

# Evaluating Optical Modulators

## Higher Yields of Optical Modulators by Direct Driving using High-Amplitude Pulse Pattern Generator

### MP1800A Signal Quality Analyzer

#### Background

The recent spread of broadband transmission systems supporting VoIP, video streaming, etc., applications is causing huge increases in communications traffic on the Internet. As a result, there is urgent demand for high-speed transmission systems in the 10-Gb/s class and R&D into these types of transmission equipment is growing rapidly. These transmission systems use plug-in optical transceivers called XFP modules to convert electrical signals to the optical signals that are sent over optical fibers. A variety of optical transceivers are being researched to meet the various wavelength and optical power requirements. Either an LN or EA type element (modulator) is used in the optical transceiver to perform the electrical-to-optical conversion. Recently, EA modulators have been combined with DFB lasers on a single chip to create an EML device (EA modulator with integrated semiconductor laser). The optical modulator is the device that determines the quality of transmissions between transmission equipment and efficient evaluation of modulator performance is extremely important.

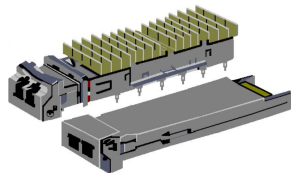


Fig. 1 XFP Module

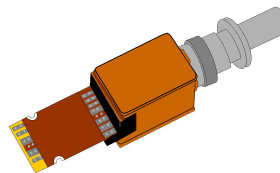


Fig. 2 EML with Integrated XFP

Until now, there has been no pulse pattern generator capable of directly driving an optical modulator. As a result, optical module vendors and manufacturers of optical transceivers have not been able to perform efficient evaluation of their products, making cost reduction difficult. Anritsu's high-amplitude data output option for its MP1800A greatly increases the efficiency of evaluation because it can directly drive optical modulators.

#### Problems in Optical Modulator Evaluation

The electrical input signal source used for modulator evaluation must satisfy the following requirements.

##### Wide Amplitude Output

The electrical signal input to the modulator must have a wide amplitude of 2 to 3 V<sub>p-p</sub> to guarantee a good extinction ratio.

##### Cross Point Adjustment Function

Due to the non-linear extinction characteristics of the optical output in comparison to the electrical input to the EA modulator, the optical output waveform suffers degraded quality with drift towards the space side of the cross point where 1 (mark) and 0 (space) of the digital data cross. This degraded waveform prevents identification of the digital data after signal transmission and is a cause of errors.

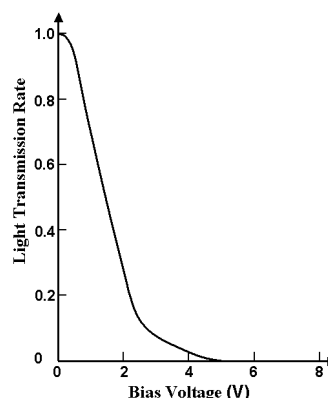


Fig. 3 Non-linear Extinction Characteristics of EA Modulator

To reduce the number of errors at receiving after the signal has been transferred through the optical fiber and improve the optical output cross point, the optical transceiver modulation driver circuit incorporates a cross-point optimizing circuit. To obtain the optimum value for the cross point, the signal source used for modulator evaluation requires a function for adjusting the cross point.

### High-quality Waveforms

To evaluate waveform degradation in modulators, the input electrical signal must be high quality. If the input electrical signal is low quality, it will not be possible to correctly evaluate whether the optical output signal degradation is caused by the input signal or by the modulator. High quality means that the waveform is free of distortion and jitter. Conventional pulse pattern generators are unable to output a signal capable of driving a modulator directly and require addition of an external amplifier in the drive circuit. The resultant restrictions listed below make it difficult to increase the modulator production yield.

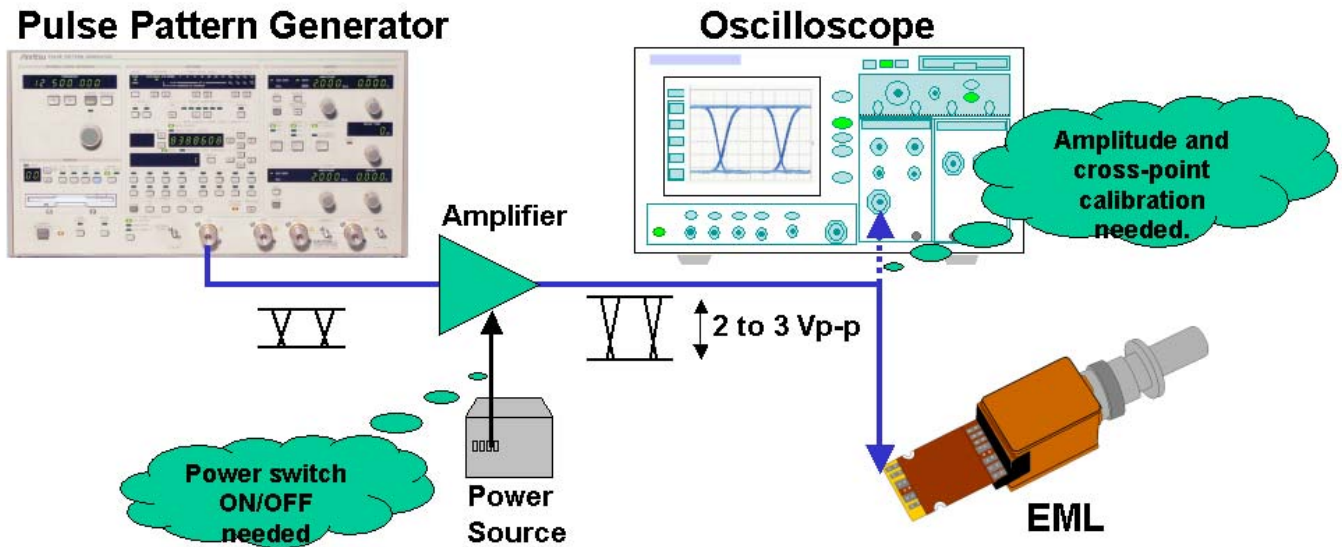


Fig. 4 Conventional Optical Modulator Evaluation using Pulse Pattern Generator requiring External Amplifier

1. The amplifier power source must be operated at each evaluation.
2. The cross-point value must be adjusted using an external oscilloscope, considering waveform distortion caused by the external amplifier.
3. As described above, the optical amplifier evaluation system is difficult to automate so evaluation requires more time, which reduces production yield.

## Driving Optical Modulator Directly using MP1800A

The MP1800A Signal Quality Analyzer is an all-in-one solution for these problems, making it easy to increase production yields of optical modulators and transceivers. Selecting the optional MU181020A-013 Pulse Pattern Generator supports generation of differential electrical signals with the following characteristics.

1. Wide amplitude from 0.5 to 3.5 Vp-p
2. Adjustable cross point from 20% to 85%
3. High-quality waveform

As a result, evaluation of optical modulators no longer requires an external amplifier and power supply, because direct driving is supported and evaluation can be performed without calibration using an oscilloscope.

Moreover, since the MP1800A has built-in GPIB and Ethernet interfaces for remote control, testing can be performed repeatedly at high efficiency using test automation software. By using these functions, evaluation times at R&D, manufacturing and maintenance of optical modulators and optical transceivers are greatly reduced, increasing productivity.

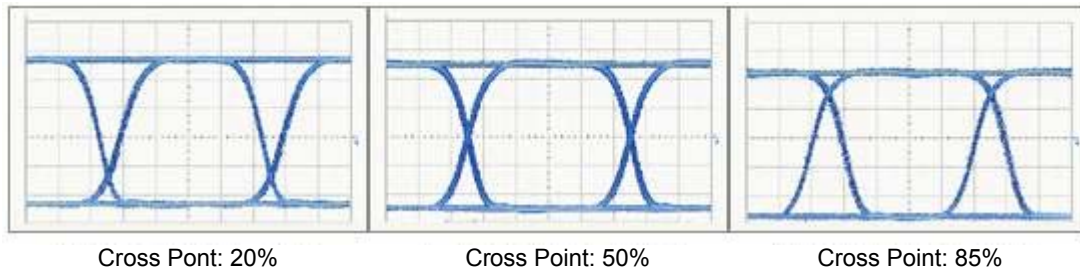


Fig. 5 MP1800A Output Waveform with Adjustable Cross Point

The MP1800A is not just a pulse pattern generator; it can also be used to receive optical or electrical signals and measure the bit error rates. This function is also very useful for evaluating optical modulators and transceivers.

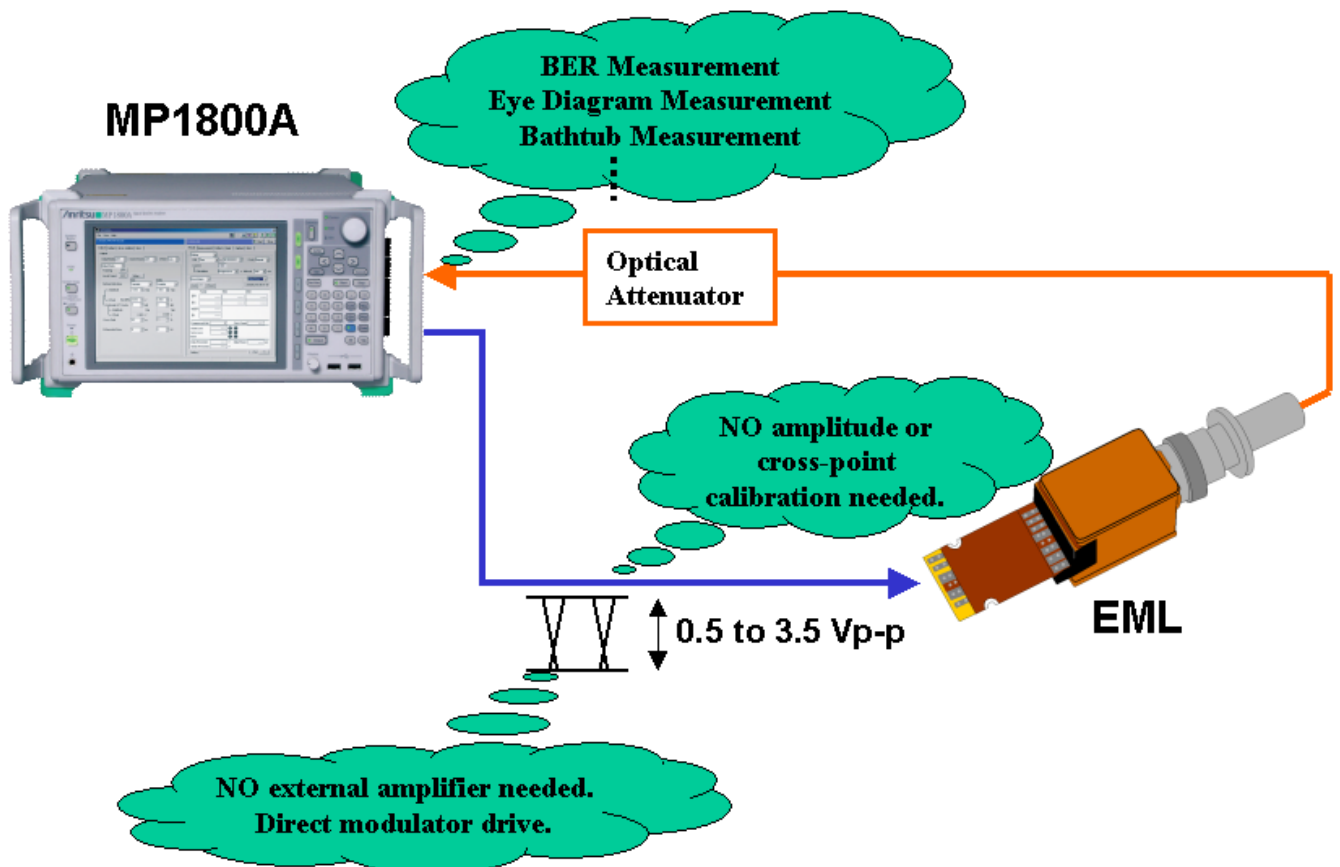


Fig. 6 Optical Modulator Evaluation using MP1800A without Amplifier and Oscilloscope

## Summary

Improving the efficiency of optical modulator evaluation requires a pulse pattern generator with a cross-point pattern that can be adjusted over a wide amplitude. The combination of Anritsu's MP1800A and MU181020A-013 3.5 V Output option is the ideal solution meeting the measurement needs for these types of digital devices. Vendors of optical modulators and optical transceivers can easily improve their production efficiency using Anritsu's popular MP1800A measurement solution.



*Fig. 7 MP1800A*

## Note

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