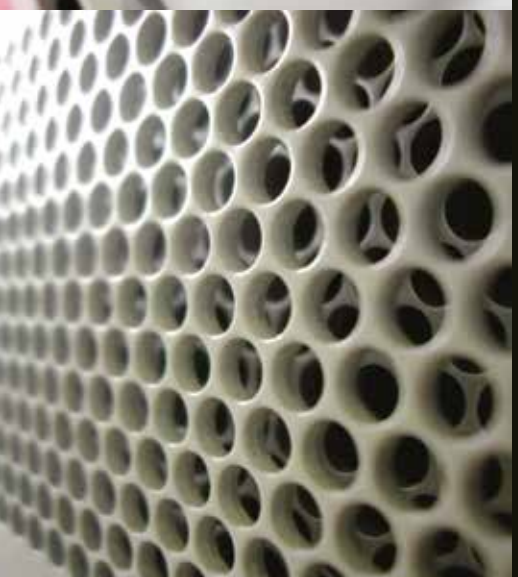
APEX Technologies

OPTICAL TEST & MEASUREMENT

Catalog

APEX TECHNOLOGIES

Experts in next generation test equipment



Experts in next generation test equipment

Created on 1998, APEX Technologies is located in the south of Paris in France. For over 22 years, we have focused on developing and manufacturing innovative ultra high performance test equipment intended for fiber optic telecommunications research. Since introducing the world's first commercially available ultra high resolution optical spectrum analyser, APEX Technologies has also been dedicated to the continued development of the optical measurement area. Our experience means we know that innovations never cease and we are driven by the "knowledge is power" policy in order to stay at the top of the advanced technology.

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Experts in next generation test equipment

OPTICAL SPECTRUM ANALYZERS

Fast sweep OSA

Combination of fast sweep
and High Resolution OSA

Top of the line OSA

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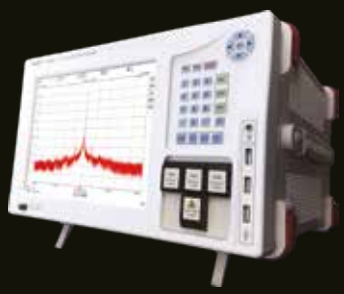
Ultra High Resolution OSA

Complex OSA

Combination of High Resolution OSA
and Optical Modulation Analyzer



Cost effective OSA

The best performance-price
ratio High Resolution OSA

MULTI-TESTS PLATFORMS

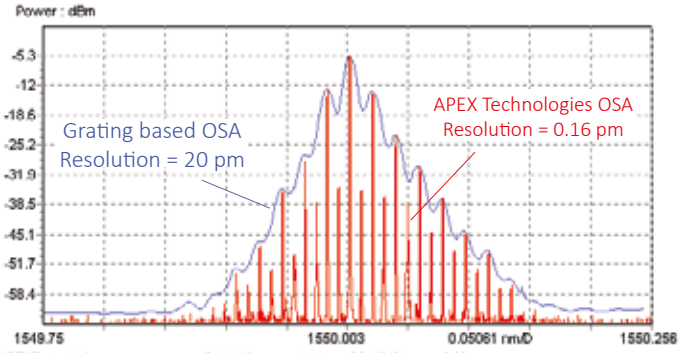
Plug-in Modules

Tunable Laser Source, DFB Laser Source,
Optical Amplifier (EDFA), Power Meter,
Variable Optical Attenuator, Polarimeter,
Optical Tunable Filter, Optical Switch

THE WORLD HIGHEST RESOLUTION OPTICAL SPECTRUM ANALYZER

AP201x series
AP206x series
AP207x series
AP208x series

Based on an interferometric principle, APEX Technologies ultra high resolution optical spectrum analyzer can achieve a 500 times better resolution than monochromator optical spectrum analyzer



Direct comparison between the two different Optical Spectrum Analyzer types measuring a 1.25 GHz modulated signal

Features:

- From 5 MHz to 250 GHz resolution
- C, L & O Band
- +/- 2 pm wavelength accuracy
- High dynamic range
- Rectangular-shape resolution filters
- High close-in dynamic range
- Built-in tunable laser source

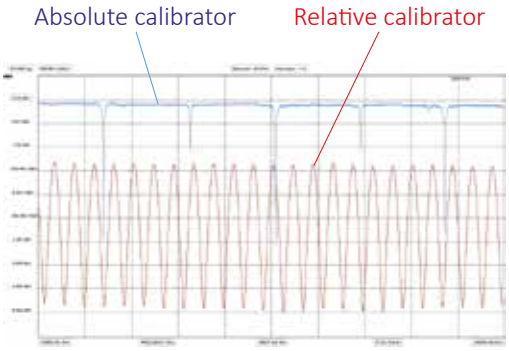
Applications:

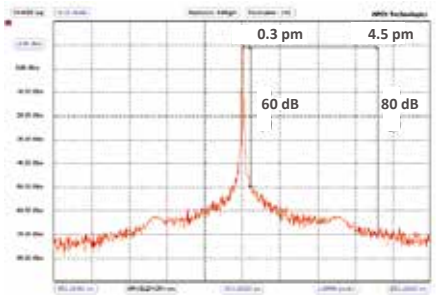
- Advanced modulation formats analysis
- Comb generator measurement
- Laser characterization
- OSNR measurement
- Optical component characterization

High wavelength accuracy

The two different internal wavelength calibrators (absolute and relative) furnish to the equipment an accurate wavelength value of the TLS position. This technique provides a very high wavelength accuracy specification of +/- 2 pm.

The absolute wavelength calibrator is a gas cell and the relative one is a Fabry-Perot with a fixed Free Spectral Range.





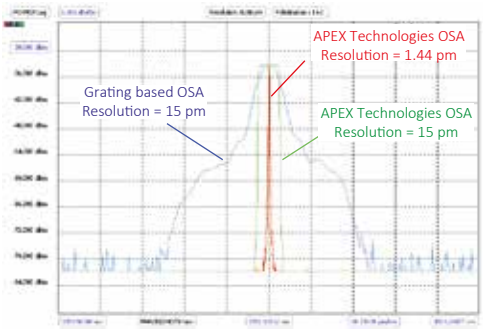
High close-in dynamic range

The resolution of APEX Technologies OSA are not related to optical filters but electrical ones. These electrical filters are close to rectangular shape.
Thanks to these special electrical filter forms, the close-in dynamic range is very high :
- @ +/- 0.1 pm from the peak, dynamic > 40 dB
- @ +/- 0.4 pm from the peak, dynamic > 60 dB
- @ +/- 6 pm from the peak, dynamic > 80 dB

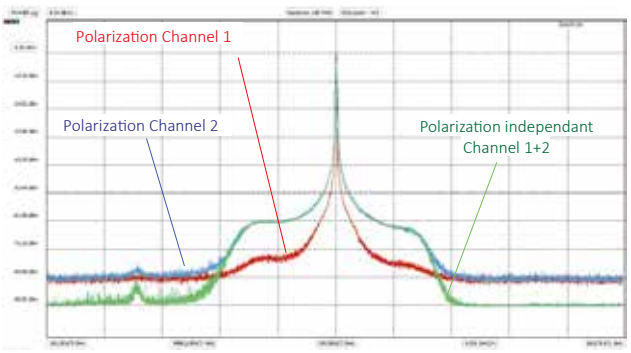
The high close-in dynamic range helps to well separate optical peaks which are extra-close to each other.

Rectangular shape filters

APEX Technologies OSA rectangular shape filters allow a nearly perfect integration of the signal over the selected resolution, while a grating based OSA filter integrates inside a wide base triangular shape.
This sharp integration allows our OSA to perform a much more realistic level measurement.



APEX Technologies and grating based OSA wavelength resolution filters shapes comparison



Two internal channels (one OSA per polarization axis)

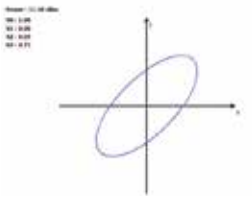
Optionaly two different aditional PM inputs are available. The user can select between the input independent of polarization or the two PM inputs.

Input independent of polarization:
The input signal is split into two orthogonal polarization axis and analysed simultaneously by two internal independent channels. By using this method, APEX OSA can display the two polarization channels separetely or recombine them and display a polarization independent measurement.

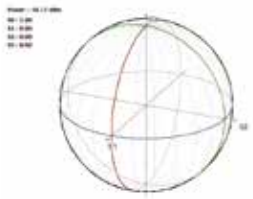
Two PM inputs:
The two input signals can be analysed simultaneously by two internal independant channels. By using this method, APEX OSA can display the two signals separetely.

Polarization analysis

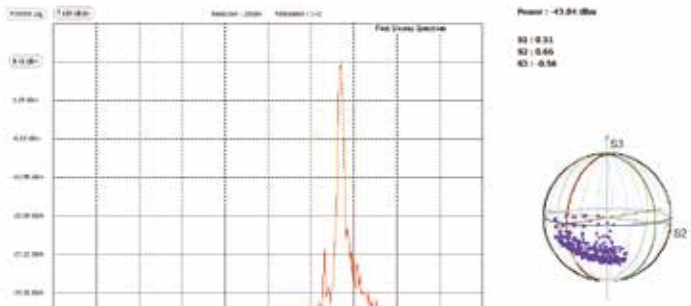
Optionally, the state of polarization can be measured. This measurement can be integrated over the full wavelength range of the polarimeter or as a function of wavelength. Three different displaying modes exist: Jones graph, Poincaré sphere and Stockes parameters oscilloscope.
Different detection modes are available: peak mode, area mode, point mode, threshold mode, markers mode.
The evolution of the state of polarization can be measured as a function of time and as a function of wavelength.



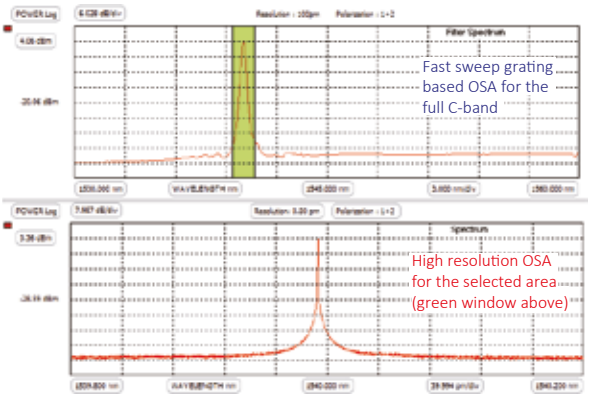
Jones vector



Poincaré sphere



Polarization state as a function of wavelength



Combination of high resolution and high speed optical spectrum analysis

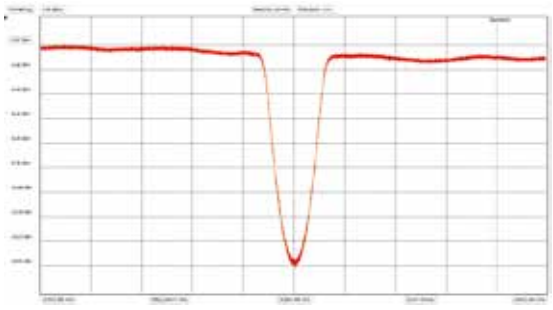
In order to meet the requests of our customers, for whom both high resolution and high speed are important, a new option is available for the AP207x series OSA. With this fast sweep option, a grating based OSA is integrated, and keeps scanning the full span with the speed of 70 nm/s. By simply choosing an area in the grating OSA graph, the optical spectrum of the selected zone will be displayed with much more details by the High Resolution OSA.

Filter function

The equipment can be used as a 150 pm bandwidth tunable filter in the full C band. This functionality also gives the possibility to filter a chosen part of the input signal to monitor it through two different ways:
- with the internal power meters
- externally, thanks to the filtered signal output

Tunable Laser Source & Tracking generator

- The built-in Tunable Laser Source local oscillator can also be used as an independent TLS. In option a TLS optical output and a control software can be integrated into the equipment.
- The tracking generator option allows the user to synchronise the wavelength TLS output with the OSA measurement. With this combination, active and passive components transmission measurements (insertion loss/gain) are possible with a dynamic range of 63 dB and a resolution of 1 MHz.



Bragg grating profile measurement using the tracking generator

OPTICAL COMPLEX SPECTRUM ANALYZER FOR ADVANCED MODULATION ANALYSIS

AP268x series

Features:

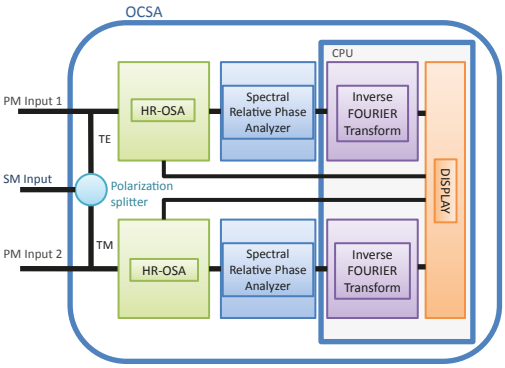
- From 5 MHz to 250 GHz resolution
- C, L & O Band
- +/- 2 pm wavelength accuracy
- High dynamic range
- Rectangular-shape resolution filters
- High close-in dynamic range
- Built-in tunable laser source
- No Baud rate limitation
- No modulation format limitation (BPSK, DPSK, 16QAM, 64QAM...)
- Phase, chirp, intensity vs time - Constellation - Eye diagram

Applications:

- Advanced modulation formats analysis
- Modulator characterization
- Comb generator temporal and spectral measurement
- Chromatic dispersion analysis
- Complex transfer function of components

Use it as an high performances OSA and Optical Modulation Analyzer !

This equipment is based on interferometric method and is able to measure spectrums with the same specifications as the AP208x series instruments. It also has the added benefit of measuring phase as a function of frequency. The phase and intensity informations can then be used to calculate chirp, phase, alpha parameter or pulse shape as a function of time. Furthermore it can display constellation, phase and intensity eye diagrams.

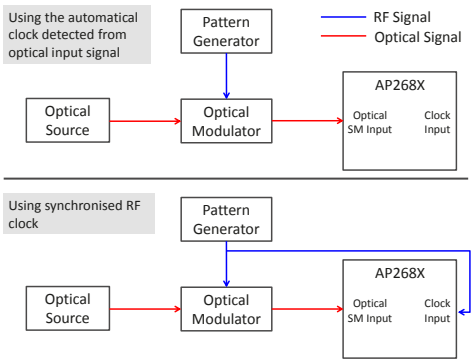


OCSA time-domain measurement advantages

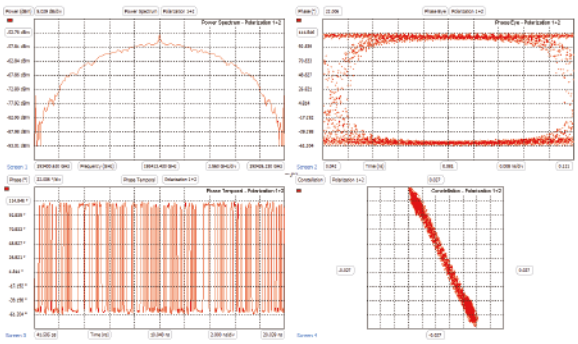
Contrary to standard optical modulation analyzers and thanks to the fact that the measurement is made in the spectral domain, APEX Technologies OCSA have no real rate-limitation.
It means that you can see it as an utopist 3 THz bandwidth optical modulation analyzer without electronic limitation able to measure any modulated signal rates (from 70 Mbaud to ~ 1,5 Tbaud).
Furthermore, it does not need any special software adapted to each modulation format and can measure any of them even the very rare and the new ones.

Complex measurement setup

As mentioned, a complex measurement needs not only the intensity but also the phase as a function of frequency. To measure the phase, the signal under test must be a repetitive signal with a pattern frequency between 70 MHz to 900 MHz. Commercially available PPG and AWG are able to generate the right pattern length to match this pattern frequency range for any signal-rate.
A reference RF pattern clock repetition signal is also required. Manually, the user can plug an external clock to the equipment. To simplify the setup, a new optical clock recovery function is available, it allows to do complex measurement without reference clock signal.



Measurement configuration with AP268x OCSA



Optical complex analysis of a PRBS signal with the pattern length of 2^7-1

User-friendly and powerful user interface

With only a few clicks, via the touch screen or USB mouse, you could have all types of results of your measurement displayed :
- High resolution spectrum
- Intensity, phase vs. frequency
- Intensity, phase, Alpha parameter, chirp vs. time
- Eye diagram, constellation
- Group delay, chromatic dispersion
- Complex transfer function of components

Wavelength range of different models:

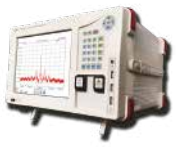
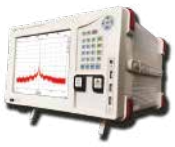
	1260	1360	1460	1530	1565	1625
	O band	E band	S band	C band	L band	
AP2010, AP2060, AP2070			~1526 nm	43 nm	~1569 nm	
AP2011, AP2061, AP2071			~1526 nm	82 nm		~1608 nm
AP2012, AP2062, AP2072				~1566 nm	42 nm	~1608 nm
AP2081, AP2681			1525 nm	82 nm		1607 nm
AP2083, AP2683			1520 nm	110 nm		1630 nm
AP2085, AP2685	1265 nm	80 nm	1345 nm			
AP2086, AP2686	1265 nm	80nm	1345 nm	1525 nm	82 nm	1607 nm
AP2087, AP2687	1265 nm	80nm	1345 nm	1520 nm	110 nm	1630 nm

Comparison of OSA Series:

AP201x Series | AP206x Series | AP207x Series | AP208x Series | AP268x Series

		AP201x	AP206x	AP207x	AP208x	AP268x
Wavelength Range						
O band					√	√
C band		√	√	√		
L band		√	√	√		
C + L band		√	√	√	√	√
Extended C + L band					√	√
O + C + L band					√	√
Resolution Bandwidth						
Optical filter bandwidth resolutions	5 MHz			√	√	√
	20 MHz	√	√	√	√	√
	100 MHz			√	√	√
	140 MHz		√	√	√	√
Optical virtual bandwidth resolutions			√	√	√	√
Input Fiber Type for OSA						
SM Input			√	√	√	√
PM Input		√		√		
Built-in Tunable Laser Source						
DFB laser		√	√	√		
External cavity laser					√	√
Sweep Speed (Max.)						
1.2 nm/s		√	√	√		
35 nm/s					√	√
Complex Measurement						
Complex analysis (intensity, phase, chirp vs. time); constellation, eye diagram						√
Option						
TLS output		√	√	√	√	√
Tracking generator		√	√	√	√	√
Optical filtered output				√	√	√
Polarimeter				√	√	√
SM/PM input interface		√				
5 MHz resolution instead of 20 MHz			√			
Fast sweep OSA (up to 70 nm/s)				√		
2 additional PM inputs					√	√
Group delay and chromatic dispersion analysis						√
Polarimeter				√	√	√

Technical specifications:


	AP201x Series	AP206x Series	AP207x Series
Wavelength measurement range [a]	AP2010A: 1526.5 to 1569.5nm AP2011A: 1526.5 to 1608.5nm AP2012A: 1566.5 to 1608.5nm	AP2060A: 1526.5 to 1569.5nm AP2061A: 1526.5 to 1608.5nm AP2062A: 1566.5 to 1608.5nm	AP2070A: 1526.5 to 1569.5nm AP2071A: 1526.5 to 1608.5nm AP2072A: 1566.5 to 1608.5nm
Wavelength span range	AP2010A: 8pm to 43nm AP2011A: 8pm to 82nm AP2012A: 8pm to 42nm	AP2060A: 8pm to 43nm AP2061A: 8pm to 82nm AP2062A: 8pm to 42nm	AP2070A: 8pm to 43nm AP2071A: 8pm to 82nm AP2072A: 8pm to 42nm
Wavelength resolution (@3dB) [a]	20MHz/0.16pm	20MHz/0.16pm 140MHz/1.12pm Optical virtual bandwidth resolutions	5MHz/0.04pm 20MHz/0.16pm 100MHz/0.8pm 140MHz/1.12pm Optical virtual bandwidth resolutions
Absolute wavelength accuracy [b]	+/- 2pm Typ. (+/- 3pm Max.)		
Wavelength repeatability	< 0.5pm (standard deviation over 20 measures)		
Dynamic range [c d]	86dB		
Close-in dynamic range [c]	>40dB @ +/- 1.3pm; >60dB @ +/- 8pm; >70dB @ +/- 30pm		
Spurious free dynamic [c]	50dB [(1)]		
Measurement level range [c d]	AP2010A: -76 to +10dBm AP2011-12A: -73 to +10dBm	AP2060A: -76 to +10dBm AP2061-62A: -73 to +10dBm	AP2070A: -76 to +10dBm AP2071-72A: -73 to +10dBm
Absolute level accuracy [e]	+/- 0.3dB [(2)] (monochromatic input signal)		
Level repeatability [a e f]	< +/- 0.1 dB (monochromatic input signal ; standard deviation over 20 measures)		
Sweep time [a]	Between 0.4nm/s (min) and 1.2nm/s (Max)		
Optical input	1xFC/APC input for PM fiber	1xFC/PC input for SM fiber	1x FC/PC input for SM fiber 2xFC/APC inputs for PM fiber
Dimensions	W x H x D : 388 x 243 x 380.1 mm / 15.27 x 9.57 x 14.96 inch		
Weight	Around 13 kg / 28.66 lbs (depending on options)		

Options specifications:

	Option 201x-01	Option 206x-01	Option 207x-01
Tunable Laser Source Specifications			
Wavelength range	Identical as the WL measurement range of the chosen model		
Spectrum line width (@3dB)	3MHz Typical		
Output power [a]	C-Band : -3dBm ● L-Band : -4 dBm Typical ● C+L Band : -6dBm @ C-Band, -7 dBm @ L-band		
SMSR	> 50dBc		
ASE	< 50dBc over 0.1nm		
RIN	-135dB/Hz		
Wavelength stability	1pm @ 15 minutes, 2pm @ 1 hour		
Power stability	0.07dB @ 15 minutes, 0.09dB @ 1 hour		
Fiber/connector type	PM fiber FC/APC connector	SM fiber FC/APC connector	
Optical tracking generator specifications			
Dynamic [g]	55dB		
Resolution	1MHz		

Option 206x-02
5MHz wavelength resolution filter instead of 20MHz

General specifications	
X scale display	Wavelength in nm or frequency in GHz
Y scale display	Optical power in mW or dBm
Connectics	GPIB, Ethernet, Electrical trigger input port, USB, VGA
Power requirements	100 to 240 V AC, 50/60 Hz, approx. 350 VA
Environmental conditions	Operating temperature: +5 to +35°C Storage temperature: −10 to +50°C Humidity: 20 to 80% RH (no condensation)

Option 207x-02	
Fast Sweep OSA + Optical filtered output (C band only)	
Wavelength range	1529nm to 1564nm
Wavelength resolution (@3dB)	Single filter: 12.5GHz/100pm Double filter: 22.5GHz/180pm
Filter rejection	Single filter: 40 dB Double filter: 70dB
Sweep time [a]	70nm/s (2Hz for C band)
Optical filter insertion loss	Single filter: 8dB Double filter: 11dB
Optical filter RBW (@3dB)	180pm
Option 207x-03	
Fast sweep OSA + Optical filtered output + Polarimeter (C band only)	

a) Typical
b) After wavelength calibration
c) Resolution 20MHz
d) 4 dB loss in case of polarimeter / filter output option
e) At 1550 or 1310nm and 0dBm
f) All resolutions except 5MHz
g) Resolution 140MHz
h) Resolution 5MHz
i) 1525 to 1607nm
j) 1265 to 1345nm
k) 1520 to 1630nm
l) Pattern frequency = Baud Rate / Pattern length

1) Inside spurious free dynamic
2) Relative to total signal power
Otherwise: possible power offset (mW) < 10^{-6} x Total signal power (mW)

Optical spectrum analyzer specifications:

	AP2081A/AP2681A	AP2083A/AP2683A	AP2085A/AP2685A	AP2086A/AP2686A	AP2087A/AP2687A
Wavelength measurement range [a]	1525 to 1607nm	1520 to 1630nm	1265 to 1345nm	1525 to 1607nm 1265 to 1345nm	1520 to 1630nm 1265 to 1345nm
Wavelength span range [a]	8pm to 82nm	8pm to 110nm	8pm to 80nm	8pm to 82nm	8pm to 110nm
Wavelength resolution (@3dB) [a]	5MHz/0.04pm 20MHz/0.16pm 100MHz/0.8pm 140MHz/1.12pm Optical virtual bandwidth resolutions				
Absolute wavelength accuracy [b]	+/- 2pm Typ. (+/- 3pm Max.)				
Wavelength repeatability	< 0.5pm (standard deviation over 20 measures)				
Dynamic range [d h]	87dB		79dB	83dB [l]; 79dB [j]	83dB [k]; 79dB [j]
Close-in dynamic range [h]	>40dB @ +/- 0.1pm; >60dB @ +/- 0.4pm; >80dB @ +/- 6pm				
Spurious free dynamic [h]	55dB Typical (50dB min) [(1)]				
Measurement level range [d h]	-77dBm (monochromatic) to +10dBm		-69dBm to +10dBm	-73 to +10dBm	-73 to +10dBm
Absolute level accuracy [a e f]	+/- 0.3dB [(2)] (monochromatic input signal)				
Level repeatability [f]	< +/- 0.1dB (monochromatic input signal ; standard deviation over 20 measures)				
Sweep time	Max. 35nm/s (filter resolution 100MHz)				
Optical input	FC/PC for SM fiber (other connectors under request)				
Dimensions	W x H x D : 450 x 250 x 500 mm / 17.72 x 9.84 x 19.69 inch				
Weight	Around 18 kg / 39.68 lbs (depending on options)			Around 18.5 kg / 40.78 lbs	
Option 208x-01/Option 268x-01					
Optical tunable laser source specifications					
Wavelength range	Identical as the wavelength measurement range of the chosen model				
Spectrum line width (@3dB)	500kHz Typical				
Output power	-5dBm Typical		-8dBm Typical	-8dBm Typical [i] -12dBm Typical [j]	-8dBm Typical [k] -12dBm Typical [j]
SMSR	> 45dBc				
ASE	< -40dBc over 0.1nm				
RIN	< -135dB/Hz				
Wavelength stability	+/- 10pm over 1 hour				
Power stability	+/- 0.09dB over 1 hour				
Fiber/connector type	SM fiber FC/APC connector				
Option 208x-02/Option 268x-02					
Optical tracking generator specifications					
Dynamic [d]	63dB		59dB	63dB [l]; 59dB [j]	63dB [k]; 59dB [j]
Resolution	1MHz				
Option 208x-03/Option 268x-03					
Optical inputs	1x FC/PC input for SM fiber + 2x FC/APC inputs for PM fiber				
Option 208x-04/Option 268x-04					
Optical filtered output + Polarimeter (C band only)					
Optical filter insertion loss	9dB				
Optical filter RBW (@3dB)	180pm				
Option 268x-05					
Group delay and chromatic dispersion analysis					

Optical modulation analyzer specifications:

	AP268x series OCSA
Spectrum domain measurement	Intensity, Phase
Time domain measurement	Intensity, Phase, Chirp, Constellation, Eye diagram (Intensity/Phase)
Clock input frequency	Clock frequency = pattern frequency [l]
Optical bandwidth	3THz
Polarization	2 Modulation Analyzer, 1 for each polarization channel
Clock power	> -17dBm at pattern frequency [l]
Pattern frequency	From 70 MHz to 900MHz
Optical spectral components measurement sensibility	-70dBm
Maximum temporal resolution	325fs
Measurement time	6nm/s (750GHz/s)

The pattern frequency length must be included in the pattern frequency range

For example at 10 Gbaud : use any pattern length between 10 and 142 (PRBS 2^7-1 included)
At 28 Gbaud: use any pattern length between 28 and 400 (PRBS 2^7-1, 2^8-1, 2^9-1 included)
At 40 Gbaud : use any pattern length between 40 and 571 (PRBS 2^7-1, 2^8-1, 2^9-1 included)
At 100 Gbaud : use any pattern length between 100 and 1428 (PRBS 2^7-1, 2^8-1, 2^9-1, 2^{10}-1 included)
At 400 Gbaud : use any pattern length between 400 and 5714 (PRBS 2^8-1, 2^{10}-1, 2^{11}-1, 2^{12}-1 included)
At 1000 Gbaud : use any pattern length between 1000 and 14285 (PRBS 2^{10}-1, 2^{11}-1, 2^{12}-1, 2^{13}-1 included)

The equipment has no Baud rate upper limitation and it can measure any modulation format

Polarimeter option specifications:

Polarimeter specifications	
Wavelength range	1520nm to 1610nm
Input power range	-60dBm to +10dBm
Maximum sampling rate	1kS/s
SOP accuracy	+/- 0.25° *(-30 to +2 dBm)* < 2° *(-35 to +5 dBm)*
Displaying modes	Full Poincaré sphere Jones graph Oscilloscope
X scale	Wavelength or time
Azimuth accuracy	+/-0.25° *(-30 to +2 dBm)*
Ellipticity accuracy	+/-0.25° *(-30 to +2 dBm)*
DOP accuracy	+/-0.5% *(-35 to +5 dBm)*
Rel. power meas. accu	+/-0.2% *(-35 to +5 dBm)*
Abs. power meas. accu	+/-1% *(-35 to +5 dBm)*

HIGH PERFORMANCE & COST EFFECTIVE OPTICAL MULTITEST PLATFORM

BUILD YOUR OWN FLEXIBLE MULTI-TEST SYSTEM

AP1000-2
AP1000-5
AP1000-8
AP1000-12

AP1000-2 mainframe controller:
- Accepts up to two modules

AP1000-5 mainframe controller:
- Accepts up to five modules

AP1000-8 mainframe controller:
- Accepts up to eight modules
- Can control up to seven AP1000-12 (92 modules in total)

AP1000-12 mainframe controller extension:
- Accepts up to twelve modules
- Can be controled by an AP1000-8 or work independently by remote control
- Allows the system to integrate up to 92 test modules using a single AP1000-8

Features:

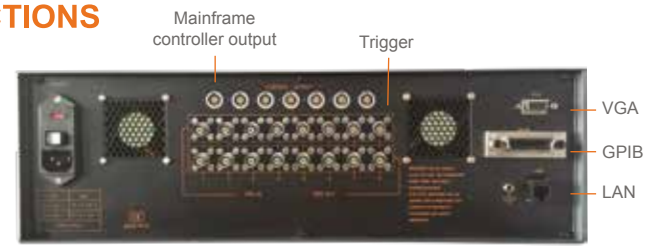
- A variety of measurement modules
- Three USB connectors on the front panel
- Internal memory
- GPIB and Ethernet remote control
- .txt file format
- 5.7 inch touchscreen

Modules:

- Tunable Laser Source
- DFB Laser
- Optical Power Meter
- Optical Amplifier (EDFA)
- Optical Variable Attenuator
- Optical Tunable Filter
- Optical Switch
- Polarimeter

MULTIPLE CONNECTIONS

- VGA connector
- USB connectors
- GPIB control
- LAN connector
- Optionnal mainframe controller output
- Optionnal trigger function



AP1000-8 back

SPECIFICATIONS

	AP1000-2	AP1000-5	AP1000-8	AP1000-12
Module slot	2	5	8	12
Internal memory	64 Gbit			
File format	txt, bmp and setup file formats			
GPIB connector	Yes			
Ethernet connector	Yes			
USB connectors	3	3	3	0
Mainframe controller outputs	No	No	7	No
Screen	Yes	Yes	Yes	No
Dimensions (mm)	236x135x477	340x135x477	460x135x477	460x135x477
Mainframe weight (kg)	4.2	4.8	5.7	5.7
Modules weight (kg)	Average: 0.65			
Environmental conditions	Operating temperature: +5 to +35°C Storage temperature: −10 to +50°C Humidity: 20 to 80% RH (no condensation)			
Power requirement	AC 100~200V or 200~250V, 50/60Hz			

EQUIPMENT CONTROL

- Touchscreen
- Mouse and keyboard (three USB ports)

REMOTE CONTROL

- Control and perform data transfer with a computer through GPIB or ethernet
- Remote control of the equipment through Internet

Tunable Laser Source modules

VERY GOOD PERFORMANCE TO PRICE RATIO SOLUTIONS

Features:

- Continuous sweeping
- ITU channels selection
- Narrow linewidth: ~ 300 kHz
- High output Power: maximum +13 dBm
- Ultra high wavelength accuracy: +/- 6 pm
- High SMSR: > 47 dB
- Narrow wavelength setting resolution: < 1pm

Software features:

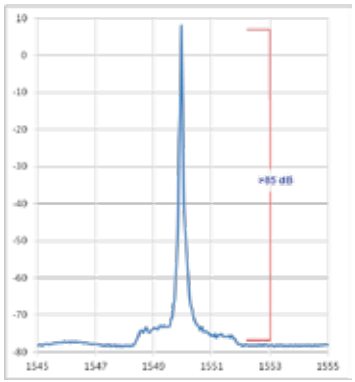
- Output modes
  - Static
  - Continuous sweep
  - Step by step sweep
  - Grid
- Scale modes
  - Wavelength or frequency
  - mW or dBm
- Calibration offset access
- Other modules measurement display

New

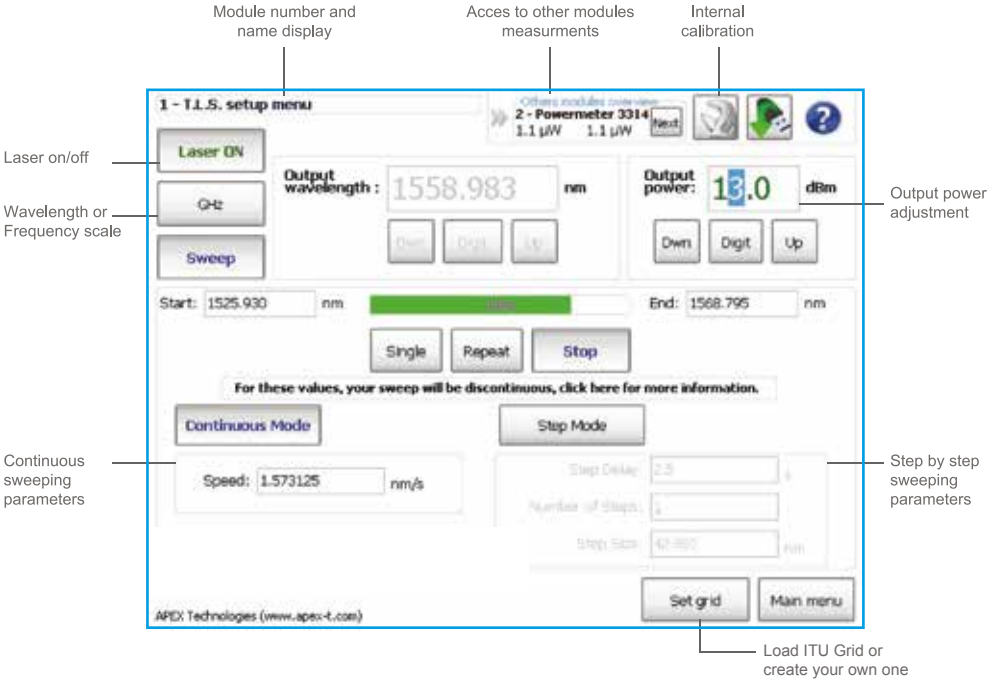
OPTION TLS03

Low SSE, high dynamic range tunable laser source

This new laser synchronizes the sweeps of our tunable laser source with an internal grating tunable filter. This combination gives the possibility to measure the transfer function of components with an extra high dynamic.



Low SSE, > 85 dB, measured by OSA with a resolution of 0.1 nm



Specifications:

	AP3350A	AP3352A
Wavelength range	1526nm to 1567nm	1567nm to 1608nm
Wavelength setting resolution	1pm	
Spectrum line width @ 3dB	300kHz typical	500kHz typical
Wavelength accuracy	+/- 6pm	
Output power	10dBm typical	
Output power adjustment	> 20dB	
SMSR	47dB (within a 0.1nm resolution)	
Signal to source spontaneous-emission ratio	67dB (within a 140MHz resolution filter at +/- 0.2nm from the signal)	
Optical isolation	25dB	
RIN	-135dB/Hz	
Wavelength stability @ +9dBm	1pm @ 15 minutes, 2pm @ 1 hour	
Power stability @ +9dBm	0.03dB @ 15 minutes,0.05dB @ 1 hour	
Static Wavelength tuning speed	Max. 3s between any two static wavelength positions	
Continuous Sweeping Speed	Adjustable from 0.11 to 1.5nm/s	
Fiber/connector type	Polarization maintaining fiber FC/APC connector	
Operating temperature	From +5°C to +35°C	
Option TLS01	Typ. +13dBm maximum output power (up to +15dBm under request)	
Option TLS02	External sine modulation (from 10kHz to 20MHz)	
Option TLS03	Low SSE > 85dB	

DFB Laser modules

ITU GRID COVERING C-BAND, L-BAND AND O-BAND

Features:

- Selected wavelength according to ITU-T Grid, C-band, L-band and O-band available
- High optical output power up to 20 mW for C-band & L-band, up to 16 mW for O-band
- High side mode suppression ratio (SMSR)
- 50 GHz spacing available
- Narrow linewidth (down to 1 MHz) available

Specifications:

	AP3390A	AP3392A	AP3395A
Peak emission wavelength	ITU-Grid for C band	ITU-Grid for L band	1310nm
Spectrum linewidth @ 3dB	1MHz		5MHz
Output power	20mW Typ.		16mW Typ.
Wavelength accuracy	+/- 6pm		
Wavelength tunability	3nm (without mode hopping)		
Side Mode Suppression Ratio	45dB Typ.		
Min. optical isolation	30dB		
RIN	-138dB/Hz		-155dB/Hz
Polarization Extinction Ratio	20dB		
Fiber/connector type	Polarization maintaining fiber Standard FC/PC connector (FC/APC under request)		Corning SMF-28 FC/PC connector
Operating temperature	From +5°C to +35°C		

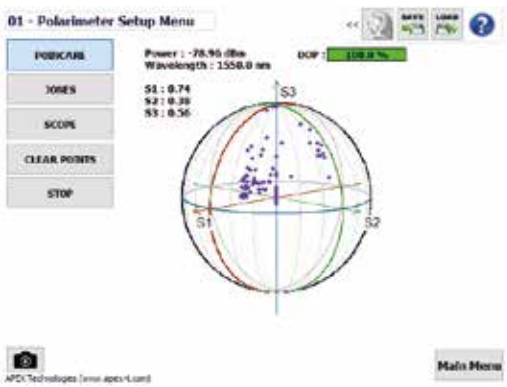
Polarimeter module

New

POLARIZATION ANALYSIS COVERING C+L BAND

Features:

- Four Stockes parameters measurement
- Instantaneous state of polarization (SOP)
- Degree of polarization of input light (DOP)
- Three different displaying modes: Jones graph, Poincaré sphere and Stockes parameters oscilloscope



	AP3321A
Optical connector	Standard FC/APC connector
Wavelength range	1520nm to 1610nm
Input power range	-60dBm to +10dBm
Maximum sampling rate	1 kS/s
SOP accuracy	+/- 0.25° *(-30 to +2 dBm)* < 2° *(-35 to +5 dBm)*
Measurable SOP states	Full Poincaré sphere
Azimuth accuracy	+/-0.25° *(-30 to +2 dBm)*
Ellipticity accuracy	+/-0.25° *(-30 to +2 dBm)*
DOP accuracy	+/-0.5% *(-35 to +5 dBm)*
Rel. power meas. accu	+/-0.2% *(-35 to +5 dBm)*
Abs. power meas. accu	+/-1% *(-35 to +5 dBm)*
Environmental conditions	Operating temperature: +5 to +35°C Storage temperature: −10 to +50°C Humidity: 20 to 80% RH (no condensation)

Optical Power Meter modules

STANDARD DISPLAY RANGE FROM -80 dBm TO + 10 dBm
HIGH POWER DISPLAY RANGE FROM -60 dBm TO + 33 dBm

Features:

- 1 or 2 inputs
- Wavelength range : 800 to 1 700 nm
- Display range : -80 to +10 dBm & -60 to +30dBm
- Different style of interchangeable connectors
- InGaAs Photodiode

Software features:

- 2 inputs immediate display
- Scale modes : mW or dBm
- Min/Max percentage function
- Other modules measurement display
- Active Power Control function : Maintains a constant optical output (Available with EDFA module and/or Variable Optical Attenuator module)

Specifications:

	AP3314A-1 (one input +10dBm max) **AP3314A-11** (Two inputs +10dBm max)	**AP3314A-3** (one input +33dBm max) **AP3314A-33** (Two inputs +33dBm max)
	AP3314A-13 (Two inputs; one +10dBm max plus one +33dBm max)	
Wavelength range	800 to 1700nm	
Calibrated wavelengths	980,1310, 1480,1550,1610nm	
Photodiode	InGaAs	
Fiber type	9/125 to 50/125µm	
Display range	-70dBm to +10dBm	-50dBm to +30dBm
Display range after zeroing	-75dBm to +10dBm	-60dBm to +30dBm
Max. permitted level	+10dBm	+30dBm (+33dBm few min)
Intrinsic uncertainty	± 0.21dB (±5%)	
Overall measurement uncertainty	980nm ±0.5dB ±0.2nW 1310~1610nm ±0.2dB ±0.1nW	980nm ±0.5dB ±20nW 1310~1610nm ±0.2dB ±10nW
Optional optical connectors	FC (female): Different styles of optical connector interchangeable adapter (ST/SC/…) and bare optical fiber adapter can be defined by customer	
Fiber type	Single-mode or Multimode 9/125µm or 50/125µm	
Operating temperature	+5°C to +35°C	

Optical Switch modules

1x2, 2x2, 1x4, 1x8 SWITCHES

Features:

- Wide Operating wavelength range
- Low Insertion loss
- Low Polarization dependence loss
- Fast Switch speed

Software features:

- Easy control
- Other modules measurement display

Specifications:

	AP3344A Switches			
	1x2	2x2	1x4	1x8
Wavelength	1290~1330nm and 1525~1610nm			
Insertion loss (max)	0.8dB	0.9dB	1.0dB	1.5dB
Return loss (min)	45dB			
Polarization Dependent loss (max)	0.07dB		0.1dB	
Crosstalk (min)	60dB			
Repeatability (max)	+/- 0.02dB		+/- 0.05dB	
WDL (max)	0.2 dB			
Switch time (max)	4ms		10ms	
Durability (min)	10^7 times			
Operating temperature	+5°C to +35°C			

Optical Variable Attenuator modules

ATTENUATION RANGE OF 30 dB, ATTENUATION STEP OF 0.1 dB

Features:

- Simple or Double module
- Attenuation range: 30dB
- Minimum insertion loss: < 1dB
- Attenuation step: 0.1 dB

Software features

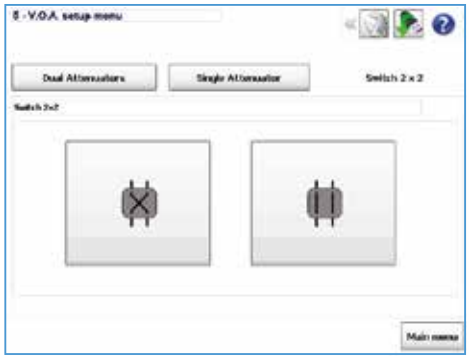
- Two channels immediate display
- Attenuation controlled by powermeter
- Other modules measurement display

AP3364-B-2 Wide attenuation range and multifunctional Optical Attenuator

This Optical Attenuator Module is based on a highly integrated combination of dual variable attenuators and optical switch in a one slot module. This multifunctional attenuator works in three modes: Dual Attenuator Mode, Single Attenuator Mode and Switch Mode. In dual Attenuator Mode, the module can work as two independent attenuators. In Single Mode, the module provides a wider attenuation range, including a shutter function. In Switch Mode, this module can work as a 2x2 Switch.

Dual attenuator mode:
- 30 dB attenuation for each channel
- Two channels simultaneaous display

Single attenuator mode:
- 60 dB total attenuation
- Shutter function



Switch mode:
- Switch 2 x 2

Specifications:

	AP3364A (single VOA) **AP3364A-2** (double VOA)	**AP3364B-2**		
		Dual VOA mode	Single VOA mode	Switch mode
Wavelength range	1310nm to 1550nm			
Attenuation range	30dB		60dB	
Attenuation step size	0.01dB			
Insertion loss	< 1dB	< 2dB	< 2.5dB	
Temperature dependent loss	< 0.2dB		< 0.25dB	
Wavelength dependent loss	< 0.3dB			
Polarization dependent loss	< 0.2dB			
Polarization mode dispersion	< 0.1ps			
Return loss	> 45dB			
Response speed	< 100ms/3dB			
Attenuation setting repeatability	< +/- 0.05dB			
Attenuation setting backlash	< 0.2dB			
Maximum optical power	300mW			
Operating temperature	+5°C to +35°C			

EDFA modules

C OR L BAND, HI-GAIN, LOW NOISE FIGURE, SATURATED OUTPUT POWER ACHIEVES UP TO +22 dBm

Features:

- Wavelength range: 1528 to 1563 nm
  or 1568 to 1612 nm **New**
- Three series of EDFA modules:
  Booster / Line / Pre-amplifier
- Gain flattened version available
- Input power down to -40 dBm
- Saturated output power up to 22 dBm
- Large input power range
- Low noise figure

Software features:

- Manual or Automatic control
- Output and Gain control
- Scale modes: mW or dBm
- Easy parameter access
- Other modules measurement display

Specifications:

	AP3370A	AP3372A	AP3370B	AP3372B	AP3370C	AP3372C
	Booster Amplifier		Line Amplifier		Pre-Amplifier	
Operating wavelength range	1528-1563nm	1568-1612nm	1528-1563nm	1568-1612nm	1528-1563nm	1568-1612nm
Input power range	-10 to +4dBm	-10 to +6dBm	-20 to 0dBm	-25 to -10dBm	-38 to -6dBm	-35 to -16dBm
Output Power	From +13 to +22dBm [a]				From -10 to +10dBm [a]	
Noise figure	Typ: 4.5dB / Max: 5dB		Typ: 5dB / Max: 6dB		Typ: 5dB / Max: 5.5dB	
Polarization dependent loss	≤ 0.3dB					
Polarization dependent gain	≤ 0.3dB		≤ 0.5dB			
Polarization mode dispersion	≤ 0.3ps		≤ 0.5ps			
Pump power leakage	-30dB Max.					
Output & input isolation	≥ 30dB					
Return loss	≥ 40dB					
Fiber type	SMF-28, 900µm loose tube, FC/APC (FC/PC on demand)					
Operating temperature	+5°C to +35°C					
Control	Manual Automatic fixed Output control		Manual Automatic fixed Output control Automatic fixed gain control		Manual	
Gain Flattened option: Flatness<1.5 dB	Full range	1570-1609nm	Full range	1570-1609nm	Full range	1570-1609nm

a) According to the model

Optical Tunable Filter modules

C-BAND, L-BAND AND C+L-BAND TUNABILITY AND ATTRACTIVE FEATURES

Features:

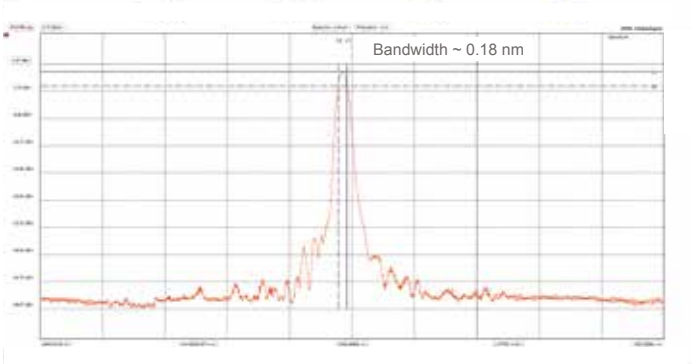
- Excellent MEMS durability, thermal stability and repeatability
- Superior optical performance
- Gaussian-shaped pass band
- Pass band optimized for 50 GHz and 100 GHz channel spacing
- C+L band tunable filter **New**

Specifications:

	AP3380A	AP3381A	AP3382A
Tuning range (nm)	1529-1564	1526-1610	1575-1610
Min IL @ peak [a]	< 4.0dB	< 4.5dB	< 4.0dB
Bandwidth @ 3dB	> 0.15nm	< 0.32nm	> 0.15nm
Bandwidth @ 20dB	< 0.68nm	~1nm	< 0.68nm
PDL	< 0.3dB	< 0.4dB	< 0.3dB
Back reflection	> 40dB		
Setting error	< +/- 50pm		
Tuning resolution	10pm		
Tuning speed	< 30ms		
Optical power	< 500mW		
Durability	> 1 billion cycles		
Operating temperature	+5°C to +35°C		
Fiber type	9/125µm SM, FC/APC (FC/PC on demand)		

a) IL measured at 25°C. IL < 5.0 dB over entire operating temperature range

Optical Transmission Spectrum*:



Optical transmission spectrum of AP3380A C-band Tunable filter

* The spectrum is obtained with an AP208x series OSA with 140 MHz resolution

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