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HP 10751A/B Calibration Procedure

Due to the complexity of the calibration procedures and the test equipment required, it is recommended that the HP 10751A/B be returned to Hewlett-Packard for calibration.

The HP 10751A/B Pressure and Temperature circuitry both require a 12-month calibration cycle. Also, calibration should be performed after repair is made to any of the 10751A/B circuits except the humidity switch.

Equipment Required. Refer to *Table 7-20* for a list of test equipment required for the HP 10751A/B calibration procedures. In addition, the procedures require the HP 5507A and the HP 3456A Digital Voltmeter. Also for convenience, the following additional equipment is recommended:

Accessories for Temperature Calibration

*Extender Cable, (10751-60201/60202 to 10751-60001)
*Extender Cable, (10751-60001 to 10751-60002)

Accessories for Pressure Calibration

*Extender Cable, (10751-60201/60202 to 10751-60001)
*Adapter, (¼ inch I.D. Pneumatic Hose to 10751A/B Pressure Transducer

Table 7-20. Recommended Test Equipment (Note 1)

INSTRUMENT	USE* (Note 2)	SPECIFICATIONS	RECOMMENDED EQUIPMENT
Quartz Thermometer with Probe	51,57	Range: 0-50°C Accuracy: ±0.04°C	HP 2804A and HP 18120A Laboratory Probe
Temperature Bath	51,57	Volume: 15 Liters Uniformity: ±0.01°C	Benco Grant Model SP15
Refrigeration Unit for Temperature Bath	51,57		Benco Grant Model CC-15
Dielectric Liquid for Temperature Bath	51, 57		Flourinet FC-40 3M Company
Precision Pressure Controller	51	Range: 22-31 in. Hg (minimum) (558.8-800 mm Hg) Accuracy: ±0.0125% of reading	Texas Instruments Model 156-02
Calibration Accessories	51, 52	Extender Cables and Adapter	See Note 3

Note 1: This equipment not required if both HP 10751A/B and 10757A/B/C are returned to Hewlett-Packard for periodic calibration.

Note 2: 51 = HP 10751A/B Calibration
57 = HP 10757A/B/C Calibration

Note 3: Contact the nearest Hewlett-Packard Sales and Support Office for assistance in ordering the any calibration accessories.

*These items are available from HP. Contact your local HP Sales and Support Office for ordering instructions.

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WARNING

MAINTENANCE DESCRIBED HEREIN IS PERFORMED WITH POWER SUPPLIED TO THE INSTRUMENT, AND PROTECTIVE COVERS REMOVED. 100 VOLTS TO 240 VOLTS AC MAY BE PRESENT IN THE HP 5507A EVEN WHEN THE FRONT PANEL SWITCH IS SET TO OFF. MAINTENANCE SHOULD BE PERFORMED ONLY BE SERVICE-TRAINED PERSONNEL WHO ARE AWARE OF THE HAZARDS INVOLVED (e.g., FIRE AND ELECTRIC SHOCK). WHERE MAINTENANCE CAN BE PERFORMED WITHOUT POWER APPLIED, THE POWER CORD SHOULD BE REMOVED.

CAUTION

The HP 10751A/B circuitry is susceptible to damage from electrostatic discharge. Therefore, use of an anti-static work station and ground straps when handling printed circuit assemblies (during assembly and disassembly) is recommended.

TEMPERATURE CALIBRATION PROCEDURE

The air temperature transducer calibration is performed with the temperature transducer assembly (10751-60002) immersed in a temperature controlled bath at 20°C ±1°C.

NOTE

The 10751-60002 should only be immersed in dielectric liquid, Flourinet FC-40 or equivalent. The 10751-60002 should not be immersed in water.

The equipment in *Table 7-19* should be configured to form the system depicted in *Figure 7-26*.

a. Set HP 5507A front panel LINE switch to OFF and remove ac power cable (W1) from instrument's rear panel.

b. On the HP 10751A/B, remove the label on the humidity switch side of the housing.

c. Remove the Pozidriv screws located beneath the label.

d. Carefully remove the HP 10751A/B cover noting how the printed circuit boards are mounted between the cover and the cable assembly.

e. Detach the 10751-60001 board from the cable assembly. Check that the key is inserted in the unused contact of the cable assembly connector corresponding to the missing pin on the 10751-60001 plug.

f. Inspect cable and connectors for damage.

g. Install extension cable (10751-60204) between cable assembly and 10751-60001.

h. Secure 10751-60001 such that power can be applied and the TEMP potentiometer, A1R1, can be adjusted.

i. Install extension cable (10751-60203) between 10751-60001 board and 10751-60002 board.

j. Immerse 10751-60002 board in the bath within close proximity of the quartz thermometer probe without resting either on the inside of the bath housing.

k. Connect HP 10751A/B cable assembly to HP 5507A rear-panel connector marked AIR SENSOR.

l. Remove HP 5507A top cover.

m. Connect the positive lead of the DVM to HP 5507A rear panel +10V REF OUTPUT connector, and the negative lead to test point TP2.

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n. Plug HP 5507A into ac outlet and set LINE switch to ON.

o. Wait until HP 5507A has completed its system self tests; the front-panel TALK, LISTEN, and SRQ LEDs are cycling.

p. Set HP 5507A to output data in Metric units. The power-up default of the HP 5507A is in Metric units. If system is set to output in English units, send mnemonic *MET to both the Axis and Automatic Compensation board. "*" is the address of the respective board.

q. Monitor the quartz thermometer to be sure that the bath temperature is stable at 20°C ±1°C to within 0.03°C for a 1 minute period.

r. Note the value of +10 V_{ref} indicated by the DVM. The measured value should be +10V ±10 millivolts. If not, check setup and see "HP 10751A/B Air Sensor Troubleshooting". Record the value of +10 V_{ref} for use in step t.

s. Connect floating negative terminal of DVM to test point TP2 (Analog Common) and positive terminal of DVM to pin 6 of R5 (AT input from air sensor), both located on the HP 10946B board. (Analog Common) on the HP 10946B.

t. Note the reading of the quartz thermometer (in °C) and calculate the adjustment voltage, V, as follows:

$$V = 0.87502 - (0.0335 \times T) + dV$$

where T = reading of the quartz thermometer, and $dV = +10\ V_{ref} - 10$

u. Adjust TEMP potentiometer A1R1, such that the DVM reading equals V from step t ±250 microvolts.

v. The accuracy of the HP 10751A/B temperature measurement can be checked using the quartz thermometer and stable bath temperature within the operating range of the 10751A/B, 0 to 40°C.

Procedure:

1. Perform the calibration procedure for the HP 5507A's Automatic Compensation board as outlined in the "HP 10946B Automatic Compensation Board Calibration" paragraphs of this section.
2. Enable Air Sensor A/D channel by sending appropriate Channel Enable Byte mnemonic (*CEB).
3. Read the temperature from the HP 5507A by sending mnemonic *ATV? where "*" is the address of the Automatic Compensation board.
4. The bath temperature can now be adjusted to various temperatures within the range of 0 to 40°C in order to verify temperature measurement specifications of the HP 10751A/B. The reading of the quartz thermometer should be allowed to stabilize at each selected temperature to within ±0.03°C for 1-minute before comparing the reading to that of the HP 5507A. An offset of +0.76°C should be added to the HP 5507A reading for comparison purposes. Adding this offset corrects for the fact that the bath temperature instead of the air temperature is being measured by the HP 10751A/B Air Sensor.
5. If any reading within the operating range indicates measurement error outside the accuracy specification of the HP 10751A/B, the temperature transducer assembly (10751-60002) should be replaced and the calibration procedure repeated.

w. Turn HP 5507A ac power to OFF and remove ac power cable (W1) from instrument's rear panel.

x. Remove 10751-60002 from the bath and allow to dry.

y. Disconnect HP 10751A/B and reassemble or continue with pressure calibration.

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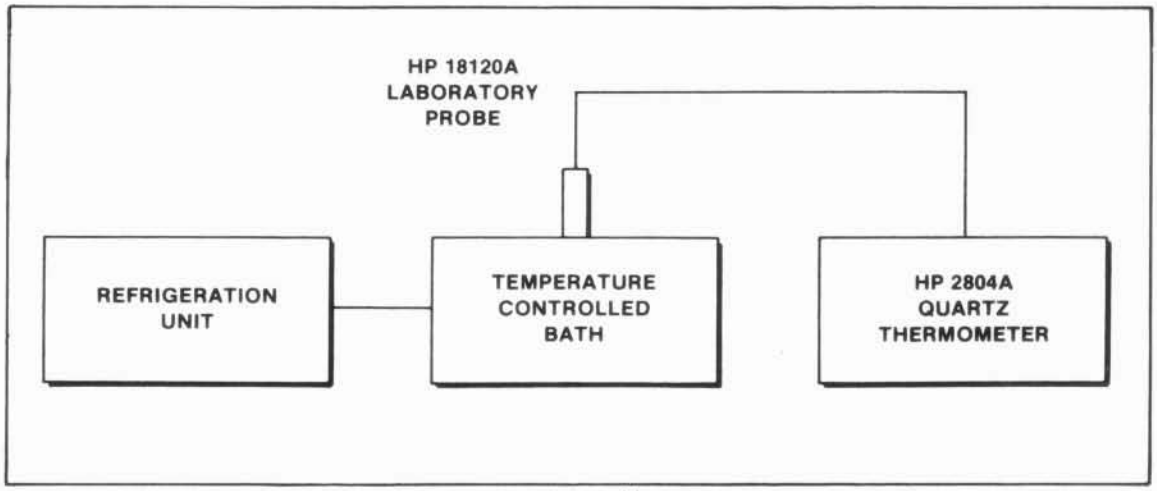


Figure 7-26. HP 10751A/B Temperature Calibration Test System Configuration

AIR PRESSURE CALIBRATION PROCEDURE

The equipment listed in *Table 7-20* should be configured to form the system depicted in *Figure 7-27.*

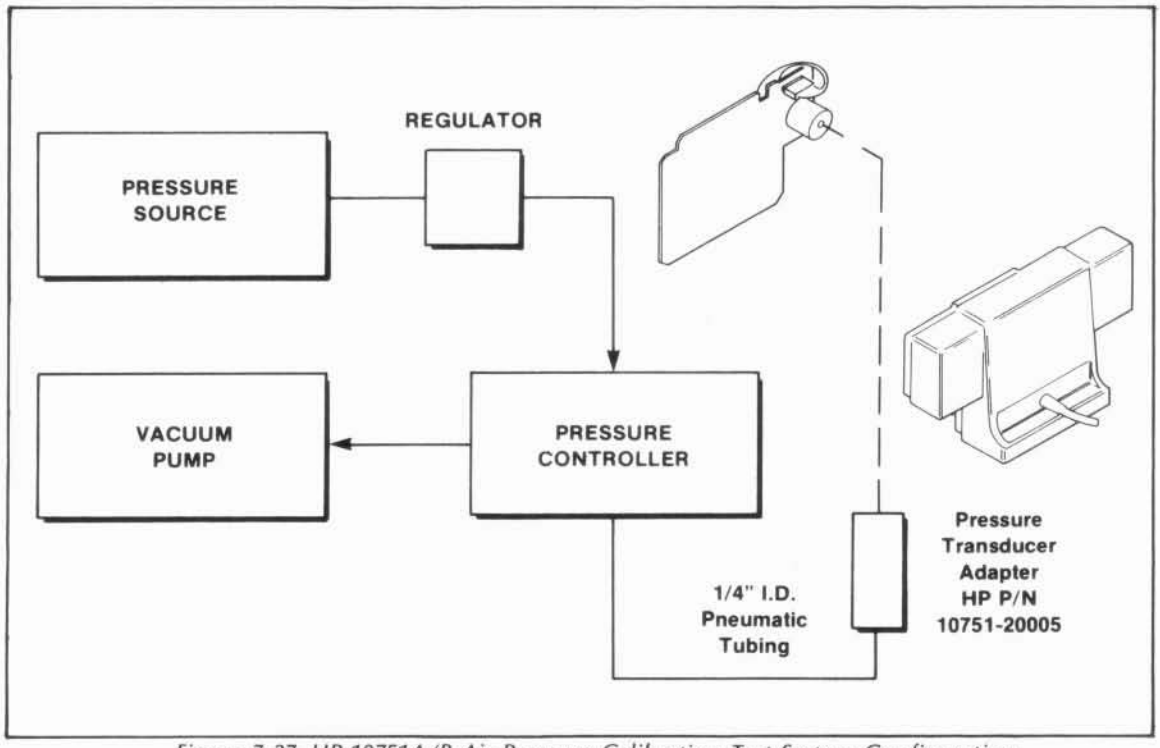


Figure 7-27. HP 10751A/B Air Pressure Calibration Test System Configuration

a. Set HP 5507A front panel LINE switch to OFF and remove ac power cable (W1) from instrument's rear panel.

b. On the HP 10751A/B, remove the label on the humidity switch side.

c. Remove the Pozidriv screws located beneath the label.

d. Carefully remove the HP 10751A/B cover noting how the printed circuit boards are mounted between the cover and the cable assembly.

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e. Detach the cable assembly from the 10751-60001 board. Check that the key is inserted in the unused contact of the cable assembly corresponding to the missing pin on the 10751-60001 connector.

f. Inspect cable and connectors for damage.

g. Install extension cable (10751-60202) between cable assembly and 10751-60001.

CAUTION

Do not expose the HP 10751A/B Air Transducer A2U1 to pressures outside its operating range of 517 to 776.5 mm Hg.

h. Secure the 10751-60001 board such that power can be applied and the GAIN and OFFSET jumpers can be adjusted.

i. On the 10751-60001 board, turn GAIN potentiometer (A1R8) fully clockwise. Set the pressure calibration GAIN jumpers to the position shown in *Figure 7-28.*

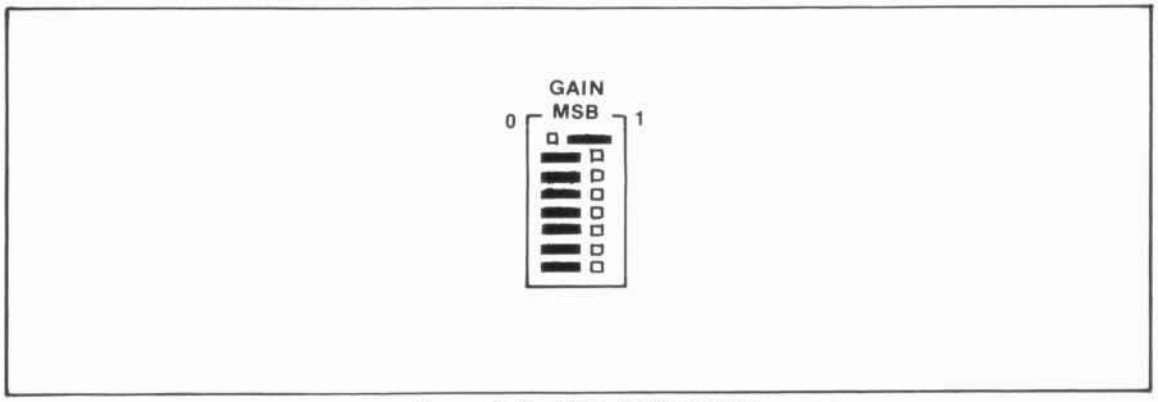


Figure 7-28. 10751-60001 GAIN Jumpers

j. Attach pressure controller to HP 10751A/B pressure transducer (10751-60303), using Adapter (10751-20005) and ¼ inch I.D. pneumatic tubing.

NOTE

The pressure transducer cylinder axis must be horizontal during calibration.

k. Attach HP 10751A/B to HP 5507A rear-panel connector marked AIR SENSOR.

l. Remove HP 5507A top cover.

m. Connect floating negative terminal of DVM to test point TP2 (Analog Common) and connect positive terminal to pin 8 of R5, both located on the HP 10946B board.

n. Connect the HP 5507A power cable to an ac main and set the LINE switch to ON.

o. Set HP 5507A to output data in Metric units. The power-up default of the HP 5507A is in Metric units. If system is set to output in English units, send mnemonic *MET to both the Axis and Automatic Compensation board. "*" is the address of the respective board.

p. Wait 30 minutes after power has been applied to the HP 5507A and 10751A/B.

NOTE

Steps q through t are to be performed for each GAIN jumper in descending order. At this time the MSB jumper should already be set to 1 and all others to 0.

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q. Set pressure controller such that pressure applied to the HP 10751A/B pressure transducer is 517 mm Hg ±0.1 mm Hg. Write down the voltage indicated by the HP 3456A. This voltage will be referred to as $V_{ap}(517)$ in step s.

r. Set pressure controller to 775.5 ±0.1 mm Hg. Write down voltage indicated by the HP 3456A. This voltage will be referred to as $V_{ap}(775.5)$ in step s.

s. If $V_{ap}(517) - V_{ap}(775.5) > 1.0106$ Volts, then leave the jumper at 1. If $V_{ap}(517) - V_{ap}(775.5) <$ 1.0106 Volts, change jumper setting from 1 to 0.

t. Change next GAIN jumper setting from 0 to 1.

u. Repeat steps q through t for each GAIN jumper.

v. Adjust GAIN potentiometer A1R8 such that

$$V_{ap}(517) - V_{ap}(775.5) = 1.0106 \pm 200 \text{ microvolts.}$$

w. Adjust OFFSET jumpers such that $V_{ap} = 0.0000V \pm 200$ microvolts at a controller pressure of 760.2 ±0.1 mm Hg.

x. The HP 10751A/B pressure measurement accuracy can be verified by using the pressure controller to check the 10751A/B pressure measurement within the operating range of the 10751A/B (517 to 775.5 mm Hg).

Procedure:

1. Perform the calibration procedure for the HP 5507A's Automatic Compensation board as outlined in the "HP Automatic Compensation Board Calibration" paragraphs of this section.
2. Enable Air Sensor A/D channel by sending appropriate Channel Enable Byte mnemonic (*CEB).
3. Read the pressure from the HP 5507A by sending mnemonic *APV? where "*" is the address of the Automatic Compensation board.
4. The pressure controller can now be adjusted to various pressures within the operating range of 517 to 775.5 mm Hg. This will verify the pressure measurement specifications of the HP 10751A/B.
5. If any reading within the operating range indicates measurement error outside the accuracy specification of the HP 10751A/B, the pressure transducer assembly (10751-60303) should be replaced.
6. Repeat calibration procedure if pressure transducer has been replaced.

y. Set HP 5507A ac LINE switch to OFF and remove ac power cable (W1) from instrument's rear panel.

z. Disconnect the test setup and reassemble the HP 10751A/B.

HP 10757A/B/C Calibration Procedure

Due to the complexity of the calibration procedures and test equipment required, it is recommended that the HP 10757A/B/C be returned to Hewlett-Packard for periodic calibration.

The HP 10757A/B/C temperature circuitry requires calibration every 12 months. Calibration should also be performed after repair is made to any of the 10757A/B/C circuits.

Equipment Required. Refer to *Table 7-20* for a list of test equipment required for the HP 10757A/B/C calibration procedures. In addition, the procedures require the HP 5507A or 5508A, and an HP 3456A Digital Voltmeter. If an HP 2804A Quartz Thermometer is used, it should have

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been checked at ice point within the previous 3 months. Glass thermometers should be checked at ice point just prior to performing the instrument calibration.

WARNING

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CAUTION

The HP 10757A/B/C circuitry is susceptible to damage from electrostatic discharge, therefore use an anti-static work station and ground straps when handling printed circuit assemblies during assembly or disassembly.

NOTE

The HP 10757A/B/C temperature sensor should only be immersed in dielectric liquid. Flourinert FC-40 or equivalent. The sensor should not be immersed in water.

The equipment in *Table 7-20* should be configured to form the system depicted in *Figure 7-27.*

a. Set HP 5507A front panel LINE switch to OFF and remove ac power cable (W1) from instrument's rear panel.

b. Remove the four screws on the HP 10757A/B/C enclosure.

c. Remove the HP 10757A/B/C cover noting how the printed circuit board is mounted.

d. Inspect cable and connectors for damage.

e. Secure 10757-60001 circuit board into one case half such that power can be applied and potentiometer A1R1 and A1R6 can adjusted.

f. Immerse the sensor head into the bath within close proximity of the quartz thermometer probe without resting either on the inside of the bath housing.

g. Connect HP 10757A/B/C cable assembly to HP 5507A rear-panel connector marked MATERIAL TEMPERATURE 1.

h. Plug HP 5507A into ac outlet and set the LINE switch to ON.

i. Wait until the HP 5507A successfully completes its power-up self tests.

j. Set the English/Metric output of the HP 5507A to Metric using the command mnemonic *MET. Power-up default is in Metric units.

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k. Replace cal match jumper JB1 with a new jumper, HP Part Number 1810-0520. Punch one conductor to match the jumper to the following diagram.

P where P is a punched (broken) conductor and U
U is an unpunched conductor
U
U
U
U
U
U

l. Set bath temperature to 0°C ±1°C. Place the thermometer and HP 10757A/B/C sensor cable end in close proximity in bath away from bath walls.

m. Allow bath to stabilize for an additional 20 minutes after the bath temperature has reached 0° ±1°C.

n. Connect DVM + and – leads to TP2 and TP1 respectively. Note DVM reading (this reading will be referred to as V_O). Note thermometer reading (this reading will be referred to as T_O).

o. Set bath temperature to 40°C ±3°C. Allow bath to stabilize for an additional 20 minutes after the bath reaches 40°C ±3°C.

p. Read DVM (this reading will be called V_{40}). Note thermometer reading (this reading will be called T_{40}).

q. Next, calculate the adjustment voltage V_{A1}:

$$V_{A1} = V_{40} + \left[(145.2 - T_{40}) \times \left(\frac{V_{40} - V_O}{T_{40} - T_O} + 0.0335 \right) \right]$$

r. Adjust the gain trimpot A1R6 until the DVM reads this voltage.

s. Again note the HP 2804A reading (new T_{40}). Calculate V_{A2}:

$$V_{A2} = -0.0335\ (T_{40} - 25.36)$$

t. Adjust the offset trimpot A1R1, and if necessary the coarse offset adjustment jumper S1 until the DVM reads V_{A2}.

u. Set HP 5507A ac LINE switch to OFF and remove ac power cable (W1) from instrument's rear panel.

v. Disconnect the test setup and reassemble the HP 10757A/B/C.

HP 5527A SYSTEM ADJUSTMENT PROCEDURES

HP 5507A Adjustment Procedures

The only HP 5507A Laser Position Transducer Electronics adjustment necessary is the adjustment to the integral system power supply. This procedure is performed only when voltages are measured outside specified limits.

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HP 5527A POWER SUPPLY ADJUSTMENTS

WARNING

MAINTENANCE DESCRIBED HEREIN IS PERFORMED WITH POWER SUPPLIED TO THE INSTRUMENT, AND PROTECTIVE COVERS REMOVED. 100 VOLTS/240 VOLTS AC MAY BE PRESENT IN THE HP 5507A EVEN WHEN THE FRONT PANEL SWITCH IS SET TO OFF. MAINTENANCE SHOULD BE PERFORMED ONLY BY SERVICE-TRAINED PERSONNEL WHO ARE AWARE OF THE HAZARDS INVOLVED (e.g., FIRE AND ELECTRIC SHOCK). WHERE MAINTENANCE CAN BE PERFORMED WITHOUT POWER APPLIED, THE POWER CORD SHOULD BE REMOVED. CONTACT WITH PRIMARY POWER VOLTAGE COULD CAUSE SERIOUS PERSONAL INJURY.

After determining that the power supply requires adjustment, perform the following procedures:

a. Remove ac power from the HP 5507A by setting ac LINE switch to OFF and removing power cable (W1) from rear panel.

b. Remove top and bottom covers of HP 5507A as previously described in the "Disassembly and Reassembly" paragraphs.

c. Remove High Voltage Shield (MP8, *Figure 7-16*).

WARNING

WHEN THE HIGH VOLTAGE SHIELD (MP8) IS REMOVED FROM THE HP 5507A, LINE VOLTAGES ARE EXPOSED WHICH ARE DANGEROUS AND MAY CAUSE SERIOUS INJURY IF TOUCHED. DO NOT REMOVE THE HIGH VOLTAGE SHIELD UNLESS IT IS NECESSARY AND ONLY WHEN THE UNIT IS DISCONNECTED FROM THE POWER MAINS.

d. Locate the following test points on the backplane (05507-60004); "GND", "+5V", "–15V", and "+15V".

e. Connect negative terminal of DVM to the "GND" test point.

f. Locate the ±15 and +5 Volt adjusment pots on the power supply assembly (A14, *Figure 7-14*). See *Figure 7-29* for visual assistance as to where these adjustment potentiometers are located.

g. Connect the positive lead of the DVM to the "+15V" test point located on the backplane.

h. Apply ac power to the HP 5507A by plugging in power cable (W1) and setting front panel LINE switch to ON.

i. Adjust +15 Volts to within limits specified in *Table 7-21*.

j. Set HP 5507A front panel LINE switch to OFF and remove ac power cable from rear panel.

k. Connect positive lead of DVM to "–15V" test point located on backplane.

l. Apply ac power to the HP 5507A by plugging in power cable (W1) and setting front panel LINE switch to ON.

m. Adjust –15 Volts to within limits specified in *Table 7-21*.

n. Set HP 5507A front panel LINE switch to OFF and remove ac power cable from rear panel.

o. Connect positive lead of DVM to the "+5V" test point located on the backplane.

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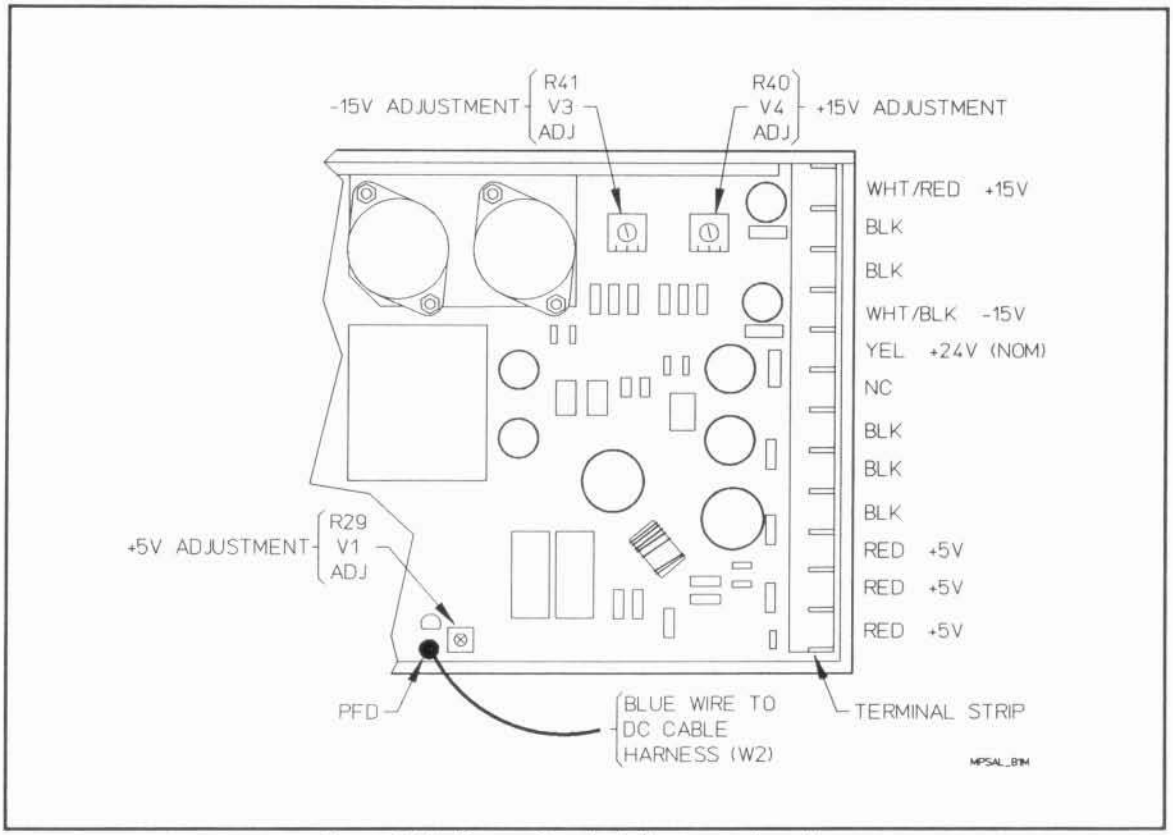


Figure 7-29. Power Supply Adjustment Locations

p. Apply ac power to the HP 5507A by plugging in power cable (W1) and setting front panel LINE switch to ON.

q. Adjust +5 Volts to within limits specified in *Table 7-21*.

r. Set HP 5507A front panel LINE switch to OFF and remove ac power cable from rear panel.

s. Alternate between both adjustment pots until voltages are within limits.

t. When all measured voltages are within their specified limits, set HP 5507A front panel LINE switch to OFF and remove ac power cable from rear panel.

u. Install High Voltage Shield (MP8, *Figure 7-16*).

v. Install top and bottom covers of HP 5507A as previously described in the "Disassembly and Reassembly" paragraphs.

Table 7-21. Power Supply Adjustments

VOLTAGE	LIMITS
+5V	$+4.85V \leq V \leq +5.05V$
+15V	$+14.5V \leq V \leq +15.5V$
–15V	$\lvert 14.5V \rvert \leq V \leq \lvert 15.5V \rvert$
+24V	No Adjustment Required

The previous adjustments should be made while the system is fully loaded (i.e., all pc boards installed; laser head, receivers, and sensors connected). For best results, adjust +15V and –15V supplies to the same absolute value. Also, adjust the +5V supply as close to +5.00 as possible.

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HP Laser Head and Receiver Adjustment Procedures

Each laser head and receiver is shipped with its own service manual. This manual contains the adjustments and checks required to keep each respective laser head and receiver at peak performance. Included in the manual are the test equipment required, equipment setups, and procedures to perform the adjustments. The following is a list of applicable documentation required for adjusting the different laser heads and receivers available from Hewlett-Packard.

Table 7-22. HP 5527A Assembly Adjustment Procedure References

INSTRUMENT NAME	MANUAL'S HP PART NO. (See Note 1)	APPLICABLE SECTION
HP 5501A Laser Head	05501-90025	IV
HP 5517A Laser Head	05517-90007	V
HP 5517B Laser Head	05517-90018	V
HP 5518A Laser Head (Laser Head & Receiver)	05528-90016	V
HP 10780B Receiver	10780-90015	IV

Note 1: The HP part number of a manual is subject to change when the manual is revised (updated).

BEFORE AND AFTER SERVICE PRODUCT SAFETY CHECK

The following safety checks must be performed after any troubleshooting and repair procedures have been completed to ensure the safe operation of the instrument.

WARNING

RESISTANCE CHECKS DESCRIBED BELOW REQUIRE THAT THE POWER CORD BE CONNECTED TO THE INSTRUMENT AND THAT AC POWER BE DISCONNECTED. BE SURE THAT THE POWER CORD IS NOT CONNECTED TO POWER BEFORE PERFORMING ANY SAFETY CHECKS.

a. VISUAL INSPECTION. 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 the cause of any such condition.

b. GROUND CONTINUITY TEST. Plug the power cord (W1) into the HP 5507A rear panel power line module. DO NOT CONNECT THE INSTRUMENT TO AC POWER. Using a suitable ohmmeter, check the resistance from the enclosure (chassis) to the ground pin on the power cord. The reading should be less than 1 Ohm. Flex the power cord while making this measurement to determine whether intermittent discontinuities exist. The resistance check should also be performed from the HP 5507A enclosure to the ground pin of the cord while flexing the interconnect cable.

c. Check any indicated front or rear panel ground terminals using the above procedures.

d. INSULATION RESISTANCE CHECK. Tie the line and neutral pins of the power cable (W1) together. Check resistance from the instrument enclosure (chassis) to line and neutral with the LINE switch ON and the power source disconnected. The minimum acceptable resistance is 2 Megohm. Replace any component that results in a failure.

e. POWER LINE MODULE CHECK. Check line fuse and line voltage selector in the HP 5507A rear panel power line module to verify that the correct fuse is installed and that the instrument is properly set for the AC source to be applied.

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EXCHANGE ASSEMBLIES

Table 7-23 lists HP 5527A/B assemblies that are not serviceable by either the customer or the HP Instrument Service Centers (see *Table 7- 24*). If one of the assemblies listed fails during the warranty period, send the assembly (or the entire instrument) to an HP Instrument Service Center where the assembly will be replaced with an exchange assembly. Exchange assemblies are available only on a trade-in basis, therefore the defective assembly must be returned for credit. The Axis board, A-Quad-B Axis Board, Servo-Axis board, Automatic Compensation board, and HP-IB board should be packaged in anti-static material. Also, the serial number of the HP 5507A/B must be included with these boards along with failure symptom information. See "Packaging" on page 7-92.

For assemblies that fail while out of warranty, contact the same previously mentioned HP Instrument Service Center or obtain pricing information and place your order through any HP Sales Office. As with assemblies covered by warranty, the defective assembly must be returned for credit. If the order is placed through an HP Sales Office, the defective assembly must be sent to that same HP Sales Office.

NOTE

The time allowed between placing the order for the exchange assembly and returning the defective assembly to HP depends on the customer's geographic location. Contact your local HP Sales and Support office for more information.

The exchange program allows the shipment of a replacement assembly within five days of when the HP office places the order. For same day shipment of replacement assemblies, contact your local HP Sales and Support Office and ask for details on the HOTLINE program.

Table 7-23. HP 5527A/B Exchange Assemblies

EXCHANGE PROGRAM NOMENCLATURE	ORIGINAL HP PART NUMBER	EXCHANGE HP PART NUMBER
HP 5501 Laser Head (See Note 1)	05501-60006	05501-69030
HP 5517A/5518A Laser Tube	05517-60801	05517-60501
HP 5517B Laser Tube	05517-60201	05517-69201
HP 5517C Laser Tube	05517-60216	
HP 10757A/B/C Material Temperature Sensor	—	
HP 10757A	—	10757-60501
HP 10757B	—	10757-60502
HP 10757C	—	10757-60503
HP 5507A/B Electronics Axis board	10932-60001/2	10932-69002
A-Quad-B Axis board	10934-60001	10934-69001
Servo-Axis board	10936-60001/2	10936-69002
Automatic Compensator board	10946-60003/4	10946-69004
HP-IB Interface board	05507-60002	05507-69002
Power Supply (HP 5507A)	0950-1660	05507-69005
Power Supply (HP 5507B)	0950-2077	0950-2077
Note 1: The HP 5501A Laser Head is no longer available.		

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Table 7-24 lists HP Service Centers capable of supporting laser products. Those centers identified with an asterisk can provide calibration of material and air temperature sensors, in addition to basic support of laser products.

Table 7-24. HP Service Centers

U.S.A.:	***Mountain View Service Center** Hewlett-Packard Company 301 E. Evelyn Avenue Mountain View, CA 94041, USA (1/415) 694-2000	**Midwest** HP Customer Service Center 5201 Tollview Drive Rolling Meadows, IL 60008 (312) 255-9800
	Southern Pacific Coast HP Customer Service Center 1421 South Manhattan Avenue Fullerton, CA 92631 (714) 758-5490	**Northeast** HP Eastern Region Service Center W 120 Century Road Paramus, NJ 07652 (201) 265-5000
	Rocky Mountain Area HP Customer Service Center 24 Inverness Place East Englewood, CO 80112 (303) 649-5524	**Southwest** HP Customer Service Center 930 E. Campbell Road Richardson, TX 75081 (214) 231-6101
Japan:	***Sagamihara Distrib & Service Ctr** Yokogawa-Hewlett-Packard Ltd. 1-27-15 Yabe, Sagamihara Kanagawa 229, Japan (81/427) 59-1311	
Europe:	***Boblingen Sales** Hewlett-Packard GmbH Zone Office South/West Schickardstrasse 2 D-7030 Boblingen West Germany (49/7031) 645	
	***Bern Sales** Hewlett-Packard (Schweiz) AG Meridweg CH-3172 Niederwangen Switzerland (41/31) 34 34 41	

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PACKAGING

The laser tube assembly should be shipped in an HP container designed for that purpose. In addition, the container must indicate that the laser tube contains magnetic material. To exchange the laser assembly, first order the replacement assembly and then upon receipt, return the old assembly in the same container. If it is necessary to ship a laser assembly, contact your nearest HP Sales and Service Office for an approved container.

Tagging for Service

If the instrument is being returned to Hewlett-Packard for service, please complete one of the blue repair tags (HP Part No. 9320-3896) located at the end of this section, and attach it to the instrument or assembly. For best service results, be as explicit as possible when describing the assembly failure symptoms.

Original Packaging

Containers and materials identical to those used in factory packaging are available through Hewlett-Packard Offices. If the instrument is being returned to HP for servicing, attach a blue tag indicating the type of service required, return address, model number, and full serial number. Also mark the container "FRAGILE" to ensure careful handling. The laser head container should indicate the instrument contains magnetic material. In any correspondence, refer to the instrument by model number and full serial number.

Other Packaging

The following general instructions should be used for repacking system components with commercially available materials. These methods DO NOT apply to the laser tube assembly, which must be shipped in an HP approved container. If the laser assembly has not been removed from the laser head itself, the laser head may be packaged and shipped with the methods below.

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

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

c. Use a layer of shock-absorbing material 70 to 100 mm (3 to 4 inches) thick around all sides of the instrument to provide firm cushioning and prevent movement inside the container. Protect the front panel with cardboard.

d. Seal shipping container securely.

e. Mark shipping container "FRAGILE" to ensure careful handling. Indicate if magnetic material is enclosed.

f. In any correspondence, refer to instrument by model number and full serial number.

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Figure 7-30
HP 5527A LASER POSITION TRANSDUCER SYSTEM BLOCK DIAGRAM

(See Page 7-93)

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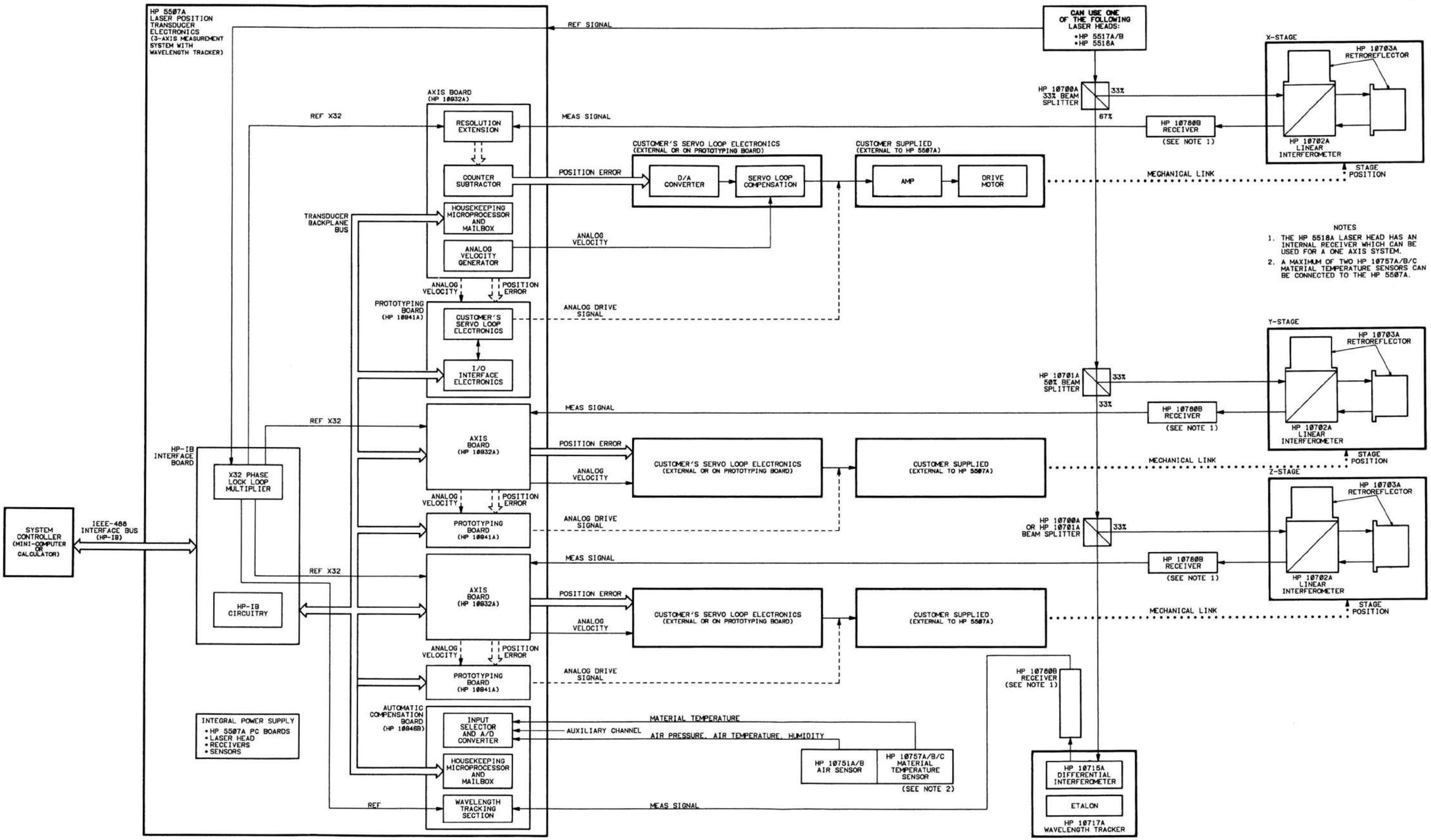


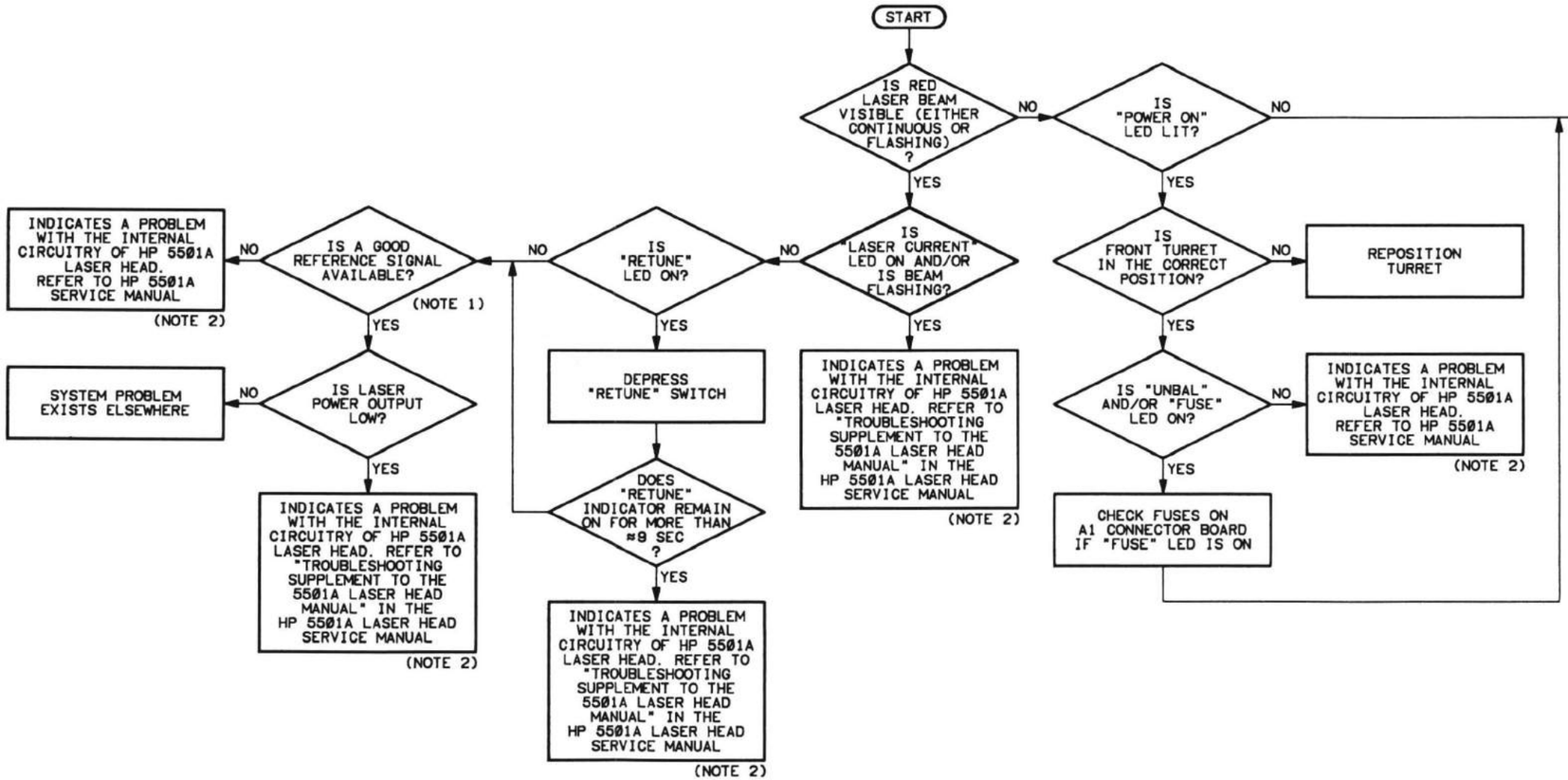
Figure 7-30. HP 5527A Laser Position Transducer System Block Diagram

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Figure 7-31
HP 5501A LASER HEAD TROUBLESHOOTING TREE

(See Page 7-95)

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NOTES

1. CHECK REFERENCE SIGNAL CONNECTOR PINS C AND D. YOU SHOULD SEE A +5V SQUARE WAVE WITH 0.5 µSEC PERIOD. SEE TABLE 4-4 IN HP 5501A LASER HEAD SERVICE MANUAL.
2. HP 5501A LASER TRANSDUCER OPERATING AND SERVICE MANUAL: HP PART NUMBER 05501-90025.

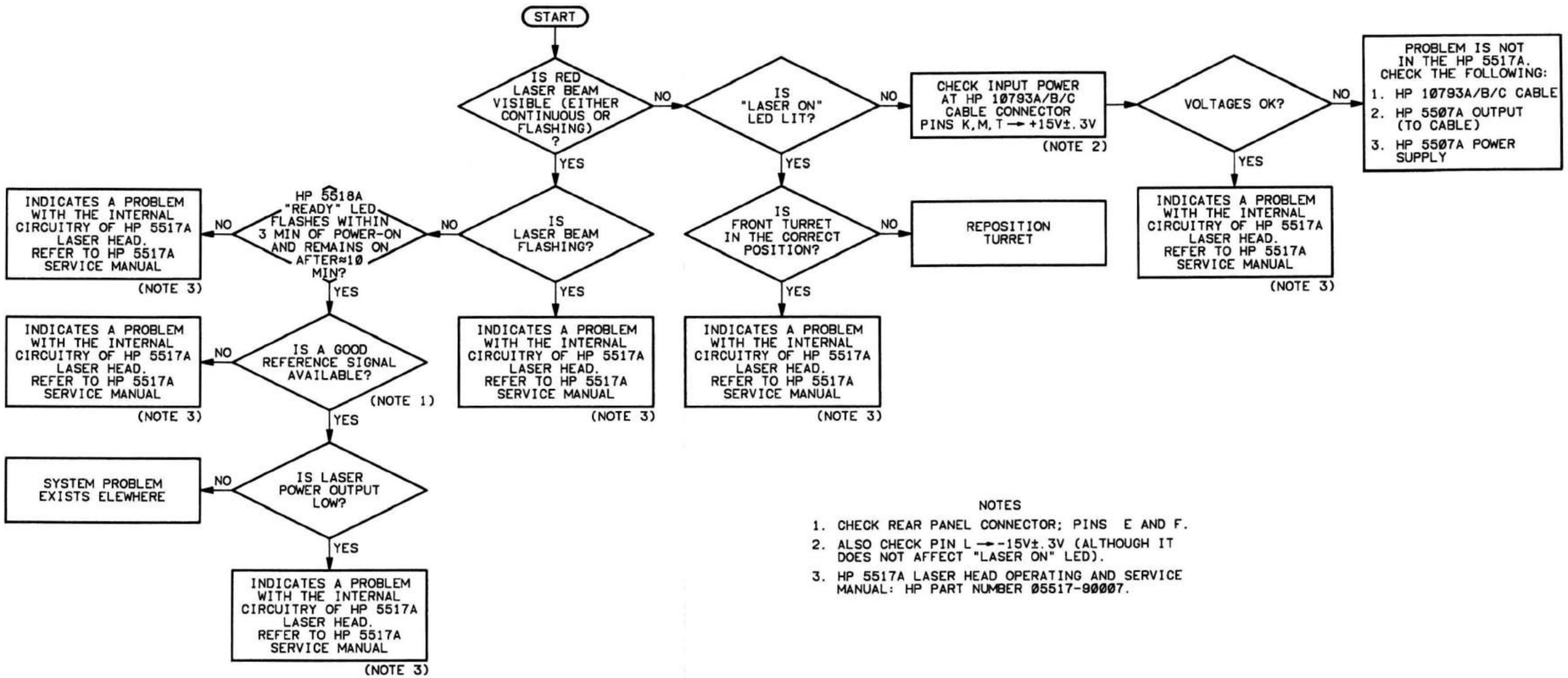
Figure 7-31. HP 5501A Laser Head Troubleshooting Tree

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Figure 7-32
HP 5517A LASER HEAD TROUBLESHOOTING TREE

(See Page 7-97)

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NOTES

1. CHECK REAR PANEL CONNECTOR; PINS E AND F.
2. ALSO CHECK PIN L → -15V±.3V (ALTHOUGH IT DOES NOT AFFECT "LASER ON" LED).
3. HP 5517A LASER HEAD OPERATING AND SERVICE MANUAL: HP PART NUMBER 05517-90007.

Figure 7-32. HP 5517A Laser Head Troubleshooting Tree

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Figure 7-33
HP 5518A LASER HEAD TROUBLESHOOTING TREE

(See Page 7-99)

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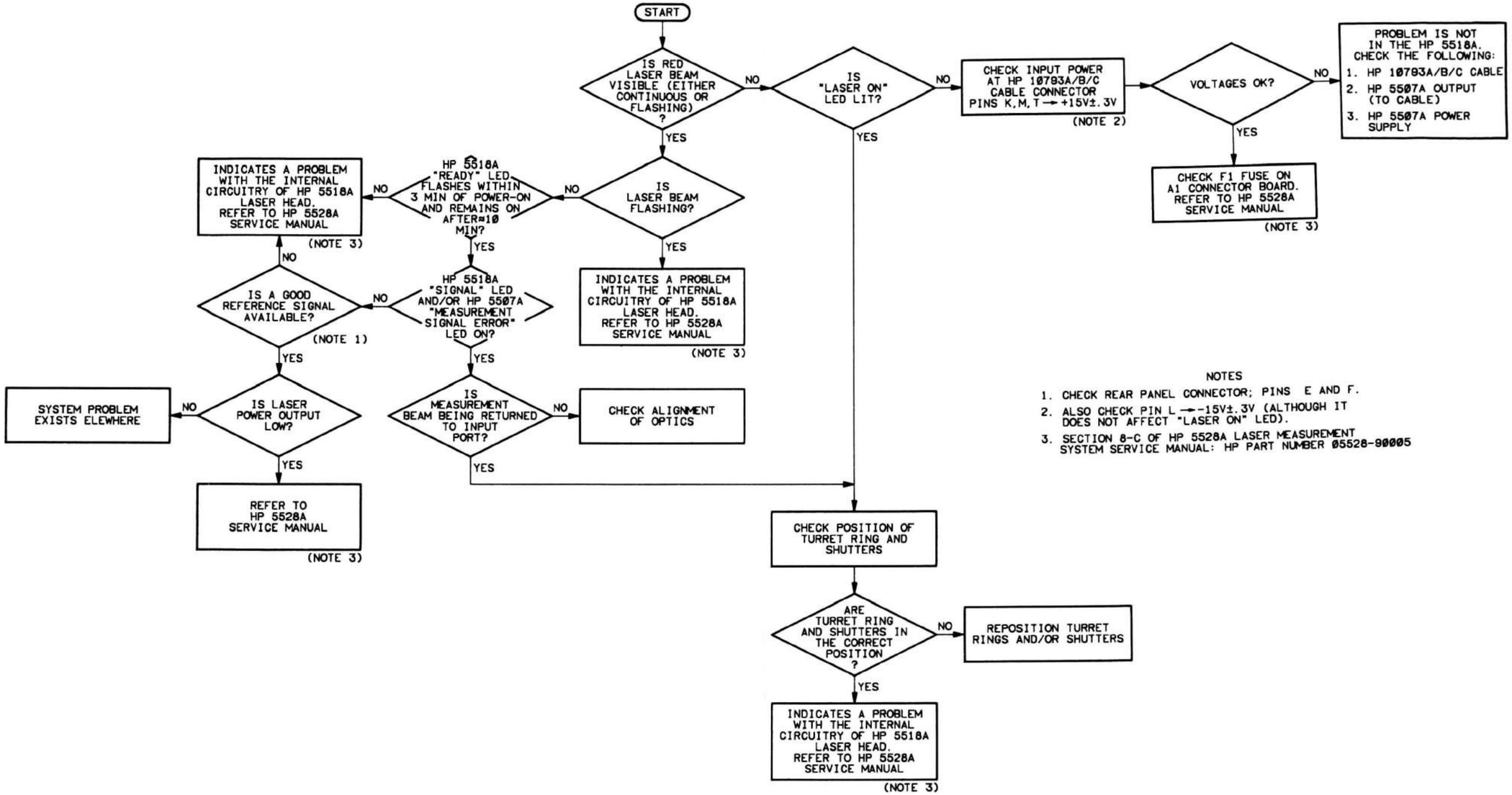


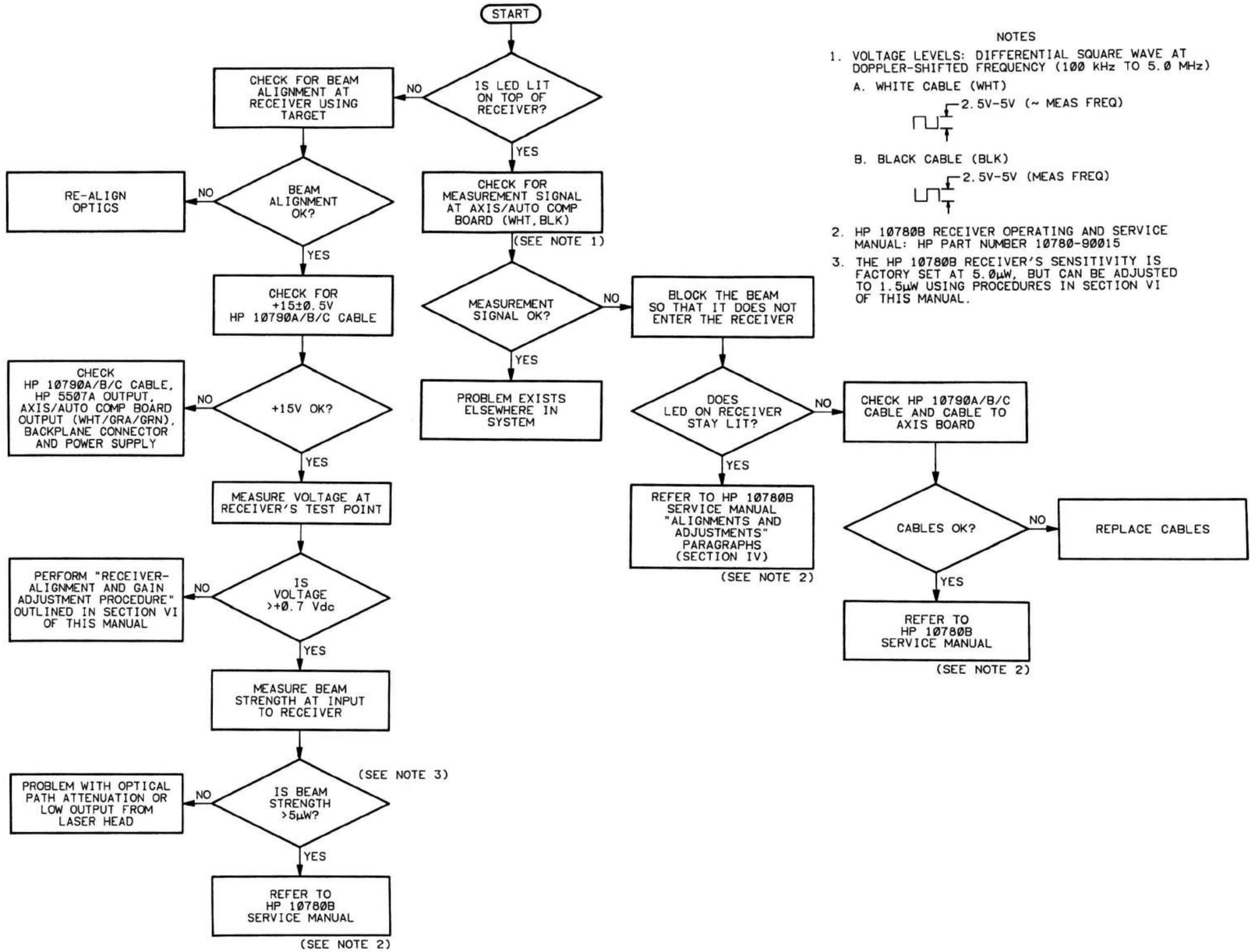
Figure 7-33. HP 5518A Laser Head Troubleshooting Tree

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Figure 7-34
HP 10780B RECEIVER TROUBLESHOOTING TREE

(See Page 7-101)

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NOTES

1. VOLTAGE LEVELS: DIFFERENTIAL SQUARE WAVE AT DOPPLER-SHIFTED FREQUENCY (100 kHz TO 5.0 MHz)
   A. WHITE CABLE (WHT)

   B. BLACK CABLE (BLK)

2. HP 10780B RECEIVER OPERATING AND SERVICE MANUAL: HP PART NUMBER 10780-90015
3. THE HP 10780B RECEIVER'S SENSITIVITY IS FACTORY SET AT 5.0µW, BUT CAN BE ADJUSTED TO 1.5µW USING PROCEDURES IN SECTION VI OF THIS MANUAL.

Figure 7-34. HP 10780B Receiver Troubleshooting Tree

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Figure 7-35
HP 5527A LASER POSITION TRANSDUCER SYSTEM SIGNAL FLOW DIAGRAM

(See Page 7-103)

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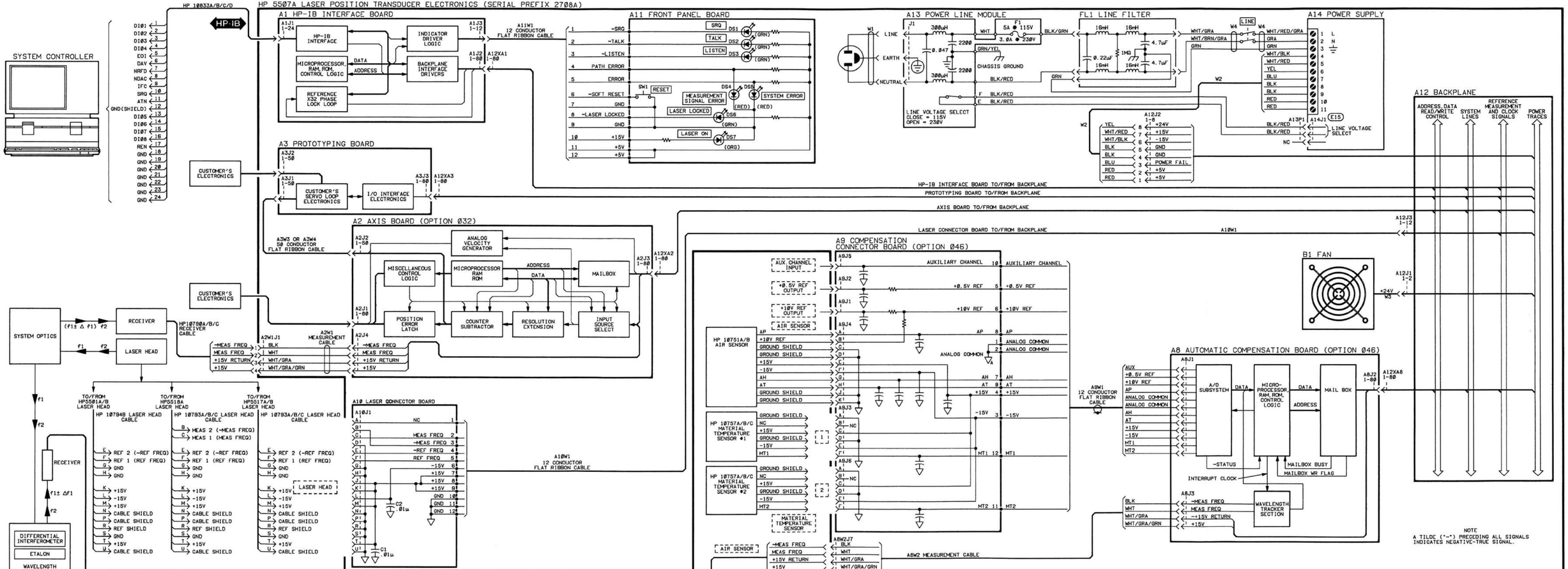


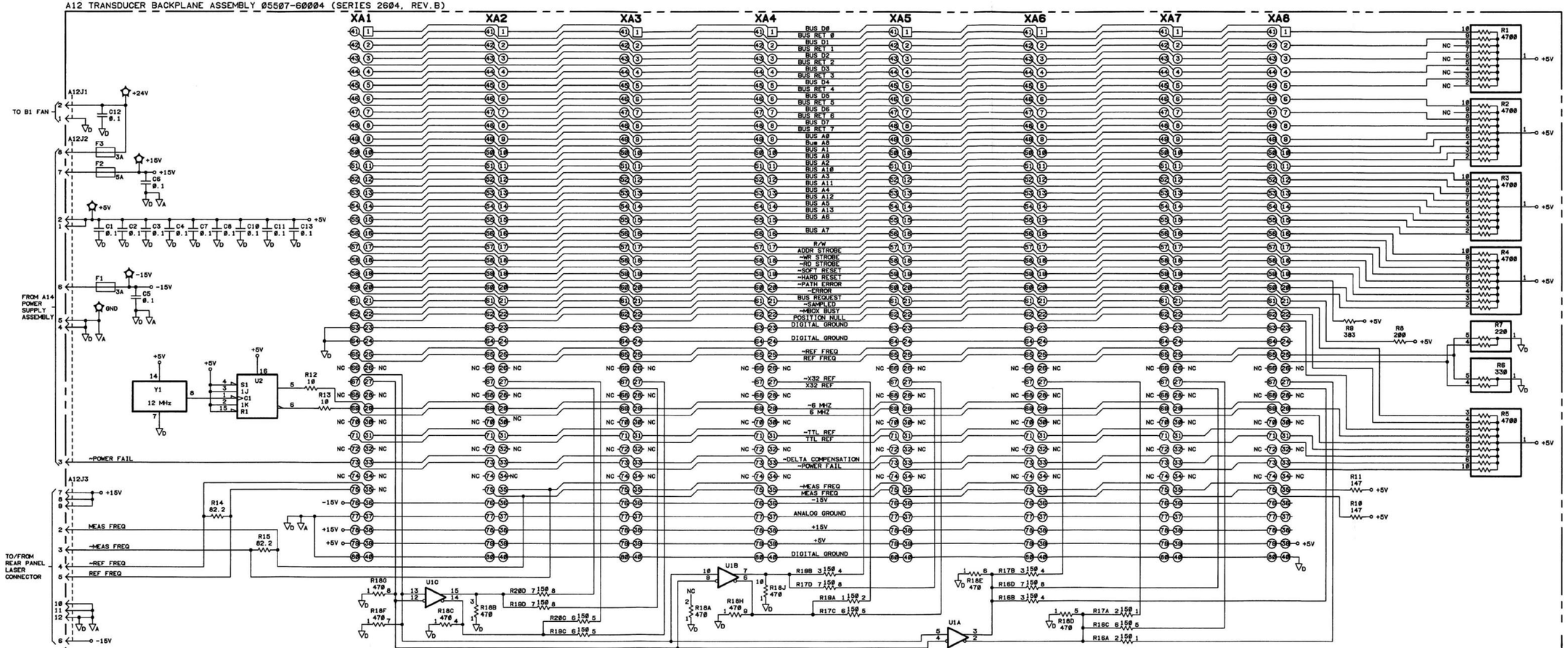
Figure 7-35. HP 5527A Laser Position Transducer System Signal Flow Diagram

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Figure 7-36
A12 TRANSDUCER BACKPLANE ASSEMBLY SCHEMATIC DIAGRAM

(See Page 7-105)

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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.
4. A TILDE ("~") PRECEDING A SIGNAL INDICATES A NEGATIVE-TRUE SIGNAL.
5. PINS 41 THROUGH 48 OF BACKPLANE CONNECTORS AX1 THROUGH AX8 (LABELED BUS RET 0 THROUGH BUS RET 7) ARE CONNECTED TO DIGITAL GROUND WHEN EITHER THE HP-1B, AXIS, PROTOTYPING, OR AUTOMATIC COMPENSATION BOARDS ARE INSERTED INTO THEIR RESPECTIVE BACKPLANE CONNECTORS.

REFERENCE DESIGNATIONS

REFERENCE DESIGNATORS	REFERENCE DESIGNATORS
C1-C13	TP1-TP6
F1-F3	Y1
J1-J3	U1, U2
R1-R29	

TABLE OF ACTIVE ELEMENTS

REFERENCE DESIGNATOR	HP PART NO.	MFG PART NO.
U1	1820-0810	MC10116P
U2	1820-1212	SN74LS112AN

Figure 7-36. A12 Transducer Backplane Assembly Schematic Diagram

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Figure 7-37
A2 AXIS BOARD J1 AND J2 CONNECTORS (INPUT/OUTPUT) PINOUT AND HARDWARE CONFIGURATION

(See Page 7-107)

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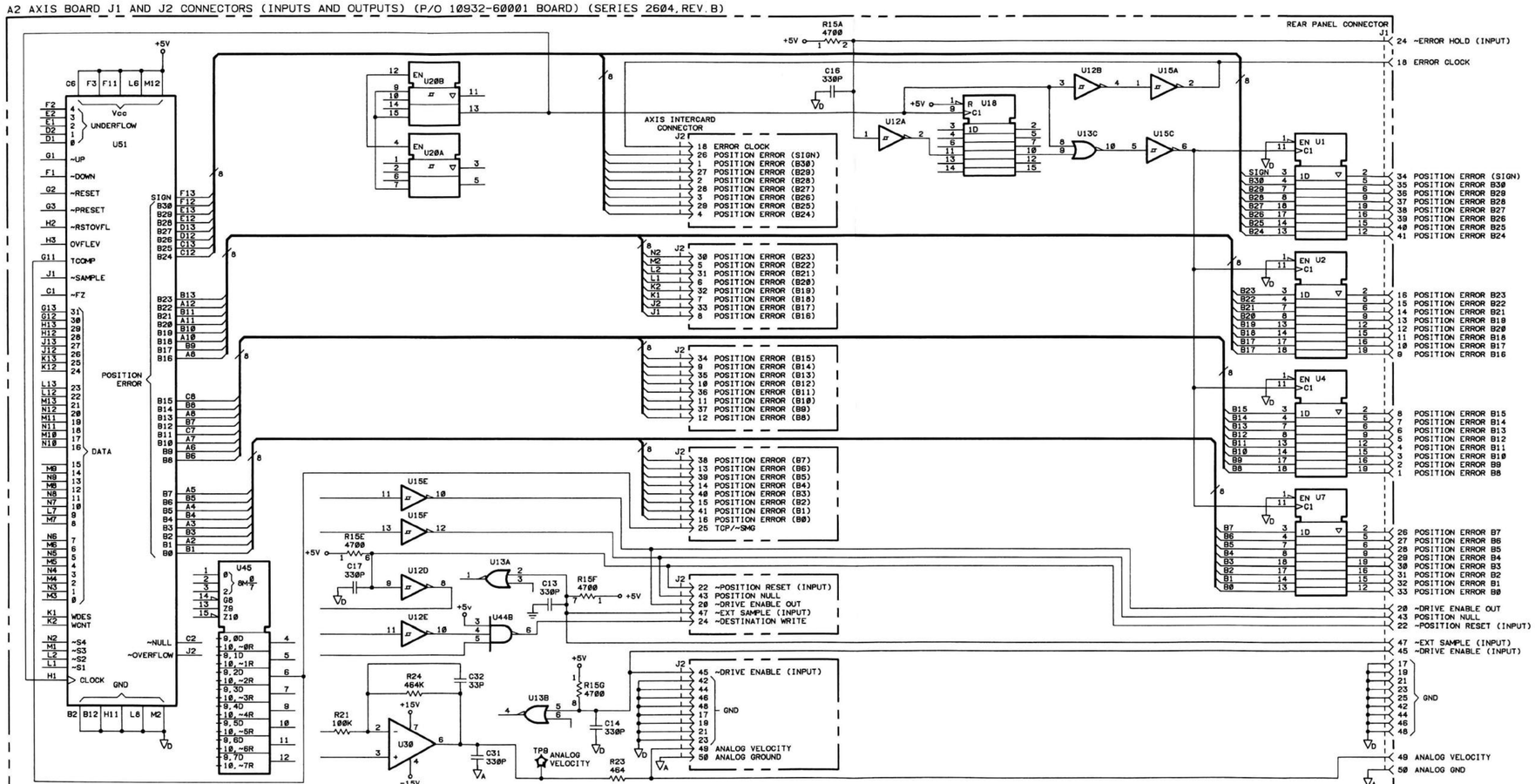


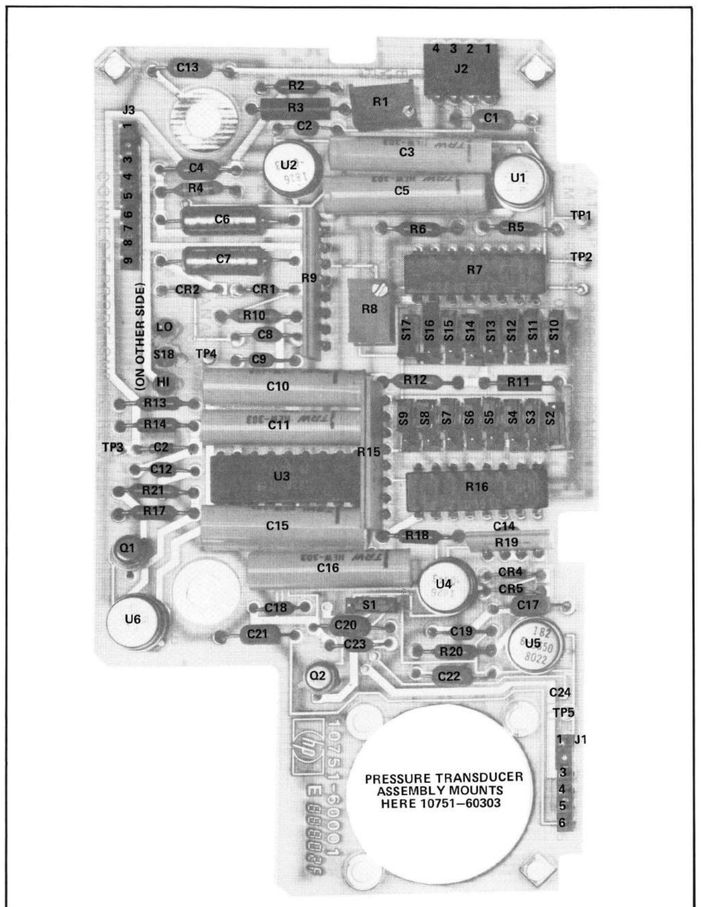
Figure 7-37. A2 Axis Board J1 and J2 Connectors (Input/Output) Pinout and Hardware Configuration

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Figure 7-38
HP 10751A/B AIR SENSOR SCHEMATIC DIAGRAM AND COMPONENT LOCATOR

(See Page 7-109)

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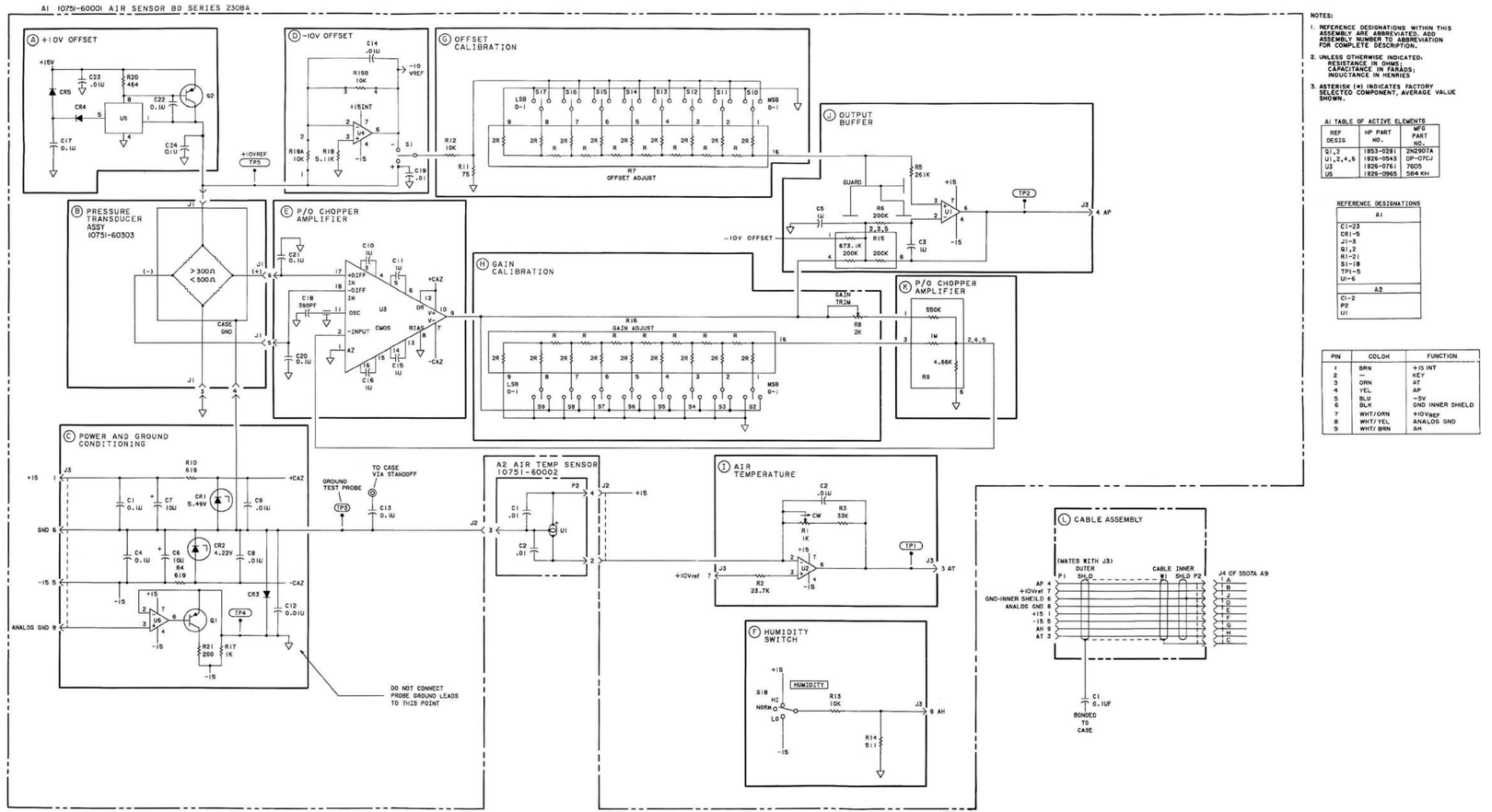


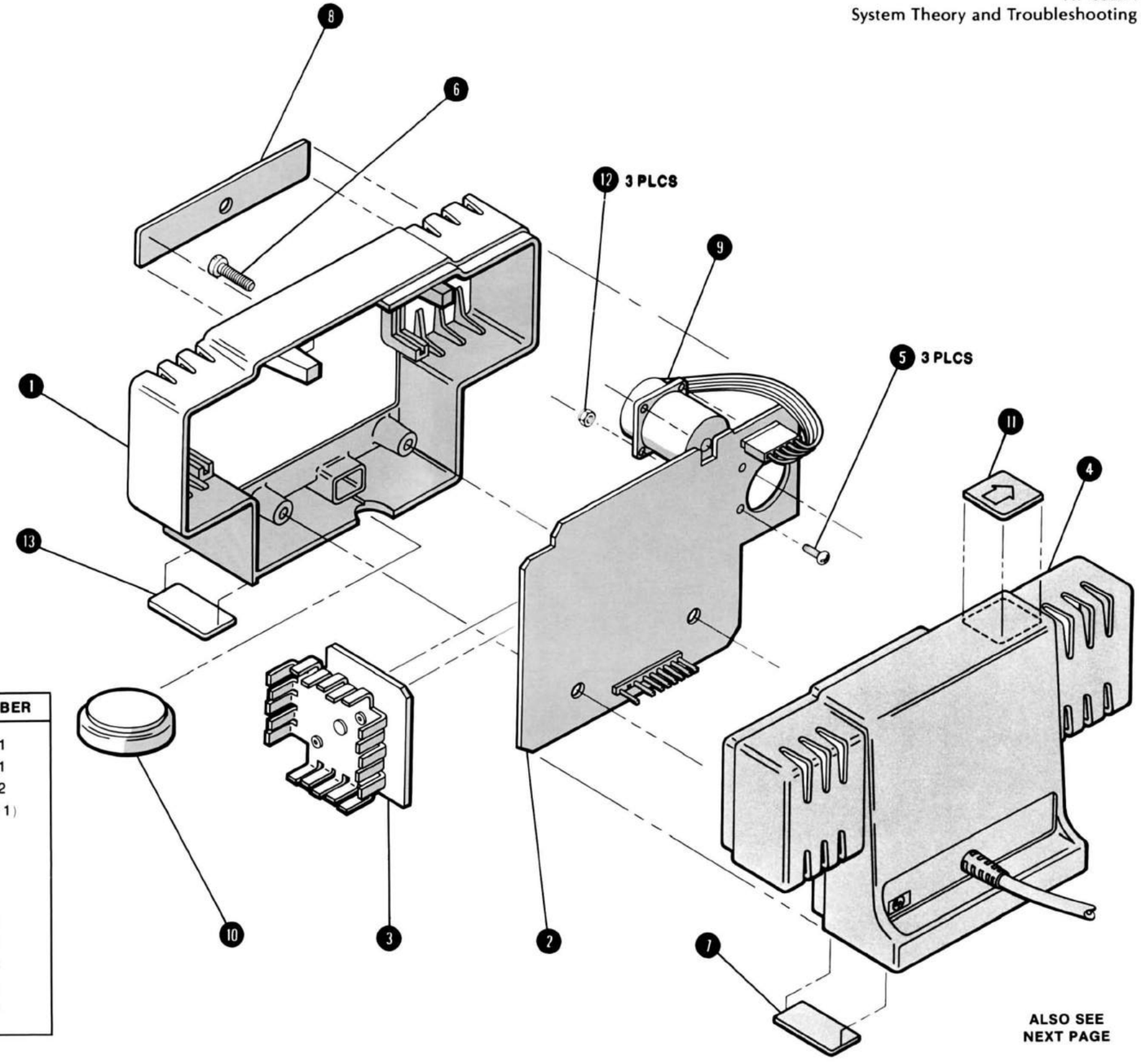
Figure 7-38. HP 10751A/B Air Sensor Schematic Diagram and Component Locator

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Figure 7-39
HP 10751A/B EXPLODED VIEWS (Sheet 1 of 2)

(See Page 7-111)

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10751A/B REPLACEABLE PARTS

ITEM	QTY.	DESCRIPTION	HP PART NUMBER
1	1	HOUSING COVER	10751-40001
2	1	BOARD ASSEMBLY, A1	10751-60001
3	1	BOARD ASSEMBLY, A2	10751-60002
4	1	CABLE AND HOUSING ASSEMBLY	(SEE TABLE 1)
5	3	SCREW 2.5 × 0.45 × 8 PHMS	0515-0403
6	2	SCREW M4 × 0.7 × 25 FHMS POZI	0515-0087
7	1	PLATE, SERIAL	7122-0214
8	1	LABEL, FRT	7121-1736
9	1	PRESSURE TRANSDUCER ASSEMBLY	0960-0656
10	1	MAGNETIC BASE ASSEMBLY	9164-0184
11	1	LABEL, ORIENTATION	7121-3528
12	3	NUT, HEX M2.5	0535-0008
13	1	LABEL, CALIBRATION	7121-2719

TABLE 1

MODEL NUMBER	CABLE AND HOUSING ASSEMBLY	CABLE LENGTH
10751A	10751-60201	5M (16.4 ft.)
10751B	10751-60202	15M (49.2 ft.)

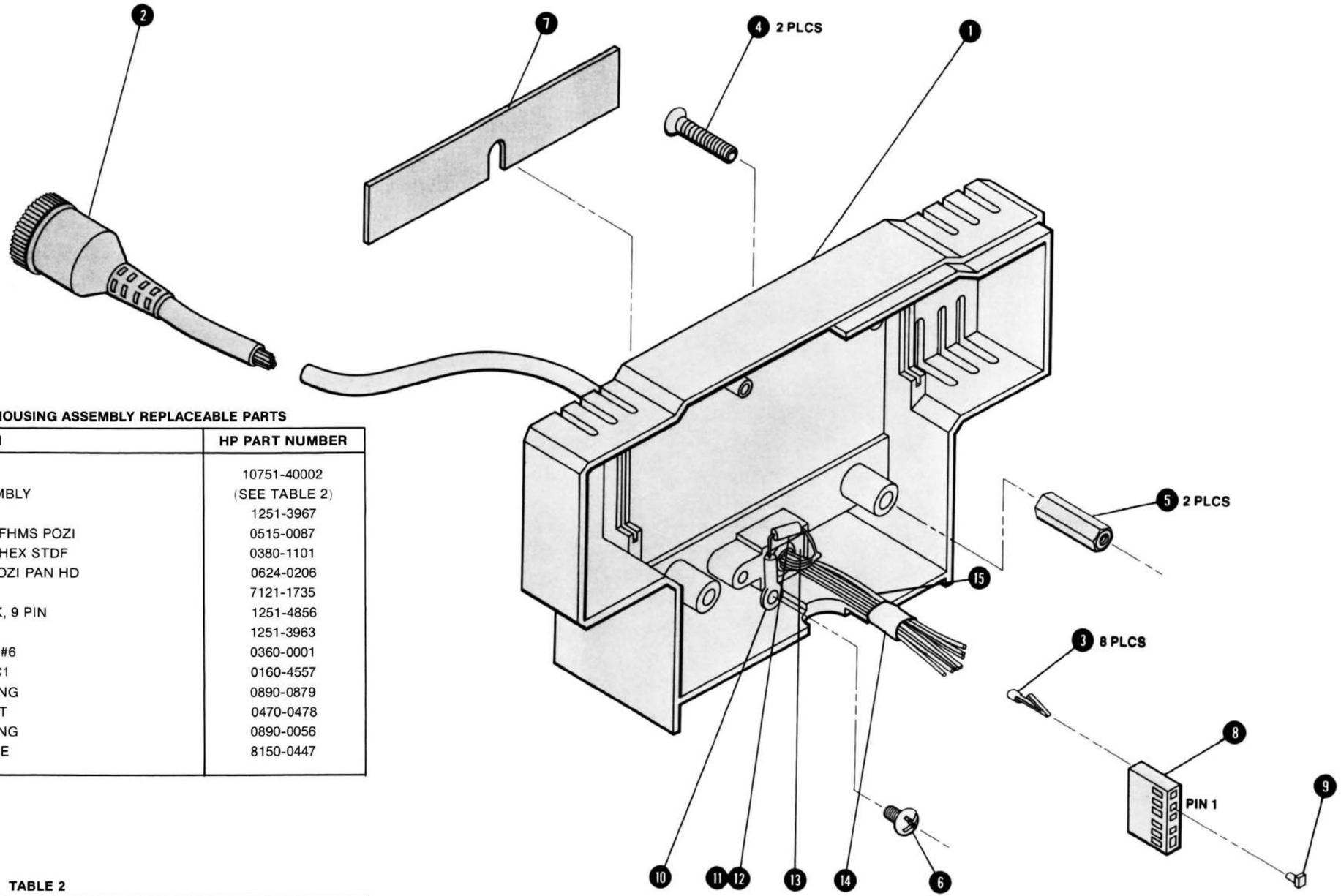
Figure 7-39. HP 10751A/B Exploded Views (Sheet 1 of 2)

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Figure 7-39
HP 10751A/B EXPLODED VIEWS (Sheet 2 of 2)

(See Page 7-113)

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10751-60201/60202 CABLE AND HOUSING ASSEMBLY REPLACEABLE PARTS

ITEM	QTY.	DESCRIPTION	HP PART NUMBER
1	1	HOUSING	10751-40002
2	1	CABLE ASSEMBLY	(SEE TABLE 2)
3	8	CONTACT	1251-3967
4	2	M4 × 0.7 × 25 FHMS POZI	0515-0087
5	2	M4 × 0.7 × 16 HEX STDF	0380-1101
6	1	#6 TAPTITE POZI PAN HD	0624-0206
7	1	LABEL, REAR	7121-1735
8	1	CONN. BLOCK, 9 PIN	1251-4856
9	1	KEY	1251-3963
10	1	SOLDER LUG #6	0360-0001
11	1	CAPACITOR C1	0160-4557
12	A/R	SHRINK TUBING	0890-0879
13	A/R	EPOXY, 2 PART	0470-0478
14	A/R	SHRINK TUBING	0890-0056
15	2 IN	WIRE, 24 GAGE	8150-0447

TABLE 2

ASSEMBLY PART NO.	ITEM 2	CABLE LENGTH
10751-60201	8120-3492	5M 16.4 ft.)
10751-60202	8120-3663	15M (49.2 ft.)

Figure 7-39. HP 10751A/B Exploded Views (Sheet 2 of 2)

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Figure 7-40
HP 10717A WAVELENGTH TRACKER TROUBLESHOOTING TREE

(See Page 7-115)

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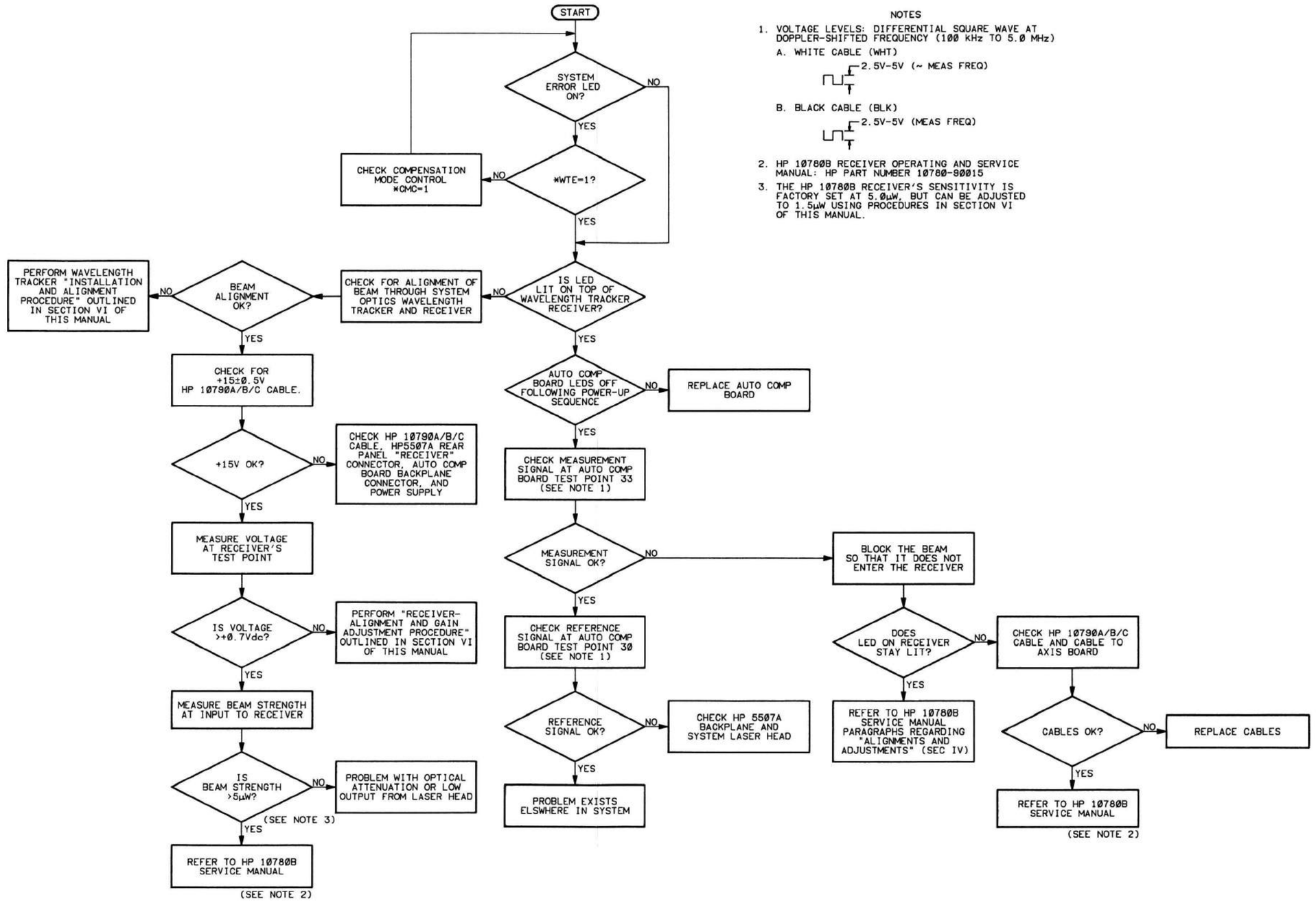


Figure 7-40. HP 10717A Wavelength Tracker Troubleshooting Tree

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SECTION VIII
SPECIFICATIONS

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SECTION VIII
SPECIFICATIONS

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The following HP 5527A Laser Position Transducer system specifications reflect the combined individual accuracy of each component. Specifications throughout this manual describe the instrument's warranted performance. Supplemental characteristics (indicated by TYPICAL or NOMINAL) are intended to provide nonwarranted performance information useful in general applications.

SYSTEM

Environmental (nominal)

The design has passed the following environmental specifications:

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

Non-operating: Can be stored and shipped in environments within the following limits: –40° to 75°C (–40° to +167°F). This unit should also be protected from temperature extremes which could cause condensation within the instrument.

Relative Humidity (Operating): 0 to 90% (Non-condensing)

EMI: Meets or exceeds VFG (FTZ) 1046-1984 Limit B as per VDE 0871 Limit B standard.

Power Requirements:

Source: 115 Vac +10%, –25%
230 Vac +10%, –15%
Frequency: 48-66 Hz

Consumption: 250 VA max

Laser Head Characteristics

Type: Helium-Neon, continuous wave, two frequency

Maximum Power Output: 1 mW
Safety Classification: To minimize specialized safety equipment and procedures on your equipment, the laser sources used in the HP 5527A Laser Position Transducer are Class II Laser Products conforming to U.S. National Center for Devices and Radiological Regulations 21 CFR 1040.10 and 1040.11.

Stability/Repeatability (HP 5517A/B/C Laser Head):
Long Term (lifetime): 0.02 ppm typical
Short Term (one hour period): 0.002 ppm typical

Measurement Capability

Optics →	Linear or Single Beam	Plane Mirror	High Resolution
Resolution	λ/64 or 10.0 nm (0.4 µin)	λ/128 or 5.0 nm (0.2 µin)	λ/256 or 2.5 nm (0.1 µin)
Range	±10.6 m (34.8 ft)	±5.3 m (17.4 ft)	±2.65 m (8.7 ft)
Maximum Axis Velocity	NOTE: Maximum Axis Velocity depends on the combination of Laser Head and Optics used for the axis.		
HP 5517A Laser Head	406 mm/sec (16 in/sec)	203 mm/sec (8 in/sec)	102 mm/sec (4 in/sec)
HP 5517B Laser Head	508 mm/sec (20 in/sec)	254 mm/sec (10 in/sec)	127 mm/sec (5 in/sec)
HP 5517C Laser Head	711 mm/sec (28 in/sec)	356 mm/sec (14 in/sec)	178 mm/sec (7 in/sec)
NOTE: The HP 5517C Laser Head is not useable with HP 5527A electronics.			

Maximum Acceleration: 10g

Number of Axes:
Servo-Axis Board: 4 maximum, with or without compoensation board

Axis Board: 5 maximum with compensation board, 6 maximum without compensation board.

Measurement Capability (Continued)

Absolute Accuracy: The accuracy of the Laser Position Transducer is fundamentally linked to the accuracy of the laser head, the choice of optics and the effects of the environment. In a given system, the absolute accuracy will be the sum of all effects present.
HP 5517A/B/C Laser Head (in vacuum):
0.1 ppm (0.02 ppm with factory calibration to MIL STD 45662)
Interferometer Nonlinearity (error due to optical leakage)
Linear or Single Beam optics: <4.2 nm (0.17 µin)
Plane Mirror optics: <2.2 nm (0.09 µin)
Differential optics: <3.5 nm (0.14 µin)
Electronics (dependent on least resolution increment):
Linear or Single Beam optics: 10 nm (0.4 µin)
Plane Mirror or Differential optics: 5 nm (0.2 µin)

Laser System Measurement Accuracy Comparison

Environment:
Pressure: 760 mm Hg 25 mm Hg
Relative Humidity: 50% 10%
Temperature: as shown

Measurement Accuracy*			
	0.1°C	1.0°C	5.0°C
No Compensation** (@ 20°C)	9.0 ppm	9.9 ppm (typical)	14.0 ppm
HP 10751A/B Air Sensor (@ 20°C)	1.5 ppm	1.6 ppm	1.7 ppm
Wavelength Tracking Compensation***	0.15 ppm	0.19 ppm	0.44 ppm
Measurement in Vacuum	0.1 ppm	0.1 ppm	0.1 ppm
Measurement in Vacuum with Factory Calibration of Laser Head to MIL STD 45662	0.02 ppm	0.02 ppm	0.02 ppm

* These accuracy specifications include the laser head term, but exclude electronics accuracy and interferometer nonlinearity terms.

** No compensation means that no correction in compensation number occurs during environmental changes.

*** System accuracy equals these values (measurement repatability) for a calibrated laser head plus accuracy of initial compensation value.

Data Transfer

32-bit Parallel Output (available for hardware, HP 10932A only):
Position or position error output 1.5-2.0 MHz (HP 5517A)
Position or position error output 1.9-2.4 MHz (HP 5517B)
Position or position error output 2.4-3.0 MHz (HP 5517C)

HP-IB Interface (rates vary with data format and system configuration):
Input (Destination and Commands): 25-350 Hz
Output (Position): 20-1500 Hz

16-Bit Binary Interface (HP 10936A Servo-Axis Board only; rates vary with data format, system configuration and board setup):
Input (Command and Destination): 0.1 - 10 kHz
Output (Position): 0.1 - 10 kHz

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HP 5517A Laser Head

Physical Characteristics

Dimensions: See *Figure 8-1.*
Weight: 3.4 Kilograms (7.5 pounds)
Magnetic Field Strength (Non-Operating):
Does not exceed 5.25 milliGauss at a distance of 460 cm (15 ft) from any point on the surface of the packaged Laser Head.
Clearance Required For Cabling: 10.16 cm (4 in) beyond back

Power

Power Input Requirements:
−15 Volts ±0.3 Volts at 0.02 Amperes maximum.
+15 Volts ±0.3 Volts at 2.2 Amperes maximum.
Heat Dissipation:
23 watts (during operation)
35 watts (during warm-up)
Warmup time: less than 10 minutes (4 minutes typical)

Laser Beam Characteristics

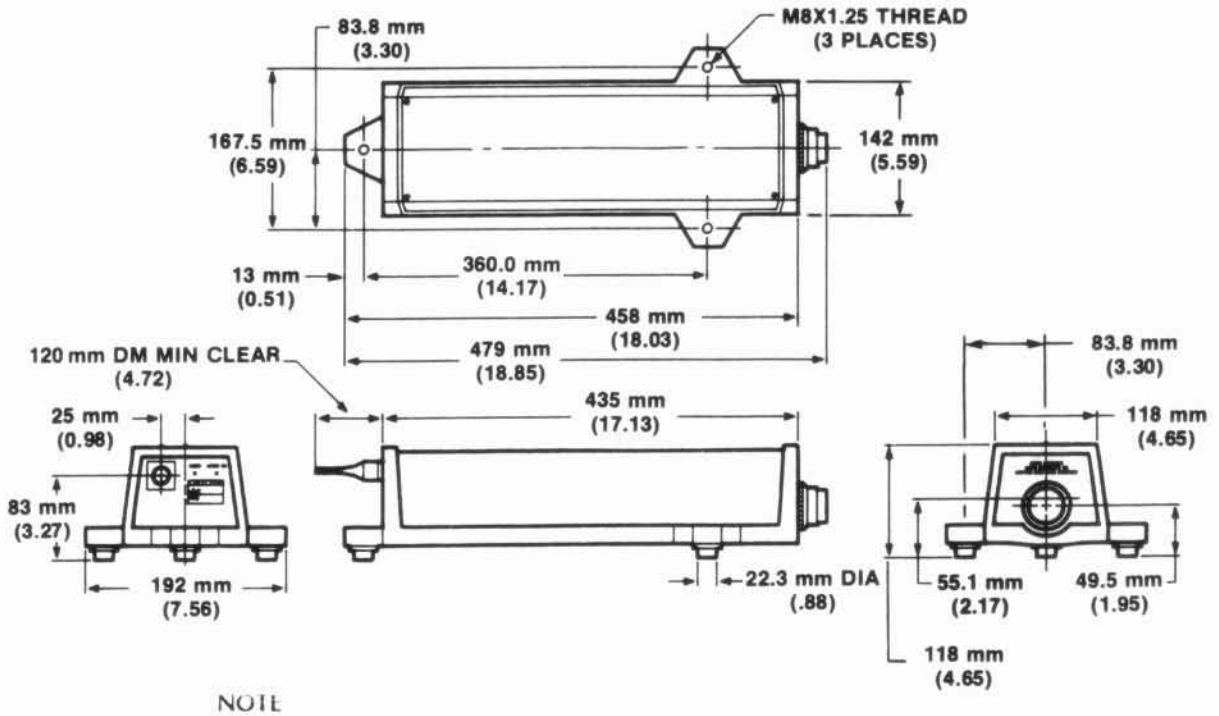
Type: Helium-Neon, Continuous Wave, Two-Frequency
Maximum Beam Power Output: 1 milliwatt
Minimum Beam Power Output: 120 microwatts
Beam Diameter: 6 millimetres (0.24 inch) typical
Vacuum Wavelength Accuracy: (3 sigma, lifetime): 0.1 ppm
Vacuum Wavelength Stability (typical 1 hour): 0.002 ppm
Vacuum Wagvelength Stability (typical lifetime): 0.02 ppm
Nominal Vacuum Wavelength: 632.99137 nanometres
Safety Classification:
Class II Laser Product conforming to U.S. National Center for Devices and Radiologicfal Health Regulations 21 CFR 1040.10 and 1040.11.

Outputs

Reference Frequency: 1.5-2.0 MHz.

NOTE

HP 5518A specifications are identical except an internal receiver is included, and the reference frequency is 1.7 to 2.4 MHz for HP 5518As with serial number 2532A02139 and above. For previous HP 5518As the reference frequency is 1.5 to 2.0 MHz.



NOTE

This is a Class II Laser Product conforming to Federal Bureau of Radiological Health Regulations 21 CFR 1040.10 and 1040.11

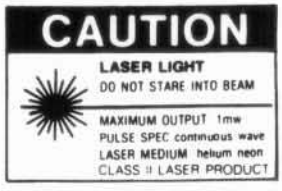


Figure 8-1. HP 5517A Laser Head, Dimensions

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HP 5517B/C Laser Head

Physical Characteristics

Dimensions: See *Figure 8-2.*
Weight: 5.5 Kilograms (12 pounds)
Magnetic Field Strength (Non-Operating):
Does not exdceed 5.25 milliGauss at a distance of 460 cm (15 ft) from any point on the surface of the packaged Laser Head.
Clearance Required For Cabling: 10.16 cm (4 in) beynod back

Power

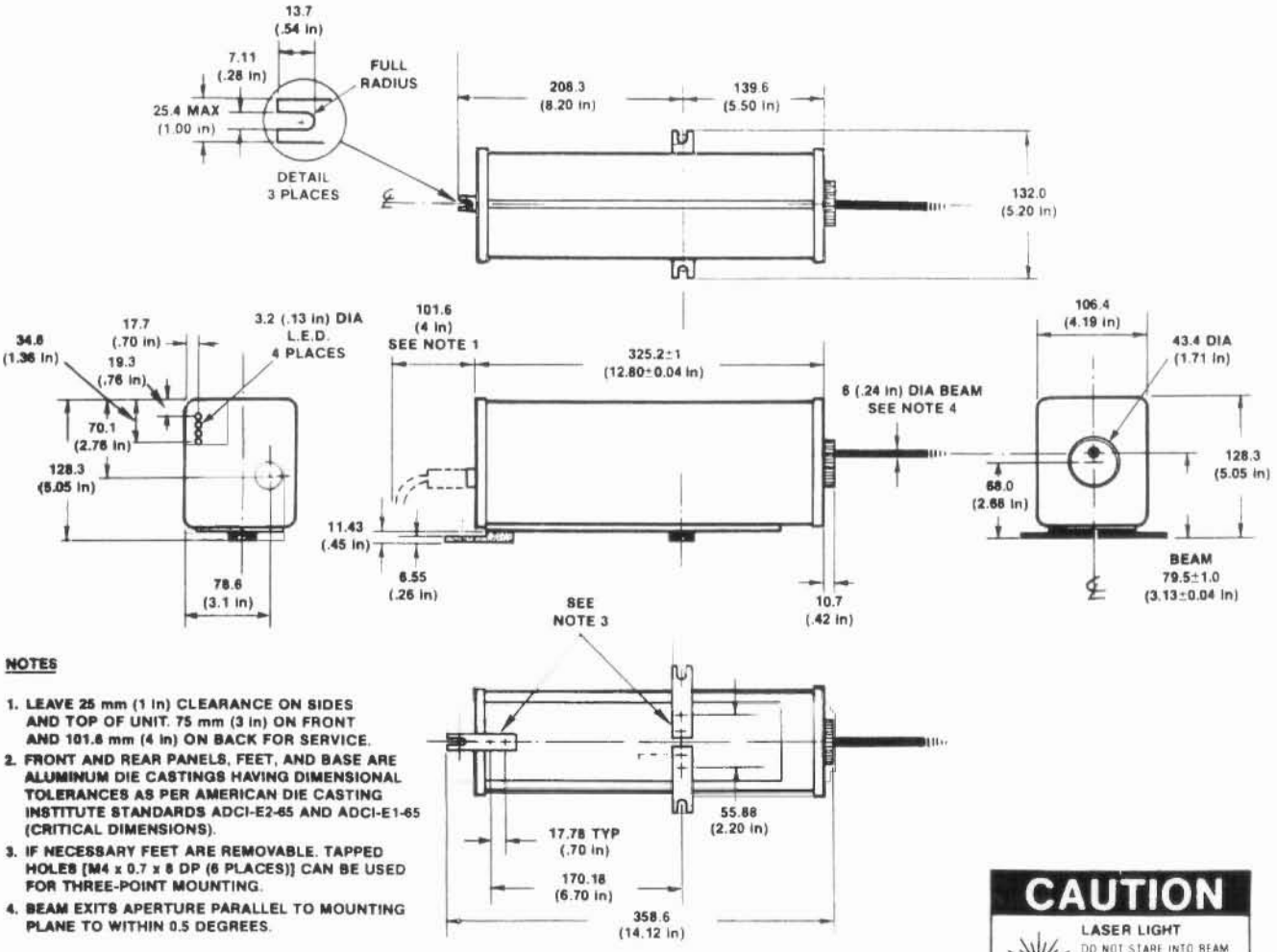
Power Input Requirements:
–15V ±0.3V at 0.02 Amperes maximum.
+15V ±0.3V at 2.5 Amperes maximum.
Heat Dissipation
23 watts (during operation)
35 watts (during warm-up)
Warmup Time: less than 10 minutes (4 minutes typical)

Laser Beam Characteristics

Type: Helium-Neon, Continuous Wave, Two-Frequency
Maximum Beam Power Output: 1 milliwatt
Minimum Beam Power Output: 120 microwatts
Beam Diameter: 6 millimetres (0.24 inch) typical
Vacuum Wavelength Accuracy: (3 sigma, lifetime): 0.1 ppm
Vacuum Wavelength Stability (typical 1 hour): 0.002 ppm
Vacuum Wavelength Stability (typical lifetime): 0.02 ppm
Safety Classification:
Class II Laser Product conforming to U.S. National Center for Devices and Radiological Health Regulations 21 CF$ 1040.10 and 1040.11.

Outputs

Reference signal: 1.9 - 2.4 MHz (HP 5517B)
2.4 - 3.0 MHz (HP 5517C)



NOTES

1. **LEAVE 25 mm (1 In) CLEARANCE ON SIDES AND TOP OF UNIT. 75 mm (3 In) ON FRONT AND 101.6 mm (4 In) ON BACK FOR SERVICE.**
2. **FRONT AND REAR PANELS, FEET, AND BASE ARE ALUMINUM DIE CASTINGS HAVING DIMENSIONAL TOLERANCES AS PER AMERICAN DIE CASTING INSTITUTE STANDARDS ADCI-E2-65 AND ADCI-E1-65 (CRITICAL DIMENSIONS).**
3. **IF NECESSARY FEET ARE REMOVABLE. TAPPED HOLES [M4 x 0.7 x 8 DP (6 PLACES)] CAN BE USED FOR THREE-POINT MOUNTING.**
4. **BEAM EXITS APERTURE PARALLEL TO MOUNTING PLANE TO WITHIN 0.5 DEGREES.**



NOTE

This is a Class II Laser Product conforming to Federal Bureau of Radiological Health Regulations 21 CFR 1040.10 and 1040.11

Figure 8-2. HP 5517B/C Laser Head, Dimensions

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HP 10702A Linear Interferometer

Dimensions: See *Figure 8-3.*
Weight: 232 grams (8.2 ounces)
Materials Used:
Housing: Stainless Steel
Apertures: Plastic (Nylon)
Optics: Optical Grade Glass
Adhesives: Low Volatility (Vacuum Grade)
Maximum Transmitted Beam Deviation: ±30 arc minutes
Optical Efficiency (including HP 10703A Reflector):
Typical: 75%
Worst Case: 71%

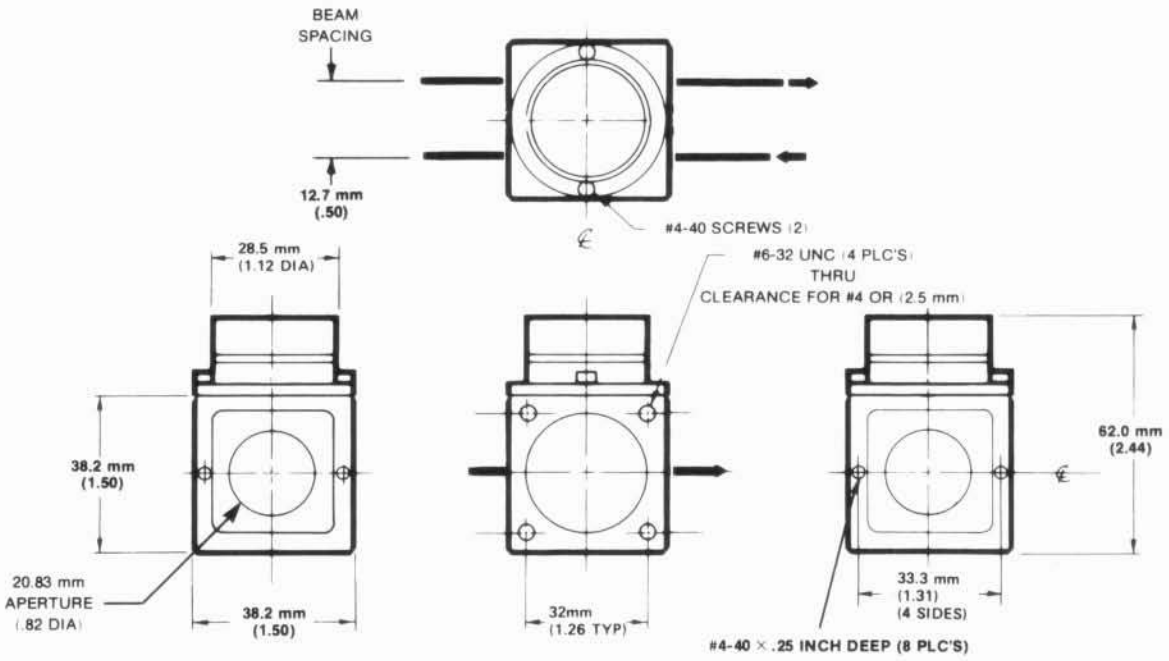


Figure 8-3. HP 10702A Linear Interferometer, Dimensions

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HP 10702A Option 001 Linear Interferometer

Dimensions: See *Figure 8-4.*
Weight: 246 grams (8.7 ounces)
Materials Used: Same as HP 10702A
Maximum Transmitted Beam Deviation: ±30 arcseconds
Optical Efficiency (including HP 10703A Reflector):
Typical: 73%
Worst Case: 69%

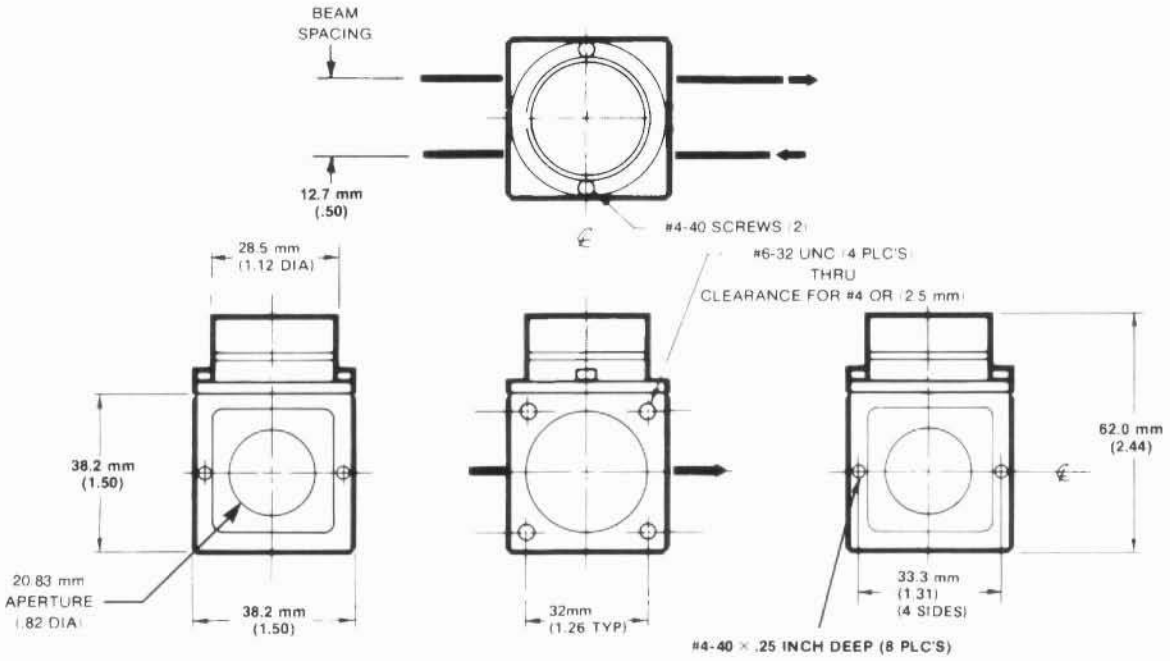


Figure 8-4. HP 10702A Option 001 Linear Interferometer, Dimensions

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HP 10705A Single Beam Interferometer

Dimensions: See *Figure 8-5.*
Weight: 85.5 grams (3.0 ounces)
Materials Used: Same as HP 10702A
Maximum Transmitted Beam Deviation: ±30 arcminutes
Optical Efficiency (including HP 10704A Reflector):
Typical: 62%
Worst Case: 59%

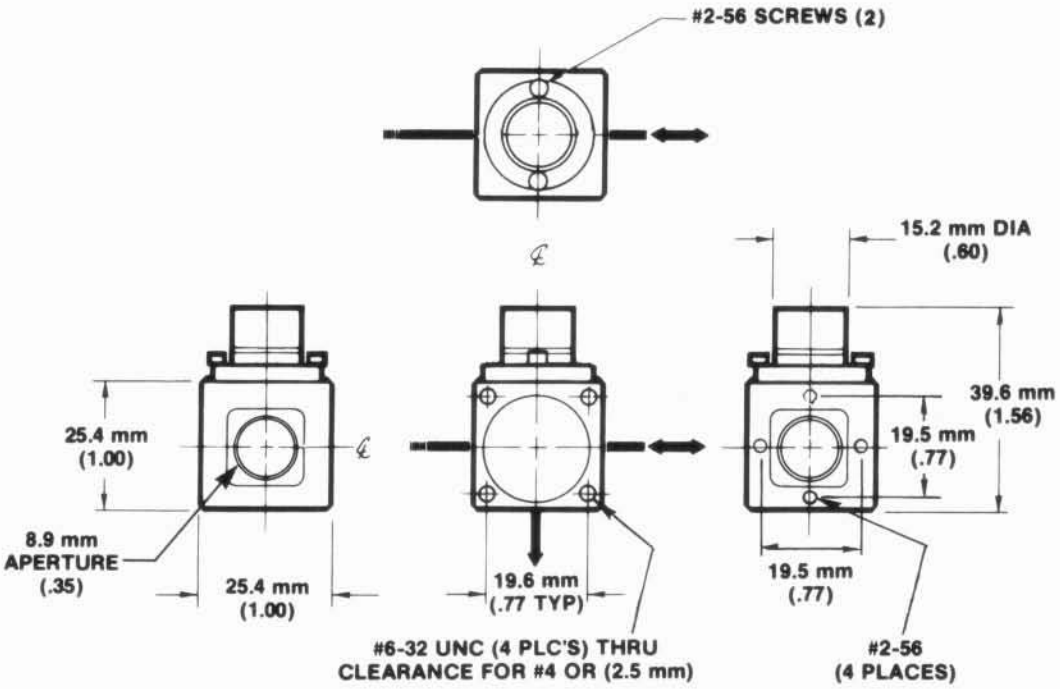


Figure 8-5. HP 10705A Single Beam Interferometer, Dimensions

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HP 10706A Plane Mirror Interferometer

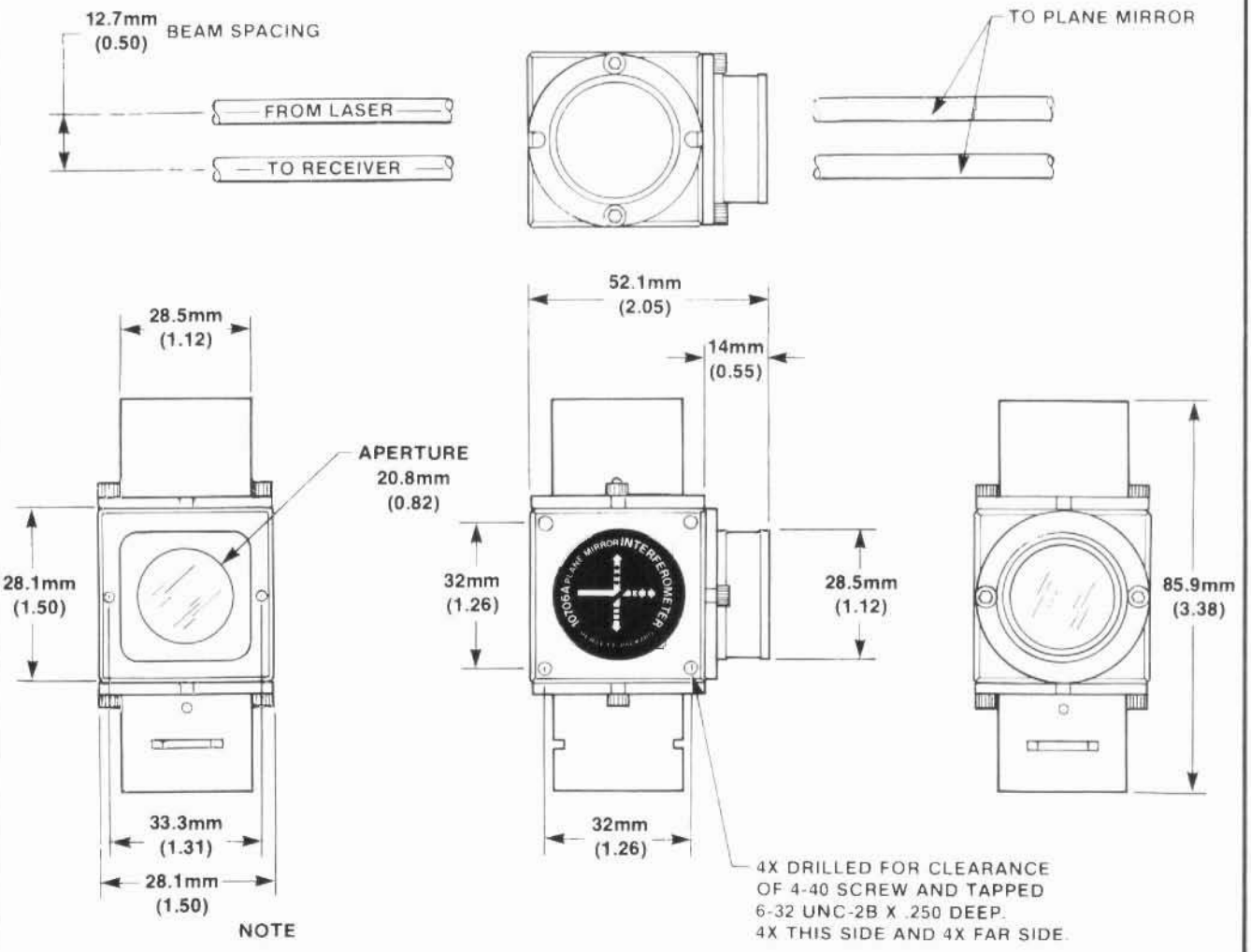
Dimensions: See *Figure 8-6.*
Weight: 308 grams (10.9 ounce)
Materials Used: Same as HP 10702A
Optical Efficiency (including a 98% effficient plane mirror reflector):
Typical: 70%
Worst Case: 54%

Plane Mirror (Measurement Mirror) Specifications
Reflectance:
recommended 98% at 633 nanometres at normal incidence (minimum 80%)
Flatness:
Depending upon the application and accuracy demands, the mirror flatness specification might be within a range from λ/4 to λ/20; i.e., 0.16 to 0.03 micrometres/6 to 1.2 microinches.

NOTE

Flatness deviations will appear as measurement errors when the mirror is scanned perpendicular to the beam. Mount should be kinematic so as not to bend mirror. If accuracy requirements demand it, mirror flatness might be calibrated —scanned and stored in the system controller — to be used as a correction factor.

Optical Surface Quality: 60 – 40 per Mil-0-13830
Mirror Alignment Requirements vs Distance:
Maximum Angular Misalignment:
Depends on distance between interferometer and plane mirror. Typical values are:
±6 arc-minutes for 152 mm (6 inches)
±3 arc-minutes for 305 mm (12 inches)
±1.5 arc-minutes for 508 mm (20 inches)



NOTE

Plane mirror flatness will determine system accuracy for X-Y stage. For example if X axis mirror is out of flat by 20 microinches (0.5 micrometre) this will cause 20 microinch error in X position.

Figure 8-6. HP 10706A Plane Mirror Interferometer, Dimensions

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HP 10706B High Stability Plane Mirror Interferometer

Dimensions: See Figure below.
Weight: 323 grams (11.4 ounce)
Materials Used:
Housing: Stainless Steel
Apertures: Plastic (nylon)
Spacers: Plastic (nylon)
Optics: Optical Grade Glass
Adhesives: Low Volatility (Vacuum Grade)
Optical Efficiency:
Typical: 60%
Worst Case (Calculated): 43%
Thermal Drift Coefficient (Change of indicated distance per degree C temperature change):
0.04 microns/deg C (1.6 μin/deg C) typical
Plane Mirror (Measurement Mirror) Recommendations:
Reflectance:
98% at 633 nanometres at normal incidence
Flatness:
Depending on the accuracy requirements of the application, mirror flatness may range from λ/4 to λ/20 (0.16 to 0.03 micrometres (6 to 1.2 microinches).

NOTE

Flatness deviations will appear as measurement errors when the mirror is translated across the beam. Mount should be kinematic so as not to bend mirror. If accuracy requirements demand it, mirror flatness might be calibrated (scanned and stored in the system controller) to be used as a correction factor.

Optical Surface Quality: 60 – 40 per Mil-0-13830
Measurement (or Reference) Mirror Pitch/Yaw*:
Depends on distance between interferometer and plane mirror. Typical mirror pitch/yaw angles are:
±6 arc-minutes for 152 mm (6 inches)
±3 arc-minutes for 305 mm (12 inches)
±1.5 arc-minutes for 508 mm (20 inches)

*Misalignment of interferometer to measurement mirror will degrade the Thermal Drift Coeifficient.

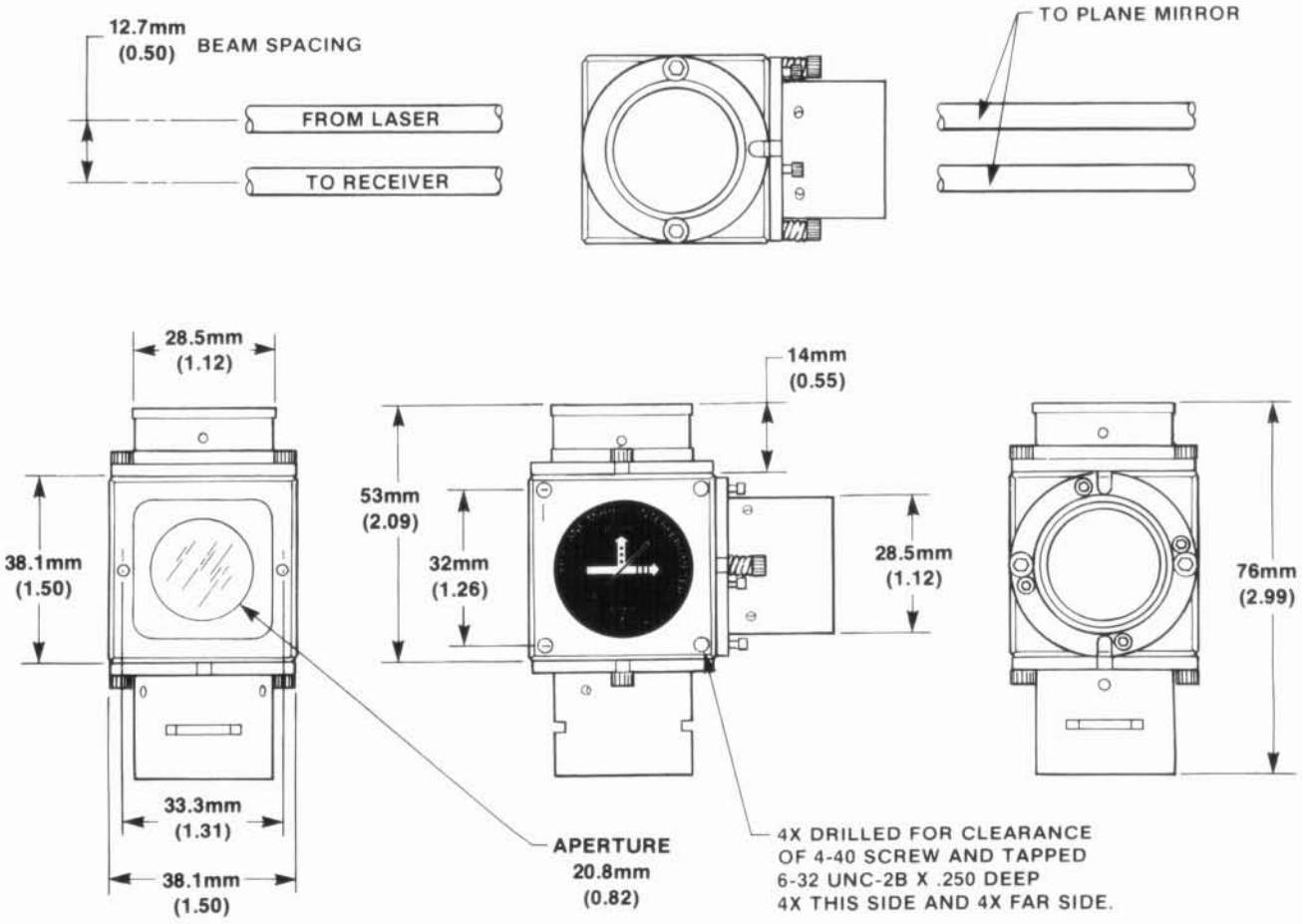


Figure 8-7. HP 10706B High Stability Plane Mirror Interferometer, Specifications and Dimensions

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HP 10716A High Resolution Interferometer

Dimensions: See Drawing Below

Weight: 502 grams (1.11 pounds)

Materials Used:
Housing: 416 Stainless Steel and 6061 Aluminum
Spacers: Nylon
Optics: Optical Grade Glass
Adhesives: Low Volatility (Vacuum Grade)

Optical Efficiency:
Typical: 30%
Worst Case: 25%

Thermal Drift Error: (Change of indicated distance per degree C temperature change):
0.04 microns/deg C (1.6 µin/deg C) typical

Fundamental Optical Resolution: λ/8

Non-linearity Error: 1 nanometre (0.04 microinch)

Maximum Transmitted Beam Deviation:
30 minutes of arc

Measurement Mirror Pitch/Yaw Tolerance:**
Depends on distance between mirror and interferometer.

Typical Pitch/Yaw Angles: 6 minutes at 152 millimetres (6 inches)
3 minutes at 305 millimetres (12 inches)
2 minutes at 508 millimetres (20 inches)

Measurement Mirror Recommendations:

Reflectance: 98% at 633 nanometres at normal incidence

Flatness: Depending on the accuracy requirements of the application, mirror flatness may range from λ/4 to λ/20 (0.16 to 0.03 micrometres) (6 to 1.2 microinches).

Optical Surface Quality: 60 – 40 per Mil-0-13830

NOTE

Flatness deviations will appear as measurement errors when the mirror is translated across the beam. Mount should be kinematic so as not to bend mirror. If accuracy requirements demand it, mirror flatness might be calibrated (scanned and stored in the system controller) to be used as a correction factor.

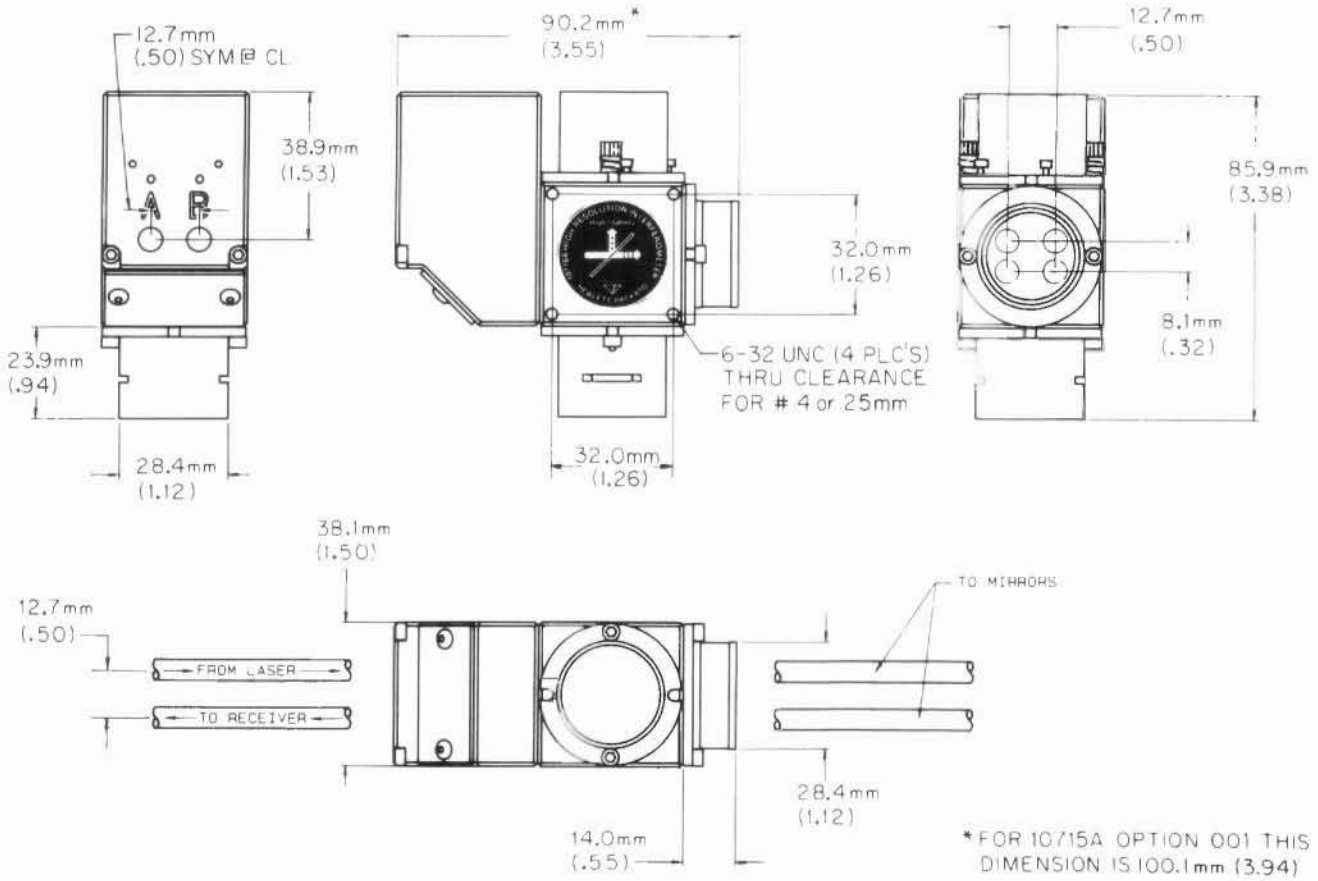


Figure 8-8. HP 10716A High Resolution Interferometer

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HP 10715A Differential Interferometer

Dimensions: See Drawing
Weight: 504 grams (1.1 pounds)
Materials Used:
Housing: Stainless Steel and Aluminum
Optics: Optical Grade Glass
Adhesives: Vacuum Grade
Optical Efficiency (Including a 98% efficient plane mirror reflector and the Reference Mirror):
Typical: 36%
Worst Case: 25%

MEASUREMENT PLANE MIRROR RECOMMENDATIONS

Reflectance: 98% at 633 nanometres, normal incidence
Optical Surface Quality: 60 – 40 per Mil-0-13830
Flatness:
Depending on the application and accuracy demands, the mirror flatness specification might be within a range from λ/4 to λ/20; (0.16 to 0.03 micrometres)

NOTE

Flatness deviations will appear as measurement errors when the mirror is scanned perpendicular to the beam. Mount should be kinematic so as not to bend mirror. If accuracy requirements demand it, mirror flatness might be calibrated (scanned and stored in the system controller) to be used as a correction factor.

MEASUREMENT OR REFERENCE MIRROR ALIGNMENT REQUIREMENTS VS DISTANCE

Maximum Angular Misalignment (pitch and yaw):
Depends on distance between mirror (reference or measurement) and interferometer. Typical values are:
±2.5 arc-minutes for 152 mm (6 inches)
±1.3 arc-minutes for 305 mm (12 inches)
±0.7 arc-minutes for 508 mm (20 inches)

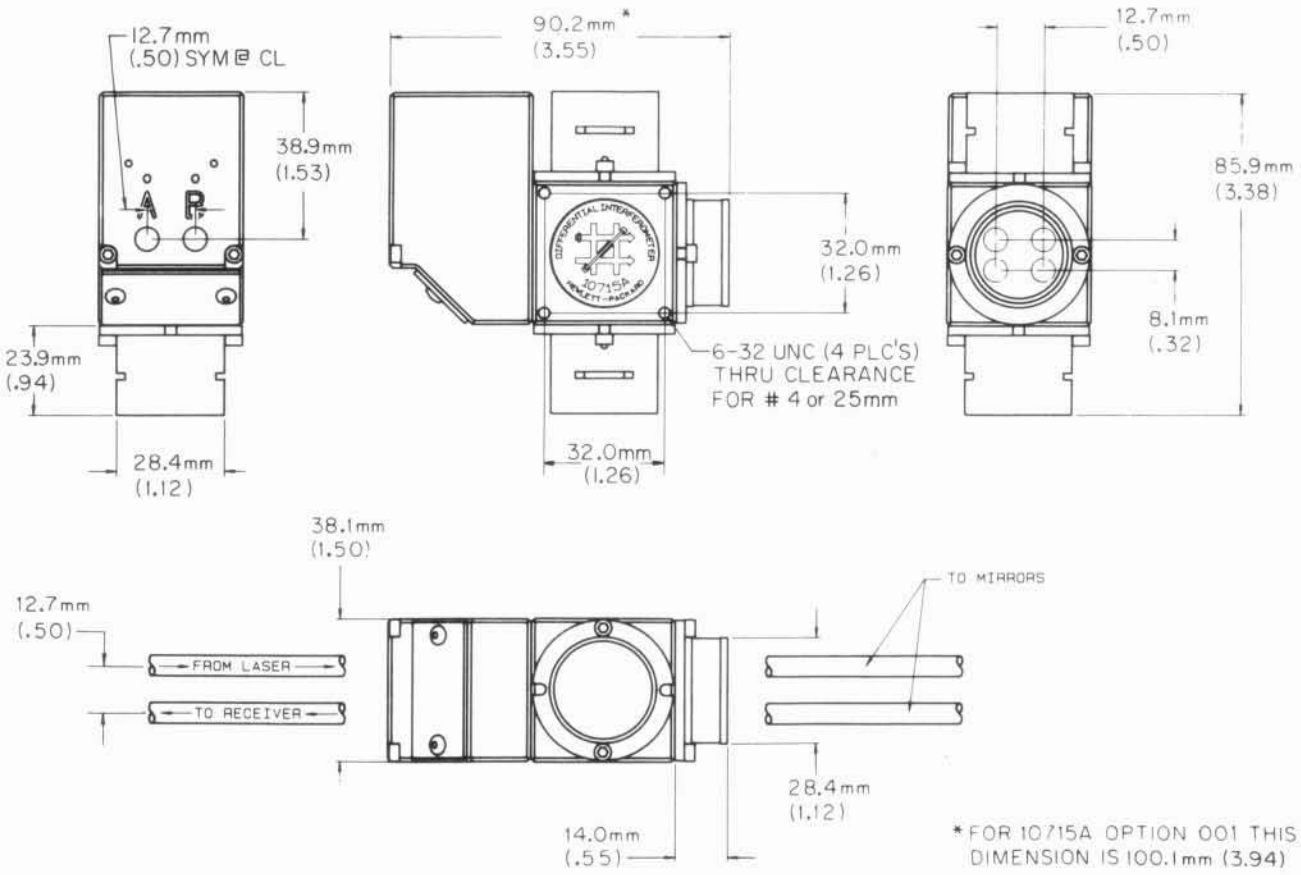


Figure 8-9. HP 10715A Differential Interferometer

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HP 10703A Retroreflector

Dimensions: See *Figure 8-7.*
Weight: 41.5 grams (1.5 ounces)
Materials Used:
Housing: Stainless Steel
End Cap: Plastic (Nylon)
Optics: Optical Grade Glass
Adhesives: Low Volatility (Vacuum Grade)

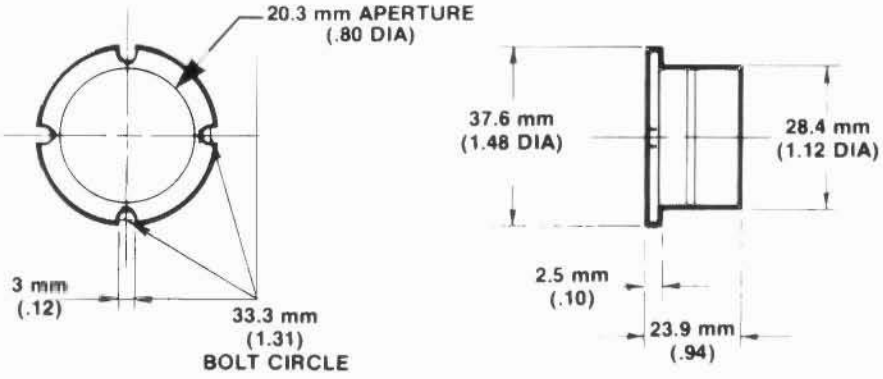


Figure 8-10. HP 10703A Retroreflector, Dimensions

Bare Cube Corner: Part Number 1000-0326
Dimensions: See *Figure 8-8.*
Weight: Glass only 11.4 grams (0.4 ounce)

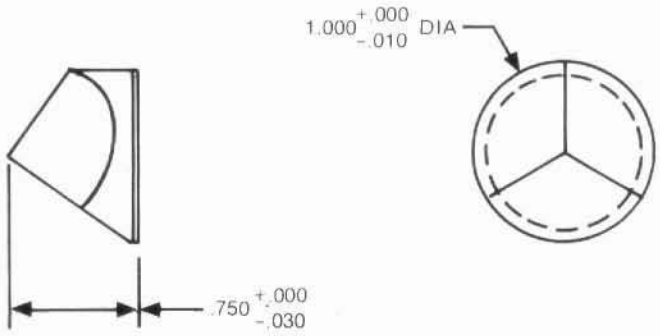


Figure 8-11. HP Cube Corner (HP P/N 1000-0326), Dimensions

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HP 10704A Retroreflector

Dimensions: See *Figure 8-9.*
Weight: 10.5 grams (0.37 ounce)
Materials Used: Same as HP 10703A

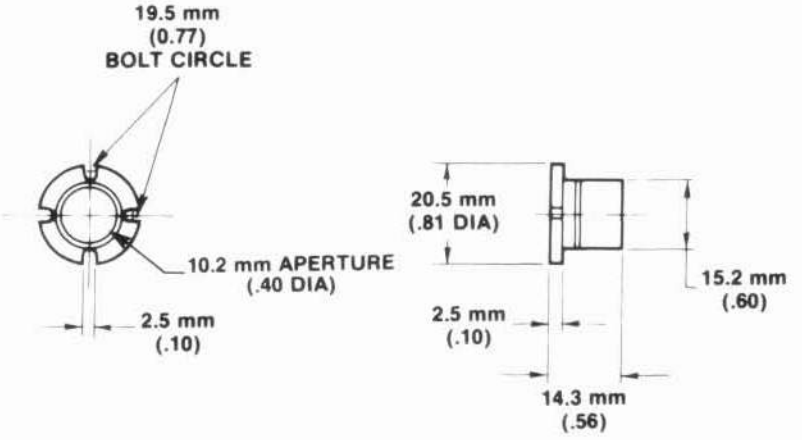


Figure 8-12. HP 10704 Retroreflector, Dimensions

Bare Cube Corner: Part Number 1000-0348
Dimensions: See *Figure 8-10.*
Weight: Glass only — 1.4 grams (0.05 ounce)

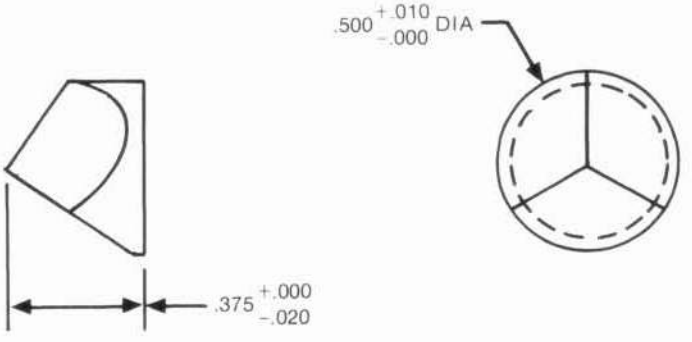


Figure 8-13. HP Cube Corner (HP P/N 1000-0348), Dimensions

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HP 10567A Dual Beam Beam-Splitter

Dimensions: See *Figure 8-11.*
Weight: 325 grams (11.5 ounces)
Materials Used:
Housing: Aluminum
Optics: Optical Grade Glass
Adhesives: Low Volatility (Vacuum Grade)
Optical Efficiency:
Typical: 45%
Worst Case: 39%

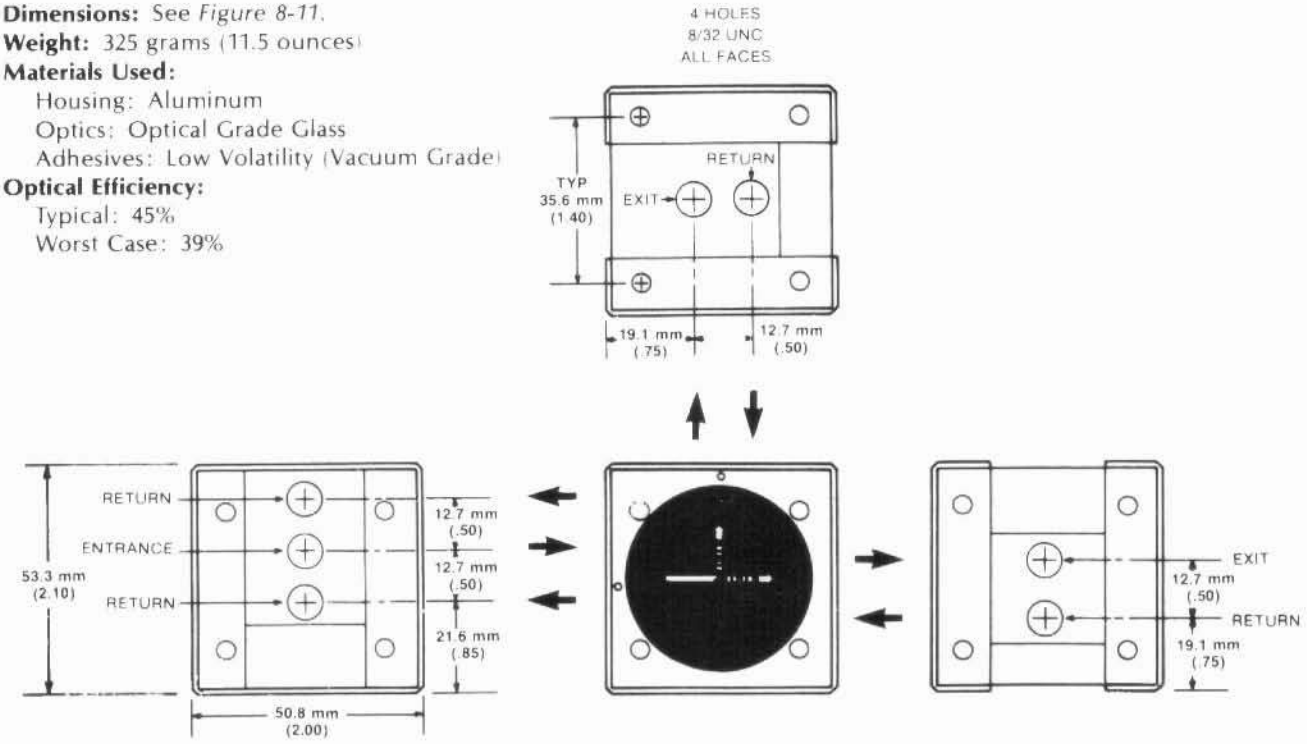


Figure 8-14. HP 10567A Dual Beam Beam-Splitter, Dimensions

HP 10700A 33% Beam Splitter

Dimensions: See *Figure 8-12.*
Weight: 62 grams (2.2 ounces)
Materials Used:
Housing: Stainless Steel
Optics: Optical Grade Glass
Adhesives: Low Volatility (Vacuum Grade)
Optical Efficiency:
33% Path: typical 30%, worst case 27%
67% Path: typical 63%, worst case 61%

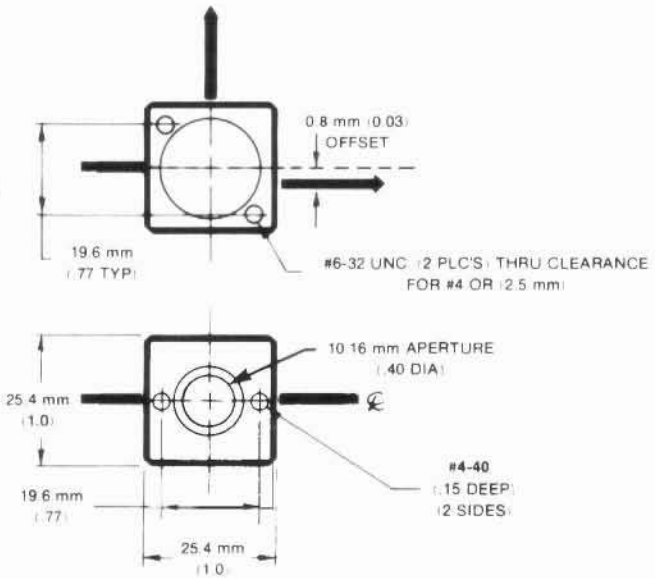


Figure 8-15. HP 10700A 33% Beam Splitter, Dimensions

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HP 10701A 50% Beam Splitter

Dimensions: See *Figure 8-13.*
Weight: 62 grams (2.2 ounces)
Materials Used: Same as HP 10700A
Optical Efficiency:
Typical: 45%
Worst Case: 39%

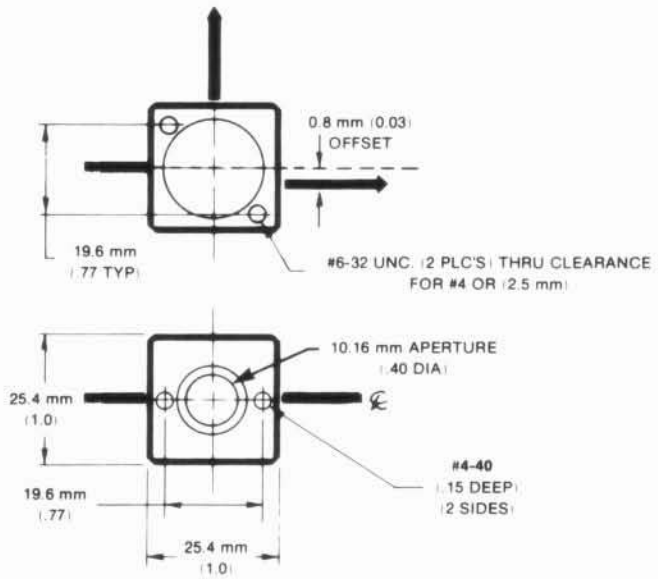


Figure 8-16. HP 10701A 50% Beam Splitter, Dimensions

HP 10707A Beam Bender

Dimensions: See *Figure 8-14.*
Weight: 58 grams (2.1 ounces)
Materials Used: Same as HP 10700A
Optical Efficiency:
Typical: 99%
Worst Case: 98%

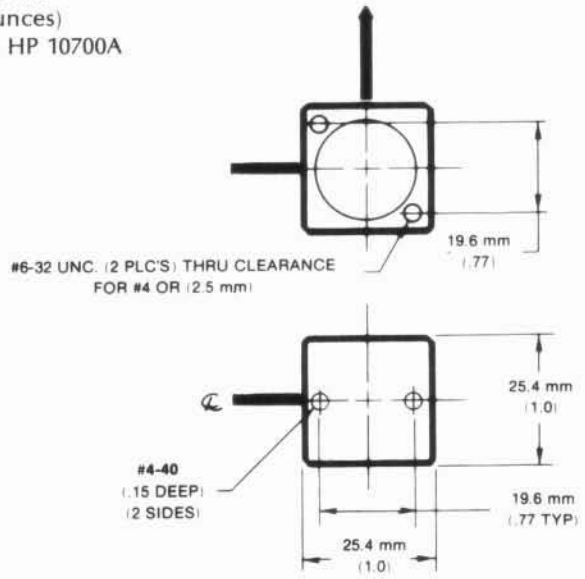


Figure 8-17. HP 10707A Beam Bender, Dimensions

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HP 10710A Adjustable Mount

Dimensions: See *Figure 8-15.*
Weight: 88.2 grams (3.1 ounces)
Angular Adjustment:
Yaw: ±8 degrees
Tilt: ±8 degrees
Materials Used: Stainless Steel

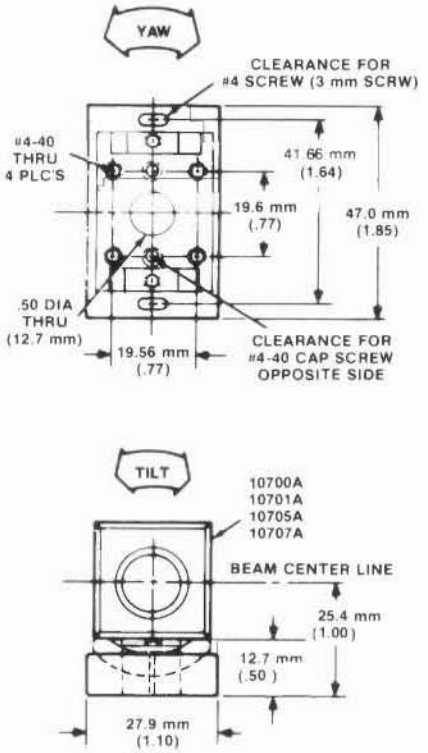


Figure 8-18. HP 10710A Adjustable Mount, Dimensions

HP 10711A Adjustable Mount

Dimensions: See *Figure 8-16.*
Weight: 141.1 grams (5.0 ounces)
Angular Adjustment:
Yaw: ±5 degrees
Tilt: ±5 degrees
Materials Used: Stainless Steel

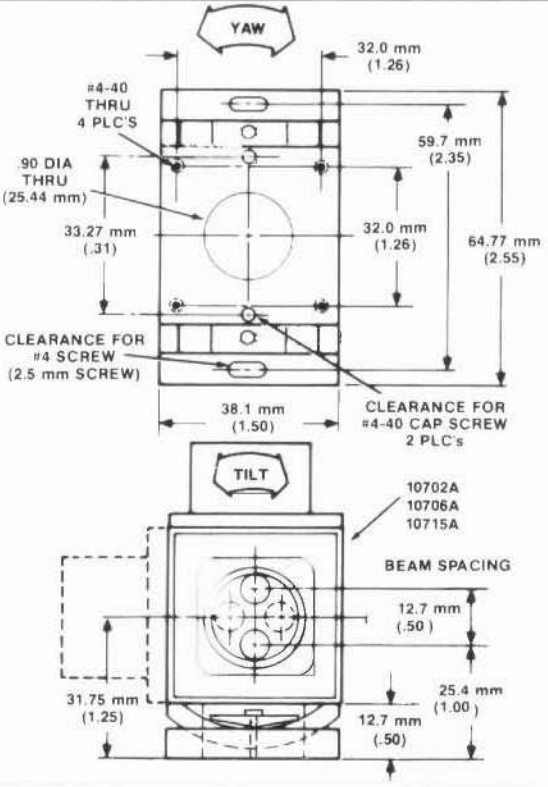


Figure 8-19. HP 10711A Adjustable Mount, Dimensions

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HP 10722A Plane Mirror Converter

Dimensions: See Figure below
Weight: 35.5 grams (1.3 ounces)
Optical Efficiency:
Typical: 95%
Worst Case: 92%

Material Used:
Housing: Stainless Steel
Optics: Optical Grade Glass
Adhesives: Low Volatility (Vacuum Grade)

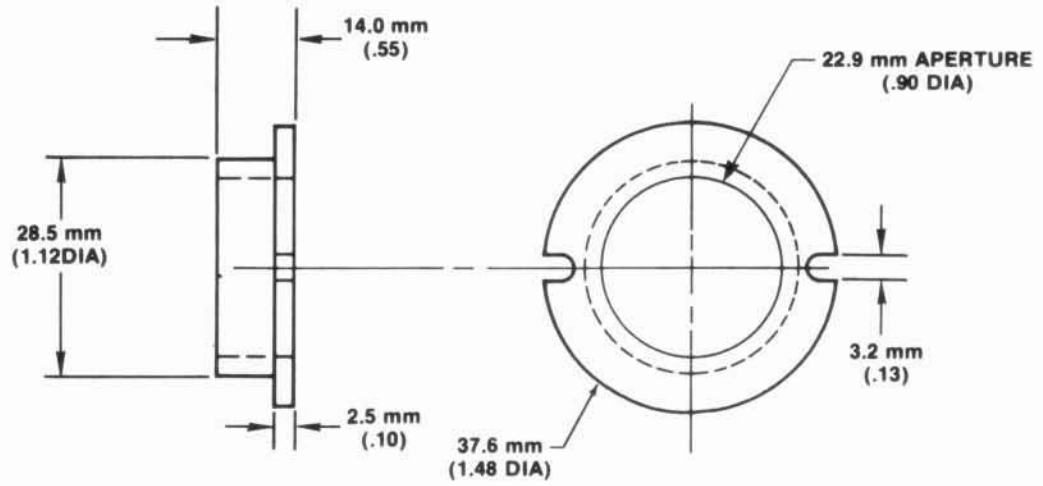


Figure 8-20. HP 10722A Plane Mirror Converter, Dimensions

HP 10723A High Stability Adapter

Dimensions: See Figure below.
Weight: 48.8 grams (1.7 ounce)
Materials Used:
Housing: Stainless Steel
Cap: Plastic (Nylon)
Optics: Optical Grade Glass
Adhesives: Low Volatility (Vacuum Grade)

For Specifications of an upgraded HP 10706A (replacement of reference cube corner with HP 10723A), See HP 10706B Specifications.

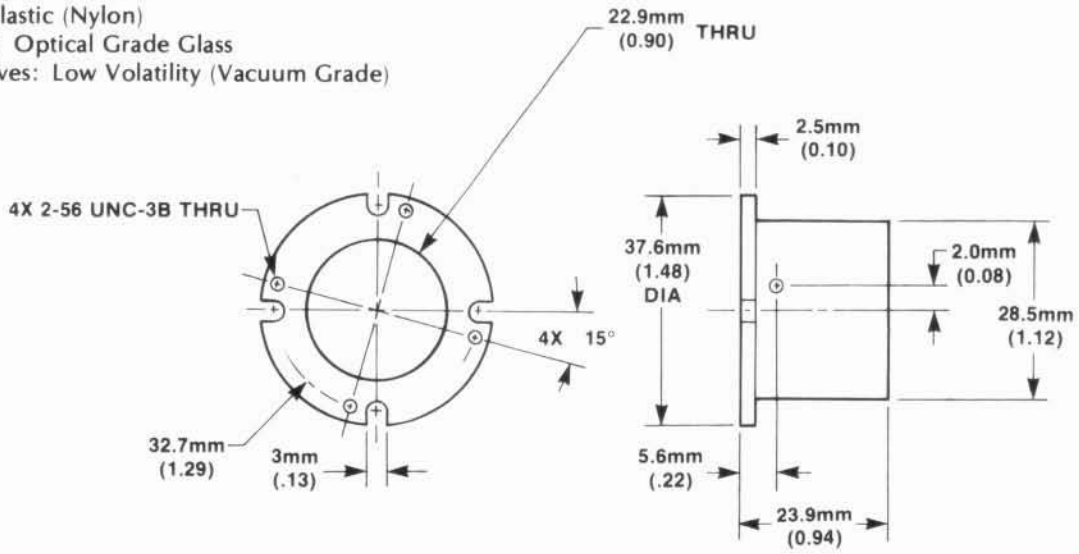


Figure 8-21. HP 10723A High Stability Adapter, Dimensions

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HP 10724A Plane Mirror Reflector

Dimensions: See Drawing

Weight: 50 grams (1.8 ounces)

Housing Material: 416 Stainless Steel

Reflectivity: 98% at 633 nanometres at normal incidence

Flatness: λ/10 (at 633 nanometres)

Installed Angular Adjustment Range:
Pitch/Yaw: 1° Configurations

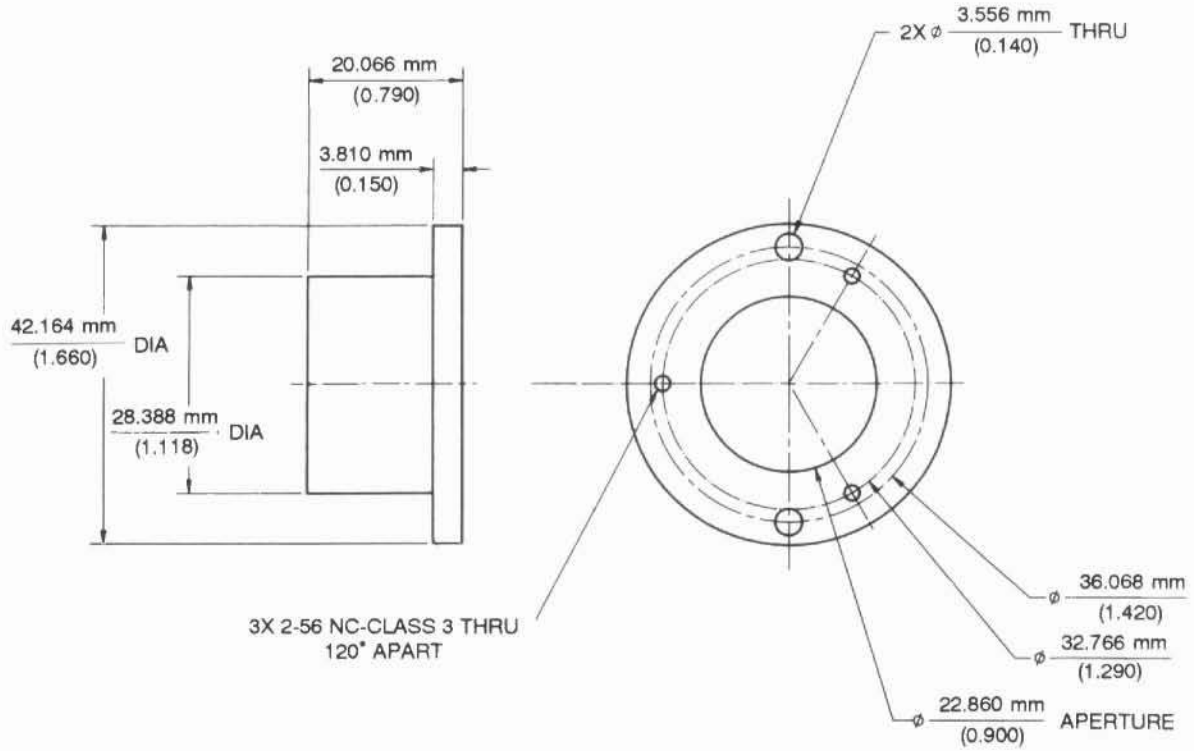


Figure 8-22. HP 10724A Plane Mirror Reflector

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HP 5507A/B LASER POSITION TRANSDUCER ELECTRONICS

Dimensions: *See Figure below.*
Clearance Required For Cabling:
10.2 cm (4 in) beyond back
Weight:
Empty: 9.2 kg (20 lbs)
Fully Loaded: 11.9 kg (26 lbs)
Power
Power Supply (available to 6 function boards, compensation board and receivers):
+5 V at 12.2 A (HP 5507A), 20 A (HP 5507B)
+15 V at 1.2 A (HP 5507A), 3 A (HP 5507B)
–15 V at 1.8 A (HP 5507A), 4 A (HP 5507B)

NOTE

Total power drawn by function boards and receivers may not exceed 82 W (HP 5507A) or 122 W (HP 5507B). See power requirements worksheet in Section 1.

Power Requirements:
Voltage:
115 Vac +10%, –25%
230 Vac +10%, –15%
Frequency: 48 to 66 Hz
Consumption: 250 VA Maximum
Fuse Ratings (primary fuse):
115V Setting: 5 A
230 V Setting: 3 A
Input/Output Format
HP-IB Interface:
Standard IEEE-488 Capability:
SH1, TE0, SR1, DC1, AH1, L2, RL0, DT1, T2, LE0, PP0, C0
Formats (Standard IEEE - 728 Compatibility)
Program message header type: HR3
Numeric Input Format: NR1, NR2, NR3, BDFA, BDFD
Numeric Output Format: NR1, NR2, BDFA, BDFD
HP-IB Data Transfer:
Input (Destination and Commands): 25-350 Hz
Output (Position): 20-1500 Hz
(Rates vary depending on data format and system configuration.)

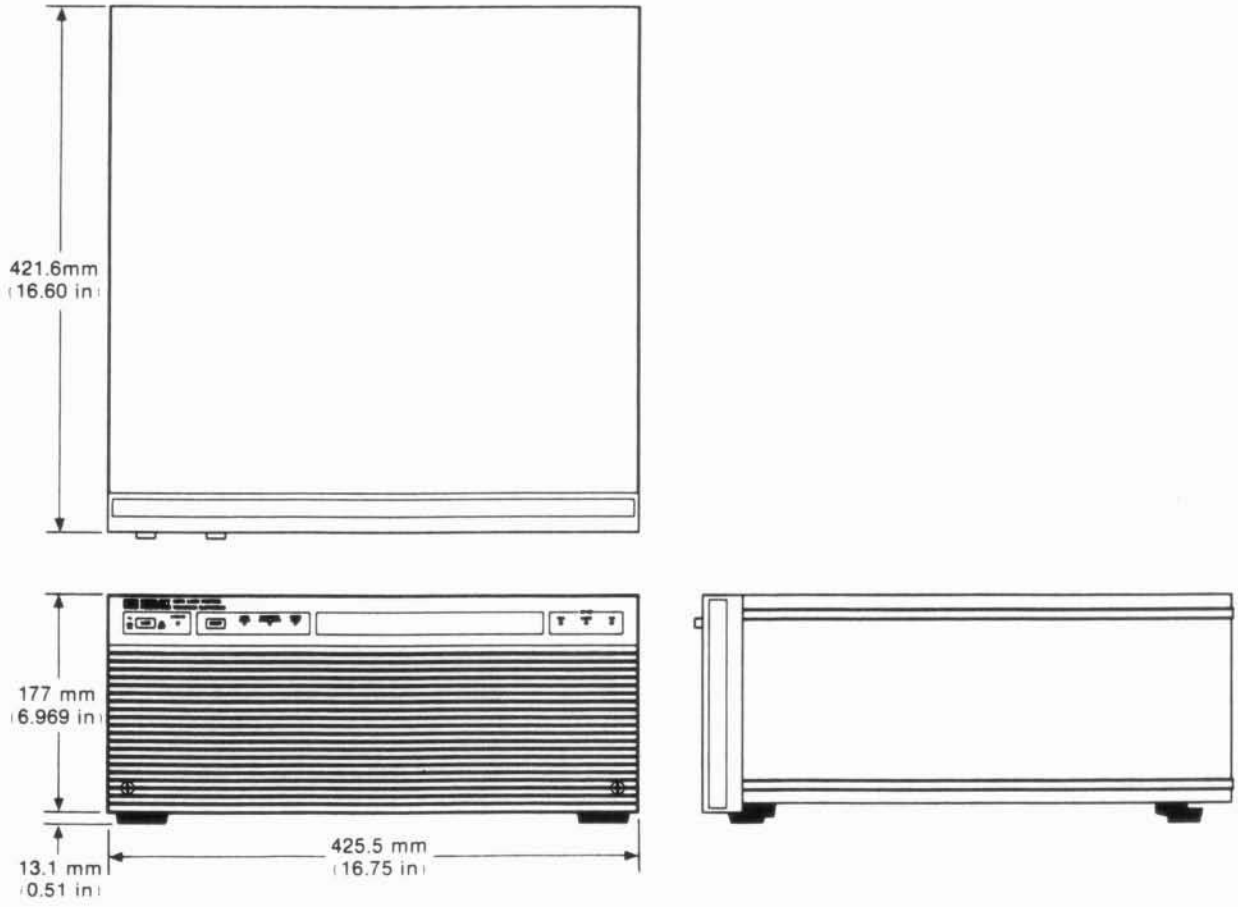


Figure 8-23. HP 5507A/B Laser Position Transducer Electronics, Dimensions

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HP 10932A Axis Board (HP 5507 Option 032)

Power
Typical Power Requirements (not including receiver):
+5 V @ 2.0 A
+15 V @ 16 mA (with fully loaded analog velocity line)
–15 V @ 12 mA (with fully loaded analog velocity line)
Fuse Rating: 3 A fuse on +5 V

Measurement Capability
Velocity (Dependent on laser head and optics):
HP 5517A Laser Head:
Linear or Single Beam Optics: 40.6 cm/s (16 in/s)
Plane Mirror or Differential Optics: 20.3 cm/s (8 in/s)
HP 5517B Laser Head
Linear or Single Beam Optics: 50.8 cm/s (20 in/s)
Plane Mirror or Differential Optics: 25.4 cm/s (10 in/s)
HP 5517C Laser Head
Linear or Single Beam Optics: 71.1 cm/s (28.0 in/s)
Plane Mirror or Differential Optics: 35.6 cm/s (14.0 in/s)
Measurement Range:
Linear or Single Beam Optics: 10.6m (34.5 ft)
Plane Mirror or Differential Optics: 5.3m (17.25 ft)

Position Error Outputs
Data Format:
Signed-Magnitude: 31 bits magnitude, 1 sign bit, positive logic*
Two's Complement: 32 bit parallel binary, positive logic*
Least Significant Bit (or one count) equals resolution
Clipping Format: 8-20 Bits
* Sign bit set indicates negative number
Rear Panel Output:
Data Rate: equal to reference frequency
HP 5517A: 1.5-2.0 MHz
HP 5517B: 1.9-2.4 MHz
HP 5517C: 2.4-3.0 MHz
Data Age (position or position-error delay time relative to motion of interferometer):
HP 5517A: 2.2-4.2 µs typical
HP 5517B: 1.9-3.6 µs typical
HP 5517C: 1.5-2.8 µs typical
Loading Capabilities:
Digital: sink 40 mA, source 3 mA
Analog Velocity: 464 ohms impedance (nominal @ 10 mA maximum
Cable Length:
Recommended maximum cable length is 3 m (assuming proper termination and no system-induced ground currents).

Internal connector Output:
Data Rate: same as rear panel output above
Data Age (position or position-error delay time relative to motion of interferometer):
HP 5517A: 1.5-2.0 µs typical
HP 5517B: 1.4-3.0 µs typical
HP 5517C: 1.2-2.5 µs typical
Loading Capabilities:
Digital: One Standard TTL Load
Analog Velocity: Same as Rear Panel above.
Cable Length: 38.1 cm (15 in)

Additional Outputs
Position Null:
Range:
Plane Mirror Optics: 0.005 µm (0.2 µin) to 20.5 µm (820 µin), selectable
Linear Optics: 0.010 µm (0.4 µin) to 41 µm (1640 µin), selectable
Response Time:
Rear Panel Output: 1 Clock Cycle (1/Reference Frequency)
HP 5517A: 500-667 ns
HP 5517B: 417-526 ns
HP 5517C: 333-420 ns
Internal Connector: Instantaneous
Analog Velocity:
Accuracy:
at 20° to 25°C: 10%
at 0° to 40°C: 20%
Response: Real Double pole at 10 kHz
Scaling:
Linear or Single Beam Optics: 0.098 V/cm/s (0.5 V/in/s)
Plane Mirror or Differential Optics: 0.192 V/cm/s (0.5 V/in/s)
Offset:
at 20° to 25°C: 10 mV
at 0° to 40°C: 20 mV
Noise:
low velocity: <40 mV p-p
high velocity: <10 mV p-p

Transfer Rates (nominal, depends on data format and customer software):

Input (destination):	HP-IB Interface:	Binary Interface:
1 axis	75 - 350 Hz	300 - 700 Hz
2 axis	35 - 150 Hz	300 - 700 Hz
3 axis	25 - 100 Hz	300 - 700 Hz
Output (position):		
1 axis	60 - 1500 Hz	250 - 1000 Hz
2 axis	30 - 80 Hz	125 - 500 Hz
3 axis	20 - 50 Hz	80 - 330 Hz

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HP 10934A A-Quad-B Axis Board

Power

Typical Power Requirements (not including receiver):
+5V @ 2.5 A.
+15V @ 40 mA.
–15V @ 45 mA.

Fuse Rating (+5V):
5 A fuse to board, 1 A fuse to rear panel output.

Measurement Capability

See Table on pg. 8-20b for velocity/range capability.

Programmable Control

Interfaces:
RS-232C (two), 8-bit parallel, and HP-IB (system).

RS-232C Baud Rate:
110, 134.5, 150, 300, 600, 1200, 1800, 2000, 2400, 4800, 9600, and 19200.

8-bit-parallel Transfer Rate (Typical):
2000 bytes/sec.

8-bit-parallel addresses:
0 to 15 (total of 16).

HP-IB Formats and Transfer Rates:
See HP 5507B Electronics specifications.

Setup Variables:
Optics Type, Direction Sense, mm/in. Select, Pulse/Quad Select, Output Resolution, Pulse Rate, Preset Distance, Deadpath Distance, Sampling Controls, Compensation Controls, Parallel Port Controls, and Serial Ports Controls.

Power-up State:
"Sav" command stores measurement systems state when "Setup Enable" switch set.

Rear Panel Status and Control

Control Interface:
Hardwire-selectable, optically-isolated 5, 12, or 24 volt.

Control Signals:
Start, Stop, Error Reset, Axis Initialize, Preset Enable, Compensation Update, External Sample (two), and Mark Input.

Status Interface:
Optically isolated open collector, max rating is 24 V and 50 mA.

Status Signals:
Ready, Axis Error, and System Error.

Pulse/Quadrature Outputs

Data Format:
Compensated phase quadrature (A Quad B), or up/down pulses.

TTL differential output (4 wire), with a 75ns pulse width for up/down pulses.

Output Rate (max. freq.):
Information is output on every edge of the A-Quad-B signal, and on leading edges of the up/down pulses.

Available output pulse rates (kHz): 781, 805 ,831, 859, 889, 920, 955, 991, 1031, 1074, 1121, 1171, 1227, 1289, 1356, 1432, 1516, 1611, 1718, 1841, 1982, 2148, 2343, 2577, 2864, 3221, 3682, 4295, or 5154.

A–Quad–B: $\frac{\text{Output pulse rate}}{4}$.
Up/down pulses: Output pulse rate.

Output Resolution:
High resolution optics: 0.002 µm to 25 µm (0.1 µin to 1000 µin).
Plane mirror optics: 0.005 µm to 50 µm (0.2 µin to 2000 µin).
Linear or single beam optics: 0.010 µm to 100 µm (0.4 µin to 4000 µin).

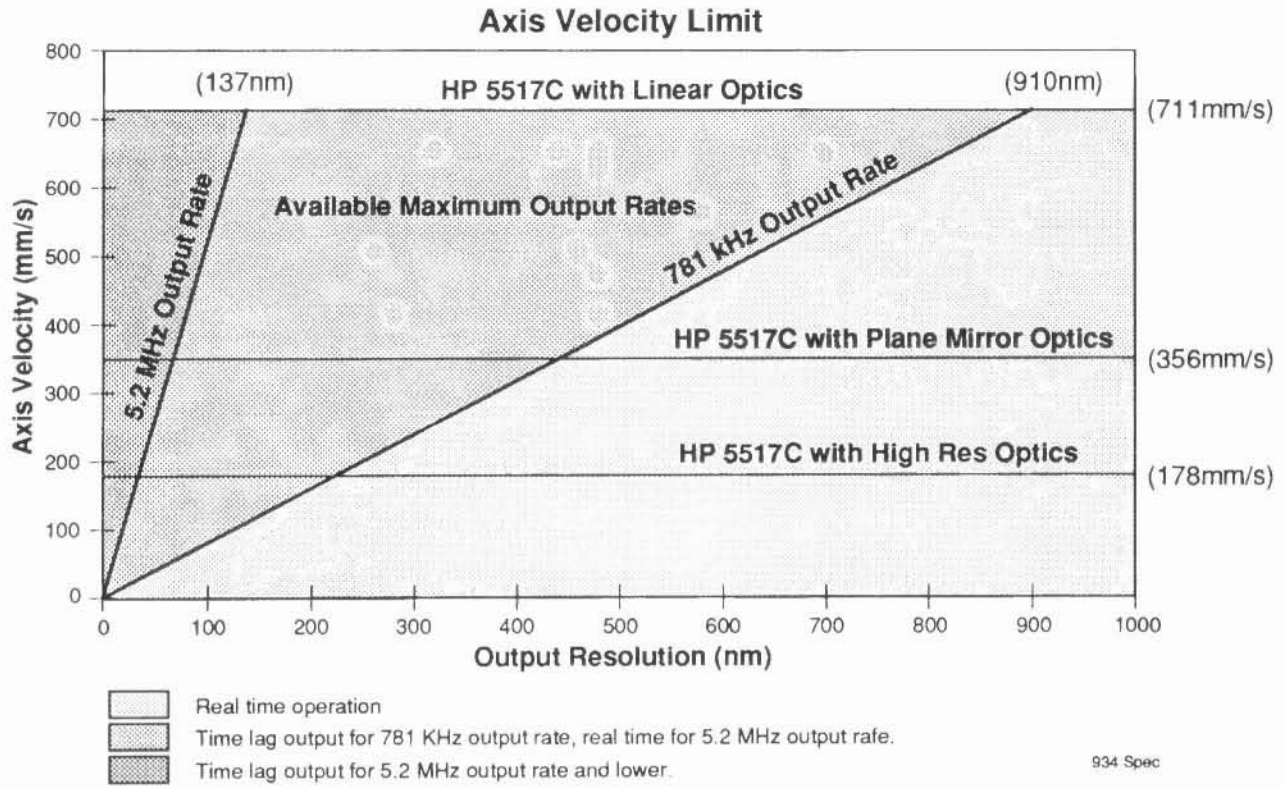
Response Time (from optics movement to last pulse edge containing information):

$$0.47\ \mu\text{sec} + (6.25 \pm 0.5)\ T_R + \left(\frac{\text{Velocity} \times T_R}{\text{Output Resolution}} + 0.5 \pm 0.5\right) T_P$$

$$T_R = \frac{1}{\text{Laser Head Reference Frequency}};\ T_P = \frac{1}{\text{Output Pulse Rate}}$$

Accuracy:
The HP 10934A adds a +1 output resolution count to the accuracy. Accuracy is dependent on system, see system specifications.

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Axis Velocity has two limits, the Laser Head/Interferometer limit, and the real time operation limit. **The Laser Head/Interferometer limit (see table below) must not be exceeded at any time, or information will be lost and an error generated.** The *Axis Velocity* for the real time operation limit is: ***Axis Velocity = (Output Resolution × Output rate)***. If this limit is exceeded (without exceeding the Laser Head/Interferometer limit) there will be an indeterminate time lag between the Pulse/Quadrature signal and the stage movement, and the output signal will continue at the maximum output rate until the signal becomes real time again (when the velocity decreases, stops, or reverses). For example, if 781 kHz is the programmed maximum *Output rate* and the the HP 5517C is used with plane mirror optics, the following limits apply: for a 200 nm *Output resolution*, the limit is 156 mm/sec for real time operation, and 356 mm/sec for time lag operation; for 600 nm *Output resolution*, the limit is 356 mm/sec (from table) because it is the Laser Head/Interferometer limit.

Laser Head/Interferometer Velocity and Range Limits, and Base Resolution:

Interferometer	High Resolution	Plane Mirror	Linear or single beam
Maximum Velocity			
HP 5517A Laser Head	102 mm/sec (4 in/sec)	203 mm/sec (8 in/sec)	406 mm/sec (16 in/sec)
HP 5517B Laser Head	127 mm/sec (5 in/sec)	254 mm/sec (10 in/sec)	508 mm/sec (20 in/sec)
HP 5517C Laser Head	178 mm/sec (7 in/sec)	356 mm/sec (14 in/sec)	711 mm/sec (28 in/sec)
Maximum Range	5.3 m (17.4 ft)	10.6 m 34.8 ft)	21.2 m (69.6 ft)
Base Resolution	0.0025 μm (0.1 μin)	0.005 μm (0.2 μin)	0.010 μm (0.4 μin)

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HP 10936A Servo-Axis Board (HP 5507A Option 036)

Power

Typical Power Requirements (not including receiver):
+5 V at 2.5 A
+15 V at 30 mA
–15 V at 45 mA
Fuse Rating: 5 A fuse on +5 V

Measurement Capability

Velocity (Dependent on laser head and optics):
HP 5517A Laser Head:
Linear or Single Beam Optics: 40.6 cm/sec (16 in/sec)
Plane Mirror or Differential Optics: 20.3 cm/sec (8 in/sec)
HP 5517B Laser head:
Linear or Single Beam Optics: 50.8 cm/sec (20 in/sec)
Plane Mirror or Differential Optics: 25.4 cm/sec (10 in/sec)
Measurement Range:
Linear or Single Beam Optics: 10.6 m (34.5 ft)
Plane Mirror or Differential Optics: 5.3 m (17.25 ft)

Programmable Control — HP-IB or 16-Bit Binary Interface

Selectable Difference Equation:
Proportional, Integral, Difference (PID)
9th Order Infinite Impulse Response (IIR) Filter
User-specified difference equation can be downloaded
Programmable Difference Equation Coefficients
Powerful TRACE command to aid user in optimizing difference equation and feedforward coefficients
Programmable Feedforward Terms
Feedforward Velocity
Feedforward Acceleration
Feedforward Delta Acceleration
Programmable Profiling Method:
Position Profiling
Velocity Profiling
Buffered Position Profiling
Programmable Sample Rate: 250 Hz to 8 kHz

Motor Drive Outputs

10 V Analog: (DAC OUT and AGND)
Resolution: 0.3 mV
Offset: 15 mV
Data Rate: Output updated at sample rate
Pulse Width Modulation: (PULSE UP-, PULSE DOWN-)
Resolution: 125 ns
Data Rate: Output updated at sample rate
16-Bit Digital (uses binary interface's DATA OUT lines)
Format: 2's complement
Data Rate: Output updated at sample rate

Additional Rear Panel Outputs

DRIVE ENABLE OUT- to turn on user motor drive
ERROR-, PATH ERROR- to inform user of system error conditions
WINDOW (output high when position is within a specified range of the marker)
Response time: 2 µs, maximum
THRESHOLD (output high when position is more positive than the marker)
Response time: 2 µs, maximum

Rear Panel Inputs

EXT SAMPLE-/EXT CLOCK-
HI LIMIT IN-, LOW LIMIT IN-:
Negative true inputs to turn off Motor Drive outputs
Maximum response time:
Sample period (1/sample rate) + 0.3 ms

16-Bit binary Interface Transfer Rates

Input (Destinations and Commands): 0.1 - 10 kHz
Output (Position): 0.1 - 10 kHz
Rates vary depending on data format, system configuration, and Servo-Axis board setup.

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