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PRODUCT INFORMATION

OPTICAL AMPLIFIERS

1 GENERAL DESCRIPTION

1.1 Introduction

The increasing demand for more bandwidth per subscriber requires decreasing the number of homes past per fiber in modern optical networks. The resulting growing number of fiber nodes requires more optical power to be generated in the head-end or hub. The application of optical amplifiers is a good solution to generate high optical output power levels for:

- feeding of long trunk lines or
- high splitting ratios in the access network.

The preferred technology for optical amplification is the application of Erbium doped fiber amplifiers: EDFAs. In contrast to semiconductor amplifiers, EDFAs have very low distortion. The noise performance with typical noise figures between 4 and 5 dB is outstanding. Furthermore, they turn out to be very reliable if 980 nm or 1480 nm single mode pump lasers are used. Different configurations of 980 nm and/or 1480 nm pump lasers leading to a standard product-range of optical amplifiers with optical output powers from 13 to 23 dBm. Internal splitters are used to supply 1 to 8 optical outputs (SVO/OVxxxx series only). For special DWDM applications an optical amplifier range equipped with a gain flattening filter is available (SVO/OVxxxxDW series).



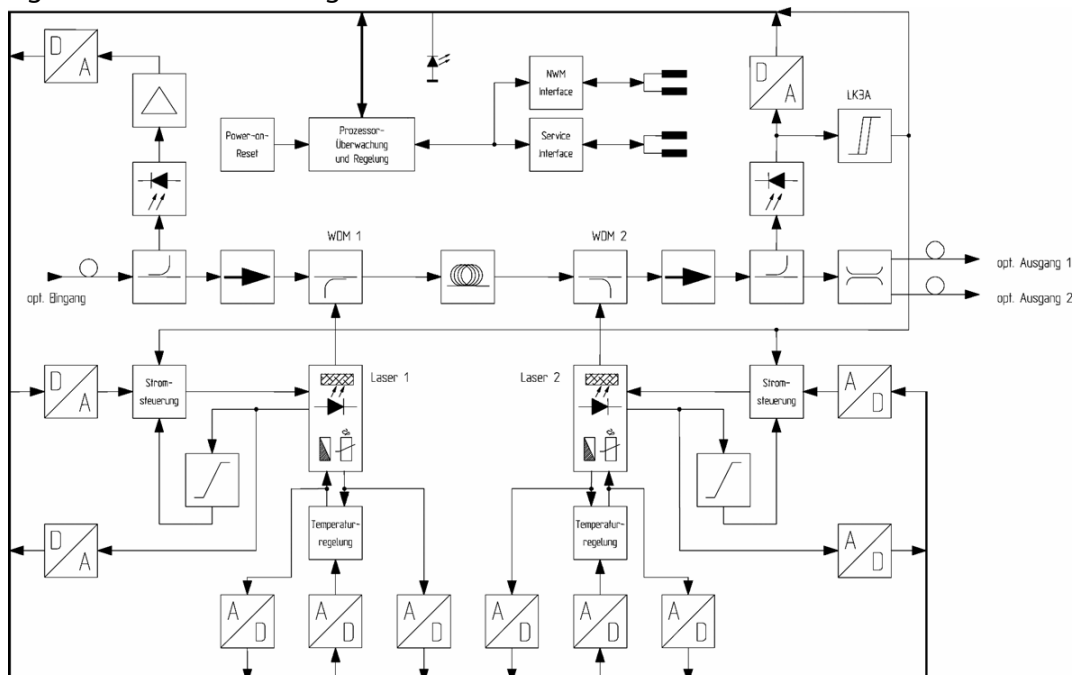
Fig. 1: View of SVO 692A/OV2165a (option with optical interfaces on the front panel)

1.2 Technical Description

The optical amplifier comes in a 1 rack unit high 19" housing. Fig. 2 shows the view of an SVO 692A/OV2165a (2 outputs, each 16.5 dBm).

There are four basic modules forming an SVO/OVxxxx or OAxxxxDW: A pump laser module with up to 4 pump laser diodes, the erbium fiber gain block including the monitor diodes, the control electronics and the power supply.

Fig. 2 shows the block diagram of an SVO 692A/OV2165a:



SVO/OV xxxx

Optical Amplifiers **EDFA**

After passing an optical tap coupler, isolator and wavelength division multiplexer (WDM) the optical input signal enters the erbium doped fiber assembly. Due to the pump power, added via the WDM(s), the signal is amplified and fed via a second (optional) WDM, isolator and tap coupler to the output (or alternatively output splitter). In the DWDM optical amplifier series OVxxxxDW additionally a gain flattening filter is added.

The pump power is generated by up to 2 pump laser diodes. The currents of the pump laser diodes are adjusted by the micro controller in order to achieve a constant output power for the complete range of input power levels.

The micro controller checks the input power level, output power level, all output powers and currents of the pump lasers as well as the temperatures. By the use of thermoelectric coolers, the temperatures of the pump lasers are kept at around 25°C in order to achieve a very long operational lifetime and high reliability. In case of any failure, an alarm is generated and displayed via the front panel LED's.

The optical amplifiers of the SVO/OVxxxx series are in general operating in constant power mode. In case the input power is below -10 dBm, all pump lasers of the optical amplifier are switched off and a loss-of-input-power alarm is generated and displayed. The optical amplifiers of the OAXxxxxDW series are generally operating in constant gain mode. An input low alarm is generated and displayed if input power is below -30 dBm.

For optical amplifiers operating in laser class 3B (>17 dBm on 1 output) a security switch function is mandatory in order to fulfill the safety requirements according to IEC 825. This function is implemented in the OVxxxx by switching on/off the device with a password protection. This security function switches on/off the pump lasers and may only be operated by educated people.

Via the EMS/NMS interfaces or the push buttons, it is possible to put the SVO/OVxxxx / OVxxxxDW into standby mode. In this case all bias currents of the power lasers are shut down. The thermoelectric coolers, however, continue working in order to achieve a very short turn-on time. This is important in networks with equipment or link redundancy.

For an EMS (element management system) or a NMS (network management system), an Ethernet 10/100 MBps interface is available at the rear side of the OVxxxxa/OVxxxxDWa. This Ethernet interface supports SNMP and Webbrowser protocols. The IP address for the Webbrowser interface can be set using the push buttons at the front panel or the RS232 local setup port at the rear side.

An additional RS485 (master) interface has been implemented at the OVxxxxa / OVxxxxDWa to poll other equipment like optical switches which are connected to the local RS485 management bus.

The OVxxxxb/OVxxxxDWb offers a RS485 interface for EMS or NMS. Optionally an external level converter from RS485 to RS232 is available to connect the Ovxxxxb / OVxxxxDWb to standard PC COM1 or COM2 interfaces.

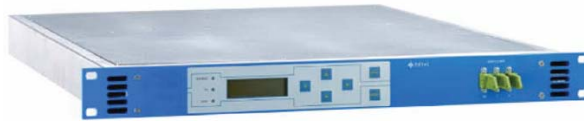
SVO/OV xxxx

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2 TECHNICAL SPECIFICATIONS

SVOxxx/OVxxxx OVxxxxDW

Optical Amplifier 1550 nm



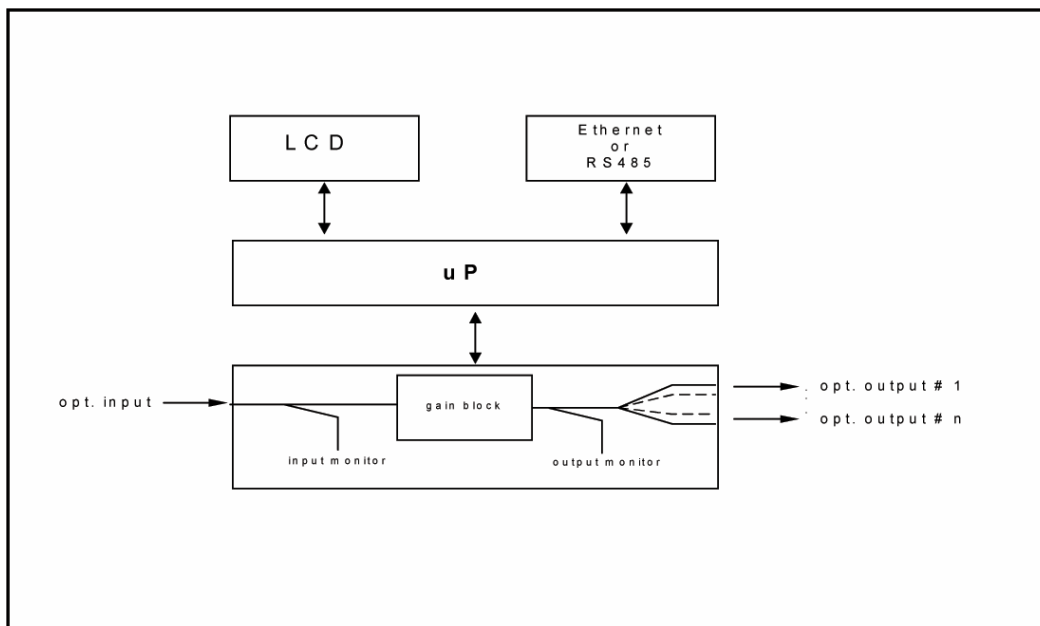
Application

Amplification of 1550 nm optical signals on single mode fibers

- DW model in particular for DWDM applications
- Output powers of 13 .. 23 dBm

Features

- Erbium doped fiber amplifier technology
- 980 nm / 1480 nm pump-laser diode(s)
- Gain flattening filter (-DW version only)
- Constant gain or output power control
- Input and output monitors
- Dual, hot-plug-in power supply modules for 100 .. 240 VAC, -48 VDC, +24 VDC
- Web and SNMP Interface (a-Version)
- RS232/RS485 control interface (b-Version)
- Built-in Network Element Controller to poll slave devices like Optical Switches
- LC display
- LED status indication
- Very thin design, only 1 HU



2.1 Optical Properties
generic data

Item	dim.	standard EDFAs SVO/OVxxxx	gain flattened EDFAs OAxxxxDW
Input signal wavelength	[nm]	1550 ± 10	1530 ... 1561
wavelength of pump lasers (typ.)	[nm]	980/1480	980
optical return loss	[dB]	>40	>40
min. optical input level	[dBm]	-3	-33
max. opt. input level	[dBm]	+6	-10
gain flatness (at nom. Gain and Pin = -10 dBm)	[dB]	-	1.0 typ. (<1.5)
dynamic gain flatness (at nom. gain)	[dB]	-	1.0 typ. (<1.5)
polarization dependent gain	[dB]	<0.2	<0.2
noise figure (@Pin=0dBm, $\lambda=1555\text{nm}$)	[dB]	<5.0	-
noise figure (@Pin=-10dBm, $\lambda=1550\text{nm}$)	[dB]	-	5.0 typ. (<6.0)
residual pump power (input and output)	[dBm]	<-10	<-10

**) different optical amplifier types

SVO/OVxxxx – standard EDFA - individual data for laser class 3A versions

Type	Opt. Output Power [dBm]
SVO 695 (OV1130)	1 x 13.0 ±0.5
SVO 690 (OV2130)	2 x 13.0 ±0.5
SVO 693 (OV4130)	4 x 13.0 ±0.5
SVO 694 (OV6130)	6 x 13.0 ±0.5
SVO 689 (OV8130)	8 x 13.0 ±0.5
SVO 697 (OV3150)	3 x 15.0 ±0.5
SVO 687 (OV4150)	4 x 15.0 ±0.5
SVO 688 (OV6150)	6 x 15.0 ±0.5
SVO 691 (OV1165)	1 x 16.5 ±0.5
SVO 692 (OV2165)	2 x 16.5 ±0.5
SVO 686 (OV3165)	3 x 16.5 ±0.5
SVO 685 (OV4165)	4 x 16.5 ±0.5

Extension A (web) or B (RS485)

OVxxxx – standard EDFA - individual data laser class 3B versions

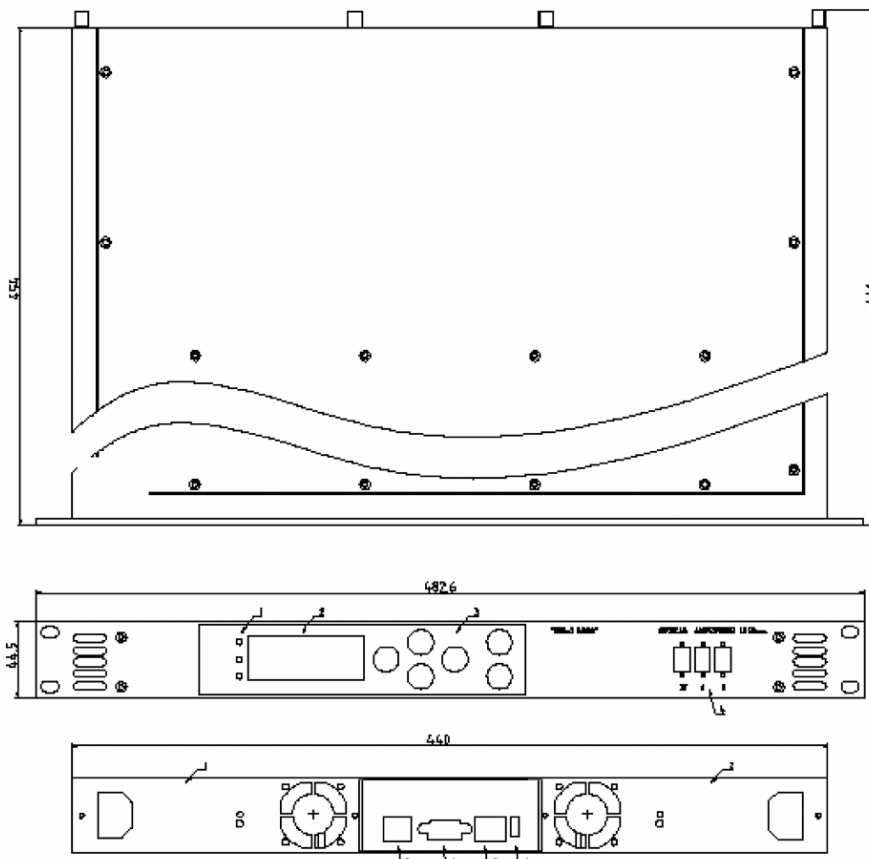
Type	Opt. Output Power [dBm]
OV1200	1 x 20.0 ±0.5
OV1220	1 x 22.0 ±0.5
OV1230	1 x 23.0 ±0.5

OAxxxxDW – DWDM EDFA - individual data

	Saturated Output Power [dBm]	Nominal Optical Gain [dB]	Gain adjustment range [dB]
OV1130DW	1 x 13.0±0.5	25 dB typ. (23 dB min)	13 dB ... nom. gain
OV1165DW	1 x 16.5±0.5	28 dB typ. (26 dB min)	16 dB ... nom. gain

2.2 Electrical and Mechanical Properties

Item	dim.	specification
Opt. Connector		any type of high return loss connectors front or rear side mounted
Optical fiber		standard singlemode 9/125 μm
Climatic Specification Operation		ETS 300 019, class 3.1
Storage		ETS 300 019, class 1.2
EMI		EN50083-2 (April 1996) EN50083-2 /A1 (February 1998)
Power Supply		Dual redundant, hot pluggable (3 Versions are available) 100...240 VAC 36...60 VDC or 23.5...24.5 VDC
Power Consumption	[W]	30 ... 60 W
Enclosure		19" / 1 RU
Weight	[kg]	9.7



2.3 Displays and Alarms

Module LED	Standard Operation	LED green
	non urgent alarm (warning)	LED yellow
	urgent alarm	LED red

OUT LED	nominal output power	LED green
	lack of output power	LED yellow
	loss of output power	LED red
	standby – operation	LED dark

IN LED	input power out of nominal operation	LED yellow
	nominal input power	LED green
	loss of input power	LED red

2.4 EMS / Service Interfaces

2.4.1 NMS server interface: Ethernet 10/100Mbps (OVxxxxa / OVxxxxDWa only)

The NMS server interface is the main NMS interface of the optical amplifier. It supports HTTP and SNMP protocols.

See the document *Device Management* for more information about the NMS server. The NMS server firmware can be downloaded for future software upgrades via the RS232 interface.

2.4.2 Local Setup interface: RS232 (OVxxxxa / OVxxxxDWa only)

Connector	Sub-D9 male
Configurations	115200 baud, 8 data, 1 stop, no parity
Interface	RS232
Pinning	Pin 1, 4, 6, 9: n.c. Pin 2: RxD Pin 3: TxD Pin 7: RTS Pin 8: CTS Pin 5: Gnd

The local setup interface can be used to locally setup the NMS server's parameter, like IP parameters and passwords by using the tool "NmsSetup.exe". Additionally it must be used to software download the NMS server firmware in the case that the NMS server crashes during software update when reprogramming application flash software over Ethernet.

Note: The local setup process can only be executed when the device starts up. After startup this interface has no meaning yet, but will be used for modem connections in the future.

2.4.3 BK device bus interface: RS485 (OVxxxxa only)

The RS485 interface can be used to connect more devices to be managed by the Ethernet NMS server interface together with the optical amplifier. The OVxxxx / OVxxxxDW in this case works as a network element controller, which polls all equipment that is connected to the RS485 port. Information about the protocol can be obtained from the document RS485 specifications.pdf.

2.4.4 BK device bus interface: RS485 (OVxxxxb only)

The RS485 interface can be used to manage the OVxxxx / OVxxxxDWL, that means to read data and to change some settings. BKtel offers a WINDOWS based software tool

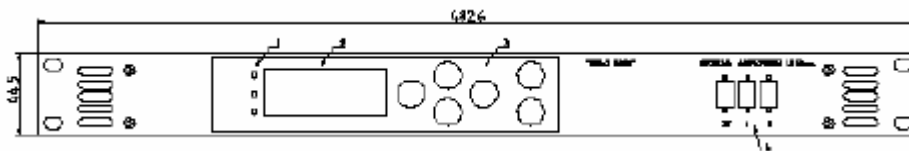
SVO/OV xxxx

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to communicate with the amplifier. Additionally, a RS485 to RS232 level converter can be offered. This allows to run the software on any WINDOWS based PC and use the COM1 or COM2 ports to communicate with the OVxxxx / OVxxxxDWL via the RS485 interface.

2.5 Front Panel

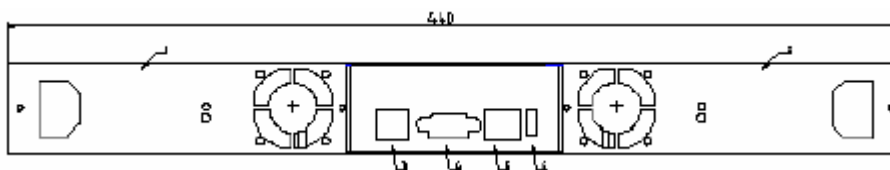
Figure 3 shows an example of the front panel view of the Ovxxxx / OVxxxxDW. The optical input and output connectors are optionally available on the rear panel.



Item	# Function
1	Status LED's
2	Liquid Crystal Display
3	Push button field for local set-up of amplifier
4	Optical input/output connectors (optionally available on rear side)

2.6 Rear Panel

The rear panel provides several field replaceable units:



Item #	Function
1,2	power supply + fan modules
3	RS485 interface (RJ-45 female)
4	RS232 interface (SUB-D9 male)
5	Ethernet interface (RJ-45 female)
6	2 green LED's (Ethernet link & data)

2.7 Power supply and fan modules

There are 3 different types of power supply and fan modules available for the OVxxxx / OVxxxxDW. All of them can be either mounted on the left hand or right hand side, It is possible to replace or exchange all of the modules during operation. This offers a big flexibility to the end user in order to customise the OVxxxx / OVxxxxDW exactly to the actual needs.

2.7.1 100 – 240 VAC module

Figure 4 gives the view on the 100 – 240 VAC power supply and fan module. There is a AC mains input. There is one LED informing about the status of the power supply module. The power unit O.K. LED is lightening green provided that the power supply module is working properly.

The power supply and fan modules may be exchanged during operation (hot plug-in technology) with having neither harm to the equipment nor having any impact on the operation of the amplifier in case of a properly working backup power supply.



Figure 4: 100 ... 240 VAC power supply and fan modules