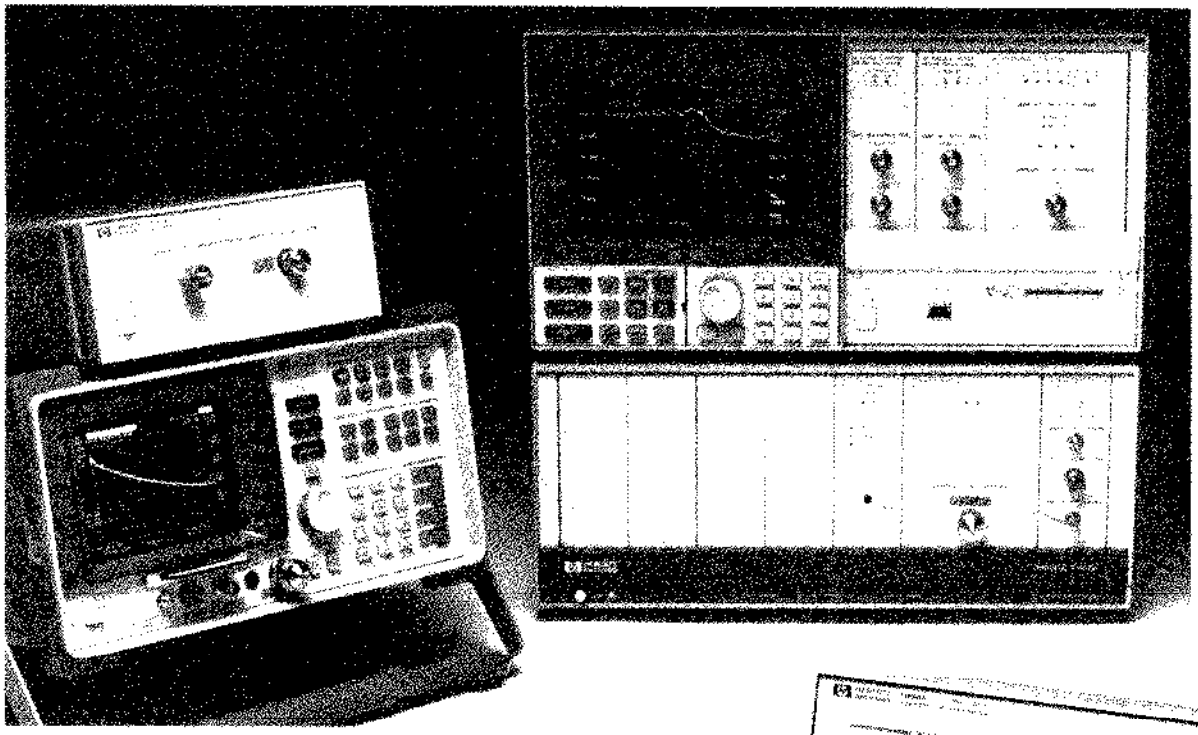
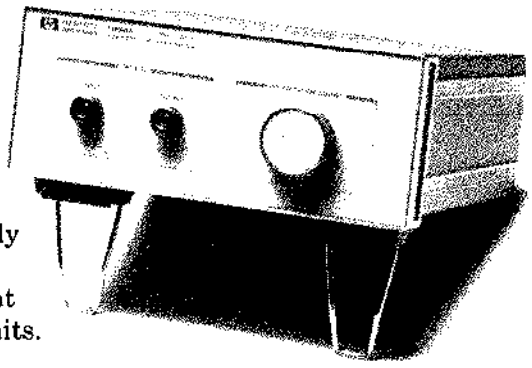
HEWLETT PACKARD

HP 11980A Fiber-Optic Interferometer

Technical Data

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 bandwidth 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.

HP 11980A Fiber-Optic Interferometer

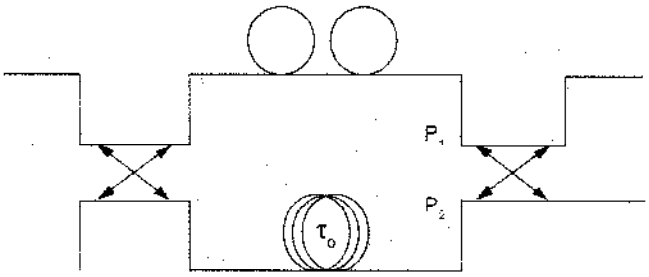


Diagram of the HP 11980A

The HP 11980A fiber-optic interferometer is an accessory to the HP 71400C, HP 71401C, and HP 83810A lightwave signal analyzers. 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.

The HP 11980A is an unbalanced fiber-optic Mach-Zehnder interferometer covering wavelengths from 1,250 nm to 1,600 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 HP 11980A delays the signal by 3.5 µsec, and Option 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.

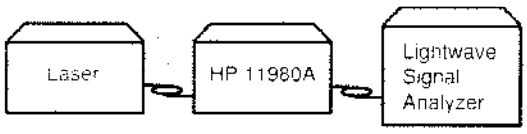


Fig. 1 Linewidth measurement test set-up

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 HP 11980A. The shape of the display is not altered by this adjustment, only its amplitude relative to the noise floor.

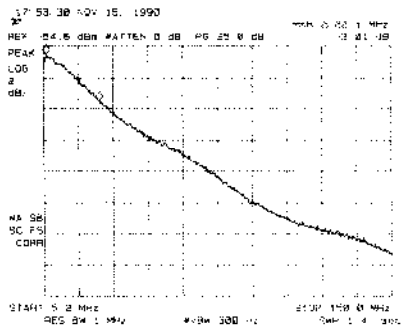


Fig. 2 Linewidth measurement made on the HP 83810A

Linewidth measurements as narrow as 30 kHz and as wide as 22 GHz can be performed with the HP 83810A signal analyzer and HP 11980A Option 005. Figure 2 shows a linewidth measurement of **xxx** MHz.

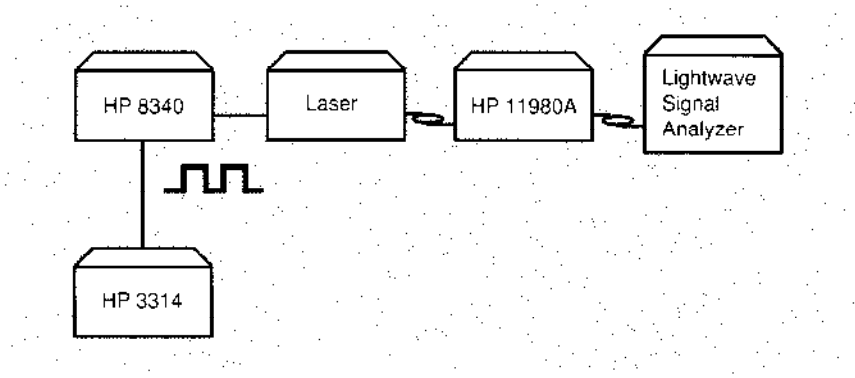


Fig. 3 Chirp measurement test set-up

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 as the interferometer delay, the combination of the HP 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.

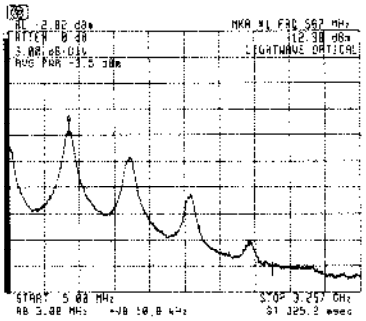


Fig. 4 DGB laser modulated with 130 MHz sinewave

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.

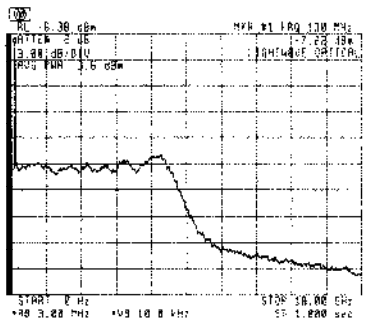


Fig. 5 11 GHz Chirp measurement

A large amount of intensity modulation is often accompanied by a large FM deviation. Figure 5 shows a laser chirping with a deviation of approximately 11 GHz. The HP 71400C and HP 83810A provide chirp-measurement capability to 44 GHz, while the 71401C is limited to 5.8 GHz.

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Specification/Characteristics

	Standard	Option 005
Optical Insertion Loss		
1,300 nm	8 dB	8 dB
1,550 nm	8 dB	8 dB
Wavelength Range (Characteristic)	1,250 nm to 1,600 nm	
Delay Time (Characteristic)	3.5 µsec	25 µsec
Linewidth (minimum) (Lorentzian with 10% uncertainity)	225 kHz	30 kHz*
Optical Connectors	Single-mode fiber connectors Diamond HMS 10/HP, FC/PC, ST, Biconic, DIN	

*100 kHz with HP 71400C and 71401C

Ordering Information

HP 11980A[1] Fiber-Optic Interferometer
Option 005 5 km fiber

HP 71400C[1] Lightwave Signal Analyzer (100 kHz - 22 GHz)
HP 71401C[1] Lightwave Signal Analyzer (100 kHz - 2.9 GHz)
HP 83810A[1] Lightwave Signal Analyzer (9 kHz - 22 GHz)

[1]Must order one of the following options:
Option 011 Diamond HMS-10/HP Connector Interface
Option 012 FC/PC Connector Interface
Option 013 DIN 47256 Connector Interface
Option 014 ST Connector Interface
Option 015 Biconic Connector Interface

For more information, call your local HP sales office listed in your telephone directory or an HP regional office listed below for the location of your nearest sales office.

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