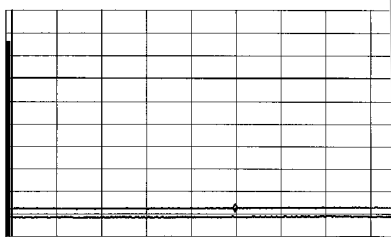


# Agilent 70810B Lightwave Section: System Improvements for Agilent 71400C and 71401C Lightwave Signal Analyzers

Product Note 71400-2

15:41:55 MAY 9, 1991

RIN (Laser)	=	-160.23 dB/Hz
— RIN (System)	=	-153.45 dB/Hz
— Thermal Noise Term	=	-158.05 dB/Hz
— Shot Noise Term	=	-156.98 dB/Hz



**Agilent Technologies**  
Innovating the HP Way

Agilent 70810B Lightwave Section:  
System Improvements for Agilent 71400C and 71401C Lightwave Signal Analyzers

The Agilent 70810B lightwave section significantly enhances the capabilities of the Agilent 71400C and 71401C lightwave signal analyzers. Unlike the Agilent 70810A, which operated as a master module within the modular measurement system (MMS), the Agilent 70810B is a slave module to the MMS local oscillator. This important difference allows the user to access and utilize the functions available in the electrical spectrum analyzer in MMS.

This product note summarizes key differences of Agilent 71400C and 71401C lightwave signal analyzers, when configured with the Agilent 70810A and 70810B lightwave sections. Key differences covered in this product note include:

- \* New features
- \* Measurement enhancements
- \* Menus
- \* System configuration
- \* Remote commands

For complete information on the operation of Agilent 71400C and 71401C lightwave signal analyzers, refer to the Agilent 70900B Local Oscillator Operation and Programming manuals.

## New Features

The Agilent 70810B lightwave section adds the following features to the Agilent 71400C and 71401C lightwave systems:

**Downloadable program (DLP):** A DLP is a program that can be written or loaded into the lightwave signal analyzer. DLPs allow the the analyzer to perform simple to very complex tasks or calculations without an external controller. The RINLasr DLP is an example of such a program.

**Memory card reader:** The memory card reader is an interface built into the Agilent 70004A display, which allows traces, states, and DLPs to be read from or stored on ROM and RAM cards.

**The HP-HIL keyboard interface:** The interface allows the user to enter commands and titles into the analyzer from the keyboard.

**Screen titles:** Screen titles are comments entered by the user, which are displayed on the analyzer screen.

**Mass storage to an external disk:** Allows the user to save/recall state and trace information, store computed data, and load DLPs directly onto an external disk drive.

**Limit lines:** Limit lines can be created to allow conditional testing in pass or fail measurements.

**Panning:** This feature allows positioning of start frequency, stop frequency, center frequency, and span without waiting for the analyzer to complete a trace sweep.

**Operates with non-lightwave modules:** When present in the lightwave system, the Agilent 70810B operates with other Agilent 70900B local oscillator compatible modules.

## Measurement Enhancements

**RIN measurement enhancements**—A DLP (RINLasr) is included with the signal analyzer. This program measures the RIN of lasers to  $-165$  dB/Hz by subtracting the receiver shot noise and thermal noise contributions from the total system noise. (See Product Note 71400-1, literature number 5091-2196E.)

The value of RIN is always displayed in electrical units independent of the display mode of operation. Therefore, the same RIN value is obtained whether the instrument is operating in lightwave electrical or optical mode.

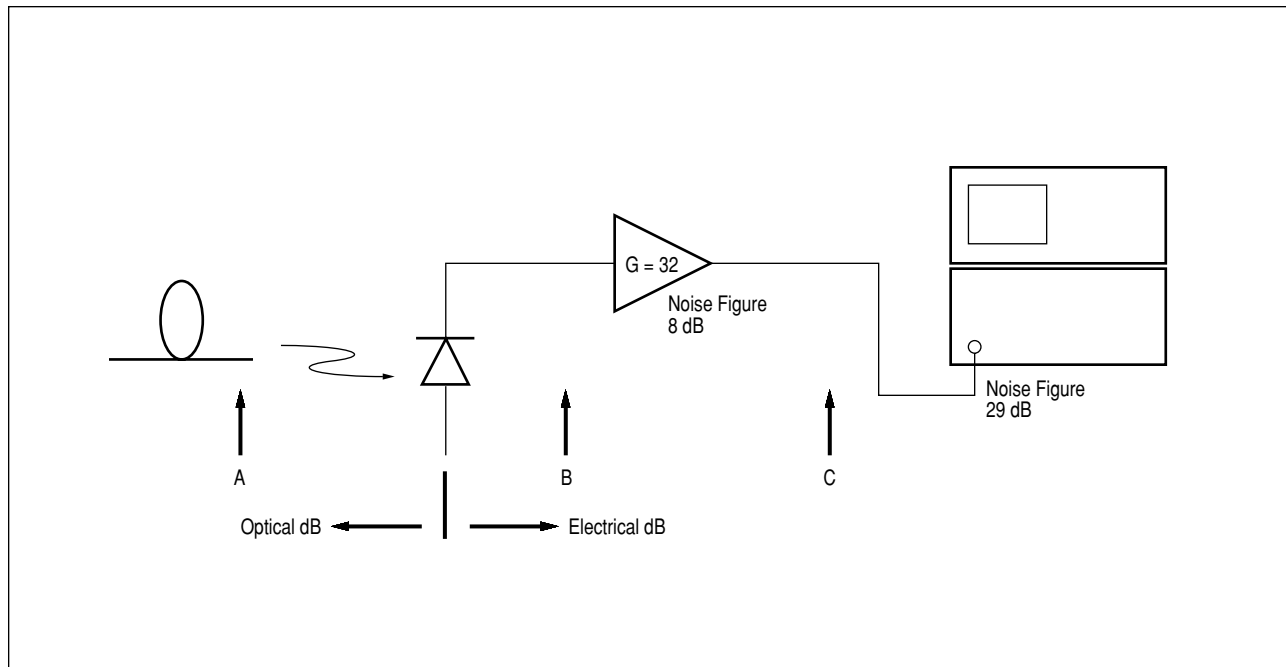
RIN can be measured independently of the average power bar. A valid measurement can be obtained with the power bar off the top of the screen.

**Relative power is independent of the power bar**—Measurement of relative power (REL PWR key) is now independent of the power-bar display.

**Linear lightwave display**—A linear graphic display is available when the lightwave input is selected. When LW MODE Opt is selected, the linear display is in power units. However, when LW MODE Elec is selected, the linear display can be in either power or voltage units.

**Independent lightwave mode annotation**—Display trace units have been decoupled from the optical average-power-meter bar, which allows trace information to be displayed in lightwave-electrical units and the optical-power meter information to be displayed in lightwave-optical units.

**New LW MODE Elec reference plane**—The lightwave electrical-mode measurement now takes into account the effects of the built-in preamplifier following the photodetector. (See figure 1.) Figure 1 shows the lightwave optical reference plane A, the new lightwave electrical reference plane B, and the old (Agilent 70810A) lightwave electrical reference plane C.



**Figure 1.** Lightwave-electrical mode reference plane change.

**Wide USRPWR adjustment range**—The USRPWR function allows the Agilent 71400C signal analyzer to be referenced to another calibrated optical-power standard. As such, this function is useful in correcting for optical connector insertion loss or uncertainty and permits the Agilent 71400C to be calibrated at a non-factory calibrated wavelength. The user power adjustment range can now be extended. The range extends from  $\pm 2$  dB from factory calibration point to  $\pm 300$  dB.

## Menus

The menus of the Agilent 71400C and 71401C lightwave signal analyzers are now similar to those of the Agilent 70000 spectrum analyzer. Major changes to the user interface are described below:

**Switch from LW optical to LW electrical mode**—To switch the display units from lightwave-optical units to lightwave-electrical units, press:

Amptd;        more, LW MODE Elec

**Select between LW and RF inputs to the Agilent 70810B**—Press:

State;        select mode, IN 2 uW 70810B or IN 1 LW 70810B

**Control average optical-power meter**—To turn the power-meter display on or off, adjust the display units, or apply a user-power offset, a new key has been added. Press:

Amptd;        more, power meter, PWR MTR On Off  
    PWR MTR ElecOpt  
    USR PWR On Off

**Change calibration wavelength**—To change the factory calibration wavelength from 1300 nm to 1550 nm, press:

Amptd;        more, LAMBDA [1550 nm] or use the arrow key up

**RIN measurements**—The Agilent 71400C and 71401C will perform two RIN measurements:  $RIN_{system}$  (RINSYS) and  $RIN_{laser}$  (RINLasr). RINSYS, the RIN function of the Agilent 70810A, provides the ratios of laser noise, shot noise, and thermal noise to the average optical power. Press:

Marker;        RIN SYS On

RINLasr provides enhanced measurement capability by subtracting the signal analyzer shot noise and thermal noise. Press:

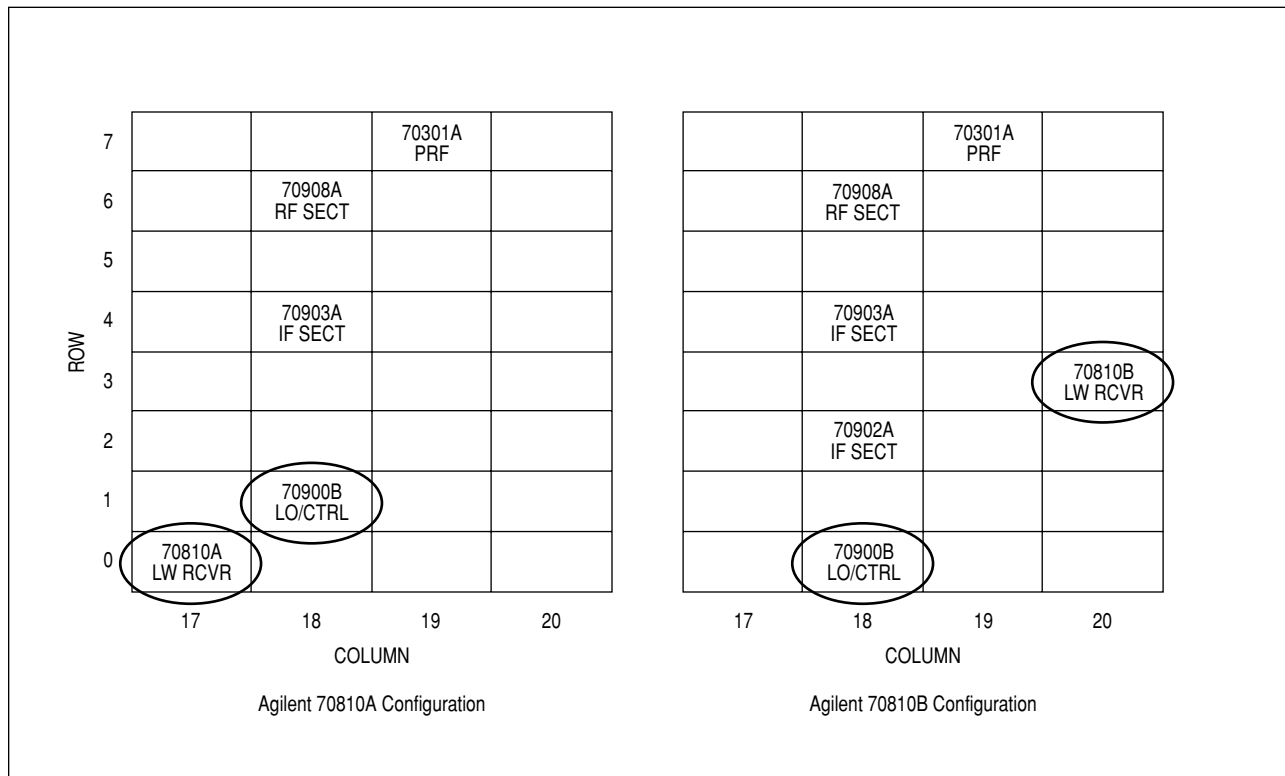
USER;        RINLasr

**Display annotation**—The following changes have been made to the display annotation:

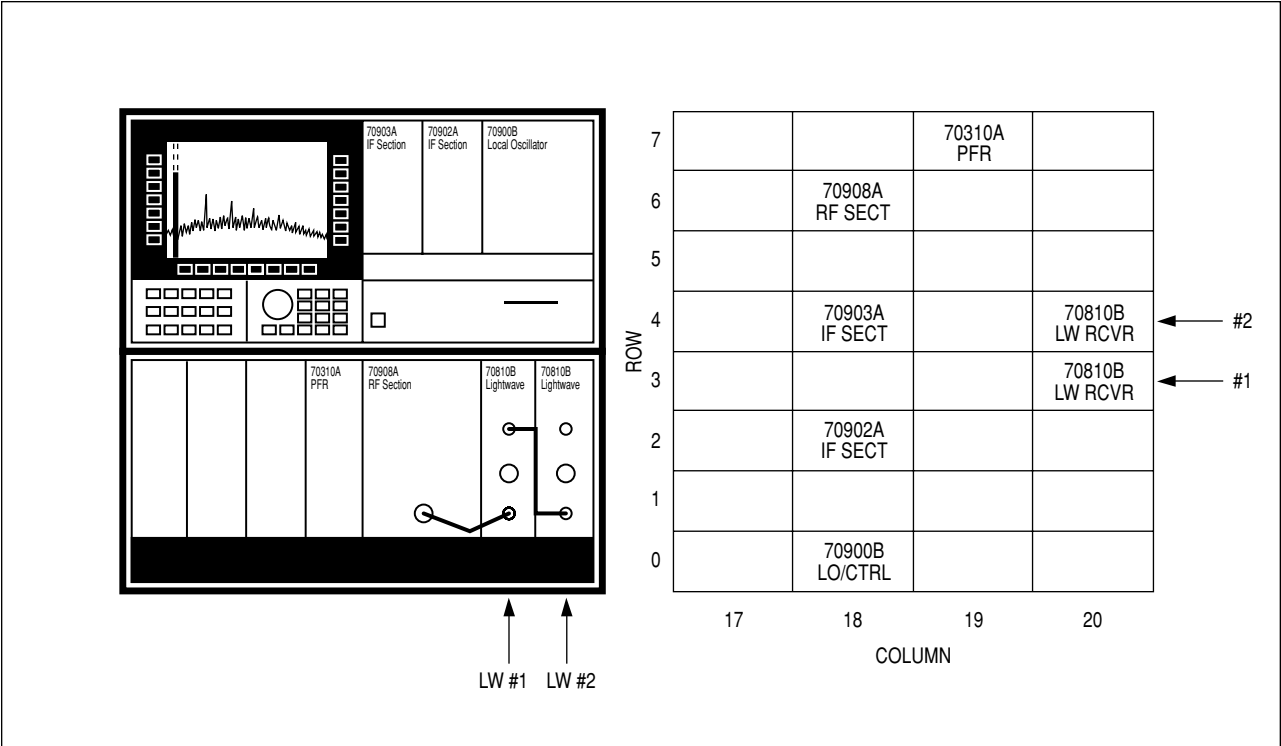
- LW MODE indicator is to the right of the ATTEN annotation.
- Zeroing indicator is an asterisk (\*) to the right of the AVG PWR annotation.
- USRPWR indicator is an asterisk (\*) to the left of the AVG PWR indicator.
- AVG PWR unit indicator follows the numeric AVG PWR indicator.

## System Configuration

**Default address**—Now that the Agilent 70810B is a SLAVE to the Agilent 70900B local oscillator, its default address has changed. When the Agilent 71400C or 71401C lightwave signal analyzers ship from the factory, the default address of the Agilent 70810B is row 3, column 20 (as shown in figure 2). Figure 2 also shows the default address map for the Agilent 70810A as configured in the lightwave signal analyzers.



**Figure 2.** Configuration changes for the Agilent 71400C and 71401C lightwave signal analyzers.



**Figure 3.** Multiple lightwave section addresses and system configurations.

Sensitivity and flatness degradation in the second lightwave section is due to the bypass switch. Also, only one system calibration is supported. Characteristic flatness in optical dB of the second lightwave section is listed below:

Frequency Range	Agilent 71400C Specifications	Agilent 71400C + 70810B Characteristics
100 kHz – 2.9 GHz	+ 1 dB	+ 1.4 dB
2.9 GHz – 6 GHz	+ 1 dB	+ 1.5 dB
6 GHz – 12 GHz	+ 1 dB	+ 1.7 dB
12 GHz – 16 GHz	+ 1 dB	+ 1.9 dB
16 GHz – 22 GHz	+ 1 dB	+ 2.0 dB



## Remote Commands

The following table describes the changes in remote programming between the Agilent 70810A and the 70810B lightwave sections. If the command is not listed, it has not been affected by the module change. All new commands supported by the Agilent 70810B lightwave signal analyzer are listed in the Agilent 70900B Local Oscillator Programming manual.

Note: All system programming must directly address the Agilent 70900B local oscillator (LO) and not the lightwave section.

<u>COMMAND</u>	<u>COMMENTS</u>
AUNITS	The AUNITS OPTICAL and ELECT options have been replaced with the new OPTMODE command.
CAL	<p>The CAL options listed below have been replaced with the following new commands:</p> <p>CAL OPTPWR —————&gt; USRPWR  CAL PREAMP —————&gt; CAL GAIN  CAL PRESET —————&gt; LAMBDA  CAL SA —————&gt; CAL ALL</p>
CALCOR	<p>The CALCOR options listed below have been replaced with the following new commands:</p> <p>CALCOR OPTPWR —————&gt; USRPWR ON/OFF  CALCOR PREAMP —————&gt; CALCOR GAIN  CALCOR SA —————&gt; CALCOR ALL</p>
LAMBDA	LAMBDA, a new command, is used to select the wavelength of operation: The wavelength of operation is 1300 or 1550 nm for the Agilent 70810B.
LN	LN (linear) supports two optional arguments, V or W, to specify the type of linear scale. The V scale is not allowed for LW MODE Opt.
LTWAVE	LTWAVE has been replaced with the INPUT command.
MKD?	MKD? query command has been replaced by the MKF? command.

MKRELPWR	MKRELPWR command is supported by the Agilent 70810B, but is no longer dependent upon the marker-delta function.
RIN?	<p>The RIN? command performs the following tasks:</p> <ol style="list-style-type: none"> <li>1) Activates the RINLasr DLP</li> <li>2) Runs a single measurement</li> <li>3) Returns, values for RIN laser, RIN system, thermal-noise term, and shot-noise term in that order.</li> </ol>
MKRIN	MKRIN is not supported by the Agilent 70810B. Use RIN? and MKRINSYS for alternate RIN commands.
MKRINSYS	MKRINSYS is a new command for the MKRIN command, but is not dependent upon the marker-delta function.
OPTCOR	OPTCOR is not supported by the Agilent 70810B.
OPTMODE	OPTMODE is a new command that replaces the OPTICAL and ELECT options of the AUNITS command.
PWRBARON	PWRBARON is a new command that controls the presence or absence of the power-bar display.
PWRMODE	PWRMODE is a new command that selects either optical or electrical units for the power bar.
RQS, SRQ, STB	<p>These commands are available, but status-bit definitions have changed.</p> <p>Bit 1 (message bit) includes condition of power-bar zeroing.          Bit 3 (previously available) is not used.          Bit 5 (error bit) includes power-bar out-of-range.          Bit 7 (previously available) is not used.</p>
SWCOR	SWCOR is not supported by the Agilent 70810B.

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