OPTICAL SWITCHES WITH NO MOVING PARTS FOR SPACE APPLICATIONS

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→ MOTIVATION

The objective of this activity is to examine the suitability of **solid state fiber optic switches** to meet future space applications and define a complete technology development and space qualification roadmap for the most suitable solid state optical switch technology for future satellite payloads.

The use of **solid state switching greatly improves the reliability of optical switch technology** when compared with the use of bulky mechanical switching systems. In addition to this benefit solid state switching can provide faster switching speeds which is required in SpaceFiber and in some optical switching applications.

→ INITIAL SURVEY

Literature survey & Questionnaire details as follows

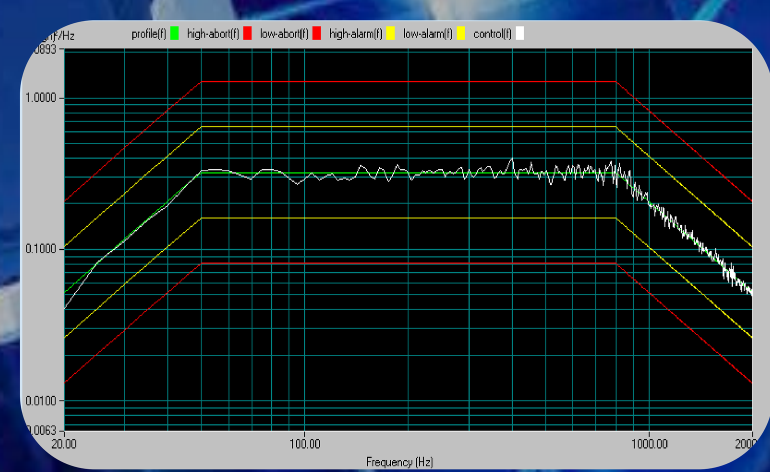
- Technical requirements for different applications
- Operating principles, advantages and inconveniences of different technologies
- Identification of potential manufacturers

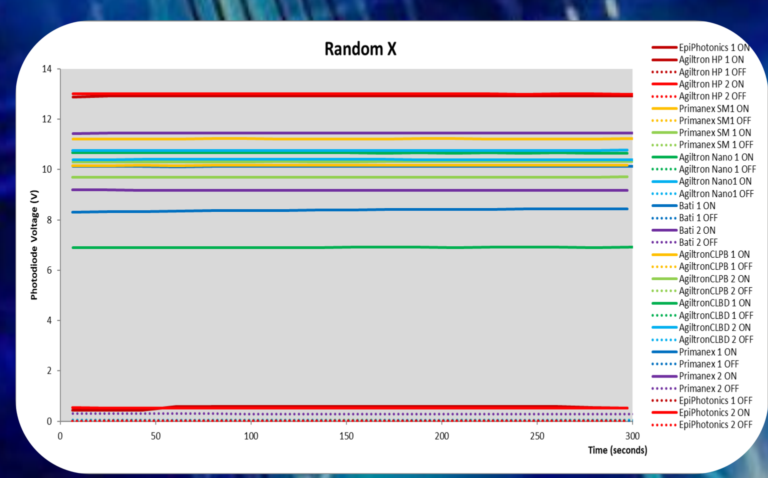
Applications	Technologies
• CO2 Monitoring Lidar	✓ Bulk Electro-optic (B-EO),
• Atom Sensor(750 and 1580nm)	✓ Waveguide Electro-optic (WG-EO),
• Optical Sensing	✓ Magneto-optic (MO)
• Digital Communications	• Acousto-optic (AO)
• Local Oscillator-Distribution	✓ Liquid Crystal (LC)
• Optical Communications (5KWpeak, 10W and 100mW)	• Thermo-optic (TO)
• Optopyrotechnics	
• Laser Interferometry	

→ TEST FLOW

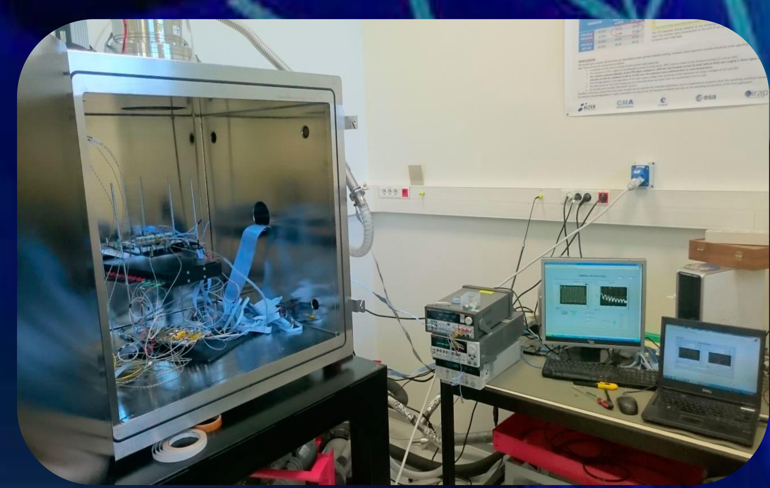
Initial EO		Electro-optical Measurement and Inspection - Insertion Loss - Crosstalk - Response Time - PDL / PER
Validation	Mechanical Test	Vibration
		Shock Test
	Vacuum Thermal	Monitored Vacuum Cycles
	Radiation	Gamma Radiation Monitoring
	Final DPA	Destructive Physical Analysis

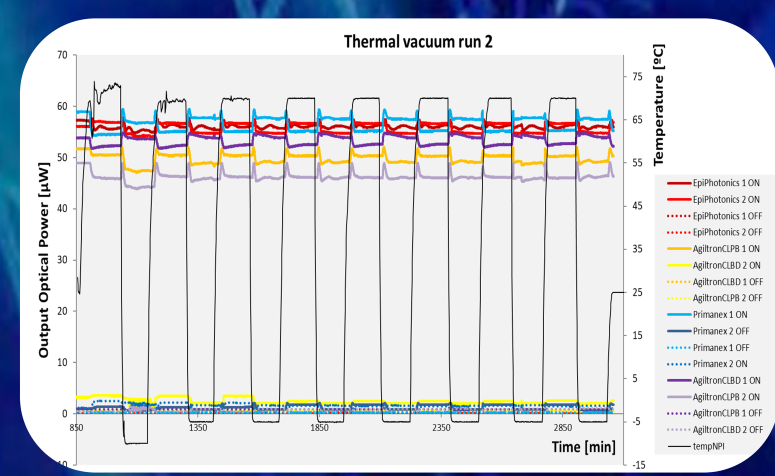
→ MECHANICAL TEST



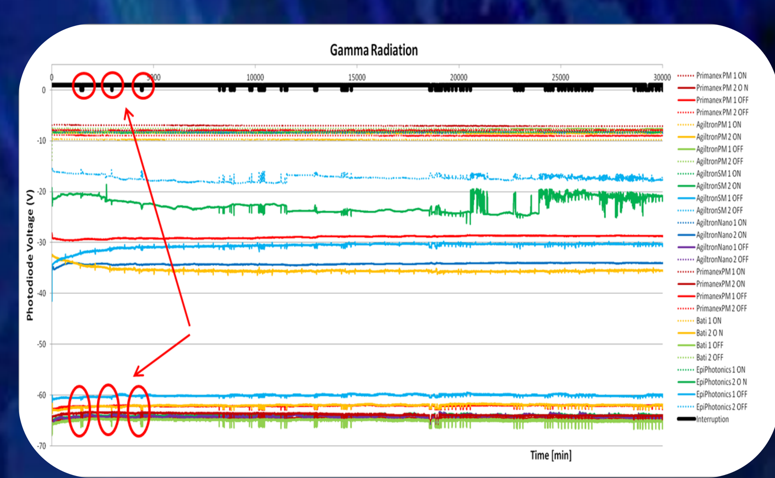


→ THERMAL VACUUM





→ RADIATION



→ RESULTS

- The optical switches **are more sensitive to temperature than mechanical or gamma radiation**
- **All the tested samples,** except EpiPhotonic (WG-EO) switch, **passed all the tests.** This failure is not inherent to the WG-EO technology (easy to solve)
- No differentiation has been found between Polarization Maintaining fibers and Single Mode fibers

→ CONCLUSIONS AND RECOMMENDATIONS

Solid state optical switches with no moving parts **are excellent candidates for space applications**, specially Bulk Electro-Optics and Magneto Optics technologies . They respond very well under typical space conditions as radiation, vibration, shocks and thermal vacuum.

The temperature should be maintained constant. The Consortium recommends the switches based on MO or B-EO for space applications. B-EO should be used for applications requiring high switching speed and MO for those requiring a minimum crosstalk

→ ACKNOWLEDGMENTS

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