SPACE SOLUTIONS

Booklet

SIMPLIFICATION IS OUR INNOVATION

Radiall™

- *Payloads*
- *Equipment*
- *Launchers*
- *Constellations*
- *Ground testing*

FOREWORD

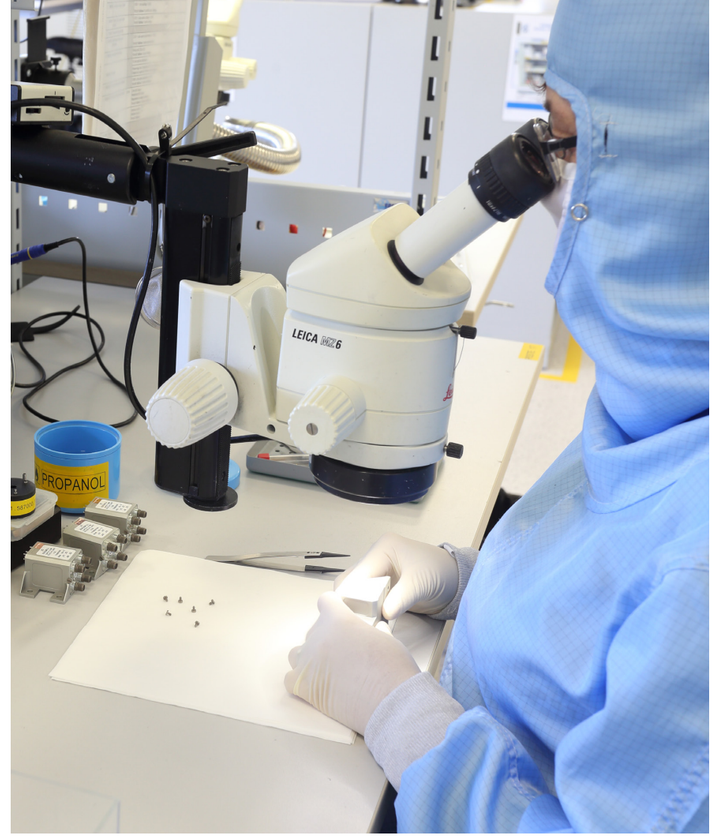
Radiall is the preferred choice across the globe when quality, reliability and performance are mission critical. With involvement in more than 300 satellite programs since 1974, our competitive solutions have established a strong reputation.

Our complete range of space qualified products with a frequency range up to Q-band includes:

- *RF connectors*
- *RF cable assemblies*
- *Microwave components*
- *Microwave switches*
- *Optical interconnect systems*

SPACE EXPERTISE

All of Radiall's space products are designed by space engineers at our state-of-the-art plant in Isle d'Abeau, France. Our 600 m² ISO 7 and ISO 8 clean rooms are among several in-house capabilities that allow us to guarantee that our customers are receiving the highest quality components on the market.



DESIGN

To ensure that customers' specific needs for dedicated applications are met, our engineers use the following tools to design and model components:

- *ANSYS*
- *Solidworks*
- *CST Microwave Studio*
- *COSMOSWorks*
- *HFSS*

TESTS

At Radiall, we understand the importance of products that meet environmental and space specifications. We use the following in-house test equipment to ensure that customers receive high performance and qualified components:

- *Vector Network Analyzers*
- *Thermal chamber with nitrogen injection*
- *Thermal vacuum chambers*
- *Automatic test benches for electrical switch parameters*
- *X-ray equipment*
- *Multipaction and power handling test benches*
- *Vibration shakers*
- *Half sine shock machine*
- *Reverberation chamber for EMC measurements*

Different Grades

FM GRADE

All space products or components are flight models by default. These models should be submitted to flight acceptance testing. They are made of parts qualified for space, and they are assembled in appropriate conditions and environments. They come ready for users to integrate.

EM GRADE

An EM shall be fully representative of flight models except that a lower standard of electrical components, materials and processes may be used. Screening is limited to full performance verifications, which are usually required by customers for electrical measurements or to qualify their own equipment. This model is not acceptable for flight use.

HIREL GRADE

The products that we consider HIREL are issued from our standard range (not space qualified), but we apply specific testing so that they comply with severe space environments. Radiall offers solutions for a variety of programs using this mode. This quality level is suitable for constellation programs that require high volume.

QM OR EQM GRADE

A QM or an EQM shall be built to full standard in accordance with requirements imposed on flight models. Flight standard parts shall be used with the same manufacturer, the same type, the same package and the same level of testing and screening as the flight models. The qualification model shall be submitted for equipment level qualification testing. This model is not acceptable for flight use.

PFM GRADE

This grade applies to Radiall switches. It is the same as FM grade except that a screening test is applied within the max qualified temperature range and at the max qualified vibration level. During screening, testing is done in a vacuum instead of with ambient pressure. This model is acceptable for flight use.

TVAC GRADE

This grade is composed of standard products that are compatible with vacuum environments.

GEO SATELLITES

Radiall is an expert in RF and microwave components. We have a wide range of space qualified products, from DC to Q-band. The SMP-LOCK connector, specifically designed for GEO satellites, is compatible with the SMP interface and includes a unique quick locking system to simplify installation and provide a secure connection.

RF SWITCHES

Radiall has more than 50 years of experience in designing and manufacturing electromechanical switches. The space qualified range, SPDT, DPDT, DP3T and T switches could be fitted with SMA, SMA 2.9, SMP-LOCK or TNC interfaces, depending on frequency band and power requirements. We offer individual switches with D-SUB, external pins or flying leads for CMD and TLM controls. We also offer interconnected, compact switch matrices, from 2 to 8 switches.

- *Excellent RF performances: VSWR and EMC*
- *Lightweight*
- *High density switch matrix*
- *T-switches, random or sequential*

RF COUPLERS & DIVIDERS

Our product range has recently been completely redesigned to offer the best RF performances: VSWR, amplitude balance and EMC. We also optimized the design to guarantee glitch-free products.

- *3 dB hybrid power dividers*
- *Directional couplers, 5 to 30 dB*
- *Dividers, 2 ways to 8 ways*
- *From L-band to Ka-band*

RF CABLE ASSEMBLIES

Our range of space qualified, low loss, flexible coaxial cable assemblies and semi-rigid cable assemblies is entirely customizable. We offer several cable diameters and various configurations of connectors. Length and shape can also be adapted to the equipment.

- *Technical support to define the best configuration*
- *ETFE jacket available for better radiation tolerance*
- *Compliance with ESCC 3408 specification*
- *Phase-matched option available*

RF CONNECTORS

Radiall's space offering includes a wide range of coaxial connectors with a frequency range up to Q-band. This includes SMA, SMA 2.9 and Very High Power TNC connectors that are ESA qualified, as well as TNC, 2.4 mm and SMP/SMP-LOCK connectors.

- *Various interfaces available*
- *ESA qualification*

RF ATTENUATORS & LOADS

Radiall offers space qualified low power attenuators (up to 2 W) and low or medium power terminations (up to 45 W). These are available with various interfaces: SMA, SMA 2.9, SMP-LOCK, 2.4 mm and TNC.

- *ESA qualification*
- *Attenuators are glitch free*
- *Robust design*

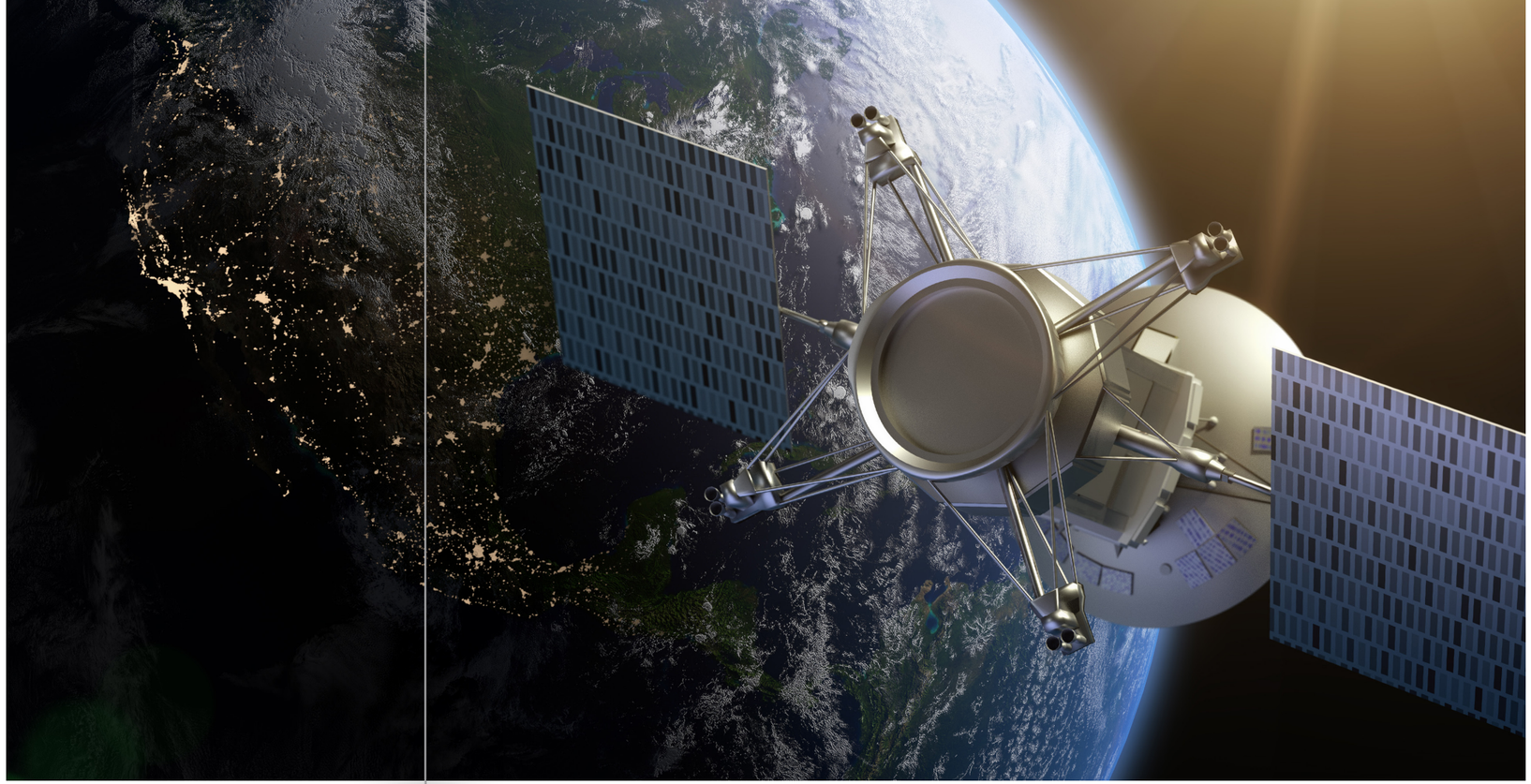
Q-MTITAN™ ARINC 846

A ruggedized, high-density optical interconnect, the Q-MTitan™ ARINC 846 brings multifiber capability through one standard size 8 Quadrax cavity. Its innovative design protects the widely used MT ferrule and provides a sealed and rugged interconnect that withstands high temperature ranges and vibration levels.

- *Fits in size 8 Quadrax cavity of multipin connectors: D38999, ARINC 600, HDQX*
- *EN4644 EPX®, EN4165, QuickFusio™ and many more*
- *Compatible with ribbon and round cable and radiation resistance fibers*
- *Excellent performance maintained in harsh environments (-55/+125 °C, Vibration 41.7 Grms, 500 mating cycles, Shocks 2,000 G)*

LEO CONSTELLATION

The space market is rapidly evolving, and some applications require both high-quality and cost-effective solutions. To satisfy such applications, Radiall's space solutions leverage our global technologies and industrial presence with simplified screening.



SMP-LOCK CONNECTORS

SMP-LOCK® combines SMP electrical performance with an additional locking mechanism that features high retention force. Various types of connectors and adapters are available for LEO constellations: male/female, straight/right angle, with flanges or thread mounts, etc. This interface is perfect for LEO programs, which typically require quick and secure connections.

- *DC – 40 GHz*
- *Secured connection*
- *Saves integration time*

RF CONNECTORS FOR BOARD-TO-BOARD APPLICATIONS

SMP interface is the most reliable and common interface for Board-to-Board space applications. We offer a wide range of models: fixed bullet with your exact required length, spring bullet and various receptacles, including a catcher's mitt design.

- *Wide range with various configurations*
- *Different retention forces available*

SMT QUARTZ RELAY

To overcome the frequency limits of SMT switches, Radiall merged the RAMSES concept with SLIM LINE technology to develop the Quartz series. This new series is a major evolution when compared to the previous SMT relay, as it can work up to 26.5 GHz.

- *Small size*
- *High frequency: 26.5 GHz*
- *Long life span: 5 million typical cycles*

HIREL RF CABLE ASSEMBLIES

Based on our space qualified range, Radiall can also offer HIREL RF cable assemblies. We guarantee the same design as the FM cable assemblies but with simplified screening and manufacturing in a low cost area.

- *Cost-effective solution*

OPTICAL FIBER LINKS

We offer a wide range of configurations to build space grade assemblies, available with high reliability connectors, cables and optical contacts: LuxCis® ARINC 801, C-MTitan™ and Q-MTitan™ ARINC 846. They can be assembled on single or multifiber cable or optical flexes.

- *Radiation-tolerant components*
- *High optical link budget*
- *Weight optimized, compact and robust optical interconnect solutions*
- *EMI/EMC compliance*
- *High level of shock and vibration compliance*
- *-55/+125 °C operational temperature range*

HDQX CONNECTORS

Radiall's High Density Quadrax connector provides high-speed communication solutions, and it combines compact and rugged qualities for high reliability and signal integrity in aerospace environments (transmission of Ethernet and RH high-speed signals).

- *Simple and secure with a central locking device*
- *Rectangular shape: space-saving*
- *Contacts grounded to the shell with high electrical continuity*
- *High density and high-speed solution combined with Q-MTitan ARINC 846, an MT-based optical contact*

GROUND TESTING

Ground testing components and systems is an essential stage in the satellite manufacturing process. It includes testing space equipment, payloads and satellites under simulated flight conditions. To optimize the cost of developing and testing space systems, Radiall offers product alternatives depending on the types of components used.

TVAC RF SWITCHES

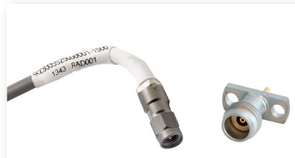
With more than 25 years of experience in the space industry, Radiall has developed a product offering that emphasizes reliability and performance and operates in thermal vacuum testing environments. Designed in accordance with our standard RAMSES product offering, TVac series switches feature identical configurations with excellent performance.

- *SPDT, DPDT, SPnT*
- *Unterminated and terminated models*
- *Long life span: up to 10 million cycles*

TESTPRO RF CABLE ASSEMBLIES

TVac test assemblies offer excellent electrical performance and high mechanical endurance. Additionally, these ruggedized assemblies offer reliability and durability when it matters most. Despite high protection resistance, Radiall's range of TVac TestPro solutions remain exceptionally flexible and user-friendly with an extended life of more than 20,000 flex cycles.

- *DC – 67 GHz*
- *Phase and amplitude stability*
- *High flexibility and reliability*



RF CABLE ASSEMBLIES & CONNECTORS

Radiall designed a wide range of coaxial connectors and cable assemblies for space testing with various interfaces, configurations and types of cable. For ground applications, Radiall offers cable assemblies and connectors based on our commercial range. If required, Radiall can offer a complete set of phase-matched, time delay-matched or amplitude-matched SHF cable assemblies.

- *Low loss (SHF range), flexible and robust cables*
- *Customized offer depending on the application*
- *EM cable assemblies are also available for equipment qualification*
- *Quick lock solution connection*

MICROWAVE COMPONENTS

Radiall develops and manufactures a wide range of coaxial microwave components, including terminations, attenuators, couplers, power dividers, filters and other specialized components.

- *Frequency range: DC – 67 GHz*
- *Power range: 0 to 1,000 W*
- *Robust design*
- *Excellent electrical performance*
- *Impedance: 50 Ohms*

OPTICAL FIBER LINKS

Value-added optical assemblies solve connectivity challenges in space environments. The wide range of compact, ruggedized and reliable configurations makes it possible to build assemblies with optimized fiber management solutions. Our range offers the possibility of assembling on a single or multifiber cable or an optical flex.

- *High reliability connectors, cables and optical contacts: LuxCis® ARINC 801, C-MTitan™ and Q-MTitan™ ARINC 846*
- *High optical link budget*
- *EMI/EMC compliance*
- *High level of shock and vibration compliance*
- *55/+125 °C operational temperature range*

OPTOELECTRONIC CONVERTERS

Radiall offers a complete range of high performance optoelectronic Active Optics by DLightsys® for harsh environments: DO-160, MIL-STD, ARINC 804.

- *Lowest power consumption (<50 mW/ch Gbps)*
- *Smallest form factor for single channel and multichannel modules (6.5 mm²/ch/Gbps)*
- *Protocol independent and large bandwidth per channel (from DC to 10 Gbps)*
- *Various packages and form factors available (LCC, Socketed, SFF, others)*
- *Free space version for Board-to-Board contactless data links*

LAUNCHERS

Vehicle launch systems require products that can withstand harsh environments due to the high levels of shock and vibration they experience. Our innovative range of products enables satellites to make safe connections in space orbits.

RF CABLE ASSEMBLIES

Various robust configurations with high resistance to mechanical shocks and vibrations are available. Our cable assemblies for launching applications are qualified to guarantee a secure connection during the launching process. We also offer a wide range of FM designed with venting holes for outgassing and to avoid Corona breakdown.

- *Random vibration up to 40 Grms*
- *Mechanical shock half sine 1,000 Grms*
- *Various diameters available*
- *Vacuum compatible option*
- *Specific screening and qualifications can be applied*

RF CONNECTORS

Compliant with the highest MIL standards, Radiall designs coaxial connectors that withstand high vibrations and shock levels.

- *Frequency up to 65 GHz*
- *Secured coupling mechanism available*
- *High corrosion resistance*
- *Temperature range up to 200 °C*

EPXB2 LIGHTWEIGHT DISCONNECT

With the increasing demand for weight-saving connection solutions, Radiall now offers an alternative EPXB2 with J plating and 21% weight savings compared to the standard EPXB2 aluminium connector.

- *Modular and user-friendly connector: fully intermateable*
- *Space-saving solution*
- *Cost-saving solution*
- *EN 4644 European standard*

RF COUPLERS & DIVIDERS

For over 30 years, Radiall has designed coaxial couplers and power dividers/combiners for embedded RF systems. Our product offering includes directional and 3 dB 90° hybrid couplers, as well as power dividers used for signal measurement. Both products comply with MIL-STD-202G.

- *Couplers operating from 0.15 to 18 GHz*
- *3, 6, 10, 20, 30 dB standard coupling values*
- *Low insertion loss and VSWR*
- *High directivity*
- *Dividers operating from 0.22 to 26.5 GHz*
- *2, 3, 4, 6 and 8 way divisions available*
- *Power dividers can be used as combiners*

Q-MTITAN™ ARINC 846

This optical interconnect features 12 fiber optic channels in a compact and rugged contact.

- *Fits in size 8 Quadrax cavity of multipin connectors: D38999, ARINC 600, HDQX, EN4644 EPX®, EN4165, QuickFusio™ and many more*
- *Compatible with ribbon and round cable and radiation resistance fibers*
- *Excellent performance maintained in harsh environments (-55/+125 °C, Vibration 41.7 Grms, 500 mating cycles, Shocks 2,000 G)*

OPTICAL FIBER LINKS

We offer high-quality harnesses and complex optical systems, including D-Lightsys® active devices, multipin connectors and ruggedized fiber optic interconnect solutions: LuxCis® ARINC 801, C-MTitan™ and Q-MTitan™ ARINC 846.

- *Lightweight and small design*
- *Material with low outgassing*
- *Immunity to EMI and RFI*
- *Resistance to radiation*
- *Simplex and multichannel assemblies*

Compliant with European export control regulations and United States ITAR.

SIMPLIFICATION
is our **INNOVATION**

We advance the design and engineering process for innovators, ground-breakers and pioneers of technology. We reduce weight, improve durability and streamline installation to provide leading-edge connectors that drive product performance.

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GLOBAL PRESENCE

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