



Integrated Power Solutions (IPS)

Power Modules

Power Switching Discretes

FPGAs and SoCs

Analog Mixed Signal ICs

Crystal Oscillators and Surface Acoustic Wave Filters

Transient Voltage Suppression (TVS) Diodes

Radio Frequency (RF) and Microwave Solutions

PCIe Switches

Ethernet Switches, PHYs, Software, and Power-over-Ethernet (PoE)

Security

Giving Wings to Innovation in Commercial Aviation





Take Flight with Microsemi

Microsemi technology has been used in all major commercial and military aerospace platforms for many decades. With our broad product and capability portfolio and a proven track record of innovation, quality, and reliability on aerospace platforms over the past 20 years, Microsemi is well-positioned as a key partner on existing and future aerospace and defense platforms. We have extensive design, product, packaging, and test capabilities (both within Microsemi and with select external partners).

We continue to leverage our technology and extensive capabilities in this segment to support the ever-increasing electronic content in today's aircraft. Microsemi has evolved to become a leading-edge systems solution provider for the most demanding aerospace applications. We invest significant R&D funds in technology and capability development to augment our portfolio of high-reliability products for the next generation of aircraft, but also to become a full technical service provider as a supplier of innovative, highly integrated, flexible, scalable, and intelligent solutions as an extension of our customers' design teams.

Microsemi's Aerospace Centre of Excellence (CoE) for Integrated Power Solutions (IPS) has successfully created the first fully qualified standard power core module (PCM) for flight critical actuation systems using SiC.

The facility is fully resourced with modeling, simulation, qualification, reliability analysis, life test, and algorithm development capabilities to provide accelerated product innovation.

As the aviation sector continues to demand higher levels of reliability and integration in the area of power electronics in order to realize the goal of more electric aircraft (MEA), Microsemi's Aerospace Centre of Excellence for Integrated Power Solutions will play a critical role in supporting this objective.

Learn more about Microsemi commercial aviation solutions at www.microsemi.com/applications/commercial-aviation



**AEROSPACE CENTRE
OF EXCELLENCE**

Electric Aircraft Increasing Microsemi Semiconductor Content

Microsemi offers an industry-leading range of high-reliability products and solutions for flight-critical avionics and power conversion applications. Microsemi products and solutions provide smaller size, lower weight, increased performance, security, reliability, and continuity of supply to address the evolving needs of the aviation industry.

Cockpit Avionics

- Flight Control
- Data Management Systems
- Health Monitoring Systems
- Crew Interface Systems

Actuation Systems

- Landing Systems
- De-icing Systems
- Wheels and Braking Systems
- High Lift Control and Monitoring
- Primary and Secondary Flight Control Actuation Systems



Cabin Management Systems

- Cabin Lighting and Control
- Flight Entertainment Systems
- Air Conditioning and Management Systems

Engine Systems and Controls

- Engine and APU Controls
- Starter Generator Systems
- Fuel Management Systems
- Power Conversion and Distribution Systems
- Full Authority Digital Engine Control (FADEC)

RF and Microwave Systems

- Communication Radios
- Airborne Weather Radar
- Satellite Communication Systems
- Air Traffic Control Primary Surveillance Radars

Cabin Management System



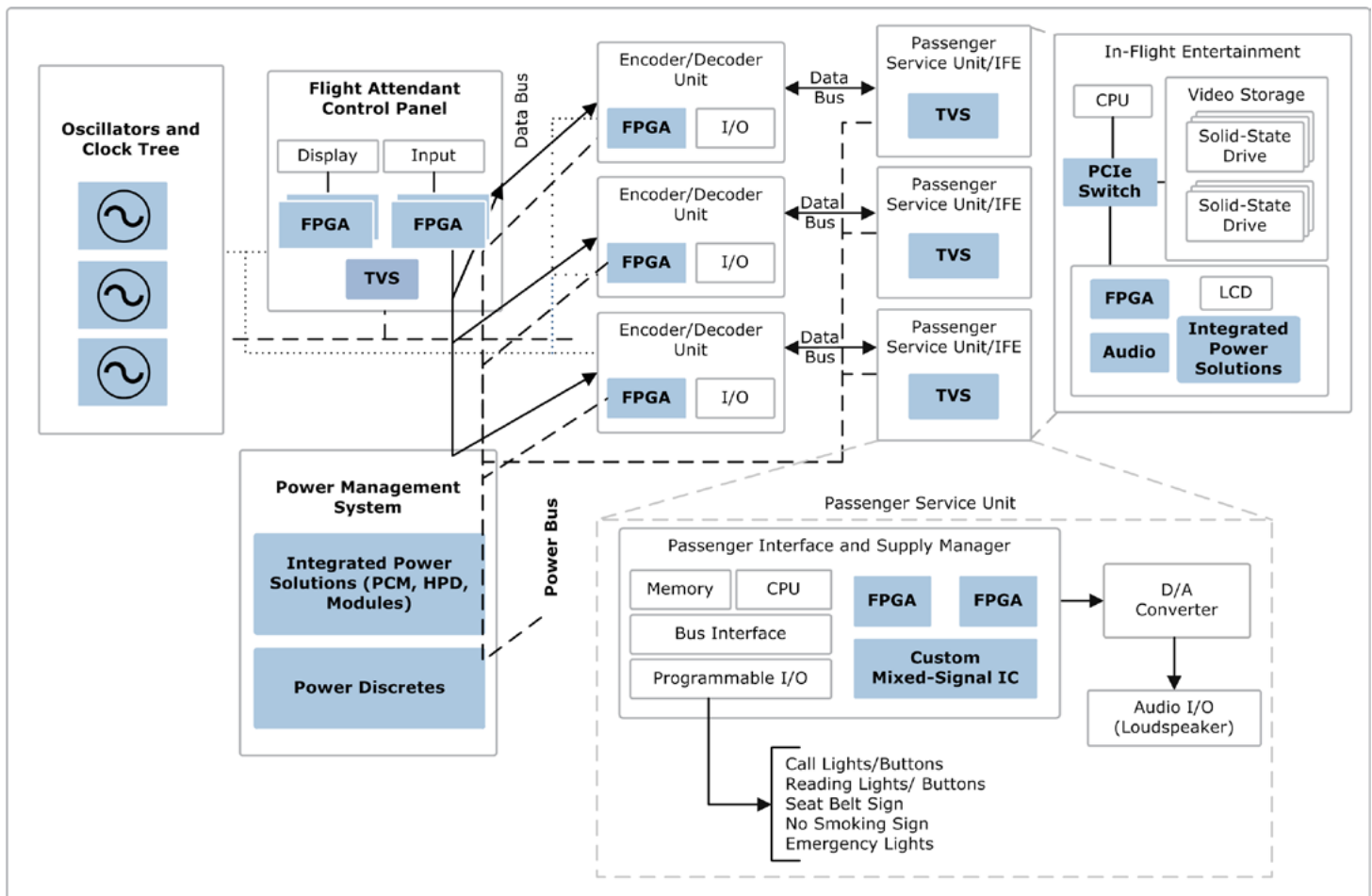
A cabin data management system involves the use of a central control unit to display data and receive input. This system collects and displays status from each passenger service unit relating to emergency lights, seat belt signs, and so on.

This system leverages FPGAs throughout, benefiting from high levels of integration, high reliability, SEU-immune configuration, and I/O expansion.

Cabin data management systems are powered off the 28 V DC avionics bus, which is created through various power architectures using our Si and SiC power MOSFETs, diodes, and integrated power solutions.

Our transient voltage suppressor (TVS) diodes are used to protect these systems from lightning strikes.

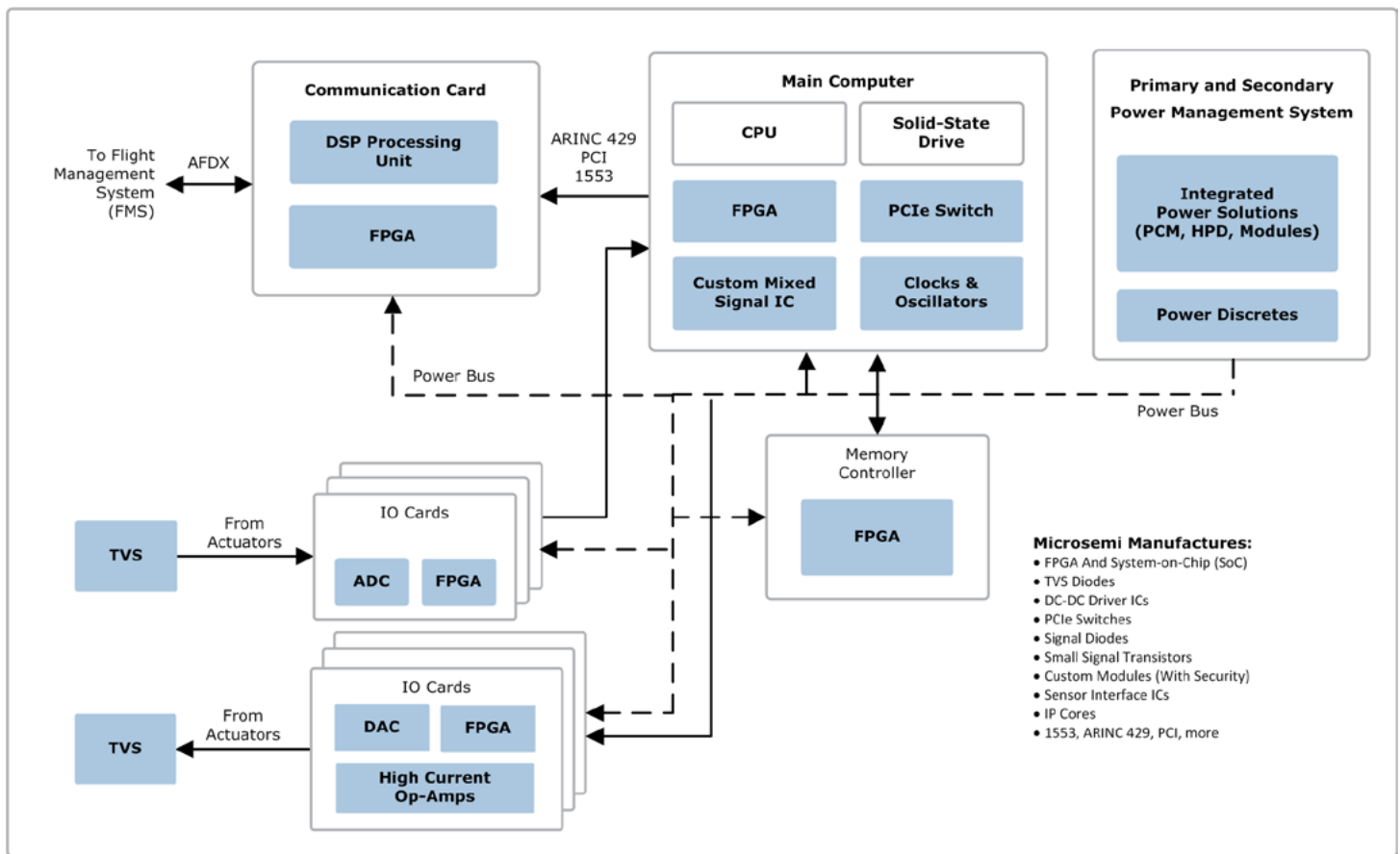
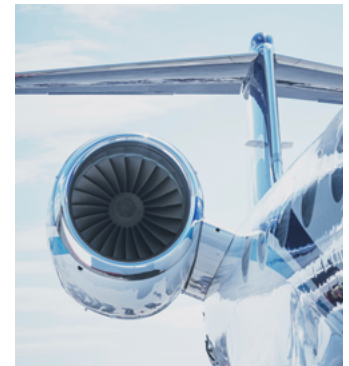
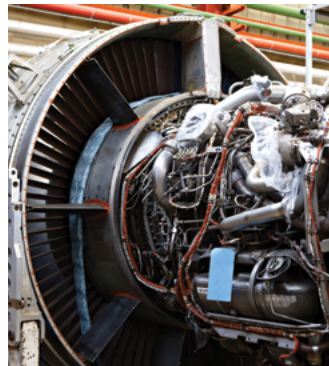
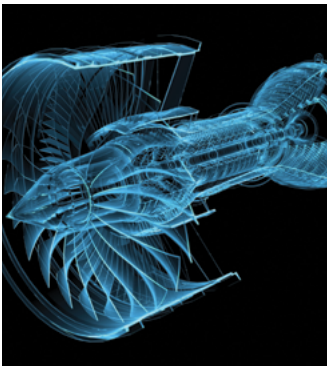
Integrated power Solutions are used in air management systems to optimize size, performance and reliability and offer scalable solutions.



Engine Systems and Control

In a full authority digital engine control (FADEC) system, all engine control unit (ECU) parameters are set by FADEC with no pilot overrides. This is classified as a design assurance level (DAL)-A design: a safety-critical, highly redundant system.

Microsemi's high-reliability products—including FPGAs, TVS, power MOSFETs, diodes, modules, IPS, and ICs—are trusted by many manufacturers and proven in the field for these applications.

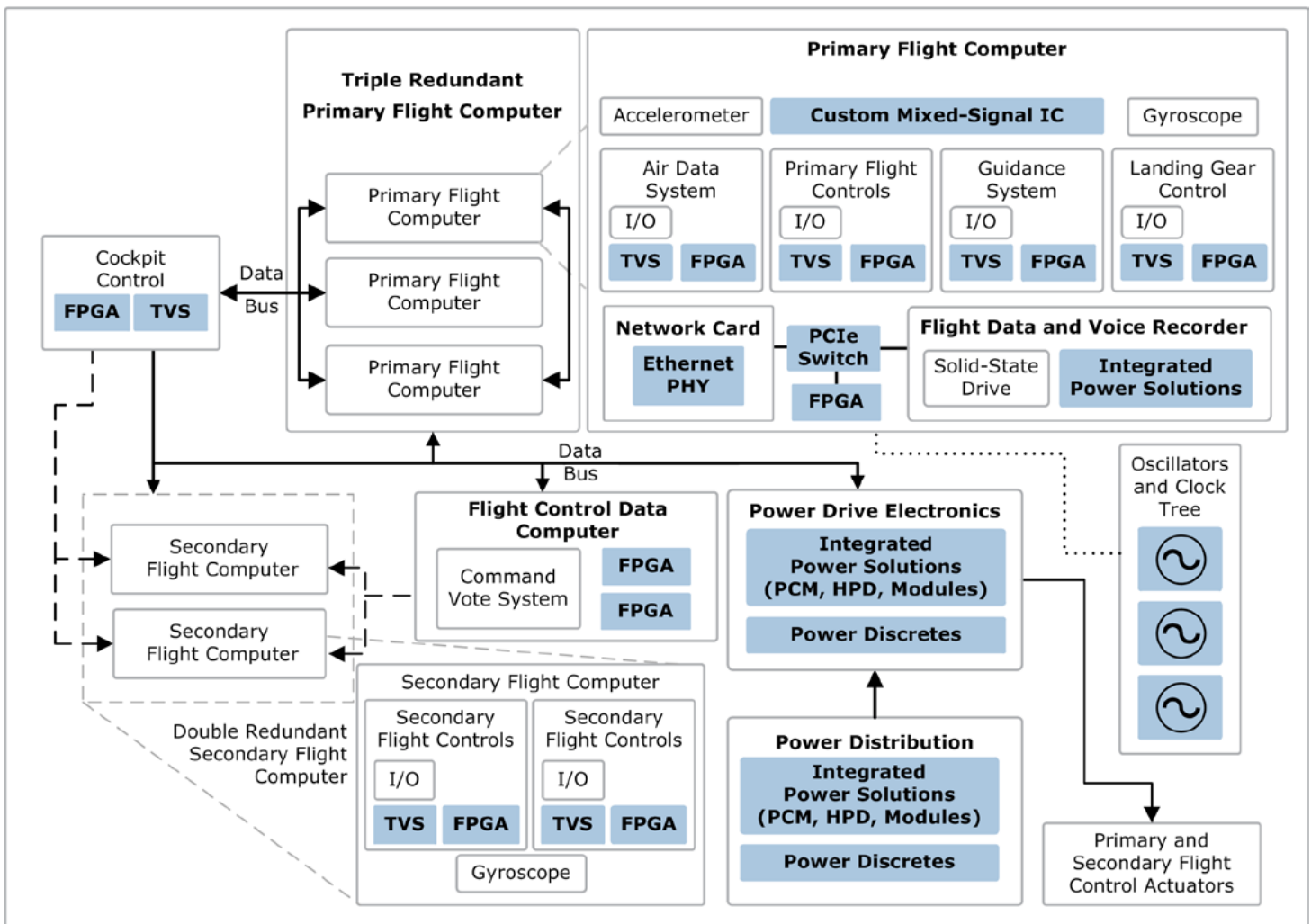


Flight Control System



With the introduction of the Fly-By-Wire (FBW) electronic flight control avionics system for More Electric Aircraft (MEA), the movement of flight controls are converted to electronic signals transmitted by wires and the flight control computers determine how to move the actuators at each control surface to provide the expected response.

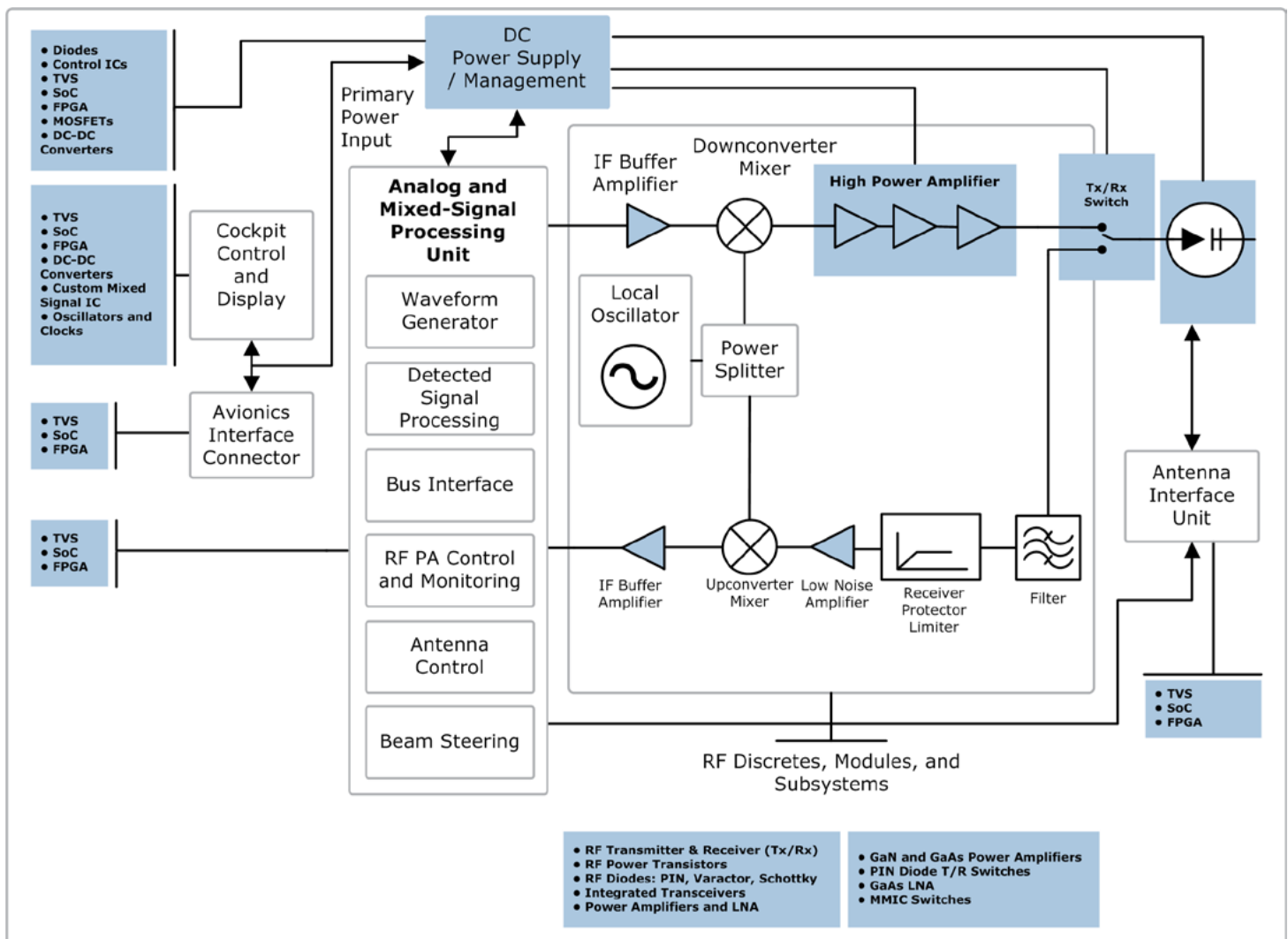
Due to the critical nature of the functions performed, technology is selected based on the highest levels of reliability, including configuration SEU immunity. Redundancy is typically built into the system design, and common failure modes are eliminated by the use of dissimilar technologies. Microsemi has supported these flight-critical electronic flight control avionics applications over many aircraft generations with its innovative FPGA (antifuse and flash), power discretes, modules, and TVS technologies.



Airborne Weather Radar

Today's modern airborne weather radar systems are lightweight, multicolor digital systems designed to provide flight crew with weather location and analysis. The intent is to detect and avoid storms along the flight path of the aircraft. Most modern airborne weather radar systems are X-band systems that radiate anywhere between 18 W and 10 kW of power.

Microsemi's broad portfolio of RF and microwave technology is perfectly positioned to solve complex engineering problems at the discrete, RFIC, MMIC, module, and subsystem levels for these application areas. It is also complemented by a wide variety of FPGA, analog mixed signal, and discrete power technologies for an overall solution.



Aviation Electrical Power Systems

Recent technological advancements in the field of power electronics, fault-tolerant architectures, electro-hydrostatic and electro-mechanical actuators, flight control systems, high-density electric motors, power generation, and conversion systems are expected to drive the adoption of MEA. The key technology drivers for electrical power systems will continue to be lower weight, higher reliability, and improved power quality and thermal

control. Microsemi's growing capability as a solutions provider of integrated power solutions offers the best cost of ownership for our aviation partners, where we integrate our state-of-the-art power, digital, and analog mixed signal technologies to offer highly integrated, high-reliability, flexible, and scalable solutions for different aircraft power system applications.

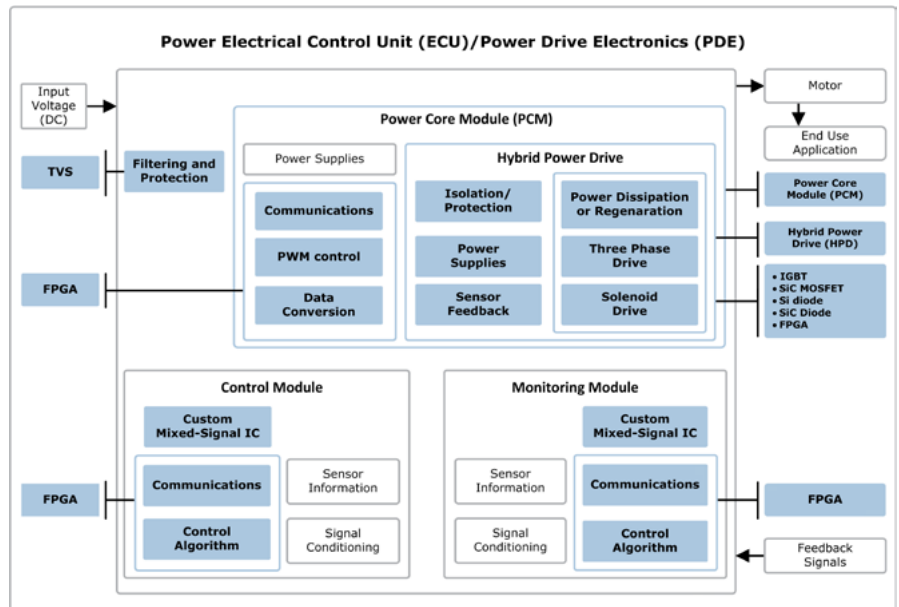
Integrated Power Electrical Control System

Designed Power Ratings:

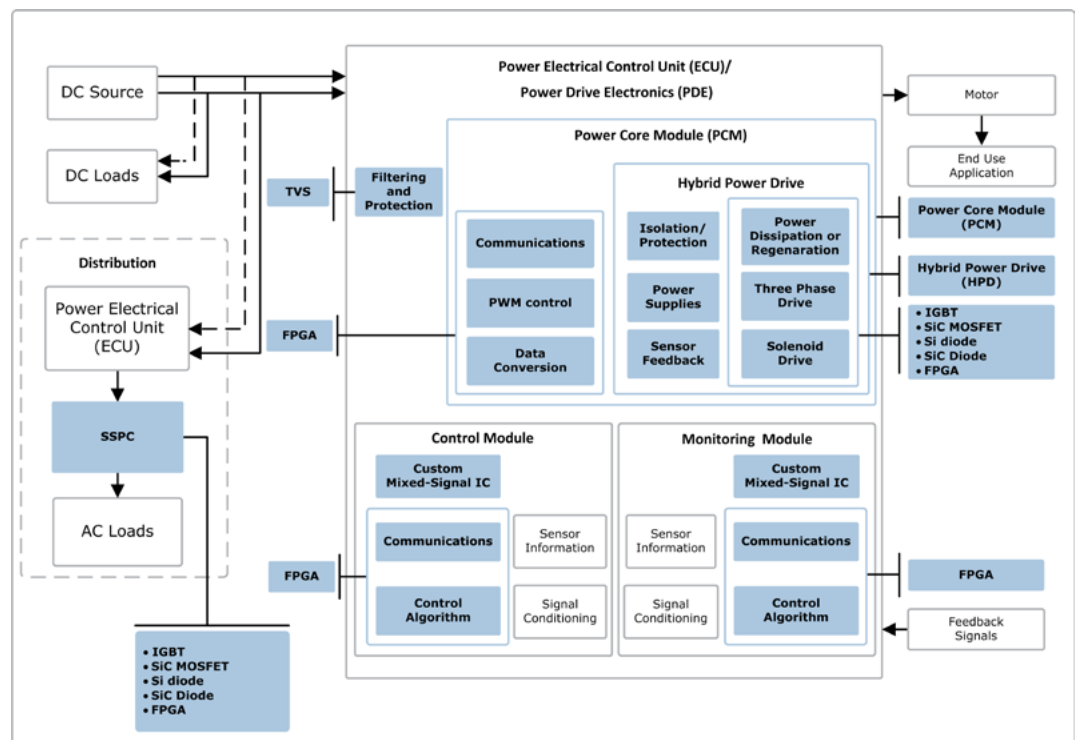
5 KVA–40 KVA (115 VAC–230 VAC
variable frequency, 270 VDC–540 VDC)

Application Areas:

- Primary and secondary flight control actuator systems such as:
 - Flaps and slats
 - Aileron
 - Rudder
 - Elevator
 - Spoiler
- Air management systems
- Fuel pumps
- Electro-hydraulic pumps
- Landing gear and braking systems
- Engine starter



Bi-directional Integrated Power Solution

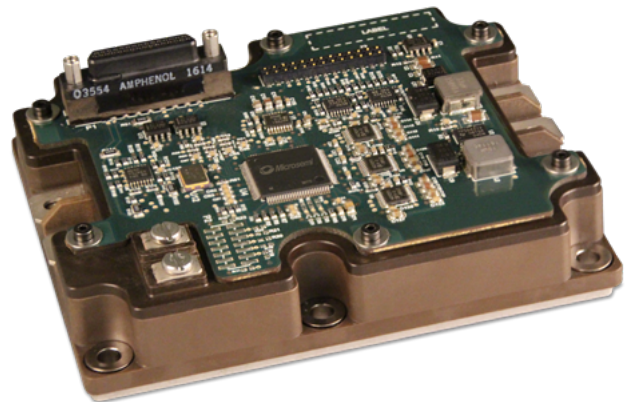


Intelligent Integrated Power Solutions (IPS)

The flagship product for commercial aviation flight control actuation systems applications is the power core module (PCM) targeted specifically at more electric aircraft (MEA). The PCM features the highest and most complex level of integration within the Integrated Power Solutions line of products. The PCM includes an integrated Microsemi flash-based FPGA and Hybrid Power Drive (HPD) stage. The PCM controls the electrical motors used in applications such as primary flight control actuation and landing gear systems. It interfaces seamlessly with the aircraft power supplies and flight computers through a telemetry interface, providing vital sensor feedback for health monitoring. Customization options are available to ensure an optimized product offering. The HPD includes a power stage, integrated gate and solenoid drive, and power supplies. The HPD also available as a stand-alone product.

Key Features of the HPD and PCM

- Fully engineered solution with a high level of integration
- Design optimized for size, weight, cost, and functionality
- Excellent performance, efficiency, and reliability
- Customized options available, leveraging standard building blocks, and reducing development time and cost
- High power density options with power ratings starting at 5 kVA designed for both 270 VDC and 540 VDC buses
- Extensive modeling, simulation, and analysis support
- Documentation package with qualification and reliability data
- Long-term reliability program in place



High-Reliability Power Modules

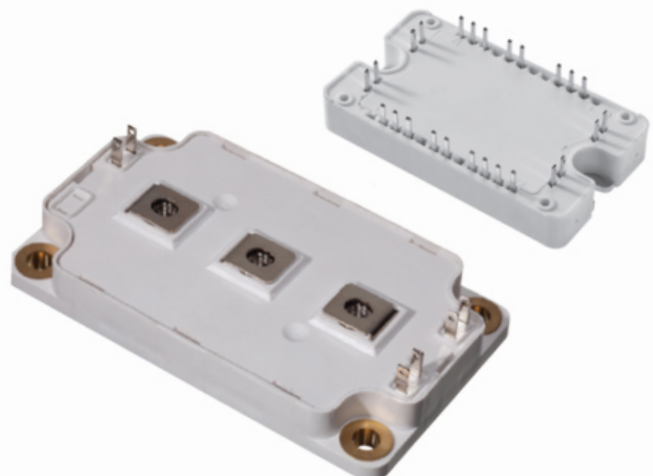
Microsemi is an industry leader in power module solutions for aviation applications. Microsemi's rugged power modules support many different power topologies, giving customers a high level of flexibility at a greater power density over discrete solutions.

For more than 20 years, the company's rugged power module solutions have been designed into key aviation applications including actuation, air conditioning, supplemental cooling, power generation, power control units, transformers, and active rectification systems. With over 15 million cumulative flight hours on commercial aviation power systems, Microsemi has evolved its technology to provide its customers with consistent, reliable performance.

The portfolio features a wide range of hermetic and non-hermetic power switching module solutions for aircraft systems. We continue to evolve our product and capability roadmap to increase functionality, reduce weight and size, and improve reliability.

Key Features

- Broad portfolio of semiconductor technologies including SiC MOSFETs, IGBTs, and Si MOSFETs
- Wide operating temperatures (-60 °C to 200 °C)
- Superior thermal performance
- Custom solutions and topologies to better meet application performances
- Mix of semiconductor and assembly technologies
- Low weight assembly materials with temperature expansion matching



Power Switching Discretes

Microsemi is a pioneer in creating power switching devices and has been doing so since 1960. These devices form the foundation of power conversion, generation, and electrical motor control for commercial aviation applications.

Microsemi's current offering includes rectifier diodes, IGBTs, power MOSFETs, and BJTs. A vast majority of Microsemi's discrete portfolio is qualified to MIL-PRF-19500. These QPL devices come in JAN, JANTX, JANTXV, and JANS qualification levels. Many devices are available with our M-flow screening option. This special flow has been designed to reduce cost but maintain a higher level of reliability over COTs solutions.

SiC Key Features

- Designed for ruggedness:
 - Highest UIS, repetitive UIS and short circuit withstand rating
 - AEC-Q101 qualification in progress on Next-Generation device
- Low RDS(on) variation over temperature
- Extended temperature range: T_j up to 175 °C
- Lowest gate resistance
- Best-in- Class SiC 700 V, 1200 V, 1700 V MOSFETs and diodes. 3.3 kV in development

Microsemi is also investing in the development of a wide range of wide bandgap silicon carbide (SiC) discrete semiconductors including SiC Schottky diodes and MOSFETs for more electric aircraft (MEA) applications. SiC technology will improve the overall system efficiency, enabling MEA goals: optimize aircraft performance, decrease operating and maintenance costs, increase dispatch reliability, and reduce gas emissions. Microsemi devices are fully AEC-Q101 qualified and will offer the industry's best UIS rating, ensuring maximum ruggedness of the technology.



FPGAs and SoCs

Microsemi supplies innovative FPGAs based on antifuse and flash technologies, and also offers high-performance intellectual property (IP) cores, software development tools, and design services that are optimized for the high-reliability commercial aviation market. Our FPGA families have a 20-plus-year heritage of proven performance across product deployments in hundreds of commercial aviation systems on Airbus, Boeing, and other aircraft.

These devices perform critical functions in design assurance level (DAL) A and B applications such as flight computers, braking systems, cockpit displays, engine controls, actuator systems, safety warning systems, cabin management, and more.

Key Features

- Best-in-class integration, power, reliability, and security
- Extended temperature range (-55 °C to 135 °C)
- Extensive flight heritage
- SEU immunity of configuration cells on both flash and antifuse-based devices
- Dissimilar technologies (antifuse and flash) to meet system redundancy needs
- More than 20 years of continuous product supply
- Motor control IP and development platform
- Up to 500K logic elements (LEs)
- Transceiver performance up to 12.7 Gbps
- IP support for ARINC 429 and MIL-STD-1553 standards
- Validation artifacts to assist with DO-254 certification



Analog Mixed Signal ICs

Microsemi has an established history of providing standard and custom high-reliability ICs to the aviation market. Our access to several process technologies and expertise in application-specific, highly integrated circuit design has enabled us to offer leading solutions for embedded aviation systems.

Our high-temperature SiC transistor driver supports galvanic isolation and overcurrent or saturation detection applications.

Key Features

- Best-in-class functional integration
- Significant space saving benefits
- Extended temperature range to 225 °C
- Single event immunity
- Standard and full custom capability
- Extensive flight heritage
- Innovative custom packaging
- Telemetry and motor control capability

Our integrated circuit technology has been designed into multiple aviation applications including:

- LVDT controllers
- Navigation gyro controllers
- Solid-state circuit breakers
- ARINC 429 TX/RX/ID systems



Crystal Oscillators and Surface Acoustic Wave Filters

Microsemi is a global leader in designing and manufacturing a comprehensive portfolio of timing solutions including rubidium oscillators, crystals, crystal oscillators (XO, VCXO, TCXO, OCXO, EMXO, VCSO), crystal filters, surface acoustic wave (SAW) filters, and oscillator-based modules for commercial aviation. We work closely with our customers to understand the application to develop the optimum solution that meets your requirements.

Aviation applications present a unique set of challenges for frequency control products. Rapid and constant variations in temperature, pressure, and humidity degrade the long-term reliability and frequency stability of standard commercial oscillators and saw filters. Vibrations from engines and turbulence affect the survivability and spectral purity of the products. Microsemi offers products specifically engineered to eliminate or minimize the impact of these environmental conditions.

SAW Key Features

- Fully integrated diplexer solutions for dual band (1200 MHz and 1600 MHz) GNSS receivers supporting all major receiver architectures
- Solutions for commercial applications, covering multi-system architectures (GPS, Glonass, Galileo, Beidou) and for single-system (GPS) architectures
- Miniature and hermetic LTCC package 2.0 mm × 1.6 mm² for applications requiring high performance in harsh environments
- High power handling capabilities for professional applications with potential strong interferers
- Low insertion loss
- Low group delay and phase ripple

Crystal Oscillators Key Features

- Solution size as small as 2.0 mm × 1.6 mm × 0.7 mm
- Frequencies supported from 32 kHz to microwave
- -55 °C to 125 °C operating temperatures
- Fast warm-up OCXOs
- Low g-sensitivity products provide immunity to degradation to phase noise and stability due to vibration and acceleration
- Ruggedized, hermetic solutions to withstand shock, vibration, pressure, humidity, and variations in temperature



Transient Voltage Suppression Diodes

An aircraft is hit by lightning approximately once every 1000 flight hours. TVS diodes provide critical protection by going into avalanche breakdown within no more than a few nanoseconds after a strike, clamping the transient voltage, and routing its current to the ground.

Between 2,000 and 5,000 Microsemi TVS diode devices have been deployed (per plane) across all major commercial airframes that are now in use throughout the industry. The company's TVS products are used in various flight-critical applications including flight control systems, multiple engine control units, and actuator controls, as well as a variety of power distribution, environmental control, communications, and instrumentation systems

Key Features

- Wide voltage and power range of both unidirectional and bi-directional TVS devices
- Industry-leading applications support and solutions for DO-160 and special requirements
- Innovative Packaging Technology (PLAD™ and PowerMite™)
- Custom package solutions for higher current, higher voltage solutions
- Low capacitance signal protection for FPGA's, IC's, or ASICs
- Controlled die foundries, assembly, and screening locations
- Extensive electrical test capability and continuous reliability monitoring



RF and Microwave Solutions

Microsemi brings a comprehensive high-reliability product portfolio to air traffic control and commercial aviation applications, and has supplied high-performance RF solutions, microwave and millimeter wave devices, components, and integrated assemblies for more than 30 years.

Microsemi offers microwave and millimeter wave antenna-to-bits solutions with a progressive emphasis on high-performance semiconductor (CMOS, SiGe, GaAs, GaN, and InP) and packaging technologies. This approach allows us to work continuously with industry leaders in the company's target markets to solve complex engineering problems at the discrete, RFIC, MMIC, module, and subsystem levels.

Key Features

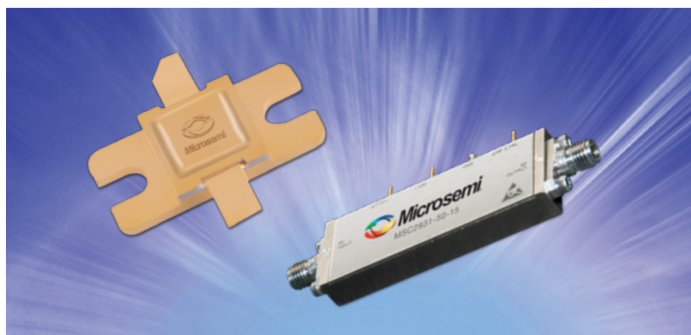
Discretes and MMICs

- Extensive portfolio spanning 10 MHz to 140 GHz frequency range
- Broad range of high-speed, high-power RF and microwave diodes
- GaN-on-SiC HEMT RF power transistors for VHF/UHF/L/S/C-band to 1400 W

- Si BJTs RF power transistors through 3.5 GHz to 1200 W
- Broadband MMICs to 65 GHz

Microwave Modules and Subsystems

- High-power amplifiers to 4 kW
- Low noise, limiting, and low phase noise amplifiers
- Up/Down converters and full transceivers
- RF/microwave, analog, and digital integration
- Packaging, form-factor, and screening to custom specifications



PCIe Switches

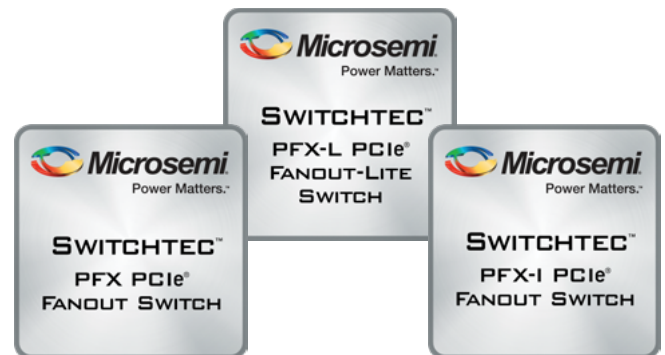
Microsemi Switchtec PCIe Gen3 switches are the industry's highest density, lowest power, high-reliability PCIe Gen3 switches for commercial aviation. To support a higher count of sensors and electronics with the more electric aircraft (MEA) movement, data throughput increases, driving a need for higher bandwidth and high-speed communication peripherals. Gen3 currently supports up to 8 GT/s interconnect performance bandwidth, with a roadmap up to 16 GT/s. Typical storage implementations for in-flight entertainment and video on-demand storage utilize x2, x4, x8, and x16 lane width interconnect configurations from the host root complex directly, or through PCIe switches, to endpoint PCIe storage devices.

Key Features

- Up to 174 GB/s switching capacity
- 96-lane, 80-lane, 64-lane, 48-lane, 32-lane, and 24-lane variants
- Ports bifurcate to x2/x4/x8/x16 lanes
- Up to 48 NTBs assignable to any port
- Logical non-transparent (NT) interconnect allows for larger topologies
- Supports 1+1 and N+1 failover mechanisms
- NT address translation using direct windows and multiple sub-windows per BAR
- Extended Temperature range (-40°C T_A to $+105^{\circ}\text{C}$ T_J)

Error Containment

- Advanced error reporting (AER) on all ports
- Downstream Port Containment (DPC) on all downstream ports
- Poisoned TLP blocking
- Completion timeout synthesis (CTS) to prevent an error state in an upstream host due to incomplete non-posted transactions
- Hot- and surprise-plug controllers per port
- GPIOs configurable for different cable/connector standards



Ethernet Switches, PHYs, Software, and Power-over-Ethernet

With over 300 million Gigabit Ethernet ports shipped, Microsemi is a global leader in Ethernet switch and physical layer IC technology and IP. As commercial aviation transitioned to Ethernet, Microsemi has been at the forefront of this transition with a growing portfolio of products with advanced features and efficient architectures that result in low power, scalability, and highly reliable performance in the transmission of voice, video, and data.

Key Features

- Faster time to production with complete hardware and software solutions
- Ethernet switch solutions with up to 100 Gbps of bandwidth
- Small package footprint designs
- Industrial temperature range operation
- Complete IEEE 1588-compliant 1 Gbps and 10 Gbps PHYs with nanosecond timestamping while performing AES-256 MACSec
- Solutions with low-alpha mold compound, improving overall SEU immunity
- Power-over-Ethernet PSE and PD ICs for powering entertainment units



Security

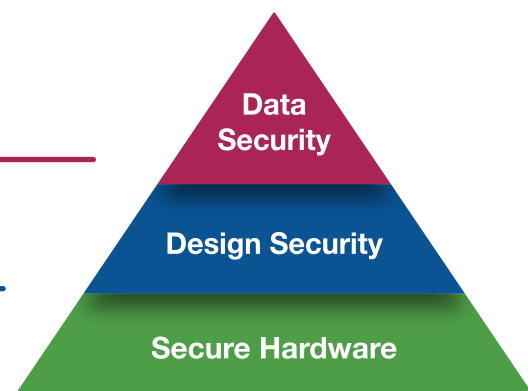
Commercial aviation systems and applications keep pushing towards more electric aircraft (MEA) to improve fuel efficiency, support a higher count of electrical actuators and sensors, and to support higher data throughput for high-speed communications. Increasing the number of electronic components increases the risk of security threats, particularly for programmable electronics, which have control over a large electronic system. Security sensitive and critical applications in commercial aviation include design assurance level (DAL) A and B applications such as the main flight computers, cockpit displays, engine controls, actuator systems, braking systems, safety warning systems, cabin managements system, and more.

Security starts during silicon manufacturing and continues through system deployment and operations. Microsemi's flash-based FPGAs represent the industry's most advanced secure programmable FPGAs.

Our flashed-based FPGA's include key capabilities required to create a trusted and secure hardware platform for a secure embedded system, making them invulnerable to cloning, copying, and reverse engineering. Sensitive data in embedded systems is protected from attacks and uncompromised.

Security Features

- Secure data communications
- Key storage using Physically Unclonable Function (PUF)
- Full design IP protection
- Anti-tamper
- Bitstream authentication
- Licensed patent-protected Differential Power Analysis (DPA) countermeasures
- Security protocols independently certified to be DPA resistant



Microsemi is continually adding new products to its industry-leading portfolio.

For the most recent updates to our product line and for detailed information and specifications, please call, email or visit our website:

Toll-free: 800-713-4113

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www.microsemi.com/applications/commercial-aviation

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