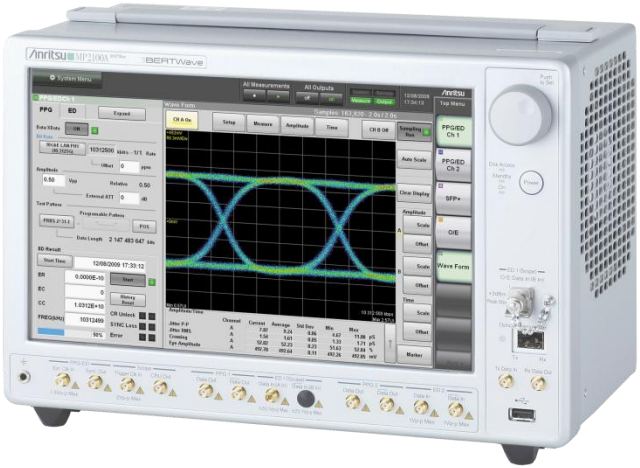
Product Introduction

MX210001A Jitter Analysis Software
MX210002A Transmission Analysis Software

MP2100A
BERTWave Series

MP2100A BERTWave Series
MX210001A Jitter Analysis Software
MX210002A Transmission Analysis Software
Product Introduction

BERTWave



Anritsu Corporation

Contents

Introduction

~ One unit supports high-speed and simultaneous BER, EYE pattern, EYE mask and Jitter analysis ~

☐ Cut Capital Costs Further and Achieve Efficient Measurement Time

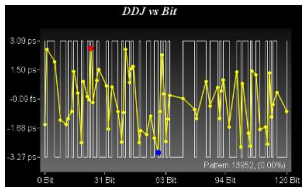
- ♦Jitter Analysis Software supports fast Jitter and WDP measurements
- ♦Combining Transmission Analysis Software with Jitter Analysis Software supports all-in-one transmission analysis (S21 measurement) and waveform emulation and Jitter measurement.

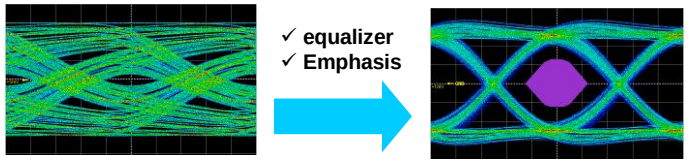
☐ MX210001A Jitter Analysis

- ♦Jitter measurements for any data
- ♦WDP measurements
- ♦High-speed measurements
  - high-speed trigger method (applying patent)
  - 5 times faster
- ♦Simultaneous measurements
  - 2ch simultaneous measurements
  - BER, EYE pattern, EYE Mask, Jitter analysis measurements

☐ MX210002A Transmission Analysis

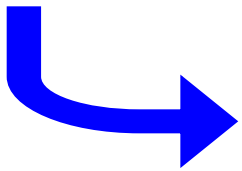
- ♦Transmission analysis (S21 Gain and Phase)
- ♦Waveform simulation（de-embedded）
  - Linear equalizer filter
  - Emphasis (4 taps max)
- ♦Simultaneous measurements
  - Simultaneous measurement of BER, EYE pattern, EYE Mask and Jitter with simulation waveform





Introduction

- **The massive increase in data processed by servers, etc., in data centers is driving introduction of high-speed interconnects with speeds exceeding 10 Gbit/s per channel.**
  - **Active Optical Cable (AOC)**
  - **Direct Attached Cable (DAC)**



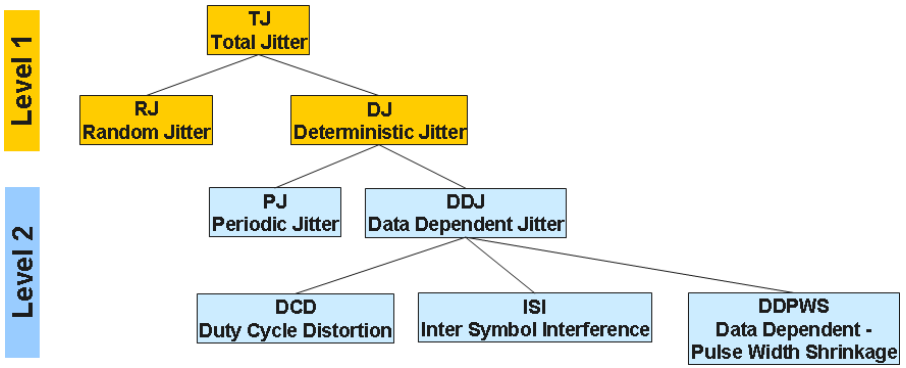
- Lower power consumption
- Lower costs
- Wavelength dispersion at short wavelength (AOC)
- High-frequency loss with copper cable (DAC)

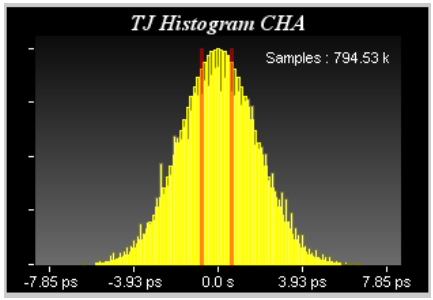
- **Jitter and Waveform Generation in Transmission Path**
  - **Device vendors requires Jitter and WDP measurements**
    - Rising equipment capital costs and measurement times are barriers to lowered costs
- **Maintain EYE opening using waveform equalization technology**
  - **Requires many instruments and complex procedures**

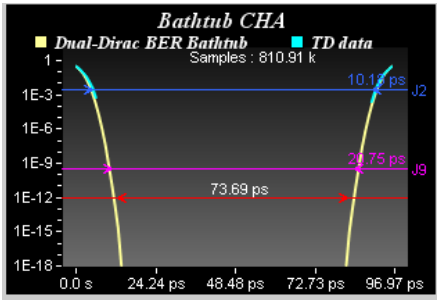
Types of Jitter

Purpose of Jitter Measurement

- Separate measurement to shorten time-consuming E-12 BER measurements
- Level 1 Jitter Measurement
  - Separate into Deterministic Jitter (DJ) and Random Jitter (RJ)
    - ✓ DJ always constant value
    - ✓ RJ increases with measurement time and follows Gaussian distribution
    - ✓ At short-term measurement, TJ is estimated at 1E-12
- Find Jitter causes and measure separately to reduce
  - Level 2 Jitter Measurement
  - DJ can be split into more detailed Jitter types



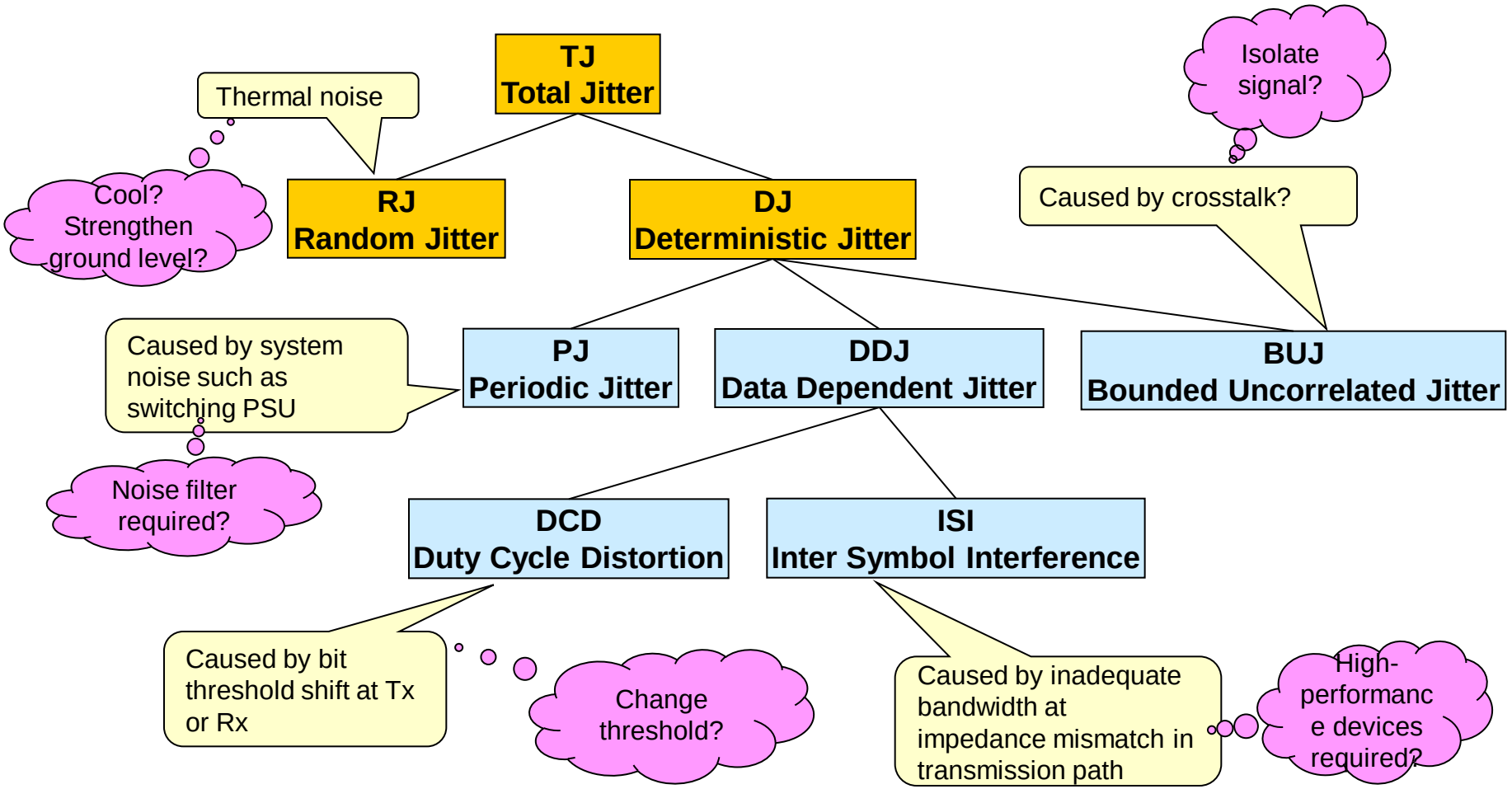




Measurement Differences using BERT and Sampling Oscilloscope

- Measurement with BERT can analyze Level 1 Jitter
  - ⇒ But difficult to investigate causes of error
- Measurement with sampling oscilloscope can analyze Level 2 Jitter
  - ⇒ Causes of errors can be estimated

Level 2 Jitter Types



WDP Measurement

What is WDP?

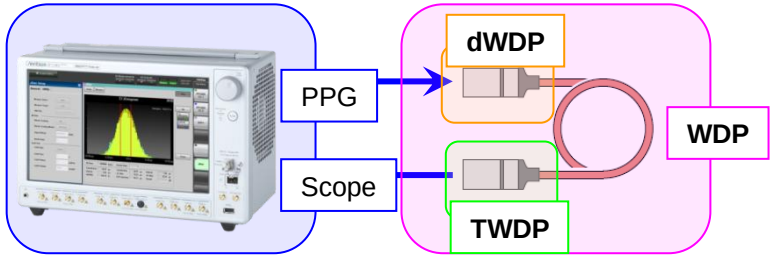
- **DUT Waveform Distortion Evaluation Method**
  - Applications: IEEE802.3aq (10GBASE-LRM), FC, SAS, etc.
- **Calculated Based on Waveform S/N**
  - Calculation procedure published as MATLAB Source

WDP Measurement Objectives

- **Waveform distortion generated by wavelength dispersion in optical transmission path**
- **Data-signal dependent waveform distortion generated by bandwidth limits in electrical transmission path**
- **Emulate characteristics of transmission path to calculate and quantify amount of Jitter at far end of transmission path caused by passage of Tx output waveform**

WDP Types

- **TWDP: Transmitter Waveform Distortion Penalty**
  - Evaluate Tx signal distortion characteristics
  - dWDP : Difference of waveform distortion penalty
  - Evaluate Rx distortion characteristics
- **WDP: Waveform distortion penalty**
  - Generalize for any DUT without Tx restrictions



Features ~ MX210001A Jitter Analysis Software ~

Jitter Measurements
- Bathtub Jitter
- Level 1 Jitter for any signal (PRBS31 inc.)
- Separate Level 2 Jitter types up to PRBS15

Simultaneous Measurements
- 2ch Simultaneous measurements
- All-in-one simultaneous Jitter, EYE Pattern and EYE Mask measurements

High-Speed Measurements
- Fast estimation of Bathtub BER (1E-18)
- Fast sampling
- Fast triggering method
  - Support fast DDJ measurement

WDP Measurements
- WDP, TWDP, dWDP measurements

Detailed Features ~ MX210001A Jitter Analysis Software ~

Histogram Method

- ✓ **Fast, simultaneous measurement**
  - Level 1 Jitter
  - Any signal (including PRBS 31)
  - Dual Dirac model
  - Bathtub and Histogram measurements
  - Simultaneous Jitter, Eye Pattern and Eye Mask measurements

Pattern Search Method

- ✓ **Detailed Jitter measurements**
  - Level 2 Jitter
  - Specific signal (data lengths up to PRBS15)
  - Separation into detailed Jitter components
  - Fast DDJ measurement using unique triggering method

Jitter Classification by Histogram and Pattern Search Methods

- ✓ **TJ BER**
  - Total Jitter at 1.0e−12
- ✓ **DJdd**
  - Deterministic Jitter (Dual Dirac model)
- ✓ **RJdd**
  - Random Jitter (Dual Dirac model)
- ✓ **TJ at sBER**
  - Total Jitter at specified BER
- ✓ **EYE Opening**
  - Horizontal EYE opening at specified BER
- ✓ **J2 BER**
  - Total Jitter at 2.5e−3
- ✓ **J9 BER**
  - Total Jitter at 2.5e−10

Jitter Classification by Pattern Search Method

- ✓ **DDJ**
  - Data Dependent Jitter vs Bit
- ✓ **DDPWS**
  - Data Dependent Pulse Width Shrinking
- ✓ **PJ**
  - Periodic Jitter (support PJ frequency estimation)
- ✓ **DCD**
  - Duty Cycle Distortion
- ✓ **ISI**
  - Inter Symbol Interference

Detailed Features ~ MX210001A Jitter Analysis Software ~

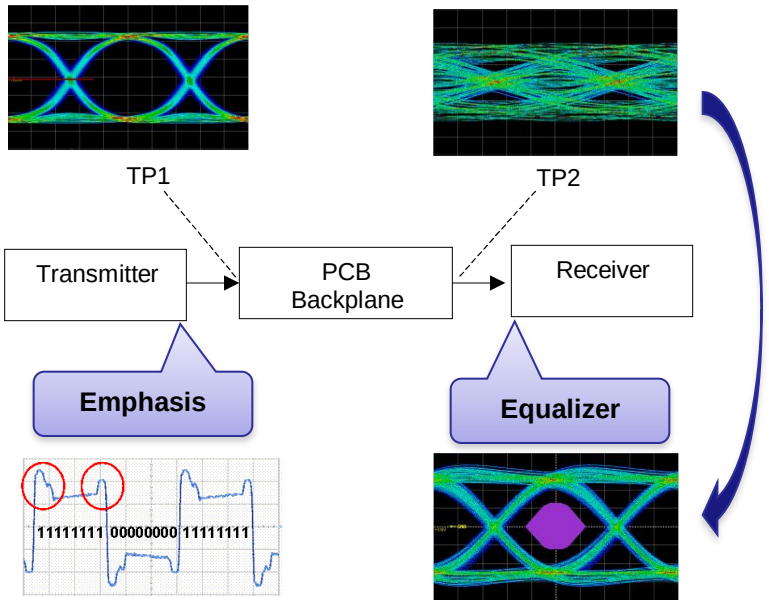
WDP Measurements

- **MATLAB ® software tracking operation**
- **Simple use with MATLAB Source recommended by various standards organizations**
- **Measures various WDP types**
  - WDP, dWDP, TWDP, dTWDP, WDPc, dWDPc, TWDPc, dWDPc

	IEEE802.3aq LRM	MSQS	FC-PI5	SFF-8341
WDP		✓	✓	✓
WDPc				✓
TWDP	✓	✓	✓	✓
TWDPc				✓
dWDP		✓	✓	✓
dWDPc				✓

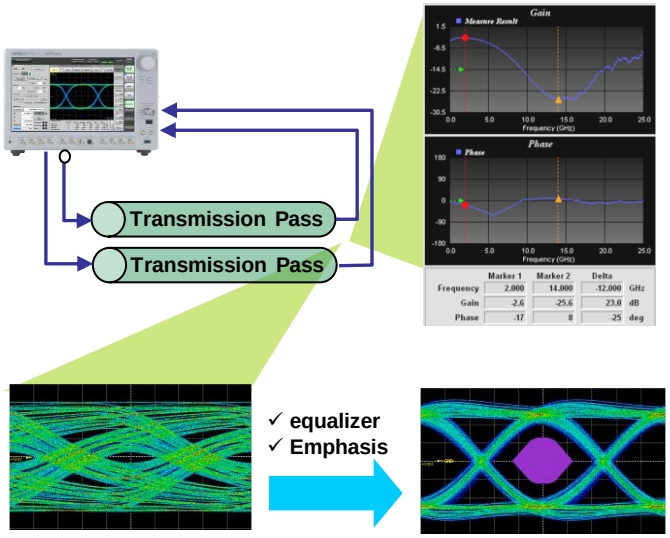
Necessity for Transmission Analysis

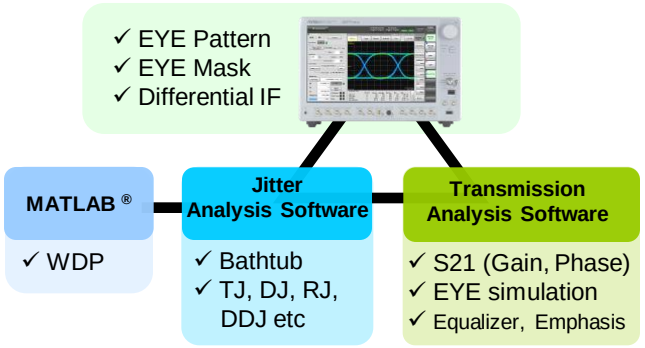
- **Problems with waveform distortion in transmission path**
  - Wavelength dispersion at short optical signal wavelengths
  - Electrical signal High-frequency attenuation
- **Maintain EYE opening using waveform equalization technology**
  - Tx: Emphasis
  - Rx: Equalizer
- **Requires many instruments and complex procedures**
  - Evaluate transmission path attenuation
  - Calculate waveform correction values
  - Reflect correction value in measured waveform
  - Evaluate Eye pattern
- **Requires tools for analyzing optimum emphasis and equalizer setting parameters**



Features ~ MX210002A Transmission Analysis Software ~

- **Transmission Analysis (S21 measurement)**
  - ♦ Measure S21 (gain and Phase) characteristics*1
  - ♦ Measure single-end and differential IFs*2
- **Waveform Simulation (de-embedded)**
  - ♦ Linear equalizer/filter
  - ♦ Emphasis (4 tap max.)
  - ♦ Calculate ideal emphasis from S21 characteristics
- **Simultaneous Measurement with Simulated Waveforms**
  - ♦ EYE Pattern
  - ♦ EYE Mask
  - ♦ Jitter (tracking operation with MX210001A)

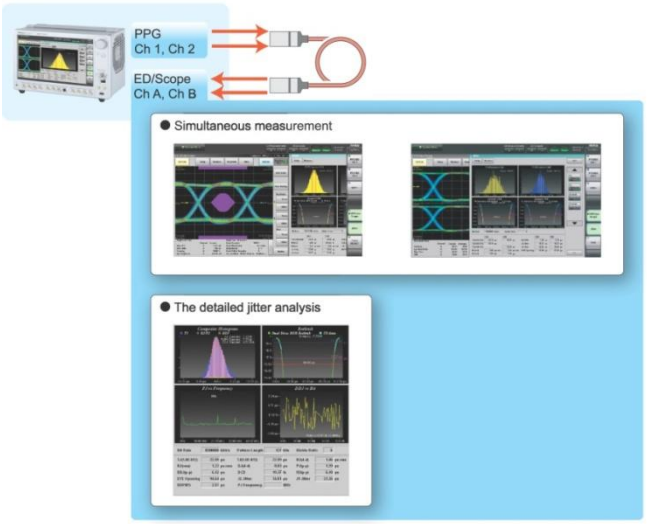




*1: MP2100 with built-in PPG and Scope functions
*2: MP2100A-001 Dual Electrical IF model

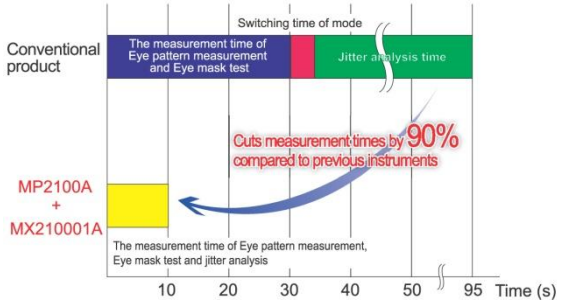
Applications

☐ Active Optical Cable (AOC) Evaluations



Typical Setup

MP2100A	**BERTWave**
MP2100A-003	**Optical/Single-ended Electrical Receiver**
MP2100A-061 to 085	**various Filter Bank and Filter**
MX210001A	**Jitter Analysis Software**
MX210002A	**Transmission Analysis Software**



Active Optical Cable (AOC) Measurements

- **EYE Pattern analysis**
  - ➢ Tr/Tf, amplitude, etc.
- **Eye Mask test**
- **Jitter analysis**
  - ➢TJ, DJ, RJ, DDJ measurements, DDPWS, etc.

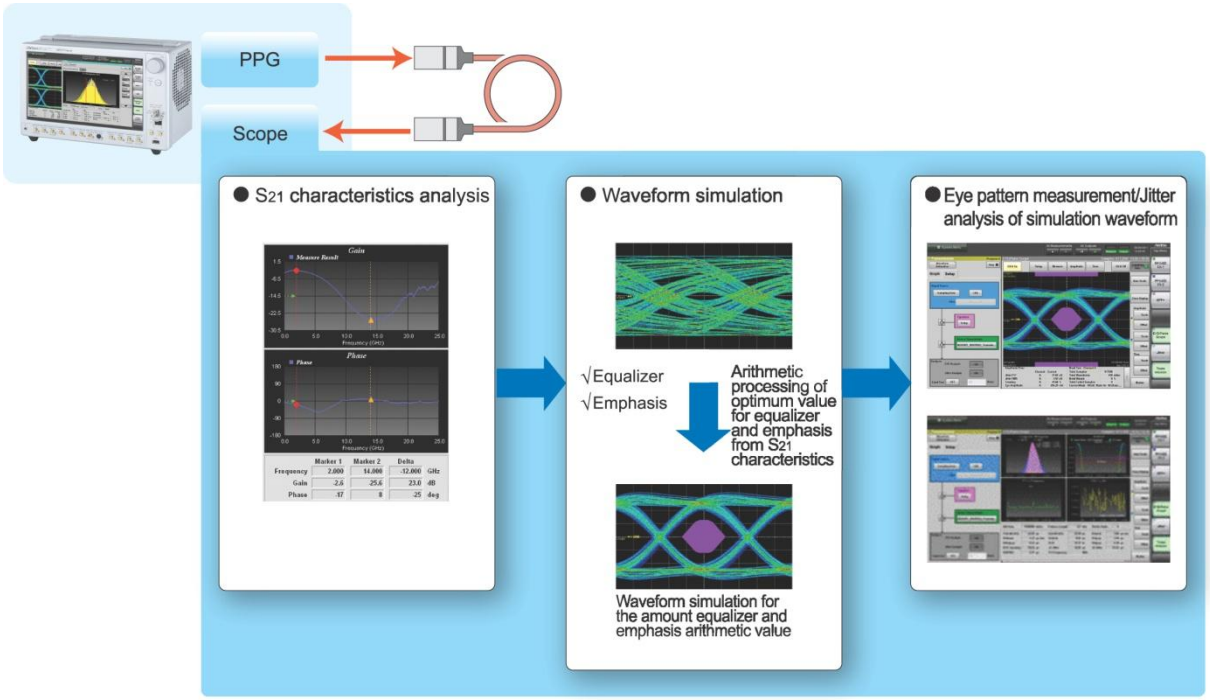
Typical values when capturing 1 million samples at Bit Rate: 10.3125Gbit/s, Test pattern: PRBS15, Back-to-back measurement

Fast Simultaneous Measurements

- ♦**Simultaneous Jitter measurement and EYE Pattern and EYE Mask tests**
- ♦**Fast sampling**
- ♦**Fast DDJ measurement using fast triggering method**
- ♦**Cuts measurement times by 90% compared to conventional instruments**

Applications

Direct Attached Cable (DAC) Measurements



Typical Setup

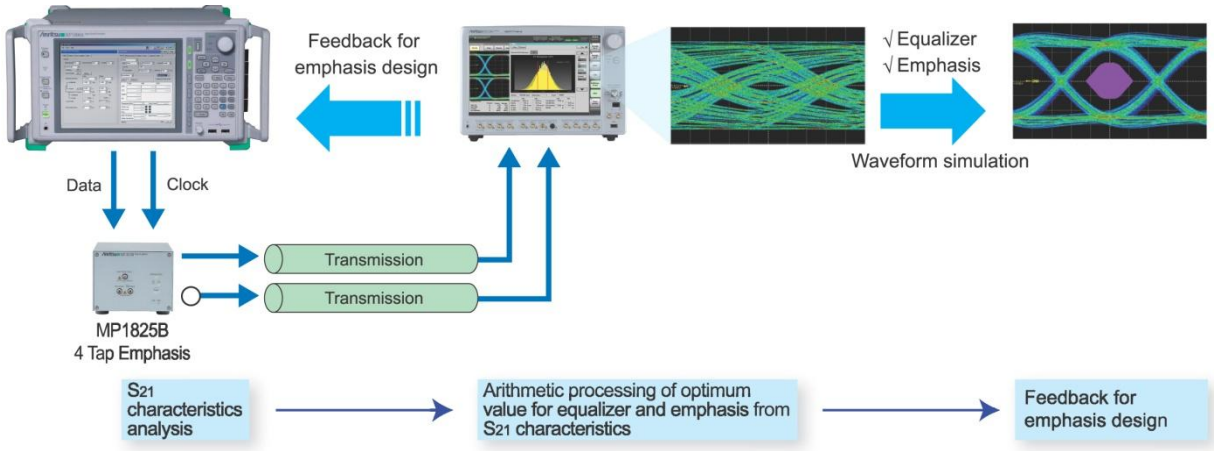
MP2100A	BERTWave
MP2100A-001	Dual Electrical Receiver
MX210001A	Jitter Analysis Software
MX210002A	Transmission Analysis Software

Waveform Simulation/Fast Jitter Analysis

- Measure DUT S21 (Gain and Phase) characteristics
- Calculate ideal equalizer, filter and emphasis values from transmission characteristics and estimate waveform
- Analyze simulation waveform Eye Pattern and run Eye Mask tests

Applications

Emphasis Effect Simulation



Typical Setup

MP2100A	BERTWave
MP2100A-001	Dual Electrical Receiver
MX210002A	Transmission Analysis Software

Emphasis Design Support

- **Confirm EYE Pattern when corrected with equalizer and emphasis**
  - **Set emphasis for 4 taps max.**
    - ✓ Same as MP1825B 4 Tap Emphasis Converter
- **Feedback to emphasis design**
  - Simulate ideal equalizer and emphasis values

Summary

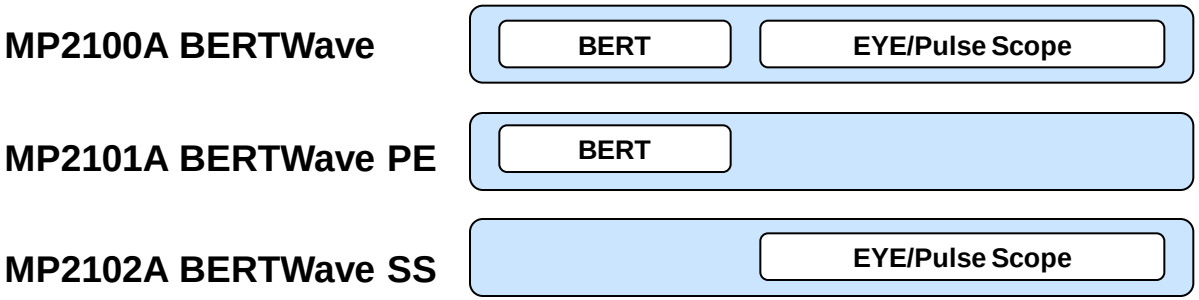
- All-in-one waveform simulation and simulated waveform EYE Pattern analysis, EYE Mask tests and Jitter analysis
- Jitter Analysis Software supports fast Jitter and WDP measurements
- High-speed Jitter measurements

Appendix

MP210xA BERTWave Series

~ 18-cm Thin, All-in-One BERT and Eye/Pulse Scope ~

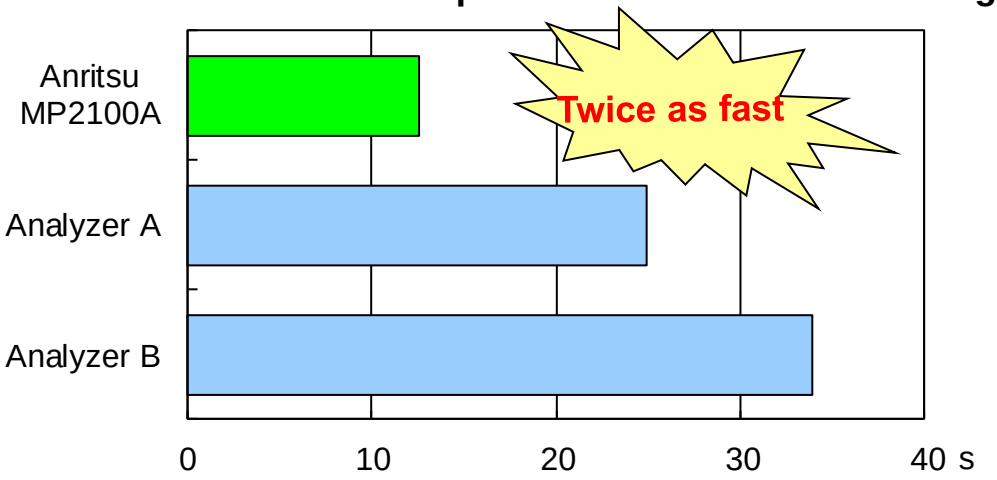
- **Fast Measurements**
  - ♦All-in-one simultaneous BER measurement and EYE Pattern analysis
  - ♦100 ksa/s sampling speeds
- **High Reproducibility**
  - ♦Extinction ratio measurement reproducibility of ±0.05dB (typ.)
- **Compact and Lightweight**
  - ♦Compact (18 cm thin) and lightweight (7 kg) design
- **Three Configurations with Strengthened Support for Optical Transceiver/Component Evaluations**

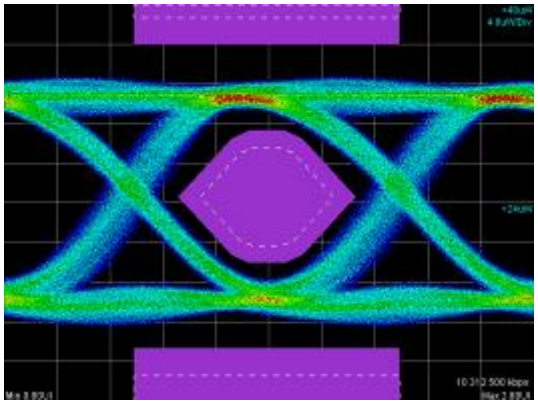


High-Speed Measurements

Two Times Faster than Conventional Instruments

- **Auto Scale + 1M Sample measurement + Mask Margin auto-measurement**





Measurement Time

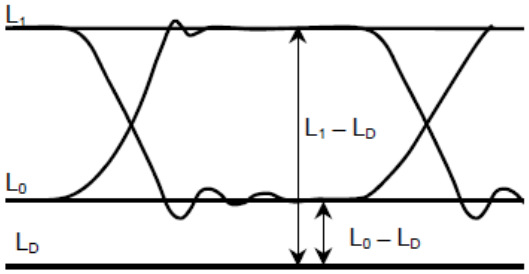
unit: [s]

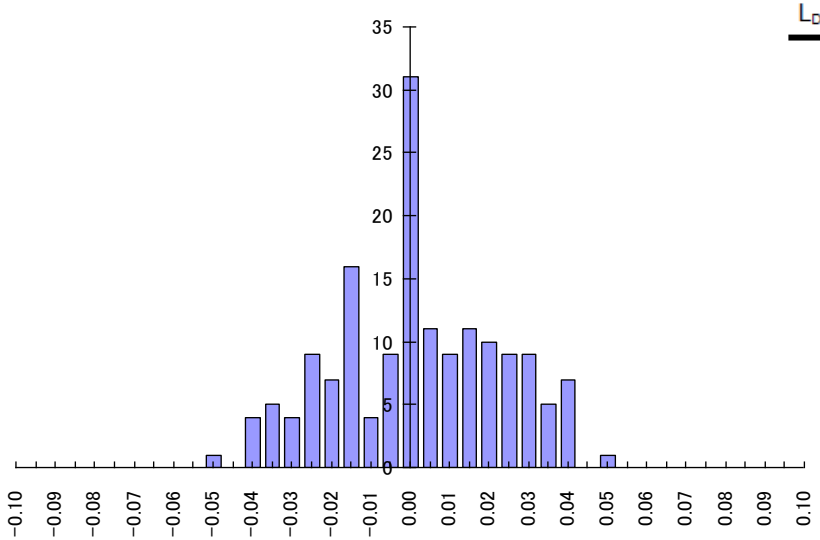
Measurement Items	Anritsu MP2100A	Analyzer A	Analyzer B
Auto Scale	2.5	3.0	3.8
1Msa Accumulation	10	9.9	30
Mask margin test	0.1 (Automatic)	12 (Manual search)	0.1 (Automatic)
Total	**12.6**	**24.9**	**33.9**

Extinction Ratio Measurement Reproducibility

Extinction Ratio Measurement Reproducibility/Instrument Error

- **Measurement dispersion held to ±0.0 5dB (typ.)**
  - Max. Error : ±0.05 dB
  - SD : 1.1%
  - 99% CL : ±0.05 dB





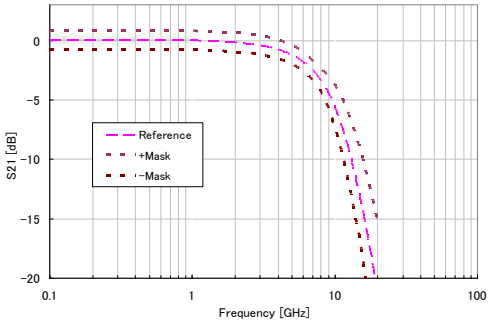
Typical instrument error values based on average value for each bit rate and extinction ratio setting
Statistics normalized for 162 samples
Random selection of actual measurements for 54 samples x three MP2100A units

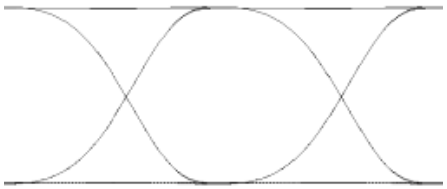
Excellent Reference Receiver Frequency Characteristics

Measuring Instrument Error and Receiver Frequency Characteristics

- Drift in Rx frequency characteristics causes waveform distortion
- Mask margin results can be over or underestimated due to dependence of DUT characteristics on waveform distortion
  - **Drift from ideal value and individual error**
- MP2100A uses newly developed Bessel filter* to achieve ideal receiver frequency characteristics
  - **Almost ideal value and small individual error**

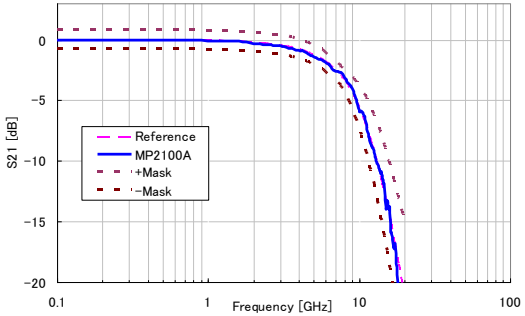
ITU-T G.691/G.957
Reference Receiver characteristics

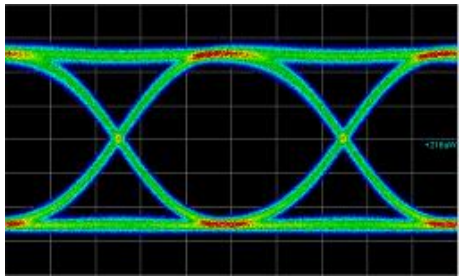




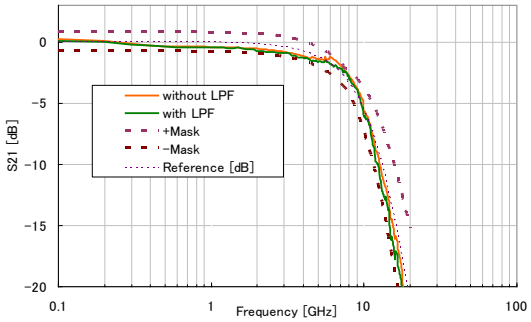
Simulation Waveform

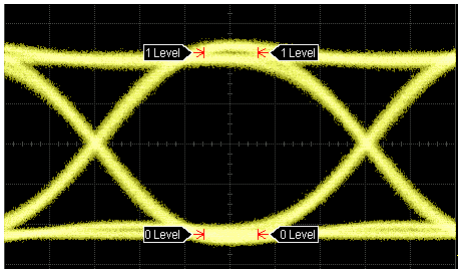
MP2100A





Analyzer B





Anritsu Product Line

Signal Quality Analyzer
MP1800A Series

Measurement solution:
- 10/25/40/56 Gbit/s device tests
- High-end R&D

Features:
- Wideband BERT: 0.1 to 56 Gbit/s
- High-quality waveform
- Multichannel configuration
- Signal integrity tests, such as Bathtub tests

Jitter Generation

Emphasis

Jitter Analysis

WDP Analysis

Equalizer Simulation

High-Speed BERT

Optical Spectrum Analyzer
MS9740A

Measurement solution:
- Optical active device evaluation, WDM analysis, EDFA analysis

Features:
- Fast measurement: Sweep time 0.2 s/5 nm
- Wide dynamic range: >58 dB
- Wide meas. wavelength range: 600 to 1750 nm
- Minimum wavelength resolution: 30 pm

OSA

EYE Pattern Analyzer with 10G BERT

BERTWave
MP2100A Series

Solution:
- 10 Gbit/s BER tests, EYE pattern analysis
- Economic R&D and Manufacturing

Features:
- All-in-one solution supporting BERT and Scope
- BERT expansion to 2 channels
- Fast remote control and high-speed eye mask tests
- Compact design (180-mm deep)

Anritsu

Specifications are subject to change without notice.

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