

# BA-4000 Bit Analyzer

100G/400G BIT ERROR RATE (BER) TESTER



BER tester powered up with forward error correction (FEC) margin.

## KEY FEATURES

100G (4x28GBd) scalable to 400G (8x56GBd)

Support NRZ and PAM4

Optional multirate PPG from 10 to 28 GBd

Support PRBS 7/9/11/13/15/23/31/13Q/31Q, SSPRQ

FEC simulator

Channel simulator

Burst/random error injection

Support linear/Gray mapping

O-SMPM connection

## FEC SIMULATION

The BER tester includes FEC simulation capabilities. This provides powerful analysis of burst error.

Main features include:

- PRBS error check and correction
- Pre-FEC and Post-FEC BER
- KP4/KR4 and low latency FEC protocols
- FEC lane striping function
- FEC symbol error distribution plot: codewords vs symbol errors
- FEC margin auto-calculation

## WITH PAM4 CODING, SIMPLE BER TEST IS NOT ENOUGH

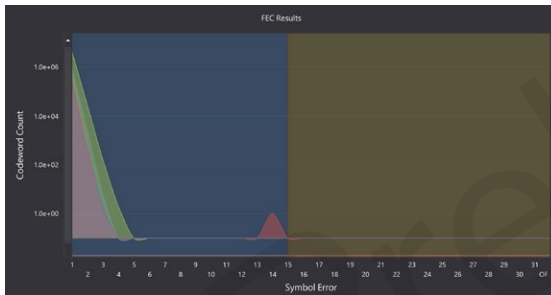
Bit Select	Injection Type	Amount	
MSB	Single B/PKT	PKT Gap	0
LSB	Burst B/PKT	PKT Count	1

Inject Errors

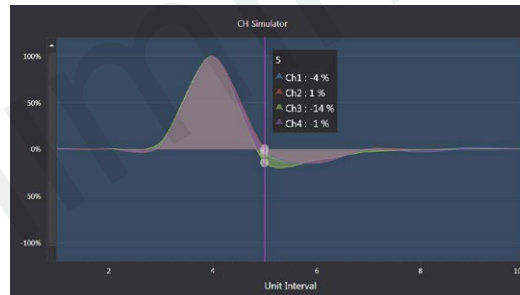
Burst and random error injection

Pre BER	5.003e-08	PN31
Pre Errors	26,581	PN31
Corrected	26,581	PN31
Post BER	0.000e+00	Sync
Margin	87% (max: 2)	KP4
# Bits	531,315,833,984	
Time	10 s	

FEC symbol error margin



FEC symbol error distribution plot



Channel response simulation

## SPECIFICATIONS

BA-4000	x-28-NRZ	x-28-PAM	x-56-PAM
Number of channels	4 (x = 4) 8 (x = 8)	4 (x = 4) 8 (x = 8)	4 (x = 4) 8 (x = 8)
Modulation	NRZ	NRZ/PAM4 NRZ only <sup>a</sup>	NRZ/PAM4
Data rate per lane <sup>a</sup> (GBd)	9.95328, 10, 10.3125, 10.709, 11.3176, 12.5, 14.025, 24.33024, 25, 25.78125, 26.5625, 27.95, 28.05, 28.125	9.95328, 10, 10.3125, 10.709, 11.3176, 12.5, 14.025, 21, 24.33024, 25 <sup>a</sup> , 25.78125, 26.5625, 27.95, 28.05, 28.125, 28.9	25.78125, 26.5625, 27.95, 28.05, 28.125, 28.9, 49.765, 53.125, 57.8
Data rate adjustment (ppm)	0 to ±300	0 to ±300	0 to ±300
PAM4 coding	n/a	Linear code/Gray code n/a <sup>a</sup>	Linear code/Gray code
Pattern supported by PPG and ED	PRBS 7/9/15/23/31	PRBS 7/9/11/13/15/23/31 <sup>a</sup> PRBS 7/9/11/13/15/23/31 PRBS 7Q/9Q/11Q/13Q/ 15Q/23Q/31Q Only PPG supports PRBS16Q, SSPRQ, and user-defined pattern	PRBS 7/9/11/13/15/23/31 PRBS 7Q/9Q/11Q/13Q/ 15Q/23Q/31Q Only PPG supports PRBS16Q, SSPRQ, and user-defined pattern
Maximum amplitude (mV <sub>ppd</sub> )	800 <sup>b,c</sup> (typical)	800 <sup>c,d</sup> (typical) 1500 <sup>c</sup> (typical, with option HAx)	800 <sup>e</sup> (typical)
Rise time/fall time (20% to 80%) (ps)	15/15 <sup>c</sup> (typical)	15/15 <sup>c</sup> (typical)	10/10 <sup>f</sup> (typical)
PAM4 eye width (zero hit) (ps)	n/a	17 <sup>d</sup> (typical) n/a <sup>a</sup>	6 <sup>e</sup> (typical)
Jitter RMS (fs)	750 <sup>c</sup> (typical)	500 <sup>c</sup> (typical)	550 <sup>f</sup> (typical)
Sensitivity (mV <sub>ppd</sub> )	100 to 800 <sup>c</sup> (typical)	200 to 800 <sup>d</sup> (typical) 150 to 1000 <sup>c</sup> (typical)	200 to 600 <sup>g</sup> (typical)
CTLE (dB)	0 to 7	0 to 8	0 to 8 (not supported from 49G to 58G)
Clock output amplitude (mV <sub>ppd</sub> )	300	400	400
Clock ratio	/8, /16 (Clock frequency / Symbol rate)	/2, /4, /8, /16, /32, /64 (Clock frequency / Symbol rate)	/2, /4, /8, /16, /32, /64 (Clock frequency / Symbol rate)
Connector type	O-SMPM connector (up to 67 GHz bandwidth)	O-SMPM connector (up to 67 GHz bandwidth)	O-SMPM connector (up to 67 GHz bandwidth)

## GENERAL SPECIFICATIONS

Size (H x W x D)	103 mm x 442 mm x 300 mm (4 in x 17.4 in x 11.8 in)
Weight	≤ 10 kg (22 lb)
Temperature	Operating: 5 °C to 40 °C (41 °F to 104 °F) Storage: -20 °C to 70 °C (-4 °F to 158 °F)
Relative humidity	20% to 80%
Power <sup>h</sup>	100/120 Vac (50/60/400 Hz) 220/240 Vac (50/60 Hz) 60 W typical/80 W max.

a. With multirate (MR4 and MR8) options.

b. Amplitude step is 200 mV<sub>ppd</sub>.

c. NRZ 25.78125 GBd signal measured by 50 GHz bandwidth scope with 40 GHz 2.92 mm, 15 cm RF cable.

d. PAM4 26.5625 GBd signal measured by 50 GHz bandwidth scope with 40 GHz 2.92 mm, 15 cm RF cable.

e. PAM4 53.125 GBd signal measured by 50 GHz bandwidth scope with 50 GHz 2.4 mm, 15 cm RF cable.

f. NRZ 53.125 GBd signal measured by 50 GHz bandwidth scope with 50 GHz 2.4 mm, 15 cm RF cable.

g. BER ≤ 10<sup>-10</sup>.

h. Operate with supply voltage fluctuations up to ±10 % of the nominal voltage.

## OPTION AVAILABLE

BA-4000	MR4	MR8	HA4	HA8	FEC4	FEC8	FGC4	FGC8
4-28-NRZ								
8-28-NRZ								
4-28-PAM	✓		✓		✓			
8-28-PAM		✓		✓		✓		
4-56-PAM					✓		✓	
8-56-PAM						✓		✓

## ORDERING INFORMATION

## BA-4000-XX-XX-XX

## Models

4-28-NRZ = 4x28 GBd NRZ BERT with O-SMPM connector  
 8-28-NRZ = 8x28 GBd NRZ BERT with O-SMPM connector  
 4-28-PAM = 4x28 GBd NRZ/PAM4 BERT with O-SMPM connector  
 8-28-PAM = 8x28 GBd NRZ/PAM4 BERT with O-SMPM connector  
 4-56-PAM = 4x56 GBd NRZ/PAM4 BERT with O-SMPM connector  
 8-56-PAM = 8x56 GBd NRZ/PAM4 BERT with O-SMPM connector

## Options

MR4 = Multi data rate 4CH<sup>a</sup>  
 MR8 = Multi data rate 8CH<sup>b</sup>  
 HA4 = High amplitude 1.5Vppd 4CH<sup>a</sup>  
 HA8 = High amplitude 1.5Vppd 8CH<sup>b</sup>  
 FEC4 = 26G PAM4 FEC simulator software 4CH<sup>c</sup>  
 FEC8 = 26G PAM4 FEC simulator software 8CH<sup>d</sup>  
 FGC4 = FEC pattern generator and checker 4CH<sup>e,g</sup>  
 FGC8 = FEC pattern generator and checker 8CH<sup>f,h</sup>

Example: BA-4000-8-56-PAM-FGC8-FEC8

## Accessories

ICBOS-KM-7 = 40 GHz, 1x8 O-SMPM to K(male) cable, 7 cm  
 ICBOS-KM-15 = 40 GHz, 1x8 O-SMPM to K(male) cable, 15 cm  
 ICBOS-KM-30 = 40 GHz, 1x8 O-SMPM to K(male) cable, 30 cm  
 ICBOS-KM-60 = 40 GHz, 1x8 O-SMPM to K(male) cable, 60 cm

ICBOS-QM-7 = 50 GHz, 1x8 O-SMPM to 2.4 mm (male) cable, 7 cm  
 ICBOS-QM-15 = 50 GHz, 1x8 O-SMPM to 2.4 mm (male) cable, 15 cm  
 ICBOS-QM-30 = 50 GHz, 1x8 O-SMPM to 2.4 mm (male) cable, 30 cm  
 ICBOS-QM-60 = 50 GHz, 1x8 O-SMPM to 2.4 mm (male) cable, 60 cm

ICBOS-SMPM-7 = 50 GHz, 1x8 O-SMPM to SMPM (female) cable, 7 cm  
 ICBOS-SMPM-15 = 50 GHz, 1x8 O-SMPM to SMPM (female) cable, 15 cm  
 ICBOS-SMPM-30 = 50 GHz, 1x8 O-SMPM to SMPM (female) cable, 30 cm  
 ICBOS-SMPM-60 = 50 GHz, 1x8 O-SMPM to SMPM (female) cable, 60 cm

ICBOS-OS-20 = 50 GHz, 1x8 O-SMPM to O-SMPM cable, 20 cm  
 ICBOS-OS-30 = 50 GHz, 1x8 O-SMPM to O-SMPM cable, 30 cm  
 ICBOS-OS-60 = 50 GHz, 1x8 O-SMPM to O-SMPM cable, 60 cm

ICBOS-VM-15 = 67 GHz, 1x8 O-SMPM to 1.85 mm (male) cable, 15 cm  
 ICBOS-VM-30 = 67 GHz, 1x8 O-SMPM to 1.85 mm (male) cable, 30 cm  
 ICBOS-VM-60 = 67 GHz, 1x8 O-SMPM to 1.85 mm (male) cable, 60 cm

ICBOS-VF-15 = 67 GHz, 1x8 O-SMPM to 1.85 mm (female) cable, 15 cm  
 ICBOS-VF-30 = 67 GHz, 1x8 O-SMPM to 1.85 mm (female) cable, 30 cm  
 ICBOS-VF-60 = 67 GHz, 1x8 O-SMPM to 1.85 mm (female) cable, 60 cm

- a. Available for BA-4000-4-28-PAM.  
 b. Available for BA-4000-8-28-PAM.  
 c. Available for BA-4000-4-28-PAM and BA-4000-4-56-PAM.  
 d. Available for BA-4000-8-28-PAM and BA-4000-8-56-PAM.  
 e. Available for BA-4000-4-56-PAM.  
 f. Available for BA-4000-8-56-PAM.  
 g. Must order with option FEC4.  
 h. Must order with option FEC8.

EXFO headquarters T +1 418 683-0211 Toll-free +1 800 663-3936 (USA and Canada)

EXFO serves over 2000 customers in more than 100 countries. To find your local office contact details, please go to [www.EXFO.com/contact](http://www.EXFO.com/contact).

EXFO is certified ISO 9001 and attests to the quality of these products. EXFO has made every effort to ensure that the information contained in this specification sheet is accurate. However, we accept no responsibility for any errors or omissions, and we reserve the right to modify design, characteristics and products at any time without obligation. Units of measurement in this document conform to SI standards and practices. In addition, all of EXFO's manufactured products are compliant with the European Union's WEEE directive. For more information, please visit [www.EXFO.com/recycle](http://www.EXFO.com/recycle). Contact EXFO for prices and availability or to obtain the phone number of your local EXFO distributor.

For the most recent version of this spec sheet, please go to [www.EXFO.com/specs](http://www.EXFO.com/specs).

In case of discrepancy, the web version takes precedence over any printed literature.