

BA-4000 Bit Analyzer

800G ビットエラーレート (BER) テスター



NRZおよびPAM4コーディングをサポートし、高度なFECツールを備え
800Gまでのテスト能力を持つ電気BERテスター

スペックシート

主な機能

NRZとPAM4をサポート

PRBS 7/9/11/13/15/23/31/13Q/31Q, SSPRQをサポート

高度なFECツール

RS-FEC Scrambled Idle Patternをサポート

チャンネル・シミュレータ

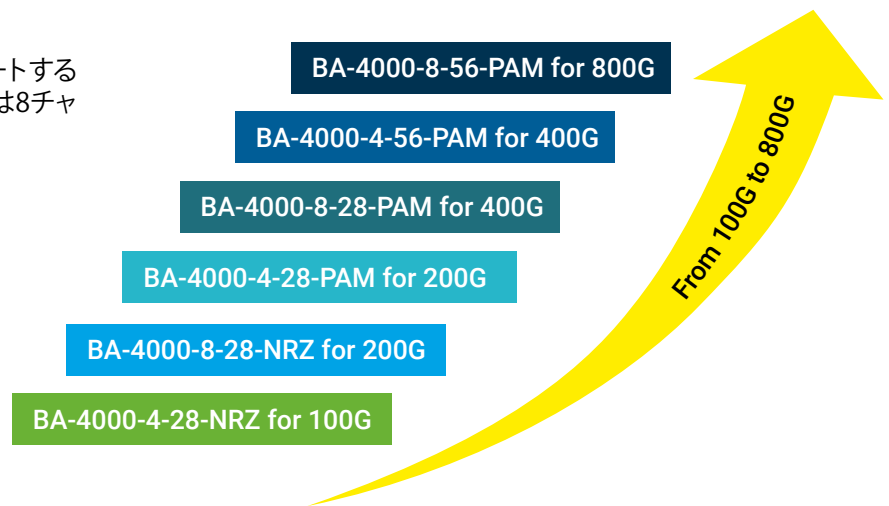
バースト/ランダムエラー挿入

リニア/グレイマッピングをサポート

O-SMPM 接続

BA-4000は800Gテストに対応

BA-4000はPAM4またはNRZコーディングをサポートする100G/200G/400G/800G電気BERテスター（4または8チャネル）の世界クラスのシリーズです。



強力でシンプルなユーザーインターフェイス

BA-4000のユーザーインターフェイスは、各チャンネルのテスト結果をシンプルかつリアルタイムに表示します。

Channel	Pre BER	Pre Errors	Corrected	Post BER	Margin	# Bits	Time
Channel 1	8.737e-09	4,696	4,696	0.000e+00	80% (max: 3)	537,460,265,600	10 s
Channel 2	2.372e-09	1,279	1,279	0.000e+00	80% (max: 3)	539,295,804,160	10 s
Channel 3	3.636e-05	19,674,924	19,674,924	0.000e+00	40% (max: 9)	541,134,126,592	10 s
Channel 4	3.834e-09	2,082	2,082	0.000e+00	80% (max: 3)	542,968,437,504	10 s
Channel 5	3.671e-11	20	20	0.000e+00	80% (max: 3)	544,804,921,728	10 s
Channel 6	3.489e-06	1,907,057	1,907,057	0.000e+00	80% (max: 3)	546,644,141,824	10 s
Channel 7	2.545e-05	13,961,536	13,961,536	0.000e+00	60% (max: 6)	548,487,245,696	10 s
Channel 8	1.976e-06	1,052,889	1,052,889	0.000e+00	80% (max: 3)	532,769,596,416	10 s

FEC シミュレーション

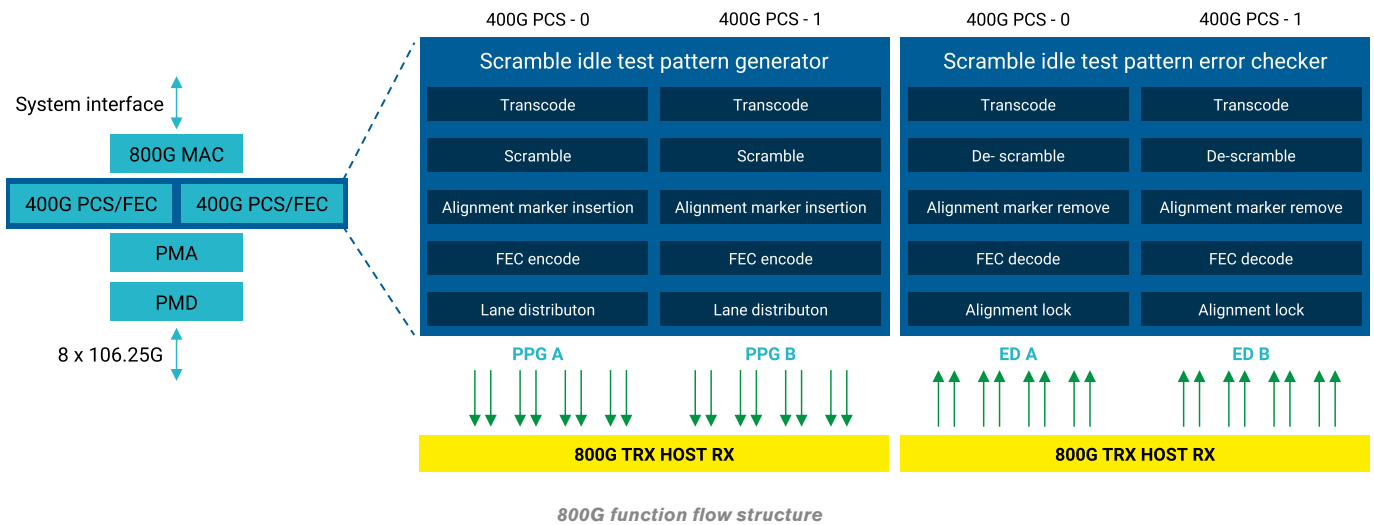
BERテスターは、FECシミュレーション機能を備えています。これにより、強力なバーストエラー解析が可能です。

主な機能は以下の通りです。:

- PRBSのエラーチェックと訂正
- プリFECとポストFECのBER
- KP4/KR4および低レイテンシーFECプロトコル
- FECレーンストライピング機能
- FECシンボルエラー分布図:コードワード vs シンボルエラー
- FECマージン自動計算機能

FEC符号化スクランブルド・アイドル

BA-4000はFGC (FEC Generator and Checker)オプションにより、光トランシーバーやDACなどの新世代800Gオプティクス開発の一環として、53GBdのホスト側インターフェースをテストするためのRS-FECスクランブルド・アイドルパターンに対応しています。

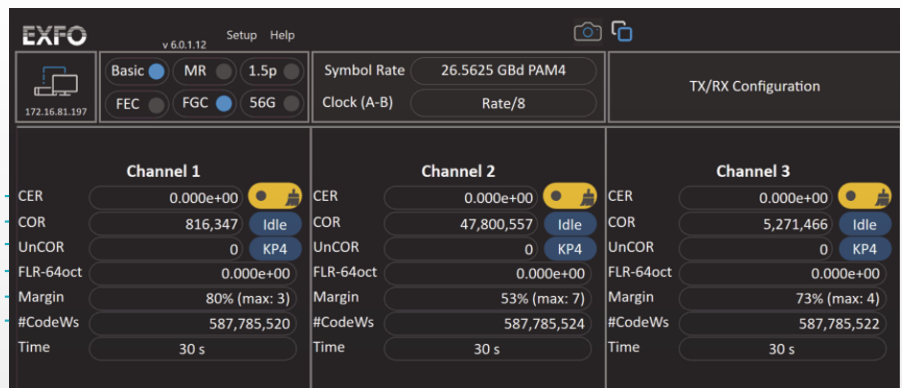


800G function flow structure

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

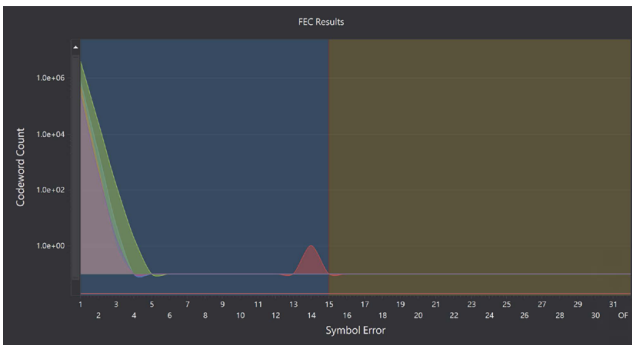
PAM4コーディングでは単純なBERテストだけでは不十分です

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

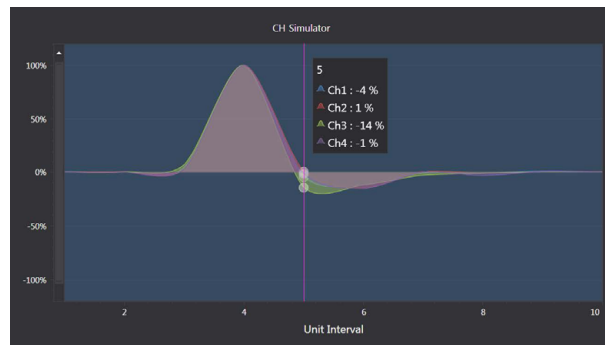
Burst and random error injection

Pre BER	5.003e-08	<input checked="" type="checkbox"/>
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

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

仕様

BA-4000	x-28-NRZ	x-28-PAM	x-56-PAM	x-56-PAM-FGC
Number of channels	4 (x = 4) 8 (x = 8)	4 (x = 4) 8 (x = 8)	4 (x = 4) 8 (x = 8)	4 (x = 4) 8 (x = 8)
Modulation	NRZ	NRZ/PAM4	NRZ/PAM4	NRZ/PAM4
Data rate per lane ^a (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	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	25.78125, 26.5625, 27.95, 28.05, 28.125, 28.9, 49.765, 51.5625, 53.125, 57.8
Data rate per lane (GBd) under FEC mode	n/a	25.78125, 26.5625, 27.95, 28.05, 28.125, 28.9	25.78125, 26.5625, 27.95, 28.05, 28.125, 28.9	25.78125, 26.5625, 27.95, 28.05, 28.125, 28.9, 51.5625, 53.125, 57.8
Data rate per lane (GBd) under FGC mode	n/a	n/a	n/a	25.78125, 26.5625 (support NRZ & PAM4), 51.5625, 53.125 (support PAM4)
Data rate adjustment (ppm)	0 to ±300	0 to ±300	0 to ±300	0 to ±300
PAM4 coding	n/a	Linear code / Gray code	Linear code / Gray code	Linear code / Gray code
Pattern supported by PPG and ED	PRBS 7/9/15/23/31	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 Scrambled Idle at FGC mode (with option FGCx)
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	PRBS 7/9/11/15/23/31 PRBS 7Q/9Q/11Q/15Q/ 23Q/31Q	PRBS 7/9/11/15/23/31 PRBS 7Q/9Q/11Q/15Q/ 23Q/31Q
Maximum amplitude (mV _{ppd})	800 ^{b,c} (typical)	800 ^{c,e} (typical)	800 ^f (typical)	800 ^f (typical)
Rise time/fall time (20% to 80%) (ps)	15/15 ^c (typical)	11/11 ^c (typical)	9.5/9.5 ^e (53.125G) 10/10 ^e (25.78125G)	9.5/9.5 ^e (53.125G) 10/10 ^e (25.78125G)
PAM4 eye width (zero hit) (ps)	n/a	23 ^d (typical)	5.5 ^f (53.125G) 23 ^f (26.5625G)	5.5 ^f (53.125G) 23 ^f (26.5625G)
Jitter RMS (fs)	750 ^c (typical)	450 ^c (typical)	400 ^c (53.125G) 450 ^c (25.78125G)	400 ^c (53.125G) 450 ^c (25.78125G)
Sensitivity ^h (mV _{ppd})	100 (NRZ 25.78125G)	200 (PAM4 26.5625G) 150 (NRZ 25.78125G)	200 ^h (PAM4 53.125G) 200 (PAM4 26.5625G) 150 (NRZ 25.78125G)	200 ⁱ (PAM4 53.125G) 200 (PAM4 26.5625G) 150 (NRZ 25.78125G)
CTLE (dB)	0 to 7	0 to 8	n/a	n/a
Clock output amplitude (mV _{ppd})	300	400	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)	/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)	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 ≤ 10⁻¹⁰i. BER ≤ 10⁻⁹

一般的な仕様

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 ^a	100/120 Vac (50/60/400 Hz) 220/240 Vac (50/60 Hz) 60 W typical/80 W max.

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

選択可能なオプション

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

オーダーリング情報

BA-4000-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 ■

FEC4 = 26G PAM4 FEC simulator software 4CH^a
 FEC8 = 26G PAM4 FEC simulator software 8CH^b
 FGC4 = FEC pattern generator and checker 4CH^c
 FGC8 = FEC pattern generator and checker 8CH^d

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

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

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