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Keysight N7004A
33 GHz Optical-to-Electrical Converter

Data Sheet

KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

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Industry's First Fully-Integrated 28 Gbps Optical Input Solution for Infiniium Real-time Oscilloscope



Figure 1. The N7004A is a high-sensitivity 33 GHz O/E converter for Infiniium real-time oscilloscopes.

- DC to 33 GHz typical (–3 dBe, electrical)
- Single-mode and multimode inputs
- 50/125 µm, 750 nm –1650 nm (covers main wavelengths: 850 nm, 1310 nm, and 1550 nm)
- Designed for reference receiver testing of industry optical standards or characterizing raw response of an optical transmitter
- Optical measurement features built into the Infiniium baseline software version 05.70 or higher
- Compatible with Infiniium V-Series, 90000 X-Series, Z-Series and discontinued 90000 Q-Series real-time oscilloscopes

The Keysight N7004A optical-to-electrical converter is a high-sensitivity photodetector module designed for direct optical-to-electrical conversion of optical telecom or data com signals into an Infiniium real-time oscilloscope with AutoProbe II interface.

Traditionally, the sampling oscilloscope is the tool of choice for viewing and measuring optical signals with oscilloscopes. Sampling oscilloscopes provide a myriad of benefits in measuring optical signals with optimized reference receiver, low noise/jitter, and various measurement features optimized to characterize optical signals. On the other hand, real-time oscilloscopes are preferred for ample debug/troubleshooting capabilities and the ability to capture intermittent single-shot events with deep memory and fast sample rates.

The N7004A is the first fully-integrated optical-to-electrical converter solution for Infiniium real-time oscilloscopes. A full suite of optical measurement software is built into the Infiniium baseline software v 05.70 and is offered at no additional cost. The N7004A comes in a compact form factor that is plugged directly into the AutoProbe II probe interface of the Infiniium oscilloscope.

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Industry's First Fully-Integrated 28 Gbps Optical Input Solution for Infiniium Real-time Oscilloscope (Continued)



Figure 2. The N7004A comes in a compact form factor that is plugged directly into the AutoProbe II probe interface of the Infiniium oscilloscope.

The adapter provides from DC to 33 GHz of electrical bandwidth. When used with an Infiniium V-Series or Z-Series 33 GHz oscilloscope, the N7004A allows users to view optical streams at speeds up to 28 Gbps, making this the ideal solution for characterizing or troubleshooting high-speed optical signals in the system level testing. The N7004A with an Infiniium real-time oscilloscope is the ideal solution for users who want to see the unfiltered response of optical transmissions as well.

Each N7004A adapter contains its unique S-parameter correction filter, and this frequency response data is used to flatten the frequency response for more accurate measurement.

The input is a 50 µm/125 µm fiber that can be used with 9 µm single-mode fiber or 50 µm multimode fiber at wavelengths from 750 to 1650 nm and has a FC/PC adaptor. The reference receiver measurement is made with a built-in 4th order Bessel Thomson software filter that allows the waveform to be viewed similarly to what an optical receiver in an actual communication system would display. The 4th order Bessel Thomson filter bandwidth is limited to 2/3 of the Brickwall bandwidth of the oscilloscope. For a 33 GHz oscilloscope with the Bessel Thomson filter on, this yields a 22 GHz Bessel Thomson filter, which covers 28 Gbps x 0.75 = 21 GHz.

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Optical and Electrical Characteristics and Specifications

N7004A	
Bandwidth, typical (electrical, –3 dBe)	33 GHz (with Brickwall filter)
	22 GHz (with 4th order Bessel Thomson filter)
Bandwidth, warranted (electrical, –3 dBe)	32 GHz (with Brickwall filter)
	21.3 GHz (with 4th order Bessel Thomson filter)
Rise time (10 to 90%), typical	13.3 psec (with Brickwall filter)
	17.7 psec (with 4th order Bessel Thomson filter)
Rise time (20 to 80%), typical	9.4 psec (with Brickwall filter)
	12.3 psec (with 4th order Bessel Thomson filter)
Optical output coupling	DC
Wavelength range	750 to 1650 nm
RMS noise (µW)	See the noise characteristics table
Conversion gain (V/W)	850 nm MM: –68 (min), –75 (typical)
	1310 nm MM/SM: –105 (min), –110 (typical)
	1550 nm SM: –105 (min), –110 (typical)
Maximum linear input power	4 mW
Maximum non-destructive input power	8 mW
Input return loss (dB)	850 nm MM: –17 (typical), –15 (max) (fully filled fiber)
	1310 nm SM: –18.5 (typical), –16 (max)
	1550 nm SM: –14 (typical)
Connector type	FC/PC to 50/125 µm fiber, compatible with single-mode or multimode fiber
Infiniium software features	Optical measurements in watts, extinction ratio with dark calibration, eye mask testing (including ability to load DCA masks with margin and user defined mask support), power of 1 and 0, optical modulation amplitude, average power, remote command support for all new features
Software compatibility	Infiniium software version 05.70 or higher

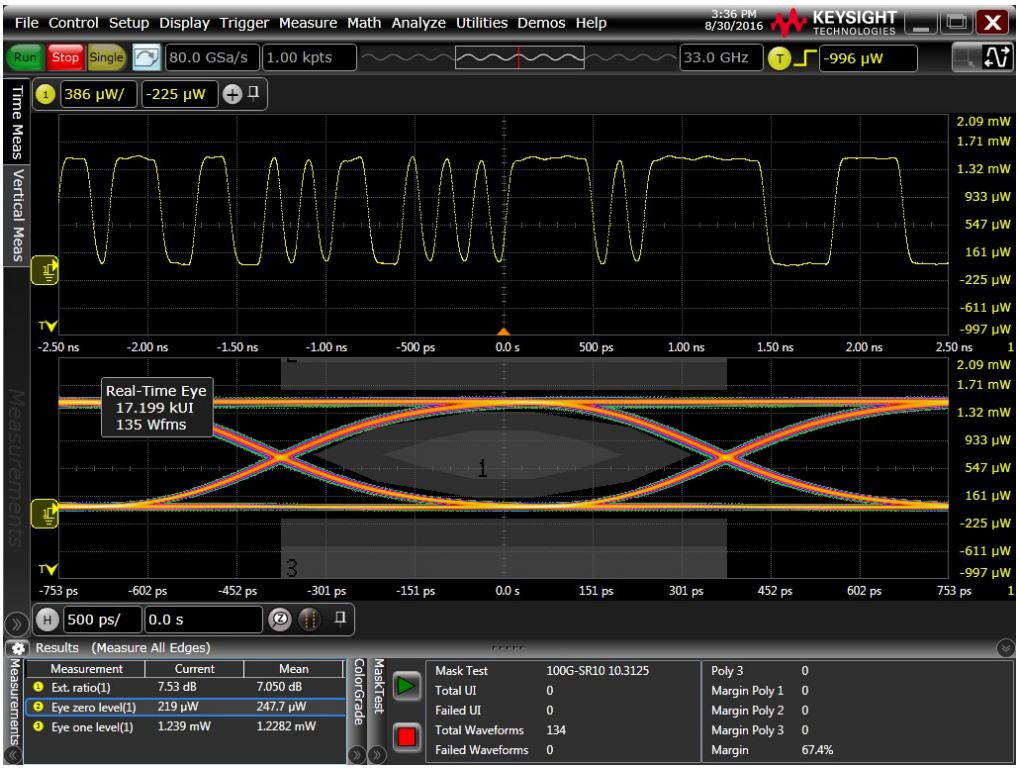


Figure 3. A full suite of optical measurement software is built into the Infiniium baseline software.

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Optical and Electrical Characteristics and Specifications (Continued)



Figure 4. The N7004A used with an Infiniium real-time oscilloscope offers user-selectable hardware Brickwall filter and 4th order Bessel Thomson filter, making the system ideal for reference receiver testing of industry standards or characterizing raw response of optical transmitters.

Noise Characteristics

Displayed noise on Infiniium 33 GHz scope (µWrms)							
Wavelength	**Filter**	**Bandwidth**	**50 µW/div**	**100 µW/div**	**200 µW/div**	**500 µW/div**	**1 mW/div**
1550 nm	Brickwall	33 GHz	7.5	7.7	12.4	32.8	61.4
	Brickwall	25 GHz	5	5.5	8.8	22.6	42.6
	Brickwall	20 GHz	4	4.6	7.2	18.1	34.2
	4th order BT	21 GHz	5.1	5.5	8.6	18.7	41.6
	4th order BT	7.5 GHz	2.7	3.1	4.5	10.7	20.6
1310 nm	Brickwall	33 GHz	6.6	7.2	11.7	31	58.2
	Brickwall	25 GHz	4.5	5.2	8.4	21.6	41.1
	Brickwall	20 GHz	3.6	4.3	6.8	17.2	33.2
	4th order BT	21 GHz	4.3	4.9	8	20.6	39
	4th order BT	7.5 GHz	2.3	2.7	4.2	10.3	19.8
850 nm	Brickwall	33 GHz	11.1	10.7	16	30.1	57
	Brickwall	20 GHz	5.9	6.1	8.7	17.2	32.1
	Brickwall	10 GHz	4.1	4.3	5.9	11.5	21.4
	4th order BT	21 GHz	7.4	7.4	9	20.2	37.8
	4th order BT	7.5 GHz	4	4.2	5.3	10.6	19.6
	4th order BT	3.8 GHz	3.2	3.3	4.1	7.7	14.1

Note 1:
21 GHz BT is for 28 Gbps compliance
7.5 GHz BT is for 10 Gbps compliance
3.8 GHz BT is for 5 Gbps compliance

Note 2:
Conversion gain at 1550 nm = 120.8 V/W, 1310 nm = 142 V/W, 850 nm = 80.7 V/W

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Environmental Characteristics

Temperature	Operating	+10 to +40 °C (–50 to +104 °F)
	Non-operating	–40 to +70 °C (–40 to +158 °F)
Humidity	80% for temperatures up to 31 °C (87.8 °F) decreasing linearly to 50% relative humidity at 40 °C (104 °F)	

Mechanical Information

Net weight	350 g (0.77 lbs)
Dimension (W x H x D)	50 mm x 60 mm x 140 mm

How Much of Oscilloscope Bandwidth Is Needed?

Infiniium real-time oscilloscope bandwidth ≥ Optical data rates in Gbps * 0.75 * 3/2
Ex: Oscilloscope bandwidth ≥ 10 Gbps * 0.75 * 3/2 = 11.25 GHz

Optical data rates	Reference receiver Bessel Thomson bandwidth (=0.75 x data rate)	Needed scope bandwidth (=3/2 of reference receiver bandwidth)	Recommended scope bandwidth (V-Series assumed)
4.25 Gbps	3.1875 GHz	> 4.78 GHz	8 GHz
10 Gbps	7.5 GHz	> 11.25 GHz	13 GHz
25 Gbps	18.75 GHz	> 28.125 GHz	33 GHz
28 Gbps	21 GHz	> 31.5 GHz	33 GHz

Ordering Information

Model numbers	Description
N7004A	33 GHz optical-to-electrical converter (including 1x optical-to-electrical converter module, 2x Fiber optic FS/FC-A1 connector, 2x FC dust cap and 1x carrying case)

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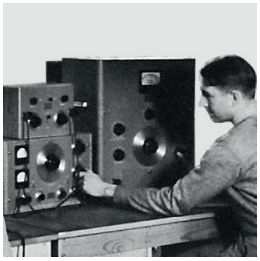
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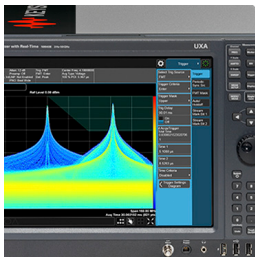
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