PLANE MIRROR CONVERTER

10581A

ACCESSORY FOR 5526A LASER MEASUREMENT SYSTEM REMOTE INTERFEROMETER

INSTRUCTION MANUAL

SERIAL PREFIX: 1148A

This manual applies directly to Hewlett-Packard Model 10581A Plane Mirror Converters with serial prefix 1148A. For units with different serial prefixes a manual change sheet is supplied.

5301 STEVENS CREEK BLVD., SANTA CLARA, CALIF. 95050

Printed: DECEMBER 1973

Manual Part No. 10581-90002 **PRINTED IN U.S.A.**

HEWLETT hp PACKARD

SAFETY PRECAUTIONS

WARNING

LASER BEAM

This instrument emits laser light. The power output of the HP laser is low in comparison to most other lasers, either continuous wave or pulsed, but due to the high brilliance factor, the output beam of any laser should never be allowed to strike the eye directly. It is the considered opinion of Hewlett-Packard Company that the light beam from this device presents NO hazard to health and safety. However, the existence of newly enacted federal regulations with respect to laser devices together with the lack of any widely accepted standards of laser power safety thresholds requires the insertion of this cautionary statement.

WARNING

HIGH VOLTAGE

High voltages are generated within the laser housing. The cover of the Model 5500C Laser is provided with an interlock to prevent accidental access to these voltages. There are no high voltages on the interconnecting cable however, should it become cut or disconnected.

CAUTION

The 10556A Retroreflector and 10565B Remote Interferometer have precision ground and accurately lapped external surfaces. DO NOT scratch, mar, dent, gouge, or injure these surfaces. Even small scratches can cause measurement errors. Do keep the precision surfaces clean. Even small dust particles can cause errors in measurements.

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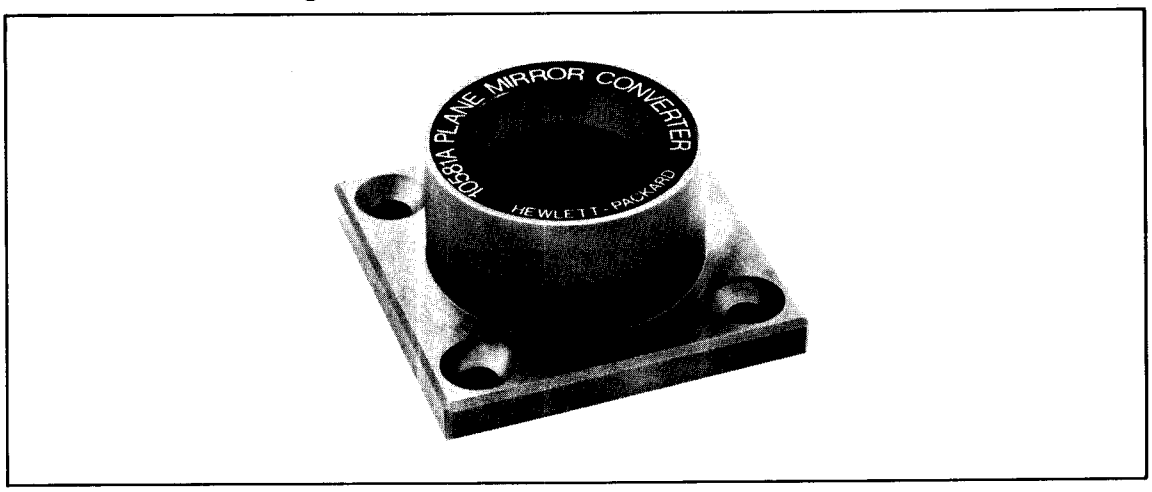
GENERAL INFORMATION

10581A PLANE MIRROR CONVERTER

The Hewlett-Packard 10581A Plane Mirror Converter (Figure 1) is an accessory for the HP 10565B Remote Interferometer. With the 10581A Plane Mirror Converter, and an additional HP 10556A Retroreflector, the HP 10565B Remote Interferometer can be converted to a Plane Mirror Interferometer. This configuration allows the 5526A Laser Measurement System to make measurements of axial displacement of a plane mirror. The stringent angular alignment requirements imposed by roof prisms or single-beam arrangements is eliminated.

Figure 1. Model 10581A Plane Mirror Converter



5526A LASER MEASUREMENT SYSTEM AND ITS PUBLICATIONS

Each component of the 5526A system and each standard option are described in separate publications. A current listing of all publications about the 5526A Laser Measurement System is available from:

HEWLETT-PACKARD
5301 Stevens Creek Boulevard
Santa Clara, California 95050
United States of America
Attention: Laser Publications

5526A LASER MEASUREMENT SYSTEM

The Hewlett-Packard 5526A Laser Measurement System measures linear distances with one millionth of an inch (.01 micron) resolution. The wavelength of light emitted by a helium-neon gas laser is used as the basic length standard.

SPECIFICATIONS

Specifications for the HP 10581A Plane Mirror Converter and Plane Mirror Reflector are as follows:

Plane Mirror Converter

Dimensions: See Figure 2.
Weight: 0.5 pounds (225 grams)
Performance: As for the Model 5526A Laser Measurement System and Option 010 Linear Interferometer.

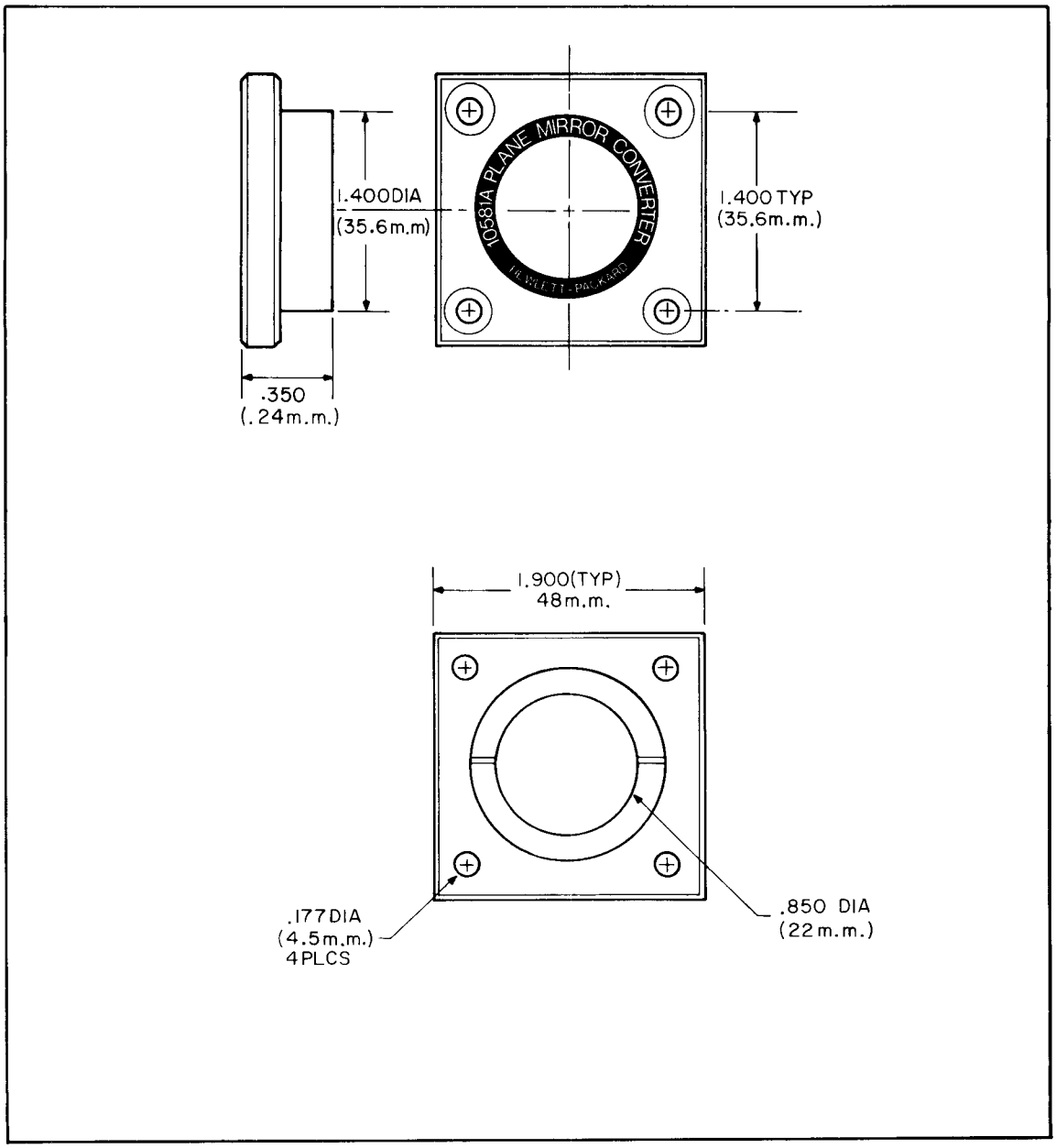
Plane Mirror Reflector (not supplied)

Flatness*: Must not deviate by more than $\lambda/8$ (3 microinches) over any 0.8 inch (20 millimeter) dimension.
Surface Finish: Metal 0.1 - 0.3 microinch arithmetic average.
Optical 80 - 40 (Mil-0-13830)
Maximum Angular Misalignment: Depends on distance between interferometer and plan mirror. Typical values are:

±25 arc-minutes for 10 inches (254 millimeters)
±15 arc-minutes for 20 inches (508 millimeters)
±5 arc-minutes for 50 inches (1270 millimeters)

*In X-Y stage applications, mirror flatness affects the overall accuracy of the system.

Figure 2. Plane Mirror Converter Dimensions



INSTRUMENT IDENTIFICATION

Each Hewlett-Packard instrument has a 10-character serial number (e.g., 0000A00000). The four-digit serial prefix identifies a group of identical instruments, and the five-digit suffix is a serial number unique to each instrument. If the serial prefix on your instrument is not on the title page of this manual, your instrument is different from this manual. A Manual Change Sheet is included with this manual to describe the differences. If the manual change sheet is missing, request one from the nearest Hewlett-Packard Sales and Service Office listed at the back of this manual.

INSTRUMENT COMPONENTS SUPPLIED

The Plane Mirror Converter includes the following items:

Table 1. Components Supplied

DESCRIPTION	HP PART NO.	QUANTITY
Window	1000-0273	2
$\lambda/4$ Plate	1000-0333	1
Screw, Socket Cap	3030-0426	4
Mt-Converter	10581-20001	1
Retainer	10581-20002	1
Label	10581-80001	1

INSTALLATION AND OPERATION

INTRODUCTION

This section provides installation and operating instructions for the 10581A Plane Mirror Converter.

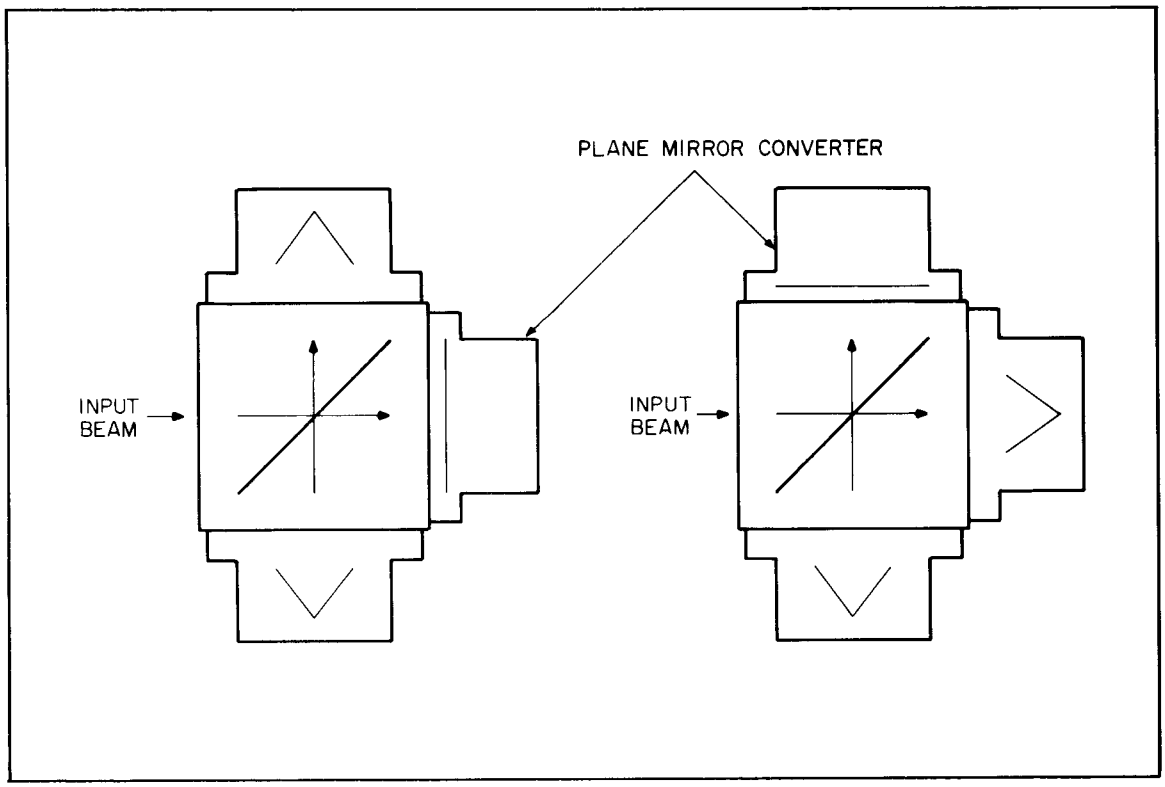
UNPACKING AND INSPECTION

Prior to shipment, this instrument was inspected and met all specifications listed in Table 1. Inspect the shipping container and, if damaged, remove and inspect the Plane Mirror Converter. If the Plane Mirror Converter is damaged, file a claim with the carrier and notify Hewlett-Packard immediately.

INSTALLATION

To mount the 10581A Plane Mirror Converter to the 10565B Remote Interferometer, use the four 8 x 32 flat-head hex socket screws supplied with the Plane Mirror Converter. The Plane Mirror Converter must be mounted to one of the two outlet ports of the Remote Interferometer. The outlet ports of the Remote Interferometer are indicated by the direction of the arrows located on the side of the Remote Interferometer. Figure 3 illustrates the correct mounting configurations of the Plane Mirror Converter.

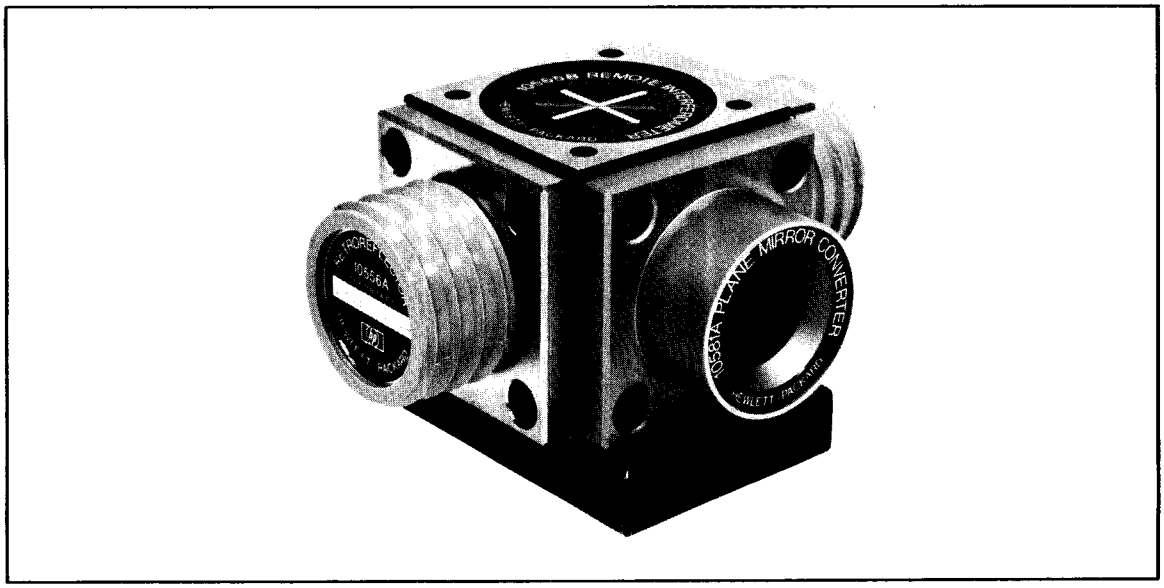
Figure 3. Plane Mirror Mounting



OPERATION

With the Plane Mirror Converter and an additional retroreflector, the Remote Interferometer can be converted to a Plane Mirror Interferometer*. The Plane Mirror Interferometer extends the Laser Measurement System's capability to make axial displacement measurements of a plane mirror reflector. A Plane Mirror Interferometer is illustrated in Figure 4.

Figure 4. Plane Mirror Interferometer



Because the the two reflections inherent in the Plane Mirror Interferometer, there is optical resolution doubling. A modified 5505A Laser Display is required to restore the read-out to the correct resolution. The modification consists of replacing the A1 Analog Board with a K05-5505A Analog Board. If the Laser Measurement System is operated without this modification, the Laser Display will indicate twice the actual displacement.

Measuring Setups

The 5526A Laser Measurement System can perform either single axis or dual axis plane mirror measurements. The dual axis option is particularly useful for X-Y stage applications. The requirements for single axis measurements are; Laser Head, Laser Display, Plane Mirror Interferometer, and a plane mirror reflector. The dual axis requirements are; Laser Head, two Laser Displays, Beam Splitter, two Plane Mirror Interferometers, and two plane mirror reflectors. Typical measuring setups for single axis and dual axis measurements are shown in Figures 5 and 6.

*The Remote Interferometer includes one retroreflector.

Figure 5. Single Axis Measurement

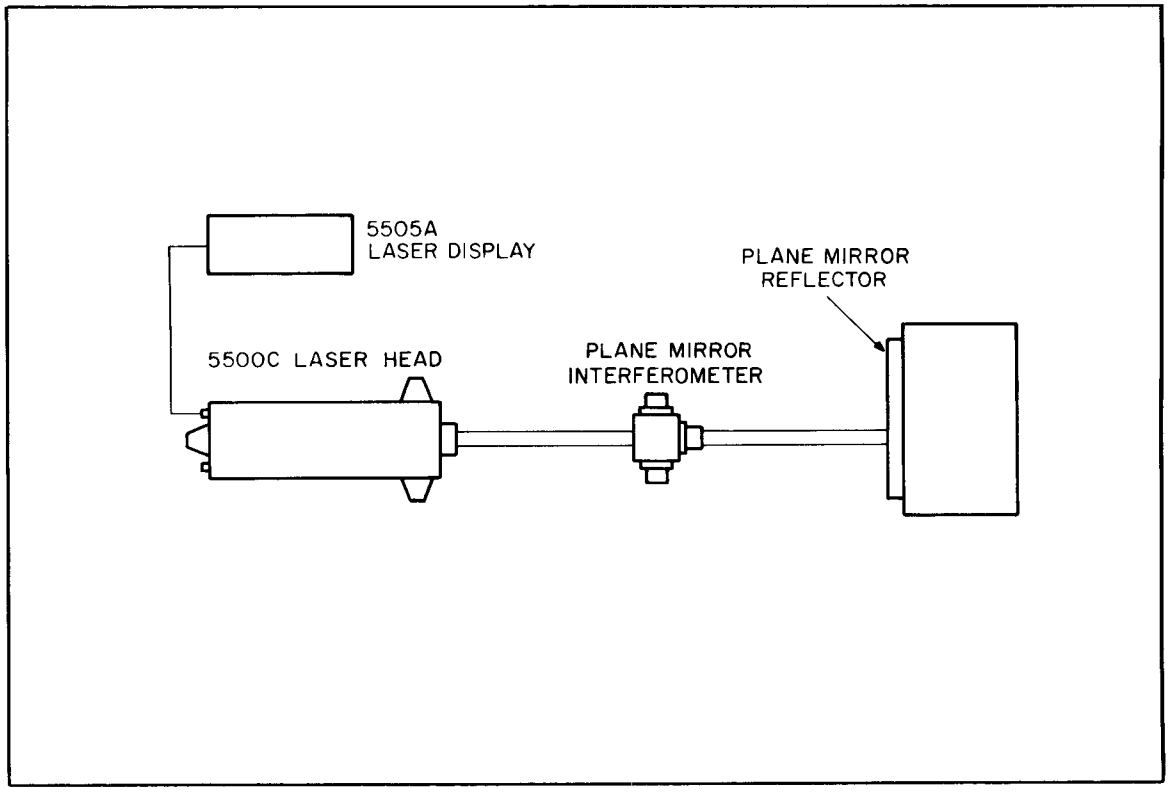
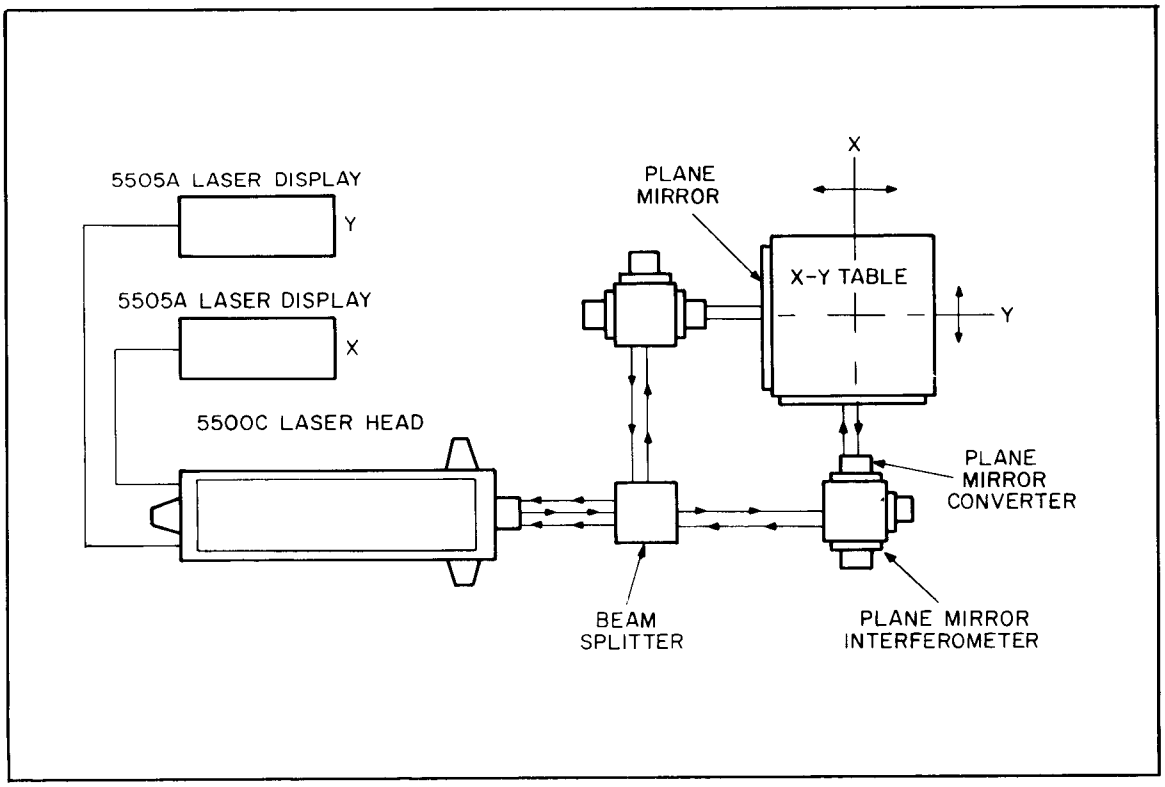


Figure 6. Dual Axis Measurement



The accuracy of the Laser Measurement System can be no better than the mounting of the plane mirror reflector. To maintain system accuracy, the plane mirror reflector must be mounted flat. When performing dual axis measurements, the plane mirror reflectors must be mounted perpendicular to the plane of measurement and at 90° to each other.

Operation Test

1. Set the Laser Head on a flat and stable surface.

2. Put a suitable plane mirror reflector, such as an HP 10551A Alignment Mirror, in line with the beam output of the Laser Head.

3. Align the plane mirror reflector so the reflected beam goes back to the laser beam exit port.

4. Put the Plane Mirror Interferometer in line with the beam output of the Laser Head. The Plane Mirror Interferometer position is illustrated in Figure 5.

5. Align the Plane Mirror Interferometer so it's reflected beam goes back to one of the Display A beam return ports.

6. Set the Laser Head aperature control to the small aperature. Slowly tilt or rotate the plane mirror reflector while observing the appropriate Display A beam return port and the laser beam exit port. Verify that the reflected beam moves about the Display A return port and not the laser beam exit port. If the reflected beam moves about the laser beam exit port, it will be very dim.

7. Align the plan mirror reflector until the two reflected beam are superimposed on the same Display A beam return port.

8. Adjust the Plane Mirror Interferometer and plane mirror reflector carefully while watching the BEAM ALIGNMENT meter on the Laser Display for maximum swing to the right in the green region. When the ALIGNMENT meter is near 8, press the RESET button. Observe that flashing stops.

9. With good alignment purposely break the beam with a piece of paper and observe that the RESET light flashes. Again press the RESET button. Press the SMOOTH, X10, and VELOCITY buttons in turn while moving the reflector. Note that the Display indicates the characteristics of each mode. (Refer to the Operator's Handbook.)

10. On the Laser Display press the TUNE ← → switch to the left and the LASER TUNING meter needle should move the the left. Hold the TUNE switch left until the TUNING meter needle moves into the read area, then release the switch. The RESET light should begin flashing about five seconds after the TUNE switch is released.

11. Push the TUNE switch to the right until the LASER TUNING meter needle is near the middle of the green area, and then release the switch. Press the RESET button and its light should stop flashing.

12. Press the TUNE switch to the right, and check that the LASER TUNING meter needle moves to the right. Check that the RESET light begins flashing after the LASER TUNING meter remains in the red area for a few seconds with the TUNE switch released.

13. Center the LASER TUNING meter needle by holding the TUNE switch in the direction the meter needle should go. Press the RESET button.

14. Slowly move the plane mirror reflector some known distance straight back from the Plane Mirror Interferometer. Verify that the 5505A Laser Display indicates the correct displacement and not twice the displacement if the K05-5505A Analog Bard is incorported in the Laser Display.

15. Slowly tilt or rotate the plane mirror reflector so the corresponding half of the laser beam begins to miss part of the return port on the Laser Head. Continue to slide the Reflector slowly until the BEAM ALIGNMENT meter needle moves slowly to the left until the needle is in the red area. The RESET light should begin flashing.

The operational test for two axis measurement is similar to the one axis operation test described in the preceding paragraphs. After the placement of the beam splitter, each separate axis is aligned in the same manner as the single axis description.

For more detailed information regarding the operation and alignment of plane mirror measurement techniques, refer to the LASER MEASUREMENT SYSTEM 5526A OPERATOR'S HANDBOOK SUPPLEMENT OPTIONS 012/013.

MAINTENANCE

GENERAL

Maintenance of the Plane Mirror Converter consists of cleaning the metal and glass surfaces.

CLEANING

Use a soft camel-hair lens brush to remove dust from the windows of the Plane Mirror Converter. (A good camera lens brush with a rubber bulb blower is recommended.) Dampen a few optical lens cleaning tissues with optical grade ethyl alcohol, shake off excess alcohol and wipe across window once. Use fresh tissue dampened with alcohol for each wipe. Allow alcohol to dry naturally.

NOTE

DO use only camera or better grade lens tissue.

DO NOT use any of the various impregnated eye glass tissues.

DO NOT use harsh solvents such as acetone or MEK to clean the interferometer.

DO NOT use excessive amounts of alcohol.

DO NOT wipe window if there is any abrasive dust or grit on it.

STORAGE

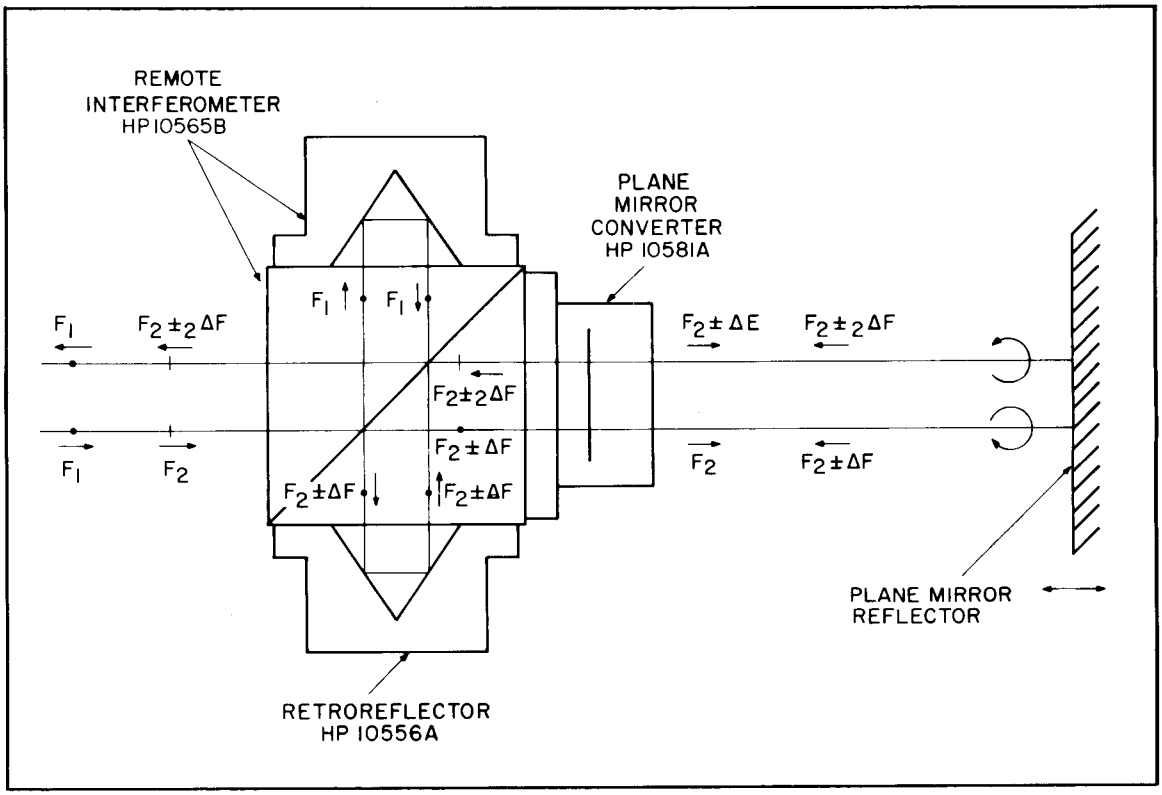
Keep the Plane Mirror Converter in its wooden storage box when it is not in use.

PRINCIPLES OF OPERATION

PLANE MIRROR INTERFEROMETER PRINCIPLES

Figure 7 illustrates the operation of the Plane Mirror Interferometer. The laser light beam containing frequencies f_1 and f_2, of orthogonal linear polarization, leaves the center aperture of the laser head and enters the inlet port of 10565B Plane Mirror Interferometer. The polarized beam splitter in the interferometer splits the laser beam into its f_1 and f_2 components. The f_1 component is deflected to a cube-corner (retroreflector), which reflects the f_1 component back to the polarized beam splitter.

Figure 7. HP 5526A Laser Measurement System Plane Mirror Interferometer



The f_2 component passes through the polarized beam splitter and the plane mirror converter where it is changed from vertical polarization to circular polarization by the plane mirror converter. The f_2 component is reflected back on itself by the plane mirror reflector, resulting in $f_2 \pm \Delta f$ by 90° to change the polarization from circular to horizontal. As a result, the polarized beam splitter reflects the $f_2 \pm \Delta f$ to the second cube-corner, as shown in Figure 7. The cube-corner reflects the $f_2 \pm \Delta f$ back to the polarized beam splitter, where it is again reflected through the plane mirror converter. The plane mirror converter changes the beam polarization from horizontal to circular. The plane mirror reflects the $f_2 \pm 2\Delta f$ back through the plane mirror converter, which rotates the $f_2 \pm 2\Delta f$ polarization by 90°, resulting in a vertically polarized beam. The $f_2 \pm 2\Delta f$ beam is passed through the polarized beam splitter and a beam composed of $f_1 - f_2 \pm 2\Delta f$ is applied to the inlet port of the laser head. The $2\Delta f$ frequency change is a result of the dual pass feature of the plane mirror interferometer (double Doppler shift).

Any tilting of the plane reflector relative to the beam axis results only in an offset of the return beam. Tilting of the reflected wavefront is compensated by the second reflection.