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Optical Fibre Capabilities
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Presentation Contents

• Manufacturing Capability
  – Passive components
  – Active components
  – Additional Fiber Laser Components

• Sub-assembly capability
  – Optical Sub-assemblies
Fibre Optic Facility Basics

• UK Factory
  – 27,000 sq ft
  – ISO 9001
  – 115 employees
  – Submarine qualified

• Czech Republic
  – Contract Manufacturing
  – ISO 9001
  – 45 fused operators
  – Submarine qualified
Fused Components

• SM Components
  – Tap couplers and wavelength combiners
  – Polarization Maintaining
  – Visible to 2um
  – Fibre laser tap monitor and pilot beam delivery

• MM components
  – Power Combiners
  – Signal feedthrough amplifier components
  – LMA taps
Fused Biconic Taper Technology

- adhesive
- waist
- tapered region

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Fusion Process

Very accurate control of process and heating profile required for uniform low loss taper and optimum device performance.

light never leaves fiber - robust device, high power
Tapered Fibre Bundles

- Bundle must be tapered to ensure good pump transmission
- Additional mode conditioning required if signal feedthrough needed
7x1 MM Combiner

- Data from 260 devices (1820 ports)
- Average port $Tr = 94\%$
- Average combiner $Tr = 94\%$
- Reliability Test program
  - 50,000 device hours under full operating conditions
Tapered Fibre Bundles – power handling comments

- Negligible power lost in down taper
- Small power lost in splice
- Most light lost where buffer begins
  - Light of higher NA cannot be captured
  - Buffer strips out light & generates heat
  - Thermal management required
Power Limits – MM Combiner

- Power combiner designs can be optimized for 1kW+ long term use.
  - Cooling helps
- Alternative design requires different buffer can also be used
  - Polyimide, silicone
- Housing design for high power transmission
  - Improved thermal transmission
  - Heat removal

Level 3, kW class housing
Additional MM components

19x1

2x1

1+1x1

PM 6+1x1
Fused Component Manufacturing
Screening, Measurement, QA
Measurements Database

- All measurements logged and saved on central database
  - With serial number of component, measurement data can be recalled immediately
  - 10 years worth of components!
Active Fibre Optics

- Singlemode Pump Lasers
- Multimode Pump Lasers
- Transmission Lasers
- Integrated Modules
- High Speed Detectors
High reliability active components

- Laser welded technology
- Proprietary patented advanced glass solder materials
- Market leader in emerging Avionic & Defence ‘actives’ photonics
- This example shows a transceiver for ‘towed decoy’ applications
Multi-element optical design
Cleanroom packaging facilities
Photonic Packaging Design Capability

• Specialist designers of optoelectronic packaging
  – In-house skill set
  – Custom design
    • Active devices
    • Optical
    • Mechanical
• Extensive experience of practical packaging issues
  – Design for manufacture
  – Thermal management
  – Hermetic design
  – Fibre handling
Wide Product capability

- Fibre pigtailed, recepticalized & free space sources
  - Lasers & LEDs
  - SLEDs & SOAs
  - DFB, FP & VSELs
- Fibre pigtailed & recepticalized detectors
  - APDs & PIN diodes
  - Arrays
Actives & Passives Reliability

- Regular Telcordia qualification
  - Actives & Passives
  - All facilities
- Harsh Environment testing
  - Military, avionic & space requirements
- Customer specific testing programmes
  - Sub-marine cable customers
  - Avionic gyroscope customers
  - Satellite customers
  - Military customers
- High Power Test Program
  - MM fibre laser components
  - SM fibre laser components
Advanced Fibre Laser Components

• Fibre coupled AOM
  – Hermetic version for sensor and space applications
  – Non-hermetic version
    • Targeting price sensitive fibre laser market
Fibre-Q performance

- Data from 440 devices
- 80MHz, 1060nm, 35ns rise time
- Specification
  - Insertion Loss < 3dB
  - Extinction ratio > 50dB
Fibre-Q summary

- Hermetic and non hermetic version
- 1060nm & 1550nm
  - 2um in development
- 1W and 5W version
- 1500+ shipped
- Space qualified version

- Up to 5W CW power
- Typical 75% transmission fibre to fibre
Fibre coupled isolator

High power Isolator 30 -100W

20W Isolator Design
High Power Isolator Performance

- Measured Data
- Isolation = 35dB
- Insertion Loss ~ 0.4dB
- Return Loss >50dB
Integrated Optical Modules

• Full design or “build to print” to meet footprint, fibre routing, components, PCBs
• Complete supply chain management of core technologies
• Extensive knowledge of passive & active components, power supplies, computer interface, motion control, thermal management
• Assembly technicians skilled in handling, routing and splicing all types of fibres & components
Optical Integrated Modules

• OEM sub-assembly

• Turnkey systems
Modules Facility
Fibre Handling Knowledge

• Constant module throughput
  – Sensor, Telecoms, Biomedical
  – 10-100 per week
  – Varying complexity
  – Leverage full G&H optics capabilities
  – Manufacturing capability in UK, CZ, and North America
Summary

• Comprehensive active and passive fibre product range
• Emphasis on high specification and high reliability
• Mature manufacturing capability with proven cost reduction roadmap
• High quality sub-assembly facility
• G&H Advanced Product Development
Additional Information