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DIGITAL VARIABLE ATTENUATOR

Features:

- CE Compliant
- High power handling (up to 2 watts)
- High speed
- Wide attenuation range
- Low PDL and wavelength dependency
- Low insertion loss and backreflection
- High resolution
- Rugged and compact design
- Calibrated for dual wavelengths, (1300-1550nm) or calibrated for C and L bands. It can also be calibrated for up to four individual wavelengths
- Wide wavelength range
- Wide range of receptacles
- Blocking technique for singlemode; neutral density filter technique for multimode fiber applications
- Computer interface
- Battery option available
- Polarization maintaining fiber versions are available.



Digital Variable Attenuator

Applications:

- Bit error rate testing
- Trouble shooting receivers and other active fiber optic components
- Simulating long distance fiber transmission
- Design of fiber optic transmitter/receiver circuitry
- Power meter linearity checks
- Power setting


RS-232 GPIB Interface

Product Description:

OZ Optics offers a compact, rugged and low cost digital attenuator with high resolution, high speed, high attenuation range and high power handling (blocking technique only). OZ Optics' digital attenuator is a hand held unit, CE approved. These attenuators have low insertion loss, low backreflection, low PDL and flat wavelength response. These units can be calibrated for up to 4 wavelengths, for C or L bands. Alternatively the unit can be calibrated for a continuous range. By using interpolation between the calibration wavelengths, the unit is capable of providing accurate attenuation levels over a continuous, broad range of wavelengths.

OZ Optics' digital attenuators are ideal for use in bit error rate testing, troubleshooting receivers and other active fiber optic components, power meter linearity checks, simulating long distance fiber transmission and power setting. A computer interface allows users to access or remotely control the unit through a PC.

OZ Optics provides digital attenuators that use either singlemode, multimode or Polarization Maintaining (PM) fiber. In general, OZ Optics uses polarization maintaining fibers based on the PANDA fiber structure when building polarization maintaining components and patchcords. However OZ Optics can construct devices using other PM fiber structures. We do carry some alternative fiber types in stock, so please contact our sales department for availability. If necessary, we are willing to use customer supplied fibers to build devices.

An optional, built-in rechargeable battery is available for field use, where AC power may not be readily accessible.

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Ordering Information For Standard Parts:

Bar Code	Part Number	Description
14205	DA-100-SC-1300/1550-9/125-S-40	Digital variable attenuator with 9/125 micron singlemode fiber with SC/Super PC receptacles, 40 dB return loss and calibrated at 1300/1550 nm
14203	DA-100-SCU-1300/1550-9/125-S-50	Digital variable attenuator with 9/125 micron singlemode fiber with SC/Ultra PC receptacles, 50 dB return loss and calibrated at 1300/1550 nm
14204	DA-100-SCA-1300/1550-9/125-S-60	Digital variable attenuator with 9/125 micron singlemode fiber with SC/APC receptacles, 60 dB return loss and calibrated at 1300/1550 nm
12617	DA-100-SCU-1550-8/125-P-50	Digital variable attenuator with 8/125 micron PM fiber with SC/Ultra PC receptacles, 50 dB return loss and calibrated at 1550 nm
8275	DA-100-SC-1550-50/125-M-35	Digital variable attenuator with 50/125 micron multimode fiber with SC/Super PC receptacles, 35 dB return loss and calibrated at 1550 nm
8148	DA-100-SC-1300-62.5/125-M-35	Digital variable attenuator with 62.5/125 micron multimode fiber with SC/Super PC receptacles, 35 dB return loss and calibrated at 1300 nm
11685	DA-100-3S-1300/1550-9/125-S-40	Digital variable attenuator with 9/125 micron singlemode fiber with FC/Super PC receptacles, 40 dB return loss and calibrated at 1300/1550 nm
10118	DA-100-3U-1300/1550-9/125-S-50	Digital variable attenuator with 9/125 micron singlemode fiber with FC/Ultra PC receptacles, 50 dB return loss and calibrated at 1300/1550 nm
8147	DA-100-3A-1300/1550-9/125-S-60	Digital variable attenuator with 9/125 micron singlemode fiber with FC/Angle PC receptacles, 60 dB return loss and calibrated at 1300/1550 nm
7513	DA-100-3A-980-6/125-S-50	Digital variable attenuator with 6/125 micron singlemode fiber with FC/Angle PC receptacles, 50 dB return loss and calibrated at 980 nm
9108	DA-100-3U-1550-8/125-P-50	Digital variable attenuator with 8/125 micron PM fiber with FC/Ultra PC receptacles, 50 dB return loss and calibrated at 1550 nm
7511	DA-100-3A-1550-8/125-P-60	Digital variable attenuator with 8/125 micron PM fiber with FC/Angle PC receptacles, 60 dB return loss and calibrated at 1550 nm
10720	DA-100-3S-1550-62.5/125-M-35	Digital variable attenuator with 62.5/125 micron multimode fiber with FC/Super PC receptacles, 35 dB return loss and calibrated at 1550 nm
11140	DA-100-3S-1300-62.5/125-M-35	Digital variable attenuator with 62.5/125 micron multimode fiber with FC/Super PC receptacles, 35 dB return loss and calibrated at 1300 nm
10119	DA-100-3S-850-50/125-M-35	Digital variable attenuator with 50/125 micron multimode fiber with FC/Super PC receptacles, 35 dB return loss and calibrated at 850 nm
11927	DA-100-3S-850-62.5/125-M-35	Digital variable attenuator with 62.5/125 micron multimode fiber with FC/Super PC receptacles, 35 dB return loss and calibrated at 850 nm
8418	DA-100-8-1300-62.5/125-M-35	Digital variable attenuator with 62.5/125 micron multimode fiber with ST/ PC receptacles, 35 dB return loss and calibrated at 1300 nm
6692	DA-100-8-850-62.5/125-M-35	Digital variable attenuator with 62.5/125 micron multimode fiber with ST/ PC receptacles, 35 dB return loss and calibrated at 850 nm
4572	GPIB-RS232	RS232 to GPIB Adapter
4571	GPIB-CABLE-2	GPIB Cable, 2 m long.
2736	POWER CORD - UK	POWER CORD for UK
2737	POWER CORD - EUROPE	POWER CORD for Europe

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Standard Product Specifications:

Fiber Type		SM/PM	MM
Available wavelengths		400-1625 nm	400-1625 nm
Insertion loss[1] (IL)	Typical	1.0 dB	2.0 dB
	Maximum	2.0 dB	4.0 dB
Attenuation range[2]		IL to 60 dB	IL to 40 dB
Attenuation resolution[3]		0.01 dB	
Wavelength dependence of attenuation[4]	from 1300 nm to 1550 nm	up to 0.3 dB	
	from 1520 nm to 1570 nm	up to 0.1 dB	
Polarization dependent loss[1]	Typical	up to 0.05 dB	
	Minimum	up to 0.01 dB	
Return loss[1]		40, 50 or 60 dB	35 dB
Speed[5]		100 ms	
Repeatability of attenuation setting	up to 10 dB	±0.03 dB	
	up to 30 dB	±0.10 dB	
Accuracy[6]	up to 40 dB	± 0.3 dB	
	40 to 55 dB	± 0.5 dB	
	55 to 60 dB	± 1.0 dB	
Power Supply		Universal 110/220V AC to 12V DC adapter Optional built-in rechargeable battery	
Battery lifetime		up to 8 hours continuous use	
Maximum optical power		up to 500 mW[7]	up to 50 mW
Computer interface	Standard	RS232 Serial Port	RS232 Serial Port
	Optional	USB	USB
Polarization extinction ratio (for PM fiber)[1]		20, 25 or 30 dB	
Dimensions[8]		5.9X3.2X1.8 in. (150x81x46 mm)	
Weight (without optional battery)		1lb. (450 grams)	

Notes :

[1] Excluding connectors.

[2] Up to 60 dB range also available for Multimode version upon request.

[3] For attenuation up to 10 dB.

[4] Measured at 23°C and at minimum attenuation (insertion loss).

[5] A 3 dB attenuation change, when initially set at 10 dB attenuation. Actual performance will vary with initial attenuation.

[6] Tested at 23°C.

[7] For 40 dB, 50 dB return losses only. 200 mW max for 60 dB. Higher power levels are available as custom parts.

[8] Excluding receptacles and protective boot.

Ordering Examples For Standard Parts:

A customer needs to control the attenuation using a computer with a GPIB interface, at 1300/1550nm. He needs FC/PC connectors and up to 10 mW power handling with 50 dB or better return loss. He should be ordering the following parts:

Bar Code	Part Number	Description
10118	DA-100-3U-1300/1550-9/125-S-50	Digital variable attenuator with 9/125 micron singlemode fiber with FC/Ultra PC receptacles, 50 dB return loss and calibrated at 1300/1550 nm
4572	GPIB-RS232	RS232 to GPIB adapter
4571	GPIB-CABLE-2	GPIB cable, 2 m long
32303	USB-RS232-CONVERTOR	USB to RS232 convertor cable

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Ordering Information For Custom Parts:

OZ Optics welcomes the opportunity to provide custom designed products to meet your application needs. As with most manufacturers, customized products do take additional effort so please expect some differences in the pricing compared to our standard parts list. In particular, we will need additional time to prepare a comprehensive quotation, and lead times will be longer than normal. In most cases non-recurring engineering (NRE) charges, lot charges, and a 5 piece minimum order will be necessary. These points will be carefully explained in your quotation, so your decision will be as well-informed as possible. We strongly recommend buying our standard products.

Questionnaire For Custom Parts:

1. How much power will be transmitted through the attenuator?
2. What type of fiber do you wish to use?
3. What is the worst acceptable return loss?
4. Will this attenuator be used in Europe or in the United Kingdom?
5. Are there any special performance requirements that you need to meet?
6. What wavelengths do you want the attenuator calibrated at?

Digital Variable Attenuator:

DA-100-X-W-a/b-F-LB(-OPT)

X = Connector code:
- 3S = Super NTT-FC/PC
- 3U = Ultra NTT-FC/PC
- 3A = Angled NTT-FC/PC
- 8 = AT & T-ST
- SC = SC
- SCA = Angled SC

See the standard tables data sheet for other connectors

W = Wavelength: Specify in nanometers: Example: 1300/1550 for standard telecom wavelength range

OPT = Options
- B=Rechargeable Battery
- LL=Low Insertion Loss (see note)
- HP=High Power (see note)

LB = Backreflection level: 40, 50 or 60dB for singlemode fibers,35dB for MM fibers

F = Fiber type:
- M=Multimode
- S=Singlemode
- P=Polarization Maintaining

a/b = Fiber core/cladding sizes, in microns 9/125 for 1300/1550nm SM fiber. See the standard tables data sheet for other standard fiber sizes

Note 1: LL ≤ 0.6 dB with units that have 60 dB return loss, LL ≤ 1 dB for rest of the attenuators
High power applications are those that handle continuous power levels above 500 mW. Maximum continuous power level should not exceed 2 watts.

Note 1: An RS232 interface is standard. For other types of interface contact OZ Optics.

Ordering Examples For Custom Parts:

A customer wants to order a digital attenuator to be calibrated at 1300 nm and 1550 nm, using singlemode fiber and FC receptacles with 50dB back reflection and ≤ 1 dB insertion loss. The part number should be: **DA-100-3U-1300/1550-9/125-S-50-LL**

Frequently Asked Questions (FAQs):

Q: What advantages or disadvantages does the beam blocking version have over the neutral density versions.
A: The beam blocking technique is naturally suited for high power applications, and can achieve greater attenuation levels. The neutral density version shows less mode dependence or modal noise in multimode applications.

Q: What do you mean by mode dependence and modal noise?
A: The term multimode means there is more than one path for light to travel inside a single fiber. These paths are known as modes. It does not mean the unit consists of multiple fibers in a bundle. When coherent laser light is coupled into multimode fiber, the output shows speckles. Bending the fiber causes the speckle pattern to change. If the losses in a system depend on which modes are excited, then changing the modes excited in the fiber changes the output power. This is known as modal noise. If the source being used is an LED, then one does not see speckles, and modal noise is not an issue. However, for laser sources, modal noise is an issue.

When blocking style attenuators are used with multimode fiber, some modes are blocked, while others are transmitted. This can produce 1dB or greater modal noise fluctuations with coherent sources. A variable attenuator using a neutral density filter is not as strongly affected by modal noise. However, neutral density filter attenuators offer lower attenuation range (around 40 dB) and can only handle about 50 mW of power.

Q: What are the standard numerical apertures (NA) for the fibers used in your attenuators? Should I specify the NA of the fiber when I'm ordering an attenuator?
A: Please see our standard tables for detailed information on our fibers. If you want to use fiber that hasn't been specified in the standard tables then you should specify it while ordering.

Q: I ordered an attenuator with 60 dB return loss but when I measured it my return losses are higher. Why?
A: If you ordered an attenuator with 60 dB return loss with connectors, the back reflection will depend on what grade of connector you selected for your fibers. Typically only angle polished (APC) style connectors will give the desired return losses. The device itself has 60 dB return loss (i.e. if you cut off the connectors and measured the return loss you will see it above 60 dB) but if you picked only ultra PC finish connectors you may only see from 50 to 55 dB return losses.

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Frequently Asked Questions (FAQs) continued:

Q: Can I use Labview to communicate with the unit?
A: Yes, contact OZ Optics for driver information.

Q: How many different wavelengths can be calibrated on a single unit? How will it affect accuracy? How will it affect costs?
A: One option is to have the unit calibrated at discrete wavelengths. Up to three wavelengths can be calibrated at 0.01 dB resolution to 60 dB. Optionally up to four wavelengths can be calibrated at 0.01 dB resolution to just 50 dB. Calibration fees are currently set at $150USD for each additional wavelength. Also calibration sources are only available for certain wavelengths.
Note that over standard wavelength ranges such as from 1520 to 1620 nm, a unit will experience about 0.1 dB variation of attenuation versus wavelength.
Another option is to have a unit calibrated over a wavelength range. This process calibrates the unit at many more wavelengths, but at lower resolution, and then uses interpolation to produce a specific attenuation at a user defined wavelength. Either six or twelve wavelengths can be used for calibration, to reduce the variation to less than 0.03 dB over the range. Again the calibration fee is $150USD per wavelength. See the application notes for more information

Q: How often should we send the unit for re-calibration?
A: We recommend yearly calibration.

Q: In case of power outage does the attenuator maintain its position?
A: Yes, it does.

Application Notes:

Sample Application: Signal Strength Monitoring And Control System
As illustrated in Figure 1 below, light from a transmission module is sent through a DA style attenuator before entering the transmission line. A 99:1 splitter is used to tap off a small monitor signal. This signal is measured with a photodiode module, which produces a digital representation of the light intensity. Based on this feedback, the computer adjusts the attenuator to set the output signal at the optimum intensity.

Wavelength calibration and accuracy

The digital variable attenuator is normally calibrated at the wavelength or wavelengths specified in the part number (Note: Parts with the wavelength specified as 1300 are in fact calibrated at 1310 nm). Standard models of the digital attenuator allow one to select between one or two calibration wavelengths. For DWDM applications, one normally orders the device calibrated for 1550 nm. Variation in the attenuation with wavelength over the C and L bands is minimal (<0.1 dB over the C and L bands for up to 30 dB attenuation).

For some applications however, people want digital attenuators that are calibrated for all wavelengths within a certain range. This can be accomplished as well. To achieve this the unit is calibrated at up to 12 different wavelengths, evenly spaced over the range in question. Two wavelengths are calibrated to 0.01 dB resolution, while the other wavelengths are calibrated to 0.1 dB resolution. The unit will use interpolation to determine the proper setting to obtain a specific attenuation at a specific wavelength. With this technique the attenuation precision is improved to better than 0.03 dB over the entire wavelength range for up to 30 dB attenuation.

OZ Optics utilizes a number of highly stables sources for calibrating digital variable attenuators for different wavelengths. These include single wavelength sources for 830, 1064, 1310, 1480, 1550, and 1625 nm, as well as tunable sources for the C and L bands (1520 - 1620nm).

Please bear in mind that the calibration process does require time to execute. As a result, the more wavelengths that you ask an attenuator to be calibrated against, the more expensive the unit will become. At the time of preparing this data sheet, calibration fees were set at $150USD for each additional wavelength requested.

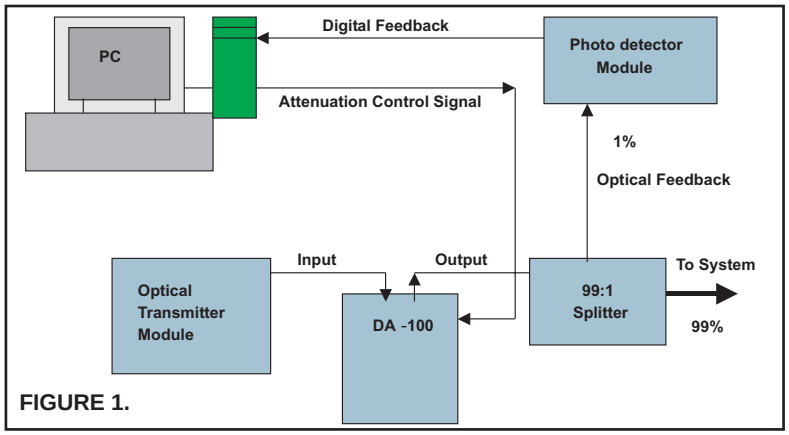


FIGURE 1.

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