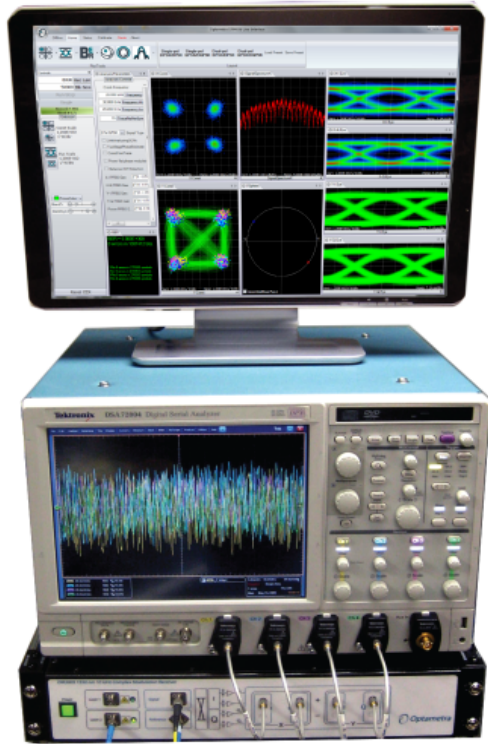




Coherent Lightwave Signal Analyzer

100 G and Beyond

OM4106B Coherent Lightwave Signal Analyzer Pro™



OM4106 Coherent Lightwave Signal Analyzer Pro: OM3105 Coherent Modulation Receiver driving real-time Tektronix oscilloscope running Optametra Signal Analysis Software Pro.. Remote CPU display shows 112Gb/s DP-QPSK signal.

Key Features

- Optametra's superior user interface offers comprehensive visualization for ease-of-use combined with the power of MATLAB
- Signal Analysis Software Pro™ included with OM4106B
- Complete coherent signal analysis system for polarization-multiplexed QPSK, offset QPSK, QAM, differential BPSK/QPSK, and other advanced modulation formats
- Displays constellation diagrams, phase eye diagrams, Q-factor, Q-plot, Spectral-plots, Poincaré sphere, extracted laser phase characteristics, BER, with additional plots and analyses available in the Pro™ MATLAB interface
- Pro™ enables access to internal functions with a direct MATLAB interface
- Optametra Signal Analysis Suite tolerates > 1 MHz instantaneous signal laser linewidth—compatible with standard network tunable sources
- No laser phase or frequency locking required
- Smart polarization separation follows signal
- Incorporates Optametra OM3105 Coherent Modulation Receiver (CMR™) for high stability, linear, polarization-diverse, optical field detection
- Includes Signal and Reference tunable laser sources in OM4106B
- Runs with Tektronix and other real-time oscilloscopes

¹ MATLAB is a registered trademark of MathWorks

Introduction

Optametra's OM4106B Coherent Lightwave Signal Analyzer Pro™ is a new 1550 nm (C- and L-band) fiber optic test system for visualization and measurement of complex-modulated signals, offering a complete solution to testing both coherent and direct-detected transmission systems. Optametra's hardware includes the OM3105 polarization-diverse Coherent Modulation Receiver™ (CMR™) enabling simultaneous measurement of modulation formats important to advanced fiber communications, including dual-polarization (DP) QPSK. Optametra's software performs all calibration and processing functions to enable real-time burst-mode constellation diagram display, eye-diagram display, Poincaré sphere, and bit-error detection. Working with a real-time oscilloscope of sufficient bandwidth, bit rates exceeding 160 Gb/s (DP-QPSK) can be analyzed.

Optametra User Interface (OUI)

The common thread through the Coherent Lightwave Signal Analyzer product line is the OUI which governs the operation and display of data. Color-grade, persistence, and color-key options are available to help you visualize the data. In the example below, the horizontal transitions are more rare than the vertical transitions due to the relative timing of the I and Q data sequence (upper middle). The other polarization constellation is shown in color grade with only the symbol points (lower middle). Color grade is also available for the eye-diagram (bottom right).

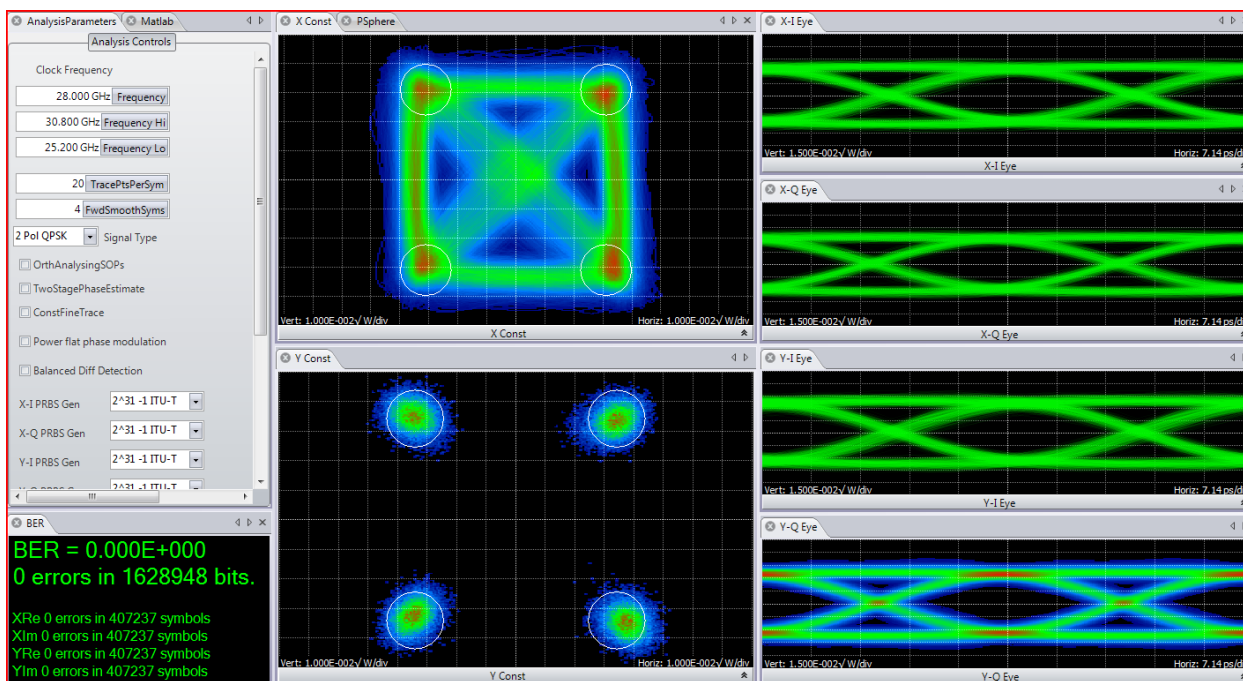


Figure 1. Optametra OM4106 User Interface showing some color-grade graphics options. Symbols can also be colored to a key indicating prior state. Data shown is 112 Gb/s PM-QPSK.

Interaction between Optametra User Interface (OUI) and MATLAB

The OUI takes information about the signal provided by the user together with acquisition data from the oscilloscope and passes them to the MATLAB workspace. A series of MATLAB scripts are then called to process the data and produce the resulting field variables. The OUI then retrieves these variables and plots them. Automatic test is accomplished by connecting to the OUI via its web service or by connecting directly to the MATLAB workspace.

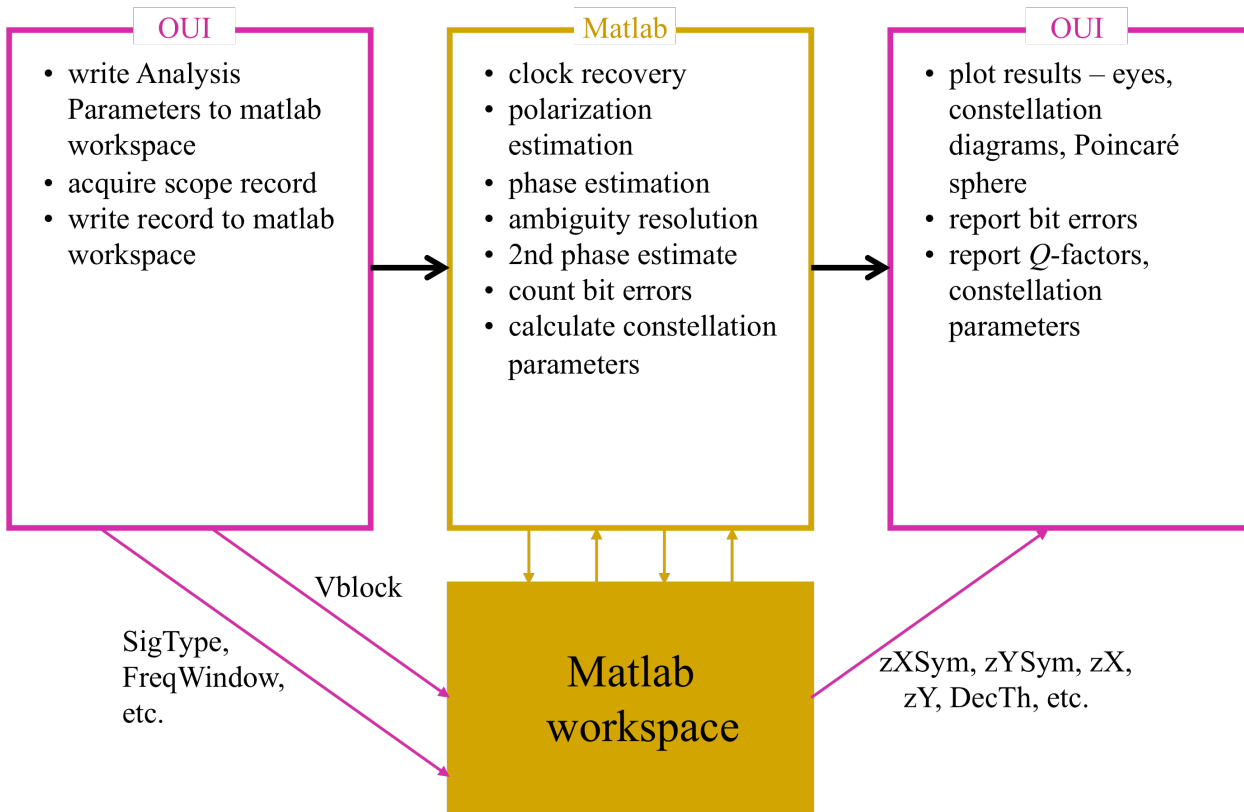


Figure 2. Illustration of data flow under control of the OUI.

Signal Processing Approach

The first step after data acquisition is to recover the clock and retiming the data at one sample per symbol at the symbol center for the polarization separation and following algorithms (shown as upper path in the figure below). The data is also re-sampled at 10x the baud rate (user settable) to define the traces that interconnect the symbols in the eye-diagram or constellation (shown as the lower path). The clock recovery approach depends on the chosen signal type. Laser phase is then recovered based on the symbol-center samples. Once the laser phase is recovered, the modulation portion of the field is available for alignment to the expected data for each tributary. At this point bit errors may be counted by looking for the difference between the actual and expected data after accounting for all possible ambiguities in data polarity. The polarity with lowest BER is chosen. Once the actual data is known, a second phase estimate may be performed to remove errors that may result from a laser phase jump. Once the field variables are calculated, they are available for retrieval and display by the OUI.

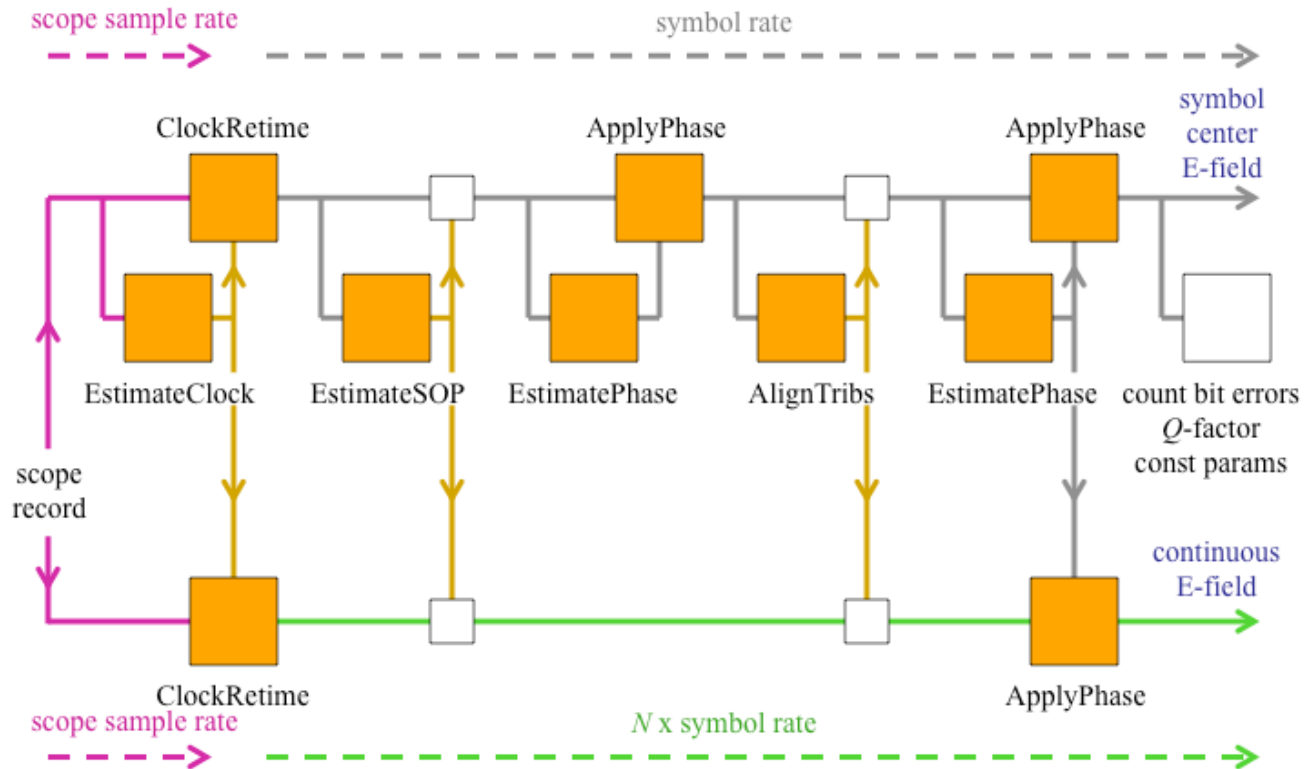


Figure 3. Data flow through the "CoreProcessing" engine

Values stated in the following tables are typical unless stated otherwise (some values oscilloscope limited)

Coherent Lightwave Signal Analyzer Pro	
Description	
Maximum detectable baud rate (@ Q of 9.5 dB)	40 Gbaud with Tektronix: DPO72004B
Maximum detectable bit rate for DP-QPSK (@ Q of 9.5 dB)	160 Gb/s with Tektronix: DPO72004B
Sample rate	50 Gs/s with Tektronix: DPO72004B
Optical field uncertainty (rms)	2%
O/E Gain imbalance between I & Q	0.1 dB
Available modulation formats	OOK, BPSK, DBPSK, DP-BPSK DQPSK, DP-QPSK, QAM, Offset QPSK Any PRBS or user supplied pattern Contact factory for new modulation formats
Control	Built-in Ethernet interface

OM3105B Coherent Receiver - (included with OM4106B)	
Description	
Optical input	C-Band 1530 to 1570 nm L-Band 1570 to 1610 nm - optional
Maximum input power	+15 dBm
Maximum input power damage level	+20 dBm
Optical Local Oscillator Output	
Optical CW output power	+14.5 dBm C-band 1527.6 to 1565.5 nm L-band 1570.01 to 1608.76 nm - optional
External Local Oscillator Input	
Optical input wavelength range	C-Band 1530 to 1570 nm L-Band 1570 to 1610 nm - optional
Suggested External local oscillator input power range	+7 dBm to +15 dBm
Maximum input peak power (damage level)	+20 dBm
Instantaneous linewidth	<2MHz
Short-term stability	<200 MHz
Additional Items	
Electrical bandwidth	30 GHz minimum, 32 GHz with equalization for OM4106B, <i>future-proof upgradable platform, as new scope bandwidths become available higher receiver bandwidths will become available</i>

Optical phase angle of I-Q mixer after correction	90° ±1°
Skew after correction	±1 ps

Data Acquisition Characteristics of Supported Oscilloscopes	
Description	4-Channel (dual-polarization)
Maximum sample rate	50 GSa/S on each channel with Tektronix: DPO72004B
Maximum record length	250 Mpoints with Tektronix: DPO72004B
Maximum data acquisition bandwidth	20 GHz on each channel with Tektronix: DPO72004B
Noise	16 GHz of bandwidth: 0.43mV rms on 10mV/Div scale (0.43%) with Tektronix: DPO72004B
	20 GHz of bandwidth: 1.57mV rms on 20mV/Div scale (0.77%) with Tektronix: DPO72004B

Local Oscillator (OM4106B)	
Description	
Wavelength range	C-band 1527.6 to 1565.5 nm
	L-band 1570.01 to 1608.76 nm
Minimum wavelength step	10 GHz
Minimum frequency step	100 MHz
Absolute wavelength accuracy	10 pm
Linewidth (short term)	100 kHz
Sidemode suppression ratio	55 dB

High Resolution Spectrometer (OM4106B)	
Description	
Maximum frequency span	LO frequency ± scope bandwidth
LO wavelength range	C-band 1527.6 to 1565.5 nm
	L-band 1570.01 to 1608.76 nm
Number of FFT points	1 million
Minimum RBW	1/max scope time window
Frequency accuracy	10 pm

Measurement Display and Analysis Tools (OM4106B)

Description

Constellation diagram

Constellation Elongation

Constellation phase angle

Constellation alignment (bias, phase angle)

Constellation mask

Eye diagram for I and Q

Eye decision threshold Q-factor

Decision threshold Q plot

Phase diagram

Signal spectrum and laser spectrum

Raw data available in MATLAB

Phase vs. Time available in MATLAB

Frequency offset available in MATLAB

I-bias; Q-bias

Poincaré sphere

Signal Quality

Tributary skew

CD Compensation

Oscilloscope Delay Compensation

Cable Delay Compensation

Calibration Routines

Full access to internal functions via MATLAB interface

Raw data replay with different parameter setting

Bit error ratio measurements

Off-line processing

General Characteristics - Scope not Included (OM4106B)

Description

Size assembled	(H x W x D) 8.9 cm x 43.2 cm x 29.85 cm / 3.5 in x 17.0 in x 11.75 in
Weight net	11.8 kg / 26 lbs
Weight shipping	15.9 kg / 35 lbs
Operating temperature range	+10° C to +35° C
Storage temperature range	-20° C to +70° C, non-condensing humidity
Humidity	15% to 80% relative humidity, non-condensing
Power requirements	115 – 230 V~ 50–60 Hz, 1 power cable, Max. 100 VA

Calibration and Warranty

Description

Calibration interval	1 year
Limited warranty (OM4106B)	1 year, On Support - extended calibration and service plan available OM4106B.

See ordering information next page

Ordering Information and Options

Model Numbers 4106B	Description
OM4106B -100	Coherent Lightwave Signal Analyzer Pro - with 4 channel 30 GHz receiver, 32 GHz w/Equalization
OM4106B -150	Local Oscillator Externally Connected - Optional
OM4106B -400	QAM and Offset QPSK – Optional
OM4106B -600	Customer's Hybrid Calibration Kit (Hardware + Software) - Optional
OM4106B -650	On-site Calibration Training (requires Calibration Kit) – Optional
OM4106B -800	On Support - Extended Calibration and Service Plan - Optional
OM4106B -801	On Support - Extended Service Plan - Optional
OM4106B -802	On Support - Extended Calibration Plan - Optional

Additional Requirements

Customer must provide Mathworks MATLAB 2009a (32-bit) software and computer for it to run on; computer must include an nVidia brand video card for compatibility with Optametra software, and must run Windows XP 32 bit or Vista (32- or 64-bit) or Windows 7 (32- or 64-bit). Please check with Optametra when ordering for the most up to date detailed requirements.

Please contact Optametra Sales (sales@optametra.com) for a price quote or to arrange a demonstration. All product descriptions and specifications are subject to change without notice.