VARIABLE OPTICAL ATTENUATOR: FEEL THE POWER

Marie-Hélène Côté, Sr. Product Manager

Attenuators are essential building blocks when developing test stations for applications such as bit-error-rate (BER) testing of transmission cards or gain and noise characterization of erbium-doped fiber amplifiers (EDFAs).

In order to increase the flexibility of our IQS-3150 Variable Optical Attenuator, we have developed an option that integrates both a coupler and a power meter into the one-slot attenuator module. This allows users to set the output power level directly, thus improving the overall testing efficiency. By allowing users to monitor the attenuator's output power in real time, the internal power meter can also be used to compensate for any power fluctuation generated from the source, while maintaining stable conditions at the device under test.

For enhanced accuracy, we have also implemented a comprehensive offset functionality allowing for accurate integration of the instrument in various test setups. In fact, two different offsets have been defined; the first is independent of wavelength and can be used to account for known loss in the test setup, whereas the second can be viewed as a calibration factor, ensuring wavelength-specific correction level, so as to compensate for losses due to the patchcords and connectors in the system.

This application note explains how to benefit from the integrated power meter option, as well as how to use the two offset features, helping you ensure efficient and accurate testing, time after time.

Integrated Power Meter Option

In many test stations that include attenuation as a parameter, knowing the power level after the attenuator also proves to be most interesting. Among the traditional ways to do this is to connect a 1x2 switch at the output of the attenuator, connecting one of the branches of the switch to a power meter and the other to the test station; or, if available, a monitor port can also be used.

However, it is now possible to perform this task using an attenuator with integrated power meter; one single module can now measure both attenuation and power level, ensuring a compact and efficient test station.

How does it work?

The signal entering the attenuator is split into two, with 5% of the light being collected on the monitoring detector and the rest going through the attenuating filter. Figure 1 illustrates the design of the attenuator with integrated power meter.

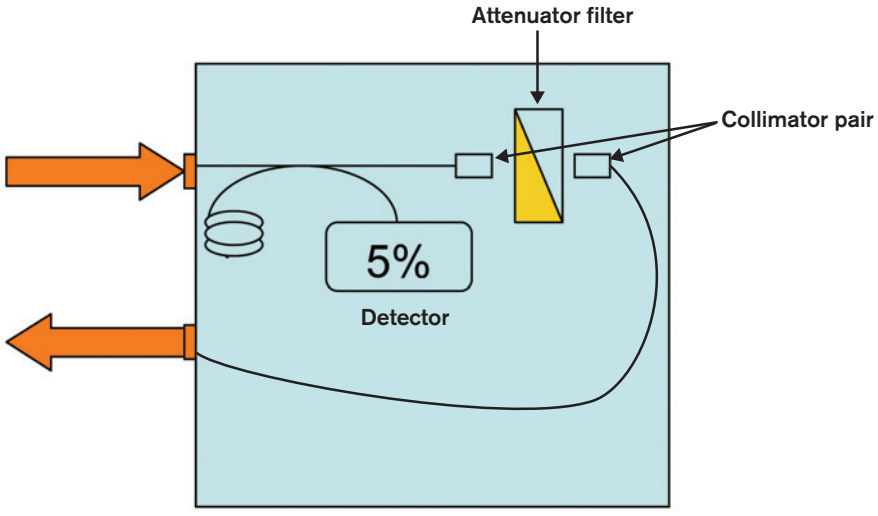


Figure 1: Illustration of the concept behind EXFO's IQS-3150 Variable Optical Attenuator with integrated power meter option

Why use it?

There are two main reasons for using this attenuator model: either when you wish to directly set the power level (rather than the attenuation) at the output of the instrument, or when you want to compensate for a power fluctuation generated by an optical source.

How is it used?

Setting the output power is done from the user interface, by selecting the Output Power control view and entering the desired value. The attenuator uses the calibration table to select the appropriate attenuation setting at the current wavelength. Figure 2 shows the Output Power control view and the displayed power values.

Note: *Values can also be entered through the usual SCPI commands.*

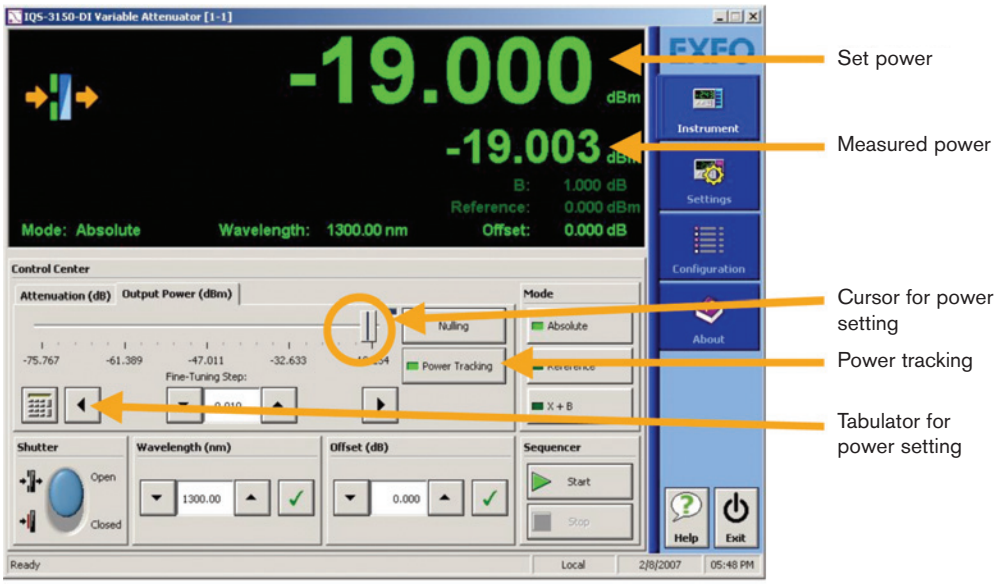


Figure 2: Output Power control view and power settings

Compensating for the drift of a source is done by activating the power-tracking feature (see Figure 2).
After setting the power-drift tolerance in the Setting menu, the attenuator will automatically control the output power within the preset limits. Figure 3 shows an example of the power-tracking effect.

In Figure 3, the target power is represented by the center line, and the limits of the drift tolerance are represented by the horizontal dotted lines. While the fictitious source presents a sinusoidal drift (full black line), the orange dotted line shows the power-tracking effect on the power at the attenuator output.

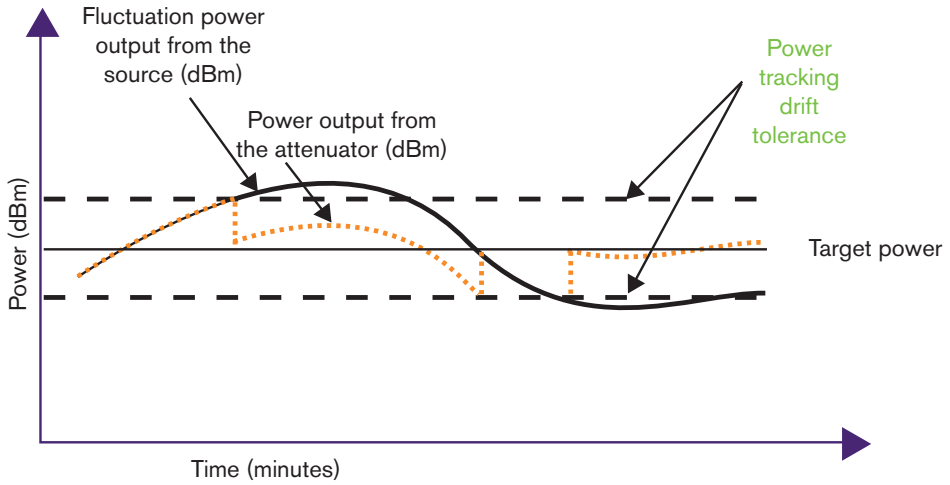


Figure 3: Power-tracking effect

Wavelength-Independent Offset: Offset Function

Offset is used to compensate for loss in the setup, and it is applied at all wavelengths. This is a numerical value that applies to all displayed attenuation and power values, independent of the selected wavelength. Figure 4 illustrates a typical application for this feature.

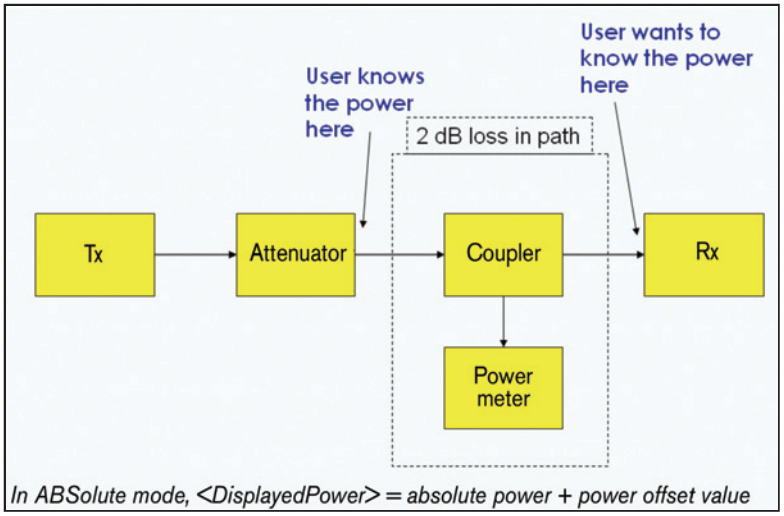


Figure 4: Typical application for the offset feature, with offset value set to 2 dB

Using the example illustrated above, a 2 dB offset can be entered directly from the user interface, as shown in Figure 5.

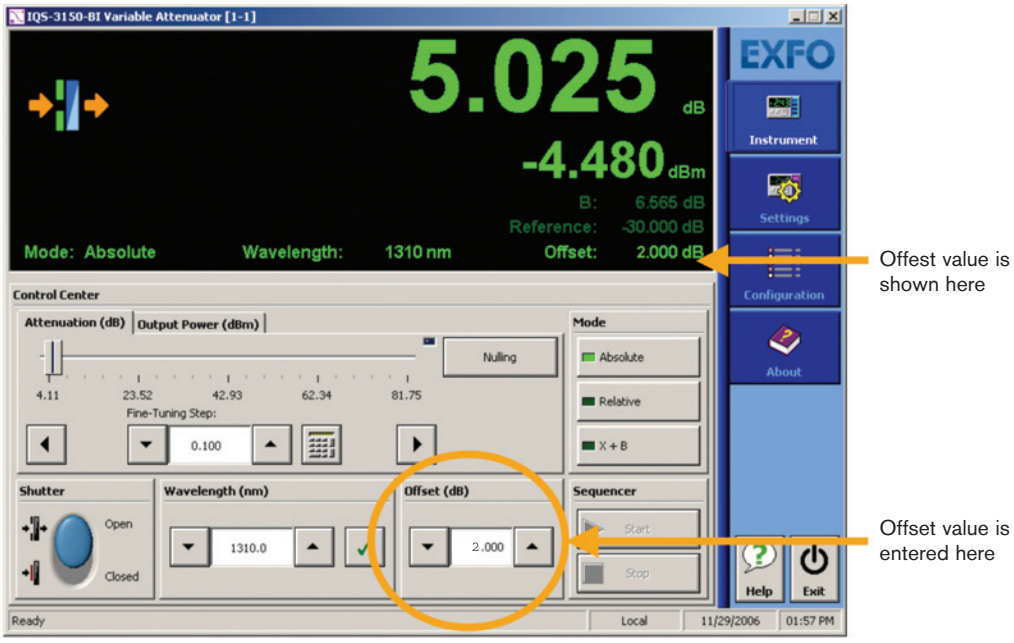


Figure 5: Entering an offset value from the IQS-3150 user interface

Wavelength-Dependent Offset: B Calibration Factor

Attenuators are manufactured with high-accuracy calibration, and for utmost precision, it is possible to enter calibration factors (B value) to compensate for wavelength-dependent loss in the setup, whether in Attenuation Control or Power Control mode. There are two available B values determined independently for each wavelength, one for each mode.

In **Power Control mode**, the displayed output power is the sum of three elements:

Displayed Power = X + B + Offset

where:

- X = Measured power (internal power meter)
- B = Correction factor applicable at this wavelength
- Offset value (independent of wavelength), optional

In **Attenuation Control mode**, the displayed attenuation value is the sum of three elements:

Displayed Attenuation = X + B + Offset

where:

- X = Physical attenuation induced by the unit
- B = Correction factor applicable at this wavelength
- Offset value (independent of wavelength), optional

In order to determine the appropriate value to enter as a B value, a reference power meter must be used. The attenuator and power meter are set to the exact wavelength of the source (as measured with a wavemeter or OSA) and then the user compares the power readings from the attenuator interface and the reference power meter. The B value is the difference between the two measurements. Figure 6 shows a typical setup to determine the B value, and Figure 7 shows where B values can be entered in the IQS-3150 user interface.

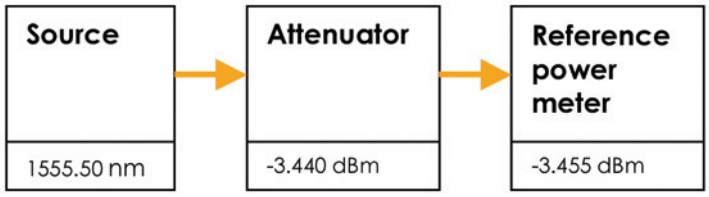


Figure 6: Illustration of how to determine the B value

The B value is the difference between the power reading of the attenuator and the power reading of the reference power meter; i.e., in the above example, -0.015 dB. This value is only applied when the attenuator is set to the wavelength of the source (1555.50 nm in this example).

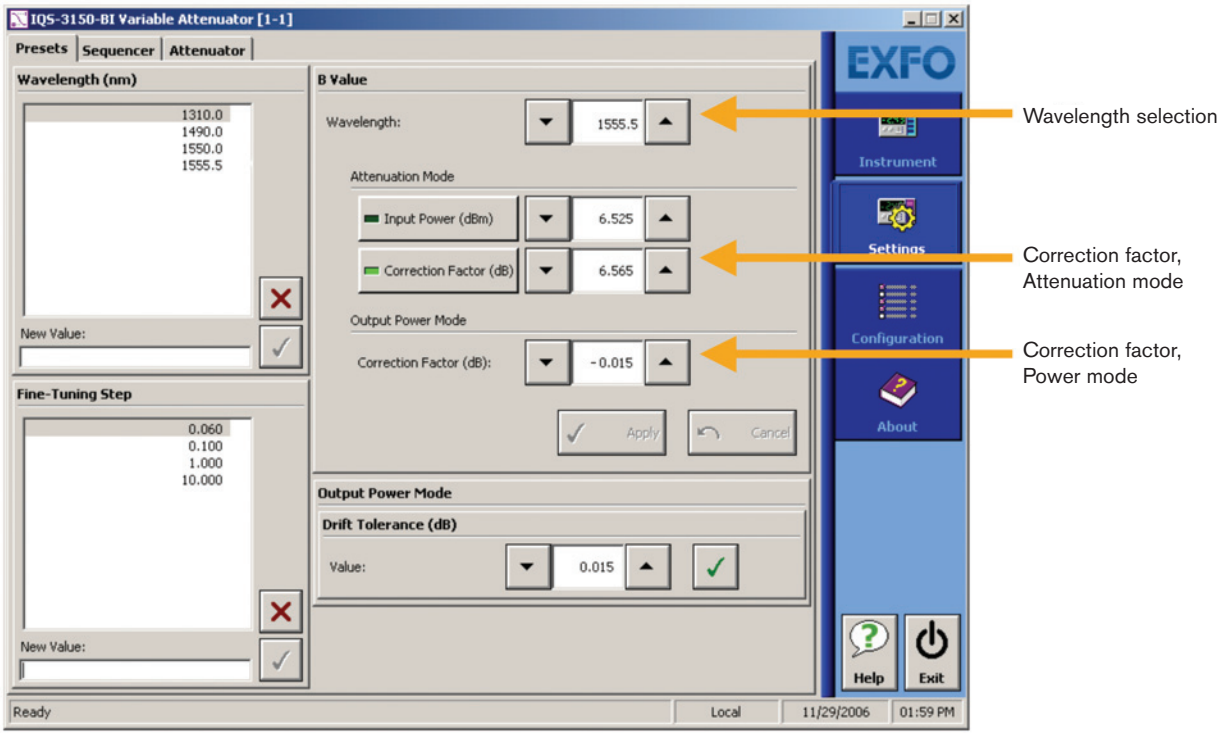


Figure 7: Entering the correction factors for any wavelength of operation, for either Power Control or Attenuation Control modes, is done in the Presets tab (accessible via the Settings menu)

In order to benefit from these calibration factors, X+B mode must be selected from the main control interface.

As attenuators are building blocks in a large variety of test stations, from BER testing of transmitters and receivers to amplifier qualification, it is important that flexibility and ease of use be part of the characteristics of test instruments. Nonetheless, precision in testing will always remain a critical element. The integrated power meter combined with the comprehensive calibration compensation features that are provided by the IQS-3150 Variable Attenuator firmware give the user the required level of precision, and the choice of entering the values either through the interface (as explained above) or through the usual SCPI commands.

EXFO Corporate Headquarters > 400 Godin Avenue, Quebec City (Quebec) G1M 2K2 CANADA | Tel.: 1 418 683-0211 | Fax: 1 418 683-2170 | info@EXFO.com

Toll-free: 1 800 663-3936 (USA and Canada) | www.EXFO.com

EXFO America	3701 Plano Parkway, Suite 160	Plano, TX 75075 USA	Tel.: 1 800 663-3936	Fax: 1 972 836-0164
EXFO Europe	Omega Enterprise Park, Electron Way	Chandlers Ford, Hampshire S053 4SE ENGLAND	Tel.: +44 2380 246810	Fax: +44 2380 246801
EXFO Asia	151 Chin Swee Road, #03-29 Manhattan House	SINGAPORE 169876	Tel.: +65 6333 8241	Fax: +65 6333 8242
EXFO China	No. 88 Fuhua, First Road, Central Tower, Room 801 Futian District	Shenzhen 518048 P. R. CHINA	Tel.: +86 (755) 8203 2300	Fax: +86 (755) 8203 2306
	Beijing New Century Hotel Office Tower, Room 1754-1755 No. 6 Southern Capital Gym Road	Beijing 100044 P. R. CHINA	Tel.: +86 (10) 6849 2738	Fax: +86 (10) 6849 2662

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