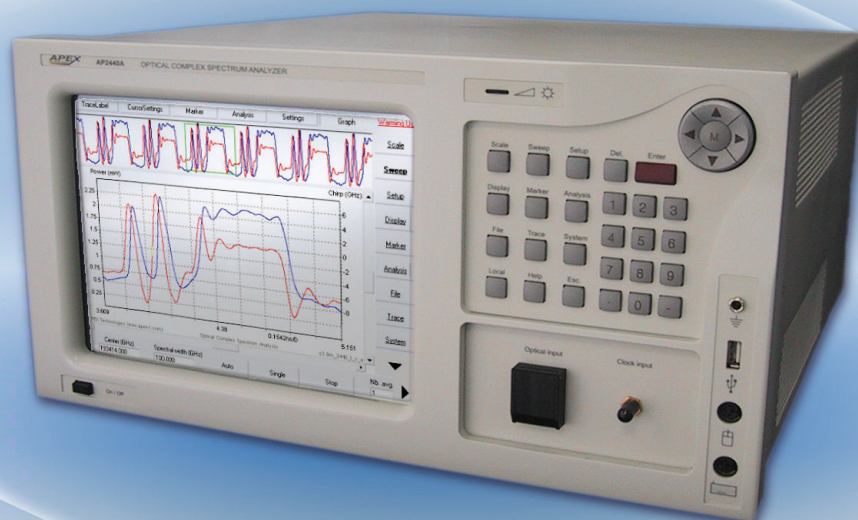


# AP2441B/AP2443B

## Optical Complex Spectrum Analyzer



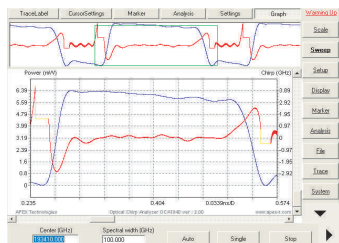
### TIME DOMAIN MEASUREMENT

Temporal resolution 75fs max., bandwidth >6THz max.

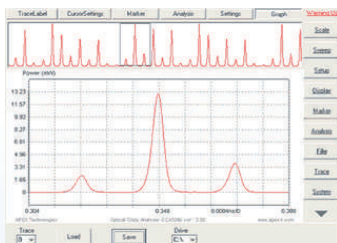
### FREQUENCY DOMAIN MEASUREMENT

Resolution 20MHz (0.16pm), C and L band

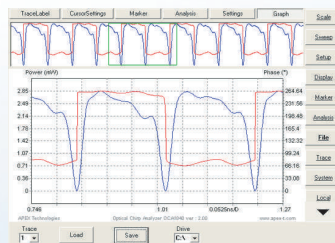
#### CHIRP & PULSE



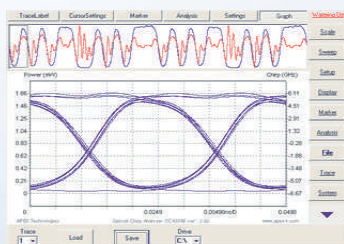
#### SHORT PULSES



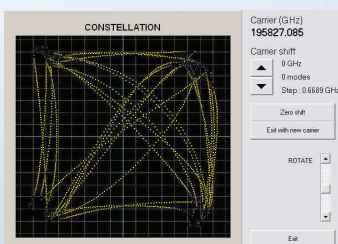
#### PHASE MODULATION



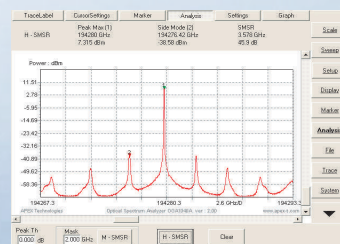
#### PHASE & INTENSITY EYE DIAGRAM



#### CONSTELLATION



#### ULTRA HIGH RESOLUTION OPTICAL SPECTRUM ANALYZER



# AP2441B/AP2443B Optical Complex Spectrum Analyzer

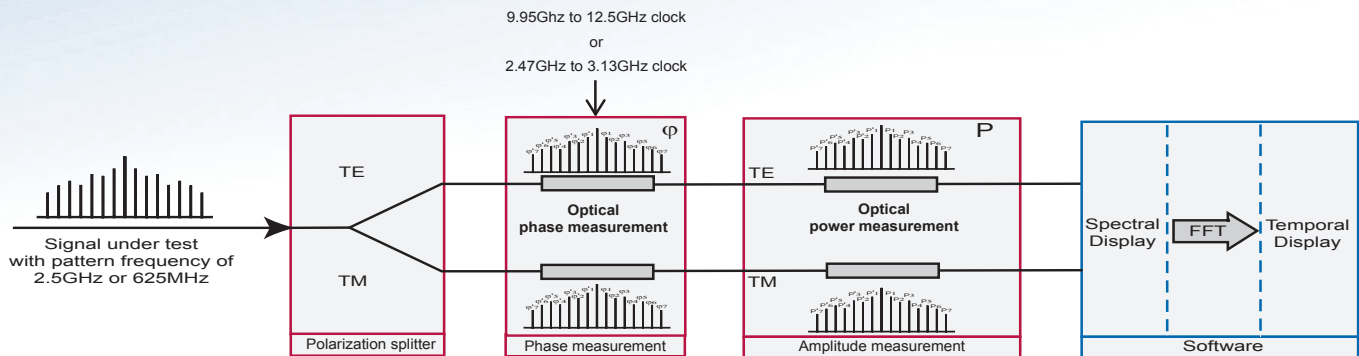
## Measurement principle

While optical spectrum analyzer can only measure power of a modulated signals, Apex Technologies complex spectrum analyzer is able to measure also the optical phase.

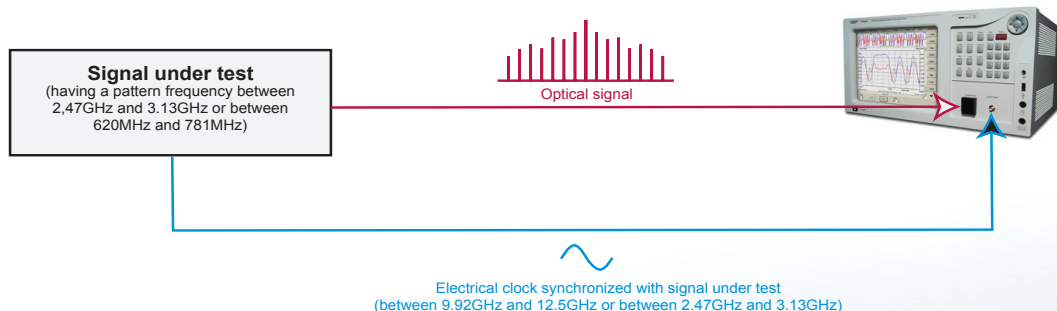
The patented method of the AP2441B/AP2443B is based upon a spectral analysis of the optical field, of which the amplitude and the phase of each frequency component are analyzed when all components are spaced by a fixed frequency ( $F_{r1}=2.5\text{GHz}$  or  $F_{r2}=625\text{MHz}$ ).

By knowing the amplitude and the phase of each spectral component, the temporal variations of the amplitude and the phase are calculated by the Fourier transform, providing the intensity and the chirp or phase as a function of time.

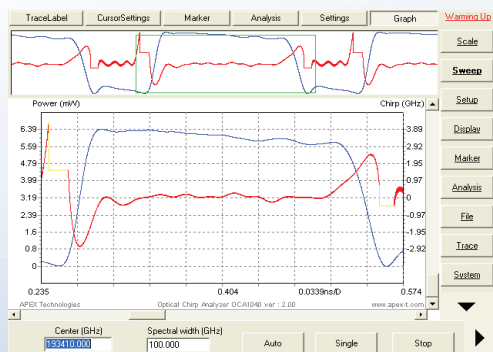
### Block diagram :



## Measurement configuration



## Application examples



### Time resolved chirp measurement :

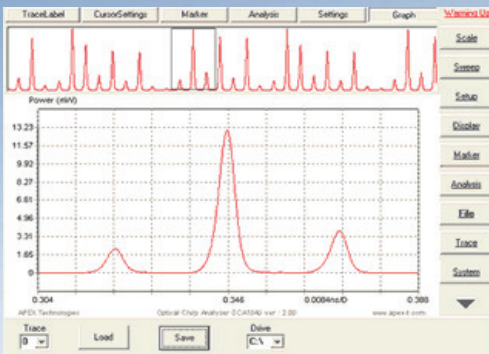
Time resolved chirp is an important parameter to predict transmitters performances in a transmission system.

AP2441B/AP2443B is the best solution in question of accuracy, repeatability and measurement time, for chirp measurement at high bit rates.

Moreover Apex Technologies complex spectrum analyzer can measure the optical pulse shape in the same measurement.

For mach-zhender modulator, it is also possible to display the Alfa parameter instead of the chirp.

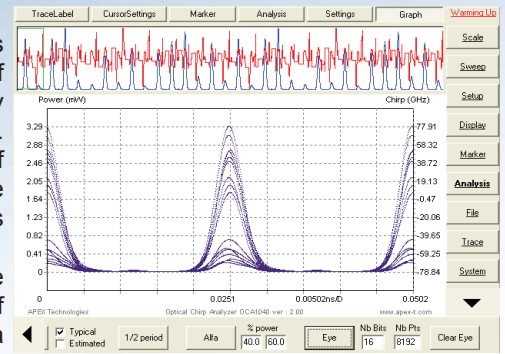
# AP2441B/AP2443 Optical Complex Spectrum Analyzer



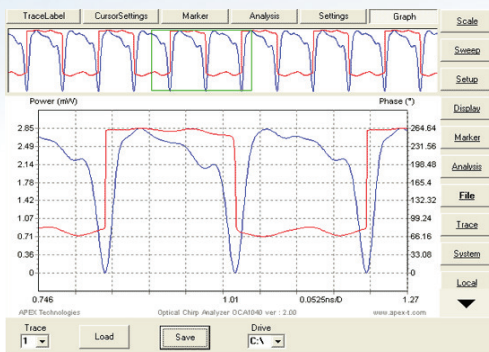
Mode locked fiber laser pulse measurement (4ps pulsewidth)

## Short pulses measurement :

Thanks to the complex spectral analysis principle, the bandwidth of AP2441B/AP2443B is determined by the wavelength range of the instrument. So, the maximum temporal resolution of AP2441B/AP2443B is 75fs, giving the capability to measure ultra short pulses used in high bit rates systems. Compared to a standard oscilloscope having a maximum bandwidth of 80GHz, AP2441B/AP2443B have a maximum bandwidth >6THz!



Eye diagram analysis of a mode locked fiber laser pulse



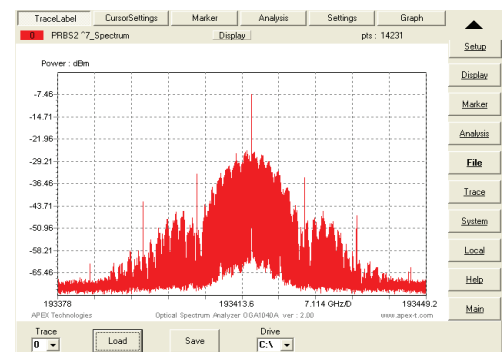
10Gb/s DPSK modulation (phase in red and intensity in blue)

## Optical phase measurement :

A lots of new modulation formats appeared using intensity but also phase modulation in long distance optical transmission.

Apex Technologies complex spectrum analyzer is the only instrument able to measure these phase modulations. It is now possible to characterize directly a phase modulation in a DPSK, QPSK, Duo-binary... modulation.

AP2441B/AP2443B can also be used as an ultra high resolution OSA to characterize spectral width of modulated signals.



10Gb/s PRBS spectrum

## Specifications

### Main frame and software specifications

OSA software functionalities	Auto measurement, Zoom function, Zoom to scale, Auto calibration, Peak search, Line width, SMSR, Markers, Horizontal and vertical lines, Peak center, ...
Complex OSA software functionalities	Auto measurement, Zoom function, Averaging function, Auto calibration, Alfa parameter analysis, Eye diagram, Polarization analysis, Accuracy function, Total power measurement...
Trace	Up to 6 traces
Screen	10.4inch, color TFT, 640x480pixels
Fron keyboard	Yes
Touch sensitive screen	Yes
USB connector	1x front panel, 2x back panel
Internal memory	More than 1,000 traces
File format	Trace file (.dat, .txt), Setup file, Screen copy (.bmp), Marker table
Mouse and keyboard connector	Yes (PS2 type in front panel)
GPIB	Yes
Ethernet	Yes (10/100 base T)
Operating temperature	+10°C to +35°C
Power requirement	AC 100 to 120V / 200 to 250V, 50/60Hz
Accessories	Touch sensitive pen
Optical input	FC/PC SMF28
Clock input	SMA

# AP2441B/AP2443B Optical Complex Spectrum Analyzer

## Optical spectrum analyzer specifications

	AP2441B	AP2443B
Wavelength measurement range	1525nm to 1607nm	1520nm to 1630nm
Wavelength span range	80pm to 82nm	80pm to 110nm
Wavelength absolute accuracy <sup>a b c</sup>	+/-3pm	
Wavelength resolution (@3db) <sup>d</sup>	20MHz (0.16pm) and 100MHz (0.8pm)	
Measurement level range <sup>a e</sup>	-70dBm (monochromatic) to +10dBm	
Absolute level accuracy <sup>a b e</sup>	+/-0.3dB	
Level repeatability <sup>a b d e</sup>	+/-0.2dB	
Close-in dynamic range <sup>a b e</sup>	>40dB @ +/-1pm >60dB @ +/-3pm	
Spurious free dynamic <sup>d</sup>	55dB Typical (50dB min)	
Sweep time <sup>d e</sup>	5s for 55nm	8s for 110nm
Optical input	FC/PC for SM fiber	
Tunable laser output	>-7dBm	
Internal absolute WL calibrator	Yes	
Display capabilities		
X scale	Wavelength in nm or Frequency in THz	
Y scale	Power in linear or log	

a) At 1550nm

b) At 0dBm

c) After wavelength calibration

d) Typical

e) Resolution 100MHz

## Optical complex spectrum analyzer specifications

	AP2441B	AP2443B
Wavelength measurement range	1525nm to 1607nm	1520nm to 1630nm
Clock frequency	Fclk1 = 9.92GHz to 12.5GHz or Fclk2=2.47GHz to 3.13GHz	
Clock power	0 to +10dBm	
Pattern frequency	Fr1=2.48GHz to 3.12GHz and Fr2=620MHz to 781MHz (see pattern table below)	
Measurement level range <sup>c</sup>	-55dBm to +10dBm	
Maximum temporal resolution <sup>a</sup>	95fs	75fs
Chirp accuracy <sup>b</sup>	+/-60MHz	
Measurement time <sup>b</sup>	5s	7s
Display capabilities		
X scale	Time in ps or Wavelength in nm or Frequency in THz	
Y scale	Intensity in mW or dBm, chirp in GHz, Phase in degree, Alfa parameter	

a) If modulated signal cover the complete wavelength range

b) Maximum chirp deviation measured on a 2.5GHz sinusoidal signal with 30% modulation ratio

c) Power range of complex spectrum components for an accurate analysis

## Optical complex spectrum analyzer pattern length

Bit rate	2.48Gb/s to 3.12Gb/s	9.92Gb/s to 12.5Gb/s	39.68Gb/s to 50Gb/s	79.36Gb/s to 100Gb/s	158.72Gb/s to 200Gb/s	317.44Gb/s to 400Gb/s	634.88Gb/s to 800Gb/s
Pattern length for Fr1	1bit	4bits	16bits	32bits	64bits	128bits	256bits
Pattern length for Fr2	4bits	16bits	64bits	128bits	256bits	512bits	1024bits