BERTWave™
MP2110A

All In One

4ch BERT+ Sampling Oscilloscope

Anritsu envision: ensure
Reduce cost. Increase productivity.


BERTWave MP2110A
Multi-channel Optical Module, Device Manufacturing and Development

Data traffic volumes are exploding with the spread of fixed-rate video streaming and cloud services. As a result, there is a need for optical interfaces for transmission equipment supporting speeds of more than 10 Gbit/s as 100 GbE and even 400 GbE and 800 GbE networks are deployed. However, there are increasing requests for less-expensive optical interfaces due to major problems with how to increase line productivity and cut costs.

The BERTWave MP2110A is an all-in-one instrument with built-in BERT (Bit Error Rate Tester) and Sampling Oscilloscope (Eye pattern analysis) designed for manufacturing inspection of 25G to 800G optical modules. It helps increase line productivity and cuts costs.

All-in-one 4ch 28.2Gbit/s BERT + 4ch sampling oscilloscope
There is a built-in Clock Recovery Unit for Sampling Oscilloscope

Customized test systems can be configured as necessary by combining options freely.

Easy, fast and high-sensitivity analysis of PAM4 signals including TDECQ with support for clock recovery

The high-speed sampling oscilloscope captures 1 million samples in 4 seconds. Measurement times are slashed by measuring four channels in parallel. Built-in PC for Stable Operation

The high-sensitivity sampling oscilloscope supports accurate performance even for PAM4 signals with a closed Eye opening, and for optical signals attenuated by optical switches, etc.

Supported Applications: Evaluation of physical-layer performance for 25G/50G/100G/200G/400G/800G optical transport modules, optical cables, and associated parts used by data centers, Core/Metro networks, 4G/5G mobile backhaul, and 5G mobile fronthaul

Transmission Paths: Ethernet, eCPRI/ROE, CPRI, SDH/SONET, OTN, InfiniBand, Fibre Channel
Optical Transceiver Modules: SFP28, QSFP28, CFP2/4/8, SFP56, QSFP56, OSFP, QSFP-DD
Cables: Active Optical Cables (AOC), Direct Attach Cables (DAC)
Devices: TOSA, ROSA, High-Speed Optical Engine, PHY, Driver ICs
Previous measurement systems were extremely complex due to the need for a separate BERT as the signal source and a sampling oscilloscope for Eye pattern analysis. Incorporating a BERT and sampling oscilloscope into the All-in-one BERTWave MP2110A greatly simplifies measurement system configuration.

Installing the BERT and sampling-oscilloscope options for up to 4ch in one unit makes it easy to implement simultaneous TRx measurements of optical modules, such as multichannel QSFP, and devices using an easily configured and controlled measurement system. This helps cut growing measurement times as the number of channels increases with development of multichannel optical modules and devices.

With a BERT and sampling oscilloscope in one box, measurement results can be captured all at once along with simultaneous Eye pattern display. As a result, all the measurement results needed to evaluate multi-channel optical modules and devices can be seen at a glance, reducing measurement times by large margins.

Simply setting one channel of the MP2110A sets all channels simultaneously. Operation is easy with simple settings and user interface. Remote commands are backwards-compatible with all BERTWave series, such as the MP2100B, facilitating instrument upgrades.
Configuring Efficient Measurement System:
Both Simultaneous All-Channel and Individual-Channel Measurement

As well as all-at-once simultaneous measurement of all channels using the sampling oscilloscope and BERT, individual channels can be measured separately. An evaluation system matching the application can be configured easily because both multichannel modules and multiple single-channel modules can be measured all at once.

Supports Both Test Methods

- **Simultaneous All-Channel Measurement**
  - All-at-once testing of 4-waveform module using simultaneous measurement of all channels
  - Shorter test times increase throughput

- **Individual-Channel Measurement**
  - Parallel testing of four separate 1-waveform modules using separate measurement of each channel
  - Reduced cost per channel cuts capital investment

4ch PAM4 TDECQ Measurement

4ch NRZ Mask Margin Measurement
Configuring Efficient Measurement System: Built-in Clock Recovery

Sampling oscilloscopes for signal waveform quality evaluation require a separate trigger clock signal synchronized with the data signal, but transmission equipment with built-in optical modules and 50G to 800G optical modules outputting PAM4 signals sometimes do not have a trigger signal. In this case, the trigger signal is generated from the data signal using clock recovery. This optional Clock Recovery Unit (CRU) can be installed in the BERTWave MP2110A Sampling Oscilloscope.

### Optical module and Optical transmission equipment

- **QSFP-DD/OSFP**: 400G DR4/FR4/SR8/FR8/LR8 (PAM4)
- **QSFP28**: 100G SR4/PSM4/CWDM4/LR4 (NRZ)
- **SFP**: 50G SR/FR/LR (PAM4)
- 25G SR/LR (NRZ)

### Excellent Operability at Lower Cost

Since this clock recovery is built-in, it offers excellent operability at a lower price. The space-saving design and reduced need for complex cable connections as well as the easy-to-use settings help cut initial capital costs.

### Wide Range of High-Performance Applications

The following clock recovery unit options are available:

- **Option 055**: Supports newest 53 Gbaud PAM4 signals (106 Gbit/s)
- **Option 054**: Supports 26 Gbaud multimode signals

These options can be combined freely to configure a flexible test system matching the site requirements at optimum cost. When all options are installed, various types of 100/200/400GbE optical modules can be evaluated without a trigger clock using one MP2110A unit.

In addition, combination with a 4ch oscilloscope supports all-at-once measurement using the recovered trigger signal to help cut evaluation times for multichannel optical modules.

### High Performance

When using high-sensitivity modules, the impact of insertion loss on the data waveform is minimized by optimizing internal division ratios, demonstrating its usefulness when monitoring signal waveforms requiring high sensitivity. Additionally, there is no waveform degradation due to multimode splitting because Option 054 performs signal splitting for input to the CRU and oscilloscope using electrical signals after O/E conversion.

### Without CRU vs. With CRU

*Waveform comparison at –2 dBm input*
Fast and Stable Measurement Performance

The MP2110A supports high-speed sampling at 250 ksamples/s. Measurement of 1 million samples can be completed in about 5 s, cutting pattern analysis time by about 65% compared to previous instruments.

The MP2110A requires no external Windows PC controller, because it has a built-in PC for measurement processing. It supports high-speed processing irrespective of external PC controller specifications.

More Accurate Performance Confirmation: Sampling Oscilloscope Performance

Sampling Oscilloscope Functions
The MP2110A sampling oscilloscope has all the performance necessary for measuring optical modules such as 25G to 800G, and optical devices used by optical modules.

- **Bandwidth:**
  - Optical: 35 GHz (SMF), 25 GHz (MMF)
  - Electrical: 40 GHz
- **High Sensitivity:** –15 dBm (typ. SMF)*
- **Low Noise:** 3.4 µW (typ. SMF)
- **Low-Jitter:** 200 fs rms (typ.)

The low-noise and high-sensitivity O/E plus low-jitter trigger support more accurate measurements of narrow Eye openings of PAM4 signals as well as attenuated signals passing through optical switches, etc., helping improve production-line yields.

In comparison to conventional instruments, the wideband O/E draws accurate patterns of the characteristics of directly driven optical signals and optical modules for long-distance transmissions.
Full Range of Measurement Functions (Sampling Oscilloscope)

Sampling oscilloscope supports both NRZ and PAM4 analysis.

![Oscilloscope Display](image)

Selection of displays for up to 32 measurement items supports confirmation of multiple PAM measurement results at one screen. Additionally, all measurement results, including items not displayed on-screen, can be captured simultaneously using remote control.

### NRZ

- Average Power (dBm, μW)*1
- Mask Margin (%)
- Extinction Ratio (dB)*1
- OMA (dBm, μW)*1
- VECP (dB)*1
- RIN OMA*1, *4
- TDEC*1, *2
- One Level, Zero Level
- Eye Amplitude, Eye Height, Eye Height Ratio
- Crossing (%)
- SNR
- Jitter (P-P, RMS) (ps)
- Rise Time, Fall Time (ps)
- Eye Width (ps)
- DCD (%)

### PAM4 (Option 095)

- Average Power (dBm, μW)*1
- TDECQ (dB), Partial TDECQ, Ceq*1
- Outer Extinction Ratio (dB)*1
- Outer OMA (μW)*1
- RIN OMA*1
- Transmitter Transition Time (Rise/Fall/Slowest)*1
- Transmitter Over/Under-shoot*1
- Transmitter Peak-to-Peak Power*1
- Linearity
  - Levels 0/1/2/3
  - Levels P-P, RMS 0/1/2/3
  - Level Skews 0/1/2/3 (ps)
  - Eye Levels Upper/Middle/Lower
  - Eye Heights Upper/Middle/Lower
  - Eye Widths Upper/Middle/Lower (ps)
  - Eye Skews Upper/Middle/Lower (ps)

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*1: Optical signals only  
*2: No IEEE 12.6 GHz hardware filter  
*3: Option 096  
*4: Option 095
NRZ Mask Margin Measurement
Testing is simple because Mask Margin tests are performed automatically. Furthermore, since the time required for Mask Margin tests is only about 1 second, line productivity is improved because standards-compliant measurements are performed at high speed in a shorter time.
• Automatic measurement within 1 second
• Real-time margin measurements
• Selectable Count and Rate at Mask Hit

PAM4 TDECQ Measurement (Option 095)
Easy capture of measurement results without complex settings. The low-noise (3.4 μW, typ.) high-sensitivity oscilloscope supports high-reproducibility measurement of even small Eye margin PAM4 signals. High-speed sampling shortens the time required for data collection for TDECQ analysis. Shorter measurement times help improve productivity even at PAM4 signal evaluation.

NRZ Jitter Analysis (Option 096)
This option supports separate analysis of Jitter components such as TJ, DJ, RJ, etc., with display in various graph formats.
• Fast, easy J2/J9/etc. measurements for manufacturing inspections (Eye Mode)
• Detailed analyses for DJ (Advanced Jitter Mode)
• Simultaneous Jitter Analysis and Eye Mask tests help cut measurement times

Histogram Measurement
Troubleshooting is made easier because waveform data component analysis can be performed using the mean, standard error, and scatter within the set data distribution.

Reference Trace Function
Saving measured waveform data for reference enables comparison of current data with previous data.
More Accurate Performance Confirmation: BERT Performance

Wideband Operation Frequency
In the standard configuration, the MP2110A BERT operates at bit rates of 24.3 Gbit/s to 28.2 Gbit/s. This range can be extended optionally to support bit rates of 9.5 Gbit/s to 14.2 Gbit/s, enabling use for various applications including 10 GbE and 100 GbE.

Excellent PPG/ED Performance
The MP2110A PPG has a low data Jitter of 600 fs rms (typ.) for accurate measurement of the characteristics of optical modules, optical devices, etc. Additionally, the 25 mV (typ.) ED supports BER measurement of low-amplitude signals resulting from transmission path losses, helping improve DUT yields.

<table>
<thead>
<tr>
<th>PPG/ED Supported Bit Rates</th>
<th>Application Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>24.3 Gbit/s to 28.2 Gbit/s</td>
<td>32G Fibre Channel, CPRI (Option 10), InfiniBand EDR, 100 GbE, 100 GbE FEC, OTU4</td>
</tr>
<tr>
<td>9.5 Gbit/s to 14.2 Gbit/s (Option 093)</td>
<td>InfiniBand FDR/QDR, Fibre Channel (16G, 10G, 10G FEC), 10 GbE (WAN, LAN), 40 GbE (4 × 10 Gbit/s), CPRI (Option 8, 9), OC-192/STM-64, OC-192/STM-64 FEC (G.975), OTU1e, OTU2, OTU2e</td>
</tr>
</tbody>
</table>

Typical PPG Waveform
25.78125 Gbit/s Electrical Loopback Waveform (at PRBS 31, 200 mV Amplitude, and Precision Trigger Option On)
One Page of a Document

**BERTWave MP2110A Panel Layout**

**Front Panel**

1. **Remote Lamp**
   Lit green while MP2110A under remote control.

2. **Standby Lamp**
   Lit orange while power supplied to MP2110A.

3. **Power Switch**
   Lit green while MP2110A powered-on; flashes during shutdown.

4. **USB Connector**
   USB 2.0 connector for connecting peripheral accessories, such as mouse, keyboard, etc.

5. **Frame Ground**
   For connecting wrist strap and DUT.

**Back Panel**

6. **Display Port**
   For connecting external monitor supporting Display Port specification.

7. **HDMI**
   For connecting external monitor supporting HDMI specification.

8. **USB 3.0**
   For connecting accessories such as keyboard, mouse, external hard disk.

9. **Ethernet**
   For connecting PC or network to control MP2110A remotely.

10. **GPIB Connector**
    For connection to PC to remote control MP2110A.

11. **Power Inlet**
    For connecting accessory power cord.
**Option 03x/04x Oscilloscope**

12 Status Lamp
Lit when remote command received at normal operation.
Color indicates Trigger Clock input status.
- Green: Trigger Clock detected normally
- Red: No trigger Clock detected — check signal input at Trigger Clock Input connector
- Orange: Incorrect trigger clock input frequency setting

13 Fail Lamp
Lit red when hardware fault detected.
This may light briefly at power-on, but there is no abnormality.

14 Trigger Clock Input Connector (SMA)
For trigger input.

15 Channel A/B/C/D Input (K or FC)
This is the oscilloscope signal input. The connector type differs depending on the option. The electrical channel uses a K-connector. The optical channel SMF and MMF can be switched.

**Option 054 CRU**

16 Clock Recovery Unit Output (SMA) (Option 054)
Connect the standard accessory U-link coaxial cable (SMA) to the Trigger Clk In connector for use.

17 Clock Recovery Unit Input (K) (Option 054)

18 O/E Monitor Output (K) (Option 054, Optical channel installed)*
Connect the standard accessory U-link coaxial cable (K) to the CRU In connector for use. Always fit the standard accessory coaxial terminator when not connected.
*: Fit the accessory Terminator when not connected.
The signal cannot be monitored correctly without termination.
**Option 055 CRU**

19 **Status Lamp**
Lit when receiving remote commands at normal start operation. Color indicates clock recovery lock status.
- Green: Locked
- Red: Unlocked (no signal input)
- Orange: Unlocked (incorrect rate setting)

20 **Recovered Clock Output (SMA)**
Clock Recovery Unit output. Connected to Trigger Clk In.

21 **Data Output (FC)**
Branch data input signal output. Connected to oscilloscope SMF optical signal input (Ch A/B/C/D In).

22 **Data Input (FC)**
SM Optical Data signal input

**Option 011/012/014 BERT**

23 **Output Lamp**
Lit green during signal output from PPG connector.

24 **Error Lamp**
Lit orange at following condition at ED.
- Unable to synchronize pattern (Sync Loss)
- Bit error detected

25 **Status Lamp**
Lit green when receiving remote commands at normal start operation

26 **Clock Output Connector (SMA)**
Outputs divided clock.

27 **Sync Clock Output Connector (SMA)**
Outputs PPG Sync clock.
Outputs PPG Sync clock (inverted)*.

28 **External Clock Input Connector (SMA)**
For input of external clock.

29 **PPG Output+/ED Input Connector (K)**
Photograph shows configuration with Option 014 (4ch) installed; Option 011 adds 1ch and Option 012 adds 2ch.

*: Fit the accessory Terminator when not connected.
Multi-channel Optical Module Evaluation

**Required Test Items**

- Rx Electrical Signal Eye Pattern Analysis (NRZ: Mask Margin, Jitter, Tr/Tf, etc.)
- Tx Optical Signal Eye Pattern Analysis (Optical Power, NRZ: Mask Margin, Jitter, Tr/Tf, Extinction Ratio, PAM4: TDECQ, Outer OMA/Extinction Ratio, Linearity etc.)
- Rx Signal Rx Sensitivity Test (BER Measurement)

TOSA/ROSA Evaluation

**Required Test Items**

- Tx Optical Signal Eye Pattern Analysis (Optical Power, NRZ: Mask Margin, Jitter, Tr/Tf, Extinction Ratio, PAM4: TDECQ, Outer OMA/Extinction Ratio, Linearity etc.)
- Rx Signal Rx Sensitivity Test (BER Measurement)

*: Use MP1900A/MP1800A PPG/ED, etc., at PAM4 signal evaluation.
**BERTWave MP2110A Application Examples**

**Active Optical Cables (AOC)/Direct Attach Cables (DAC) Evaluation**

![BERTWave MP2110A](image)

**Required Test Items**

- 4ch Simultaneous BER Measurement (Crosstalk Test)
- Differential Electrical Signal Eye Pattern Analysis
- Differential Electrical Signal Jitter Analysis

**Optimized Measurement Costs**

With All-in-one simultaneous BER measurements and Eye pattern analysis, the MP2110A slashes capital costs by eliminating the need to purchase a separate BERT and sampling oscilloscope. Additionally, easy expandability to up to a 4ch BERT and an optical 4ch sampling oscilloscope supports simultaneous BER measurement at the Rx side of optical modules as well as optical waveforms at the Tx side, slashing multi-channel optical module measurement times by up to 65%.

**Tx/Rx Signal Mask Margin Test, Rx Signal Eye Pattern Analysis (Jitter, Tr/Tf, etc.), Tx Signal Eye Pattern Analysis (Jitter, Tr/Tf, Extinction Ratio, etc.)**

The MP2110A high sampling speed of up to 250 ksamples/s and built-in automatic Mask Margin test function cut Mask Margin test times.

**Rx Signal Reception Sensitivity Test (BER Measurement)**

The MP2110A BERT has a built-in PPG with a low data Jitter of just 600 fs rms (typ.) plus an ED with a high sensitivity of 25 mV (typ.). This excellent ED performance improves line yields by supporting BER measurement of low-amplitude signals after passage through the transmission path.

**4ch Simultaneous BER Measurement (Crosstalk Test)**

Expanding the BERTWave series BERT to up to 4ch supports All-in-one simultaneous Tx/Rx measurements of high-speed, multi-channel AOC and DAC devices now becoming common as well as identification of crosstalk interference. Furthermore, Tx signal Eye pattern analysis is supported by installing the sampling oscilloscope option.

**Differential Electrical Signal High Speed Eye Pattern/Automatic Mask Margin Tests**

Eye pattern analysis of differential electrical signals is supported by installing MP2110A-021. Moreover, the MP2110A high sampling speed of up to 250 ksamples/s and built-in automatic Mask Margin measurement function cut Mask Margin test times. Moreover, installing Option 096 supports jitter analysis of input signals.
# BERTWave MP2110A Specifications

## Common

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote Interfaces</td>
<td>Ethernet, GPIB</td>
</tr>
<tr>
<td>Peripheral Devices</td>
<td>HDMI, Display Port, USB3.0 (4 ports on rear panel), USB2.0 (6 ports on front panel), Ethernet (2 ports, 10/100/1000 Base-T), Line-Out, Mic</td>
</tr>
<tr>
<td>* Screen output requires a display with a resolution of 1280 × 800 or higher</td>
<td></td>
</tr>
<tr>
<td>OS</td>
<td>Windows</td>
</tr>
<tr>
<td>Internal Storage devices</td>
<td>SSD, 60 GB or more</td>
</tr>
<tr>
<td>Power Voltage</td>
<td>100 Vac to 240 Vac, (100 Vac/200 Vac System Auto-switching), 50 Hz/60 Hz</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>≤300 VA</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>+5°C to +40°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>−20°C to +60°C</td>
</tr>
<tr>
<td>Dimensions</td>
<td>422 (W) × 142.5 (H) × 389.4 (D) mm (excluding projections)</td>
</tr>
<tr>
<td>Mass</td>
<td>&lt;11 kg</td>
</tr>
<tr>
<td>CE</td>
<td>EMC 2014/30/EU, EN61326-1, EN61000-3-2</td>
</tr>
<tr>
<td></td>
<td>LVD 2014/35/EU, EN61010-1</td>
</tr>
<tr>
<td></td>
<td>RoHS 2011/65/EU, EN50581</td>
</tr>
</tbody>
</table>

## BERT (shared PPG/ED)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Clock</td>
<td>Frequency: 10 MHz</td>
</tr>
<tr>
<td></td>
<td>Frequency Accuracy: ±10 ppm (1 hour after power-on, design guaranteed)</td>
</tr>
<tr>
<td></td>
<td>Bit Rate Offset: ±100 ppm (common to all channels)</td>
</tr>
<tr>
<td>External Clock Input</td>
<td>Connector: SMA (f)</td>
</tr>
<tr>
<td></td>
<td>Termination: 50Ω, AC coupled</td>
</tr>
<tr>
<td></td>
<td>Amplitude: 0.2 Vp-p to 1.6 Vp-p</td>
</tr>
<tr>
<td></td>
<td>Waveform: Square Wave or Sine Wave</td>
</tr>
<tr>
<td></td>
<td>Division: 1/16 (at operating bit rate of 9.5 Gbit/s to 14.2 Gbit/s)</td>
</tr>
<tr>
<td></td>
<td>1/40 (at operating bit rate of 24.3 Gbit/s to 28.2 Gbit/s)</td>
</tr>
<tr>
<td>Clock Output</td>
<td>Connector: SMA (f)</td>
</tr>
<tr>
<td></td>
<td>Termination: 50Ω, AC coupled</td>
</tr>
<tr>
<td></td>
<td>Clock Source: Ch1/2 or Ch3/4</td>
</tr>
<tr>
<td></td>
<td>Division Ratio: 1/2 (at 9.5 Gbit/s to 14.2 Gbit/s operation bit rate)</td>
</tr>
<tr>
<td></td>
<td>1/4 (at 24.3 Gbit/s to 28.2 Gbit/s operation bit rate)</td>
</tr>
<tr>
<td></td>
<td>Amplitude: 0.3 Vp-p to 0.5 Vp-p</td>
</tr>
<tr>
<td></td>
<td>Duty: 50 ±10%</td>
</tr>
<tr>
<td>Sync Output</td>
<td>Connector: SMA (f)</td>
</tr>
<tr>
<td></td>
<td>Division Ratio: Pattern Sync, 1/8, 1/16, 1/40</td>
</tr>
<tr>
<td></td>
<td>Output Level</td>
</tr>
<tr>
<td></td>
<td>High Level (V_{OH}): −0.2 V to 0.05 V</td>
</tr>
<tr>
<td></td>
<td>Low Level (V_{OL}): −1.2 V to −0.7 V</td>
</tr>
<tr>
<td>Operation Bit Rates</td>
<td>24.3 Gbit/s to 28.2 Gbit/s</td>
</tr>
<tr>
<td></td>
<td>9.5 Gbit/s to 14.2 Gbit/s (with Option 093 installed)</td>
</tr>
<tr>
<td></td>
<td>(in 1 kbit/s steps)</td>
</tr>
</tbody>
</table>
## BERTWave MP2110A Specifications

### PPG

**Number of Channels**
- MP2110A-011: 1 (Data Out, Data Out)
- MP2110A-012: 2 (Data Out, Data Out)
- MP2110A-014: 4 (Data Out, Data Out)

**Connector:** K (f)

**Amplitude**
- Setting Range: 0.1 Vp-p to 0.8 Vp-p, 10 mV steps (single-end)
  - 0.2 Vp-p to 1.6 Vp-p, 20 mV steps (differential output)
- Accuracy: ±0.02 V ± 20% for settings (at 25.78125 Gbit/s)
- Data Crossing: 50% ±10% (at 25.78125 Gbit/s, 0.3 Vp-p Amplitude)
- Tr/ff (20 to 80%): 15 ps (typ.), 17 ps (max.) (at 25.78125 Gbit/s, 0.3 Vp-p Amplitude)

<table>
<thead>
<tr>
<th>Jitter (rms)</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>600 fs</td>
<td>900 fs</td>
</tr>
<tr>
<td></td>
<td>900 fs</td>
<td>1200 fs</td>
</tr>
<tr>
<td>Intrinsic RJ (rms)</td>
<td>400 fs</td>
<td>600 fs</td>
</tr>
<tr>
<td></td>
<td>800 fs</td>
<td>1000 fs</td>
</tr>
</tbody>
</table>

*1: At 25.78125 Gbit/s, 0.3 Vp-p Amplitude, at 25°C ±5°C test pattern PRBS 2^31 – 1
*2: At 25.78125 Gbit/s, 0.3 Vp-p Amplitude, at 25°C ±5°C, 1/16 Clock Pattern
*3: With MP2110A-014 installed and when measurement channel and same channel clock source selected
  Example: Ch1/2 selected as clock source and measuring Ch1
*4: With MP2110A-014 installed and when measurement channel and different channel clock source selected
  Example: When Ch3/4 selected as clock source and measuring Ch1

**Data Format:** NRZ

**Test Patterns**
- PRBS: 2^7 – 1, 2^9 – 1, 2^15 – 1, 2^23 – 1, 2^31 – 1
- Auxiliary Pattern: 1/2 Clock Pattern, 1/16 Clock Pattern

**Functions**
- Output On/Off, Pattern Inversion, Error addition

### ED

**Input Number**
- MP2110A-011: 1 (Data, Data, Differential Input)
- MP2110A-012: 2 (Data, Data Out, Differential Input)
- MP2110A-014: 4 (Data, Data Out, Differential Input)

**Connector:** K (f)

**Termination:** 50Ω, AC coupled * The DC component is terminated to GND via a 50Ω.

**Data Format:** NRZ, Mark Ratio 50%, single-end or differential input

**Amplitude:** 0.05 Vp-p to 0.8 Vp-p

**Threshold:** –0.085 V to +0.085 V, 1 mV steps (single-end input, with external ATT factor of 0 dB)

**Sensitivity:**
- 25 mVp-p typ. (20°C to 30°C)
- 40 mVp-p max.

**40 mVp-p max.**
- 25.78125 Gbit/s bit rate, PRBS 2^31 – 1 test pattern, single-end, Mark Ratio 1/2, loopback connection

**Jitter Tolerance:** 25.78125 Gbit/s bit rate, PRBS 2^31 – 1 test pattern, single-end, 50 mV amplitude

**Clock Recovery**
- Built-in

**Test Patterns**
- PRBS: 2^7 – 1, 2^9 – 1, 2^15 – 1, 2^23 – 1, 2^31 – 1, Inverted Pattern

**Measurements**
- Alarm Detection: Sync Loss (test pattern and asynchronous)
- Bit Error Rate Detection
  - Error Rate: 0.0001E–18 to 1.0000E–03
  - Error Count: 0 to 9999999, 1.0000E07 to 9.9999E17
- Regenerating Clock Detection: Input signal frequency (sampling method)
- History: Sync Loss, Bit Error (display reset supported)

**Gate Settings**
- Measurement time: 1 second to 9 days 23 hours 59 minutes 59 seconds
- Gating cycle: Single/Repeat/Untimed
- Display update interval: Can display results during measurement (Current)
### Sampling Oscilloscope

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sampling Mode</strong></td>
<td>Eye, Pulse, Coherent Eye, Advanced Jitter (Option 096)</td>
</tr>
<tr>
<td><strong>Sampling Speed</strong></td>
<td>250 ksamples/s (nominal, Sampling Mode Eye, Number of Samples 1350, 25.78125 Gbaud bit rate, 6.4453125 GHz clock rate, 2UI bit count)</td>
</tr>
<tr>
<td><strong>NRZ Measurement</strong></td>
<td>Average Power (dBm, μW)<em>, Extinction Ratio</em>, OMA (dBm, μW)<em>, OMA at Crossing</em>, VECP*, RIN OMA*, RIN OMA*&lt;sup&gt;4&lt;/sup&gt;, TDECQ*&lt;sup&gt;4&lt;/sup&gt;, <em>4, RIN OMA</em>&lt;sup&gt;4&lt;/sup&gt;, One Level, Zero Level, Eye Amplitude, Eye Height, Eye Height Ratio, Crossing, SNR, Jitter (p-p, RMS), Rise Time, Fall Time, Eye Width, DCD</td>
</tr>
<tr>
<td><strong>NRZ Mask Test</strong></td>
<td>Supported Masks: Selected by filter, user created Mask Adjustment: Auto Align, user defined Margin Type: Hit Count, Hit Ratio</td>
</tr>
<tr>
<td><strong>NRZ Jitter Analysis (Option 096)</strong></td>
<td>TJ (J2, J4, J9, User Defined BER, Eye Opening), RJ (d-d), RJ (rms)&lt;sup&gt;3&lt;/sup&gt;, DJ (d-d), PJ (p-p)&lt;sup&gt;3&lt;/sup&gt;, PJ Frequency&lt;sup&gt;3&lt;/sup&gt;, DDJ (p-p)&lt;sup&gt;3&lt;/sup&gt;, DDPWS&lt;sup&gt;3&lt;/sup&gt;, DCD&lt;sup&gt;3&lt;/sup&gt; Graph: TJ/RJ/PJ/DJ Histogram, DDJ vs. Bit, Bathtub, PJ vs. Frequency</td>
</tr>
<tr>
<td><strong>PAM4 Measurement (Option 095)</strong></td>
<td>Average Power (dBm, μW)*, TDECQ&lt;sup&gt;4&lt;/sup&gt;, Partial TDECQ&lt;sup&gt;4&lt;/sup&gt;, Ceq&lt;sup&gt;4&lt;/sup&gt;, Outer ExR&lt;sup&gt;4&lt;/sup&gt;, Outer OMA&lt;sup&gt;4&lt;/sup&gt;, RIN OMA&lt;sup&gt;4&lt;/sup&gt;, Transmitter Transition Time (Rise/Fall/Slowest)&lt;sup&gt;3&lt;/sup&gt;, Transmission Over/Under-shoot&lt;sup&gt;3&lt;/sup&gt;, Transmitter Peak-to-Peak Power&lt;sup&gt;3&lt;/sup&gt;, Linearity, Levels 0/1/2/3, Levels RMS (0/1/2/3), Levels P-P (0/1/2/3), Level Skews (0/1/2/3), Eye Levels (Upper/Middle/Lower), Eye Heights (Upper/Middle/Lower), Eye Widths (Upper/Middle/Lower), Eye Skews (Upper/Middle/Lower)</td>
</tr>
<tr>
<td><strong>PAM4 TDECQ Measurement (Option 095)</strong></td>
<td>TDECQ Equalizer No. of Taps: 3 to 13 Tap Width: 1 UI (T-spaced) Threshold Adjustment (IEEE802.3cd) Target SER can be specified</td>
</tr>
</tbody>
</table>

*1: Optical signals only  
*2: No IEEE 12.6 GHz hardware filter  
*3: Enabled when Advanced Jitter Mode  
*4: Enabled when Coherent Eye Mode  
*5: Option 095

### Sampling Oscilloscope (Horizontal System)

**Trigger Clock Input**
- Connector: SMA (f)  
- Termination: 50Ω, AC coupled  
- Frequency: 0.1 GHz to 15.0 GHz  
- Division Ratio: 1 to 99 (but 1, 2, 4, 8, 16, 32, 40, 48, 64 only in Pulse Mode and Coherent Eye Mode)  
- Trigger clock Sensitivity: 100 mVp-p (typ.), 200 mVp-p (max., typ. value using Option 024)  
  - *Specified as square-waveform input but also supports sine-wave input above 1 GHz  
- Max. Amplitude: 1.2 Vp-p  
- Absolute Max input: 2 Vp-p  
- RMS Jitter

<table>
<thead>
<tr>
<th>Option</th>
<th>1ch, 2ch</th>
<th>4ch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trigger Clock Frequency (GHz)</td>
<td>0.1 to 1.25</td>
<td>1.25 to 15</td>
</tr>
<tr>
<td>Typ.</td>
<td>1.0 ps</td>
<td>400 fs</td>
</tr>
<tr>
<td>Max.</td>
<td>1.5 ps</td>
<td>1.35 ps</td>
</tr>
</tbody>
</table>

*: Option 024 Precision Trigger On

### Sampling Oscilloscope (Electrical Channel)

**Data Input**
- Connector: K (f)  
- Termination: 50Ω, DC coupled  
- Absolute Max. Rating: ±2 V  
- Dynamic Range: ±400 mV (Relative value of amplitude offset), Recommended input amplitude ±400 mVp-p

**Amplitude Setting**
- Scale: 1 mV/Div to 200 mV/Div, 1 mV steps  
- Off-set: –500 mV to +500 mV, 1 mV steps

- ± amplitude accuracy ±2% for read value (Calculation example: At 400 mV amplitude read value and 50 mV offset voltage)  
- The following figure shows the amplitude accuracy after calibration.

**Amplitude Accuracy**

- 3-dB Bandwidth: 40 GHz (typ.)  
- Flatness: ±1 dB (10 MHz to 30 GHz, typ.)  
- RMS Noise: 1.5 mV (typ.)  
- 2.5 mV (max.)
### Sampling Oscilloscope (Optical Channel)

#### Connector

<table>
<thead>
<tr>
<th>Wavelength, Fiber Coupling</th>
<th>Fiber Coupling</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMF 1 ch, 2ch</td>
<td>62.5 μm GI Multimode fiber, accepts Single Mode fiber</td>
</tr>
<tr>
<td>4 ch</td>
<td>Single Mode fiber</td>
</tr>
<tr>
<td>MMF 1 ch, 2ch, 4ch</td>
<td>62.5 μm GI Multimode fiber, accepts Single Mode fiber</td>
</tr>
</tbody>
</table>

#### Bandwidth (No Filter)

<table>
<thead>
<tr>
<th>Wavelength, Fiber Coupling</th>
<th>SMF: 35 GHz (typ.)</th>
<th>MMF: 25 GHz (typ.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 GbE/4 (25.78125 Gbit/s)</td>
<td>50 GbE/100 GbE/200 GbE/400 GbE</td>
<td></td>
</tr>
<tr>
<td>100 GbE/4 FEC (27.7393 Gbit/s)</td>
<td>26.5625 Gbaud MM TDECQ (11.2 GHz)</td>
<td></td>
</tr>
<tr>
<td>OTU4 (27.952493 Gbit/s)</td>
<td>26.5625 Gbaud (12.6 GHz) IEEE802.3cd draft2.0</td>
<td></td>
</tr>
<tr>
<td>32GFC (28.05 Gbit/s)</td>
<td>26.5625 Gbaud SM TDECQ (13.3 GHz)</td>
<td></td>
</tr>
<tr>
<td>1260 nm to 1650 nm</td>
<td>53.1250 Gbaud SM TDECQ (16.6 GHz)</td>
<td></td>
</tr>
<tr>
<td>860 nm to 1650 nm</td>
<td>53.1250 Gbaud (38.7 GHz)</td>
<td></td>
</tr>
<tr>
<td>62.5 μm GI Multimode fiber, accepts Single Mode fiber</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Filters

<table>
<thead>
<tr>
<th>SMF</th>
<th>MMF</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTU4 Filter</td>
<td>OTU4 Filter</td>
</tr>
<tr>
<td>03x (excluding 030)</td>
<td>Typ. 3.4 µWrms, Max. 4.3 µWrms (Typ. 4.8 µWrms, Max. 6.1 µWrms)</td>
</tr>
<tr>
<td>04x (excluding 040)</td>
<td>Typ. 4.1 µWrms, Max. 5.2 µWrms (Typ. 5.8 µWrms, Max. 7.4 µWrms)</td>
</tr>
<tr>
<td>030</td>
<td>Typ. 4.8 µWrms, Max. 6.1 µWrms (Typ. 6.8 µWrms, Max. 8.6 µWrms)</td>
</tr>
<tr>
<td>040</td>
<td>Typ. 5.8 µWrms, Max. 7.3 µWrms (Typ. 8.2 µWrms, Max. 10.4 µWrms)</td>
</tr>
<tr>
<td>No Filter</td>
<td></td>
</tr>
<tr>
<td>03x (excluding 030)</td>
<td>Typ. 5.4 µWrms, Max. 7.5 µWrms (Typ. 7.6 µWrms, Max. 10.6 µWrms)</td>
</tr>
<tr>
<td>04x (excluding 040)</td>
<td>Typ. 5.5 µWrms, Max. 7.5 µWrms (Typ. 7.8 µWrms, Max. 10.6 µWrms)</td>
</tr>
<tr>
<td>030</td>
<td>Typ. 7.6 µWrms, Max. 10.6 µWrms (Typ. 10.8 µWrms, Max. 15.0 µWrms)</td>
</tr>
<tr>
<td>040</td>
<td>Typ. 7.8 µWrms, Max. 10.6 µWrms (Typ. 11.0 µWrms, Max. 15.0 µWrms)</td>
</tr>
<tr>
<td>No Filter</td>
<td></td>
</tr>
<tr>
<td>03x</td>
<td>Typ. 6.7 µWrms, Max. 8.4 µWrms (Typ. 9.5 µWrms, Max. 11.9 µWrms)</td>
</tr>
<tr>
<td>04x</td>
<td>Typ. 7.0 µWrms, Max. 8.9 µWrms (Typ. 9.9 µWrms, Max. 12.6 µWrms)</td>
</tr>
<tr>
<td>030</td>
<td>Typ. 8.1 µWrms, Max. 10.5 µWrms (Typ. 11.4 µWrms, Max. 14.9 µWrms)</td>
</tr>
<tr>
<td>04x</td>
<td>Typ. 8.6 µWrms, Max. 11.1 µWrms (Typ. 12.1 µWrms, Max. 15.7 µWrms)</td>
</tr>
</tbody>
</table>

### Optical Noise

<table>
<thead>
<tr>
<th>Wavelength, Fiber Coupling</th>
<th>SMF (1310 nm OTU4 Filter)</th>
<th>MMF (850 nm OTU4 Filter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>03x (excluding 030)</td>
<td>–15 dBm (–13.5 dBm)</td>
<td></td>
</tr>
<tr>
<td>04x (excluding 040)</td>
<td>–14 dBm (–12.5 dBm)</td>
<td></td>
</tr>
<tr>
<td>030</td>
<td>–13.5 dBm (–12 dBm)</td>
<td></td>
</tr>
<tr>
<td>040</td>
<td>–12 dBm (–10.5 dBm)</td>
<td></td>
</tr>
</tbody>
</table>

### Mask Sensitivity

<table>
<thead>
<tr>
<th>Wavelength, Fiber Coupling</th>
<th>Mask Margin (Hit Count 0) reaches 0% (calculated from optical noise)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMF (1310 nm OTU4 Filter)</td>
<td>–2 dBm (at 1310 nm, ExR 8 dB signal input)</td>
</tr>
<tr>
<td>MMF (850 nm OTU4 Filter)</td>
<td>+2 dBm (at 850 nm, ExR 3 dB signal input)</td>
</tr>
</tbody>
</table>

### Amplitude Setting

<table>
<thead>
<tr>
<th>Wavelength, Fiber Coupling</th>
<th>Typical Maximum Input Power (Before Distortion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMF 1 ch, 2ch</td>
<td>–2 dBm (at 1310 nm, ExR 8 dB signal input)</td>
</tr>
<tr>
<td>4 ch</td>
<td>+2 dBm (at 1310 nm, ExR 4 dB signal input)</td>
</tr>
<tr>
<td>MMF 1 ch, 2ch, 4ch</td>
<td>+2 dBm (at 850 nm, ExR 3 dB signal input)</td>
</tr>
</tbody>
</table>

### Absolute Max. Rating

<table>
<thead>
<tr>
<th>Wavelength, Fiber Coupling</th>
<th>SMF</th>
<th>MMF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Value</td>
<td>+5 dB</td>
<td>+7 dB</td>
</tr>
<tr>
<td>Peak</td>
<td>+8 dB</td>
<td>+10 dB</td>
</tr>
</tbody>
</table>

### Optical Return Loss

<table>
<thead>
<tr>
<th>Wavelength, Fiber Coupling</th>
<th>SMF: –27 dB (typ., at 1310 nm SMF connection)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMF: –20 dB (typ., at 850 nm MMF connection)</td>
<td></td>
</tr>
</tbody>
</table>

### Optical Power Meter Accuracy

<table>
<thead>
<tr>
<th>Input Level</th>
<th>Accuracy (typ.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>–18 to –12 dB</td>
<td>±0.6 dB</td>
</tr>
<tr>
<td>–12 to 0 dB</td>
<td>±0.35 dB</td>
</tr>
<tr>
<td>0 to +2 dB</td>
<td>±0.55 dB</td>
</tr>
</tbody>
</table>

*: This specified value does not apply to SMF input at the 1ch and 2ch configurations.
### 26G Clock Recovery (SMF/MMF/Electrical) (Option 054)

<table>
<thead>
<tr>
<th>Ch B O/E Monitor Out (with built-in optical channel oscilloscope)</th>
<th>Connector: K (f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversion Gain: 60 V/W (SMF input, typ.), 33 V/W (MMF input, typ.)</td>
<td></td>
</tr>
<tr>
<td>Insertion Loss: 1.5 dBo (typ.)</td>
<td></td>
</tr>
</tbody>
</table>

#### Data Input
Connector: K (f), 50Ω, AC coupled  
*The DC component is terminated to GND via a 50Ω.*  
Data Format: NRZ, PAM4  
Bit Rate: 25.5 Gbaud to 28.2 Gbaud  
Input Sensitivity: 10 mVp-p (typ.), 20 mVp-p (max.)  
Max. Amplitude: 800 mVp-p  
Absolute Maximum Input: 1 Vp-p  
Contiguous Zeros Tolerance: ≥500 bits at PRBS 2^n – 1 Zero Substitution Pattern  
Auto Relock

#### Recovered Clock Output
Connector: SMA (f), 50Ω, AC coupled  
Recovery Mode  
Amplitude: 480 mVp-p (typ.)  
Division Ratio: 1/2  
Jitter: 250 fs rms (typ.), 400 fs rms (max.)  
Loop Bandwidth: Select from 4 MHz, 10 MHz, bit rate/1667, Attenuation: –20 dB/dec  
Through Mode  
Amplitude: 500 mVp-p (typ.)  
Operation Frequency: 0.1 GHz to 1.7625 GHz (1/16 Clock)  
Jitter: 200 fs rms (typ.), 400 fs rms (max.)

*1: 25°C ±5°C  
*2: NRZ, at 25.78125 Gbit/s, PRBS 2^n – 1, 10-MHz Loop Bandwidth, using MP2110A PPG  
*3: NRZ, at 25.78125/26.5625/28.05 Gbit/s, 400 ±100 mVp-p, 1/4 Clock Pattern, 10-MHz Loop Bandwidth, using MP2110A PPG  
*4: NRZ, at 25.78125/26.5625/28.05 Gbit/s, 400 mVp-p, 1/16 Clock Pattern, using MP2110A PPG

### 26G/53G Clock Recovery (SMF) (Option 055)

#### Optical Data Input
FC Connector (changeable)  
Wavelength, Fiber Coupling: 1260 nm to 1620 nm, Single Mode fiber  
Data Format: NRZ, PAM4  
Bit Rate: 25.5 Gbaud to 28.9 Gbaud, 51 Gbaud to 58 Gbaud  
Input Sensitivity: Outer OMA 100 µW (typ., Open Eye (PRBS13Q, TDECQ 2.0 dB), 26.5625/53.125 Gbaud)  
Outer OMA 630 µW (typ., Stressed Eye (SSPRQ, TDECQ 3.4 dB), 53.125 Gbaud)  
Absolute Max. Rating: +9.0 dBm (Average), +12.0 dBm (Peak)  
Contiguous Zeros Tolerance: ≥500 bits at PRBS 2^n – 1 Zero Substitution Pattern  
Optical Return Loss: –30 dB (typ., 1310 nm)  
Auto Relock

#### Optical Data Output
FC Connector (changeable)  
Insertion Loss: 1.5 dB (typ.), 2.3 dB (max., 1310 nm)

#### Recovered Clock Output
Connector: SMA (f), 50Ω, AC coupled  
Recovery Mode  
Amplitude: 440 mVp-p (typ.), 340 mVp-p (min.)  
Division Ratio: 1/4 (at 25.5 Gbaud to 28.9 Gbaud input), 1/8 (at 51 Gbaud to 58 Gbaud input)  
Jitter: 200 fs rms (typ.), 400 fs rms (typ.)  
Loop Bandwidth: Select from 4 MHz, 10 MHz, bit rate/1667, Attenuation: –20 dB/dec  
Through Mode  
Amplitude: 220 mVp-p (typ.), 200 mVp-p (min.)  
Operation Frequency: 0.1 GHz to 1.81 GHz, 3.19 GHz to 3.625 GHz (1/16 Clock)  
Jitter: 200 fs rms (typ.), 400 fs rms (max.)

*1: 25°C ±5°C  
*2: 4 MHz Loop Bandwidth  
*3: at 26.5625/53.125 Gbaud Clock Pattern, Outer OMA 0 dBm
# BERTWave MP2110A Selection Guide

## Selection Conditions and Function

<table>
<thead>
<tr>
<th>Selection Conditions and Function</th>
<th>Selection/Option Additions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oscilloscope</strong></td>
<td></td>
</tr>
<tr>
<td>Select any one or both.</td>
<td></td>
</tr>
<tr>
<td>Electrical 2ch</td>
<td>MP2110A-021</td>
</tr>
<tr>
<td>Electrical 1ch + Optical 1ch</td>
<td>MP2110A-033 or 043*1</td>
</tr>
<tr>
<td>Optical 1ch</td>
<td>MP2110A-035 or 045*1</td>
</tr>
<tr>
<td>Optical 2ch</td>
<td>MP2110A-036 or 046*1</td>
</tr>
<tr>
<td>Optical 4ch</td>
<td>MP2110A-032 or 042*1</td>
</tr>
<tr>
<td>Optical 4ch</td>
<td>MP2110A-030 or 040*1</td>
</tr>
<tr>
<td>Optical 4ch</td>
<td>MP2110A-039 or 049*1</td>
</tr>
<tr>
<td>Select any one.</td>
<td></td>
</tr>
<tr>
<td><strong>Electrical 2ch</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Electrical 1ch + Optical 1ch</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Optical 1ch</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Optical 2ch</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Optical 4ch</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Select additions.</strong></td>
<td></td>
</tr>
<tr>
<td>PAM4 Analysis Software</td>
<td>MP2110A-095</td>
</tr>
<tr>
<td>NRZ Jitter Analysis Software</td>
<td>MP2110A-096</td>
</tr>
<tr>
<td>Precision Trigger (1ch/2ch)*2</td>
<td>MP2110A-024*2</td>
</tr>
<tr>
<td>26G Clock Recovery (25.5G to 28.2G, SMF/MMF/Electrical)</td>
<td>MP2110A-054</td>
</tr>
<tr>
<td>Select any one.</td>
<td></td>
</tr>
<tr>
<td><strong>BERT</strong></td>
<td></td>
</tr>
<tr>
<td>Select any one.</td>
<td></td>
</tr>
<tr>
<td>1ch</td>
<td>MP2110A-011</td>
</tr>
<tr>
<td>2ch</td>
<td>MP2110A-012</td>
</tr>
<tr>
<td>4ch</td>
<td>MP2110A-014</td>
</tr>
<tr>
<td>Select additions.</td>
<td></td>
</tr>
<tr>
<td>Bit Rate Extension (Adds 10G band)</td>
<td>MP2110A-093</td>
</tr>
</tbody>
</table>

*1: Only the optical channel reference receiver (Bessel filter approximation characteristics) are different for Option 04x and Option 03x.
*2: Either 1ch or 2ch can be selected for Option 024 Precision Trigger. Cannot be added for 4ch oscilloscope (Option 030/039/040/049).

## Block Diagram

### Option 03x/04x Oscilloscope

- **Ch A/B Data In**
- **Ch A/B/C/D SMF Data In**
- **Ch A/B/C/D MMF Data In**
- **Ch B/O/E Monitor Out**
- **CRU In**
- **Recovered Clock Out**
- **Trigger Clock In**

### Option 054 CRU

- **CRU**
- **Recovered Clock Out**
- **SMF Data Out**
- **SMF Data In**

### Option 055 CRU

- **CRU**
- **Recovered Clock Out**
- **SMF Data Out**
- **SMF Data In**

### BERT

- **Option 011**
- **Option 012**
- **Option 014**

* Optical channel: The clock in the optical signal input to Ch B is recovered.
* Electrical channel: There is no Monitor Out connector when Ch B is an electrical channel. Split the signal using the Pick-off tee and input to CRU In.
## BERTWave MP2110A Ordering Information

When making a contract, determine the configuration by referencing the selection guide (p.21) and specify the type, model, name, and quantity. The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

<table>
<thead>
<tr>
<th>Model/Order No.</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1632A</td>
<td>3ch BERT Retrofit</td>
</tr>
<tr>
<td>J1341A</td>
<td>4ch BERT Retrofit</td>
</tr>
<tr>
<td>J1632A</td>
<td>1ch BERT Retrofit</td>
</tr>
<tr>
<td>J1341A</td>
<td>2ch BERT Retrofit</td>
</tr>
</tbody>
</table>

### Main Frame

- **BERTWave**

### Standard Accessories

- **Power Cord**
- **GND Connection Cable**: 1
- **MX210000A BERTWave Control Software CD-ROM**: 1

### Options

- **MP2110A-011**: 1ch BERT
- **MP2110A-012**: 2ch BERT
- **MP2110A-014**: 4ch BERT
- **MP2110A-030**: Dual Optical Scope for Singlemode Baseband Flat
- **MP2110A-031**: Dual Optical Scope for Multimode Baseband Flat
- **MP2110A-040**: Quad Optical Scope for Singlemode
- **MP2110A-041**: Quad Optical Scope for Multimode
- **MP2110A-042**: Optical and Single-ended Electrical Scope Baseband Flat
- **MP2110A-043**: Optical and Single-ended Electrical Scope Baseband Flat
- **MP2110A-044**: Optical and Single-ended Electrical Scope Baseband Flat
- **MP2110A-045**: Optical and Single-ended Electrical Scope Baseband Flat
- **MP2110A-046**: Optical and Single-ended Electrical Scope Baseband Flat
- **MP2110A-047**: Optical and Single-ended Electrical Scope Baseband Flat
- **MP2110A-048**: Optical and Single-ended Electrical Scope Baseband Flat
- **MP2110A-049**: Optical and Single-ended Electrical Scope Baseband Flat
- **MP2110A-050**: Optical and Single-ended Electrical Scope Baseband Flat
- **MP2110A-051**: Optical and Single-ended Electrical Scope Baseband Flat
- **MP2110A-052**: Optical and Single-ended Electrical Scope Baseband Flat
- **MP2110A-053**: Optical and Single-ended Electrical Scope Baseband Flat
- **MP2110A-054**: Optical and Single-ended Electrical Scope Baseband Flat
- **MP2110A-055**: Optical and Single-ended Electrical Scope Baseband Flat

### Retrofit Options

- **Windows10 Upgrade Retrofit**: 2
- **1ch BERT Retrofit**: 3
- **2ch BERT Retrofit**: 4
- **4ch BERT Retrofit**: 5
- **1ch BERT Retrofit**: 6
- **2ch BERT Retrofit**: 7
- **4ch BERT Retrofit**: 8

### Standard Accessories

- **MP2110A-030**: Replaceable Optical Connector (FC-PC): 2
- **MP2110A-031**: FC ADAPTER CAP: 2
- **MP2110A-032**: Open: 1
- **MP2110A-033**: Jitter Analysis Software Retrofit: 3
- **MP2110A-034**: Jitter Analysis Software Retrofit: 4
- **MP2110A-035**: Jitter Analysis Software Retrofit: 5
- **MP2110A-036**: Jitter Analysis Software Retrofit: 6

### Maintenance Service

- **MP2110A-ES510**: 3 Years Extended Warranty Service
- **MP2110A-ES550**: 5 Years Extended Warranty Service

### Miscellaneous

- **Coaxial Adaptor (K-P · K-J, SMA compatible)**
- **Fixed Optical Attenuator (SM, 5 dB)**
- **Fixed Optical Attenuator (SM, 3 dB)**
- **Fixed Optical Attenuator (SM, 2 dB)**
- **Fixed Optical Attenuator (SM, 1 dB)**
- **Open: Coaxial connector cover**
- **Open: Optical connector cover**
- **Open: Connector cover**
- **Open: Connector cover**
- **Open: Connector cover**
- **Open: Connector cover**

### Other Accessories

- **USB Mouse**: 1
- **Wrist Strap**: 2
- **TERMINATOR**: 3
- **ESD DISCHARGER**: 4
- **5 Years Extended Warranty Service**: 5
- **Maintenance Service**: 6
- **Open: Connector cover**
- **Open: Connector cover**
- **Open: Connector cover**
- **Open: Connector cover**
- **Open: Connector cover**

*1: BERT retrofit supported when BERT not installed or to increase number of channels changing Option 03x and 04x, same channel configuration.

*2: This option upgrades the Windows Embedded Standard 7 to the Windows 10 Enterprise LTSC. It is performed by Anritsu factory or service center return.

*3: This retrofit supported with BERT not installed.

*4: This retrofit supported with BERT not installed.

*5: About PAM4 Analysis Software Retrofit is sometimes, depending on the serial number, the customer can perform the retrofit, but sometimes return to the factory may be necessary. Contact your sales representative for more details.

In addition, refer to page 21 (MP2110A Selection Guide) for any restrictions on option configurations.
BERTWave MP2100B

For R&D and Manufacturing of 10G and 40G Multi-channel Optical Modules

- All-in-one BER and Eye-pattern analysis
- Built-in 1 ch to 4 ch 12.5 Gbit/s BERT
- High-speed mask tests
- Jitter 1 ps high-quality PPG and 10 mVp-p high-sensitivity ED

The all-in-one MP2100B has a built-in BER tester and sampling oscilloscope for running simultaneous BER tests and eye pattern analyses required for developing and manufacturing modules. The number of BERT channels can be expanded to four, all supporting simultaneous BER measurements. Additionally, the high sampling speed reduces the eye pattern measurement time. Multi-channel optical modules, such as QSFP+, can be measured more efficiently using the MP2100B.

Optical Spectrum Analyzer MS9740B

600 nm to 1750 nm

Faster measurement speed shortens measurement time and improves production efficiency

- Faster measurement speed of <0.2 s/5 nm reduces total analysis time for active optical devices
- Built-in applications for evaluating active optical devices
- Built-in Fast mode cuts measurement time by 50% for better production efficiency to predecessor MS9740A using 200 Hz or 1 kHz bandwidth
- Excellent cost performance
- >58 dB dynamic range (0.4 nm from peak wavelength)
- 30 pm minimum resolution
- Low power consumption (75 VA), light weight (15 kg max.)

The MS9740B reduces production costs by shortening active optical device evaluation times and supporting efficient analysis applications.
Specifications are subject to change without notice.