

BK Optical System

optical transmitters **BOTyyyZnn-ccc**

Introduction

The optical transmitter BOTyyyZnn-ccc represents a family of directly modulated 1310 and 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 and cable data signals. For the two optical wave-length-windows 1310 nm and 1550 nm, currently there are several variants available:

- BOT1310Snn optical transmitter equipped with un-cooled 1310 nm DFB laser; available output levels +3 dBm (BOT1310S03) and +6 dBm (BOT1310S06); mainly dedicated to return path applications.
- BOT1310Mnn high linear optical transmitter equipped with un-cooled 1310 nm DFB laser; available output levels +3 dBm (BOT1310M03) and +6 dBm (BOT1310M06); for broadband CATV downstream an upstream applications.
- BOT1310Xnn-ccc extreme linear analogue transmitter with cooled 1310 nm DFB laser; available output levels +8, +11, +13 and +15 dBm (BOT1310X08-ccc...BOT1310X15-ccc); for broadband CATV applications, calibrated for standard frequency plans (extension -ccc) such as Cenelec-42, NTSC-77, PAL-D 84 and BK-862.
- BOT1550Snn and BOTCWyySnn, optical transmitter equipped with un-cooled 1550 nm DFB laser; available output levels +3 dBm (BOT1550S03, BOTCWyyS03) and +6 dBm (BOT1550S06, BOTCWyyS06); CWDM wavelength-range between 1470 nm (BOTCW11Snn) and 1610 nm (BOTCW17Snn); mainly dedicated to return path applications.
- BOT1550Lnn-ccc and BOTDWyyLnn-ccc, high linear analogue transmitters with cooled 1550 nm DFB laser; available output levels +8 and +11 dBm (BOT1550L08-ccc...BOTDWyyL08-ccc...BOT1550L11-ccc..BOTDWyyL11-ccc); for narrowcast downstream or upstream applications, with a nominal operating wavelength of 1550 nm or DWDM wavelengths in the 1550 nm window. All of these variants can be calibrated for standard frequency plans (extension -ccc) such as Cenelec-42, NTSC-77, PAL-D 84 and BK-862.

All BOTyyyZnn-ccc are equipped with state of the art electronic circuitry supporting fully electronically (no mechanical) adjustments. Each transmitter has two RF inputs, allowing easily combining of broadcast (BC) and narrow-cast (NC) signals. One input test-point (TP1) allowing measuring and supervising of the RF input signals.

Additionally a laser driver test-point (TP2) is available, enabling measuring:

- the DC output power of the transmitter;
- the total optical RMS modulation index (OMI_{totrms}).

Future proof operation is accomplished due to the possibility of downloading updates of the transmitter firmware using the RS-485 element management system interface.

There are several options of optical connectors such as SC/APC, FC/APC and E2000 available.

The optical transmitter comes in a modular BK-type housing to be mounted either on BK-sub-rack of type BBT00x or BK outdoor housing of type ODH006 and ODH012.



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Product line:

Type	Wavelength	Laser Type	Output Power	Application
BOT1310S03 BOT1310S06	1310 nm	Un-cooled Laser, Standard	+3 dBm +6 dBm	NC, RET
BOT1310M03 BOT1310M06	1310 nm	Un-cooled Laser, Extended standard	+3 dBm +6 dBm	BC, NC, RET
BOT1310X08 BOT1310X11 BOT1310X13 BOT1310X15	1310 nm	Cooled Laser, Extreme Linear	+8 dBm +11 dBm +13 dBm +15 dBm	BC, NC
BOT1550S03 BOT1550S06	1550 nm	Un-cooled Laser, Standard	+3 dBm +6 dBm	RET
BOT1550L08 BOT1550L11	1550 nm	Cooled Laser, High Linear	+8 dBm +11 dBm	NC
BOTCW11S03 BOTCW11S06	1470 nm	CWDM un-cooled, Standard	+3 dBm +6 dBm	RET-CWDM
...				
BOTCW18S03 BOTCW18S06	1610 nm	CWDM un-cooled, Standard	+3 dBm +6 dBm	RET-CWDM
BOTDW23L08 BOTDW23L11	1558.98 nm	DWDM, cooled, High Linear	+8 dBm +11 dBm	NC-DWDM, RET- DWDM
...				
BOTDW37L08 BOTDW37L11	1547.72 nm	DWDM, cooled, High Linear	+8 dBm +11 dBm	NC-DWDM, RET- DWDM

The extension -ccc (in BOTyyyZnn-ccc) specifies the frequency plan such us

- C42 for CENELEC42
- D84 for PAL-D84
- N77 for NTSC77
- B47 for Optolink (T Systems)
- B50 for BK upgrade (ISH)

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Optical Transmitter for 1310 nm

Application

- Electrical to optical conversion of QAM signals on standard single mode fibers (CCITT rec. G652)
- upstream transmission in HFC networks

Features

- un-cooled DFB laser with optical isolator
- enhanced performance
- high reliability design
- incl. pre-amplifier with automatic load control
- RS 485 interface for electronically adjustment of slope, gain, output power and OMI
- BK modular technique, 3 multi-color LED display

Model Number		BOT1310S3	BOT1310S6
Typical performance data			
Optical Output Power	[dBm]	3	6
Optical power tolerance	[dB]	±1	±1
Optical power adjustment range	[dB]	0..-3	0..-3
Optical Wavelength	[nm]	1310 ±20	1310 ±20
Optical Connector		any HRL type	any HRL type
Optical Return Loss	[dB]	>35	>35
Side Mode Suppression	[dB]	>30	>30
Laser output level test-point	[V/mW]	0.1 ±0.02	0.1 ±0.02
Optical Modulation Index	[%]	4	4
RIN	[dBc/Hz]	-145	-145
RF bandwidth	[MHz]	5..450	5..450
Flatness 7..450 / 5..7 MHz	[dB]	±0.75/±1,5	±0.75/±1,5
RF Input level/channel (OMI=4%)	[dBμV]	80	80
RF high level input (OMI=4%)	[dBμV]	93	93
RF level adjustment range	[dB]	0...24	0...24
RF slope adjustment range	[dB]	-2..+16	-2..+16
IM2 (2 carriers, OMI=10%)	[dBc]	-45	-45
IM3 (2 carriers, OMI=10%)	[dBc]	-50	-50
Measurement test-point	[dB]	-20, ±1	-20, ±1
RF Input impedance	[ohm]	75	75
RF Return loss (-1.5 dB/oct.)	[dB]	20 at 47 MHz	20 at 47 MHz
Supply Voltage	[VDC]	24	24
Power consumption /stand-by	[W]	<12 / <4	<12 / <4
Operating Temperature Range	[°C]	-10 ... +55	-10 ... +55
Operational lifetime	[Year]	19,5	19,5
MTBF	[FIT]	5900	5900
Size	[BK]	1	1

Also available:	Output level	Remarks

BK Optical System

optical transmitters **BOTyyyZnn-ccc**



Optical Transmitter for 1310 nm

Application

- Electrical to optical conversion of CATV signals on standard single mode fibers (CCITT rec. G652)
- Downstream or upstream transmission in HFC networks

Features

- un-cooled DFB laser with optical isolator
- enhanced performance
- high reliability design
- incl. pre-amplifier with automatic load control
- RS 485 interface for electronically adjustment of slope, gain, output power and OMI
- BK modular technique, 3 multi-color LED display

Model Number		BOT1310M3	BOT1310M6
Typical performance data			
Optical Output Power	[dBm]	3	6
Optical power tolerance	[dB]	-1..+2	-1..+2
Optical power adjustment range	[dB]	0..-3	0..-3
Optical Wavelength	[nm]	1310 ±20	1310 ±20
Optical Connector		any HRL type	any HRL type
Optical Return Loss	[dB]	>35	>35
Side Mode Suppression	[dB]	>30	>30
Laser output level test-point	[V/mW]	0.1 ±0.02	0.1 ±0.02
Optical Modulation Index	[%]	4	4
RIN	[dBc/Hz]	-151	-151
RF bandwidth	[MHz]	5..862/1000	5..862/1000
Flatness 5..862 / 5..1000 MHz	[dB]	±0.75/±1,5	±0.75/±1,5
RF Input level/channel (OMI=4%)	[dBμV]	80	80
RF high level input (OMI=4%)	[dBμV]	93	93
RF level adjustment range	[dB]	0...24	0...24
RF slope adjustment range	[dB]	-3..+16	-3..+16
CSO (CENELEC 42)	[dBc]	-60	-60
CTB (CENELEC 42)	[dBc]	-63	-62
Measurement test-point	[dB]	-20, ±1	-20, ±1
RF Input impedance	[ohm]	75	75
RF Return loss (-1.5 dB/oct.)	[dB]	20 at 47 MHz	20 at 47 MHz
Supply Voltage	[VDC]	24	24
Power consumption /stand-by	[W]	<12 / <4	<12 / <4
Operating Temperature Range	[°C]	-10 ... +55	-10 ... +55
Operational lifetime	[Year]	19,5	19,5
MTBF	[FIT]	5900	5900
Size	[BK]	1	1

Also available:	Output level	Remarks

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optical transmitters **BOTyyyZnn-ccc**

Optical Transmitter for 1310 nm



Application

- Electrical to optical conversion of CATV signals on standard single mode fibers (CCITT rec. G652)
- downstream or upstream transmission in HFC networks

Features

- DFB laser with optical isolator
- thermoelectric cooler
- enhanced performance
- high reliability design
- incl. pre-amplifier with automatic load control
- RS 485 interface for electronically adjustment of slope, gain, output power and OMI
- BK modular technique, 3 multi-color LED display

Model Number		BOT1310X11	BOT1310X13
Typical performance data			
Optical Output Power	[dBm]	11	13
Optical power tolerance	[dB]	±0.5	±0.5
Optical power adjustment range	[dB]	0..-3	0..-3
Optical Wavelength	[nm]	1310 ±20	1310 ±20
Optical Connector		any HRL type	any HRL type
Optical Return Loss	[dB]	>45	>45
Side Mode Suppression	[dB]	>30	>30
Laser output level test-point	[V/mW]	0.1 ±0.02	0.1 ±0.02
Optical Modulation Index	[%]	4	4
RIN	[dBc/Hz]	-157	-157
RF bandwidth	[MHz]	5..1000	5..1000
Flatness 7..862 / 5-1000 MHz	[dB]	±0.75/±1,5	±0.75/±1,5
RF Input level/channel (OMI=4%)	[dBμV]	80	80
RF high level input (OMI=4%)	[dBμV]	93	93
RF level adjustment range	[dB]	0...24	0...24
RF slope adjustment range	[dB]	-2..+16	-2..+16
CSO (CENELEC 42)	[dBc]	66	66
CTB (CENELEC 42)	[dBc]	66	66
CXM (CENELEC 42)	[dBc]	70	70
Measurement test-point	[dB]	-20, ±1	-20, ±1
RF Input impedance	[ohm]	75	75
RF Return loss (-1.5 dB/oct.)	[dB]	20 at 47 MHz	20 at 47 MHz
Supply Voltage	[VDC]	24	24
Power consumption /stand-by	[W]	<12 / <4	<12 / <4
Operating Temperature Range	[°C]	-10 ... +55	-10 ... +55
Operational lifetime	[Year]	19,5	19,5
MTBF	[FIT]	5900	5900
Size	[BK]	1	1

Also available:	Output level	Remarks
BOT1310X8	8 dBm	E2000 or SC/APC 8°
BOT1310X15	15 dBm	E2000 or SC/APC 8°

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optical transmitters **BOTyyyZnn-ccc**

Optical Transmitter for 1550 nm



Application

- Electrical to optical conversion of CATV signals on standard single mode fibers (CCITT rec. G652)
- downstream or upstream transmission in HFC networks

Features

- DFB laser with optical isolator
- thermoelectric cooler
- enhanced performance
- high reliability design
- incl. pre-amplifier with automatic load control
- RS 485 interface for electronically adjustment of slope, gain, output power, OMI and pre-chirping
- BK modular technique, 3 multi-color LED display

Model Number		BOT1550L8	BOT1550L11
Typical performance data			
Optical Output Power	[dBm]	8	11
Optical power tolerance	[dB]	±0.5	±0.5
Optical power adjustment range	[dB]	0..-3	0..-3
Optical Wavelength	[nm]	1550 ±20	1550 ±20
Optical Connector		any HRL type	any HRL type
Optical Return Loss	[dB]	>45	>45
Side Mode Suppression	[dB]	>30	>30
Laser output level test-point	[V/mW]	0.1 ±0.02	0.1 ±0.02
Optical Modulation Index	[%]	4	4
RIN	[dBc/Hz]	-156	-156
RF bandwidth	[MHz]	5..1000	5..1000
Flatness 7..862 / 5-1000 MHz	[dB]	±0.75/±1,5	±0.75/±1,5
RF Input level/channel (OMI=4%)	[dBμV]	80	80*
RF high level input (OMI=4%)	[dBμV]	93	93
RF level adjustment range	[dB]	0...24	0...24
RF slope adjustment range	[dB]	-2..+16	-2..+16
CSO (CENELEC 42)	[dBc]	66	66
CTB (CENELEC 42)	[dBc]	66	66
CXM (CENELEC 42)	[dBc]	70	70
Measurement test-point	[dB]	-20, ±1	-20, ±1
RF Input impedance	[ohm]	75	75
RF Return loss (-1.5 dB/oct.)	[dB]	20 at 47 MHz	20 at 47 MHz
Supply Voltage	[VDC]	24	24
Power consumption /stand-by	[W]	<12 / <4	<12 / <4
Operating Temperature Range	[°C]	-10 ... +55	-10 ... +55
Operational lifetime	[Year]	19,5	19,5
MTBF	[FIT]	5900	5900
Size	[BK]	1	1

Remarks

* early version BOT1550X11 requires 80 dBμV for **5%** OMI.

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optical transmitters **BOTyyyZnn-ccc**



Optical CWDM Transmitter for 1550 nm

Application

- Electrical to optical conversion of QAM signals on standard single mode fibers (CCITT rec. G652)
- CWDM upstream transmission in HFC networks

Features

- un-cooled DFB laser with optical isolator
- enhanced performance
- high reliability design
- incl. pre-amplifier with automatic load control
- RS 485 interface for electronically adjustment of slope, gain, output power and OMI
- BK modular technique, 3 multi-color LED display

Model Number		BOTCWyyS3	BOTCWyyS6
Typical performance data			
Optical Output Power	[dBm]	3	6
Optical power tolerance	[dB]	±1	±1
Optical power adjustment range	[dB]	0..-3	0..-3
Optical Wavelength	[nm]	1470..1610 ±3	1470..1610 ±3
Optical Connector		any HRL type	any HRL type
Optical Return Loss	[dB]	>35	>35
Side Mode Suppression	[dB]	>30	>30
Laser output level test-point	[V/mW]	0.1 ±0.02	0.1 ±0.02
Optical Modulation Index	[%]	4	4
RIN	[dBc/Hz]	-145	-145
RF bandwidth	[MHz]	5..450	5..450
Flatness 7..450 / 5..7 MHz	[dB]	±0.75/±1,5	±0.75/±1,5
RF Input level/channel (OMI=4%)	[dBμV]	80	80
RF high level input (OMI=4%)	[dBμV]	93	93
RF level adjustment range	[dB]	0...24	0...24
RF slope adjustment range	[dB]	-2..+16	-2..+16
IM2 (2 carriers, OMI=10%)	[dBc]	-45	-45
IM3 (2 carriers, OMI=10%)	[dBc]	-50	-50
Measurement test-point	[dB]	-20, ±1	-20, ±1
RF Input impedance	[ohm]	75	75
RF Return loss (-1.5 dB/oct.)	[dB]	20 at 47 MHz	20 at 47 MHz
Supply Voltage	[VDC]	24	24
Power consumption /stand-by	[W]	<12 / <4	<12 / <4
Operating Temperature Range	[°C]	-10 ... +55	-10 ... +55
Operational lifetime	[Year]	19,5	19,5
MTBF	[FIT]	5900	5900
Size	[BK]	1	1

Remarks

CWDM wavelengths (yy) 1470, 1490, 1510, 1550, 1570, 1590, 1610 nm

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optical transmitters **BOTyyyZnn-ccc**

Optical DWDM Transmitter for 1550 nm



Application

- Electrical to optical conversion of narrowcast QAM signals on standard single mode fibers (CCITT rec. G652)
- DWDM downstream or upstream transmission in HFC networks

Features

- DFB laser with optical isolator
- thermoelectric cooler
- enhanced performance
- high reliability design
- incl. pre-amplifier with automatic load control
- RS 485 interface for electronically adjustment of slope, gain, output power, OMI and pre-chirping
- BK modular technique, 3 multi-color LED display

Model Number		BOTDWyyL8	BOTDWyyL11
Typical performance data			
Optical Output Power	[dBm]	8	11
Optical power tolerance	[dB]	±0.5	±0.5
Optical power adjustment range	[dB]	0..-3	0..-3
Optical Wavelength	[nm]	1550, ITU channel	1550, ITU channel
Optical Connector		any HRL type	any HRL type
Optical Return Loss	[dB]	>45	>45
Side Mode Suppression	[dB]	>30	>30
Laser output level test-point	[V/mW]	0.1 ±0.02	0.1 ±0.02
Optical Modulation Index	[%]	4	4
RIN	[dBc/Hz]	-156	-156
RF bandwidth	[MHz]	5..1000	5..1000
Flatness 7..862 / 5-1000 MHz	[dB]	±0.75/±1,5	±0.75/±1,5
RF Input level/channel (OMI=4%)	[dBμV]	80	80
RF high level input (OMI=4%)	[dBμV]	93	93
RF level adjustment range	[dB]	0...24	0...24
RF slope adjustment range	[dB]	-2..+16	-2..+16
CSO (CENELEC 42)	[dBc]	66	66
CTB (CENELEC 42)	[dBc]	66	66
CXM (CENELEC 42)	[dBc]	70	70
Measurement test-point	[dB]	-20, ±1	-20, ±1
RF Input impedance	[ohm]	75	75
RF Return loss (-1.5 dB/oct.)	[dB]	20 at 47 MHz	20 at 47 MHz
Supply Voltage	[VDC]	24	24
Power consumption /stand-by	[W]	<12 / <4	<12 / <4
Operating Temperature Range	[°C]	-10 ... +55	-10 ... +55
Operational lifetime	[Year]	19,5	19,5
MTBF	[FIT]	5900	5900
Size	[BK]	1	1

Remarks

DWDM wavelengths (yy) ITU channel, ±100 GHz software adjustable

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Wavelength declaration (yyyy) is based on wavelength or ITU grid channel number.

ITU Channel Number	DWDM Frequency	DWDM Wavelength
21	192.100 THz	1560.61 nm
22	192.200 THz	1559.79 nm
23	192.300 THz	1558.98 nm
24	192.400 THz	1558.17 nm
25	192.500 THz	1557.36 nm
26	192.600 THz	1556.55 nm
27	192.700 THz	1555.75 nm
28	192.800 THz	1554.94 nm
29	192.900 THz	1554.13 nm
30	193.000 THz	1553.33 nm
31	193.100 THz	1552.52 nm
32	193.200 THz	1551.72 nm
33	193.300 THz	1550.92 nm
34	193.400 THz	1550.12 nm
35	193.500 THz	1549.32 nm
36	193.600 THz	1548.51 nm
37	193.700 THz	1547.72 nm
38	193.800 THz	1546.92 nm
39	193.900 THz	1546.12 nm
40	194.000 THz	1545.32 nm
41	194.100 THz	1544.53 nm
42	194.200 THz	1543.73 nm
43	194.300 THz	1542.94 nm
44	194.400 THz	1542.14 nm
45	194.500 THz	1541.35 nm
46	194.600 THz	1540.56 nm
47	194.700 THz	1539.77 nm
48	194.800 THz	1538.98 nm
49	194.900 THz	1538.19 nm
50	195.000 THz	1537.40 nm
51	195.100 THz	1536.61 nm
52	195.200 THz	1535.82 nm
53	195.300 THz	1535.04 nm
54	195.400 THz	1534.25 nm
55	195.500 THz	1533.47 nm
56	195.600 THz	1532.68 nm
57	195.700 THz	1531.90 nm
58	195.800 THz	1531.12 nm

ITU Channel Number	CWDM Wavelength
1	1270 nm
2	1290 nm
3	1310 nm
4	1330 nm
5	1350 nm
6	1370 nm
7	1380 nm
8	1410 nm
9	1430 nm
10	1450 nm
11	1470 nm
12	1490 nm
13	1510 nm
14	1530 nm
15	1550 nm
16	1570 nm
17	1590 nm
18	1610 nm