Keysight 81491A/81492A Reference Transmitter Module

Getting Started

KEYSIGHT
TECHNOLOGIES

Notices

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Safety Notices

CAUTION

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WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

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1 Getting Started

This chapter introduces the features of the Keysight 81491A and 81492A Reference Transmitter Modules.

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Safety Considerations

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements.

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.

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

Safety Symbols

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

Hazardous laser radiation.

Initial Inspection

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

The Performance Tests give procedures for checking the operation of the instrument. If the contents are incomplete, mechanical damage or defect is apparent, or if an instrument does not pass the operator's checks, notify the nearest Keysight Technologies Sales/Service Office.

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.).

WARNING You MUST return instruments with malfunctioning laser modules to a Keysight Technologies Service Center for repair and calibration.

Line Power Requirements

The Keysight 81491A/81492A Reference Transmitter Module operates when installed in the Keysight 8163A/B Lightwave Multimeter, Keysight 8164A/B Lightwave Measurement System, or Keysight 8166A/B Lightwave Multichannel System.

Firmware Requirements

The Keysight 81491A/81492A Reference Transmitter Module can only operate with more recent versions of the mainframe firmware.

To find the version of your firmware

1   Press *Config*.
2   Move to [About Mainframe], and press *Enter*.
    The bottom line shows the firmware revision.

On a Keysight 8163A/B Lightwave Multimeter, you should have firmware V5.25 or greater.

On a Keysight 8164A/B Lightwave Measurement System, you should have firmware V5.25 or greater.

On a Keysight 8166A/B Lightwave Multichannel System, you should have firmware V5.25 or greater.

Operating Environment

The safety information in the Keysight 8163A/B Lightwave Multimeter, Keysight 8164A/B Lightwave Measurement System, & Keysight 8166A/B Lightwave Multichannel System User's Guide summarizes the operating

ranges for the Keysight 81491A/81492A Reference Transmitter Module. In order for these modules to meet specifications, the operating environment must be within the limits specified for the mainframe.

Storage and Shipment

The 81491A/81492A module can be stored or shipped at temperatures between -40 °C and +70 °C. Protect the module from temperature extremes that may cause condensation within it.

The *recommended* storage temperature range for 81491A-085 is +10°C to +40°C. If stored outside this range, the module must be conditioned at room temperature for at least 72 hours before use.

Environmental Information

Table 1   Compliance and Environmental Information

| Safety Symbol	Description
	This product complies with WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste.
	Product Category: With reference to the equipment types in WEEE Directive Annex I, this product is classed as a "Monitoring and Control instrumentation" product.
	Do not dispose in domestic household waste.
	To return unwanted products, contact your local Keysight office, or see http://about.keysight.com/en/companyinfo/environment/takeback.shtml for more information.

Laser Safety Information

The laser sources specified by this user guide are classified according to IEC 60825-1 (2007)

The laser sources comply with 21 CFR 1040.10 except for deviations pursuant to Laser Notice No. 50, dated 2007-June-24.

Table 2   Reference Transmitter Module Safety Information

	Keysight 81491A-135 and 81492A-135	Keysight 81491A-085
Laser type	CW DFB Laser with built-in isolator	DFB-Laser 850nm MMF with built-in isolator
Wavelength range	1310 nm / 1550 nm	850nm
Max. CW output power*	‹10 mW	‹4 mW
Source OUT	‹35 mW	na
Beam waist diameter	9 μm	50 μm
Numerical aperture	0.1	0.1
Laser Class according to IEC 60825-1 (2007)- International	1M	1M
Max. permissible CW output power **	52 mW / 163 mW	5.3 mW
* Max. CW output power means the highest possible optical CW power that the laser source can produce at its output. ** Max. permissible CW output power is the highest possible power that is permitted within the appropriate IEC laser class.		

Laser Safety Labels
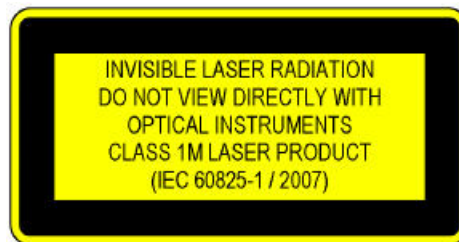
A sheet of laser safety labels is included with the laser module as required. In order to meet the requirements of IEC 60825-1 we recommend that you stick the laser safety labels, in your language, onto a suitable location on the outside of the instrument where they are clearly visible to anyone using the instrument.

WARNING

Please pay attention to the following laser safety warnings:

• Under no circumstances look into the end of an optical cable attached to the optical output when the device is operational. The laser radiation can seriously damage your eyesight.

• Do not enable the laser when there is no fiber attached to the optical output connector.

• The laser is enabled by pressing the gray button close to the optical output connector on the front panel of the module. The laser is on when the green LED on the front panel of the instrument is lit.

• The use of the instruments with this product will increase the hazard to your eyes.

• The laser module has built-in safety circuitry which will disable the optical output in the case of a fault condition.

• Close all unused fiber connections.

• Refer servicing only to qualified and authorized personnel.

NOTE

Laser safety errors might sometimes appear erroneously on calibration of the reference transmitter's operating point in conjunction with the usage of an external tunable laser source (TLS). This does not affect the safety of the product.

As a workaround, repeat the operating point calibration and reduce the output power of the TLS as appropriate.

Getting Started with the Reference Transmitter Module

What is a Reference Transmitter Module?

A reference transmitter is an electrical-optical (E/O) converter, where the data input modulates the output of a (DFB) laser.

Keysight's Reference Transmitters are designed to offer excellent eye quality for NRZ and PAM4 signal and can serve as universal E/O converter. The 81491A supports speed up to 32 Gbaud and 81492A upto 56 Gbaud NRZ and 53 Gbaud PAM4. The single-mode (SM) flavors (81491A-135, 81492A-135) include internal lasers at 1310 nm and 1550 nm. The 81491A comes in Multimode (MM) flavor and includes an internal laser at 850 nm (MM). External optical input for usage with tunable laser sources is available on the SM options.

The separation of the signal source and the modulator is the only way to offer a zero-chirp modulation. This is essential for a clean and repeatable eye diagram when modulating with an appropriate clean external source to fulfill the requirements of the IEEE standard. Another advantage of this design, compared with directly modulated transmitters, is the wide extinction ratio range that can only be achieved by this architecture. Additionally, the reference transmitter has a linear transmission behavior. This means that when used with an electrical arbitrary waveform generator, Keysight Reference Transmitter Module can be used as an optical arbitrary waveform generator.

The Front Panel

Figure 1   Front Panel of the Reference Transmitter Module: option –135 (left) and
–085 (right)

Figure 2   Front Panel of the 81492A-135 Reference Transmitter Module

To insert these modules into your mainframe see your mainframe's User's Guide.

Optical Connections

The output of the Keysight Reference Transmitter 81491A-135 and 81492A-135 (single mode) is equipped with an angled contact optical connector. The optical source output and optical input connectors are angled and should be connected using a polarization maintaining fiber (PMF).

The output of the Keysight Reference Transmitter 81491A-085 (multimode) is equipped with a multimode angled contact optical connector.

CAUTION	To avoid excess loss and reflection-induced interferences, use cables with same connectors only.

Figure 3   Angled and Straight Contact Connector Symbols

Unlocking the Laser

You have to unlock the laser before you can switch it on.

You can unlock the laser when you first switch the mainframe by entering the password.

If you need to unlock the laser later, perform the following steps:

1   Press *Config*.
2   Move to [Unlock], and press *Enter*.
3   Enter the password, and press *Enter*.
4   Press *Close*.

NOTE

The default password for the mainframe is "1234".

Enabling and Disabling the Laser Output

Switch the laser on and off by pressing the Active button on the front panel of the module.

The State parameter and the Active LED indicate whether the module is emitting radiation.

If the laser is active, the State parameter is On and the Active LED on the front panel of the module is lit.

If the laser is inactive, the State parameter is Off and the green LED on the front panel of the module is unlit.

RF Data In

CAUTION   Do not apply signals to the Data In that exceed -2V and +2V. Within this range, the signal voltage must be less than 2V peak-to-peak.

The RF input is a 1.85 mm female RF connector. It is AC coupled. For linear operation, the RF input signal should be less than or equal to 200mV for 81492A-135, 600 mV for option 81491A-135, and 300 mV for option 81491A-85. This is the linear regime of the E/O converter.

Values outside this range will overdrive the output signal

If you have applied a signal that overdrives the output

1   Reduce the level of the input.
2   Turn the laser off and back on again.

Accessories

The following diagram provides information on the available options and accessories for the most common applications.
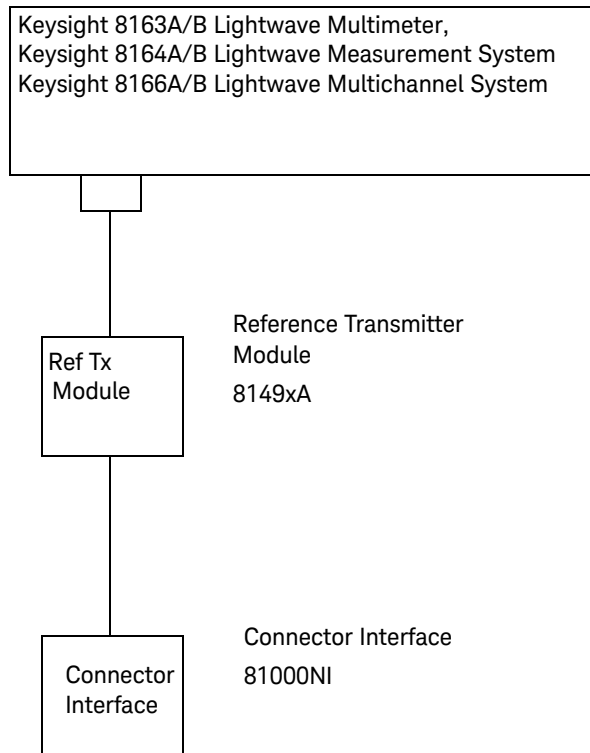
```
┌─────────────────────────────────────────────────────────┐
│ Keysight 8163A/B Lightwave Multimeter,                  │
│ Keysight 8164A/B Lightwave Measurement System           │
│ Keysight 8166A/B Lightwave Multichannel System          │
│                                                          │
└─────────────────────────────────────────────────────────┘
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Reference Transmitter
Module

Ref Tx
Module

8149xA

Connector Interface

Connector
Interface

81000NI

Figure 4   Available Options and Accessories

Operation

Setting the Wavelength

1   On your mainframe, move to the channel of the reference transmitter
    module.

2   Move to [λ], and press *Enter*.

3   Select the wavelength, and press *Enter*.

Setting the Optical Attenuation

1 On your mainframe, move to the channel of the reference transmitter module.

2 Move to [Att] for the wavelength you are using, and press *Enter*.

3 Set the attenuation, and press *Enter*.

Calibrating and Setting the Operating Point

For the best possible results, the operating point for the reference transmitter should be as close as possible to the center of the modulator's transfer characteristic. This ensures you can make the best use of the linear part of the transfer characteristic.
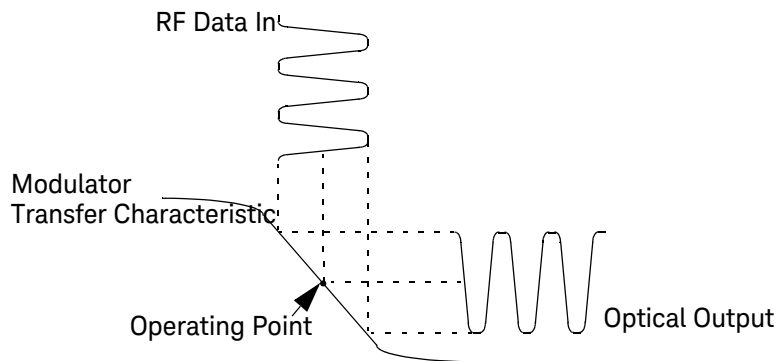
When you turn the instrument on, a default value is used, and "Unc" or "Uncal" is shown on the display.

The reference transmitter also checks its temperature periodically. If the temperature differs too much from the temperature at which the last recalibration was performed, this is reflected in the modules status line in the user interface ("Uncal" for 8164A/B, "Unc" for 8163A/B and 8166A/B).

The instrument can set a first approximation to the best operating point.

1 Press *Tx Recal*.

To fine tune the operating point

2 Set up your equipment as displayed in Figure 5.

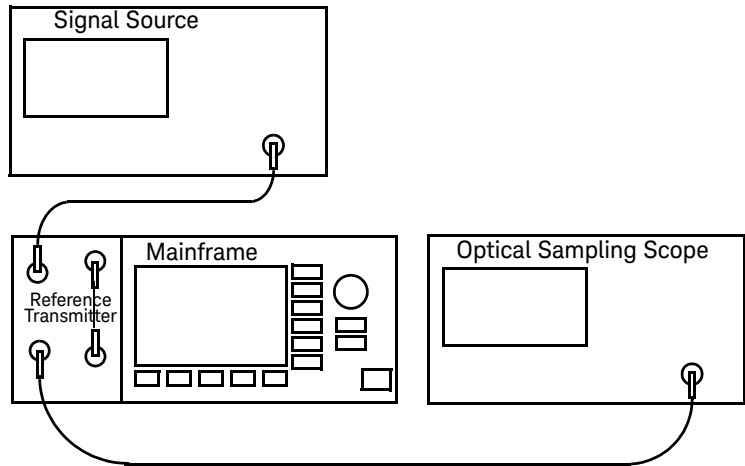Figure 5   Operating Point Setup

3   On the signal source, set up a "best case" signal.

4   Turn on the laser of the reference transmitter.

5   Set up the optical sampling scope to show the "eye".
    The crossing point for the eye should be at 50% ± 1%.
    If the crossing point is in this range, you do not need to adjust the
    operating point and you can start testing.
    Otherwise continue with the following steps.

6   On your mainframe, move to the channel of the reference transmitter
    module.

7   For the wavelength you are using, move to [Oper pt.].

    OR

    1   Press *Menu*.

    2   Move to [Oper Pt.] for the wavelength you are using, and press
        Enter.

8   Set the value for the offset, and press *Enter*.
    You can adjust the operating point from -50 to 50.

9   Refresh the results on the optical sampling scope.
    If the crossing point is in the range 50% ± 1% (see Figure 1), you do not
    need to adjust the operating point further and you can start testing.
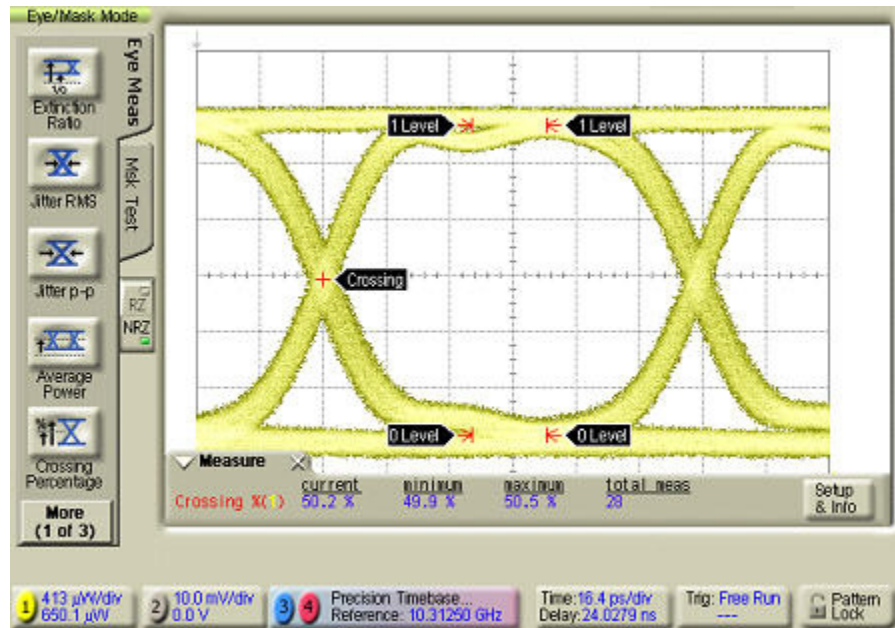
Figure 6   Modulator bias operating point optimized to eye crossing of 50% ± 1

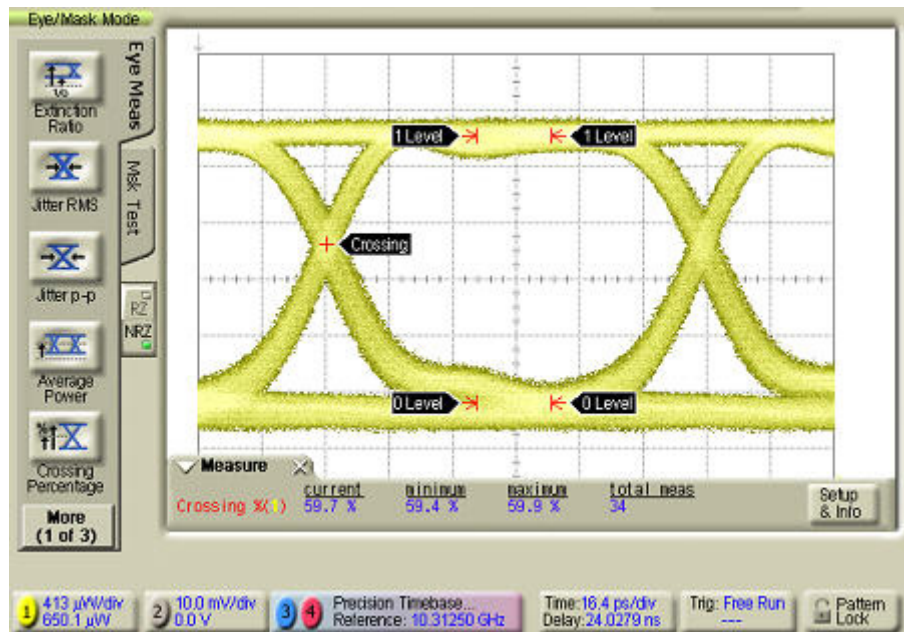If the operating point is not optimized (see Figure 7), return to step 8.

Figure 7   Modulator bias operating point not optimized.

2 Warranty Information

All system warranties and support agreements are dependent upon the integrity of the Keysight Reference Transmitter Module. Any modification of the system software or hardware will terminate any obligation that Keysight Technologies may have to the purchaser. Please contact your local Keysight field engineer before embarking in any changes to the system.

Remove all doubt

Keysight offers a wide range of additional expert test and measurement services for your equipment, including initial startup assistance, onsite education and training, as well as design, system integration, and project management.

Our repair and calibration services will get your equipment back to you, performing like new, when promised. You will get full value out of your Keysight equipment throughout its lifetime. Your equipment will be serviced by Keysight-trained technicians using the latest factory calibration procedures, automated repair diagnostics and genuine parts. You will always have the utmost confidence in your measurements.

For more information on repair and calibration services, go to

www.keysight.com/find/removealldoubt

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