

64 Gbaud PAM4 DAC G0374A

Signal Quality Analyzer MP1900A/MP1800A Series

64 Gbaud PAM4 DAC Overview

Features

Operating baud rate: DC to 64 Gbaud Half-rate Data and Clock inputs High quality and low Intrinsic Jitter waveform Differential output: 0.7 Vp-p typ. (single-end) Amplitude control: >6 dB Jitter transparency Adjustable Duty cycle I/O Interface: DC-coupled Power consumption: <8.5 W Size: 210 (W) x 88 (H) x 230 (D) mm

Applications

PAM4 Signal generation 200GbE/400GbE, CEI-56G, Fibre Channel Telecom high-speed transmissions





Required Items

Name/Model	Qty	Note
Signal Quality Analyzer MP1900A	1	Requires 2 x 2ch PPG (MU195020A) and MU181000A/B + MU181500B option
or MP1800A		Requires 2 x 2ch PPG (MU183020A) or 4ch PPG (MU183021A) (2 x 2ch PPG recommended for BER and Jitter tests) and MU181000A/B + MU181500B option
G0374A 64 Gbaud PAM4 DAC	1	
Power Cord	1	Standard accessory
Sampling Oscilloscope	1	86100D (86118A 70 GHz Head + 86107A Time base)
Coaxial Cables J1612A (specified electrical length, 80 cm, Individual delay difference of <3 ps)	4	4 Data inputs, standard accessory
J1611A (130 cm)	1	Clock input, standard accessory
34VV50 Adapter or J1655A (20 cm)	1	DAC output to scope (V-connector, 20 cm or shorter cable)
J1625A (1 m) or J1342A (80 cm)	2	Scope trigger Clock
V210 Terminator	1	For unused DAC output
41V-6 6 dB Attenuator	1	For scope input
J1678A ESD Protection Adapter-K	(5)	For Data and Clock inputs

* Duty Cycle Distortion, pulse width difference between even and odd bits, adjustable using CLKref voltage

Coaxial Cable Connections (64G x 2ch Combination)



AUX Output (1/64 Clock Output)

G0374A Block Diagram



Setting Procedure (1/3)

- 1. Connect power cords of instruments to grounded power outlet.
- 2. Connect coaxial cables between the G0374A, SQA, and scope.
 - (Use J1678A for Data and Clock inputs of G0374A to prevent ESD and EOS damage.)
- 3. Power-up G0374A.
- 4. Set Combination Setting to 64Gx2ch Combination.
 - For MP1900A mainframe and two MU195020A sets, click Module Settings button at bottom of GUI screen and click Combination setting button on Module Settings screen. Select 64Gx2ch Combination on Inter module combination setting.
 - For two MU183020A sets, click Combination Setting button at top of GUI screen and select 64Gx2ch Combination at Channel Synchronization as Combination function between modules.
 - For MU183021A, select 64Gx2ch Combination at Combination setting on Misc2 tab.
- 5. Set all Data output **Amplitude** to **1.0 Vp-p and Offset** to **Vth 0V.** The Grouping Setting function is useful when configuring multiple channels with the same settings.
 - For MP1900A mainframe and two MU195020A sets, click Module Settings button at bottom of GUI screen and click Module Grouping button on Module Settings screen. Set Output and Pattern of PPG Slot 1 and Slot 2 to ON. This shares the output amplitude, offset, and pattern settings of Data1 with the other Data outputs. Click [Execute] at [Module Grouping] to reflect the settings at Inter module grouping.
 - For two MU183020A sets, click "Setting..." button at Grouping setting on Misc2 tab of both PPGs and select "Output" checkbox. This shares the output amplitude and offset settings of Data1 with Data2.
 - For MU183021A, click "Setting..." button at Grouping setting on Misc2 tab and select "Data1-4" from Group dropdown list and select "Output" checkbox. This shares the output amplitude and offset settings of Data1 with Data2.

Setting Procedure (2/3)

- 6. Set MU195020A or MU18302xA AUX output to 1/64 Clock output for scope trigger.
- 7. Set MU195020A or MU18302xA Clock output to full rate for Clock input of DAC.
- 8. Set Vamp1 and Vamp2 to maximum and set Data Duty to 0.
- 9. Turn on SQA output.
- 10. For two MU195020A and MU183020A sets at the Data1 setting screens of both PPGs, or for MU183021A at Data1 setting screen, set pattern to "Data" and bit length of 16 bits (0001 1011 0010 0111) and confirm that output waveform repeats 01230213 over.
- 11. Set same Delay value for all Data inputs and adjust so 01230213 is output. We recommend adjusting in 0.1UI units and setting Delay to the center of the proper adjustment range because the proper adjustment range is about 0.5UI (/period).
- 12. Set pattern to PRBS15 and monitor waveform using time-base trigger.
- 13. Adjust DCD (pulse width difference between even and odd bits) using Data Duty control.
- 14. Adjust amplitude using Vamp1 and Vamp2 control.

Setting Procedure (3/3)

- > The adjustment procedures in steps 10 and 11 are required when the bit rate is changed.
- > To change to NRZ signal:
 - When using MP1900A mainframe and two MU195020A sets, click Module Settings button at bottom of GUI screen and click Combination setting button on Module Settings screen. Select 2CH Combination on Inter module combination setting. Click [Execute] at [Module Grouping] to reflect the settings at Inter module grouping.
 - When using two MU183020A sets, click Combination Setting button at top of GUI screen and set Channel Synchronization to 2ch Combination as Combination function between modules.
 - For MU183021A, change to 2ch CH Sync at Misc2 tab.

This will align the start bit positions for each 2ch Combination pattern used for MSB and LSB input, and the PRBS15 NRZ waveform can be confirmed when output is set to On because the pattern is set to the PRBS15 default .



Typical Waveform at Setting



Pattern setting "0001 1011 0010 0111" "01230213" observed



Magnified "01230213"

Typical Waveforms (1/2)





Vamp1 and Vamp2 set to maximum

Adjust amplitude using Vamp1 and Vamp2 control

Ancitsu envision : ensure

Typical Waveforms (2/2)

64 Gbaud: Sample waveform before adjusting DCD using Data Duty



56 Gbaud: Sample waveform before adjusting DCD using Data Duty



Adjust Data Duty





Setting Procedure for NRZ 2Tap Emphasis (1/2)

After completing the previous settings, monitor the NRZ signal and use the following procedure to add Emphasis.

1. Change the D0A and D0B input cable connections in slide 4 as shown below.



AUX Output (1/64 Clock Output)

Setting Procedure for NRZ 2Tap Emphasis (2/2)

2. Set Combination Setting to the same settings as at NRZ output (see slide 8).

3. Set the same patterns at the Data1, 2 and Data 3, 4 combinations as set at 2ch Combination.

- 4. Set the Data3, 4 pattern Logic to NEG.
- 5. Add 1UI to the Delay setting of Data4 (PPG output connected to D0A input).

56 Gbaud 2Tap Emphasis, sample waveform





64 Gbaud, 16 bit "11...00..." pattern



MP1900A/MP1800A Setting for Each Waveform Pattern

Output		PPG Settings			G0374A Settings					
Modulation	Baud Rate	Composition	Combination Setting	Amplitude Offset	CLK Out	D1A	D1B	D0A	D0B	Comment
PAM4 2.4 94 94 94 94 94 94 94 94 94 94 94 94 94	>32.1G	2ch	-	-	-	-	-	-	-	-
	2.4 to 32.1G	2ch	2ch Combination	2 V Vth 0 V		Divided Data1	Divided Data1	Divided Data2	Divided Data2	
	4.8 to	2ch x 2 slot or 4ch	64G x 2ch Combination	1.0 V	Full	PPG1_Data1 or Data1	PPG1_Data2 or Data2	PPG2_Data1 or Data3	PPG2_Data2 or Data4	
	64G	4ch	4ch Combination	Vth 0 V		Data1	Data3	Data2	Data4	
NRZ 4.8 t 640		2ch	2ch	1.0 V Vth 0 V	Full	Data1	Data2	(open or 0 V)	(open or 0 V)	Max. amplitude is 0.6 V. typ. AC-coupled input not supported
	1 9 to		Combination	2.0 V Vth 0 V		Divided Data1	Divided Data2	Divided Data1	Divided Data2	
	4.8 to 64G	2ch x 2 slot	2ch Comb. and 2ch CH Sync.	1.0 V Vth 0 V		PPG1_Data1	PPG1_Data2	PPG2_Data1	PPG2_Data2	Pattern of PPG2 same as PPG1, Pos logic and not delayed
		4ch	2ch Comb. and 2ch CH Sync.			Data1	Data2	Data3	Data4	Pattern of Data3/4 combination same as Data1/2, Pos. logic and not delayed
NRZ with Emphasis	2 4.8 to	2ch x 2 slot	2ch Comb. and 2ch CH Sync.	1.0 V Vth 0 V Fu	F U	PPG1_Data1	PPG1_Data2	PPG2_Data2 +1UI Delay	PPG2_Data1	Pattern of PPG2 same as PPG1, Neg. logic
	64G	4ch	2ch Comb. and 2ch CH Sync.		Full	Data1	Data2	Data4 +1UI Delay	Data3	Pattern of Data3/4 combination same as Data1/2, Neg. logic





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