SPEC SHEET

BA-4000 Bit Analyzer

800G BIT ERROR RATE (BER) TESTER

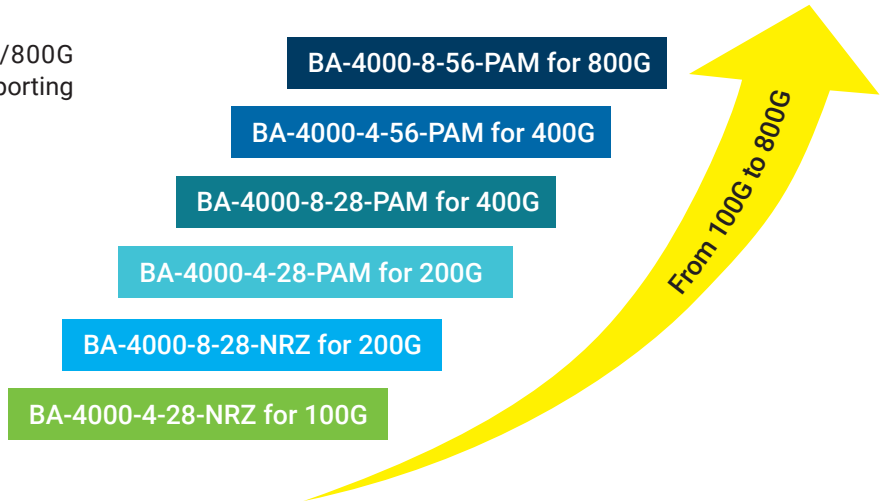
- Electrical BER tester supporting NRZ and PAM4 coding, with advanced FEC tools and with testing capabilities up to 800G.

KEY FEATURES

- Supports NRZ and PAM4
- Supports PRBS 7/9/11/13/15/23/31/13Q/31Q, SSPRQ
- Advanced FEC tools
- Supports RS-FEC Scrambled Idle Pattern
- Channel simulator
- Burst/random error injection
- O-SMPM connection
- Channel histogram
- Channel mapping
- Automation: API support

BA-4000 READY FOR 800G TESTING

The BA-4000 is a world-class series of 100G/800G electrical BER testers (either 4 or 8 channels) supporting PAM4 or NRZ coding.



POWERFUL AND SIMPLIFIED USER INTERFACE

The BA-4000 graphical user interface (GUI) provides simplified and real-time test results per channel. It requires an external Windows-based PC with Ethernet capability to run the GUI and API.

FEC SIMULATION

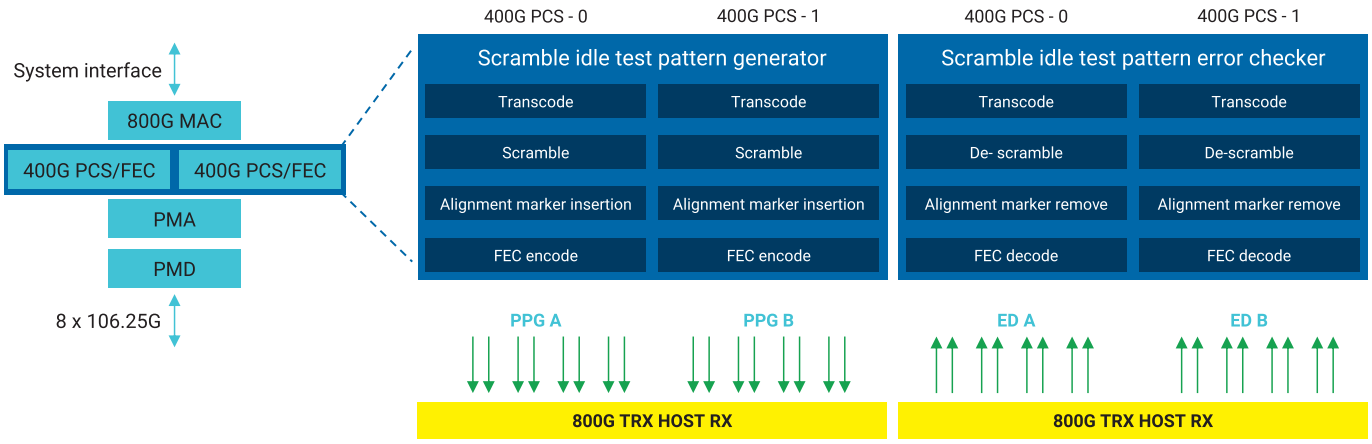
The BER tester includes FEC simulation capabilities. This provides powerful burst error analysis.

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

FEC encoded scrambled idle

With the FEC Generator and Checker (FGC) option, the BA-4000 addresses RS-FEC scrambled idle pattern for testing 53 GBd host side interfaces as part of the development of new-generation 800G optics, including optical transceivers, DAC, etc.



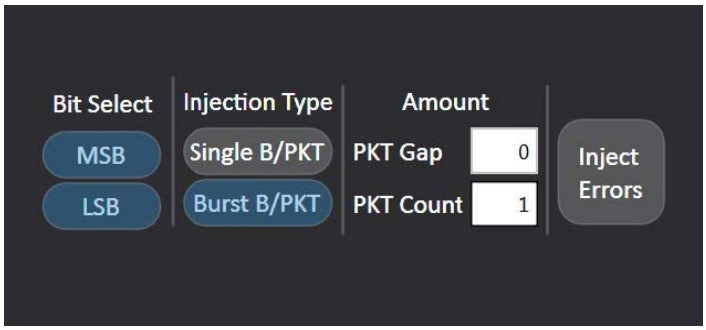
800G function flow structure

FGC option
BA-4000-FGC4/8

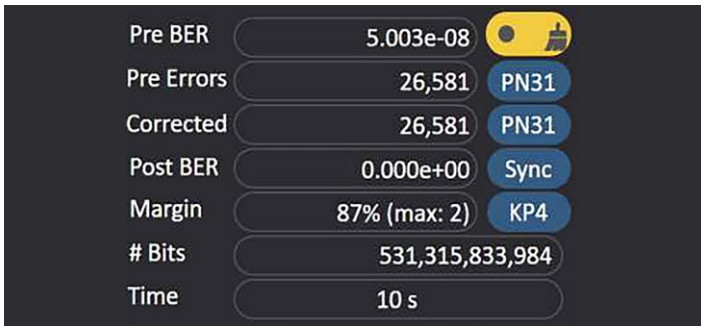
- Codeword error ratio
- Corrected codeword
- Uncorrected codeword
- FLR-64oct
- FEC margin
- Total codewords

FEC encoded scramble idle metrics in the GUI

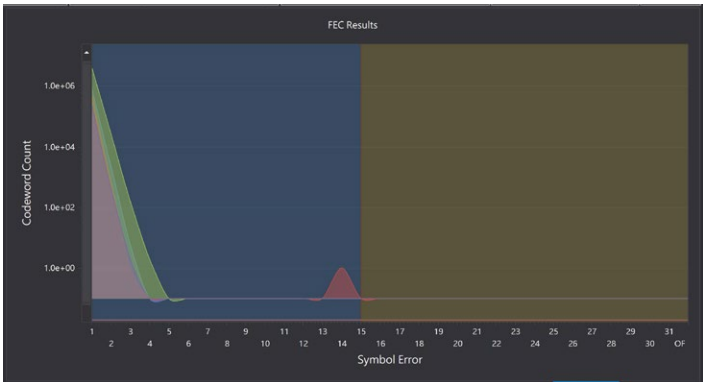
WITH PAM4 CODING, A SIMPLE BER TEST IS NOT ENOUGH



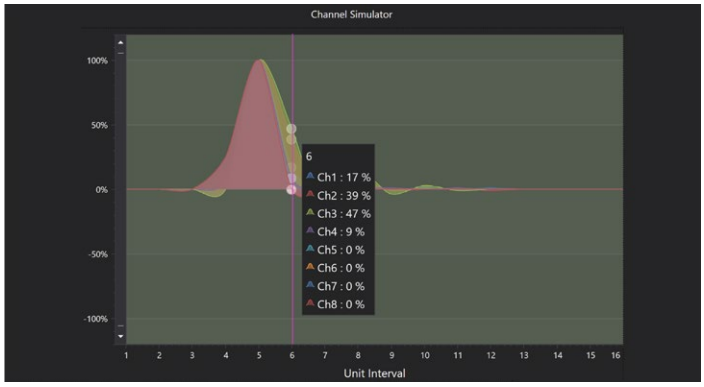
Burst and random error injection



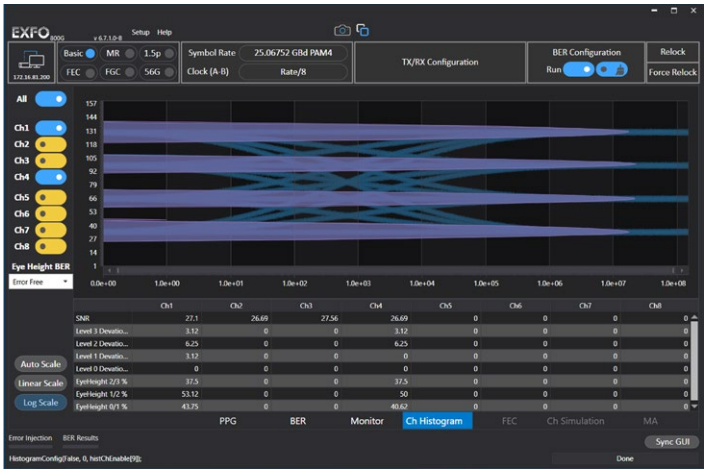
FEC symbol error margin



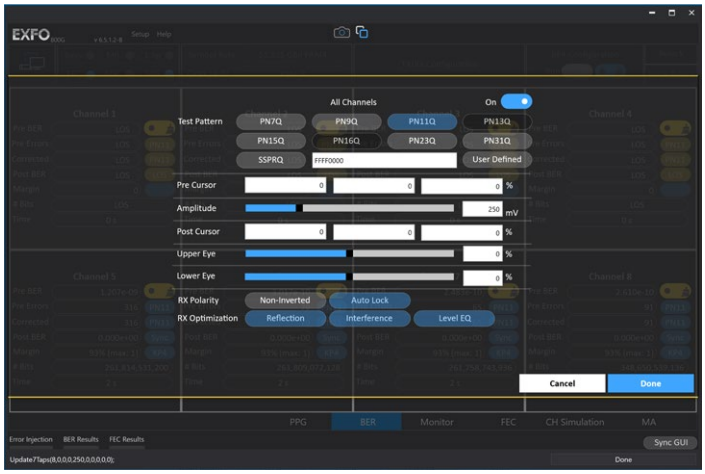
FEC symbol error distribution plot



Channel response simulation



Channel histogram



7-tap mode

All specifications are typical, at 23 °C ± 2 °C unless otherwise specified.

SPECIFICATIONS

BA-4000	x-28-NRZ	x-28-PAM x-28-PAM-FECx	x-56-PAM-FECx x-56-PAM-FGCx-FECx	x-56-HP-FECx x-56-HP-FGCx-FECx
Number of channels	4 (x = 4) or 8 (x = 8)	4 (x = 4) or 8 (x = 8)	4 (x = 4) or 8 (x = 8)	4 (x = 4) or 8 (x = 8)
Modulation	NRZ	NRZ/PAM4	NRZ/PAM4	NRZ/PAM4
Data rate per lane (GBd) [a, k]	8.5, 9.95328, 10, 10.3125, 10.709, 11.3176, 12, 12.5, 14.025, 21.0, 24.33024, 24.8832, 25, 25.06752, 25.78125, 26.5625, 27.95, 28.05, 28.125, 28.9	24.8832, 25, 25.06752, 25.78125, 26.5625, 27.95, 28.05, 28.125, 28.9, 29.0625	24.8832, 25, 25.06752, 25.78125, 26.5625, 27.95, 28.05, 28.125, 28.9, 29.0625, 49.765, 49.7664, 50, 50.13504, 51.5625, 53.125, 55.9, 55.90747, 56.125, 56.25, 57.8, 58.125, 59.375	24.8832, 25, 25.06752, 25.78125, 26.5625, 27.95, 28.05, 28.125, 28.9, 29.0625, 49.765, 49.7664, 50, 50.13504, 51.5625, 53.125, 55.9, 55.90747, 56.125, 56.25, 57.8, 58.125, 59.375
Data rate per lane [k] (GBd) under FGC mode	n/a	24.8832, 25.0, 25.06752, 25.78125, 26.5625, 27.95, 28.05, 28.125, 28.9, 29.0625	24.8832, 25, 25.06752, 25.78125, 26.5625, 27.95, 28.05, 28.125, 28.9, 29.0625, 49.765, 49.7664, 50, 50.13504, 51.5625, 53.125, 55.9, 55.90747, 56.125, 56.25, 57.8, 58.125, 59.375	24.8832, 25, 25.06752, 25.78125, 26.5625, 27.95, 28.05, 28.125, 28.9, 29.0625, 49.765, 49.7664, 50, 50.13504, 51.5625, 53.125, 55.9, 55.90747, 56.125, 56.25, 57.8, 58.125, 59.375
Data rate per lane (GBd) under FEC mode	n/a	n/a	25.78125, 26.5625 (support NRZ and PAM4), 51.5625, 53.125 (support PAM4)	25.78125, 26.5625 (support NRZ and PAM4), 51.5625, 53.125 (support PAM4)
Data rate adjustment (ppm)	0 to ±300	0 to ±300	0 to ±1000	0 to ±1000
PAM4 coding	n/a	Linear/Gray code	Linear/Gray code	Linear/Gray code
Pattern supported by PPG and ED	PRBS 7/9/15/23/31 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	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
Pattern supported by PPG and ED under FEC mode	n/a	PRBS 7/9/11/15/23/31 PRBS 7Q/9Q/11Q/15Q/23Q/31Q [l]	PRBS 7/9/11/15/23/31 PRBS 7Q/9Q/11Q/15Q/23Q/31Q [l]	PRBS 7/9/11/15/23/31 PRBS 7Q/9Q/11Q/15Q/23Q/31Q [l]
Maximum amplitude (mV_{ppd})	800 [b, c]	800 [c, e, j]	800 [f, j]	800 [f, j]
Rise/fall time (20% to 80%) (ps)	16.5/16.5 [c]	11/11 [c]	10/10 [e] (53.125G) 10/10 [c] (25.78125G)	10/10 [e] (53.125G) 10/10 [c] (25.78125G)
PAM4 eye width (zero hit) (ps)	n/a	23 [d]	5.5 [f] (53.125G) 23 [d] (26.5625G)	5.5 [f] (53.125G) 23 [d] (26.5625G)
Jitter RMS (fs)	750 [c]	450 [c]	500 [e] (53.125G) 450 [c] (25.78125G)	500 [e] (53.125G) 450 [c] (25.78125G)
Sensitivity (mV_{ppd}) [g]	100 (NRZ 25.78125G)	200 (PAM4 26.5625G)	250 [h, i] (PAM4 53.125G)	200 [h, l, m] (PAM4 53.125G)
CTLE (dB)	0 to 7	0 to 8	n/a	n/a
ED damage level (mV_{ppd})	1200	1200	1200	1200
Clock output amplitude (mV_{ppd})	300	400	400	400
Clock ratio (clock frequency / symbol rate)	/8, /16	/2, /4, /8, /16, /32, /64	/2, /4, /8, /16, /32, /64	/2, /4, /8, /16, /32, /64
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)	O-SMPM connector (up to 67 GHz bandwidth)

a. Fixed rate.

b. Amplitude step is 200 mV_{ppd}

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. NRZ 53.125 GBd signal measured by 50 GHz bandwidth scope with 50 GHz 2.4 mm, 15 cm RF cable. Post-cursor is −2%.

f. PAM4 53.125 GBd signal measured by 50 GHz bandwidth scope with 50 GHz 2.4 mm, 15 cm RF cable. Post-cursor is −2%.

g. Measured by direct loopback from PPG to ED with 40 GHz O-SMPM, 20 cm RF cable.

h. BER ≤ 10^{-10}

i. If greater sensitivity is required, please contact EXFO for the high-performance model.

j. Support overdrive 900 mV_{ppd}

k. Use GUI version 6.17 or newer.

l. Under FEC mode, no support of PRBS13Q, PRBS16Q, SSPRQ, and user-defined pattern at ED.

m. Receiving range is up to 500 mV_{ppd} and BER ≤ 10^{-10}

GENERAL SPECIFICATIONS		
Size (H x W x D)		103 mm x 442 mm x 300 mm (4.1 in x 17.4 in x 11.8 in)
Weight		≤ 10 kg (22 lb)
Temperature	Operating Storage	5 °C to 40 °C (41 °F to 104 °F) –20 °C to 70 °C (–4 °F to 158 °F)
Relative humidity		20% to 80%
Power		100 Vac to 240 Vac (47 Hz to 63 Hz) 60 W typical / 80 W max.

AVAILABLE OPTIONS

BA-4000	FEC4	FEC8	FGC4	FGC8
4-28-NRZ				
8-28-NRZ				
4-28-PAM	✓			
8-28-PAM		✓		
4-56-PAM	✓		✓	
8-56-PAM		✓		✓
4-56-HP	✓		✓	
8-56-HP		✓		✓

ORDERING INFORMATION

BA-4000-XX-XX

Models
- 4-28-NRZ = 4×28 GBd NRZ BERT with O-SMPM connector
- 8-28-NRZ = 8×28 GBd NRZ BERT with O-SMPM connector
- 4-28-PAM = 4×28 GBd NRZ/PAM4 BERT with O-SMPM connector
- 8-28-PAM = 8×28 GBd NRZ/PAM4 BERT with O-SMPM connector
- 4-56-PAM = 4×56 GBd NRZ/PAM4 BERT with O-SMPM connector [a]
- 8-56-PAM = 8×56 GBd NRZ/PAM4 BERT with O-SMPM connector [b]
- 4-56-HP = 4x56 GBd NRZ/PAM4 BERT (better sensitivity) with O-SMPM connector [a]
- 8-56-HP = 8x56 GBd NRZ/PAM4 BERT (better sensitivity) with O-SMPM connector [b]

Options
- FEC4 = FEC simulator software 4CH [c]
- FEC8 = FEC simulator software 8CH [d]
- FGC4 = FEC pattern generator and checker 4CH [e]
- FGC8 = FEC pattern generator and checker 8CH [f]

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

a. Must be ordered with FEC4 option.
b. Must be ordered with FEC8 option.
c. Available for BA-4000-4-28-PAM, BA-4000-4-56-PAM and BA-4000-4-56-HP
d. Available for BA-4000-8-28-PAM, BA-4000-8-56-PAM and BA-4000-8-56-HP
e. Available for BA-4000-4-56-PAM and BA-4000-4-56-HP. Must be ordered with FEC4 option.
f. Available for BA-4000-8-56-PAM and BA-4000-8-56-HP. Must be ordered with FEC8 option.

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