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Operating and Programming Manual

HP 81553SM Lightwave Multimeter Source Module

SERIAL NUMBERS

This manual applies to all instruments.

HP Part No. 81553-90011
Printed in Germany

Second Edition
E0796

>Control Serial Number: Edition 2 applies directly to all instruments.
First Edition : 1st May 1990 : 81553-90011 : E0590
Second Edition : 1st March 1991 : 81553-90011 : E0391 ; 1st April 1992 : 81553-90011 : E0492 ; 1st February 1994 : 81553-90011 : E0294 ; 1st December 1994 : 81553-90011 : E1294 ; 1st July 1996 : 81553-90011 : E0796

Safety Considerations

Before operation, review the instrument and manual, including the red safety page, for safety markings and instructions. You must follow these to ensure safe operation and to maintain the instrument in safe condition.

Initial Inspection

Warning



To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers, panels, etc.).

Line Power Requirements

The HP 81553SM operates when installed into the HP 8153A Lightwave Multimeter mainframe

Initial Safety Information for Laser Source Modules

The Specifications for these modules are as follows:

	HP 81553SM
Laser Type	FP-Laser InGaAsP
Laser Class	
According to IEC 825-1 (not USA) (EN 60825-1 Europe)	3A
According to 21 CFR 1040.10 (USA)	1
Output Power	>0dBm
Beam Diameter	9μm
Numerical Aperture	0.1
Wavelength	1550±20nm

Sicherheitsinformation für Laser Quellen

Die Spezifikationen für die Lasereinschübe sind wie folgt:

	HP 81553SM
Laser Typ	FP-Laser InGaAsP
Laser Klasse Entsprechend IEC 825-1 (EN 60825-1 Europa)	3A
Ausgangsleistung	>0dBm
Strahldurchmesser	9μm
Numerische Apertur	0.1
Wellenlänge	1550±20nm

Informations et Consignes de Sécurité Relatives à l'Utilisation des Lasers.

Les Spécifications des Modules Laser sont les Suivantes:

	HP 81553SM
Type de Laser	FP-Laser InGaAsP
Classe du Laser	
Conforme au STD IEC 825-1 (EN 60825-1 Europe)	3A
Puissance de Sortie	>0dBm
Diamêtre du Faisceau	9μm
Ouverture Numérique	0.1
Longueur d'Onde	1550±20nm

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HP 81553SM Specifications

Specifications describe the instrument's warranted preformance. Supplementary performance characteristics describe the instrument's non-warranted typical performance.

Because of the modular nature of the instrument, these performance specifications apply only to this module. You should insert these pages into the appropriate section of the manual.

Table C-1. HP 81553SM Specifications

Type	FP-Laser
Central Wavelength[1]	1550nm±20nm
Fiber Type	single mode 9/125μm
Spectral Bandwidth (RMS)[2]	<4nm rms
Output Power[3]	>0dBm
CW-Stability[4]	
Short Term (15min, T=Constant)	±0.003dB
Long Term (6h, T=0 to 55°C±1K)	±0.03dB
Operating Tempreature	0°C to +55°C
Dimensions	75mm H, 32mm W, 335mm D (2.8"×1.3"×13.2"×)
Weight	net 0.7kg (1.5lbs), shipping 1kg (2.2lbs)
Recalibration Period	1 year

[1] Central Wavelength is shown on the display.
[2] rms: root mean square.
[3] Class 3A according to IEC 825-1 (1993), Class 1 according to FDA CFR 21 (1986)
[4] After a warm-up time of 60 min. with output enabled. If previously stored at the same temperature, 20 min. only.

Supplementary Performance Characteristics

Internal Digital Modulation

You can select internal modulation frequencies of 270HZ, 1kHz, or 2kHz. All outputs are pulse shaped, with a duty cycle of 50%.

Output Attenuation

The output can be attenuated from 0 to 6dB, in steps of 0.1dB.

Stability

The value of the long term CW-stability doubles with just one minute warmup time (source enabled).

D

HP 81553SM Performance Tests

Introduction

The procedures in this section test the optical performance of the instrument. The complete specifications to which the HP 81553SM is tested are given in Table C-1. All tests can be performed without access to the interior of the instrument. The performance tests refer specifically to tests using the Diamond HMS-10/HP connector.

Equipment Required

Equipment required for the performance test is listed below.

Note



The source module under test can be inserted into the second channel of the Power Meter Standard. In this case, the second multimeter mainframe is not necessary.

Instrument/Accessory	Rec. Model	Required Characteristic
Power Meter Standard (C01)	HP 8153A Mainframe with HP 81533A Optical Head Interface Module with HP 81524A Optical Head	Uncertaintay ±1.5%
Multimeter Mainframe	HP 8153A	
Connector Adapter (head)	HP 81000AA	
Connector Interface	HP 81000AI 2ea (08154-61701)	
Singlemode Fiber	HP 81101AC	
BNC to BNC Cable	8120-1840	
Oscilloscope		

Test Record

Results of the performance test may be noted in the Performance Test Record. The Test Record can also be used as a permanent record and may be reproduced without written permission from Hewlett-Packard

Test Failure

If the HP 81553SM fails any performance test, return the instrument to the nearest Hewlett-Packard Sales/Service Office for repair.

Instrument Specification

Specifications are the performance characteristics of the instrument that are certified. These specifications, listed in Table C-1, are the performance standards or limits against that the HP 81553SM can be tested. Appendix C also lists some supplemental characteristics of the HP 81553SM and should be considered as additional information.

Any changes in the specifications due to manufacturing changes, design, or traceability to the National Institute of Standards and Technology (NIST) (formerly the National Bureau of Standards) will be covered in a manual change supplement or revised manual. The specifications listed in such a change supercede any previously published.

Performance Tests

The performance tests given in this section are separated into Output Power Test and Stability Test. Perform each step in the tests in the order thay are given, using the corresponding test equipment.

Note



Make sure that all optical connections in the test setups given in the procedure are dry and clean. For cleaning, use the cleaning instructions in Appendix E.

The ambient temperature must be constant (±1K) during the test. The power meter must be zeroed before the measurement.

Output Power and Stability Tests

Specifications:

Optical output power of 10/125μm fiber:	>0dBm
Stability over 15 minutes at constant temperature:	±0.003dB
Stability over 6h and ±1K env. temp. window:	±0.03dB

I. Output Power Test

1. Make sure that cable connectors and detector windows are clean.

2. Turn instruments on, enable the laser output of the HP 81553SM and allow instruments to warm up for at least 20 minutes.
3. On the power meter:
   a. Set λ to the wavelength displayed for the HP 81553SM source channel.
   b. Make sure that the CAL parameter on the power meter is set to zero.
   c. With the connector adapter, on the optical head, covered with a plastic cap, press (Zero) to zero the power meter.
4. Connect the equipment as shown in Figure D-1.

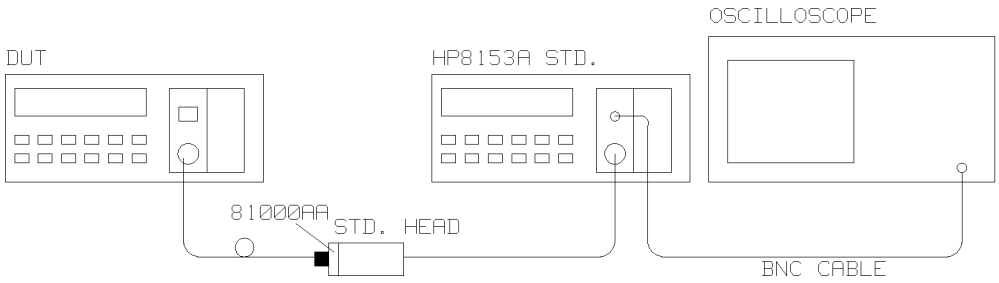


Figure D-1. Performance Test Setup

5. On the HP 8153A with the module under test:
   a. Press (Param) until the AUX parameter is selected. Make sure that this parameter is set to CW.
   b. Press (Param) until the ATT parameter is selected. Make sure that this parameter is set to zero.
6. Measure the output power and note the result in the Test Record.

II. Attenuation Function Test

7. On the power meter, press (Disp→Ref). Press (dB) to select a display in dB.
8. Using the modify keys on the HP 8153A with the module under test, increase the attenuation and check that the output power changes.

   Note the reaction on the Test Record.
9. Set the attenuation to 1.0dB.

III. Modulation Function Test

10. Using a BNC cable, connect the power meter transducer output to the oscilloscope input and set the oscilloscope as follows: 0.5V/DIV DC coupled, 1ms/DIV.
11. On the power meter, switch the autoranging off and select the 0dBm range.
12. On the HP 8153A with the module under test, press (Param) to select the AUX parameter. Monitor the frequency change on the oscilloscope as you set the modulation to 270Hz, 1kHz, and then to 2kHz. Use (⇧) and (⇩) to modify the modulation.

    Note the reaction on the Test Record.

IV. Stability Test

1. Enable the HP 81553SM laser output and allow the instruments to warm up for 20 minutes.
2. Select the channel with the source.
   a. Press (Param) to select the AUX parameter. Set this parameter to CW.
   b. Press (Param) to select the ATT parameter. Set this parameter to zero.
3. On the power meter:
   a. Cover the input to the sensor with a plastic cap and press (Zero) to zero the meter.
   b. Press (Param) to select the λ parameter. Set this parameter to the value displayed for the source.
   c. Press (Param) to select the T parameter. Set this parameter to 1s.
4. Using the HP 81101AC cable, connect the output of the source to the input of the sensor. Make sure that the cable is fixed and that it cannot be moved during the measurement.
5. Select the MENU mode on the power meter.
   a. Press (Record) to select STABILTY.
   b. Press (Edit) and select the T_TOTAL parameter. Set the T_TOTAL parameter to 15 minutes.
   c. Press (Edit) and then (Exec) to run the stability application.

6. When the stability test has completed, press (More) to select the SHOW application. Press (Edit) and then (Next)/(Prev) to display the DIFF result. Divide this result by 2 to obtain the value for the stability:

$$\frac{DIFF}{2} = Stability\,(dB)$$

   Note the result on the Test Record.

7. Repeat the stability measurement (steps 5 and 6) with T_TOTAL set to 6 hours.

Performance Test for the HP 81553SM

Test Facility:

_____		Report No.	_____
_____		Date	_____
_____		Customer	_____
_____		Tested By	_____

Model	HP81553SM Source Module		
Serial No.	_____	Ambient temperature	_____ °C
Options	_____	Relative humidity	_____ %
Firmware Rev.	_____	Line frequency	_____ Hz

Special Notes:

_____

_____

_____

_____

_____

_____

_____

Test Equipment Used:

	Description	Model No.	Trace No.	Cal. Due Date
1.	Lightwave Multimeter (Std.) (C01)	HP 8153A		
2.	Opt. Head Interface Module (C01)	HP 81533A		
3.	Optical Head 1310nm (C01)	HP 81524A		
4.	Lightwave Multimeter (DUT)	HP 8153A		
5.	Connector Interface	HP 81000AI	N/A	N/A
6.	Connector Adapter	HP 81000AA	N/A	N/A
7.	Singlemode Fiber	HP 81101AC	N/A	N/A
8.	BNC to BNC Cable	P/N 8120-1840	N/A	N/A
9.	Oscilloscope			
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				

Performance Test for the HP 81553SM

Model HP 81553SM Source Module No. _____ Date _____

Test No.	Test Description	Minimum Spec.	Result	Maximum Spec.	Measurement Uncertainty
I.	**Output Power Test**				
	Output Power	0dBm	_____		0.1dB
II.	**Attenuation Function Test**				
	Passed (P)/Failed (F)		_____		
III.	**Modulation Function Test**				
	Passed (P)/Failed (F)		_____		
IV.	**Stability Tests**				
	Stability (15min.)	-0.003dB	_____	+0.003dB	
	Stability (6h.)	-0.03dB	_____	+0.03dB	

E

Cleaning Procedures

The Cleaning Kit

A full cleaning kit contains the following items:

Isopropyl alcohol This is usually available from pharmaceutical suppliers or chemists.

If possible, use alcohol supplied for medical purposes, rather than impure alcohol or alcohol with additives.

Caution
Do not use other solvents as some can damage plastic materials and claddings. For example, Acetone dissolves the adhesives used in fiber optic devices.

Warning
Never drink this alcohol as this can lead to blindness or other serious damage to your health.

Cotton-swabs Use swabs such as Q-tips or other cotton-swabs. These are typically available from local distributors of medical or hygiene products (such as supermarkets or pharmacies).

Note If you are cleaning connector interfaces or adapters, the diameter of the cotton swab is important. Cotton swabs for babies normally have a smaller diameter.

Caution

- Do not use foam swabs, as these can leave filmy deposits on the surface you are cleaning.
- Store your cotton-swabs carefully and never reuse them. Dust and dirt from the air or from previous cleaning, can scratch or dirty your optical device.

Soft-tissues These are available from most stores and distributors of medical and hygiene products (such as supermarkets or pharmacies).

Use multi-layer tissues made from non-recycled cellulose. These are more absorbent and softer than other types and they do not scratch the surface of your device.

Caution
Store your soft-tissues carefully and never reuse them, as dust and dirt from the air or from previous cleaning can scratch and dirty your optical device.

Pipe-cleaner This is available from tobacco shops.

Ensure that the bristles of the pipe-cleaner are soft, so that they do not scratch your device during cleaning.

Caution
Store your pipe-cleaners carefully and never reuse them as dust and dirt from the air or from previous cleaning can scratch and dirty your optical device.

Compressed Air This is available from laboratory suppliers.

It is essential that your compressed air is free of dust, water and oil. Only use clean, dry air. If you do not, it can lead to filmy deposits or scratches.

When using compressed air from a can,

- Hold the can upright. A slant can cause propellant to escape with the compressed air and dirty your optical device.
- Spray the first couple of seconds into the air, as the first stream of compressed air can contain condensation or propellant. Any condensation produces a filmy deposit.

If you are using compressed air from a can, you should select one with a CFC-free propellant, for the sake of the environment.

Other Cleaning Tools

To examine devices you also require:

Microscope	Select a microscope with a magnification range of between 50X and 300X. These should be available from photographic stores or laboratory suppliers. Ensure that the light source of the microscope is flexible. This helps you to examine your device closely and from different angles. A microscope allows you to determine the type of dirt on your device and its extent. Then you can choose the correct cleaning procedure and later to examine the results of cleaning. With a microscope you can also determine if your optical device is scratched.
Ultrasonic bath	This is typically available from photographic stores or laboratory suppliers. An ultrasonic bath very gently removes greasy and other stubborn dirt from optical devices. Only use an ultrasonic bath with isopropyl alcohol, as other solvents can damage or dirty your optical device.
Warm water and liquid soap	Use water only if you are sure that your optical device will not corrode or be damaged. Do not use hot water, as this can lead to mechanical stress that can damage your optical device. Ensure that your liquid soap has no abrasive properties or perfume in it, as these can scratch or damage your optical device. Do not use normal washing-up liquid, as it can leave behind an iridescent film.
Premoistened cleaning wipes	These are available from HP. The part number is HP 92193N (80 Wipes per box). These are tissues that are moistened with isopropyl alcohol.
Polymer film	This is typically available from professional photographic stores or laboratory suppliers. Polymer film is very gentle on optical surfaces and is particularly good for cleaning extremely sensitive devices such as mirrors.
Infrared sensor card	This is typically available from laboratory suppliers. With this card you can qualitatively check the uniformity of your emitted laser light, because when the laser light is projected onto the sensor card it becomes visible.
Lens Cleaning Paper	Some lens cleaning papers and cleaning kits available, for example, in photographic stores are not suitable for cleaning fiber optic devices. To be sure, please ask the salesperson or the manufacturer.

Preserving Connectors

Listed below are some hints on how to keep your connectors in the best possible condition.

Making Connections

Before you make any connection you must ensure that all cables and connectors are clean. If they are dirty, use the appropriate cleaning procedure.

When inserting the ferrule of a patchcord into a connector or an adapter, make sure that the fiber end does not touch the outside of the mating connector or adapter. Otherwise you will rub the fiber end against an unsuitable surface, producing scratches and dirt deposits on the surface of your fiber.

Dust Caps and Shutter Caps

Be careful when replacing dust caps after use. Do not press the bottom of the cap onto the fiber as any dust in the cap can scratch or dirty your fiber surface.

When you have finished cleaning, put the dust cap back on, or close the shutter cap if the equipment is not going to be used immediately.

Keep the caps on the equipment always when it is not in use.

All of Hewlett-Packard's lightwave instruments and accessories are shipped with either laser shutter caps or dust caps. If you need additional or replacement dust caps, contact your Hewlett-Packard sales office.

Immersion Oil and Other Index Matching Compounds

Where it is possible, do not use immersion oil or other index matching compounds with your device. They are liable to impair and dirty the surface of the device. In addition, the characteristics of your device can be changed and your measurement results affected.

Cleaning Instrument Housings

Use a dry and very soft cotton tissue to clean the instrument housing and the keypad. Do not open the instruments as there is a danger of electric shock, or electrostatic discharge. Opening the instrument can cause damage to sensitive components, and in addition your warranty will be voided.

Cleaning Procedures

If you are unsure about the correct cleaning procedure for your device or if you are unsure whether the procedure given here is suitable for your device, check with the manufacturer or sales distributor, or try the procedure on a dummy or test device first.

Cleaning Cable Connectors

Cleaning connectors is difficult as the core diameter of a singlemode fiber is only about 9μm. This generally means you cannot see streaks or scratches on the surface. To be certain of the condition of the surface of your connector and to check it after cleaning, you need a microscope.

In the case of scratches, or of dust that has been burnt onto the surface of the connector, you may have no option but to polish the connector. This depends on the degree of dirtiness, or the depth of the scratches. This is a difficult procedure and should only be performed by skilled personnel, and as a last resort as it wears out your connector.

Warning
Never look into the end of an optical cable that is connected to an active source.

To assess the projection of the emitted light beam you can use an infrared sensor card. Hold the card approximately 5 cm from the output of the connector. The invisible emitted light is projected onto the card and becomes visible as a small circular spot.

Preferred Procedure

1. Clean the connector by rubbing a new, dry cotton-swab over the surface using a small circular movement.
2. Blow away any remaining lint with compressed air.

Procedure for Stubborn Dirt

Use this procedure particularly when there is greasy dirt on the connector:

1. Moisten a new cotton-swab with isopropyl alcohol.
2. Clean the connector by rubbing the cotton-swab over the surface using a small circular movement.
3. Take a new, dry soft-tissue and remove the alcohol, dissolved sediment and dust, by rubbing gently over the surface using a small circular movement.
4. Blow away any remaining lint with compressed air.

An Alternative Procedure

The better, more gentle, but more expensive cleaning procedure is to use an ultrasonic bath with isopropyl alcohol.

1. Hold the tip of the connector in the bath for at least three minutes.
2. Take a new, dry soft-tissue and remove the alcohol, dissolved sediment and dust, by rubbing gently over the surface using a small circular movement.
3. Blow away any remaining lint with compressed air.

Cleaning Connector Adapters

Caution
Some adapters have an anti-reflection coating on the back to reduce back reflection. This coating is extremely sensitive to solvents and mechanical abrasion. Extra care is needed when cleaning these adapters.

Preferred Procedure

1. Clean the adapter by rubbing a new, dry cotton-swab over the surface using a small circular movement.
2. Blow away any remaining lint with compressed air.

Procedure for Stubborn Dirt

Use this procedure particularly when there is greasy dirt on the adapter:

1. Moisten a new cotton-swab with isopropyl alcohol.
2. Clean the adapter by rubbing the cotton-swab over the surface using a small circular movement.
3. Take a new, dry soft-tissue and remove the alcohol, dissolved sediment and dust, by rubbing gently over the surface using a small circular movement.
4. Blow away any remaining lint with compressed air.

Cleaning Connector Interfaces

Caution

- Be careful when using pipe-cleaners, as the core and the bristles of the pipe-cleaner are hard and can damage the interface.
- Do not use pipe-cleaners on optical head adapters, as the hard core of normal pipe cleaners can damage the bottom of an adapter.

Preferred Procedure

1. Clean the interface by pushing and pulling a new, dry pipe-cleaner into the opening. Rotate the pipe-cleaner slowly as you do this.
2. Then clean the interface by rubbing a new, dry cotton-swab over the surface using a small circular movement.
3. Blow away any remaining lint with compressed air.

Procedure for Stubborn Dirt

Use this procedure particularly when there is greasy dirt on the interface:

1. Moisten a new pipe-cleaner with isopropyl alcohol.
2. Clean the interface by pushing and pulling the pipe-cleaner into the opening. Rotate the pipe-cleaner slowly as you do this.
3. Moisten a new cotton-swab with isopropyl alcohol.
4. Clean the interface by rubbing the cotton-swab over the surface using a small circular movement.
5. Using a new, dry pipe-cleaner, and a new, dry cotton-swab remove the alcohol, any dissolved sediment and dust.
6. Blow away any remaining lint with compressed air.

How to clean instruments with a physical contact interface

Where possible, remove any connector interface from the optical output of the instrument before you start cleaning.

Light dirt

Use compressed air to blow away larger particles of dirt. Clean the instrument's connector with a dry cotton swab. Then you can blow away any remaining filaments left by the swab.

Cleaning in this was is appropriate if there is no fat on the surface of the device, as it is a very gentle method.

Heavy dirt

If you find sediments like fat, you should moisten a cotton swab with isopropyl alcohol and clean the connector. Afterwards, use a soft tissue to remove the alcohol, any dissolved sediment, and the dust. Any bits left behind can be blown away with compressed air.

Caution



Cleaning an instrument's connectors is rather tricky, as the core diameter of a single-mode fiber is only about 9μm. Usually this means that you will be unable to see any streaks or scratches on the surface.

You should use a microscope to be absolutely certain of the amount of dirt on the surface of your connector, and to check that it has been thoroughly cleaned.

Do not press the swabs or the soft tissue too hard onto the optical surface of your device, as this could cause scratches and other damage.

By using an infrared sensor card you can check whether the projection of the light beam is correct. Hold the card approximately 50mm/2 inches away from the output of the connector. The invisible beam is projected onto the card and becomes visible to the naked eye as a small circular spot. Never look into the end of an optical output as this can seriously damage your eyesight.

If you are unable to remove the dirt as described above, you should examine the surface of your optical device using a microscope. Do not try to clean with other solvents, like Acetone, as this may damage your optical device.

If you discover scratches, or if the dust has burnt into the surface due to a high power application, then your only option (depending on the degree of pollution and depth of the scratches) is to polish the connector.

Polishing connectors is very difficult. We strongly recommend that only skilled personnel should attempt this. This measure is only to be used if absolutely necessary, as it will reduce the life span of your optical device.

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