TELEDYNE
MICROELECTRONIC TECHNOLOGIES
Everywhereyoulook™

Optoelectronics

Products, Packaging & Engineering Services

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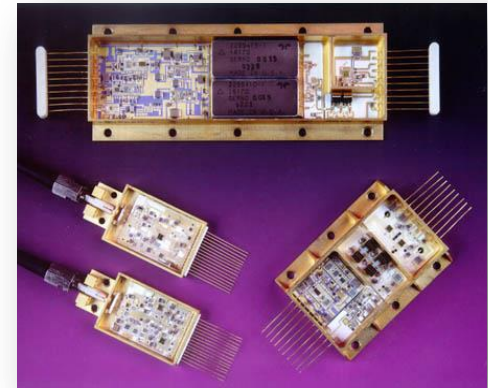
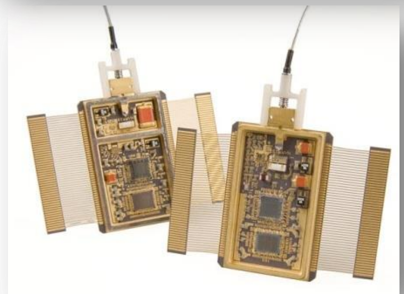
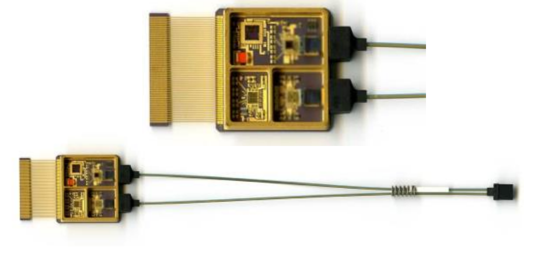
Teledyne Ruggedized Optical Devices

- International Space Station
  - 125 Mbps, FDDI suite of devices
  - All data-audio-video communications go thru Teledyne devices
- F22
  - 500 Mbps, MM Fiber
  - Very Low Profile (0.140")
  - Over 15,000 devices to date
  - 52 Tx & 53 Rx per aircraft
- F35, Joint Strike Fighter
  - 2.5 Gbps per Channel, MM fiber
  - Miniature footprint (1" x 1" x 0.200")
  - Over 5,000 devices to date
  - 55 Quad Transceivers per aircraft







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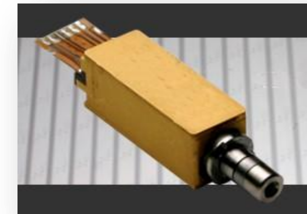
Optical Networking

Push the envelope in next generation optical networks



Optical Routers & Transponders

- OC768, 16 channels
- Multiple rates to 44 Gbps
- Highly integrated single chip modules
- High frequency and noise isolation
- Solder bump flip chip
- High Temperature Co-fired Ceramic (HTCC)
- BGA substrate
- Utilizing stripline and microstrip provisions

TOSA/ROSA

- Up to 11 Gbps & 80 Km
- TDM & DWDM, 1550 nm
- Sonet/SDH, Ethernet
- High speed gain chip
- Planar wave guide

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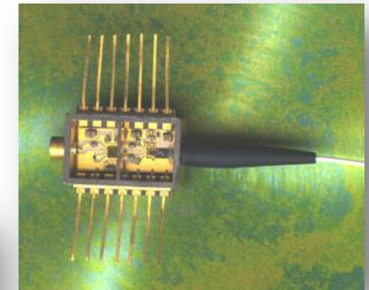
Application Experience

- 2 Gbps Quad Channel Transceiver
- 10 Gbps Receiver
- 10 Gbps TOSA
- Wavelength locked light source
- MEMS mirror array (n x n) optical switch
- Laser Pump Module for Raman Amplifier
- Tunable wavelength laser source
- DWDM Tx/Rx
- Mach-Zehnder waveguide modulator
- High power laser sources (up to 10W)
- MEMS HUD
- MEMS F-P interferometer based navigation grade accelerometer
- Fiber Bragg grating array for optical gain control
- Fiber optic pressure sensors



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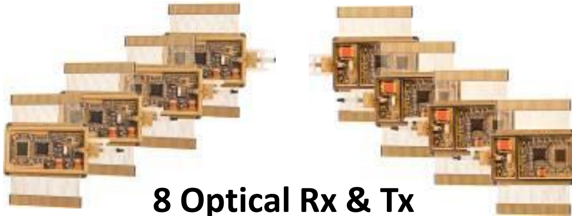
Optoelectronics Advanced Design & Packaging

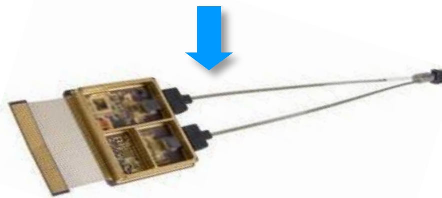
Ruggedized Fiber Optics Transmitters, Receivers and Transceivers

Custom Design & Packaging

- High Reliability
- Hermetic
- MIL-PRF-38534 Class H



8 Optical Rx & Tx
500 Mbps, 1.5” x1”x 0.15” ea



Quad Optical Transceiver
2.5 Gbps per channel, 1” x 1” x 0.2”

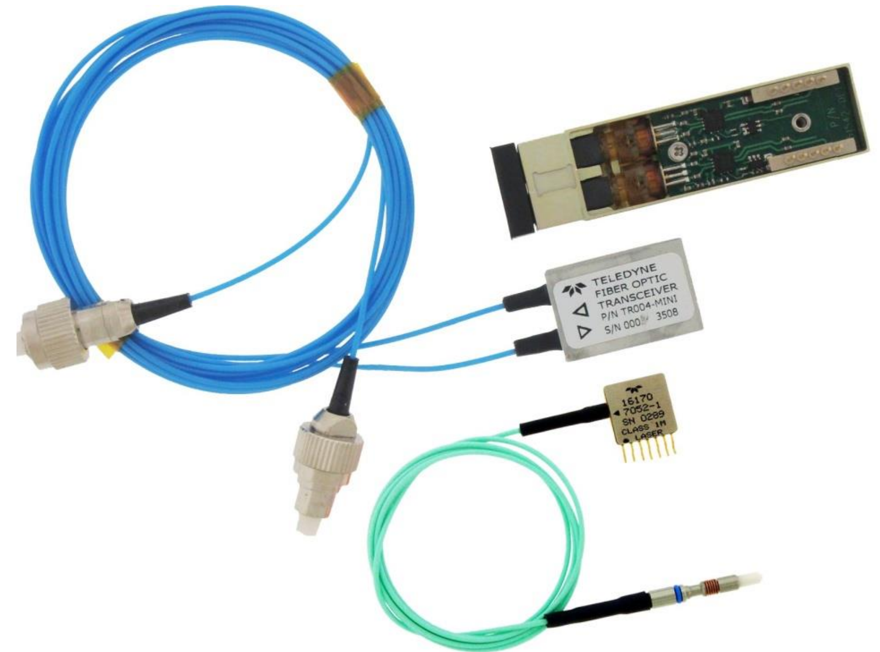
Standard Devices

- Up to 4.25 Gbps, -40°C to +95°C, soon 105°C
- High Reliability Industrial Packaging & Components
- Extended shock and vibration, moisture resistant
- Standard connector interface: LC/MT/FC and others
- Single mode, Multimode, Ethernet, Duplex, Multiplex

SFF: 1.9” x 0.5” **MINI:** 0.8” x 0.5” **Micro Form Factor (MFF):** 0.375” x 0.375”

Teledyne Optical Device Roadmap

- Phase 1: Currently available
  - TX004-SFF: 4.25 Gbps SFF MM Dual Transmitter
  - RX004-SFF: 4.25 Gbps SFF MM Dual Receiver
  - TR004-SFF: 4.25 Gbps SFF MM Transceiver
  - TR004-MINI: 4.25 Gbps MM Transceiver
  - TX004-MFF: 4.25 Gbps MFF MM Transmitter
  - RX004-MFF: 4.25 Gbps MFF MM Receiver
  - TXSM4-MFF: 4.25 Gbps MFF SM Transmitter
  - RXSM4-MFF: 4.25 Gbps MFF SM Receiver
- Phase 2: 10 Gbps
  - Moisture resistant
  - MINI, MFF
- Phase 3: 4.25 & 10 Gbps
  - Hermetically sealed
  - MINI, MFF
- Phase 4: 4.25 & 10 Gbps Arrays
  - 4 to 8 channels per device
- Phase 5: Space Qualified Transceivers



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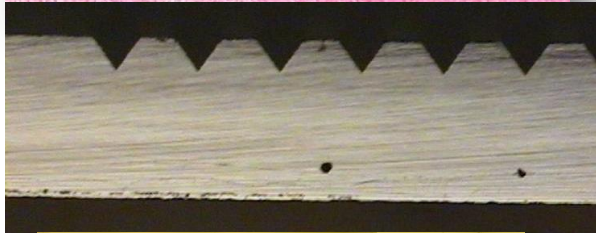
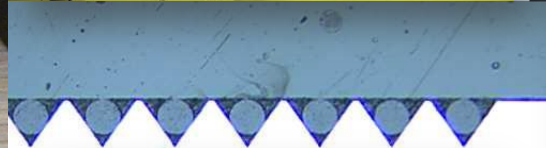
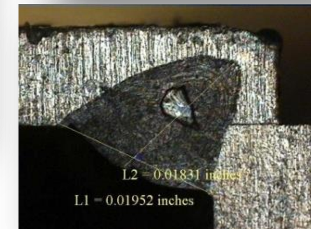
Nano/MicroTechnology



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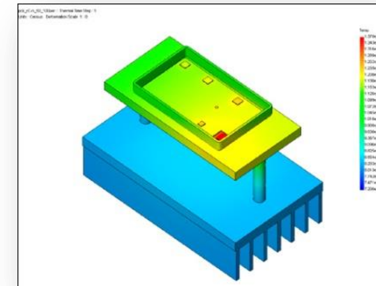
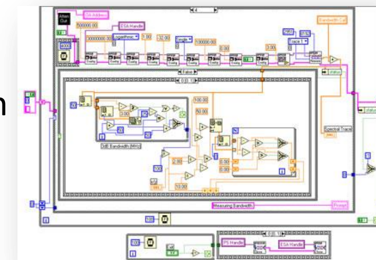
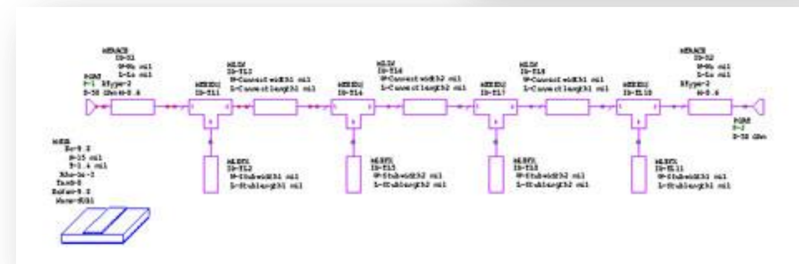
Comprehensive Design Tools

- 2D Microwave - EEsof, Microwave Office
- 3D Microwave - Ansoft, HFSS
- Photonic Design and Simulation
  - Zemax – Far Field Optics
  - RSoft – Near Field Optics
- Pro Engineering, Pro Mechanica, COSMOS, SolidWorks
  - 3D Mechanical Design
  - FEA, Stress Analysis, Thermal Analysis, Dynamic Analysis
- Mentor Graphics MCM Station
  - Schematic Capture
  - Autorouting
  - High Speed/Crosstalk Analysis
  - Idea - Schematic Capture, Digital Simulation
  - Quick Fault - Test Vector Generation
- OrCad
  - Schematic Capture
  - Autorouting
- AutoCAD
  - Substrate layout
  - Hybrid packaging design
  - Microelectronic interconnection
- PSPICE
  - Design, Analysis and Simulation







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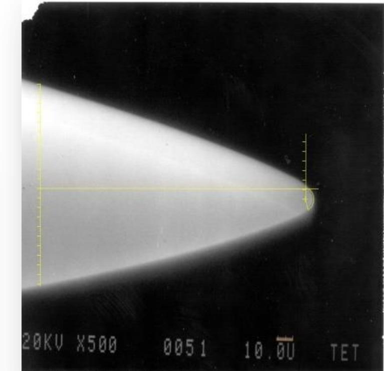
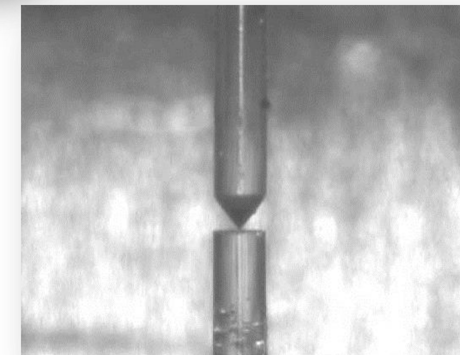
Enabling Optoelectronic Technologies

- Processes
  - Alignment, single and multi-mode fiber
  - Fusion splicing regular and PM fibers
  - Multi-channel fiber (array)
  - Alignment for high power (up to 10 W)
  - Hermetically sealed fiber packaging
    - Single fiber and multi-fiber array
    - In-house fiber metallization
  - V-Groove fabrication (2 Ch – 128 Ch)
  - Optical bench fabrication
  - Single and Multi-mode fiber tip lensing
  - Multiple fiber termination technologies
  - Beam profile characterization
- Optical Design and Analysis
  - Optical Modeling
    - Near field (BeamProp)
    - Free-space (ZEMAX)
- Fiber Lensing
    - Micro-lens array
    - Fiber tip lens (SM&MM)
    - Free-space collimation and focusing





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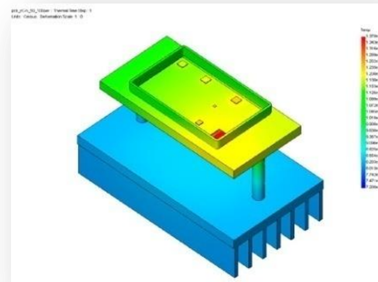
Diversified Packaging Technology Portfolio

- Substrates
  - Ceramics
    - Al_2O_3, BeO, AlN
    - Multi-layer thick film
      - Standard
      - Photo-etchable
      - High Frequency
    - Single-layer thin film
    - Cofired (LTCC, HTCC)
  - Laminates
    - FR-4
    - Polyimide
    - Rigid-Flex
    - Insulated Metal
    - Proprietary High Tg

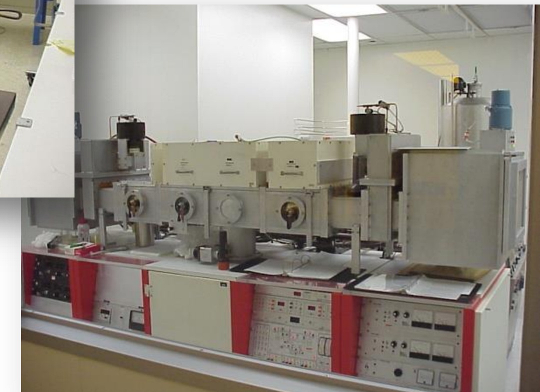


- Assembly
  - Chip and wire
  - Flip Chip
  - SMT
  - Mixed Technologies
  - Chip Scale Packaging

- Technical Expertise
  - Multi-disciplinary product engineering
  - Routing and layouts
  - Circuit simulation, design, analysis
  - Established processes, SPC monitored
  - Concurrent Engineering Teams

Substrate Capabilities

- Thin Film Ceramic
  - Nickel & Gold Plating
  - Nichrome, TaN, Gold & TiW Sputtering
  - Fine line capability (0.001” lines w/0.0005” spacing)
  - Nichrome & TaN resistors
- Thick Film Fine Line Ceramic
  - FODEL
  - Photo-Etchable
  - Low-K Dielectric



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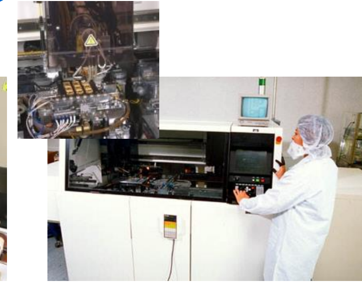
Enabling Manufacturing Technologies

Microelectronic Interconnection:

Dispensing

Die Attach

Wire Bonding


Flip Chip

SMT:

Stenciling/ Screen Printing

SMT Pick & Place

Solder Reflow

Packaging & Testing:

Cover Seal

Encapsulation

Test Systems

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Process Validation & Screening

Wire Bond Pull and Shear Tester

Sonoscan

Pressurizing Helium Chamber

Temp Cycling

Fine Leak Test

Gross Leak Test

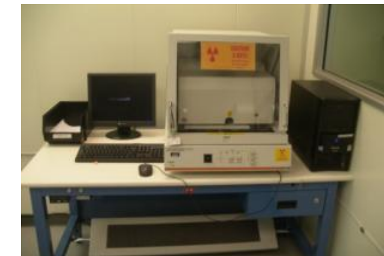
Real Time X-Ray

HAST

Centrifuge

Vibration

Mechanical Shock


XRF (X-Ray Fluorescence) Tester

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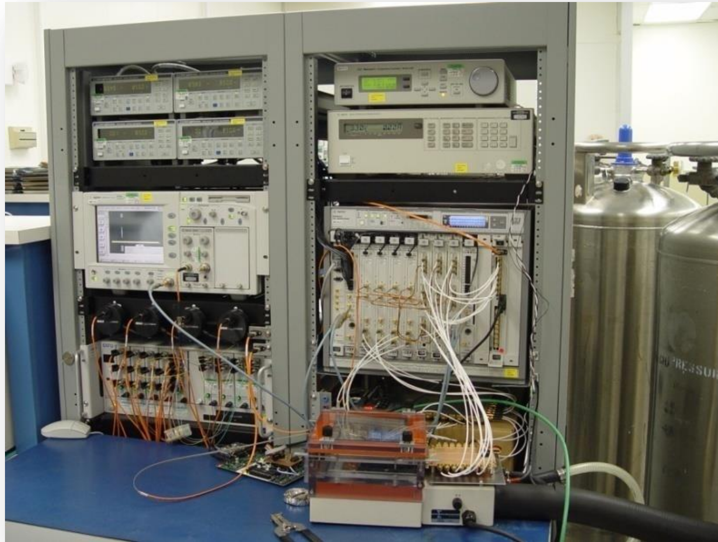
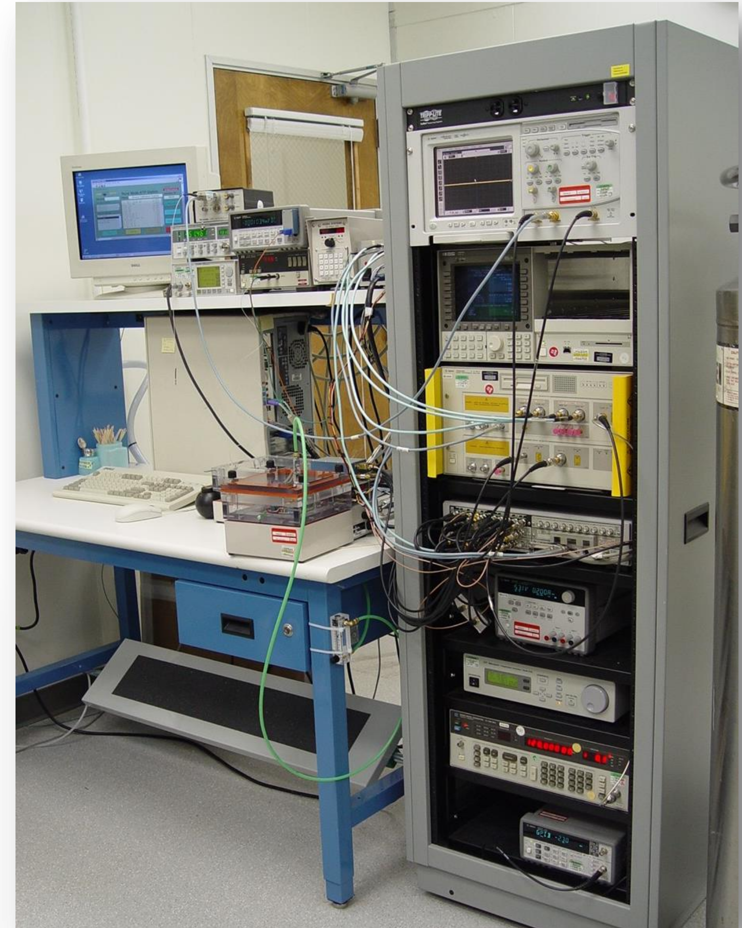
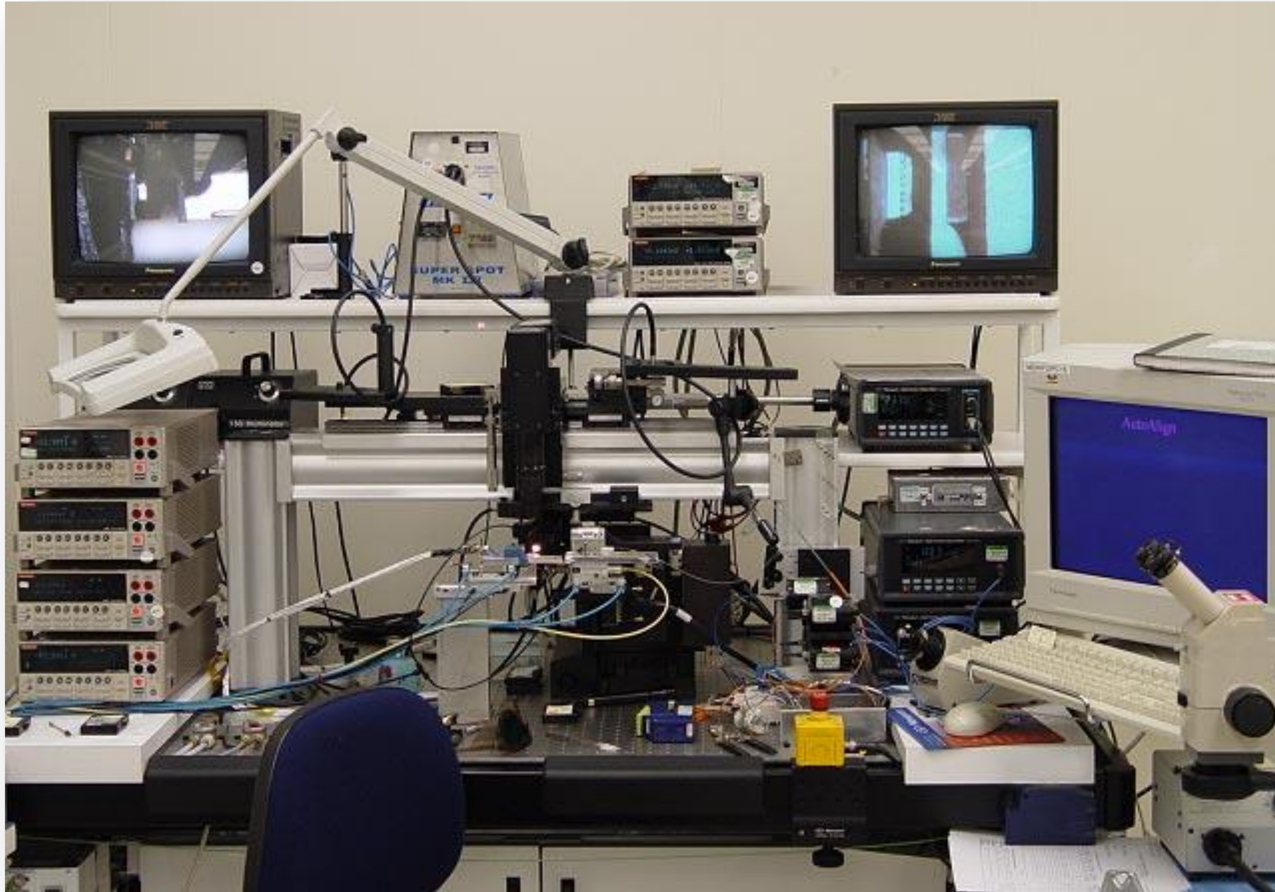
Fiber Optics Test Stations





Automatic Alignment Station



6 degrees of freedom alignment station

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Certifications and Qualifications

- MIL-PRF-38534, General Specification for Hybrid Microcircuits
  - Facility and Manufacturing process certified and qualified by DSCC for Class "H" and "K" devices
  - Laboratory Suitability to MIL-STD-883 for 21 test methods
- ISO 9001:2008, Quality Management System
- SAE AS/EN/JISQ9100:2009 Revision C
- D6-82479 Appendix A, Advanced Quality Systems
  - Facility certification to Boeing D1-9000 updated in June 2002 to include AS 9100
- MIL-STD-790, Product Assurance Program for Electronic and Fiber Optic Parts Specification
- MIL-PRF-28750, Qualified Products List - Solid State Relay
- DOD DMEA (Defense Microelectronics Activity) Microelectronics Trusted Source

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Teledyne Solution

- Defense, Aviation, Space, and Ruggedized Industrial
  - Requires high performance fiber optic devices
  - Increased data rates, small size, EMI immunity, ease of scalability, lightweight
- Existing Standard Commercial Fiber Optic Suppliers
  - Devices do not meet ruggedized environmental requirements
  - Not willing to provide custom devices
- Teledyne fills the need
  - HRIP design for ruggedized applications
  - Long history with optical devices in these markets

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