



# 32Gbaud PAM4 True BER Measurement Solution

Signal Quality Analyzer MP1800A Series

32Gbaud Power PAM4 Converter G0375A

32Gbaud PAM4 Decoder with CTLE G0376A

# MP1800A Series PAM4 Measurement Solution Features

- Supports high 64 Gbaud rate for both PAM4 and NRZ
- 32 Gbaud 4ch PAM4 transmission capacity (256 Gbit/s for one MP1800A)
- Excellent expandability
  - 32 Gbaud PAM4 4ch Multi-channel
  - Expandability to 64 Gbaud
- Low Intrinsic Jitter, high-quality waveforms
- High-amplitude PAM4 output (G0375A + 32G PPG)
- High-input-sensitivity error detection
- Supports 28 Gbaud CTLE and CDR functions (G0376A + 32G ED)
- Supports receiver tests using Jitter Addition function

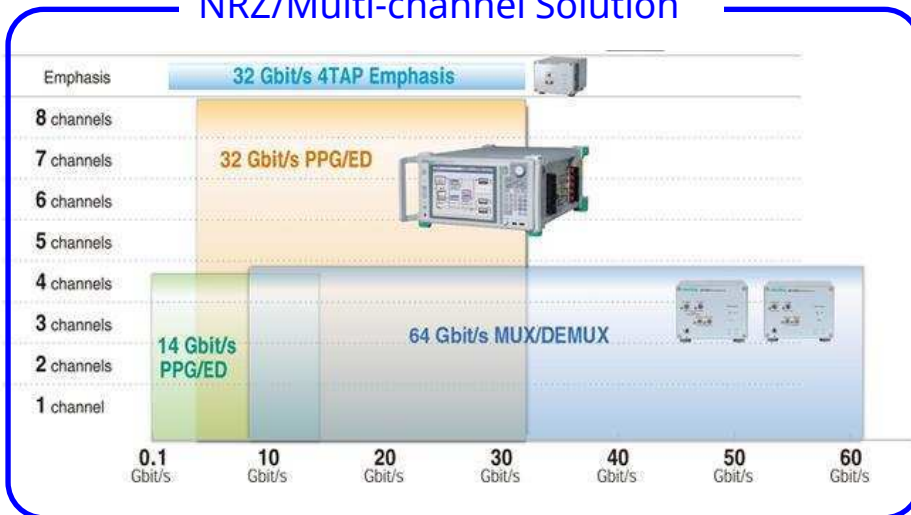
**Future-proof instrument configuration**

**Effective inspection supported by functions and performance**

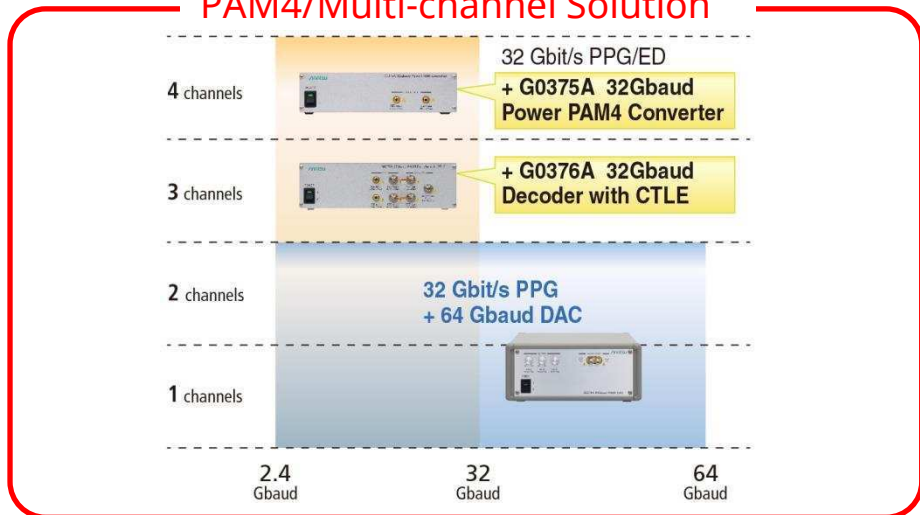
## [PAM4 Applications]

- 28 Gbaud PAM4 ICs, Backplanes, Active Optical Cables, CEI-56G-PAM4
- 53 Gbaud/26 Gbaud, 200GbE/400GbE Optical Modules, Optical Devices, IC

### NRZ/Multi-channel Solution



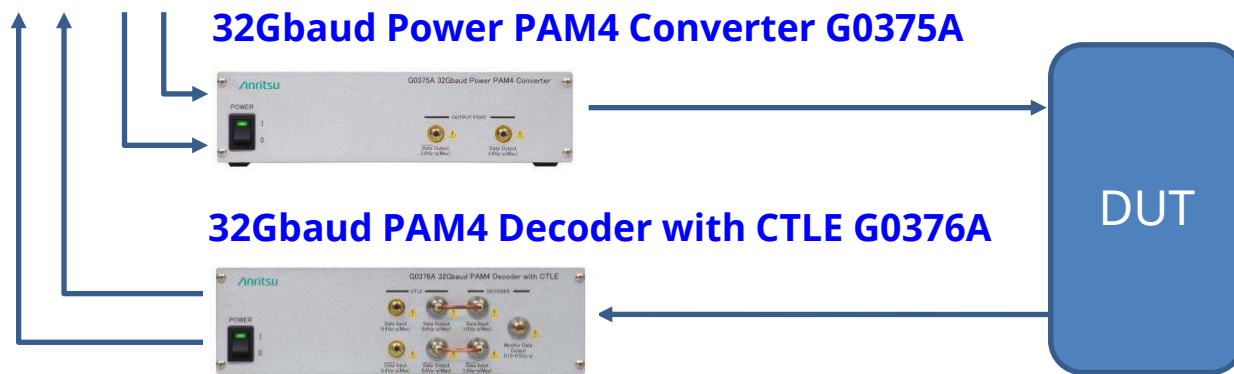
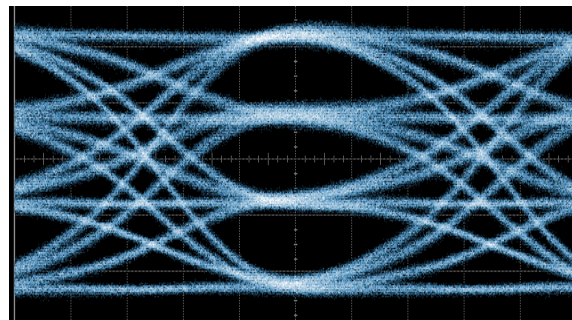
### PAM4/Multi-channel Solution



# 32 Gbaud PAM4 BER Solution

- Compact Remote Head G0375A and G0376A for 32 Gbit/s 2ch PPG/ED
- True PAM4 BER measurement support

28 Gbaud 2.0 Vp-p (single-end), 4.0 Vp-p (differential)



**32Gbaud Power PAM4 Converter G0375A**

**32Gbaud PAM4 Decoder with CTLE G0376A**

DUT

- Compact Remote Head for close connection to DUT
- Multi-channel
- Excellent expandability and PAM4/NRZ support
- High-amplitude PAM4 output
- Clean Eye/low Jitter
- Emphasis output (set with MP1825B)
- Variable Eye linearity
- True PAM4 BER measurement
- High input sensitivity
- CTLE
- CDR (with ED, 28 Gbaud)

# G0375A 32G High-Amplitude PAM4 Signal Generation

- EA modulator direct-driving, high-amplitude output and 3Eye independent level control support TOSA evaluation without external driver amplifier to reduce setup procedures and time
- Clean Eye and low-jitter waveforms using reference signal source support high-reproducibility evaluations

## G0375A Features

- Baud rates of 10 Gbaud to 32.1 Gbaud
- High-amplitude PAM4 output of 2.2 Vp-p (single-end), and 4.4 Vp-p (differential)
- Low-jitter output waveforms with 200 fs (typ.) RJ
- Compact Remote Head
- Emphasis output (set with MP1825B)

MP1800A SQA  
32 Gbit/s 2ch PPG

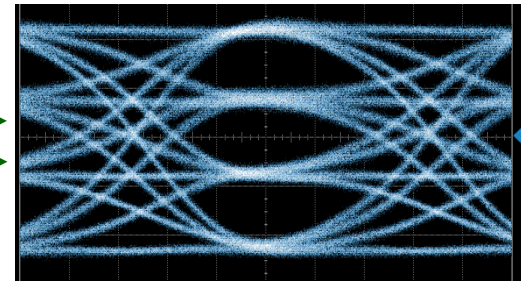


MSB  
LSB

**G0375A**  
**32Gbaud Power**  
**PAM4 Converter**



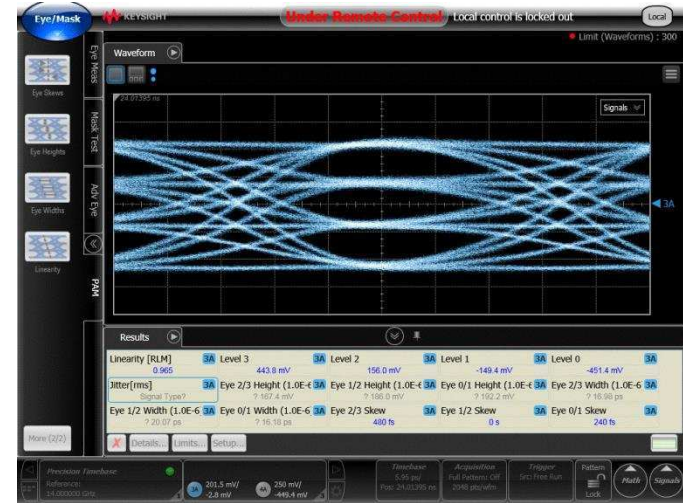
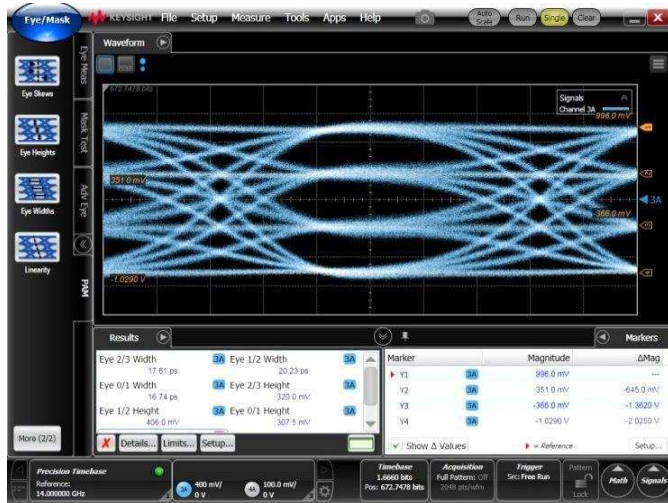
**Differential 4.0 Vp-p Output**



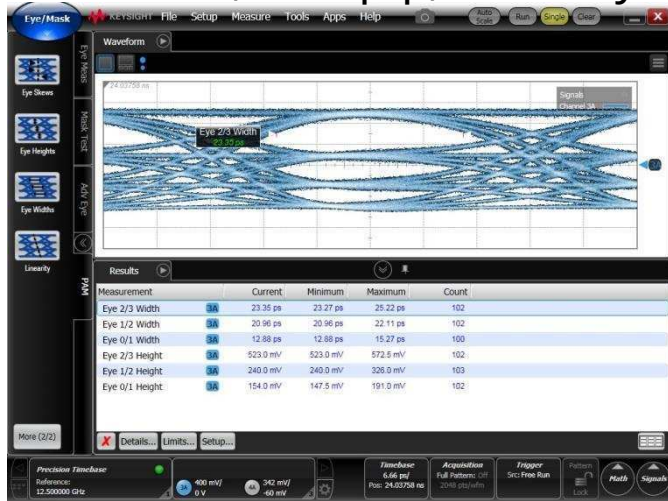
# G0375A PAM4 Typical Waveforms

28 Gbaud, 2.0 Vp-p, PRBS13Q

28 Gbaud, 0.9 Vp-p, PRBS13Q



## 25 Gbaud, 2.0 Vp-p, Linearity Control



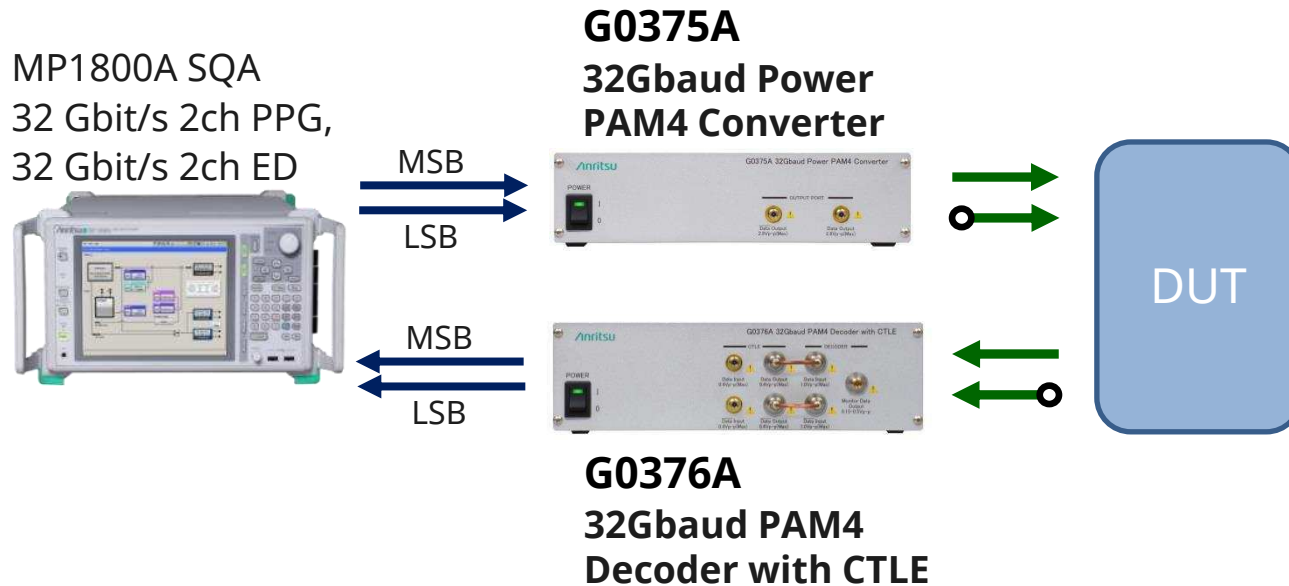
Monitored using J1728A 40-cm cable + 41V-20 Attenuator + 70-GHz Band Oscilloscope

# G0376A 32G PAM4 BER Measurement

- Implements high-input-sensitivity PAM4 True BER measurement for more accurate design verification
- Combining CTLE and CDR (32G ED function) supports device Jitter Tolerance test

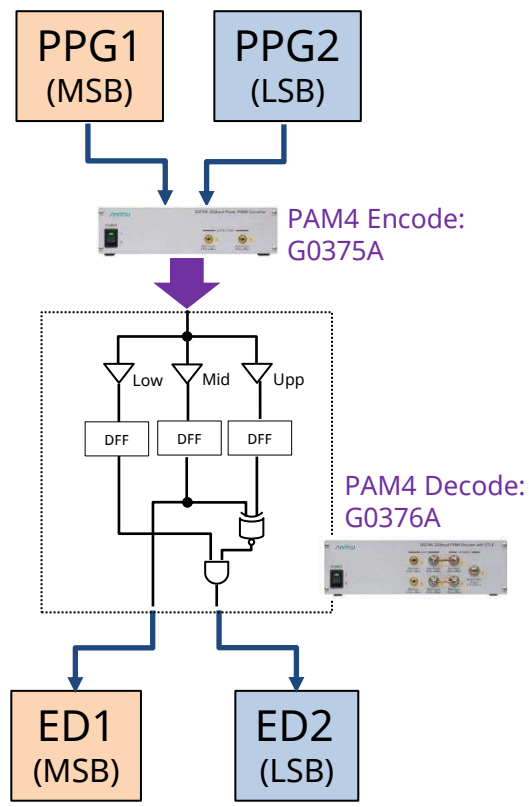
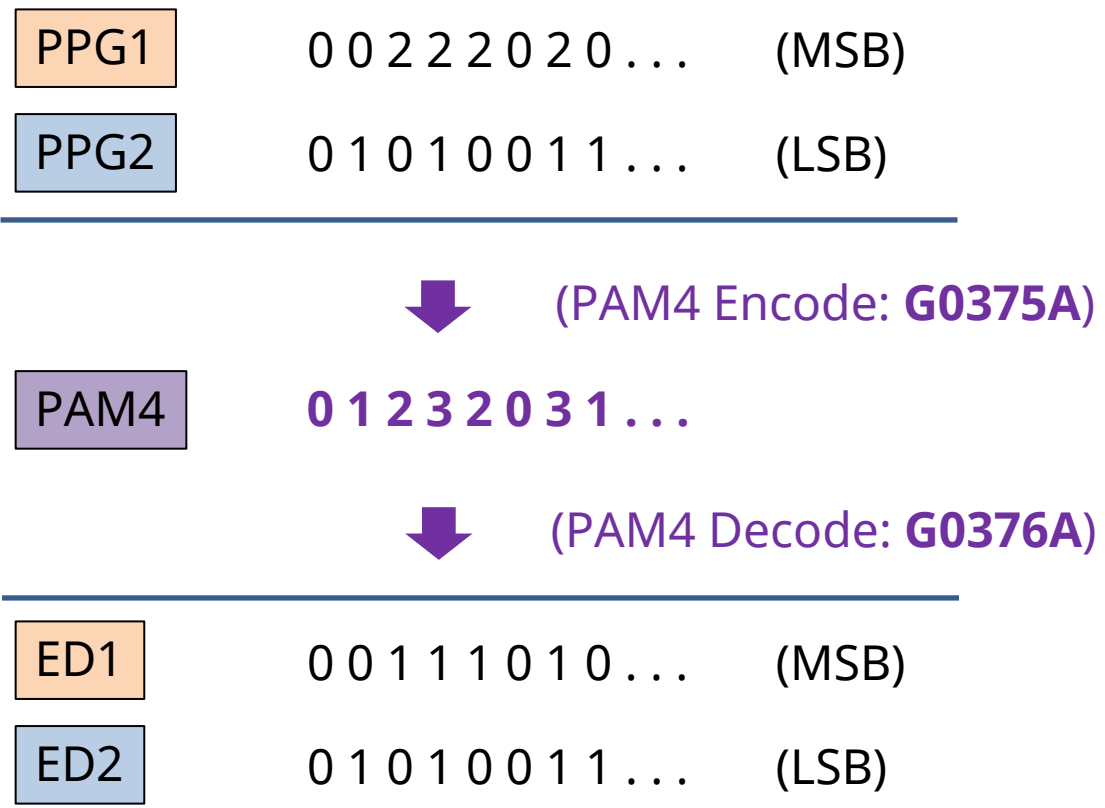
## G0376A Features

- Baud rate of 10 Gbaud to 32.1 Gbaud
- High input sensitivity (Eye Height 40 mV@28 Gbaud)
- Tunable CTLE (Gain -12 to 0 dB)
- CDR Function (set with MU183040B-022)



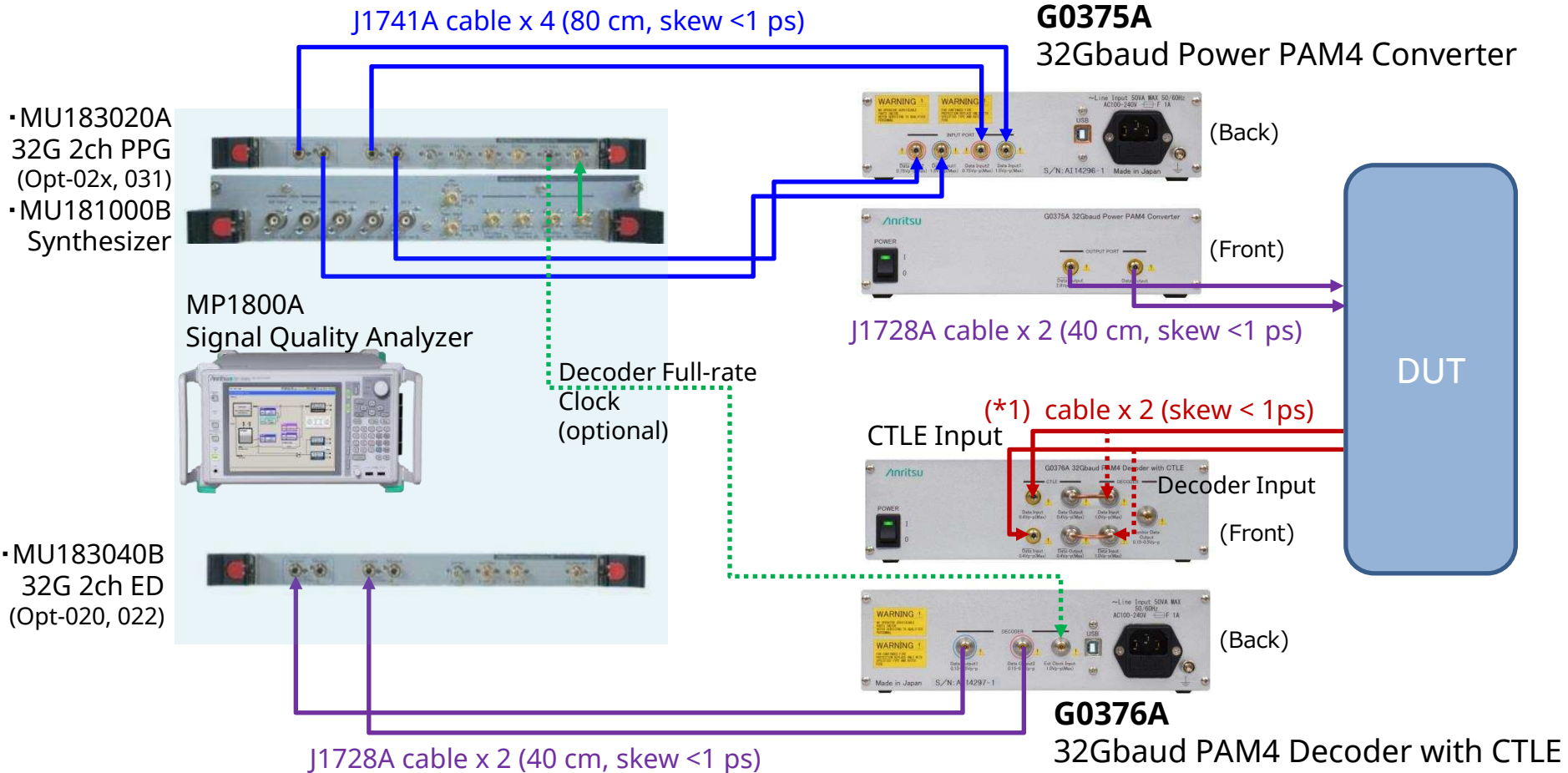
# PAM4 BER Measurement using MP1800A Series G0375A/G0376A

Combining 32G 2ch BERT (MSB/LSB) and PAM4 Converter/Decoder supports both PAM4 and NRZ BER measurements



# Reference Setup for 32Gbaud PAM4 BER Solution

## True BER measurement of PAM4 signal



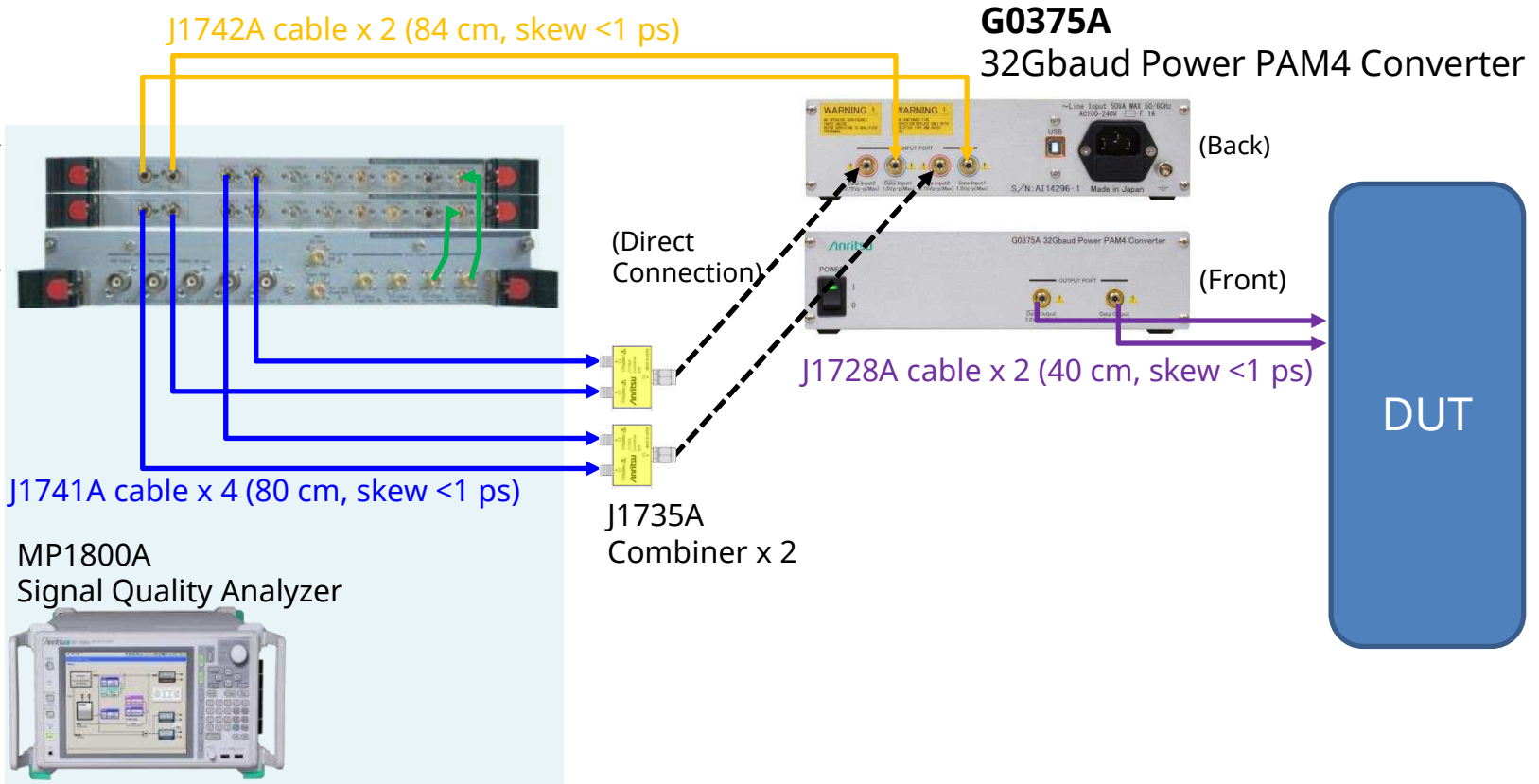
(\*1) J1728A or lower loss cable



# Reference Setup for TOSA Evaluation Solution

High-amplitude, low-jitter PAM4 signal generation with Linearity control

- MU183020A  
32G 2ch PPG  
(Opt-02x, 031) x2
- MU181000B  
Synthesizer



# G0375A/G0376A I/O Control

- G0375A:

PAM4 output level controlled by using control software to control output amplitude of connected PPG

- G0376A:

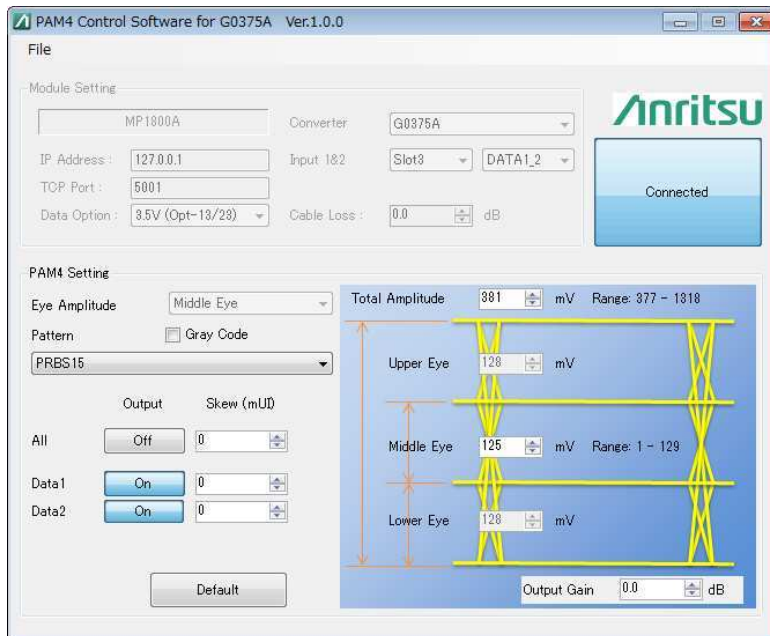
Control CLTE gain and Pam4 Decoder input threshold voltage (Vref for each of Upper/Middle/Lower) via USB connection

(Control Software can be downloaded from download site at MP1800A home page)

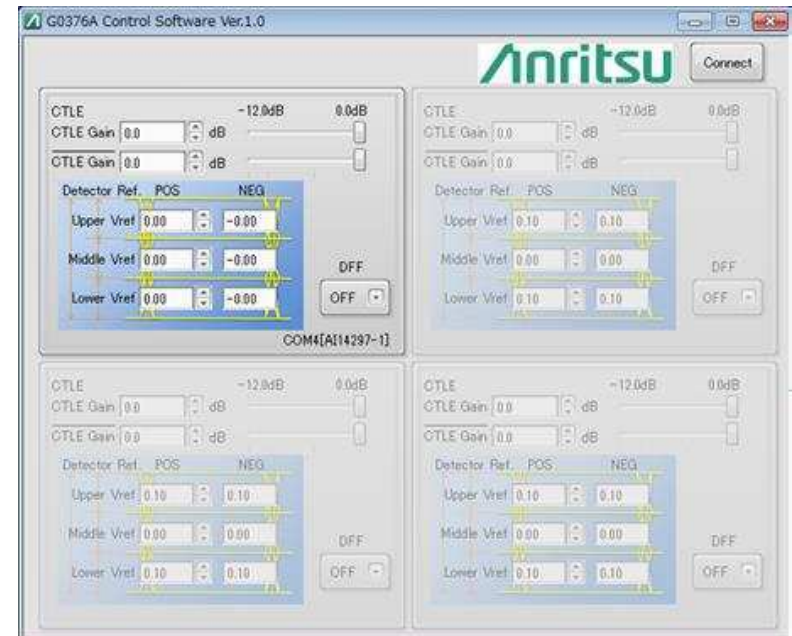
<https://www.anritsu.com/en-au/test-measurement/support/downloads?model=MP1800A>)

## Control Software Screen Examples

- G0375A



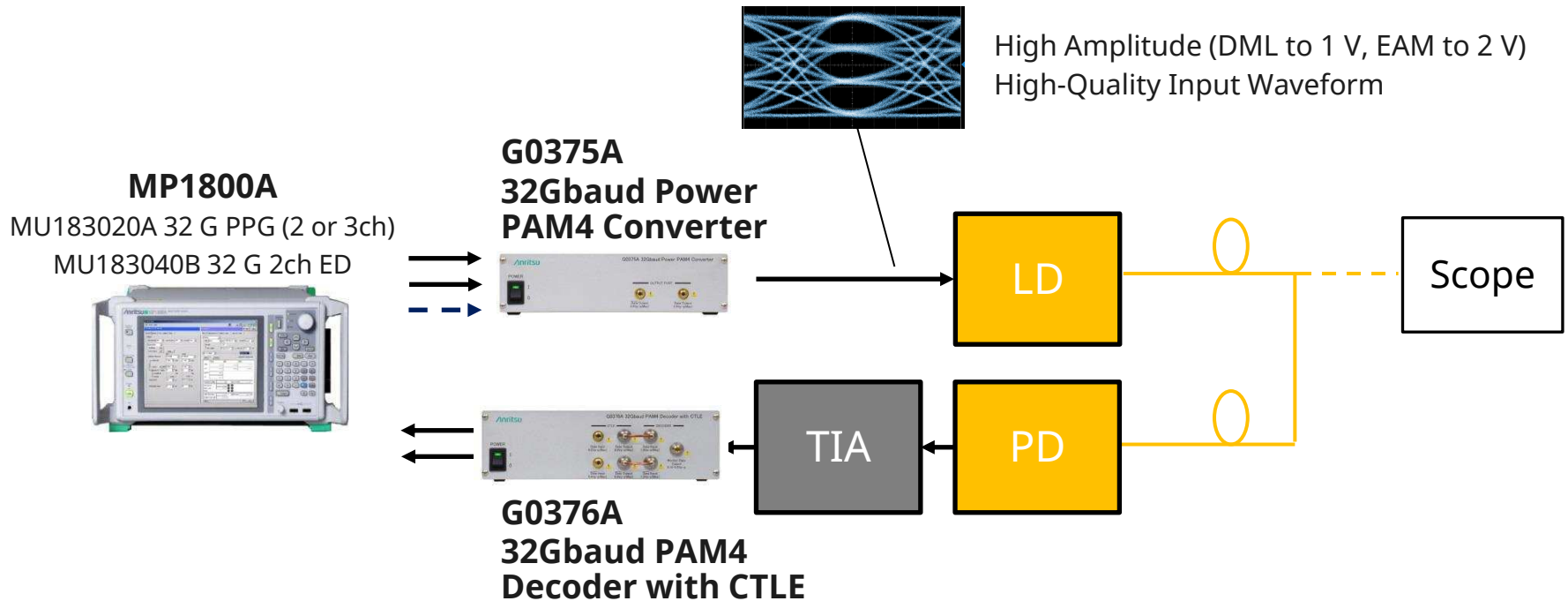
- G0376A



# Main Application (1)

## Evaluation of 28Gbaud PAM4 TOSA/ROSA

- High-quality, low-jitter PAM4 signals
- PAM4 Linearity control
- Eye opening adjustment using CTLE function



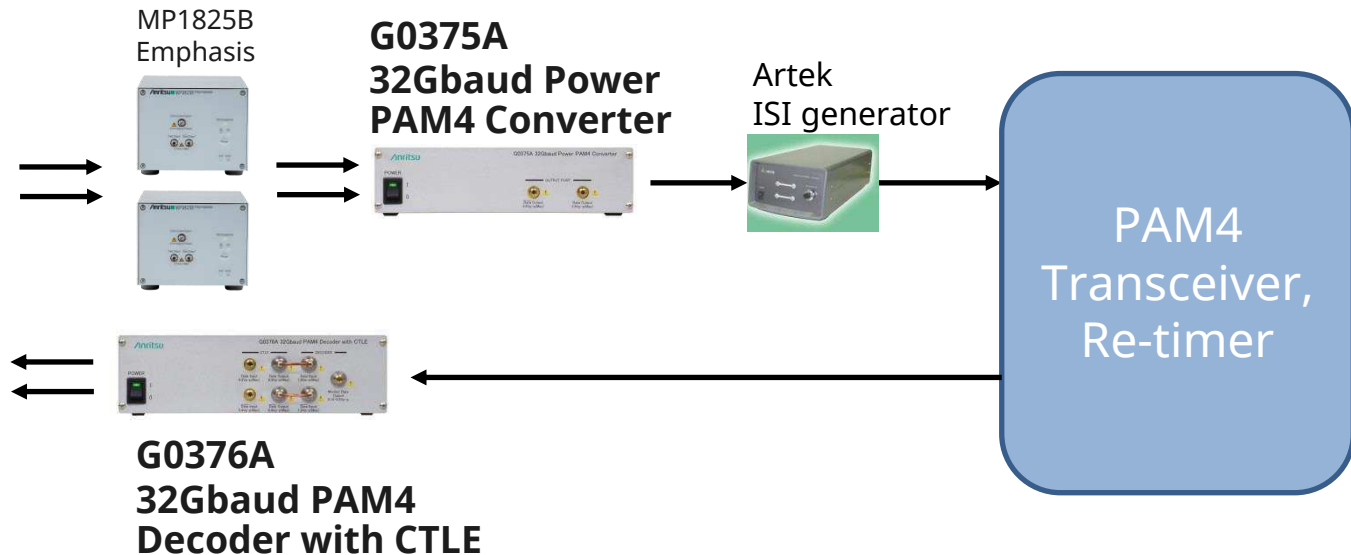
# Main Application (2)

Supports 400 GAUI-8, CEI-56G-VSR-PAM4 Electrical I/F Rx tests

- Low-jitter PAM4 waveform
- 4Tap Emphasis function
- Jitter Addition function RJ/BUJ/SJ
- CTLE (14 GHz peak frequency)
- CDR function (as set with MU183040B-022)

## MP1800A

MU183020A 32 G 2ch PPG  
MU183040B 32 G 2ch ED  
MU181500B Jitter  
MU181000B Synthesizer  
MX183000AJTOL software



# Recommended 32G PAM4 BER Measuring Instruments

Model	Name	Option	Qty	Remark
G0375A	32Gbaud Power PAM4 Converter	-	1	
G0376A	32Gbaud PAM4 Decoder with CTLE	-	1	
MP1800A	Signal Quality Analyzer	001, 002, 007, 015, 032	1	
MU181000B	12.5GHz 4port Synthesizer	-	1	
MU181500B	Jitter Modulation Source	-	1	For Jitter Tolerance Test
MU183020A	28G/32G bit/s PPG	022 or 023, 031	1	Qty is 2 when Linearity control
MU183040B	28G/32G bit/s High Sensitivity ED	020, 022	1	
J1728A	Electrical Length Specified Coaxial Cable (0.4m, K connector)	-	(2)	Waveform monitoring cable
J1735A	Combiner	-	2	Need to Linearity control
J1742A	Electrical Length Specified Coaxial Cable (0.84m, K Connector)	-	2	Need to Linearity control

# G0375A 32Gbaud Power PAM4 Converter main Specifications

Item	Specification	Remarks
Number of Outputs	2 (Data, xData)	AC coupling, K (female) connector
Baud-Rate	10 to 32.1 Gbaud	
Output Amplitude	2.2 Vp-p (typical), 2.8 Vp-p (maximum)	Data1 input 1.5 Vp-p, Data2 input 0.75 Vp-p, and Gc setting = 0 dB
Gain	0 dB (typical)	(Data1 input + Data2 input) to xData output, Gc setting = 0 dB
Random Jitter (RMS)	200 fs (typical)	PRBS13Q pattern
Tr/Tf (20%-80%)	12 ps (typical)	PRBS13Q pattern
Eye Linearity(RLM)	0.9 (typical)	Gc setting = 0 dB
Gain Control, Gc	-6 to 0 dB	Auxiliary gain control function
Number of Inputs	4 (Data1, xData1, Data2, xData2)	K (female) connector, Uses PPG Data3 and J1735A Combiner at 3 Eye independent level control
Maximum Input Amplitude	Data1, xData1 input: 1.5 Vp-p Data2, xData2 input: 0.75 Vp-p	Data1 input + Data2 input $\leq$ 2.25 Vp-p

# G0376A 32Gbaud PAM4 Decoder with CTLE Main Specifications

## - PAM4 Decoder Specifications

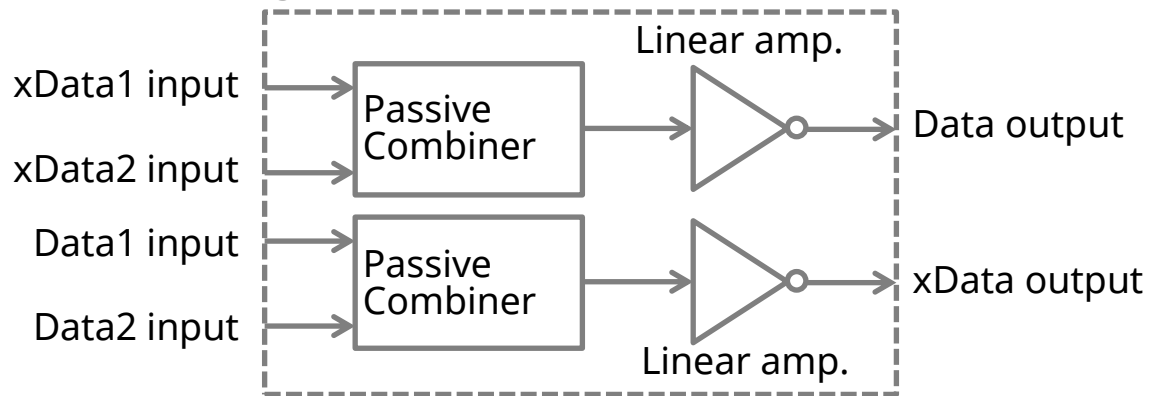
Item	Specification	Remarks
Number of Inputs	3 (Data, xData, Clock input)	K (female) connector
Baud Rate	10 to 32.1 Gbaud (DFF = On) 10 to 28 Gbaud (DFF = Off)	
Data Input Amplitude	0.5 Vp-p (maximum)	Single-end, Vth =0 V
Data Input Sensitivity	0.04 V (typical)	28 Gbaud, Single-end, Eye Height
Clock Input Frequency	10 to 32.1 GHz	Full-rate clock, for DFF On mode
Clock input amplitude	0.3 to 1.0 Vp-p	
Number of Outputs	3 (Data1, Data2, Monitor output)	K (female) connector
Output Amplitude	0.3 Vp-p (typical)	Data1, Data2, Monitor output
Internal DFF	Selectable ON / OFF	Uses external Clock for D-FF ON mode

## - CTLE Specifications

Item	Specification	Remarks
Number of Inputs	2 (Data, xData)	K (female) connector
Data Input Amplitude	0.4 Vp-p (maximum)	Single-end, AC coupling
CTLE Gain	-12 to 0 dB	
CTLE Peak Frequency	14 GHz (typical)	
Number of Outputs	2 (Data, xData)	K (female) connector

# G0375A/G0376A Block Diagrams

## - G0375A Block Diagram



## - G0376A Block Diagram

