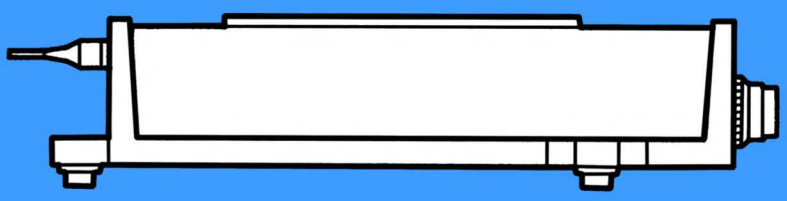
OPERATING AND SERVICE MANUAL

5517A
Laser Head



HEWLETT PACKARD

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

HEWLETT PACKARD

OPERATING AND SERVICE MANUAL

Model HP 5517A
Laser Head

SERIAL PREFIX EFFECTIVITY

This manual applies to 5517A Laser Heads with serial number prefix 2408A. Lower number serial prefixes are covered in Section VII, higher number serial prefixes are documented with "Manual Changes" Supplements as described in Section VII.

MANUAL PART NUMBER 05517-90007
Microfiche Part Number 05517-90008

Printed: MAY 1985

ELECTRICAL SAFETY CONSIDERATIONS

GENERAL

The product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product is a Safety Class I instrument (provided with a protective earth terminal).

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed. Refer to Section II, Installation.

SAFETY EARTH GROUND

An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

SAFETY SYMBOLS

Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual.

Indicates hazardous voltages.

Indicates earth (ground) terminal.

The **WARNING** sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a **WARNING** sign until the indicated conditions are fully understood and met.

The **CAUTION** sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a **CAUTION** sign until the indicated conditions are fully understood and met.

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection).

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to the neutral (earthed pole) of the power source.

Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

For continued protection against the fire hazard, replace the line fuse(s) only with 250V fuse(s) of the same current rating and type (for example, normal blow, time delay, etc.). Do not use repaired fuses or short circuited fuseholders.

From 1.8 kilovolts to 12 kilovolts dc is present on the anode of the laser tube in the 5518A. Exercise extreme caution when working inside the instrument. The high voltage could cause serious personal injury if contacted. Any adjustments performed should be by service trained personnel only.

LASER HEAD SAFETY CONSIDERATIONS

LASER RADIATION IS EMITTED FROM THE APERTURE ON THE 5517A LASER HEAD AS ILLUSTRATED ON THE FOLLOWING PAGE. DO NOT STARE INTO BEAM. THIS PRODUCT IS A CLASS II LASER PRODUCT CONFORMING TO U.S. NATIONAL CENTER FOR DEVICES AND RADIOLOGICAL HEALTH REGULATIONS 21 CFR 1040.10 AND 1040.11 AND TO INTERNATIONAL LASER SAFETY REGULATIONS. THE MAXIMUM RADIANT POWER OUTPUT IS 1 MILLIWATT, THE PULSE SPECIFICATION IS CONTINUOUS WAVE, THE LASER MEDIUM IS HELIUM-NEON, AND THE WAVELENGTH IS 632.991 NANOMETRES.

LASER RADIATION IS ACCESSIBLE WHEN THE 5517A COVER IS REMOVED AND THE TEST-NORM SWITCH, A1S1, IS IN THE TEST POSITION.

USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS RADIATION EXPOSURE.

LASER HEAD SAFETY LABELS

(U.S.A. ONLY)

FEDERAL COMMUNICATIONS COMMISSION RADIO FREQUENCY INTERFERENCE STATEMENT

Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. As temporarily permitted by regulation it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

END PRODUCT LASER SAFETY CONSIDERATIONS

The 5517A Laser Head complies with U.S. National Center for Devices and Radiological Health regulations 21 CFR 1040.10 and 1040.11 and conforms to international laser safety regulations.

These regulations may also apply to the end product into which the 5517A will be designed. Care must be taken to insure that the end product complies with all applicable national and local laser safety regulations.

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SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This Operating and Service Manual contains information required to install, operate, test, adjust, and service the Hewlett-Packard Model 5517A Laser Head. The information in this manual is specific to the 5517A and is intended to supplement other publications available for Hewlett-Packard Laser Transducer Products. A separate System Manual, HP 5501A Laser Transducer System Manual, HP Part Number 05501-90028, is available that details information required to setup, align, and apply the Laser Head to perform various types of interferometer measurements.

1-3. The HP part number of this manual is listed on the title page. Also listed is a microfiche part number which may be used to order 4×6-inch microfilm transparencies of the manual. The microfiche package also includes the latest "Manual Changes" supplement and any pertinent Service Notes.

1-4. MANUAL ORGANIZATION

1-5. This Service Manual is organized as follows:

SECTION I GENERAL INFORMATION covers Manual Organization, Instruments Covered by the Manual, Safety Considerations, Specifications, Recommended Test Equipment, and Warranty Information.

SECTION II INSTALLATION covers Grounding Considerations, Power Requirements, Interconnecting Cabling, Operating and Storage Environments, Storage and Shipment, and Packaging.

SECTION III OPERATION provides operating information and covers Equipment Front and Rear Panel Features, Warmup Time Considerations, Program Notes, and Operator's Maintenance.

SECTION IV PERFORMANCE TESTS provides Safety Considerations, Performance Tests, and a Test Record.

SECTION V ADJUSTMENTS covers Safety Considerations, Test Equipment Required, Adjustment Procedures, and an Adjustment Record.

SECTION VI REPLACEABLE PARTS includes Tables of Replaceable Parts including illustrated parts breakdowns of chassis and mechanical assemblies, Abbreviations, Ordering Information, and the HP Direct Mail Order System.

SECTION VII MANUAL CHANGES describes how to update or backdate the manual for prefixes other than those listed in *Table 1-1.*

SECTION VIII SERVICE contains Safety Considerations, Theory and Block Diagram Descriptions, Trouble Isolation, Troubleshooting, Schematics, and Component Locations.

1-6. INSTRUMENTS COVERED BY THE MANUAL

1-7. Attached to each instrument is a serial plate. The serial number is in the form: 0000A00000. It is in two parts; the first digits and the letter are the serial number prefix and the last five digits are the suffix. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The suffix is assigned sequentialy and is unique to the individual instrument. The contents of this manual apply to instruments with the serial number prefix listed on the title page of this manual.

1-8. An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a yellow "Manual Changes" supplement. This supplement contains updating information that explains how to change the manual to be applicable to newer instruments.

1-9. In addition to the new series number prefix change information, the supplement may contain information for correcting errors in the manual (errata). To keep this manual as current and as accurate as possible, Hewlett-Packard recommends that you periodically request the latest "Manual Changes" supplement. The supplement for this manual is identified with the manual print date and part number, both of which appear on the manual title page. Complementary copies of the supplement are available.

1-10. SAFETY CONSIDERATIONS

1-11. The 5517A Laser Head is a Safety Class I product and has been designed and tested in accordance with international safety standards, including HD* 194 and IEC* 348. It is also a Class II Laser Product certified as conforming to Bureau of Radiological Health Regulations 21 CFR** 1040.10 and 1040.11, and to international laser safety regulations. The instrument and the manual should be inspected and reviewed for safety markings and instructions before operation. A safety summary is included on the page following the title page.

**HD, Harmonization Document*

**IEC, International Electrotechnical Commission*

***CFR, Code of Federal Regulations (U.S.A.)*

1-12. SPECIFICATIONS

1-13. *Table 1-1* lists the specifications and performance characteristics for the 5517A Laser Head.

Table 1-1. 5517A Laser Head Specifications and Performance Characteristics

Description: The HP 5517A Laser Head contains an automatically tuned Helium-Neon laser, circuits to control the laser, and a reference optical receiver. The laser generates a coherent, collimated, two frequency beam of light. This is a Class II Laser Product conforming to Federal Bureau of Radiological Health Regulations 21 CFR 1040.10 and 1040.11.

Environmental Conditions:

Temperature (Operating): 0 to 40 °C (32 to 104 °F)

Temperature (Non-Operating): Can be stored or shipped in environments within the following limits:

-40 to +75 °C. This unit should also be protected from temperature extremes which could cause condensation within the instrument.

Relative Humidity (Operating): 0 to 95% Non-condensing

Vacuum Wavelength (Nominal): 632.991372 nanometers

Vacuum Wavelength Accuracy: $\pm 1 \times 10^{-7}$

Vacuum Wavelength Stability: $\pm 2 \times 10^{-8}$, typical

Beam Diameter: 6 mm typical

Maximum Beam Power Output: 1 milliwatt

Minimum Beam Power Output: 120 microwatts

Warm Up Time: less than 10 minutes (4 minutes typical)

Power Requirements:

The 5517A requires the following power inputs:

-15 Volts ±0.3 Volts at 0.02 Amperes maximum
+15 Volts ±0.3 Volts at 2.5 Amperes maximum

Dimensions: 48 × 19 X 12 cm

Weight: 5.5 Kg

1-14. DESCRIPTION

1-15. The HP 5517A (*Figure 1-1*) is intended to be used in the 5501A system as a laser source. This system is covered in a separate manual titled *"5501A Laser Transducer System"*. The Laser Head is supplied with 2 Screws M8 × 1.25 × 25 mm HP Part Number 0515-0798. Interconnect Cable 10791A/B/C is available as an accessory.

Figure 1-1. 5517A Laser Head

1-16. The Laser Head consists of a thermally-tuned laser tube, control circuits, a reference receiver, and a high-voltage power supply. The tube provides a coherent collimated light source consisting of two orthogonally polarized frequency components. One component is polarized parallel to the plane of the mounting feet and the other is polarized perpendicular to that plane.

1-17. Before the laser beam is emitted from the Laser Head, a portion of it is sampled. Most of this sample is fed into the reference receiver to determine the difference in frequency between the two optical components. This difference frequency is called the **Reference Frequency**. The remainder of the sampled beam is used to control the tuning of the laser.

1-18. During a measurement, the laser beam is directed through external measurement optics and then returned to an external measurement receiver to determine the measurement difference frequency. If the optics remain stationary, the **Measurement Frequency** and the **Reference Frequency** are the same. Relative motion between the measurement optics results in a change of the **Measurement Frequency**. The system compares the reference and measurement frequencies and calculates the displacement of the optics.

1-19. RECOMMENDED TEST EQUIPMENT

1-20. Equipment required to maintain the Laser Head is listed in *Table 1-2.* Other equipment may be substituted if it meets or exceeds the critical specifications listed in the table.

Table 1-2. Recommended Test Equipment

Instrument	**Use***	**Critical Specifications**	**Recommended Equipment** (Equipment Having Equivalent Characteristics May Be Substituted)
Oscilloscope	T	100 MHz Bandwidth	HP 1740A
Laser Power Meter	T	Range: 1 microwatt to 1 milliwatt Accuracy: ±10%	United Detector Technology Model 351L
Clip-on Milliammeter	T,A	10 ma range accuracy ±10 ma	HP 428B
Logic Pulser	T	TTL level	HP 546A
Current Tracer	T	Sensitivity: 1 ma to 1 amp	HP 547A
Logic Clip	T	TTL Compatible 16-pin I.C. mounting	HP 548A
Logic Probe	T	TTL/CMOS Capability with Pulse Memory	HP 545A
Digital Voltmeter	T	DC Volts: Floating Inputs Input Resistance: >10E10 ohms 10V Range Accuracy: ±250 microvolts 1V Range Accuracy: ±52 microvolts	HP 3456A
Signature Analyzer	T	—	HP5005A

*P=Performance Test; C=Calibration; A=Adjustments; T=Troubleshooting; S=Shortened Performance Test

1-21. WARRANTY

1-22. The warranty statement for the instrument including the laser tube is located on the inside cover of this manual.

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section provides installation instructions for the Model 5517A Laser Head including unpacking, inspection, and reshipment, installation, operating environment, and storage. Installation includes information on the 10791A/B/C Power Supply/Reference Signal Cable, grounding considerations, power supply requirements, power dissipation, fusing, dimensions, and mounting and fixturing.

2-3. UNPACKING, INSPECTION, AND RESHIPMENT

2-4. The following paragraphs contain information for unpacking and inspection, warranty claims, laser tube shipment, tagging for service, and packaging for reshipment.

WARNING

TO AVOID HAZARDOUS ELECTRIC SHOCK, DO NOT PERFORM ELECTRICAL TESTS WHEN THERE ARE SIGNS OF SHIPPING DAMAGE TO ANY PORTION OF THE OUTER ENCLOSURE (COVERS, PANELS, METERS).

2-5. Unpacking and Inspection

2-6. 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 instrument has been checked mechanically and electrically. 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 or some component fails the performance tests, 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 materials for the carrier's inspection. The HP office will arrange for repair or replacement at HP's option without waiting for a claim settlement.

2-7. Warranty Claims

2-8. Contact the nearest HP Sales and Service Office (see manual back cover) for information relative to warranty claims.

2-9. Laser Tube Shipment

NOTE

The laser tube assembly MUST be shipped in an approved HP container.

2-10. The laser tube assembly (05517-60301) should only be shipped in an HP container designed for that purpose. In addition, the container must indicate that the laser tube contains magnetic material. If it is necessary to ship a laser tube, contact your nearest HP Sales and Service Office for an approved container.

2-11. Tagging for Service

2-12. If the instrument is being returned to Hewlett-Packard for service, please complete one of the blue repair tags located at the end of this section and attach it to the instrument.

2-13. Packaging for Reshipment

1. Original Packaging

   a. The same containers and materials used in factory packaging can be obtained through Hewlett-Packard Sales and Service Offices listed at the rear of this manual.

   b. If the HP 10791A/B/C is being returned to Hewlett-Packard for service, attach a tag indicating the type of service required, return address, and model number. Mark the container FRAGILE to assure careful handling.

   c. In any correspondence refer to the equipment by model number.

2. Other Packaging Methods

   a. If it becomes necessary to reship equipment, good commercial packing should be used. Contract packaging companies can provide dependable custom packaging on short notice. The following general instructions should be followed when repackaging with commercially available materials.

   b. If shipping to a Hewlett-Packard Service Office or Center, attach a tag indicating the type of service required, return address, and model number.

   c. Wrap the equipment in heavy paper or plastic.

   d. Use a strong shipping container. A double-wall carton made of 350 pound test material is adequate.

   e. Use enough shock-absorbing material (three to four inch layer) around all sides of the equipment to provide a firm cushion and prevent movement inside the container.

   f. Seal the shipping container securely.

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

2-14. INSTALLATION

2-15. The following paragraphs provide installation information for the HP 5517A Laser Head and the 10791A/B/C Power Supply/Reference Signal Cable including system cabling, grounding considerations, power supply requirements, power dissipation, fusing, and mounting and fixturing.

2-16. System Cabling

2-17. The HP 5517A Laser Head is designed for use with the HP 5501A Laser Transducer System. The 10791A/B/C Power Supply/Reference Signal Cable (Figure 2-1) is available for system interconnection. For a complete description of the HP 5501A system, refer to the HP 5501A Laser Transducer System Manual, HP Part Number 05501-90028. Section III of this manual covers operation of the HP 5517A in an HP 5501A system and includes operation and programming information to supplement that given in the system manual.

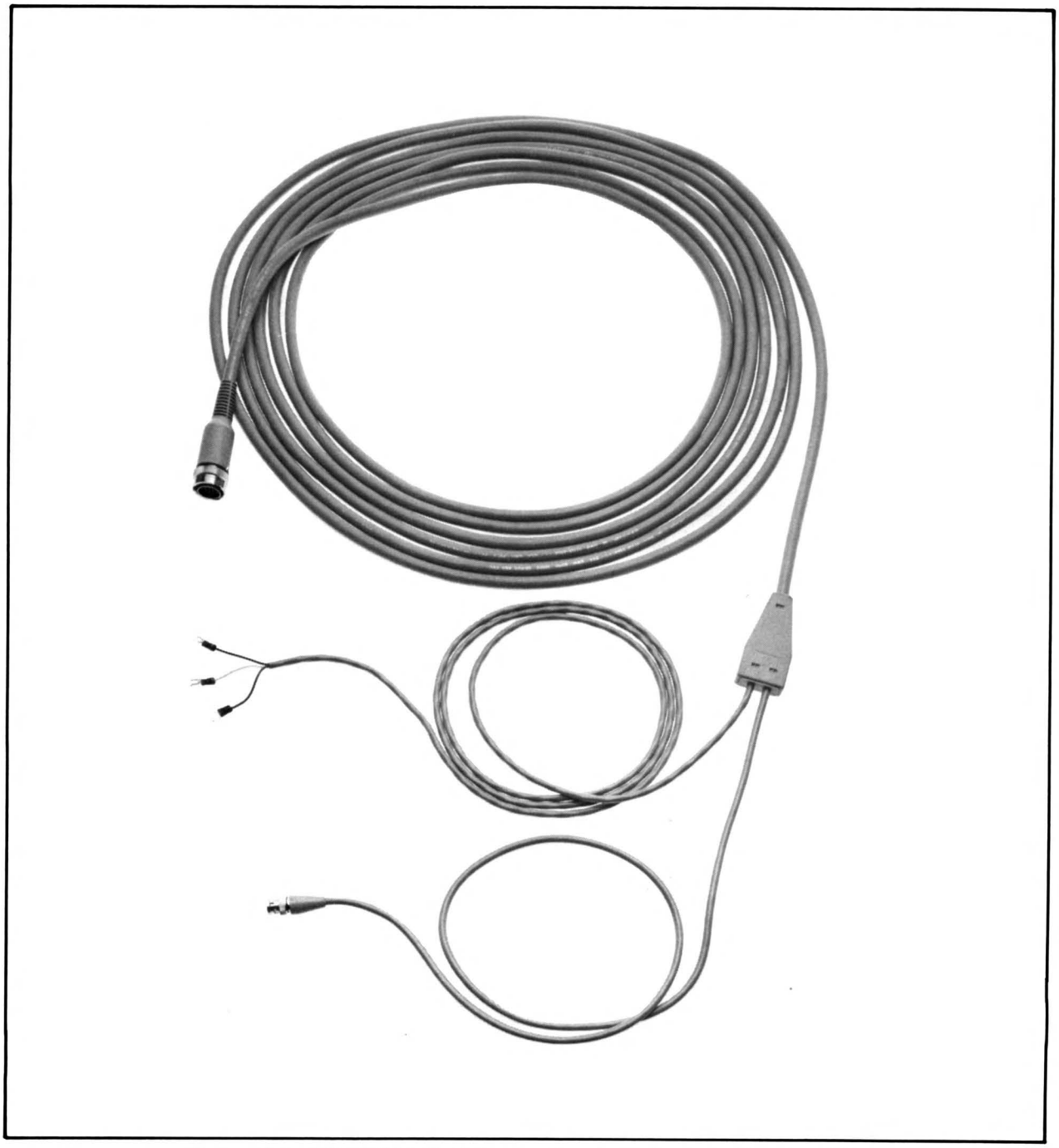


Figure 2-1. HP 10791A/B/C Power Supply/Reference Signal Cable

2-18. The difference between the A, B, and C cables is the length. The A version is 3 metres, the B version is 7 metres, and the C version is 20 metres.

2-19. The HP logo on the cable is aligned with the connector key so that when the logo is oriented upward, the cable connector key will align properly with the 5517A rear panel connector. *Figure 2-2* shows how to interconnect the 5517A to the system power supply and the HP 10760A Counter. *Figure 2-3* shows how to interconnect the 5517A to the system power supply and the HP 10764A/B/C Fast Pulse Converter. *Figure 2-4* shows how to interconnect the 5517A to the system power supply and the 10781A Pulse Converter. Be sure to observe the current and grounding requirements described below. *Figure 2-5* shows the wiring diagram for the 10791A/B/C Cable.

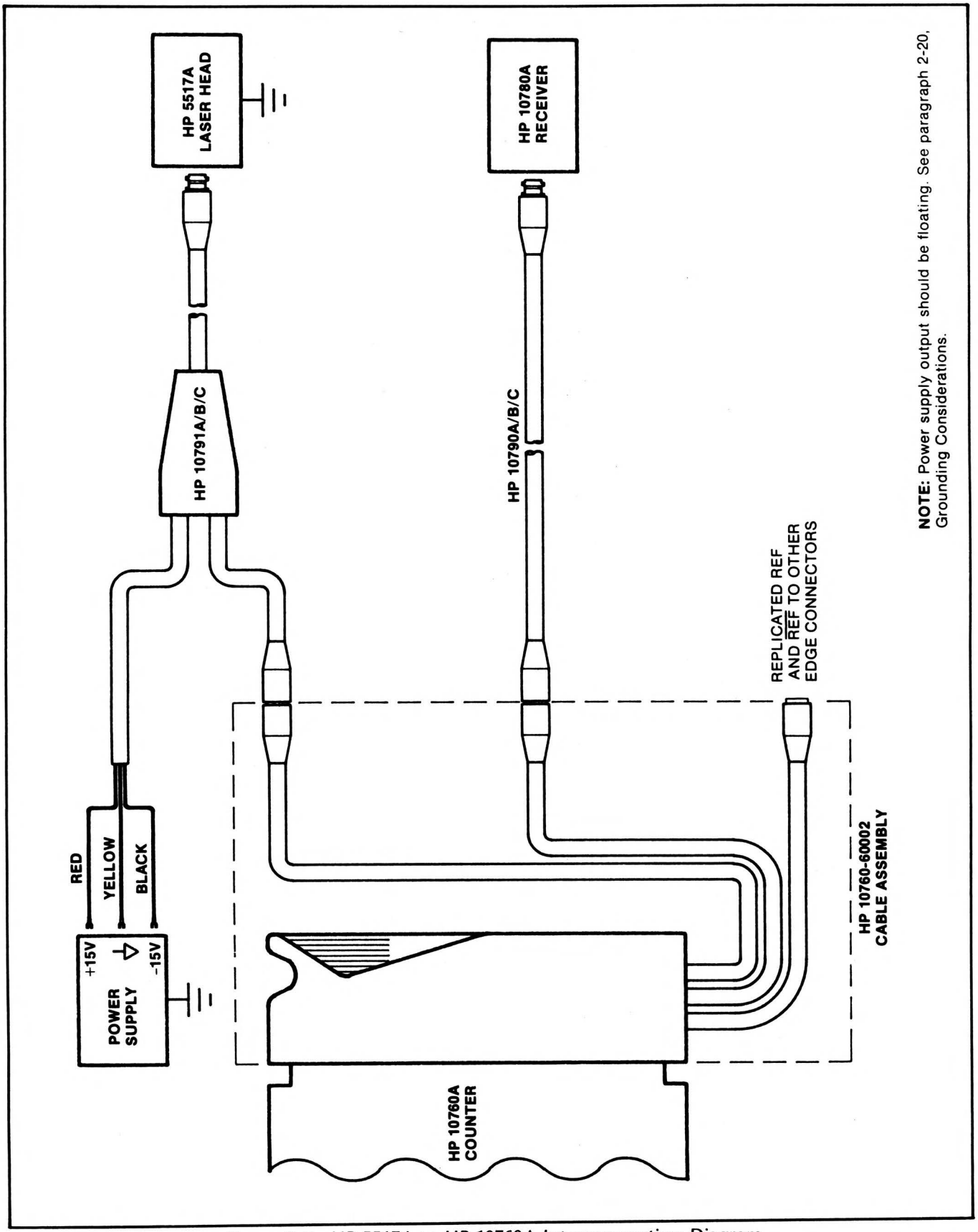


Figure 2-2. HP 5517A to HP 10760A Interconnection Diagram

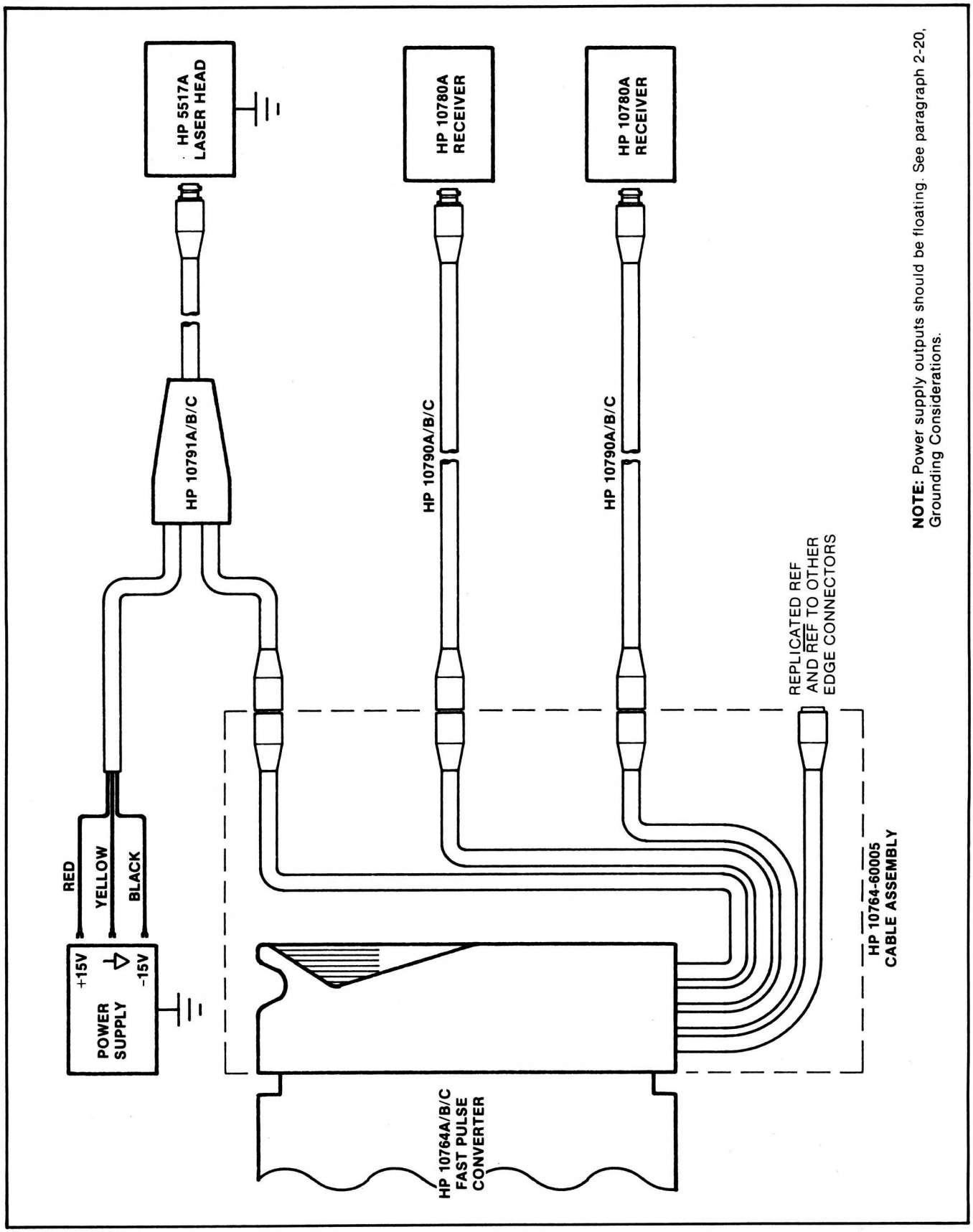


Figure 2-3. HP 5517A to HP 10764A/B/C Interconnection Diagram

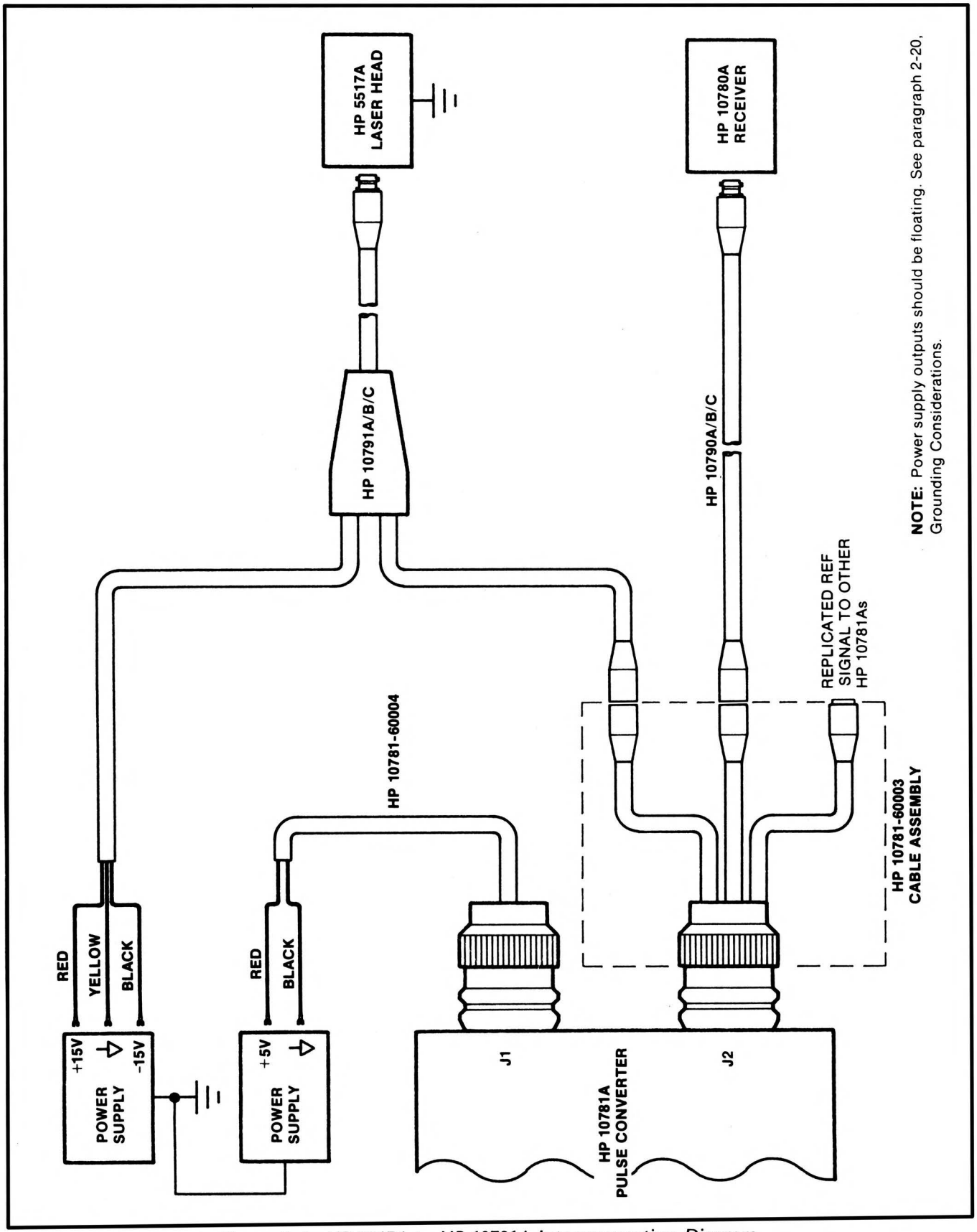


Figure 2-4. HP 5517A to HP 10781A Interconnection Diagram

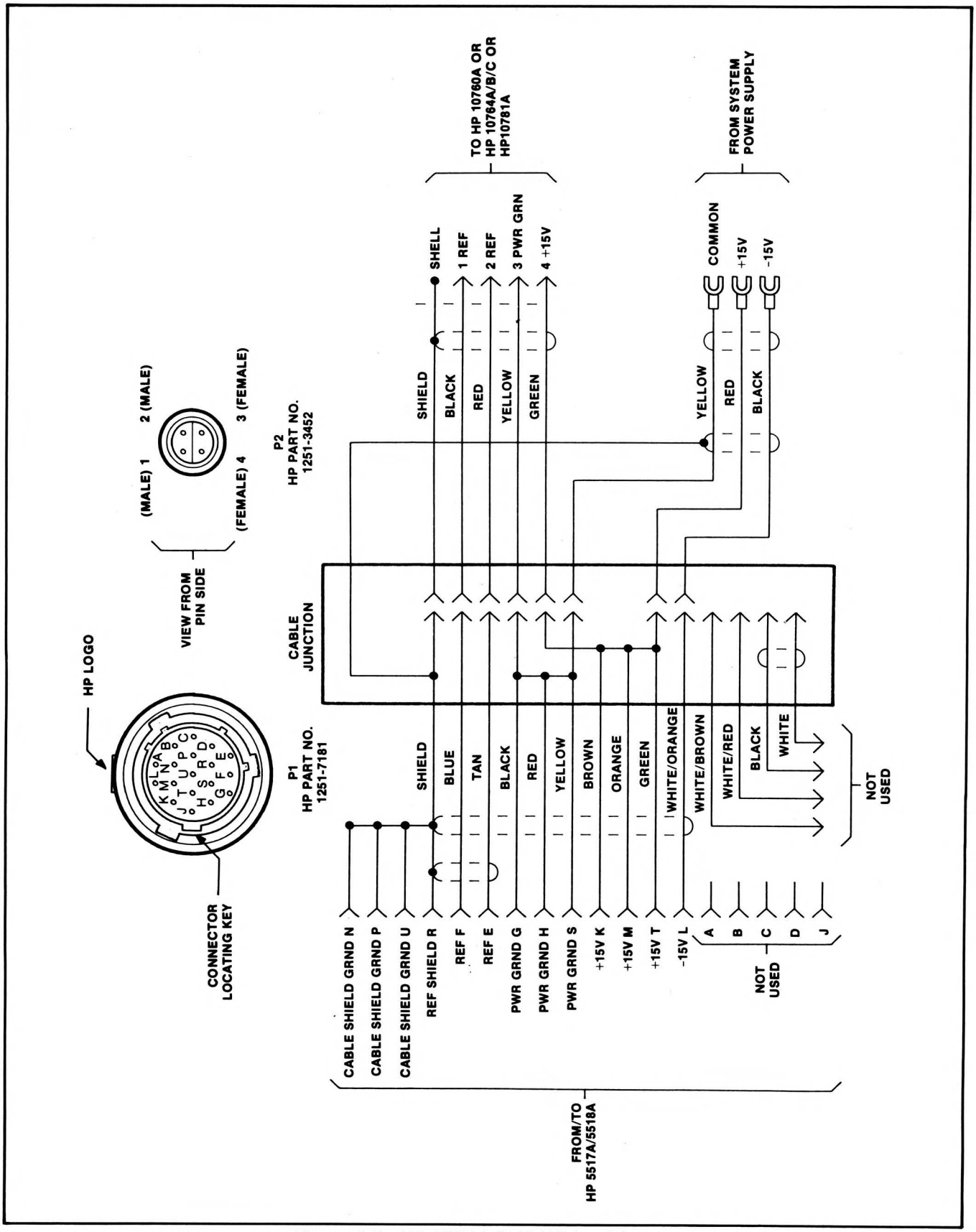


Figure 2-5. HP 10791A/B/C Wiring Diagram

2-20. Grounding Considerations

2-21. The laser transducer system can be connected to earth ground through the HP 5517A base for proper system grounding (cable shielding and operator safety). Also to avoid ground loops, the laser head base should be the only connection to earth ground. To accomplish this, the outputs of the ±15 Volt Power Supplies used to power the laser should be floating. The +5 Volt Power Supply output required for either the 10740A based electronics or 10781A Pulse Converters, should also be floating. Alternatively, any other single point earth ground connection can be used to satisfy grounding requirements.

2-22. Power Supply Requirements

2-23. *Table 2-1* lists the supply voltages, currents, and tolerances required by the HP 5517A Laser Head. Note that other components of the system also use ±15 Volts (see the current requirements on page 1-15 of the HP 5501A Laser Transducer System Manual). Add these to the laser head current requirements to obtain the overall system requirements.

Table 2-1. HP 5517A Power Supply Requirements

Supply Voltage	Tolerance	Current Requirement
+15 Volts	±0.3 Volts	2.5 Amperes peak during warmup 1.5 Amperes peak after warmup 3.5 Amperes peak surge for approximately 2 milliseconds at power-up
-15 Volts	±0.3 Volts	0.02 Amperes
Line Regulation	0.01%	
Load Regulation	0.01%	
Ripple + Noise	60 millivolts peak to peak	
Isolated Output		
Over Voltage Protection		
Under Voltage Protection (current limited)		

2-24. Power Dissipation

2-25. The HP 5517A dissipates approximately 23 watts during operation. During the warm-up period, the power dissapation varies with a peak power requirement of approximately 38 watts.

2-26. Fusing

2-27. The HP 5517A has an internal 1 ampere fuse to protect the +15V line from failures of the High Voltage Power Supply located inside the Laser Head.

2-28. Dimensions

2-29. *Figure 2-6* shows the HP 5517A Laser Head dimensions.

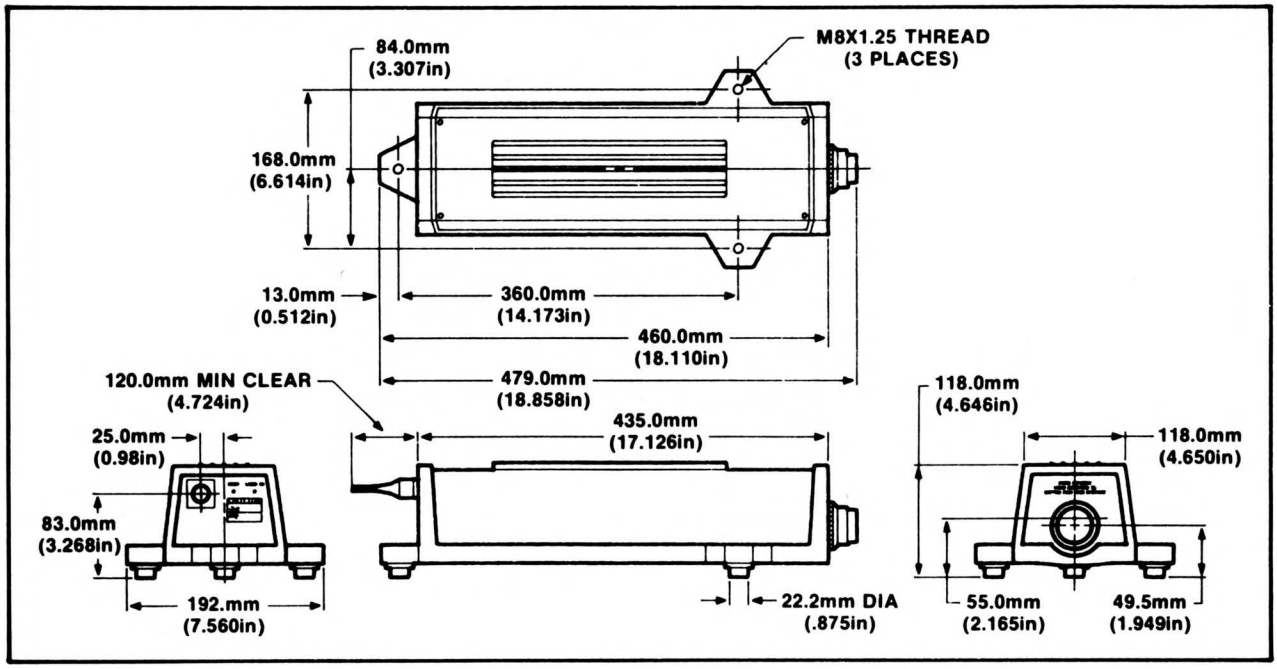


Figure 2-6. HP 5517A Laser Head Dimensions

2-30. Mounting and Fixturing

2-31. Heat Flow Considerations. The laser tuning technique of the 5517A requires efficient heat exchange with the ambient. Heat flow is primarily through the laser assembly heat sink which extends through the cover assembly. When the 5517A is mounted horizontally and forced air circulation is not available or is not desirable, the recommended orientation is that which has the heat sink surface facing up.

2-32. In cases where vertical mounting of the 5517A is desired, care should be taken to prevent laser beam disturbances due to air turbulence caused by the 5517A heat exchange. It is most important to prevent differential effects which can occur due to turbulence in a beam path between a polarizing beam splitter and a retroreflector or plane mirror. Differential turbulence causes fluctuations in the optical path length difference that is being measured. Both differential and common mode turbulence can cause fluctuations in alignment by bending the light beam. Common mode turbulence is turbulence that is present in the beam path between the 5517A and a polarizing beam splitter. In either case some amount of noise can be present in the interferometer measurement due to turbulence.

2-33. If interferometer components (optics) are mounted very close to the 5517A such that the operating temperature of the optic is effected, it is recommended that alignment and operation of the interferometer be performed after the 5517A has been running for a sufficient period of time to allow thermal equilibrium to be established. In well ventilated installations, one hour of running time should be sufficient. When enclosures are used and the ambient temperature is changed by several degrees (centigrade) by the 5517A, thermal equilibrium is not established as quickly and the laser should be run for a longer period of time.

2-34. Mounting Hardware. Three machine screws, HP Part Number 0515-0798, are provided that allow mounting the laser on a mounting plate or bulkhead provided by the user. For measurement axis alignment purposes it is recommended that slotted holes be provided in the mounting plate. If temperature changes can occur which may introduce stress due to different coefficients of expansion of the cast aluminum laser base and the mounting plate, kinematic fixturing of the rear mounting foot is recommended.

2-35. Alignment of Measurement Axes. For information required to align measurement axes and to install the various interferometer components available for use with the 5517A, consult Section II of the HP 5501A Laser Transducer System Manual. The system manual provides accuracy considerations, alignment procedures and mounting recommendations for all transducer measurements.

2-36. Pointing Stability. The angle at which the laser beam exits the 5517A can change by up to 60 arc seconds (30 arc seconds typical) from turn-on through the time when the 5517A and its surroundings reach thermal equilibrum.

2-37. The 5517A should not be exposed to ambient temperature changes greater than ±5°C during operation to keep pointing stability variations to within a few arc seconds during interferometer measurements.

2-38. OPERATIONAL VERIFICATION CHECK

2-39. Refer to Section IV, Performance Tests and Calibration.

2-40. OPERATING ENVIRONMENT

Temperature (Operating): 0 to 40°C (32 to 140°F)

Relative Humidity (Operating):0 to 95% Non-condensing

Vibration: The 5517A Laser Head has been tested to withstand 0.25 mm (0.010 inch) peak-to-peak excursion at 10 to 55 Hz for 15 minutes and 30 g shock for 11 milliseconds on each of the orthogonal axes.

2-41. STORAGE

2-42. Environment

2-43. The instrument can be stored or shipped in environments within the following limits:

Temperature	−40 to 75°C (−40 to 167°F)
Altitude	15,240 metres (50,000 feet)

2-44. The instrument should also be protected from temperature extremes which could cause condensation within the instrument.

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section provides operating information for the 5517A Laser Head. Included are operation features of the instruments front and rear panel controls and connectors and Operator's maintenance. Also provided is supplemental operating information for HP 5501A Laser Transducer Systems equipped with HP 5517A Laser Heads. Included are operating instructions and programming notes to supplement those given in the HP 5501A Laser Transducer System Manual, HP Part Number 05501-90028.

3-3. Installation instructions for the HP 5517A Laser Head and the HP 10791A/B/C Power Supply/Reference Signal Cable are given in Section II of this manual.

3-4. 5517A LASER HEAD, FRONT PANEL CONTROLS

3-5. Following are descriptions of the 5517A front panel features shown in *Figure 3-1.*

Figure 3-1. 5517A Front Panel Controls

1

TURRET Shutter. A shutter is located behind the aperture in the turret. Three positions can be selected, open, reduced, and closed. The open aperture position is used during normal operation and the reduced aperture is used during alignment of measurement axes.

3-6. 5517A LASER HEAD, REAR PANEL INDICATORS AND CONNECTORS

3-7. Following are descriptions of the 5517A rear panel features shown in *Figure 3-2.*

Figure 3-2. 5517A Laser Head, Rear Panel Connectors and Indicators

2

LASER ON Indicator. An amber indicator installed to alert the operator that the 5517A Laser Head is activated and emitting a laser beam. Electrically, this indicator monitors the +15 Volt supply line.

3

READY Indicator. About half way through the laser warm-up period, this indicator will blink on and off to indicate that the laser is in the process of warming up. When the 5517A is ready for use, the LED assumes a steady on condition.

4

J2 Connector. An 18-pin connector used to connect the 5517A Laser Head to the transducer electronics and power. Use interconnecting cable HP Model 10791A/B/C. See Section II for interconnection details.

3-8. WARMUP TIME

3-9. When power is applied to the HP 5517A, an internal state machine resets the laser head to a warmup mode. This mode is used to establish the initial operating temperature of a glass rod that controls the laser cavity length. When this temperature is reached, the state machine switches to an optical tuning mode. Upon successful switching from warmup to optical mode, the laser head enables the REFERENCE signal and lights a READY LED indicator on the rear panel to indicate that the laser head is ready for use.

3-10. Warmup Time Operating Notes

- Allow a full 10 minute warmup period for the HP 5517A.
- Warmup completion is indicated by the READY LED on the HP 5517A rear panel.
- If warmup is not complete after 10 minutes, a failure may be indicated.
- If the READY indication at the laser head is not convenient to use because of the mounting scheme, try the alternate monitoring suggestions that follow.

3-11. HP 10740A Coupler Based Systems — Manual Monitoring

- The REFERENCE and MEASUREMENT signals terminate at either the HP 10760A Counter Card or the HP 10764A/B/C Fast Pulse Converter Card.
- Each of these cards includes an LED to monitor the presence of the REFERENCE and MEASUREMENT signals.
- The REFERENCE LED will be extinguished until the HP 5517A is ready for use.

HOWEVER, FOR SYSTEMS WITH MULTIPLE HP 10760A CARDS

- Every ODD HP 10760A that uses the replicated REF and $\overline{\text{REF}}$ will have their REFERENCE LED lit during the laser head warmup period. (This is due to inversion in the replication circuitry.) Note that this does not apply to multiple HP 10764A/B/C card installations.
- The MEASUREMENT LED will momentarily light several times during the laser head warmup period provided that the HP 10780A Receiver is aligned properly with the beam. (This occurs because the laser periodically produces functional optical frequencies during warmup.)

NOTE

The above monitoring scheme assumes no reversal of the REF and $\overline{\text{REF}}$ lines in the cabling.

3-12. Systems with HP 10745A or HP 10746A Cards — Automatic Monitoring

3-13. Systems with these cards can use the system computer and software to monitor the laser head warmup. Before describing the software, it will be helpful to examine some background information on the HP 10740A Coupler, HP 10745A HP-IB Interface, and HP 10746A Binary Interface.

3-14. HP 10740A Coupler — Error Signal Information

- Four error signal lines are provided on the HP 10740A Backplane:
  - REFERENCE ERROR BIT
  - MEASUREMENT ERROR BIT
  - V.O.L. ERROR BIT
  - OVFL BIT

3-15. HP 10746A Error Signal Processing

- If any of the 10740A backplane error bits are true, the four most significant bits of the most significant word in a data transfer from the HP 10746A to the host computer will be all ones. These four bits are normally the decimal point bits.

- Errors are not the only condition that can set these bits to all ones. When the difference output of an addressed HP 10762A is within tolerance, these bits will also be set.

- After detecting all ones, the host computer must check the next four MSB's to differentiate between an error condition and the within tolerence condition.

- If the tolerence condition is true, these next four bits will also be all ones. Otherwise, each of these bits corresponds to one of the backplane error bits.

3-16. HP 10745A Background Information

- When a backplane error bit is true, the HP 10745A asserts SRQ. The STATUS BYTE of the HP 10745A can be read to determine the source of SRQ. In the STATUS BYTE, bit 0 corresponds to the REFERENCE ERROR-BIT.

3-17. Program Modifications

3-18. To monitor warmup time, the following program modifications can be added to the example programs contained in *Tables 4-12* and *4-13* of the HP 5501A Laser Transducer Operating and Service Manual, HP Part Number 5501-90028. If desired, some form of time-out algorithm can be added to check if the HP 5517A warms up within 10 minutes.

3-19. *Table 3-1* shows the program steps used to modify *Table 4-12* in the HP 5501A System Manual. The program uses the HP 10760A x-axis card to monitor the laser warmup.

3-20. *Table 3-2* shows the program steps used to modify *Table 4-13* in the System Manual. The program is for a 2-axis system with the HP 10746A in 16 bit mode and using positive true logic. The program uses the x-axis card to monitor the laser warmup.

3-21. *Tables 3-3, 3-4,* and *3-5* are complete listings of the modified versions of *Tables 4-12* and *4-13.*

Table 3-1. Program Modifications for Table 4-12 in the HP 5501A System Manual

```
 0: gsb "warmup"

38: "warmup":clr
  7;rem 7

39: wrt 709,"000
 X"

40: wrt 709,"1X2
 X30"

41: if rds(7)<12
 8;ret

42: rds(709)→B

43: if B<64;gto
 "bus error"

44: B-112→B

45: if B>=8;B-
 8→B

46: if B>=4;B-
 4→B
47: if B>=2;B-
 2→B

48: if B=1;dsp
 "LASER NOT READ
 Y"

49: if B=1;gto -
 11

50: gsb "check"

51: ret

52: "bus error":

53: prt "SRQ
 ASSERTED BUT
 10745A STATUS
 BYTE,BIT6 CLEAR
 "
54: stp

55: gto 0

56: end
```

Branch to subroutine to monitor laser status

Send Device Clear; Send Remote Enable

Send 10740A Backplane Reset, preset x-axis counter and select normal resolution

Transfer x-axis counter (10760A) contents, including error bits, to 10745A

If SRQ false; $\overline{\text{REFERENCE ERROR BIT}}$ must be false; laser ready

Read 10745A STATUS BYTE to verify that it is asserting SRQ

If 10745A not asserting SRQ; alert operator

Isolate $\overline{\text{REFERENCE ERROR BIT}}$

If true; 5517A not READY

Try again

Otherwise, use subroutine "check" to identify remaining error

Return to step one if only $\overline{\text{OVF ERROR}}$ true

Alert operator that SRQ asserted by other device

Return to step 0 if CONTINUE pressed

Table 3-2. Program Modifications for Table 4-13 in the HP 5501A System Manual

`0: gsb "warmup"`	**Branch to warmup subroutine monitor laser status**
`66: "warmup":wtb 2,0,0,0`	**System reset — 10746A 16 bit mode**
`67: wtb 2,1,130, 3`	**1 = simultaneous sample 130 = transfer X Comparator Counter contents to 10746A 3 = prepare for output to host computer**
`68: rdb(2)→B;if B<0;65536+B→B`	**Read first word**
`69: if B<61440; ret`	**If 4 MSB's are clear, 5517A is READY**

`70: int(B/256)- 240→B;15-B→B`
`71: if B>=8;B- 8→B`
`72: if B>=4;B- 4→B`
	Otherwise isolate $\overline{\text{REFERENCE ERROR BIT}}$

`73: if B>=2;dsp "LASER NOT READ Y"`	
`74: if B>=2;sto -8`	**If $\overline{\text{REFERENCE ERROR BIT}}$ true, try again**
`75: wtb 2,1,130, 3`	**Abort transfer and set-up new transfer in order to read first word again.**
`76: rdb(2)→B;if B<0;65536+B→B`	**Use subroutine "er" to identify remaining error**
`77: gsb "er"`	
`78: ret`	**Return to program step 1 if only $\overline{\text{OVL ERROR BIT}}$ true**
`79: end`	

Table 3-3. Modified HP 10745A HP-IB Interface Program
(Replaces Table 4-12 in the HP 5501A System Manual)

```
0: gsb "warmup"
1: wrt 709,"006X"
2: wrt 709,"2V30"
3: red 709,C
4: 0)E
5: "loop":E+1)E;if E=10;gto -3
6: wrt 709,"102X30"
7: red 709,X
8: if rds(7)<128;gto +2
9: 0)A;gsb "status"
10: (X-16)*6.23023e-6*C)X
11: fmt 1,f12.6
12: dsp X
13: gto "loop"
14: "status":rds(709))B
15: if B>=64;gsb "check"
16: wrt 709,"0P"
17: ret
18: "check":B-112)B
19: if B>=8;gsb "ovf"
20: if B>=4;prt "VOL OUT OF RANGE";B-4)B;0)D
21: if B>=2;prt "MEAS ERROR";B-2)B;0)D
22: if B=1;prt "REF ERROR";0)D
23: if D=1;ret
24: if A=0;prt "X-AXIS ERROR"
25: if A=1;prt "Y-AXIS ERROR"
26: dsp "GO TO GAGE";stp
27: gto 0
28: "ovf":B-8)B;1)D
29: if A=0;X-2^28/10)X
30: if A=1;Y-2^28)Y
31: ret
32: "warmup":clr 7;rem 7
33: wrt 709,"000X"
34: wrt 709,"1X2X30"
35: if rds(7)<128;ret
36: rds(709))B
37: if B<64;gto "bus error"
38: B-112)B
39: if B>=8;B-8)B
40: if B>=4;B-4)B
41: if B>=2;B-2)B
42: if B=1;dsp "LASER NOT READY"
43: if B=1;gto -11
44: gsb "check"
45: ret
46: "bus error":
47: prt "SRQ ASSERTED BUT 10745A STATUS BYTE,BIT6 CLEAR"
48: stp
49: gto 0
50: end
```

Table 3-4. Modified HP 10746A Binary Interface Program
(Replaces Table 4-13 in the HP 5501A System Manual)

```
0: gsb "warmup"
1: wtb 2,0,0,0,98,3
2: gsb "in"
3: B)C
4: ent "X TOLERANCE IN MICRONS?",r1
5: ent "Y TOLERANCE IN MICRONS?",r2
6: "newdest":0)X;ent "X DESTINATION IN MM?",X
7: 0)Y;ent "Y DESTINATION IN MM?",Y
8: "comp":wtb 2,98,3
9: gsb "in"
10: B)C
11: X)A;gsb "cnv"
12: A)X
13: Y)A;gsb "cnv"
14: A)Y
15: int(r1/1.58248e-1)*2^28+X)A
16: gsb "out"
17: wtb 2,131
18: int(r2/1.58248e-1)*2^28+Y)A
19: gsb "out"
20: wtb 2,147
21: "newsample":wtb 2,1,130,3
22: 0)F
23: gsb "in"
24: B)r3
25: wtb 2,146,3
26: 1)F
27: gsb "in"
28: B)r4
29: fmt 1,2f10.0,f10.7
30: wrt .1,r3-160,r4-160,C
31: if abs(X-r3)<=r1/(.158*C) and abs(Y-r4)<=r2/(.158*C);gto "newdest"
32: gto "newsample"
33: "in":rdb(2))B;if B<0;65536+B)B
34: if B>=61440;gto "er"
35: rdb(2))G;if G<0;65536+G)G
36: int(B/4096))D
37: B-4096*D)B
38: (65536*B+G)*tn^(2-D))B;ret
39: "cnv":A/(1.58248e-4*C)+160)A;ret
40: "out":wtb 2,4
41: int(A/65536))B;if B>32767;B-65536)B
42: wtb 2,B
43: A-65536*int(A/65536))B;if B>32767;B-65536)B
44: wtb 2,B
45: ret
46: "er":int(B/256)-240)B;15-B)B
47: if B>=8;prt "vol error";B-8)B;0)D
48: if B>=4;B-4)B;1)D
49: if B>=2;prt "ref error";0)D
50: if B=1;prt "meas error";0)D
51: if D=0;gto "prterr"
52: rdb(2))B
```

Table 3-4. Modified HP 10746A Binary Interface Program
(Replaces Table 4-13 n the HP 5501A System Manual) (Continued)

```
53: wtb 2,240,3
54: rdb(2)>B;if B<0;65536+B>B
55: rdb(2)>G;if G<0;65536+G>G
56: int(B/4096)>D
57: B-4096*D>B
58: (65536*B+G)*tn^(2-D)>B
59: if F=0 and B-160#0;B-2^28>B
60: if F=1 and B-160#0;B-2^28>B
61: ret
62: "prterr":if F=0;prt "X-AXIS ERROR"
63: if F=1;prt "Y-AXIS ERROR"
64: dsp "GO TO GAGE";stp
65: gto 0
66: "warmup":wtb 2,0,0,0
67: wtb 2,1,130,3
68: rdb(2)>B;if B<0;65536+B>B
69: if B<61440;ret
70: int(B/256)-240>B;15-B>B
71: if B>=8;B-8>B
72: if B>=4;B-4>B
73: if B>=2;dsp "LASER NOT READY"
74: if B>=2;gto -8
75: wtb 2,1,130,3
76: rdb(2)>B;if B<0;65536+B>B
77: gsb "er"
78: ret
79: end
```

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. This section contains a performance test for the 5517A Laser Head. A test record is included to record test results for future comparison.

4-3. RECOMMENDED TEST EQUIPMENT

4-4. Test equipment required for the performance test is included in the procedure. Detailed critical specifications for the required test equipment are contained in *Table 1-2,* Recommended Test Equipment. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

4-5. TEST RECORD

4-6. Results of the performance test may be tabulated on the test record at the end of these procedures.

4-7. 5517A PERFORMANCE TEST

4-8. The 5517A performance test consists of measuring the laser power output.

4-9. Laser Power Output Test

4-10. Test Equipment Required. The following test equipment is required to test the laser output power.

Laser Power Meter, United Detector Technology Model No. 351L

4-11. Procedure

a. Connect the 5517A to the 5501A system using Interconnect Cable 10791A/B/C as shown in *Figure 4-1.*

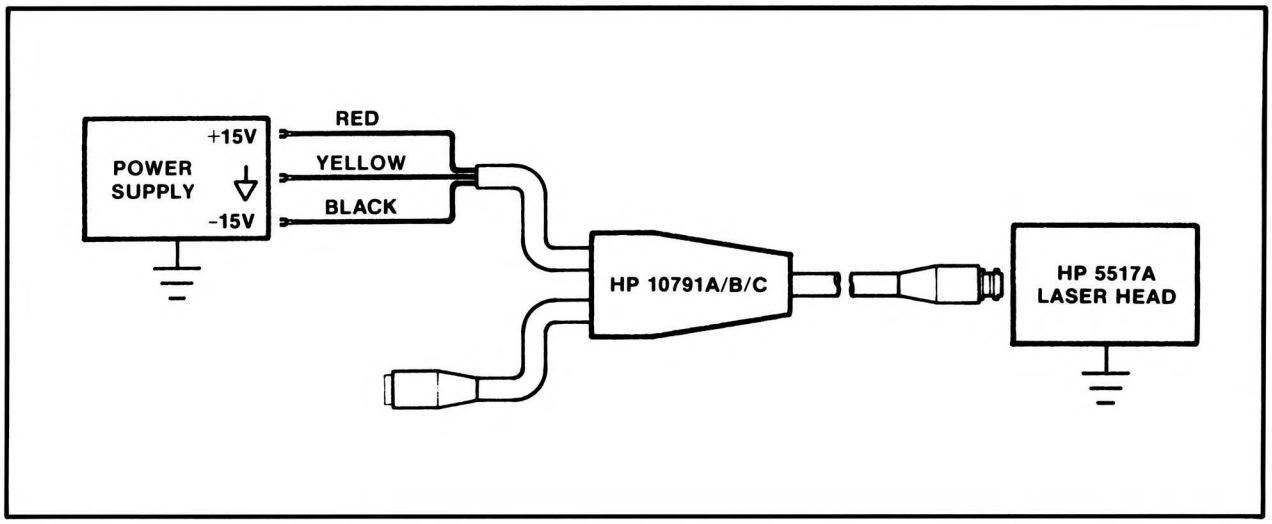


Figure 4-1. 5517A Power Connections

b. On the 5517A, set the exit shutter of the turret assembly to its open aperture position.

c. Turn the ±15 Volt Power Supply on and wait until the READY indicator is on, not blinking. This should occur less than 10 minutes after power is applied.

d. Using the Laser Power Meter, align the power meter detector for maximum reading.

e. If the laser power output is less than 120 microwatts, perform the laser tube current adjustment procedure in Section V.

Table 4-1. Test Record

Test or Calibration	Date/Entry	Date/Entry
1. 5517A Laser Power Output Test	_____	_____

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section describes adjustments and checks required to return the 5517A Laser Head to peak operating capabilities when repairs have been made. Included in this section are test equipment required, equipment setups and procedures to perform the adjustments.

5-3. SAFETY CONSIDERATIONS

5-4. The following warnings contain information that must be understood for your safety.

WARNING

FROM 1.8 KILOVOLTS TO 12 KILOVOLTS DC IS PRESENT ON THE ANODE OF THE LASER TUBE IN THE 5517A. EXERCISE EXTREME CAUTION WHEN WORKING INSIDE THE INSTRUMENT. THE HIGH VOLTAGE COULD CAUSE SERIOUS PERSONAL INJURY IF CONTACTED. THE FOLLOWING ADJUSTMENTS SHOULD BE PERFORMED BY SERVICE-TRAINED PERSONNEL.

NOTE

The High Voltage Power Supply, A5, is defeated automatically by A1S2, when the 5517A cover is removed. For Adjustments and Servicing purposes, the High Voltage Supply can be re-enabled by setting the TEST-NORM switch, A1S1, to TEST after the 5517A cover is removed.

WARNING

LASER RADIATION IS ACCESSIBLE WHEN THE 5517A COVER IS REMOVED AND THE TEST-NORM SWITCH, A1S1, IS IN THE TEST POSITION.

5-5. RECOMMENDED TEST EQUIPMENT

5-6. Test equipment required for each adjustment is included in the adjustment procedure. Detailed critical specifications for the required test equipment are contained in *Table 1- 2*. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

5-7. FACTORY SELECTED COMPONENTS

5-8. As of the publication date on the title page of this manual there are no factory selected components.

5-9. ADJUSTMENT PROCEDURES

5-10. The following paragraphs contain the adjustment procedures for the Laser Head. A performance test is given in Section IV.

5-11. Reference Temperature Adjustments

5-12. This adjustment sets the laser preheat temperature to 105°C (221°F). The adjustment must be performed at room temperature, 21 to 25°C (69.8 to 77.0°F).

5-13. Test Equipment Required. The reference temperature adjustment requires the following test equipment:

Digital Voltmeter, HP Model 3456A

5-14. Preliminary Procedure

5-15. The adjustment may be made from either a cold start or when power has been applied for some period of time. In either case with power on or off, observe the safety precautions in paragraph 5-3 and proceed as follows:

a. On the Laser Head, remove the 4 pozi-drive screws at each corner of the top cover.

b. Remove the Laser Head top cover by pulling up on each end.

c. At the rear of the Laser Head, on Connector Board A1, check that the NORM-TEST switch is set to NORM. See *Figure 5-1.*

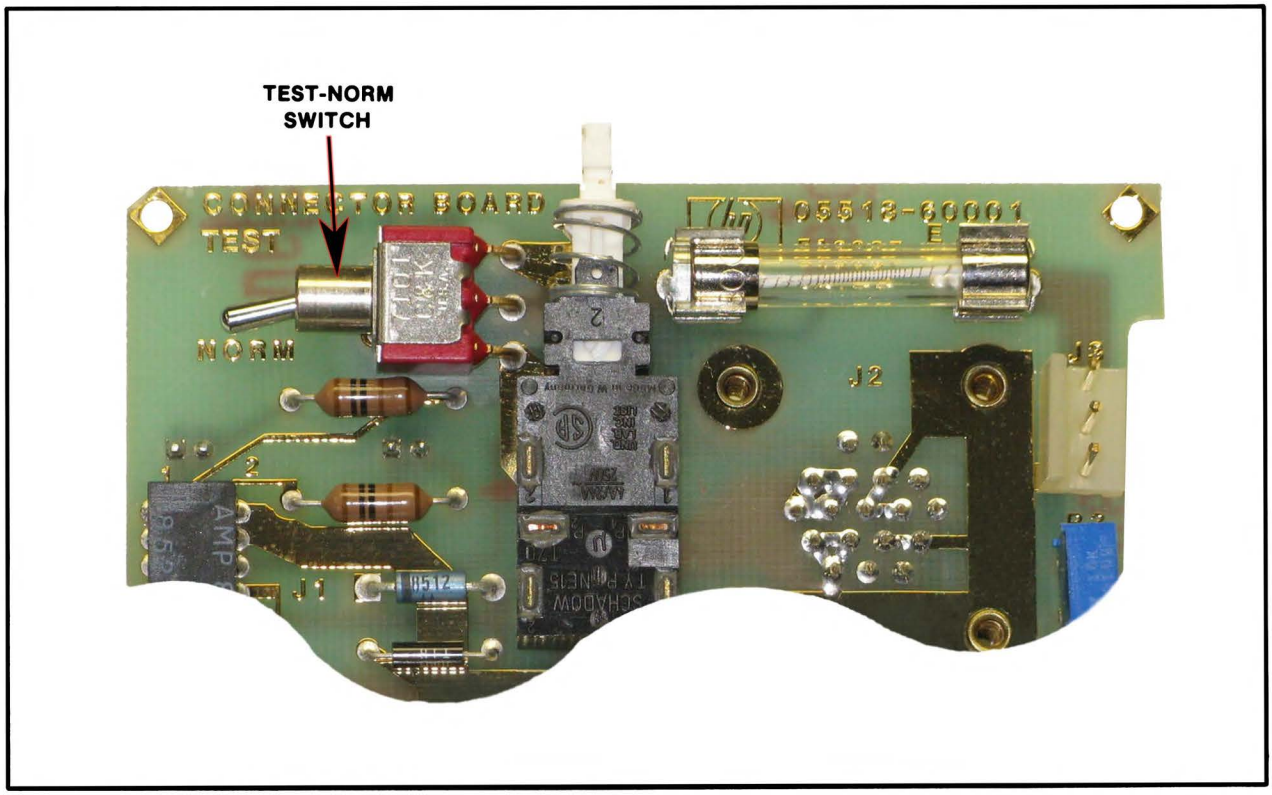


Figure 5-1. 5517A A1 Connector Board, NORM-TEST Switch Location

d. On A3, change the HEATER jumper from NORM to OFF. See *Figure 5-2.*

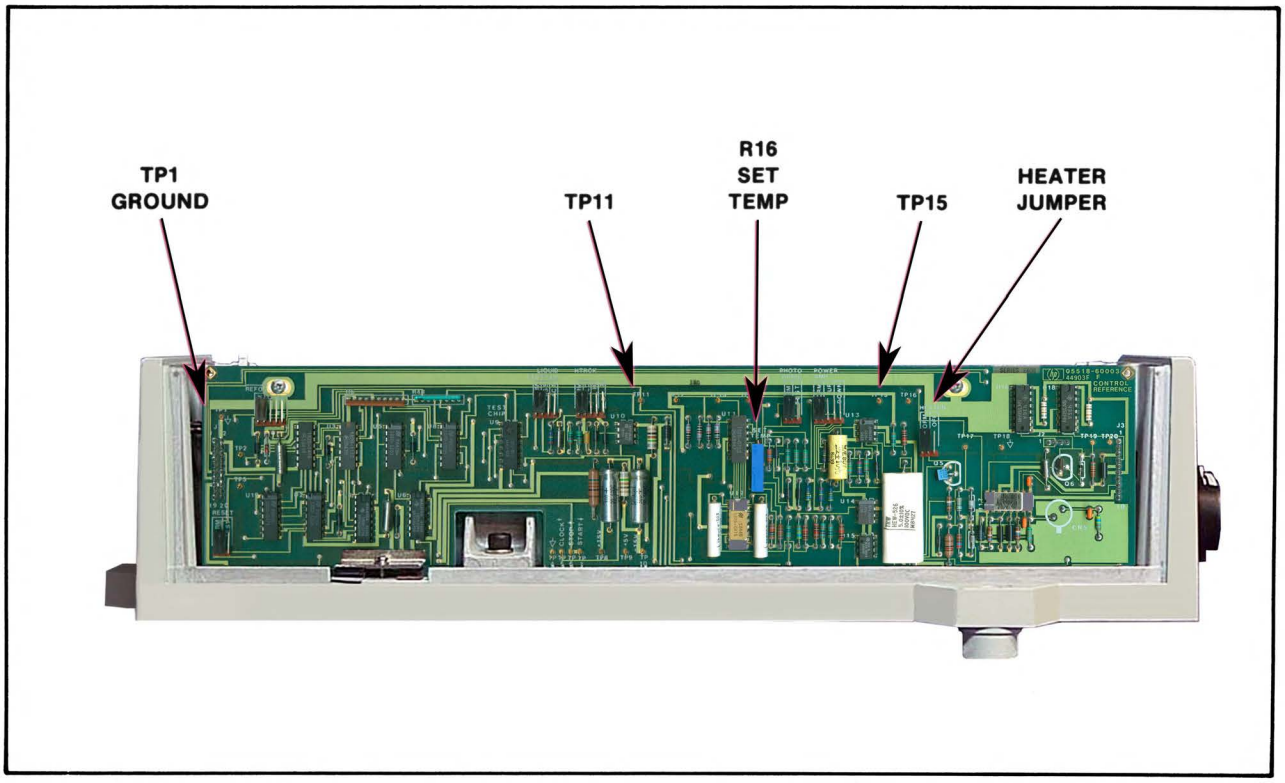


Figure 5-2. 5517A A3 Controller/Ref Board, Jumpers, Test Points, and Adjustment Locations

e. Apply power to the Digital Voltmeter and set its controls to the 1 volt DC range. Connect the positive lead of the Digital Voltmeter to A3TP11, connect the negative lead to A3TP1. See *Figure 5-2.*

f. If primary power has been off for at least 2 hours, apply primary power to the system power supplies and continue with the adjustment procedure in Paragraph 5-16.

If primary power has been off for less than 2 hours, apply primary power to the system power supplies and wait until the Digital Voltmeter reading stabilizes to within 1 millivolt in 10 minutes, then proceed with the adjustment procedure. Stabilization may take up to 2 hours.

5-16. Procedure. To adjust the reference temperature, proceed as follows:

a. Check that the Voltmeter reads between 0.2V and 0.3V. This voltage is V(A3TP11) and must be stable to within ±1 millivolt within a 10 minute period, see step f in the preliminary procedure above.

b. Calculate the heater adjust set point using the following equation: $Vset = 1.285 \times V(A3TP11)$.

c. Connect Digital Voltmeter plus lead to A3TP15. Connect the minus lead to A3TP1. See *Figure 5-2.*

d. Check that the voltage at A3TP15 equals Vset ±1 millivolt as calculated in step b. If not, adjust A3R16 SET TEMP (see *Figure 5-2*).

e. Note and record the SET TEMP voltage in *Table 5-1.*

f. On A3, change the HEATER jumper back to NORM.
Remove the test equipment leads, and re-install the Laser Head cover.

5-17. Laser Tube Current Adjustment

5-18. This procedure adjusts the laser tube current to 3.5 milliamperes ±0.1 milliampere.

5-19. Test Equipment Required. The laser current adjustment requires the following test equipment:

Clip-On DC Milliammeter, HP Model 428B

5-20. Procedure. To adjust the laser tube current, observe the safety precautions in Paragraph 5-4 and proceed as follows:

a. Turn the system power supplies OFF.

b. On the Laser Head, remove the 4 pozi-drive screws at each corner of the top cover.

c. Remove the Laser Head top cover by pulling up on each end.

d. On the A1 Connector Board, set TEST-NORM switch to TEST. See *Figure 5-1.*

e. Set the milliammeter to the 10 milliampere range.

f. Locate the anode lead that connects between the high voltage power supply and the ballast resistor. See *Figure 5-3.* Clip the milliammeter probe to this lead with the arrow on the probe pointing away from the power supply. Keep the probe as far as possible from and perpendicular to the magnet assemblies. It may be necessary to prop up the probe to achieve the perpendicular orientation.

g. On the milliammeter, adjust for zero indication. If zero indication can not be obtained, degauss the probe as directed on the back of the milliammeter.

NOTE

After the zero setting has been made on the milliammeter, do not move the probe, this will effect the zero setting.

h. Apply power to the system power supplies.

i. Adjust A1R3 (*Figure 5-1*) for 3.5 milliamperes ±0.1 milliampere. If the current cannot be adjusted to this value see Laser High Voltage Troubleshooting in Section VIII. If the laser power output as measured according to paragraph 4-9, is not greater than 120 microwatts at this current level, the laser assembly may require replacement.

j. Record the Laser Tube current in *Table 5-1.*

k. Turn off the system power supplies, disconnect the probe, set the TEST-NORM switch to NORM, and re-install the Laser Head cover.

Table 5-1. Adjustment Record

Adjust	Date/Value	Date/Value	Date/Value	Date/Value
Laser Output Power	____/____ uW	____/____ uW	____/____ uW	____/____ uW
Vset	____/____ V	____/____ V	____/____ V	____/____ V
Laser Tube Current	____/____ ma	____/____ ma	____/____ ma	____/____ ma

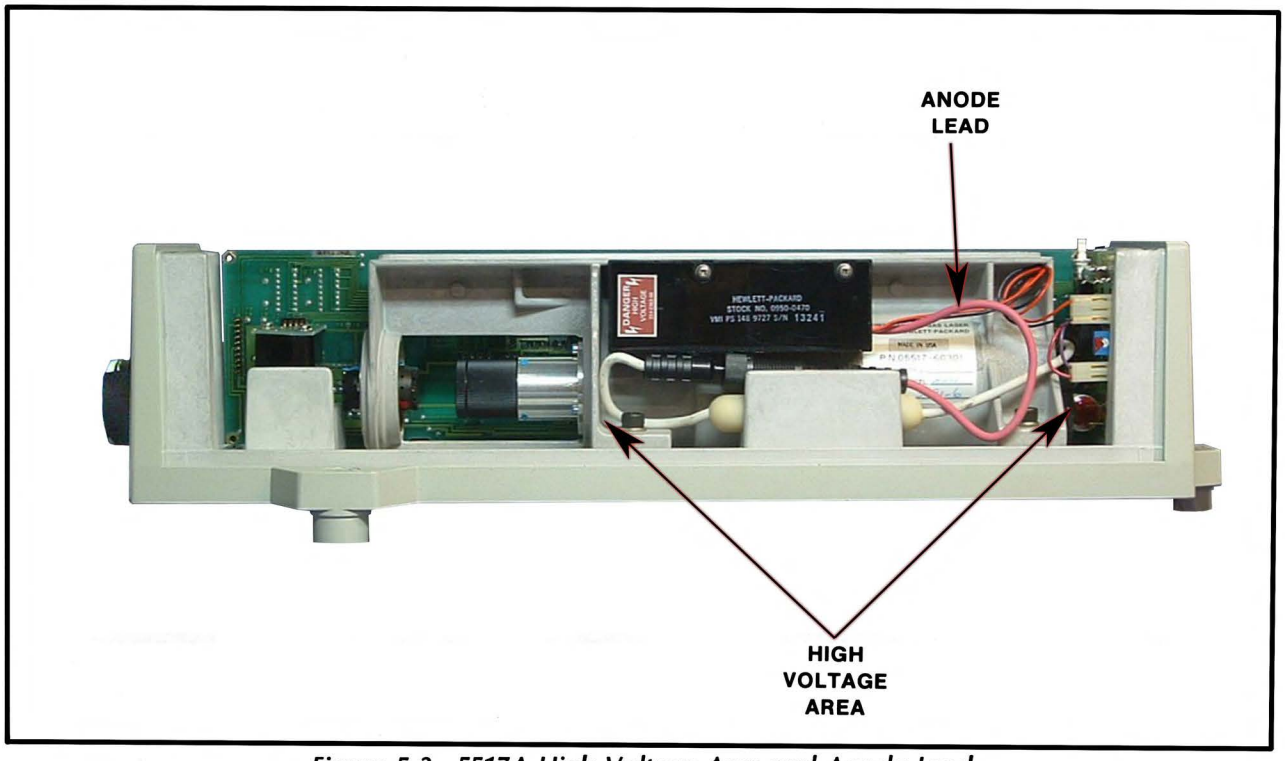


Figure 5-3. 5517A High Voltage Area and Anode Lead

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering replacement parts. Part numbers for replacement parts are provided in either illustrated parts breakdown or tabulated listings depending on the type of part. Purchase Order and Direct Mail Order information are provided in Paragraphs 6-7 through 6-12.

6-3. *Table 6-1* gives abbreviations used in the parts lists and throughout the manual. *Tables 6-2* lists replaceable parts that are mounted on pc board assemblies. *Table 6-3* contains the names and addresses that correspond to the manufactures code numbers given in *Tables 6-2. Figure 6-1* shows illustrated parts breakdowns showing the chassis mounted parts and assemblies for the 5517A.

6-4. ABBREVIATIONS

6-5. *Table 6-2* lists abbreviations used in the parts list, the schematics and throughout the manual. In some cases, two forms of the abbreviations are used, one in all capital letters, and one partial or no capital letters. This occurs because the abbreviations in the parts list are always all capital letters. However, in the schematics and the other parts of the manual, other abbreviation forms are used with both upper and lower case letters.

6-6. ORDERING INFORMATION

6-7. To order a part listed in the replaceable parts tables or figures, quote the Hewlett-Packard part number, indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

6-8. To order a part that is not listed in this section, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

6-9. DIRECT MAIL ORDER SYSTEM

6-10. Within the USA, Hewlett-Packard can supply parts through a direct mail order system. Advantages of using the system are as follows:

a. Direct ordering and shipment from the HP Parts Center in Mountain View, California.

b. No maximum or minimum on any mail order (there is a minimum order amount for parts ordered through a local HP office when the orders require billing and invoicing).

c. Prepaid transportation (there is a small handling charge for each order).

d. No invoices – to provide these advantages, a check or money order must accompany each order.

6-11. Mail order forms and specific ordering information is available through your local HP office. Addresses and phone numbers are located at the back of this manual.

Table 6-1. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

- A = assembly
- AT = attenuator; isolator; termination
- B = fan; motor
- BT = battery
- C = capacitor
- CP = coupler
- CR = diode; diode thyristor; varactor
- DC = directional coupler
- DL = delay line
- DS = annunciator; signaling device (audible or visual); lamp; LED
- E = miscellaneous electrical part
- F = fuse
- FL = filter
- H = hardware
- HY = circulator
- J = electrical connector (stationary portion); jack
- K = relay
- L = coil; inductor
- M = metre
- MP = miscellaneous mechanical part
- P = electrical connector (movable portion); plug
- Q = transistor; SCR; triode thyristor
- R = resistor
- RT = thermistor
- S = switch
- T = transformer
- TB = terminal board
- TC = thermocouple
- TP = test point
- U = integrated circuit; microcircuit
- V = electron tube
- VR = voltage regulator; breakdown diode
- W = cable; transmission path; wire
- X = socket
- Y = crystal unit-piezo-electric
- Z = tuned cavity; tuned circuit

ABBREVIATIONS

- A = ampere
- ac = alternating current
- ACCESS = accessory
- ADJ = adjustment
- A/D = analog-to-digital
- AF = audio frequency
- AFC = automatic frequency control
- AGC = automatic gain control
- AL = aluminum
- ALC = automatic level control
- AM = amplitude modulation
- AMPL = amplifier
- APC = automatic phase control
- ASSY = assembly
- AUX = auxiliary
- AVG = average
- AWG = american wire gauge
- BAL = balance
- BCD = binary coded decimal
- BD = board
- BE CU = beryllium copper
- BFO = beat frequency oscillator
- BH = binder head
- BKDN = breakdown
- BP = bandpass
- BPF = bandpass filter
- BRS = brass
- BWO = backward-wave oscillator
- CAL = calibrate
- ccw = counterclockwise
- CER = ceramic
- CHAN = channel
- cm = centimeter
- CMO = coaxial
- COEF = coefficient
- COM = common
- COMP = composition
- COMPL = complete
- CONN = connector
- CP = cadmium plate
- CRT = cathode-ray tube
- CTL = complementary transistor logic
- CW = continuous wave
- cw = clockwise
- D/A = digital-to-analog
- dB = decibel
- dBm = decibel referred to 1 mW
- dc = direct current
- deg = degree (temperature interval or difference)
- ... ° = degree (plane angle)
- °C = degree Celsius (centrigrade)
- °F = degree Fahrenheit
- °K = degree Kelvin
- DEPC = deposited carbon
- DET = detector
- diam = diameter
- DIA = diameter (used in parts list)
- DIFF AMPL = differential amplifier
- div = division
- DPDT = double-pole, double-throw
- DR = drive
- DSB = double sideband
- DTL = diode transistor logic
- DVM = digital voltmeter
- ECL = emitter coupled logic
- EMF = electromotive force
- EDP = electronic data processing
- ELECT = electrolytic
- ENCAP = encapsulated
- EXT = external
- F = farad
- FET = field-effect transistor
- F/F = flip-flop
- FH = flat head
- FOL H = fillister head
- FM = frequency modulation
- FP = front panel
- FREQ = frequency
- FXD = fixed
- g = gram
- GE = germanium
- GHz = gigahertz
- GL = glass
- GND = ground(ed)
- H = henry
- h = hour
- HET = heterodyne
- HEX = hexagonal
- HD = head
- HDW = hardware
- HF = high frequency
- HG = mercury
- HI = high
- HP = Hewlett-Packard
- HPF = high pass filter
- HR = hour (used in parts list)
- HV = high voltage
- Hz = hertz
- IC = integrated circuit
- ID = inside diameter
- IF = intermediate frequency
- IMPG = impregnated
- in = inch
- INCD = incandescent
- INCL = include(s)
- INP = input
- INS = insulation
- INT = internal
- kg = kilogram
- kHz = kilohertz
- kΩ = kilohm
- kV = kilovolt
- lb = pound
- LC = inductance-capacitance
- LED = light-emitting diode
- LF = low frequency
- LG = long
- LH = left hand
- LIM = limit
- LIN = linear taper (used in parts list)
- lin = linear
- LK WASH = lockwasher
- LO = low; local oscillator
- LOG = logarithmic taper (used in parts list)
- log = logarithm(ic)
- LPF = low pass filter
- LV = low voltage
- m = metre (distance)
- mA = milliampere
- MAX = maximum
- MΩ = megohm
- MEG = meg (10^6) (used in parts list)
- MET FLM = metal film
- MET OX = metal oxide
- MF = medium frequency; microfarad (used in parts list)
- MFR = manufacturer
- mg = milligram
- MHz = megahertz
- mH = millihenry
- mho = conductance
- MIN = minimum
- min = minute (time)
- ... ′ = minute (plane angle)
- MINAT = miniature
- mm = millimetre
- MOD = modulator
- MOM = momentary
- MOS = metal-oxide semiconductor
- ms = millisecond
- MTG = mounting
- MTR = meter (indicating device)
- mV = millivolt
- mVac = millivolt, ac
- mVdc = millivolt, dc
- mVpk = millivolt, peak
- mVp-p = millivolt, peak-to-peak
- mVrms = millivolt, rms
- mW = milliwatt
- MUX = multiplex
- MY = mylar
- μA = microampere
- μF = microfarad
- μH = microhenry
- μmho = micromho
- μs = microsecond
- μV = microvolt
- μVac = microvolt, ac
- μVdc = microvolt, dc
- μVpk = microvolt, peak
- μVp-p = microvolt, peak-to-peak
- μVrms = microvolt, rms
- μW = microwatt
- nA = nanoampere
- NC = no connection
- N/C = normally closed
- NE = neon
- NEG = negative
- nF = nanofarad
- NI PL = nickel plate
- N/O = normally open
- NOM = nominal
- NORM = normal
- NPN = negative-positive-negative
- NPO = negative-positive zero (zero temperature coefficient)
- NRFR = not recommended for field replacement
- ns = nanosecond
- NSR = not separately replaceable
- nW = nanowatt
- OBD = order by description
- OD = outside diameter
- OH = oval head
- OP AMPL = operational amplifier
- OPT = option
- OSC = oscillator
- OX = oxide
- oz = ounce
- Ω = ohm
- P = peak (used in parts list)
- PAM = pulse-amplitude modulation
- PC = printed circuit
- PCM = pulse-code modulation; pulse-count modulation
- PDM = pulse-duration modulation
- pF = picofarad
- PH BRZ = phosphor bronze
- PHL = phillips
- PIN = positive-intrinsic-negative
- PIV = peak inverse voltage
- pk = peak
- PL = phase lock
- PLO = phase lock oscillator
- PM = phase modulation
- PNP = positive-negative-positive
- P/O = part of
- POLY = polystyrene
- PORC = porcelain
- POS = positive; position(s) (used in parts list)
- POSN = position
- POT = potentiometer
- p-p = peak-to-peak
- PP = peak-to-peak (used in parts list)
- PPM = pulse-position modulation
- PREAMPL = preamplifier
- PRF = pulse-repetition frequency
- PRR = pulse repetition rate
- ps = picosecond
- PT = point
- PTM = pulse-time modulation
- PWM = pulse-width modulation
- PWV = peak working voltage
- RC = resistance capacitance
- RECT = rectifier
- REF = reference
- REG = regulated
- REPL = replaceable
- RF = radio frequency
- RFI = radio frequency interference
- RH = round head; right hand
- RLC = resistance-inductance-capacitance
- RMO = rack mount only
- rms = root-mean-square
- RND = round
- ROM = read-only memory
- R&P = rack and panel
- RWV = reverse working voltage
- S = scattering parameter
- s = second (time)
- ... ″ = second (plane angle)
- S-B = slow-blow fuse (used in parts list)
- SCR = silicon controlled rectifier; screw
- SE = selenium
- SECT = sections
- SEMICON = semiconductor
- SHF = superhigh frequency
- SI = silicon
- SIL = silver
- SL = slide
- SNR = signal-to-noise ratio
- SPDT = single-pole, double-throw
- SPG = spring
- SR = split ring
- SPST = single-pole, single-throw
- SSB = single sideband
- SST = stainless steel
- STL = steel
- SQ = square
- SWR = standing-wave ratio
- SYNC = synchronize
- T = timed (slow-blow fuse)
- TA = tantalum
- TC = temperature compensating
- TD = time delay
- TERM = terminal
- TFT = thin-film transistor
- TGL = toggle
- THD = thread
- THRU = through
- TI = titanium
- TOL = tolerance
- TRIM = trimmer
- TSTR = transistor
- TTL = transistor-transistor logic
- TV = television
- TVI = television interference
- TWT = traveling wave tube
- U = micro (10^{-6}) used in parts list)
- UF = microfarad (used in parts list)
- UHF = ultrahigh frequency
- UNREG = unregulated
- V = volt
- VA = voltampere
- Vac = volts ac
- VAR = variable
- VCO = voltage-controlled oscillator
- Vdc = volts dc
- VDCW = volts, dc, working (used in parts list)
- V(F) = volts, filtered
- VFO = variable-frequency oscillator
- VHF = very-high frequency
- Vpk = volts peak
- Vp-p = volts peak-to-peak
- Vrms = volts rms
- VSWR = voltage standing wave ratio
- VTO = voltage-tuned oscillator
- VTVM = vacuum-tube voltmeter
- V(X) = volts, switched
- W = watt
- W/ = with
- WIV = working inverse voltage
- WW = wirewound
- W/O = without
- YIG = yttrium-iron-garnet
- Zo = characteristic impedance

NOTE

All abbreviations in the parts list will be in upper case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

Table 6-2. 5517A P.C. Board Assemblies Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	05518-60001	**8**	**1**	**A1 CONNECTOR BOARD ASSEMBLY (SERIES 2236)**	**28480**	**05518-60001**
A1C1	0160-4557	0	11	CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C2	0180-0116	1	1	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A1C3	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C4	0180-2867	3	1	CAPACITOR-FXD 390UF+100-10% 40VDC AL	28480	0180-2867
A1C5	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1CR1	1901-0731	7	2	DIODE-PWR RECT 400V 1A	28480	1901-0731
A1CR2	1902-0632	9	1	DIODE-ZNR 1N5354B 17V 5% PD=5W TC=+75%	04713	1N5354B
A1DS1	1990-0895	1	4	LED-LAMP LUM-INT=80MCD IF=100UA-MAX	28480	1990-0895
A1DS2	1990-0895	1		LED-LAMP LUM-INT=80MCD IF=100UA-MAX	28480	1990-0895
A1F1	2110-0007	4	1	FUSE 1A 250V TD 1.25X.25 UL	75915	313001
A1J1	1251-6777	4	1	CONNECTOR 20-PIN F POST TYPE	28480	1251-6777
A1J2	1251-7180	5	1	CONNECTOR 18-PIN F CIRCULAR	28480	1251-7180
A1J3	1251-6010	8	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-6010
A1J4	1251-5170	9	2	CONNECTOR 2-PIN M POST TYPE	28480	1251-5170
A1R1	0757-0338	2	3	RESISTOR 1K 1% .25W F TC=0+-100	24546	CS-1/4-T0-1001-F
A1R2	0757-0338	2		RESISTOR 1K 1% .25W F TC=0+-100	24546	CS-1/4-T0-1001-F
A1R3	2100-3274	2	1	RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100 3274
A1R4	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4 1/8-T0-3161-F
A1S1	3101-2413	2	1	SWITCH-PB DPDT MOM 4A 250VAC	28480	3101-2413
A1S2	3101-1955	5	1	SWITCH-TGL SUBMIN SPDT .02A 20VAC/DC PC	28480	3101-1955
A1XF1	2110-0269	0	1	FUSEHOLDER-CLIP TYPE.25D-FUSE	28480	2110-0269
				MISCELLANEOUS A1 PARTS		
	0380-1548	9	1	STANDOFF-RIVET 10 LM 2.5	28480	0380-1548
	4040-1614	4	2	STANDOFF-LED	28480	4040-1614

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

Table 6-2. 5517A P.C. Board Assemblies Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3	**05518-60003**	**0**	**1**	**A3 CONTROLLER/REFERENCE BOARD (SERIES 2408)**	**28480**	**05518-60003**
A3C1	0180-2929	8	1	CAPACITOR-FXD 68UF+-10% 10VDC TA	28480	0180-2929
A3C2	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C3	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C4	0180-1746	5	1	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3C5	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C6	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C7	0180-1735	2	1	CAPACITOR-FXD .22UF+-10% 35VDC TA	56289	150D224X9035A2
A3C8	0160-4812	0	1	CAPACITOR-FXD 220PF +-5% 100VDC CER	28480	0160-4812
A3C9	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C10	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C11	0180-0049	9	2	CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A3C12	0180-0049	9		CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A3C13	0160-3072	2	2	CAPACITOR-FXD 1UF +-10% 100VDC MET-POLYE	28480	0160-3072
A3C14	0160-3072	2		CAPACITOR-FXD 1UF +-10% 100VDC MET-POLYE	28480	0160-3072
A3C15	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C16	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C17	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C18	0160-2453	1	1	CAPACITOR-FXD .22UF +-10% 80VDC POLYE	28480	0160-2453
A3C19	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C20	0160-5237	5	1	CAPACITOR-FXD 5UF +-10%	28480	0160-5237
A3C21	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C22	0160-0576	5	3	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C23	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A3C24	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A3C26	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C27	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C28	0180-0309	4	1	CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
A3C29	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A3C30	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C31	0160-4824			CAPACITOR-FXD 680PF +-5% 100 VDC CER	28480	0160-4824
A3CR1	1901-0040	1	1	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR2	1901-0731	7		DIODE-PWR RECT 400V 1A	28480	1901-0731
A3CR3	1902-3059	0	1	DIODE-ZNR 3.83V 5% DO-35 PD=.4W	28480	1902-3059
A3CR4	1902-0551	1	1	DIODE-ZNR 6.2V 5% PD=1W IR=10UA	28480	1902-0551
A3CR5	1990-0770	1		PHOTODIODE ID=30NA-MAX	32694	OP 913 (SELECTED)
A3CR6	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3J1	1251-4547	2	1	CONNECTOR 20-PIN M POST TYPE	28480	1251-4547
A3J2	1251-5801	3	1	CONNECTOR 4-PIN M POST TYPE	28480	1251-5801
A3J3	1251-6776	3	1	CONNECTOR 10-PIN M POST TYPE	28480	1251-6776
A3JMP1	1251-4047	7	3	CONNECTOR 3-PIN M POST TYPE	28480	1251-4047
A3JMP2	1251-4813	5	3	CONNECTOR 5-PIN M POST TYPE	28480	1251-4813
A3JMP3	1251-6957	2	1	CONNECTOR 4-PIN M POST TYPE	28480	1251-6957
A3JMP4	1251-4813	5		CONNECTOR 5-PIN M POST TYPE	28480	1251-4813
A3JMP5	1251-4047	7		CONNECTOR 3-PIN M POST TYPE	28480	1251-4047
A3JMP6	1251-4813	5		CONNECTOR 5-PIN M POST TYPE	28480	1251-4813
A3JMP7	1251-4047	7		CONNECTOR 3-PIN M POST TYPE	28480	1251-4047
A3L1	9100-1630	7	2	INDUCTOR RF-CH-MLD 51UH 5% .166DX.385LG	28480	9100-1630
A3L2	9100-1630	7		INDUCTOR RF-CH-MLD 51UH 5% .166DX.385LG	28480	9100-1630
A3L3	9140-0158	6	2	INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A3L4	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A3Q3	1853-0332	1	1	TRANSISTOR PNP SI DARL PD=70W	04713	MJE1091
A3Q5	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q6	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3R2	0698-6360	6	5	RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R5	1810-0279	5	1	NETWORK-RES 10-SIP4.7K OHM X 9	01121	210A472
A3R6	0699-0069	2	4	RESISTOR 2.15M 1% .125W F TC=0+-100	28480	0699-0069
A3R7	0698-4009	6	1	RESISTOR 50K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5002-F
A3R8	0757-0448	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A3R9	0757-0814	9	1	RESISTOR 511 1% .5W F TC=0+-100	28480	0757-0814
A3R10	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R11	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R14	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R15	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R16	2100-3161	6	1	RESISTOR-TRMR 20K 10% C SIDE-ADJ 17-TRN	02111	43P203
A3R17	0698-3457	6	1	RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A3R18	0757-0446	3	1	RESISTOR 15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1502-F
A3R19	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3R20	0757-0280	3	4	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R21	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R22	0757-0438	3	2	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3R23	0698-3260	9	1	RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A3R24	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3R25	0757-0442	9	3	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F

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

Table 6-2. 5517A P.C. Board Assemblies Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R26	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	28480	C4-1/8-T0-1002-F
A3R27	0699-0069	2		RESISTOR 2.15M 1% .125W F TC=0+-100	28480	0699-0069
A3R28	0757-0443	0	1	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A3R29	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R30	0757-0472	5	1	RESISTOR 200K 1% .125W F TC=0+-100	24546	C4 1/8-T0-2003-F
A3R31	0698-3454	3	2	RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A3R32	0699-0069	2		RESISTOR 2.15M 1% .125W F TC=0+-100	28480	0699-0069
A3R33	0698-3454	3		RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A3R36	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R37	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R38	0698-0083	8	2	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3R39	0757-0351	9	1	RESISTOR 402 1% .25W F TC=0+-100	24546	C5-1/4-T0-402R-F
A3R40	0698-3446	3	1	RESISTOR 383 1% .125W F TC=0+-100	24546	C4 1/8-T0-383R-F
A3R41	0698-0085	0	1	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A3R43	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4 1/8-T0-1961-F
A3R44	0757-0438	0	1	RESISTOR 5.11K 1% .124W F TC=0+-100	28480	0757-0438
A3R45	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3R46	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3R48	1810-0374	1	1	NETWORK-RES 8-SIP1.0K OHM X 4	01121	208B102
A3R49	0699-0071	6	2	RESISTOR 4.64M 1% .125W F TC=0+-100	28480	0699-0071
A3R50	0699-0069	2		RESISTOR 2.15M 1% .125W F TC=0+-100	28480	0699-0069
A3R51	0699-0071	6		RESISTOR 4.64M 1% .125W F TC=0+-100	28480	0699-0071
A3R52	0757-0276			RESISTOR 61.9 1% .125W F TC=0+-100	28480	0757-0276
A3R53	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	CA-1/8-TO-511R-F
A3TP1-A3TP20	1251-4707	6	20	CONNECTOR-SGL CONT PIN .031-IN-BSC-SZ	28480	1251-4707
A3U1	1820-1416	5	1	IC SCHMITT-TRIG TTL LS INV HEX 1-INP	01295	SN74LS14N
A3U2	1820-1203	8	1	IC GATE TTL LS AND TPL 3-INP	01295	SN74LS11N
A3U3	1820-1112	8	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A3U4	1820-2078	7	1	IC CNTR TTL LS DECD DUAL 4-BIT	01295	SN74LS490N
A3U5	1820-1201	6	1	IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A3U6	1820-2096	9	1	IC CNTR TTL LS BIN DUAL 4-BIT	01295	SN74LS393N
A3U7	1826-0122	0	1	IC 7805 V RGLTR TO-220	07263	7805UC
A3U8	1820-0939	5	1	IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	3L585	CD4013BE
A3U9	1260-0510	0	1	IC PACKAGE	28480	1260-0510
A3U10	1820-2466	7	1	IC TIMER CMOS	32293	ICM7555IPA
A3U11	1826-0753	3	1	IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-C	04713	MC34004BL
A3U12	1826-0416	5	1	IC SWITCH ANLG QUAD 16-DIP-C PKG	27014	LF13331D
A3U13	1826-0493	8	1	IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG	04713	MLM308AP1
A3U14	1826-0296	9	1	IC OP AMP GP 8-DIP-P PKG	28480	1826-0296
A3U15	1826-0065	0	1	IC COMPARATOR PRCN 8-DIP-P PKG	S0545	UPC311C
A3U16	1820-2668	1	2	IC DRVR TTL LINE DRVR DUAL 3-INP	01295	SN75114N
A3U17	1826-0775	9		IC 16-DIP-P PKG	28480	1DA7Q
A3U18	1820-2668	1		IC DRVR TTL LINE DRVR DUAL 3-INP	01295	SN75114N
A3U19	1820-0471	0	1	IC INV TTL HEX 1-INP	01295	SN7406N
				MISCELLANEOUS A3 PARTS		
	0340-0907	8		INSULATOR-XSTR NYLON	28480	0340-0907
	1258-0141	8	7	JUMPER-REM	28480	1258-0141
A4	**05518-60004**	1	1	**A4 SAMPLER BOARD**	**28480**	**05518-60004**
A4CR1	1990-0770	1		PHOTODIODE	32694	OP 913 (SELECTED)
A4P1	1251-6778	5	1	CONNECTOR 4-PIN F POST TYPE	28480	1251-6778
	0340-0907	8		INSULATOR	28480	0340-0907

FOR 5517A MISCELLANEOUS AND CHASSIS PARTS, SEE FIGURE 6-1.

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

Table 6-3. Manufacturer's Code List

Mfr No.	Manufacturer Name	Address		Zip Code
S0545	Nippon Electric Co.	Tokyo	JP	
00000	Any Satisfactory Supplier			
01121	Allen-Bradley Co.	Milwaukee	WI	53204
01295	Texas Instr Inc Semicond Cmpnt Div	Dallas	TX	75222
02111	Spectrol Electronics Corp	City of Ind	CA	91745
03888	K D I Pyrofilm Corp	Whippany	NJ	07981
04713	Motorola Semiconductor Products	Phoenix	AZ	85008
06665	Precision Monolithics	Santa Clara	CA	05050
07263	Fairchild Semiconductor Div	Phoenix	AZ	85008
07716	TRW Inc Burlington Div	Burlington	IA	52601
11236	CTS of Berne Inc	Berne	IN	46711
16299	Corning Glass Wks Component Div	Raleigh	NC	27604
19701	Mepco/Electra Corp	Mineral Wells	TX	76067
24546	Corning Glass Works (Bradford)	Bradford	PA	16701
27014	National Semiconductor Corp	Santa Clara	CA	95051
28480	Hewlett-Packard Co Corporate HQ	Palo Alto	CA	94304
3L585	RCA Corp Solid State Div	Somerville	NJ	
32694	Optron Inc	Carrollton	TX	75006
32293	Intersil Inc	Cupertino	CA	95014
50088	Mostek Corp	Carrollton	TX	75006
51642	Centre Engineering Inc	State College	PA	16801
56289	Sprague Electric Co	North Adams	MA	01247
75915	Littlefuse Inc	Des Plaines	IL	60016
80175	Quickset Inc	Northbrook	IL	60026
84411	TRW Capacitor Div	Ogallala	NE	69153
98291	Sealectro Corp	Mamaroneck	NY	10544

Item	Qty	Description	HP Part No.
1	1	B.D. ASSEMBLY	05518-60003
2	1	INSULATOR, XSTR	0340-0864
3	2	M3 × .5 × 6.0 PHMS	0515-0211
4	5	WASHER, FLAT	3050-0891
5	1	LASER ASSEMBLY	05517-60301
6	3	LOCK WASHERS SPLIT RING	2190-0592
7	3	M6 × 1.0 × 12 SOCHD	0515-0331
8	1	GASKET, EMI	8160-0398
9	1	COVER	05518-00008
10	4	M3 × .5 × 6.0 FMS BK	0515-0332
11	1	POWER SUPL ASSEMBLY	05518-60303
12	2	M3 × .5 × 35 FHMS	0515-0333
13	1	BD ASSEMBLY, CONN.	05518-60001
14	4	WASHERS, FLAT	3050-0795
15	1	LABEL, REAR	7121-3876
16	1	LABEL, MRF DATE	7121-1650
17	1	MTG CLIP X STR	05518-00002
18	1	M3 × .5 × 10.0 PHMS	0515-0407
19	1	SAMPLER ASSEMBLY	05518-60307
20	1	BD. ASSEMBLY, SAMPLER	05518-60004
21	2	3M × .5 PHMS × 40	0515-0252
22	1	BASE, MACHINED	05518-20302
23	1	LABEL, FRONT	7121-3877
24	1	LOCKING PIN	05517-20002
25	1	STRAIGHTNESS MOUNT	05518-40008
26	1	BASE TURRET	05518-40005
27	1	SHUTTER, BEAM	05518-00004
28	1	FACE, TURRET	05517-00002
29	2	M2.5 × .45 PHMS	0515-0736
30	1	SPRING, TURRET	05518-00006
31	2	RIVET, TUBULAR	0361-0089
32	1	NAME PLATE	7120-0004
33	2	M4 × 7 L.K. 1OLG 8H	0515-0414
34	3	SG CAP M8 × 1.25 × 25	0515-0798
35	4	M2.5 × .45 × 8.0 LG PHMS	0515-0403
36	1	LIQUID CRYSTAL	1990-0768
37	2	CONDUCTIVE RUBBER STRIPS	8160-0357

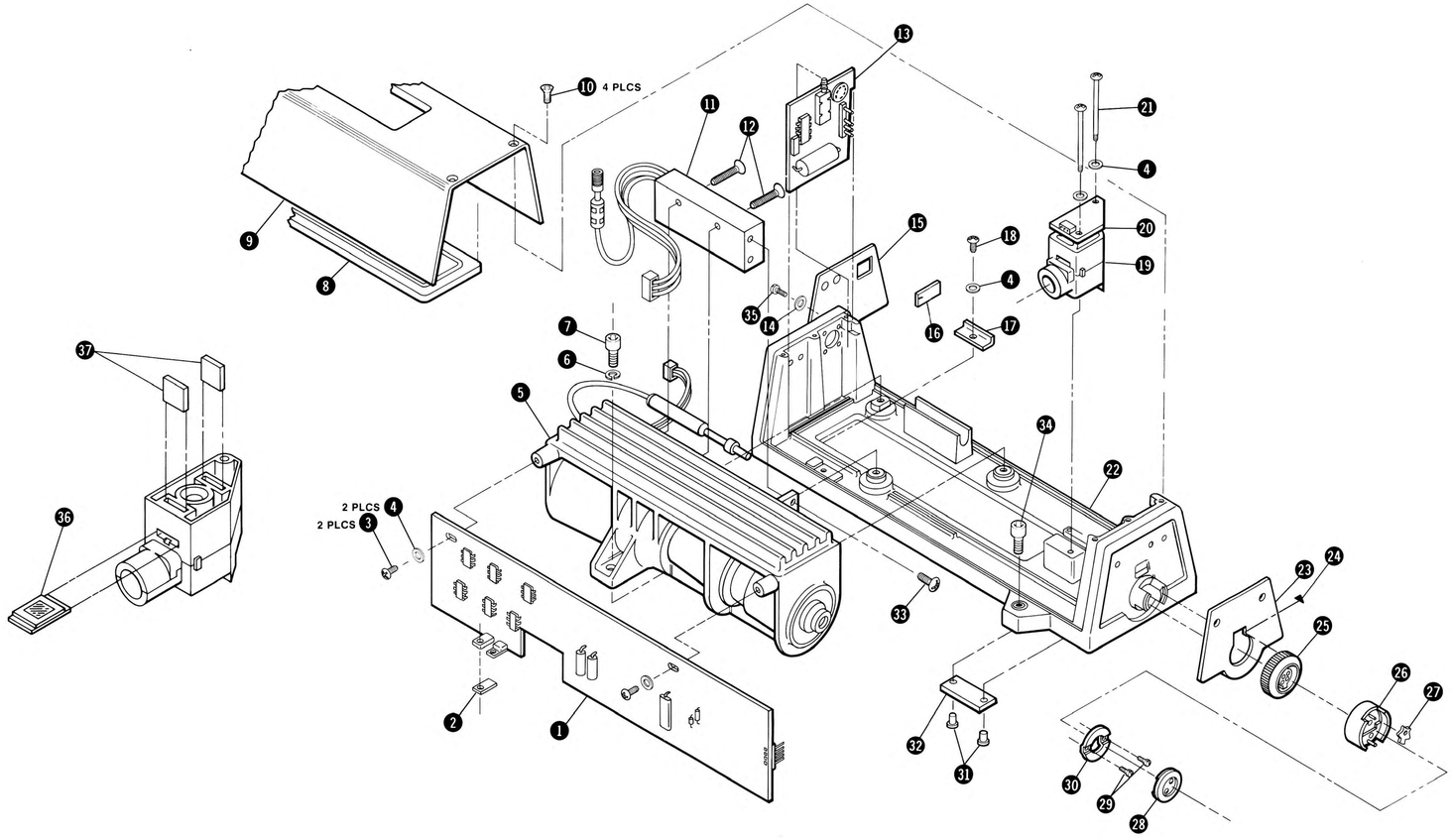


Figure 6-1. 5517A Laser Head Exploded View

Figure 6-1
5517A LASER HEAD EXPLODED VIEW

(See Page 6-7)

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains information required to update or backdate this manual to cover newer or older instruments with serial prefixes different than those shown on the title page.

7-3. Newer Instruments

7-4. Newer instruments may have a higher serial number prefix than that listed for the particular instrument. The manual shipped with a 5517A Laser Head will include a "Manual Changes" sheet that describes all required changes to update the manual. If any of the instruments shipped with the system have a higher serial number than those listed on the title page and the "Manual Changes" sheet does not cover the prefix, contact your local HP Sales and Service Office for information.

7-5. Older Instruments

7-6. Older instruments may have a lower serial number prefix than that listed on the title page of this manual. The following table lists the serial number prefixes of older instruments that differ from the instruments documented in this manual. Find the prefix in the table that corresponds to your instrument and make the backdating changes specified.

Table 7-1. 5517A Manual Backdating

If Your Instrument Has Serial Prefix or Serial Number	Make Backdating Change
2328A	1

CHANGE 1 (SERIES 2328A)

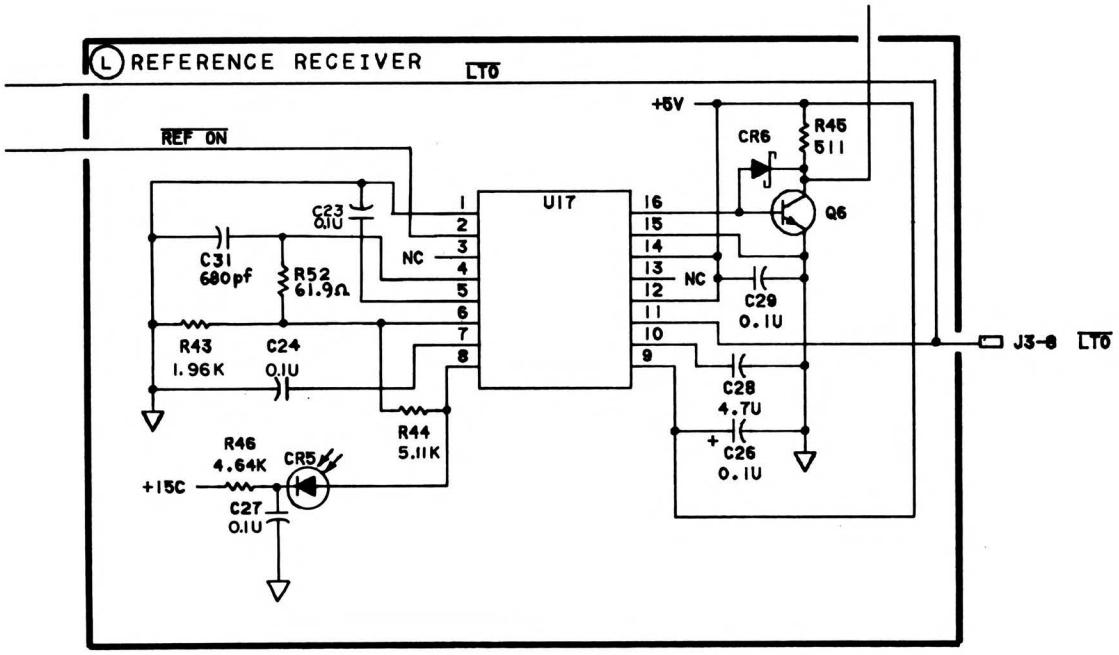
HP 5517A Laser Heads with Serial Prefix 2328A differ from later versions as follows:

The A3 Controller/Reference Board did not have A3C31 installed. A3L5 and L6 Ferrite beads were installed and A3R44 was a 4.22K. A3R52 was not installed.

To backdate this manual to be applicable to HP 5517A's with Serial Prefix 2328A, make the following changes:

Page 6-4/6-5, A3 Parts List:
Change A3 series to 2328A.
Delete A3R52 and A3C31.
Change A3R44 to 0698-3154 resistor 4.22K 1% .125W F TC=0+-100 24546 C4-1/8-TO-4221-F.
Add A3L5 and A3L6; 9170-0029; Core-Shielding bead; 28480; 9170-0029.

Page 8- , Figure 8-18, A3 Controller/Reference Board, Schematic Diagram:
Replace Section "L REFERENCE RECEIVER" with the following:



SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section contains service information for the 5517A Laser Head including safety considerations, theory, block diagrams, schematic diagrams, component locators, and troubleshooting and repair procedures. Useful service information is provided in other sections of the manual including; performance tests in Section IV, adjustments in Section V, and exploded view illustrations and parts lists in Section VI.

8-3. Theory of Operation

8-4. The theory of operation is presented at two levels:

- Block Diagram Description. These paragraphs describe the Laser Head major functional blocks and modes of operation. The description references the 5517A Laser Head Block Diagram, *Figure 8-2.*

- Board Level Theory of Operation. These paragraphs are arranged by assembly number order and describe the circuitry at the component level. The descriptions are used with schematic diagrams for A1, A3, and A4. Assembly A2 is not assigned in the 5517A.

8-5. Troubleshooting and Repair

8-6. Troubleshooting and repair information was not available at the time of publication. To receive this information, please fill out the attached card and return it to Hewlett-Packard. No postage is required when the card is mailed in the United States of America. Since this card will be used as the address label, be sure to include the complete address and name of the recipient.

8-7. Recommended Test Equipment

8-8. *Table 1-2* in Section I lists the test equipment required for service. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

8-9. Service Aids

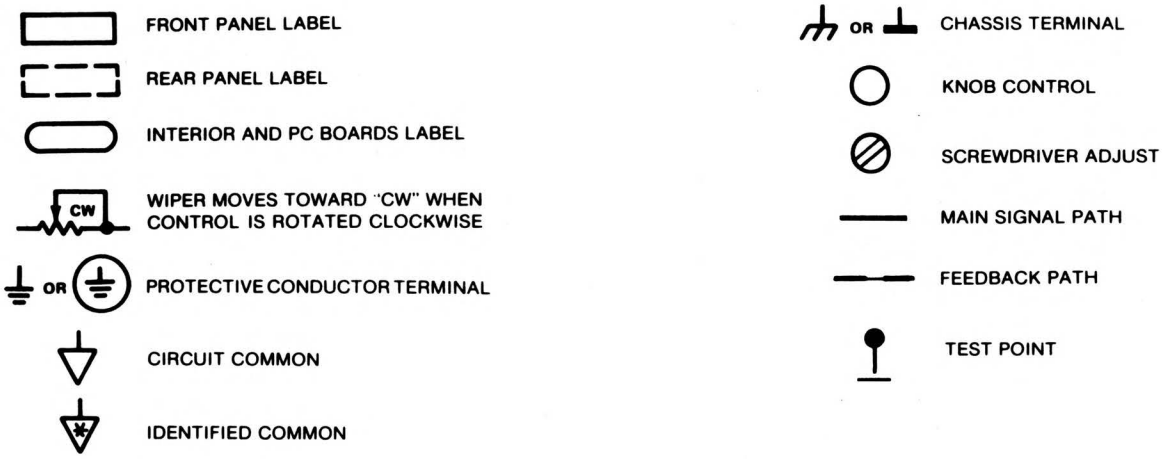
8-10. This system uses both metric and english hardware. *Figure 6-1* should be used to determine the correct hardware descriptions, part numbers and the proper tools to employ for assembly and disassembly.

8-11. Schematic Diagram Symbols and Reference Designations

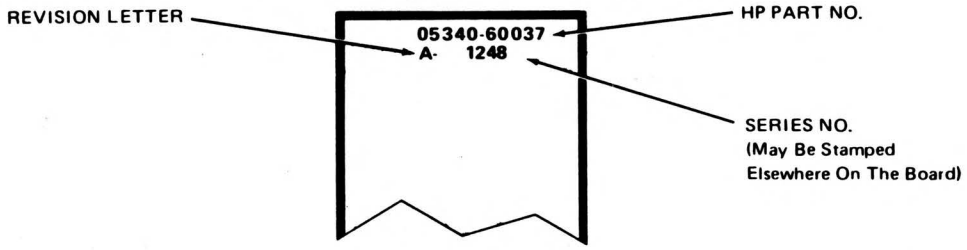
8-12. The logic symbology used on the schematic diagrams conform to ANSI Y32.14-1973 (IEEE Std. 91-1973). This standard supersedes MIL STD 806B.

8-13. *Figure 8-1* shows some of the symbols used on the schematic diagrams. In the center of this figure, the scheme for printed circuit board identification is presented. Also shown at the bottom of *Figure 8-1* is the method used to identify reference designators, assemblies, and subassemblies.

SYMBOLS



PRINTED CIRCUIT BOARD IDENTIFICATION



REFERENCE DESIGNATIONS

REFERENCE DESIGNATIONS WITHIN ASSEMBLIES ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION. JACKS ARE THE STATIONARY CONNECTORS AND PLUGS ARE THE MORE MOVEABLE OF TWO CONNECTORS.

ASSEMBLY	ABBREVIATION	COMPLETE DESCRIPTION
A25	C1	A25C1
A25A1	CR1	A25A1CR1
NO PREFIX	J3	J3

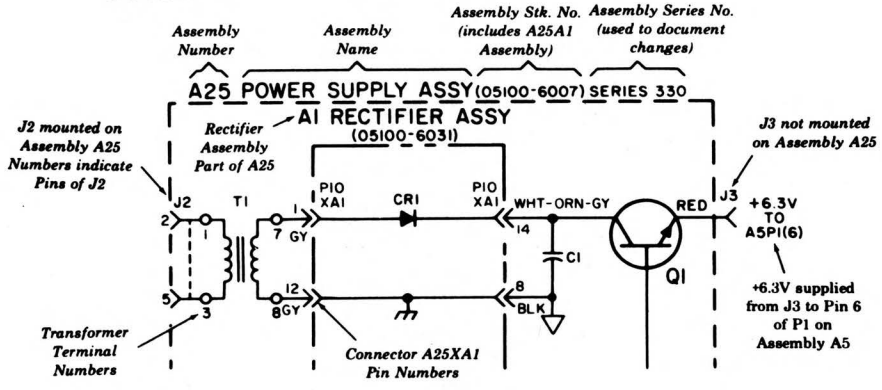


Figure 8-1. Schematic Diagram Notes

8-14. Safety Considerations

8-15. The following paragraphs contain warnings and cautions that must be followed for your protection and to avoid damage to the equipment.

WARNING

MAINTENANCE DESCRIBED HEREIN IS PERFORMED WITH POWER SUPPLIED TO THE EQUIPMENT AND WITH THE PROTECTIVE COVERS REMOVED. SUCH MAINTENANCE SHOULD BE PERFORMED ONLY BY SERVICE-TRAINED PERSONNEL WHO ARE AWARE OF THE HAZARDS INVOLVED (FOR EXAMPLE, FIRE AND ELECTRIC SHOCK). WHERE MAINTENANCE CAN BE PERFORMED WITHOUT POWER APPLIED, THE POWER TO THE EQUIPMENT SHOULD BE REMOVED.

BEFORE ANY REPAIR IS COMPLETED, ENSURE THAT ALL SAFETY FEATURES ARE INTACT AND FUNCTIONING, AND THAT ALL NECESSARY PARTS ARE CONNECTED TO THEIR PROTECTIVE GROUNDING MEANS.

WARNING

FROM 1.8 KILOVOLTS TO 12 KILOVOLTS DC IS PRESENT ON THE ANODE OF THE LASER TUBE IN THE 5517A. EXERCISE EXTREME CAUTION WHEN WORKING INSIDE THE INSTRUMENT. THE HIGH VOLTAGE COULD CAUSE SERIOUS PERSONAL INJURY IF CONTACTED. THE INSTRUMENT SERVICE SHOULD BE PERFORMED BY SERVICE-TRAINED PERSONNEL ONLY.

NOTE

When the 5517A cover is removed, the High Voltage Power Supply, A5, is defeated automatically by A1S2. For Adjustments and Servicing purposes, the High Voltage Supply can be re-enabled by setting the TEST-NORM switch, A1S1, to TEST after the 5517A cover is removed.

WARNING

LASER RADIATION IS ACCESSIBLE WHEN THE 5517A COVER IS REMOVED AND THE TEST-NORM SWITCH, A1S1, IS IN THE TEST POSITION. AVOID EXPOSURE TO THE EYES.

8-16. Safety Symbols

8-17. The following safety symbols are used on the instrument or in this manual.

Instruction manual symbol. The product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.

Indicates dangerous voltage fed from internal or external sources exceeding 1000 volts.

Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.

Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. A terminal marked with the symbol must be connected to ground in the manner described in the installation (operating) manual, before operating the equipment.

Frame and chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.

Alternating current.

Direct current.

Alternating or direct current.

The WARNING signal denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury.

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

8-18. Before and After Service Product Safety Checks

8-19. Visually inspect the interior of the serviced instrument for any signs of abnormal internally generated heat, such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing. Determine and remedy cause of any such condition.

8-20. LASER HEAD BLOCK DIAGRAM DESCRIPTION

8-21. The major structures of the 5517A are shown on the Laser Head Block Diagram in *Figure 8-2* and include the control electronics, the laser assembly, the sampler assembly, the reference receiver, and the high voltage power supply. All of the necessary control signals for the operation of the 5517A are generated internally. Power requirements are ±15 Volts DC from external system power supplies.

8-22. Overall, the purpose of the laser head is to emit a collimated, dual frequency laser beam with a high degree of stability. A portion of the emitted beam is directed to the sampler assembly to establish a reference frequency while the main portion of the beam is directed to external optics and returned to an external measurement receiver to develop a measurement frequency. The system electronics compare the reference and measurement frequencies to calculate the displacement of the optics.

8-23. The control electronics determine the tuning of the laser assembly to ensure an accurate laser wavelength for making measurements. Two phases of tuning are used, warmup mode and optical mode. When the desired characteristics of the laser beam are obtained during the optical mode, the system is ready to make measurements.

8-24. The laser assembly optics ensure correct laser frequency polarizations and also collimate the laser beam. Collimating minimizes variations in the diameter of the beam as it travels away from the laser head. Laser frequency F2 is polarized in a plane parallel to the bottom of the 5517A chassis. The other laser frequency F1 is polarized perpendicular to F2. The difference between the two laser frequencies F1 and F2 is small compared to their optical frequencies. The exit aperture shutter of the turret assembly has three positions. The first blocks the laser beam entirely; the second allows a small-diameter laser beam to exit for optical alignment purposes; and the third passes the entire laser beam.

8-25. Before the laser light is emitted from the 5517A, a portion of it is sampled by the sampler assembly. Most of this sample feeds into the reference receiver and the remainder of the sample is used to control laser tuning. The reference receiver generates the reference frequency signal by mixing the two laser frequencies. The reference frequency is in the range of 1.5 to 2.0 MHz and is a TTL level square wave. When the laser tuning stabilizes, the reference frequency is sent to the system electronics.

8-26. During a measurement, the laser beam follows a path through external measurement optics and to the 10780A Measurement Receiver. If the optics remain stationary, the measurement frequency and the reference frequency are the same. Relative motion between the measurement optics results in a change of the measurement frequency. The electronics compare the measurement frequency to the reference frequency and calculate the displacement of the optics. The measurement frequency output from the 10780A system receiver requires proper alignment of measurement optics in addition to stable laser tuning.

8-27. The High Voltage Power Supply requires +15 Volts as input. This supply generates up to 12 kilovolts DC at power-on. After the laser starts, the power supply output drops to approximately 2 kilovolts DC.

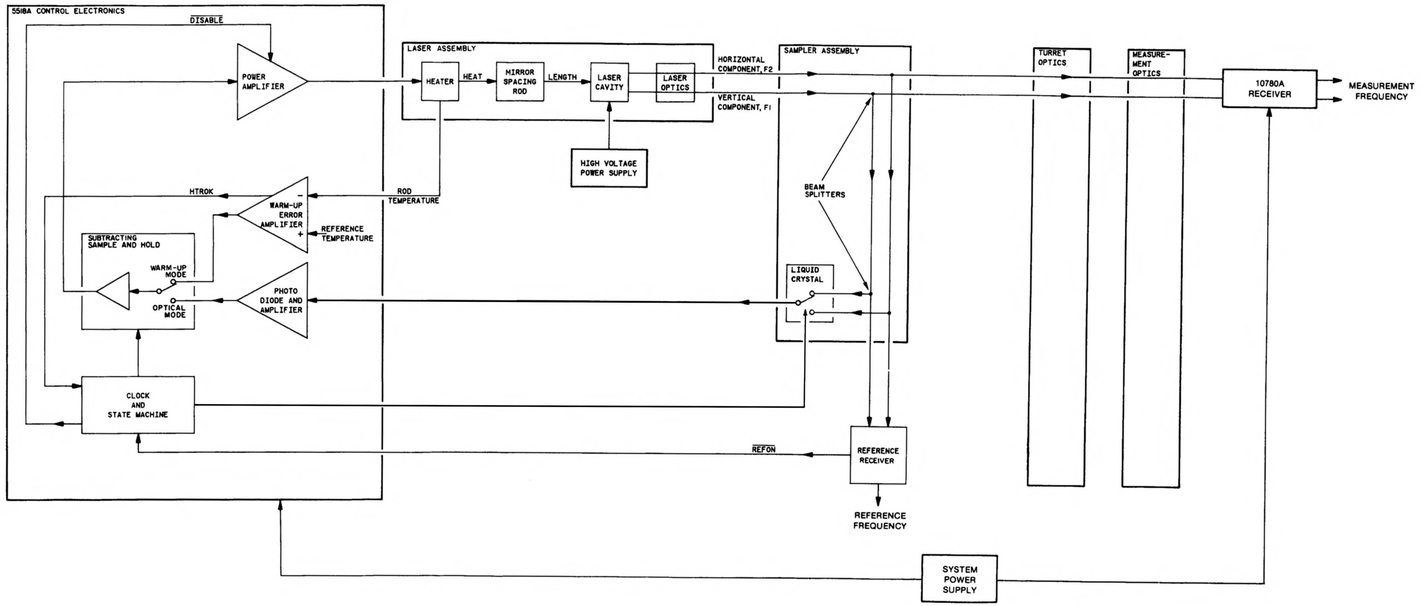


Figure 8-2. 5517A Laser Head Block Diagram

Figure 8-2
5517A LASER HEAD BLOCK DIAGRAM

(See Page 8-5)

8-28. Laser Tuning

8-29. The laser assembly produces stable frequency components only when the laser assembly cavity length is properly controlled. The cavity length is determined by the separation of two mirrors that are held against the ends of a glass rod. The 5517A uses a thermal tuning technique to control the cavity length. Cavity length increases when the rod is heated and decreases when it cools.

8-30. A heater coil wrapped around the glass rod is used to increase the cavity length. Rod cooling by conduction to surrounding material is used to decrease cavity length. To properly control the rod temperature, the rate at which it cools should approximate the rate at which it is heated. The 5517A raises the cooling rate by maintaining the rod at an elevated temperature.

8-31. Warmup Mode Tuning

8-32. One of two feedback loops used to control the laser assembly establishes the initial operating temperature of the glass rod. When power is first supplied to the 5517A, the state machine (see *Figure 8-3*) resets to its warmup mode. In the warmup mode, the state machine controls the subtracting sample and hold so that the feedback is as shown in *Figure 8-4*. The warm-up error amplifier produces an error signal that is proportional to the difference between the rod temperature and a reference temperature. The warm-up mode feedback loop controls the rod temperature until it equals the reference temperature. The reference temperature is adjustable and factory set to be higher than the hottest expected ambient temperature.

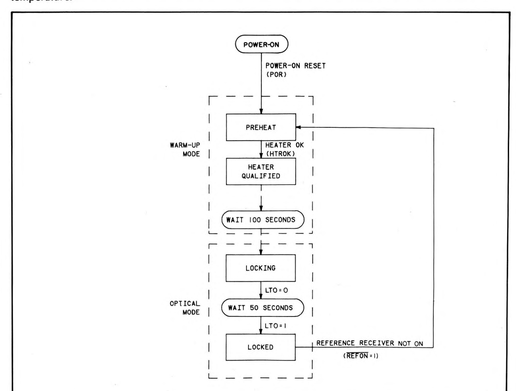


Figure 8-3. State Diagram for State Machine

8-33. The heater coil is used both to heat the rod and to sense its temperature. For 2.56 seconds (nominal) out of every 25.6 seconds (nominal) of the warm-up cycle (see *Figure 8-5*), the state machine disables the power amplifier and the heater allowing the heater coil to stabilize to the rod temperature. The heater coil and a resistor in the power amplifier form a voltage divider. As the heater resistance increases with rising temperature, the divider voltage increases. The difference between this voltage and the reference voltage is amplified to provide the warm-up mode error signal.

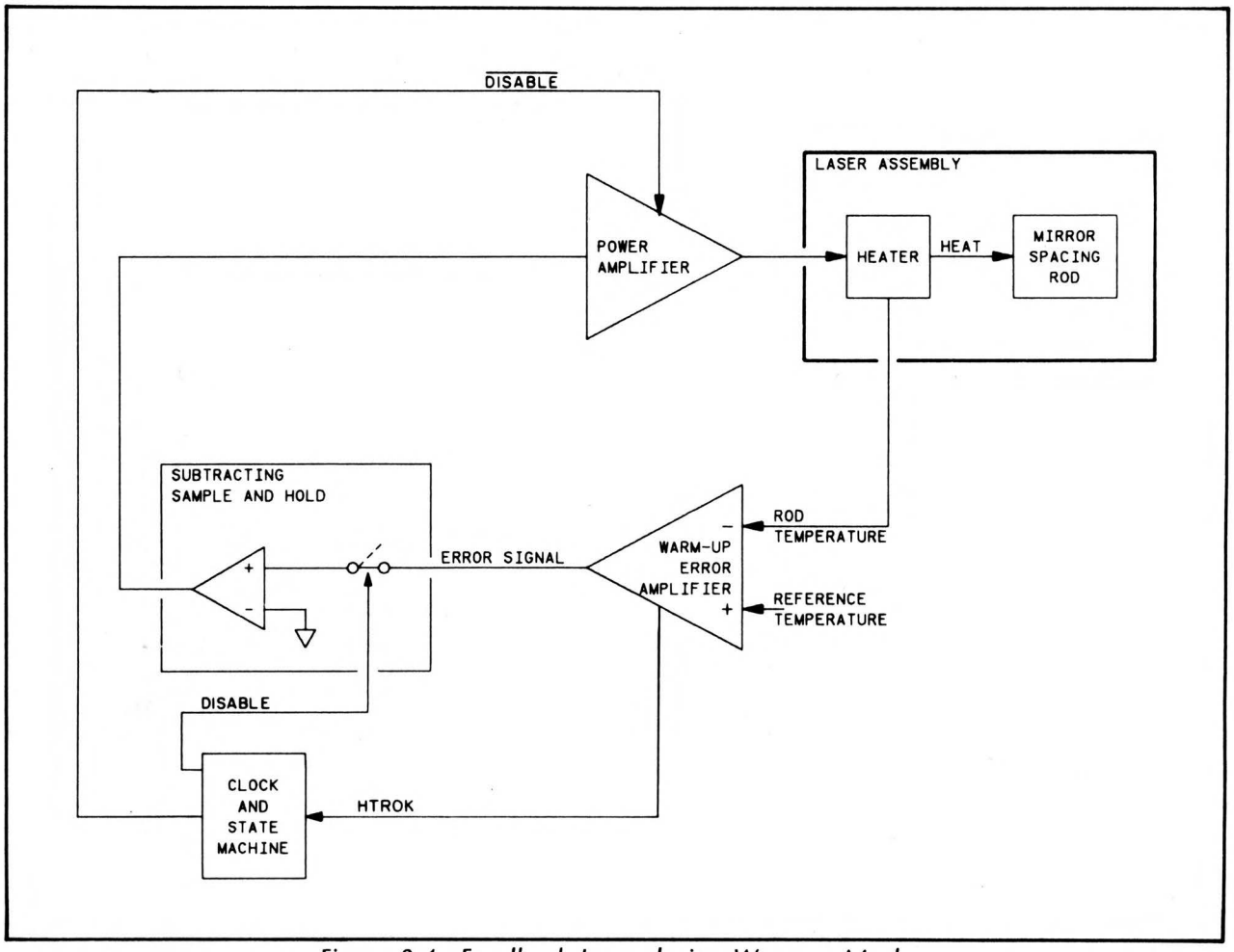


Figure 8-4. Feedback Loop during Warmup Mode

8-34. At the end of the 2.56 second disable period, the heater coil temperature has settled to the rod temperature. The error signal is sampled and held and the power amplifier is enabled. During the remainder of the 25.6 second period, the power amplifier, re-enabled and under control of the sampled error signal, drives the heater.

8-35. When the error signal gets close to zero, the warm-up error amplifier sends a digital signal called Heater O.K. (HTROK) to the state machine. HTROK is sampled by the state machine whenever the error signal is sampled. After HTROK is sampled true, the state machine waits 100 seconds before switching to optical mode.

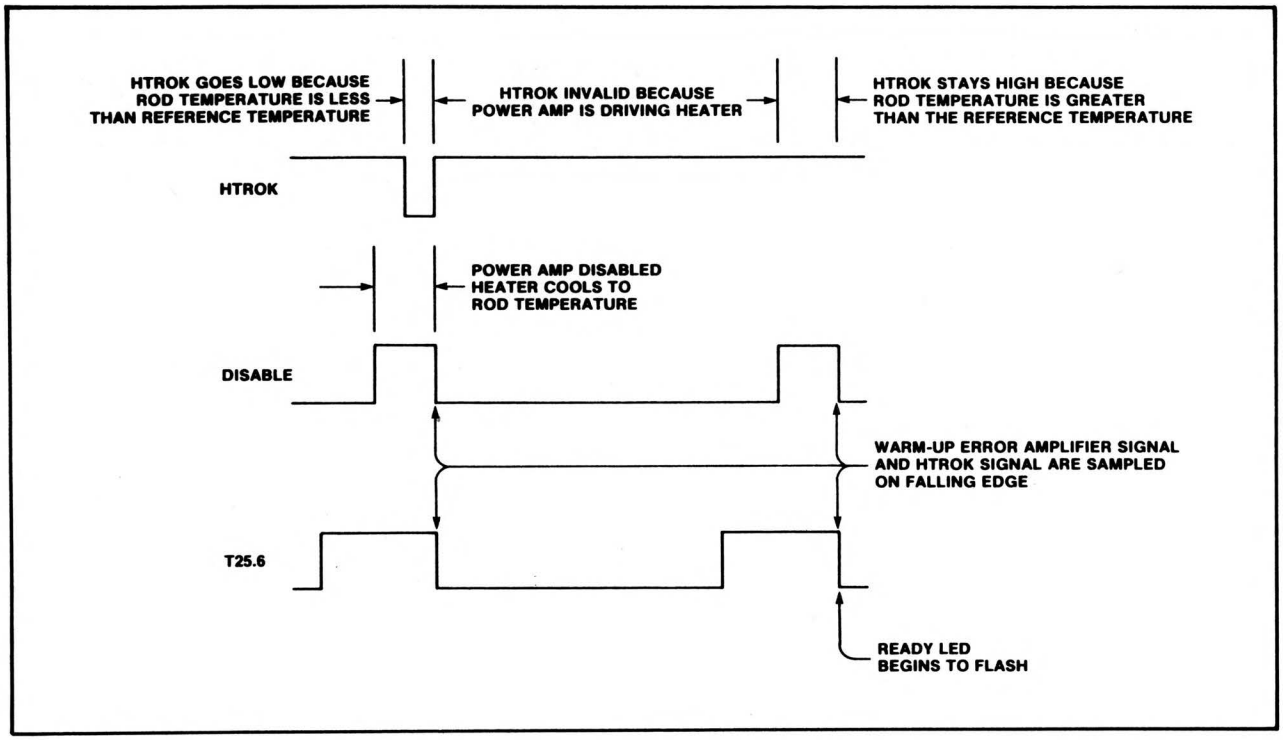


Figure 8-5. Warmup Mode Timing Diagram

8-36. Optical Mode Tuning

8-37. In optical mode, the state machine switches the subtracting sample and hold inputs from warm-up feedback to optical feedback as shown in *Figure 8-6*. The optical mode feedback controls the laser cavity length by measuring and comparing the power of the two laser frequency components. Cavity length is controlled such that the difference in power is zero. When the difference is maintained at zero, the desired characteristics of the laser beam are established and a measurement can be performed.

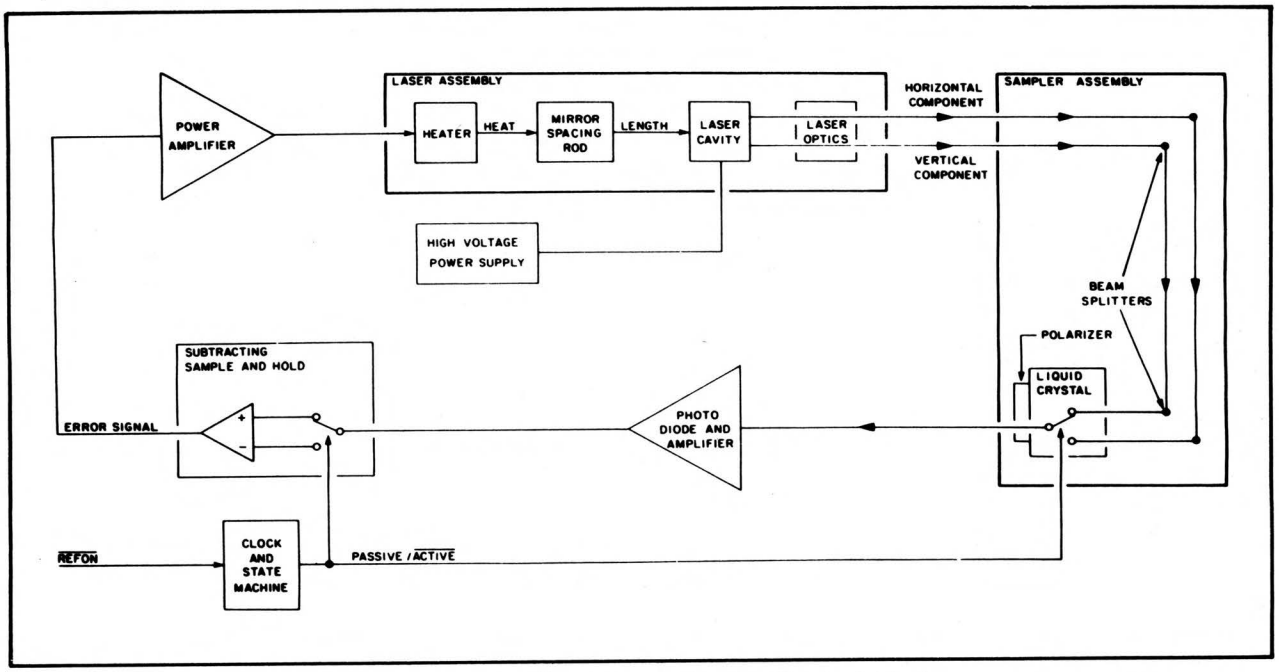


Figure 8-6. Feedback Loop During Optical Mode

8-38. The power in each laser frequency component is measured by sampling some of the laser light with a pair of non-polarizing beam splitters (see *Figure 8-7*) and passing one of the laser frequency components, then the other, through an optical switch and onto a photodiode. The beam splitters are part of the A7 Sampler Assembly and the photodiode is mounted on the A4 Sampler Board. A liquid crystal and a polarizer comprise the optical switch.

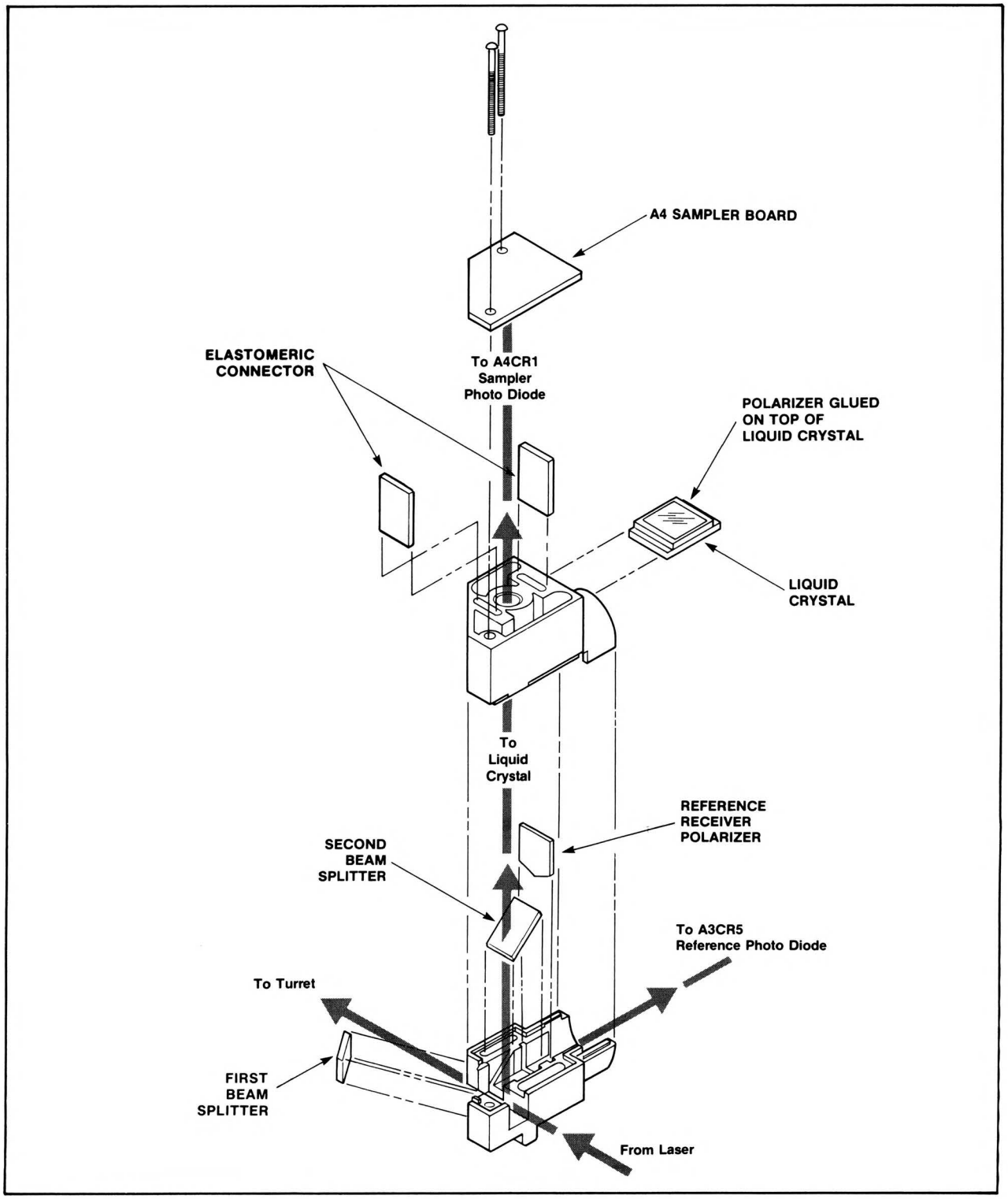


Figure 8-7. Sampler Assembly, Exploded View

8-39. When the state machine excites the liquid crystal into its active state (see *Figure 8-8*), the laser beam passes through the liquid crystal unaltered. The polarizer blocks the horizontal component and passes the vertical component onto the photodiode. The photodiode current is proportional to the power in the vertical component and is amplified and converted to a voltage by the photodiode amplifier. The voltage is held on the positive input of the subtracting sample and hold circuit.

8-40. When the state machine places the liquid crystal in its passive state, the liquid crystal rotates the polarization of both components by 90 degrees. In this state, the polarizer blocks the vertical component and passes the horizontal component. The voltage out of the photodiode amplifier is proportional to the horizontal component and is held by the negative input of the subtracting sample and hold circuit. The error signal output of the subtracting sample and hold circuit is proportional to any difference in power between the two components.

8-41. After the optical mode tuning has stabilized, LTO is held true enabling the reference frequency output. Proper laser tuning and reference receiver operation is indicated by $\overline{\text{REFON}}$ true. $\overline{\text{REFON}}$ false will cause the state machine to reset to the warm-up mode.

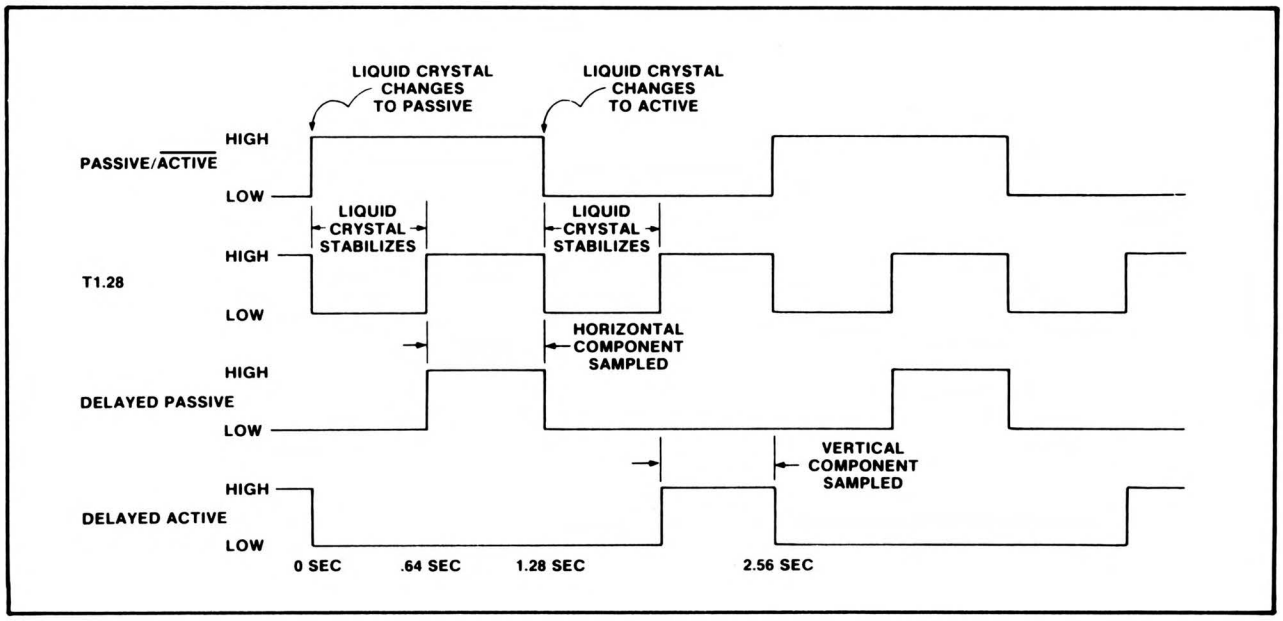


Figure 8-8. Optical Mode Timing Diagram

8-42. Laser Assembly Optics

8-43. The laser assembly optics ensure correct laser frequency polarizations and also collimate the laser beam. When the laser beam leaves the laser assembly, the horizontal component is polarized parallel to the bottom of the 5517A. The vertical component is polarized perpendicular to the horizontal component. The laser beam is collimated to minimize variations in beam diameter as it travels away from the laser head.

8-44. Reference Receiver

8-45. The beam splitters of the A7 Sampler Assembly direct some of the laser light through another polarizer and onto another photodiode. Because of the polarization orientation, the beam power after this polarizer varies sinusoidally at the difference frequency of the two laser frequency components. The beam power at the difference frequency is converted to current by the photodiode and amplified to TTL levels. The frequency of the TTL output is the reference frequency. The reference receiver electronics also provide a digital signal called Reference Receiver On (REFON) that tells the state machine the laser is working properly.

8-46. Turret

8-47. The exit aperture shutter of the turret assembly has three positions. The first blocks the laser beam entirely; the second allows a small diameter laser beam to exit for optical alignment purposes; and the third passes the entire laser beam.

8-48. ASSEMBLY/SCHEMATIC LOCATIONS OF HP 5517A BLOCK DIAGRAM ELEMENTS

ELEMENT	HP 5517A ASSEMBLY
Control Electronics	A3 and A4
Power Amplifier	A3
Warm-up Error Amplifier	A3
Subtracting Sample & Hold	A3
Photo diode & Amplifier	A4 and A3
Clock and State Machine	A3
Laser Assembly	A5
Sampler Assembly	A7
Reference Receiver	A3 and A7

8-49. INDICATORS

LASER ON

An amber indicator installed to alert the operator that the HP 5517A Laser Head is activated and emitting a laser beam. Electrically, this indicator monitors the +15 Volt line supplied by the system power supply which is used by the HP 5517A to generate its operating power.

READY

The READY indicator is extinguished when the HP 5517A is in the warm-up mode. It flashes on and off when the HP 5517A begins the optical mode and is fully on when the HP 5517A is ready for use.

8-50. BUILT-IN TEST AIDS

8-51. Several jumpers are included to aid in testing. The LIQUID CRYSTAL jumper JMP3 places the liquid crystal in either the active or passive state. JMP7, HEATER, disables the power amplifier. JMP5, PHOTODIODE, substitutes a known current for the photodiode and is used for testing the photodiode amplifier and the subtracting sample and hold circuits. JMP6, POWER AMP, supplies ±100 mV to U13 pin 3 to test the power amplifier. The $\overline{\text{REFON}}$ jumper, JMP2, sets the $\overline{\text{REFON}}$ signal so that U17 cannot influence the state machine. The HTROK jumper, JMP4, sets the HTROK signal so that U15 cannot influence the state machine. If JMP4 is not in NORM, the clock runs at about 75 kHz. The RESET jumper, JMP1, places the state machine in a repetitive mode to allow signature measurements. U9 is a dummy 16 pin DIP package with no integrated circuit. All of the important digital signals connect to U9 so that a logic clip can be used for monitoring.

NOTE

There are two "LO" positions for the REFON jumper, and two "UP" positions for the POWER ON jumper. For proper placement, refer to the schematic for A3 when using these jumpers.

8-52. The following is a summary of the signal functions on U9:

Table 8-1. A3 U9 Test IC Signal Summary

PIN	PURPOSE
1, 2, 3, 4	Timing of sample and hold during optical mode.
5, 6	Timing of sample and hold during warmup mode.
7, 10	Liquid crystal drive
9	Presets digital circuitry
11, 12, 13	Indicates state of the state machine
14, 15	Inputs to the state machine

8-53. ASSEMBLY REMOVAL INSTRUCTIONS

8-54. *Figure 8-9* shows the 5517A assembly locations. The exploded view diagram in Section VI provides access and removal information as well as assembly part number references.

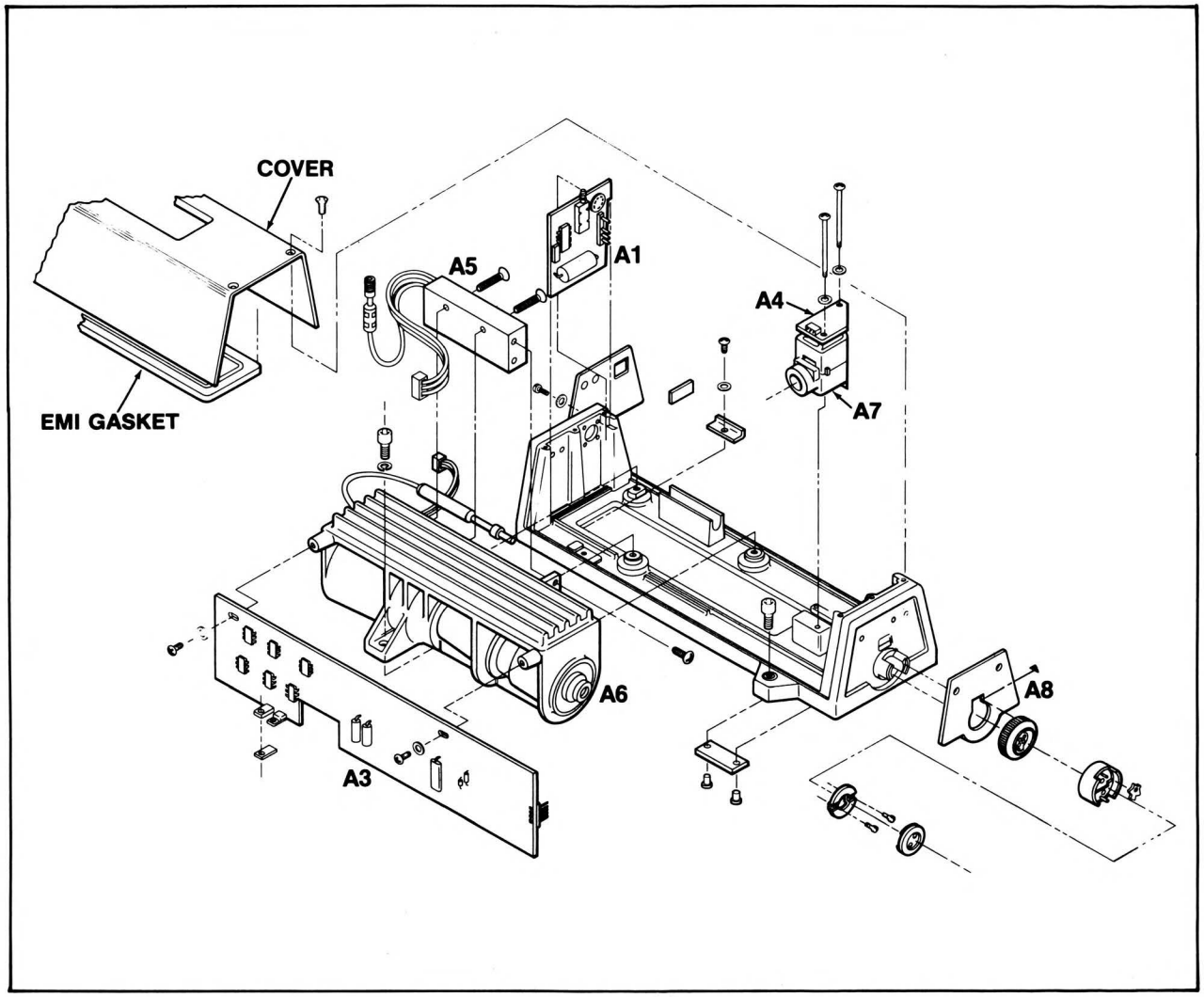


Figure 8-9. 5517A Assembly Designations

8-55. The laser assembly consists of an aluminum housing, laser tube, magnets, telescope and the quarter-wave/half-wave plate assembly. The telescope expands and collimates the beam. The quarter-wave plate and half-wave plate establish the orientation of the two laser beam components.

8-56. TROUBLE ISOLATION

8-57. Quick Tuning Checkout Procedure

8-58. The following procedure provides a means to quickly check the entire optical tuning subsystem of the laser. Before performing the procedure, study the information in Paragraphs 8-28 through 8-41 to gain the necessary background information to aid in interpreting the test results. *Figure 8-10* illustrates the effects of mirror spacing on F1 and F2.

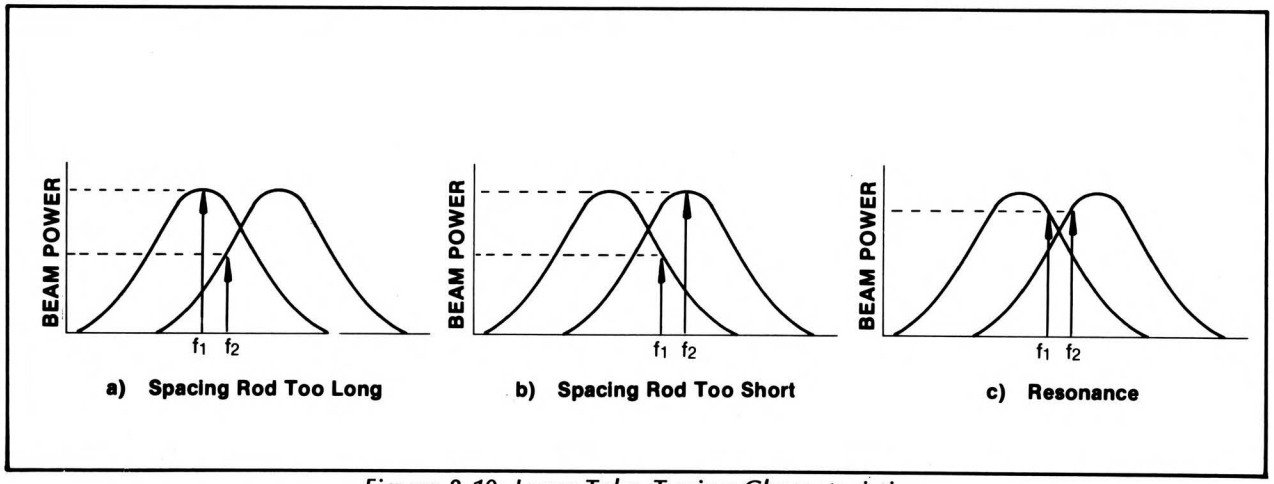


Figure 8-10. Laser Tube Tuning Characteristics.

8-59. The procedure consists of monitoring test point TP16 on A3 with an oscilloscope to determine the relative amplitudes of F1 and F2 with the heater turned off. If the sampler, photodiode, and amplifier are functioning properly and the heater is turned off, the traces on the oscilloscope will show switching to different levels as it monitors the sampling of F1 and F2. With continued observation of the trace switching, these levels which correspond to F1 and F2 will change amplitudes since the tuning is uncontrolled.

8-60. To perform the quick isolation procedure, proceed as follows:

a. Observe the READY LED on the rear panel of the HP 5517A. If after approximately 2 minutes from power up, the LED begins flashing, you can assume that the clock, dividers, state machine, warm up and power amplifier stages are working properly.

b. Remove the HP 5517A cover.

c. Connect a dc-coupled oscilloscope to TP16 on A3 as shown in *Figure 8-11*. Also see Figure 8-18 for test point locations.

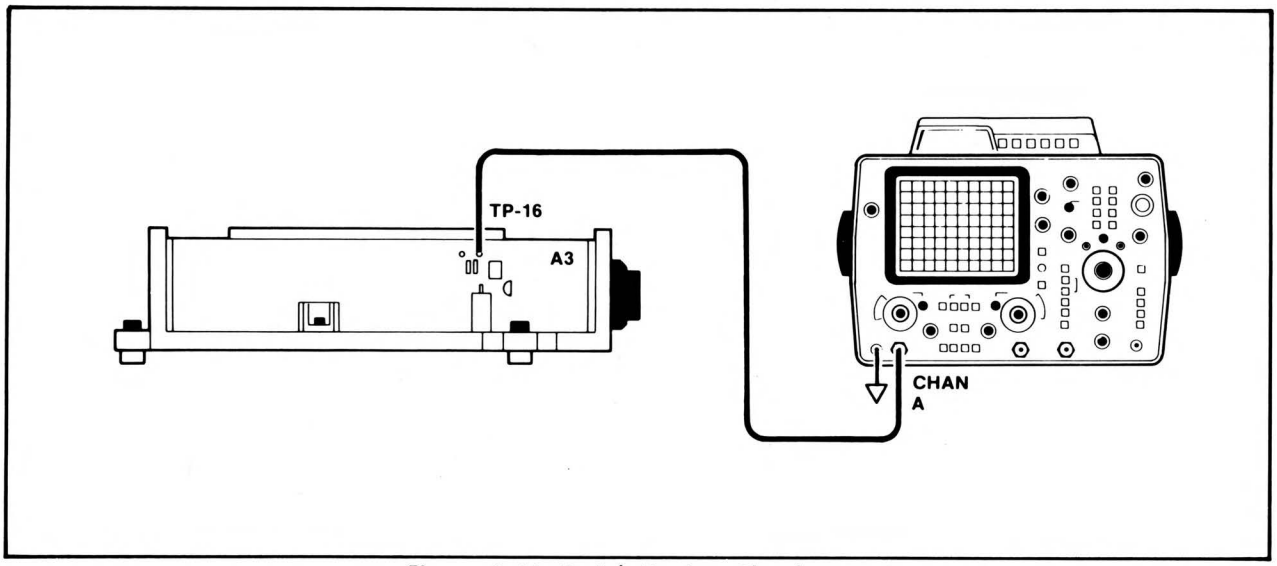


Figure 8-11. Quick Tuning Check, Test Setup

d. Enable the laser high voltage section by setting the TEST-NORMAL switch on Connector board A1 to TEST.

e. On A3, change HEATER jumper, JMP7 from NORM to OFF.

f. Set oscilloscope controls as follows:

   1. Timebase to 2 msec/div or faster.
   2. Trigger to normal. Adjust the triggering for minimum flickering of the trace.
   3. Vertical attenuator to .05V/div for X10 probe use or to .5V/div when using a direct probe. Set coupling to dc.

g. To simulate a failure to observe how the waveforms at TP16 behave, move JMP3 "LIQUID CRYSTAL" jumper to ACT. Note that the scope trace wanders up and down in a very smooth continuous manner with varying speed. If this occurs in step h, the liquid switch or A3U11 is defective. Return JMP3 "LIQUID CRYSTAL" jumper to original position.

h. If the sampler, photodiode, and amplifier are working properly, the oscilloscope display will show the trace switch between two distinct levels. See *Figure 8-12* below. With continued observation these levels, which correspond to F1 and F2, will change amplitudes since the tuning is uncontrolled. The difference between the levels varies with time between a maximum difference and a minimum difference.

i. Disconnect the test equipment and set HEATER jumper JMP7 to NORM. Set TEST-NORM switch to NORM and replace HP 5517A cover.

NOTE

WAVEFORM WILL APPEAR AS A "FLAT" LINE AND WILL MOVE UP AND DOWN ON THE DISPLAY DURING NORMAL OPERATION.

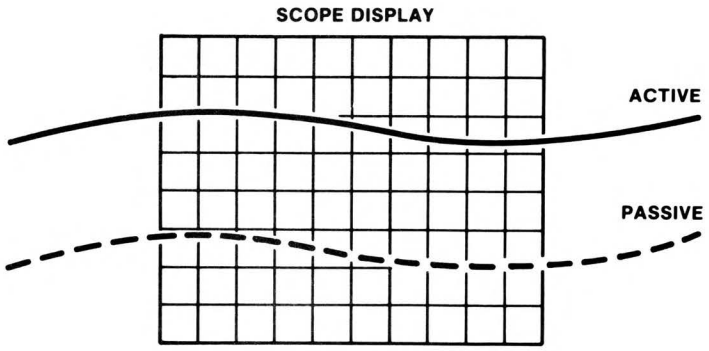


Figure 8-12. Quick Tuning Check, Waveform Display

8-61. Testing the Liquid Crystal Switch

8-62. The following material and test equipment is required for the test:

a. A white piece of cardboard.

b. An incandescent lamp.

c. A continuity tester.

d. A sheet of polarizer material HP Part Number 1000-0616.

8-63. To test the liquid crystal, proceed as follows:

a. Remove the liquid crystal from the sampler assembly as shown in *Figure 8-13* below:

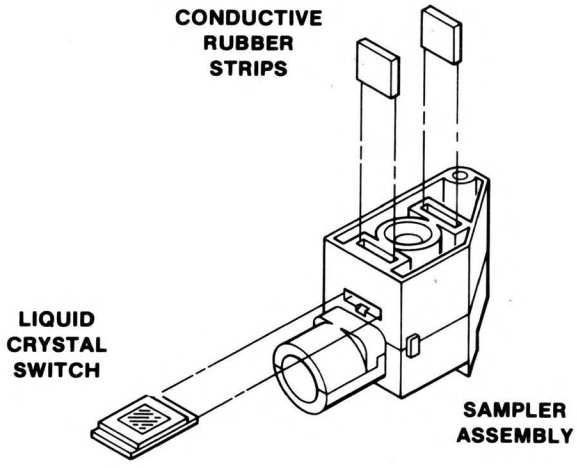


Figure 8-13. Liquid Crystal Removal

b. Place the liquid crystal in the test setup shown in *Figure 8-14* below:

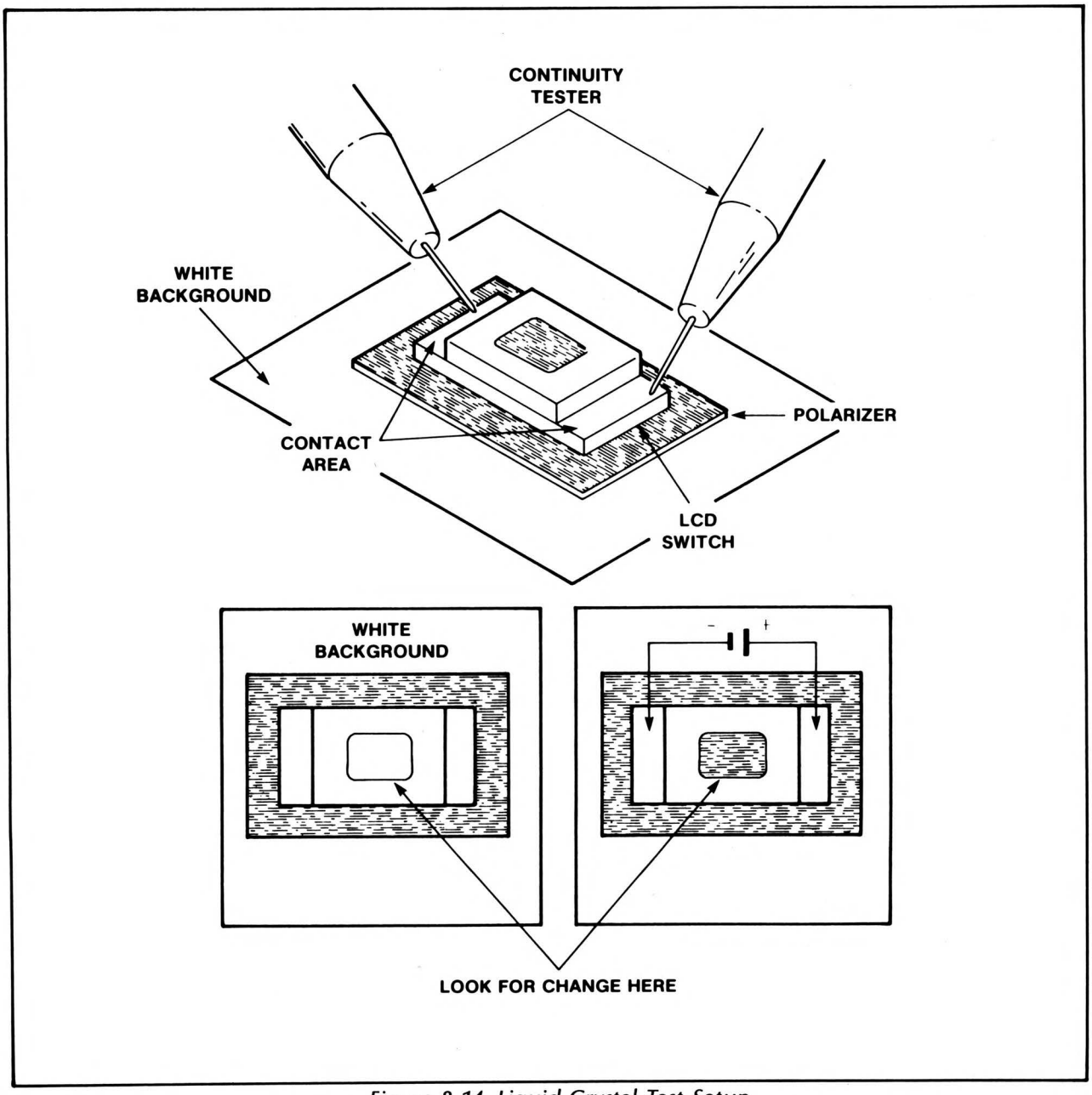


Figure 8-14. Liquid Crystal Test Setup.

CAUTION

During the following test, the liquid crystal will be probed with the continuity tester. Probe the liquid crystal momentarily. Sustained dc current flow through the liquid crystal may damage the device.

c. Gently place the probes of the continuity tester on the end shoulders of the liquid crystal as shown in *Figure 8-14* and observe the window area, it should go from light to dark while probing the device. A faint change of color or no change indicates a faulty liquid crystal. The replacement HP part number for the liquid crystal is 1990-0768.

8-64. Trouble Isolation Procedure

8-65. Before 5517A trouble isolation is attempted, the 5517A block diagram description (Paragraphs 8-20 through 8-47) should be read. All electronic tests can be performed using an HP 5005 Signature Multimeter.

WARNING

WITH THE 5517A COVER REMOVED AND A1S2 SET TO THE TEST POSITION, UP TO 12 KILOVOLTS WILL BE PRESENT AT THE OUTPUT OF THE HIGH VOLTAGE POWER SUPPLY ASSEMBLY A6.

NOTE

After servicing the 5517A, be sure to set A1S2 to the NORM position, otherwise power will be disconnected.

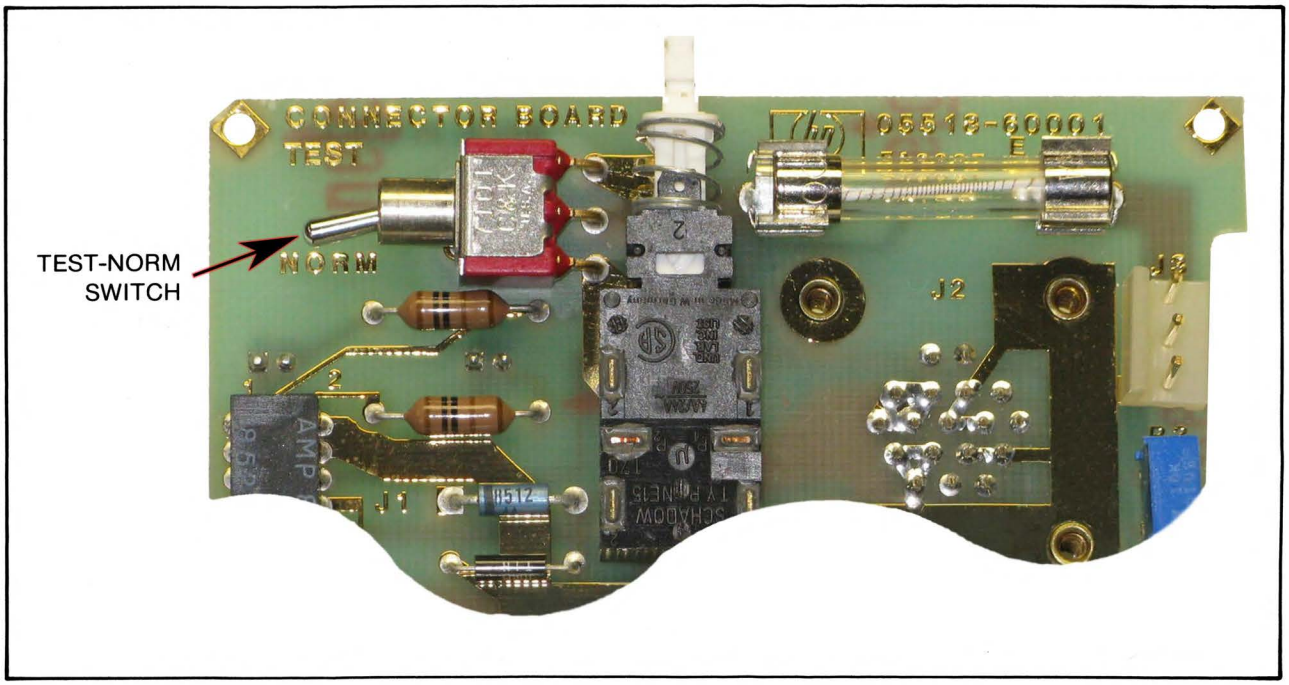


Figure 8-15. 5517A Switch A1S2

8-66. Procedure

8-67. Apply power to the 5517A. If no laser light is emitted, check that the exit shutter is not closed. Otherwise, see High Voltage Power Supply Troubleshooting in Paragraph 8-75. Note: Within 10 minutes of turn-on the 5517A should light the READY LED indicator continuously and output the Reference Frequency signal. Otherwise, proceed with step a of this procedure. If the failure mode occurs after the 5517A has reached the optical tuning mode (normal operation), skip steps a through f of this procedure. Steps a through f address failures that prevent the laser from reaching stable tuning.

a. Disconnect power and remove the cover of the 5517A. Set A1S2 to TEST and verify all boards are seated correctly and all test jumpers on A3 board are to the left (NORM). Turn power on. Check the following voltages. If any are incorrect, see Power Supply Troubleshooting in A3 Troubleshooting Procedures (Paragraph 8-134 or see A1 Connector Board Troubleshooting Procedures (Paragraph 8-71):

WARNING

WITH A1S2 IN THE TEST POSITION, THE 5517A HIGH VOLTAGE POWER SUPPLY IS ENABLED.

A3TP8 - 14.5V to 15.5V
A3TP9 - 4.75V to 5.25V
A3TP10 - neg 13.8V to neg 14.8V

Turn the power off for a few seconds, then back on. Observe READY LED on the 5517A. Find the description in steps b through e that matches your observation and follow that step.

b. LED takes longer than 3 minutes to start to blink. Either the digital section is not working or the heater is not being heated properly. Check the following procedures:

A3 Digital Section
A3 Power Amplifier
A3 Warm-Up Error Amplifier
A3 Subtracting Sample and Hold

c. LED blinks within 3 minutes, blinks for less than 3 minutes, goes off, then repeats this action. This indicates that the warm-up mode feedback is not properly controlling the heater voltage. Check the following procedures:

A3 Power Amplifier
A3 Warm-Up Error Amplifier
A3 Digital Section
A3 Subtracting Sample and Hold

d. LED blinks within 3 minutes, blinks for less than 3 minutes, comes on for one second (twice as long as when it is blinking) then goes off briefly. This action is then repeated. (An equivalent observation is LTO line (A3U9pin11) comes on for 1 second every few minutes). Either the optical mode feedback is not working or the reference receiver is defective. See Quick Tuning Checkout Procedure, Paragraph 8-57, and Reference Receiver Troubleshooting, Paragraph 8-136.

e. LED blinks within 5 or 10 seconds, comes on for a few minutes after approximately 3 minutes, then starts blinking again. Check A3 Power Amplifier section and especially A3Q3 and A3Q5.

f. Any other LED observation indicates a defective digital section. See A3 Digital Section Troubleshooting Paragraph 8-122.

g. If a Reference Frequency Signal error is indicated after the laser has successfully reached normal operation (READY LED on continuously and Reference frequency signal output) make the following observation. Does the READY LED extinguish when the failure occurs? If so, the optical tuning may be failing or the reference receiver may be resetting the state machine due to marginal signal

strength. Use the Laser Power Output Test (Paragraph 4-9) as a check of the laser assembly and 5517A Quick Tuning Procedure to get an indication of the function of the optical tuning subsystem before proceeding with lower level testing. Use the Reference Receiver Troubleshooting Procedure, Paragraph 8-136, to check signal level if the laser assembly and tuning circuits appear to be functioning properly. If the READY LED does not extinguish, spurious errors may be occurring on the reference frequency signal. Various internal and external noise or interference may be responsible. Check A3 ground connections and V_{cc} coupling capacitors. Check that the 5517A cover is fastened securely with the EMI gasket properly installed. Marginal optical signal to the reference receiver may aggravate noise problems. Check for adequate signal according to Reference Receiver Troubleshooting, Paragraph 8-136. Improper system grounding may also cause noise problems, see Section II.

8-68. A1 CONNECTOR BOARD CIRCUIT THEORY

8-69. The Connector Board interconnects the main laser cable, laser tube heater, laser power supply, and the A3 Controller/Reference Board. The schematic diagram for A1 is shown in *Figure 8-16*.

8-70. Capacitors C1 through C4 serve to filter out noise on the power supply lines. C4 filters current spikes created by the high voltage power supply. Diodes CR1 and CR2 provide transient protection. Switch S1 is a safety interlock which removes power from the laser power supply when the 5517A cover is removed. Switch S2 defeats the interlock so the laser can be serviced. S1 and S2 are wired in such a way that the interlock must be enabled before replacing the cover. F1 protects the system against laser power supply failures. J4 is the connector for the laser tube heater and cathode. DS1 lights when the high voltage supply is powered. DS2 lights when the 5517A is ready for use. R3 is used to adjust laser current as per the adjustment procedures in Section V.

8-71. A1 CONNECTOR BOARD TROUBLESHOOTING

WARNING

HIGH VOLTAGE IS PRESENT ON J4 IF THE LASER IS ON AND THE TUBE CONNECTOR IS NOT CONNECTED TO J4.

8-72. Use the schematic diagram *Figure 8-16*, an ohmmeter, and a voltmeter to troubleshoot A1. Check to see if F1 is blown. Check for proper transmission of power supply voltages. Check for proper diode action across CR1 and CR2. Check C1 through C5 for shorts. Check switches S1 and S2. Check R3 and R4.

8-73. HIGH VOLTAGE POWER SUPPLY CIRCUIT THEORY

8-74. The high voltage supply (*Figure 8-17*) receives +15V from the system power supplies through A1S1, A1S2, and A1F1. A1R3 and A1R4 set the high voltage output current limit. The laser discharge current passes through the high-voltage connector and ballast resistor to the laser anode and from the laser cathode to A1J4 pin 1.

WARNING

NEVER REMOVE A1J4 WITH THE HIGH VOLTAGE SUPPLY ON, DANGEROUS HIGH VOLTAGE EXISTS.

8-75. HIGH VOLTAGE POWER SUPPLY TROUBLESHOOTING

WARNING

LASER RADIATION IS ACCESSIBLE WHEN THE 5517A COVER IS REMOVED AND THE TEST-NORM SWITCH A1S1 IS IN THE TEST POSITION.

FROM 12 KILOVOLTS TO 1.8 KILOVOLTS DC IS PRESENT ON THE ANODE OF THE LASER TUBE IN THE 5517A. EXERCISE EXTREME CAUTION WHEN WORKING INSIDE THE INSTRUMENT. THE HIGH VOLTAGE COULD CAUSE SERIOUS PERSONAL INJURY IF CONTACTED. ANY MAINTENANCE SHOULD BE BY SERVICE TRAINED PERSONNEL ONLY.

Various conditions result from a faulty HV power supply.

a. NO LASER LIGHT is emitted. First check that A1S2 is set to "NORM" when the cover is on or "TEST" when the cover is off. Check that F1 is not blown and that the voltage at F1 is +15V. Check the high voltage connector and A1J3 and A1J4. Turn the power off and disconnect the high voltage connector. Carefully connect a high voltage probe, (you will need to make a jumper to extend the probe into the high voltage connector), turn power back on, and perform an open circuit voltage test. The voltage should be 10kV to 12kV. If not, replace the high voltage power supply. If the laser still doesn't work then replace the laser assembly.

WARNING

AFTER TESTING, THE POWER SUPPLY MAY TAKE UP TO 3 MINUTES FOR THE VOLTAGE TO DECAY.

b. Laser light is emitted but flashes or causes a REF Error. Turn power off and disconnect A1J4. Insert A 1K resistor (Rt) between the J4 pin 1 connector. (Leave J4 pin 2 disconnected). Connect an oscilloscope across Rt. Turn on the power and allow the laser to warm up. Observe the DC test voltage. It should be between 3 and 4 volts. If not, perform the current adjustment procedure in paragraph 5-17 of this manual. Set the scope to view the AC component and calculate the percent ripple. There should be less than 3% ripple in the test voltage. If not, replace the HV power supply. If the ballast resistor is bad the test voltage might be a nonperiodic intermittent voltage. If this is so, replace laser tube assembly.

NOTE

If a power supply problem is intermittent, then sometimes a tap with a screwdriver will aggravate the problem for test purposes.

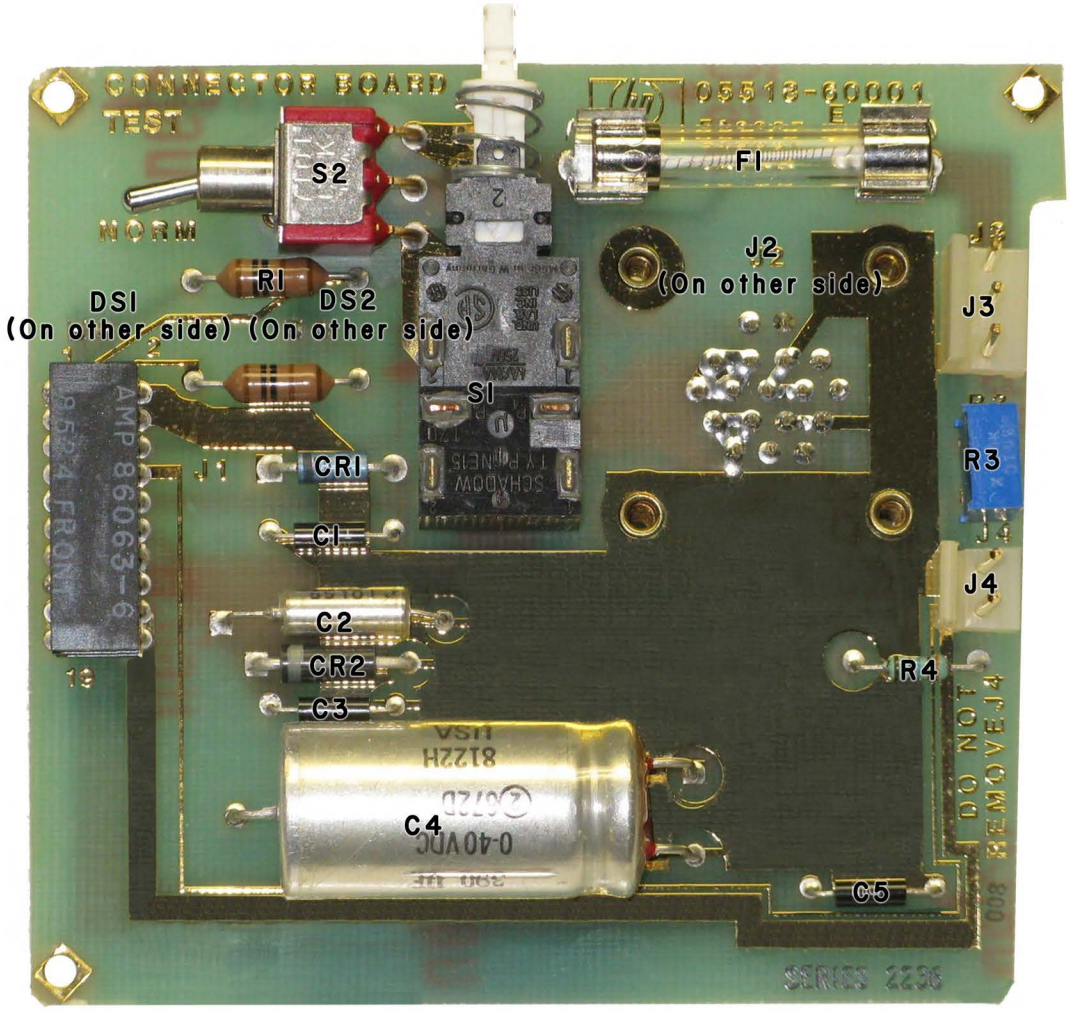
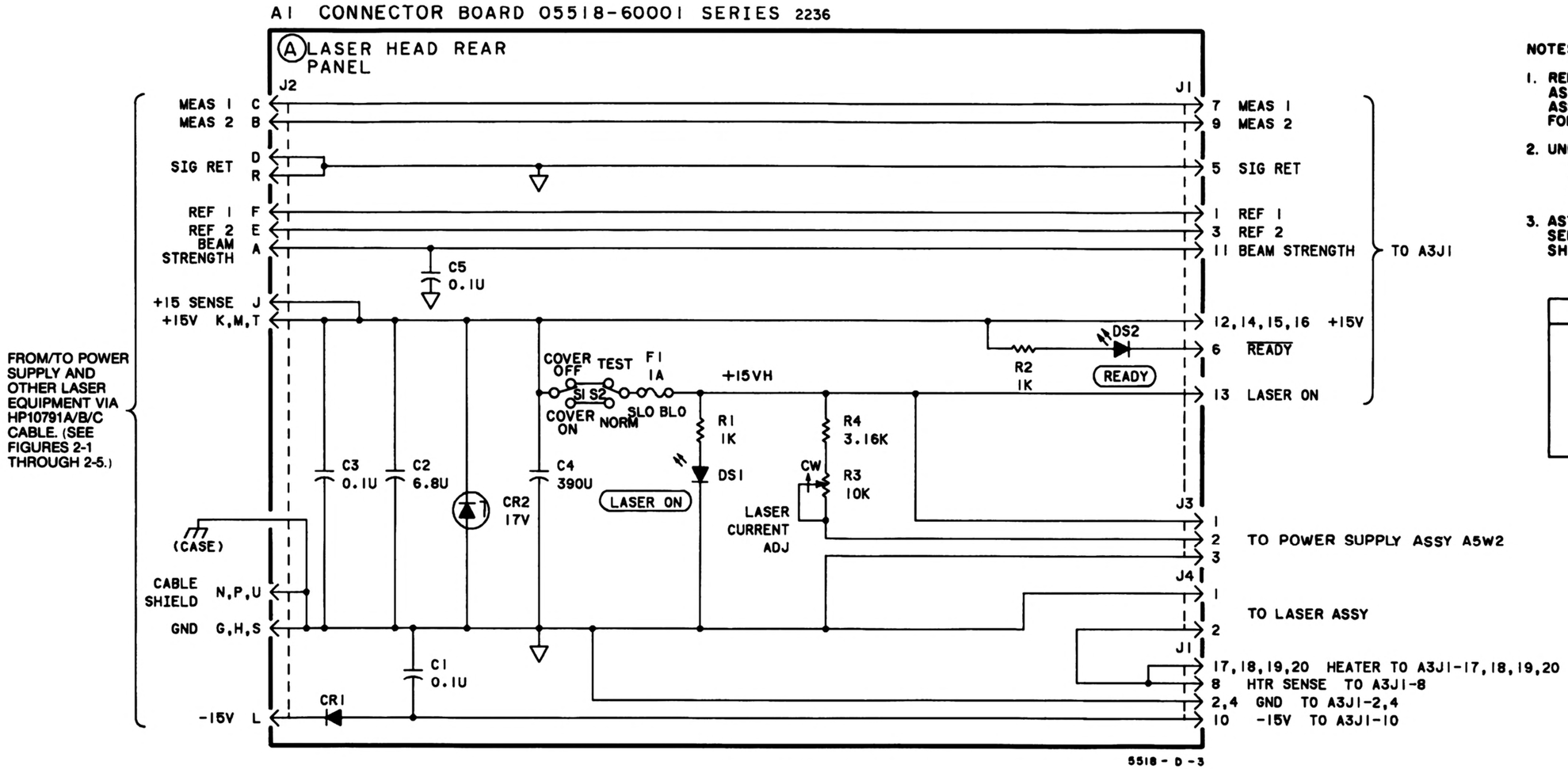

CONNECTOR BOARD
TEST
NORM
S2
F1
05513-60001
J2
(On other side)
J3
R1
DS1
(On other side)
DS2
(On other side)
S1
J1
CR1
C1
R3
J4
C2
CR2
C3
R4
C4
C5
DO NOT REMOVE J4
SERIES 2236

Figure 8-16
A1 CONNECTOR BOARD 05518-60001, SCHEMATIC DIAGRAM

(See Page 8-21)



NOTES:

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN FARADS;
   INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES FACTORY SELECTED COMPONENT, AVERAGE VALUE SHOWN.

Reference Designations
C1-5
CR1, 2
DS1, 2
F1
J1-4
R1-4
S1, 2

Figure 8-16. A1 Connector Board 05518-60001, Schematic Diagram

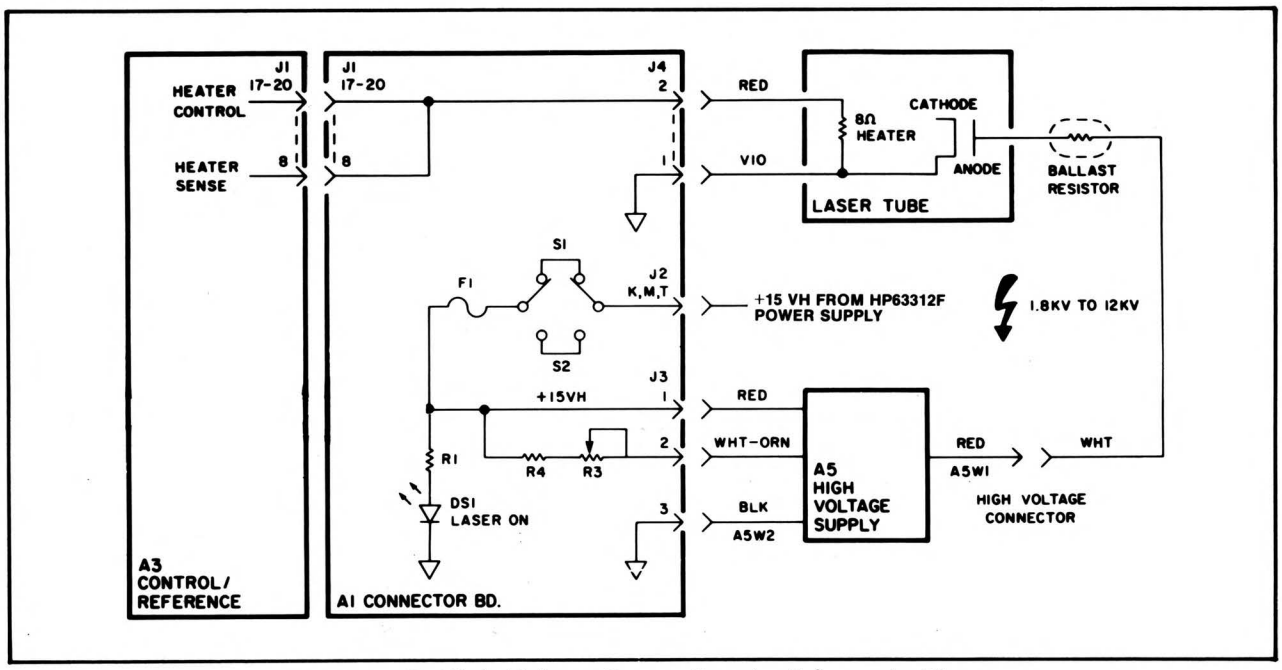


Figure 8-17. High Voltage Power Supply, Schematic Diagram

8-76. A3 CONTROLLER/REFERENCE BD & A4 SAMPLER BD CIRCUIT THEORY

8-77. Introduction

8-78. *Figure 8-18* shows the schematic diagram for the A3 Controller/Reference Board and the A4 Sampler Board.

8-79. The A3 and A4 boards contain the electronics for the following portions of the Laser Head Block Diagram:

Power Amplifier
Warm-up Error Amplifier
Photodiode and Amplifier
Liquid Crystal
Clock and State Machine
Subtracting Sample and Hold
Reference Receiver

8-80. Clock

8-81. The frequency of oscillator U10 is determined by timing components R8, C7 and C8. For normal operation, C7 and C8 connect in parallel to give an output frequency of approximately 100 Hz. For testing and signature analysis purposes, the oscillator can be configured to run at 75 kHz by moving the HTROK jumper JMP4 from the NORM position to the HI position. This removes C7 from the oscillator circuit.

8-82. Dividers

8-83. The dividers, consisting of U4A and U6, convert the 100 Hz oscillator signal into the desired periods. The first stage of the divider is U6, a dual 4-bit counter, which divides the 100 Hz by 256. The last output of U6 at pin 8 has a period of 2.56 seconds (nominal). The output of U4A at pin 13 has a period of 5.12 seconds while the output at pin 9 provides a period of 25.6 seconds. These two outputs are ANDed by U2C to produce a signal called DISABLE which is high 2.56 seconds out of every 25.6 seconds. DISABLE is used by the subtracting sample and hold circuit and the Power Amplifier.

8-84. State Machine

8-85. The state machine, consisting of U3, U4B, and U8A, determines the four states of controller operation. The warmup mode is divided into two states, preheat and heater qualified. The optical mode is divided into locking and locked states (see *Figure 8-3* State diagram for State Machine). The sequence from preheat to locked is described in the following paragraphs.

8-86. Upon power-up, the power-on reset circuit places the state machine in the preheat state and the power amplifier turns the heater full on.

8-87. U8A samples the HTR OK signal on the falling edge of DISABLE to allow sufficient time for the heater coil to cool to the rod temperature. See *Figure 8-5,* Warmup Mode Timing Diagram. When the heater temperature rises to the proper value, the HTR OK signal from U15 causes the output of U8A, HTRQ, to go high. The state machine enters the heater qualified state and the READY LED blinks approximately once per second. The rate of blinking is determined by the output of U6B which is gated through U2A and U19C to the READY LED. Blinking continues until the state machine enters the locked state.

8-88. When HTRQ goes true, U4B changes states from reset to count. Unless reset by HTR OK dropping low, U4B counts for 100 seconds and then clocks U3A. This sets OPTICAL high and locks HTRQ on. The 100 second period is sufficient to stabilize the heater temperature.

8-89. When OPTICAL goes high, the state machine enters the locking state and optical feedback controls the heater. After this state has been held for 50 seconds LTO (U1F, pin 12) goes high and the controller enters the locked state. If REFON (a signal from the Reference Receiver) is not high, the entire circuit will be reset by the Power-On-Reset circuit. Otherwise U1F and U19E turn on the READY indicator LED indicating that the HP 5517A is ready for use.

8-90. Liquid Crystal

8-91. The liquid crystal, which is mounted on A4, connects to CMOS driver U8B via elastomeric connector strips.

8-92. When the PASSIVE/$\overline{\text{ACTIVE}}$ signal at U6B pin 8 is high, both outputs of U8B are high, thereby placing zero potential across the LC. This is the passive state of the LC and causes the laser beam polarization to rotate by 90 degrees.

8-93. When PASSIVE/$\overline{\text{ACTIVE}}$ is low, U8B produces a 50 Hz, symmetrical square wave output to configure the LC in the active state. During this state, the LC does NOT rotate the laser beam polarization.

8-94. Photodiode and Amplifier

8-95. The polarizing filter which lies between the LC and the photodiode (CR1 of A4) allows only one of the two orthogonal components of the laser beam to strike the photodiode. During the passive state of the LC, the polarizing filter blocks the vertical component and the photodiode current is proportional to the horizontal component. During the active state, the photodiode current is proportional to the vertical component. The output of U11D at TP16 is the photodiode current multiplied by an effective resistance of:

$$\frac{(R20 + R22)\ R17}{R20}$$

8-96. Warm-up Error Amplifier and Comparator

8-97. The bridge formed by R9 and the heater on one side and R16, R18, and R19 on the other generates an error signal on the order of 1 mV/deg C because the resistance of the heater increases with increasing temperature. The Warm-up Error Amplifier, U14, amplifies this error.

8-98. The output of the HTR OK comparator, U15, goes high when the error voltage nears zero. The temperature at which HTR OK occurs is set by potentiometer R16 as described in the Reference Temperature Adjustment in Section V.

8-99. Subtracting Sample and Hold

8-100. During warm-up mode, U19B disables the heater for 2.56 seconds out of every 25.6 seconds. During the 2.56 second disable, the heater temperature stabilizes and U12B samples the output of U14. When U12B opens, the sampled voltage is held on C13 and buffered by U11B. Switch U12C connects C14 and the input of U11C to ground.

8-101. During the optical mode, U11D alternately drives one of the sample and hold circuits then the other. One sample and hold circuit (U12D, C14, U11C) samples the output of U11D proportional to the horizontal component. The other sample and hold circuit (U12A, C13, U11B) is used for the vertical component.

8-102. The first counter (U6) in the divider section controls the liquid crystal and the sample and hold circuits. A sample and hold is performed once per cycle of T1.28 alternating between the vertical and horizontal components (see *Figure 8-8* Optical Mode Timing). Thus each component is sampled once every 2.56 seconds. The LC is allowed to stabilize for 0.64 seconds before the switch to the sample and hold is closed. The hold cycle begins when the switch opens at the end of a cycle of T1.28 and at the end of a half cycle of PASSIVE. The present half cycle of PASSIVE/$\overline{\text{ACTIVE}}$ determines which component is sampled. Op-amp U11A computes the difference between the two sample and holds.

8-103. Power Amplifier

8-104. The output of U11A drives the power amplifier which in turn drives the laser tube heater. The frequency response of the power amplifier is determined by the input filter (R31, R27 and C18) and the nonlinear feedback for op-amp U13 (R32, R33, R39, R40, R41, C20, CR3 and CR4).

8-105. Q5 provides level shifting to drive the base of the Darlington power transistor Q3. U19B disables the output stage by grounding the base of Q5 when the heater error voltage is sampled during the warm-up mode.

8-106. Reference Receiver

8-107. The reference receiver consists of diode CR5, an amplifier U17, a transistor level shifter Q6 and associated passive components. The receiver amplifies and converts the sinsoidal output from CR5 to a square wave. When $\overline{\text{LTO}}$ goes low, and the receiver amplifier has adequate signal level input, the receiver is enabled and provides a low TTL signal $\overline{\text{REFON}}$. During the warmup and locking modes, the receiver supplies no useful information and is therefore disabled ($\overline{\text{LTO}}$ high).

8-108. CR5 is reverse biased to reduce its capacitance. The +15V bias voltage is filtered by R46 and C27. A polarizer oriented at 45 degrees to both optical frequency components passes optical power at the reference frequency onto CR5. The reference frequency is the difference in frequency between the two optical frequency components of the laser beam.

8-109. U17 contains two amplifiers. The gain of the first amplifier is set by R44. The gain of the second amplifier is fixed. A peak detector circuit charges C28 to a DC value proportional to the output of U17. With no current from the photodiode, the voltage on C28 is approximately equal to the voltage on C24. When

photodiode current is present, the change in voltage on C28 is the amplitude of the signal coming out of the second amplifier. When the amplitude exceeds 100 mV, the voltage at pin 2 ($\overline{\text{REFON}}$) drops to TTL low. Q6, CR6 and R45 shift the output of U17 to TTL levels. C22, C23, C24, C26 and C29 are used for coupling and bypass. A TTL high on pin 11 ($\overline{\text{LTO}}$) gates off the reference frequency output and raises pin 2 to V_{CC}.

8-110. Line Driver

8-111. U16 provides the necessary power to output the reference frequency signal to the system electronics. L3 limits the current spikes in U16. The special grounding and decoupling of the line drivers and receivers prevent crosstalk and oscillations.

8-112. Power-On Reset (POR)

8-113. When power is turned on, or REFON drops low during the locked state of the optical mode, the power-on reset circuit sets the state machine in preheat state.

8-114. Power

8-115. +15V and -15V are supplied by the system power supplies via Interconnect Cable HP 10791A/B/C. The +5V is generated by U7. CR2 protects U7. C5 stabilizes U7 and C4 filters U7 output. +15VC is the +15VD supply after it has been filtered by L2 and C11. L1 and L2 filters -15V. C2,3,6,16,17,21 provide local decoupling of the supplies.

8-116. A4 Sampler Board

8-117. The Sampler board connects to Controller/Reference board A3. The only active component on A4 is A4CR1, a photodiode that provides a signal to U11D on A3. Pads on the underside of A4 connect to the liquid crystal via elastomeric connectors which project from the sampler assembly. Liquid crystal operation is discussed in the A3 theory section.

8-118. A3 CONTROLLER/REFERENCE BOARD TROUBLESHOOTING

8-119. Service for A3 is divided into the following procedures, consult Paragraph 8-64, 5517A Trouble Isolation to determine which procedure to use.

a. Digital
b. Photodiode and amplifier
c. Liquid crystal
d. Subtracting sample and hold
e. Power amplifier
f. Warm-up error amplifier
g. Power supplies
h. Reference receiver

8-120. Standard Troubleshooting Procedures

8-121. In the following tests, reference is frequently made to "localize the defective element by standard troubleshooting procedures". This consists of the following:

a. The test procedure places a group of IC's in a definite state and:
    1. provides the correct values of the input and output signals characteristics

    OR

2. implies use of the schematic to determine the signal characteristics

   OR

3. simply states a suspected component

b. When the test procedure specifies a suspected component, replace it and run the test again.

c. When signal characteristics are known, measure the signals until a component is found that has correct inputs but erroneous outputs. Most likely this component is defective. If not, check for:

   1. output loading such as a board short
   2. shorted input on a downstream circuit

   If inputs are incorrect, check for open traces and faulty outputs from previous stages.

d. If an erroneous signal comes from another board, perform the test procedure for the suspected board.

8-122. Digital Troubleshooting

8-123. This procedure covers the clock, dividers, power-on-reset, and state machine blocks of the A3 board. The procedure assumes that the power supplies are functioning properly. The procedure requires use of standard troubleshooting procedures which are outlined in Paragraph 8-120.

8-124. Troubleshooting Strategy: Signature analysis is used in this section to isolate faulty digital components. Malfunctions in the clock, dividers, or power-on-reset blocks will not allow the signature analyzer to operate properly. Proper clock operation is verified first, then an attempt at verifying the state machine using signature analysis is made. If the signature analyzer doesn't work the dividers and resets must be repaired and then the state machine can be verified.

NOTE

Upon successful completion of a check, unless otherwise specified, return jumpers to original position.

a. Defeat high voltage interlock by setting A1S2 to TEST. Turn power on. Position all jumpers to the left. Measure clock frequency at TP5 (CLOCK). If it is 100 Hz ±20% go to step b. If not, check clock section components.

b. Move HTROK jumper to HI. If clock frequency is now 75 kHz ±20%, go to step c. If not, check C8.

c. Keep HTROK in HI. Set REFON jumper to HI. Set up signature analysis clock, start, and stop signals for falling edge detection as indicated in the lower center portion of A3. Take signatures on U9.

   pin 16 (+5V Test Signature) 104C
   pin 2 5653
   pin 3 2333
   pin 5 3357
   pin 7 HP8P
   pin 10 U729
   pin 11 6PCP
   pin 12 0148
   pin 13 A10H

   Check signature of U19, pin 10 = A957

   If these are OK, go to step m.

   If the signature analyzer will not take signatures, then there is a malfunction in the dividers or power-on-reset sections, go to step d.

   If the signature analyzer works, but one or more signatures are wrong, go to step e.

d. Set HTROK to HI, REFON to HI, and RESET to TEST. Connect TP2, TP3, and pin X of HTROK jumper to ground (TP1 or TP18). Verify the dividers by measuring the frequencies at the following IC pins and determine that they are equal to the indicated ratios, i.e., the frequency at U6 pin 13 should be equal to the frequency at TP5 divided by 16. Note: The counter function of the signature analyzer may not work so a dedicated counter might be needed.

Measure Frequency at IC	pin	Frequency should be equal to ratio of	If Incorrect, faulty part is:
U6	13 =	F(TP5/16) or ~4.8 kHz	U6
U4	15 =	F(U6 pin 13/16) or ~300 Hz	U4 or U6
U4	1 =	F(U4 pin 15/10) or ~30 Hz	U4
U4	7 =	f(U4 pin 1/10) or ~3 Hz	U4

If no problem is found, proceed to step e.

e. Set HTROK to HI, REFON to HI, RESET to TEST. Connect TP2, TP3, and pin X of HTROK jumper to ground. (TP1 or TP18). Set up the signature analysis clock, start, and stop signals for falling edge detection. Using the signatures listed in step s, localize the defective element by using standard signature analysis troubleshooting. Begin with U9 and use the schematic to trace back faulty signals. Check U1 pin 6, U19 pin 10, and U2 pin 6 right away, they are critical points. If no trouble is found, go to step f.

f. Remove ground connection on HTROK jumper. Is U8, pin 6 signature FP96? If not, U8A or R48B is faulty. If so, go to step g or see Warm-Up Error Amplifier Troubleshooting.

g. Remove the ground connection on TP3 and leave off. Is the +5V signature (TP9) = CP5P? If not, go to step h. If so go to step j.

h. Set HTROK to LO. Is U8 pin 1 low? if not, U8 is bad. If yes, go to i.

i. Is TP3 high? If yes, go to j. If no, check U4B, U5D, U19D, R5D.

j. Remove ground connection on TP2 and leave off. Set HTROK to HI. Is +5V signature = AF7A? If yes, go to step m. If no, go to step k.

k. Remove RESET jumper. Tie center pin to +5V. Is TP2 high? If not, replace U19 or R5B. If so, go to l.

l. With settings same as step k, check that U4 pins 1, 2, 9, 12, 13, and 16 are all high. If not, U4 is bad. At this point, the digital section should be OK.

m. Set REFON to HI, HTROK to X, all other jumpers to left. U9 pin 13 should be high. If not, check U8A. If so go to step n.

n. Keep REFON to HI, set HTROK to LO. U9, pin 13 should be low. If not, U8A is bad. If so, go to step o.

o. Set REFON to LO. U9, pin 9 should be low. If not, U2B is bad. If so, go to step p.

p. Turn the power off. Set REFON to HI, HTROK to HI. Check that U9, pin 9 comes on then blinks at a few Hz or so at power on. If OK go to step q. If not, replace C1 and check CR1, R5A, R5I, and R48A.

q. Return HTROK and REFON jumpers to norm. The READY LED should start blinking in a few seconds or so. If yes, go to step r. If no, check A1R1 and A1DS2.

r. Turn power off. Set REFON to HI. Set POWER AMP jumper to UP. Turn power on and allow the laser to run for five minutes. Observe the voltages at U19 pins 3 and 4. Pin 3 will be mostly at a TTL low but will periodically go high for a few seconds. Pin 4 should be at a voltage of at least 10V when pin 3 is low and should immediately go low when pin 3 goes high. If this is the case, then return all jumpers to the right, the Digital Section is OK. If pin 4 doesn't go low when pin 3 goes high, replace U19. If pin 4 doesn't reach at least 10V when pin 3 is low, see A3 Power Amp section.

s. Signature Analysis Signatures

Conditions for signature analysis:

HTROK = HI, REFON = HI, RESET = TEST; TP2, TP3, and pin X of HTROK jumper to ground.

Pin	U1	U2	U3	U4	U5	U6	U8	U9	U19
1	X	4UHP	CCPC	6678	4CCA	41A5	CCPC	4CCA	F9C3
2	X	7U30	41A5	0000	FP96	0000	UA4P	4H86	X
3	X	41A5	FP96	8A5F	P861	FO9F	27HH	A5P7	7130
4	F9C3	4A39	41A5	0000	4UHP	CU8C	UA4P	4UHP	X
5	UA4P	CCPC	FP96	2OH3	P861	267H	41A5	7130	961P
6	CCPC	961P	8U33	FP96	4H86	9CHA	0000	6678	PC06
7	0000	0000	0000	UA4P	0000	0000	0000	C5U7	0000
8	27HH	7130	3P95	0000	CCPC	4UHP	4UHP	0000	0000
9	6678	8U33	7U30	6678	CCPC	4CCA	CC8F	UA4P	CCPC
10	OP7C	6678	41A5	AOHO	CCPC	4A39	4UHP	CC8F	PC06
11	4UHP	538U	20H3	88F5	A5P7	FF57	41A5	7U30	7U30
12	7U30	F9C3	FP96	0000	P861	0000	CC8F	FP96	0000
13	3P95	41A5	CCPC	538U	OP7C	9CHA	C5U7	CCPC	CCPC
14	41A5	41A5	41A5	0000	41A5	41A5	41A5	X	41A5
15	X	X	X	4UHP	X	X	X	X	X
16	X	X	X	41A5	X	X	X	41A5	X

8-125. Photodiode and Amplifier Troubleshooting

8-126. The procedure assumes that the power supplies are functioning properly. Use a dedicated digital voltmeter, not the signature analyzer voltmeter function.

a. Defeat high-voltage interlock by setting A1S2 to TEST. Set HTROK jumper to LO, PHOTODIODE jumper to TEST, liquid crystal jumper to PASS. Is voltage at TP16 more negative than -4V? If no, go to step c. If yes, go to step b.

b. Set LIQUID CRYSTAL jumper to ACT. Is voltage at TP16 more positive than -1V? If no, go to step c. If yes, go to step d.

c. Verify U11 pin 13 is 0V ±10 mV. If not, replace U11. Verify voltage at TP16 is 6/11 of that at U11D pin 14 and voltage at junction of R20-R22 is 1/11 of that at U11D pin 14. If not, check R6, R17, R20, R22, and R24. Also U12A or U12D may be incorrectly loading this node.

d. Amplifier is OK. Check photodiode. Verify laser is on. Set photodiode jumper to NORM. Measure TP16 voltage. If it is ≥+0.5V then photodiode A4CR1 is good. If it is ~-6V then either the photodiode is shorted or U11 is bad. If it is -0.5V to +0.5V go to step e.

e. Remove photodiode jumper (A3JMP5) and check for diode action between the left hand pin of the jumper and ground. If no diode action is observed, replace A4CR1. Otherwise, not enough light is reaching the photodiode. Remove the sampler assembly and inspect the liquid crystal, beam splitters and A4CR1 for dirt, scratches, etc. If O.K., see Liquid Crystal Troubleshooting.

8-127. Liquid Crystal Troubleshooting

8-128. This procedure assumes the digital circuits and the photodiode and amplifier circuit are functioning properly.

a. Set A1S2 to TEST. Verify laser is on. Set all jumpers on A3 to left except liquid crystal to PASS. Insert test polarizer (HP P/N 1000-0616) between laser assembly and sampler assembly. The bottom edge of the polarizer should be parallel to the base of the 5517A. Measure TP16 voltage. Is it <0.2V? If yes, go to step c. If not, go to step b.

b. Rotate polarizer 90 degrees. Is TP16 voltage <0.2V? If yes, go to step c. If no, go to step f.

c. Rotate polarizer 90 degrees. Is TP16 voltage >0.5V? If yes, go to step d. If not, go to step f.

d. Set Liquid Crystal jumper to ACT. Is TP16 voltage <0.2V? If yes, go to step e. If not, go to step f.

e. Rotate polarizer 90 degrees. Is TP16 voltage >0.5V? If yes, the liquid crystal is OK. If no, go to step f.

f. Liquid crystal may not be working. See Paragraph 8-61, Liquid Crystal Test. Check that the elastomeric connectors are connecting A4 and liquid crystal.

NOTE

The older HP 5517A's have the black conductive rubber strips instead of the pink elastomeric connectors. The conductive rubber strips were found to develop bad contacts at A4 and the liquid crystal. If this problem develops, clean both sets of contacts with isopropyl alcohol and install the elastomeric connectors (HP part number 8160-0530).

8-129. Subtracting Sample and Hold Troubleshooting

8-130. This procedure assumes the digital circuit and photodiode and amplifier are functioning properly.

a. Set $\overline{\text{REFON}}$ jumper to LO, set HTROK to HI. Wait for READY LED to remain on. Set HTROK to NORM. Set photodiode jumper to TEST, set LIQUID CRYSTAL jumper to ACT. Using a dedicated DC voltmeter, check that the voltage at TP16 is -50 mV to +50 mV? If yes, go to step c. If no, go to step b.

b. The circuitry connected to pin 2 or pin 15 of U12 is incorrectly loading photodiode amp when switch U12A or U12D is closed. Check U11, C13, and C14.

c. Is voltage at TP13 equal to voltage at TP16 within 10 mV? If no, go to step d. If yes, go to step e.

d. Verify U12 pin 8 is low. Measure voltage from U11B pin 5 to TP13. Is it -10 mV to +10 mV? If yes, go to step i. If no, U11B is defective or its output is incorrectly loaded.

e. Is voltage at TP14 equal to voltage at TP16 within 10 mV. If yes, go to step g. If no, go to step f.

f. Verify U12 pin 9 is low. Measure voltage from U11C, pin 10 to TP14. Is it -10 mV to +10 mV? If yes, go to step i. If no, U11C is defective or its output is incorrectly loaded.

g. Set POWER AMP jumper to UP. Is voltage at TP12 between -20 mV and +20 mV? If yes, go to step i. If no, go to step h.

h. Verify U11A pin 3 voltage is about 1/2 of TP13 voltage. Verify U11A pin 2 voltage = U11A pin 3 voltage. If not, U11A, R10, R12, R14, or R15 may be bad.

i. Place liquid crystal jumper to NORM. TP16 will alternate between about 0V to about -5V. Record these voltages (the delta V function of the 5005 is useful here). Measure voltage at TP13. It should be the same 0V reading as at TP16, within 20 mV. If OK, go to step k. If not, go to step j.

j. Measure the voltage on C13. During and just after the switch (U12A) is closed (delayed active signal on U9 pin 3), the voltage should equal the approximate zero voltage at TP16. If it is not, or if the voltage rapidly goes to zero, then C13 is shorted or the switch U12A does not work. Also check that U12B is open and U11B is not shorting this node.

k. Is the voltage at TP14 within 20 mV of the approximate -5V voltage at TP16. If yes, go to step m. If not, go to step l.

l. Measure the voltage on C14. During and just after the switch, U12D, is closed (Delayed Passive signal on U9, pin 2), the voltage should equal the approximate -5V at TP16. If it is not, or the voltage rapidly goes to zero, then C14 is shorted or U12D is faulty. Also check that U12C is open and U11C is not, shorting this node.

m. Set PHOTODIODE jumper to TEST, LIQUID CRYSTAL to PASS, POWER AMP to UP. Verify TP16 voltage is approximately -5V. Measure voltage at TP14, record this as V14. Measure voltage at U11A pin 3, record this as V3. Measure voltage at TP12. Is it equal to [2×V3] - V14 within 30 mV? If yes, go to step o. If no, go to step n.

n. Verify U11A pin 2 is at the same voltage as U11A pin 3. If not, U11A or R15 bad. Also check R14, R10, and R11.

o. The procedure thus far has shown that the subtracting sample and hold works during optical mode. Next the operation during warmup is checked. Turn power off. Move all A3 jumpers to NORM except $\overline{\text{REFON}}$ to HI. Connect an ohmmeter between pin 6 and 7 of U12B. Turn power on. Meter should read open circuit when the DISABLE signal (U9, pin 5) is low. Meter should read less than 250 ohms when DISABLE is high. (The 5005 measures ohms to ground so pin 6 or pin 7 of U12B will have to be grounded for this test). If the result is satisfactory, go to step p. If not, U12B is defective.

p. Connect an ohmmeter between U12 pin 10 and ground. Ohmmeter should read less than 250 ohms while OPTICAL (U9, pin 12) is low. If it does, go to step q. If not, U12C is faulty.

q. Set $\overline{\text{REFON}}$ to LO, HTROK to HI and wait for ready LED to stay on. Ohmmeter should read open. If not, U12C is bad or the node is shorted. If it reads open, the sample and hold is OK.

8-131. Power Amplifier Troubleshooting

a. Set HTROK jumper to HI, $\overline{\text{REFON}}$ to LO and wait for READY LED to stay on. Set POWER AMP jumper to UP. Remove HEATER jumper. Is voltage at U13 pin 3 approximately 0.1V? If not, check R27, R31, R49, R50, R51, C18, and U13. If so, go to step b.

b. Within 3 minutes of setting POWER AMP to UP, is the voltage at TP11 >13V. If yes, go to step d. If not, go to step c.

c. Is U13 pin 6 >13V. If yes, go to step j. If no, replace R33 or U13.

d. Set Power Amplifier jumper to DOWN. Is voltage at TP 11 <0.6V within 3 minutes? If yes, go to step g. If no, go to step e.

e. Is U13 pin 6 <–10V? If yes, go to step l. If no, go to step f.

f. Is U13 pin 3 approximately -0.1V? If yes, check R33 or U13. If no, check R49, R50, R51, U13.

g. While observing voltage at TP11, move POWER AMP jumper from DOWN to UP. TP11 voltage should jump to about 5V and then ramp up 0.1V/second. If OK, go to step h. If the jump is >5.7V then either R32, R40, C20, or CR3 is open; or R33 is shorted; or check R49, R50, or R51. If the jump is <4.5V then either R32, R40, R41, CR3 or CR4 is shorted; or R39 is open; or check R49, R50, R51. If the ramping is too slow or too fast, then check R33, R49, R50, R51 and C20. If OK, go to step h.

h. When TP11 voltage is >13V, measure voltage from TP11 to TP17. If it is 5.7V to 6.7V, go to step i. If it is >6.7V, then CR4 is open. If it is <5.7V, then either R40, R41, or CR4 is shorted; or R39 is open.

i. Set HEATER jumper to OFF. Voltage at TP11 should be 0.2V to 0.6V. If so, the power amp is OK. If it is <0.2V, R9 is open.

j. Set POWER AMP to UP, HEATER jumper to NORM. Wait for U13 pin 6 to be >13V. Measure voltage at Q5 base. If it is <1V, go to step k. If it is >1V, R36 may be open.

k. Measure voltage across R37. If it is zero, then Q5 or R38 is open. If it is greater than 1V then C20, heater, or R39 is shorted; or Q3 or R33 is open; or check R21 and U14 loading this node; or Q3 is bad.

l. Set POWER AMP jumper to DOWN. Wait for U13 pin 6 to be <–10V. Measure voltage at Q5 base. If it is >1V, then Q5 is shorted. If it is <1V, go to step m.

m. Measure voltage across R37. If it is >1V, then Q5 is shorted or R37 open. If it is zero, then Q3 or R9 is shorted or the heater is open.

8-132. Warm-Up Error Amplifier Troubleshooting

8-133. This procedure assumes the power amplifier is functioning properly.

a. Set HEATER jumper to OFF. Is TP11 voltage 0.2V to 0.6V? If yes, go to step b. If no, go to power amplifier servicing.

b. Is TP15 voltage 0.2V to 0.6V? If yes, go to step c. If no, R18, R19 or U14 is faulty.

c. Check R16 to see if it is shorted. Short TP15 to TP11. Measure U14 pin 6. Does the voltage stabilize between –1.5V and +1.5V? If yes, go to step d. If no, R21, R23 or U14 is faulty.

d. Remove TP15 to TP11 short and short TP15 to ground (TP18). Is U14 pin 6 voltage more negative than –12V? If yes, go to step e. If no, U14 is faulty.

e. Is voltage at U15 pin 3 half of U14 pin 6 voltage? If yes, go to step f. If no, R25, R26, U12 or U15 is faulty.

f. Is voltage at U15 pin 2 between 1.2V and 1.3V? If yes, go to step g. If no, R28, R29, R30 or U15 is faulty.

g. Is U15 pin 7 >3V? If yes, go to step h. If no, R5F, R48C, U8A or U15 is bad.

h. Remove TP15 short and short TP11 to ground. Is U14 pin 6 voltage >12V? If yes, go to step i. If not, U14 is bad.

i. Is U15 pin 7 between 0.10 and 0.20? If yes, the warm-up error amplifier is OK. If no, R5F, R48C, U8A or U15C is faulty.

8-134. Power Supplies Troubleshooting

8-135. If the correct voltage is not observed on A3TP8, 9, or 10 typical power supply troubleshooting should be followed. Following are suggested points to check:

a. Power comes from the 63312F Power Supply.

b. A1CR1 is in series with the –15V line.

c. A3L1 and A3L2 are in series with the power supplies.

d. There should be >200 ohms from +15V to ground.

e. If F1 blows, check for open in A1R3, A1R4 or middle lead of A1J3 open, or excessive current to High Voltage power supply. (See High Voltage Power Supply Troubleshooting in Paragraph 8-75.

f. Power supply components are on A1 and A3.

8-136. Reference Receiver Troubleshooting

a. With power removed from the 5517A set the REFON jumper on A3 to LO and HTROK to HI. Turn the 5517A power on. Does the READY LED eventually start blinking then remain on continuously? If no, see 5517A Trouble Isolation Procedure, Paragraph 8-64 and procedures recommended therein.

b. Are TTL level signals present at A3U16 pins 1 and 3 at a frequency between 1.5 and 2.0 MHz? If so the reference receiver may be working properly. If not, trace the signal path from U17 pin 16 to U16 pins 5, 6, and 7 (TP19) and check for the following:

U17 pin 16: 0.3 to 0.7 volt square wave at the REFERENCE FREQUENCY,1.5 to 2.0 MHz.

TP19: TTL level square wave at the REFERENCE FREQUENCY, 1.5 to 2.0 MHz.

If there is no activity found check U17 pin 2. If pin 2 is at a TTL high level or changing states then either the laser is not tuned properly, or the Reference Receiver is failing or not receiving adequate signal. Verify laser tuning according to step c before continuing with step d. If U17 pin 2 is at a TTL low level and there is no output activity as described above then U17 may be bad or it's output may be shorted. Go to step d.

c. Align a 10780A receiver so that the laser output beam is incident on the photodiode lens. If the laser is properly tuned, the LED on top of the 10780A should light and the 10780A should output a square wave at the REFERENCE FREQUENCY. This test can be performed with the laser installed using one of the axes' receivers. In this case, if the axis interferometer is installed, vibration, etc. will modulate the REFERENCE FREQUENCY but a frequency in the range of 1.5 to 2.0 MHz should still be apparent. If no steady REFERENCE FREQUENCY signal is detected by the 10780A then a laser tuning failure is indicated which is independent of the Reference Receiver. See 5517A Trouble Isolation Procedure, Paragraph 8-64. Otherwise proceed with step d.

d. Measure and record the DC voltages at U17 pin 10 and the CR5-R46 node. With REFON jumper still set to LO, place a piece of paper between the laser assembly and the sampler assembly to block the laser beam. The voltage at U17 pin 10 should drop by 250 mV or more, indicating adequate signal, and the following DC voltages should be measured on the pins of U17 with the beam blocked:

PIN	DC VOLTAGE	POSSIBLE TROUBLE
9,12,14	V_{cc}	Power Supply
1,15	gnd	Ground
11	TTL HIGH	U17, U3B, Digital Circuits
8	0.7V ±0.1	R44, U17
7	4.8V ±0.1	C22, U17
6	0.7V ±0.1	R43, R44, C23, U17
5	2.3V ±0.2	C24, U17
4	0.8V ±0.1	C23, U17
10	1.6V ±0.2	C28, U17
3	V_{cc}+0/–0.1	U17
2	V_{cc}+0/–0.1	U17
13	<80 mV	U17
16	0.7V ±0.1	Q6, U17

If any voltage is incorrect, check or replace the listed part.

If the voltage at pin 10 does not drop according to the above, measure the DC voltage at the CR5-R46 node with the beam blocked. It should be approximately 15 volts and should have increased at least 6 mV above the value measured and recorded previously when the laser beam was unblocked. If not check R46, C27, or CR5. CR5 can be checked by removing power from the 5517A and checking for diode action of CR5 using a DC ohmmeter. Resistance measured in the reverse direction should be much larger than the resistance measured in the forward direction. If CR5 is OK replace U17.

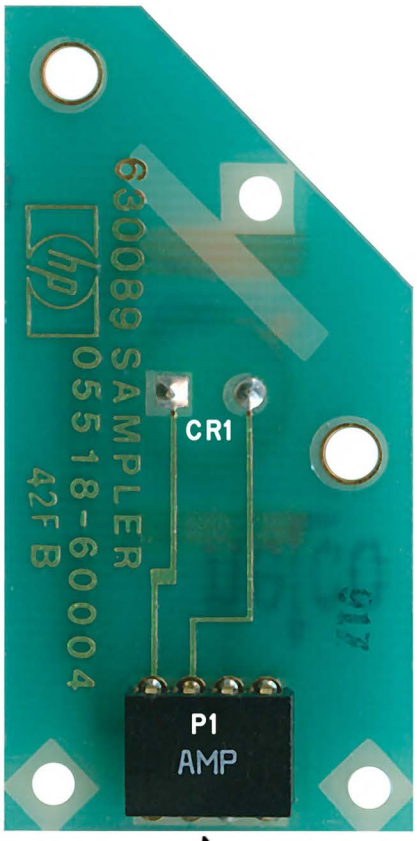
e. In cases of marginal signal strength the following factors should be checked:

Laser assembly output power.
Sampler assembly function.

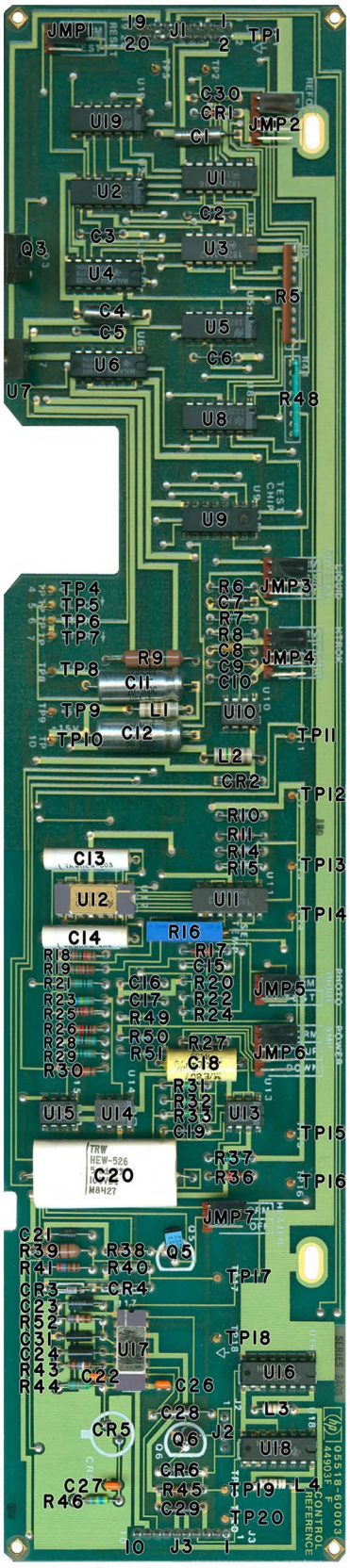
The laser assembly output power should be checked according to Laser Power Output Test, Paragraph 4-9.

The sampler assembly can be checked as follows:

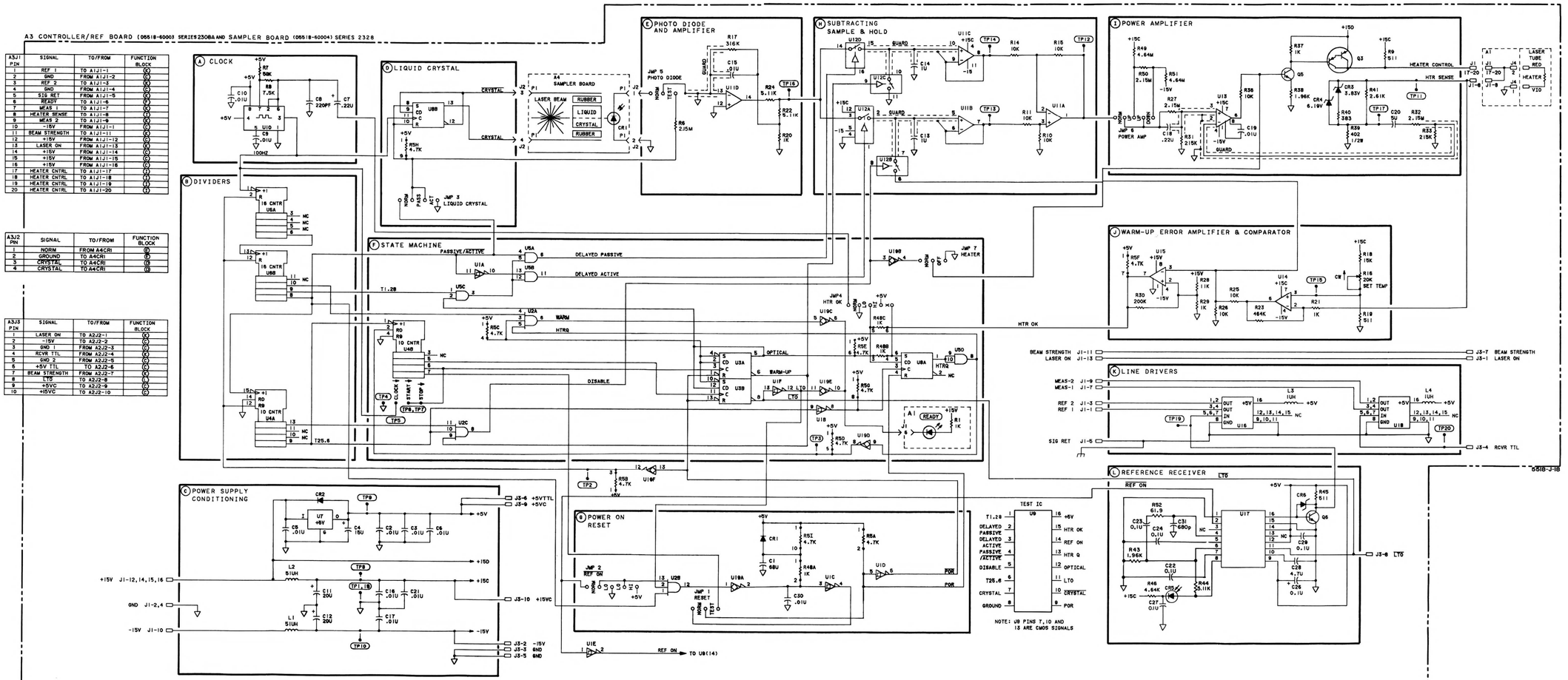
1. Remove power from the 5517A.
2. Remove A4
3. Rest the test polarizer, HP P/N 1000-0616A, (supplied with 5517A), against the exposed Reference Receiver exit port of the sampler. The test polarizer will serve as a viewing screen in order to examine the laser beam which is normally incident on the Reference Receiver photodiode. Apply power to the 5517A. Examine the laser beam cross section illuminating the polarizer. It should be circular and centered within a few millimeters with respect to the exit port although slight eclipsing is normal. If any intensity variations are visible across the beam diameter they should be straight regularly spaced lines of high and low intensity, not spots or irregular shapes. Rotate the polarizer 90 degrees and repeat the above observations. The sampler can be removed and the internal beam splitters and polarizers examined for scratches dirt or cloudiness. Check the A3CR5 lens for scratches, dirt, or cloudiness. Also, see Liquid Crystal Troubleshooting, step f.



A4 SAMPLER BOARD
COMPONENT LOCATOR



A3 CONTROLLER/REFERENCE
BOARD COMPONENT LOCATOR



NOTES:

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN FARADS; INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES FACTORY SELECTED COMPONENT, AVERAGE VALUE SHOWN.

Reference Designations
C1-31
CR1-6
J1-3
JMP1-7
L1-6
Q3,5,6
R2, 5-11, 14-33, 36-41, R43, R44 R46, R48-R52
TP1-20
U1-19

DELETED C15, Q1, Q2, Q4, R1, R3, R4, R12, R13, R34, R35, R42, R45, R47, R52, L5, L6

TABLE OF ACTIVE ELEMENTS

Reference Desig.	HP Part No.	Mfr. Part No.
Q3	1853-0332	MJE1091
Q5, 6	1854-0215	2N3904
U1	1820-1416	SN74LS14N
U2	1820-1203	SN74LS11N
U3	1820-1112	SN74LS74AN
U4	1820-2078	SN74LS490N
U5	1820-1201	SN74LS08N
U6	1820-2096	SN74LS393N
U7	1820-0122	7805UC
U8	1820-0939	CD4013BE
U9	1260-0510	1260 0510
U10	1820-2466	ICM7555IPA
U11	1826-0753	MC34004BL
U12	1826-0416	LF13331D
U13	1826-0493	MLM308API
U14	1826-0296	1826 0296
U15	1826-0065	UPC311C
U16,18	1820-2668	SN75114N
U17	1826-0775	1826-0775
U19	1820-0471	SN7406N

Figure 8-18. A3 Controller/Reference Board 05518-60003 and A4 Sampler Board 05518-60004, Schematic Diagram

Figure 8-18
A3 CONTROLLER/REFERENCE BOARD 05518-60003 AND A4 SAMPLER BOARD 05518-60004, SCHEMATIC DIAGRAM

(See Page 8-35)

MANUAL UPDATING CHANGES **CHANGE DATE:** December 20, 1984

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

This supplement adapts your manual to instruments with serial numbers prefixed through **2504.**

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

Instrument: Model 5501A
Laser Transducer System
System Operating & Service Manual

Manual Part No: 05501-90028
Manual Microfiche: 05501-90029
Manual Print Date: May 1983

ABOUT THIS SUPPLEMENT

The information in this supplement is provided to correct manual errors and to update 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.

Manual updating supplements are revised as often as necessary to keep manuals as accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the model number, print date, and part number listed at the top of this page.

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
2312A thru 2504	These changes do not affect the contents of the System Operating & Service Manual.

MANUAL UPDATING CHANGES **CHANGE DATE:** August 1, 1985

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

This supplement adapts your manual to instruments with serial numbers prefixed through **2532.**

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

Instrument: HP 5517A Laser Head Operating & Service Manual

Manual Part No: 05517-90007

Manual Microfiche: 05517-90008

Manual Print Date: May 1985

ABOUT THIS SUPPLEMENT

The information in this supplement is provided to correct manual errors and to update 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.

Manual updating supplements are revised as often as necessary to keep manuals as accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the model number, print date, and part number listed at the top of this page.

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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.

HEWLETT PACKARD

LIST OF EFFECTIVE PAGES

SERIAL PREFIX OR SERIAL NUMBER	PAGES
2408A	8-35
2520A	6-7
2532A	1-4, 2-9, 6-7, 8-12

SERIAL PREFIX OR SERIES NUMBER	CHANGES

Page 1-4, Figure 1-1. 5517A Laser Head:

2532A >The Laser Head cover no longer requires a top hole because the laser tube fins have been machined down.

Page 2-9, Figure 2-6. HP 5517A Laser Head dimensions:

2532A >The Laser Head cover no longer requires a top hole because the laser tube fins have been machined down.

Page 6-7, Figure 6-1. 5517A Laser Head Exploded View:

2520A >Change MP10 from 0515-0332 (6-MM LG) to 0515-0426 SCREW-MACH 3 X .5 10-MM LG.
>Add MP10a 3050-1227 WASHER-BEVELED.

2532A >Delete Item 8, Gasket-EMI, part number 8160-0398.
>Change Item 9, Cover, part number from 05518-00008 to 05518-00011.

NOTE
The Laser Head cover no longer requires a top hole because the laser tube fins have been machined down.

Page 8-12, Figure 8-9. 5517A Assembly Designations:

2532A >The Laser Head cover no longer requires a top hole because the laser tube fins have been machined down.

Page 8-35, Figure 8-18. A3 Controller/Reference Board Schematic Diagram:

2408A >Change A3 SERIES to 2408.

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