Introducing IC-TROSA
Integrated Coherent Transmit & Receive Optical Sub-Assembly

Optics for Next-Generation Coherent Networks

The Optical Internetworking Forum ("OIF") has long been a driving force for developing multi-vendor interoperability and performance specifications for optical components. The OIF has now released its most recent Implementation Agreement, "IC-TROSA", which represents a leap forward in multi-sourced coherent board-mounted component technologies.

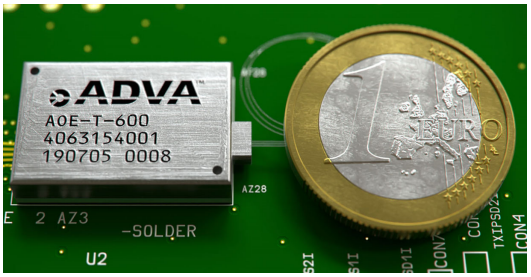

Figure 1: Type-1 Optical BGA IC-TROSA. 100-600Gb/s coherent modulator/driver/receiver in a single integrated SMT package.

The IC-TROSA integrates all the electro-optic components required for a dual-polarization coherent modulator and receiver into a single small board-mounted package. The Type-2 package also includes the tunable laser source.

The OIF Implementation Agreement specifies two cutting edge package designs, the Type-1 and the Type-2, which are specifically targeted to enable next-generation low power, small form factor (SFF), multi-vendor interoperable coherent transceiver components.

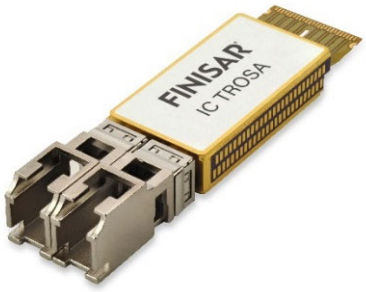

Figure 2: Type-2 IC-TROSA. 100-600 GB/s coherent laser/modulator/driver/receiver in a single integrated fiber-free package.

Integration Drives New Applications

The ever increasing data rate requirements for next-generation optical networks will push coherent transmission toward the network edge as 100Gb/s replaces 10Gb/s SFF interfaces and into high-density, high data rate Data Center Interconnect applications such as defined by OIF's soon to be released 400ZR Implementation Agreement. This expansion of the coherent transmission application space requires reductions both in size and cost, while at the same time increasing the per wavelength data rates up to 600Gb/s. The two most important technology developments enabling these new coherent applications are the availability of low power DSPs based on 7nm CMOS nodal technology and the highly integrated electro-optics provided by the IC-TROSA.

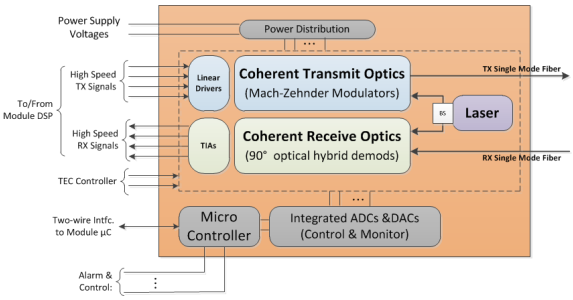

Figure 3. IC-TROSA functional integration, Type-2 includes the tunable laser source.

IC-TROSA takes a large step forward in integration by including several functions within the package.

Traditionally, board-mounted coherent electro-optics were comprised of separate analog receiver and modulator components, tunable laser, external RF amplifiers, with complex phase stabilizations maintained via external closed-loop control hardware mounted on the host PCB. The IC-TROSA integrates all these functions into a single small component. Additionally, the management interface provides control, alarms and performance monitoring which are fully defined by the IC-TROSA specification. The control and monitor functions were adopted from the widely used CFP-MSA-Management Interface Specification 2.6 and the OIF-CFP2-ACO-01.0 Implementation Agreement, and are communicated across a two-wire interface. The IC-TROSA's management interface will be compatible with future pluggable transceiver modules complying with the OIF Coherent Management Interface Specification which is currently under development. This OIF common management interface is targeted for use in future coherent QSFP, OSFP, and COBO modules enabling many new applications such as the Data Center Interconnect applications covered by OIF's upcoming 400ZR Implementation Agreement.

IC-TROSA Features

The maximum body dimensions (excluding the optical interface) are 15 × 22.5 × 3.6mm^3 for the Type-1 optical BGAs and 15.1 × 30 × 6.5mm^3 for the Type-2 package. The specification also allows for smaller devices, as long as they remain electrically and optically compliant. These packages represent a dramatic reduction in required PCB surface area compared to current standardized coherent optics implementations. The two IC-TROSA package types are each optimized for one of the two primary semiconductor material platforms widely used in today's coherent components. The Type-1 package is optimized around advantages provided by silicon photonics, while the Type-2 package elevates the advantages of Indium Phosphide.

The primary common features of both IC-TROSA designs are:

- Three different E-O bandwidth classes supporting 100Gb/s to 600Gb/s on a single wavelength
- Support for multiple mQAM modulation format and symbol rate combinations
- Highly integrated electro-optics
- Integrated performance monitoring, control, and alarms
- Significant size reduction compared to other multi-source designs
- Enables coherent transmission in small form factors: QSFP-DD, OSFP, COBO, CFPx, proprietary line cards and modules
- Includes a defined digital Management Interface with characteristics adopted from CFP2-ACO and QSFP-DD
- Abstraction of complex vendor specific analog controls into a standardized high level digital interface

IC-TROSA not only integrates TX and RX functions, but it also provides control, alarms and optical self-monitoring to its host application. The board-mounted optical component is, therefore, similar to a common pluggable analog coherent optics (ACO) transceiver module as viewed from the control interface point of view. When integrated into a pluggable transceiver it appears as a "module within a module" which shortens transceiver development time and costs. The digital management interface abstracts the numerous and complex vendor specific analog controls into a small integrated optical engine useful for many different products.

Unique Advantages

The Type-1 package is based on a very space efficient ball grid array (BGA) architecture which is commonly used for complex electrical integrated circuits. The Type-1 optical BGA is designed to take full advantage of the ability for silicon photonics to be used in non-hermetic packaging with no need for active thermal control such as commonly provided by integrated thermo-electric coolers. The unique advantages of the Type-1 IC-TROSA optical BGA package are:

- Low cost and non-hermetic
- Very high package bandwidth
- Compatible with standard mass production SMT reflow processes
- Largest available number of electrical contacts/mm^2
- Provides path for future CMOS integration within the same package

The Type-2 package primarily leverages optical amplification advantages provided by the Indium Phosphide material platform. The Type-2 integrates a narrow-linewidth tunable laser source and the modulators may optionally include integrated Semiconductor Optical Amplifiers (SOA), which compensate for optical power losses in the transmit optics. The primary advantages of the Type-2 package are:

- Highest level of optics integration, removing the need for external tunable lasers and optical amplifiers
- High transmit output power
- Eliminates all fiber management inside a pluggable module

Summary

The OIF IC-TROSA Implementation Agreement is now released. It represents one of the key technology advancements in the ongoing effort to extend the application space of coherent optical communications and to provide interoperable, multi-vendor solutions to the optical telecommunications market.

The OIF IC-TROSA Implementation Agreement can be found at:

https://www.oiforum.com/technical-work/implementation-agreements-ias/

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