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Variable ISI MU195020A-040, 041

Signal Quality Analyzer-R MP1900A

1 Outline

This guide explains how to use the MU195020A-040, -041 Variable ISI options to generate waveforms with emulated ISI loss, as well as signals with channel emulation based on the S-parameter, and loss-compensated signals.
These options use the maximum 10Tap Emphasis function (MU195020A-011, -021 options) to generate signals emulating I/O channel loss for various high-speed devices and PC boards. This enables easy channel-loss dependent high-speed device performance tests without needing to prototype multi-channel boards, helping play a key role in shortening development times.

[Target Applications]
100GbE backplanes and cables, CEI-28G/25G, High-speed Interconnect

Table 1-1 Main Functions

Function Name	Option	Outline
10 Tap Emphasis	011/021	The MU195020A 10Tap Emphasis option generates signals emulating high-speed signals and channels of various devices. Adding this Variable ISI Opt-040, -041 supports the following functions.
ISI	040/041	Setting the Nyquist frequency and loss supports generation of a signal with emulated loss for output from the PPG Data output connector.
Channel Emulator		This function generates a signal emulating the S-parameter insertion loss for output from the PPG Data output connector. In addition, it also supports generation of a signal compensated for insertion loss.

Step (1) Emphasis Manual Setting, (2) Channel Emulator, and (3) ISI setting use the 10Tap Emphasis hardware. The (1), (2), and (3) settings can be combined. Refer to the Appendix for the setting range.

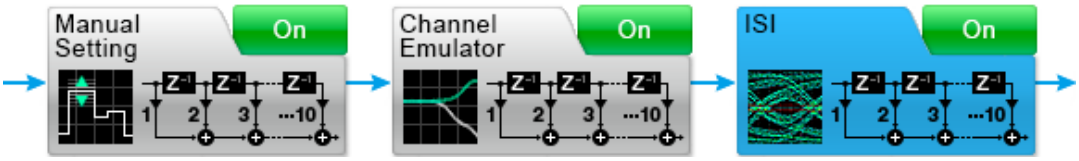


Fig. 1-1 Emphasis Function Setting Screens

2 About ISI Function

2.1. Function Outline

This function adds the ISI loss at the [ISI] tab of the MU195020A 21G/32G bit/s SI PPG [Emphasis] tab to the PPG Data output.
Controlling the ISI using a combination of the reference board J1758A and Emphasis settings not only prevents impedance mismatching but also enables evaluation approximating signals used by an actual ISI board.

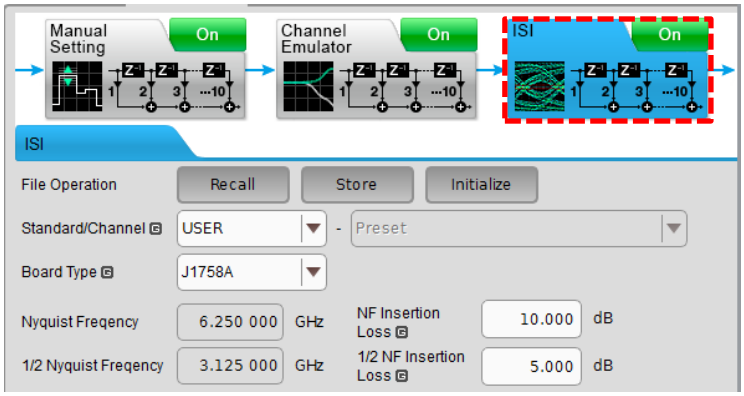


Fig. 2.1-1 ISI Setting Screen

It is used as follows by selecting the [Board Type] setting.

When J1758A Selected:

Outputs signal corresponding to ISI setting in combination with J1758A ISI Board (8 dB@14 GHz transmission path board)

When "Not Specified" Selected:

Adds set loss to loss of externally connected Compliance ISI board

*Although this can be used without connecting an external board, the signal waveform shape may be stepped as a function for controlling the signal in 1-bit units for using Emphasis.

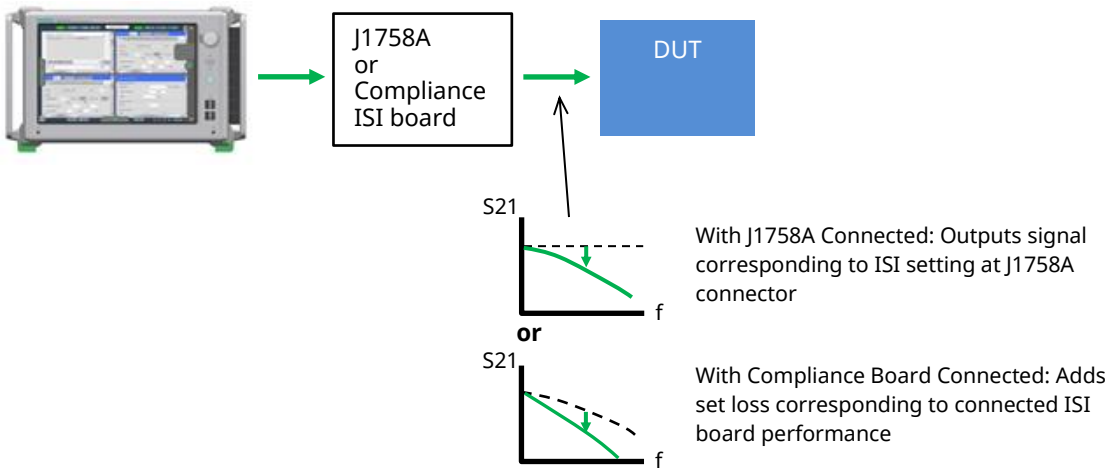


Fig. 2.1-2 Outline of Variable ISI Function

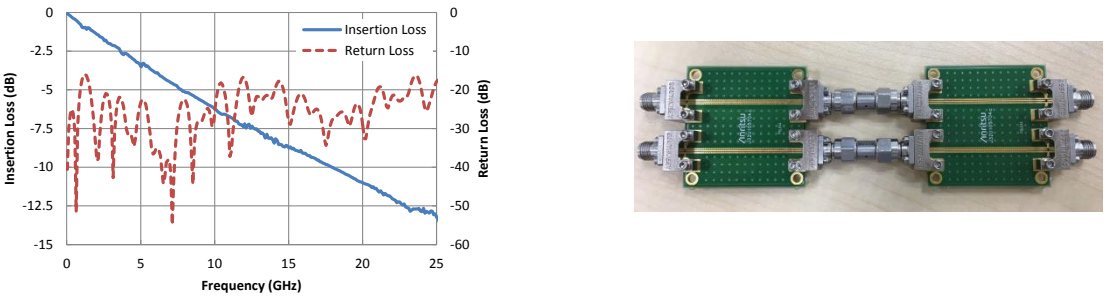


Fig. 2.1-3 Typical J1758A Performance and External Appearance (Reference)

2.2. Preparing for Use

・Required Equipment (With J1758A Connected and Using Control Signal with Added ISI)

Table 2.2-1 Required Equipment List

Model	Name	Option and Remarks	Qty	Check
MP1900A	Signal Quality Analyzer-R		1	
MU181000B	12.5 GHz 4 Port Synthesizer	-	1	
MU195020A	21G/32 Gbit/s SI PPG	1 ch: 010, 011, 040 2 ch: 020, 021, 041	1	
J1624A	Coaxial cable 0.3 m	・MU181000B to MU181500B, (Standard cable of MU181000B) ・MU181500B to MU195020A (Standard cable of MU181500B)	2	
J1758A	ISI Board		1	
J1728A	Coaxial Electrical Length Standard Cable (0.4 m, K-connector)	・MU195020A to J1758A ・J1758A to DUT or Scope	4	

・Connections

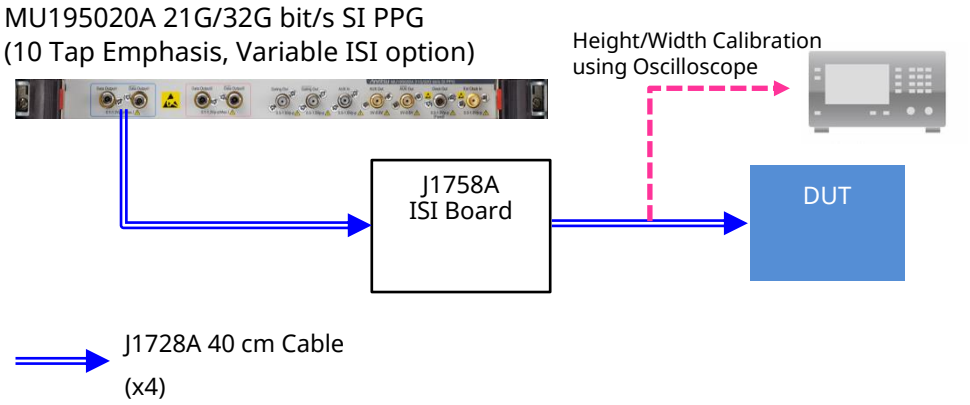


Fig. 2.2-1 ISI Addition Connection Cable

2.3. How To Use

1. Connect the MU195020A PPG Data Output connector and J1758A with the J1728A cable as described in section 2.2 and input the signal to the oscilloscope to perform signal calibration.
2. Set the operation bit rate and output amplitude at the MU195020A setting screen.

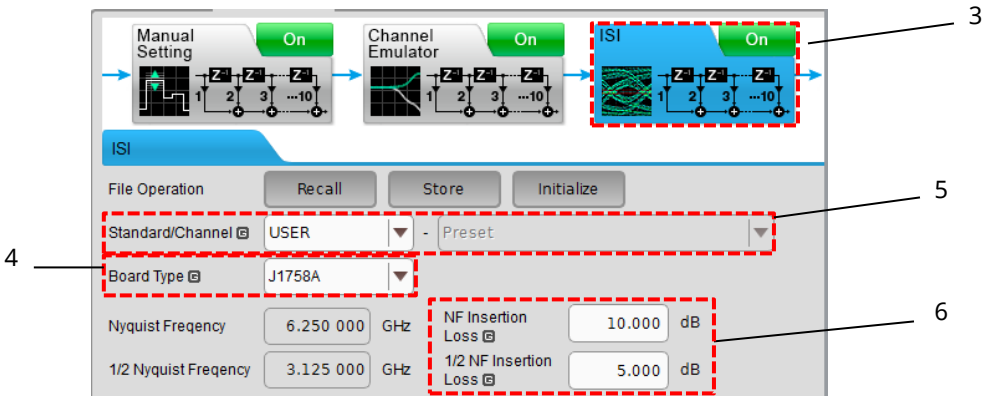


Fig. 2.3-1 ISI Setting Screen

3. Set [ISI] to On at the [Emphasis] tab of the MU195020A setting screen.
4. Select [J1758A] at [Board Type].
5. When adding ISI using the loss value specified by the CEI-25G LR, CEI-28G SR, MR, and VSR standards, select the relevant standard at [Standard Channel]. (NF Insertion Loss and 1/2 NF Insertion Loss are set automatically.)
   When testing using other bit rates and standards, select USER.
6. Observe the waveform with the oscilloscope and change the automatically set NF Insertion Loss and 1/2 NF Insertion Loss values to change the loss.
7. Confirm the oscilloscope waveform (requires oscilloscope CTLE control matching standard) and set [Manual Setting] at the [Emphasis] tab to On. The Emphasis corresponding to the loss waveform set at ISI is synthesized. Adjust the Emphasis setting to obtain the required Eye Height and Eye Width.

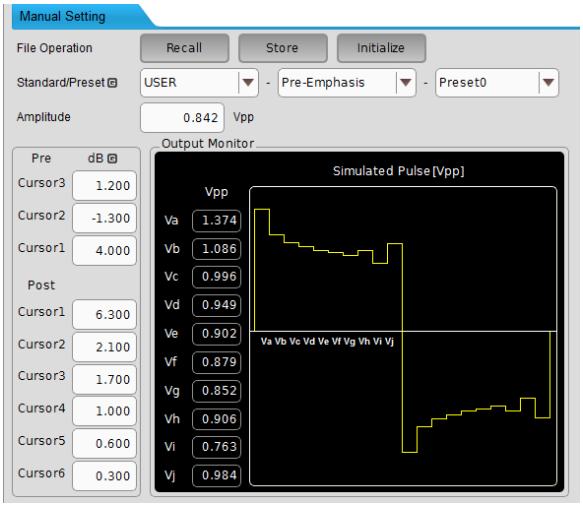


Fig. 2.3-2 Emphasis Manual Setting Screen

8. Connect the corrected signal to the DUT and perform the stress test.

[Example of output waveform at 14 dB (NF) setting for 28 Gbit/s with ISI function and using J1758A]

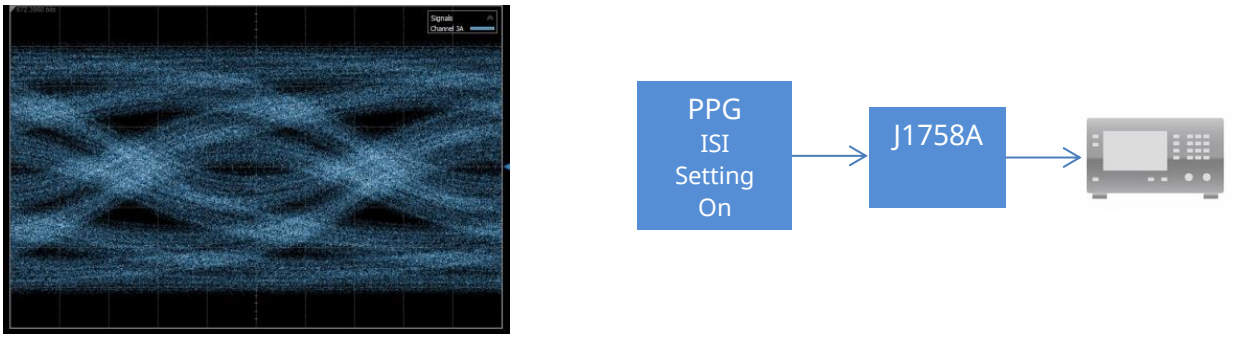


Fig. 2.3-3 Reference ISI Output Waveform

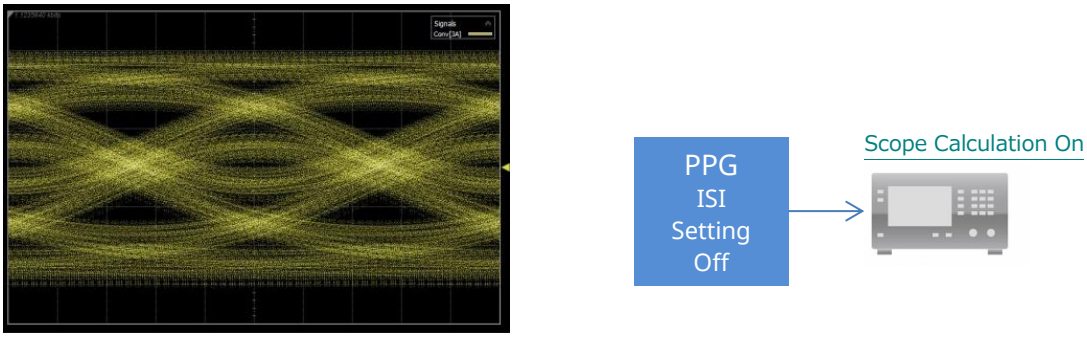


Fig. 2.3-4 Example of Adding Same 14 dB Loss to PPG (ISI Off) Waveform with Oscilloscope Simulation

3 About Channel Emulator Function

3.1. Function Outline

This function sets the loss to add to the PPG Data output based on the S-parameter data at [Channel Emulator] of the MU195020A 21G/32G bit/s SI PPG [Emphasis] tab. Additionally, it can also generate a loss-compensated signal.
As a result, it can be used to evaluate the effect of known component and boards at DUT evaluation.
When setting each of the previous ISI and Channel Emulator items individually, setting On enables setting from the Emphasis Manual Setting Screen in the normalized state (function added by MU195020A-040/041).
When loading S-parameter data at the Channel Emulator setting screen, clicking [Transfer] enables either compensation for S-parameter loss or setting the Added Emphasis setting to Manual Setting. In this case, it is possible to perform Added Emphasis adjustment from the Transfer state without normalizing. The Transfer function does not require the MU195020A-040/041 option.

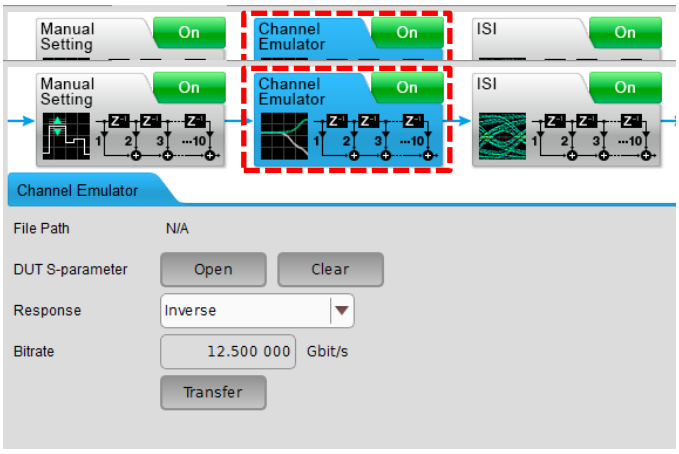


Fig. 3.1-1 Channel Emulator Setting Tab

It is used as follows by selecting the [Response] setting.

When “Normal” Selected:

Generates signal with emulated S-parameter S21 or SDD21

When “Inverse” Selected:

Generates S-parameter S21 or SDD21 compensated signal

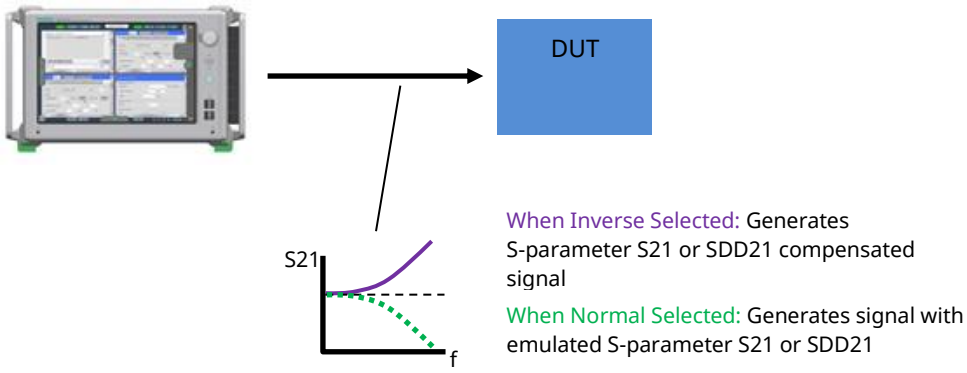


Fig. 3.1-2 Outline of Channel Emulator Function

3.2. Preparing for Use

- **Required Equipment**

  Refer to section 2.2.

- **Setup**

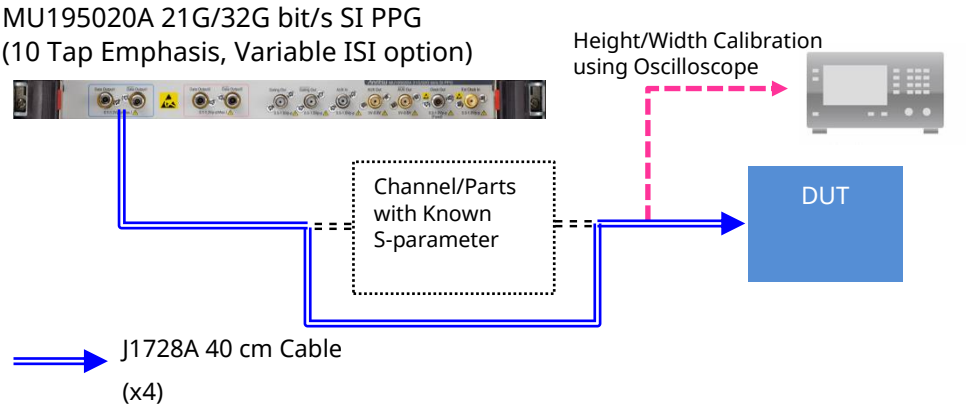


Fig. 3.2-1 Channel Emulator Connection Example

3.3. How to Use

1. The S-parameter data are provided for the channels and parts in the effect verification described in section 3.2.
2. Set the operation bit rate and output amplitude at the MU195020A setting screen.
3. Input the PPG output directly to the oscilloscope.
4. Set [Channel Emulator] at the [Emphasis] tab of the MU195020A setting screen to On.
5. Select either Normal or Inverse at the [Response] setting.
6. Load the provided S-parameter files (step 1) by clicking [Open] at DUT S-parameter.

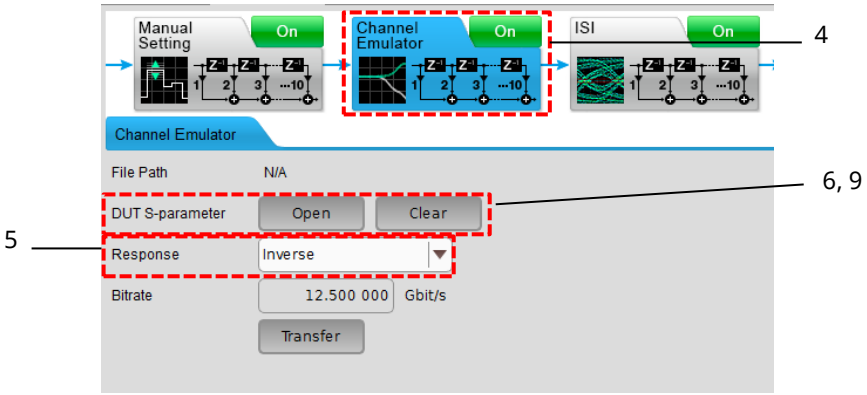


Fig. 3.3-1 Channel Emulator Setting Screen

7. Confirm the oscilloscope waveform (requires oscilloscope CTLE control matching standard) and set [Manual Setting] at the [Emphasis] tab to On. Adjust the Emphasis setting to obtain the required Eye Height and Eye Width.
   (Refer to section 4 Setting Emphasis.)
8. Input the confirmed signal to the DUT and perform the evaluation.
9. Click [Clear] of [DUT S-parameter] and repeat steps 6 through 8 to load the data and perform measurement to perform comparison verification of effects due to different performance without actually connecting multiple channels/parts.

4 Reference Example

The following explains an example of compensating for loss of 6 dB at 8 GHz using Channel Emulator.

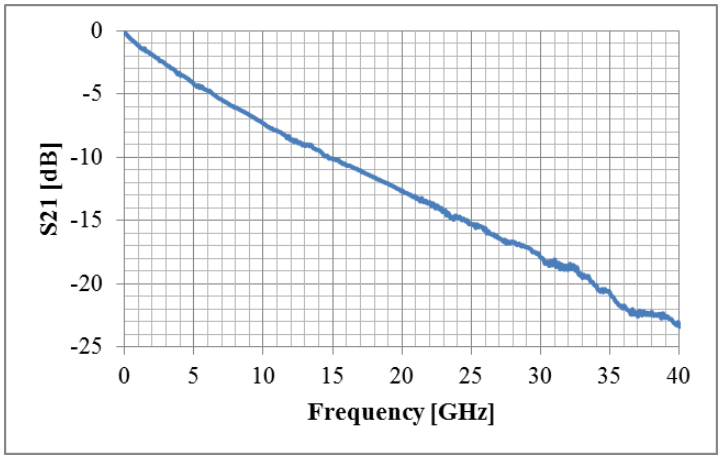


Fig. 4-1 6 dB at 8 GHz S21 Data

1. Connect the PPG to the channel/parts and connect the output of the channel/parts to the oscilloscope.

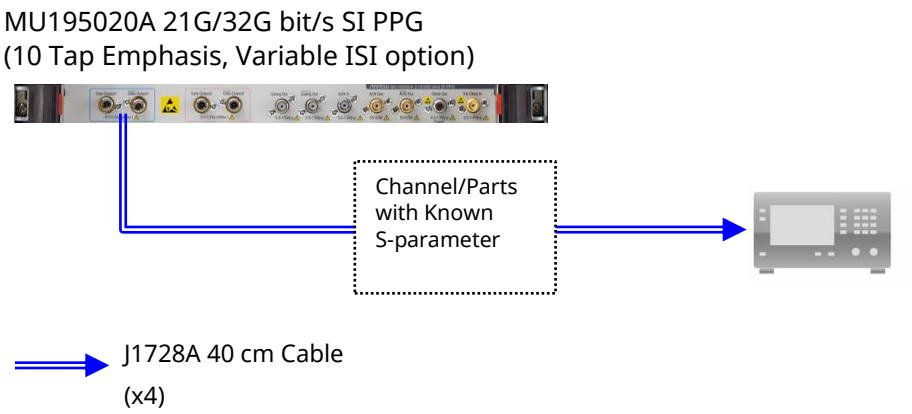


Fig. 4-2 Equipment Setup

2. Set the operation bit rate and output amplitude at the MU195020A setting screen.
3. Set [Channel Emulator] at the [Emphasis]tab of the MU195020A setting screen to Off.
4. Select Inverse at the [Response] setting field.
5. Load the provided S-parameter file by clicking [Open] of [DUT S-parameter].
6. Check the waveform with the oscilloscope; there is no Emphasis compensation at this time.

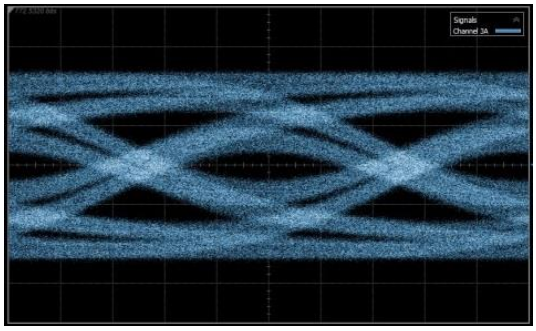


Fig. 4-3 Waveform A including ISI due to PCB frequency-dependent loss

7. Click [Transfer] to switch the screen to the [Manual Setting] tab and perform the Emphasis-Coefficient setting for loss calibration according to the loaded S-parameter.
8. With [Manual Setting] set to ON, the Emphasis set at step 7 is applied to the PPG output data.

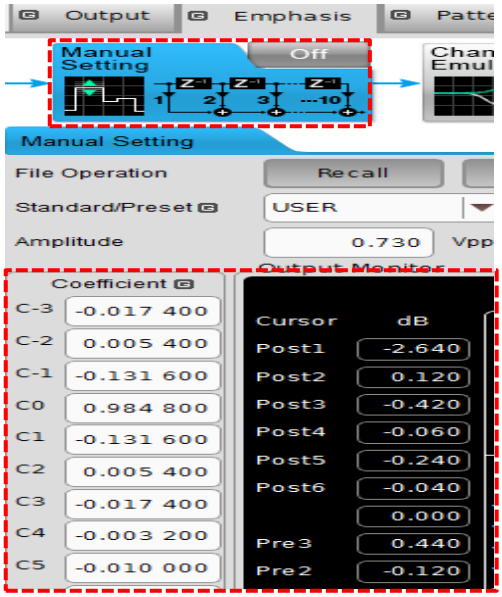


Fig. 4-4 Waveform including ISI due to PCB frequency-dependent loss

9. Check the oscilloscope waveform. The frequency characteristics have been corrected by the Emphasis; confirm that the EYE opening has been widened.
   *Equalization does not always minimize jitter and distortion because the EYE waveform corrected for frequency dependent loss using the inverse of the loaded S-parameter is calculated from the Emphasis settings for 1-bit time units based on the loss data for the Nyquist or lower frequencies.

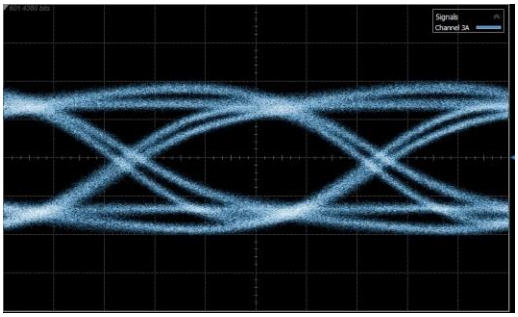


Fig. 4-5 Waveform B: EYE waveform after correction for frequency-dependent loss using inverse of loaded S-parameter

10. The waveform can be fine-adjusted by changing the coefficient setting. For example, Coefficient C-1 and C1 are equivalent to Pre-Cursor1 and Post-Cursor1, and waveform changes resulting from changing these variables can be confirmed.

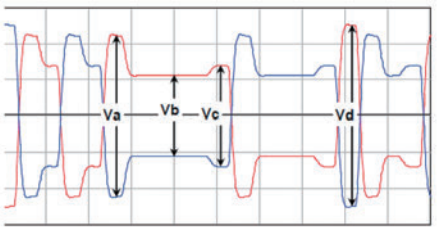
Appendix (MU195020A-011/021, 040/041 Main Standards (Specifications): Refer to MP1900A data sheet.)

10Tap Emphasis

When Option x11 or Option x21 is added.

Emphasis Tap	10 (6 post-cursor, 3 pre-cursor)
Cursor Setting Range	–20 to +20 dB, 0.1 dB step*1
Accuracy	±1 dB (typ.)*2
Emphasis Peak Voltage Setting Range	0.1 Vp-p to 1.5 Vp-p (Single-end)
Transition Time from Idle State	≤8 ns*3

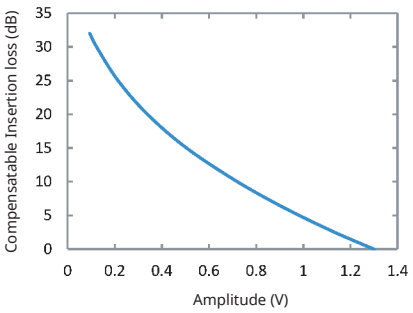
*1: Post-Cursol: $20\log_{10}(\frac{V_a}{V_b})$, Pre-Cursol: $20\log_{10}(\frac{V_c}{V_b})$



*2: Defined for the preset of 8 Gbit/s, 16 Gbit/s, and 25 Gbit/s for PCIe 3 and PCIe 4 respectively.
*3: Maximum time to transition to valid diff signaling after leaving Electrical Idle

Channel Emulator*4	Normal: Outputs signal emulating transmission channel equivalent to read S-parameter at PPG Data Output Inverse: Outputs signal with set De-Emphasis for compensating for transmission channel loss equivalent to read S-parameter at PPG Data Output
Response	Normal, Inverse
S-Parameter file	S2P File (extension *.s2p), S4P File (Input ports 1 and 3; Output ports 3 and 4, extension *.s4p)

*4: The following graph indicates the maximum transmission channel loss that can be compensated for using the Channel Emulator function without causing a decrease in Amplitude.

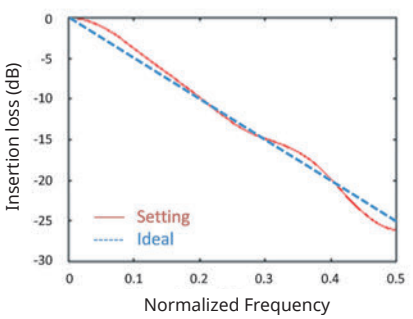


Variable ISI

With either Option x40 or Option x41

Variable ISI	Sets ISI-generated channel loss and outputs this emulated waveform at PPG output Data signal (Output waveform amplitude standardized as set amplitude) Use either in combination with ISI Board J1758A (select J1758A) or in combination with external channel board (select Not Specified)
Frequency Setting	Can set Insertion Loss at Nyquist or 1/2 Nyquist frequency
Insertion Loss Setting	1.5 to 25 dB 0.01 dB step @Nyquist Frequency 0 to 25 dB 0.01 dB step @1/2Nyquist Frequency
Insertion Loss Accuracy*	±1 dB nominal (design guarantee) at Nyquist frequency, 10 dB, with 1,0 pattern repetition ±1 dB nominal (design guarantee) at 1/2 Nyquist frequency 5 dB, with 1, 1, 0, 0 pattern repetition Bit rates of 16 Gbit/s, 25 Gbit/s (Option 01 installed), Eye Amplitude of 1.0 Vp-p, each spectrum
Channel Emulator On/Off	Used in combination with Variable ISI and 10Tap Emphasis

*: The Insertion Loss Accuracy is shown by the following graph of the frequency characteristics when 25 dB and 12.5 dB is set at the Nyquist frequency and 1/2 Nyquist frequency, respectively. (ISI Nominal Data)



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● **United States**
Anritsu Company
1155 East Collins Blvd., Suite 100, Richardson,
TX 75081, U.S.A.
Toll Free: 1-800-267-4878
Phone: +1-972-644-1777
Fax: +1-972-671-1877

● **Canada**
Anritsu Electronics Ltd.
700 Silver Seven Road, Suite 120, Kanata,
Ontario K2V 1C3, Canada
Phone: +1-613-591-2003
Fax: +1-613-591-1006

● **Brazil**
Anritsu Eletronica Ltda.
Praça Amadeu Amaral, 27 - 1 Andar
01327-010 - Bela Vista - Sao Paulo - SP
Brazil
Phone: +55-11-3283-2511
Fax: +55-11-3288-6940

● **Mexico**
Anritsu Company, S.A. de C.V.
Av. Ejército Nacional No. 579 Piso 9, Col. Granada
11520 México, D.F., México
Phone: +52-55-1101-2370
Fax: +52-55-5254-3147

● **United Kingdom**
Anritsu EMEA Ltd.
200 Capability Green, Luton, Bedfordshire, LU1 3LU, U.K.
Phone: +44-1582-433200
Fax: +44-1582-731303

● **France**
Anritsu S.A.
12 avenue du Québec, Bâtiment Iris 1- Silic 612,
91140 VILLEBON SUR YVETTE, France
Phone: +33-1-60-92-15-50
Fax: +33-1-64-46-10-65

● **Germany**
Anritsu GmbH
Nemetschek Haus, Konrad-Zuse-Platz 1
81829 München, Germany
Phone: +49-89-442308-0
Fax: +49-89-442308-55

● **Italy**
Anritsu S.r.l.
Via Elio Vittorini 129, 00144 Roma, Italy
Phone: +39-6-509-9711
Fax: +39-6-502-2425

● **Sweden**
Anritsu AB
Kistagången 20B, 164 40 KISTA, Sweden
Phone: +46-8-534-707-00
Fax: +46-8-534-707-30

● **Finland**
Anritsu AB
Teknobulevardi 3-5, FI-01530 VANTAA, Finland
Phone: +358-20-741-8100
Fax: +358-20-741-8111

● **Denmark**
Anritsu A/S
Torveporten 2, 2500 Valby, Denmark
Phone: +45-7211-2200
Fax: +45-7211-2210

● **Russia**
Anritsu EMEA Ltd.
Representation Office in Russia
Tverskaya str. 16/2, bld. 1, 7th floor.
Moscow, 125009, Russia
Phone: +7-495-363-1694
Fax: +7-495-935-8962

● **Spain**
Anritsu EMEA Ltd.
Representation Office in Spain
Edificio Cuzco IV, Po. de la Castellana, 141, Pta. 5
28046, Madrid, Spain
Phone: +34-915-726-761
Fax: +34-915-726-621

● **United Arab Emirates**
Anritsu EMEA Ltd.
Dubai Liaison Office
902, Aurora Tower,
P O Box: 500311- Dubai Internet City
Dubai, United Arab Emirates
Phone: +971-4-3758479
Fax: +971-4-4249036

● **India**
Anritsu India Private Limited
2nd & 3rd Floor, #837/1, Binnamangla 1st Stage,
Indiranagar, 100ft Road, Bangalore - 560038, India
Phone: +91-80-4058-1300
Fax: +91-80-4058-1301

● **Singapore**
Anritsu Pte. Ltd.
11 Chang Charn Road, #04-01, Shriro House
Singapore 159640
Phone: +65-6282-2400
Fax: +65-6282-2533

● **P.R. China (Shanghai)**
Anritsu (China) Co., Ltd.
Room 2701-2705, Tower A,
New Caohejing International Business Center
No. 391 Gui Ping Road Shanghai, 200233, P.R. China
Phone: +86-21-6237-0898
Fax: +86-21-6237-0899

● **P.R. China (Hong Kong)**
Anritsu Company Ltd.
Unit 1006-7, 10/F., Greenfield Tower, Concordia Plaza,
No. 1 Science Museum Road, Tsim Sha Tsui East,
Kowloon, Hong Kong, P.R. China
Phone: +852-2301-4980
Fax: +852-2301-3545

● **Japan**
Anritsu Corporation
8-5, Tamura-cho, Atsugi-shi, Kanagawa, 243-0016 Japan
Phone: +81-46-296-6509
Fax: +81-46-225-8352

● **Korea**
Anritsu Corporation, Ltd.
5FL, 235 Pangyoyeok-ro, Bundang-gu, Seongnam-si,
Gyeonggi-do, 13494 Korea
Phone: +82-31-696-7750
Fax: +82-31-696-7751

● **Australia**
Anritsu Pty. Ltd.
Unit 20, 21-35 Ricketts Road,
Mount Waverley, Victoria 3149, Australia
Phone: +61-3-9558-8177
Fax: +61-3-9558-8255

● **Taiwan**
Anritsu Company Inc.
7F, No. 316, Sec. 1, NeiHu Rd., Taipei 114, Taiwan
Phone: +886-2-8751-1816
Fax: +886-2-8751-1817

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