

Innovation for the next generation

AT4039E

4-Channel 56 GBd PAM & NRZ |
400G BERT

4 x 56 GBd NRZ/PAM-4 BERT | SSPRQ, PRBS13Q &
PRBS31Q | TX and RX Equalizers | Signal SNR and
histogram



Summary

The AT line of products is highly integrated for the Advantest V93000 system and fits right underneath the load board, in the cavity of the test head extender. Due to this, the signal path to the DUT is kept extremely short.

The AT line of instruments is made to work for packaged silicon systems as well as for wafer probing and is meant to enable at-speed testing of SerDes, transceivers, amplifiers and other active and passive high-speed digital components. The AT family consists of pattern generators, error detectors and sampling oscilloscopes.

AT4039E

4 x 56 GBd BERT

Introduction

The AT4039E is a fully featured 400G BERT that can be configured as a 4-channel PAM4 56 GBaud or 4-channel NRZ 56 Gbps lanes. Also, half rates of 28GBd are supported in PAM and NRZ modes. The transmitters support all standard test patterns mandated by IEEE and OIF such as PRBS13Q, SSPRQ, PRBS31Q, etc...

The user may also program the TX to output a user-defined pattern up to 131 kb long.

Key Features

Transmit

- Data Rates: 23 – 29 & 46 – 58 GBaud (116 Gbps)
- Ability to tune the bit rate in steps of 100 kbps and find the RX PLL locking margin.
- Independent control of inner eye levels
- Up to 0.8 Vppd output swing
- Supports Gray coding and polarity inversion
- Available patterns are:
 - PRBS 7/9/11/13/15/16/23/31/58 and their inverses
 - PRBS13Q, PRBS31Q
 - SSPRQ
 - Square wave
 - Error injection
- 3-tap LUT-based Pre- and Post-emphasis or 7-tap linear FFE

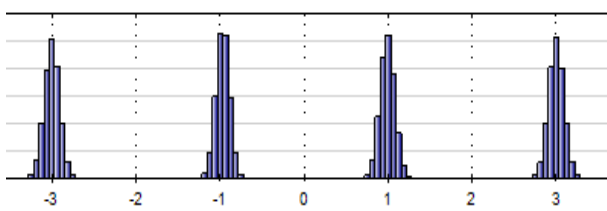


Figure 1: PAM eye histogram

Receive

- Adaptive DFE and FFE with reflection canceller and MLSD
- Programmable front-end attenuator
- SNR monitoring over time
- PAM histogram monitor
- PAM slicer threshold adjustable
- Error-detection on following patterns:
 - PRBS 7/9/11/15/16/23/31
 - PRBS13Q and PRBS31Q
 - Automatic pattern detect
 - LOS indicators

General

- API libraries with documentation.
- LabView driver and Python wrapper available.
- Same product available in ATE format for Verigy 93K and Teradyne.

Target Applications

- Production testing of transceivers
- Functional and SI testing

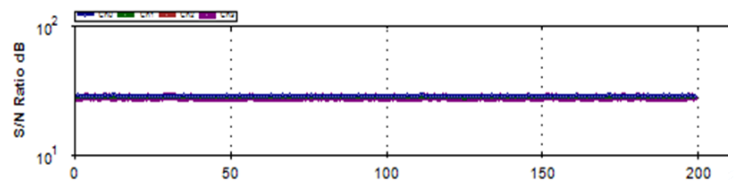


Figure 2: SNR capture over time

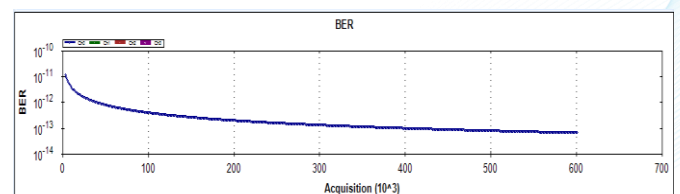


Figure 3: BER curves of 1 channel

Electrical Specifications

Parameter	Specifications
Bit Rates	23 – 29 GBaud and 46 – 58 GBaud
TX Amplitude Differential	0 - 800 mVpp
Patterns	PRBS 7/9/11/13/15/16/23/31/58 PRBS13Q, 31Q and SSPRQ Square wave
TX Amplitude Adjustment	Steps of 1 mV
Pre- / Post-emphasis	6 dB
Pre-Emphasis Resolution	1000 steps
Equalizing Filter Spacing	1UI
Random Jitter RMS	<290 fs ¹
Rise/ Fall Time (20–80%) ²	<10 ps
Coding	Gray coding supported
Output Return Loss up to 10GHz	< -15dB
Output Return Loss (16-25GHz)	< -10dB
Error Detector input range	50 mV– 800 mV diff.
Total DFE/FFE/CTLE Equalization	Up to 13 dB
TX/RX connectors	Blind-mate SMPM
Reference clock Output	Rate div 16/32/128/256
Diff. Input Return Loss	Better than 10 dB
Eye monitor resolution	8 bits horizontal across 2UI / 9 bits vertical
Clock Input Range	Up to 4.4 GHz
Clock Input Amplitude	200 - 1000 mV
Input Impedance	50 Ω
Temperature range	0-75 °C
Power (ATE version only)	12 V, 1.5A

PRBS Pattern	Polynomial
7	$x^7 + x^6 + 1$
9 variant 1	$x^9 + x^4 + 1$
9 variant 2	$x^9 + x^5 + 1$
11	$x^{11} + x^9 + 1$
13Q	$x^{13} + x^{12} + x^2 + x + 1$
15	$x^{15} + x^4 + 1$
16	$x^{16} + x^5 + x^3 + x^2 + 1$
23	$x^{23} + x^{18} + 1$
31	$x^{31} + x^{28} + 1$
58	$x^{58} + x^{39} + 1$

¹ With appropriate pre and post emphasis settings and 50 GHz scope. Trigger from adjacent data channel rate/8

Mechanical Dimensions

The AT4039E is customized to fit and seamlessly function inside an Advantest HSIO test head extender. One cassette can host 2 AT4039E; you can fit a total of 4 such cassettes in a V93K tester.

Dimensions: 265.6 x 33.2 x 58 mm³



Figure 4: AT4039E Pinout. Closest to the backplane connector is TX1N

Ordering Information

Option	Description
AT4039E	400G BERT (4 CH 56 GBd PAM4)

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