

# **Operating and Programming Manual**

## **HP 81534A Return Loss Module**

### **SERIAL NUMBERS**

This manual applies to all instruments.



**HP Part No. 81534-90012**  
**Printed in Germany**

**Second Edition**  
**E0796**



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### Printing History

New editions are complete revisions of the manual. Update packages, contain additional and replacement information to be incorporated into the manual by the customer. The date on the title page only changes when a new manual is published. When an edition is reprinted, all the prior updates to the edition are incorporated.

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## 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

Inspect the shipping container for damage. If there is damage to the container or cushioning, keep it until you have checked the contents of the shipment for completeness and verified the module both mechanically and electrically.

The Performance Tests give procedures for checking the operation of the module. If the contents are incomplete, mechanical damage or defect is apparent, or if a module does not pass the operator's checks, notify the nearest Hewlett-Packard office.

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### 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.).**

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### Power Requirements

The HP 81534A operates when installed into the HP 8153A Optical Multimeter mainframe.

### Operating Environment

The HP 8153A safety information summarizes the HP 81534A operating environment ranges. In order for the HP 81534A to meet specifications, the operating environment must be within the limits specified in this section.

### Storage and Shipment

The module can be stored or shipped at temperatures between  $-40^{\circ}\text{C}$  and  $+70^{\circ}\text{C}$ . Protect the module from temperature extremes that may cause condensation within it.



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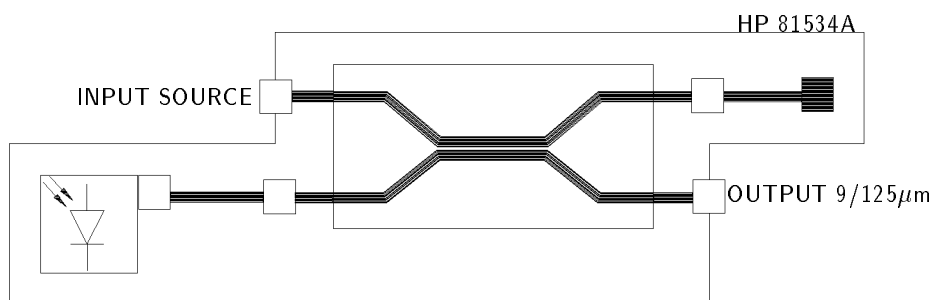


## The HP 81534A in Measure Mode

This chapter describes the use of the module for making return loss measurements. Theoretical aspects of the measurement are covered at the end of the chapter.

### How to Make Return Loss Measurements with the HP 81534A

The HP 81534A includes a sensor and coupler in one module for use in the HP 8153A mainframe for the making of return loss measurements.



**Figure 2-1. The Contents of the HP 81534A Module (Standard Version)**

The module is intended for use with a single mode laser source (HP 81552SM 1310nm, HP 81553SM 1550nm, HP 81554SM 1310 and 1550nm, or HP 8155A 1310nm and 1550nm) to make return loss measurements.

## Setting up to Make a Return Loss Measurement

The return loss setup described here uses a HP 81553SM source, inserted as a second module in the same mainframe as the return loss module.

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### Note



This description is for the standard HP 81534A Return Loss Module, not for the pigtail version.

Notes are given where the procedure for the pigtail version may be significantly different.

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It is recommended that you attach a patchcord to the return loss module output.

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### Caution



HP supplies patchcords with a Diamond HMS-10/HP/HRL high return loss connector on one end. These patchcords are necessary so that the connector at the output is not damaged. The the full range of patchcords available are described in Appendix B.

---

Because of the high return loss connector used and a length of fiber greater than the coherence length of the laser source, the patchcord reduces the disturbance of the source due to reflections.

The setup described uses a fiber with Diamond HMS-10/HP/HRL and Diamond HMS-10/HP connectors throughout.

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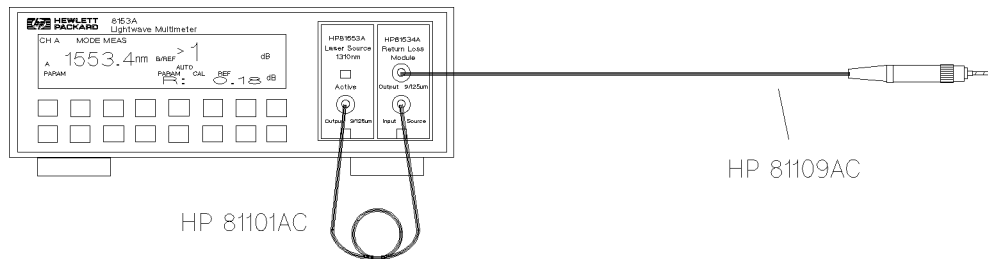
### Opt.001



If you are using the HP 81534A Option 001 it is strongly recommended that you attach a connector or a working fiber to the end of the pigtail so that you can avoid cutting the pigtail as much as possible. (The replacement of the pigtail fiber is not covered by the warranty for the instrument.)

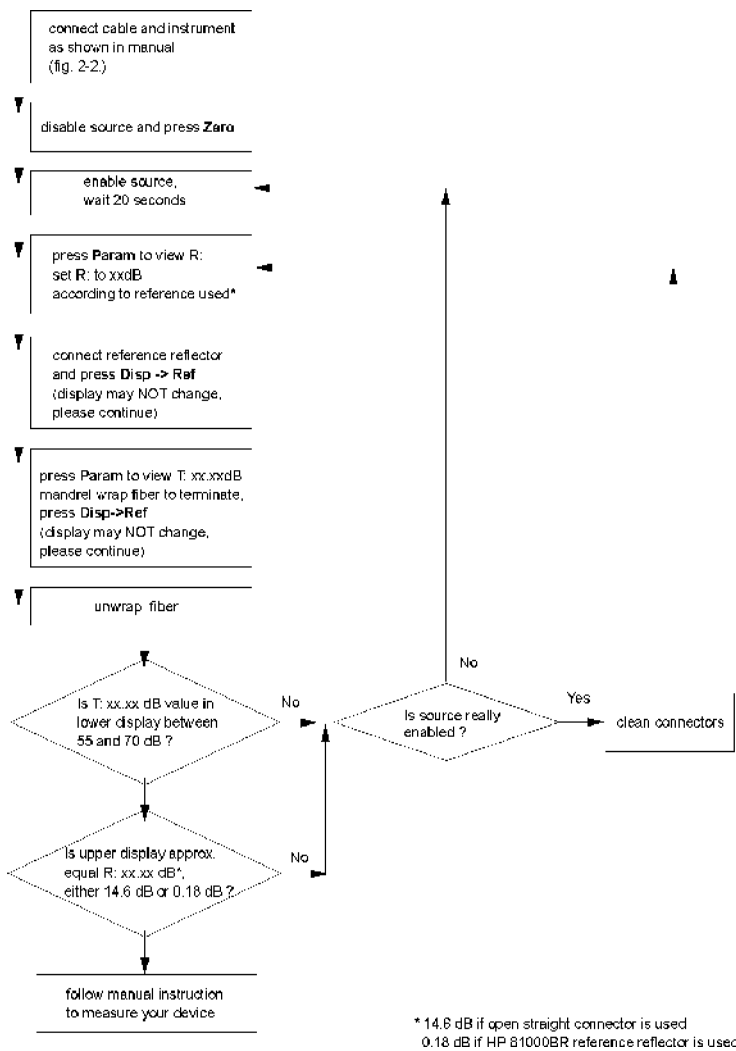
---

1. Making sure to clean all the connectors, set up the instrument as shown in the figure. Connect the source to the HP 81534A Input. Attach the high return loss connector of the patchcord to the Output. The high return loss connector on these cables is the connector with the orange sleeve. For best results and higher repeatability, fix the cables.



**Figure 2-2. Set Up for Return Loss Measurements**

2. Make sure the instrument has warmed up.
3. Make sure that the source is inactive and that you have covered the end of the patchcord. Press **Zero** to remove electrical offsets in the instrument.
4. Press **Param** to select the T parameter (the measurement averaging time). Make sure that the selected averaging time is suitable for your measurements. You should use at least 200ms, but you should increase this to at least 1s for return losses greater than 50dB. (Longer averaging times give more accurate results, but decrease the speed at which the instrument measures.)
5. Press **Param** to select the  $\lambda$  parameter. Edit this parameter and set it to the actual wavelength of the source.
6. Enable the source.



**Figure 2-3.**  
**HP 81534A: Calibrating for Return Loss Measurements: procedure as described in steps 1-14**

**2-4 The HP 81534A in Measure Mode**



## Making Calibration Measurements

Whenever the HP 81534A Return Loss Module is in the HP 8153A mainframe, the result field shows return loss. The calibration values used are either the most recently measured, where these are available, or default values.

If you are unsure of one or both of the calibration values you are using, make the appropriate calibration measurements again. If you have changed your measurement setup,

## Measuring the Reflection Reference

7. Press **Param** to select the CAL REF parameter. The current value for the known return loss is displayed with R: at the side of the character field.

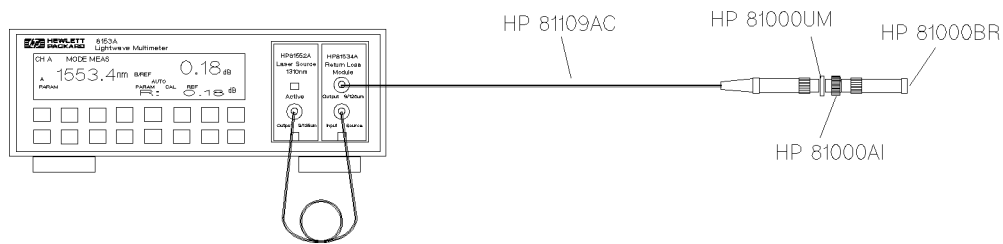


Figure 2-4. Measuring the Reflection Reference

8. Attach a component with a known return loss to the end of the patchcord. The HP 81000BR Back Reflector is such a component, offering a return loss of  $0.18 \pm 0.1$  dB.



Figure 2-5. Measuring the Reflection Reference

9. Make sure that the value displayed for R: is correct. Set R: to the value of the return loss of the reference reflection you are using. For example, if you are using the HP 81000BR reference reflector, set R: 0.18dB. If not, edit the parameter so that it has the correct value.

---

**Opt.001**

If you are using a cleaved fiber end as your reference, the reflection reference is approximately 14.6dB.



10. Press **(Disp→Ref)**. The instrument measures the power reflected by the component. The read value should now be the same as the value entered for R:.

---

**Note**

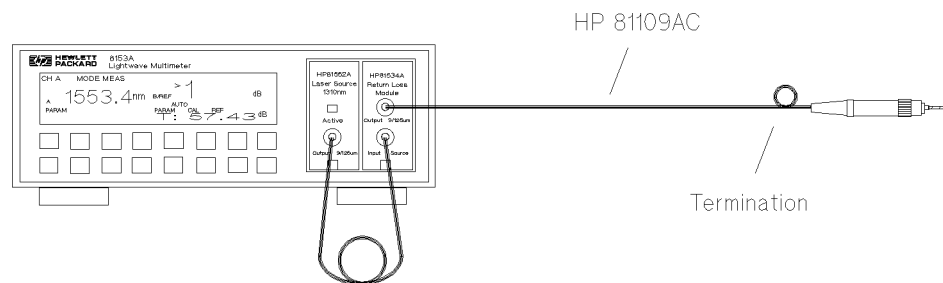
This value may not be the same the first time you take this reference after powering the instrument on.



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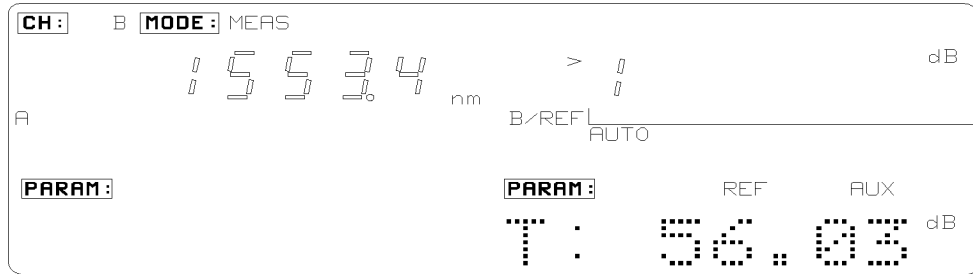
**Measuring the Termination Parameter**

11. Press **(Param)** to select the REF AUX parameter. T: is displayed at the side of the character field.



**Figure 2-6. Measuring the Termination Parameter**

12. Terminate the cable so that there are no reflections coming from the end. You can do this by wrapping the fiber five times around the shaft of a screwdriver (or some similar object with a diameter of around 5mm).



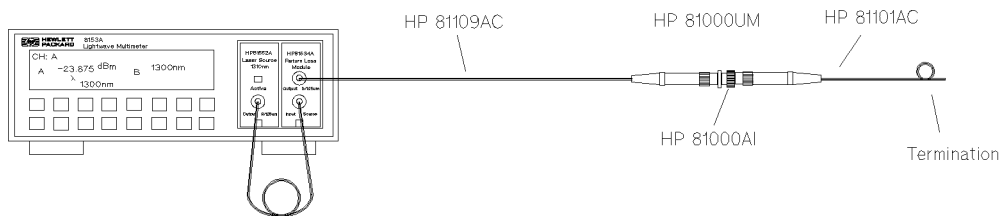
**Figure 2-7. Measuring the Termination Parameter**

13. Press **(Disp→Ref)**. The instrument measures and sets the termination parameter.

### Measuring the Return Loss

The value shown in the result field is the return loss.

14. Attach the DUT.



**Figure 2-8. Measuring the Return Loss of the DUT (in this example: a Connector Pair)**

Terminate your system close to the DUT to make sure that you are only measuring reflections from the DUT.

It is not necessary to make new calibration measurements for each DUT. You can make the calibration measurements for your system, and then measure the return loss of many devices.

---

## The HP 81534A in Measure Mode - Some Exceptions

The HP 81534A acts like any other sensor module when operating in measure mode with two exceptions.

- The units are fixed at dB. **(dB)** and **(dBm/W)** do not have any effect.
- Autoranging cannot be disabled. **(Auto)**, **(Up)**, and **(Down)** display the selected range while you are pressing them, but otherwise they have no effect.

---

## A Background to Return Loss Measurements with the HP 81534A

When light is incident on an optical component, most of it passes through, or into, the component, some light is absorbed, and some is reflected. In many applications the reflections are unwanted, because they can affect the emission characteristics of any laser in the system. In such applications it is important to have measurements of the reflections for the components in the system.

The reflection factor for a component is a measure of how much light the component reflects. It is the ratio of the power reflected by the device to power incident on the device. More normally we talk about the return loss of a component. The return loss is a value in dB, given by the formula:

$$\text{Return Loss}[dB] = -10 \log(\text{Reflection Factor})[dB]$$

or

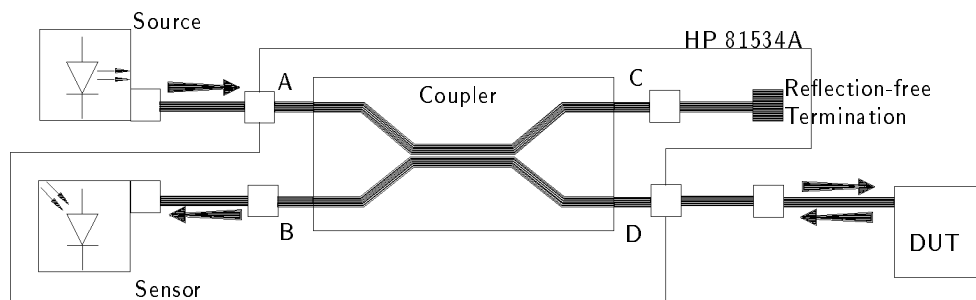
$$\text{Return Loss}[dB] = -10 \log\left(\frac{\text{Reflected Power}}{\text{Incident Power}}\right)[dB]$$

Return loss can be measured in several ways. A description of the method used by the HP 81534A follows. You can successfully make return loss measurements with the return loss module without reading this description.

The method used requires the following equipment:

- laser source with a stable output,
- a power-sensor, and
- a coupler.

These are connected as shown in the following figure.



**Figure 2-9. Return Loss Equipment**

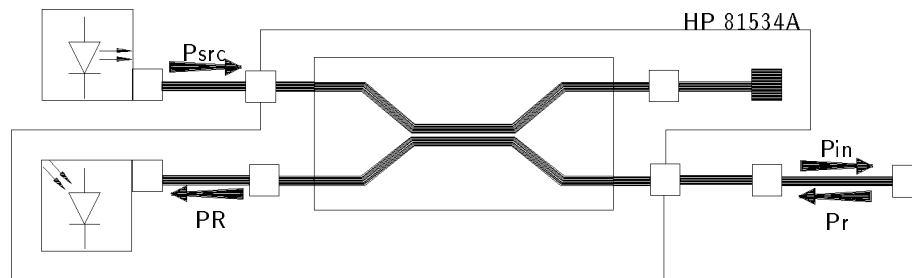
The description starts with measuring the reflection factor. When we have got this figure, we can convert it easily to the return loss.

### Taking Calibration Measurements

Before measuring the reflection factor of a device under test (DUT), take some calibration measurements. These eliminate wavelength dependencies, coupler directivity, insertion losses, backscattering and other non-ideal characteristics of the system.

### Measuring the Reflected Power from a Component with Known Reflection Factor

First, attach a component with a known reflection factor in place of the DUT, and measure the power reflected. This is our reflection reference.



**Figure 2-10.**

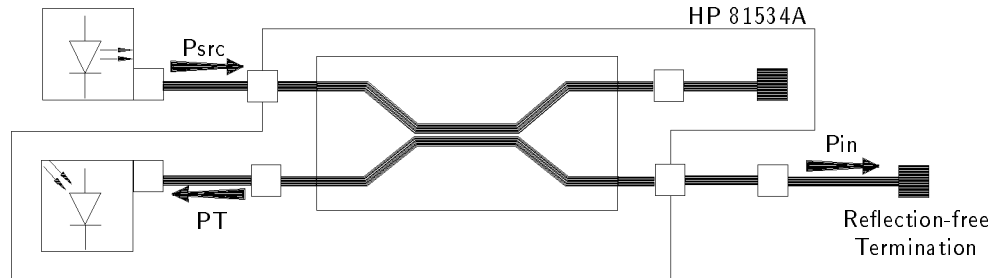
**Measuring the Power from a Component with Known Reflection Factor**

This measured power from the reflection reference is called  $P_R$ . The reflection factor for the component is called  $R_R$ . Normally the return loss for the component ( $RL_R$ ) is specified, but these values are related:

$$RL_R = -10 \log R_R$$

### Measuring the Power when there are No Reflections

Next, terminate the cable so that there are no reflections from the end. All the power measured by the sensor now, is due to the non-ideal nature of the measurement system. This is our termination parameter.



**Figure 2-11. Measuring the Power with the Connector Terminated**

This measured power for the termination parameter is called  $P_T$ .

### Using our Measured Powers to get an Equation in Known Terms

The reflected power, measured by the instrument, from the component with the known reflection factor ( $P_R$ ), is given by the sum of

- the part of the power, reflected by the component, which is transmitted through the coupler, and
- the reflections due to the measurement system.

That is:

$$P_R = kP_r + P_T \quad (1)$$

The constant  $k$  is a multiplier giving the proportion of power transmitted through the coupler from the DUT port to the sensor port. In other words, when optical power is input at the DUT port,  $k$  times that power is output at the sensor port. It is not necessary to know the value for this constant, it can be eliminated later.

### 2-10 The HP 81534A in Measure Mode

Here, the value for the reflection factor of the component is known. The power reflected by the component is given by multiplying the incident power by the reflection factor. That is:

$$P_r = P_{in}R_R$$

By substituting this into equation number (1) it eliminates the value for the power reflected at the component, which cannot be measured directly. It does introduce another power that cannot be measured directly (the power incident on the component). This value is constant for the measurement system and can be eliminated later.

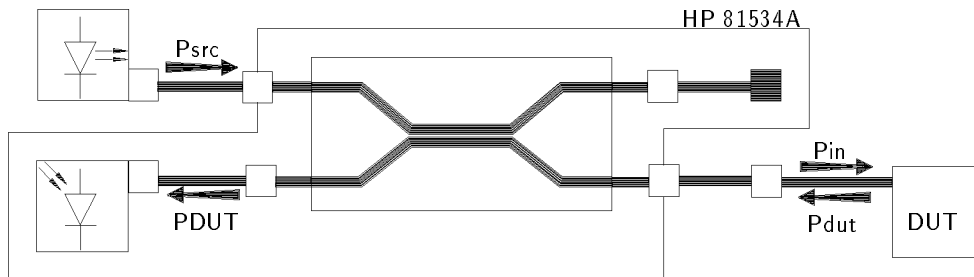
$$P_R = k(P_{in}R_R) + P_T$$

This equation can be changed around to give:

$$kP_{in} = \frac{P_R - P_T}{R_R} \quad (2)$$

## Measuring the Reflections from the DUT

Now attach the DUT.



**Figure 2-12. Measuring the Reflections from the Device Under Test**

The instrument measures the power reflected from the DUT. This power is called  $P_{DUT}$ .

### Using our Measurements to Calculate the Return Loss

The reflected power measured by the instrument from the DUT ( $P_{DUT}$ ) is given by the sum of

- the part of the power, reflected by the DUT, which is transmitted through the coupler, and

- the reflections due to the measurement system.

That is:

$$P_{DUT} = kP_{dut} + P_T$$

By using the same procedure as used above for  $P_R$ , this expression becomes:

$$kP_{in} = \frac{P_{DUT} - P_T}{R_{DUT}} \quad (3)$$

Equations (2) and (3) can be combined:

$$\frac{P_{DUT} - P_T}{R_{DUT}} = \frac{P_R - P_T}{R_R}$$

This can be reorganized to give an equation for the reflection factor of the DUT in terms of power readings, and the known reflection factor:

$$R_{DUT} = R_R \frac{P_{DUT} - P_T}{P_R - P_T}$$

All the values, except  $R_{DUT}$ , are known, or can be measured directly. From this it is easy to calculate a value for  $RL_{DUT}$ , the return loss of the device under test.

$$RL_{DUT} = -10 \log R_{DUT}$$

## Summary

There are three steps in making a return loss measurement for a device.

1. Measure the power from a component with a known reflection factor (expressed normally as the return loss, in dB). The known reflection factor has the value  $R_R$ , the power reading gives the value  $P_R$ .
2. Measure the offset power when the DUT connection is terminated to be reflection free. This gives the value  $P_T$ .
3. Measure the power from the DUT. This is the value  $P_{DUT}$ . The return loss of the DUT can now be calculated from the equation

$$RL_{DUT} = -10 \log \left( R_R \frac{P_{DUT} - P_T}{P_R - P_T} \right)$$



## The HP 81534A in Menu Mode

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The HP 81534A acts like any other sensor module when operating in menu mode with one exception.

- It is not possible to run the Loss application using the HP 81534A.

---

**Note**

As with other sensor modules, it is only possible to set the parameters for the module in measure mode. In particular, for the HP 81534A, this means setting the CAL REF (reflection reference) and REF AUX (termination parameter) before changing to menu mode to run an application.

---

On printouts and plots, when you are using the HP 81534A, the meanings of the parameters are slightly altered.

- The Cal Factor refers to the CAL REF (reflection reference).
- The Reference refers to the REF AUX (termination parameter).



## The HP 81534A HP-IB Commands

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The HP 81534A uses all the HP 8153A mainframe HP-IB commands and some HP 8153A sensor commands. The mainframe commands are: the common commands, the status commands, the DISPlay commands, and the SYSTem commands. These mainframe commands are not described here.

---

**Note**

The operation of some HP 81534A sensor commands and queries is slightly different from the same commands and queries on the HP 8153A. In particular, the SENSE:POWer:REFEreNce:STATe command performs a different function.

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### ABORt Commands

This command relates to the triggering of sensor modules.

**Table 8-1. ABORt Command Summary**

Command Parameter

ABORt[1|2]

### Specifying the Channel

You specify the channel by attaching a numeric suffix to the mnemonic. You access channel A by using ABORt1, you access channel B by using ABORt2. If do not add a suffix to the mnemonic, channel A is assumed.

## **ABORt**

### **Syntax**

ABORt[1|2]

### **Description**

This command aborts the measurement you are making.

### **Related Commands**

INIT:IMM, INIT:CONT, INIT:CONT?

### **Example**

OUTPUT 722;"ABOR"

---

## FETCh Commands

This command relates to measuring signals with the sensor modules.

**Table 8-2. FETCh Command Summary**

<u>Command</u>	<u>Parameter</u>
FETCh[1 2]	
	[ :SCALAr]
	:POWER
	[ :DC]?

### Specifying the Channel

You specify the channel by attaching a numeric suffix to the FETCh mnemonic. You access channel A by using FETCh1, you access channel B by using FETCh2. If you do not add a suffix to the mnemonic, channel A is assumed.

### FETCh[:SCALAr]:POWER[:DC]

#### Syntax

FETCh[1|2][ :SCALAr]:POWER[:DC]?

#### Response

<value>

#### Description

This command gets a reading from the module. It does not provide its own triggering and so must be used with either a continuous or a preceding immediate trigger. The value read back is a floating point number in exponential number (NR3). The units of the number read back are dB.

For the effect of the choice of averaging time, see “FETCh Commands” in Chapter 8 of the HP 8153A mainframe manual.

#### Related Commands

READ:SCAL:POW:DC?, SENS:POW:REF:STAT, SENS:POW:REF:STAT?, INIT:IMM, INIT:CONT, INIT:CONT?

**Example**

OUTPUT 722;"FETC:POW?"  
ENTER 722;A\$

---

## INITiate Commands

This command relates to the triggering of sensor modules.

**Table 8-3. INITiate Command Summary**

<b>Command</b>	<b>Parameter</b>
INITiate[1 2]	
:CONTinuous	<boolean>
:CONTinuous?	
[:IMMediate]	

### Specifying the Channel

You specify the channel by attaching a numeric suffix to the mnemonic. You access channel A by using INITiate1, you access channel B by using or INITiate2. If you do not add a suffix to the mnemonic, channel A is assumed.

### INITiate:CONTinuous

#### Syntax

INITiate[1|2]:CONTinuous" <wsp><boolean>

#### Description

This command initiates the trigger system for continuous trigger operation, that is, measurements are made continuously.

#### Related Commands

ABOR, INIT:IMM, INIT:CONT?

#### Example

```
OUTPUT 722;"INIT1:CONT OFF"
```

## **INITiate:CONTinuous?**

### **Syntax**

INITiate[1|2]:CONTinuous?"

### **Response**

<boolean>

### **Description**

This command returns whether the triggering system is operating continuously or not. The status is returned as either 0 or 1. 0 means that continuous triggering is not selected. 1 means that continuous triggering is selected.

### **Related Commands**

ABOR, INIT:IMM, INIT:CONT

### **Example**

```
OUTPUT 722;"INIT:CONT?"  
ENTER 722;A$
```

## **INITiate[:IMMEDIATE]**

### **Syntax**

INITiate[1|2][:IMMEDIATE]"

### **Description**

This command initiates the trigger system and completes one full trigger cycle, that is, one measurement is made.

### **Related Commands**

ABOR, INIT:CONT, INIT:CONT

### **Example**

```
OUTPUT 722;"INIT2"
```



---

## READ Commands

These commands relate to measuring signals with the sensor modules.

**Table 8-4. READ Command Summary**

<u>Command</u>	<u>Parameter</u>
READ[1 2]	[ :SCALar]
	:POWER
	[ :DC]?

### Specifying the Channel

You specify the channel by attaching a numeric suffix to the or READ mnemonic. You access channel A by using READ1, you access channel B by using READ2. If you do not add a suffix to the mnemonic, channel A is assumed.

### READ[:SCALar]:POWER[:DC]

#### Syntax

READ[1|2][ :SCALar]:POWER[:DC]?

#### Response

<value>

#### Description

This command gets a reading from the module. This command provides its own triggering and does not need a triggering command. The value read back is a floating point number in exponential number (NR3). The units of the number read back depend on whether the absolute or relative measurement mode is being used, and which units have been selected. The possible units are Watts, dBm, or dB.

Each new measurement is available after the averaging time.

#### Related Commands

FETC:SCAL:POW:DC?, INIT, INIT:CONT, INIT:CONT?, SENS:POW:REF:STAT, SENS:POW:REF:STAT?

**Example**

OUTPUT 722;"READ:POW?"  
ENTER 722;A\$

---

## SENSe Commands

Sense commands include most of the functions for setting up and using the module.

**Table 8-5. SENSe Command Summary**

Command	Parameter	Note
SENSe[1 2]		
:CORRection		
:COLLect		
:ZERO		
:ZERO?		
[:LOSS		
[:INPut		
[:MAGNitude]]	<value>	cal factor
[:MAGNitude]]?		cal factor
:POWer		
:ATIME	<value>[<unit>]	
:ATIME?		
:RANGe		
:AUTO?		
[:UPPER]?		
:REFerence?	TOREF 2	
:STATe	<boolean>	
:WAVElength	<value>[<unit>]	
:WAVElength?		

### Specifying the Channel

You specify the channel by attaching a numeric suffix to the SENSe mnemonic. You access channel A by using SENSe1, and channel B by using SENSe2. If you do not add a suffix to the mnemonic, channel A is assumed.

## **SENSe:CORRection:COLLect:ZERO**

### **Syntax**

SENSe[1|2]:CORRection:COLLect:ZERO''

### **Description**

This command zeros the electrical offsets for the module.

### **Related Commands**

SENS:CORR:COLL:ZERO?

### **Example**

OUTPUT 722;"SENS2:CORR:COLL:ZERO"

## **SENSe:CORRection:COLLect:ZERO?**

### **Syntax**

SENSe[1|2]:CORRection:COLLect:ZERO?''

### **Response**

<value>

### **Description**

This command returns the status of the most recent zero command. 0 means that the zero succeeded without errors. 1 means that no remote zeroing operation has been performed. Any other value means that the remote zeroing failed, the value is the error code returned from the zero operation. The error codes are listed in Appendix I of the HP 8153A mainframe manual.

### **Related Commands**

SENS:CORR:COLL:ZERO

### **Example**

OUTPUT 722;"SENS2:CORR:COLL:ZERO?"  
ENTER 722;A\$

**SENSe:CORRection[:LOSS[:INPut[:MAGNitude]]]?**

**SENSe:CORRection[:LOSS[:INPut[:MAGNitude]]]**

**Syntax**

SENSe[1|2]:CORRection''[:LOSS[:INPut[:MAGNitude]]] <wsp><value>[<unit>]

0 dB ≤ value ≤ +99.99dB

unit is DB

**Description**

This command enters the value of the known return loss for the reflection reference. The value is a floating point number (NRf). The units are dB.

**Related Commands**

SENS:CORR:COLL:LOSS:INP:MAGN?

**Example**

OUTPUT 722;"SENS2:CORR:COLL:LOSS:INP:MAGN 10DB"

**SENSe:CORRection[:LOSS[:INPut[:MAGNitude]]]?**

**Syntax**

SENSe[1|2]:CORRection''[:LOSS[:INPut[:MAGNitude]]]?

**Response**

<value>

**Description**

This command returns the value of the known return loss for the reflection reference. The value is returned as a floating point number (NR3) in dB. No units are returned in the response message.

**Related Commands**

SENS:CORR:COLL:LOSS:INP:MAGN

### **SENSe:CORRection[:LOSS[:INPut[:MAGNitude]]]?**

#### **Example**

```
OUTPUT 722;"SENS2:CORR:COLL:LOSS:INP:MAGN?"  
ENTER 722;A$
```

### **SENSe:POWer:ATIME**

#### **Syntax**

SENSe[1|2]:POWer:ATIME'' <wsp><value>[<unit>]

20ms ≤ value ≤ 3600s

unit is S|MS

#### **Description**

This command sets the averaging time for the module. The input power-level is read and averaged over this period. You specify the averaging time as a floating point number (NRf). Units can be attached, either seconds or milliseconds can be specified. Seconds are the units used if you do not specify units.

#### **Related Commands**

SENS:POW:ATIME?

#### **Example**

```
OUTPUT 722;"SENS:POW:ATIME 200MS"
```

### **SENSe:POWer:ATIME?**

#### **Syntax**

SENSe[1|2]:POWer:ATIME?''

#### **Response**

<value>

20ms ≤ value ≤ 3600s

#### **Description**

### **SENSe:POWer:RANGe[:UPPER]?**

This command returns the setting for the averaging time for the module. The averaging time is returned as a number in exponential number (NR3). The returned value is in seconds. No units are returned in the response message.

#### **Related Commands**

SENS:POW:ATIME

#### **Example**

```
OUTPUT 722;"SENS2:POW:ATIME?"  
ENTER 722;A$
```

### **SENSe:POWer:RANGe:AUTO?**

#### **Syntax**

SENSe[1|2]:POWer:RANGe:AUTO?"

#### **Response**

<boolean>

#### **Description**

This command returns 1, to indicate that automatic power ranging is being used by the module.

#### **Related Commands**

SENS:POW:RANG:UPPER?

#### **Example**

```
OUTPUT 722;"SENS2:POW:RANG:AUTO?"  
ENTER 722;A$
```

### **SENSe:POWer:RANGe[:UPPER]?**

#### **Syntax**

SENSe[1|2]:POWer:RANGe[:UPPER]?"

## **SENSe:POWer:RANGe[:UPPER]?**

### **Response**

<value>

-110dBm ≤ value ≤ +30dBm

### **Description**

This command returns the range setting for the module. The range is returned as a signed integer (NR1). The returned value is in dBm. No units are returned in the response message.

### **Related Commands**

SENS:POW:RANG:AUTO?

### **Example**

```
OUTPUT 722;"SENS1:POW:RANG:UPPER?"  
ENTER 722;A$
```

## **SENSe:POWer:REFerence?**

### **Syntax**

SENSe[1|2]:POWer:REFerence?'' <wsp>TOREF|2

### **Response**

<value>

value ≤ +230dB

### **Description**

This command returns the level that is set for the termination parameter (the reflections with the output terminated reflection-free). The parameter is returned as a floating point number in exponential number (NR3). The returned value is in dB. No units are returned in the response message.

### **Related Commands**

SENS:POW:REF, SENS:POW:REF:STATE



## **SENSe:POWer:WAVElength**

### **Example**

```
OUTPUT 722;"SENS1:POW:REF? TOREF"  
ENTER 722;A$
```

## **SENSe:POWer:REFerence:STATe**

### **Syntax**

```
SENSe[1|2]:POWer:REFerence:STATe'' <wsp><boolean>
```

### **Description**

This command takes the reference measurements for the reflection reference, and the termination parameter. The reference is specified by a boolean. **OFF**, or **0**, takes the parameter for the reflection-free termination. **ON**, or any non-zero value, takes the reading for the reflection reference.

### **Related Commands**

```
SENS:POW:REF?, SENS:CORR:COLL:LOSS:INP:MAGN,  
SENS:CORR:COLL:LOSS:INP:MAGN?
```

### **Example**

```
OUTPUT 722;"SENS1:POW:REF:STATE ON"
```

## **SENSe:POWer:WAVElength**

### **Syntax**

```
SENSe[1|2]:POWer:WAVElength'' <wsp><value>[<unit>]
```

850nm ≤ value ≤ 1700nm.

unit is NM|UM|M

### **Description**

This command sets the wavelength for this module. You specify the wavelength as a floating point number (NRf). The units can be nanometers, micrometers or meters. Meters are the units used if you do not specify units.

### **Related Commands**

SENS:POW:WAVE?

### **Example**

OUTPUT 722;"SENS2:POW:WAVE 1310NM"

### **SENSe:POWer:WAVElength?**

### **Syntax**

SENSe[1|2]:POWer:WAVElength?"

### **Response**

<value>

850nm ≤ value ≤ 1700nm

### **Description**

This command returns the wavelength setting for the module. The result is returned as a floating point number in exponential number (NR3). The returned value is in meters. No units are returned in the response message.

### **Related Commands**

SENS:POW:WAVE

### **Example**

OUTPUT 722;"SENS2:POW:WAVE?"  
ENTER 722;A\$

# B

## HP 81534A Accessories

---

Besides the full range of accessories listed for the HP 8153A, there are some additional accessories that have been developed for use with the HP 81534A Return Loss Module.

### Reference Reflector

<b>Model No.</b>	<b>Description</b>
HP 81000BR	Reference Reflector

### High Return-Loss Patchcords

<b>Model No.</b>	<b>Description</b>
HP 81102AC	Diamond HMS-10/HP/HRL - Diamond HMS-10/HP/HRL
HP 81102BC	Diamond HMS-10/HP/HRL - Bare Fiber
HP 81102DC	Diamond HMS-10/HP/HRL - Radiall
HP 81102PC	Diamond HMS-10/HP/HRL - FC/APC
HP 81102SC	Diamond HMS-10/HP/HRL - DIN/HRL-10
HP 81109AC	Diamond HMS-10/HP/HRL - Diamond HMS-10/HP

The Diamond HMS-10/HP/HRL connector on these cables has an orange sleeve.

### Through Adapters

<b>Model No.</b>	<b>Description</b>
HP 81000UM	Universal Through Adapter

You can screw the through-adapter onto any of the 81000xI connector interfaces. It enables the mating of a Diamond HMS-10/HP connector to Diamond HMS-10/HP, PC, DIN, Biconic, ST, D4, or SC.



## HP 81534A Specifications

---

### Definition of Terms

<b>Wavelength range:</b>	The range of wavelengths for which the return loss meter can be used within specific uncertainties.
<b>Dynamic range:</b>	The range of return losses for which the specified uncertainties apply, with an upper limit of 0 dB (100% reflection). <b>Conditions:</b> wavelengths as specified, averaging time 1s, input power level 0 dBm. R and T parameters properly set prior to measurement. Return loss at test port > 55 dB.
<b>Relative uncertainty:</b>	For a specified range of return losses, the maximum difference between the actual return loss and measured return loss. Includes receiver nonlinearity and receiver polarization sensitivity. <b>Conditions:</b> stable input power level of 0 dBm, temperature within $\pm 1\text{K}$ wavelength range as specified, R and T parameters properly set to measurement. Return loss at test port > 55 dB.
<b>Total uncertainty:</b>	For a specified range of return losses, the maximum difference between the actual return loss, starting from an actual return loss of 0 dB. Includes receiver nonlinearity, polarization sensitivity and uncertainty of reference reflector. <b>Conditions:</b> reference reflector new or recently calibrated, stable input power level of 0 dBm, temperature within $\pm 1\text{K}$ wavelength range as specified. R and T parameter properly set to measurement. Return loss at test port > 55 dB.
<b>Calibration strategy:</b>	<b>For Record Only</b> The performance test of the 81534 includes only the tests of the relative uncertainty (linearity) and of the dynamic range. The external source method is not part of the 81534 performance test, but serves as a method for the calibration of a reference reflector only (correct R value)

## Performance Specifications

Specifications describe the instrument's warranted performance. 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.

### HP 81534A Specifications

	Standard Version (Connector Output)	Option 001 (Pigtail Output)
<b>Sensor Element</b>	InGaAs	
<b>Wavelength range</b>	1250-1600nm	
<b>Dynamic range</b> <sup>[1]</sup>	60dB	65dB
<b>Applicable fiber type</b>	9/125 $\mu$ m	
<b>Relative Uncertainty</b> <sup>[2][3]</sup>	$\leq\pm 0.25$ dB (0dB to 50dB) $\leq\pm 0.50$ dB (50dB to 60dB)	$\leq\pm 0.25$ dB (0dB to 55dB) $\leq\pm 0.50$ dB (55dB to 65dB)
<b>Total Uncertainty</b> <sup>[2][4]</sup>	$\leq\pm 0.40$ dB (0dB to 50dB) $\leq\pm 0.65$ dB (50dB to 60dB)	$\leq\pm 0.40$ dB (0dB to 55dB) $\leq\pm 0.65$ dB (55dB to 65dB)
<b>Dimensions</b>	75mm H, 32mm W, 335mm D(2.8" $\times$ 1.3" $\times$ 13.2")	
<b>Weight</b>	net 0.6kg (1.3lbs), shipping 1kg (2.2lbs)	
<b>Recalibration period</b>	1 year	1 year <sup>[5]</sup>
<b>Warmup time</b>	5 min.	

[1] Measured with source output power of 0dBm.

[2] Measured using an HP 81552SM, HP 81553SM, or HP 81554SM module, an HP 8155A or equivalent laser source

[3] Due to the polarization sensitivity of the coupler. With a mechanically stable setup this can typically be reduced to  $\leq\pm 0.05$ dB.

[4] Includes relative uncertainty, uncertainty of reference reflector (HP 81000BR or cleaved fiber end) and linearity.

[5] When you are returning a HP 81534A Option 001, make sure to attach a representative connector, or a 1m length of working fiber to the end of the pigtail fiber.

### C-2 HP 81534A Specifications

# D

## HP 81534A Performance Test

---

The procedure in this section is the performance test of the instrument. The complete specification to which the HP 81534A is tested is given in Appendix C. All tests can be performed without access to the interior of the instrument. Where not otherwise specified, the test equipment given corresponds to tests carried out with Diamond HMS-10/HP connectors.

### Equipment Required

Equipment required for the functional test is listed in the table. Any equipment that satisfies the critical specifications of the equipment given in the table may be substituted for the recommended models.

<b>Instrument/Accessory</b>	<b>Recommended Model</b>	<b>Quantity</b>
Lightwave Multimeter	HP 8153A	2
Optical Attenuator	HP 8156A #101	1
Laser-Modul 1310 nm	HP 81552SM	1
Laser-Modul 1550 nm	HP 81553SM	1
<i>or</i> Laser-Modul 1310/1550 nm	HP 81554SM	1
Optical Power Sensor	HP 81532A	1
Fiber HMS-10/HP	HP 81101AC	2
Fiber HMS-10/HP/HRL	HP 81109AC	1
Interface Adapter	HP 81000AI	4
Universal Adapter	HP 81000UM	1

In addition, if you are testing the Option 001 (pigtail) module, you need

Optical Fiber Jacket Remover	Sumitomo Electric JR-1 Jacket Remover	1
Optical Fiber Cleaner	Fujikura CT-03 High Precision Fiber Cleaver	1
	<i>and/or</i> Drukker Intern. 5290 Fiber Optic Cleaving Knife	1
Coating Remover	RXS Schrumpftechnik-Garnituren GmbH	1
	V26824-B408-V14 Provisions-Absetzwertzeug	
Plastic Cap	5040-9351	2

In addition, when you need to do an update of your reference reflector

	Optical Head Interface Model	HP 81533B	1
	Optical Head	HP 81524A	1
	Optical Isolator, 1310 nm	HP 81210LI	1
<i>or</i>	Optical Isolator, 1550 nm	HP 81310LI	1
	Interface Adapter	HP 81000AI	2
<i>or</i>	Interface Adapter	HP 81000FI	2
	<i>dependent on isolator connector option</i>		
	Connector Adapter	HP 81000AA	1

---

## Test Record

Results of the performance test may be tabulated on the Test Record provided after the test procedures. It is recommended that you fill out the Test Record and refer to it while doing the test. Since the test limits and setup information are printed on the Test Record for easy reference, you can also use the record as an abbreviated test procedure (if you are already familiar with the test procedures). You can also use the Test Record as a permanent record. The Test Record may be reproduced without written permission from Hewlett-Packard.



---

## Test Failure

If the HP 81534A fails any performance test, return the instrument to the nearest Hewlett-Packard Sales/Service Office for repair.

When you are returning an HP 81534A Option 001, make sure you attach a representative connector, or a 1m length of working fiber, to the end of the pigtail fiber.

---

## Instrument Specification

Specifications are the performance characteristics of the instrument that are certified. These specifications, listed in Appendix C, are the performance standards or limits against which the HP 81534A can be tested. Appendix C also lists some supplemental characteristics of the HP 81534A. Supplemental characteristics 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, are covered in a manual change supplement, or revised manual. Such specifications supersede any that were previously published.

---

## Performance Test (Standard Module)

### Note



Make sure that all optical connections of the test setups given in the procedure are dry and clean. **DO NOT USE IMMERSION OIL** (see the cleaning procedure).

The optical cables from the laser source to and from the HP 8156A Attenuator to the power meter must be fixed on the table to ensure minimum cable movement during the tests.

### Caution



Do not connect the HP 81000BR Reference Reflector directly to the HP 81534A Module.

---

**Opt.001**

It is strongly recommended that you attach a connector or a working fiber to the end of the pigtail so that you can avoid cutting the pigtail as much as possible. (The replacement of the pigtail fiber is not covered by the warranty for the instrument.)

---

**Note**

Further tests:

After having switched off the HP 8153A/HP 81534A, *new* settings for reflection reference R and termination parameter T are necessary to get new results.

---

## I. Dynamic Range Test / Noise Level

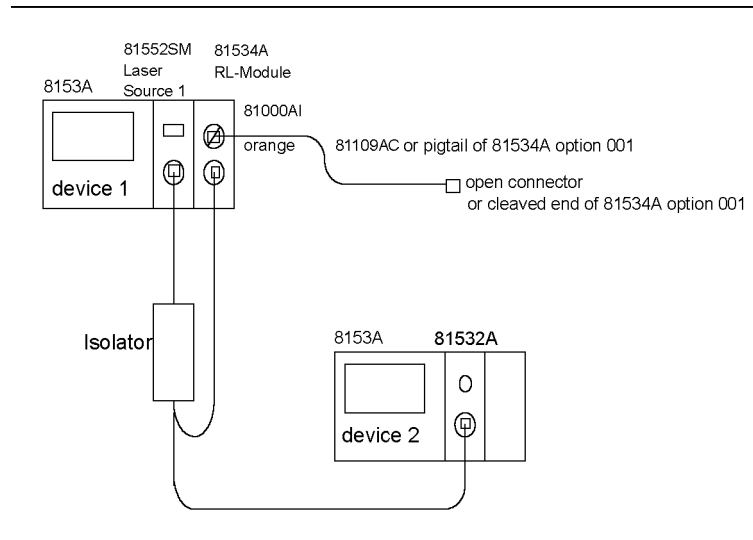
1. Make sure that all the connectors are clean.

Option 001: Make sure that the pigtail end has a good cleave.

2. Connect the output cable of the laser source to the power meter as shown by the dotted line on Figure D-1.
3. Enable the source and set the output power to  $-6.00 \pm 0.05\text{dBm}$  by using the ATT parameter of the laser source or an Optical Attenuator (between the Isolator and the power meter).
4. Set up the instrument as shown in Figure D-1.

Connect the source to the HP 81534A Input.

For best results and higher repeatability, fix the cables so that they do not move.



**Figure D-1. Dynamic Range Test Setup**

5. Make sure the instrument has warmed up. Select the channel of the HP 81534A with **(Chan)**
6. Disable the source and cover the end of the patchcord to protect from any external light. Press **(Zero)** to remove electrical offsets in the instrument.
7. Press **(Param)** to select the T parameter (the measurement averaging time). Set the averaging time to 1s.
8. Press **(Param)** to select the  $\lambda$  parameter.  
 Edit this parameter so that you set it to the actual wavelength of the source.  
 Note the wavelength in the Test Record.
9. Enable the source.
10. Press **(Param)** to select the CAL REF parameter. Set the calibration reference
  - a. to the reference R = 14.70 dB for the straight open end of the patchcord,

b. for option 001: to the reference  $R = 14.60$  dB for the cleaved end.

---

**Note**



Measurement uncertainties are based on a new patchcord with straight open end. “New” means clean and undamaged.

For option 001, measurement uncertainties are based on a good cleave. “Good” means straight, optically flat and clean.

If you are unsure about the quality of your patchcord (your cleave), calibrate the reference  $R$  by using the procedure given in Appendix D.1 (Appendix D.2 for option 001).

---

11. Press **(Disp → Ref)**. The instrument measures the power reflected by the open end of the patchcord (cleaved end of the pigtail with option 001).
12. Press **(Param)** to select the AUX parameter. **T** is displayed at the side of the character field.
13. Terminate the cable so that there are no reflections coming from the end. You can do this by wrapping the fiber five times around the shaft of a screwdriver (or some similar object with a diameter of around 5mm). Make the termination close to the module (within 20cm of the Output).
14. Press **(Disp → Ref)**. The instrument measures the terminated reference, and sets the T parameter. Make sure that the display shows a value for the T parameter  $> 55$  dB ( $> 60$  dB for option 001).

If you cannot achieve  $> 55$ dB (or  $> 60$  dB for option 001):

- check the output connector and the cable connected to it for possible dirt, smear and scratches on the connecting surfaces,
- make sure that the output is not broken.

for option 001:

- The cleave has a great effect on the measurement. It may be necessary to cleave the fiber more often to get the performance.

15. Unterminate and terminate the cable again as described in step 13.

Check during 10 seconds that the HP 8153A displays  $> 60$  dB ( $> 65$  dB for option 001) on the upmost field B/REF. Note the lowest measured value during this time in the Test record.

---

**Note**

The T-parameter represents the parasitic reflections in the 81534A, such as the reflectance at the test port. It is displayed in the form of a return loss (for example, T: 62.52 dB), after the 81534A has been correctly calibrated for the R-parameter.

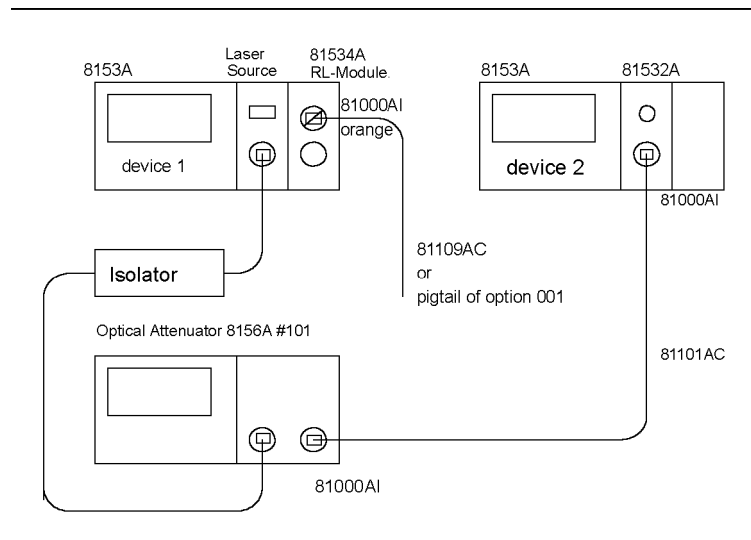
The displayed return loss of the DUT (for example, B/REF 84.37 dB) is the actual measurement result corrected by subtracting the parasitic reflections.

---

## II. Relative Uncertainty Test

### Taking Attenuator Reference

1. Connect the equipment as shown in Figure D-2.



**Figure D-2. Attenuator reference**

2. Set the 8153A.
  - a. laser source module

Use the 81552SM Laser Source module, or if using the 81554SM Dual Laser Source select wavelength of 1310 nm (nominal).

Note the actual displayed wavelength in the Test Record.

b. power meter module

Set the wavelength to the same value as for the laser source.

Set the averaging time T to 1s.

Press **(dBm W)** until dBm is displayed. This sets the power reading to dBm.

3. Make sure the Attenuator is disabled.

Press **(Zero)** to zero the power meter.

4. Enable the laser source.

Wait 1 minute until the laser has stabilized.

5. Set the Attenuator to 0.00 dB.

Set the wavelength to the same value as the laser source.

Enable the Attenuator.

6. Set the attenuation of the laser source by using the ATT parameter to get  $-6.00 \pm 0.05$  dBm on the 81532A.

7. On the power meter:

Press **(dB)** to set the power reading to dB, the press **(Disp → Ref)**

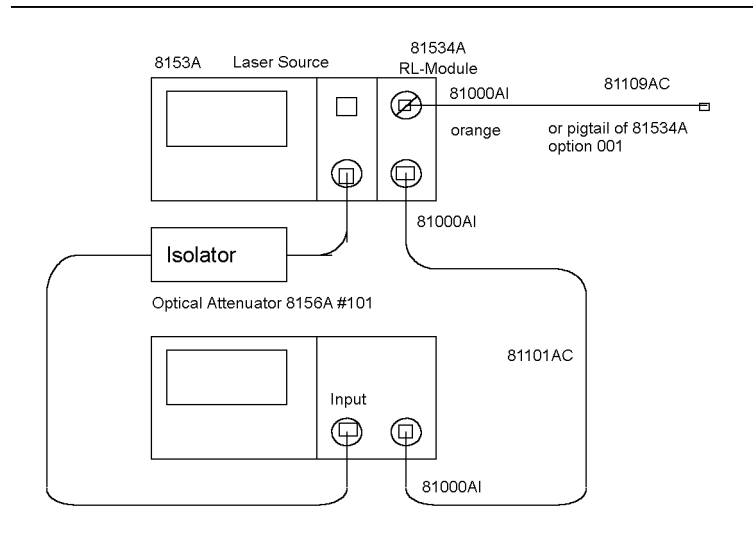
8. Set the Attenuator to 5 dB.

Note the *absolute* amount of the displayed value on the 8153A in the column Actual attenuated Power (81532A) in the Test Record for this Attenuator setting (for example, if the display is  $-4.997$ , note 4.997).

9. Repeat step 8 for all Attenuator settings given in the test record.

Measuring Relative uncertainty:

10. Connect the equipment as shown in Figure D-3 below.



**Figure D-3. Relative Uncertainty**

11. Set the 81534A to the same wavelength as given by the laser source.  
Set the average time T to 1s.
12. Make sure that the Attenuator is disabled and the laser source is switched off.  
Press **(Zero)** to zero the 81534A.
13. Enable the laser source and the Attenuator.  
Wait 1 minute until the laser has been stabilized.
14. Set the Attenuator to 0.00 dB.
15. On the 8153A, press **(Param)** to select the CAL REF parameter. Set the calibration reference to 0.00 dB.  
The test will be performed *relative* to this reference.
16. Press **(Disp → Ref)**. The instrument measures the power coming from the Attenuator.

17. Disable the Attenuator.  
Press **(Param)** to select the AUX parameter. T: is displayed at the side of the character field.
18. Press **(Disp → Ref)**. The instrument measures no light, and sets the T parameter.
19. Set the attenuator to 5 dB.
20. On the 8153A, press **(Menu)** once, then **(Record)** 2 times to select the LOGGING application.
21. Press **(Edit)** to select SAMPLES and use the cursor keys to set the number of samples to 50.
22. Press **(Edit)** again to return to LOGGING.
23. Press **(Execute)** to start measurement.
24. Without bending it, move the HP 81109AC cable slightly to generate different polarization states when the instrument is sampling.  
The HP 81109AC is the cable connecting the HP 81534A Output to the Attenuator.
25. When sampling is finished, press **(More)** to select the SHOW application.  
Press **(Edit)** to select the MAXIMUM parameter. Note the value in the column MAX (81534A) in the Test Record.  
Press **(Next)** to select the MINIMUM parameter. Note the value in the column MIN (81534A) in the Test Record.
26. Calculate:  
MAXIMUM minus Displayed Relative Power, and  
MINIMUM minus Displayed Relative Power.  
Note the results in the Test Record.
27. Press **(EDIT)** to return to SHOW.  
Press **(Record)** twice to return to LOGGING.
28. Repeat steps 23 to 27 for all Attenuator settings given in the Test Record.



---

**Note**

The last step of 35 dB corresponds to a 55.7 dB return loss because during this test a  $-6$  dBm input power and an RL = 14.7 dB is used.

---

29. Press **(Edit)**, then press **(Mode)** to return to MEAS mode.

30. Repeat steps 1 to 29 with the higher wavelength of 1550 nm (nominal).

### III Absolute Uncertainty

The Absolute Uncertainty of the 81534A includes the Relative Uncertainty (see previous test), the variations of the test setup (cable layout, connectors) and the uncertainty of the reference reflector. As variations of the test setup and the reference reflector are dependent on the customers' equipment, the Absolute Uncertainty cannot be tested at the factory/Service Office.

Absolute calibration shall be performed by the procedure given in section 2 of this User's Guide using a calibrated reference reflector.

In Appendix D.1 (Appendix D.2 for option 001), a procedure is given to calibrate any reference reflector, like HP 81000BR or even an open fiber end. For ease of use we recommend the straight fiber end.

---

**Note**

The HP 81109AC patchcord which is connected to the 81534A's output when calibrating the reference reflector is part of this. So do not remove the patchcord after calibration.

---

**Test Record for the HP 81534A**

Page 1 of 5

Test Facility:

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

Model            HP 81534A Return Loss Module

Serial No.        \_\_\_\_\_            Ambient temperature    \_\_\_\_\_ °C

Options            \_\_\_\_\_            Relative humidity        \_\_\_\_\_ %

Firmware Rev.    \_\_\_\_\_            Line frequency            \_\_\_\_\_ Hz

Special Notes:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Test Record for the HP 81534A**

Test Equipment Used:

Description	Model No.	Serial No.
1. Lightwave Multimeter	HP 8153A	_____
2. Lightwave Multimeter	HP 8153A	_____
3a. Laser-Modul 1310 nm	HP 81552SM	_____
3b. Laser-Modul 1550 nm	HP 81553SM	_____
3c. Laser-Modul 1310/1550 nm	HP 81554SM	_____
3d. _____	_____	_____
3e. _____	_____	_____
4a. Optical Power Sensor	HP 81532A	_____
4b. _____	_____	_____
5a. Optical Attenuator	HP 8156A #101	_____
5b. _____	_____	_____
6a. Optical Isolator	HP 81210LI	_____
6b. Optical Isolator	HP 81310LI	_____
6c. _____	_____	_____
7. Fiber HMS-10/HP	HP 81101AC	_____
8. Fiber HMS-10/HP/HRL	HP 81109AC	_____
9. Interface Adapter	HP 81000AI	_____
10. Universal Adapter	HP 81000UM	_____
11. _____	_____	_____
12. _____	_____	_____

**Test Record** Page 3 of 5

Model HP 81534A Return Loss Module,

Option \_\_\_\_\_, No. \_\_\_\_\_, Date \_\_\_\_\_

**I. Dynamic Range /Noise Level**

performed at wavelength \_\_\_\_\_ nm

Description	Result	Minimum Spec	Measurement Uncertainty
81534A standard	_____ dB	60 dB	±0.7 dB
81534A option 001	_____ dB	65 dB	±0.7 dB

**II. Relative Uncertainty.** Wavelength 1310 nm

Actual wavelength: \_\_\_\_\_ nm

Attenuator setting	Actual attenuated Power (81532A)	MAX (81534A)	MIN (81534A)	Result: MAX minus Actual atten. Power	Result: MIN minus actual atten. Power	Max Spec.	Min Spec.	Measurement Uncertainty
dB	dB	dB	dB	dB	dB	dB	dB	dB
0	REF	—	—	—	—	—	—	—
5						+0.25	-0.25	±0.1
15						+0.25	-0.25	±0.1
25						+0.25	-0.25	±0.1
35						+0.25	-0.25	±0.1

**Test Record** Page 4 of 5

Wavelength 1550 nm

Actual wavelength: \_\_\_\_\_ nm

<b>Attenuator setting</b>	<b>Actual attenuated Power (81532A)</b>	<b>MAX (81534A)</b>	<b>MIN (81534A)</b>	<b>Result: MAX minus Actual Power</b>	<b>Result: MIN minus actual Power</b>	<b>Max Spec.</b>	<b>Min Spec.</b>	<b>Measurement Uncertainty</b>
dB	dB	dB	dB	dB	dB	dB	dB	dB
0	REF	—	—	—	—	—	—	—
5						+0.25	-0.25	±0.1
15						+0.25	-0.25	±0.1
25						+0.25	-0.25	±0.1
35						+0.25	-0.25	±0.1

Note that there is no increase in measurement uncertainty at high return losses. This is based on disabling the attenuator during T setting in the performance test, thereby eliminating the influence from the T parameter (in the actual use of the 81534A, the T parameter is responsible for the increase in uncertainty at high return loss values).

**Test Record** Page 5 of 5

Model HP 81534A Return Loss Module,

Option \_\_\_\_\_, No. \_\_\_\_\_, Date \_\_\_\_\_

**III. Absolute Uncertainty**

The following table is information for the customer's use when doing Absolute Uncertainty calibration with his equipment and test setup.

The Absolute Uncertainty is calculated by rms of the "Uncertainty of the reference reflector" and the Relative Uncertainty:

Absolute Uncertainty =

$$\sqrt{(U_{ref})^2 + (U_{rel})^2}$$

	<b>U<sub>ref</sub></b> <b>Uncertainty of the</b> <b>reference reflector</b> <b>dB</b>	<b>U<sub>rel</sub></b> <b>Relative</b> <b>Uncertainty</b> <b>dB</b>	<b>U<sub>abs</sub></b> <b>Absolute</b> <b>Uncertainty</b> <b>dB</b>
81534 standard: calibrated open fiber end with HP-HMS-10, straight (Appendix D.1)	±0.1	±0.1	±0.15
81534 option 001: calibrated cleaved fiber end (Appendix D.2)	±0.2	±0.1	±0.23

**Measurement Uncertainties U<sub>x</sub>**

81534A standard:

Uncertainty of reference reflector U<sub>ref</sub>, as per procedure given in Appendix D.1.

81534A option 001:

Uncertainty of reference reflector (final cleave) U<sub>ref</sub>, as per procedure given in Appendix D.2.

# D.1

## **Calibrate a reflector as reference**

---

HP 81534A (Standard Module) using the External Source method

---

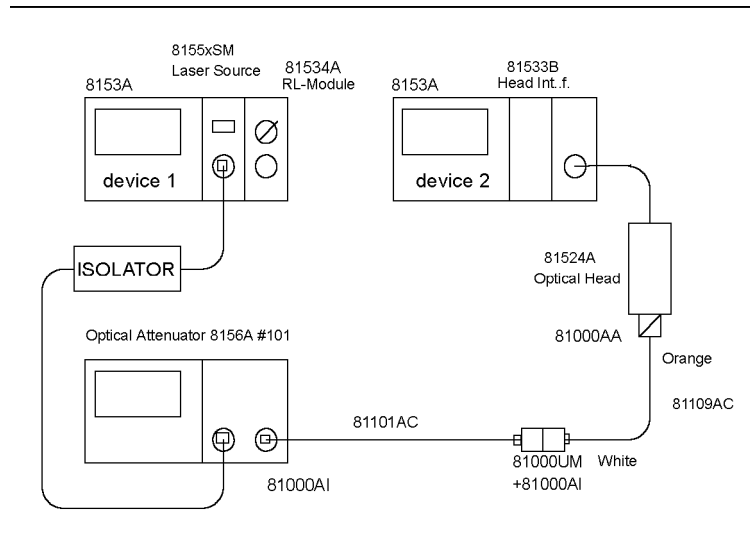
Make sure that all connectors are clean.

Fix the patchcord on the desk properly to avoid unnecessary movements.

Allow the instruments to warm up.

### **Setting Reference Reflected Power:**

1. Connect the instruments as shown in Figure D.1-1



**Figure D.1-1. Setting reference reflected power**

2. Have the laser source disabled, set ATT parameter to 0.0 dB, set the wavelength to nm (nominal).
3. Disable the Attenuator.
4. Set the power meter to the same wavelength as the laser source.  
Press **(ZERO)** to zero the power meter.  
Press **(dBm W)** to set the power meter to “dBm” reading.
5. Set the wavelength of the 81534A to the same as for the laser source. Cover the Input and the Output of the 81534A to protect from any light.  
Zero the 81534A.
6. Enable the attenuator and the laser source and wait one minute to allow the laser source to settle.
7. Set the attenuator to the same wavelength as the laser source.  
Modify its attenuation to get a reading of  $-20.000$  dBm on the power meter.

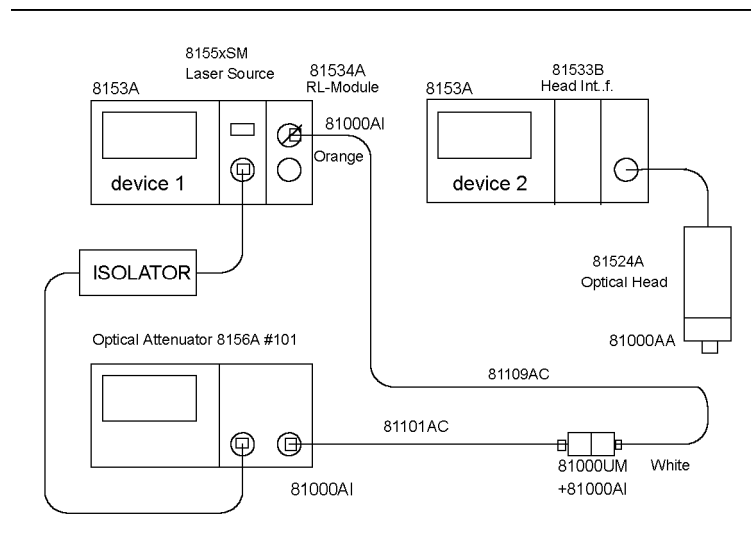
#### **D.1-2 Calibrate a reflector as reference**



Setting the correct R parameter on the 8153A:

8. Disconnect the patchcord from the Optical Head and connect it to the 81534A Output as shown in Figure D.1-2.

Move the patchcord as little as possible.



**Figure D.1-2. Getting R parameter for 100% reflected power.**

9. On the 81534A:

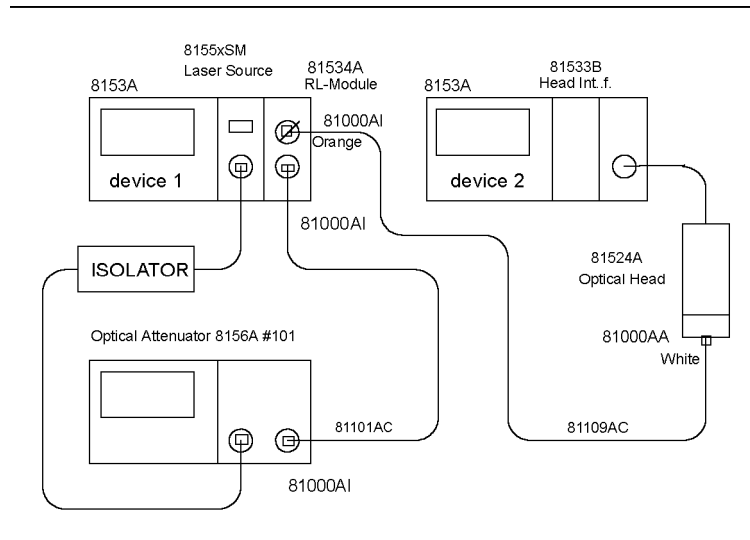
Press **(Param)** to get  $\lambda$ , set  $\lambda$  to the same value as laser source.

Press **(Param)** to get T, set T to 1 s.

Press **(Param)** to get CAL REF, set R: 0.00dB using the Modify keys; then press **(Disp → Ref)**.

10. Open the interconnection at the 81000 UM.

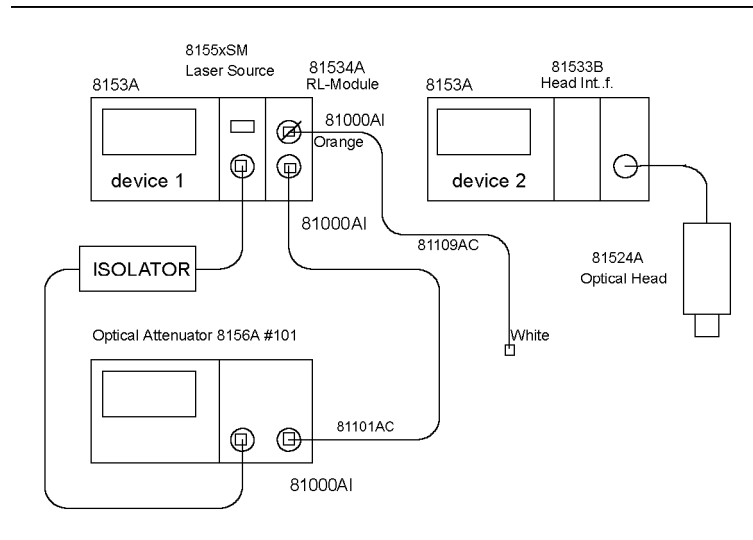
Connect the attenuator's output to the 81534A Input and the 81534A Output to the Optical Head as shown in Figure D.1-3.



**Figure D.1-3. Setting input reference power**

11. Modify the setting of the attenuator to get a reading of  $-20.000$  dBm on the power meter.
12. Disconnect the patchcord from the Optical Head, as seen in Figure D.1-4

#### **D.1-4 Calibrate a reflector as reference**



**Figure D.1-4.**  
**Setting T parameter, Measuring Open Connector as Reference Reflector**

13. On device 1, channel B press **Param** to get REF AUX.
14. Terminate the cable so that there are no reflections coming from the end.  
 You can do this by wrapping the fiber five times around the shaft of a screwdriver (or some similar object with a diameter of around 5 mm).  
 Make the termination close to the 81534A (within 20 cm from the Output).
15. Press **Disp → Ref**. The instrument measures the termination reference, and sets the parameter. Make sure that the display shows a value > 55 dB.  
 Taking open connector end as “reference relector”:
16. Still having the patchcord coming from the HP 81534A’s Output open, note the value displayed as B/REF in the 8153A, device 1.

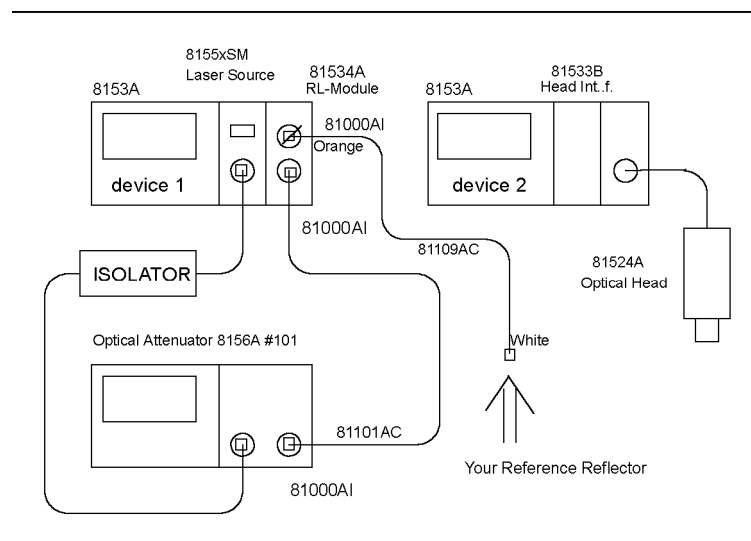
**This value is your reference R for an Open Connector to perform return loss measurement within the specified Absolute Uncertainty of the HP 81534A**

---

**Note**

For ease of further use, we recommend this as the reference of your measurements. When the instrument is switched off and on again, the calibration factors will be lost. Still having the patchcord connected to the HP 81534A's Output you must enter the value found in step 16 as the R parameter and calibrate for the new T parameter as described in steps 13 to 15.

---

**Measuring *your* reference reflector**

**Figure D.1-5. Setting T parameter, Measuring *Your* Reference Reflector**

Mount your reference reflector to the end of the patchcord.

Note the value displayed as B/REF in the 8153A, device 1, as the actual value of your Reference Reflector.

**This value is your reference R to perform return loss measurement within the specified Absolute Uncertainty of the HP 81534A.**

**D.1-6 Calibrate a reflector as reference**

# D.2

## Calibrate Cleaved Fiber End As Reference

---

HP 81534A (Option 001)

This is a procedure to calibrate the Absolute Uncertainty of the HP81534, option 001.

---

**Note**

This procedure is dependent on the quality of the cleave. Measurement Uncertainty therefore cannot be given.

---

1. Try to get a good cleave.
2. Set CAL REF to parameter R: to 14.60 dB (based on a refractive index of 1.46).
3. When having the fiber terminated, set the AUX parameter T:.
4. This first cleave shows a value of 14.60 dB.
5. Do several more cleaves and note their results until you have got 3 results with less than 0.1 dB difference (including the lowest result).
6. The cleave with the lowest return loss (that is smallest value, the one with the largest reflection) is the one with the new reference value 14.60 dB.
7. Calculate the difference of the values of the last return loss and the one with the lowest value.
8. Add this calibrated difference to 14.60 dB.  
The result will be your momentary CAL REF.

Example:

number of cleaves	displayed return loss dB	difference to best cleave dB	Absolute CAL REF dB
1 (CAL REF)	14.60		
2	14.67		
3	15.27		
4	14.73		
5	<b>14.52</b>	0.00	14.60
6	<b>14.57</b>		
7	<b>14.58</b>	+0.06	<b>14.66</b>

The best cleave was the fifth attempt, and thus is defined by 14.60 dB.

The last return loss measurement is to be offset by +0.06 dB (14.58 dB – 14.52 dB) and thus results in a final return loss of 14.66 dB.

#### D.2-2 Calibrate Cleaved Fiber End As Reference

## Cleaning Procedures

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In general, *whenever possible use physically contacting dry connectors*. Fiber connectors may be used dry or wet. Dry means without index matching compound. If there is a need to use an index matching compound, use only HP index matching oil (part number 8500-4922). Clean the connectors, interfaces and bushings carefully each time after use.

---

### Cleaning Materials

	<b>HP P/N</b>
Lens Cleaning Paper	9300-0761
Special Cleaning Tips	9300-1351
Blow Brush	9300-1131
Adhesive Cleaning tape	15475-68701
Isopropyl Alcohol	Not available from HP. This should be available from any local pharmaceutical supplier.
Pipe Cleaner	

---

## Cleaning Fiber/Front-Panel Connectors

1. In order to clean the instrument front panel connector remove the connector interface.
2. Apply some isopropyl alcohol to the lens cleaning paper and clean the surface and the ferrule of the connectors.
3. Using a new dry piece of cleaning paper wipe the connector surface and ferrule until they are dry and clean.
4. Lightly press the adhesive tape several times against the connector surface to remove any remaining particles. After use store the tape in the container.
5. Protect the connector surface with a cap.

---

## Cleaning Connector Interfaces

1. Apply some isopropyl alcohol to the pipe cleaner and wash the inside of the connector interface.
2. Using a new dry pipe cleaner, dry the inside of the connector interface.
3. Remove the brush part from the blow brush and blow air through the inside of the interface to remove any remaining particles.

---

### Note



If any index matching compound was used, use an ultrasonic bath with isopropyl alcohol to clean the connector interfaces.

---



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## Cleaning Connector Bushings

As used on the HP 8158B and HP 81000AS/BS.

Normally the connector bushings require no cleaning. However, if it appears that cleaning is necessary, use only the blow brush with the brush part removed.

---

### Caution



- NEVER insert any cleaning tool into the bushing as this may affect the optical system.
  - NEVER use any index matching compound, cleaning fluid or cleaning spray.
- 

---

## Cleaning Detector Windows

As used on the HP 81520A and HP 81521B.

1. Use the blow brush to remove any particles from the surface.
2. Wipe the surface with cleaning paper or special cleaning tips.

---

## Cleaning Lens Adapters

---

**Caution** Do not use any cleaning fluid or cleaning spray.



- 
1. Using the blow brush, remove dust.
  2. Wipe the surfaces with the special cleaning tips.

---

## Cleaning Detector Lens Interfaces

As used on the HP 81522A and HP 8140A and HP 8153A detector modules.

Normally, the lens interface can be cleaned by using the blow brush. If adhesive dirt must be removed perform as follows:

1. Using the blow brush, remove the dust from the lens surface.
2. Press the special cleaning tip to the lens surface and rotate the tip.

---

### Note



Use alcohol for cleaning only then when above procedure does not help or if the dirt is caused by oil or fat.

---

## How to clean instruments with a recessed lens interface

### Light dirt

If you find any particles of dirt on the fixed connector interface, or on the input of the optical block, clean them with compressed air.

This cleaning method is gentle to your optical device and is an ideal approach if there is no fat on the surface of your device.

### Heavy dirt

Using compressed air, blow away larger particles of dirt. Clean the recessed lens interface with a dry cotton swab by rubbing gently over its surface. Then blow away any remaining filaments left by the swab.

Isopropyl alcohol should only be used if there is fat on the lens. In this case, choose a new swab and moisten it with alcohol. Remove the dirt by gently rotating the swab using light pressure. Then select a fresh, dry swab to wipe away the alcohol. Blow away any remaining filament with compressed air.

---

### Caution



Do not press the swabs too hard onto the optical surface of your device, as this may produce scratches and your recessed lens could be misaligned.

Alcohol will dissolve some types of dirt. If this then forms a deposit on the edge of the optical input it cannot be removed. You should therefore only use alcohol if absolutely necessary.

Other solvents, like Acetone, should also not be used, as they may damage your optical device and reduce its performance.

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