

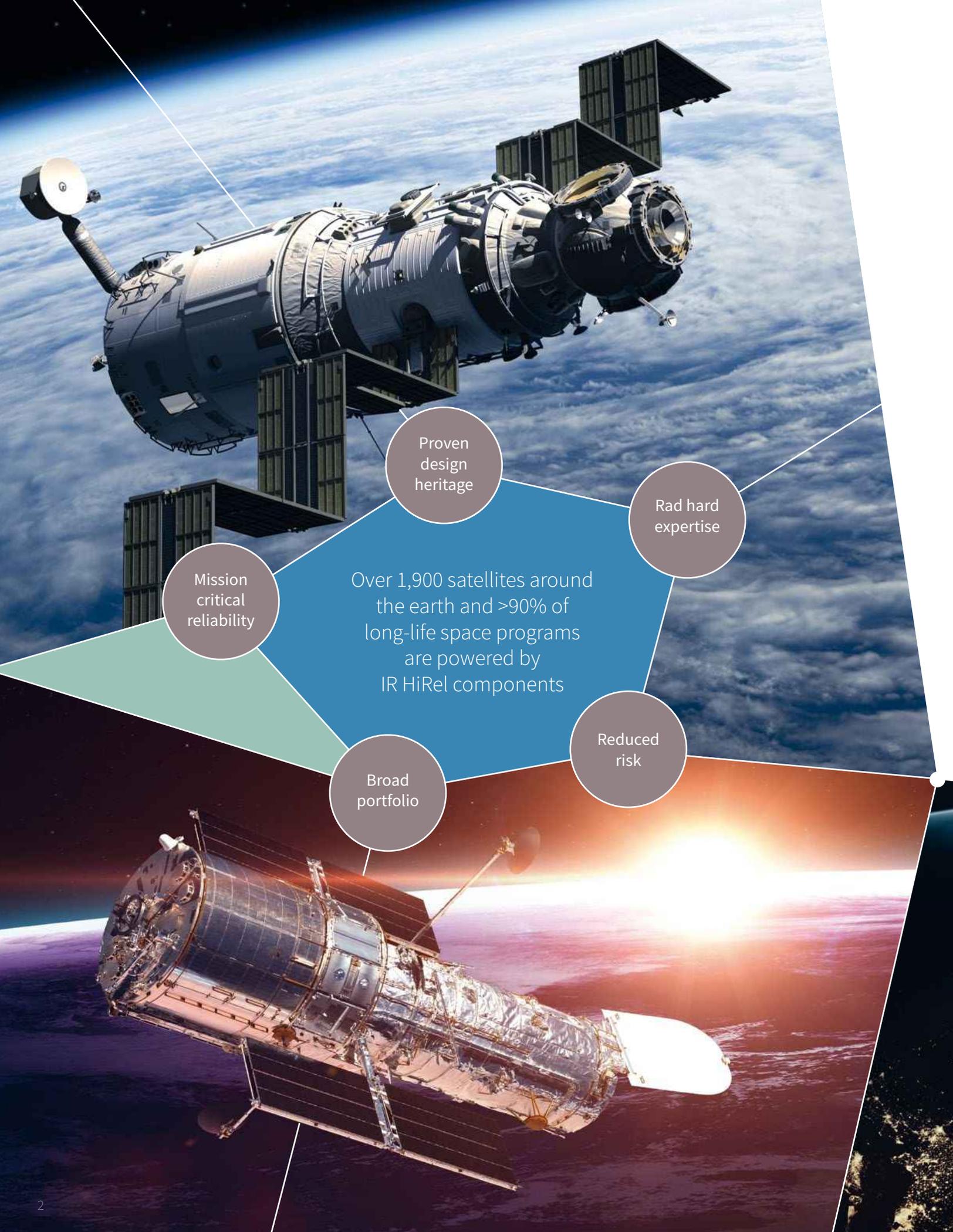
A detailed illustration of a satellite in space. The satellite has a central body with gold-colored thermal insulation and several large, rectangular solar panels extending outwards. The background shows the Earth's surface with white clouds and a blue sky, transitioning into a starry space background. A green triangular shape is in the top right corner, containing the text 'We power space'.

We power space

Space power management solutions

www.infineon.com/irhirel

IOR HiRel
An Infineon Technologies Company



Proven design heritage

Rad hard expertise

Mission critical reliability

Over 1,900 satellites around the earth and >90% of long-life space programs are powered by IR HiRel components

Reduced risk

Broad portfolio

Trusted source for space power solutions

A pioneer in power electronics since 1947, International Rectifier HiRel Products, Inc. (IR HiRel) is a leader in high-reliability, radiation-hardened (rad hard) power conversion for space flight applications, from space exploration to national security programs and more.

Our design, operations and quality systems meet and exceed military standards. IR HiRel offers standard and custom semiconductor-based products specifically designed for space applications where commercial electronics cannot meet the requirements.

Applications range from planetary exploration vehicles to communications, navigation, and observation satellites, classified missions and similar programs where failure-free performance is required in severe mechanical, thermal and radiation environments.

IR HiRel's specialized team of experts provides proven, high performance and fully documented products to expedite approval paths with management and end customers.

Thousands of programs, decades in space

IR HiRel has a long history serving the space industry. We understand the engineering and manufacturing requirements and challenges of designing for reliable performance in the extreme thermal, mechanical and radiation environments of space. For decades, customers have relied on IR HiRel's power solutions in thousands of mission-critical space, aerospace and national security programs. Many of these missions are still in flight today.

IR HiRel combines its world-class heritage with deep technical expertise and product innovation to deliver benchmark power solutions for customers. Our rad hard power management portfolio is recognized globally for its excellent performance, reliability, longevity, and unparalleled design heritage.





Continuous innovation

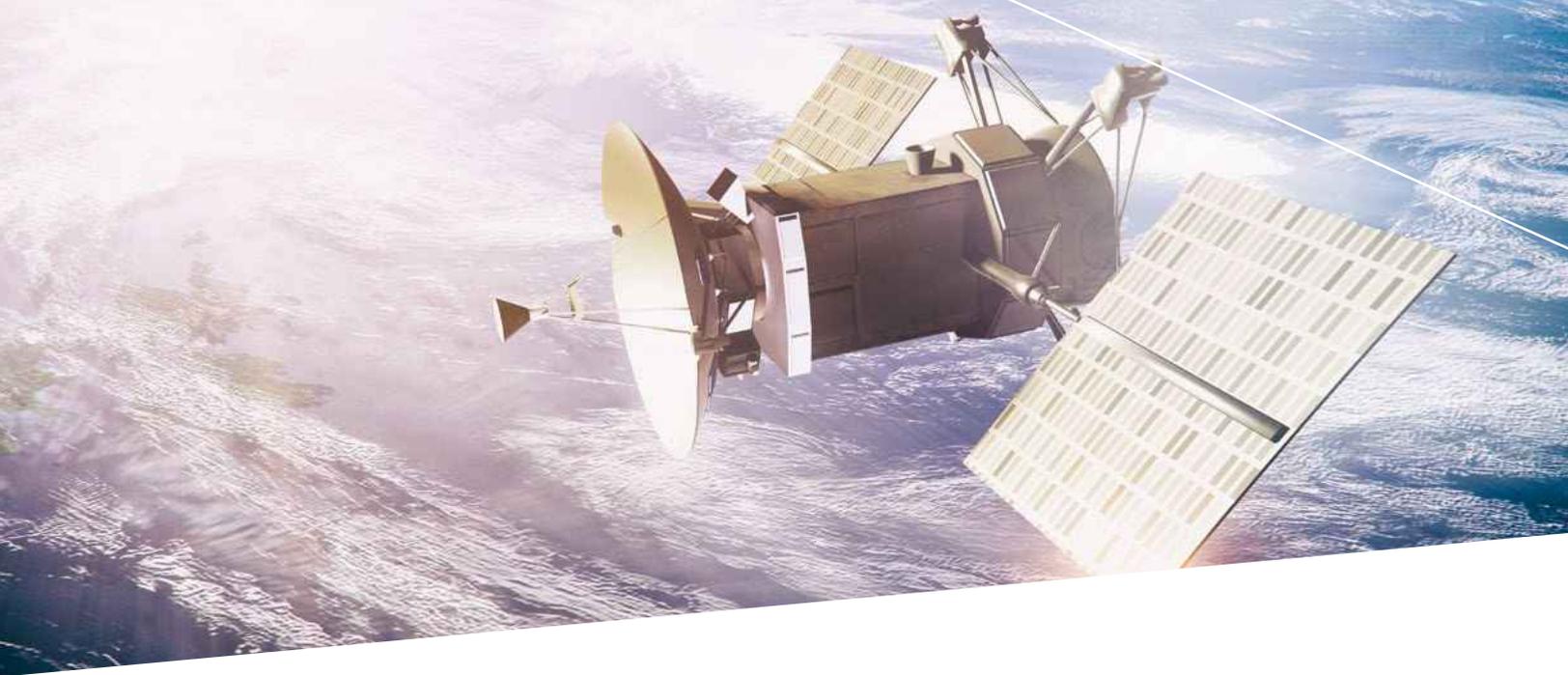
IR HiRel continues to invest and develop next-generation rad hard technologies that maintain the rigorous performance standards required in space. Our advances in rad hard silicon platforms, packaging and die sizes pave the way for improved performance and efficiency, while preserving the quality and reliability levels our customers need.

Continuous development and upgrade of proven DC-DC converter platforms improves end-of-life performance with advanced electrical features and solid radiation performance. IR HiRel addresses component obsolescence and maintains this proven product line with integration of suitable off-the-shelf, validated components with improvements when the opportunity exists.

Radiation hardness assurance (RHA)

IR HiRel's rad hard MOSFETs are tested to verify their radiation hardness capability, with our assurance program based on the requirements outlined in MIL-PRF-19500 and associated slash sheets. IR HiRel exceeds the standard requirements with sampling plans up to two times greater than is required for every manufacturing lot. Both pre- and post-irradiation performance are tested and specified using the same drive circuitry and test conditions in order to provide a direct comparison. Heavy de-rating of the rad hard power MOSFETs virtually eliminates the possibility of SEGR and SEB.

IR HiRel DC-DC converters use proven, radiation-by design methodology based on a vast library of radiation tolerant and established reliability components controlled by our internal specifications. Both our PCB and hybrid designs are validated through analyses such as stress, thermal and worst case analyses which covers manufacturing tolerance, application load range, aging and radiation effects, per MIL-PRF-38534 Class K for hybrid products. Our converters can be used with confidence as is in most space missions without any additional de-rating.



Quality conformance inspection

Unlike standard commercial products, IR HiRel products undergo various levels of quality conformance inspection (QCI) to ensure that the products are capable of performing to specifications in the application's harshest environments. IR HiRel's program supports a breadth of screening and QCI levels based on US DLA specifications and ESA equivalents:

- > MIL-PRF-19500 and MIL-STD-750 for discrete MOSFET and diode semiconductors manufactured to JANTXV or JANS level
- > MIL-PRF-38534 and MIL-STD-883 for DC-DC converters, filters, solid-state relays (SSR) and power hybrids manufactured to class H or class K level
- > MIL-PRF-38535 and MIL-STD-883 for ICs and voltage regulators manufactured to class B or class S level
- > Source Control Drawing (SCD)

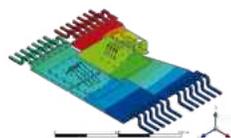
Flexible custom capabilities

IR HiRel's expert design team regularly works with customers to semi-customize or develop fully custom products to address complex, specific requirements and applications. Created in partnership with customers, IR HiRel's custom designed products are engineered for optimal integration with host equipment, reducing development effort and risk.

Services include turnkey design-to-specification and build-to-print hybrid power modules and circuit card assemblies to deliver products that fit perfectly to the application in compact, reliable packages. IR HiRel follows a gated product development process that provides all necessary analyses and documentation, verification and validation to ensure smooth release to manufacturing and successful qualification.



Specification review and development plan



Design, analysis and verification



Process engineering and design validation



Manufacturability readiness and qualification



Space power solutions portfolio

IR HiRel's rad hard power management portfolio for space is the industry's broadest, spanning from component level with rad hard MOSFETs via hybrid-based DC-DC converters and open frame PCB-based DC-DC converters to complete system level power supplies. Combining over thirty years of

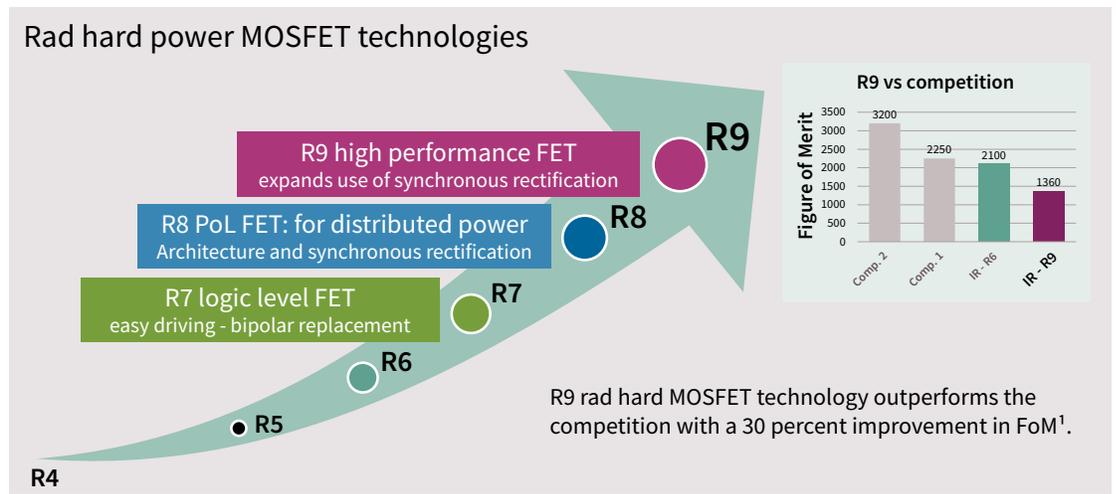
experience and a unique diversity of expertise and talents, IR HiRel is the ideal partner for tailoring power solutions to individual customer needs, from minor modifications to full-custom solutions.

Rad hard MOSFETs

IR HiRel is a renowned leader in high-reliability power solutions, being the first manufacturer to offer rad hard power MOSFETs for space in 1987. Over the last three decades, IR HiRel has continuously innovated in silicon design, packaging technology and quality with US DLA QPL products up to MIL-PRF-19500 JANS level.

IR HiRel offers a broad selection of N-channel and P-channel rad hard MOSFETs in a wide range of hermetic packaging options screened to MIL-PRF-19500 and available as QPLs.

Rad hard power MOSFET technologies



¹ Figure of Merit is $R_{DS(on)} \times Q_G$ (Gate Charge)

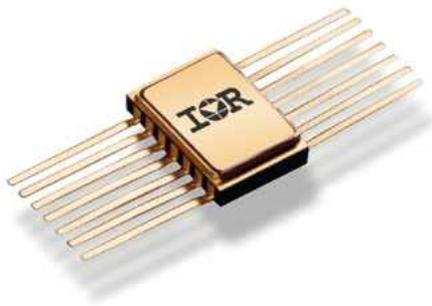


SupIR-SMD
Better than SMD-2 on carrier, 37% smaller and 45% lighter



SMD-0.5e
Improved design
Direct-to-PCB mounting

Rad hard gate drivers



Engineered to match our rad hard MOSFETs for maximum performance, IR HiRel's space-grade high-side and low-side MOSFET drivers are rated at 100krads(Si) for TID and have been characterized for SEE. These gate drivers feature a wide operating supply range up to 20V, low propagation delay and high drive currents. Increase reliability and reduce solution size and weight by replacing bulky magnetic or opto-coupler based gate driver designs with IR HiRel's space-grade gate drivers.



Space-grade DC-DC converters

IR HiRel's broad portfolio and implementation technologies allow customers to optimize their systems around different key performance parameters such as:

- › Size
- › Mass
- › Feature set
- › Power conversion efficiency
- › Flexibility for input and output voltages
- › Use of standard qualified parts
- › EMI performance
- › System requirements like redundancy and TM/TC interfaces

The power solutions are offered through a large portfolio of space-level rad hard hermetic, hybrid DC-DC converters and PCB open frame and enclosed power supplies, from a few watts to hundreds of watts, with options for parallel operation and redundant systems.



Hermetic hybrid DC-DC converters

- › Over 500 years of engineering hybrid converters expertise
- › General purpose, application-specific and customized DC-DC converters, including MIL-STD-461 filters
- › Qualified to MIL-PRF-38534 Class K, many available as Standard Microcircuit Drawings
- › Standard and advanced functionality and protections
- › License-free exportable (EAR99) rad hard products
- › DLA approved Radiation Hardness Assurance (RHA) plan
- › All components fully de-rated up to full output power level
- › Immunity to total ionizing dose (TID), single event effects (SEE), neutron and prompt dose radiation environments
- › End-of-life performance verification with supporting design analyses for use as is, with no additional de-rating in most applications
- › Mission specific radiation environment testing and analysis



PCB open frame and enclosed power supplies

- › Application-specific power converters with matching customer requirements for individual output regulation, and features for redundant operation and output protection
- › A key application segment is EPC for RF with output sequencing, in-orbit output voltage adjustments, very high CS rejection and low output noise
- › Advanced topology and magnetic design enable industry's best power conversion efficiency, especially for the 'low voltage, high current' segment
- › Generic design practices allow modification to different power buses and program requirements with minimal engineering effort, and short lead time without undue risk

Backed by IR HiRel's vast space heritage, customers can source high-reliability, qualified products that reduce project risk and time to market. Our flight-proven DC-DC converters are easy to design in and can be used as is with confidence in a wide range of applications, with no or limited de-rating or external circuitry.



IR HiRel delivers a range of products based on standard platforms and general design philosophy which can be tailored to the customer's program requirements and compliant to customer Source Control Drawing (SCD). Fully customized designs are also supported. All models and variants can be supplied with full data analysis package.

Solid state relays

IR HiRel's solid state relay (SSR) portfolio includes rad hard single, dual and octal devices in hermetically sealed packages and tested up to 100krads(Si) total ionizing dose. The family includes optically coupled, buffered and non-buffered solid state relays, with input and output MOSFETs using IR HiRel's industry-leading rad hard MOSFET technology. Choose our SSRs for high-reliability applications including solar array management, heater controls, bus switching, and ground power isolation. In addition to our standard SSRs, IR HiRel also offers custom space-grade power control modules designed to customers' specifications.



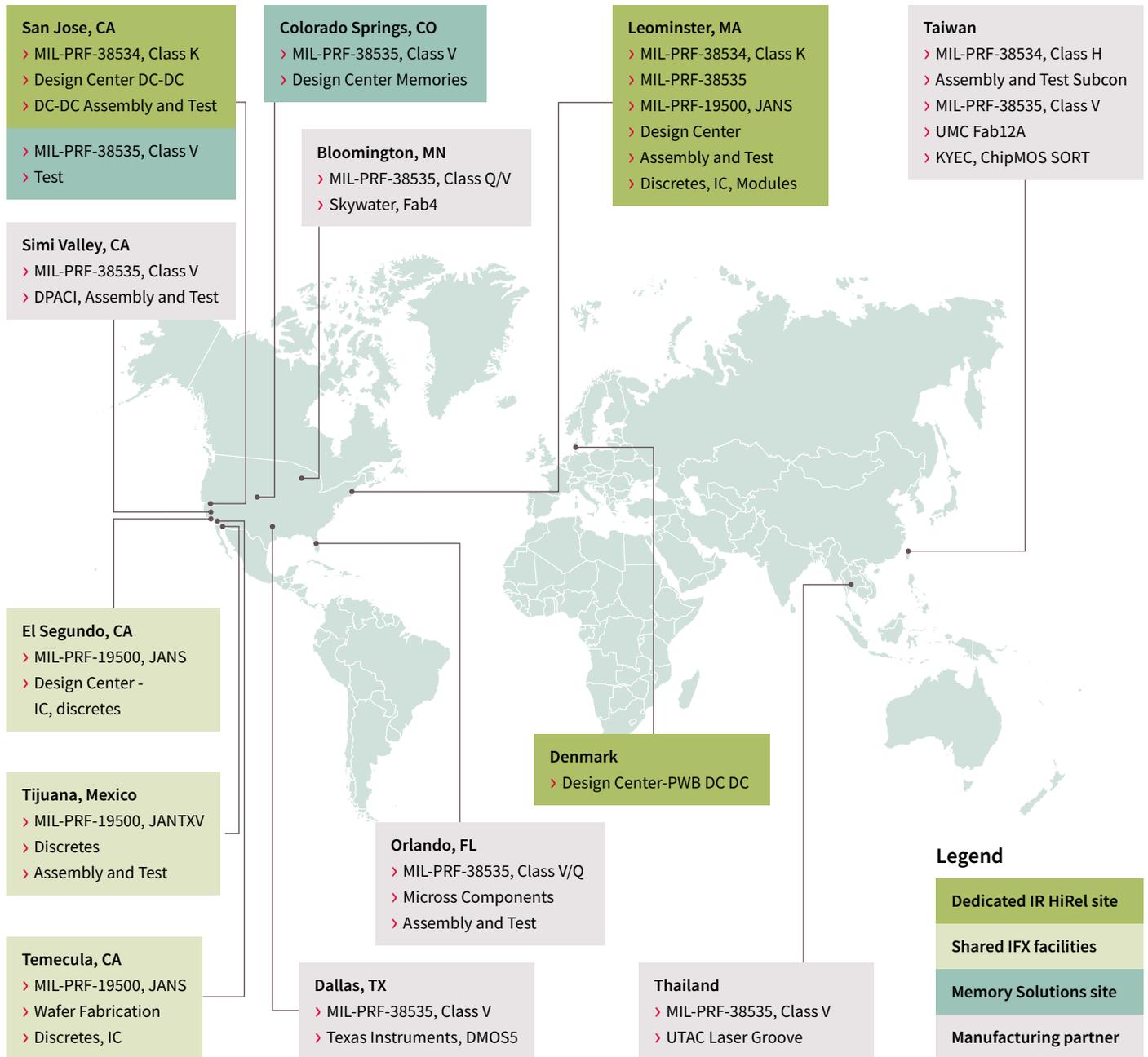
Schottkys & rectifiers

IR HiRel's portfolio includes high-reliability, hermetically packaged Schottky and ultra-fast rectifiers. Offered in variety of voltages and industry standard surface mount and through-hole packages, our Schottky and ultra-fast rectifiers are available in single, common cathode, common anode

and double configurations. Schottky quality screening levels include MIL-PRF-19500 JANTX, JANTXV and JANS, with US DoD DLA QPLs also available. The ultrafast rectifiers are screened to MIL-PRF-19500 equivalent.



IR HiRel locations and DLA certified sites



A world leader in rad hard power solutions

IR HiRel is an Infineon Technologies company. Together, we offer a broad selection of solutions certified to ESA and DLA standards for our global customers. We focus on the quality

and reliability of our power conversion solutions, reducing development effort and risk, so that our customers can meet requirements faster and work smarter.

International Rectifier HiRel products

- > San Jose, CA +1 408 434-5000
- > Leominster, MA +1 978 534-5776

www.infineon.com/irhirel

Published by
International Rectifier HiRel Products, Inc.
An Infineon Technologies Company
El Segundo, California 90245 USA

© 2021 Infineon Technologies AG.
All Rights Reserved.

Document number: B119-11090-V2-7600-EU-EC-P
Date: 02/2021

Please note!

This Document is for information purposes only and any information given herein shall in no event be regarded as a warranty, guarantee or description of any functionality, conditions and/or quality of our products or any suitability for a particular purpose. With regard to the technical specifications of our products, we kindly ask you to refer to the relevant product data sheets provided by us. Our customers and their technical departments are required to evaluate the suitability of our products for the intended application.

We reserve the right to change this document and/or the information given herein at any time.

Additional information

For further information on technologies, our products, the application of our products, delivery terms and conditions and/or prices please contact your nearest Infineon Technologies office (www.infineon.com).

Warnings

Due to technical requirements components may contain dangerous substances. For information on the types in question please contact your nearest International Rectifier HiRel Products, Inc., an Infineon Technologies company, office.

International Rectifier HiRel Components may only be used in life-support devices or systems with the expressed written approval of International Rectifier HiRel Products, Inc., an Infineon Technologies company, if failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety and effectiveness of that device or system.

Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.