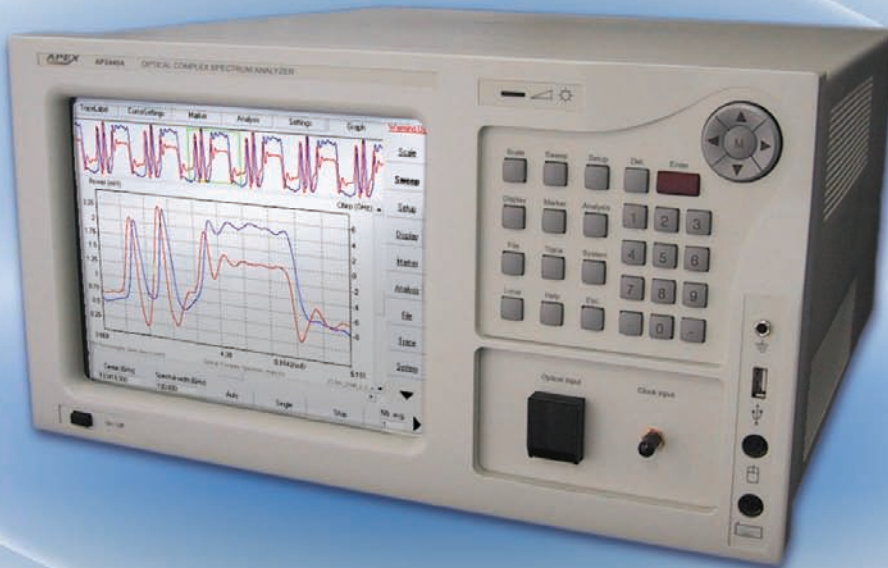# APEX TECHNOLOGIES

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
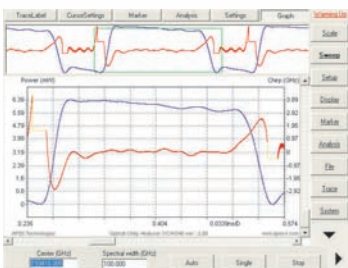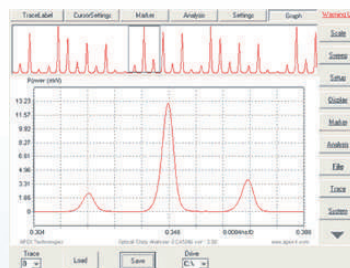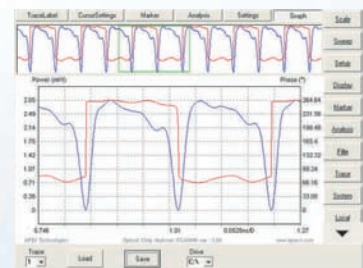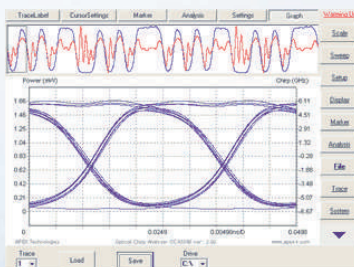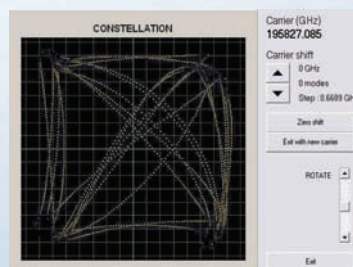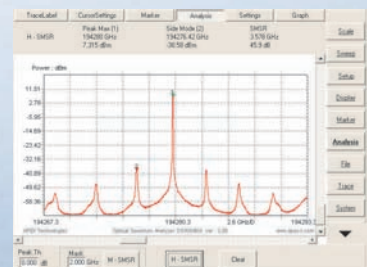
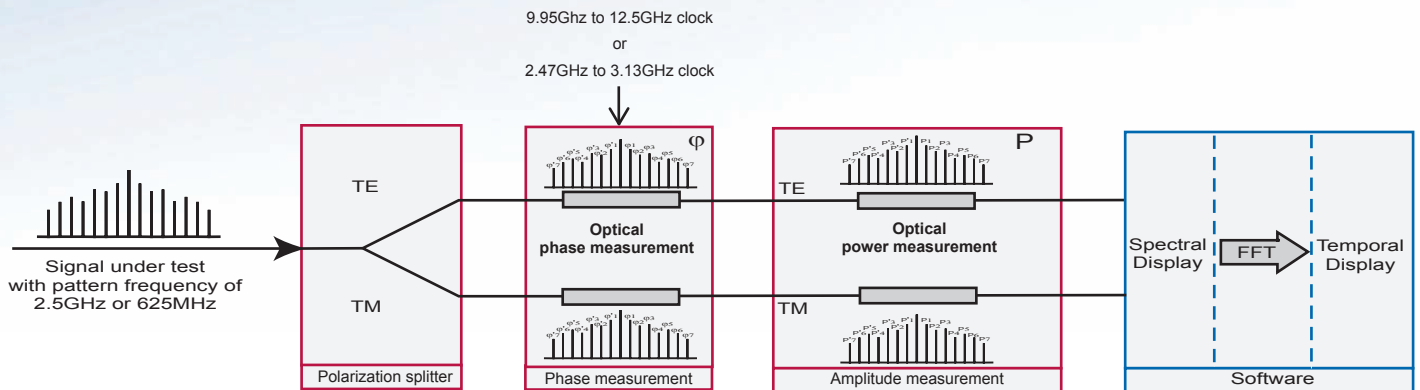# AP2441B/AP2443B Optical Complex Spectrum Analyzer

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.
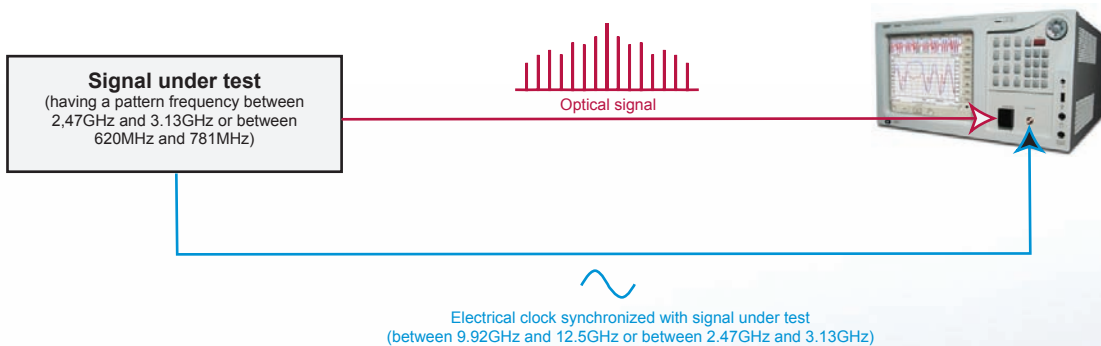
The patented method of the AP2441B/AP2443B is based upon a spectral analysis of the optical field, of which the amplitude and the phase of each frequency component are analyzed when all components are spaced by a fixed frequency (Fr1=2.5GHz or Fr2= 625MHz).

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

Signal under test
(having a pattern frequency between 2,47GHz and 3.13GHz or between 620MHz and 781MHz)

Optical signal

Electrical clock synchronized with signal under test
(between 9.92GHz and 12.5GHz or between 2.47GHz and 3.13GHz)

Application examples
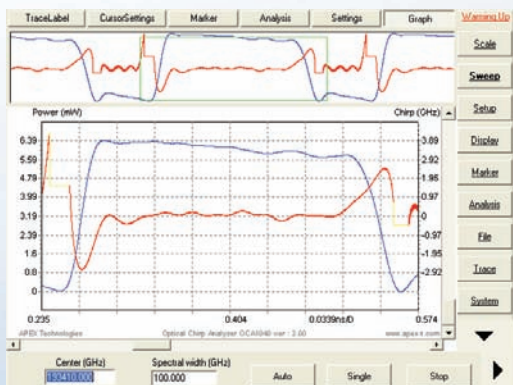
Time resolved chirp measurement :
Time resolved chirp is an important parameter to predict transmitters performances in a transmission system.
AP2441B/AP2443B is the best solution in question of accuracy, repeatability and measurement time, for chirp measurement at high bit rates.
Moreover Apex Technologies complex spectrum analyzer can measure the optical pulse shape in the same mesurement.
For mach-zhender modulator, it is also possible to display the Alfa parameter instead of the chirp.

AP2441B/AP2443 Optical Complex Spectrum Analyzer
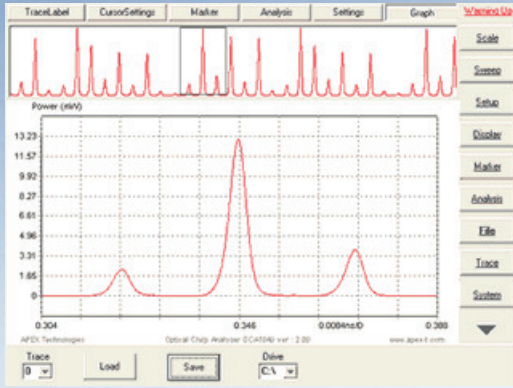
Mode locked fiber laser pulse measurement (4ps pulsewidth)

**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!
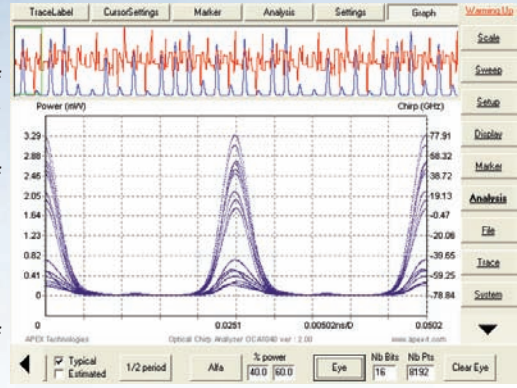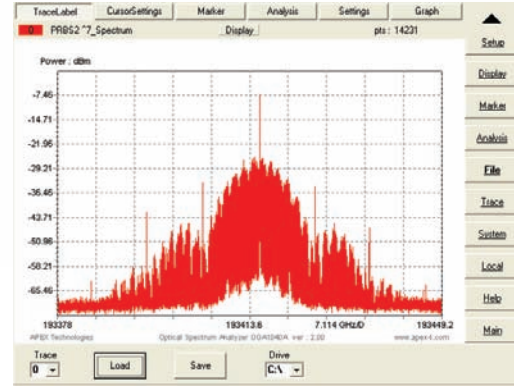

Eye diagram analysis of a mode locked fiber laser pulse
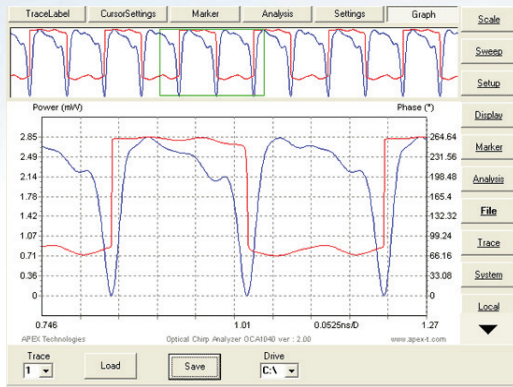
10Gb/s DPSK modulation (phase in red and intensity in blue)

High resolution spectrum analyzer :

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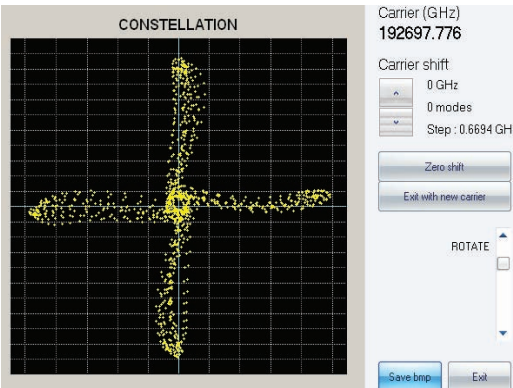
Optical phase analyzer :

A lots of new modulation formats appeared using intensity but also phase modulation in long distance optical transmission.
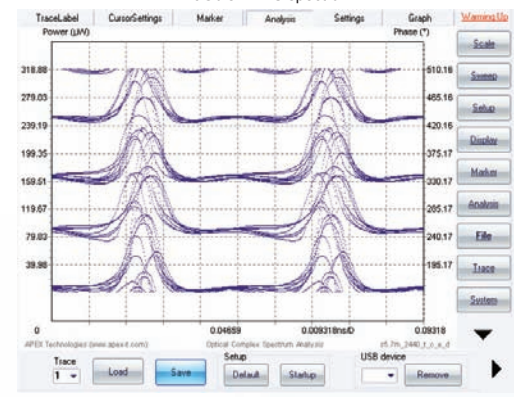
Apex Technologies complex spectrum analyzer is the only instrument able to measure these phase modulations :

New modulation formats :

It is now possible to characterize directly a phase modulation, and display a phase eye diagram and a constellation for any bite rate in a DPSK, QPSK, Duo-binary... modulation.

10Gb/s PRBS spectrum

20 Gbaud/s RZ-QPSK constellation

20 Gbaud/s RZ-QPSK phase eye diagram

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 centre,…
Complex OSA software functionalities	Auto measurement, zoom, averaging, auto calibration, alfa parameter analysis, phase and intensity eye diagram, constellation, polarization split, accuracy estimation, total power measurement…
Trace	Up to 6traces
Screen	10.4inch, color TFT,
Front keyboard	Yes
USB connector	Yes
Internal memory	More than 1,000 traces
File format	Trace file (.dat, .txt), setup file, screen copy (.bmp), marker table
Mouse and keyboard	Yes (USB 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
Optical input	FC/PC SMF28
Clock input	SMA

Specifications are subject to change without notice.

September 2008

AP2441B/AP2443B Optical Complex Spectrum Analyzer

	AP2441B	AP2443B
Optical spectrum analyzer specifications		
Wavelength measurement range	1525nm to 1607nm	1520nm to 1630nm
Wavelength span range	80pm to 82nm	80pm to 110nm
Wavelength absolute accuracy [a b c]	+/-3pm	
Wavelength resolution(@3dB) [d]	20MHz (0.16pm) and 100MHz (0.8pm)	
Measurement level range [a e]	-70dBm (monochromatic) to +10dBm	
Absolute level accuracy [a b e]	+/- 0.3dB	
Level repeatability [a b d e]	+/- 0.2dB	
Close-in dynamic range [a b e]	>40 dB @ +/- 1pm	>60dB @ +/- 3pm
Spurious free dynamic [d]	55dB Typical (50dBmin)	
Sweep time [d e]	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 GHz	
Y scale	Optical power in mW or dBm	
Optical complex spectrum analyzer specifications		
Wavelength measurement range	1525nm to 1607nm	1520nm to 1630nm
Clock frequency	Fclk1 = 9.92GHz to 12.5GHz or Fclk2 = 2.47 to 3.13GHz	
Clock frequency (option OCSA03)	Fclk1 = 6GHz to 12.5GHz or Fclk2 = 1.5GHz to 3.13GHz	
Clock power	0 to +10dBm	
Pattern frequency	Fr1 = 2.48GHz to 3.12GHz and Fr2 = 620MHz to 781MHz (see pattern table bellow)	
Pattern frequency (option OCSA03)	Fr1 = 1.5GHz to 3.12GHz and Fr2 = 375MHz to 781MHz (see pattern table below)	
Measurement level range [h]	-55dBm to + 10dBm	
Maximum temporal resolution [f]	95fs	75fs
Chirp accuracy [g]	+/- 60MHz	
Measurement time [g]	5s	7s
Display capabilities		
X scale	Time in ps or Wavelength in nm or Frequency in GHz	
Y scale	Intensity in mW or dBm, chirp in GHz, phase in degree, alfa parameter	
Options		
OSA01	Continuous and step by step Optical Tunable laser source	
OSA02	Optical tracking generator for transmission measurements	
OCSA03	No bit rate limitation option (see pattern table below)	
OCSA04	Group delay and chromatic dispersion analysis	

Optical complex spectrum analyzer pattern length

The bit rate of the signal under test divided by the pattern length must be included in the pattern frequency range[i]

Bit rate	2.48Gb/s to 3.12Gb/s	4.96Gb/s to 6.24Gb/s	9.92Gb/s to 12.5Gb/s	19.84Gb/s to 25Gb/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
Bit rate (OCSA03)	1.5Gb/s to 3.12Gb/s	3Gb/s to 6.24Gb/s	6Gb/s to 12.5Gb/s	12Gb/s to 25Gb/s	24Gb/s to 50Gb/s	48Gb/s to 100Gb/s	96Gb/s to 200Gb/s	192Gb/s to 400Gb/s	384Gb/s to 800Gb/s
Pattern length for Fr1	1bit	2 bits	4 bits	8 bits	16 bits	32 bits	64 bits	128 bits	256 bits
Pattern length for Fr2	4 bits	8 bits	16 bits	32 bits	64 bits	128 bits	256 bits	512 bits	1024 bits

a) At 1550nm
b) At 0dBm
c) After wavelength calibration
d) Typical
e) Resolution 100MHz

f) If modulated signal covers the complete wavelength range
g) Maximum chirp deviation measured on a 2.5GHz sinusoidal signal with 30% modulation ratio
h) Power range of complex spectrum components for an accurate analysis
i) The pattern repetition frequency must be included in the pattern frequency range, the clock and the pattern must be synchronised

Specifications are subject to change without notice.