OLA-150
Optical Attenuator

BN 2206/05, Series AA ...

Plug-in Module for
OMS-150 Optical Measuring System

Operating Manual

Please file the table of contents and text pages as Chapter 7 in your OMS-150 operating manual, BN 2207/98.21.

BN 2206/98.21

Wandel & Goltermann
Communications Test Solutions

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

Wandel&Goltermann GmbH & Co.
Elektronische Meßtechnik
Mühleweg 5, D-72800 Eningen u. A.
©1998

Author: TD/MDD
Translator: John Nutley/Gary Hess

Order no.: 2206/98.21
Edition: 01/98.04, AA ...

Subject to change without notice.
Our normal guarantee and delivery terms apply.

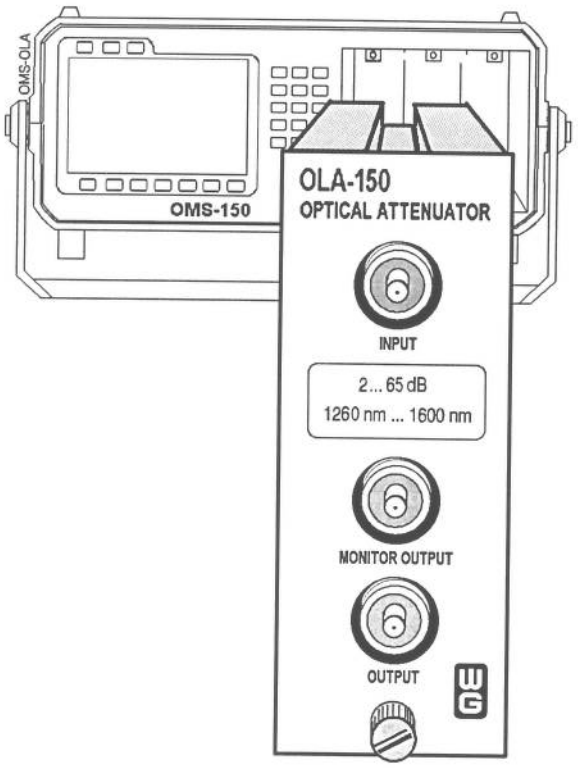
Printed in Germany

Contents

7 OLA-150 Optical Attenuator

7 OLA-150 Optical Attenuator

7.1 Introduction



Application

The OLA-150 is primarily intended for determining the dynamic characteristics of system receivers using single mode technology (9/125 µm) and operating in the 2nd and 3rd optical windows (1300 and 1550 nm wavelengths).

The excellent reflection characteristics of the OLA-150 make it particularly useful for operation with feedback-sensitive DFB laser systems and bidirectional communications systems using wavelength division multiplex. Generally, the OLA-150 is used together with an optical power level meter (preferably from the OLP range of modules) and a bit error meter for these applications.

When used together with a Laser Source from the OLS-xxx range, other applications are possible. For example: the combination of OLA-150 and OLS-xxx modules yields a variable level optical source for precise linearity measurements.

Function

The OLA-150 uses a neutral density filter placed in the expanded optical path between the input and output fibers for attenuating the light (attenuator module). The position of the filter is altered by a motorized drive system to provide defined attenuations in the range from 2.5 up to 65 dB (1300 nm) or up to 60 dB (1550 nm). An additional shutter is provided in front of the attenuation filter and can be placed in the optical path to give 100% attenuation when required.

When the shutter is open, the actual attenuation value is displayed; this value also includes the connector losses.

Constant linearity to within ± 0.2 dB (typically) over the entire attenuation range is achieved by individual calibration of the display as a function of the attenuation filter characteristic. Calibration in the factory is at the two standard wavelengths, 1310 and 1550 nm. The use of appropriate correction factors allows the attenuation to be set with great accuracy within ±50 nm of the calibrated wavelengths.

Operation

The setting menu (mainframe) provides various methods for setting the attenuation and wavelength. Discrete values can be entered using the numeric keys, or the value can be continuously varied using the rotary knob. Sub-menus allow the parameters to be set rapidly to preferred standard values.

The current attenuation is shown as an absolute or relative value. The display resolution can be varied. The insertion losses of test setups or of the OLA connectors can be taken into account simply by using the relative value display (reference attenuation).

Monitor output

A portion of the attenuated optical signal is fed via a 10 dB coupler to the monitor output for special applications. This enables bit error ratio tests (BERTs, MONITOR OUTPUT) in parallel with an optical power level measurement (OUTPUT).

Test connectors

The OLA-150 is looped into the test configuration via appropriate adapters which are available for all commonly-used systems, such as DIN, FC, ST, etc. The test connections are of the physical contact (PC) type. The use of these connectors, plus the anti-reflection coated components in the attenuator module, make the OLA-150 ideal for very low reflection measurements. A return loss of > 35 dB can be achieved with the OLA-100. This can naturally only be fully utilized if the cables are also equipped with very low reflection PC connectors (e.g. DIN, Super FC-PC). Some test cables available from the W&G range (K 31xx series) are fitted with such connectors, making them especially suitable for use in systems which are particularly vulnerable to feedback problems.

7.2 Parameter display and menu

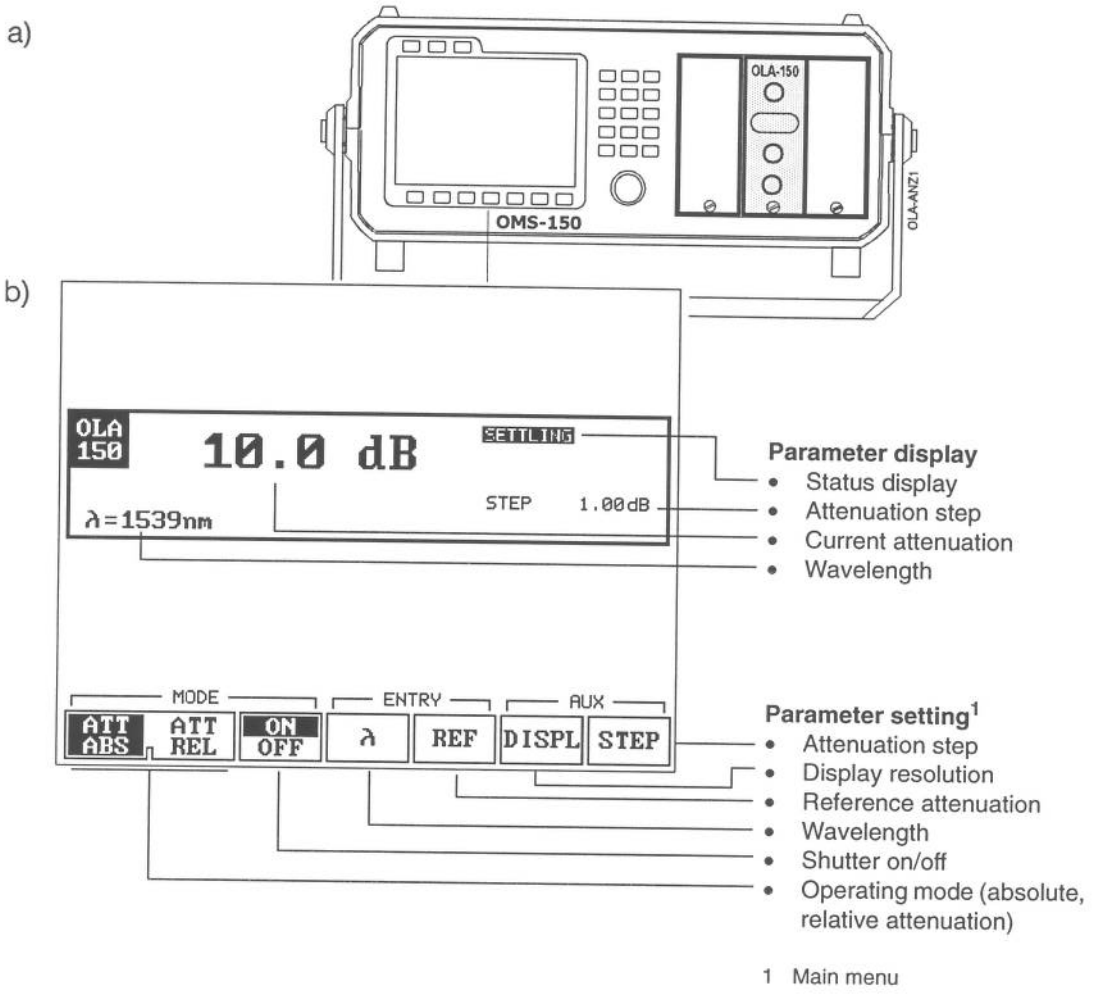


Fig. 7-1 OMS-150 configured as optical attenuator

a) OLA-150 module fitted in slot S2
b) Parameter display and menu

7.3 Parameter overview

7.3.1 Manual operation (menu tree)

(see Fig. 7-1)

Parameter		Meaning	Page
MODE	**ATT ABS**	Absolute Attenuation	7-7
	ATT REL	Relative Attenuation	7-9
	ON/OFF	Shutter on/off	7-11
ENTRY	**λ**	Wavelength	7-13
	REF	Reference attenuation	7-15
AUX	**DISPL**	Display resolution	7-17
	X	1 dB display resolution	
	X.X	0.1 display resolution	
	X.XX	0.01 display resolution	
AUX	**STEP**	Attenuation step	7-18
	STEP DOWN	Increase attenuation by one step	
	STEP UP	Decrease attenuation by one step	
	ATT MIN	Set minimum attenuation	
	ATT MAX	Set maximum attenuation	
	STEP SIZE	Set attenuation step	
	FIXED ATT	Fixed attenuation steps	7-19
	10.00	– fixed value, e.g. 10 dB[1]	
	20.00	– fixed value, e.g. 20 dB[1]	
	30.00	– fixed value, e.g. 30 dB[1]	
	40.00	– fixed value, e.g. 40 dB[1]	
	50.00	– fixed value, e.g. 50 dB[1]	
	ATT TO KEY	– Store fixed attenuation step	

1 Fixed attenuation steps can be programmed as required

7.3.2 Remote control (IEC/IEEE command tree)

Program word	Meaning	Seite
:ATTenuator<SN>		
:POWer		
:ATTenuation <data>	Attenuation (absolute/relative)	7-8
:ATTenuation?		
:PATTenuation <data>	Programming fixed attenuation steps	7-20
:PATTenuation?	Query attenuation value	7-20
:ILOSs?	Query residual attenuation	7-8
:REFerence		
:STATe <data>	Toggle "ABS-/REL" display	7-12
:STATe?		
:VALue <data>	Reference attenuation	7-16
:VALue?		
:STATe <data>	Shutter "on/off"	7-11
:STATe?		
:STEP <data>	Attenuation step width	7-19
:STEP?		
:WAVelength <data>	Wavelength	7-14
:WAVelength?		
:DISPlay <SN>		
:NFORmat		
:LOGarithmic <data>	Display resolution	7-17
:INSTrument <SN>		
:COUPle		
:WAVelength <data>	Module coupling for wavelength	7-14
:WAVelength?		

Abbreviations used for program words

Abbreviation	Meaning
<SN>	Whole number 1 I 2 I 3 for selecting the SLOT number
<wsp>	White space: Separates Program Data from Command Program Header
<NR1>	Whole number
<NR2>	Floating point number without exponent
<NR3>	Floating point number with exponent
MIN	Syntax for minimum value of a numerical parameter (Character Program Data)
MAX	Syntax for maximum value of a numerical parameter (Character Program Data)
DEF	Syntax for default value of a numerical parameter (Character Program Data)
ON | 1	Alternative syntax for On status of switch functions (Boolean Program Data)
OFF | 0	Alternative syntax for Off status of switch functions (Boolean Program Data)

Note: See section 4.4 “Syntax” for more information.

7.4 Operating modes (MODE)

Absolute attenuation ATT ABS

Meaning

ATT ABS (ATTenuation ABSolute) displays the absolute attenuation in the wavelength range 1260 to 1600 nm. The displayed attenuation value (Units: dB) corresponds to the current attenuation between the test connections.

Attenuation range

The attenuation range of the OLA-150 is (typically) 2.5 to 60 dB.

The wavelength characteristic of the attenuation filter allows higher attenuation values to be set at lower wavelengths than at higher wavelengths.

Attenuation range in the main path "INPUT —> OUTPUT" according to display:

1260 bis 1360 nm: **2.5 to 65 dB**

1360 bis 1600 nm: **2.5 to 60 dB**

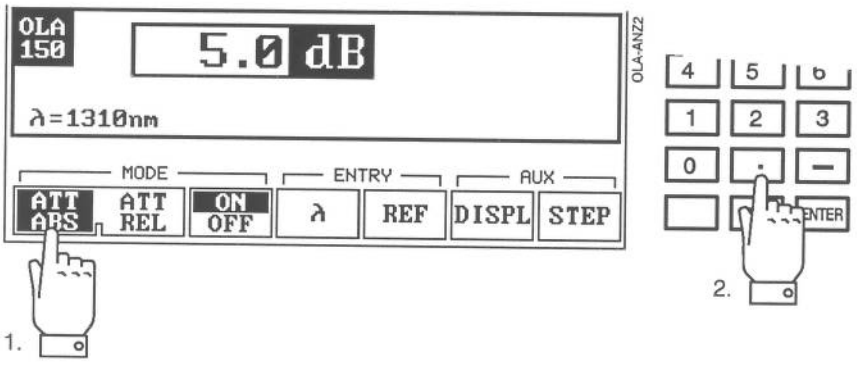
If the maximum attenuation is set, the attenuation value will be switched automatically if the 1360 nm wavelength is exceeded.

Note: The Attenuation which is effected in the secondary path "INPUT —> MONITOR OUTPUT", is 10 dB higher than the attenuation in the main path.

The minimum settable attenuation is basically governed by the plug attenuations. This residual attenuation varies from one instrument to another and is specified individually for each OLA-150 under the parameter **ILOSS** (Insertion LOSS). An insertion loss of < 2 dB is achievable with high-quality connectors.

Note: The attenuator function must be activated using the **ON/OFF** menu switch: ON is marked. The actual attenuation value is displayed.

Menu setting



⇒ Set discrete attenuation values using numeric keys + "ENTER" (see example above).

– or –

⇒ Continuous variation of attenuation values using rotary knob.

Program word

Before absolute attenuation will be programmed, you have to check that switch "ABS/REL" (see page 7-12) is set to OFF.

Setting:

```
:ATTenuator <SN>
   :POWer
      :REFerence
         :STATe<wsp>OFF
```

- Switch

```
:ATTenuator<SN>
   :POWer
      :ATTenuation<wsp>2.00[1]
                       .
                       .
                       65.00
                       MIN[2]
                       MAX
                       DEF
                       UP[3]
                       DOWN[3]
                       ATT<n>[4]
```

- Absolute attenuation
  - individual
  - ...
  - ...
  - min. value
  - max. value
  - default
  - increase
  - decrease
  - fixed value

Query:

```
:ATTenuator<SN>
   :POWer
      :ATTenuation?
      :ILOSs?
```

Response:

```
<NR3> in dB
```

Default:

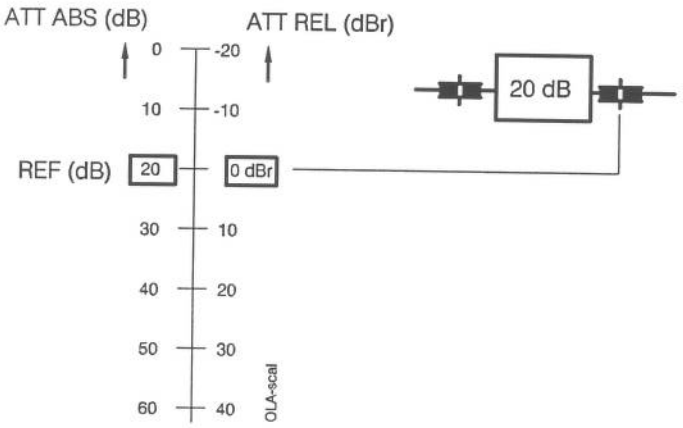
```
2 dB
```

1 Basic units: dB; single value settings can be made using decimal numeric data <NR1>, <NR2>, <NR3
2 Same as residual attenuation (ILOSs)
3 Changes the attenuation by one STEP value
4 <n>: 1 ... 5 attenuation steps 1...5

Relative attenuation — ATT REL

Meaning

ATT REL (ATTenuation RELative) switches to display of relative attenuation. The insertion losses of the test setup or of the OLA-150 connectors (ILOSS) can be stored as a reference value (REF) to which all subsequent attenuations are referred (display in dBr).



Definition

ATT REL (dBr) = ATT ABS (dB) - REF (dB)

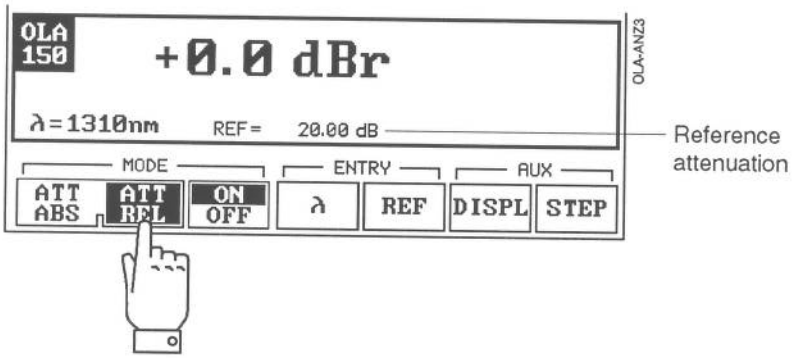
Relative attenuation — Absolute attenuation — Reference attenuation

Display range

-120 dBr bis +185 dBr (λ < 1360 nm)

-120 dBr bis +180 dBr (λ > 1360 nm)

Menu setting



Program word (SCPI)

Before relative attenuation will be programmed, you have to check that switch "ABS/REL" (see page 7-12) is set to ON.

Setting:

```
:ATTenuator <SN>
   :POWer
      :REFerence
         :STATe<wsp>ON
```

- Switch

```
:ATTenuator<SN>
   :POWer
      :ATTenuation<wsp> -120.00[1]
                        .
                        .
                        185.00[1]
                        MIN[2]
                        MAX
                        DEF
                        UP[3]
                        DOWN[3]
                        ATT<n>[4]
```

- Relative attenuation
  - individual
  - ...
  - ...
  - min. value
  - max. value
  - default
  - increase
  - decrease
  - fixed value

Query:

```
:ATTenuator<SN>
   :POWer
      :ATTenuation?
```

Response:

```
<NR3> in dBr
```

Default:

```
2 dBr (Referenzdämpfung 0 dB)
```

1 Basic units: dB; single value settings can be made using decimal numeric data <NR1>, <NR2>, <NR3
2 Same as insertion loss (ILOSs)
3 Changes the attenuation by one STEP value
4 <n>: 1 ... 5 attenuation steps 1...5

Shutter on/off — ON/OFF

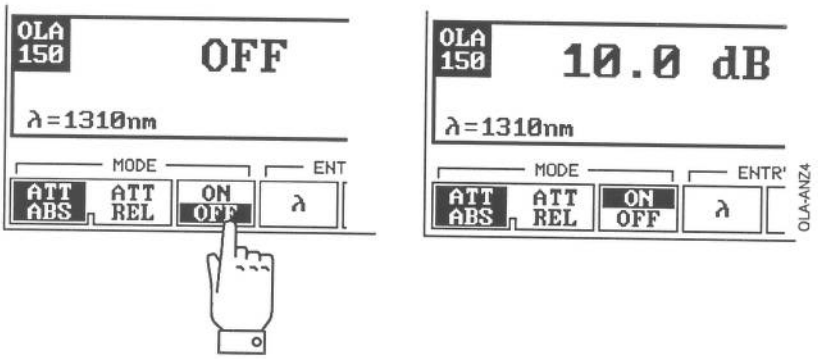
Meaning

A shutter is provided in the optical path between the input and output connections in addition to the attenuation filter. The shutter is controlled by the **ON/OFF** function.

OFF The shutter is closed: Infinite attenuation (100%).
ON The shutter is open: The actual attenuation setting (filter position) is the effective attenuation. This attenuation value is shown in the display and the OLA-150 is ready for further attenuation settings.

Note: Attenuation settings using the rotary control are disabled in the *OFF* position, to avoid unintentional changes in setting.

Menu setting



Program word

Setting:

- Shutter on
- Shutter off

```
:ATTenuator <SN>
   :POWer
      :STATe<wsp> ON[1]
                  OFF[1]
```

Query:

```
:ATTenuator<SN>
   :POWer
      :STATe?
```

Response:

```
<NR1> 0í1
```

Default:

```
OFF
```

1 Boolean

ABS / REL display :REF:STAT

Meaning

The `REFerence:STATe` command toggles between absolute and relative attenuation display modes in remote control mode.

OFF Display of absolute attenuation
ON Display of relative attenuation

When using relative attenuation, the value of reference attenuation (see page 7-15) have to be taken into consideration; see also definition on page 7-9.

Program word

Setting:
```
:ATTenuator <SN>
   :POWer:
      :REFerence
         :STATe<wsp>ON[1]
                   OFF[1]
```

Query:
```
:ATTenuator<SN>
   :POWer:
      :REFerence
         :STATe?
```

Response: `<NR1> 0 | 1`

Default: `OFF`

1 Boolean
2 Absolute attenuation display

7.5 Main parameters (ENTRY)

Wavelength λ

Meaning

The wavelength λ is defined as a point on the attenuation filter characteristic; (see Fig. 7-2). The filter is calibrated at the standard wavelengths of 1310 and 1550 nm. To allow accurate setting of the attenuation over the entire wavelength range, correction values from the characteristic are applied. These values are stored in EPROMs specific to each attenuation filter, covering the wavelength range from 1260 to 1600 nm. This allows attenuation values to be set with high accuracy for the entire wavelength range (resolution 1 nm).

The wavelength can be set using the rotary control or the numeric keys. The preferred wavelengths of 1310 nm and 1550 nm are also directly selectable. If other modules are fitted in the mainframe, the wavelength can be set by coupling modules.

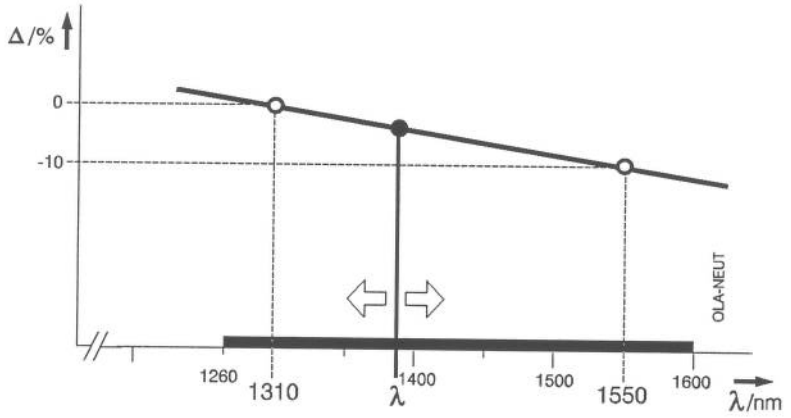
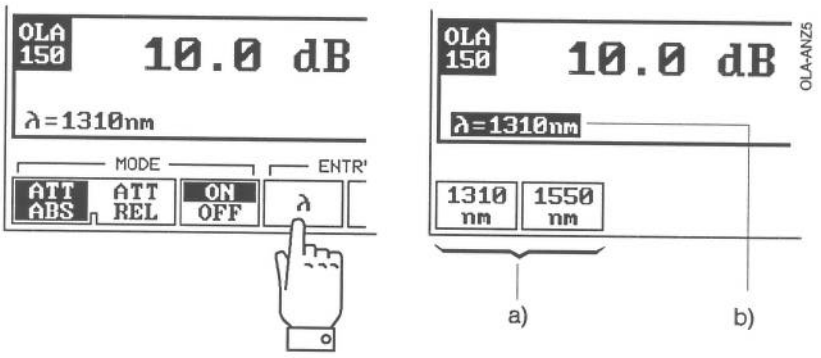
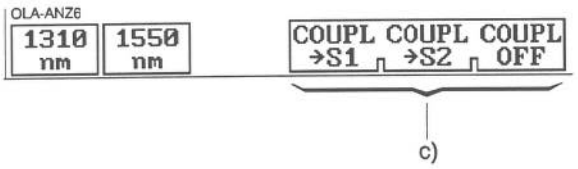


Fig. 7-2 Attenuation filter characteristic

Menu setting



a) Default values:
   ⇒ Select menu field **1310 nm** (or 1550 nm).
b) Individual entry:
   ⇒ Enter wavelength value with rotary control or digit keys ("ENTER").



c) Module coupling for Slot 1 or Slot 2:
⇒ Select menu field **COUPL -> S1** (or COUPL -> S1).

Program word

Wavelength

Setting:
```
:ATTenuator<SN>
   :POWer
      :WAVelength<wsp> 1260NM[1]
                       .
                       .
                       1600NM[1]
```

Query:
```
:ATTenuator<SN>
   :POWer
      :WAVelength?
```

Response:
```
<NR3>
```

Default: 1310NM

1 Base units meters; Suffix m, mm, µm, nm; Entering discrete values as decimal numeric data <NR1>, <NR2>, <NR3> or MIN, MAX, DEFAULT

Module coupling

Setting:
```
:INSTrument<SN>
   :COUPle
      :WAVelength<wsp> S1
                       S2
                       S3
                       OFF
```

- Couple to S1
- Couple to S2
- Couple to S3
- Couple off

Query:
```
:INSTrument<SN>
   :COUPle
      :WAVelength?
```

Response:
```
<Character Response Data>
S1 | S2 | S3 | OFF
```

Default: OFF

Reference attenuation REF

Meaning

The reference attenuation **REF** is used as a reference value for the relative attenuation display; see ATT REL parameter (see Sec. 7.4).

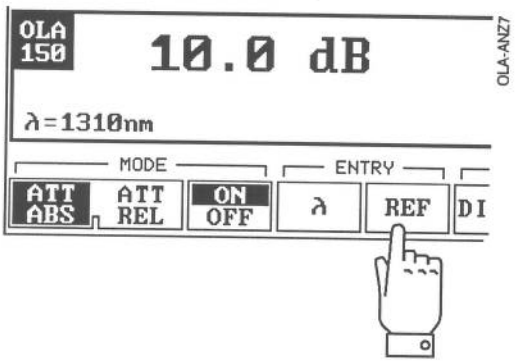
REF can be set by transferring the actual atttenuation value (ATT ABS) or by direct entry using the rotary knob or numeric keys.

The individually calibrated insertion loss **ILOSS** of the OLA-150 can be used directly as the reference attenuation.

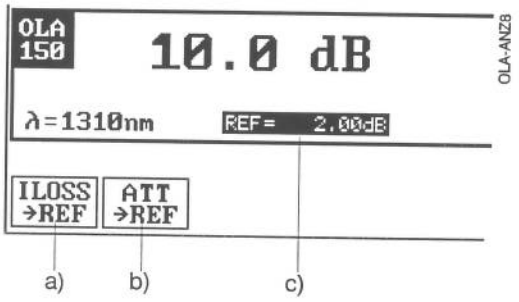
Setting range

-120 to +120 dB

Menu setting



⇒ Enable entry (---> sub-menu).



a) Transfer of the residual attenuation as the reference attenuation:
   ⇒ Select menu field **ILOSS-->REF**

b) Current absolute attenuation as reference attenuation:
   ⇒ Select menu field **ATT-->REF**

c) Individual entry of reference attenuation:
   ⇒ Enter reference attenuation with rotary control or digit keys ("ENTER").

Program word

Setting:

```
:ATTenuator<SN>
   :POWer:
      :REFerence
         :VALue<wsp>
```

- continuous
  - ...
  - ...
  - ...

```
-120[1]
.
.
+120[1]
```

```
:ATTenuator<SN>
   :POWer:
      :REFerence
         :VALue<wsp>
```

- discrete
  - residual
  - absolute attenuation
  - min. value (-120 dB)
  - max. value (120 dB)
  - default (0 dB)

```
ILOSs
ATTenuation
MIN
MAX
DEF
```

Query:

```
:ATTenuator<SN>
   :POWer:
      :REFerence
         :VALue?
```

Response:

```
<NR3> in dB
```

Default:

```
0 dB
```

1 Base unit: dB
Single value settings can be made using decimal numeric data <NR1>, <NR2>, <NR3>

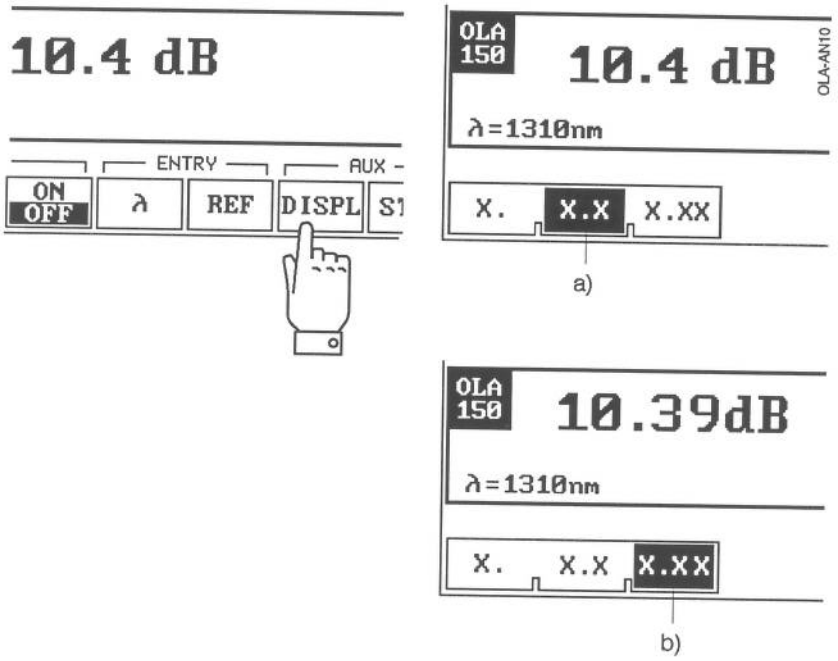
7.6 Auxiliary parameters (AUX)

Display resolution — DISPL

Meaning

DISPL is used to set the display resolution to 1 dB, 0.1 dB or 0.01 dB to suit the measurement application.

Menu setting



a) Original setting: 0.1 dB resolution
b) New setting: 0.01 dB resolution

Program word

Setting:

```
:DISPlay<SN>
   :DISPlay<SN>
      :LOGarithmic<wsp>0
                       1
                       2
```

- 1 dB
- 0.1 dB
- 0.01 dB

Query:

```
:DISPlay<SN>
   :DISPlay<SN>
      :LOGarithmic?
```

Response:

```
<NR1>; 0 | 1 | 2
```

Default:

```
1
```

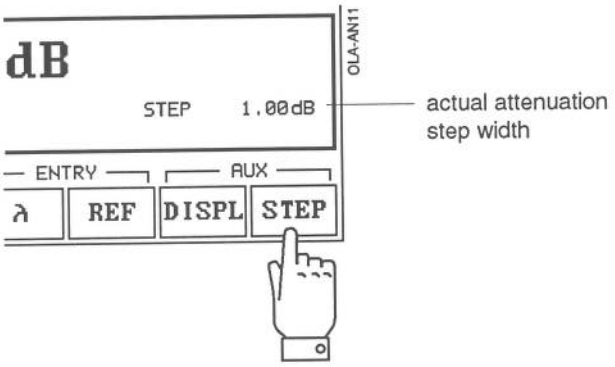
Attenuation step width/Fixed attenuation values STEP

Attenuation step width

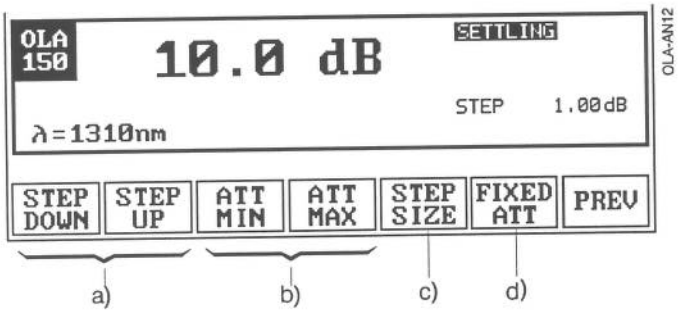
Meaning

The **STEP** function allows the attenuation to be varied in fixed steps. The step width can be set as required.

Menu setting



⇒ Call up selection menu.



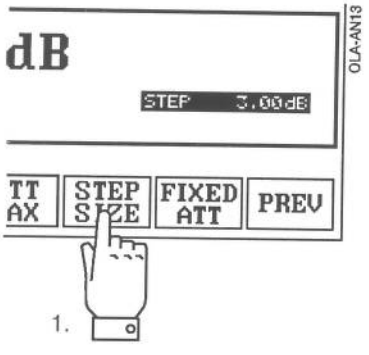
a) Changing the attenuation in steps:
   ⇒ One step smaller: Select menu field **STEP DOWN**.
   ⇒ One step larger: Select menu field **STEP UP**.
   The STEP UP and STEP DOWN functions are repeated if you hold down the softkey (auto-repeat function).

Note: The attenuation can also be changed in steps using the rotary control in the selection menu (with the current STEP value).

b) Setting the attenuation limits:
   ⇒ Minimum attenuation: Select menu field **ATT MIN**.
   ⇒ Maximum attenuation: Select menu field **ATT MAX**.

c) Setting the attenuation step-size individually:
   ⇒ Select menu field **STEP SIZE**.
   ⇒ Enter the attenuation step-size (e.g. 3 dB) with the rotary control or digit keys ("ENTER"); see figure on next page.

d) Setting fixed attenuation values: See section "Fixed attenuation values" on page 7-19.



Programming word

Setting:

- individual

```
:ATTenuator<SN>
   :POWer
      :STEP<wsp> 0.01[1]
                 65.00[1]
```

- Min. step-size

```
                 MIN
```

- Max. step-size

```
                 MAX
```

- 1 dB step

```
                 DEF
```

Query:

```
:ATTenuator<SN>
   :POWer
      :STEP?
```

Response:

```
<NR3> in dB
```

Default:

```
                 1.00
```

1 Base unit dB; entry of individual parameter value as <NR1>, <NR2>, <NR3> also with DB suffix

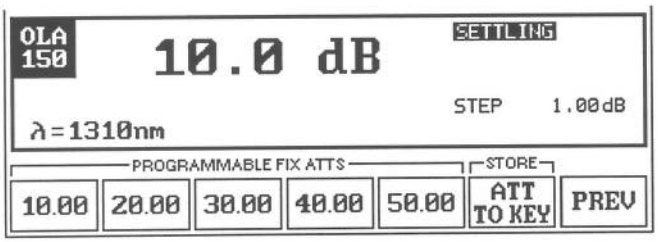
Fixed attenuation values

Meaning

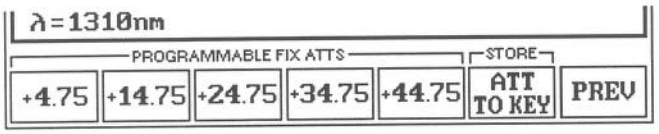
Use the **STEP** function to program and call up five fixed attenuation values.

Menu setting

1. Call up the **FIXED ATT** function in the selection menu for the attenuation step-size.
   The submenu from Fig. 7-3, page 7-20 is opened.
2. Set the attenuation value as usual with the keypad or rotary control.
3. Press the **ATT TO KEY** key.
   Input of the fixed attenuation begins (inverse display of ATT TO KEY)
4. Press desired fixed attenuation key (softkey 1 to 5).
   - The attenuation value is accepted.
   - ATT TO KEY changes back to default display.



ATT ABS mode



ATT REL mode
(e.g. REF = 5.25 dB)

Fig. 7-3 Submenu for fixed attenuation values

Program word

Before programming the absolute attenuation value, make sure that the ABS/REL switch (see page 7-12) is set to OFF.

Setting:
```
:ATTenuator <SN>
   :POWer
      :PATTenuation?<wsp>ATT<n>[1],2.00[2]
                                .
                                .
                                65.00[2]
```

Query:
```
:ATTenuator<SN>
   :POWer
      :PATTenuation?<wsp>ATT<n>[1]
```

Response:
```
<NR3> in dB
```

1 <n>: 1 to 5
2 Base unit dB (input also with suffix); parameter values can be displayed as <NR1>, <NR2> or <NR3>.

7.7 Specifications OLA-150

Wavelength

Setting range ..... 1260 to 1600 nm
Resolution ..... 1 nm
Standard wavelengths ..... 1310 nm and 1550 nm

Attenuation

Nominal range
from 1260 to 1360 nm ..... Residual attenuation up to 65 dB
from 1360 to 1600 nm ..... Residual attenuation up to 60 dB
Resolution ..... 0.01 dB
Insertion loss (residual attenuation) ..... < 2.5 dB
Shutter isolation (position OFF) ..... > 80 dB (typ. 100 dB)
Setting time for any given attenuation value ..... ≤ 3 s
Function ..... continuous, bi-directional

Monitor output ..... 10 dB tap

Accuracy

Total attenuation uncertainty[1] ..... ± 0.8 dB

Repeatability of attenuation setting[2] ..... ± 0.1 dB, typ. 0.05 dB
Linearity[3] ..... ± (0.2 dB + 0.3% of displayed value)

Optical interfaces

Measurement adapters ..... for FC/PC, SC/PC, DIN, E-2000, ST, etc., Adapter BN 2060/00.xx
Connectable fiber type ..... 9/125 µm (SM)
Return loss ..... > 35 dB (typ. 40 dB)
Max. input power ..... +20 dBm

1 With DIN connectors, error for wavelength setting max. ± 50 nm from 1310 or 1550 nm; when using FC, SC or ST connectors, the operating error increases by typ. ± 0.3 dB.
2 Without loosening connections, for constant ambient conditions, 30 to 70% rel. humidity.
3 Without loosening connections, error for wavelength setting max. ± 50 nm from 1310 or 1550 nm, 30 to 70% rel. humidity.

General specifications

Temperature

Reference range ..... 23 °C ± 3 °C
Nominal range of use ..... 0 °C to +50 °C
Storage and transport ..... -40 °C to +70 °C

Air humidity

Nominal range of use
up to 30 °C, relative humidity ..... 5 to 85%
over 30 °C, absolute humidity ..... < 25 g/m^3

Note: Occasional condensation is tolerable.

Electromagnetic interference (EMC)

EMI/RFI generation
– Verified to ..... EN 50081-1:1992 (CISPR 22 Class B)
– AC line effects ..... see mainframe
– Magnetic intrinsic spurious field
at AC line frequency ..... see mainframe
EMI/RFI susceptibility
– Verified to ..... EN 50082-1:1992 (IEC 801, Parts 1 to 6)

Dimensions and weight

Dimensions (w x h x d in mm) ..... 38 x 102 x 288
Weight ..... 980 g
Measurement adapters ..... BN 2060/00.xx
Adapter cables K31xx
Couplers ..... S 31xx

Miscellaneous

Traceability ..... to NIST, NPL, PTB
Recommended calibration interval ..... 1 year
Warm-up time (for validity of specifications) ..... 5 min

9 Error messages

9.1 Introduction

Error message system

The OMS-150 is equipped with an error message system which indicates any operating or equipment error immediately to the user. Error messages are output in manual and remote-control operating modes.

Error numbers

The errors are identified by a preceding error number and are subdivided into various error classes. A distinction is made between the device-specific error messages, such as may occur during the self test, and the error messages which are triggered by the user. The latter are mainly warnings or operating hints, as the OMS-150 function is not otherwise affected.

When device-specific error messages occur, however, operation will in general be restricted or a total failure may even result. In all such cases, the local Wandel & Goltermann service center should be contacted for advice.

Operator errors

-100 ... -499	General operator errors specified by SCPI Standard 19.7. These are basically programming errors which may occur during remote control of the OMS-150. See Sec. 9.2.1, Page 9-3 through to Sec. 9.2.4, Page 9-7. The SCPI error numbers are prefixed with a *minus sign* to distinguish them from the non-standardized (manufacturer-specific) error numbers.
101 ... 113	Operator errors caused by incorrect module selection. See Sec. 9.2.5, Page 9-8.
404 ... 410	Operator errors occurring in conjunction with memory and configuration menu settings. See Sec. 9.2.7, Page 9-10
601 ... 610	Errors occurring during transfer or acceptance of system controller function. See Sec. 9.2.8, Page 9-11.

Device errors

200 ... 204	Device errors which may occur in the mainframe. See Sec. 9.2.6, Page 9-9.
<SN>000 ... <SN>012	Device errors which may occur in the modules (type-independent). See Sec. 9.2.9, Page 9-13..
<SN>100 ... <SN>151	Device errors which may occur in the OLA modules. See Sec. 9.2.10, Page 9-15.
<SN>200 ... <SN>253	Device errors which may occur in the OLS modules. See Sec. 9.2.11, Page 9-17.
<SN>300 ... <SN>380	Device errors which may occur in the OLP or OBR modules. See Sec. 9.2.12, Page 9-19.

Error display

If an error occurs during manual or remote-controlled operation, the error message preceded by the appropriate error number is displayed in the status line of the OMS display. Normally, error messages are accompanied by a beep, which indicates the error situation. In remote-control mode, the error messages are written into a buffer memory (error queue). The plain text message shown in the status line or stored in the error queue will normally be sufficient to identify the cause of the error correctly.

Acknowledging error messages

Manual operation

The error message is acknowledged by the next keystroke and the status line is then blanked.

Remote control

The command SYSTem:ERRor? reads the contents of the error queue; the read operation acknowledges the error message.

If the message 0 "No error" is output, the error queue is empty.

9.2 Error messages in numerical order

9.2.1 SCPI Command Errors

Syntax or semantic errors detected by the parser.

The "Command Error" status bit (bit 5) in the Standard Event Status Register is set to 1 (IEEE 488.2, 11.5.1). The register can be queried with *ESR? (Common Command).

-100

"Command error"

The general syntax rules of IEEE 488.2 were not adhered to.

-102

"Syntax error"

The command or parameter value entered cannot be identified.

-104

"Data type error"

An incorrect parameter or numerical parameter value was specified.

-105

"GET not allowed"

Trigger command received during data transmission.

-108

"Parameter not allowed"

The number of parameter values allowed was exceeded for the entered command (a parameter value generally follows the header).

-109

"Missing parameter"

The parameter value was not specified.

-110

"Command header error"

General error detected in header.

-113

"Undefined header"

The transmitted header (syntax OK) does not match instrument or module.

-114

"Header suffix out of range"

Numeric suffix in header is incorrect; e.g. SLOT number in module-specific command is incorrect.

-120

"Numeric data error"

The numerical parameter type is incorrect (e.g. *Non Decimal Numeric Data* entered instead of *Numeric Data*, compare IEEE 488.2, 7.7.4.2).

-130

"Suffix error"

The parameter type was specified with incorrect units.

9.2.2 SCPI Execution Errors

Syntactically correct commands cannot be executed. The "Execution Error" status bit (bit 4) in the Standard Event Status Register is set to 1 (IEEE 488.2, 11.5.1). The register can be queried with *ESR? (Common Command).

-213

"Init ignored"

Trigger command cannot be executed as end of measurement cycle not waited for, e.g. when INIT:IMM is programmed with INIT:CONT ON set.

-220

„Parameter error"

General error in parameter value detected.

-221

"Settings conflict; ..."

Settings not possible while device processing internal sequences (calibration, zeroing, tests, etc.).

This error message can also occur during manual operation.

-222

"Out of range; ..."

Parameter value is outside the defined range. In general, this error message is supplemented by the corresponding limit value being shown.

This error message can also occur during manual operation.

-224

"Illegal parameter value"

The entered value does not correspond to the expected value (e.g. discrete value from a parameter list).

-230

"Data corrupt or stale"

Query made (e.g. with FETCH:POW?) before measurement sequence processed. The result may therefore be incorrect.

9.2.3 SCPI Device Specific Error

-350

"Queue overflow"

The error queue is full; too many errors have occurred (max. queue length is 30 errors).

The "Device specific Error" status bit (bit 3) in the Standard Event Status Register is set to 1 (IEEE 488.2, 11.5.1). The register can be queried with *ESR? (Common Command).

-360

"Communication error"

Communication via the serial interface is faulty.

-361

"Parity error"

A parity error has occurred during serial communication (parity bit incorrectly set).

-362

"Framing error"

The stop bit was not detected during serial communication.

-363

"Input buffer overflow"

Software or hardware input buffer overflow due to inaccurate or missing handshake.

9.2.4 SCPI Query Errors

Errors which may occur during queries of the OMS-150. The status bit "Query Error" (bit 2) in the Standard Event Status Register is set to 1 (IEEE 488.2, 11.5.1). The register can be queried with *ESR? (Common Command).

-410

"Query INTERRUPTED"

Query / response cycle incomplete. Response not awaited.

-420

"Query UNTERMINATED"

The query has been incompletely received. A response cannot be given.

-430

"Query DEADLOCKED"

The query requested more data than can be accommodated by the output buffer of the OMS-150.

9.2.5 Programming errors when selecting modules

101

"Command to empty Slot1"

Slot 1 is empty. Numerical suffix <SN> is incorrect.

102

"Command to empty Slot2"

Slot 2 is empty. Numerical suffix <SN> is incorrect.

103

"Command to empty Slot3"

Slot 3 is empty. Numerical suffix <SN> is incorrect.

111

"Unknown Command to Slot1"

The command issued to slot 1 does not match the module type.

112

"Unknown Command to Slot2"

The command issued to slot 2 does not match the module type.

113

"Unknown Command to Slot3"

The command issued to slot 3 does not match the module type.

9.2.6 Mainframe device errors

200

"Keyboard Interface failed"

Keyboard defective (self test). Contact your local W&G Service Center.

201

"Battery down"

The device setting memory is no longer buffered (self test).

Possible cause

Battery defective or at end of its useful life. The battery must be replaced. Contact your local W&G Service Center.

202

"Display: EEPROM test failed"

E^2PROM module in display unit defective (self test). Contact your local W&G Service Center.

203

"Display: EPROM test failed"

EPROM module in display unit defective (self test). Contact your local W&G Service Center.

204

"Display: RAM test failed"

RAM module in display unit defective (self test). Contact your local W&G Service Center.

205

"GPIB: test failed"

IEEE bus module defective (self test). Contact your local W&G Service Center.

9.2.7 Operator errors in memory and configuration menu settings

401

"Setup mismatch"

Settings in the selected setup do not match the current module configuration. Original configuration can be determined using the VIEW function.

402

"No data"

Setup cannot be recalled from empty memory position (status: FREE).

403

"Setup is already used"

Setup cannot be stored in a memory position which is already used (status: USED).

404

"Unknown device in Slot1"

Unknown module type detected in slot 1 during mainframe self test. Cause: Use of a "new" module version in conjunction with older mainframe software.

405

"Unknown device in Slot2"

Unknown module type detected in slot 2 during mainframe self test. Cause: Use of a "new" module version in conjunction with older mainframe software.

406

"Unknown device in Slot3"

Unknown module type detected in slot 3 during mainframe self test. Cause: Use of a "new" module version in conjunction with older mainframe software.

407

"Checksum error system:set"

Check sum of data transmitted by command SYSTEM:SET is incorrect.

408

"Invalid hardcopy feed setting"

Hardcopy feed is not allowed because the specified slot is empty or is equipped with an OLS or OLA module.

9.2.8 System controller function errors

601

"Warning: OMS is system controller"

The OMS is set as system controller. It has been addressed at the same time by an external system controller.

603

"No listener on bus"

The OMS transmits data as talker but cannot locate a listener on the bus.

604

"External system controller on bus"

The OMS is set as system controller. It has detected an external system controller on the bus.

605

"OMS is not system controller"

Hardcopy has been initiated although the OMS is not the system controller.

606

"Timeout during TCT"

The "Transfer Control" signal (TCT) has not been received although the OMS has requested system control.

607

"Not ready for data"

The OMS cannot transmit data although it is set as system controller.

608

"Data not accepted"

The OMS cannot transmit the data completely to the listener.

609

"Missing external system controller address"

The OMS has no information on the address of the external system controller. Specify the address using the Common Command *PCB.

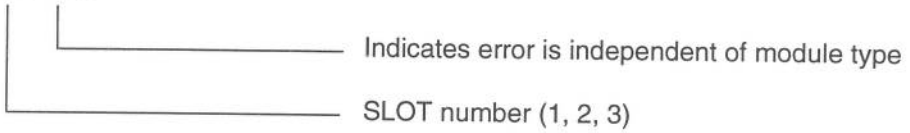
610

"Timeout during SRQ"

The OMS has made a Service Request which was not answered within the timeout period.

9.2.9 Module device errors (type-independent)

<SN>0xx



<SN>000

"Slot<SN>: RAM test failed"

RAM module of the module in slot <SN> defective (self test). Contact your local W&G Service Center.

<SN>001

"Slot<SN>: ROM test failed"

ROM module of the module in slot <SN> defective (self test). Contact your local W&G Service Center.

<SN>002

"Slot<SN>: EEPROM test failed"

E^2PROM module of the module in slot <SN> defective (self test). Contact your local W&G Service Center.

<SN>003

"Slot<SN>: DPR test failed"

Dual-Port RAM module of the module in slot <SN> defective (self test). Contact your local W&G Service Center.

<SN>004

"Slot<SN>: Device not calibrated"

Module in slot <SN> is not calibrated (self test). Contact your local W&G Service Center.

<SN>005

"Slot<SN>: 12V voltage test failed"

Power supply to module in slot <SN> failed (self test). Contact your local W&G Service Center.

<SN>006

"Slot<SN>: LED test failed"

Internal LED service display of module in slot <SN> defective (self test). Contact your local W&G Service Center.

<SN>010

"Slot<SN>: Absent"

Module detected at start of measurement operation is no longer detected (e.g. due to defective dual-port RAM); (self test). Contact your local W&G Service Center.

<SN>011

"Slot<SN>: DPR transmission time out"

Communication from mainframe to module in slot <SN> defective.

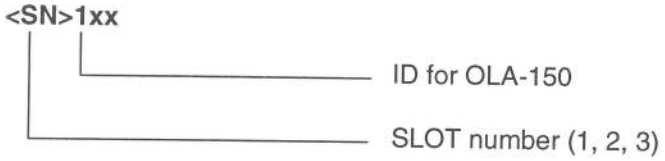
<SN>012

"Slot<SN>: DPR receive time out"

Communication from module in slot <SN> to mainframe defective.

9.2.10 OLA module errors

<SN>1xx



<SN>100

"Slot<SN>: Clock test failed"

Clock circuit for A to D converter defective (self test). Contact your local W&G Service Center.

<SN>101

"Slot<SN>: ADC test failed"

A to D converter defective (self test). Contact your local W&G Service Center.

<SN>102

"Slot<SN>: Counter test failed"

Counter unit in motor control defective (self test). Contact your local W&G Service Center.

<SN>103

"Slot<SN>: HCTL test failed"

HCTL module in motor control defective (self test). Contact your local W&G Service Center.

<SN>104

"Slot<SN>: +5V motor driver test failed"

5 V supply for motor driver defective (self test). Contact your local W&G Service Center.

<SN>150

"Slot<SN>: Calibration data not found"

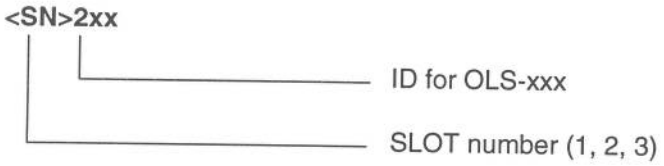
Module is not calibrated. Check sum in E^2PROM module incorrect. The displayed attenuation value is approximate. Contact your local W&G Service Center.

<SN>151

"Slot<SN>: Motor not movable"

Motor control defective: Motor jammed or current supply to motor defective. Contact your local W&G Service Center.

9.2.11 OLS module errors



<SN>200

"Slot<SN>: UREF & DAC test failed"

2.5 V reference voltage failed or internal A to D converter of processor defective. Laser regulation no longer operating precisely (self test). Contact your local W&G Service Center.

<SN>201

"Slot<SN>: DAC laser 1.3 µm test failed"

D to A converter regulating the 1310 nm laser failed (self test). Contact your local W&G Service Center.

<SN>202

"Slot<SN>: DAC laser 1.5 µm test failed"

D to A converter regulating the 1550 nm laser failed (self test). Contact your local W&G Service Center.

<SN>203

"Slot<SN>: Oscillator test failed"

Frequency generator of internal modulation stage defective (FMOD) (self test). Contact your local W&G Service Center.

<SN>204

"Slot<SN>: Watchdog test failed"

Automatic laser deactivation is defective (self test). Contact your local W&G Service Center.

<SN>205

"Slot<SN>: Peltier laser 1.3 µm test failed"

Peltier element of Laser 1 (1310 nm) is defective. Contact your local W&G Service Center.

<SN>206

"Slot<SN>: Peltier laser 1.5 µm test failed"

Peltier element of Laser 2 (1550 nm) is defective. Contact your local W&G Service Center.

<SN>250

"Slot<SN>: Laser 1.3 µm Temp. out of range"

Temperature control of laser 1 (1310 nm) faulty -> laser switched off. Contact your local W&G Service Center.

<SN>251

"Slot<SN>: Laser 1.5 µm Temp. out of range"

Temperature control of laser 2 (1550 nm) faulty -> laser switched off. Contact your local W&G Service Center.

<SN>252

"Slot<SN>: Laser 1.3 µm Level out of range"

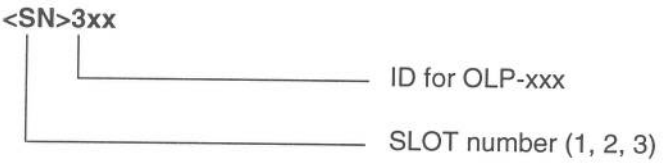
Level control of laser 1 (1310 nm) faulty -> laser switched off. Contact your local W&G Service Center.

<SN>253

"Slot<SN>: Laser 1.5 µm Level out of range"

Level control of laser 1 (1550 nm) faulty -> laser switched off. Contact your local W&G Service Center.

9.2.12 OLP/OBR module errors



<SN>300

"Slot<SN>: DSP interface test failed"

Error in digital filter; interface to signal processor defective (self test). Contact your local W&G Service Center.

<SN>301

"Slot<SN>: DSP ram test failed"

RAM module of digital filter defective (self test). Contact your local W&G Service Center.

<SN>302

"Slot<SN>: 8V voltage test failed"

Reference voltage for measurement unit failed (self test). Contact your local W&G Service Center.

<SN>303

"Slot<SN>: ASV offset. volt. test failed"

Error in analog unit ASV (self test). Contact your local W&G Service Center.

<SN>304

"Slot<SN>: ASV DC-path test failed"

Error in DC path of analog unit ASV (self test). Contact your local W&G Service Center.

<SN>305

"Slot<SN>: ASV gain test failed"

Amplifier in analog unit defective (self test). Contact your local W&G Service Center.

<SN>306

"Slot<SN>: ASV AC-path test failed"

Error in AC path of analog unit ASV (self test). Contact your local W&G Service Center.

<SN>350

"Slot<SN>: DSP interface"

Error in digital filter (DSP) occurred during operation. Contact your local W&G Service Center.

<SN>351

"Slot<SN>: Temp. out of range"

Temperature of input unit can no longer be controlled. Contact your local W&G Service Center.

<SN>352

"Slot<SN>: Cal or zeroing failed"

Instrument defect detected during calibration or dark-current adjustment (zeroing). Contact your local W&G Service Center.

<SN>353

"Slot<SN>: Too much light for zeroing"

Error detected during dark-current adjustment (zeroing) ---> input not blanked.

Cause: OLP-110/-130/-150: Screw cover not fitted during zeroing.

If this fault occurs when the input is correctly blanked, contact your local W&G Service Center.

<SN>354

"SLOT <SN>: invalid EEPROM cal data"

Error reading or writing OBR calibration data. The calibration data are stored in the EEPROM each time the module is calibrated.

<SN>355

"SLOT <SN>: Open port: High reflection"

Possible error after OPEN PORT calibration.

<SN>356

"SLOT <SN>: Term port: Low refl. (source on?)"

Possible error after TERM PORT calibration.

Notes:

11 Specifications (Mainframe) / Ordering information

11.1 Specifications of OMS-150 Mainframe

Case

Module rack for up to three optical modules.

Display and controls

TF color LCD graphics display . . . . . 320 x 240 pixels; 5.5"
Controls . . . . . .function softkeys, keypad and rotary control

Remote control

Bus interface . . . . . .to <IEC 625>/IEEE 488
Serial interface . . . . . to RS 232 (V.24/V.28)
Command language . . . . . .to SCPI standard

Power supply

	Nominal range	Operating range
A.C. line voltage	110 to 127 V 220 to 240 V	90 to 140 V 193 to 264 V

Voltage range switching is automatic
Max. power consumption . . . . . .150 VA
A.C. line frequency . . . . . .50/60 Hz ± 5%

Safety class

To IEC 1010/EN 61010-1 . . . . . Class I

Temperature

Nominal range of use . . . . . 0 °C to +50 °C
Storage and transport. . . . . -40 °C to +70 °C

Humidity

Nominal range of use

up to 30°C, relative humidity . . . . . 5 to 85%
above 30°C, absolute humidity. . . . . ≤ 25 g/m^3

Note: Occasional formation of condensation is permissible. Permanent operation in climates with warm moist temperature will be not guaranteed.

Electromagnetic interference

Conforms to CE requirements

EMI/RFI generation . . . . . corresponds to EN 50081-1: 1992 (CISPR 22, class B)
EMI/RFI susceptibility . . . . . corresponds to EN 55082-1: 1992

Dimensions and weight

Dimensions (w x h x d) in mm . . . . . 349 x 159 x 357
Weight (without modules) . . . . . .approx. 6.1 kg

11.2 Ordering information

Optical Power Meters[1]

OLP-110 . . . . . BN 2201/02
OLP-130 . . . . . BN 2201/04
OLP-150 . . . . . BN 2201/05

Optical Laser Source[1]

OLS-150 (Laser) . . . . . BN 2202/05

Optical Attenuator[1]

OLA-100 . . . . . BN 2206/05

Optical Back-Reflection Meter[2]

OBR-100 . . . . . BN 2232/01

O/E Reference Converter and Power Meter[1]

OEC-104 . . . . . BN 2242/01

Optical Switches[1]

OSW-114 . . . . . BN 2236/01
OSW-122 . . . . . BN 2236/02

Mainframe

OMS-150 . . . . . BN 2207/05

Optical Performance Tester[1]

OPT-150 . . . . . BN 2207/15

1 Without measurement adapter
2 Without measurement adapter for transmitter output
3 Complete, consisting of OMS-150, OLP-150, OLS-150 and OLA-150

Adapters

Each optical module requires at least one adapter for operation
(3 required for OLA-150, 5 required for OSW-114, 4 required for OSW-122).

Adapters for optical modules except OLP-150 . . . . . BN 2060/00.xx series
Adapters for OLP-150 . . . . . BN 2014/00.xx series

BN 2060/00.xx

ST Type (AT&T) . . . . . BN 2060/00.32
PKI . . . . . BN 2060/00.33
HMS-10/A . . . . . BN 2060/00.34
HMS-10 (screw and BNC connector) . . . . . BN 2060/00.35
SMA . . . . . BN 2060/00.36
Biconic[1] . . . . . BN 2060/00.37
Bare fiber adapter . . . . . BN 2060/00.39
D4 (NEC) . . . . . BN 2060/00.40
DIN 47256, HRL-10/DIN[2] . . . . . BN 2060/00.50
FC, FC-PC, FC-APC (NTT)[2] . . . . . BN 2060/00.51
SC, SC-PC, SC-APC (NTT)[2] . . . . . BN 2060/00.58

1 For OLS and OLA modules only. If used with single-mode point contact (PC) connectors, only suitable for keyed biconic plug from AT&T.
2 Suitable for use as OBR-100 measurement interface adapter.

BN 2014/00.xx (for OLP-150)

D4 (NEC) . . . . . BN 2014/00.01
SMA . . . . . BN 2014/00.02
430 (Stratos) . . . . . BN 2014/00.03
HMS-0/HFS-3 (screw and BNC connector) . . . . . BN 2014/00.04
PKI . . . . . BN 2014/00.07
Bare fiber adapter . . . . . BN 2014/00.08
FC (NTT) . . . . . BN 2014/00.09
HMS-10 (screw and BNC connector) . . . . . BN 2014/00.10
Ericsson TSR 301 . . . . . BN 2014/00.11
Biconic . . . . . BN 2014/00.13
Socapex 725/Souriau 8016 . . . . . BN 2014/00.14
PFO (Radiall) . . . . . BN 2014/00.15
DIN 47256, HRL-10/DIN . . . . . BN 2014/00.17
VFO (Radiall) . . . . . BN 2014/00.19
WECO/SIRTI . . . . . BN 2014/00.20
ST Type (AT&T) . . . . . BN 2014/00.21
Mini-BNC (Sumitomo) . . . . . BN 2014/00.23
SC (NTT) . . . . . BN 2014/00.24

Cables

Test/adapter cables, length 2000 mm

9/125 µm single mode fiber ..... K 31xx series
50/125 µm multi-mode fiber ..... K 30xx series

K 31xx

DIN 47256 to DIN 47256 ..... K 3100
DIN 47256 to DIN 47256, length 350 mm ..... K 3120
DIN 47256 to FC-PC (NNT) ..... K 3101
DIN 47256 to VFO (Radiall) ..... K 3102
DIN 47256 to HMS-0-PC (Diamond) ..... K 3104
DIN 47256 to Biconic-PC ..... K 3105
DIN 47256 to SC-PC (NNT) ..... K 3111
DIN 47256 to Pigtail ..... K 3199
SC-PC (NNT to SC-PC (NNT) ..... K 3110
FC-PC (NNT) to FC-PC (NNT) ..... K 3112
FC-PC (NNT) to FC-PC (NNT), length 350 mm ..... K 3123
ST-PC (AT&T) to ST-PC (AT&T) ..... K 3122

K 30xx

DIN 47256 to DIN 47256 ..... K 3000
DIN 47256 to FC (NNT) ..... K 3001
DIN 47256 to ST-Typ (AT&T) ..... K 3009
DIN 47256 to Pigtail ..... K 3099
ST-Typ (AT&T) to ST Type (AT&T) ..... K 3014
F-SMA to S-SMA ..... K 3015

K 31xx

Test/adapter cables 9/125 µm equipped at one or both ends with angled connectors (APC) for connecting devices under test to the measurement interface of the OBR-100 or for connecting to devices fitted with APC connectors; length 2000 mm.

HRL-10/DIN to DIN 47256 ..... K 3113
HRL-10/DIN to FC_PC (NNT) ..... K 3114
HRL-10/DIN to SC-PC (NNT) ..... K 3115
HRL-10/DIN to ST-PC (AT&T) ..... K 3116
HRL-10/DIN to FC-APC (NNT) ..... K 3117
HRL-10/DIN to HRL-10/DIN ..... K 3118
HRL-DIN to SC-APC (NNT) ..... K 3128
HRL-10/DIN to Pigtail ..... K 3119
FC-APC (NNT) to HRL-10/DIN ..... K 3117
FC-APC (NNT) to DIN 47256 ..... K 3121
FC-APC (NNT) to FC-PC (NNT) ..... K 3129
FC-APC (NNT) to FC-APC (NNT) ..... K 3130
SC-APC (NNT) to SC-PC (NNT) ..... K 3125
SC-APC (NNT) to DIN 47256 ..... K 3126
SC-APC (NNT) to SC-APC (NNT) ..... K 3127
SC-APC (NNT) to HRL-10/DIN ..... K 3128

Couplers

S 31xx

DIN ..... S 3100
FC ..... S 3101
F-SMA ..... S 3102
Biconic ..... S 3105
ST Type (AT&T) ..... S 3109

Reference reflector

A reference reflector is included with the OBR-100; Please specify version required when ordering.

Referece standard for calibrating OBR-100 fitted with
HRL-10/DIN connector ..... BN 2232/90.01
FC-APC connector ..... BN 2232/90.03
SC-APC connector ..... BN 2232/90.04

Other accessories

Software drivers
(LabWindows DOS/CVI, LabVIEW, HP VEE, 3,5" floppy disk ..... BN 2241/95.99
Optical connector cleaning tape 2229/90.07
Protective covers SD-930 (set) ..... BN 960/00.01
Transport case TPK-960/3 ..... BN 960/00.05
19" rack-mounting kit ..... BN 2203/00.07
Storage box ABK-30 (for adapters) ..... BN 2126/30

IEC/IEEE bus cable (1.2 m)[1] ..... K 420
IEC/IEEE bus cable (2 m) ..... K 421

RS 232/V.24, V.28 interface cable
(zero modem, female - female 2 x 25pole/9pole SUB-D connectors) ..... K 764
RS 232/V.24 printer cable ..... K 750

1 Included with mainframe

Calibration reports

Only available for new deliveries of OMS-150 modules

OLP-110/-130/-150 ..... BN 2201/00.01
OLS-150 ..... BN 2202/00.01
OLA-150 ..... BN 2206/00.01
OBR-100 ..... BN 2232/90.02
OSW-114, -122 ..... BN 2236/90.01
OEC-104 ..... BN 2242/90.01

Index

Symbols

Numerics

A

B

C

D

E

F

G

H

I

L

M

N

O

P

Q

R

S

T

U

V

W

Y

Z

Wandel & Goltermann Environmental Management Program

Superb performance and high quality have always characterized Wandel & Goltermann datacom and telecom measurement technology products. In this same world-class tradition, WG has an established, proactive program of environmental management.

Environmental management is an integral part of WG's business philosophy and strategy requiring the development of long-term, productive solutions to problems in the key areas of economics, technology, and ecology.

A systematic environmental management program at WG is essential in regard to environmental policy and enhances cooperation between ourselves and our business partners.

The WG Environmental Management Program considers:

Product design and manufacture

Environmental restrictions and requirements are taken into account during the planning and manufacture of WG products. This attention ranges form the raw materials and finished components selected for use and the manufacturing processes employed, through to the use of energy in the factory, and right on up to the final stages in the life of a product, including dismantling.

Hazardous materials

WG avoids or uses with care any hazardous or dangerous material in the manufacturing process or the end product. If the use of a dangerous material cannot be avoided, it is identified in product documentation and clearly labeled on the product itself.

Packaging materials

Preference is given to reusable or biodegradable single-substance packaging materials whenever possible.

Environmental management partnerships

WG encourages our customers and suppliers who take this responsibility seriously to join WG in establishing their own environmental management programs.

Recycling used products

Wandel & Goltermann has an effective program for the recycling and/or disposal of used equipment. Our customers in Germany can already take advantage of our return service for used instruments. In Europe, all new equipment purchased from WG can be returned for scrapping at the end of its useful life, free of charge.

If you would like specific information about the Wandel & Goltermann Environmental Management Program, please contact us at

Germany:
Environmental Management:
Tel: +49-(0)7121 86 1470 · Fax: +49-(0)7121 86 1115

United Kingdom:
Design Office:
Tel: +44-1752 772 773 · Fax: +44-1752 709 897

United States:
Environmental Management:
Tel: +1-919 941 5730 · Fax: +1-919 941 5751

France:
Environmental Management
Tel: +33-(0)2 99 84 70 40 · Fax: +33-(0)2 99 84 70 44

Wandel & Goltermann Worldwide (Sales Organizations)

Europe

Austria
Wandel & Goltermann GmbH
Postfach 13
Elisabethstraße 36
A-2500 Baden
Tel. +43-22 52-85 521-0
Fax +43-22 52-80 727
Tlx, 047-14 375 wgo a

Belgium/Luxembourg
Wandel & Goltermann nv/sa
Imperiastraat 10
B-1930 Zaventem
Tel. +32-2 725 18 19
Fax +32-2 725 41 42

Finland
Wandel & Goltermann AB
Tekniikantie 12
FIN-02150 Espoo
Tel. +358-0-4354 3199
Fax +358-0-455 1522

France
Wandel & Goltermann France
46 bis, rue Pierre Curie
B.P. 10
Zone Industrielle Les Gâtines
F-78373 Plaisir Cédex
Tél. +33-(0)1 30 81 50 50
Fax +33-(0)1 30 55 87 75

Germany
Wandel & Goltermann GmbH & Co.
Vertriebsgesellschaft
Postfach 11 55
D-72794 Eningen u.A.
Tel. +49-7121-98 56 10
Fax +49-7121-98 56 12
e-mail: vertrieb@wago.de

Italy
Wandel & Goltermann S.R.L.
Technologie di Misura
Elettroniche
Via Pomponazzi 25
I-20 141 Milano
Tel. +39-2-895 12 381
Fax +39-2-895 11 780

Norway
Wandel & Goltermann AB
Postboks 134, Skøyen
Hovaret 13
N-0212 Oslo
Tel. +47-22-504090
Fax +47-22-504025

Spain/Portugal
Wandel & Goltermann S.A.
c/ Arturo Soria n° 343-3°
E-28033 Madrid
Tel. +34-1-383 98 01
Fax +34-1-383 22 63

Sweden
Wandel & Goltermann AB
Box 6044
Ellen Keys Gata 60
S-129 06 Hägersten
Tel. +46-8-449 48 00
Fax +46-8-449 48 39

Switzerland
Wandel & Goltermann
(Schweiz) AG
Postfach 779
Morgenstrasse 83
CH-3018 Bern 18
Tel. +41-31 991 77 81
Fax +41-31 991 47 07

The Netherlands
Wandel & Goltermann bv
Postbus 1575
NL-5602 BN Eindhoven
Tel. +31-40-267 97 00
Fax +31-40-267 97 11

United Kingdom
Wandel & Goltermann Sales Ltd.
Portland House
Aldermaston Park
Aldermaston
Berkshire RG7 4HR
England
Tel. +44-1189 409200
Fax +44-1189 409210
e-mail: wguk.help@wago.de

East and South East Europe
see Austria

North America

Canada
Wandel & Goltermann Inc.
21 Rolark Drive
Scarborough, Ontario M1R 3B1
Tel. +1-416-291-7121
Fax +1-416-291-2638

Mexico
Wandel & Goltermann de
México, S.A. de C. V.
San Francisco No. 6
Col. Del Valle
México D.F.
C.P. 03100 México
Tel. +52-5-543 66 44
Fax +52-5-543 86 60

USA
Wandel & Goltermann
Technologies, Inc.
P.O.Box 13585
Research Triangle Park,
NC 27709-3585
Tel. +1-919-941-57 30
Fax +1-919-941-57 51

Latin America

Argentina/Uruguay
Wandel & Goltermann S.A.
Montañeses 2599
RA-1428 Buenos Aires
Tel. +54-17 84 47 00
Fax +54-17 86 79 17

Brazil/Chile/Peru/Bolivia/ Paraguay
Wandel & Goltermann
Instrumtaçào Ltda. & Cia.
Av. Eng. L. C. Berrini,
936-8. andar
04571-000 Sào Paulo - SP
Brazil
Tel. +55 11-5505-32 66
Fax +55 11-5505-15 98

Columbia/Ecuador
Wandel & Goltermann
Andina Ltda.
A.P. 55052
Cra. 14 No. 85-82, Oficina 401
Santa Fé de Bogotá DC
Columbia
Tel. +57-1 256 4001
Fax +57-1 616 3267

Guatemala/Central America/ Caribbean Islands
Wandel & Goltermann
Centroamerica y el Caribe
6a. Calle 6-48 zona 9
Edificio Tivoli Plaza, of. 507
Apartado Postal 27 61
01901 Guatemala Ciudad
Guatemala
Tel. +502-3 31 80 65
Fax +502-3 31 86 82

Venezuela
Wandel & Goltermann Venezuela
Av. Eugenio Mendoza
con 1era. Transversal
Edif. Banco de Lara, Piso 7, Ofic. A-1
La Castellana Z.P. 1060
Caracas, Venezuela
Tel. +58-2-2630203/2630605
Fax +58-2-2636465

Asia

Middle East
see Germany

South East Asia
see Australia

India
Wandel & Goltermann
Pvt. Ltd.
16-A, Palam Marg
Vasant Vihar
New Delhi 110057
India
Tel. +91-11-6148537
Fax +91-11-6148538

Israel
see Germany

CIS Countries/ Iran/Turkey/Pakistan
see Austria

China
Wandel & Goltermann Pty. Ltd.
Beijing Office
Suite 1902
Ever Bright Building
6, Fu Xing Men Wai Da Jie
Beijing 100045
Peoples Republic of China
Tel. +86 10 6856 1034
Fax +86 10 6856 1031

Hong Kong
Wandel & Goltermann Ltd.
Rm 1501, Fook Lee
Commercial Centre
Town Place, 33 Lockhart Road
Wanchai, Hong Kong
Tel. +852-25 28-62 83
Fax +852-25 29-55 93

Japan
Wandel & Goltermann K.K.
Kyoritsu Shin-Yokohama Bldg. 6F
2-15-12 Shin-Yokohama,
Kouhoku-ku, Yokohama
222-0033 Japan
Tel. +81-45-473-9501
Fax +81-45-473-9812

Republic of Korea
Wandel & Goltermann Ltd.
2nd., Yehsung Bldg.
150-30 Samsung-dong
Kangnam-ku,
Seoul 135-090, Korea
Tel. +82-2-563 22 36 (7)
Fax +82-2-563 22 39

Singapore
Wandel & Goltermann
Singapore Pte Ltd
51 Goldhill Plaza #20-05
Singapore 308900
Tel: +65-356-3246
Fax: +65-356-3247

Australia/Pacific Islands
Wandel & Goltermann Pty. Ltd.
P.O. Box 419
World Trade Centre
Melbourne, Victoria 3005
Tel. +61-39-690 67 00
Fax +61-39-690 67 50

New Zealand
Wandel & Goltermann Pty. Ltd.
P.O. Box 10 418
The Terrace
Wellington 6036
Tel. +64-4-49 52 290
Fax +64-4-49 52 292

Africa
Wandel & Goltermann GmbH & Co.
Vertriebsgesellschaft
Postfach 11 55
D-72794 Eningen u.A.
Tel. +49-7121-86 11 83
Fax +49-7121-86 21 55
e-mail: vertrieb@wago.de

A closely linked network of 29 affiliated companies and more than 65 agencies ensures that our customers receive the best possible advice in solving specific measurement problems. For more detailed information, please turn to your local sales agency.