# *Finisar*®

# Hybrid Raman-EDFA Module

## PRODUCT BRIEF

### KEY FEATURES

▶ Integrated Raman and EDFA design with unified gain control

▶ Supports up to three 14xx nm Raman and 980 nm EDFA pumps, in various configurations

▶ Variable gain operation with dynamic range of up to 17 dB

▶ Exceptionally low effective noise figure for all gain values

▶ Superior gain flatness <0.7 dB typical, for all fiber types, and not dependent on fiber losses.

▶ Class 1M* laser eye safety according to IEC 60825, and CDRH 21 CFR §1040.10

▶ Automatic restart and shut-down mechanisms

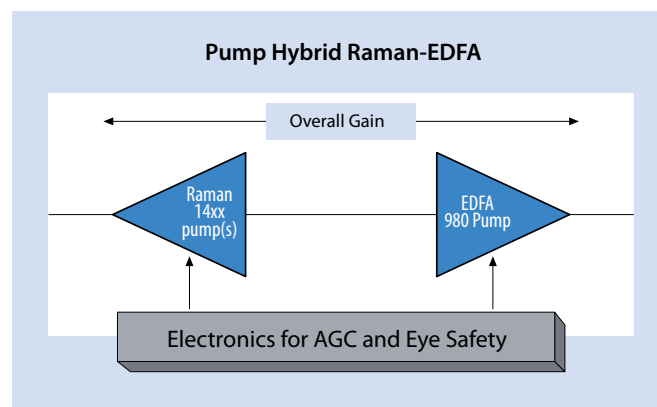▶ Standard RS232 or I²C communication protocols

### APPLICATIONS

▶ Extending metro, regional, LH and ULH WDM links (3000 km and beyond)

▶ System upgrade to 40 Gb/s, 100 Gb/s, and coherent detection

▶ Link extension beyond 1000 km without adding 3R O-E-O sites

▶ OSNR-sensitive applications

▶ Dynamic ROADM networks

### OVERVIEW

Finisar's Hybrid Raman-EDFA module enables cost-effective deployment of ultra-long haul networks as well as the extension of existing long-haul, regional and metro networks, without the need for 3R O-E-O regeneration. The Hybrid module consists of a counter-propagating Raman pump unit and a variable gain (VG) EDFA. These two elements are integrated to provide exceptionally low noise figure and excellent gain flatness - two imperative parameters for ultra-long haul systems. The module can support up to three Raman/EDFA pumps in various configurations.
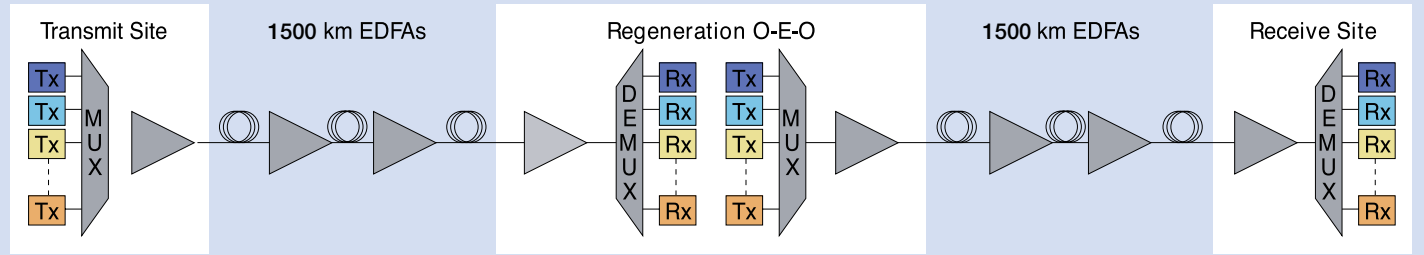
Since the module's first stage is a Raman pre-amplifier which has a negative effective noise figure, the overall combination of the Raman pre-amplifier and VG EDFA has a very low effective noise figure. This allows the link reach to be extended 3 to 4 times in comparison to a system based on traditional EDFAs. The Hybrid control circuitry operates in advanced automatic gain control (AGC) mode, in which the actual Raman gain is automatically measured and then complemented using the EDFA gain. The required total gain is therefore constantly maintained. This fast AGC circuitry provides excellent transient suppression, allowing the amplifier to keep the gain constant particularly in cases where there are fast and large changes in the input power (regardless of ASE produced by the Raman pump).

The module incorporates laser safety mechanisms, ensuring that both the Hybrid Raman-EDFA module itself and the network in which it is installed can be classified as Class 1M* with respect to laser safety.
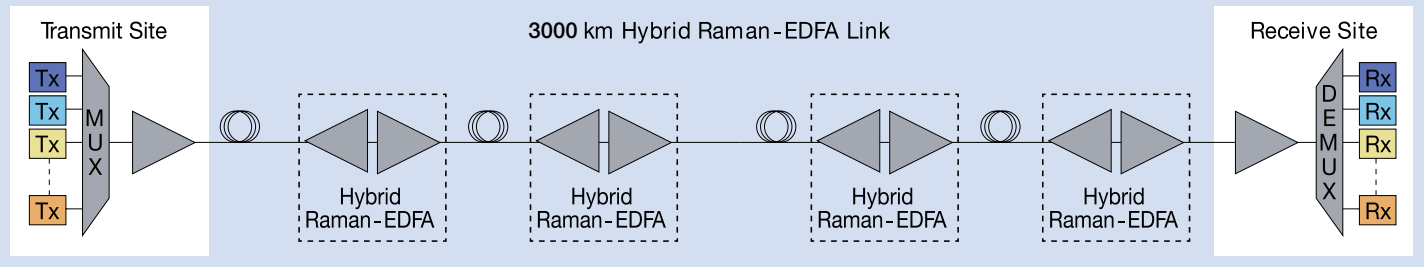




**Pump Hybrid Raman-EDFA**

Overall Gain

Raman 14xx pump(s)

EDFA 980 Pump

Electronics for AGC and Eye Safety

# Hybrid Raman-EDFA Module

## O-E-O Option



Transmit Site — 1500 km EDFAs — Regeneration O-E-O — 1500 km EDFAs — Receive Site

## Hybrid Option



Transmit Site — 3000 km Hybrid Raman-EDFA Link — Receive Site

## KEY SPECIFICATIONS

| Parameter | | | Specifications | | | Remarks |
|-----------|---|---|---|---|---|---------|
| | | | Min. | Max. | Unit | |
| Wavelength Range | | | 1528 | 1567 | nm | |
| Input Power Range | | | -35 | +11 | dBm | Other input power ranges can be specified |
| Saturated Output Power | | | 21 | | dBm | |
| Gain Range | | | 15 | 40 | dB | Any 17 dB dynamic range can be selected for 3-pump design |
| Noise Figure | 2-pumps | G >= 24 | | 1 | dB | For G.652 fiber, depends on dynamic gain range |
| | 3-pumps | G >= 28 | | 0 | | |
| Gain Flatness Peak-Peak | | | | 0.7 | dB | Including Raman gain |
| Gain Setting Accuracy | | | -0.5 | +0.5 | dB | |
| Transient Overshoot/Undershoot | | | | ±1 | dB | Up to 19 dB add/drop |
| Transient Setting Time | | | | 400 | ms | |
| PDG + PDL | | | | 0.35 | dB | |
| Mechanical Dimensions | 2-pumps | | 125x200x16 mm | | mm | Without heat sink |
| | 3-pumps | | 140x200x24 mm | | | |
| Power Consumption | 2-pumps | | | 32 | W | |
| | 3-pumps | | | 45 | | |

\* Class 1M products are not hazardous under normal circumstances, but may pose an eye hazard when the laser output is viewed with certain optical instruments (for example eye loupes, magnifiers and microscopes) within a distance of 100 mm