ES10L / ES10XL

Optical CATV Transmitter 1550 nm

and

ES26XL

Optical CATV & SAT-IF Transmitter 1550 nm

Operating Manual

Rev. 01 November 2008

Safety instructions

Attention:

Please read the instructions completely and carefully

before putting into operation!

All operation steps should be carried out in the prescribed sequence!

Improper putting into operation can cause serious danger for persons or damage the devices.

INVISIBLE LASER RADIATION

DO NOT STARE INTO BEAM OR VIEW DIRECTLY WITH OPTICAL INSTRUMENTS

CLASS 1M LASER PRODUCT

MAXIMUM OUTPUT POWER:
15.6 mW
WAVELENGTH: 1550 nm

IEC 60825-1 (08/2001)

Warranty

All products manufactured by BKtel communications GmbH are guaranteed to be free from defect in material and workmanship for a period of two (2) years from the date of shipment. During the warranty period, BKtel communications GmbH will repair, or replace at its option, any product or parts thereof which have been sold by BKtel communications GmbH or authorised representatives to the Buyer, where such products or parts thereof, upon inspection by BKtel communications GmbH and in the sole opinion of BKtel communications GmbH are determined to be defective in workmanship or material. BKtel communications GmbH reserves the right to issue a credit note for any defective product or parts thereof, as determined by BKtel communications GmbH, as an alternative to the repair or replacement of such defective product or parts thereof. This warranty shall extend to all products and parts thereof which have been proved defective through normal use, but this warranty shall not cover any products or parts thereof that have been subjected to conditions exceeding the applicable specifications or ratings for such products or parts thereof, or such products or parts thereof which have been disassembled, modified or otherwise abused.

Buyers must notify BKtel communications GmbH in writing of any warranty claim not later than 30 days after the expiration of the warranty period. Any claims under this warranty must be made by the Buyer, and no claim will be accepted from any third party. All claims for shortage of products ordered, or for incorrect charges, must be presented to BKtel communications GmbH within 10 days after shipment of products by BKtel communications GmbH.

Limitation

The remedies provided for above are the Buyer's sole and exclusive remedies. BKtel communications GmbH shall not be liable to a Buyer, or any other third parties, for installation and removal costs, or for any other special, consequential or indirect damage, including without limitation the loss of production or profit, arising from any cause whatever, even if BKtel communications GmbH has been advised to the possibility of such damage or damages, or even if such damage or damages is alleged to arise from negligent acts, omissions, or conduct of BKtel communications GmbH or its employees. The liability of BKtel communications GmbH is expressly limited to the replacement or correction of defective products or parts thereof, or to the issuance of a credit note for the purchase price of such products or parts thereof. This warranty is in lieu of all other warranties expressed or implied including, without limitation, any implied warranties or merchantability or fitness for a particular purpose.

Repair Procedures

Defective products or parts thereof shall be returned to BKtel communications GmbH, transportation pre-paid, at the address shown below, using the original packing carton or one that will provide equal protection. All products or parts thereof which have been returned to BKtel communications GmbH, but which are found to meet all previously applicable specifications for such products or parts thereof, shall be subject to an examination charge of not less than US $ 250.00. All products or parts thereof which are returned to BKtel communications GmbH, and which are not accompanied by an itemised statement of defects shall be returned to the Buyer at the Buyers expense, and no evaluation of such product or part shall be carried out.

BKtel communications GmbH shall only accept returns for which an approved Return Material Authorisation (RMA) has been issued.

Repairs are warranted for the remainder of the original warranty or 90 days, whichever is greater.

Claims for Shipping Damage

When the product is received by the Buyer, it should be immediately inspected for damage to the product or shortages on the packing list. If the product is damaged, a claim should be filed with the carrier. A quotation for estimated costs of repair can be obtained from BKtel communications GmbH. Negotiation and settlement with the carrier must be accomplished by the Buyer.

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TABLE OF CONTENTS

DOKUMENT STATUS

Document Operating Manual ES10 and ES26

Revision	Date	Responsible	Remarks
00	31.07.2008	Illies	Document created
01	03.11.2008	Illies	- NEC appl. SW release 2.4.2 - CSO regulation mode revised - Alarm & Warning Flags revised

1 PARTS LIST

This document contains the description for the following units:

Issue	Description
Transmitter unit	1. Modular external modulated 1550 nm optical transmitter basic unit for CATV (ES10) 2. Modular external modulated 1550 nm optical transmitter basic unit for CATV and SAT-IF (ES26)
I/O ports	Not for ES10L-types
Power supply + fan module	Power supply + fan module 100 VAC ... 240 VAC
	Power supply + fan module ±36 VDC ... ±60 VDC
	Power supply + fan module 24 VDC
	Fan-only module
Optical interface	SC-APC optical connector, 8° angle (default)
	SC-APC optical connector, 9° angle (option)
	FC/APC optical connector, JDS-standard (default)
	FC/APC optical connector, NTT-standard (option)
	E2000 – 0.1 dB optical connector
	HRL-10 optical connector

The ES10/ES26 is available as an OEM product with customized front panel printing.

2 TYPES INFORMATION

Transmitter characteristics

Type	Opt. output power	SBS Threshold	Freq. Plan	NMS Interface	I/O ports	Wave-length	Opt. connector	RF-input Opt. Output	OEM Version	Power supply

Types

Property	**Key**	**Meaning**
Version	ES10 ES26	47…870 MHz 47…870 MHz and 950…2605 MHz
Type	XL L	XL L (only ES10)
Opt. output power	60 70 85 100	+6.0 dBm (ES10L + ES10XL)) +7.0 dBm (ES10L) +8.5 dBm (ES10L + ES10XL + ES26XL) +10 dBm (ES10XL + ES26XL)
SBS threshold	165 190	+16.5 dBm (fix, only L-type) +13.0 ... +19.0 dBm (adjustable)
Frequency plan	C42 N77 PAL84 xxx	C42 N77 PAL84 Customer specifics
NMS interface	A B	HTTP / SNMP Ethernet RS485
I/O ports	1	only XL
Wavelength	X 15xx.xx	1548….1560nm 15xx.xxnm ITU Wavelength
Optical connector	1 2 3 4 5	E2000 SC/APC FC/APC-NTT FC/APC-JDS SC/APC with shutter
RF-input / opt. output	F R	On front side On rear side
OEM Version	0 OEM	BKtel OEM Version
Power supply	230/230 48/48 24/24 230 48 24 230/48	2 x (100 … 240 VAC) 2 x (±36 … ±72 VDC) 2 x (23.5 … 24.5 VDC) 1x (100 … 240 VAC) 1 x (±36 … ±72 VDC) 1 x (23.5 … 24.5 VDC) mixed 230 VAC/ 48 VDC

Example Transmitter characteristics: ES10XL-85-190-N77-A-1-1558.99-2-F-0-230/230:
Optical transmitter type ES10XL with (2x) 8.5 dBm output power, max. 19 dBm SBS threshold, calibrated for NTSC77 frequency plan, with HTTP/SNMP Ethernet NMS interface, with I/O ports, operating nominally on 1558.99 nm, with SC/APC connectors, RF input on the front and optical outputs at the rear side, BKtel version with dual 100 … 240 VAC power supplies.

3 GENERAL DESCRIPTION

3.1 Introduction

The optical transmitter ES10/ES26 represents a family of externally modulated 1550 nm DFB laser transmitters. These products have been developed to fulfill the requirements of modern Hybrid Fiber Coax networks for the transmission of CATV, cable phone, cable data signals and SAT-IF (only ES26). There are currently 2 different base versions available:

- ES10L for applications with moderate fiber length of < 50 km
  This version features a SBS threshold of 16.5 dBm, a narrow linewidth laser (0.65 MHz), output powers of 2 * 7 dBm (-70 version) or 2 * 8.5 dBm (-85 version) and a RS485 interface for EMS (element management systems).

For highest requirements on transmission performance and features the

- ES10XL/ES26XL for applications with very long fiber length exceeding 50 km
  is proposed. This version offers a SBS threshold which can be adjusted between 13 and 19 dBm, a very narrow linewidth laser (0.3 MHz), output powers of > 2 * 8.5 (-85 version) or > 2*10 dBm (-100 version), ITU – grid compatible wavelength which can be adjusted by +/- 100 GHz, an 10/100 Ethernet Webserver and SNMP interface for EMS/NMS (element/network management systems). Future proof operation is accomplished due to the possibility to download updates of the network controller firmware and the transmitter firmware.

Both transmitters ES10/ES26 transmitter are offered for 4 different standard frequency plans. Specifications for other frequency plans are available on request.

The optical transmitter comes in a 1 unit high 19“ housing. Fig. 3.1.1 shows the view of an ES10 with RF_{IN} socket, $RF_{Monitor}$ socket and optical connectors on the front panel. Optionally these connectors can be located on the rear panel. The ES26 Fig. 3.1.2 includes additionally a SAT_{IN} and $SAT_{Monitor}$ socket at the front side.

Fig. 3.1.1: View of ES10

Fig. 3.1.2: View of ES26XL

A Liquid Crystal Display (LCD) provides information about actual settings and properties. 6 push buttons are used to enter data locally. The background light of the LCD is switched on automatically, when a push button is pressed.

The ES10/ES26 provides plug in power supply modules. The minimum configuration is one power supply + fan module together with a redundant fan-only module. Optionally two power supply + fan modules can be used for improved reliability. The power supply modules are offered in 3 different input voltage specifications: 100 ... 240 VAC, ±36 ... ±60 VDC and 24 VDC. One feature of the ES10/ES26 is the possibility to use two different power supply + fan modules in one transmitter: e.g. power supply + fan module no. 1 could be a 100 ... 240 VAC unit, power supply + fan module no. 2 could be a ±36 ... ±60 VDC unit.

The optical interface can be ordered with optical connectors as specified in the parts list (pls. ref. to 1). Without the need of using special tools it is possible to change the optical interface by replacing the optical connector interface plate by another one as specified in the parts list.

For an EMS (element management system) or a NMS (network management system) an Ethernet 10/100 Base-T Ethernet interface is available at the rear side of the ES10XLa/ES26XLa. This Ethernet interface supports SNMP and HTTP protocols. The IP address for the Webserver interface can be set using the push buttons at the front panel or the RS232 local set-up port at the rear side.

An additional RS485 (master) interface has been implemented at the ES10XLa/ES26XLa to poll other equipment like EDFAs or optical switches which are connected to the local RS485 management bus.

There are optionally one general purpose I/O port and 4 input-only ports available for additional alarm or remote functions. These I/O ports are accessible via the Webserver interface.

The ES10L/XLb offers two RS485 (slave) interfaces for EMS or NMS. An external level converter from RS485 to RS232 can be offered on request to connect the ES10L/XLb to standard PC-COM1 or –COM2 interfaces. Furthermore, there is one alarm output, which can be used for simple alarm messaging functions.

3.2 Principle of Operation

The transmitter is based on 5 functional blocks: RF-path, cw-DFB-laserdiode, integrated optical modulator, control electronics and power supply. The functional diagram is given in Fig. 3.2.2.

The RF input signal is fed into a preamplifier including an automatic gain control circuitry. The AGC stabilizes the output signal of the preamplifier to maintain a stable RMS- (root-mean-square) optical modulation index (OMI) of the optical modulator. Input level variations are compensated as long as the AGC circuit is working in its nominal gain range.

The AGC can be turned off for a constant gain operation via the push buttons, or the Ethernet interface in order to tailor the CNR/CSO/CTB performance to the used frequency plan and the requirements of the customer by using a different input level.

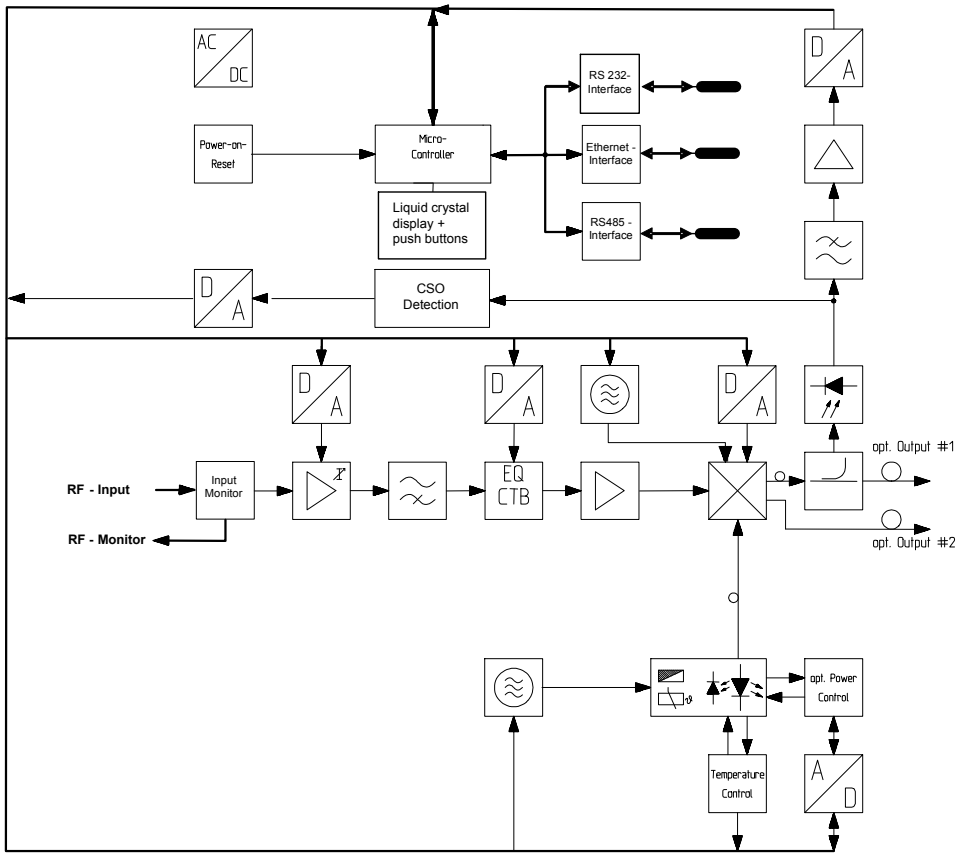


Fig. 3.2.1: ES10 Block Diagram

The central core of the transmitter is the electrooptical modulator working as a Mach-Zehnder-interferometer. The light from the laserdiode is coupled into an optical strip waveguide. An integrated optical splitter divides the light into two identical portions which are phase modulated by an RF signal applied to the electrodes of the modulator. The concept of the electrodes results in a push pull phase modulation of both branches. Following the modulating section the signals of both arms are combined and interfere. The interference of the phase modulated signals results in an amplitude modulation of the output light signal which is available on both outputs of the combiner.

The necessary cw input light for the modulator is produced by a DFB laserdiode working with 1550 nm wavelength. There are two control loops for operating the laserdiode at constant optical output power as well as at constant temperature by means of a thermoelectric cooler. The ES10XL has been designed for DWDM applications and allows tuning the operation frequency (wavelength) by +/- 100 GHz in steps of 50 GHz. The laserdiode operating current is controlled in order to compensate for ageing effects. The temperature of the laserdiode is controlled by regulating the required drive current for the thermoelectric cooler. At 90% of the available cooler drive current and/or >130% of the initial laserdiode operating current a warning is generated which indicates ageing. At 100% cooler drive current the laserdiode operating current is switched off to protect the laserdiode against irregular temperature conditions and an alarm is generated indicating severe malfunction. Both types of indications are causing the corresponding LED on the front plate of the optical transmitter to emit. In case of a warning the LED lights yellow since the unit is still working properly, however close to its limits. In case of an alarm the LED is emitting red light. The messages to the network management system are of course more detailed. They include the actual values of the currents and temperature as well as alarm flags.

To suppress the Stimulated Brillouin Scattering (SBS) the wavelength spectrum of the optical signal is broadened. Two technologies are used:

- Broadening the optical spectrum by modulating the laserdiode operating current
- Broadening the optical spectrum by driving an optical phase modulator

These SBS circuits are mandatory to avoid stimulated Brillouin scattering in optical fibers and allow operation with optical amplifiers feeding at least +13 dBm of optical power into standard single mode fibers. For the XL-version of the transmitter all microwave signals can be adjusted in amplitude via the push-buttons on the front panel to optimize the SBS and SPM (self phase modulation) performance.

The coupling of light from the laserdiode into the modulator is performed by using polarization maintaining optical fiber. The optical modulator provides two optical outputs. The signal of one of these outputs is tapped to an InGaAs photodiode. The electrical signal of this photodiode is evaluated for two reasons to supervise a proper working of the cw laserdiode. In case of optical output power drop of 2 dB of nominal power an B-grade alarm (=warning alarm) is generated, in case of optical output power 0 dBm an A-grade alarm (=urgent alarm) is generated.

When switching on the ES10/ES26, the transmitter starts up adjusting the bias point of the electrooptical modulator by output power regulation, it's called "Output power based". After warm up sequence, regulation is performed by checking the CSO beats and minimizing them, which is called "CSO based". Both states are shown in the parameter menu. When internal working temperature is reached, the bias point of the electrooptical modulator is evaluated by one of two methods:

1. Channel controlled:
   A detector circuit measures CSO and CTB distortions to optimize the bias point of the electrooptical modulator. For a proper operation of the detection circuit at least two TV carriers with a frequency spacing of 24 MHz have to be present. Using this standard software setting of the detection scheme all known European and Chinese frequency plans are supported: CENELEC frequency plan, all regular 8 MHz spacing frequency plans as well as the German 7/8 MHz frequency plan. Additionally it is possible to change the standard software setting to work with regular 6 MHz frequency plans (NTSC) or pure 7 MHz frequency plans via push-buttons on the front panel or via the NMS interface.
2. Pilot controlled: (*)
   An internal pilot tone is used to check for distortion products out-of-band. Service signal frequency range 47 to 862 MHz is not targeted by pilot tone control.

The ES26 transmitter provides the same functions as ES10 transmitter and moreover a SAT-IF signal input in order to additionally transmit SAT-IF frequency band. Its block diagram is depicted in Fig. 3.2.2. RF signal input for SAT-IF signals is separately controlled by an amplifier also providing AGC option. Again, AGC stabilizes the SAT-IF output signal of the preamplifier to maintain stable RMS- (root-mean-square) optical modulation index (OMI) of the optical modulator regarding SAT-IF signal part. Input level variations are compensated as long as the AGC circuit is working in its nominal gain range.

It is recommended to switch on SAT-IF AGC, but it can be turned off for a constant gain operation in order to allow for special user requirements.

***) Note:** This function is protected by US-Patent 5,400,417 from 21.03.1995. In case of usage the permission of patentee is required.

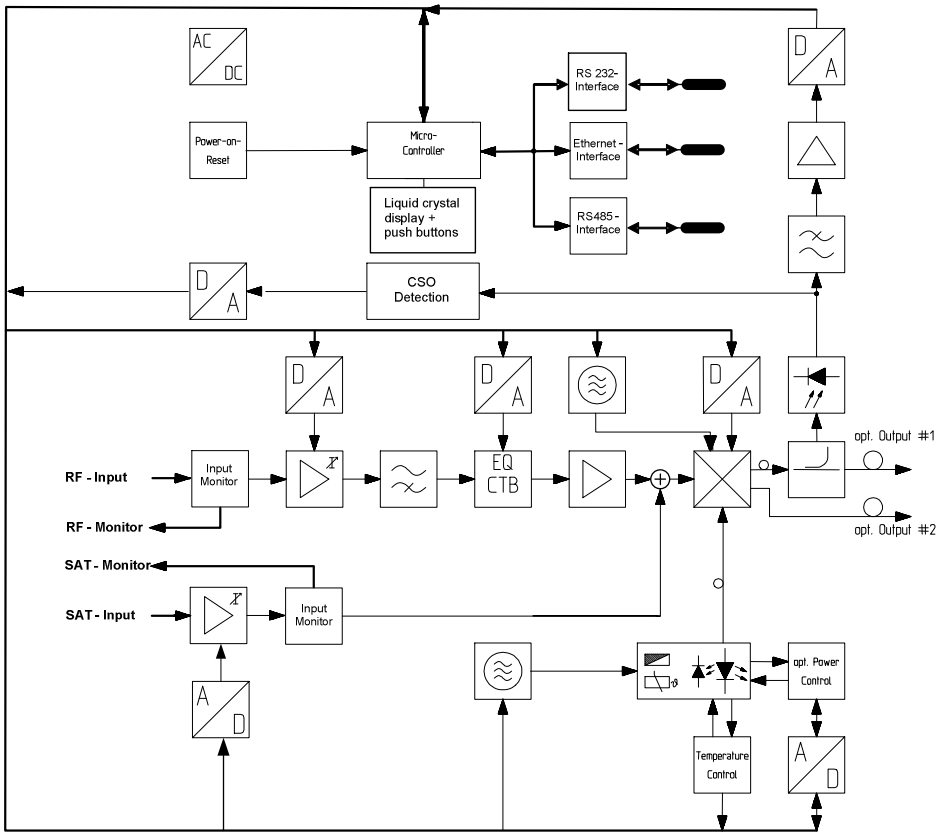


Fig. 3.2.2: ES26 Block Diagram

The ES10XLa/ES26XLa is equipped with 4 data interfaces at the rear side:

- RS232 for a local set-up of the NMS Interface,
- RS485 (master) for polling other BKtel equipment like EDFAs or optical switches and translating this information to the Ethernet interface (HTTP and SNMP),
- Ethernet 10/100 Base-T supporting SNMP and Webserver (HTTP) protocols for interfacing to a EMS or NMS
- General purpose I/O interface

The ES10L/XLb is equipped with two RS485 (slave) interfaces for interfacing to an EMS or NMS. Additionally, there are two output ports available for simple alarm or warning messaging.

Plug in power supply/fan modules for different input voltages are available for 100 ... 240 VAC, 36 ... 60 VDC and 24 VDC. Each module can be simply removed during operation without disturbing the operation of the transmitter by removing 2 screws.

3.3 Principle of Element Management

The interface configuration for Element Management or Network Management systems is shown in the next two figures for the ES10XLa/ES26XLa with embedded NEC (network element controller = SNMP Proxy Agent) and the ES10L/ESXLb.

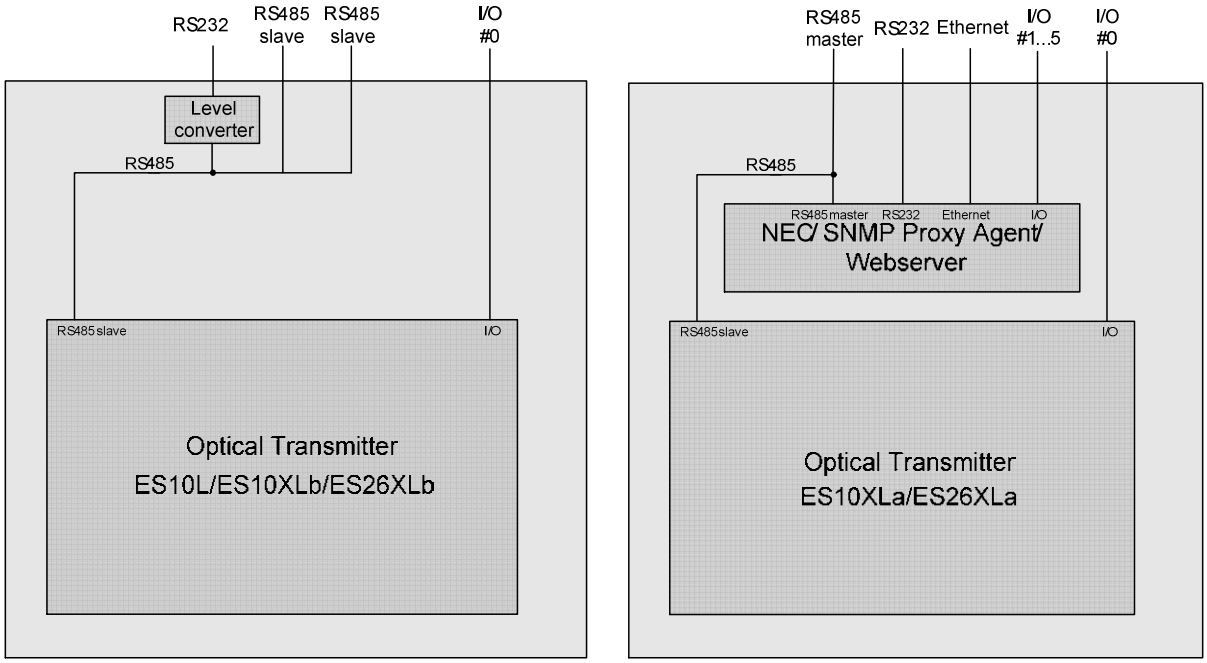


Fig. 3.3.1: a) EMS / NMS Interface of ESxb b) EMS / NMS Interface of ESxa

The ES10XLa/ES26XLa versions (ref. to Fig. 3.3.1 a) contain an embedded network element controller (NEC) which works as a SNMP Proxy Agent. All equipment (EDFAs, optical switches, receivers and power supplies) which are connected to the RS485 master interface and which support the BKtel RS485 protocol are polled. The received data is then translated into SNMP and HTTP and can be accessed via the Ethernet interface. The NEC is able to poll up to 48 devices on the RS485 bus. On the optional I/O ports #1 … 5 warnings/alarms collected from all polled devices can be accessed. The application software of the NEC can be updated easily in order to support new devices. An overview of software releases is given in chapter 11. BKtel offers the MIB-files for easy implementation of the SNMP interface into element/network management systems (EMS/NMS) such as Cablewatch (BKtel), HP Open View or Rosa (SA former Barco Networks).

The ES10L/XLb-versions (ref. to Fig. 3.3.1 b) does not contain an embedded NEC. The RS485 slave interface of the transmitter can be accessed directly, but should be connected to an external NEC-E (e.g. BKtel's Ethernet controller NEC-E in BK mechanics).

The picture below explains how the ES10XLa / ES26XLa interfaces to other devices and a SNMP EMS.

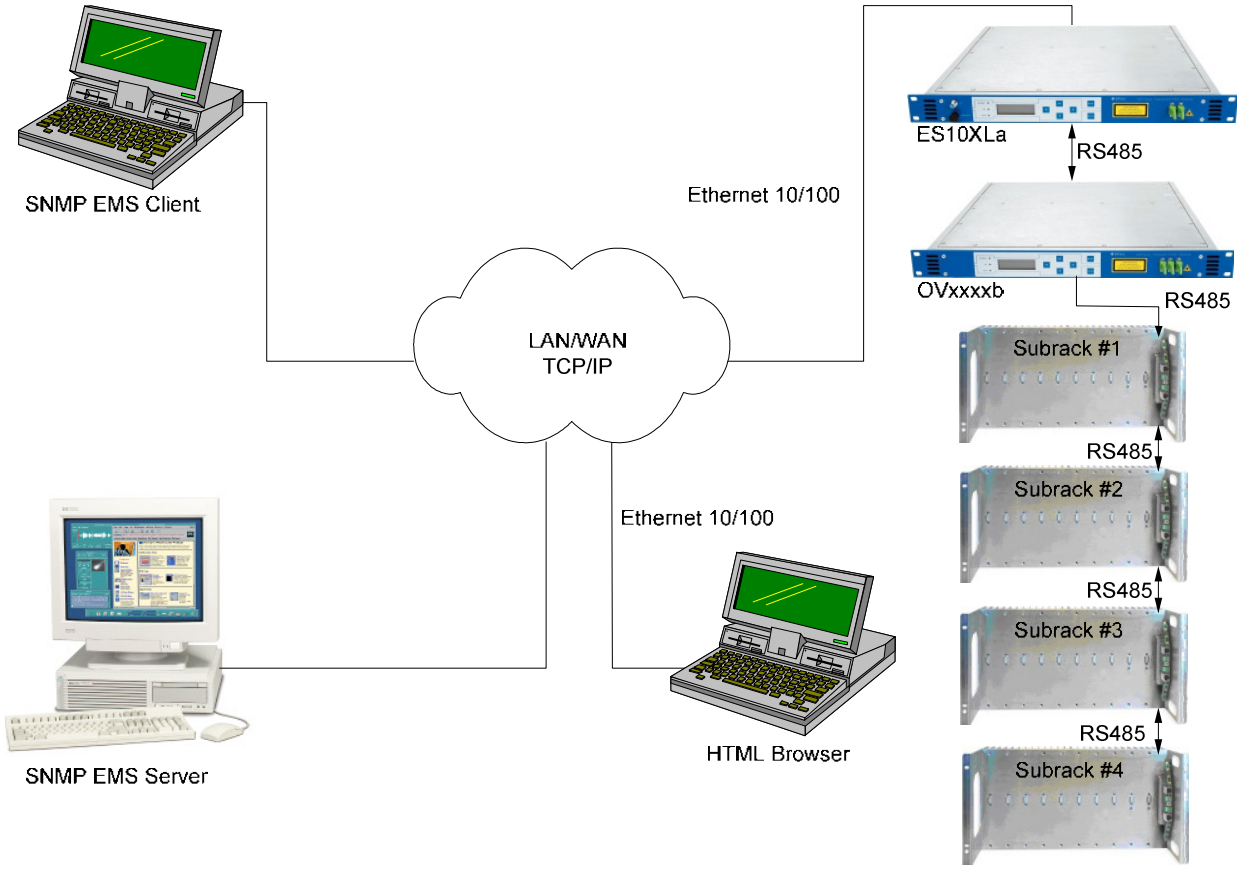


Fig. 3.3.2: The ES10XLa interfacing with other equipment and a SNMP EMS.

In this figure the ES10XLa/ES26XLa with embedded NEC (upper right corner) is connected to other (BKtel) devices via the RS485 interface. In the example there is an optical amplifier OVxxxxb (without embedded NEC) in 19”-1RU housing, similar to the ES10/ES26, and in total 4 subracks interfacing to the RS485 bus. A variety of BKtel devices which can be mounted on these subracks like EDFAs, optical switches, optical transmitters and receivers. For an actual overview please refer to www.bktel.com or contact BKtel directly. All of these connected devices only provide RS485 slave interfaces, since the NEC of the ES10XLa/ES26XLa is the dedicated RS485 bus master, polling all other devices. The NEC (SNMP Proxy Agent) within the ES10Xla/ES26XLa polls all devices and translates this information to Ethernet-HTTP and Ethernet-SNMP.

3.3.1 Webbrowser Communication

Local management access on the embedded network element controller NEC-E (or NEC-E in BK-mechanics) is executed with a Webbrowser by establishing the NEC-E IP address. Besides the Webbrowser no other software is necessary. The access computer is only in need of an Ethernet interface; no dongles are required. If the NEC-E is not connected to a LAN/WAN, one can directly link the computer with the embedded NEC-E (or NEC-E in BK-mechanics) by crossed RJ45 cable.

As soon as the Webbrowser establishes the link to the NEC-E with the correct IP address, all chassis devices connected to the RS485 bus are listed on the first page.

Clicking on a device listed in the menu “Devices” leads to further webpages, which allow supervision and adjustment of the selected device.

3.3.2 NMS Communication

The embedded network element controller NEC-E (or NEC-E in BK-mechanics) provides an HMS compliant SNMP protocol for communication with the server of a central (umbrella) network management system (NMS). SNMP MIBs are available on request.

The NMS can deal with the complete set of device management features by SNMP MIB, because all management functions are implemented in SNMP. Alarms are indicated by traps. Of course, decentralized network element controller access by Webbrowser is simultaneously available.

4 TECHNICAL SPECIFICATIONS

ES10XL/ES26XL

ES10L

Optical Transmitter 1550 nm

Application

Electrical to optical conversion of multichannel CATV signals like AM-VSB, FM and QAM signals

Enables the usage of optical amplifiers (EDFAs) as boosters or repeaters in order to realize large scale HFC networks

Excellent performance in order to realize links exceeding 100 km (XL-Version)

Features

Low noise, narrow linewidth cw-DFB laser

ITU-Grid wavelength (XL-Version)

Wavelength adjustable +/- 100 GHz (XL-Version)

Electrooptical modulator with 2 optical outputs

Automatic RF gain control: cw, video, manual mode

> 2 * 10 dBm output power (XL-100-Version)

Adjustable SBS threshold up to 19 dBm to increase transmission distance (XL-Version)

Front panel RF test point –20 dB

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 BKtel Optical Switches and BKtel Optical Amplifiers via RS485 (a – version only)

LC display and LED status indication

General purpose I/O interface for remote functions (XL version only)

Very thin, only 1 U design for mounting into 19”, ETSI or JIS racks

ES26XL

Optical Properties		ES26XL-85	ES26XL-100
Wavelength		1548 nm …1560 nm or ITU-grid CH23… CH37	
Side mode suppression	[dB]	> 30	
Wavelength adjustment range	[GHz]	-100, -50, 0, +50, +100	
Optical power	[dBm]	2 x 8.5 min.	2 x 10.0 min.
Relative intensity noise for CATV (for optical fiber return loss >40km)	[dBc/Hz]	< -158 (typ. < -160)	
SBS-Suppression threshold:			
CATV&SAT-IF application, 25km	[dBm]	+15 *)	
CATV application, 65 km	[dBm]	+19	
Laser linewidth (typ.)	[MHz]	0.3	

*) SBS suppression threshold should be adjusted application individually as low as possible for best signal performance, since using +14…+15 dBm threshold may result in 2 dB penalty of CNR for carrier frequencies 80…110 MHz and 4 dB penalty for band I (47…68 MHz) carrier frequencies.

Electrical Properties CATV

RF-frequency Range	[MHz]	47…862
Frequency response flatness	[dB]	< ±0.75
Nom. Input level per TV channel	[dBµV]	80
Input level range (per carrier)	[dBµV]	78…96 (for OMI =5% per CATV carrier)
True RMS input level range	[dBm]	-16…+2 (for ALC correctly working)
Slope range	[dB]	-2 (cable equivalent) … +8 (cable equalization)
RF impedance	[Ω]	75
Return loss	[dB]	> 20 (@ 47MHz) -1.5dB/octave, minimum 15
RF monitor (test point) level	[dB]	-20 (-0.8 … +0.2)

Electrical Properties SAT-IF

RF-frequency Range	[MHz]	950…2605
Frequency response flatness	[dB]	< ±2
Input level range (per SAT-IF carrier)	[dBµV]	82…98 (OMI_{SAT} = 1.0% per SAT-IF carrier)
True RMS input level range	[dBm]	-11…+5 (for ALC correctly working)
RF impedance	[Ω]	75
Return loss	[dB]	> 10
RF monitor (test point) level	[dB]	66 ± 2.5 (for OMI = 1.0%)

Performance Characteristics CATV

Transmitter version		**C42**	**D84**	**N77**
Channel allocation plan for test		**CENELEC 42**	**PAL-D 84**	**NTSC 77**
Number of TV carriers		42	84	77
Noise bandwidth	[MHz]	5	5	4
CNR Tx/Rx *)	[dB]	54.5 (52.5)	51.5 (49.5)	53 (51)
CNR Link 1 *)	[dB]	53.5 (51.5)	50.5 (48.5)	52 (50)
CSO Tx/Rx and Link 1 #)	[dBc]		64	
CTB Tx/Rx and Link 1	[dBc]		63	

*) Values are valid for pure CATV application, value in backets (…) are valid for CATV & SAT-IF application with 36 QPSK modulated SAT-IF signals with carrier frequencies in the range of 1000…2600 MHz.

#) Optical output #1

Performance Characteristics SAT-IF

CNR *)	[dB]	> 27
Intermodulation products *)	[dBc]	< -35 (including intermodulations due to CATV signal!)
Spurious signals *)	[dBc]	< -38

*) Measurement conditions as described in table “Test Condition” under row “Tx/Rx”; moreover 36 QPSK modulated SAT-IF signals with carrier frequencies in the range of 1000…2600 MHz and 27 MHz IF bandwidth are used.

Test Configurations

	Booster EDFA [2])	1st Fiber Length [3])	In-Line EDFA [2])	2nd Fiber Length [3])	Receiver $P_{opt,Rx}$ [4])
Tx/Rx [1])	no	no	no	no	0 dBm
Link 1 [1])	15 dBm	25 dBm	no	no	0 dBm
Transmitter mode for all tests	ALC of both, CATV and SAT-IF input switched ON!				

[1]) RF input level at 80 dBµV per TV carrier

[2]) EDFA with noise figure N = 5 dB

[3]) Non-dispersion shifted fiber

[4]) Receiver Rx with equivalent input noise current density of I_{EQ} = 7 pA/√Hz and efficiency η = 0.95 A/W

ES10XL

Optical Properties		ES10XL-60	ES10XL-85	ES10XL-100
Wavelength		1548 nm …1560 nm or ITU-grid CH23… CH37		
Wavelength adjustment range	[GHz]	-100, -50, 0, +50, +100		
Side mode suppression	[dB]	> 30		
Optical power	[dBm]	2 x 6.0 min.	2 x 8.5 min.	2 x 10.0 min.
Relative intensity noise for CATV (for optical fiber return loss >40km)	[dBc/Hz]	< -158 (typ. < -160)		
SBS-Suppression	[dBm]	Threshold adjustable between +13 and +19 dBm		
Laser linewidth (typ.)	[MHz]	0.3		

Electrical Properties

RF-Frequency Range	[MHz]	47 –1000
Flatness	[dB]	< ±0.75 (47…860 MHz) <±1.5 (860 MHz…1 GHz)
Nom. Input level per TV channel	[dBµV]	80
Input level range (per carrier)	[dBµV]	78…96 (for OMI =5% per CATV carrier)
True RMS input level range	[dBm]	-16…+2 (for ALC correctly working)
Slope range	[dB]	-2 (cable equivalent) … +8 (cable equalization)
RF impedance	[Ω]	75
Return loss	[dB]	> 20 (@ 47MHz) -1.5dB/octave, minimum 15
RF monitor (test point) level	[dB]	-20 (-0.8 …+0.2@ 862 MHz, -1,3 dB @ 1GHz)

Performance Characteristics

Transmitter version		C42	B52	D59	D84	N77
Channel plan		CENELEC 42	PAL-B/G	PAL-D 59	PAL-D 84	NTSC 77
Number of channels TV / FM (-4dB) / QAM64 (-10dB)		42 / 0 / 0	52 / 36 / 46	59 / 0 / 0	84 / 0 / 0	77 / 0 / 0
Noise bandwidth	[MHz]	5	5	5	5	4
CNR Tx/Rx	[dB]	55.5	53.5	54.0	52.5	53.5
CNR Link 1	[dB]	55.0	53.0	53.5	52.0	53.0
CNR Link 2	[dB]	53.0	51.0	52.5	50.5	52.0
CNR Link 3	[dB]	50.5	49.5	50.5	49.0	50.0
CSO Tx/Rx and Link 1	[dBc]	65	70	65	65	65
CSO Link 2	[dBc]	63	70	65	65	65
CSO Link 3 at output #1	[dB]	62	65	65	63	65
CTB	[dBc]	65	71	65	65	65

Test Configurations

	Booster EDFA	1st Fiber Length	In-Line EDFA	2nd Fiber Length	RX
Tx/Rx	no	no	no	no	0 dBm
Link 1	no	35 km	no	no	0 dBm
Link 2	16 dBm	65 km	no	no	0 dBm
Link 3	13 dBm	52 km	13 dBm	52 km	0 dBm

Rx with 7 pA/√Hz input noise current density
EDFAs with 5dB noise figure
RF input level at 80 dBµV / TV channel

ES10L

Optical Properties		ES10L-60	ES10L-70	ES10L-85
Wavelength		1548 nm …1560 nm or ITU-grid CH23… CH37		
Side mode suppression	[dB]	> 30		
Optical power	[dBm]	2 x 6.0 min.	2 x 7.0 min.	2 x 8.5 min.
Relative intensity noise for CATV (for optical fiber return loss >40km)	[dBc/Hz]	(typ. < -160)		
SBS-Suppression	[dBm]	Fixed threshold +16.5 dBm		
Laser linewidth (typ.)	[MHz]	0.65		

Electrical Properties

RF-Frequency Range	[MHz]	47 –862
Flatness	[dB]	<±0.75
Nom. Input level per TV channel	[dBµV]	80
Input level range (per carrier)	[dBµV]	78…96 (for OMI =5% per CATV carrier)
True RMS input level range	[dBm]	-16…+2 (for ALC correctly working)
Slope range	[dB]	-2 (cable equivalent) … +8 (cable equalization)
RF impedance	[Ω]	75
Return loss	[dB]	> 20 (@ 47MHz) -1.5dB/octave, minimum 15
RF monitor (test point) level	[dB]	-20 (-0.8 …+0.2@ 862 MHz, -1,3 dB @ 1GHz)

Performance Characteristics

Transmitter version		C42	B52	D59	D84	N77
Channel plan		CENELEC 42	PAL-B/G	PAL-D 59	PAL-D 84	NTSC 77
Number of channels TV / FM (-4dB) / QAM64 (-10dB)		42 / 0 / 0	52 / 36 / 46	59 / 0 / 0	84 / 0 / 0	77 / 0 / 0
Noise bandwidth	[MHz]	5	5	5	5	4
CNR Tx/Rx	[dB]	55.5	53.5	54.0	52.5	53.5
CNR Link 1	[dB]	54.0	52.5	53.0	51.5	52.5
CNR Link 2	[dB]	51.0	50.5	51.5	49.0	51.0
CNR Link 3	[dB]	48.5	48.5	49.0	46.5	48.5
CSO Tx/Rx and Link 1	[dBc]	64	70	65	65	65
CSO Link 2	[dBc]	63	70	65	65	65
CSO Link 3 at output #1	[dB]	62	65	65	63	65
CTB	[dBc]	65	71	65	65	65

Test Configurations

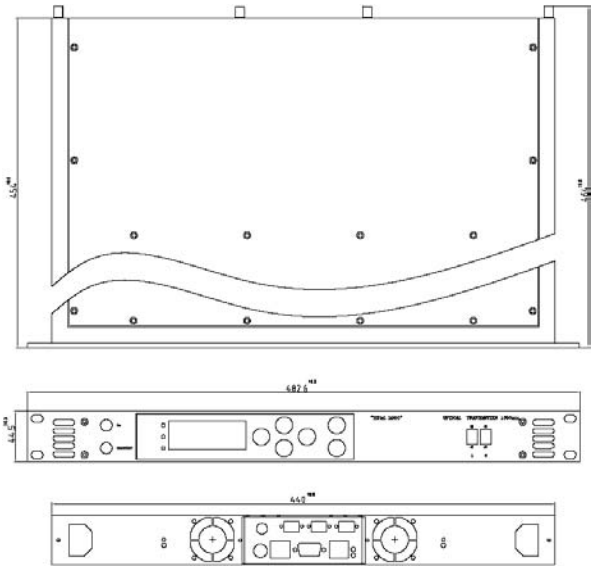
	Booster EDFA	1st Fiber Length	In-Line EDFA	2nd Fiber Length	RX
Tx/Rx	no	no	no	no	0 dBm
Link 1	no	35 km	no	no	0 dBm
Link 2	16 dBm	65 km	no	no	0 dBm
Link 3	13 dBm	52 km	13 dBm	52 km	0 dBm

Rx with 7 pA/√Hz input noise current density
EDFAs with 5dB noise figure
RF input level at 80 dBµV / TV channel

ES26XL / ES10XL / ES10L

General:

Opt. Connector		any type of high return loss connectors front or rear side mounted
Optical fiber		standard single mode 9/125 µm
RF-connector		F-female, front or rear side mounted
Control interface		a-version: Ethernet 10/100 interface (only XL version) b-version: RS485/232 interface
Power Supply Dual redundant, hot pluggable (3 Versions are available)		100...240 VAC 36...72 VDC or 23.5...24.5 VDC
Power Consumption	[W] [W]	ES10XL: < 56 / 63 (1 / 2 power supply unit(s) equipped) ES26XL: < 60 / 68 (1 / 2 power supply unit(s) equipped)
Enclosure		19" / 1 rack unit [U] (optionally compatible to ETSI or JIS standards)
Weight	[kg]	XL: ≈ 9.0 (depend on power supply)
Safety		EN 60950 Laser class 1M according IEC 60825-1 (eyesafe for normal viewing)
EMC		EN50083-2
Climatic specification Operation Storage		 ETS 300019, class 3.1 ETS 300019, class 1.2



4.1 Displays and Alarms

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

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

Table 4.1.1: Meaning of LED display

The table beyond shows the condition triggering the LEDs on the front panel. The “Module” LED summarizes the condition of the transmitter and information of the SAT input.

The “IN” and “Out” LEDs provide detailed information of the RF input and optical output status of the transmitter.

4.2 I/O Ports of ES10/ES26 (Option for a-versions)

The ES10XLa/ES26XLa from hardware release 2.0 (ref. to 11.1) is optionally equipped with 2 general purpose I/O and 4 input-only binary mode ports. The ports can be configured via the Webserver (HTTP) interface. The schematics of these ports are given below.

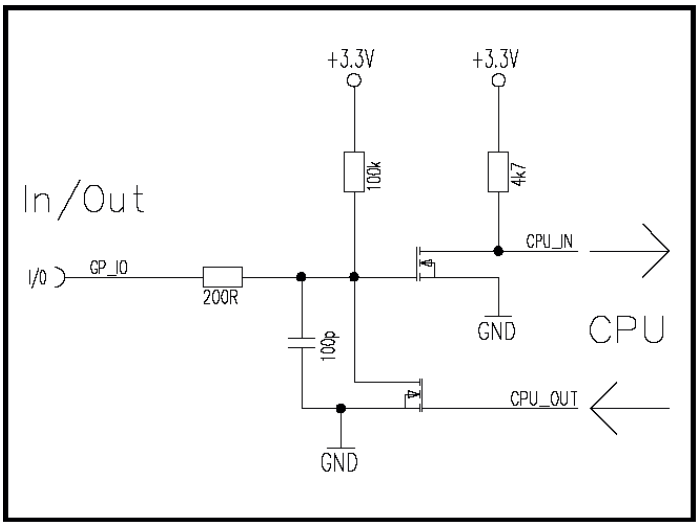


Fig. 4.2.1: Schematics of I/O port

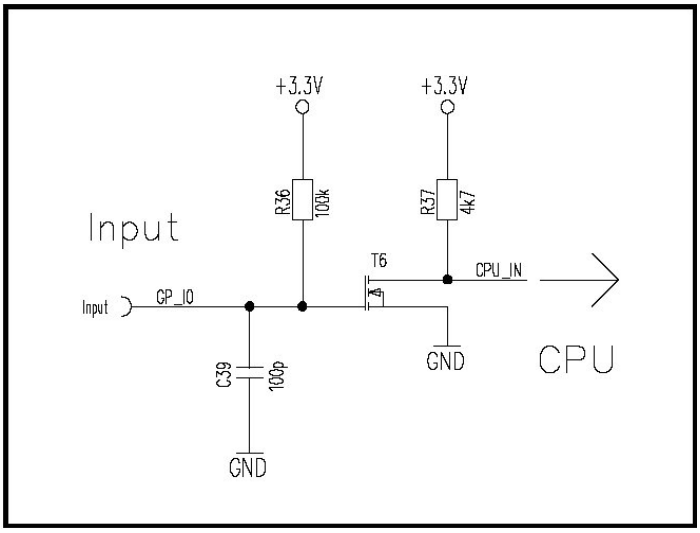


Fig. 4.2.2: Schematics of input-only port

Notes:

- The maximum voltage applied to all ports should be not below GND level and should not exceed +5 VDC.
- The input level for input high should be >1.6 V; the input level for input low has to be < 0.8 V.
- The input-only port and the open drain output port have a pull-up resistor of about 100 kΩ towards 3.3 V.
- The active low output resistance to GND of the output port is < 210 Ω.

The ES10XLa/ES26XLa uses an 8 pin Mini-DIN connector for external Input/Output handling. The connector is located on the backside of the device near to the NMS RS485 Master connector.

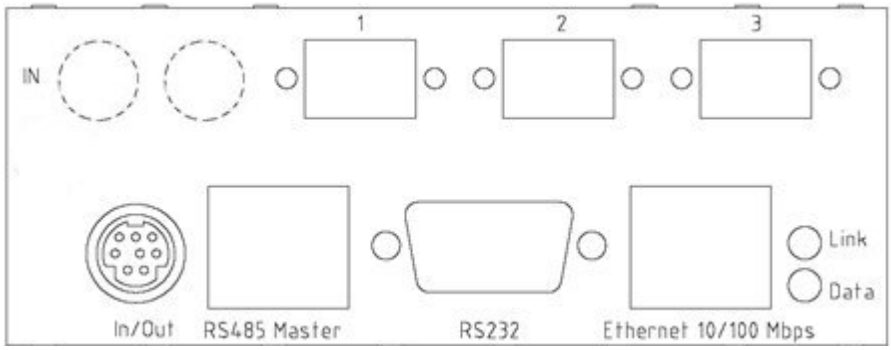


Fig. 4.2.3: ESXLa rear side connectors

Fig. 4.2.4 shows the view on the 8 port mini-DIN connector

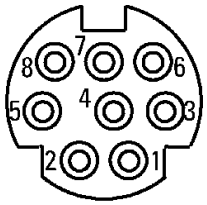


Fig. 4.2.4: 8 pin mini-DIN connector pinout

The mini-DIN connector pins are used as described in the following table.

Function in ES10XL/ES26XL (a-versions only)	**Pin Number of mini-DIN connector**	**Comments**
GND	2	Ground
+5.1 VDC (+/- 5%) (voltage under no-load condition)	1	Max. 80 mA, protected by a serial Fuse (< 6 Ohms)
Input / Output No. 0 (from hardware release 2.0 and software release 2.0)	5	Used for redundancy switching feature (input port) or as alarm output port.
Input / Output No.1	7	Either Input or Output, configurable by Software;
Input only No.2	3	Input mode configurable by Software
Input only No.3	8	Input mode configurable by Software
Input only No.4	4	Input mode configurable by Software
Input only No.5	6	Input mode configurable by Software

Table 4.2.1: mini-DIN-connector pin assignment of I/O ports

Notes:

- On pin 1, there is a 5.1 VDC (+/-5 %) supply voltage available for feeding an external interface box, which e.g. could contain optocouplers or relays, external sensors etc.; the current sinked from this port should not exceed 80 mA.
- I/O #0 is directly related to the transmitter. If the port is used as an output, alarms related to the transmitter can be accessed on this output. If the port is used as an input it enables easy redundancy switching between two redundant ES10XLa. For details please refer to 7.15.
- I/O #1 to 5 are directly related to the NEC. The output port I/O No. 1, can therefore be used to display a warning or an alarm, if

  1. one of the (up to 50) RS485-polled devices or
  2. the ES10/ES26 or
  3. at least one of the input ports (I/O #2..5), which has been set to indicate a warning or an alarm,

  exhibits a warning or an alarm. For details please refer to 6.7.
- All I/O ports can be addressed and configured via the Ethernet Webserver (HTML) interface or via SNMP.
- In order to not degrade the EMI performance of the ES10XLa/ES26XLa, a shielded cable with the shield connected to pin 2 (GND) of the mini-DIN–connector has to be used.

4.3 I/O Port of ES10/ES26 (Option for b-versions)

The ESxb is equipped with one I/O port. The schematics is given in Fig. 4.2.2.

The ES10L/XLb uses an 8 pin Mini-DIN connector for external Input/Output handling. The connector is located on the backside of the device near to the NMS RS485 Master connector.

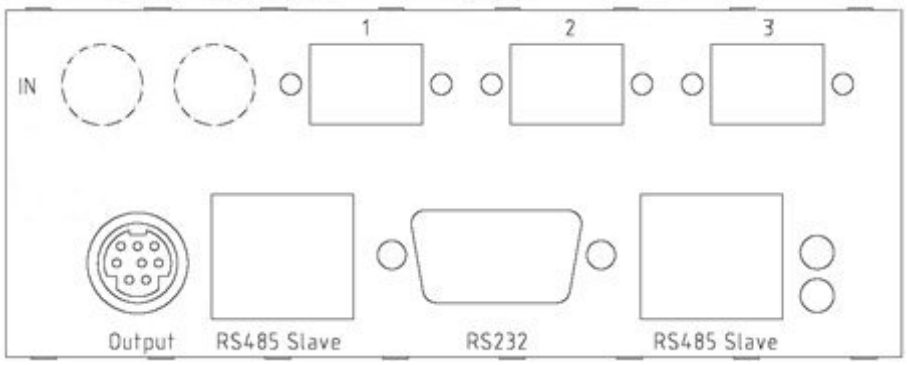


Fig. 4.3.1: ES10L/XLb rear side connectors

Fig. 4.3.2 shows the view on the 8 port mini-DIN connector

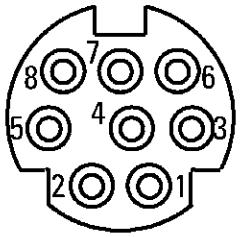


Fig. 4.3.2: 8 pin mini-DIN connector pinout :

The mini-DIN connector pins are used as described in the following table.

Function in ES10L/ES26XL (b-versions only)	**Pin Number of mini-DIN connector**	**Comments**
GND	2	Ground
+5.1 VDC (+/- 5%) (voltage under no-load condition)	1	Max. 80 mA, protected by a serial Fuse (< 6 Ohms)
Input / Output No.0	5	Used for redundancy switching feature (input port) or as alarm output port.
Input / Output No.1	7	N/A
Input only No.2	3	N/A
Input only No.3	8	N/A
Input only No.4	4	N/A
Input only No.5	6	N/A

Table 4.3.1: Mini-DIN-connector pin assignment of I/O ports

Notes:

- On pin 1, there is a 5.1 VDC supply voltage available for feeding an external interface box, which e.g. could contain optocouplers or relays etc.; the current sinked from this port should not exceed 80 mA.
- In order to not degrade the EMI performance of the ES10/ES26, a shielded cable with the shield connected to pin 2, (GND) of the mini-DIN–connector has to be used.
- I/O #0 is directly related to the transmitter. If the port is used as an output, alarms related to the transmitter can be accessed on this output. If the port is used as an input it enables easy redundancy switching between two redundant ES10/ES26. For details please refer to 7.15.

4.4 EMS / Service Interfaces

4.4.1 NMS server interface: Ethernet 10/100Mbps (a-versions only)

The NMS server interface is the main NMS interface of the optical transmitter. It supports HTTP and SNMP protocols. The NMS server firmware can be downloaded for future software upgrades via the RS232 interface.

4.4.2 Local Setup interface: RS232 (a-versions 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 by Bktel manufacturing unit to locally setup the NMS server's parameter, like IP parameters and passwords, …

Additionally it must be used to software download the NMS server firmware in case the NMS server crashes during software updates 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 function yet, but in the future will be used for modem connections.

4.4.3 BK device bus interface: RS485-master (a-versions only)

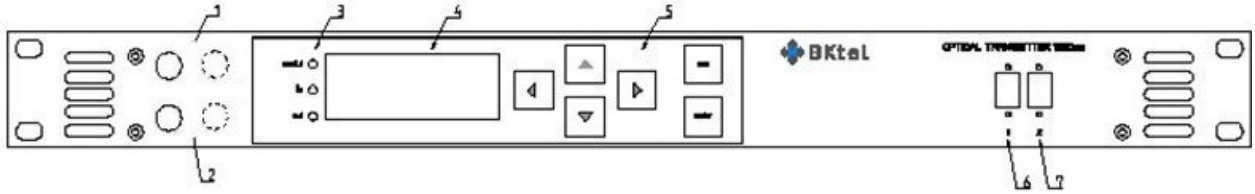
The RS485 interface can be used to connect more devices to be managed by the Ethernet NMS server interface installed in the optical transmitter. The ES10XLa/ES26XLa in this case works as a network element controller (RS485-master), which polls all equipment that is connected to the RS485 port.

4.4.4 BK device bus interface: RS485-slave (b-versions only)

The RS485-slave interfaces can be used to manage the ES10L/ES26XLb, which means to read data and to change settings. Additionally, on a SUB-D9 male connector beside the RJ-45 a RS485 to RS232 level converter is included.

4.5 Front Panel

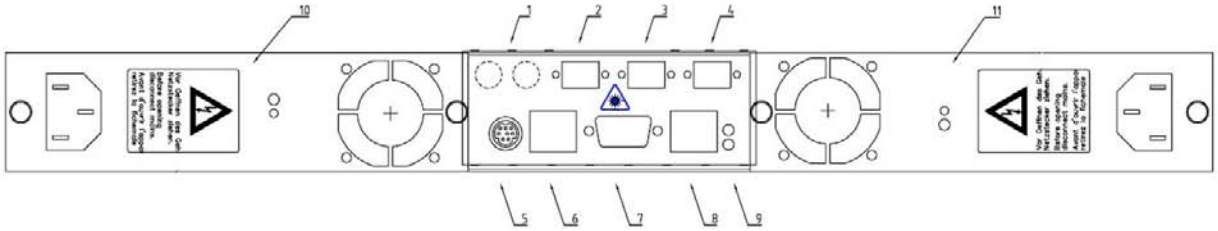
Figure 4.5.1 shows an example of the front panel view of the ES10/ES26. The RF-input and the optical connectors are optionally available on the rear panel.



Item #	Function
1	RF-input (optionally available on rear side)
2	RF-monitor output
3	Status LED's
4	Liquid Crystal Display
5	Push button field for local set-up of transmitter
6, 7	Optical connectors (optionally available on rear side)

4.6 Rear Panel

The rear panel is described in the following list:



Item #	Function
1	RF-input (optional located on front panel)
2, 3	Optical fiber outputs (optional located on front panel)
4	Not used in ES10/ES26, cover
5	I/O ports
6	RS485 interface (RJ-45 female): a-versions: master; b-versions: slave
7	RS232 interface (SUB-D9 male)
8	a-versions: Ethernet interface; b-versions: RS485 slave interface (RJ-45 female)
9	2 green LEDs Ethernet link & data (a-versions only)
10, 11	power supply + fan modules (field replaceable)

4.7 Power Supply and Fan Modules

There are 3 different types of power supply and fan modules available for the ES10/ES26. 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 customize the ES10/ES26 exactly to the actual needs.

The necessary outlets for the power supply modules have to be located in the proximity of the device and have to be easily accessible.

4.7.1 100 – 240 VAC module

Fig. 4.7.1 provides a view on the 100 – 240 VAC power supply and fan module. There is a AC mains input. There is one LED indicating the status of the power supply module. The power unit O.K. LED is lightening green when the power supply module is working properly.

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

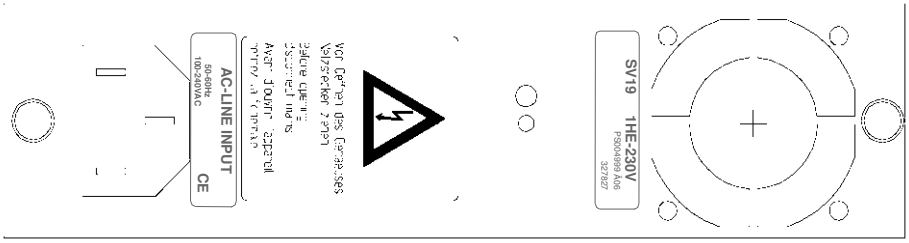


Fig. 4.7.1: 100 ... 240 VAC power supply and fan modules

4.7.2 ±48 VDC module

Fig. 4.7.2 shows the ±48 VDC power supply and fan module. There is a ±48 VDC cable terminal in order to connect the supply voltage. It is important to take care of the correct polarity of the DC supply voltage, either 0 or +48 VDC connected to the – and + terminals, respectively or 0 and – 48 VDC connected to the + and – terminals, respectively.

A fuse and a spare fuse are implemented inside the power supply and fan module and can be replaced if required. There is one LED informing about the status of the power supply module. The power unit O.K. LED is lightening green indicating that the power supply module is working properly.

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

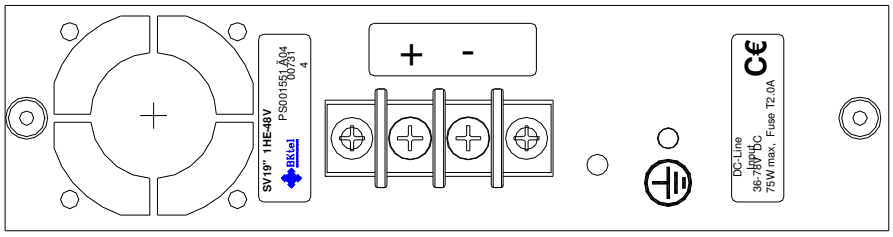


Fig. 4.7.2: ±48 VDC power supply and fan modules

4.7.3 ±24 VDC module

24 VDC modul shows the 24 VDC power supply and fan module. There is a 24 VDC cable terminal in order to connect the supply voltage. It is important to take care of the right polarity of the DC supply voltage. A fuse and a spare fuse are implemented inside the power supply and fan module and can replaced if required. 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 might be exchanged during operation (hot plug-in technology) with neither harming the equipment nor having any impact on the operation of the transmitter in case of a properly working backup power supply.

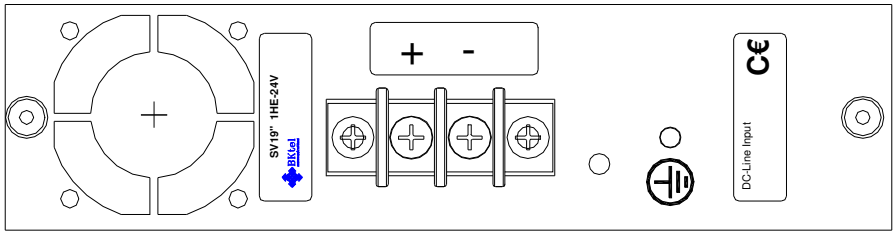


Fig. 4.7.3: 24 VDC power supply and fan modules

4.7.4 Fan-only module

For applications, where only one power supply is required, BKtel offers a fan-only module. Fig. 4.7.4 provides the view on the fan-only module.

The fan-only module can be exchanged during operation (hot plug-in technology) with having neither harming to the equipment nor having any impact on the operation of the transmitter in case of a properly working power supply.

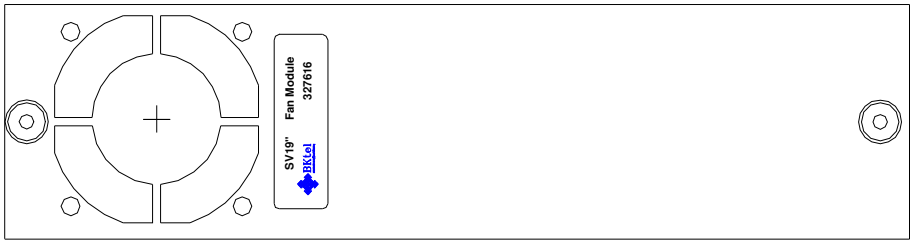


Fig. 4.7.4: Fan-only module

4.8 Labeling

The optical transmitter carries a label specifying hardware model, product number, hardware release and the ordering number (Fig. 4.8.1). Fig. 4.8.2 reveals the characteristics of the device with all options (ref. to chapter 2). Fig. 4.8.3 specifies the MAC address if applicable. In case of questions please specify all these information when communicating with BKtel or sales representatives.

Fig. 4.8.1. Device label with product number and serial number

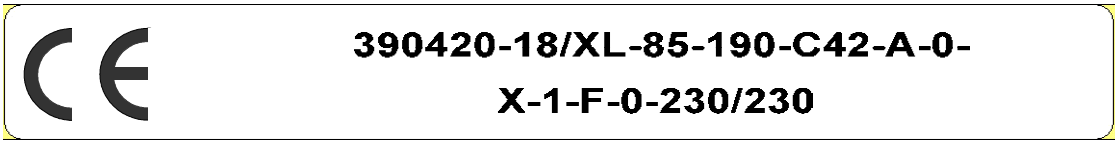


Fig. 4.8.2. Label with product number and all characteristics (ref. to chapter 2)

Fig. 4.8.3. MAC Address

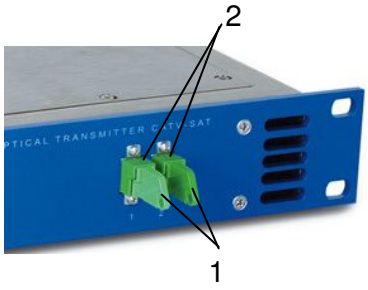
5 OPERATING THE ES10/ES26

5.1 Handling Optical Components

5.1.1 Handling Optical Fibers

The smallest permissible bending radius for fibers used to connect HFC devices is 30 mm (diameter of 60 mm). A smaller radius significantly attenuation of the fiber optic cables and even damage the fibers. Therefore, handle the fibers carefully, especially during installation.

5.1.2 Connecting and Disconnecting Optical Connectors



Please proceed as follows connecting optical links:

1. Loosen the dust caps from the transmitter's optical port (1) and fiber patch cord.
2. Note the orientation of the device's optical connector (2)! Plug the optical male connector of the patch cord in a sliding matter into the female connector of the device.
3. Save the dust caps.

Please proceed in the reverse order for disconnecting optical links.

WARNING

Do not stare into the laser beam of view directly with optical instruments!

In order to prevent uncontrolled emission of laser beams, close the optical line connector immediately after opening the connection, using the dust caps designed for this purpose.

5.1.3 Cleaning Optical Connections

When a connector has been connected and disconnected several times, or following a fault, it may be necessary to clean the plug pins or bushing casing.

Only those cleaning agents and materials which have been authorized by the manufacturer may be used:

- Cleaning cloths made of fluff–free, disposable paper (Kimwipes from Kimberly–Clark)
- Cleaning fluid: Isopropanol min. 99 %
- Nylon brush (Curadent Co. Diamond)
- Brush (Co. Diamond Z–216/32)
- Rubber bellows (Co. Diamond Z–216/19)
- Compressed air

Laser Radiation

If you inspect the front of the plug when the equipment is switched on, there is a danger of damage to your eyes.

Therefore, always switch the equipment off for this kind of work. Use a measuring device to ensure that there is no laser beam emission from the fiber.

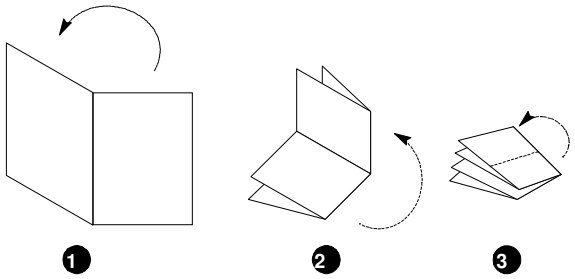
NOTICE

Do not touch the surface with your fingers when cleaning.

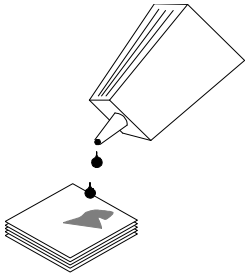
Plug pins with imprinted grooves on the front must only be daubed clean using a brush.

Dust or fluff can be blown away using the rubber bellows or dust–free compressed air.

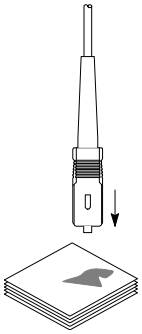
5.1.3.1 Cleaning the plug pins



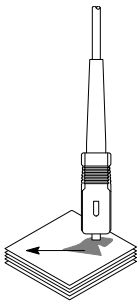
1. Fold the cleaning cloth three times. The cloth pad now constitutes an eight–layered cloth.



2. Moisten the folded cloth a little using the cleaning fluid, ensuring that a dry area remains.



3. Place the front surface of the connector, or the connector shaft on the moistened part of the cloth, pressing lightly. Let the cleaning fluid work into the dirt for a short time.



4. Move the connector to and fro on the moistened part of the cloth, turning slightly and pressing lightly.
   Slide the front surface of the connector, or connector shaft, from the moist to the dry area, without breaking the surface contact with the cloth, so that no cleaning agent residue is left.

NOTICE If the result of cleaning is not good, repeat the procedure.

5. Reconnect the connector or close it immediately with a dust cap.

5.1.3.2 Cleaning the connector of the transmitter device

NOTICE

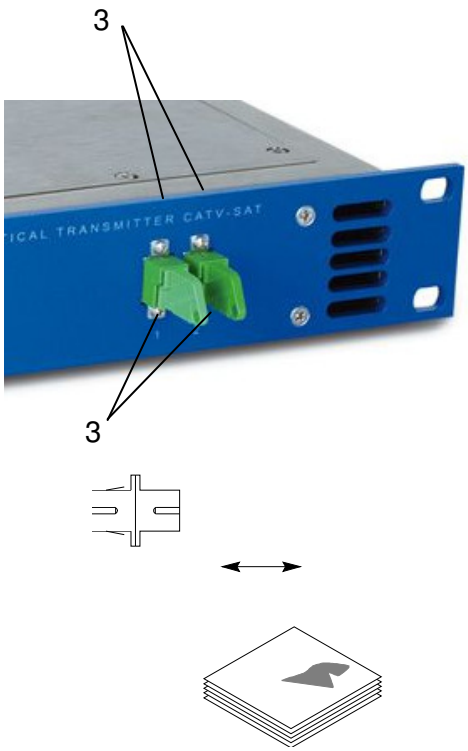
Cleaning the device connector(s) requires device opening.

Since device opening may damage its function, warranty extinguishes when doing so!

Therefore, cleaning the connector may be only performed by BKtel manufacturing engineers or BKtel repair engineers! Please send device to BKtel in case you assume dirty device's bushings and/or connectors!

NOTICE

Only clean device's bushing and bushing case when no connector is connected. Extremely dirty bushings must be replaced.



1. Disconnect the optical connector or remove the dust cap from the bushing.
2. Dissolve both screws of each optical connector. Caution: Extract the connector very carefully!
3. Disconnect the internal optical connector (inside the device) and clean it as described in the proceeding section. Caution: Do not extend the connector by more than 1 cm from the device body.
4. If the bushing is dirt, disconnect the bushing fixing by loosing the appropriate screws.

4a. Push the nylon brush through the bushing casing several times and then blow clean with rubber bellows or compressed air. Rub the outer casing and fiber bushing with a cleaning cloth, if necessary.

4b. Install bushing in the device again and close the device.

5.2 Power-Up Sequence

- Be sure that the ES10/ES26 is going to be put into operation under the specified environmental conditions. Avoid temperature shocks after transportation of the ES10/ES26 and allow sufficient time to accommodate with the environmental conditions at the operating site.
- If not already realised install the appropriate power supply + fan modules, respectively fan-only modules.
- Connect the ES10/ES26 to one or two (in case of redundant power supplies) appropriate power supply lines. If only one power supply cable (instead of two) is connected to an ES10/ES26 equipped with redundant power supplies, an alarm will be generated and shown with a yellow brightening MODULE LED.
- After start (with appropriate power line connections), the MODULE LED is lightening green and the LCD illumination is on. Then the LCD illumination is switched off and all front side LED's are lightening yellow for a short time in order to enable a LED test. Afterwards all LEDs should be lightening green and the microcontroller starts to test the laser and optical modulator. During this test, which takes about 70 seconds, the optical output power on both outputs varies between zero power and about twice the nominal power (Poutnom + 3 dB). **Afterwards with no RF-input signal applied, the output power may vary about +/- 1 dB on both outputs, since the CSO control loop in "channel controlled" mode, which fixes the bias point of the modulator and consequently the output power, only works precisely with a RF input signal applied.**
- After this procedure the LEDs should monitor the status of the transmitter.

5.3 Setting appropriate Operating Conditions

5.3.1 Optical output signal

Connect a fiber optic cable with an appropriate, cleaned connector to one of the optical outputs in order to feed an HFC network. Keep in mind that the ES10/ES26 is a laser class 1M product according to IEC 60825, which requires adequate safety precautions to avoid hazard to people working with the transmitter.

5.3.2 Applying an appropriate RF input signal

For proper operation, an appropriate RF input signal within the specifications as given in this section has to be applied at the RF input port. With an appropriate input signal the transmitter starts to search for the optimum bias point of the electrooptical modulator. After about 30 seconds, the optical output levels of both outputs are stable.

The optical transmitter ES10/ES26 has a built-in RF power meter function, which monitors the total rms (root-mean-square) level at the input of the transmitter. This rms level has to be in a certain range, so that the transmitter can be properly adjusted. The rms level range depends on the type of ES10/ES26 and is given in the table below. **Please take care that the rms level of input signal is within the given range!**

ES10/ES26 Version	Total OMI OMI_{totrms}	RMS Level Range P_{rms}	P_{VSB} Level Range (unmodulated)	P_{VSB} Level Range (modulated)
C42 (42 PAL)	18.8 %	-16 … +2 dBm	76 … 94 dBµV	80 … 98 dBµV
PAL84 (84 PAL)	19.4 %	-16 … +2 dBm	74 … 92 dBµV	78 … 96 dBµV
N77 (77 PAL)	18.6 %	-16 … +2 dBm	74 … 92 dBµV	78 … 96 dBµV
ISH (35 PAL, 17 64QAM, 3 256QAM)	18.4 %	-16 … +2 dBm	77 … 95 dBµV	80 … 98 dBµV
Upgrade (47 PAL, 17 64QAM, 6 256QAM, 36 FM)	18.9 %	-16 … +2 dBm	74 … 92 dBµV	77 … 95 dBµV
KDG470 (33 PAL, 14 64QAM, 36 FM)	18.75 %	-19 … -1 dBm	73 … 91 dBµV	75 … 93 dBµV
KDG470b (33 PAL, 14 64QAM, 36 FM)	18.75 %	-16 … +2 dBm	76 … 94 dBµV	78 … 96 dBµV

Table 5.3.1.1: ES10/ES26 RF input leveling

This rms level P_{rms} depends on the number of AM-TV, FM-radio and QAM carriers and their individual leveling at ES10/ES26 RF input port. It can be calculated, when the number of all carriers and their individual carrier levels are known:

$$P_{rms}[dBm] = \begin{matrix} P_{VSB}[dB\mu V] - 108.75 + \\ +10 \cdot \log\left(N_{VSB} \cdot 10^{LVSB/10dB} + N_{FM} \cdot 10^{LFM/10dB} + N_{64QAM} \cdot 10^{L64QAM/10dB} + N_{256QAM} \cdot 10^{L256QAM/10dB}\right) \end{matrix}$$

Where:

- P_{VSB} is the level of the analogue TV carriers (in dBµV)
- N_{VSB} is the number of analogue TV carriers
- L_{VSB} is 0 dB for unmodulated carriers (test) and -4 dB for modulated carriers (real video)
- N_{FM} is the number of audio-radio carriers
- L_{FM} is the audio-radio level referred to the level of the analogue TV carriers (e.g. L_{FM}= -4 dB)
- N_{64QAM} is the number of 64QAM modulated carriers (digital TV, Fast Internet)
- L_{64QAM} is the 64QAM carrier level referred to the level of the analogue TV carriers (e.g. L_{64QAM}= -10 dB)
- N_{256QAM} is the number of 256QAM modulated carriers (digital TV, Fast Internet)
- L_{256QAM} is the 256QAM carrier level referred to the level of the analogue TV carrier (e.g. $L_{256QAMM}$= -6 dB)

Examples:

1. C42 test signal (unmodulated carriers, common European test scenario):
   N_{VSB}= 42, P_{VSB}= 80 dBµV, N_{VSB}= 0 dB: P_{rms}= -12.5 dBm
2. C42 real video signal (modulated carriers):
   N_{VSB}= 42, P_{VSB}= 80 dBµV, N_{VSB}= -4 dB: P_{rms}= -16.5 dBm
3. N77 test signal (unmodulated carriers, common Japanese/US test scenario):
   N_{VSB}= 77, P_{VSB}= 80 dBµV, N_{VSB}= 0 dB: P_{rms}= -9.9 dBm
4. KDG470 real video signal (modulated carriers):
   N_{VSB}= 33, P_{VSB}= 79 dBµV, N_{VSB}= -4 dB, N_{64QAM}= 14, L_{64QAM}= -10 dB, N_{FM}= 36, L_{FM}= -4 dB:
   P_{rms}= -15.1 dBm

The built-in RF power meter controls the rms input level and indicates its status at the INPUT LED. There are two RF modes, which can be selected:

5.3.2.1 RF Mode “AGC-on”

This mode is the recommended mode for standard operation!

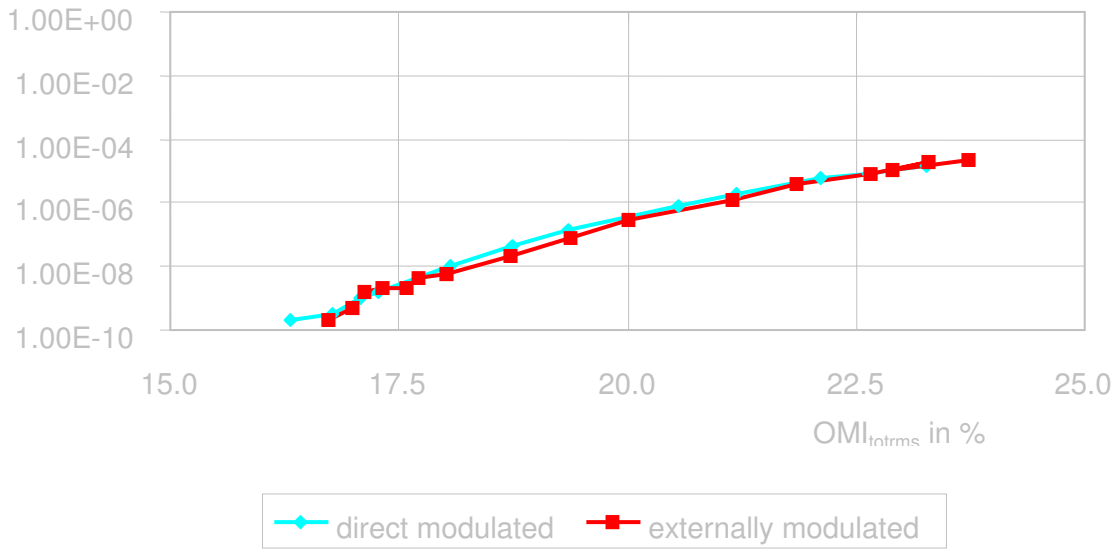
As long as the input level is within the working range of the transmitter (specified by the table above), the transmitter will itself adjust the optimum gain. Then, the specified total rms modulation index OMI_{totrms}, will be automatically obtained by the AGC.

If the input power is lower or higher than required (outside the specified range) the input LED lights yellow and a warning is generated. If the input power is missing or very high, the input LED lights red and an alarm is generated.

The AGC always tries to maintain the requested optical modulation index as described. This index should be high in order to result in good noise behavior. Yet, too high modulation index causes bit errors, which come up due to overmodulation (clipping) of the transmitter. Therefore, an optimum optical modulation index exists, which is given in the table above. The ES10/ES26 is factory adjusted to achieve a BER of max. 10^{-9} with most frequency plans using the built in AGC function.

Note:

The subsequent diagram shows the relationship between OMI_{totrms} and the bit error rate (BER) measured for 64QAM transmission. Obviously, OMI_{totrms} should be below about 20% in order to obtain BERs better than 10^{-6}.



The BER also depends on the mix of AM, FM and QAM channels. If the QAM load is very small compared to the AM and FM load the OMI_{totrms} might be chosen about 1 dB higher while still obtaining the BER as given in the diagram.

5.3.2.2 RF Mode “AGC-off”

In this mode, which is for experienced users only, the user has the flexibility to change the gain of the internal RF amplifier by at least -6 … +6 dB according to his individual requirements. However, this adjustment is changing the RF input sensitivity. The OMI_{totrms} is measured for the applied input signal and the selected gain and can be monitored on the LCD display or via the Ethernet interface.

This mode should only be used with great care since the automatic protection against overmodulation as given in the AGC-on mode is lost.

5.3.3 Adjusting regulation mode

There are two kinds of bias point regulations: “Channel controlled” and “Pilot controlled”.

Since the transmitter working in “channel controlled” mode requires an input signal in order to adjust its electrooptical modulator’s bias point, at least 2 RF channels with a channel spacing of 24 MHz (software adjustable) are required to obtain a stable performance.

In “pilot controlled” mode, RF input signal is not required for internal bias point adjustment, because the transmitter uses an internal pilot control. The pilot frequency is outside the transmitted RF frequency range in order not to target user’s signals.

5.3.4 Applying an appropriate RF SAT-IF input signal

For proper operation of ES26 SAT-IF input, an appropriate SAT-IF RF input signal within the specifications has to be applied at the SAT-IF RF input port. The SAT-IF signal should provide an rms level within the range specified in the following table. In this case, the SAT-IF AGC can adjust the optimum $OMI_{SAT,totrms}$ as recommended in the table.

ES26 Version	**Total OMI $OMI_{SAT,totrms}$**	**RMS Level Range $P_{SAT,rms}$**	**P_{SAT} Level Range (for 36 SAT carriers)**
C42 (42 PAL)	4.2 %	-11 … +5 dBm	82 … 98 dBµV
PAL84 (84 PAL)	3.0 %	-11 … +5 dBm	82 … 98 dBµV
N77 (77 PAL)	3.0 %	-11 … +5 dBm	82 … 98 dBµV
ISH (35 PAL, 17 64QAM, 3 256QAM)	4.2 %	-11 … +5 dBm	82 … 98 dBµV
Upgrade (47 PAL, 17 64QAM, 6 256QAM, 36 FM)	4.2 %	-11 … +5 dBm	82 … 98 dBµV
KDG470 (33 PAL, 14 64QAM, 36 FM)	4.2 %	-11 … +5 dBm	82 … 98 dBµV
KDG470b (33 PAL, 14 64QAM, 36 FM)	4.2 %	-11 … +5 dBm	82 … 98 dBµV

Table 5.3.1.1: ES26 SAT-IF RF input leveling

5.3.5 ITU frequency adjustments in DWDM applications (XL only)

The ES10/ES26 offers the feature to tune the optical frequency (respectively wavelength) of the transmitter by +/-100 GHz in steps of 50 GHz in order to enable DWDM applications.

The tuning can be performed via the buttons on the front panel or via the Ethernet interface.

5.3.6 Optical power on /off

The transmitter can be configured as a back-up transmitter with optical output power off. This allows turning on the transmitter within less than 10 seconds in situations when a fast switching to a redundant transmitter is requested.

The optical power on/off switching can be performed via the buttons on the front panel or via the Ethernet interface.

5.3.7 SBS suppression setting (XL only)

The ES10XL/ES26XL enables to change the SBS suppression of the transmitter.

SBS (Stimulated Brillouin Scattering) is a well known problem in long distance, high power transmission. For extremely coherent optical light, SBS occurs already at optical powers of around +6 dBm (4 mW) in standard single mode fibers. With electronic measures the coherency of the light can be degraded which increases the SBS threshold that means the optical power which leads to strongly perturbing SBS effects, destroying the CNR and CSO performance especially in the lower transmission frequency band.

If the SBS threshold is increased, another effect, the SPM (self phase modulation) arises. This effect degrades the CSO performance in the higher frequency band. SPM depends on the total dispersion which is present in the transmission system.

SBS and SPM are both nonlinear effects in optical fibers and depend on

- the launched optical power
- the fiber properties (especially fiber loss and mode field diameter)
- the link properties (number of splices and total splice loss)

Both effects are worse with

- higher optical power
- lower mode field fiber diameter
- higher quality, lower loss fiber
- fewer, lower loss splices

BKtel tests the SBS and SPM performance of the ES10/ES26 with a standard IEC rec. G652 fiber under worst case conditions: link containing no splices and providing a fiber loss of only 0.19 dB/km. For this test arrangement the SBS suppression is specified keeping in mind the SPM problems.

SBS suppressions between 13 and 16.5 dBm are recommended for fiber links with lengths of 65 km or more.

It is recommended to use the high SBS threshold settings (> 16.5 dBm) for distances below 65 km, and the lower SBS thresholds for longer distances.

The SBS threshold can be selected in **0.5 dB** steps between 13.0 and 19.0 dBm for optimization of the SBS performance in individual applications and link characteristics.

5.4 LED Display

The ES10/ES26 has a LED display (3 LED's for MODULE, INPUT and OUTPUT) and a LCD in combination with 6 menu buttons on the front panel for read and set parameters:

For normal operation all LED's should light green. In case of warnings and alarms the responsible LED's turn into yellow or red and the LCD shows further explanations.

Module status

Normal operation: MODULE LED green

Non urgent alarms: MODULE LED yellow

- fan 1 or fan 2 failure
- Power supply 1 or power supply 2 failure
- Laser cooler current >90 %. In this case the temperature of the transmitter is too high. Improve thermal heat flow in order to decrease the operating temperature.
- Laser bias current >130%. The laser has degraded.

In case of a fan or power supply failure the power supply/fan unit has to be replaced. BKtel offers fans as regular spare parts, too.

Urgent alarms: MODULE LED red

- Laser cooler current =100 %. In this case the temperature of the transmitter is too high. Improve thermal heat flow in order to decrease the operating temperature.

In case of an urgent alarm the transmitter is switched off internally and can only be restarted with a power on reset by disconnecting the power supply or via the NMS system.

INPUT status

Normal operation: INPUT LED green

Non urgent alarm: INPUT LED yellow

RF-input low or high

- In AGC mode: AGC is out of range
- In Manual Mode: OMI total rms is out of range

Urgent alarm: INPUT LED red

- RF-input is missing.

OUTPUT status

Normal operation: OUTPUT LED green

Non urgent alarm: OUTPUT LED yellow

- **The output power drops below +5dBm (below+1dBm for the "M" Version).**
  The transmitter is still working but with reduced performance. It has to be sent to BKtel for maintenance.

Urgent alarm: OUTPUT LED red

- The output power drops below -4 dBm
  The transmitter is not ight ad ed. It has to be sent to BKtel for maintenance.

5.5 Push Button / LCD Display

Security items

When changing a parameter using the LCD interface in unlocked state, you have to enter a four digit numeric keycode to login. The LCD login times out after 5 minutes with no key pressed.

The factory default keycode is 1111.

NOTE: Changing the keycode to 0000 disables the code and the parameters can be changed without entering a code.

Keys default usage

ESC key The ESC key is used mainly to cancel operations or to switch back a menu level.

ENTER key The ENTER key is used mainly to execute operations or to enter into a new menu level.

The ▼▲ Cursor keys are used to select a menu entry or to toggle between possible parameters.

The ◄► Cursor keys are used to change letters in a number or a string or to scroll in text screens.

General Note

In the following, the menu structure of the LCD interface is shortly explained. For more details, please see also the following 5, where all the device indications and device configuration parameters are explained in more detail.

Menu structure

Press ENTER at the Root-Screen to get a menu that contains the NMS server "NEC-E" menu entry first, followed by the transmitter "ES10/ES26" and a list of aliasnames of all detected RS485 bus BK devices.

Root-Screen

NMS Server “NEC-E”	This menu contains all NMS Server specifics
Transmitter “ES10 or ES26”	This menu contains all transmitter specifics

If further devices are connected to RS485 bus of ES10/ES26 device:

Device No. 1 (Device's aliasname is shown)

Device No. 2 (Device’s aliasname is shown)

…

NMS Server menus

NMS Server

Alarms / Warnings / Infos	Server status information
IP Settings	Set the IP parameters of the server
Keycode	Change the LCD keycode
Properties	Show server properties like software- and hardware releases
Date & Time	Adjust the server's real time clock
Reset Server	Software reset the server
Rescan RS485	(Re)Search for RS485 devices on the bus
Logout	Logout from LCD and return to Root-Screen

NMS Server->IP Settings	**NOTE**: Don’t forget to **Save Settings** after a change
Save Settings	Save the changed IP parameters; the server gets reset after saving the new data
IP address	Change or show the IP address
Netmask	Change or show the netmask
Default router	Set or show the default router

Optical transmitter device menus

Alarms / Warnings / Infos	Show transmitter's alarm, warning or info messages

Settings

SBS Suppression	Change or show the SBS suppression mode
Channel Distance	Change or show the channel distance
OMI	Show OMI_{totrms} , change the OMI_{totrms} for AGC mode
RF Gain	Show RF gain, change RF Gain for manual gain mode, related to the nominal gain for nominal OMI and nominal RF-Input power. For RF gain 0 dB an input level of 80 dBµV causes 5% OMI.
OMI nominal	Show nominal OMI_{totrms} for AGC mode
SAT OMI	Show OMI_{totrms} , change the OMI_{totrms} for AGC mode
SAT RF Gain	Show SAT RF gain, change SAT RF Gain for manual gain mode, related to the nominal gain for nominal SAT OMI and nominal SAT RF-Input power.
SAT OMI nominal	Show nominal SAT OMI_{totrms} for AGC mode
Laser Frequency	Change or show the lasers ITU optical frequency (DWDM only)
Slope	Change or show RF slope for CATV input
SAT Slope	Change or show SAT RF slope for SAT input
AGC Mode	Change or show the AGC mode
SAT AGC Mode	Change or show the SAT AGC mode
Optical Output Power	Change or show optical output power
CSO Regulation Mode	Change or show the CSO regulation mode
I/O Port Mode	Change or show the I/O port mode
Output Port Mask	Change or show the output port mask
RF Input Alarmmode	Change or show RF input alarmmode

Parameters

RF Input	Shows RF total rms (root-mean-square) input power of SAT-IF input signal ***If the input power is out of range for the selected OMI- or Gain-settings, an input warning will be generated and the showed value may be not valid.***
OMI	Shows the OMI total rms. ***If the el. input power or the selected gain is out of range for a measureable OMI value, an input warning will be generated and the showed value may be not valid.***

Sat Input	Shows RF total rms input power of SAT-IF input signal ***If the input power is out of range, an input warning will be generated and the showed value may be not valid.***
SAT OMI	Shows the SAT OMI total rms. ***If the el. input power or the selected gain is out of range for a measureable OMI value, an input warning will be generated and the showed value may be not valid.***
Output power	Shows optical output power level
TEC Current	Shows cooler current related to maximum
Laser Current	Shows laser current related to beginning-of-life value
Module Temperature	Shows internal temperature
+24V, +3.3V, +5V, +10V, -2.5V	Shows actual voltage of internal power supplies
Reg. State	Shows the regulation state of electrooptical modulator

For actualization of values just go back to the ES10/ES26 menu and enter again

Limits (limit values of above mentioned parameters for warning and for alarming state)

Parameters and order see “Parameters” menu

Properties (show device properties)

Hardware Rel.	Hardware release
Appl. Sw. Rel.	Application software release
Bootl. Sw. Rel.	Bootloader software release
Serial number	Serial number of manufacturing unit

Miscellaneous

Reset Device	Generates a reset of the transmitter device
Reset to Default Settings	Reset to factory adjustments

Aliasname	Change device's aliasname

6 CONTROLLING A NEC

In general the ES10/ES26 is connected to a network element controller NEC which can be

- a NEC which is directly embedded in the 19'' housing.
  This is the case of an ES10XLa or ES26XLa.
- a NEC-E, a network element controller in BK-housing
  (with LCD, push buttons and 12 general purpose I/O ports)
- a NEC-E-19'', a network element controller in 19"-1RU housing
  providing 12 general purpose I/O ports or
- an embedded NEC in other BKtel products
  such as an optical amplifier OVxxxxa or a direct modulated transmitter DS26

The NEC allows supervising and controlling the function of the transmitter and other equipment which is connected to the RS485 master interface, using the integrated Ethernet webserver (HTTP) interface.

In case of the ES10XLa/ES26XLa the NEC-E is embedded and a connection between NEC-E and ES10/ES26 has been established internally. In order to enable the communication of an ESxb with a NEC, the RS485 slave port of the ESxb has to be connected with the RS485 master port of the NEC. The NEC Ethernet interface has to be connected to a PC either directly via a crossed Ethernet cable or via a LAN. It is important to set the IP address of the NEC in order to be compatible with the available LAN IP addresses. The IP address can be changed using the push-buttons and the LCD (please refer to NEC operating manual). In the example below the IP address has been set to be 172.23.41.113.

6.1 Communicating with the NEC

If a Webbrowser gets in touch with the NEC of the transmitter a display as shown below will appear within the Webbrowser (e.g. MS Internet Explorer):

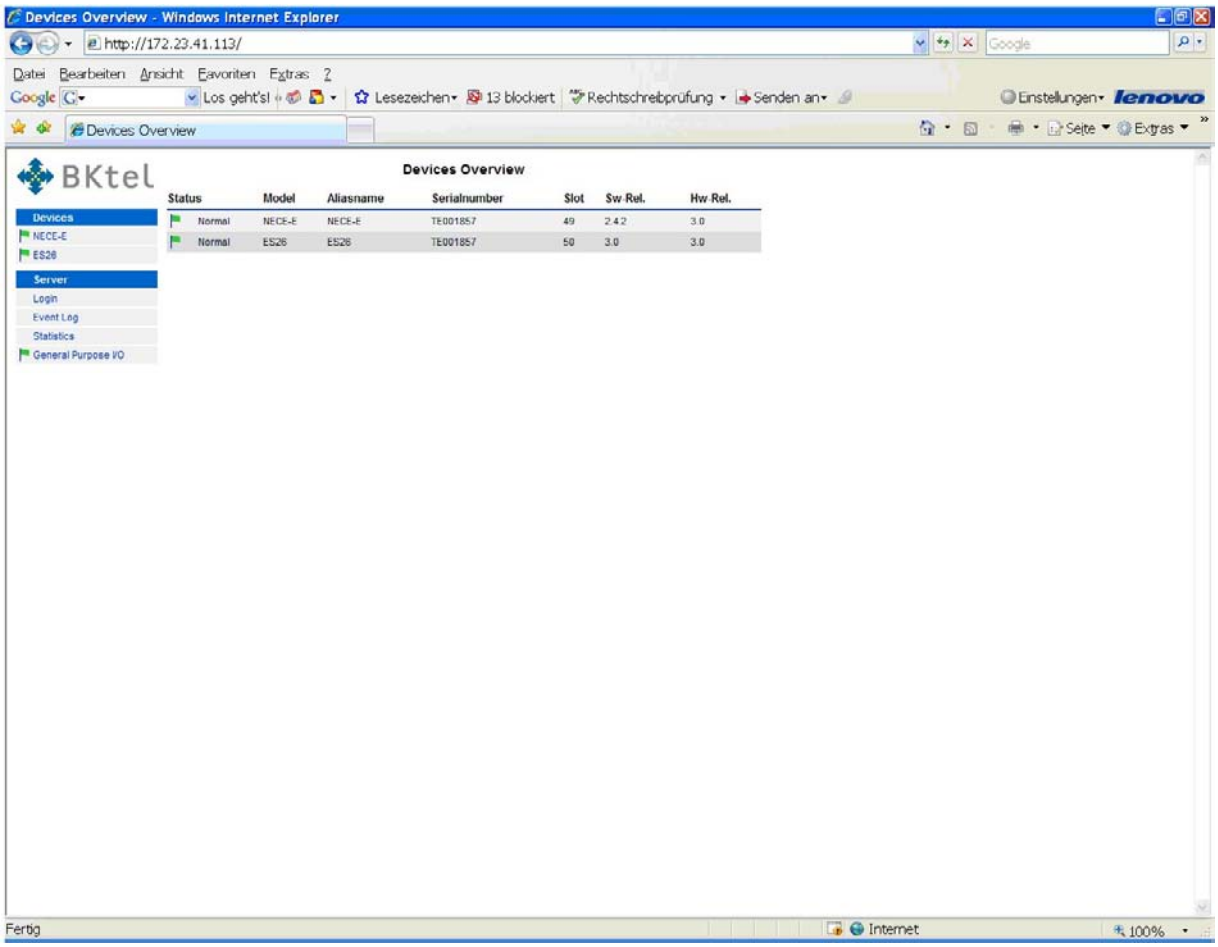


Fig. 6.1.1: Display of Webbrowser (Microsoft I.E.)

Selecting “Devices” all devices are shown which are connected to and recognized by the NEC. In the example above only one device is connected to the embedded NEC, the ***ES26XLa***. This equipment is currently displayed in the main window of the browser. At the same time ***Status*** is highlighted in the main window. That means the main window currently displays the **status** of the **ES26XLa**.

By selecting a different menu in the main window Parameters, Voltages, Settings, Limits, Limits 2 and Properties of the ES26XLa can be selected.

For location of a device connected to the NEC, the flag in front of the devices name can be used. Pressing this flag initiates the module LED to blink for 10 seconds.

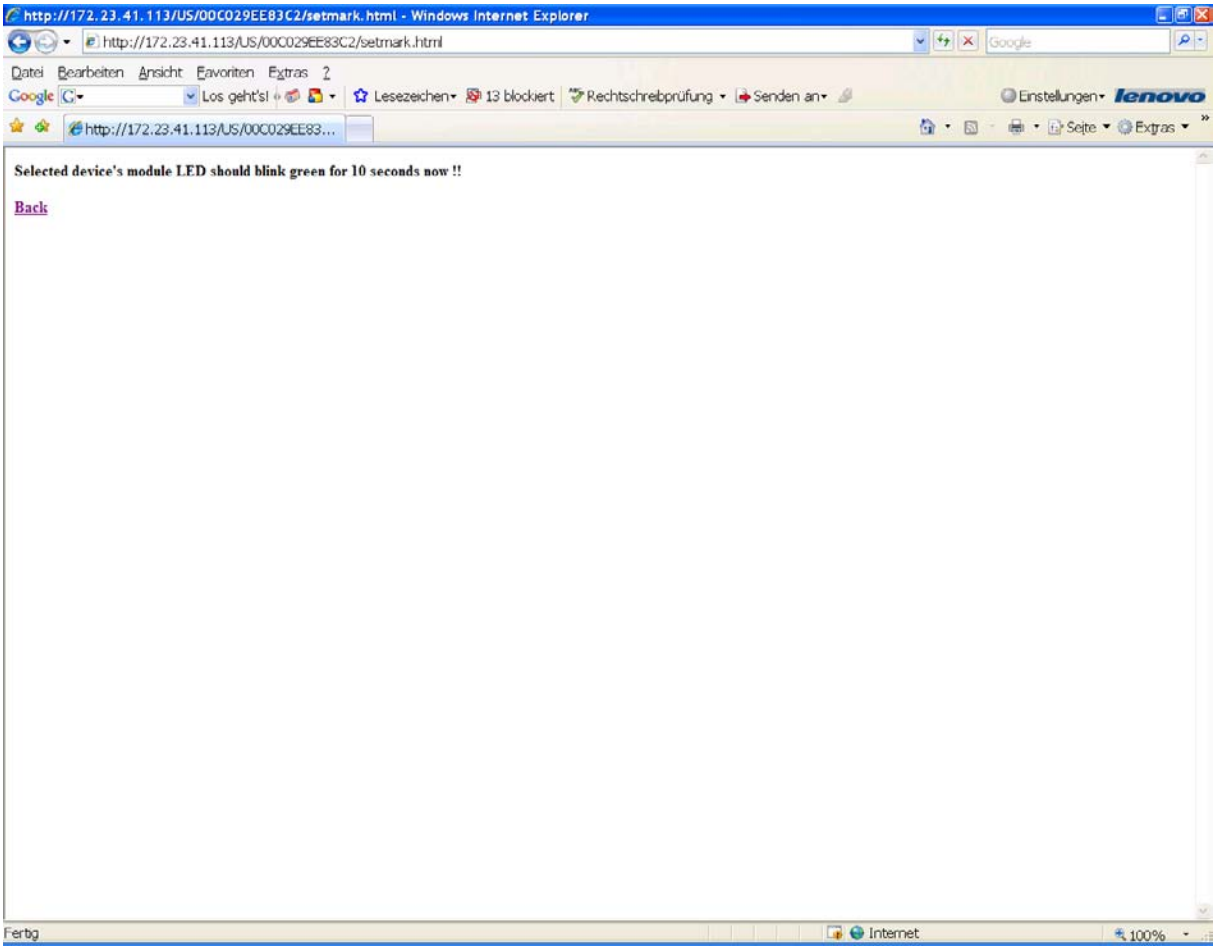


Fig. 6.1.2: Log-in to the NEC (server)

In order to change values within the equipment recognized by the NEC, it is necessary to ***login*** to the NEC (= server). Otherwise, it will only be possible to view all the values, however, not to change them.

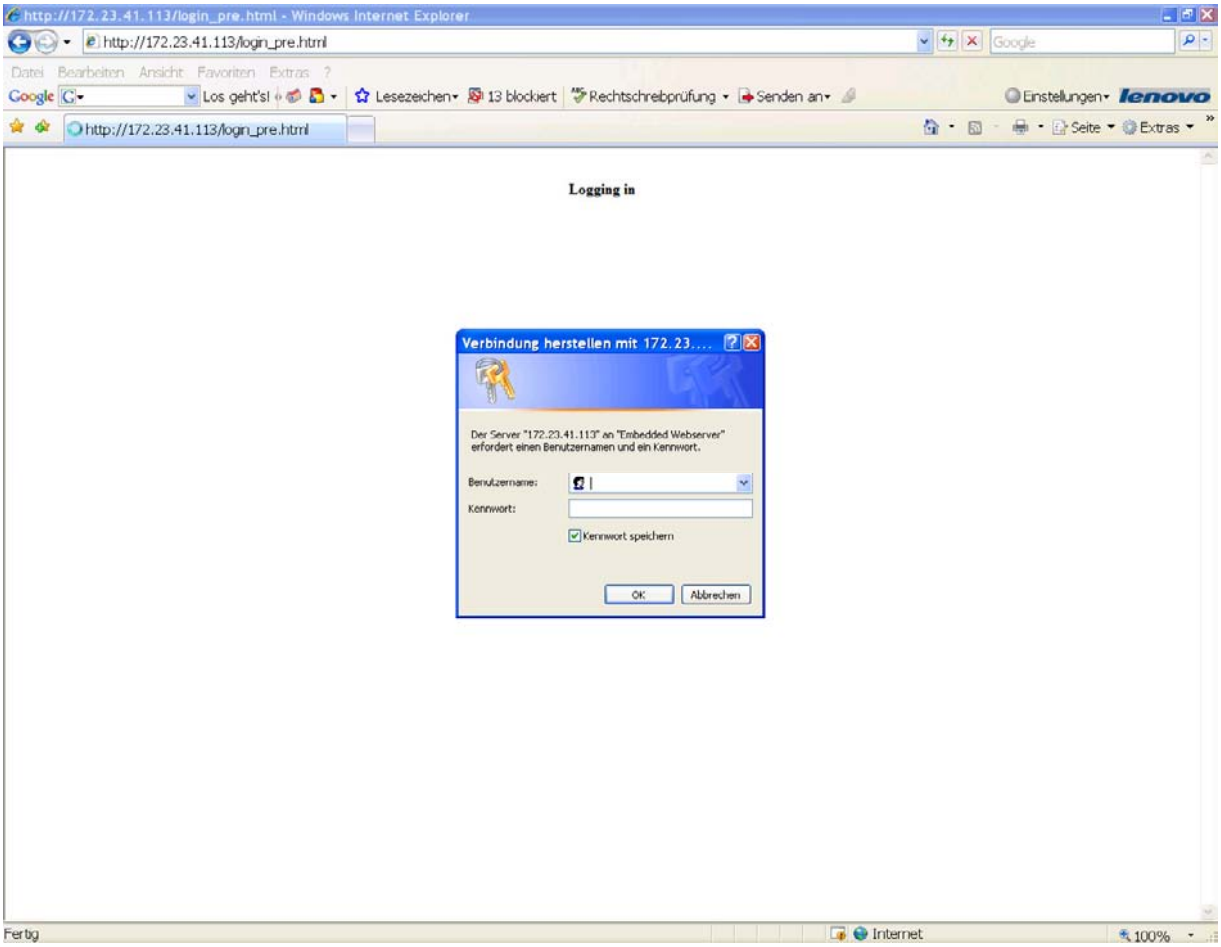


Fig. 6.1.3: Display of login menu

If ***login*** is selected, it is required to enter the user name and the appropriate password.

Note: The buttons occur in different languages depending on the actual Windows language setting.

After login two additional menu buttons appear in the menu 'Devices': Devices update and Configure Slots. In the main window a button *RescanAll* allows to research the network for newly connected devices. Please note that new BK devices should be automatically detected by the server when inserted into the RS485 bus, but if there are problems then this button might help the server to find all devices.

6.2 Devices Update

Using this menu button an update of the selected devices firmware is possible as can be seen in Fig. 6.2.1.

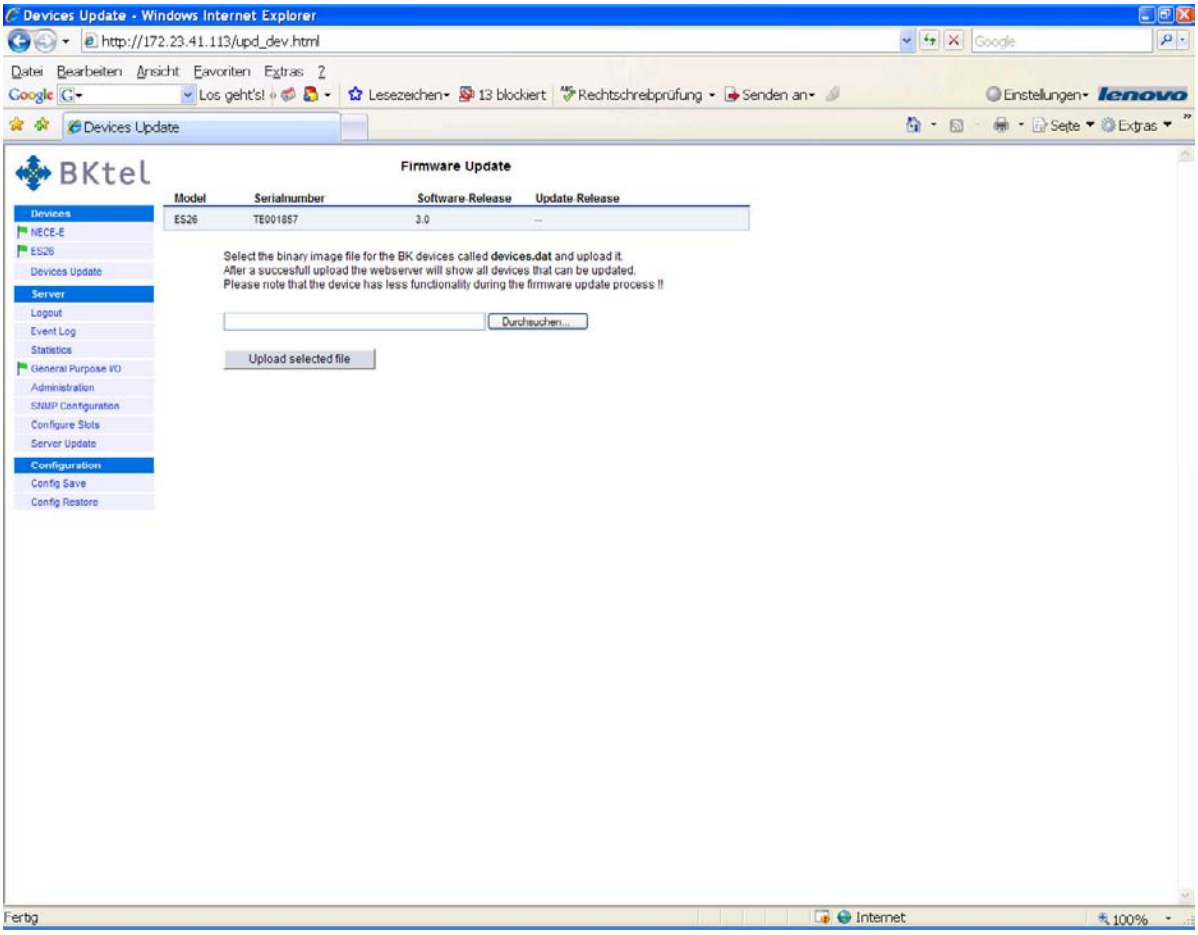


Fig. 6.2.1: Devices update menu

6.3 Configure Slots (optionally)

The menu Configure Slots can optionally provide the possibility to assign a slot number to the specific device. The number range is from 1 to 48. Number 49 is reserved. In case no numbers are assigned number 50 and above are automatically used. In case the device is a BKtel product mounted in a BBT00x subrack, the slot number is detected and assigned automatically. For details see the operational manual of the BBT00x.

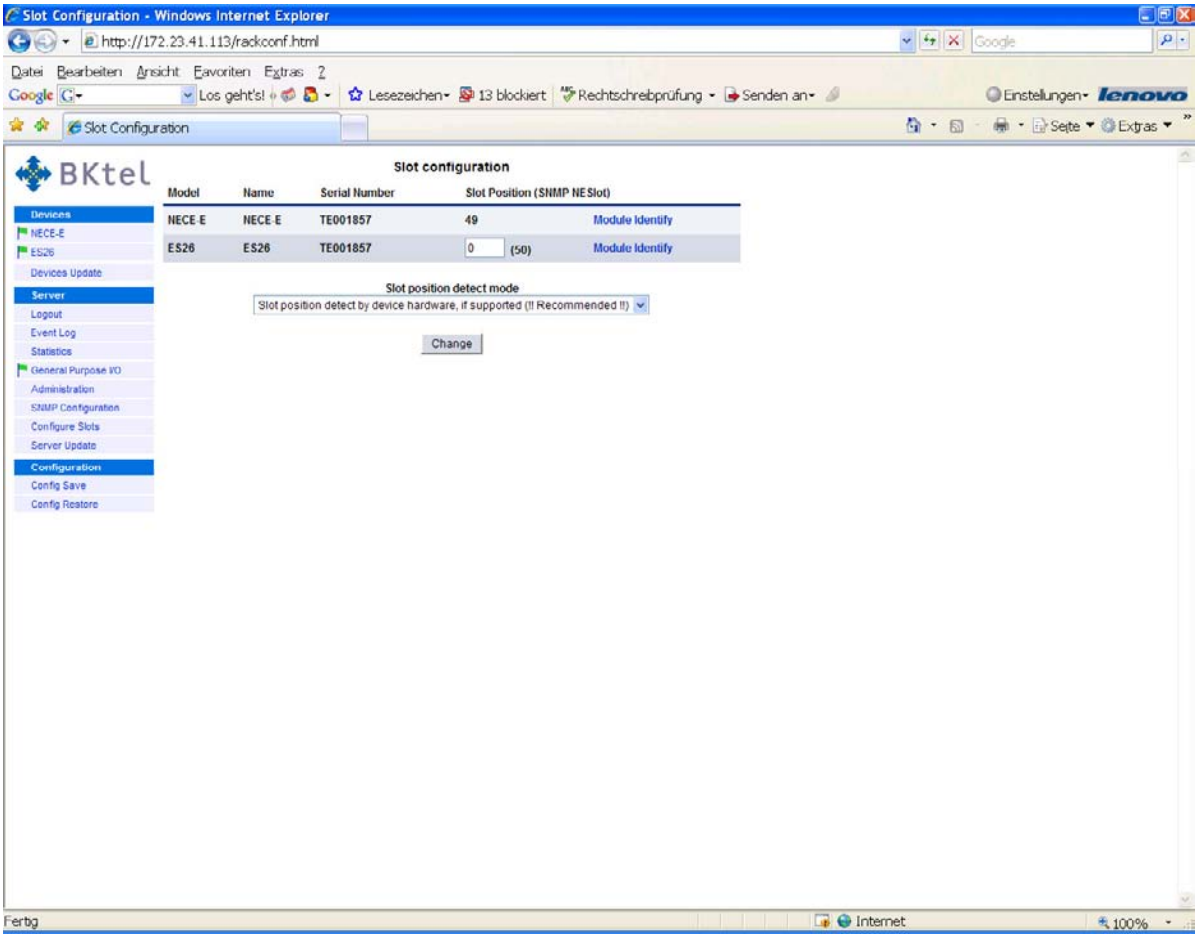


Fig. 6.3.1: Configure slots menu

6.4 Server Properties

Selecting the menu Server the sever properties are displayed as shown in the following figure.

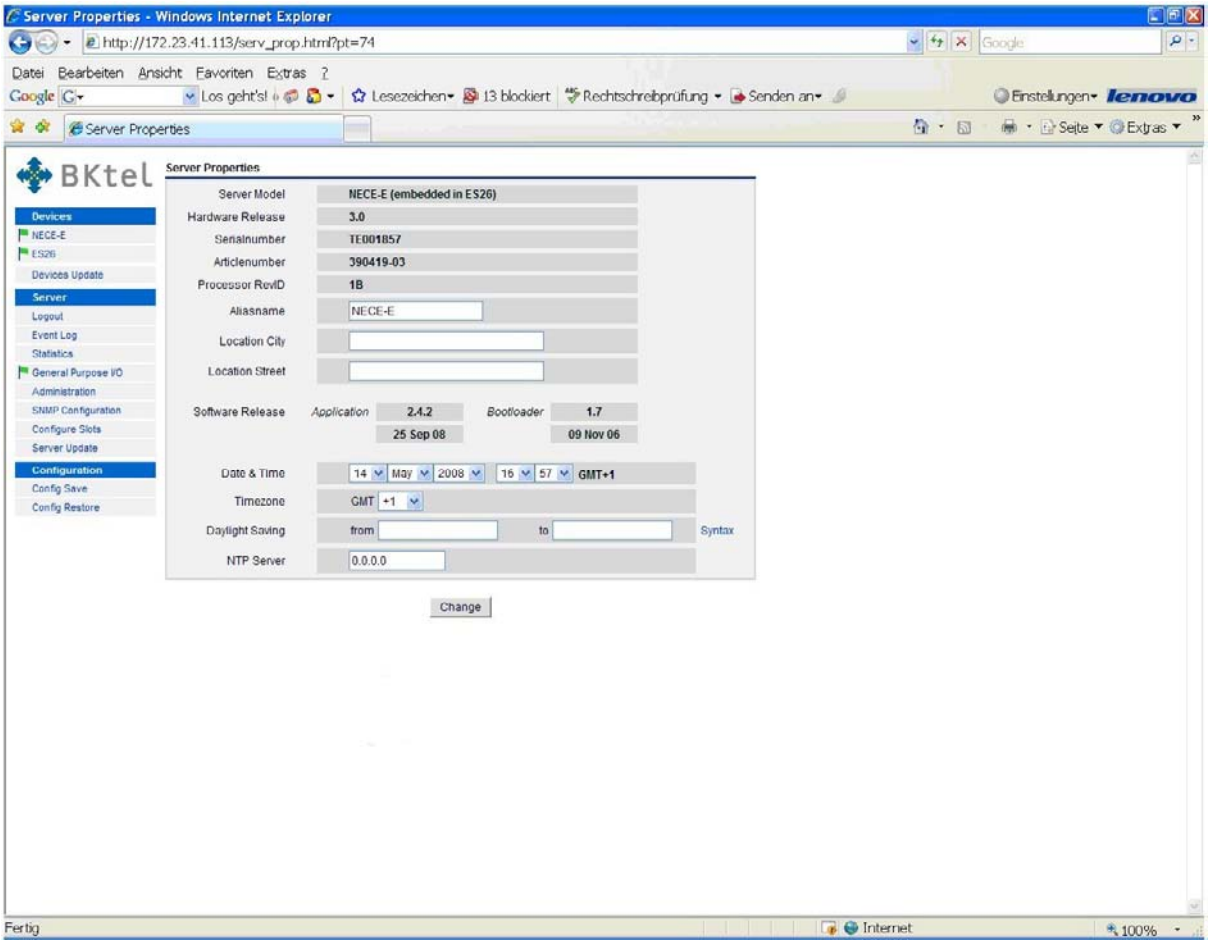


Fig. 6.4.1: Server properties

6.5 Event Log

After login the ***Event Log*** of the Server (=NEC) can be displayed. Depending on the operating conditions the event log looks similar to what is shown in the picture below:

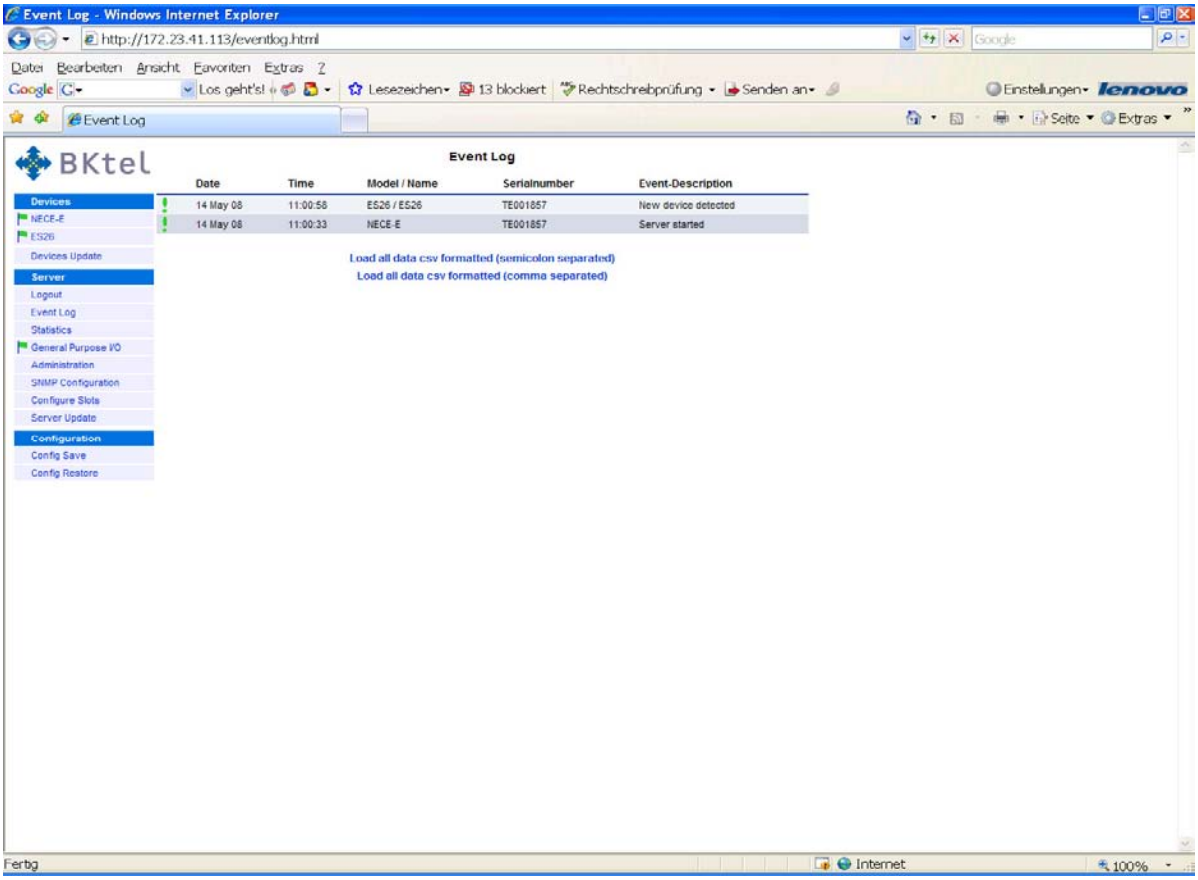


Fig. 6.5.1: Event log page

There are several marks, filled or unfilled, used to show all events.

- Green exclamation marks show events which occur during normal operation. If the exclamation mark is filled with green colour, which means that the event is still present. If the exclamation mark is empty (filled with white colour) it means that the event has passed. At the same time, the previous shown event with filled exclamation mark is scratched out.

- Red flags show urgent alarms. The meaning of filled or unfilled flags is the same as with the exclamation mark.

- Orange flags show warnings. The meaning of filled or unfilled flags is the same as with the exclamation mark.

All events are shown with time stamps, the equipment causing the event, the serial number of the equipment and a description of the event. Since one NEC (=Server) might supervise many different equipment (transmitter, optical switches, optical amplifiers, optical receivers …) the events of all the supervised equipment will be shown in the main window.

Up to 64 entries in the event log page are displayed. If this number is reached, the oldest entry is deleted in order to provide space for a new entry.

6.6 Trap Statistics

The statistics of sent, pending and discarded traps is shown in these fields and allows to check, whether the SNMP trap settings are set correctly and/or the communication with the trap receiver works properly.

- **Traps sent:** The number of trap packets, which have been sent by the NEC. Rem: Trap packets are counted, example: In case of 4 registered trap receivers the counter is increased by 4 for each trap-event
- **Traps pending:** The number of trap packets, which the NEC-E has still to send.
- **Traps discarded:** The number of trap-packets the NEC-E has discarded. The counter is incremented in case of any “discarded” trap, that means in any case of NEC-E trap memory-overflow or not in advance via SNMP Get Request verified traps.

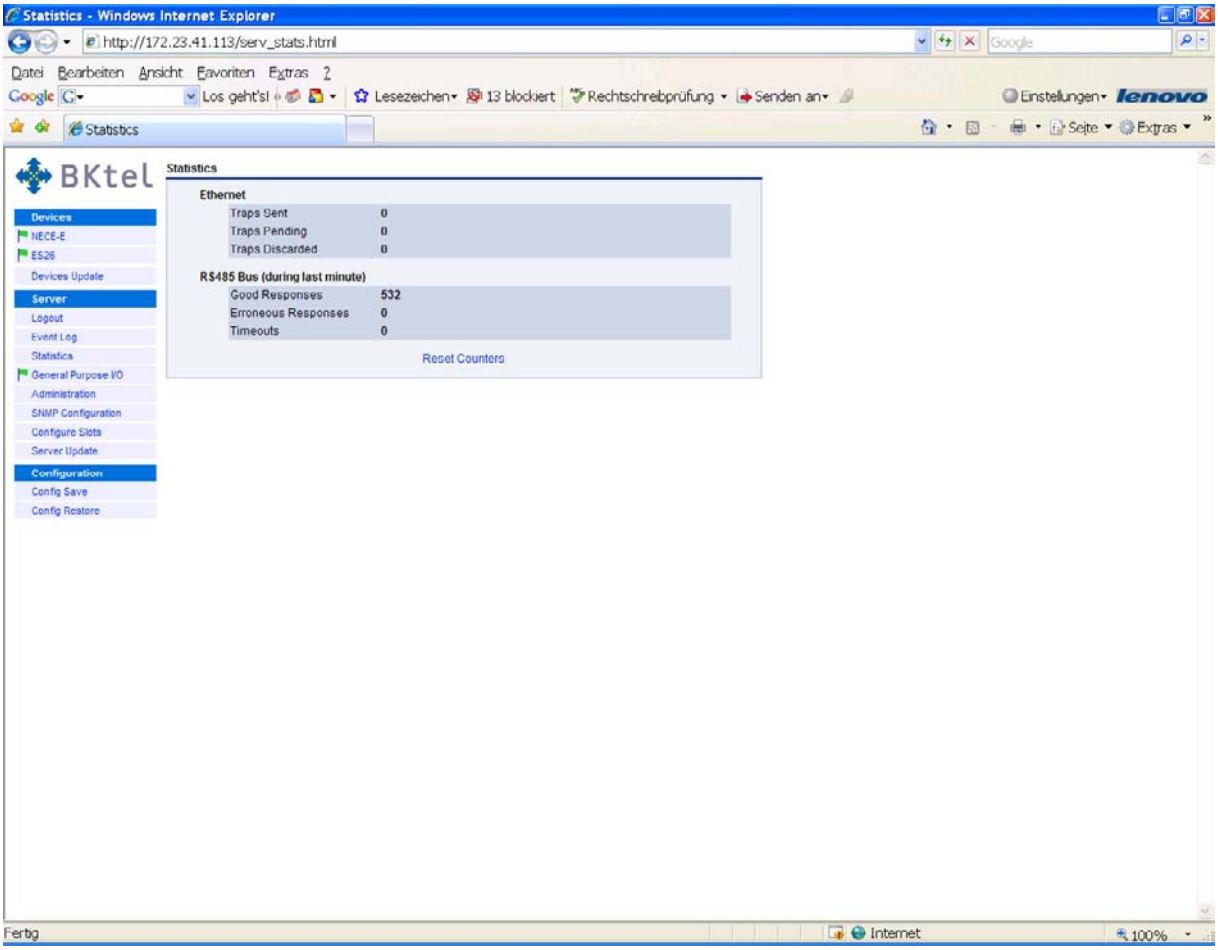


Fig. 6.6.1. Statistics page

6.7 General Purpose I/O Ports of NEC Server (Option)

The NEC-E provides optionally general purpose I/O ports for remote control functions (ref. to 4.2).

By selecting this item in the Server Menu, a display as shown below will appear:

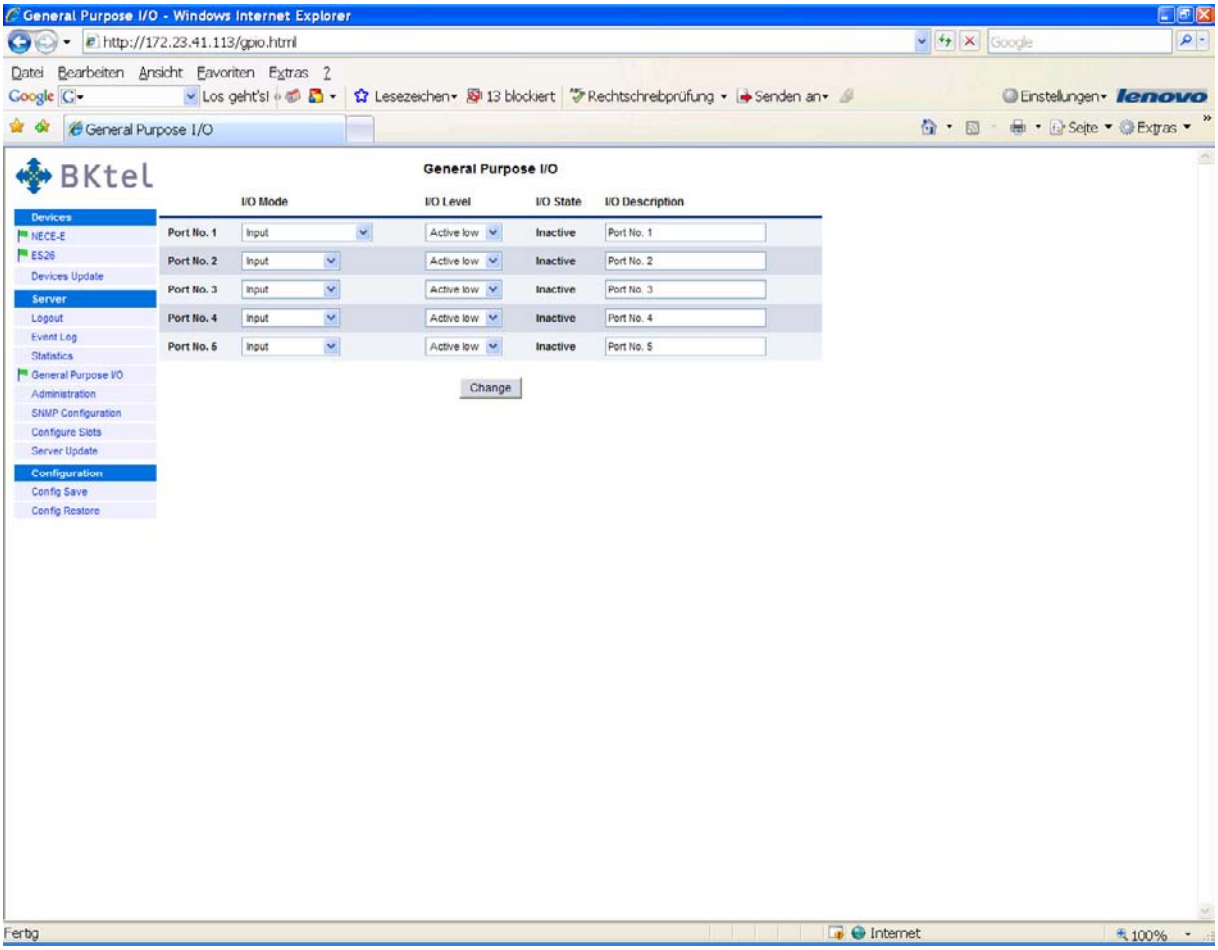


Fig. 6.7.1: Display of I/O ports menu

In the I/O mode column, the mode of both the I/O port and all 4 input-only ports (ref. to 4.2) can be set. The picture below shows the available options for the I/O port:

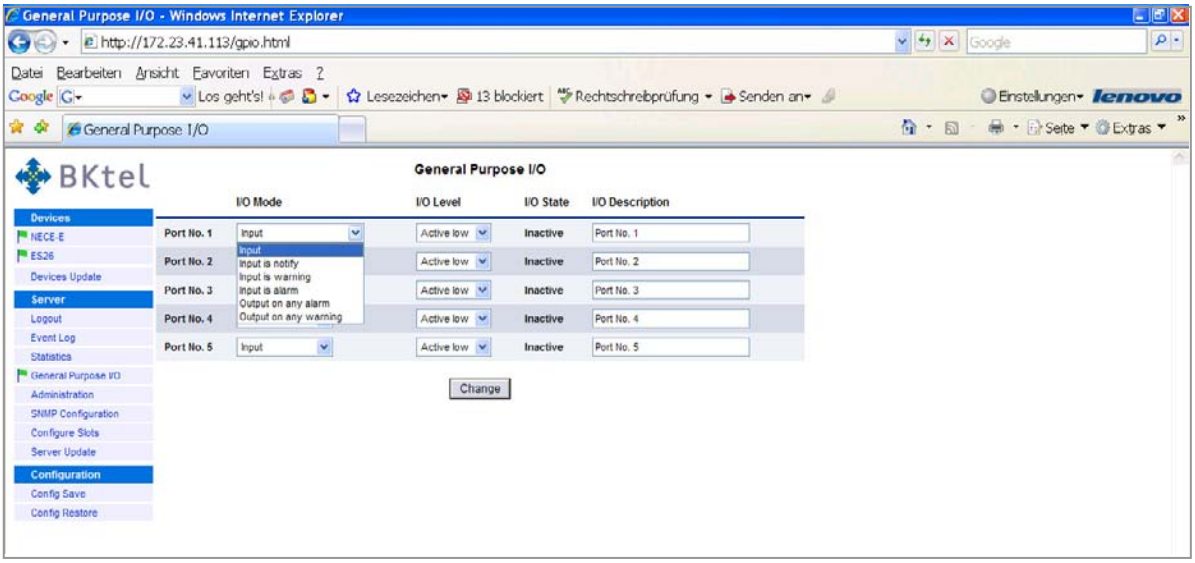


Fig. 6.7.2: Available modes of operation for the I/O port

The options for the input ports are shown in the picture below:

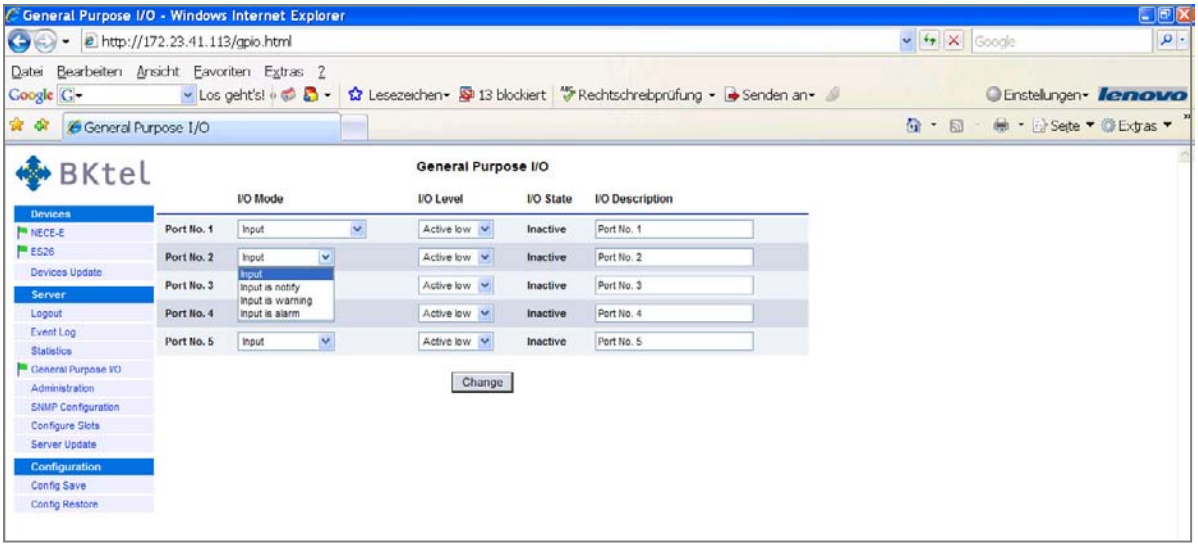


Fig. 6.7.3: Available modes of operation for input ports

The available modes of operation for the I/O ports are given in the table below:

Port mode	Description	Application (examples)
Input	Input signal (default = factory stetting)	Somebody entered the headend (available on ports 1 … 5)
Input is notify	Input signal creates a notify message (exclamation mark) in status display	Somebody entered the headend (available on ports 1 … 5)
Input is warning	Input signal creates a warning message (orange flag) in status display	Temperature in room is too high (available on ports 1… 5)
Input is alarm	Input signal creates an alarm message (red flag) in status display	Headend failure (available on ports 1… 5)
Output on any alarm	Output will become active with any alarm. Alarm limits for the ES10XLa can be set in limit menus of ES10XLa	(available for port 1)
Output on any warning	Output will become active with any warning. Warning limits can be set in limit menus of ES10XLa/ES26XLa	(available for port 1)

Table 6.7.1: Modes of the I/O ports

All ports can be set to be either active low or active high. A description of the I/O port function can be added to each port optionally

6.7.1 Examples of I/O port status information

An ES10XLa/ES26XLa polls also an EDFA (e.g. OVxxxxb) via the RS-485 interface.

Please note, that the I/O port #0 is directly related to the transmitter unit (ES10XL/ES26XL, refer to 7.17) whereas all other I/O ports (#1 …5) are related to the NEC.

- We assume that **I/O #0 is set to output on any warning** (and alarm)
- We assume that **I/O #1 is set to output on any alarm** (no warnings)

The following table lists the state of I/O #0 and #1 for some alarm situations.

Alarm situation	I/O #0 (output on any warning)	I/O #1 (output on any alarm)
RF input of ES10/ES26 is low (warning); OVxxxxb has no warnings or alarms	Active	Inactive
RF input level of ES10/ES26 is extremely low (alarm)	Active	Active
Optical input power level of OVxxxxb is low (warning); ES10/ES26 has no warnings or alarms	Inactive	Inactive
Optical input power level of OVxxxxb is low (warning); ES10/ES26 has no warnings or alarms; I/O #2 is set to alarm on input; I/O #2 receives an alarm	Inactive	Active
Optical input power level of OVxxxxb is very low (alarm); ES10/ES26 has no warnings or alarms	Inactive	Active

6.8 Server Administration

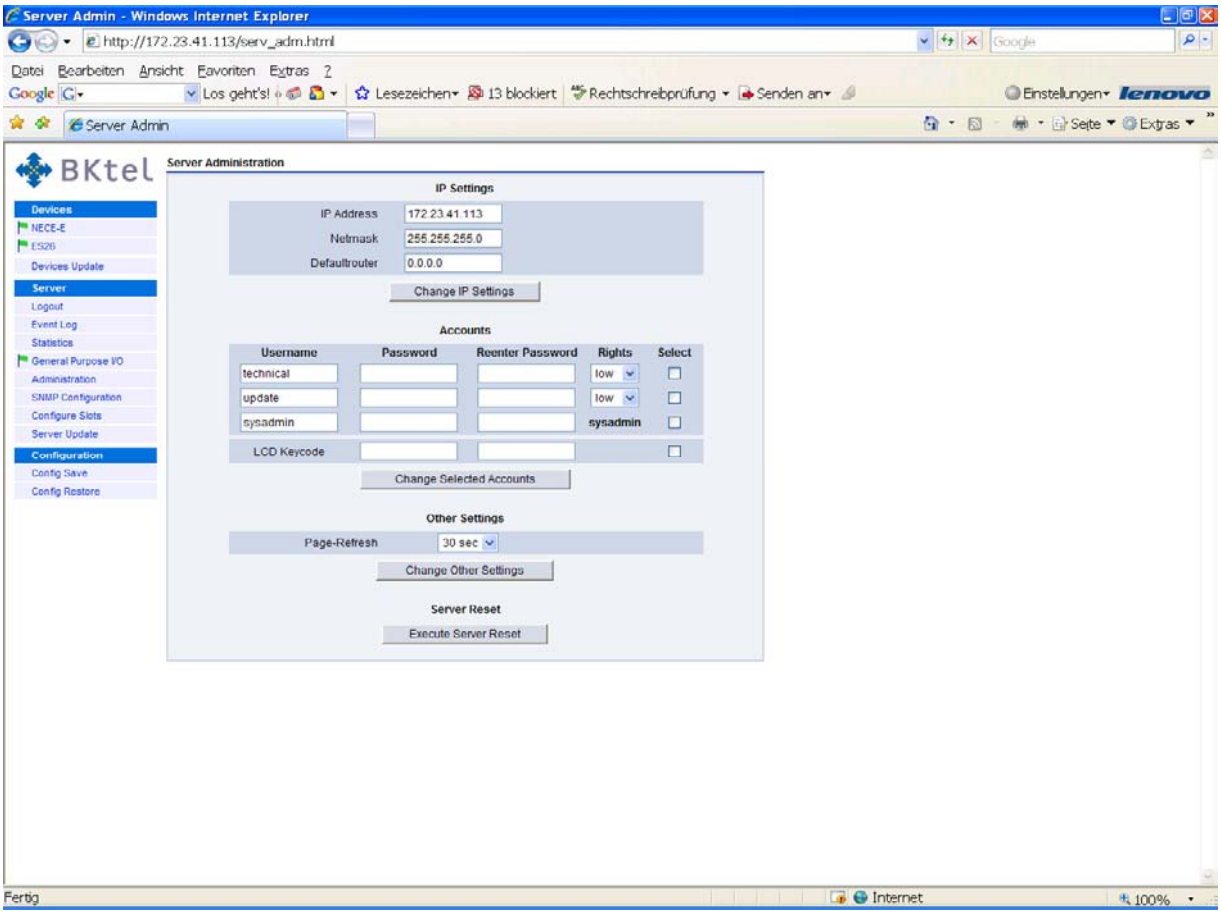


Fig. 6.8.1: Server administration menu

The server administration menu allows modifying the IP parameters, the user names and passwords and the interval, how fast the Webbrowser pages are updated.

The update interval has to be chosen carefully, especially if the number of devices polled by the NEC is quite high, in order to avoid too much communication traffic. The new parameters in the different blocks are executed by clicking on the change button of the individual block.

There are three levels of login priorities defined.

Username	**Factory Default Password**	**Description**
technical	***technical***	In this level all parameters are allowed to be changed, except the update and server administration items.
Update	***update***	In this level (additionally to the “technical” level) the server and device update processes can be executed.
Sysadmin	***sysadmin***	System administrator level, all tasks can be done.

6.9 SNMP Configuration

A SNMP configuration menu is available as shown in the picture below:

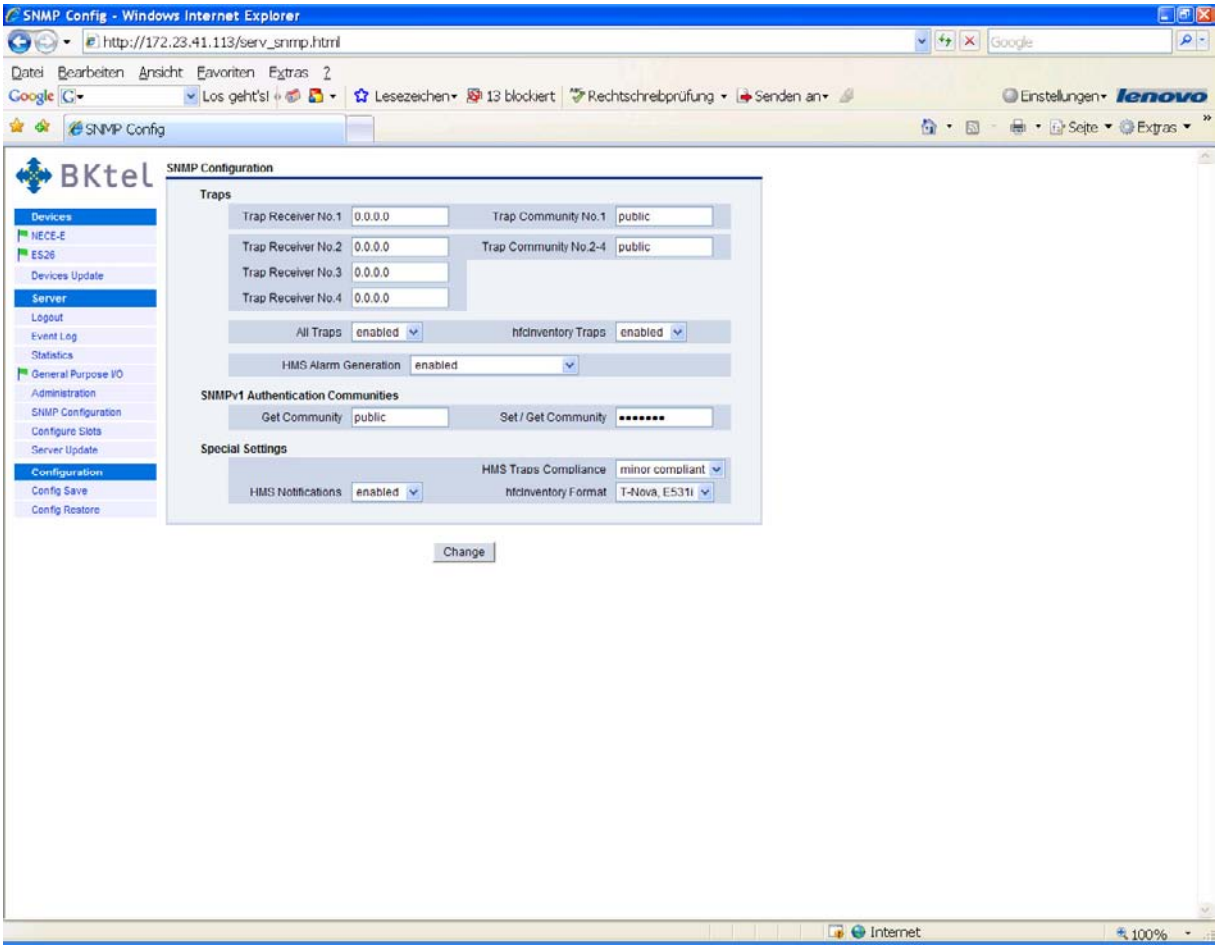


Fig. 6.9.1: SNMP configuration menu

Traps

The SNMP configuration menu allows entering the IP trap receiver addresses for up to 4 trap receivers, and to change the trap community strings for trap receiver #1 and trap receiver #2 to #4. Additionally all traps can be disabled/enabled. Furthermore the inventory traps might be disabled or enabled.

A further button allows selecting the SCTE HMS alarm generation:

- Disable all traps
- Enable all traps

Enable and resend all traps; this function is helpful for testing SNMP communication with the trap receiver(s)

SNMPv1 Authentication Communities

Separate strings can be allocated to the get community and the set/get community.

Special Settings

HMS Traps Compliance (see also SCTE-HMS-ALARMS-MIB und SCTE-HMS-COMMON-MIB)	
minor compliant (1)	**full compliant**
hmsAlarmEvent Trap is sent with ENTERPRISE OID *alarmsIdent (1.3.6.1.4.1.5591.1.2)*, instead of OID *scteHmsTree (1.3.6.1.4.1.5591.1) as demanded by* HMS MIB	As demanded by HMS MIB, hmsAlarmEvent Trap is sent with ENTERPRISE OID *scteHmsTree (1.3.6.1.4.1.5591.1)*.
hmsColdStart Trap is sent to RFC1215 with ENTERPRISE OID *commonIdent (1.3.6.1.4.1.5591.1.3)*, instead of OID *scteHmsTree (1.3.6.1.4.1.5591.1) as demanded by* HMS MIB and with Trap-Type COLD START.	As demanded by HMS MIB, the hmsColdStart Trap is sent with the ENTERPRISE OID *scteHmsTree (1.3.6.1.4.1.5591.1)* and with Trap-Type ENTERPRISE SPECIFIC + Specific-Trap-Type 0.

HMS Notifications	
enabled (1)	**disabled**
All messages of type “Notification” are sent as Trap and are inserted in the SNMP SCTE HMS tables. Since HMS does not recognize Notifications, “HMS-Severity” *minor* is reported	All messages of type “Notification” are not sent as Trap and are not inserted in the SNMP SCTE HMS tables. In the Webbrowser the Notifications are still shown

hfcInventory Format	
T-Nova, E531i (1)	**DKS, T12-9**
The SNMP variable “hfcInventoryFabricData” of the T-NOVA-HFC-INVENTORY-MIB is provided in the format defined by Biedenbach (T-Nova, E531i)	The SNMP variable “hfcInventoryFabricData” of the T-NOVA-HFC-INVENTORY-MIB is provided in the format defined by Herberg (DKS, T12-9)

Trap Verify

If traps are to be transmitted via non permanent links like dial-up links (e.g. using ISDN or standard analog modem), it is important to verify that the link to the trap receiver is working before any SNMP traps are sent. Otherwise the traps could get lost.

Several settings have been introduced to obtain a verification of the link between the trap transmitter (=NEC) and trap receiver:

- **Verify before trap**. If enabled, via SNMP Get Request the "sysDescr" OID of the host having the "Trap Verify Receiver" IP address (see below) is executed before the pending traps are sent. Only after successful reply all pending traps are sent. For permanent-on links (e.g. LANs), *"disabled"* is the recommended setting. For other links *"enabled*" is the recommended setting.
- **Trap verify receiver:** Here the IP address of the receiver, verifying the link, can be entered. In many cases it might be one of the trap receiver addresses as entered in 0. However, in dial-up links, optionally the IP address of a receiving modem (e.g. ISDN router) could be used instead of the IP address of a real trap receiver.
- **Timeout:** A timeout time between 30 and 600 seconds might be specified, in order to detect a link error. The NEC-E is waiting the specified time for replies on the "sysDescr" SNMP Get Requests. After this time all pending traps are sent, regardless of a reply has arrived or not. Important: In this case of timeout the 'traps sent' and the "traps discarded" counter (see below) are incremented.
- **Trap Accumulation Time:** It is possible to collect traps during the "*Trap accumulation time",* which can be set between 0 and 60 seconds, until they are transmitted ight ad e. This feature helps to reduce connection fees in dial up connections. In the following cases the accumulated traps are in any case released for sending:

  The internal trap memory is 3/4 filled.

  The SNMP agent of the NEC-E is polled by any kind of manager.
- **Test "trap verify receiver" response:** This function is very useful to set up and test the communication in modem links. By clicking this link it can be tested, whether the "Trap Verify Receiver" is answering correctly on the SNMP Get Request. (Timeout after 30 seconds). This link is only visible, when "Verify before Trap" is enabled.

6.10 Server Update

It is possible to update the Server (=NEC) firmware by uploading it to the optical transmitter using the Webserver software upload menu as shown below.

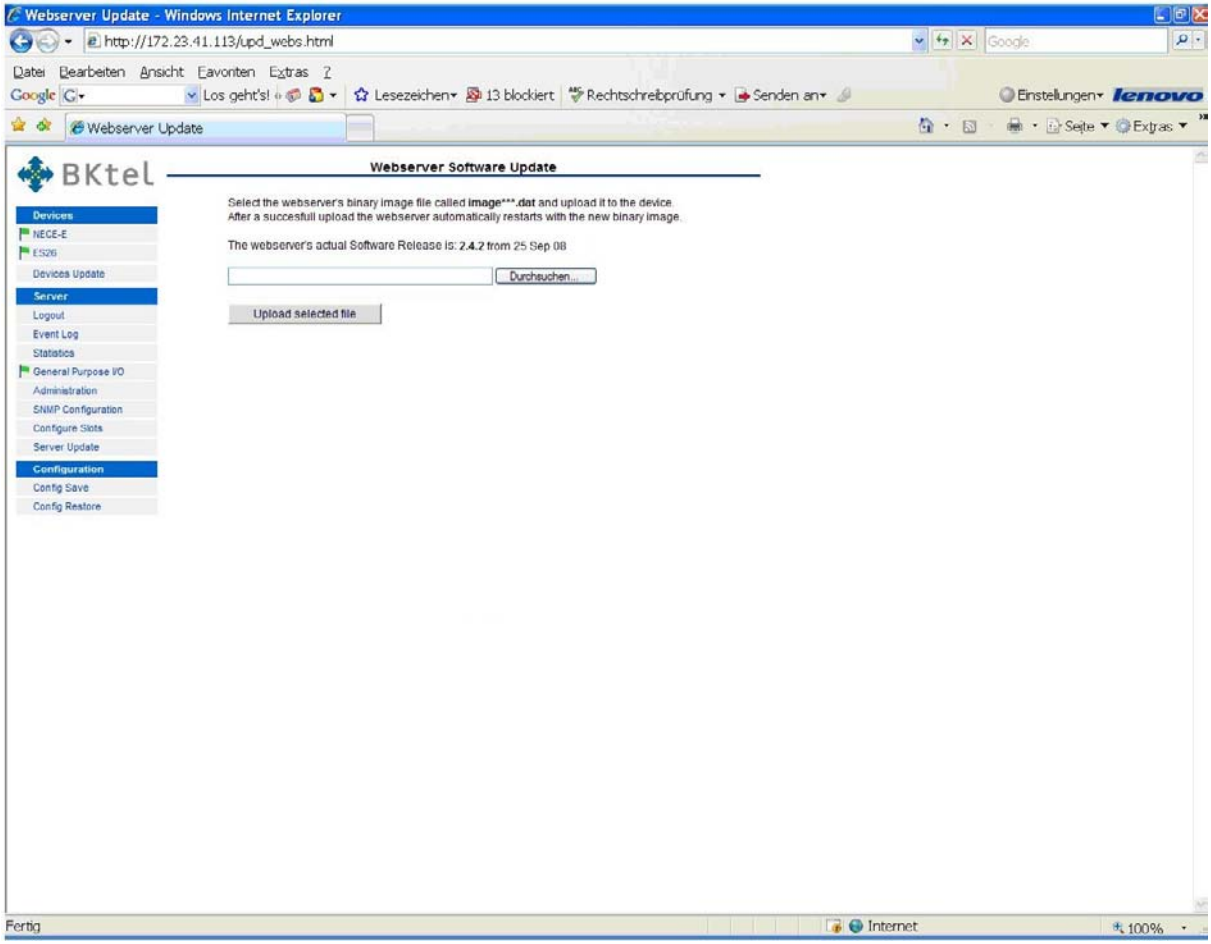


Fig. 6.10.1: Server update menu

A Server software update might be required, if new equipment has to be supervised by the NEC, connected to the RS485 (master) interface, or if the changes to the WebBrowser- or SNMP-Ethernet interfaces have to be implemented.

Note: The buttons occur in different languages depending on the actual Windows language setting.

6.11 Config Save

A configuration menu is optionally available. The menu allows the user to save and/or to restore the configuration settings of the equipment controlled by the NEC. Pushing the ‘Config Save’ button the following picture appears:

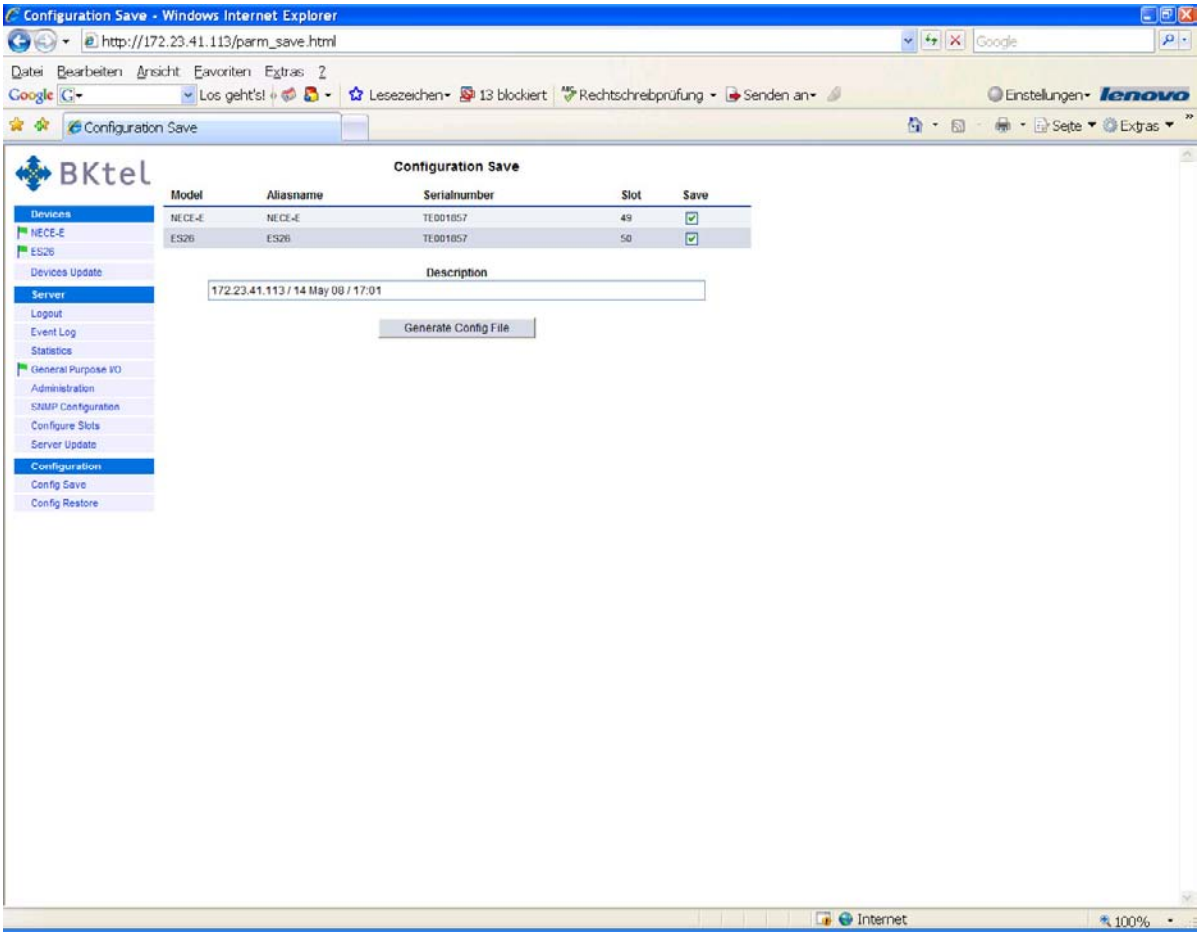


Fig. 6.11.1: Config save menu

A table of the controlled devices with model name, alias name, serial number and slot number is displayed. Devices can be marked for configuration saving using last column of the table. Pressing the ‘Generate Config file’ button a file with the settings of the selected devices is generated and stored in the flash memory of the NEC. To save the file locally, the button ‘Save generated Config file’ can be used. The default file name is displayed below the button. Also this link can be used to initiate the file storage.

6.12 Config Restore

Pushing the ‘Config Restore’ button the file saved in the NEC memory is available for restoring as shown in the picture below.

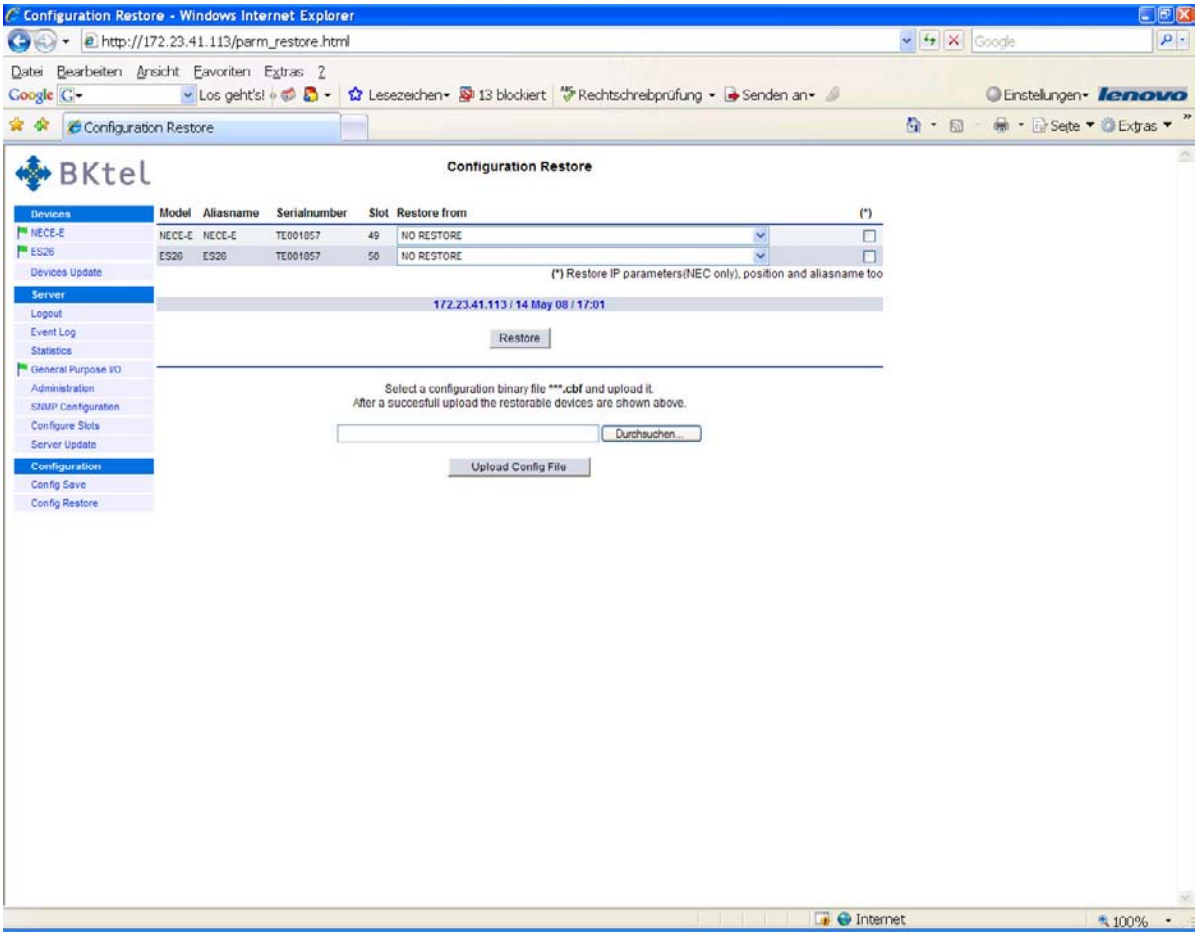


Fig. 6.12.1: Config restore menu

In the column ‘Restore from’ the available configurations can be selected by model name, alias name, serial number and slot number. The ‘Restore’ button starts the restoration.

In the last column it can be selected if the equipment should also take over the aliasname and slotnumber. In this way the device can be completely recovered in its settings. In this manner it is easy to configure a replacement unit or restore the configuration of an entire group of devices e.g. after a system crash.

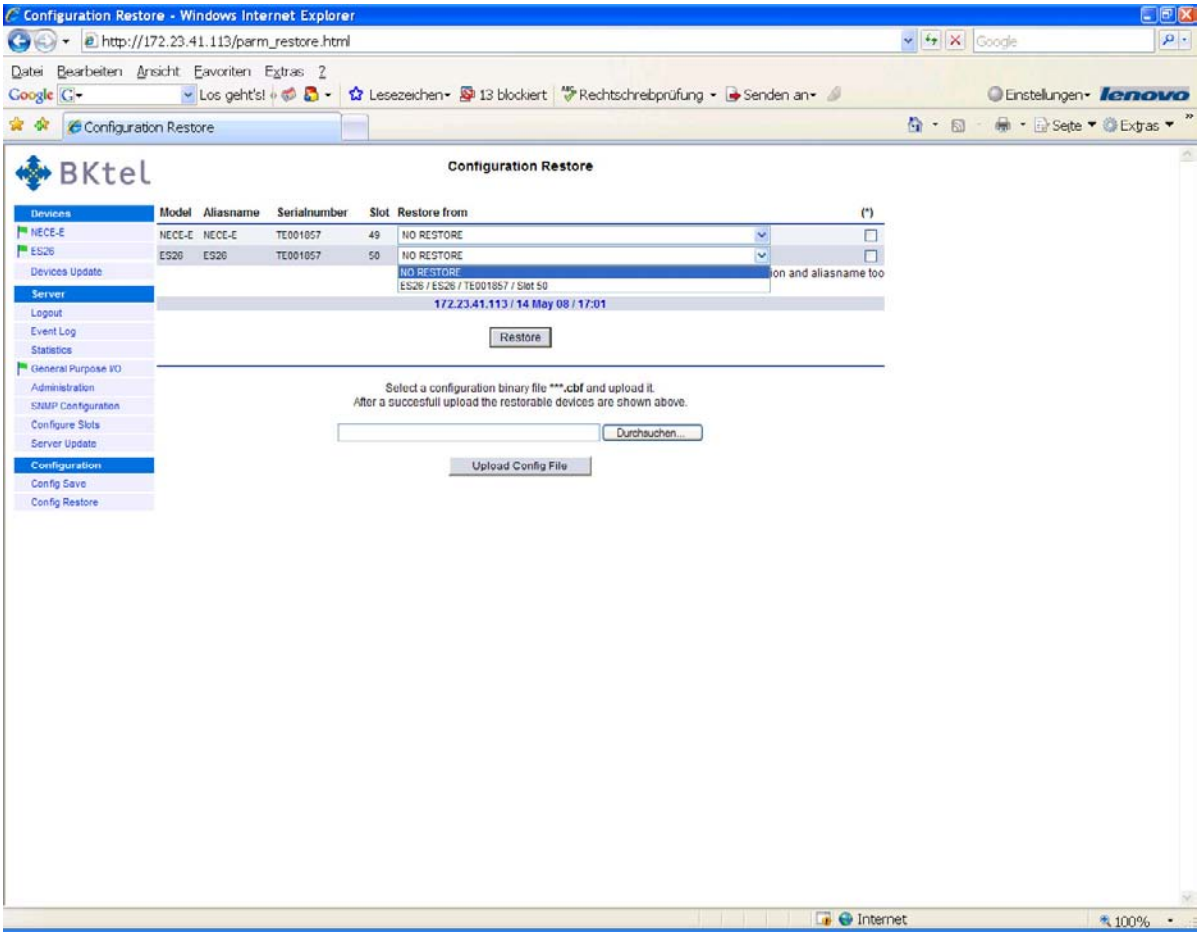


Fig. 6.12.2: Config restore menu

In case configuration settings of a device should be transferred to another device e.g. in a different system, the mark has to be deselected. Only the configuration settings are then applied, the aliasname and slotnumber of the device is not altered.

Using the ‘Upload Config file’ button a local file can be loaded into the NEC memory and further on be used for restoring configuration settings as described.

7 CONTROLLING ES10/ES26 VIA A NEC

7.1 Status Menu

The figure below shows the status menus of the ES10/ES26.

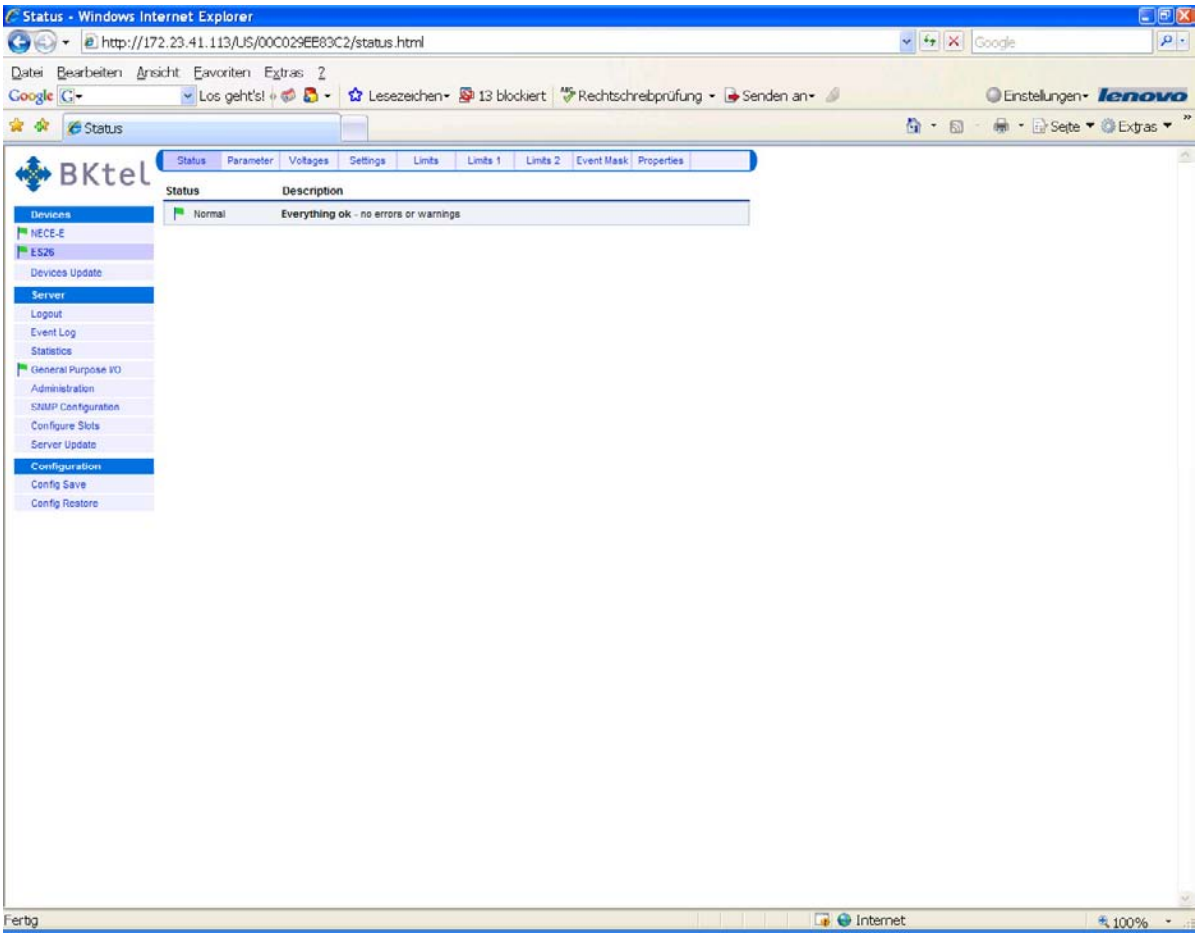


Fig. 7.1.1: Status menu of ES10/ES26

The actual status of the transmitter is shown using a mark and a description.

There are several marks, filled or unfilled, used to show all events.

- A green flag indicates that the transmitter is working properly.
- An orange flag shows a warning. A certain parameter is out of the nominal range. The reason for that should be checked and solved as soon as possible.
- A red flags show an urgent alarms. An immediate action is required to fix the failure.
- An exclamation mark provides a message about a certain mode of operation or change

7.2 Parameters Menu

The parameters menu displays the most important values of the transmitter for operation.

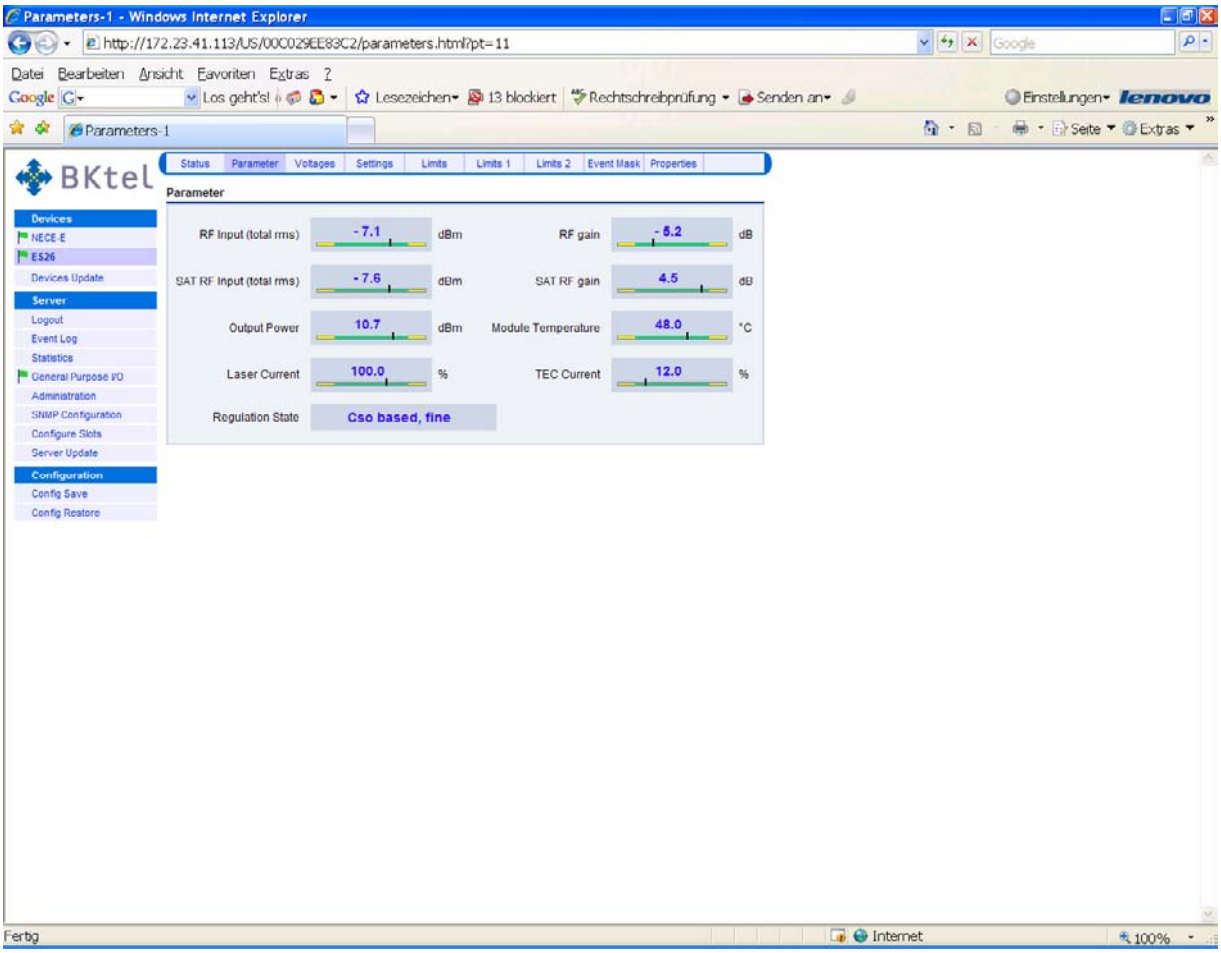


Fig. 7.2.1: Parameters menu of ES10/ES26

For proper operation, the black vertical bars should meet the green fields. Note: The scaling of the green and yellow fields might be different in order to obtain a good reading, especially of the green field.

7.3 Internal Voltages

The voltages menu displays all internal supply voltages like shown below.

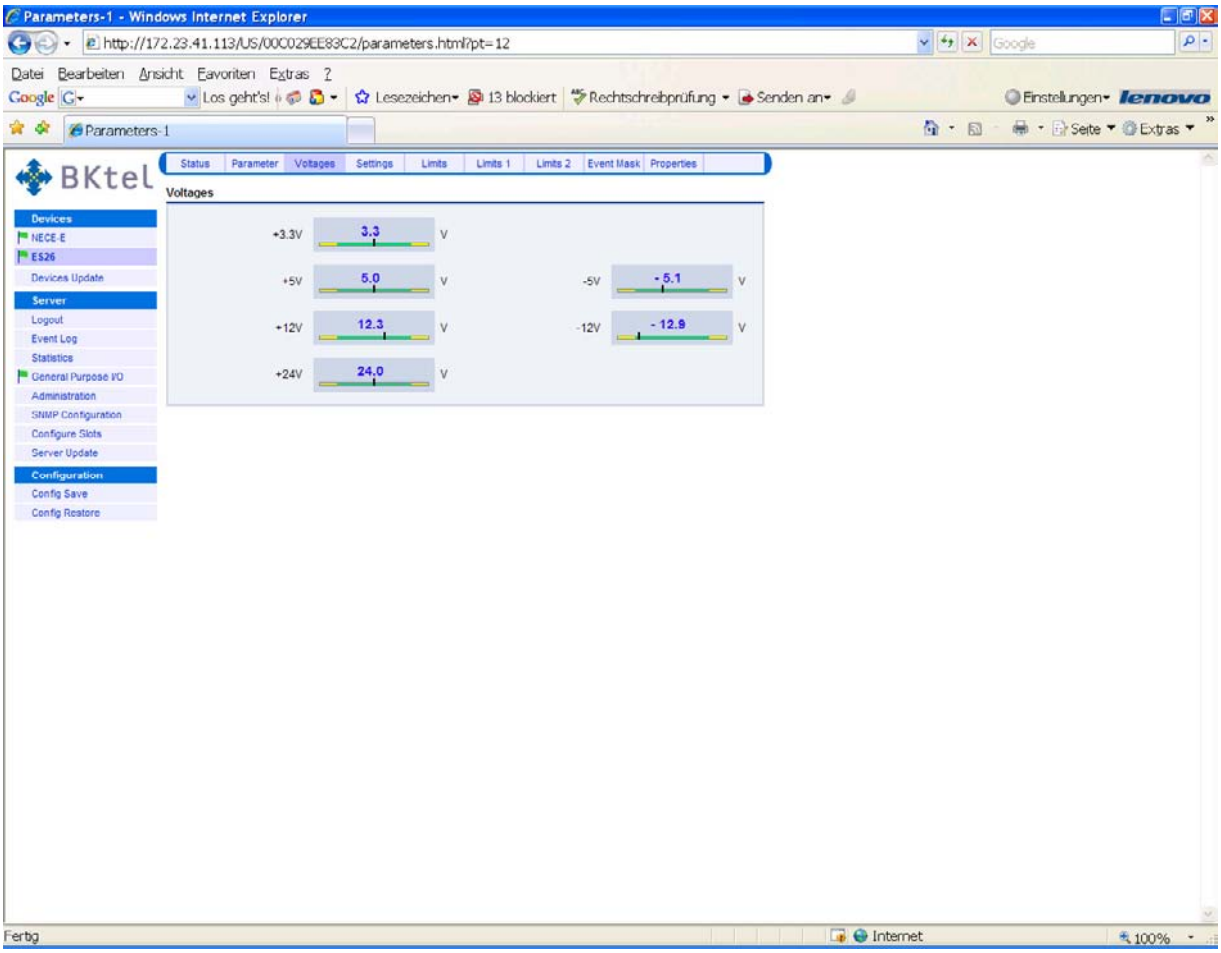


Fig. 7.3.1: Internal voltages menu of ES10/ES26

For proper operation, the black vertical bars should meet the green fields. Note the thresholds for alarms are not adjustable by the user but are factory settings only.

7.4 Settings Menu

This menu allows changing some basic adjustments of the ES10/ES26. Note: Some of the settings require certain hardware and software releases. Please refer to the manual supplied with the transmitter if some options are different or missing compared to this picture.

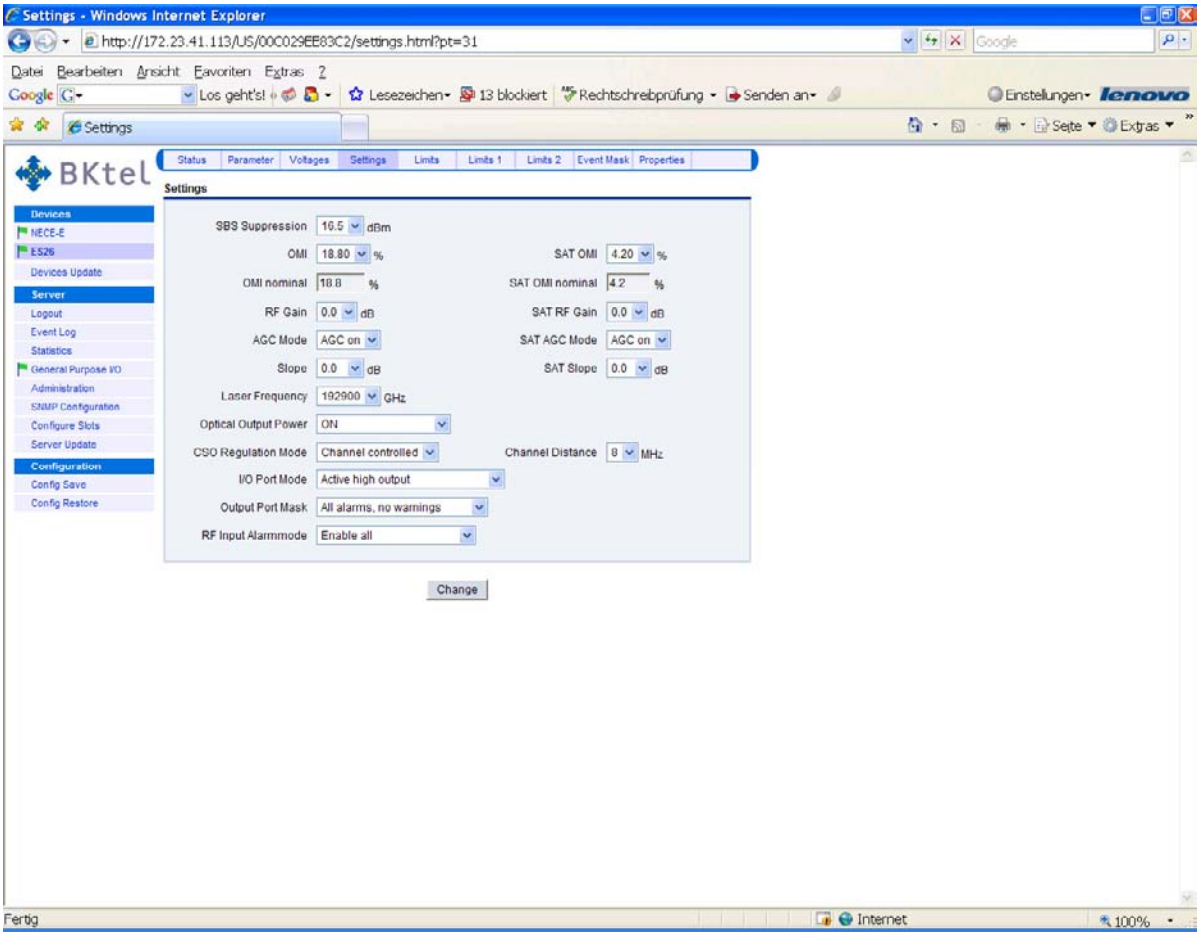


Fig. 7.4.1: Settings menu of ES10/ES26

7.5 Changing SBS Threshold

The picture below shows, how to change the SBS suppression (threshold) between 13.0 and 19.0 dBm for the **ES10XL/ES26XL** (be aware that the ES10L has a fixed SBS threshold of 16 dBm). It is important to understand, that the SBS setting has a major impact on the transmission performance, especially for very long fiber transmission (e.g. 100 km) and high frequencies (860 MHz). Please refer to 5.3.7. The SBS suppression can be adjusted in 0.5dB steps (calibrated). From NEC application software release 1.11 the adjustment can be carried out in 0.1 dB-steps, which are in this case interpolated, the 0.5 dB steps are still calibrated.

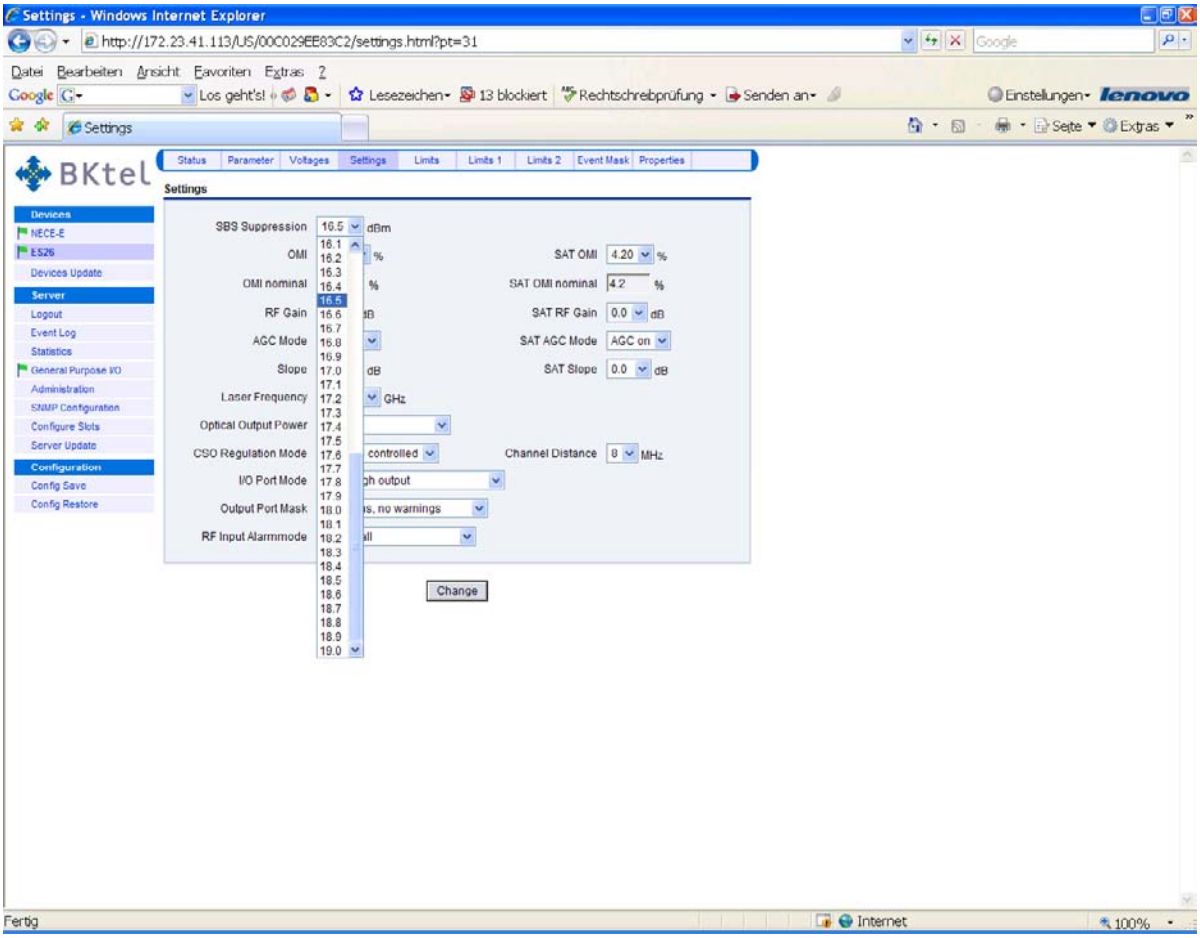


Fig. 7.5.1: Changing the SBS threshold of the ES10XL/ES26XL

7.6 Changing OMI_{totrms} (AGC on modes only)

The picture below shows, how to adjust the RF OMI total rms, in order to optimize the transmission performance in terms of CNR, CSO, CTB and BER. For details, please refer to 5.3.

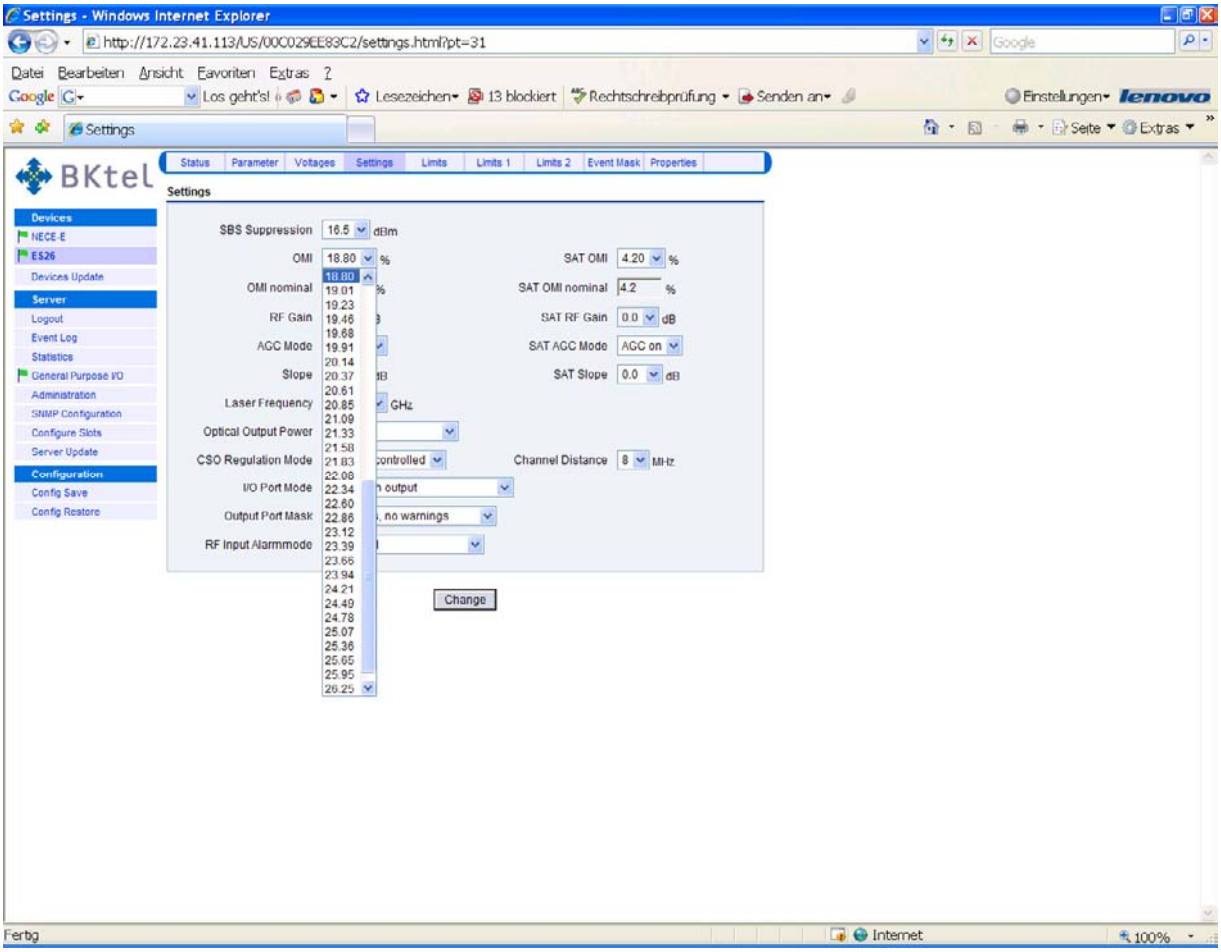


Fig. 7.6.1: Setting RF OMI_{totrms} of ES10/ES26

With software release 2.0, the RF OMI_{totrms} (OMIrms in the figure beyond) is shown in %. In previous software releases, RF OMI_{totrms} was shown relative (in dB) to a nominal value.

The display in % enables an easy comparison e.g. with the graphs as shown in 5.3. For that reason, ES10 application software release 1.12 and later supports this feature.

Notes:

1. OMI nominal refers to a factory setting and cannot be changed by the user.
2. RF-OMI_{totrms} setting is only relevant in AGC-on mode.
3. The setting range for RF-OMI_{totrms} might change slightly from device to device due to production tolerances.

7.7 Setting Gain (AGC off mode only)

The picture below shows how to adjust the RF gain, in order to optimize the transmission performance in terms of CNR, CSO, CTB and BER.

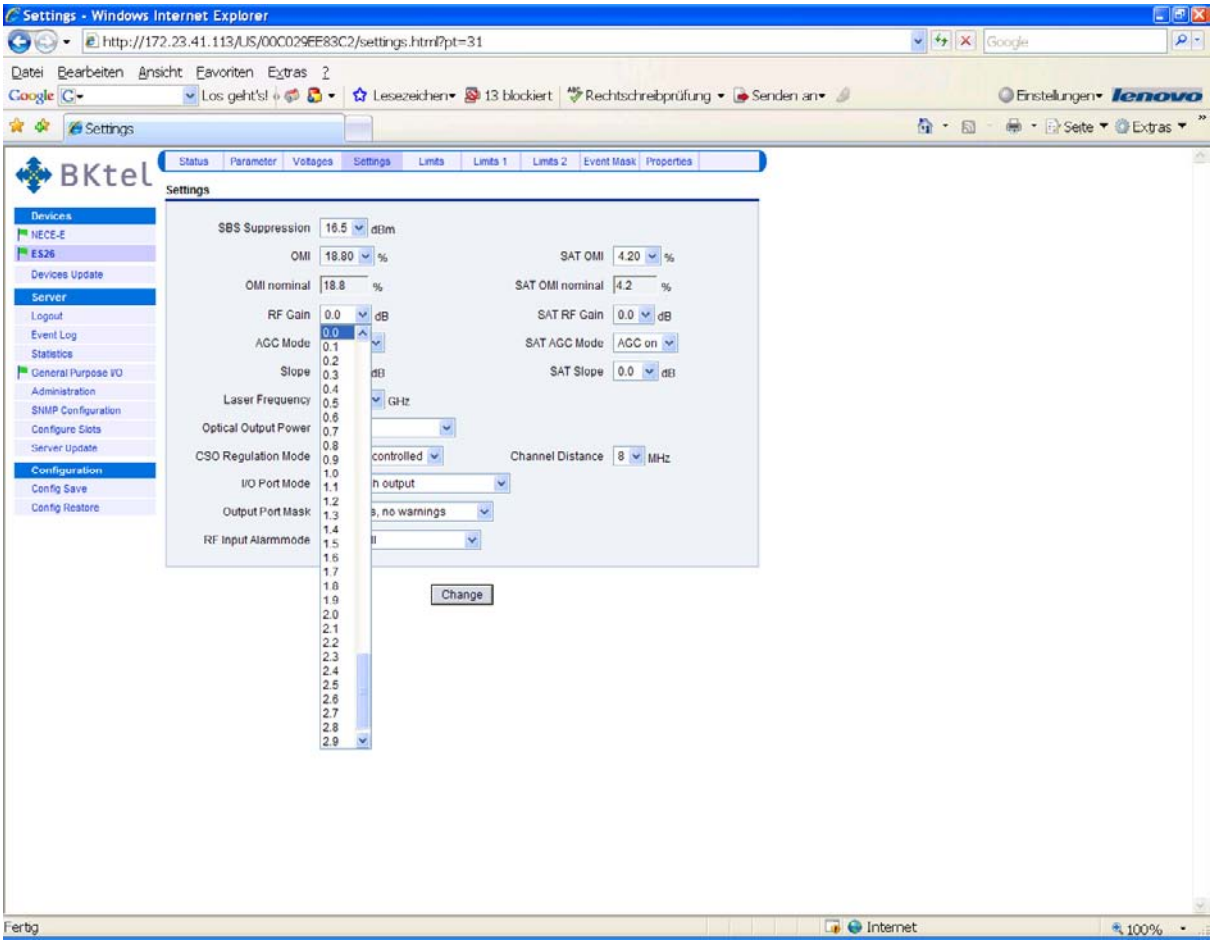


Fig. 7.7.1: Setting RF gain of ES10/ES26

ES10 application software release 2.0 and later supports this feature.

Notes:

1. The RF gain setting is only relevant in AGC-on mode.
2. The setting range for RF gain might change slightly from device to device due to production tolerances.
3. Changing the RF gain changes the input sensitivity of the ES10/ES26 in AGC off mode; 0 dB is the nominal RF gain. Setting the RF gain to e.g. 2 dB improves the input sensitivity of the ES10/ES26 from e.g. 80 dBµV to 78 dBµV.

7.8 Changing AGC Mode

The transmitter can be operated in manual- (AGC off) as well as an automatic- gain controlled (AGC on) mode. For details please refer to 5.3.1.

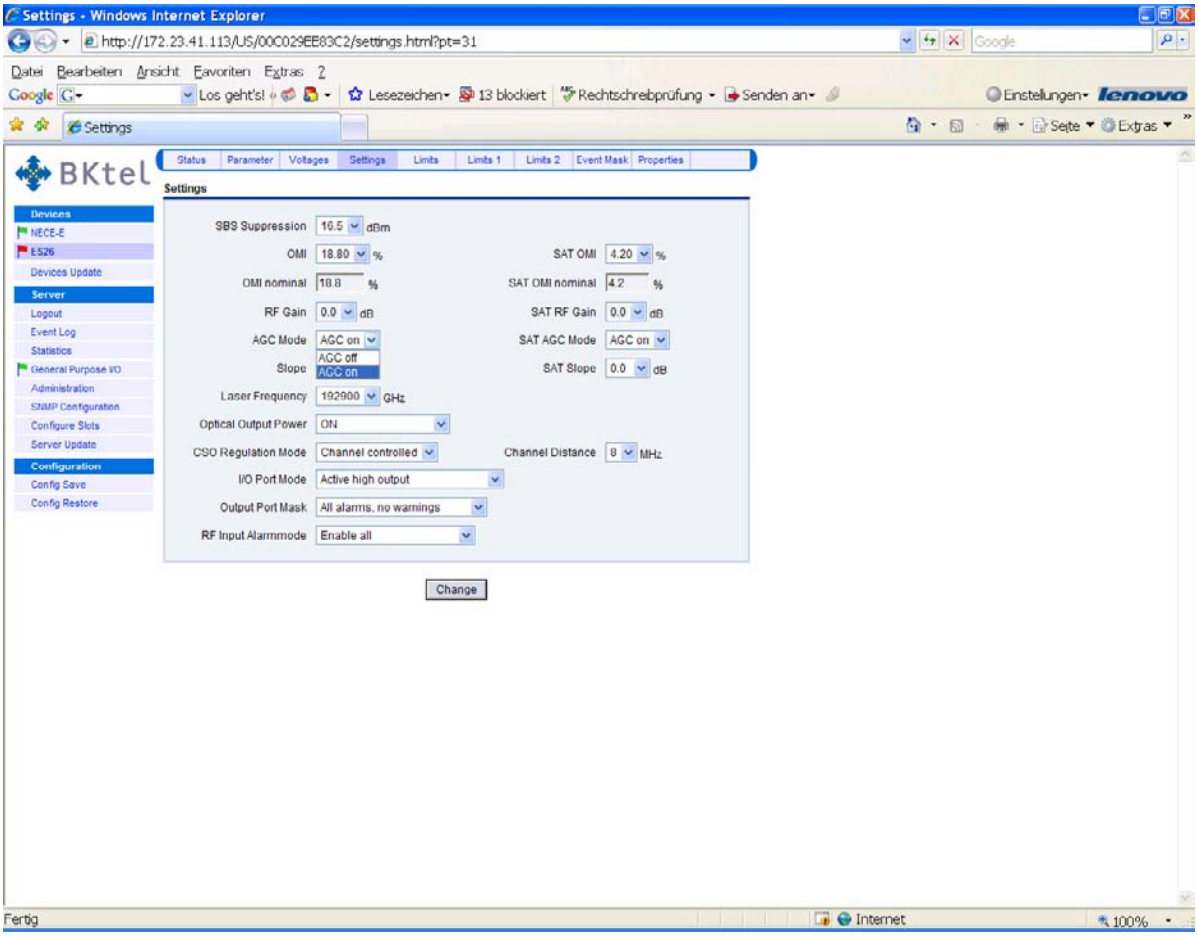


Fig. 7.8.1: Selecting the RF AGC mode of the transmitter of ES10/ES26

7.9 Setting Slope

The ES10/ES26 enables to change the slope of its internal RF amplifier stages. The slope equalizer follows a RF cable compensating or RF cable simulating characteristics.

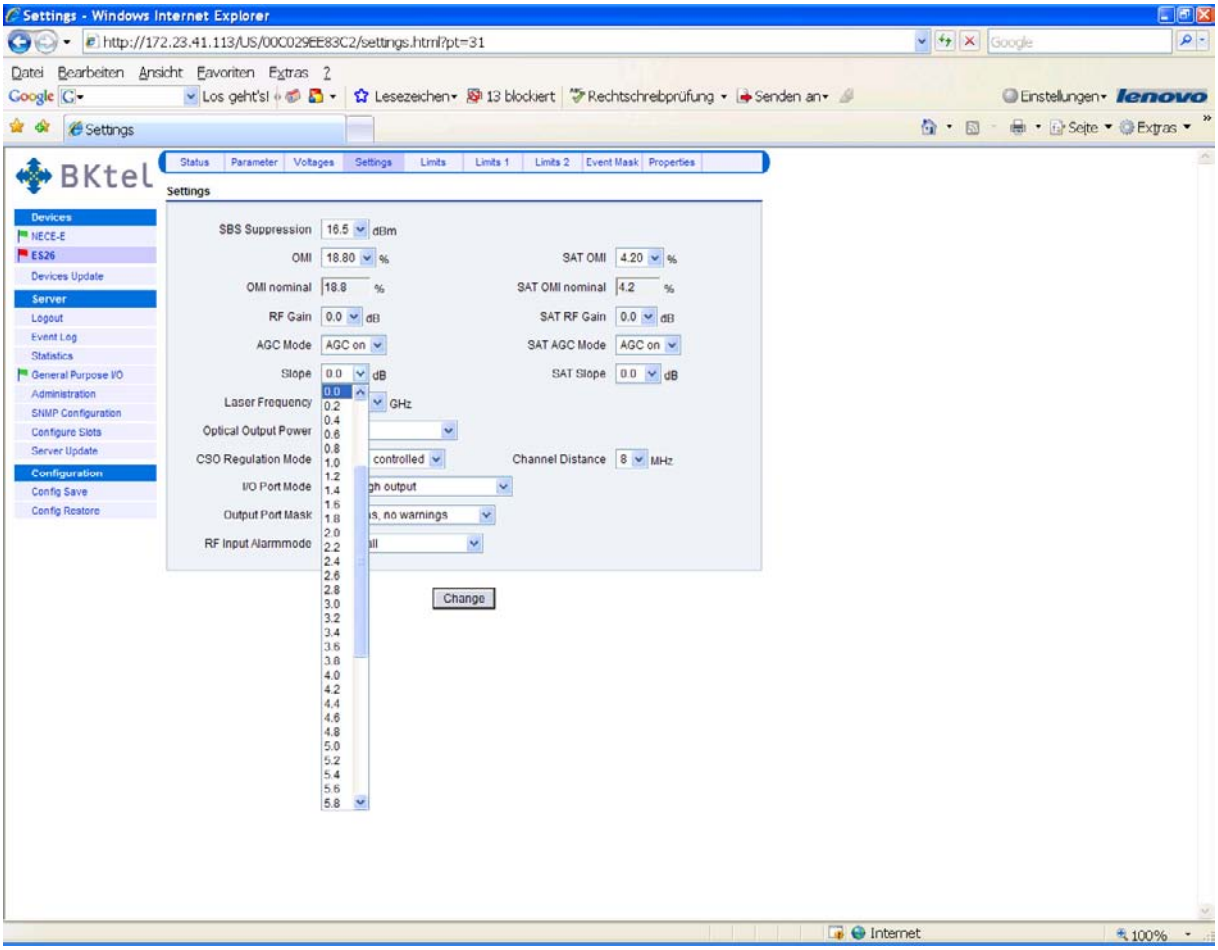


Fig. 7.9.1: Setting the RF gain slope

7.10 Changing SAT-IF OMI_{totrms} (ES26 only)

The picture below shows, how to adjust the SAT OMI total rms, in order to optimize the transmission performance in terms of noise, intermodulation and BER. For details, please refer to 5.3.

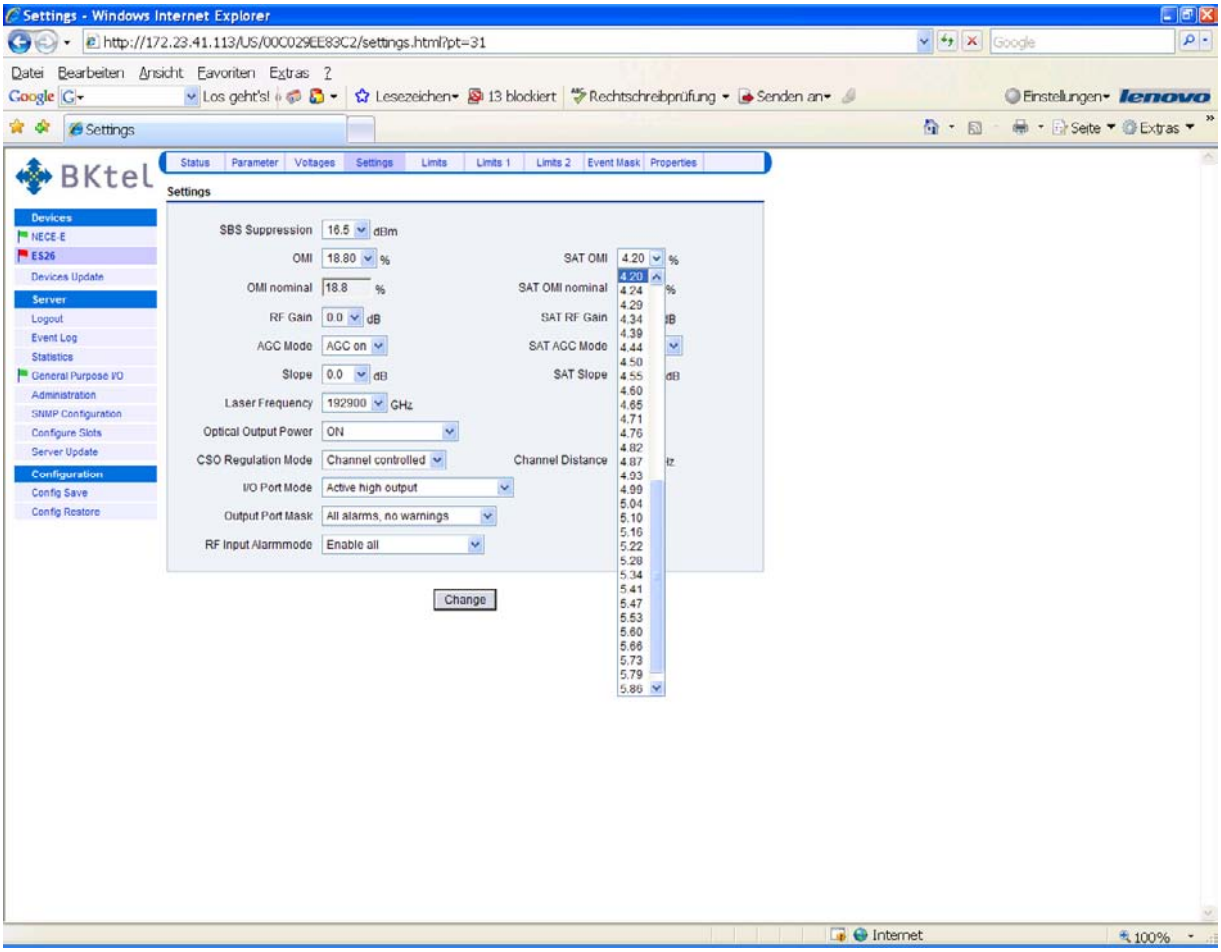


Fig. 7.10.1: Setting SAT OMI_{totrms} of ES26

The SAT OMI_{totrms} (SAT OMIrms in the figure beyond) is shown in %.

Notes:

1. SAT OMI nominal refers to a factory setting and cannot be changed by the user.
2. SAT OMI_{totrms} setting is only relevant in AGC-on mode.

7.11 Setting SAT-IF Gain (ES26 only)

The picture below shows how to adjust the SAT RF gain, in order to optimize the transmission performance in terms of noise, intermodulation and BER.

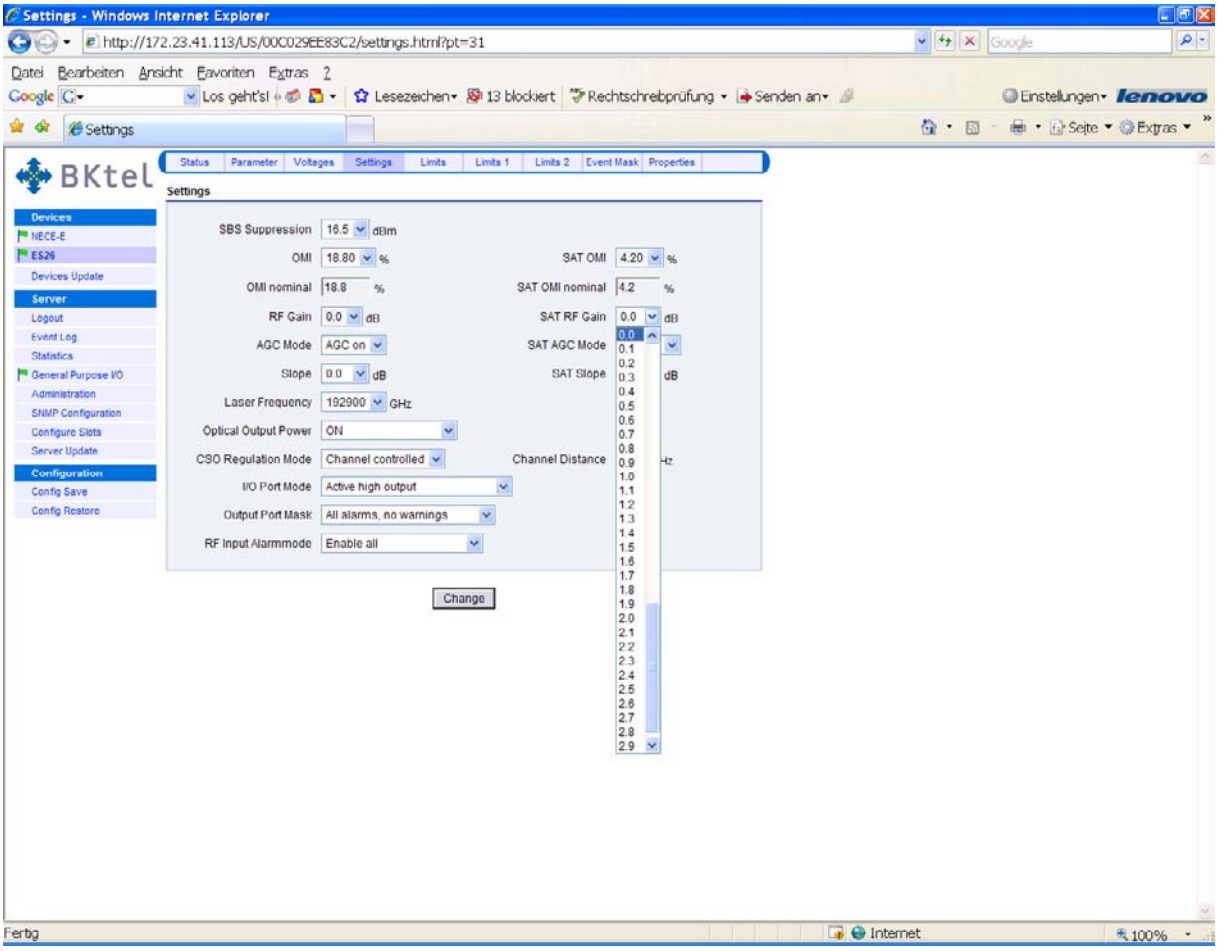


Fig. 7.11.1: Setting SAT RF gain of ES26

Notes:

1. The SAT RF gain setting is only relevant in AGC-on mode.
2. The setting range for SAT RF gain might change slightly from device to device due to production tolerances.
3. Changing the RF gain changes the input sensitivity of the ES26 in AGC off mode; 0 dB is the nominal SAT RF gain. **Setting the RF gain to e.g. 2 dB improves the input sensitivity of the ES26 from e.g. 90 dBµV to 92 dBµV.**

7.12 Changing SAT-IF AGC Mode (ES26 only)

The transmitter can be operated in non-AGC (manual) as well as an automatic gain control mode.

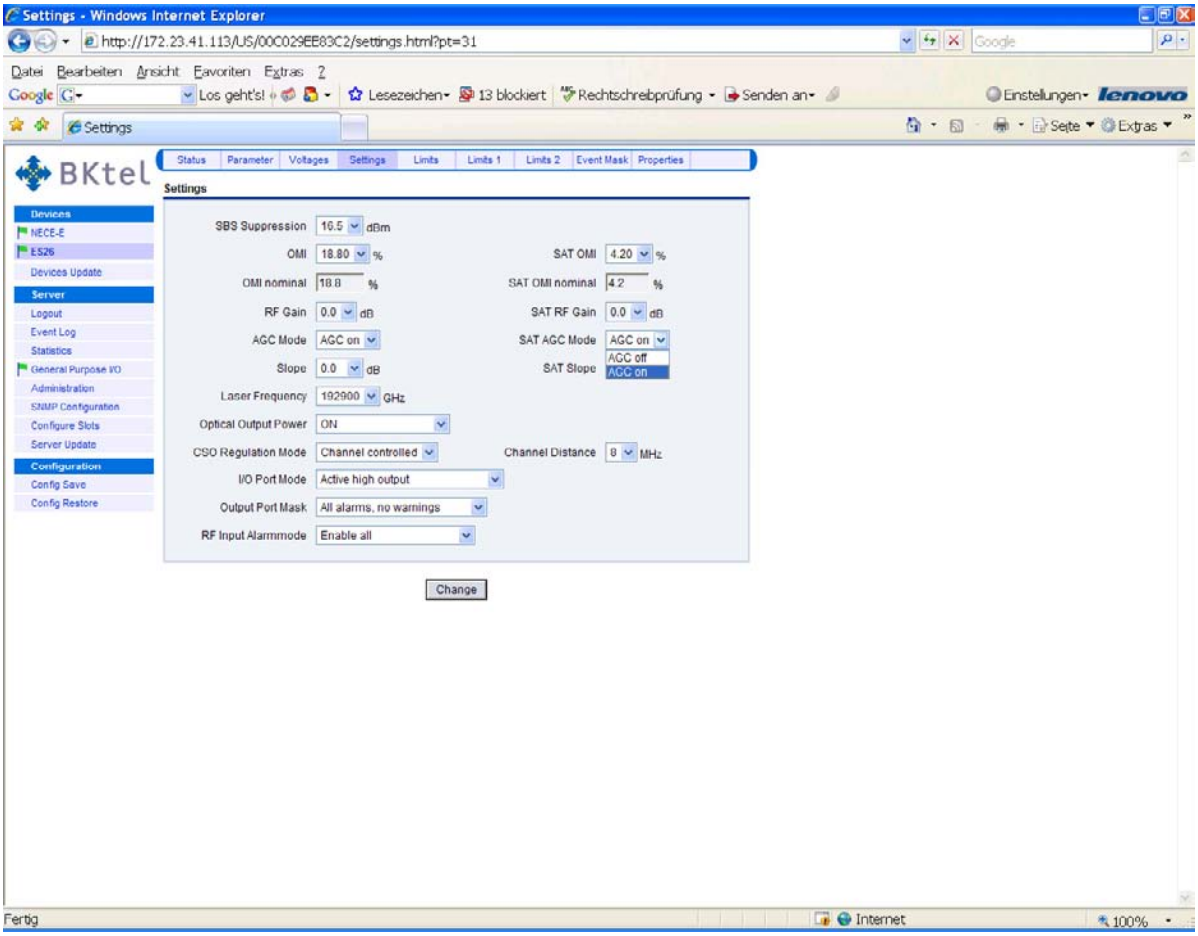


Fig. 7.12.1: Selecting the SAT AGC mode of the transmitter of ES26

7.13 Setting SAT-IF Slope (ES26 only)

The ES26 enables to change the slope of its internal SAT RF amplifier stages. The slope equalizer follows a RF cable compensation or RF cable simulating characteristics.

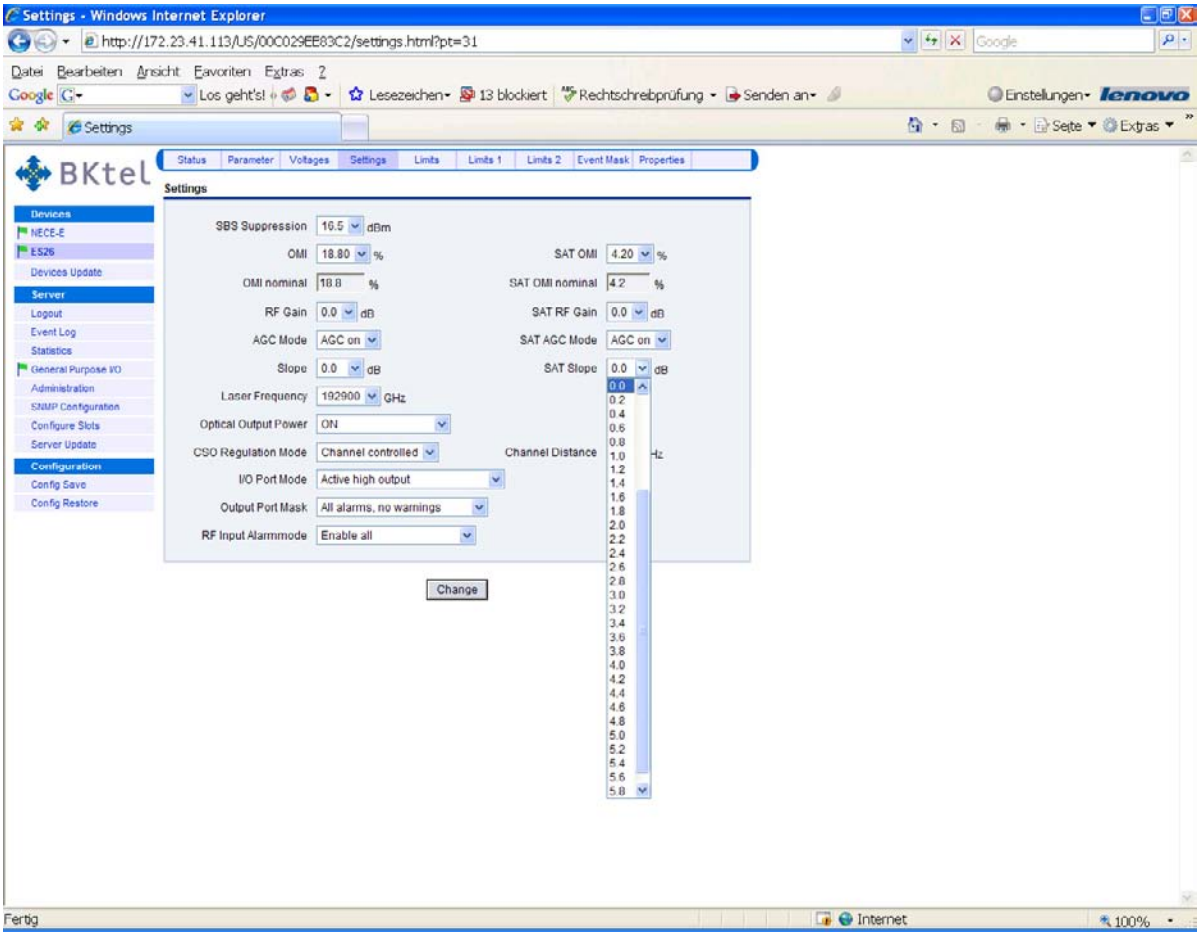


Fig. 7.13.1: Setting the SAT RF gain slope

7.14 Changing ITU Frequency

The figure below shows, how to change the ITU frequency (optical wavelength) of the transmitter in steps of 50 GHz up to +/- 100 GHz (not available for ES10L).

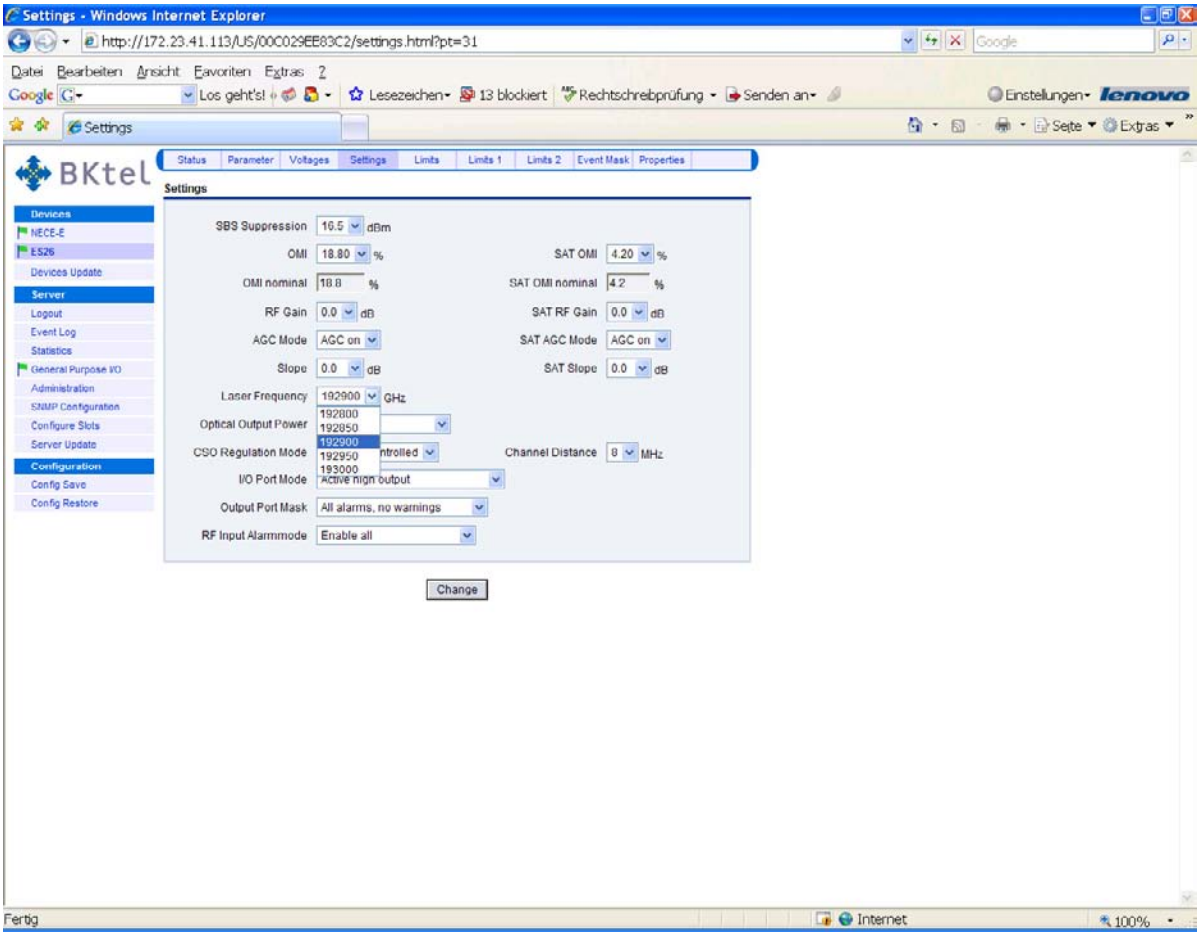


Fig. 7.14.1: Changing the ITU frequency of the transmitter ES10XL/ES26XL

7.15 Changing Optical Output Power Mode

There are 3 different output power modes available for the ES10/ES26 as shown in the picture below:

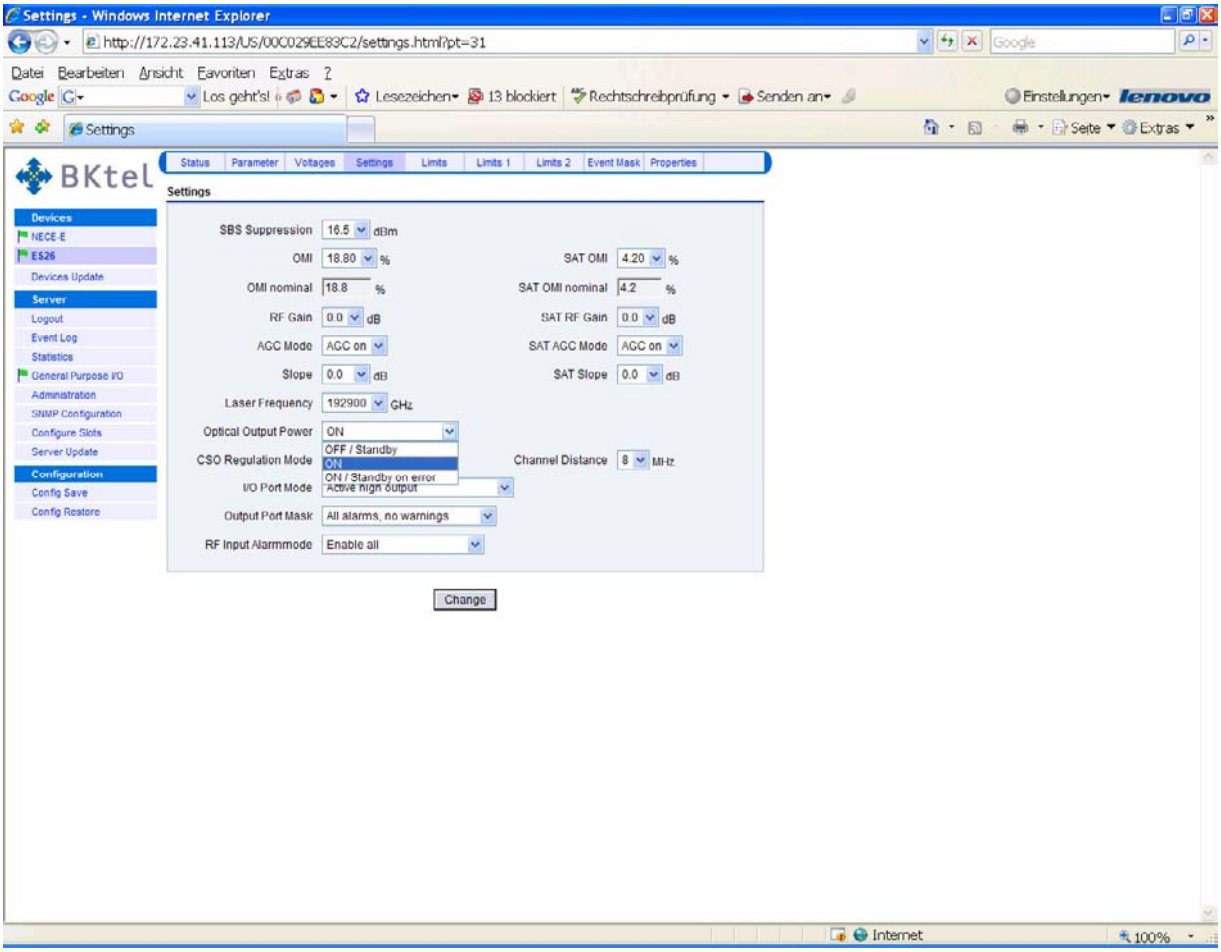


Fig. 7.15.1: Setting the optical output power mode of ES10/ES26

1. OFF / Standby. By selecting this mode the ES10/ES26 will operate with optical output power switched off. However, the laser temperature is still kept at the operating temperature by driving the peltier cooler enabling a fast switching-on time. Additionally the RF input monitor is operating. Note: In future software releases it is intended not to completely switch off the optical power but to decrease the optical power below a certain threshold (e.g. –3 dBm) in order to enable the supervision of the laser in standby mode and in order to enable the supervision of the fiber link between the ES10/ES26 and the subsequent EDFA or RX.
2. ON. The transmitter output power is always on **(default = factory setting)**.
3. ON / Standby on alarm. The transmitter output power is on, as long as there is no internal alarm. In case that an alarm condition occurs, the output power is switched into standby mode. This operating mode has been designed especially for redundant transmitter operation: If e.g. an RF input alarm occurs, the optical output power is switched to standby mode. This consequently should also disable the subsequent EDFA. If a pair of two ES10/ES26 with subsequent EDFA are intended to be used for redundant operation

(master/slave mode, ref. to 7.17) this feature will automatically switch from the master TX + EDFA to the slave TX + EDFA. In this case the I/O No. 0 ports of both ES10/ES26 have to be connected and the master/slave settings according to 7.17 have to be chosen. Note: The requirements for an alarm condition can be set by adjusting the alarms thresholds as explained in 7.18.

7.16 Changing Regulation Mode

The figure below shows, how to change the CSO regulation mode of the transmitter (not available for ES10L). For details please refer to 3.2.

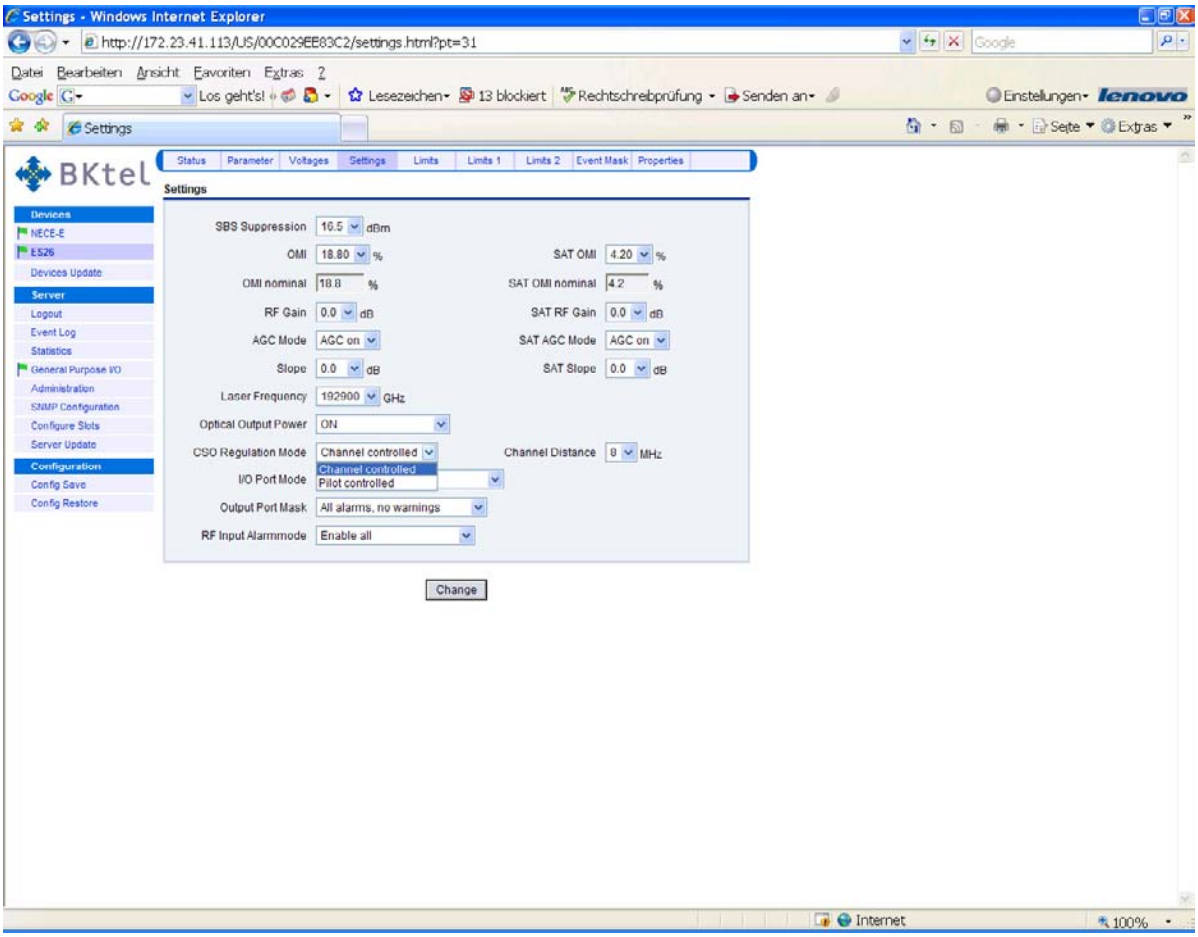


Fig. 7.16.1: Changing the CSO Regulation Mode of ES10/ES26

7.17 Changing I/O Port's Mode

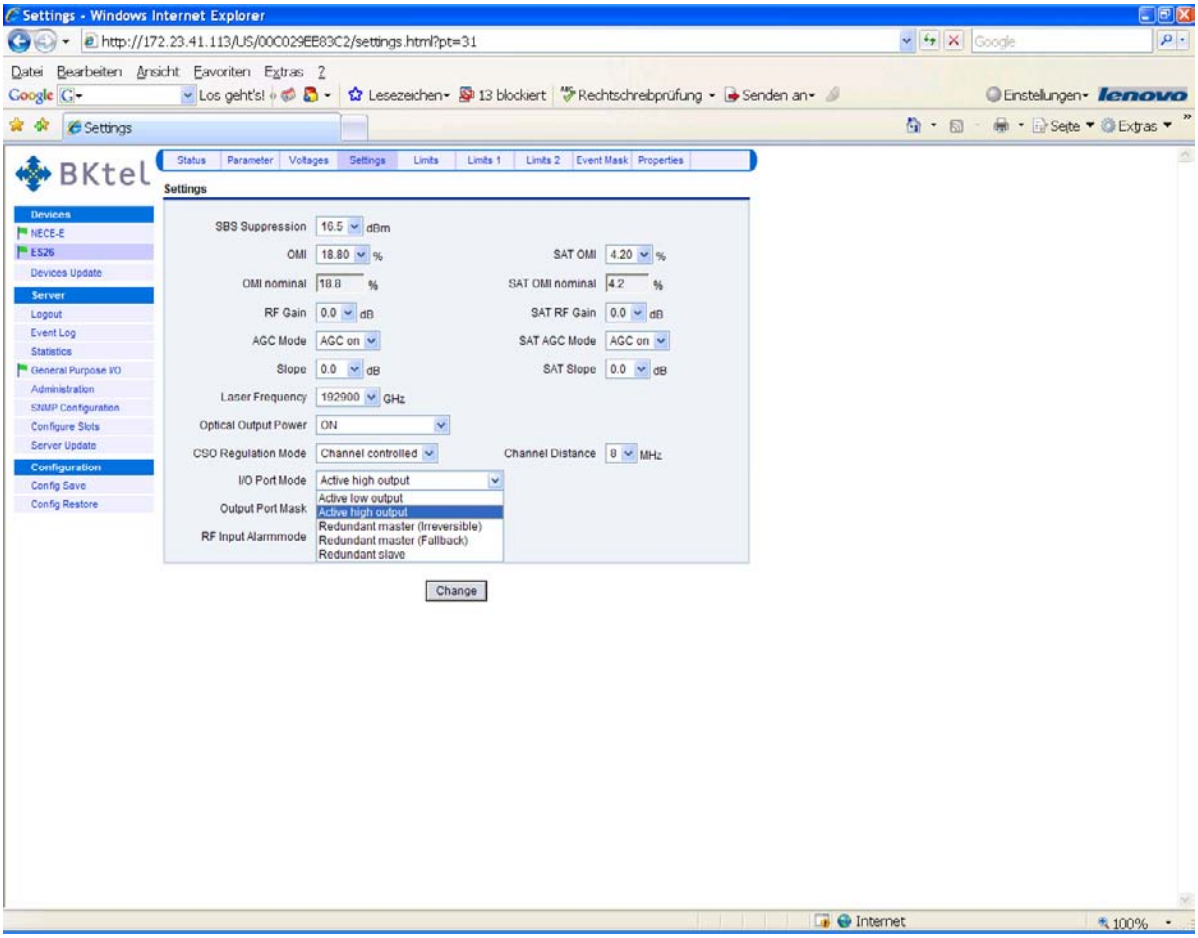


Fig. 7.17.1: Setting the I/O port mode of ES10/ES26

The I/O port No. 0 can be set either to be an output port, where 4 modes of operation are available:

- active low
- active high **(default = factory setting)**
- redundant master (irreversible) or
- redundant master (fallback)

or being an input port, which implies the redundant slave mode.

The table below shows the mode of operation and the impact on I/O port No. 0

Mode of operation	Description	I/O port No. 0
Active low	In case of any alarm, which arises in case any of the alarm thresholds has been reached or due toan internal error the I/O port becomes low.	Output, active low
Active high **(Default = factory setting)**	In case of any alarm, which arises in case any of the alarm thresholds has been reached or due to an internal error the I/O port becomes high.	Output, active high
Redundant master (irreversible)	In case of any alarm, which arises in case any of the alarm thresholds has been reached or due to an internal error the I/O port becomes high.In case the alarm condition disappears, the transmitter will remain in the alarm state until it is reset manually. This mode is implemented to prevent a frequent switching into active/stand-by mode of two redundant transmitters	Output, active high This port should be connected to the corresponding I/O port No. 0 of the redundant transmitter which is set into redundant slave mode.
Redundant master (fallback)	In case of any alarm, which arises in case any of the alarm thresholds has been reached or due to an internal error the I/O port becomes high.. In case the alarm condition disappears, the transmitter will go back into normal operation, which will set the connected redundant slave mode into stand-by operation.	Output, active high This port should be connected to the corresponding I/O port No. 0 of the redundant transmitter which is set into redundant slave mode.
Redundant slave	In case that the input port is low, the transmitter will go into stand-by operation. In case that the I/O port No. 0 (input) will become high, the transmitter will go into normal (nominal) mode.	Input, active high This port should be connected to the corresponding I/O No. 0 port of the redundant transmitter which is set into redundant master mode.

Note:

The alarm I/O port alarm mask determines whether

- only alarms <u>but no</u> warnings **(default = factory setting)** or
- alarms <u>and</u> warnings

trigger the I/O port No. 0 in output mode.

Application: Automatic redundancy switching of 2 ES10/ES26 located side by side:

- Connect a cable between the master and the slave ES10/ES26 connecting both I/O No. 0 ports and GND.
- Set the master ES10/ES26 in one of the two Redundant master modes
- Set the master ES10/ES26 I/O port mask to the desired mode. Set the slave ES10/ES26 into the Redundant Slave mode

Observance:

- As long as the master ES10/ES26 does not show any alarm, the slave ES10/ES26 should be sleeping (in stand-by operation), since the I/O port No. 0 level will be in low state.
- If the master alarm faces an alarm situation, it will set the I/O port No. 0 level to high state, therefore awakening the slave transmitter from sleeping (stand-by mode).
- If the cable between the master ES10/ES26 and the slave is cut or removed, the slave device will go from sleeping (stand-by) mode into normal operation due to the internal 100 kΩ pull-up resistor.
- If the power supply from the master ES10/ES26 is removed completely, the slave device will go from sleeping (stand-by) mode into normal operation immediately.

Note:

The slave transmitter might need up to 5 seconds to provide a high performance output signal, when starting from stand-by. For that reason, the master transmitter will after an alarm situation create an I/O port high signal to start the slave transmitter and will, however, operate in normal mode (as far as possible) for five seconds, until it switches into stand-by mode. The purpose of this method is to make the interruption of the signal as short as possible.

An overview of all alarm and warning flags, which can create an alarm or warning situation is given in chapter 7.22 and 7.23.

7.18 Setting an Alarm/Warning Mask for I/O Port #0

The ES10/ES26 allows setting an alarm/warning mask, which determines whether a warning or alarm is shown or suppressed on I/O port #0.

The menu is shown in the picture below.

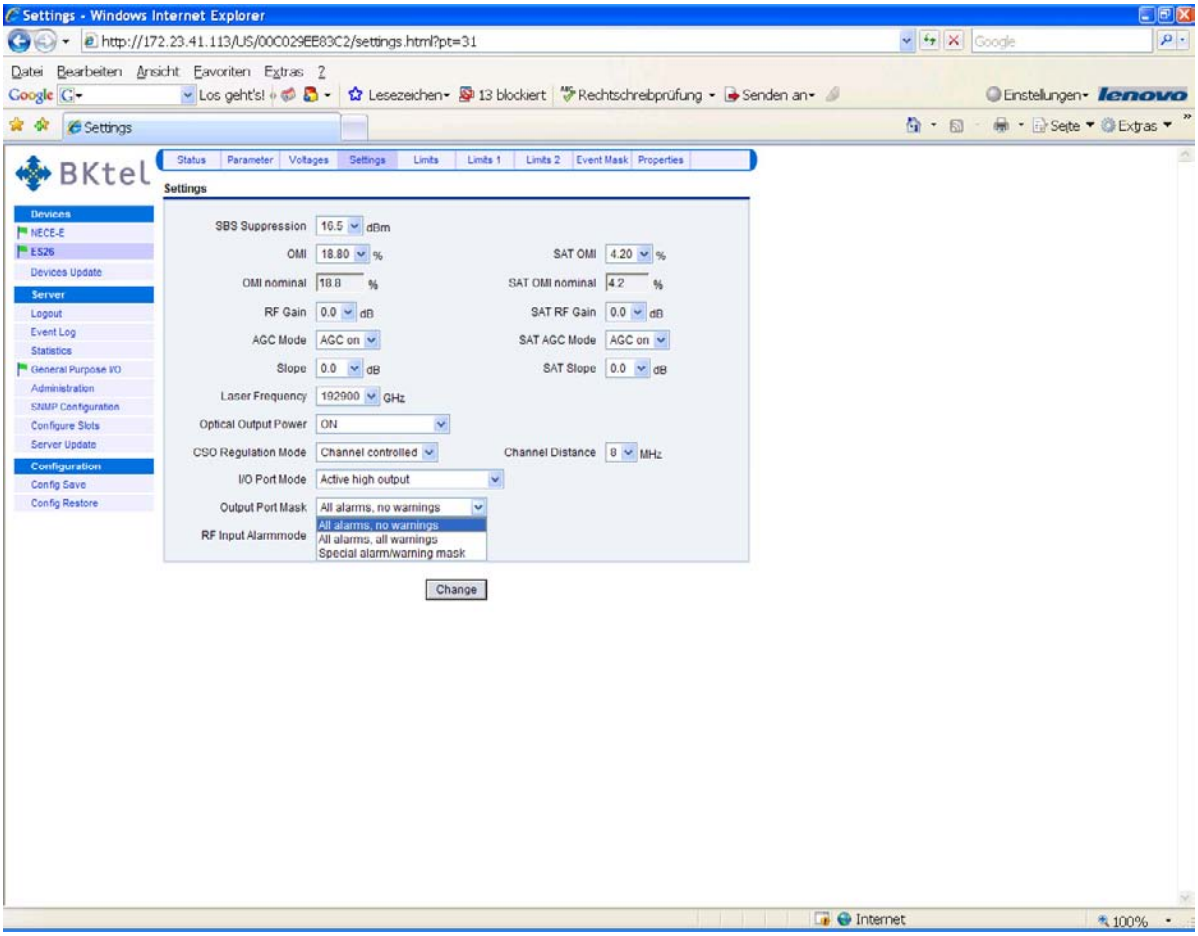


Fig. 7.18.1: Setting the alarm/warning mask for the output port of ES10/ES26

With this feature all warnings / alarms of the ES10/ES26 can be either enabled or disabled by the user in relation to the output #0 port. If the output mask is applied a notify message will be shown on the status menu screen.

7.19 Changing RF Input Alarm Mode

The figure below shows, how to change the RF input alarming mode of the transmitter (not available for ES10L).

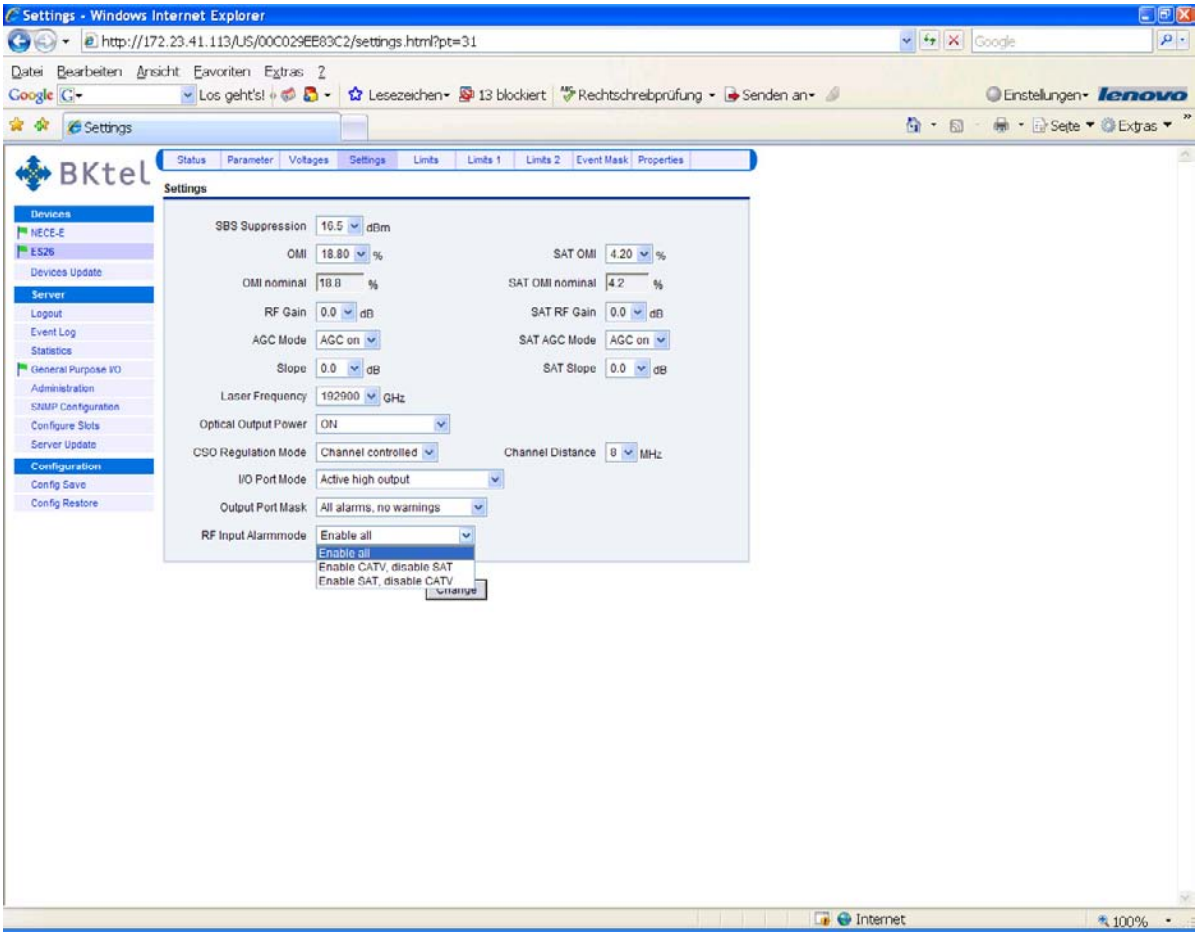


Fig. 7.19.1: Changing the RF Input Alarming Mode of ES10/ES26

7.20 Setting CATV Signal Channel Spacing

The ES10/ES26 provides a unique technology to minimize CSO distortions without requesting pilot tones. By setting the channel spacing to the correct value (ref. to 5.3.1) the CSO control loop will operate with utmost performance. The picture below shows how to set the channel spacing.

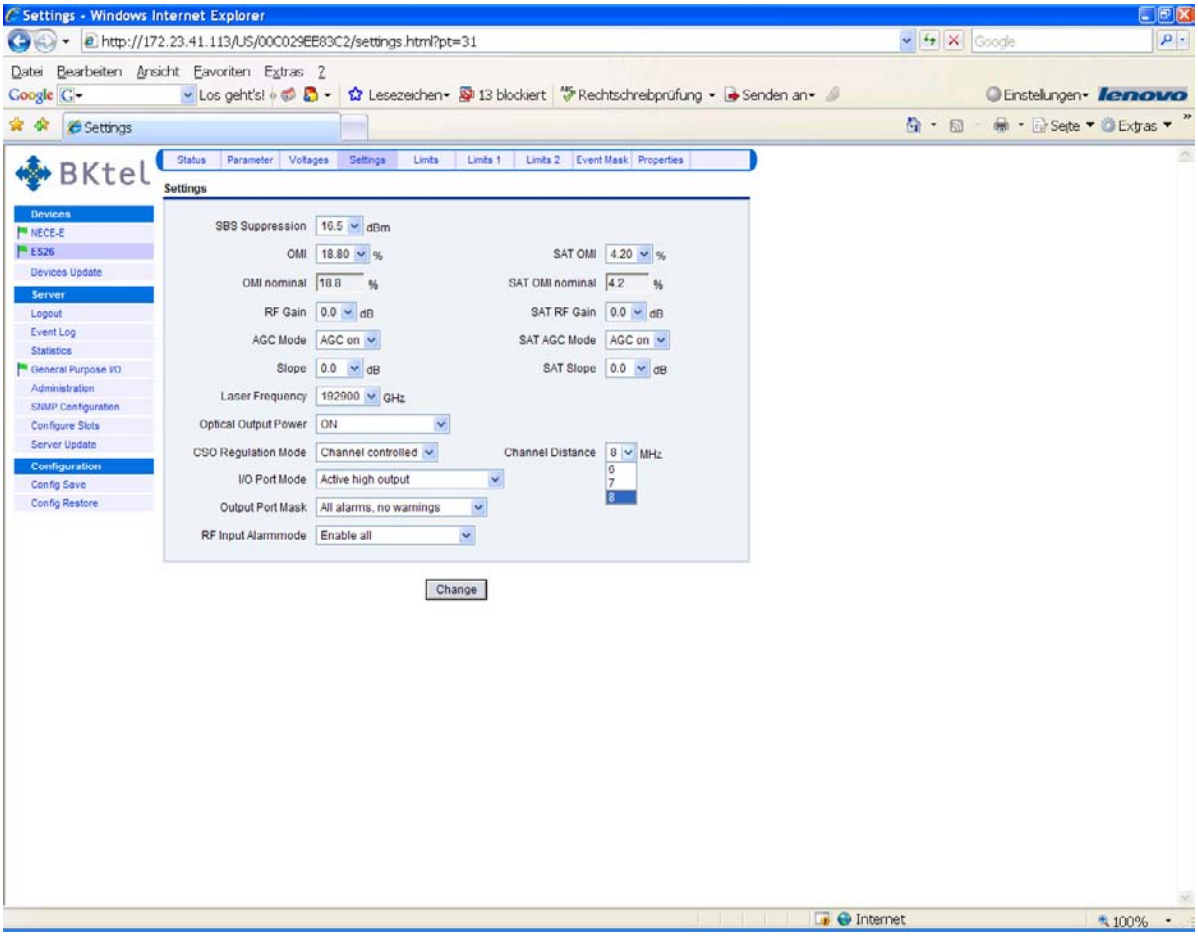


Fig. 7.20.1: Setting the channel spacing of ES10/ES26

NTSC channel plans in general provide a 6 MHz spacing; PAL-D and CENELEC channel plans in general show an 8 MHz spacing. In Europe also 7 MHz spacing is used in some channel plans.

7.21 Setting an Event Mask for Webserver and SNMP Interface

The ES10/ES26 allows setting an event mask, which determines whether a warning or alarm or a notification is shown or suppressed in the Webserver status screen as well as transmitted via the SNMP interface.

The menu is shown in the two following figures.

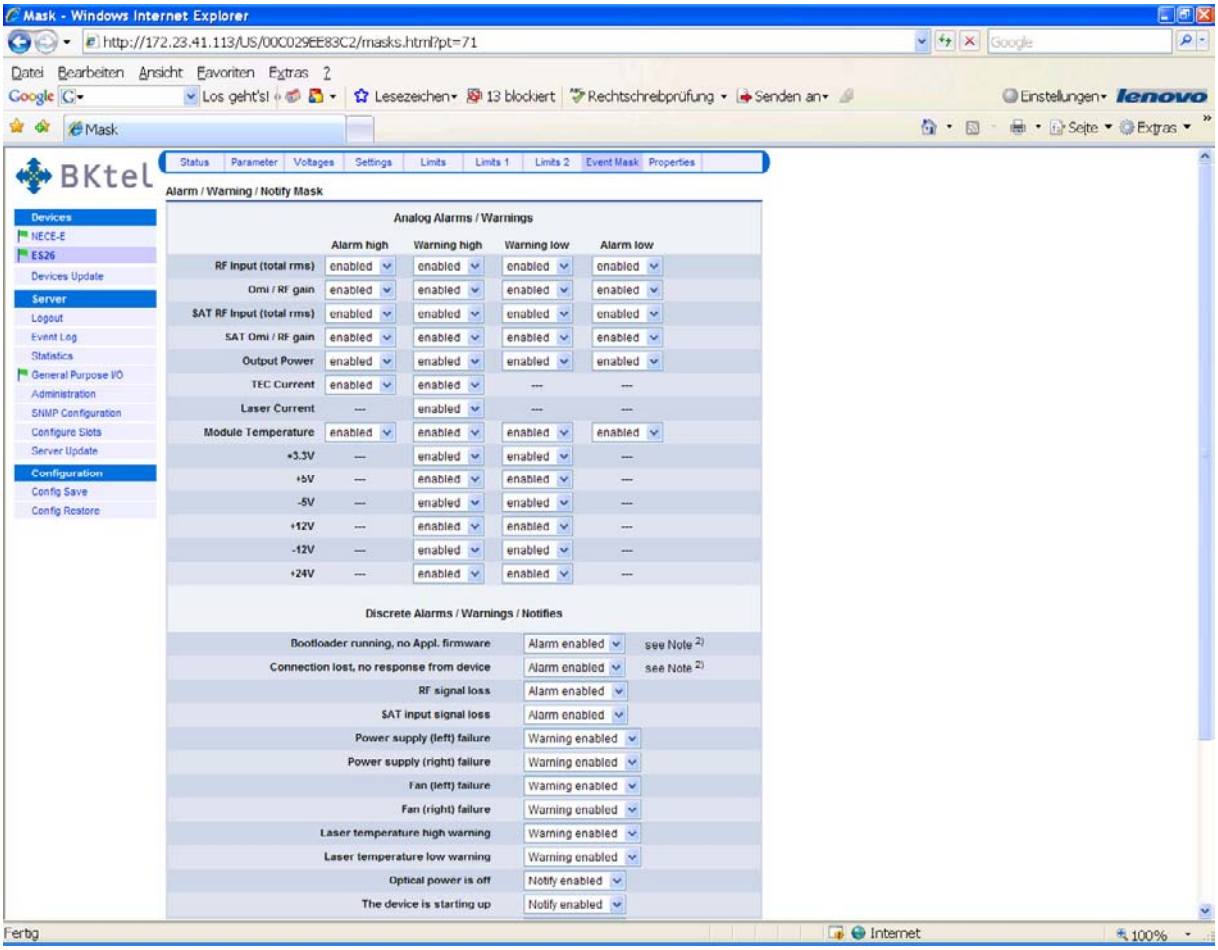


Fig. 7.21.1: Setting the event mask for the Webserver and SNMP interface of ES10/ES26

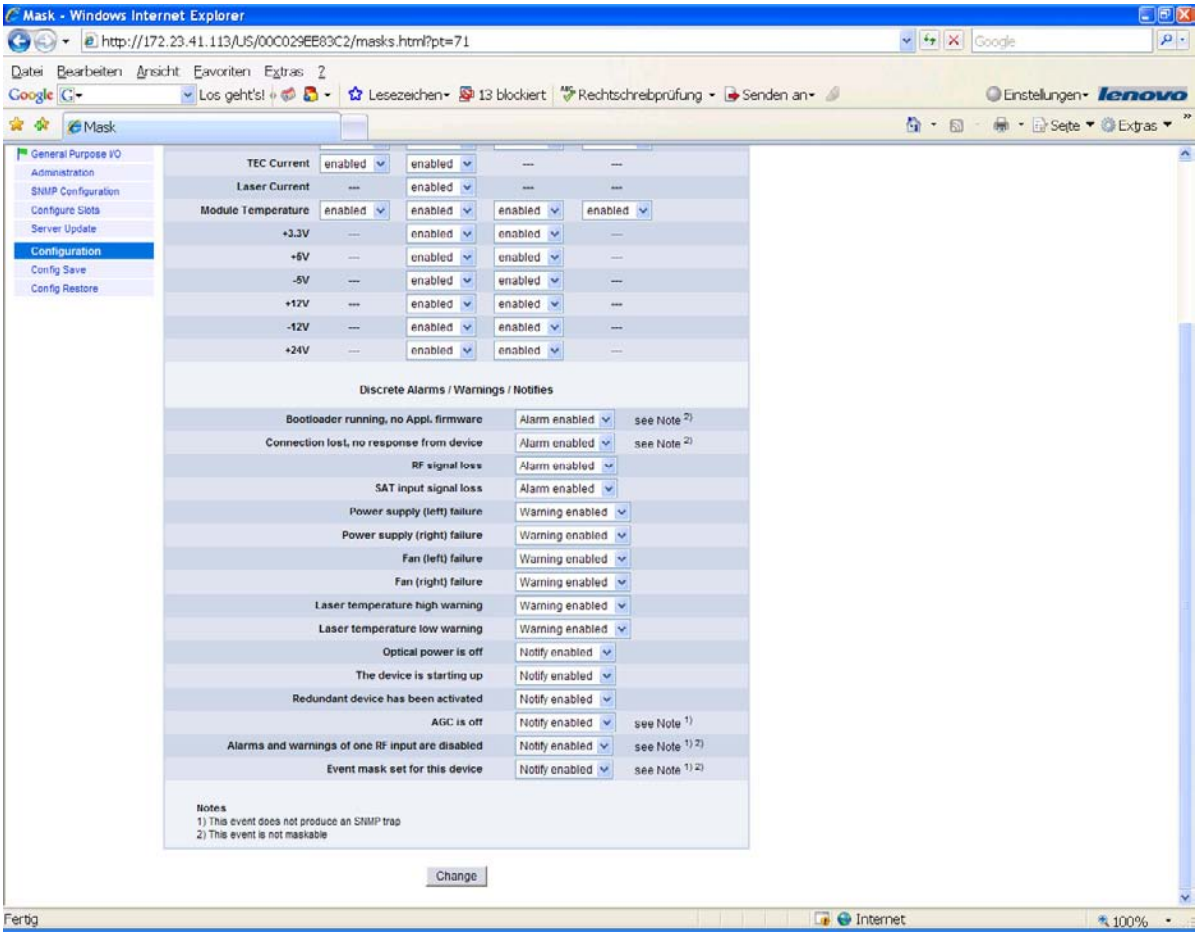


Fig. 7.21.2: Setting the event mask for the Webserver and SNMP interface of ES10/ES26

With this feature all warnings / alarms of the ES10/ES26 can be either enabled or disabled by the user in relation to the LEDs on the frontpanel, the Webserver status screen and SNMP interface. If the alarm/warning mask is applied a notify message will be shown on the status menu screen (ref. to 6.9).

7.22 Alarm Flags

Index	Flag	Description
0	TEC_HIGH_ALARM	Peltier current is higher than the alarm limit (> 100%), (Laser switched off)
1	**OUTPUT_PWR_LOW_ALARM**	Optical output power is lower than the alarm limit
2	**RF_INPUT_LOW_ALARM**	RF signal is lower than the alarm limit
3	**OUTPUT_PWR_HIGH_ALARM**	Optical output power is higher than the alarm limit
4	**RF_INPUT_HIGH_ALARM**	RF signal is higher than the alarm limit
5	**OMI_OR_RFGAIN_LOW_ALARM**	The calculated rf gain (if AGC on) or the calculated omi (if AGC off) is lower than the alarm limit
6	**OMI_OR_RFGAIN_HIGH_ALARM**	The calculated rf gain (AGC on) or the calculated omi (AGC off) is higher than the alarm limit
7	**RF_SIGNAL_LOSS**	IF RF INPUT LOW ALARM is disabled and RF signal is lower then typical -17 dBm (guaranteed: -16 dBm)
8	**SAT_RF_SIGNAL_LOSS**	SAT RF signal is lower then -12 dBm
...		
26	BOOTLOADER_RUNNING_NO_APPLICATION_FIRMWARE	No application firmware loaded, f. ex. After failed firmware update
27	CONNECTION_LOST_NO_RESPONSE_FROM_DEVICE	Device connected to the management bus of the NEC (RS485 bus) doesn't respond
28	MODULE_TEMP_LOW_ALARM	Module temperature is lower than the alarm limit (< 0 °C)
29	MODULE_TEMP_HIGH_ALARM	Module temperature is higher than the alarm limit (> 70°C)
30	RESERVED	Reserved for the NMS Controller (Do not use these bits)
31	RESERVED	Reserved for the NMS Controller (Do not use these bits)

Table 7.21: Situations triggering an alarm flag in the ES10/ES26; Flags in bold letters can be controlled via the limits menu (ref. to 7.24)

7.23 Warning Flags

Index	Flag	Description
0	**OUTPUT_PWR_LOW_WARNING**	Optical output power is lower than the warning limit
1	LASER_HIGH_WARNING	The laser current of one laser is higher than the warning limit (> 130%)
2	TEC_HIGH_WARNING	The peltier current of one laser is higher than the warning limit (< 90%)
3	**RF_INPUT_LOW_WARNING**	RF signal is lower than the warning limit
4	POWER_SUPPLY_WARNING	One of two power supplies fails (obsolete)
5	FAN_LEFT_WARNING	The left fan (looking from device's front side) fails (doesn't rotate)
6	FAN_RIGHT_WARNING	The right fan (looking from device's front side) fails (doesn't rotate)
7	**OUTPUT_PWR_HIGH_WARNING**	Optical output power is higher than the warning limit
8	**RF_INPUT_HIGH_WARNING**	RF signal is higher than the warning limit
...		
12	POWER_SUPPLY_LEFT_WARNING	The left power supplies (looking from device's front side) fails
13	POWER_SUPPLY_RIGHT_WARNING	The right power supplies (looking from device's front side) fails
14	**OMI_OR_RFGAIN_LOW_WARNING**	The calculated rf gain (if AGC on) or the calculated omi (if AGC off) is lower than the warning limit
15	**OMI_OR_RFGAIN_HIGH_WARNING**	The calculated rf gain (AGC on) or the calculated omi (AGC off) is higher than the warning limit
16	+3.3V_LOW_WARNING	Supply +3.3V is lower than the warning limit
17	+3.3V_HIGH_WARNING	Supply +3.3V is higher than the warning limit
18	+5V_LOW_WARNING	Supply +5V is lower than the warning limit
19	+5V_HIGH_WARNING	Supply +5V is higher than the warning limit
20	-5V_LOW_WARNING	Supply -5V is lower than the warning limit
21	-5V_HIGH_WARNING	Supply -5V is higher than the warning limit
22	+12V_LOW_WARNING	Supply +12V is lower than the warning limit
23	+12V_HIGH_WARNING	Supply +12V is higher than the warning limit
24	-12V_LOW_WARNING	Supply -12V is lower than the warning limit
25	-12V_HIGH_WARNING	Supply -12V is higher than the warning limit
26	+24V_LOW_WARNING	Supply +24V is lower than the warning limit
27	+24V_HIGH_WARNING	Supply +24V is higher than the warning limit
28	LASER_TEMP_DIFF_LOW_WARNING	Laser temperature difference from nominal value is lower than the warning limit (≥ 1°C below nominal value)
29	LASER_TEMP_DIFF_HIGH_WARNING	Laser temperature difference from nominal value is higher than the warning limit (≥ 1°C above nominal value)
30	MODULE_TEMP_LOW_WARNING	Module temperature is lower than the warning limit (< 5°C)
31	MODULE_TEMP_HIGH_WARNING	Module temperature is higher than the warning limit (> 65°C)

Table 7.21: Situations triggering a warning flag in the ES10/ES26; Flags in bold letters can be controlled via the limits menu (ref. to 7.24)

7.24 Limits Menus

The two limits menus of the ES10/ES26 determine, what deviations from the nominal values of some of the operating conditions of the transmitter lead to either warning or alarm messages. In order to avoid inadequate changes, some settings are factory settings only.

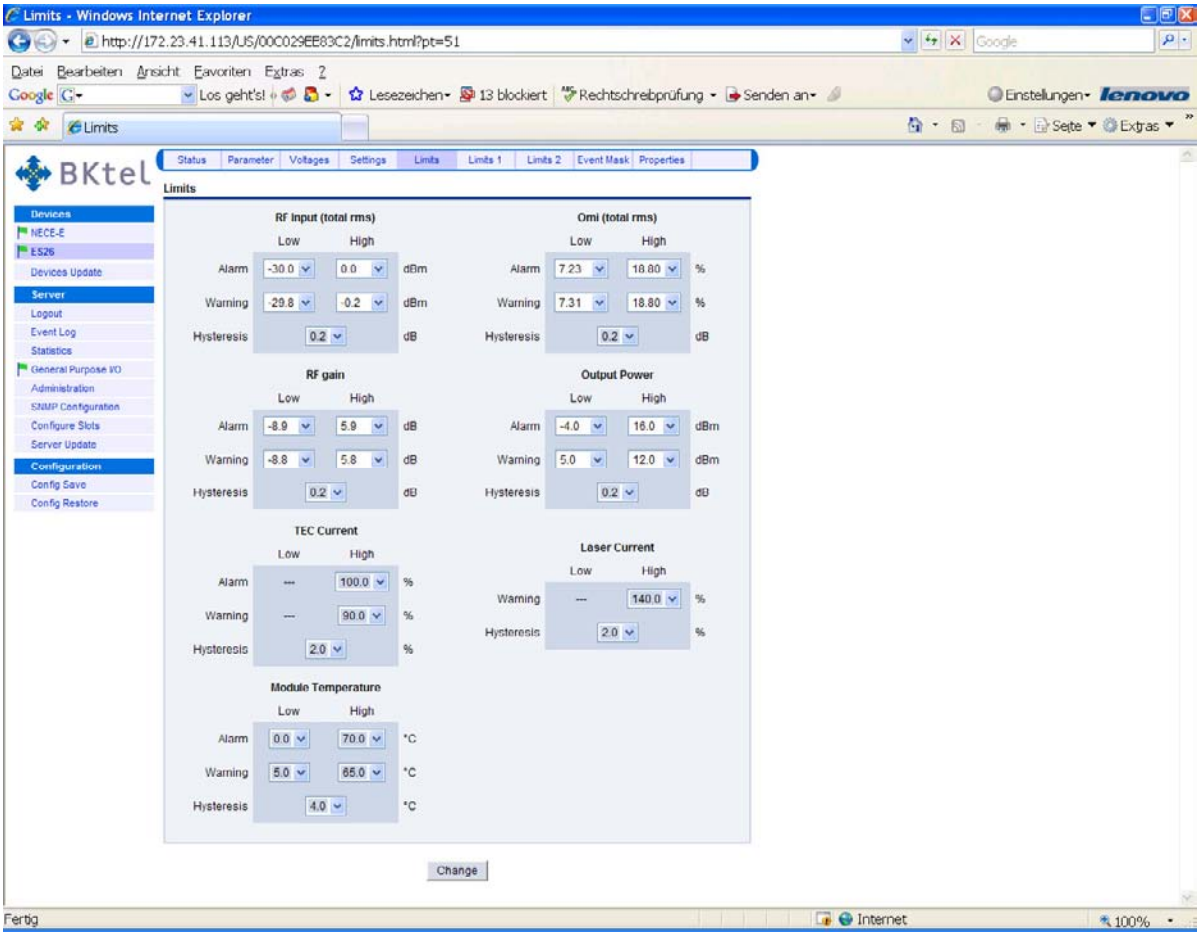


Fig. 7.24.1: Limits menu of ES10/ES26

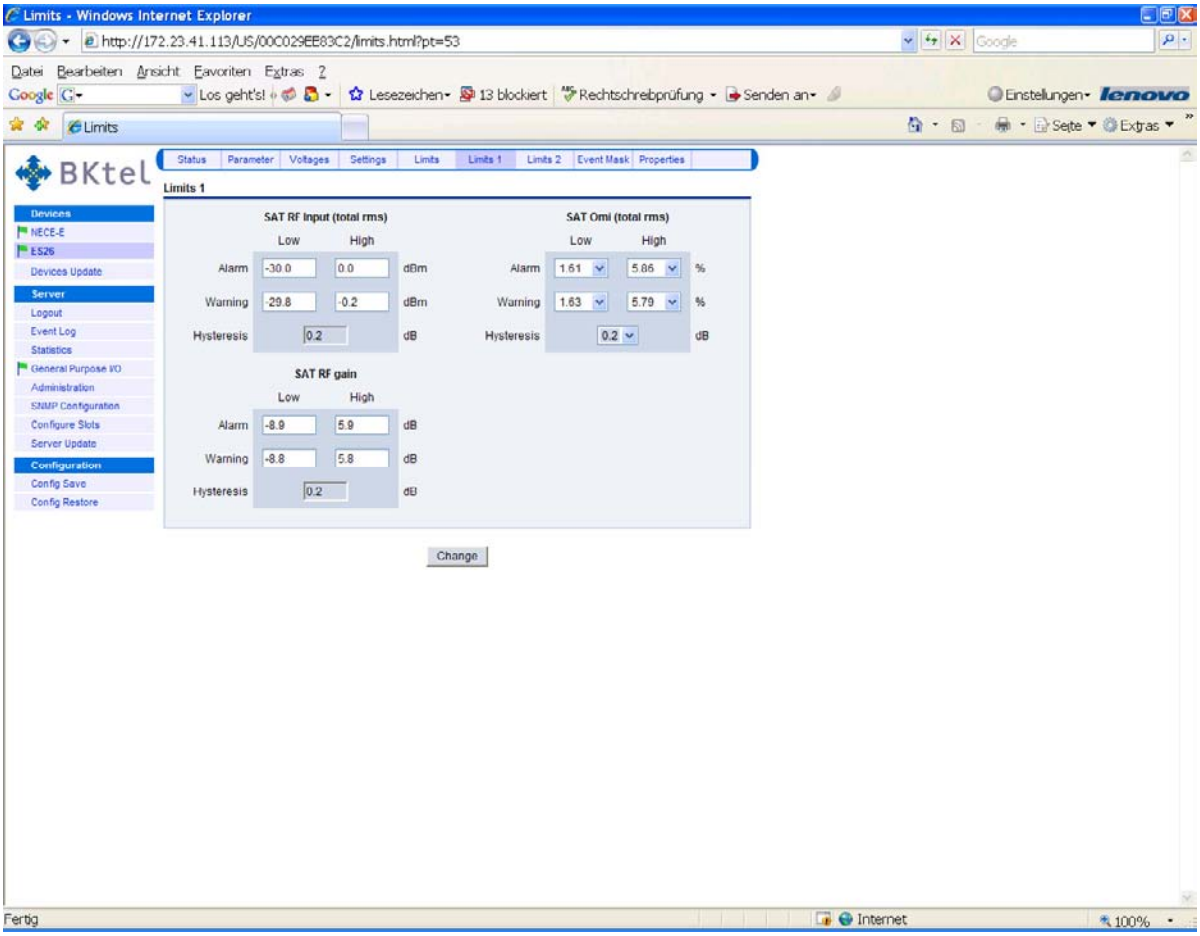


Fig. 7.24.2: Limits 1 menu (only ES26)

After successful log-in, the warning and alarm thresholds for the RF rms input level, OMI total rms, RF gain and optical output power can be set by the customer.

It is recommended to be very careful in setting the alarm thresholds in order to avoid meaningless alarms, e.g. due to temperature changes etc.. For the output power warning a range of at least +/- 1 dB is recommended.

Note:

The settings range for the alarms thresholds for RF input, RF gain and OMItotrms might change slightly from device to device due to production tolerances.

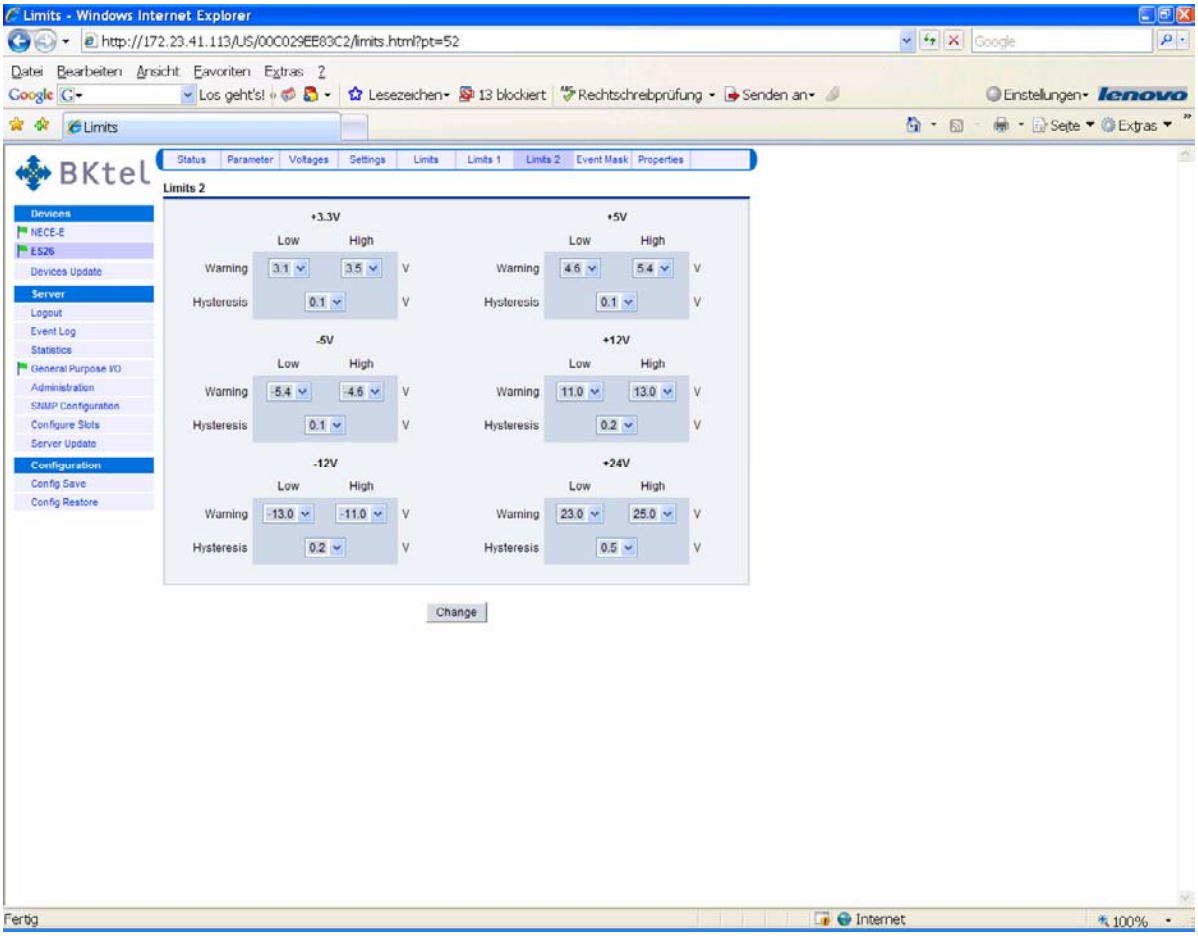


Fig. 7.24.3**:** Limits-2 menu of ES10/ES26

Note: All settings of the limits-2 menu are factory settings only.

7.25 Properties Menu

The properties menu of the ES10/ES26 provides on overview of the appearance of the transmitter such as hardware model, hardware release, serial number and the software releases. Optionally an aliasname and some user data may be edited. The aliasname occurs in the Devices tree of all Webbrowser displays as well as in the LCD.

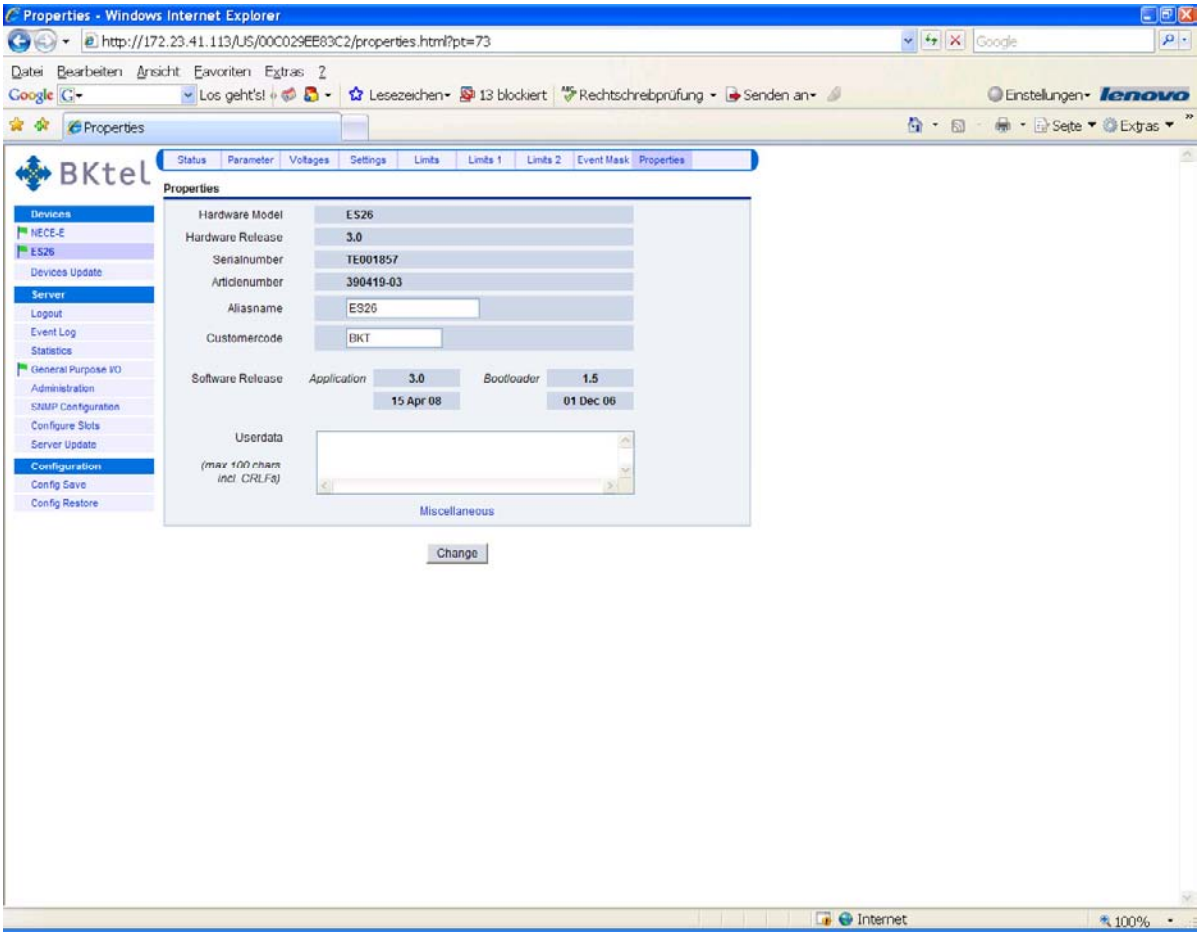


Fig. 7.25.1: Properties menu of ES10/ES26

The miscellaneous button can be used to request either a

- reset to factory settings and cold start
- reset of the transmitter (= cold start)

Note: Be very careful in executing these reset commands since they force cold start situation, where the transmitter might need about 30 seconds to get back to full performance properties.

8 CONTROLLING OTHER DEVICES WITH A NEC

One of the nice features of the ES10/ES26 transmitters with embedded SNMP-proxy-agent and Webserver (NEC) is, that also additional BKtel equipment can be managed or monitored through this circuitry either

- via the push-buttons / LCD field of the ES10/ES26
- the Webserver (HTTP)
- SNMP interface.

In order to use this function, additional BKtel equipment has to be connected to the RS485 (master) interface of the NEC by using a standard RJ-45 patch cable. All BKtel subracks (BBT001 … 003) provide two RJ-45 sockets located on the interface card on the right hand side of the subrack. Other BKtel 19”-1RU devices (EDFAs and optical switches) provide two RS485 slave interfaces on the rear side of the equipment. The two RS 485 interfaces are typically used for daisy chaining the RS485 interface bus.

There are some limitations to be considered for a proper functioning of the EMS-server:

1. Physical limitations: For the RJ-45 cable a CAT6 or better data cable is recommended. The length of the cable should be chosen as short as possible. A distance of 10 m should not be exceeded anyway.
2. General limitations: A maximum of 48 devices can be managed by one NEC.
3. In order to get a correct display of the “rackview” function of the NEC, there are 2 more limitations required:

- All devices to be managed by one NEC have to be positioned in one rack (and on one side of the rack if the rack is equipped with equipment from both sides).
- A maximum of four subracks can be used. The address of all subracks have to be set correctly by adjusting the decimal switches located on the interface panel of the subracks. Adress “1” has to be used for the upper subrack, the next following subrack will obtain address “2” and so on.

After powering up, the NEC will poll all equipment connected to the RS485 interface automatically. It might take up to about 2 minutes until all equipment have been identified. This is also true if equipment is removed or added during normal operation of the NEC.

9 MAINTENANCE

- Clean connector ends with a lint free tissue and alcohol before every mating.
- Loose screws fixing the optical connector plate
- Remove the connector from the connector bulkhead.
- Clean the connector ends with a lint-free tissue and alcohol.
- Reinstall the connector into the bulkhead ensuring that the cables/fiber´s are not stressed.
- **Caution: Do not extend the connector by more than 1 cm from the body of the ES10/ES26.**

10 TROUBLESHOOTING

To avoid problems with the ES10/ES26 and 1550 nm transmission there are some general rules which are important to follow.

- Use only carefully cleaned angled connectors like SC/APC, FC/APC, E2000 and similar ones for the whole transmission system between optical transmitter and receiver. A mix of angled and non angled connectors will result in high insertion loss, and a degradation of the CSO and CNR performance.
- Avoid bending losses of fiber optic cables. Since optical transmission on 1550 nm significantly more sensitive to bending losses it is very important to avoid narrow curvatures
- Use a proper levelled, flat RF-input signal. The flatness of the input signal (e.g. ± 1 dB) will directly result in the same variation of CNR, CSO and CTB (in this example: ± 1 dB).
- Be careful to understand all nonlinearities in optical fibers with 1550 nm transmission, long distances and high optical powers. CNR and CSO can easily degrade due to self phase modulation and Brillouin scattering. In doubts check the performance of the link by using an optical attenuator instead of using optical fiber to see whether the performance is limited due to impacts from the fiber.
- In case of technical questions please ask our sales representative.
- **Note: Since the transmitter is working internally with very high optical power and microwave signals it is not admitted to open the transmitter for personal safety and EMC reasons. Do not open the transmitter! In case of other than fan/power supply failures the transmitter has to be sent to BKtel for maintenance!**

11 RELEASES

11.1 ES10/ES26 Hardware Releases

11.1.1 Hardware Releases for ES10XL (a-versions)

Rel.	Date	Description
3.0	June 2008	First delivered release of optical transmitter ES10

11.1.2 Hardware Releases for ES10L/XL (b-versions)

Rel.	Date	Description
3.0	June 2008	First delivered release of optical transmitter ES10

11.1.3 Hardware Releases for ES26XL (a-versions)

Rel.	Date	Description
3.0	June 2008	First delivered release of optical transmitter ES26

11.1.4 Hardware Releases for ES26XL (b-versions)

Rel.	Date	Description
3.0	June 2008	First delivered release of optical transmitter ES26

11.2 ES10/ES26 Software Releases

11.2.1 Application Software Releases for ES10/26XL (a-versions)

Rel.	Date	Description
3.0	June 2008	First delivered release of optical transmitter ES10/ES26

11.2.2 Application Software Releases for ES10/ES26XL (b-versions)

Rel.	Date	Description
3.0	June 2008	First delivered release of optical transmitter ES10/ES26
3.1	July 2008	Start-up faster

11.2.3 Bootloader Software Releases for ES10/ES26

Rel.	Date	Description
1.5	June 2008	First delivered release of optical transmitter ES10/ES26

11.3 Network Element Controller Releases (ES10/ES26a Versions)

11.3.1 Hardware Releases for Embedded NEC (ESxa-versions)

Rel.	Date	Description
3.0	June 2008	First delivered release of optical transmitter ES10/ES26

11.3.2 NEC Application Software Releases for Embedded NEC (ESxa-versions)

Rel.	Date	Description
2.4	June 2008	First delivered release of optical transmitter ES10/ES26
2.4.2	Sep 2008	With Firefox 3 no file uploads were possible, bug in webserver fixed

11.3.3 NEC Bootloader Software Releases for Embedded NEC (ESxa-versions)

Rel.	Date	Description
1.7	June 2008	First delivered release of optical transmitter ES10/ES26