N7718C Optical Reference Transmitter

Single-Mode Fiber Optical Reference Transmitter Enables 200G/Lane Design Validation and 400G/Lane Pathfinding

Introduction

The Keysight N7718C Optical Reference Transmitter is suitable for any intensity-modulated signal format with rates of 120 Gbaud and beyond. It operates in the optical O-band (1.3 µm window). Users can connect the optical input to either the built-in 1310 nm DFB laser or a tunable laser to cover LR4, ER4, CWDM4, or other wavelength grids. The N7718C works with Keysight Arbitrary Waveform Generators (AWG) and the M8000 Series of BER Test Solutions.

Optical transceiver manufacturers and optical interconnect solution providers need to validate standards compliance and ensure interoperability at data rates beyond 200 Gbps per lane. Meanwhile, research for data rates at 400 Gbps per lane has already started.

No RF Amplifier Required

Thanks to the N7718C's low V_{π} users do not always need an RF amplifier, which would add jitter and noise, to achieve a cleaner optical signal.

Automated Bias Control

The N7718C's convenient automated bias-control mode works without dithering in the quadrature point. Therefore, it will not inject any unwanted spectral components to the optical signal.

KEYSIGHT

Optical Receiver Stress Test Automation

The turnkey Keysight N4917DJCA optical receiver stress test solution consists of the M8050A High-Performance BERT, M8053A interference source and the N7718C. Rather than using in-house transmitters with a given signal quality, optical receiver designers can use the solution to simulate a 120 Gbaud optical transmitter to validate their receivers under variable conditions. Those conditions include optical extinction ratio and TDECQ, as well as stress conditions like noise, jitter, and interference.

The N7718C optical reference transmitter, driven by the M8050 Series BERT, generates clean and stressed signals. This approach enables the automated testing of optical receiver designs for compliance with the upcoming IEEE 802.3dj standard.

Please refer to the N4917DJCA 1.6T Optical Receiver Test Application web page for further information.

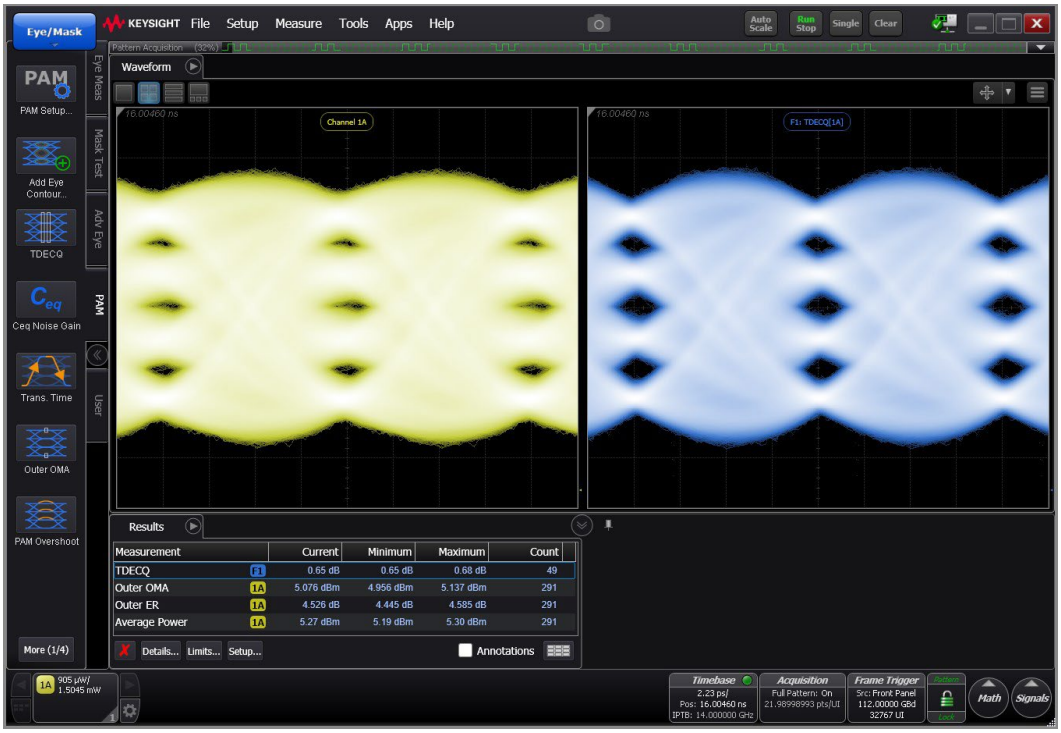

Figure 1. Optical output performance of a 112 Gbaud PAM4 pattern, measured with a Keysight N1032A DCA optical channel module at the output of N7718C that is connected to a high-performance BERT.

Research for Higher Data Center Throughput

Paired with the M8199B, the industry's fastest AWG, the N7718C can generate optical signals for IM/DD applications, such as NRZ, PAM4, PAM6, and PAM8 waveforms. This capability enables research for transmission at 448 Gbps net bitrate per lane, paving the way for 3.2 Tbps links.

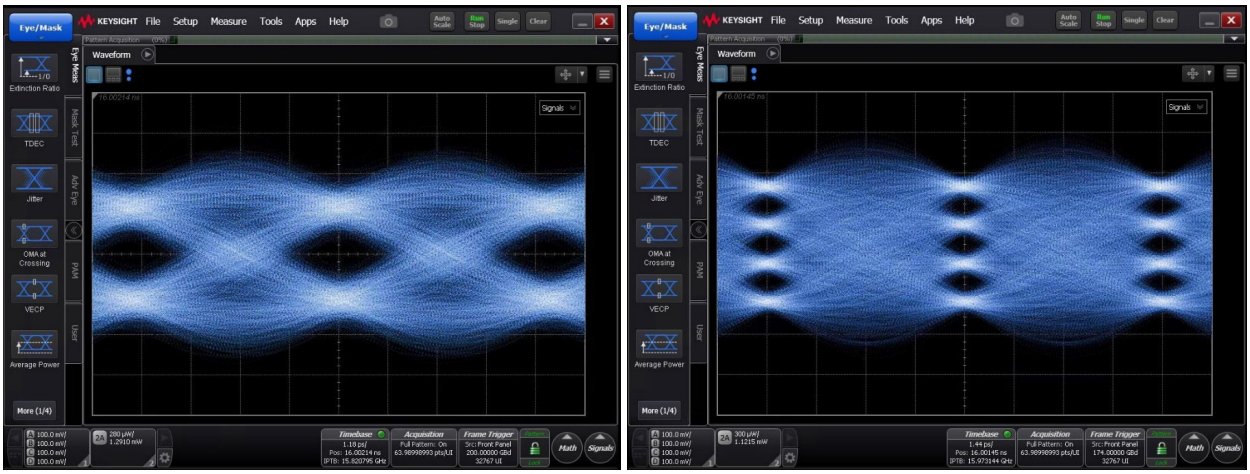

Figure 2. 200 Gbaud NRZ (left) and 174 Gbaud PAM4 (right) [1].

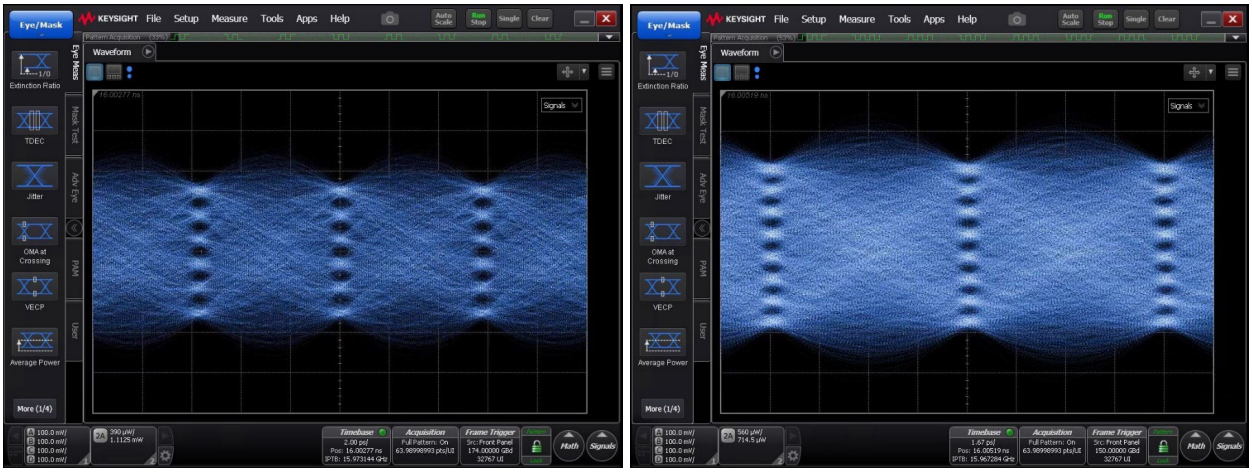

Figure 3. Examples of 448 Gbps per lane: 174 Gbaud PAM6 (left) and 150 Gbaud PAM8 (right) [1].

[1] Signals generated with the N7718C reference transmitter driven by an M8199B AWG (ch1p and ch2n connected to a high-bandwidth balun). Optical signal measured with an N1032A DCA optical channel module. Digital pre-distortion of AWG, 30 cm RF cables and balun applied at the transmitter side. System Impulse Response Correction (SIRC) with flat response and linear equalization, also removing noise and interference components that are not correlated to the trigger signal, are applied in FlexDCA software.

Definitions

Generally, all specifications are valid at the stated operating and measurement conditions and settings, with uninterrupted line voltage.

Specifications (Guaranteed)

Describes warranted product performance that is valid under the specified conditions. Specifications include guard bands to account for the expected statistical performance distribution, measurement uncertainties changes in performance due to environmental changes and aging of components.

Typical Values (Characteristics)

Characteristics describe the product performance that is usually met but not guaranteed. Typical values are based on data from a representative set of instruments.

General Characteristics

Give additional information for using the instrument. These are general descriptive terms that do not imply a level of performance.

Technical Specifications

	N7718C-313
Optical input power range	+8 dBm to +20 dBm nominal +15 dBm
Max. safe input power	+20 dBm
Operating wavelength range	1260 nm to 1360 nm
Output power at quadrature bias point	Typical ≥ +5.5 dBm (using internal laser, set to +18.5 dBm)
Frequency roll-off (characteristic)	> 102 GHz (10 dB) > 77 GHz (6 dB)
RF input amplitude range	200 mV to 2 V
V_{π} at 1310 nm (characteristic)	< 1.45 V at 10 kHz
Max. safe RF input amplitude	4 V peak-peak

Optical Laser Output	**N7718C-100**
Wavelength	1310 nm ± 10 nm
Max. output power	+18.5 dBm
Attenuation range	0 dB to 5.5 dB
Optical power stability	Typical ±0.02 dB, 15 minutes
Laser safety information	All laser sources specified by this data sheet are classified as Class 1M according to IEC 60825-1:2014 and EN 60825-1:2014/A11:2021. All laser sources comply with 21 CFR 1040.10 except for deviations pursuant to Laser Notice No. 50, dated 2007, June 24.

Technical Specifications (continued)

Specifications in this table apply when the N7718C is driven by an M8050A Pattern Generator (PG). Settings and measurement conditions as follows:

- SIRC bandwidth 56.25 GHz
- Signal rate: 113 GBd
- Pattern: PRBS 2^{15}-1 (NRZ); SSPRQ (PAM4)
- RF input amplitude: 800 mV

	N7718C-313
Max. baud rate (PAM4)	≥ 120 GBd
TDECQ (PAM4) [1]	Typical < 3.5 dB (Outer ER > 8 dB, without M8050A PG de-emphasis) Typical < 1.2 dB (Outer ER > 3 dB, with M8050A PG de-emphasis)
TDEC (NRZ)	Typical < 1.7 dB at 1310 nm
Jitter (NRZ) [2]	Typical total jitter < 5.3 ps peak-peak Typical random jitter < 180 fs rms
Rise and fall time (NRZ) (20% to 80%)	Typical < 5 ps
Extinction ratio (NRZ)	Typical ≥ 3.1 dB
Outer ER (PAM4) [1]	Typical > 8 dB at 1310 nm (without M8050A PG de-emphasis) Typical > 3 dB at 1310 nm (with M8050A PG de-emphasis)
Outer OMA (PAM4) [1]	Typical > 6.5 dBm at 1310 nm (without M8050A PG de-emphasis) [3] Typical > 3.5 dBm at 1310 nm (with M8050A PG de-emphasis) [3]

1. TDECQ equalizer set to 15 tap, 4×10^{-3} SER, as per IEEE 802.3dj, Rev. 6 March 2024, clause 180; 7 tap de-emphasis on transmitter side.
2. Measured with N1032A optical DCA module.
3. Modulator optical output power 5.5 dBm. Modulator maintained at quadrature.

General Specifications

	N7718C
Optical laser output	Angled, Panda PMF, 9/125 µm; requires 81000xI connector interface
Optical (laser) input	Angled, Panda PMF, 9/125 µm; requires 81000xI connector interface
Optical (data) output	Angled, Panda PMF, 9/125 µm; requires 81000xI connector interface
RF input	1.0 mm female, single-ended
Line power	AC 100 V to 240 V ± 10%, 50/60 Hz, 60 VA max.
Operating temperature	+5 °C to +40 °C
Operating humidity	≤ 80%, non-condensing
Storage temperature	–40 °C to +70 °C [1]
Max. operating altitude	2000 m
Warm-up time	30 minutes
Recommended recalibration period	2 years
Dimensions	420 mm × 212 mm × 43 mm (excluding front and back rubber cushions and connectors)
Weight	3 kg (6 lbs)
User Interface	**N7718C**
LAN Access (1 Gbit/s): HTTP VXI-11 SCPI-telnet SCPI-raw HISLIP	IPv4 and IPv6 Socket connection: http://<ip_address> or http://<host_name> port 111 (IPv4 only) port 5024 port 5025 port 4880
USB Access (USB 2.0)	Remote NDIS (virtual Ethernet link over USB); USB Mass Storage functions (read-only) USBTMC

1. Recommended storage temperature range is +10°C to +40°C. If stored outside this range, the instrument must be conditioned at room temperature for at least 72 hours before use.

Ordering Information

Product/Option	Description
N7718C	Optical Reference Transmitter, single mode with external optical input
Option	**Bandwidth Selection (Must Choose One)**
N7718C-313	For 120 GBd and higher, O-band operation
Option	**Laser Selection (Must Choose One)**
N7718C-100	With integrated 1310 nm DFB laser and external optical input
N7718C-050	With external optical input
Product	**Required Accessories**
81000xI	Three (3) 81000xI connector interfaces are required for option N7718C-100, two (2) 81000xI connector interfaces are required for option N7718C-050
Product/option	**Recommended Accessories**
N7799C-1CM	Rack Mount Kit for 2 half-width instruments, 1 Rack Height Unit. Includes low profile rails, fitted to Keysight System II racks with 24-inch-spaced mounts. Requires Filler Kit N7799C-0CM for mounting single instrument
N7799C-0CM	Filler Kit for N7799C-1CM. Required for single half-width instrument; includes front panel and base plate
N7799C-3PM	Patch cord, PMF, FC/APC (narrow key) connectors, protective polymer tubing, 35 cm long
N7799C-DOC	Documentation of N77-C Platform, Physical Medium
	Included Accessories
	Test report Keysight safety leaflet, China RoHS Addendum USB-A to USB-B cable, 2 m/ 7 ft Ethernet LAN cable. CAT-6, RJ45 plugs, 2m/ 7 ft Country-specific power cord

User Interface Screen Captures

The N7718C optical reference transmitter's graphical user interface provides detailed information about the optical input power and output power, as well as the ratio of both values over time. The panel also includes relevant parameters and settings of the automated bias control and the built-in laser source. Responsive design ensures that the display adjusts to the browser window and the chosen zoom factor, allowing to comfortably arrange multiple instrument views on one screen.

Figure 4. Bias control in N7718C user interface: output/input power ratio at quadrature point.

Web User Interface but No LAN?

Connect instrument and PC via USB. The instrument shows up as a new drive: double-click the shortcut on that drive. This lets any modern browser open a connection to the instrument: the graphical user interface appears. It's as simple as that!

For More Information

To find more optical test instruments, check the following links:

Coherent transmission test instruments: www.keysight.com/find/oma

Lightwave component analyzers: www.keysight.com/find/lca

Optical test instruments: www.keysight.com/find/oct

Optical signal conditioning products: www.keysight.com/find/voa

Optical multiport power meters: www.keysight.com/find/MPPM

Polarization solutions: www.keysight.com/find/pol

Tunable laser sources: www.keysight.com/find/tls

Keysight photonic discussion forum: community.keysight.com

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