OLA-25
Optical Attenuator
(variable)

BN 2200, series A onwards

Operating Manual

Wandel & Goltermann
Electronic Measurement Technology

Please direct all enquiries to your local Wandel & Goltermann sales company. The adresses are given at the end of this handbook.

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INTRODUCTION

The OLA-25 is a continuously variable optical attenuator designed for attenuating optical signals carried by single-mode fibers (9/125 μm) operating at 1300 and 1550 nm.

The attenuator module is a neutral density filter placed in the broadened light beam between the input and output connections. The attenuation value is variable between 3 and 60 dB and depends on the position of the filter, which is set using the rotary control on the front panel.

The actual attenuation includes the losses of both test ports. It is displayed with a resolution of 0.1 dB on the LC display. The display error remains at $< \pm$ 0.2 dB. This accuracy is obtained by individual calibration of the display to match the attenuation filter characteristic. The OLA-25 is factory calibrated at 1300 and 1550 nm. It is set to the corresponding nominal wavelength using the slide switch.

The OLA-25 is looped into the test circuit using test adapters, available for all standard 2.5 mm connector systems (DIN, FC, ST, etc.). Adapter cables can be used if different connectors are required.

The test ports are physical contact (PC) types. This, together with the anti-reflex coated components in the attenuator module, guarantees a constant high return loss of > 23 dB.

In normal operation the display of the OLA-25 is battery-powered.
If the attenuation can be read directly from a bit error tester or optical power level meter in the test circuit, the display can be switched off, as the OLA-25 still functions as an attenuator in this mode.

1 Specifications

1.1 Wavelength

Useful range ..... 1250 to 1600 nm
Calibrated at ..... 1300 and 1550 nm

1.2 Attenuation

Nominal range ..... 3 to 60 dB
Insertion loss ..... $\leq$ 3 dB
Setting ..... continuously variable over entire range (10 turns)
Return loss [1] ..... > 23 dB
Max. tolerable input level ..... +3 dBm

[1] Valid for DIN connector (BN 2060/00.30) and when W&G series K 31 xx cables are used.

1.3 Error limits

Operating error [1) 2)] ..... ± 0.95 dB
Display error [3)] ..... ± 0.2 dB +0.2 % of displayed value

Attenuation setting repeatability [3)] ..... ± 0.1 dB

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1) Valid for DIN connector (BN 2060/00.30) and when W&G series K 31 xx cables are used.

2) Including connector losses over nominal range of use. The total error is increased by typically ± 0.3 dB when other connectors (FC, ST, HMS-10) are used.

3) Excluding connector losses.

1.4 Test ports

Fiber type ..... single-mode fiber 9/125 µm
Internal connector type ..... 2.5 mm (physical contact)

Test adapters
for directly connecting various
2.5 mm connectors .....DIN, FC-PC, ST, HMS-10

Adapter cables
Reference cable (9/125 µm);
one end completed with DIN connector,
other end choice from .....DIN, FC-PC, HMS-0, -10
Biconic, Radiall, pigtail
Length .....2 m

1.5 Display

Type .....3 digit LC Display
Display value ..... absolute attenuation
..... (incl. connector loss)
Resolution .....0.1 dB
Over- or underrange indication ..... LO (< 3 dB)
.....HI (> 60 dB)

1.6 General specifications

Power supply
Built-in, exchangeable
dry battery .....9 V, IEC 6LF 22
or NiCd battery .....e.g. Varta TR 7/8
A.C. power ..... separate a.c. line adapter/charger

Operating time
with dry battery ..... approx. 45 h
with NiCd battery .....approx. 10 h

Auto-off after 15 minutes, or permanent operation.
When working with fixed attenuation values the instrument can be left switched off.

EMI/RFI suppression .....to DBP regulation 1046/1984
or CISPR Publ. 11, Cenelec HD 344

Ambient temperature

Nominal range of use ..... -10° C to +50° C
Storage and transport ..... -40° C to +70° C

Humidity

≤ +40° C (relative humidity) ..... 5 to 95 %
> +40° C (absolute humidity) ..... ≤ 30 g/m^3
Long-term operation in humid climates is not guaranteed.
Size (w x h x d in mm) ..... 98 x 170 x 55
Weight ..... approx. 900 g

1.7 Ordering information

OLA-25 Optical Attenuator *) ..... BN 2200/01
To operate the OLA-25, two test adapters are required which correspond to the type of connector system used.
Test adapter "fiber to fiber" connection (at extra cost)
DIN 47256 ..... BN 2060/00.30
NTT (FC-PC) ..... BN 2060/00.31
ST type AT & T ..... BN 2060/00.32
HMS-10/A (SMA connection) ..... BN 2060/00.34
HMS-10 (screw connection
or BNC plug) ..... BN 2060/00.35

*) Without test adapters

Accessories (charged extra)

Adapter- and connector cables (9/125 µm) **), from DIN 47256 connector to

- DIN 47256 ..... K3100
- FC type NTT (PC version) K3101
- Radiall VFO K3102
- Diamond HMS-0 (3.5 mm) K3104
- WECO 2016A (biconic) K3105
- Diamond HMS-10 (2.5 mm) K3106
- Pigtail K3199

Shoulder strap ..... BN 820/00.52

NiCd battery ..... BN 820/00.50

**) The DIN test adapter BN 2060/00.30 is required in order to connect the adapter cables.

LNT-1 AC Line Adapter/Charger ..... BN 2068/01
with line cord and 2 charger cables.
Please specify type of line cord required:

Line cord with	European plug	K490
	US plug	K491
	UK plug	K492
	Australian plug	K493

MK-1 equipment case to hold 1 x OLA-25, BN 2090/05
1 x LNT-1, optical cables etc.

MK-4 equipment case to hold 3 instruments...2092/11
in the OLS-/OLP-/OLA-25 range,
2 x LNT-1, cables and test adapters.

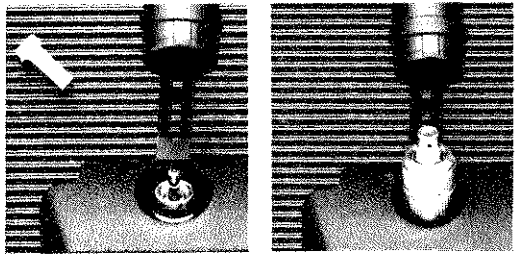
2.1 Test ports

2.1.1 Fitting the test adapters

For normal operation the OLA-25 must be completed with BN 2060/00.XX test adapters, in order to be able to connect the fiber optics connector or test cable on the system side. The test adapters are usually supplied with the instrument as an accessory.
After removing both dust caps from the OLA-25, the internal test connections (2.5 mm connector pins) are accessible. Further dust caps to protect these sensitive connector pins should also be pulled off, see Figure 2-1.
The test adapters can now be fitted.

Note:

- When screwing the test adapter in to place, make sure that the internal centering sleeve is correctly positioned. If necessary twist it slightly so that the safety catch clicks.
- After screwing in the test adapter, replace the dust caps which are permanently attached to the housing. This protects the surface of the connector pin from dust. (Loose dust caps are no longer used).
- During assembly take care not to touch the connector pin surfaces so that the fiber end faces are not exposed to dirt or scratched.



a) b)

Figure 2-1 OLA-25 test port
a) without test adapter
b) with test adapter in place

2.1.2 Cleaning the test ports

The OLA-25 is fitted with physical contact (PC) connectors (2.5 mm pin) which guarantee interference-free operation across the entire temperature range. Since the fiber ends are in physical contact and the light spot diameter is a mere 0.009 mm, careful handling of the ports is necessary to ensure reliable operation. The procedures outlined below should be observed.

Make sure that the dust caps are always fitted over the test ports when the instrument is not looped into a test setup, as even small dust particles on the fiber end surfaces can affect the attenuation value or cause damage (see Figure 2-2a).

The test ports should be cleaned before every use of the instrument. Use the following procedure:

- Unscrew the test adapter from the test ports. The fiber end surfaces of the plug pins are now easily accessible (see Figure 2-1a).
- Lightly press a piece of adhesive tape (e.g. Scotch Magic Tape or similar weak adhesive tape) onto the surfaces of the ports. Remove the tape. The cleaned surface (125 µm zone) should look like Figure 2-2b.
- Moisten a lint-free tissue with isopropyl alcohol and wipe the surfaces of the test ports.
- Wipe again using a dry tissue.
- Blow any dust off using clean compressed air.

As a final check the fiber end surfaces can be examined under a pocket microscope.
For regular inspections in the field we recommend the pocket microscope:
BUEHLER FIBROSCOPE 0801-9505
Buehler Ltd.
41 Waukegan Road
Lake Bluff
Illinois USA 60044.

2.1.3 Connector life

The insertion loss of an optical connector depends on the mechanical tolerances of the mating surfaces as well as the degree of cleanness. The tolerances may deteriorate in relation to the number of times that the connector is used (plug/unplug cycles). The hard metal version of the connector pin and test adapter (centering sleeve) guarantees a long and reliable life. If care is taken (regular cleaning) more than 1000 plug/unplug cycles can be expected without a change in attenuation.
The life of the connections to the OLA-25 can be extended by leaving the adapter cable which is used for the measurement plugged in. The MK-1 equipment case is laid out to accommodate this configuration.

2.2 Power supply

The OLA-25 needs no power supply in order to function as an optical attenuator, as the attenuator module is totally mechanical.
However, to display the current attenuation value a LC display is needed. This can be powered by any of the following:

- a 9 V dry battery
- a 9 V rechargeable battery
- an a.c. line adapter/charger unit.

2.2.1 Battery operation

One 9 V dry- or rechargeable battery is required. The following types are suitable:

- Dry battery: IEC 6LF22 or 6LR61, operating life approximately 45 h; (supplied with the OLA-25 as standard).
- NiCd rechargeable battery: VARTA or SAFT type TR 7/8 or similar, operating life approximately 10 hours. A suitable battery can be ordered as an accessory.

Discharged battery:

Figure 2-4 Discharged battery warning

When the batteray voltage drops, the warning "BAT" appears on the left in the display. The OLA-25 switches off automatically after 15 minutes.

To change the battery:

- Turn the instrument upside down.
- Push the slide of the battery cover downwards and remove the cover.
- Pull up the plastic tab and remove the old battery.
- Fit the new battery into the instrument with the contacts to the right, negative pole uppermost. The battery will not fit unless it is correctly positioned. Do not use force.
- Finally replace the cover, and push the slide upwards to lock.

⚠ Important

If the dry battery is used to replace a NiCd battery or vice versa, make sure that the switch located inside the battery compartment is correctly positioned (see Figure 2-5). If it is wrongly positioned the dry battery may be destroyed or the NiCd battery will not recharge.

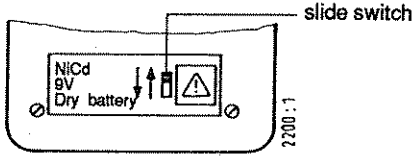


Figure 2-5 Battery type changeover switch

Please dispose of used batteries carefully.

2.2.2 AC line operation and battery recharging with the LNT-1

The recommended a.c. line adapter/charger unit, LNT-1 (BN 2068/01 accessory), can also be used to recharge the NiCd battery if one is used. Before connecting up the LNT-1, make sure that the following safety requirements are met:

⚠ **Important**

Safety class	The LNT-1 is a safety class II instrument as defined in VDE 0411 or IEC publication 348.
AC line voltage	Make sure that the operating voltage of the LNT-1 and the a.c. line voltage correspond.
Temperature	The LNT-1 is designed for indoor use, and can be operated in ambient temperatures between 0 and +50° C.
Ventilation	When in use, set up the LNT-1 so that sufficient ventilation is available.
Condensation	Do not operate the LNT-1 if condensation has formed.

AC line operation:

- Connect the OLA-25 and the LNT-1 using the charger cable provided: plug the adapter/charger jack into the charging socket on the right-hand side of the OLA-25.
- Plug in the LNT-1 power cord.
- Switch on the OLA-25 using the green ON/OFF button; the attenuation display appears with the indication "PERM".

Charging the NiCd battery:

- Connect the OLA-25 to the LNT-1 as for a.c. line operation.
- Hold down the "ON/OFF" switch on the OLA-25 until the green "CHARGE" LED lights.
- The charging cycle takes 14 hours; at the end of this period charging stops automatically.
- It is also possible to operate the OLA-25 whilst charging is in progress.
- It is also possible to start the charging cycle even if a dry battery is fitted. No charging current will flow if the switch in the battery compartment is correctly set.
- If the a.c. power line fails, charging will not continue. The cycle will need to be restarted.

2.3 EMI/RFI suppression

The instrument conforms to the following regulations governing EMI/RFI suppression:

Regulation 1046/1984 of the Federal German Postal Authority (DBP),
VDE regulation 0871, Class B limit value,
CISPR publication 11 (150 kHz to 1 GHz)
CENELEC HD 344 (CLC-CISPR HD4) and
FCC Rules, Part 15, Subpart J, Class A

If this instrument is used in conjunction with other equipment, this must also conform to the above requirements to ensure adequate EMI/RFI suppression. W&G instruments conform to these standards when used as part of a system as long as they are correctly set up and the specified connecting cables are used.

When used correctly with other equipment, these regulations will also be conformed with. Please ensure that only the recommended connecting cables and connectors are used and that adequate screening is provided where necessary.

If a W&G instrument should generate EMI/RFI inspite of the above precautions, we will be happy to offer advice.

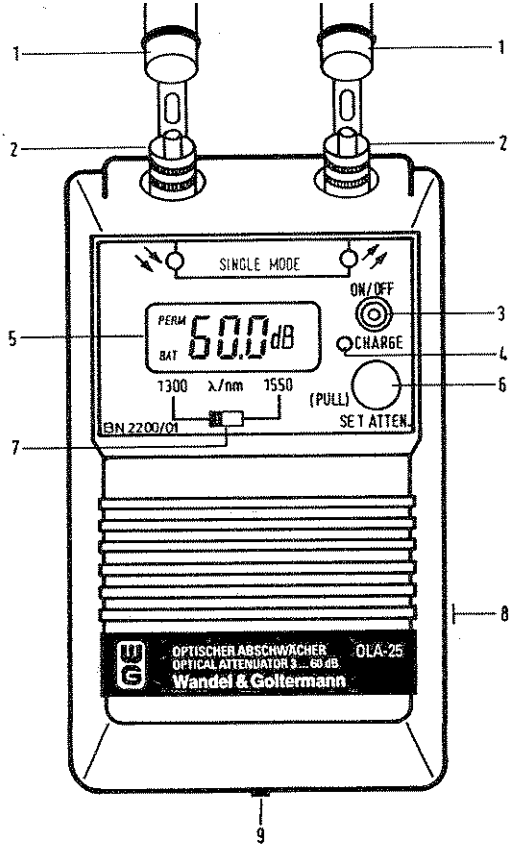
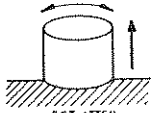
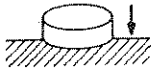
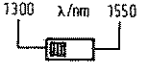


Figure 3.1-1 Front view of the OLA-25

3 Operation

3.1 Overview

No.	Symbol	Explanation
1		Dust caps
2		Test ports, with test adapters screwed into place (BN 2060/00.XX)
3	ON/OFF 	On/off switch - press button briefly - Auto-off circuit on - press button longer (approx. 2 seconds) permanent operation mode - press button longer (approx. 4 seconds) recharging battery
4	CHARGE 	LED "CHARGE" lights when the battery is being charged. (see ON/OFF switch)

No.	Symbol	Explanation
5		Shows attenuations value with the warning that the battery is almost discharged ("BAT") and that the instrument is in permanent operation ("PERM")
6		Rotary control to set the attenuation value - Pull knob up to select the attenuation value - Push knob in to lock
		This rotary control does not have an end-stop. When the setting limits of the attenuation value are reached, the display shows - LO; lower limit (< 3 dB) - HI; upper limit (> 60 dB)
7		Wavelength changeover switch

No.	Symbol	Explanation
8		Socket for a.c. line Adapter/charger on the side of the instrument
9		Threaded bush for shoulder strap on the side of the instrument

OLA-25 operating instructions

- Prepare test ports: see section 2.1
  (cleaning, selecting test adapter)
- Loop the OLA-25 into the test circuit: see section 3.4
- Switch on: see section 3.2.1
- Set the required wavelength: see section 3.2.2.1
- Set the attenuation value: see section 3.2.2.2

3.2 Instrument settings

3.2.1 Switching on, auto-off and permanent operation

The "ON/OFF" button (3) switches the OLA-25 on and off.

When battery powered, the OLA-25 can be operated in either auto-off or permanent operation modes:

- Press the button briefly when switching on ("PERM" does not appear in the display): The instrument switches off automatically after approximately 15 minutes.
- Hold the button down until "PERM" appears in the display (see Figure 3-2). The instrument is then in permanent operation mode.

Figure 3-2 "PERM" indicates permanent operation

The auto-off circuit is disabled when the OLA-25 is operated using an a.c. adapter/charger unit (see section 2.2.2).

If the a.c. power supply fails and a battery has been fitted, it takes over the power supply and the instrument switches itself off automatically after approximately 15 minutes.

3.2.2 Setting the wavelength and attenuation values

3.2.2.1 Setting the wavelength

The slide switch (7) is used to set the wavelength of 1300 nm or 1550 nm.

3.2.2.2 Setting the attenuation

The attenuation range is 3 dB to 60 dB.

⚠ **Important**
The displayed attenuation value also includes the losses of both connectors on the OLA-25; see section 4.1.

The OLA-25 can also be used to attenuate the light level for wavelength other than 1300 nm or 1550 nm in the range 800 nm to 1700 nm. However, the displayed attenuation value needs to be corrected; see section 4.3.

The attenuation is set continuously using the rotary control (SET ATTEN.). Pull up the knob to set the attenuation.
- To increase attenuation turn knob clockwise
- To decrease attenuation turn knob anticlockwise

Attenuation can be set to a resolution of 0.1 dB.

As the position of the attenuation filter is continuously variable, it may happen that the last digit of the displayed value is not stable. If this is a problem, turn the control slightly until the display is stable.

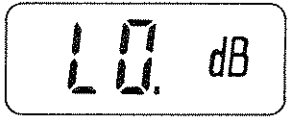
Press the knob in to lock the setting.

The attenuation value is not affected by switching the OLA-25 off.

The rotary control has no end-stop. If the upper limit (60 dB) is exceeded, the display shows:

Note:
If the control is turned further in a clockwise direction the maximum attenuation value is reached and the attenuation value will then rapidly decrease. This is due to the way the OLA-25 is constructed and is of no consequence in normal operation.

If the lower limit (3 dB) is exceeded, the display shows:



3.3 Looping the OLA-25 into a test circuit

3.3.1 General information

Due to the symmetrical construction of the OLA-25 it is possible to operate it inversely. The assigning of the test ports as input and output as shown on the front panel can be reversed if required by the test configuration. The return loss a_R - normally referred to the left-hand test port - is then also valid for the right-hand test port.

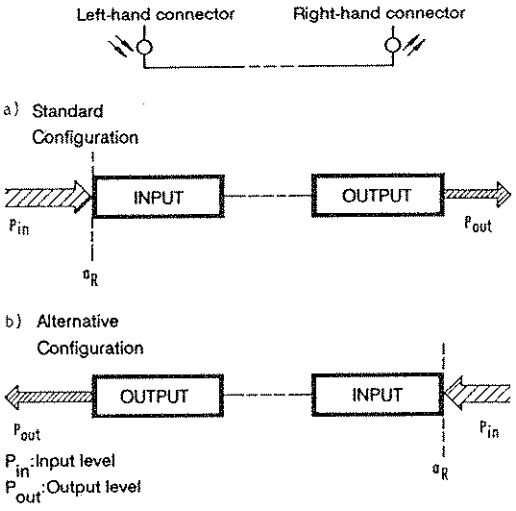


Figure 3-3 Input and output are reversible

3.3.2 Connection using test adapters (2.5 mm connectors)

If the user has a 2.5 mm connector system, cables from the system can be connected directly using the corresponding BN 2060/00.XX test adapters (see Figure 3-4). The OLA-25 should be completed with the right test adapters (see section 2.1.1).

At present test adapters are available for the following types of 2.5 mm connector (XX):

* DIN 47 256
* NTT FC-PC
* ST type AT&T
* HMS-10/A Diamond (SMA connection)
* HMS-10 Diamond (with screw connection and BNC plug)

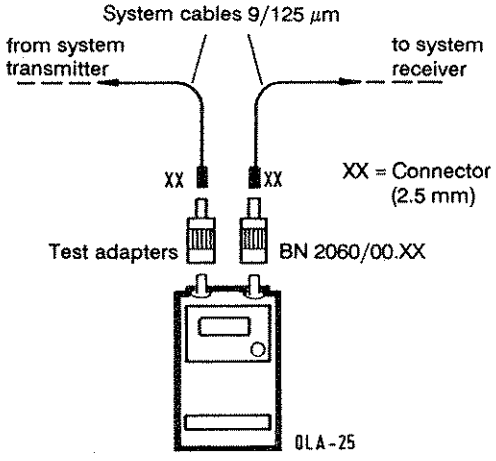


Figure 3-4 Direct connection of system cables via test adapters

3.3.3 Connection using W&G K 31XX adapter cables

If the transmission system does not use the standard 2.5 mm connector system, 9/125 µm adapter cables from the K 31XX series (accessory) are available to match non-standard connectors to the OLA-25 (see Figure 3-5). These cables always have the DIN connector for connection to the OLA-25 but the connector to the system can be selected, e.g. Biconic, Radiall VFO, etc.

Due to their good transmission qualities, the W&G K 31XX adapter cables are suitable for use as test- or reference cables; the displayed attenuation value on the OLA-25 also includes the connector losses of the DIN connectors.

For reference measurements based on the DIN connector, cable versions are available which are completed with DIN, FC and HMS-10 connectors (2.5 mm) on the system side.
When the adapter cables are used, the OLA-25 must be fitted with BN 2060/00.30 test adapters.

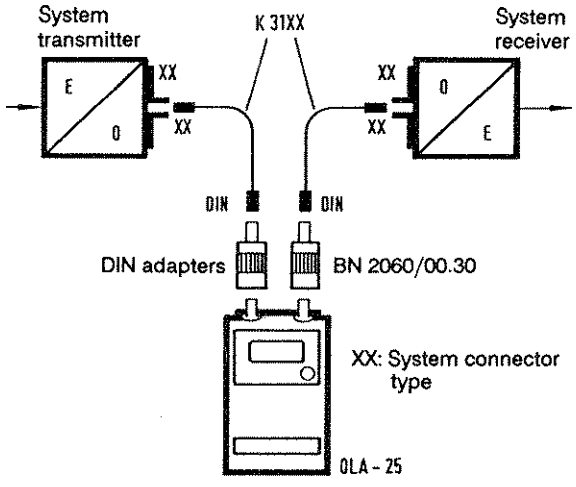


Figure 3-5 Connection using K 31XX series adapter cables (monomode systems)

3.3.4 Test example

Measuring the sensitivity of a digital receiver, determined as a function of the bit error rate and the minimum permissible receive level.

Setting up the test configuration

- Disconnect terminal equipment [1], [2] from the fiber optics link (cable rack).
- Loop the OLA-25 into the system (teminal equipment) via the exchange wires K_1 and K_2. (Select the test adapters according to the system connector XX).
- Connect the bit error test set between the multiplex equipment and the terminal equipment.

⚠ Protection from laser radiation

To avoid unnecessary exposure to laser radiation when connecting the OLA-25 to terminal equipment which is in operation, the following procedure should be observed:

- Connect the OLA-25 to the receiver section R_{x2} using cable K_2 (right-hand connector).
- Connect cable K_1 to the left-hand connector of the OLA-25.
- Connect the free end of cable K_1 to the transmitter section T_{x1}.

Determining the receiver sensitivity

- Disconnect cable K_2 from the receiver R_{x2}.
  ⚠ Warning - laser radiation accessible.
- Connect an optical power level meter (e.g. OLP-25 from W&G) to the OLA-25 and set the absolute level display and wavelenght as shown in Figure 3-5b.
- The displayed level on the OLP-25 corresponds to the minimum receiver sensitivity.

Note:
When measuring receiver sensitivity the following must be taken into account:

- Extinction factor
- Receiver R_{x2} connector loss
- OLP-25 measurement error

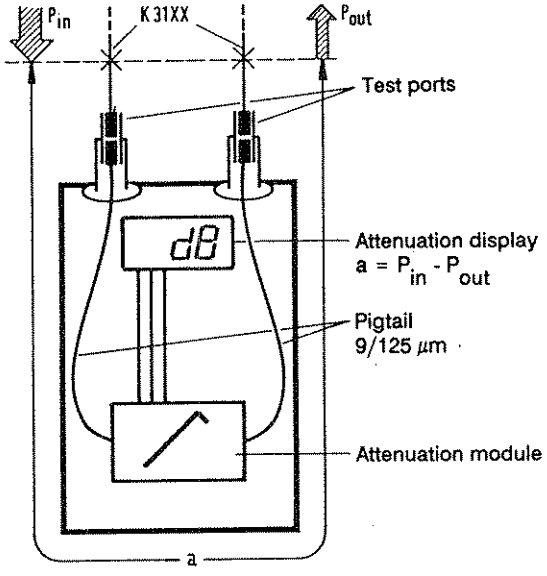
4 Further information

4.1 Displayed optical attenuation

The optical attenuation displayed on the OLA-25 corresponds to the actual insertion loss, a, which includes the losses of the attenuation module and the connector losses (see Figure 4.1-1). As these losses are included in the calibration, there is no need to correct for connector losses as would normally be the case.

As two connectors (one to the instrument and the other to the system cable side) are involved when characterizing the insertion loss of fiber optics connectors, the cable side on the OLA-25 is represented by the reference connector to DIN 47 256. This makes it possible to specify the whole connection using W&G test cables (K 31XX series, see also section 3.3.2).
The attenuation error given in the specifications (see also the error limits in section 1.3) refers to this configuration; see Figure 4.1-1.

If the OLA-25 is operated using alternative connectors (FC, ST, HMS-10) via BN 2060/00.XX test adapters (see section 3.3.1) and using cables from other manufacturers, the error data in section 1.3 should be taken as a typical value. The losses of both test ports are considerably influenced by the connectors used (general condition, temperature) and may be greater than or less than the additional $\pm$ 0.3 dB stated.



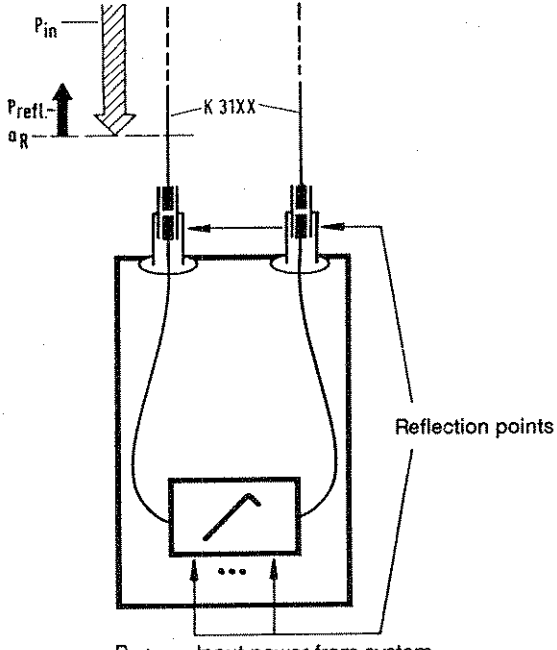
P_{in} : Input power from system
P_{out} : Output power to system

Figure 4.1-1 Displayed attenuation a on the OLA-25

4.2 Return loss

The attenuator module (see Figure 4.1-1) of the OLA-25 has a return loss of at least 25 dB. The return loss of > 23 dB given in the specifications also includes the reflections due to the test ports and represents the actual performance of the OLA-25 in the test configuration (see Figure 4.2-1).

The connectors to DIN 47 256 are included as reference connections, as used on the test cables from Wandel & Goltermann (K 31XX series). If the OLA-25 is operated using alternative connectors (FC, ST, HMS-10) in connection with cables from other manufacturers, the actual return loss, a_R, cannot be specified accurately. This is because of the great fluctuations between the various connector types which determine the total reflection behaviour.



P_{in}: Input power from system
$P_{refl.}$: Reflected level, generated from the sum of the partial reflections
a_r: Actual return loss

Figure 4.2-1 Definition of return loss

The return loss value a_R given in section 1.2 describes the behaviour when the attenuation due to the module is minimum (a < 3 dB) which is the least favorable condition. If the attenuation of the OLA-25 is increased, the reflections detected at the output are reduced so that the total return loss is stabilized at a value of typically 26.5 dB.

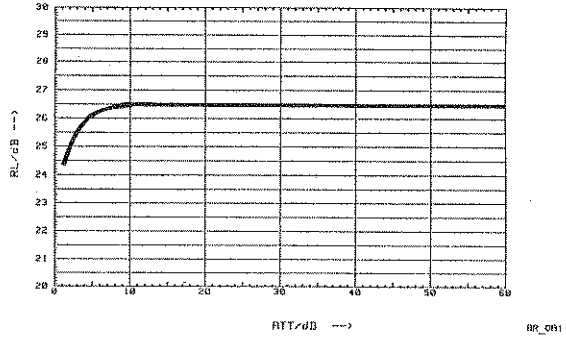


Figure 4.2-2 Return loss a_R when the attenuation of the OLA-25 is altered

4.3 Light attenuation at non-calibrated wavelengths

The attenuation display of the OLA-25 is calibrated at 1300 nm and 1550 nm. The OLA-25 can also be used in systems with wavelengths other than 1300 nm or 1550 nm. The attenuation can be set correctly using correction factors as given in the set of curves in Figure 4.3-1.

Example:
- System wavelength = 1250 nm
- The attenuation a displayed on the OLA-25 is 50.0 dB (wavelength switch on 1300 nm)

Correction
- The correction value read off the set of curves (-50 nm curve):
  a = +0.6 dB
- Actual attenuation a = 50.6 dB

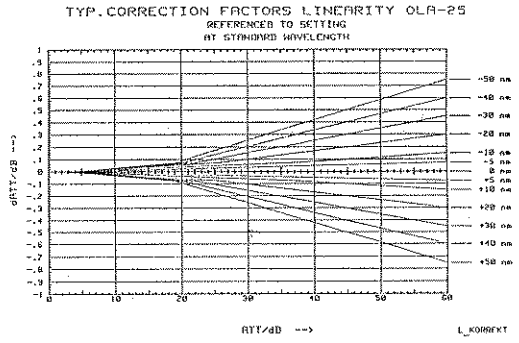


Figure 4.3-1 Correction values a_{corr} for determining the actual attenuation $a = a + \Delta a$

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