

Infinite Capacity Engine – Data Center (ICE-D) DR8 photonic integrated circuit (PIC)

Taking advantage of the unique capabilities of its U.S.-based optical semiconductor fab, Nokia's ICE-D DR8 PIC is a highly integrated solution that combines multiple optical functions (e.g., lasers, modulators, drivers) onto a single monolithic chip, resulting in industry-leading density, low latency and power efficiency.

The ICE-D DR8 PIC is a monolithic indium phosphide (InP) highly integrated PIC designed to deliver ultra-low power and scalable optical intra-data center connectivity for the AI era. It integrates four distributed-feedback (DFB) lasers, an eight-channel Mach-Zehnder (MZM) array and eight semiconductor optical amplifiers (SOAs). This design comprises a complete O-band transmitter PIC for 1.6 Tb/s, 106 Gbaud PAM4 IEEE-based DR8 applications.

With a low peak-to-peak driving voltage (V_{pp}) and high bandwidth, the ICE-D DR8 PIC enables lowest-power 1.6 Tb/s optical transceivers with best-in-class performance for both linear direct-drive (LPO) and fully retimed optics (FRO). It can easily be packaged in industry-standard transceiver formats for a number of different intra-data center applications. CMIS-compliant reference designs and samples are also available.

The ICE-D DR8 PIC's highly integrated design contains an absolute minimum of subcomponents to deliver industry-leading performance, higher reliability and high-volume manufacturability.



Benefits include:

- Significantly reduced power consumption: With unique capabilities enabled by the monolithic InP-based PIC, subsystems manufacturers can build optical transceivers that reduce intra-data center connectivity power requirements by as much as 75%, compared to fully retimed optical transceivers, by enabling less than 10 W/module.
- Increased scalability: Capable of speeds up to 3.2 Tb/s, the ICE-D DR8 PIC provides scalable connectivity to support the high-volume intra-data center optical interconnection requirements of even the most demanding AI applications
- Easy integration: The ICE-D DR8 PIC can easily be packaged in industry-standard transceiver formats supporting different intra-data center applications, including LPO, LRO and fully retimed optics, providing a flexible, scalable and low-powered solution.

- High-volume manufacturability: Taking advantage of Nokia's vertical integration, and enabled by the monolithic and arrayed single-chip design, the ICE-D DR8 PIC helps meet the demand for hundreds of thousands to millions of units inside the data center.

Features

- Low switching voltage MZM
- High bandwidth
- Hermetic InP PIC
- Monolithic integration of laser and modulator
- 8-channel 1.6 Tb/s in a single chip
- Extensive reliability data over 20 years

Benefits

- Low power consumption (<10 W LPO module)
- High output power (1-5 dBm fiber coupled)
- Superior performance (e.g., TDECQ, RLM)
- Support for LPO/LRO/retimed
- Simplified module assembly

Application

- Integration into the design of pluggable transceivers for intra-data center connectivity, such as 1.6 Tb/s fully retimed, half-retimed or LPO

Technical specifications

PIC configuration

- 4 DFBs, 8 MZMs

Operating temperature

- 60 °C (optimized for low power consumption)

Power

- Typical PIC power dissipation: 1.9 W

Ordering information

- PN: ICE-D-200-DR8

Figure 1. Functional block diagram

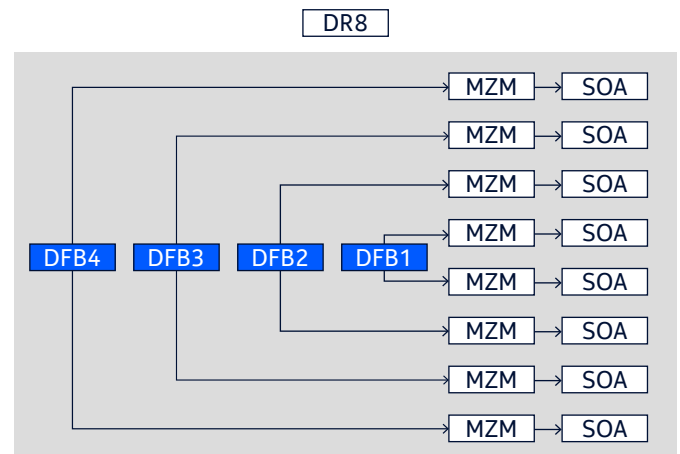
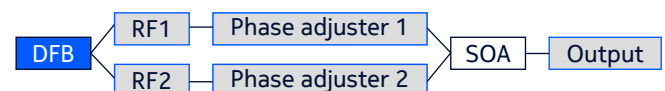


Figure 2. Block diagram of each lane (8 total)





Technical specifications

Optical and electrical characteristics (chip-on-carrier temperature: 60°C)

Parameters	Symbol	Minimum	Typical	Maximum	Unit
Center wavelength	λ	1304.5	1311	1317.5	nm
Side mode suppression ratio	SMSR	30	50		dB
Relative intensity noise	RIN			-140	dBc/Hz
DFB operating current	I_{op}		145		mA
DFB bias voltage	V_{op}		1.35		V
SOA forward current	I_{soa}		60		mA
SOA bias voltage	V_{soa}		1.2		V
Modulator differential impedance			60		ohms
Modulator V_{π}	V_{π}		1.5		V
Modulated fiber coupled output power		1	3	5	dBm
Total PIC power dissipation	P_{diss}		1.9		W

About Nokia

Nokia is a global leader in connectivity for the AI era. With expertise across fixed, mobile, and transport networks, powered by the innovation of Nokia Bell Labs, we're advancing connectivity to secure a brighter world.

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