

AGITERSERVICE



M8 仪器型号:

M8047C

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M8047C Redriver

Version 1.0

Enabling Your Successful PCIe Design Deployments

The Keysight M8047C, when paired with the M8040A or M8050A platforms, enhances your chip development process for PCIe by offering advanced equalization capabilities.



Introduction

The M8047C Redriver enhances the equalization capabilities of the M8046A error detector for both PAM4 and NRZ applications. Additionally, the M8047C functions as a remote head, allowing for the use of shorter cables.



Description

The M8047C Redriver enables testing of devices with longer back channels than the M8000 Series error detectors could accept by themselves. It offers a continuous-time linear equalizer. Using the M8047C Redriver (together with M8046A) the backchannel reach can be extended to approximately 28 dB @ 16 GHz for PAM4 signals (BER \leq 1.0e-6) and 37 dB @ 16 GHz for NRZ signals (BER \leq 1.0e-12). It is designed to operate up to 32 GBd.



Figure 1. PCI Express Receiver Testing is a typical use case of the M8047C Redriver

The M8047C Redriver is targeting PCI Express[®], OIF CEI as well as IEEE 802.3 applications within its range of operation.

The M8047C is controlled through the M8070B graphical user interface. The Redriver appears as an additional module in the M8070B software.



Specifications

Achievable backchannel compensation for PCI Express 64 GT/s



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Figure 2. Above setup mimics a LinkEQ TX test scenario for PCIe 64 GT/s using PCIe 5.0 Base specification channels

The most challenging test setup from a backchannel equalization perspective is the LinkEQ TX response time test which needs to split the return signal between an oscilloscope and an error detector which further decreases the signal for the error detector. To simulate a PCIe 64 GT/s transmitter the BERT pattern generator was calibrated and characterized at TP3. The SNDR was around 36.5 dB. RJ was calibrated to 250 fs rms using noise removal on the oscilloscope. Amplitude was calibrated to 800 mV_{pp,diff}. Two cases have been checked, transmission with SSC and without SSC. In case of transmission without SSC the error detector CR was set to a first order behavior with a 2 MHz loop BW. In case of transmission with SSC the error detector CR was set to a second order behavior with 20 MHz loop BW and peaking to ensure tracking of the SSC. In all cases the backchannel was optimized by varying the Tx EQ preset, M8047C equalization, M8046A FFE, input voltage window, thresholds and sampling point delay.





Figure 3. Measurements using a transmission without SSC. Blue dots are showing the best achieved BER for the best combination of Tx preset, M8047C equalization, M8046A FFE and input window, thresholds and sampling point optimization.





Figure 4. Measurements using a transmission with SSC. Blue dots are showing the best achieved BER for the best combination of Tx preset, M8047C equalization, M8046A FFE and input window, thresholds and sampling point optimization.

The achievable backchannel BER is highly dependent on the transmitter signal characteristics like SNDR, PLM and jitter. The BER limit for optimized backchannel is intended to provide guidance for an achievable backchannel BER if a transmitter and channel with similar characteristics as in above experiment is used.



Data input and data output

The M8047C Redriver has a differential data input and differential data output to be inserted in the test set-up for loss compensation of the channel using adjustable CTLE of the M8047C.

Table 1. Data input

Parameter

Symbol rate	2 GBd to 32 GBd	
Line coding	NRZ / PAM4	
Absolute maximum input voltage	-2.0 V to +2.0 V	
range		
Maximum input amplitude	1.0 Vpp,differential	
Input type	Differential	
	Low frequency: DC coupled 50 Ω (nom.) to GND	
	High frequency: AC coupled 100 Ω (nom.)	
Connector	2.4 mm, female	

Table 2. Data output

Parameter

Output	On / Off
Maximum output amplitude	2.0 Vpp,differential
External termination	100 Ω Do not operate into open
Coupling	AC-coupled, differential
Connector	2.4 mm, female



Status indicators, general characteristics and physical dimensions

Table 3. Status indicators

Output enabled, green LED	Off: Data output is turned off On: Data output is enabled
Instrument status, red/green LED	Off: M8047C is not powered Green, static: Instrument is ready Green, blinking: Used to identify the instrument Red: Indicates an instrument error

Table 4. General characteristics and

physical dimensions

Operating temperature	0 °C to 40 °C (32 °F to 104 °F)	
Storage temperature	-40 °C to 70 °C (-40 °F to 158 °F)	
Operating humidity	15% to 95% relative at 40 °C (non-condensing)	
Storage humidity	24% to 90% relative at 65 °C (non-condensing)	
Operating altitude	Up to 3000 m	
Physical dimensions (W x H x D)	~110 mm x 80 mm x 170 mm	
Weight net	0.28 kg	
Weight shipping	0.85 kg	
Interface to controlling PC	USB Type C	
Power consumption	2.5 W max., powered through USB interface	
Recommended recalibration period	2 years	
EMC tested acc. to	IEC 61326-1	
Safety tested acc. to	IEC 61010-1, UL61010-1, CAN/CSA-C22.2 No. 61010-1	
Quality management	ISO 9001, 14001	



User Interface and Remote Control

The M8070B system software for M8000 series of BER measurement solutions and the module driver for M8047C is required to control the M8047C.



Figure 5. The user interface of M8070B system software provides control of all parameters. It provides a graphical user interface and remote control via SCPI. Shown is the Module View of the M8047C.

Estimated channel loss refers to the complete loss of the backchannel at 16 GHz. The Continuous Time Linear Equalizer (CTLE) in the M8047C will be set internally to compensate for the given estimated loss in the channel. The range can be adjusted between 8 dB and 37 dB.

Compensation adjustment can be used as a fine adjustment for the internal CTLE. Depending on the transmitter equalization selected this needs to be adjusted. The range can be adjusted between -20 to +20.

Compensation bias factor provides some additional high frequency peaking for frequencies higher than 10 GHz. This value is automatically selected and overwritten in case the estimated channel loss is set. The range can be adjusted between 0 to +3.



Software

Table 5. User interface and remote-control interface of M8070B and M8047C

Parameter	
Programming language	SCPI
Save/Recall	Yes
Software update	Under the help menu the M8070B can show if there are newer SW revisions of M8070B or M8047C module driver packages available for download from K.com.
Offline version	Yes. Can be used without M8047C hardware connected.
License types	Not licensed. M8000B baseline software and M8047C module driver do not require a license.

Control PC

Table 6. The M8070B system software and M8047C module driver needs to be installed on a controlling PersonalComputer. The M8047C is powered by the USB interface of that PC.

Parameter

Interface to M8047C	USB type C		
Memory	Minimum 8 GB RAM recommended		
Operating system	Windows 10, 64-bit or Windows 11, 64-bit		
Display resolution	Minimum requirement 1024 x 768		
Software pre-requisites	Keysight IO Libraries Suite 2024 M8070B: M8047C module driver:	Update 1 (build 21.0.47) or above Version 11.0.240.16 or above Version 1.0 or above	



Specification Definitions

Specification (spec.)

The warranted performance of a calibrated instrument that has been stored for a minimum of 2 hours within the operating temperature range of 0 °C to 40 °C and a 15-minute warm up period. Within \pm 10 °C after auto calibration. All specifications include measurement uncertainty and were created in compliance with ISO-17025 methods. Data published in this document are specifications (spec) only where specifically indicated.

Typical (typ.)

The characteristic performance, which 80% or more of manufactured instruments will meet. This data is not warranted, does not include measurement uncertainty, and is valid only at room temperature (approximately 23 °C).

Nominal (nom.)

The mean or average characteristic performance, or the value of an attribute that is determined by design such as a connector type, physical dimension, or operating speed. This data is not warranted and is measured at room temperature (approximately 23 °C).

Measured (meas.)

An attribute measured during development for purposes of communicating the expected performance. This data is not warranted and is measured at room temperature (approximately 23 °C).

Accuracy

Represents the traceable accuracy of a specified parameter. Includes measurement error and time base error, and calibration source uncertainty.

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