Technology Innovator. Broad Product Portfolio. Trusted Partner.

- Optics industry leader with 1B+ annual revenue
- Founded in 1988
- IPO in 1999 (NASDAQ: FNSR)
- Best-in-class broad product line
- Vertically integrated with low cost manufacturing
- Experienced management team
- Significant focus on R&D and capacity expansion
- 14,000 employees
- 1300+ Issued U.S. patents
Broad Product Portfolio and Customer Base

**DATA COM**

**PRODUCTS**
- SFP
- SFP+
- QSFP/QSFP28
- CFP2/CFP4
- CFP
- Optical Engine (BOA)
- CXP
- Active Optical Cables
- XFP
- X2/XENPAK

**CUSTOMERS**
- EMC
- Intel
- Extreme Networks
- Cisco
- BROCADE
- Juniper Networks
- Dell
- NetApp
- IBM
- Emulex
- H3C
- HP
- QLogic
- Oracle
- Mellanox Technologies

---

**TELECOM**

**PRODUCTS**
- SFP
- XFP
- SFP+
- CFP2-ACO
- Coherent Transponder
- ROADM line card
- WSS
- WDM Passives
- Amplifiers
- High speed components
- Tunable laser
- CATV
- PON

**CUSTOMERS**
- Alcatel-Lucent
- Ericsson
- Hitachi
- Nokia
- Ciena
- NEC
- Coriant
- ADVA
- Transmode
- Cyan
- Infinera
High-Volume Low Cost Manufacturing

**Ipoh, Malaysia**
- 640,000 sq ft facility with 200,000 sq ft clean room
- Ipoh manufactured products
  - All high-volume transceivers / transponders
  - CATV products
  - 21M total units shipped in FY 2014
- ISO 9001 and 14001 certified

**Wuxi, China**
- Two multi-floor buildings provide 330k sq ft each on 550k sq ft land
- Adds significant manufacturing capacity for
  - Passive Components
  - Parallel Products
  - WSS and ROADM line cards
  - High-end TOSAs/ROSAs
  - Amplifiers
- ISO 9001 certified

Finisar-owned Assembly and Manufacturing Facilities
Finisar Amplifiers in Network Applications

- Long-Haul / Regional
- Metro Ring
- Meshed Network
- ROADM / Amplification Node
- In-Line Amplifier
- Modules
- Access
- Long Links / SAN / Datacom
- Ultraspan
- Metro Ring
**Systems with Higher OSNR Requirements**

**Coherent Modulation Formats 100Gbps and up**
- Coherent systems have more stringent OSNR requirements
- E.g. OSNR ~18dB for 400G systems

**Network Topology: Reconfigurable, Meshed Networks**
- Multiple paths between network nodes
  - Need for amplifiers with better Noise Figure
  - Need for amplifiers with fast transient control capabilities

**Finisar Amplification Products**
- **System-Level**
  - Rack-Mountable Raman, Hybrid and EDFAs
  - Easily Integrated in Network Elements
  - Superior NF
  - Fast Transient Control
- **Modules**
  - Raman, Hybrid and EDFAs
  - Superior NF
  - Fast Transient Control
Trends in the Amplifiers Market

- High bit-rate, reconfigurable, meshed networks
  - OSNR improvements required for 100G+ coherent modulation formats
  - Protection links required with longer spans
  - Lower Noise Figure (NF) required for amplifiers
  - Raman or Hybrid Raman/EDFA amplification required

- Finisar UltraSpan Raman products enable lower NF and superior OSNR
## Markets and Applications

### Telecommunication Networks
- New deployments in or across remote regions (e.g. deserts, polar regions)
- Hut-skipping applications for better Capex and Opex
- System aging: use of amplification to recuperate increasing link losses in the fiber plant

### Oil & Gas, Mining, Power/Utilities
- Monitoring (SCADA, etc), “smart-grid”, dedicated network, mission-critical traffic
- Connect to remote location without the need of intermediate amplification sites

### Secure Private Networks (Civil, Financial Institutions, Defense)
- Point to point connections between facilities (data centers) over hundreds of kilometers
- UltraSpan enables connection without the need of intermediate amplification sites
- Increased link security & integrity (signals cannot be tapped amplification sites)
- Lowest possible latency

### Island Hopping
- Point to point connections between mainland and isolated settlements (e.g. on islands)
- UltraSpan enables connection without the need of intermediate amplification sites
  - Removes the need of very expensive undersea EDFAs and Submarine Line Terminals

---

**UltraSpan supports emerging long-span connectivity needs**
Product Offering for Amplifiers

- **Amplifier Product Families – UltraSpan™**

**UltraSpan™ Products**

1RU EDFAs and Raman
- EDFAs
  - Fixed or Variable Gain
  - Single/Dual EDFA
  - Pout up to 23dBm
- Power Booster
  - 26dBm Pout
- Raman
  - Up to 800mW Raman pump power

1RU Gateways
- All-in-one transmission and amplification solution
  - 622Mb/s up to 10Gb/s
  - 1 to 4 client and line side interfaces
  - Enabling point to point connectivity up to 350Km
  - Integrates with other UltraSpan products to extend reach up to 500Km

3RU High Power Raman
- Up to 2W Raman pump power
- Up to 6 Raman pumps with redundancy
- Redundant, hot-swappable power supplies
UltraSpan™ Products

**UltraSpan™ Products**

- Rack Mount Units are branded as UltraSpan™
  - System level 1RU or 3RU (Rack Unit Height)
- Product can be used immediately as a functioning system level product out of the box and added to the current network
- Fully Functioning Amplifiers
  - Web Based GUI Interface, Full Certification, Rack Mount Configuration
- System-Level Products
  - Ease of integration in existing Network Elements via SNMP
Ultraspan – Ease of use

- Each Ultraspan product can be controlled via
  - Web-based GUI
  - SNMP v2 and v3 supported
  - Remote management via OSC as an option
Ultra-Long links without intermediate amplification sites

- For some links intermediate amplification sites might be either impractical, or economically disadvantageous. These can be:
  - Trunks linking the main network to a remote area
  - Dedicated links for special, mission critical applications
    - Oil & Gas operations (onshore/offshore)
    - Power lines (Smart Grid applications)
    - Island-hopping from the mainland without expensive submarine amplifiers
    - Private networks with low-latency and/or privacy/security requirements (e.g. for financial institutions)

*Assuming 0.2dB/Km attenuation*
Fiber attenuation can vary between 0.16 to 0.2dB/Km
- Spans up to 490Km can be supported
- Highly dependent on bit-rate

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Maximum Link Budget (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10G, No FEC, No SBS suppression</td>
<td>Fiber attenuation (dB/Km)</td>
</tr>
<tr>
<td>100G Coherent</td>
<td>0.19</td>
</tr>
<tr>
<td>Tx</td>
<td>Rx</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>S</td>
<td>Standard EDFA</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>1U +</td>
<td>1U Power Booster + Standard EDFA</td>
</tr>
<tr>
<td>S</td>
<td></td>
</tr>
<tr>
<td>1U +</td>
<td>1U Power Booster + Standard EDFA</td>
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<tr>
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</tr>
<tr>
<td>1U +</td>
<td>1U Power Booster + Standard EDFA</td>
</tr>
<tr>
<td>S</td>
<td></td>
</tr>
<tr>
<td>3U +</td>
<td>3U Co-Raman + Standard EDFA</td>
</tr>
<tr>
<td>S</td>
<td></td>
</tr>
<tr>
<td>3U +</td>
<td>3U Co-Raman + Standard EDFA</td>
</tr>
<tr>
<td>S</td>
<td></td>
</tr>
<tr>
<td>1U +</td>
<td>1U Power Booster + Standard EDFA</td>
</tr>
<tr>
<td>S</td>
<td></td>
</tr>
<tr>
<td>1U +</td>
<td>1U Power Booster + Standard EDFA</td>
</tr>
<tr>
<td>S</td>
<td></td>
</tr>
<tr>
<td>3U +</td>
<td>3U Co-Raman + Standard EDFA</td>
</tr>
<tr>
<td>S</td>
<td></td>
</tr>
</tbody>
</table>
Ultra-Long (400Km) Unrepeatered Link – Signal Evolution

- Rx power too low
- Degraded OSNR

Without distributed amplification
UltraSpan Market Applications

**Ultra-Long Links**
- Opex & Capex improvement
- Higher security
- Lower latency

**Island-Hopping**
- Opex & Capex improvement
  - No submarine amps

**Hut-skipping**
- Integrates with existing systems
- Reduced latency
- Higher link security

**Smart-Grid**
- SCADA / grid control
- Voice/Data
  - Opex & Capex improvement
Hut-Skipping with Hybrid Raman Amplifiers

- High gain hybrid amplifiers can be used for hut-skipping applications
  - Gain range: 19-37dB
  - Link OSNR for 100Gbps with -2dBm/ch at each span input
    Minimum OSNR = 14dB

![Diagram showing EDFA, Inline EDFA (ILA), Hybrid, ILA, EDFA Preamp, Hybrid](image)

**Graphs showing Link OSNR vs. # of spans for 30 dB spans and 32 dB spans**
Ultra Long-Haul Links with Mid-Gain Hybrid Amps

- Mid-gain (15-28dB) Hybrid EDFA/Raman

- Link OSNR for 100Gbps traffic with -2dBm/Ch at each span input. Minimum OSNR = 14dB
New Product – Ultraspan™ GateWay

- Fully turn-key solution for unrepeatered ultra-long links up to 350Km
- Multi-rate client- and line interfaces
  - Client: 622Mb/s to 2.5Gb/s
  - Line: 2.7Gb/s with FEC
    - Up to 10Gb/s - dispersion limited
- Integrated EDFA preamp and booster
- In-band OSC channel for remote management
- Sampling in Q3/Q4 CY2015
Ultraspan Gateway – Typical application

- Gateway integrates with existing equipment at operations center and remote site
- No additional hardware required for link bring-up
- The whole link can be managed from the operations center as a single element

- Control and supervision of remote unit in the field is readily available via a dedicated in-band OSC
- Local access to authenticated Admin users via LAN interface

350Km reach
Without the need of any additional equipment
# UltraSpan™ Products at a Glance - 1RU

## Product Overview

### UltraSpan™ Raman & ROPA 1RU Rack Mount Units

<table>
<thead>
<tr>
<th>PRODUCT PART NUMBER</th>
<th>SHORT DESCRIPTION</th>
<th>Gain</th>
<th>Pump Power</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOA-R9100PR-RBW2C-AA003</td>
<td>UltraSpan Raman, Counter-propagating, 1RU Network interfaced, 450mW pump, 1529 - 1564nm, 10dB Typical gain, OSC 100-155Mb/s (pass), 48V Supply, NEBS, Class 1M</td>
<td>10dB</td>
<td>450mW</td>
<td>Production</td>
</tr>
<tr>
<td>FOA-R9100PR-RBW3C-AA004</td>
<td>UltraSpan Raman, Counter-propagating, 1RU Network interfaced, 700mW pump, 1529 - 1564nm, 14.5dB Typical gain, OSC 100-155Mb/s (pass), 48V Supply, NEBS, Class 1M</td>
<td>14.5dB</td>
<td>700mW</td>
<td>Production</td>
</tr>
<tr>
<td>FOA-R9400PR-RPA3C-AA001</td>
<td>UltraSpan ROPA Pump Unit, 1U Network interfaced, 1532 - 1566.5nm, 800mW output power, NEBS, Class 1M</td>
<td>-</td>
<td>800mW</td>
<td>Production</td>
</tr>
<tr>
<td>50-10-0040-01R</td>
<td>Erbium Doped Remote Optical Amplifier. EDF ROPA, compact mechanical formfactor designed to work with our 1U/3U ROPA chassis. Up to 20dB gain with pump power of 10dBm, co-packaged with isolators</td>
<td>20dB</td>
<td>-</td>
<td>Production</td>
</tr>
</tbody>
</table>

### UltraSpan™ Power Booster 1RU Rack Mount Units

<table>
<thead>
<tr>
<th>PRODUCT PART NUMBER</th>
<th>SHORT DESCRIPTION</th>
<th>Gain</th>
<th>Output Power</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOA-R2100PB-EPB2C-AA010</td>
<td>UltraSpan Power Booster EDFA, 1RU Network interfaced, 1529 - 1564nm, 25.5dBm, 6dB gain including 1510nm OSC Booster 11dBm Output Power, 48V Supply, NEBS, Class 1M</td>
<td>6dB</td>
<td>25.5dBm</td>
<td>Production</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>11dBm</td>
<td>-</td>
</tr>
</tbody>
</table>
# UltraSpan™ Products at a Glance - 3RU

## Product Overview

### UltraSpan™ Raman & ROPA 3RU Rack Mount Units

<table>
<thead>
<tr>
<th>PRODUCT PART NUMBER</th>
<th>SHORT DESCRIPTION</th>
<th>Gain</th>
<th>Pump Power</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOA-R9100SA-RBW6C-AA016</td>
<td>UltraSpan Raman, Counter-propagating, 3RU Network Interfaced, 1600mW output power, 1528.5 - 1566.5nm, up to 30dB average gain, redundant 48V supply, NEBS, Class 1M</td>
<td>30dB</td>
<td>1600mW</td>
<td>Production</td>
</tr>
<tr>
<td>FOA-R9200SA-RFW6C-AA015</td>
<td>UltraSpan Raman, Co-propagating, 3U Network Interfaced, 1600mW output power, 1528.5 - 1566.5nm, up to 30dB average gain, redundant 48V supply, NEBS, Class 1M</td>
<td>30dB</td>
<td>1600mW</td>
<td>Production</td>
</tr>
<tr>
<td>FOA-R9400SA-RPA6C-AA017</td>
<td>UltraSpan ROPA Pump Unit, 3U Network Interfaced, 1532 - 1566.5nm, 1600mW output power, NEBS, Class 1M</td>
<td>-</td>
<td>1600mW</td>
<td>Production</td>
</tr>
<tr>
<td>50-10-0040-01R</td>
<td>Erbium Doped Remote Optical Amplifier: EDF ROPA, compact mechanical formfactor designed to work with our 1U/3U ROPA chassis. Up to 20dB gain with pump power of 10dBm, co-packaged with isolators</td>
<td>20dB</td>
<td>-</td>
<td>Production</td>
</tr>
</tbody>
</table>

### UltraSpan™ Power Booster, ROPA 3RU Rack Mount Units

<table>
<thead>
<tr>
<th>PRODUCT PART NUMBER</th>
<th>SHORT DESCRIPTION</th>
<th>Gain</th>
<th>Output Power</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOA-R2100SA-EPB6C-AA091</td>
<td>UltraSpan Power Booster EDFA, 3U Network Interfaced, 1529 - 1565nm, 29dBm, 11dB gain, without redundancy, NEBS, Class 1M</td>
<td>11dB</td>
<td>29dBm</td>
<td>Production</td>
</tr>
</tbody>
</table>
Amplifiers Products Roadmap

Contact:

PC: 518102
Fax: +86-755-26739078
E-mail: Sales@skyloyal.com.cn
Add: Room F7-005, Taiyi Building, No.235 of Haicheng Road, Xixiang Town, Bao'an District, Shenzhen, China.
Tel: +86 755-26739061-5 26739067 26739069 26739070
1RU UltraSpan WDM Gateway

FOA-M2000GW-EFG2C-AA059

PRODUCT FEATURES
- All-in-one product for ultra-long unrepeatered WDM links* up to 350Km
- Multi-Rate client and line interfaces
  - Client: 622Mb/s up to 10Gb/s
  - Line: 2.5-10Gb/s**
- Integrated EDFA preamp and booster
- Integrated MUX/DMUX
- Integrated, in-band OSC for remote management
- Network interfaced
  - Remote software upgrade
  - SNMP v2 or V3 and web-based GUI
- Class 1M

AVAILABILITY
- Alpha  Q1/Q2 CY2016
- Beta   Q2/Q3 CY2016
- Production  Q3/Q4 CY2016

* 4 Channels in C-Band
** Dispersion-limited reach at 10Gb/s
UltraSpan with OTDR Capabilities

- OTDR embedded in the platform as an option or as a pluggable module - see slide 21

- Benefits:
  - Line diagnostics – important for system deployment and monitoring especially when high-power Raman is used
  - No need of maintenance staff or extra, stand-alone test equipment
  - In-service testing/monitoring
    - Out-of-band OTDR wavelength allows Non-Traffic-Affecting testing
  - Integrated in UltraSpan products to maximize system-level integration and ease of use
    - OTDR Measurement can be collected at the NMS level
  - High-performance with lower cost than stand-alone OTDR instruments

### AVAILABILITY
- Alpha Q3/Q4 CY2016

### Table: Target Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Target Spec</th>
<th>UoM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Range</td>
<td>40 dB</td>
<td>dB</td>
</tr>
<tr>
<td>Reflective Dead zone</td>
<td>0.2 m</td>
<td>m</td>
</tr>
<tr>
<td>Spatial resolution</td>
<td>0.1 m at 1Km range Or 100m at 100Km range</td>
<td>m</td>
</tr>
<tr>
<td>Distance range</td>
<td>120 Km</td>
<td>Km</td>
</tr>
<tr>
<td>Technique</td>
<td>Direct pulse and pattern auto-correlation</td>
<td></td>
</tr>
<tr>
<td>Source peak output power</td>
<td>10 dBm</td>
<td>dBm</td>
</tr>
<tr>
<td>Maximum Processing time</td>
<td>120 s</td>
<td>s</td>
</tr>
</tbody>
</table>
UltraSpan with Integrated OCM

- Integrated Optical Channel Monitoring (OCM) in UltraSpan products

- Benefits
  - Traffic diagnostics and troubleshooting
  - Ease of integration/access to monitoring data via UltraSpan controls and communications interface
    - Information available at the NMS level – for system level performance monitoring and optimization
  - Improved amplifier performance
    - OCM data used in EDFA/Raman control loops to
      - Adaptively maximize gain flatness
      - Adaptively minimize Noise Figure

AVAILABILITY
- Alpha Q3/Q4 CY2016
## Target Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Min</th>
<th>Max</th>
<th>UoM</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel Spacing</td>
<td>Arbitrary: Flexible grid</td>
<td></td>
<td></td>
<td>As per ITU G694.1</td>
</tr>
<tr>
<td>Frequency Range</td>
<td>191.250</td>
<td>196.125</td>
<td>THz</td>
<td></td>
</tr>
<tr>
<td>Slice width</td>
<td>0.3125</td>
<td></td>
<td>GHz</td>
<td></td>
</tr>
<tr>
<td>Programmable Slice/Channel Width</td>
<td>0.3125</td>
<td>4875</td>
<td>GHz</td>
<td>From single slice to full C-Band</td>
</tr>
<tr>
<td>Input Channel Power</td>
<td>-46</td>
<td>0</td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td>Absolute Channel Power Accuracy</td>
<td>-0.5</td>
<td>+0.5</td>
<td>dB</td>
<td>Input Power ≥ -36dBm</td>
</tr>
<tr>
<td>Relative Power Accuracy</td>
<td>-1.0</td>
<td>+1.0</td>
<td>dB</td>
<td>Input Power &lt; -36dBm</td>
</tr>
<tr>
<td>Power repeatability</td>
<td>±0.15</td>
<td></td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>Return Loss</td>
<td>35</td>
<td></td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>Absolute Frequency Accuracy</td>
<td>-1.0</td>
<td>+1.0</td>
<td>GHz</td>
<td></td>
</tr>
<tr>
<td>Relative Frequency Accuracy</td>
<td>0.5</td>
<td></td>
<td>GHz</td>
<td></td>
</tr>
<tr>
<td>Frequency Readout Resolution</td>
<td>0.3125</td>
<td></td>
<td>GHz</td>
<td></td>
</tr>
<tr>
<td>Sweep Time</td>
<td>200</td>
<td></td>
<td>ms</td>
<td>Full C-Band Sweep</td>
</tr>
</tbody>
</table>

- Much faster and higher resolution than conventional OSA available on the market
- Inherent high absolute frequency accuracy
- Fully configurable for span and number of slices/channel widths
High Performance EDFA in MSA Package

- Standard MSA Package

Features
- Possible configurations
  - Variable Gain EDFA
  - Variable Switched Gain EDFA (2 gain ranges)
  - Dual Fixed Gain EDFAs (2 amps in 1 box)
- Integrated controls for gain/power and transient control
- High-Level Specifications
  - Up to 21dBm Pout
  - Up to 35dB gain
  - Optimized NF across full gain range

Availability
- Alpha Q1/Q2 CY2016
Pluggable EDFA

- CFP2 Form Factor

Features

- Single Variable Gain EDFA or Dual Fixed Gain
- Integrated controls for gain/power and transient control
- High-Level Specifications
  - Up to 20dBm Pout
  - Up to 30dB gain

Availability

- Alpha Q2/Q3 CY2016
Pluggable OTDR

**Benefits**

- OTDR functionality embedded in the optical network
  - Anywhere a CFP2 slot is available
- Fiber plant testing without technician intervention or extra test equipment
- Out-of-band wavelength
  - Non-Traffic-Affecting testing

<table>
<thead>
<tr>
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<td>Direct pulse and pattern auto-correlation</td>
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<td>10 dBm</td>
<td>dBm</td>
</tr>
<tr>
<td>Maximum Processing time</td>
<td>120 s</td>
<td>s</td>
</tr>
</tbody>
</table>
Thank You!

Contact:

PC: 518102
Fax: +86-755-26739078
E-mail: Sales@skyloyal.com.cn
Add: Room F7-005, Taiyi Building, No.235 of Haicheng Road, Xixiang Town, Bao'an District, Shenzhen, China.
Tel: +86 755-26739061-5 26739067 26739069 26739070
Extra Slides
UltraSpan™ for Test & Measurement
UltraSpan™ for Test & Measurement

- C-band Lab Amplifiers in bench-top or rack-mountable versions
  - Ethernet control interface
    - .Net based DLL for integrating EDFA control into users system
    - Web-based GUI
  - 110-220V AC Power Supply
  - Easy to use and integrate in existing test set-ups

<table>
<thead>
<tr>
<th>Product Number</th>
<th>Product Name</th>
<th>Key features</th>
<th>Control parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOA-M2200TM-EFG1C-AA060</td>
<td>UltraSpan Fixed Gain EDFA</td>
<td>17 dBm $P_{out}$</td>
<td>Gain, power</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17 dB Gain</td>
<td></td>
</tr>
<tr>
<td>FOA-M2200TM-EFG2C-AA061</td>
<td>UltraSpan Dual Fixed Gain EDFA</td>
<td>20 dBm $P_{out}$ (per amp)</td>
<td>Gain, power</td>
</tr>
<tr>
<td></td>
<td></td>
<td>23 dB gain (per amp)</td>
<td></td>
</tr>
<tr>
<td>FOA-S2000TM-ASE3C-AA062</td>
<td>UltraSpan High Power ASE</td>
<td>26.5 dBm $P_{out}$</td>
<td>On-Off</td>
</tr>
</tbody>
</table>
T&M Application Example: Optical Component Testing

Ultraspan
High-Power ASE source

Optical Switch
or WaveShaper

DUT

DUT

DUT

DUT

DUT

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Ultraspex
Hi-Res OSA

Batch testing of multiple devices

WaveAnalyzer
T&M Application Example: Transceiver Testing

- Ultraspan ASE for OSNR loading
- WaveShaper for Transmission Emulation (Filtering, Attenuation)
- WaveAnalyzer for Signal Measurement

![Diagram of transceiver testing setup]

**Tx**

Ultraspan High-Power ASE Source

WaveShaper 4000 Programmable Filter/Combiner

WaveAnalyzer Hi-Res OSA

**Rx**

Filter bandwidth 10 - 100 GHz in 10 GHz steps
T&M Application Example: Transceiver R&D

- Recirculating Optical Loop
  - Ultraspan Amplifiers
  - WaveAnalyzer for Signal Analysis/OSNR Measurement
  - WaveShaper for WSS Emulation
### UltraSpan™ EDFAs for Test and Measurement

<table>
<thead>
<tr>
<th>PRODUCT PART NUMBER</th>
<th>SHORT DESCRIPTION</th>
<th>FULL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOA-M2200TM-EFG1C-AA060</td>
<td>Single EDFA</td>
<td>Fixed Gain EDFA, 17dBm Output Power, 17dB Gain</td>
</tr>
<tr>
<td>FOA-M2200TM-EFG2C-AA061</td>
<td>Dual EDFA</td>
<td>Dual, Fixed Gain EDFA, 1530-1564nm, 20dBm Output Power, 23dB Gain</td>
</tr>
<tr>
<td>FOA-S2000TM-ASE3C-AA062</td>
<td>Class 3B ASE Source</td>
<td>Class 3B ASE Source, 26.5dBm Pout, whole C band</td>
</tr>
<tr>
<td>FOA-R7100TM-EVG2C-AA063</td>
<td>Variable Gain EDFA</td>
<td>Variable Gain EDFA, 19.5dBm Pout, 13/21dB Gain</td>
</tr>
</tbody>
</table>
Amplifier Modules Product Family
Modular amplification solutions
- C-Band
  - Single Channel or WDM Fixed and Variable Gain EDFAs
  - Raman and Hybrid Raman-EDFAs
- OSC-EDFAs
  - Edge of C-Band for OSC amplification over ultra-long links

Standard platforms available to
- Leverage components commonality
- Deliver the best value

Fully-custom solutions
Module Platforms at a Glance

**Fixed Gain EDFA**
- MSA Compact EDFA (70x90x15 mm)
- Micro EDFA (45x70x12 mm)

**Variable Gain EDFA**
- High power VG/FG EDFA (100x150x15 mm)
- Compact VG EDFA (70x90x16.5 mm)

**Hybrid & High Power**
- Hybrid Raman-EDFA (130x200x21 mm or 100x230x25 mm)
# Module Platforms at a Glance

## Product Overview

**EDFA Module Platforms**

<table>
<thead>
<tr>
<th>Platform</th>
<th>Dimensions LxWxT (mm³)</th>
<th>Gain</th>
<th>Output Power</th>
<th>Notes</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro EDFA</td>
<td>40x75x12</td>
<td>5-26dB</td>
<td>16dBm</td>
<td>single/multi-channel uncooled pumps</td>
<td>Production</td>
</tr>
<tr>
<td>MSA Compact EDFA</td>
<td>70x90x15</td>
<td>Fixed: up to 23dB Variable: up to 22.5dB</td>
<td>up to 22.5dBm</td>
<td>FG or VG configurations available</td>
<td>Production</td>
</tr>
<tr>
<td>High power VG and FG EDFA</td>
<td>100x150x15</td>
<td>Up to 37dB</td>
<td>up to 26dBm</td>
<td>Dual pump/ dual VOA, high power, With, or without mid-stage access</td>
<td>Production</td>
</tr>
<tr>
<td>Hybrid Raman-EDFA</td>
<td>130x200x21 or 100x230x25</td>
<td>19-37dB</td>
<td>20.5dBm</td>
<td>Up to 700mW Raman pump output power</td>
<td>Production</td>
</tr>
<tr>
<td>EDFA Array</td>
<td>150x180x18.5</td>
<td>17dBm</td>
<td></td>
<td>8 uncooled pumps</td>
<td>Development</td>
</tr>
</tbody>
</table>
# Amplifier Modules at a Glance

## Product Overview

### Single Channel Micro EDFA, 45x70x12mm

<table>
<thead>
<tr>
<th>PRODUCT PART NUMBER</th>
<th>SHORT DESCRIPTION</th>
<th>Gain</th>
<th>Output Power</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOA-M1100MB-ESC1C-AA001</td>
<td>Single-channel, Uncooled Pump, 1529.5-1564nm, Automatic Power Control, 16dBm Output Power, 3.3V PS, LVTTL Communication, LC/UPC connectors, 0/70°C case, Class 1M</td>
<td>5-26dB</td>
<td>16dBm</td>
<td>Production</td>
</tr>
</tbody>
</table>

### Fixed Gain EDFA w/VOA, 70x90x16.5mm

<table>
<thead>
<tr>
<th>PRODUCT PART NUMBER</th>
<th>SHORT DESCRIPTION</th>
<th>Gain</th>
<th>Output Power</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOA-M2300CD-EFV1C-AA009</td>
<td>Fixed Gain 22dB w/VOA on Output, 1529.5-1564nm, 19dBm Output Power, 5V PS, LVTTL Communication, LC/UPC connectors with output 1% monitor, 0/70°C case, Class 1M</td>
<td>22dB w/ VOA</td>
<td>19dBm</td>
<td>Production</td>
</tr>
</tbody>
</table>

### Optical Supervisory Channel (OSC) EDFA

<table>
<thead>
<tr>
<th>PRODUCT PART NUMBER</th>
<th>SHORT DESCRIPTION</th>
<th>Gain</th>
<th>Output Power</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOA-M1500CB-ESC1C-AA011</td>
<td>Single-channel, 1504.5-1517.5nm, Automatic Power Control, 13dBm Output Power, 3.3V PS, RS-232 Communication, LC/UPC connectors, 0/70°C case, Class 1M</td>
<td>5-25dB</td>
<td>13dBm</td>
<td>Production</td>
</tr>
</tbody>
</table>
## Amplifier Modules at a Glance – Fixed Gain

### Product Overview

**Fixed Gain EDFA 70x90x15mm**

<table>
<thead>
<tr>
<th>PRODUCT PART NUMBER</th>
<th>SHORT DESCRIPTION</th>
<th>Gain</th>
<th>Output Power</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOA-M2200CB-EFG1C-AA002</td>
<td>Fixed Gain 15dB, Dual Mode, 1529.5-1564nm, 17dBm Output Power, 5V PS, LVTTL Communication, LC/UPC connectors with 1% output monitor, 0/70°C case, Class 1M</td>
<td>15dB</td>
<td>17dBm</td>
<td>Production</td>
</tr>
<tr>
<td>FOA-M2200CB-EFG1C-AA003</td>
<td>Fixed Gain 20dB, Dual Mode, 1529.5-1564nm, 17dBm Output Power, 5V PS, LVTTL Communication, LC/UPC connectors with 1% output monitor, 0/70°C case, Class 1M</td>
<td>20dB</td>
<td>17dBm</td>
<td>Production</td>
</tr>
<tr>
<td>FOA-M2200CB-EFG1C-AA004</td>
<td>Fixed Gain 25dB, Dual Mode, 1529.5-1564nm, 17dBm Output Power, 5V PS, LVTTL Communication, LC/UPC connectors with 1% output monitor, 0/70°C case, Class 1M</td>
<td>25dB</td>
<td>17dBm</td>
<td>Production</td>
</tr>
<tr>
<td>FOA-M2200CB-EFG1C-AA005</td>
<td>Fixed Gain 15dB, Dual Mode, 1529.5-1564nm, 20dBm Output Power, 5V PS, LVTTL Communication, LC/UPC connectors with 1% output monitor, 0/70°C case, Class 1M</td>
<td>15dB</td>
<td>20dBm</td>
<td>Production</td>
</tr>
<tr>
<td>FOA-M2200CB-EFG1C-AA006</td>
<td>Fixed Gain 20dB, Dual Mode, 1529.5-1564nm, 20dBm Output Power, 5V PS, LVTTL Communication, LC/UPC connectors with 1% output monitor, 0/70°C case, Class 1M</td>
<td>20dB</td>
<td>20dBm</td>
<td>Production</td>
</tr>
<tr>
<td>FOA-M2200CB-EFG1C-AA007</td>
<td>Fixed Gain 25dB, Dual Mode, 1529.5-1564nm, 20dBm Output Power, 5V PS, LVTTL Communication, LC/UPC connectors with 1% output monitor, 0/70°C case, Class 1M</td>
<td>25dB</td>
<td>20dBm</td>
<td>Production</td>
</tr>
<tr>
<td>FOA-M2200CB-EFG1C-AA008</td>
<td>Fixed Gain 33dB, Dual Mode, 1529.5-1564nm, 20.5dBm Output Power, 5V PS, LVTTL Communication, LC/UPC connectors with 1% output monitor, 0/70°C case, Class 1M</td>
<td>23dB</td>
<td>20.5dBm</td>
<td>Production</td>
</tr>
</tbody>
</table>
### Product Overview

#### Compact Variable Gain EDFA, 70x90x16.5mm

<table>
<thead>
<tr>
<th>PRODUCT PART NUMBER</th>
<th>SHORT DESCRIPTION</th>
<th>Gain</th>
<th>Output Power</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOA-M7300CD-EVG1C-AA002</td>
<td>Variable Gain 15-30dB, 1529.5-1564nm, 17dBm Output Power, 5V PS, LVTTL Communication, LC/UPC connectors, 0/70°C case, Class 1M</td>
<td>15-30dB</td>
<td>17dBm</td>
<td>Production</td>
</tr>
<tr>
<td>FOA-M7300CD-EVG1C-AA003</td>
<td>Variable Gain 10-25dB, 1529.5-1564nm, 19.5dBm Output Power, 5V PS, LVTTL Communication, LC/UPC connectors, 0/70°C case, Class 1M</td>
<td>10-25dB</td>
<td>19.5dBm</td>
<td>Production</td>
</tr>
<tr>
<td>FOA-M7300CD-EVG1C-AA004</td>
<td>Variable Gain 10-25dB with 0-4dB mid-stage, 1529.5-1564nm, 18dBm Output Power, 5V PS, LVTTL Communication, LC/UPC connectors, 0/70°C case, Class 1M</td>
<td>10-25dB</td>
<td>18dBm</td>
<td>Production</td>
</tr>
</tbody>
</table>

#### Variable Gain Dual Stage EDFA, 100x150x18mm

<table>
<thead>
<tr>
<th>PRODUCT PART NUMBER</th>
<th>SHORT DESCRIPTION</th>
<th>Gain</th>
<th>Output Power</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOA-M7100DA-EVG2C-AA013</td>
<td>Variable Gain 25-37dB, 4-9dB Mid-stage, 1529.5-1564nm, 20.5dBm Output Power, 5V PS, LVTTL Communication, LC/UPC connectors, 0/70°C case, Class 1M</td>
<td>25-37dB</td>
<td>20.5dBm</td>
<td>Production</td>
</tr>
<tr>
<td>FOA-M7100DA-EVG2C-AA014</td>
<td>Variable Gain 17-32dB, 4-9dB Mid-stage, 1529.5-1564nm, 20.5dBm Output Power, 5V PS, LVTTL Communication, LC/UPC connectors, 0/70°C case, Class 1M</td>
<td>17-32dB</td>
<td>20.5dBm</td>
<td>Production</td>
</tr>
<tr>
<td>FOA-R7100DA-EVG2C-AA015</td>
<td>Variable Gain 17-32dB, 4-9dB Mid-stage, 1529.5-1564nm, 23dBm Output Power, 5V PS, LVTTL Communication, LC/UPC connectors, 0/70°C case, Class 1M</td>
<td>17-32</td>
<td>23dBm</td>
<td>Production</td>
</tr>
</tbody>
</table>
## Product Overview

### Hybrid Raman-EDFA, 220x160x26mm

<table>
<thead>
<tr>
<th>PRODUCT PART NUMBER</th>
<th>SHORT DESCRIPTION</th>
<th>Gain</th>
<th>Output Power</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOA-R9300TH-HBR3C-AA001</td>
<td>Dual Raman Pump, Variable Gain 19-37dB, 1529-1567nm, 20.5dBm Output Power, 5V PS, LVITL Communication, LC/UPC and E2000 connectors, 0/70°C case, Class 1M</td>
<td>19-37dB</td>
<td>20.5dBm</td>
<td>Production</td>
</tr>
</tbody>
</table>

### Raman Amplifier Module, 2-pumps 176x200x34mm

<table>
<thead>
<tr>
<th>PRODUCT PART NUMBER</th>
<th>SHORT DESCRIPTION</th>
<th>Gain</th>
<th>Pump Power</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOA-R9000DE-RBW2C-AA002</td>
<td>Raman, Counter-Propagating, 700mW pump, 1529-1567nm, 5V PS, LVITL Communication, LC/UPC and E2000 connectors, 0/70°C case, Class 1M</td>
<td>14.5dB</td>
<td>700mW</td>
<td>Production</td>
</tr>
</tbody>
</table>
Thank You

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