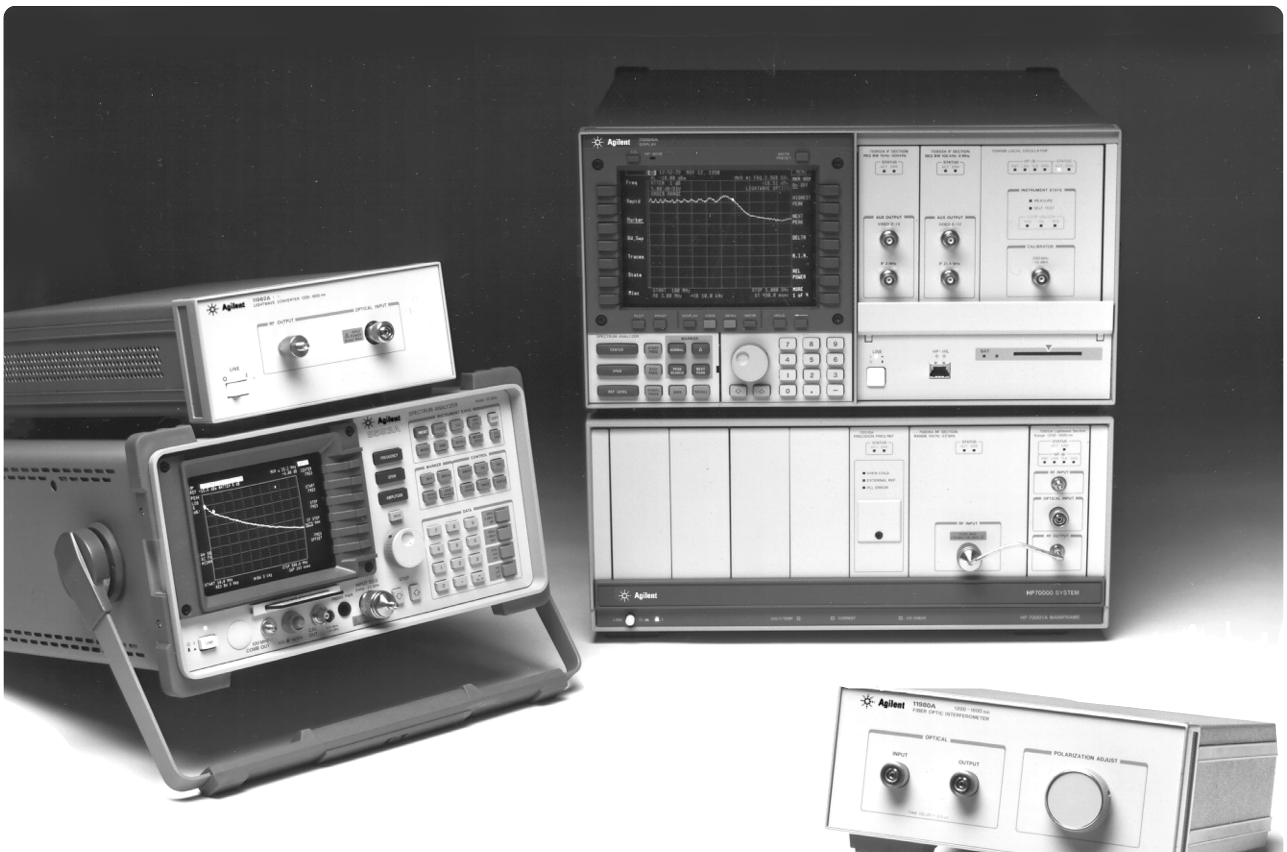
Agilent 11980A Fiber-Optic Interferometer

Product Overview

Linewidth and Power Spectral Measurements of Single-Frequency Lasers



Single-frequency lasers, such as distributed feedback (DFB) and distributed Bragg reflector (DBR), have become increasingly important in lightwave signal transmissions. Today, they are used in systems to minimize transmission penalties resulting from dispersion in long-haul optical-fiber communications links. In the future, lightwave coherent communication systems will employ multiple single-line lasers to increase the system band-width of a single fiber.

Characterizing the single-frequency laser linewidth and measuring chirp and FM characteristics that result when a laser is directly modulated are important in determining laser-component and system-performance limits.

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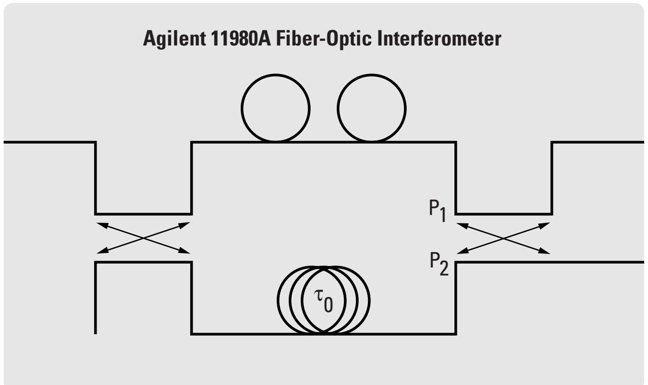

Diagram of the Agilent 11980A

The Agilent 11980A fiber-optic interferometer is an accessory to the Agilent 71400C lightwave signal analyzer. It uses a self-homodyne technique to convert optical phase or frequency deviations into intensity variations. These variations are detected by the high-speed PIN photodiode and preamplifier in the lightwave signal analyzer and displayed.

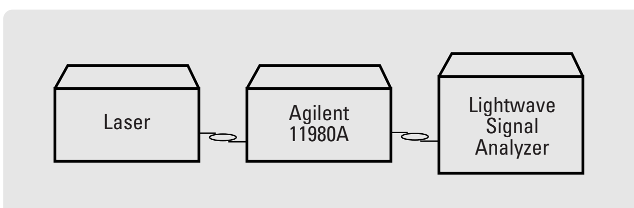

Figure 1. Linewidth measurement test set-up

Linewidth Measurements

Linewidth describes the static spectral bandwidth of the laser. The measurement is performed by simply connecting the single-line laser output to the input of the interferometer and connecting the interferometer output to the input of the lightwave signal analyzer. The signal-to-noise ratio of the displayed spectrum can be optimized using the manual polarization-state adjustment on the front panel of the Agilent 11980A. The shape of the display is not altered by this adjustment, only its amplitude relative to the noise floor.

The Agilent 11980A is an unbalanced fiber-optic Mach-Zehnder interferometer covering wavelengths from 1250 nm to 1600 nm. Its input directional coupler splits the incoming optical signal into two equal parts. The two signals then travel along separate fiber paths. One arm contains a spool of fiber to delay the incoming signal and disrupt the coherence between the two arms. The standard Agilent 11980A delays the signal by 3.5 µsec, and the 11980A-005 delays it by 25 µsec. A mechanical polarization-state controller, added to the other arm of the interferometer, maximizes the output power. The two signals are then recombined using another directional coupler and are output to the front panel.

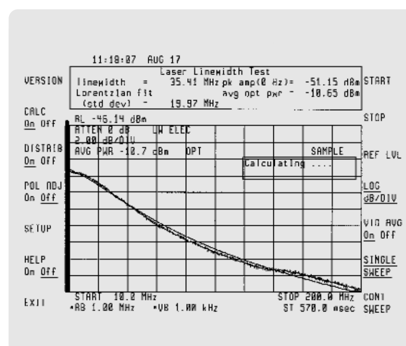

Figure 2. Linewidth measurement made on the Agilent 83810A

Linewidth measurements from as narrow as 100 kHz to greater than 22 GHz can be performed with the Agilent 71400C signal analyzer and 11980A-005.

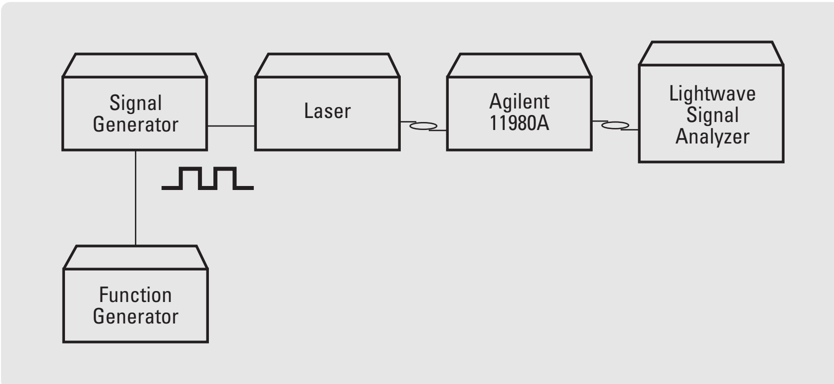

Figure 3. Chirp measurement test set-up

Chirp/FM Characteristic Measurements

Chirp, or spectral bandwidth widening, is caused by varying the drive current or directly modulating the laser. Chirp can be undesirable because it broadens the laser's spectral bandwidth, resulting in reduced system bandwith due to chromatic dispersion in fiber-optic cable. On the other hand, the chirping mechanism can be used to create FM via direct laser current modulation.

By adding a modulation source that can be gated with the same period typically as the interferometer delay, the combination of the Agilent 11980A and the lightwave signal analyzer allows chirp measurements of single-line lasers. Gating is used to achieve the appropriate phase relationship in the two arms to homodyne the chirped laser spectrum with the unmodulated spectrum.

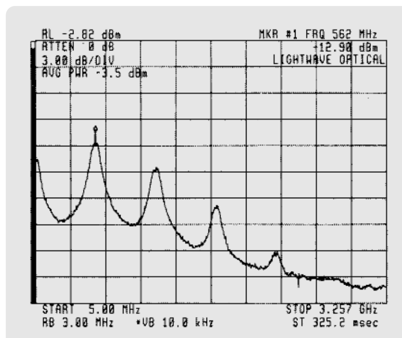

Figure 4 DGB laser modulated with 130 MHz sinewave

Figure 4 shows the chirp resulting when a typical DFB laser is modulated with a 130 MHz sinewave. Chirp effects can be analyzed using sinewave, squarewave, or PRBS modulation as the modulation source.

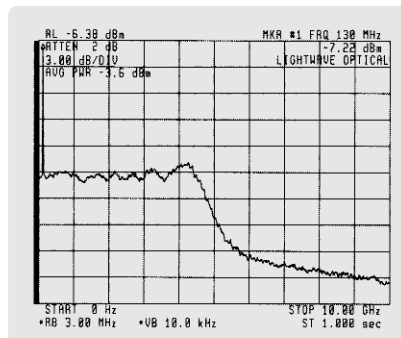

Figure 5. 11 GHz Chirp measurement

A large amount of intensity modulation is often accompanied by a large FM deviation. Figure 5 shows a laser chirping with a deviation of approximatley 11 GHz.

Specifications/Characteristics

	Standard	11980A-005
Optical Insertion Loss		
1300 nm	8 dB	9 dB
1550 nm	8 dB	9 dB
Wavelength Range (Characteristic)	1250 nm to 1600 nm	
Delay Time (Characteristic)	3.5 µsec	25 µsec
Linewidth (minimum) (Lorentzian with 10% uncertainty)	225 kHz	<100 kHz
Optical Connectors	Single-mode fiber connectors Diamond HMS 10, FC/PC, ST, SC	

Ordering Information

Agilent 11980A Fiber-Optic Interferometer

Must order one of the optical connectors listed below.

11980A-005 5 km fiber (25 µsec delay)

Agilent 71400C Lightwave Signal Analyzer (100 kHz to 22 GHz) (100 kHz to 22 GHz)

Must order one of the optical connectors listed below.

Optical Connectors (choose one)

81000AI	Diamond HMS-10 Connector
Option 12	FC/PC Connector
81000SI	DIN 47256 Connector
81000VI	ST Connector

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