" in second line of paragraph 3-28.

PAGE 4-16. PERFORMANCE TESTS:

All Serials >Add "One HP 3458A Digital Voltmeter" to paragraph 4-23.

SERIAL PREFIX OR SERIES NUMBER	CHANGES

PAGES 6-29/6-31, TABLE 6-2. A24 200 MHz MULTIPLIER REPLACEABLE PARTS:

2732A01381 & above

>Change A24 (05370-60124) SERIES to 2732.
>Change A24C3, C9, C23, C29, C30, C40, C41, and C50 from 0160-3878 (1000 PF) to 0160-4040, CAPACITOR-FXD 1000 PF +-5% 100VDC CER.
>Change A24R22 from 0698-4002 (5K ohms) to 0698-3152, RESISTOR-FXD 3.48K 1% .12W F TC=0+-100.
>Change A24R25, from 0757-0444 (12.1K ohms) to 0757-0289 RESISTOR-FXD 13.3K 1% .12W TF TC=0+-100.
>Change A24R26 from 0757-1093 (3K ohms) to 0757-1094 RESISTOR FXD 1.47K 1% .12W TF TC=0+-100.

2740A

>Change A24 (05370-60124) SERIES to 2740.
>Change A24R22 from 0698-3152 (3.48K ohms) to 0757-0290 RESISTOR-FXD 6.19K 1% .12W F TC=0+-100.
>Change A24R25 from 0757-0289 (13.3K ohms) to 0757-0439 RESISTOR-FXD 6.81K 1% .12W TF TC=0+-100.

PAGES 6-31/6-32, TABLE 6-2. A25 DISPLAY & KEYBOARD ASSY REPLACEABLE PARTS:

All Serials

>Change A25J1/J3 from 1200-0519 to 1200-0482 SOCKET IC, 16-PIN DIP-SLDR.
>Add Reference Designation A25MP1 to part number 05341-20037.
>Add Reference Designation A25MP2 to part number 05341-40001.
>Add Reference Designation A25MP3 to part number 05370-40001.
>Add MP5, Qty 1, 4040-2121 STANDOFF-LED 7.5MML.
>Change A25XDS11 from 1200-0474 to 1200-0638.

PAGE 6-32, TABLE 6-2. A26 FRONT PANEL CONTROLS REPLACEABLE PARTS:

All Serials

>Replace A26 (05359-60026) Front Panel Control Replaceable Parts List with the following:

REF DESIG	HP PART NUMBER	C D	QTY	DESCRIPTION
A26	05359-60026	4	1	FRONT PANEL CONTROL
A26J1	1200-0482	9	2	SOCKET, IC 16-PIN DIP
A26J2	1200-0482	9		SOCKET, IC 16-PIN DIP
A26R1	2100-2492	4	1	RESISTOR, VARIABLE SS 5K 20% LIN
A26R2	2100-2661	9	2	RESISTOR, VARIABLE V SS 1K 20% LIN
A26R3	2100-2661	9		RESISTOR, VARIABLE V SS 1K 20% LIN
A26S1	3101-2220	9	5	SWITCH, SL DPDT MNTR .5A 125VAC/DC
A26S1	3101-2220	9		SWITCH, SL DPDT MNTR .5A 125VAC/DC
A26S2	3101-2220	9		SWITCH, SL DPDT MNTR .5A 125VAC/DC
A26S3	3101-2220	9		SWITCH, SL DPDT MNTR .5A 125VAC/DC
A26S4	3101-2220	9		SWITCH, SL DPDT MNTR .5A 125VAC/DC
A26S5	3101-2220	9		SWITCH, SL DPDT MNTR .5A 125VAC/DC

MANUAL CHANGES MODEL 5359A (05359-90008)

SERIAL PREFIX OR SERIES NUMBER	CHANGES

PAGE 6-33, TABLE 6-2. A27 10 MHZ CRYSTAL OSCILLATOR ASSEMBLY REPLACEABLE PARTS:

All Serials >Delete A26 replaceable parts.
>Add the following A27 10MHz Crystal Oscillator Assembly information:

REPAIR OF A27 HIGH-STABILITY TIME BASE OSCILLATOR:
Should a failure occur in A27, the High-Stability Time Base Oscillator assembly, this assembly should be replaced with a restored unit, HP Part Number 10811-69111, or a new unit (Part Number 10811-60111). Repairs to the oscillator are strongly discouraged because of the difficulty in reconfirming the oscillator's specifications after repair.

PAGES 6-34/6-38, TABLE 6-2. CHASSIS AND MISCELLANEOUS PARTS:

All Serials >Replace pages 6-34/6-38 with pages 6-34/6-35.

2812A >Add C5, 0160-4065, Qty 1, CAPACITOR-FXD .1UF +-20% 250VAC (RMS).

2904A >Replace pages 6-34/6-35 with pages 6-34/6-35 (Series 2904).

PAGE 8-5, TABLE 8-1. ASSEMBLY IDENTIFICATION:

All Serials >Change A9 part number from 05370-60109 to 05370-60082.
>Change A21 part number from 05359-60021 to 05370-60124.

PAGE 8-83, FIGURE 8-10. A1/A2/A6 MOTHERBOARD/POWER SUPPLY SCHEMATIC DIAGRAM/ COMPONENT LOCATOR:

All Serials Component Locator:
>Change reference designator U5 (near board center, between R16 and R17) to Q5.

2812A >Add C5, .1UF capacitor, between the WHT/BRN/GRY and WHT/RED/GRY lines of the fan switch circuit (lower left corner).

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
				CHASSIS PARTS - SERIES 2904A		
C5	0160-4065	5	1	CAPACITOR-FXD .1UF +-1UF +20% 250VAC RMS	28480	0160-4065
W11	05359-60411	1	1	CABLE AY-START, PROBE	28480	05359-60411
W12	05359-60412	2	1	CABLE AY-STOP, PROBE	28480	05359-60412
W13	05359-60413	3	1	CABLE AY-REAR PANEL	28480	05359-60413
W14	05359-60414	4	1	CABLE AY, 10MHZ TB	28480	05359-60414
W15	05359-60415	5	1	CABLE AY, PULSE	28480	05359-60415
W16	05359-60416	6	1	CABLE AY, EXT TRIGGER	28480	05359-60416
W17	05359-60417	7	1	CABLE AY, EVENTS IN	28480	05359-60417
W18	05359-60418	8	1	CABLE AY, SYNCH OUT	28480	05359-60418
	0340-0596	1	4	INSULATOR-XSTR THRM-CNDCT	28480	0340-0596
	0340-0833	9	4	INSULATOR-XSTR POLYE	28480	0340-0833
	0360-0040	2	1	TERMINAL-SLDR LUG LK-MTG FOR #1/4 SCR	28480	0360-0040
	0370-0914	0	1	BEZEL-PB KNOB .490LG,.330W .165-IN-HI;JADE	28480	0370-0914
	0370-0970	8	1	PUSHBUTTON .230 X .390 X .413-IN-H; JADE	28480	0370-0970
	0370-1005	2	4	KNOB-BASE PTR 3/8 JGK .125-IN-ID	28480	0370-1005
	0380-0008	4	1	SPACER, RND .5-IN-LG .18-IN ID	28480	0380-0008
	0380-0018	6	2	SPACER, .25-IN-LG .194-IN-ID	28480	0380-0018
	0380-0644	4	2	STANDOFF-HEX .327-IN-LG 6-32 THD	28480	0380-0644
	0510-1148	2	18	RETAINER, PUSH-ON KB-TO-SHFT EXT	28480	0510-1148
	0510-0896	5	6	SCREW-MACH M4 X 0.7 10MM-LG	28480	0515-0896
	0515-1055	0	8	SCREW-MACH M4 X 0.7 6MM-LG 90-DEG-FLH-HD	28480	0515-1055
	0515-1132	4	4	SCREW-MACH M5 X 0.8 10-MM-LG	28480	0515-1132
	0515-1232	5	4	SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD POZI	28480	0515-1232
	0515-1331	5	8	SCREW-METRIC SPECIALTY M4 X 0.7 THD; 6	28480	0515-1331
	0520-0174	3	2	SCREW-MACH 2-56 .25-IN-LG PAN-HD POZI	28480	0520-0174
	0624-0208	4	8	SCREW-TAPPING 6-32 .5-IN-LG PAN-HD-POZI	28480	0624-0208
	1200-0523	9	14	LOCK-DUAL INLINE PKG INLINE PKG	28480	1200-0523
	1205-0335	1	1	HEATSINK TO-3-CS	28480	1205-0335
	1251-3283	1	1	CONN-RECT MICRORIBBON 24-CKT 24-CONT	28480	1251-3283
	1460-1345	5	2	TILT STAND, SST	28480	1460-1345
	2100-0305	5	1	FUSE 1.25A 250V TD 1.25X.25UL	75915	3131.25
	2190-0017	4	4	WASHER-LK HLCL NO.8 .168-IN-ID	00000	ORDER BY DESCRIPTION
	2190-0034	5	2	WASHER-LK HLCL NO.10 .194-IN-ID	00000	ORDER BY DESCRIPTION
	2190-0046	9	8	WASHER-LK HLCL NO. 6 .141-IN-ID	00000	ORDER BY DESCRIPTION
	2190-0047	0	1	WASHER-LK 82 CTSK EXT T NO. 6 .142-IN-ID	00000	ORDER BY DESCRIPTION
	2190-0068	5	2	WASHER-LK INTL T 1/2-IN .505-IN-ID	00000	ORDER BY DESCRIPTION
	2190-0102	8	7	WASHER-LK INTL T 15/32-IN .472-IN-ID	00000	ORDER BY DESCRIPTION
	2190-0843	4	1	WASHER-LK INTL T NO.8 .165-IN-ID	00000	ORDER BY DESCRIPTION
	2200-0103	2	8	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2360-0113	2	6	SCREW-MACH 6-32 .25-IN-LG PAN-HD POZI	00000	ORDER BY DESCRIPTION
	2360-0125	6	4	SCREW-MACH 6-32 .75-IN-LG PAN-HD POZI	00000	ORDER BY DESCRIPTION
	2360-0211	1	2	SCREW-MACH 6-32 .75-IN-LG 82-DEG	00000	ORDER BY DESCRIPTION
	2360-0321	4	3	SCREW-PAN HEAD 6-32 1-IN-LG UNC2-A	28480	2360-0321
	2360-0476	0	8	SCREW-MACH 6-32 .188-IN-LG 100-DEG 2	00000	ORDER BY DESCRIPTION
	2420-0001	5	1	NUT-HEX W/LKWR 6-32 THD .109-IN THK	00000	ORDER BY DESCRIPTION
	2420-0003	7	1	NUT-HEX DBL-CHAM 6-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	2950-0006	3	1	NUT-HEX W/LKWR 6-32-THD .109-IN-THK	00000	ORDER BY DESCRIPTION
	2950-0035	8	1	NUT-HEX DBL-CHAM 15/32-32 THD	00000	ORDER BY DESCRIPTION
	2950-0054	1	2	NUT-HEX DBL-CHAM 1/2-28 THD .125-IN-THK	00000	ORDER BY DESCRIPTION
	3050-0001	1	4	WASHER-FLAT MTLC NO.8 .172-IN-ID	00000	ORDER BY DESCRIPTION
	3050-0066	8	7	WASHER-FLAT .147-IN-ID MTLC NO.6	00000	ORDER BY DESCSRIPTION
	3160-0309	5	1	FINGER GUARD	4N833	12601-43 UL VERSION
	5021-8496	5	2	TRIM, FRONT HANDLE	28480	5021-8496
	5021-5803	2	1	FRAME, FRONT	28480	5021-5803
	5021-8403	4	1	FRAME, REAR	28480	5021-8403
	5021-5837	2	4	STRUT-CORNER	28480	5021-5837
	5040-0170	6	6	SUPPORT, BOARD	28480	5040-0170
	5040-6928	4	1	STRIP, DIVIDER	28480	5040-6928
	5040-6937	5	3	CLIP, WINDOW	28480	5040-6937
	5040-6967	1	8	DIVIDER STRIP	28480	5040-6967
	5041-8801	8	2	FOOT	28480	5041-8801
	5041-8802	9	1	TOP TRIM	28480	5041-8802
	5041-8821	2	4	STANDOFF, REAR PANEL	28480	5041-8821
	5041-8822	3	2	FOOT, NON-SKID	28480	5041-8832

See introduction to this section for ordering information
***Indicates factory selected value**

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				CHASSIS PARTS - SERIES 2904 (Cont'd)		
	5041-0244	7	3	KEY CAP, 55.M	28480	5041-0244
	5041-0253	8	6	KEY CAP, 1/2	28480	5041-0253
	5041-0286	7	1	KEY CAP, 1/2	28480	5041-0286
	5041-0310	8	1	KEY CAP, BLANK	28480	5041-0310
	5041-0319	7	1	KEY CAP, LIGHT PIPE	28480	5041-0319
	5041-0776	0	1	KEY CAP, CLEAR	28480	5041-0776
	5041-0841	0	1	KEY CAP, .	28480	5041-0841
	5041-0846	5	1	KEY CAP, 0	28480	5041-0846
	5041-0847	6	1	KEY CAP, 1	28480	5041-0847
	5041-0848	7	1	KEY CAP, 2	28480	5041-0848
	5041-0849	8	1	KEY CAP, 3	28480	5041-0849
	5041-0850	1	1	KEY CAP, 4	28480	5041-0850
	5041-0851	2	1	KEY CAP, 5	28480	5041-0851
	5041-0852	3	2	KEY CAP, 6	28480	5041-0852
	5041-0853	4	1	KEY CAP, 7	28480	5041-0853
	5041-0854	5	1	KEY CAP, 8	28480	5041-0854
	5041-0855	6	2	KEY CAP, UP	28480	5041-0855
	5041-1602	3	1	KEY-HALF, GOLD	28480	5041-1602
	5041-8819	4	2	STRAP HANDLE CAP, FRONT	28480	5041-8819
	5041-8820	7	2	STRAP HANDLE CAP, REAR	28480	5041-8820
	5060-9462	9	1	HP-IB EXTENDER ASSY	28480	5060-9462
	5062-3704	3	2	STRAP HANDLE ASSEMBLY	28480	5062-3704
	5062-3780	5	1	COVER-SIDE ASSEMBLY	28480	5062-3780
	5062-3735	8	1	COVER ASSEMBLY, TOP	28480	5062-3735
	5062-3747	2	1	COVER ASSEMBLY, BOTTOM	28480	5062-3747
	5061-9499	4	2	HANDLES, SYSTEM II	28480	
	5061-9677	0	1	KIT-RACK FLANGE	28480	5061-9677
	5061-9683	8	1	KIT-RACK HANDLE & FLANGE	28480	5061-9683
	5061-9771	5	1	RACK FLANGE	28480	5061-9771
	05359-00001	9	1	PANEL, DRESS FRONT	28480	05359-00001
	05359-00002	0	1	PANEL, SUB FRONT	28480	05359-00002
	05359-00004	2	2	BULKHEAD, BOARD GUIDE	28480	05359-00004
	05359-00008	6	1	COVER-SIDE ASSEMBLY, PERFORATED	28480	05359-00008
	05359-20201	3	1	WINDOW	28480	05359-20201
	05359-20203	5	1	SUPPORT, MOTHERBOARD	28480	05359-20203
	05359-20204	6	1	SUPPORT, MOTHERBOARD	28480	05359-20204
	05370-00005	8	1	POWER SUPPLY, CHASSIS	28480	05370-00005
	05370-00014	9	1	DIFFUSER #1	28480	05370-00014
	05370-00015	0	1	DIFFUSER #2	28480	05370-00015
	05371-80025	1	1	INSULATOR, MYLAR	28480	05371-80025

See introduction to this section for ordering information
*Indicates factory selected value

MANUAL CHANGES MODEL 5359A (05359-90008)

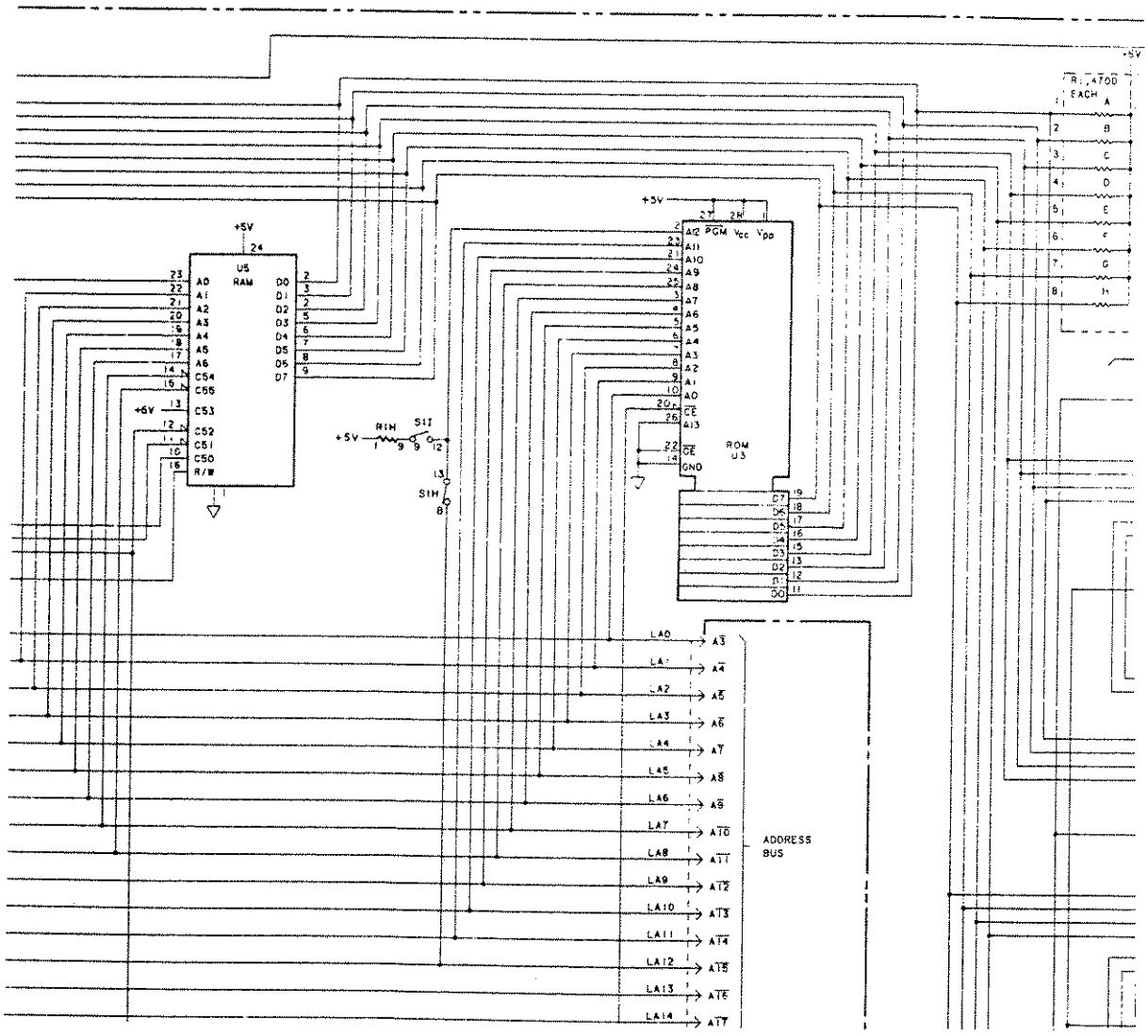
SERIAL PREFIX OR SERIES NUMBER	CHANGES

PAGE 8-89, FIGURE 8-13. A9 PROCESSOR ASSEMBLY SCHEMATIC DIAGRAM/COMPONENT LOCATOR:

All Serials >Change A9U5, U8, and U10 from 1818-0135 to 1818-0701 in Table of Active Elements.

2808A >Change A9 part number from 05359-60027 to 05359-60082, Series 2808.

>Replace A9U3 with the following partial schematic:



Component Locator:
>Delete reference to "C21 on circuit side of board".
>Add C21 between C13 and R10, near U18.

SERIAL PREFIX OR SERIES NUMBER	CHANGES

PAGE 8-95, FIGURE 8-16. A15 HP-IB INTERFACE ASSEMBLY SCHEMATIC DIAGRAM/ COMPONENT LOCATOR:

2732A

>Change A15 (05370-60015) SERIES to 2732.
>Add A15C13 (.01 UF) between pins 1 and 8 of A15U11.

Component Locator:
>C13 is added to the circuit side of A15 between pins 1 and 8 of U11.

PAGE 8-99, FIGURE 8-18. A17 OUTPUT REFERENCE ASSEMBLY:

2740A01431

>Replace A17CR5 (Diode, Switching) with A17R81 (0 ohms).

PAGE 8-113, FIGURE 8-25. A24 200 MHz MULTIPLIER ASSY SCHEMATIC DIAGRAM/ COMPONENT LOCATOR:

2732A01381 & above

>Change A24 (05370-60124) SERIES to 2732.
>Change A24R22 value from 5K ohms to 3.48K ohms.
>Change A24R25 value from 12.1K ohms to 13.3K ohms.
>Change A24R26 value from 3K ohms to 1.47K ohms.

2740A

>Change A24 (05370-60124) SERIES to 2740.
>Change A24R22 value from 3.48K ohms to 6.19K ohms.
>Change A24R25 value from 13.3K ohms to 6.81K ohms.

PAGE 8-119, FIGURE 8-28. A27 10-MHZ CRYSTAL OSCILLATOR SCHEMATIC DIAGRAM:

2004A

NOTE

The 10544A Crystal Oscillator Assembly has been replaced by the 10811 Crystal Oscillator.

>Delete reference to Option 001. Option 001, High Stability Crystal Oven is now standard in the HP 5359A.

REPAIR OF HIGH-STABILITY TIME BASE OSCILLATOR:
Should a failure occur in A27, the High-Stability Time Base Oscillator assembly, this assembly should be replaced with a restored unit, HP Part Number 10811-69111, or a new unit (Part Number 10811-60111). Repairs to the oscillator are strongly discouraged because of the difficulty in reconfirming the oscillator's specifications after repair.