Power Matters.™

Space Power and Point-of-Load Solutions Product Overview

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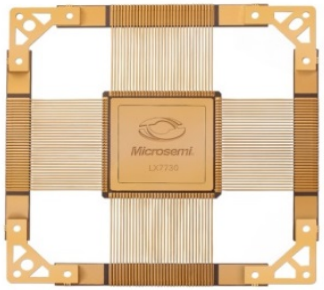
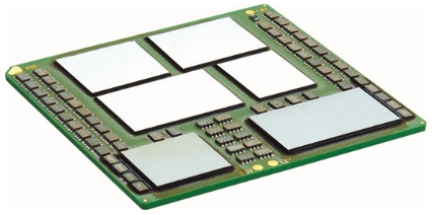
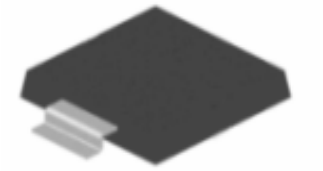
Company Overview

- Leading-Edge Semiconductor Solutions Differentiated by:
  - Performance
  - Reliability
  - Security
  - Power
- Solid Financial Foundation
  - FY2016 Revenue: $1.6B
  - 4800 employees today
- Major Focus Products
  - FPGA and ASIC
  - Timing and OTN
  - Mixed-Signal and RF
  - Switches and PHYS
  - Storage Controllers
  - Discretes and integrated power solutions

Microsemi Space Pedigree







Extensive Space Heritage

- Developing space solutions for six decades
- Proven track record of innovation, quality, and reliability

Broad Solutions Portfolio

- Power, mixed-signal, and digital, for bus and payload applications

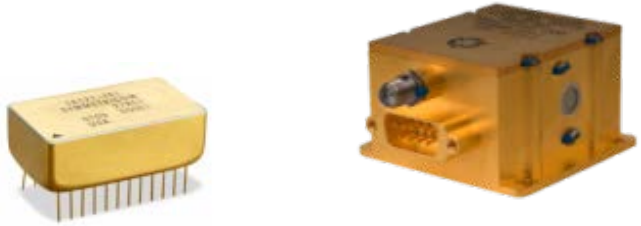
Expanding our Product Portfolio through Continuous Innovation

Partner for the Long Run

- 60 Year space heritage

Delivering Comprehensive Space Portfolio

Radiation-Tolerant FPGAs	High Performance, High Density, Low Power TID up to 300 Krad, SEL Immune RTG4 FPGAs up to 300 MHz and 150K LE RTProASIC3, RTAX and RTSX-SU QML Qualified
Rad-Hard Mixed Signal Integrated Circuits	Telemetry and Motor Control Space System Managers High Side Drivers Regulators and PWMs Extensive Custom IC Capability
Space Qualified Oscillators	Ovenized Quartz Oscillators Hybrid Voltage Controlled and Temperature Compensated Crystal Oscillators Cesium Clocks
Rad-Hard Power Solutions	Rad-hard JANS Diodes, Bi-Polar Small Signal Transistors, and MOSFETs Rad-hard Isolated DC-DC Converter Modules Custom Power Supplies 2 W to > 5 KW Linear and POL Hybrids Electromechanical Relays

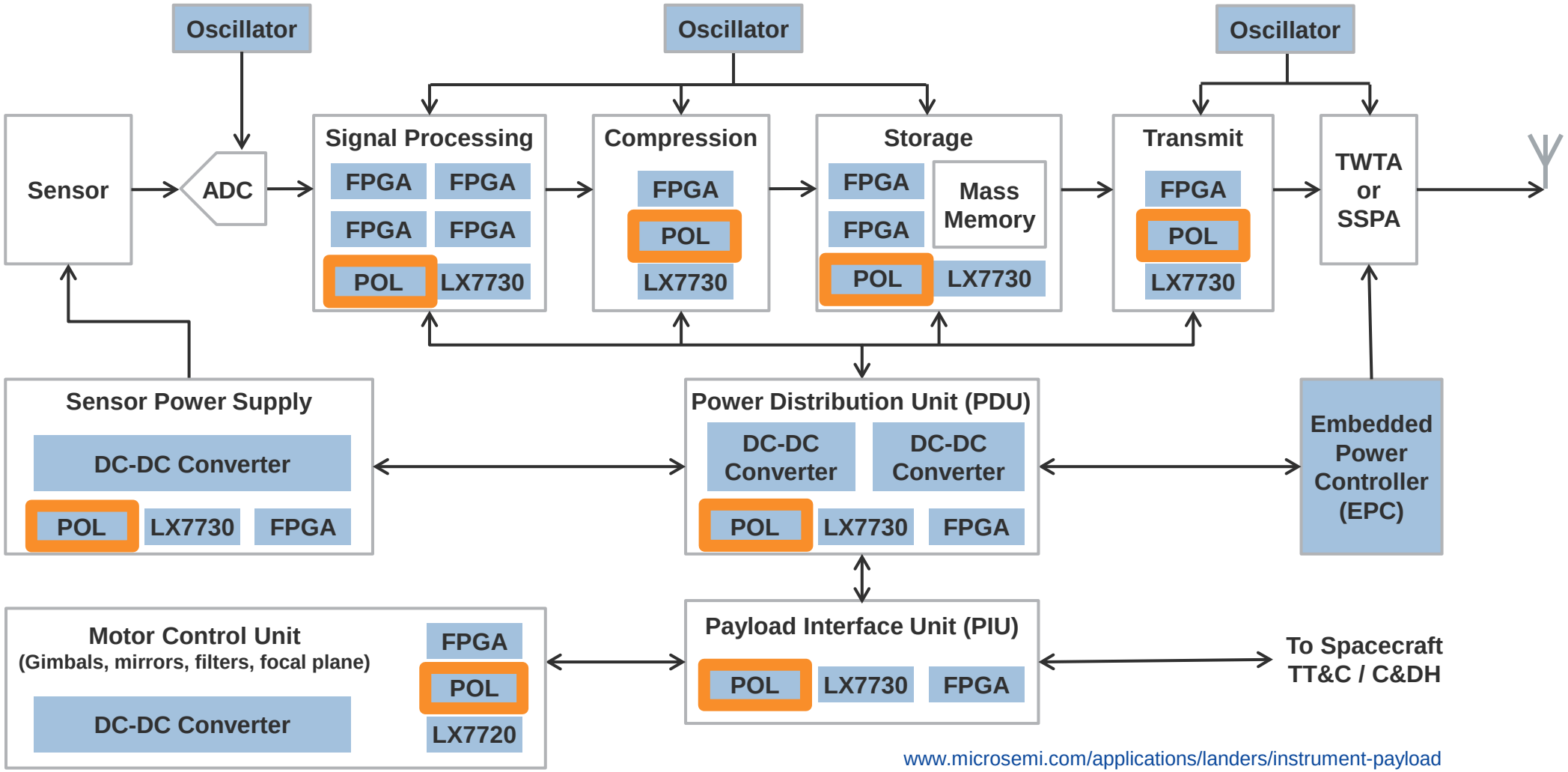


Agenda

- Power Products Overview
- Non-isolated point-of-load and hybrid capabilities
- Isolated bus convertors for satellite bus power rails
- What's next for SWAP (Size Weight and Power) improvements?
  - Point-of-Load Hybrids
  - Point of Module

Portfolio Breadth: Example Signal Processing Payload

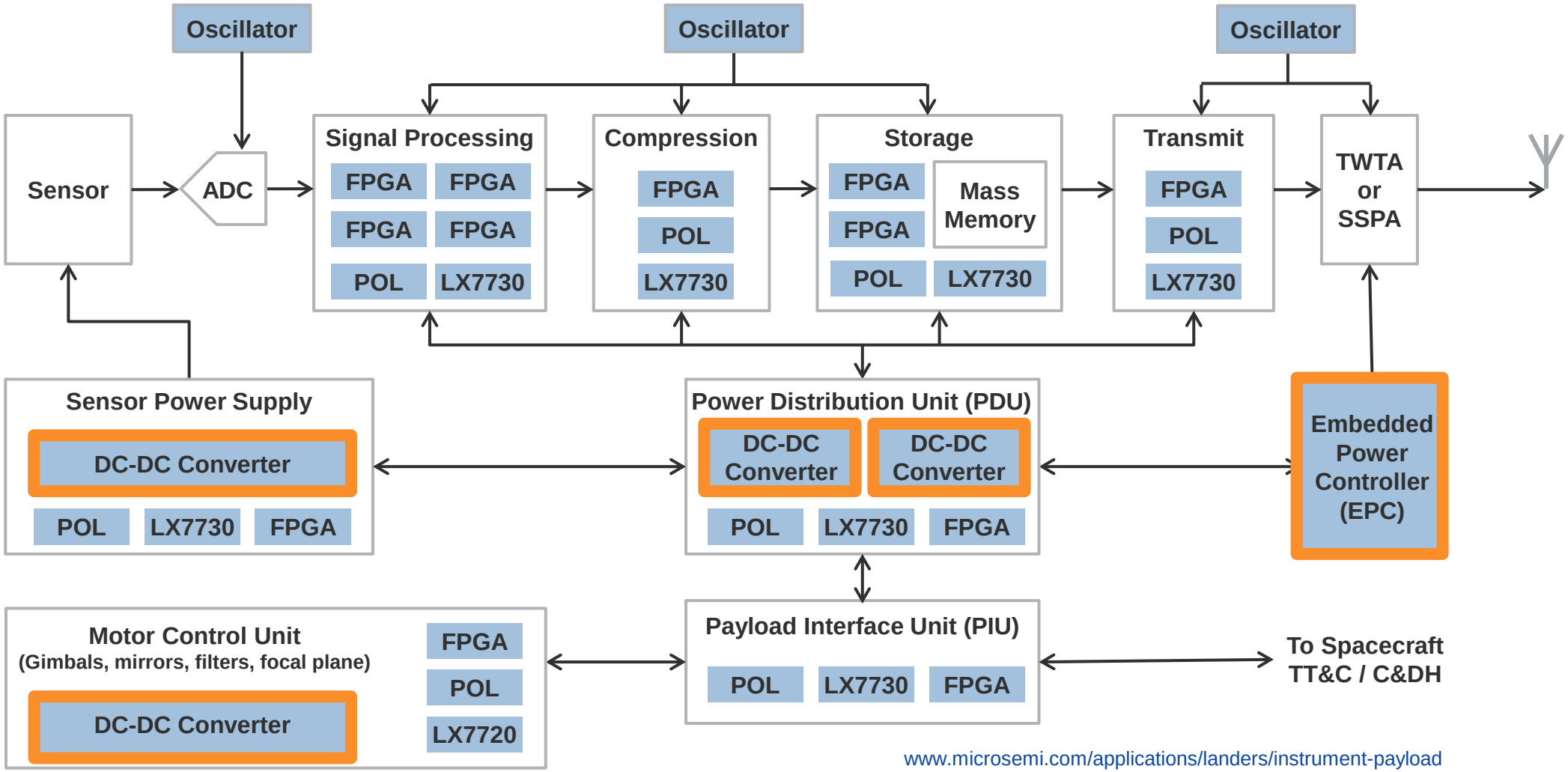
- LDO Regulators and Switchers



www.microsemi.com/applications/landers/instrument-payload

Portfolio Breadth: Example Signal Processing Payload

- Integrated Power Solutions and Discretes



www.microsemi.com/applications/landers/instrument-payload

Space Executive Overview

- **60 years of flight heritage** on hundreds of space programs

- **Widest discrete product portfolio** of any space component manufacturer
  - **Dominate role** in Defense Logistics Agency (DLA) Qualified Manufacturers List: **>75% of total slash sheets**
  - **First company to have diodes qualified to space level** (JANS qualification) by DLA (formerly DSCC)
  - **Over 95%** of the product portfolio is **EAR99**

- **Over 30 years of space power supply** design expertise with zero in-flight failures

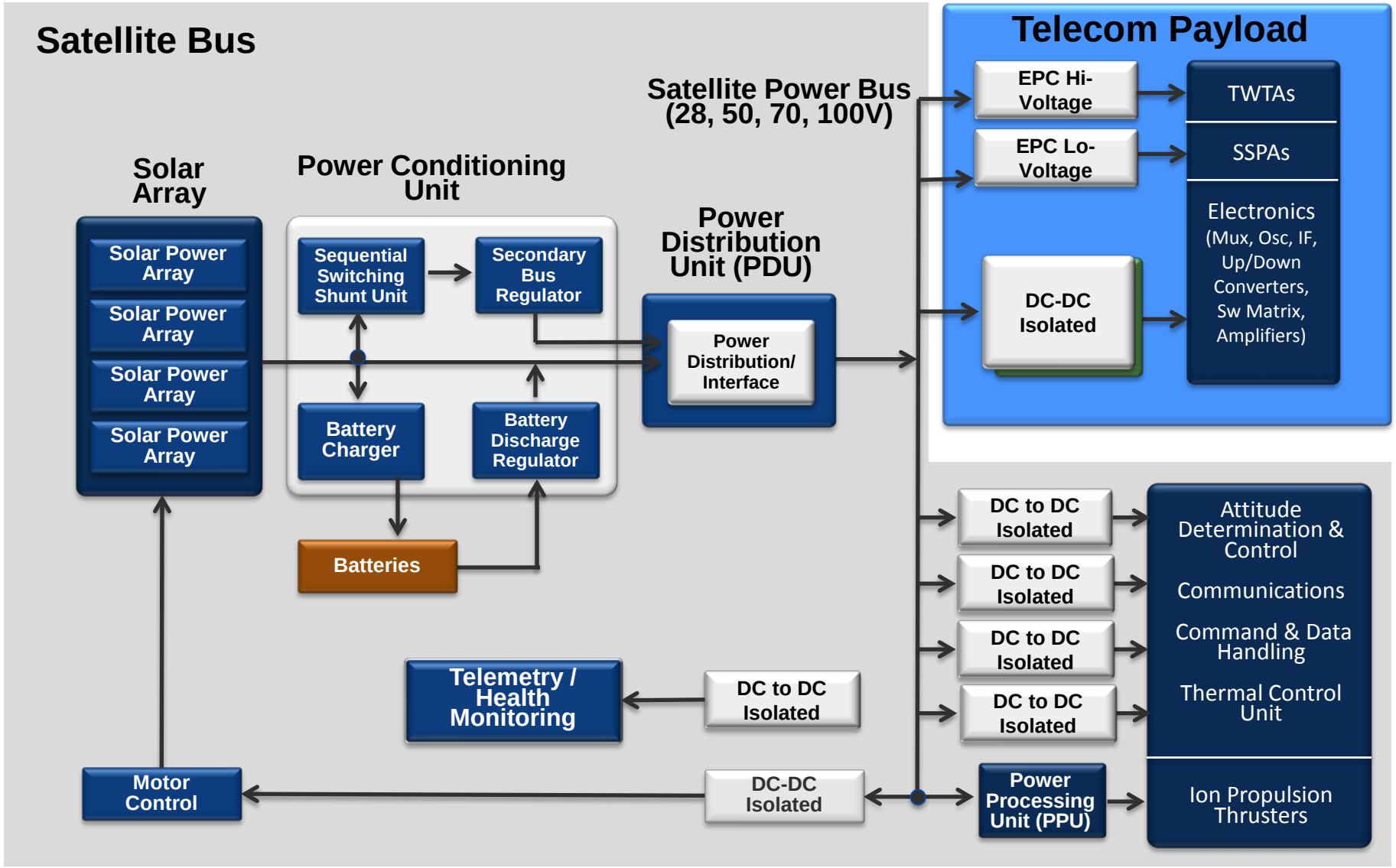
- Internal **packaging and radiation-hardened by design expertise** for discretes and hybrids

- **Comprehensive** High-Reliability Plastic / Non-hermetic Product Portfolio

- **Superior manufacturing and quality** system ideal for **high-reliability** applications
  - AS9100/ISO9001, MIL-PRF-38534, MIL-PRF-19500, LEAN processing

- Continue to be a **market leader in space and radiation-hardened applications**
  - Intense focus on system level solutions to meet our customers' needs today and tomorrow
  - Leverage our breadth of technology and core strengths around packaging, radiation effects and design, quality, and reliability

Satellite Power System (with example payload)



System Architecture Drivers

- Isolated power topologies provide **fault isolation**
- **High voltage** power bus provides significant cost savings through weight reduction
- Long inductance paths between supply and load drive **distributed power topologies**
- Distributed power topologies are often **non-efficient** due to multiple stages
- Point of load solutions take up valuable **real estate** for digital designer
- **Radiation performance** in power supply is critical to avoid single point of failure

Space Power Products

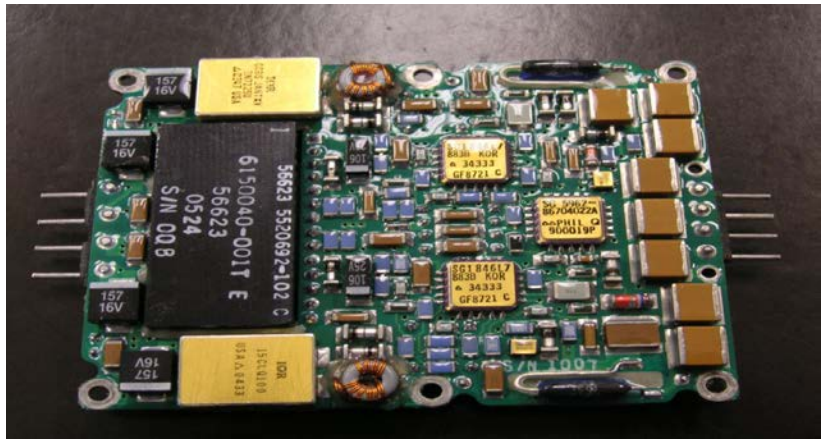
Product Family	Target Application/ Sub-System	Key Differentiation	Key Products
Radiation-Hardened Isolated DC-DC Converters	• Power conditioning unit (PCU) • Electronic Power Convertor (EPC) • Power distribution unit (PDU) • System power bus convertor (DC-DC) • Power Processing Unit (PPU) • Ion propulsion thrusters	• Highest output power and efficiency • Robust SMT construction • Hundreds of successful space missions • Greatest customization flexibility without added schedule risk • Shortest lead times	• SA50 Family - Catalog and semi-custom power solutions w/ EMI filtering • 30+years of flight hours with **0 failures** • Worst-case analysis on hundreds of space programs • Custom Power Solutions
Radiation-Hardened Power Discretes: JANS Diodes, Bi-Polar Transistors, MOSFETs	• Power conditioning unit (PCU) • Electronic Power Convertor (EPC) • Power distribution unit (PDU) • System power bus convertor (DC-DC) • Power Processing Unit (PPU) • Ion propulsion thrusters	• Broadest JANS QPL portfolio • Low Dose Rate guaranteed bipolar transistors • **Largest** glass diode and transistor family in the market • Devices on over **75% of the available slash sheets**	• Small Signal Glass Diodes, Rectifiers, Schottky Diodes • Voltage and Current Regulators • Protection Devices • Bipolar Transistors
Radiation-Hardened Hybrids: Linear and Switching	• Point of Load (POL) • Distributed power supplies in payloads	• **DLA MIL-PRF-38534-certified facility** • Highest level of integration to allow for optimal power footprint near digital circuits • Optimized for distributed power architectures	• MHP8565A (**smallest** radiation-hardened, QML-certified 4 A solution on the market—ideal for LEO orbits)
High-Voltage Electromechanical Relays	• Power conditioning unit (PCU) • Power distribution unit (PDU) • System batteries • Latching relays • High Voltage switching for thrusters	• Vacuum-sealed, ultra-low leakage rates • Broad range of High Voltage 4 kV–10 kV • Highest reliability • Extensive heritage in space	• Several hundred relays are used per satellite in various applications • New investments being made in new high voltage

PBA Surface Mount vs. Hybrid Technology

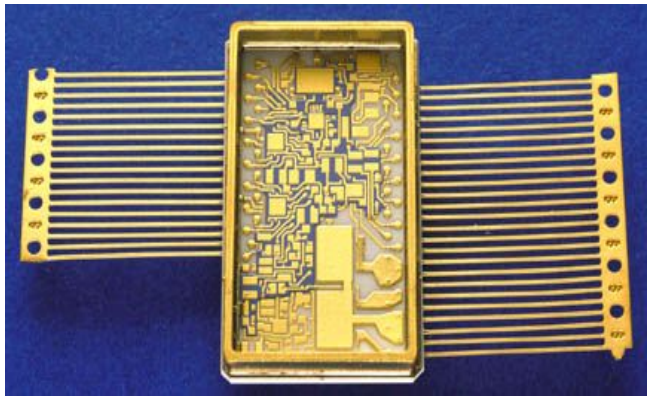
- SMT vs. Hybrid Processing Capabilities Present Tradeoffs

	SMT	HYBRID
Assembly Process	Automated	Manual/Automated
Device Attachment	Solder	Eutectic / Epoxy
Connections	Solder	Wire Bond
Components	Package pre-screened	Basic Die / KGD
Semi-custom	Available	Not Available
Qualification	Same flow down as the rest of the design	MIL-STD-38534

Microsemi has the capability to work to the optimum solution for your application

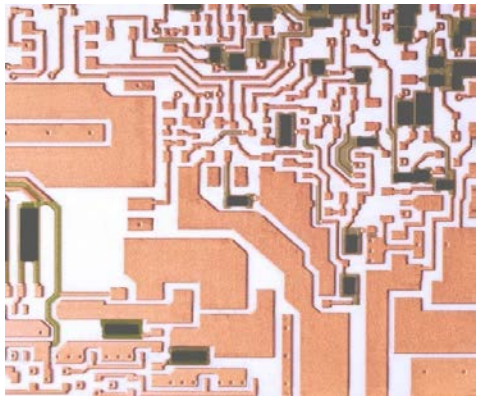


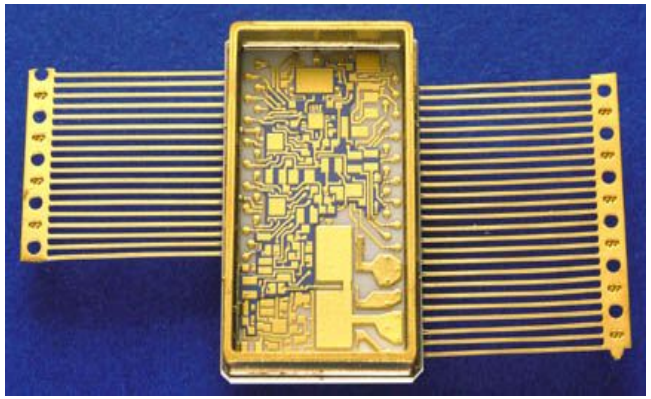
- SMT modules
  - Quick-turn semi-custom capability
  - Full program requirement flow
  - Offset customer resourcing
- Hybrids
  - Optimal size integration
  - Qualified to MIL-STD-38534



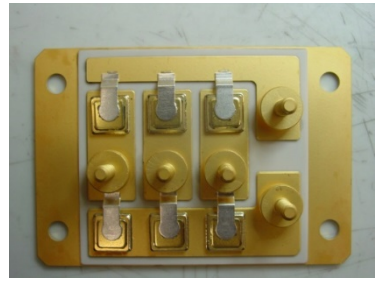
Hybrid Capabilities (Catalog and Custom Design)

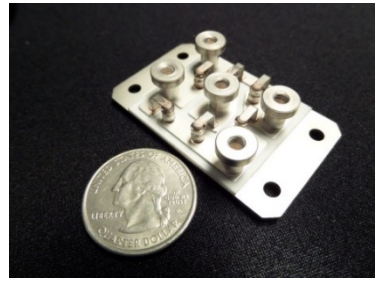
- Supporting Aerospace and Defense Markets
- Quality Certification
  - MIL-PRF-38534 Class H and K certified
- Design Capabilities
  - Electrical design (worst-case analysis)
  - Substrate design and fab (thick film)
  - Mechanical and thermal design
  - Power module capability
- Custom Design or Build to Print
  - Total parts management
  - Hybrid assembly and die attach
  - Au and Al gold wire bonding
  - High-temperature assembly
  - Hermetic and non-hermetic package assembly
  - Internal electrical and radiation test
  - Vibration or shock testing available





- Example Custom Products
  - Custom analog and digital devices
  - D/A and A/D converter modules
  - Op-Amp modules
  - Power supplies and drivers
  - Differential amplifiers
  - Resistor ladders
  - Analog switch modules
  - Wide-band amplifier modules
  - Custom rectifier modules





MHP85xx Family

Radiation-Hardened Point-of-Load Hybrids—Optimized for LEO

Family Features

- Current mode control
- Enable input pin for power sequencing
- Designed for –55 ° C to 125 ° C operation
- Peak efficiencies over 87%
- Worst-case accuracy less than 5%
- Simple external soft start circuit
- Nominal 500 kHz switching frequency (583 kHz for MHP8566)
- TID >100 krad(Si) for HDR and LDR
- SEL, SEB, SEGR, and SEFI immune up to 85.5 MeV
- SEU (SET) immune in LEO orbit (up to 58 MeV)

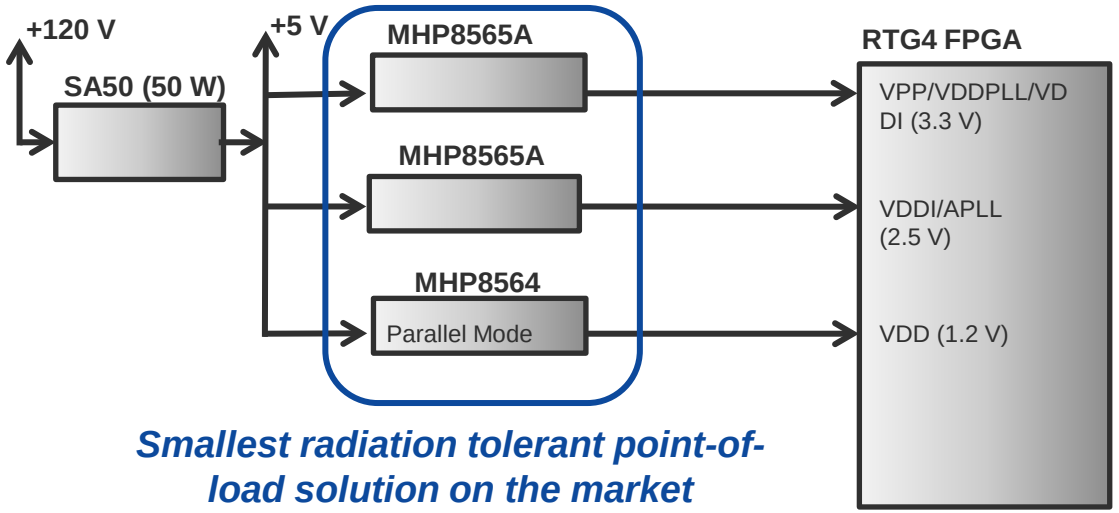
Benefits

- **Built-in DLA certified MIL-PRF-38534 facilities (Class H and K)**
- Radiation hardness assurance (RHA) approved through DLA
- Several Vin and output current options available based on similar design to minimize component changes
- Optimal solution size through integrated hermetic hybrid design
- TID testing follows MIL-STD-883, Method 1019.6
- High-input Vin allows for operation with sufficient de-rating margin
- SMD already approved on base MHP8565 design

Device Specific Features

- MHP8564 (SMD In Process)
  - Vin = +4.5 V to +12 V (input cap rated for +25 V)
  - Iout = 4 A (parallelable to double output current and reduce ripple)
  - Vout = +1.21 V to +4.5V through external set resistor or fixed out
  - External sync pin and remote voltage sense option
  - Ultra small 16-pin flat pack package
- MHP8565A (5962R13236)
  - Vin = +4.5 V to +12 V (input cap rated for +16 V)
  - Iout = 3 A
  - Vout = +1.21 V to +4.5 V through external set resistor
  - Ultra small 5-pin MO-078 package

Point-of-Load Solution



Smallest radiation tolerant point-of-load solution on the market

Power Supply Flight Heritage

- 50+ successful programs
- 30+ years experience
  - No in flight failures
- End to end support
  - Design
  - Analysis
  - Qualification
  - Production
- In house production
  - ISO9000 & AS9100C Certified

SA50 Series Isolated DC-DC Features – EAR99

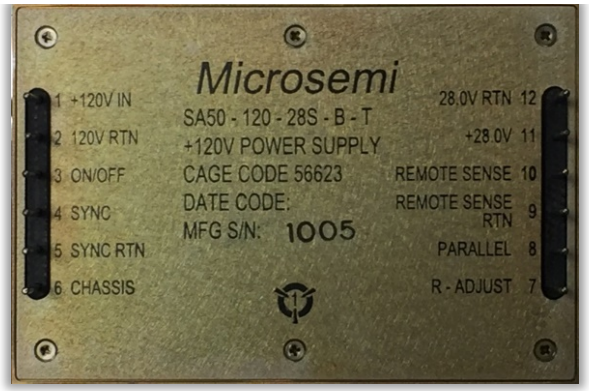
Features

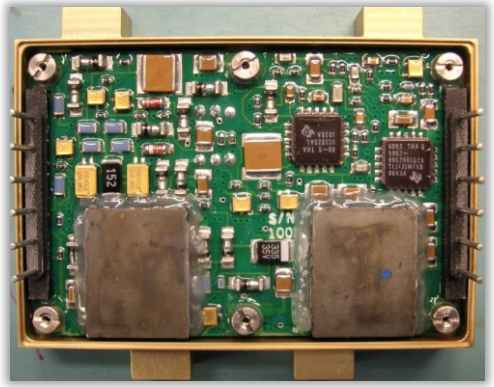
- 120 Vin, customizable for 28Vin with internal EMI filter
- Triple, dual, and single output versions (**20+ catalog options**)
- Isolated outputs
- 50 W total combined power output
- Inhibit, remote sense, and remote adjust
- Isolated sync input, 500 kHz
- Less than 1% accuracy over temp and radiation
- **>86% efficient full load at 5 ±15 V output (T version)**
- 3.055” L × 2.055” W × 0.50” H envelope
- Total dose rating of 100 krad(Si) at LDR
- SEE (all effects) >80 MeV-cm2/mg (H version)
- Thermal resistance= 0.041 ° C in^2/W (measured at 55 ° C)
- NASA outgassing compliant: (TML)= 1% max,(CVCM)= 0.1% max

Benefits

- Support for standard satellite bus voltages
- No external EMI filtering needed saving valuable real estate
- Semi-custom solution in half the lead time of a full custom solution
- Patented load sharing techniques to maximize performance
- Optimal output voltage accuracy through internal reference and remote current sense
- Peak efficiency at full load
- Up to 5 modules can be connect in parallel
- Best in class radiation performance and accuracy
- EAR99 Solution

Package





Design Support Available

- Radiation analysis
- Worse case analysis
- Reliability analysis
- FEMA
- First article qualification test report
- EMI test report
- Structural analysis
- Stress analysis
- Thermal analysis

SA50 Series RH Isolated DC-DC Options

Standard Types

SA50-120-12S-B-P
SA50-120-12S-B-T
SA50-120-15S-A-H
SA50-120-15S-A-P
SA50-120-28S-B-H
SA50-120-28S-B-P
SA50-120-28S-B-T
SA50-120-3R3-14T-B-P
SA50-120-3R3-14T-B-TX1
SA50-120-5-12T-A-P
SA50-120-5-12T-A-T
SA50-120-5-15T-A-H
SA50-120-5-15T-A-P
SA50-120-5-15T-A-T
SA50-28-5-15T-A-H
SA50-28-5-15T-A-P
SA50-28-5-15T-A-T

Options

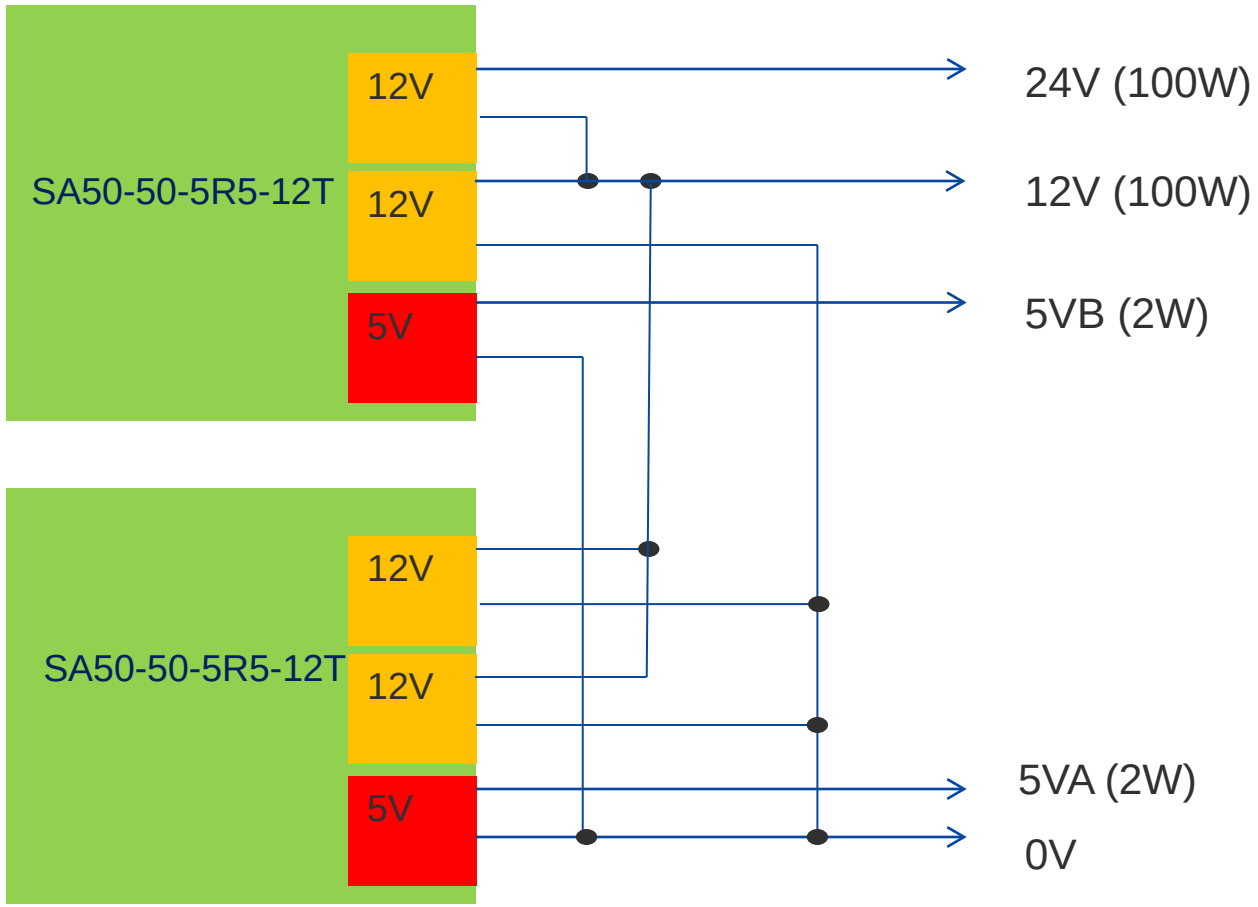
- Input voltages: 28 V, 100 V, and 120 V standard, and others custom (for example, 50 V)
- Single outputs: 3.3 V, 5 V, 12 V, 15 V, and 28 V standard, and others custom
- Dual outputs: Special configurations of triples
- Triple outputs: 3.3 V or 5 V with 12 V or 15 V standard, and others can be available
- Case style: A= leads out the side, B= leads out the top
- Performance level: P= Prototype. T= SEE Tolerant, TID Hard. H= SEE Hard, TID Hard.

For more information, see www.microsemi.com/product-directory/modules-a-hybrids/1450-dc-to-dc-converters.

The following are also available:

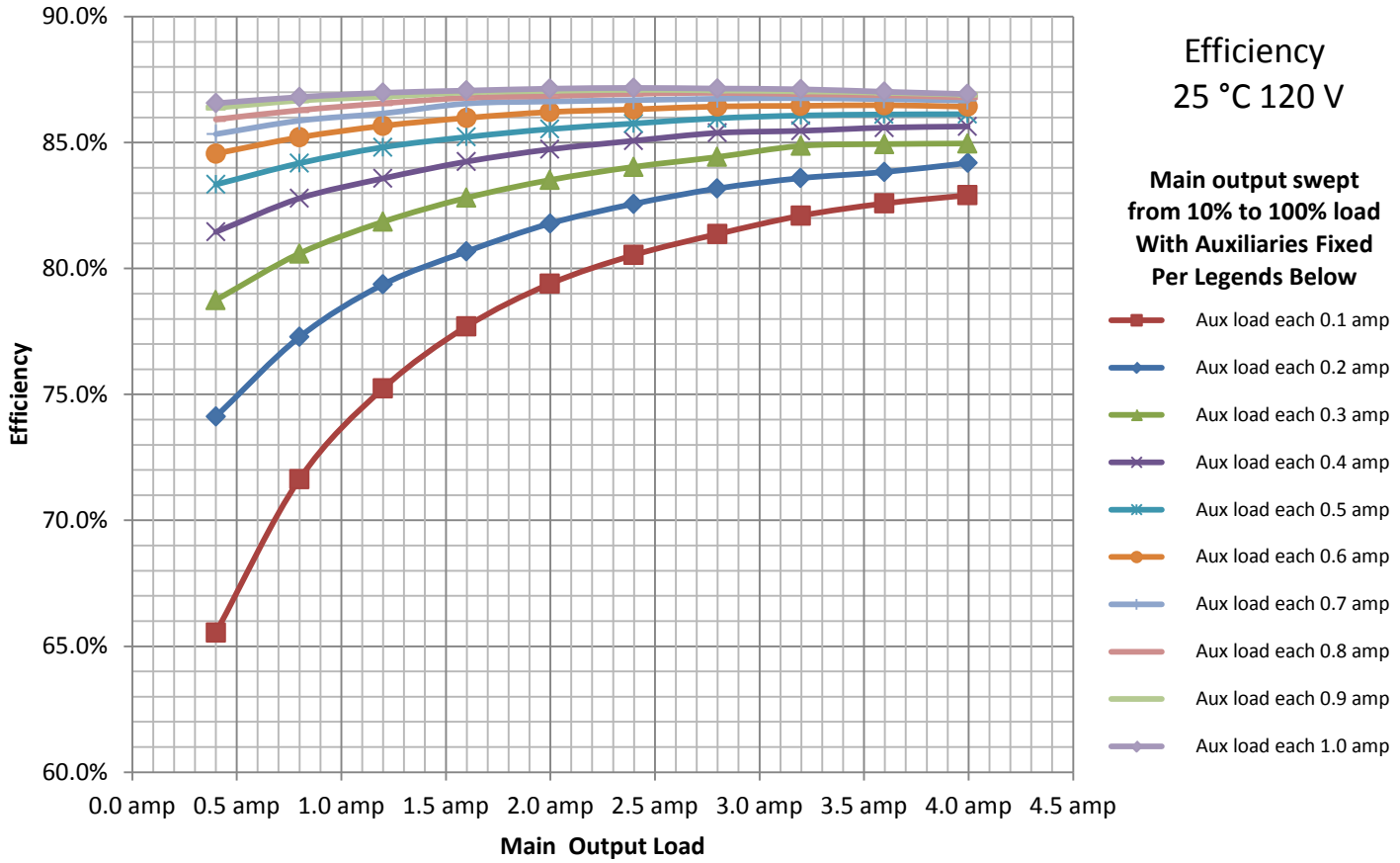
- Semi- and full-customized versions
- Filter solutions (such as SF200-28)

Example Configuration using two modules



- 2 x 5V rails to be loaded by >2W each (preload or system load)
- 3 x 12V rails connected in parallel for up to 100W
- 1 x 24V rail connected in cascade with 12V bus for up to 100W
- Power will *AUTOMATICALLY AND DYNAMICALLY* distribute amongst the various loads due to the inherent cross regulation characteristic of the SA50-50-5R5-12T

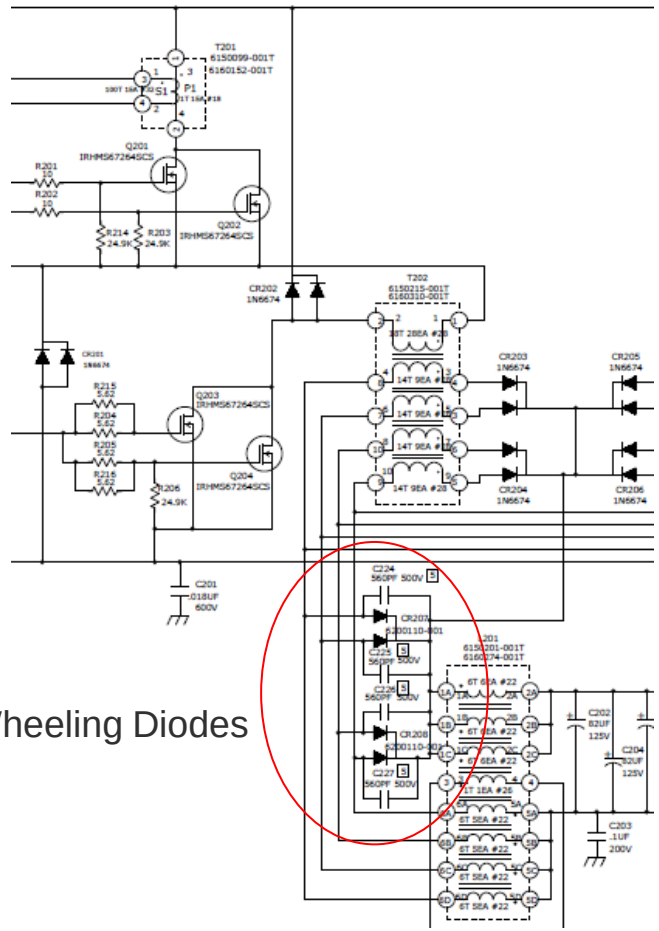
Efficiency Performance, SA50 120 V Triple



At 86-87% efficiency, SA50 sets a high standard for main-bus to regulated-payload sub bus power conversion.

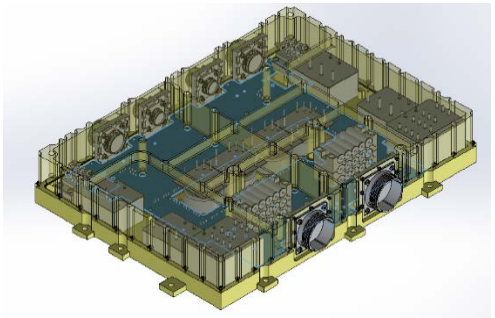
SA50 Architecture Customization with *Microsemi Silicon Carbide (SiC) Diodes*

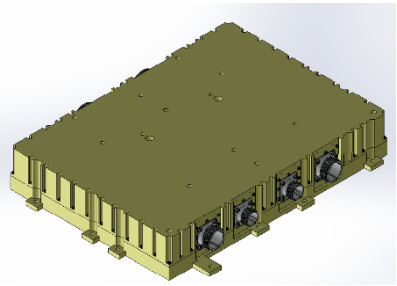
Two Switch Forward Topology



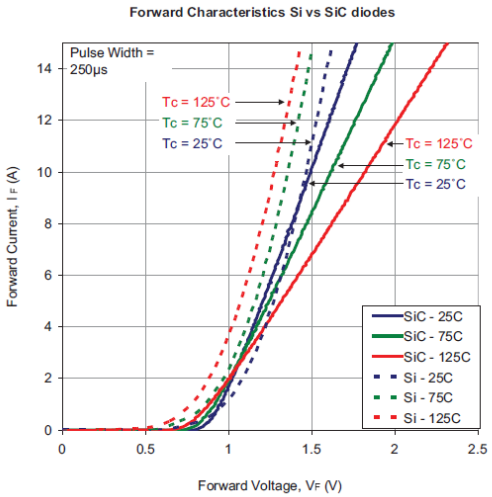
Free Wheeling Diodes

- Problems with freewheeling diodes efficiency prompted substitution of SiC Diodes
  - Promotes high efficiency and reliability
- Multiple secondary's to promote current sharing
  - However not for freewheel current
- IN6674 space qualified silicon diodes for all positions initially

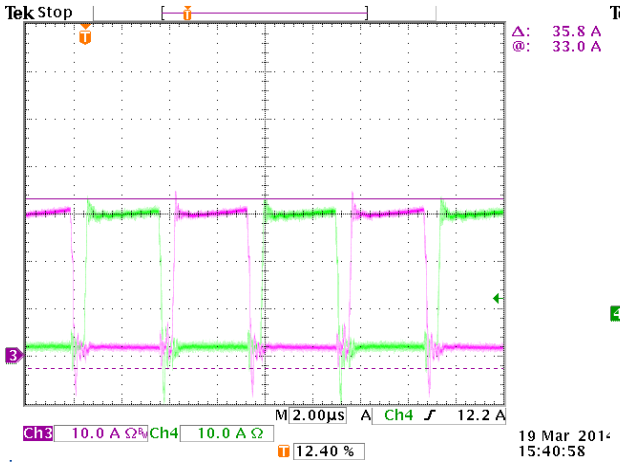




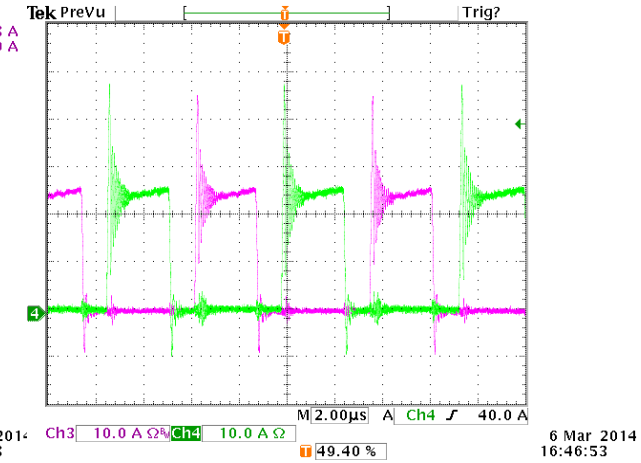
High Power DC-DC Converter benefits from SiC



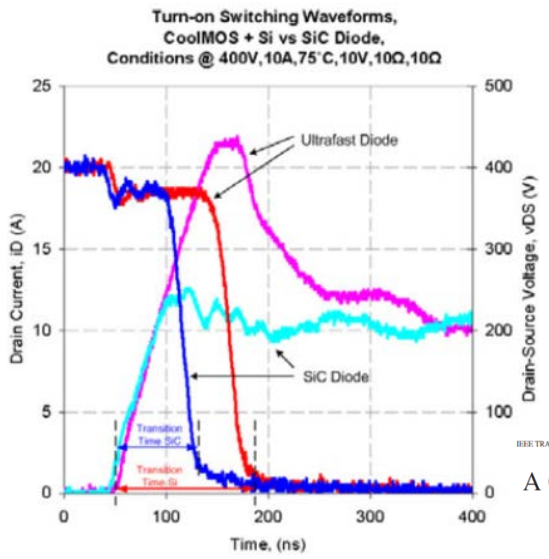
Comparison of Silicon and Silicon Carbide Forward Voltage Drops



Current Driving a Silicon Carbide Free Wheeling Diode



Current Driving a Silicon Free Wheeling Diode



IEEE TRANSACTIONS ON POWER ELECTRONICS, VOL. 28, NO. 1, JANUARY 2013 289

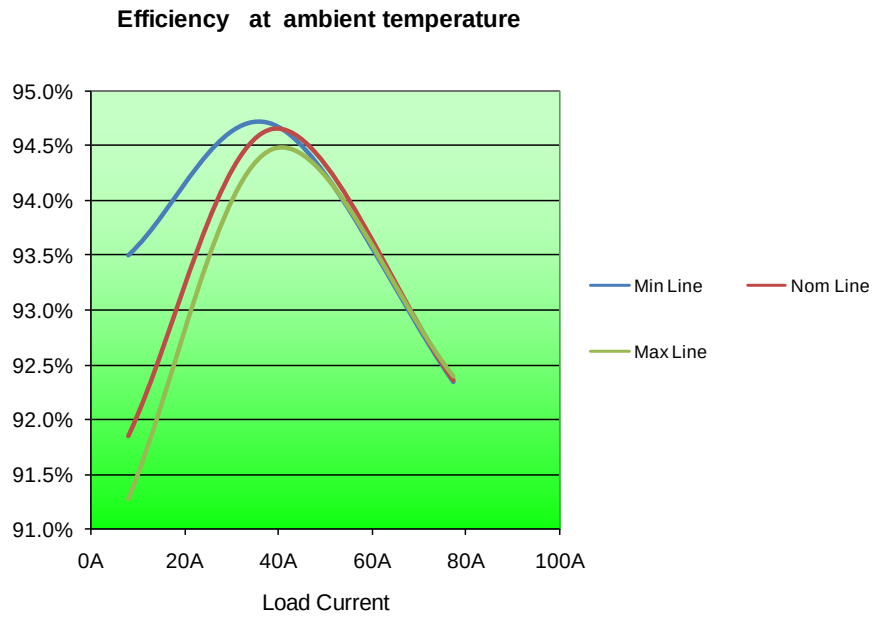
A Comparative Performance Study of an Interleaved Boost Converter Using Commercial Si and SiC Diodes for PV Applications

Carl Ngai-Man Ho, *Senior Member, IEEE*, Hannes Breuninger, *Member, IEEE*, Sami Pettersson, *Member, IEEE*, Gerardo Escobar, *Senior Member, IEEE*, and Francisco Canales, *Member, IEEE*

- Forward voltage drop favors Silicon
- Dominant loss in the topology comes from reverse recovery
- Silicon Carbide a clear winner with close to zero Qrr!!

Microsemi Creates a SiC Space Diode Solution

- Initial proof of concept from a Plastic Package SiC Diode used to verify performance
- Flight Custom solution created
  - SiC Die + High Reliability Screening + Hermetic Package
- Microsemi builds & qualifies a new hermetic SiC diode part in very short order as part of a custom solution



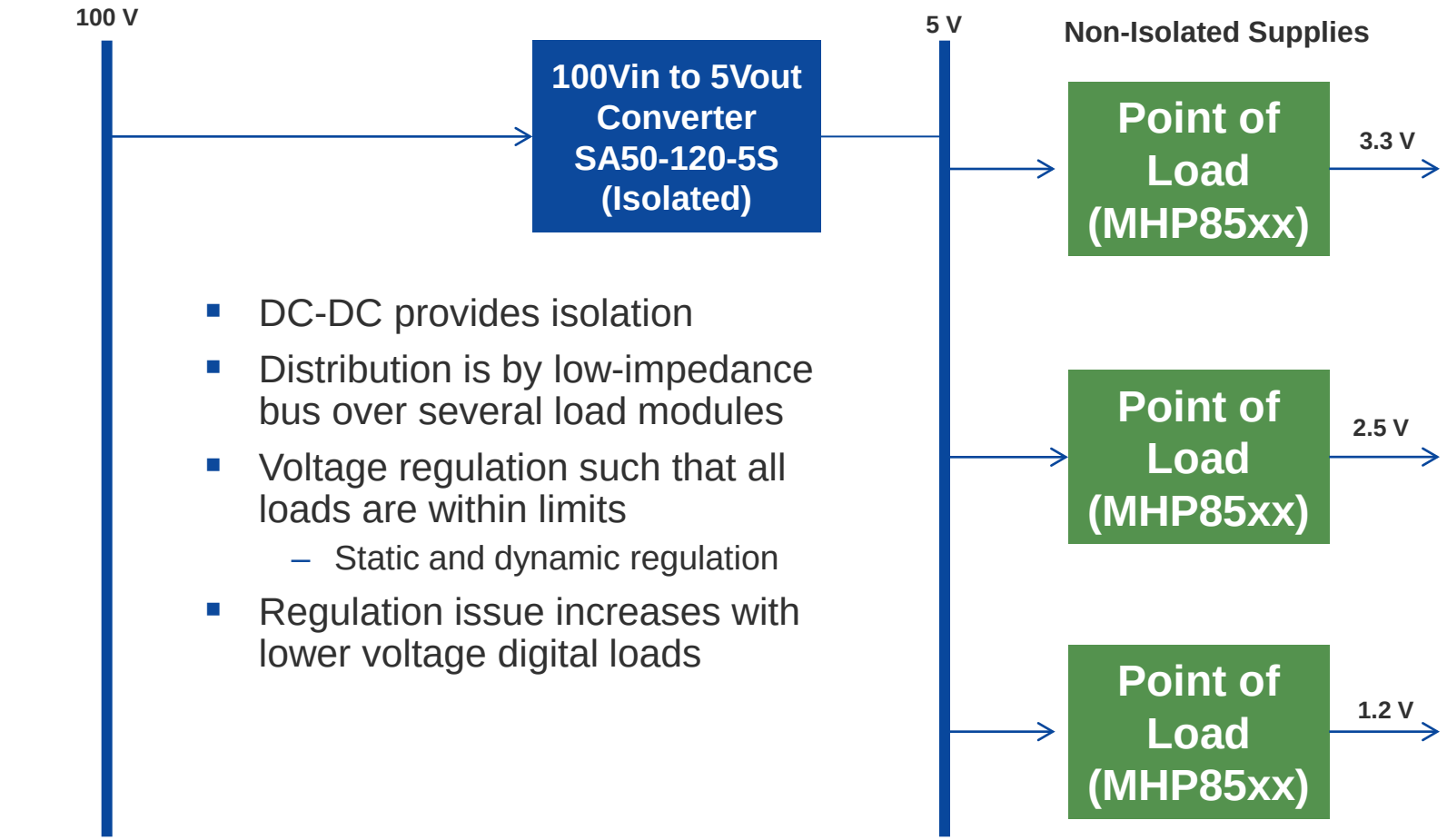
Final efficiency of SiC version meets desired efficiency profile

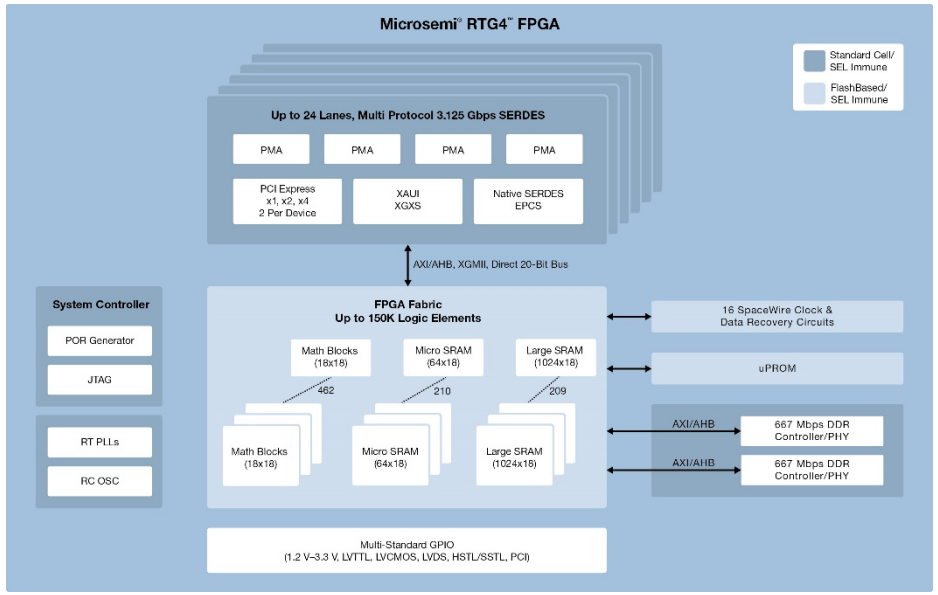
Summary and Conclusion for Custom Solution

- Microsemi has the ability to solve serious technical issues in real time through strong internal team collaboration of expertise
  - Internal capabilities allow for greater potential for program success
- SiC diodes can greatly enhance efficiency of high power space DC-DC converters
- Current generation SiC diodes appear to require a deep derating of Vrr to reliably withstand SEE
  - 650V diode was derated to 250V in this case (38% of rated)
  - Derating ratio does not necessarily apply to other Vrr ratings
- Surge current screening of SiC diodes should carefully account for the positive Vf characteristic and dynamic heating of the SiC die during the pulse

SWAP Improvement Concepts

Traditional Space Power Distribution

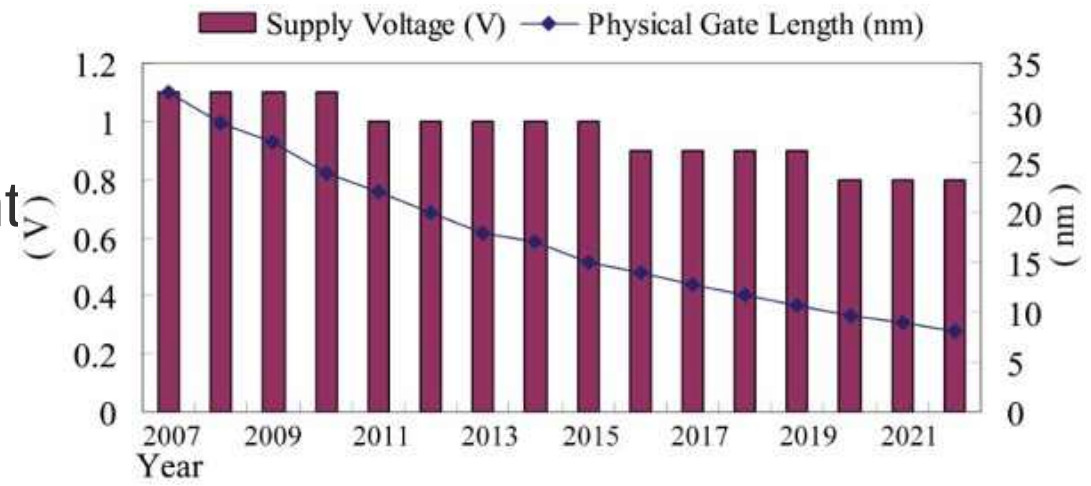




System Efficiency = SA50 (86%) x MHP85xx (84%) = 72%

FPGA Trends

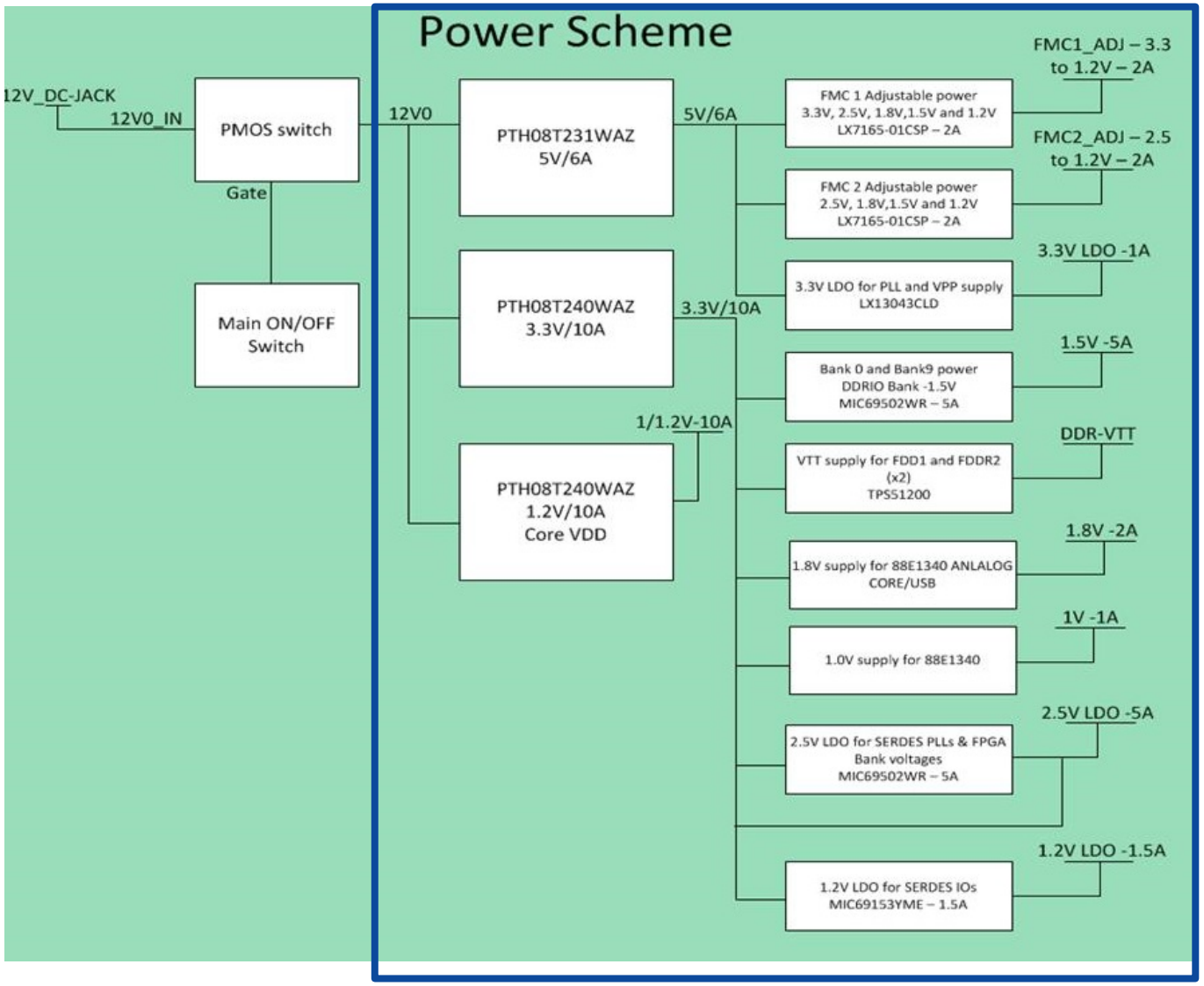
- Future requirements are for greater flexibility and much higher data capability
- Reduced feature sizes comes lower core voltages, higher currents and greater transient requirements
- Power topologies and design methodologies must adapt to changing requirements
- The system designer needs to understand future requirements in order to effectively assess partitioning of the power system
- Entire power generation and distribution system must be reviewed to maximize the overall system efficiency and effectiveness



Typical Power Supply Challenges

- Per NASA and ESA studies ~**30%** of the satellite weight is in power distribution
- Key Drivers
  - Over design for worst-case analysis due to high digital (uC, ASIC, FPGA, etc..) power estimates
  - Isolation requirements between the main bus, payloads, and sub-systems
  - System efficiencies 55% to 75%
    - Large variation in typical and worst-case power estimates (2-4x)
    - Multiple inefficient power stages vs. one direct conversion stage
  - Conduction cooling coupled with inefficacies drive large, heavy thermal relief
  - Point of load solutions are often >2.6cmx 2.6cm thus requiring >30% of critical real estate on digital cards
  - Legacy technology limitations to raise the system bus voltage
    - MOSFET Single Event SOA curves have traditionally been derated higher voltages

Point of Load – RTG4 Commercial Power Evaluation Board



- Typical 6U card size
  - 23cm x 16cm = 368cm^2
- RTG4 Evaluation Board
  - 12 point of load power rails
- Standard space point of load solutions are large
  - ~2.6 cmx 2.6 cm
- >20% board area on a 6U card would be dedicated to point of load power
  - Not including any ADC's or memory that would potentially need an isolated power rail

MHP5061

3 Vin–6.3 Vin, 6 A, Synchronous Hybrid Point-of-Load DC-DC Converter

Device Features

- VIN = 3 V to 6.3 V
- Internal reference (0.8 V)
- Adjustable frequency 100 kHz to 1 MHz
- Parallel operation 180° out of Φ with sync pin
- Internal VREF 1.5% variation over temp and radiation
- Ultra-fast transient response to lower output impedance
- Integrated design (Cin, Cout, and Lswitch)
- External compensation and soft-start
- External enable and output power good
- 95% peak efficiency

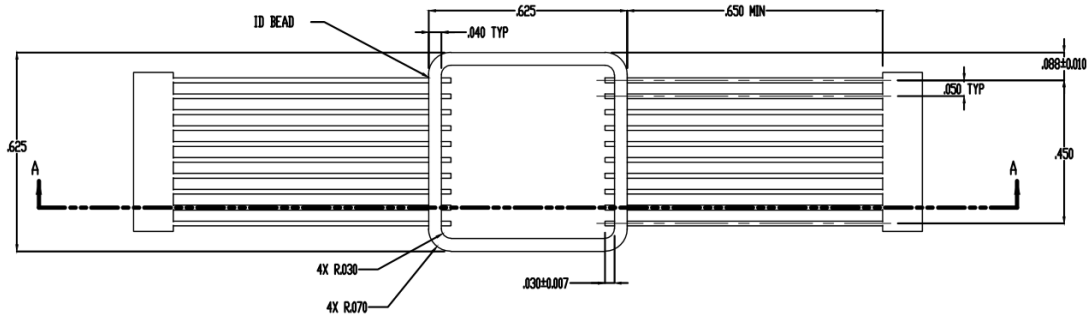
Benefits

- **DLA certified MIL-PRF-38534 facilities**
- Optimal solution size—integrated hermetic hybrid design
- **40% smaller than current solutions on the market**
- Radiation hardness assurance (RHA) DLA-approved TID testing follows MIL-STD-883, Method 1019.6
- Minimizes solution size through small package and excellent load transient response with smaller output capacitances
- 12 A current output through current share
- Ease of implementing power sequencing schemes
- Pspice models available

Radiation Performance

- TID = 100 krad(Si), radiation hardness assured
- SEL/SEB/SEGR immune to LET 65 MeV at 125 °C
- SEFI/SET onset > LET = 65 MeV

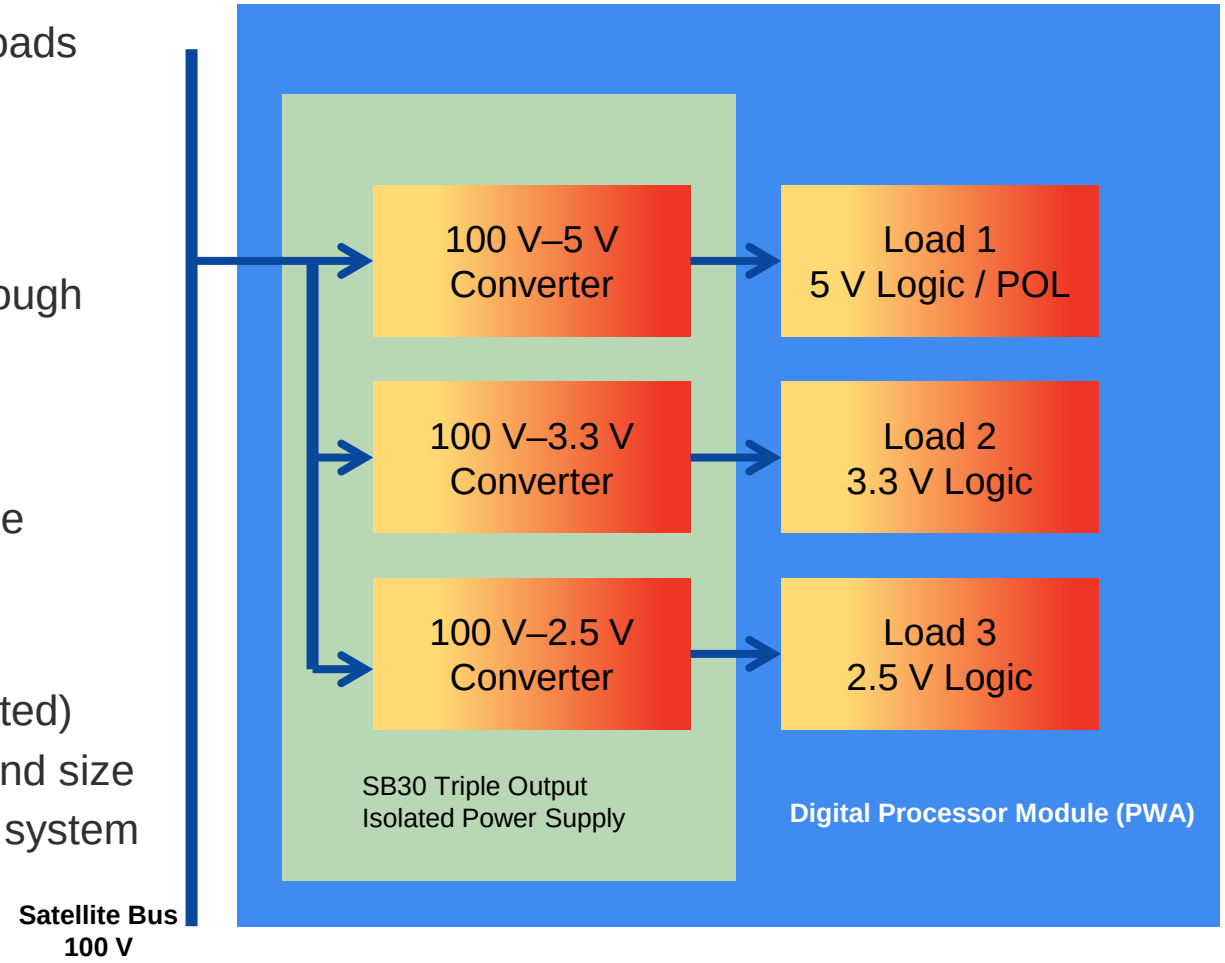
Package Size



Isolated Point-of-Module Concept – Single Stage Conversion

- **Description**
  - Module POL concept based on SA50 topology
  - Designed to support three independent low-voltage digital loads
  - Mil Std 461 compliance at the satellite bus
  - Input-to-output isolation
- **Features**
  - Large step loads or noise are not seen on adjacent rails through independent outputs
  - Excellent load-step response
  - Power-up/power-down sequencing built in
  - Internal and external synchronization to reduce system noise
- **Benefits**
  - Each channel has individual current limit
  - Regulates with no load on any output (independently regulated)
  - Point of load power stage eliminated to improve efficiency and size
  - Switching noise frequency can be set externally to optimize system performance

Digital Logic Loads (5V, 3.3V, and 2.5V) are supplied directly from Point-of-Module



SB30 Dual Isolated DC-DC Features – EAR99

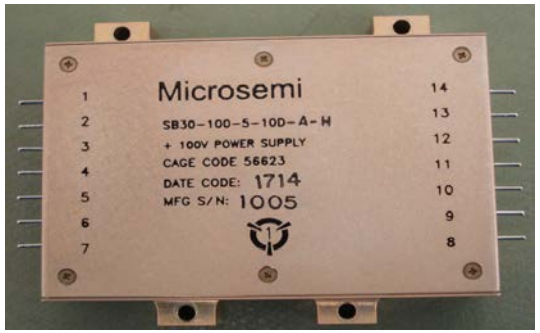
Features

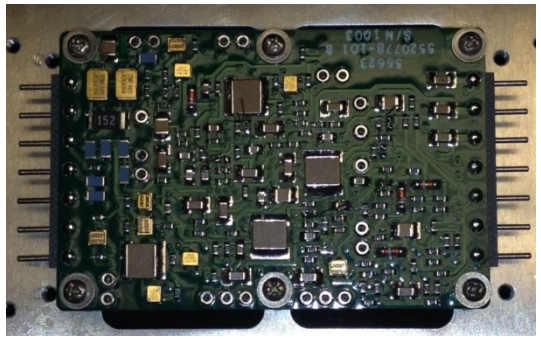
- Dual output for digital loads with internal EMI filter
  - +5 V at 2 A; 10 V at 1 A
- Input-output isolation
- 100Vin, 20 W total combined power output
- Inhibit, remote adjust, power good output
- Isolated sync input, 500 kHz
- Better than 1% accuracy over temp and radiation
- >70% efficient full load all conditions
- 3.050” L × 2.050” W × 0.625” H envelope
- Total dose rating of 100 krad(Si) at LDR
- SEE (all effects) >80 MeV-cm2/mg (H version)
- Thermal resistance= 0.041 ºC in^2/W (measured at 55 ºC)
- NASA outgassing compliant: (TML)= 1% max,(CVCM)= 0.1% max

Benefits

- Single stage isolated power solution for digital loads
- No external EMI filtering needed saving valuable real estate
- Individual PWM control for each load
- Optimal output voltage accuracy through internal reference
- Peak efficiency at full load
- Best in class radiation performance and accuracy
- EAR99 Solution
- Flight proven architecture from SA50

Package





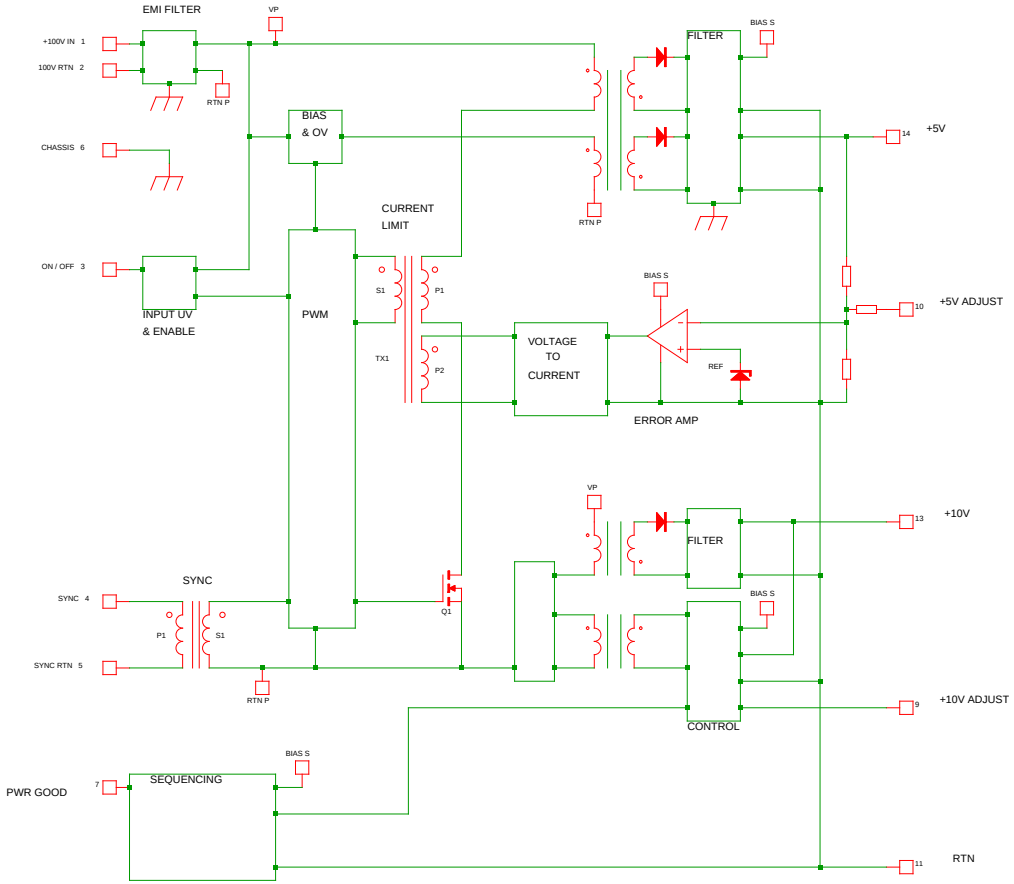
Design Support Available

- Radiation analysis
- Worse case analysis
- Reliability analysis
- FEMA
- First article qualification test report
- EMI test report
- Structural analysis
- Stress analysis
- Thermal analysis

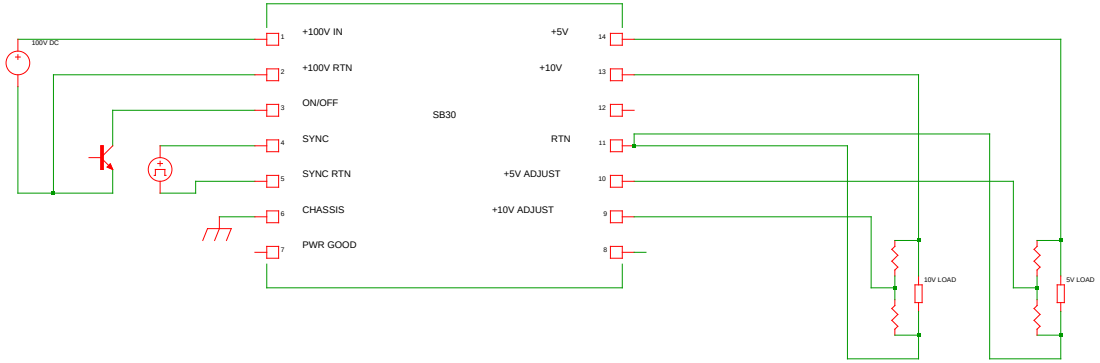
SB30 Dual DC-DC (Available)

All SB30 Output Is Externally Trim-able
Each Output Is Adjustable ±10%

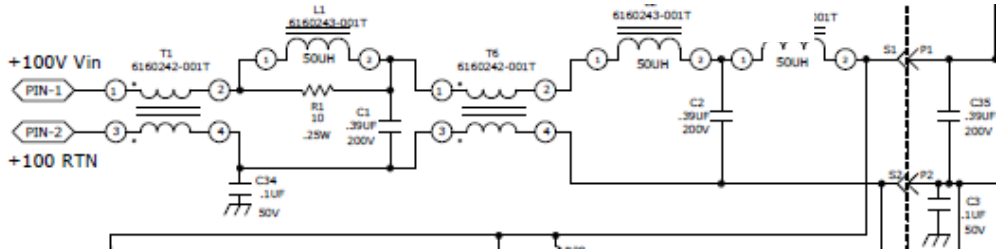
Schematic



Pinout

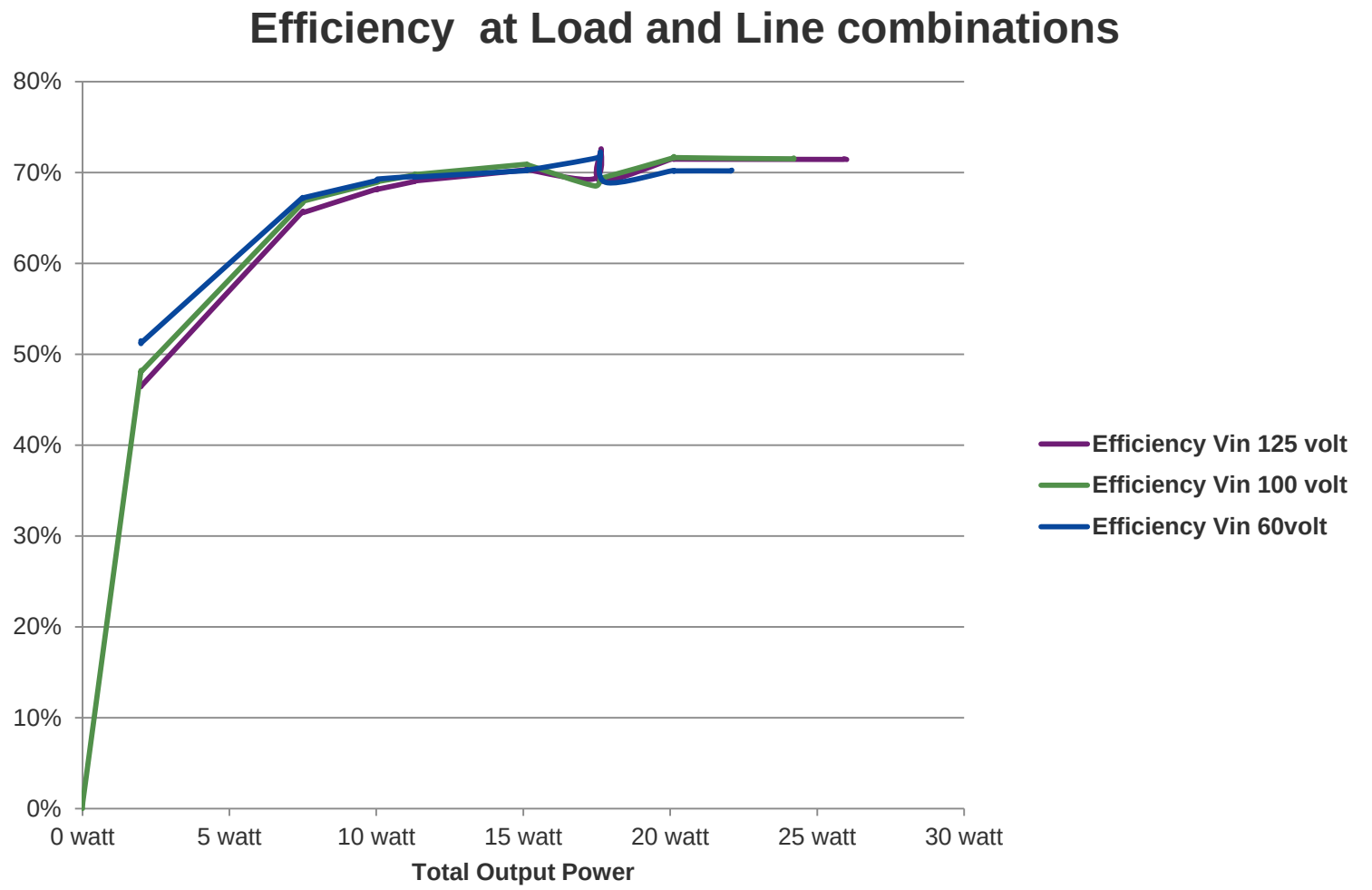


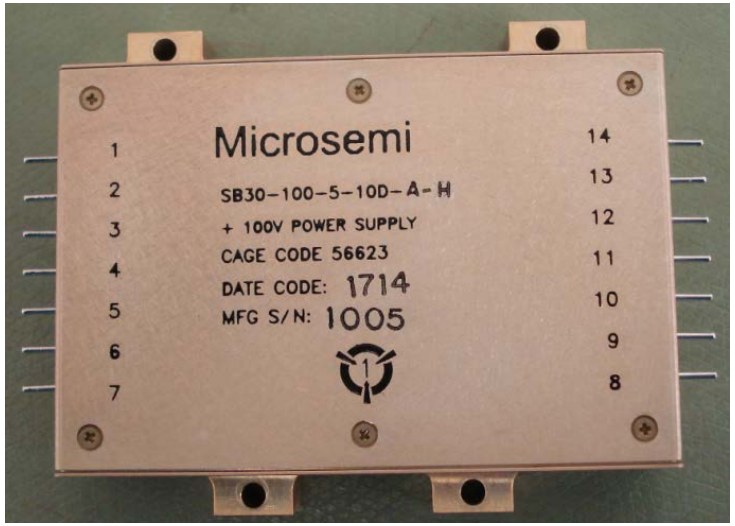
Built-In EMI Filter



- Multistage filter with differential and common mode filtering
- Meets MIL-STD-461 conducted emission requirements
- Effective decoupling between payload modules

SB30 Dual Efficiency Performance





SB30 Triple Isolated DC-DC Features – EAR99

Features

- 28, 50, 70, 100, or 120 Vin
  - Input-output isolation
- Triple output for digital loads with internal EMI filter
  - +5 V at 2 A; +3.3 V at 3 A; +2.5 V at 3 A; customizable
- 30 W total combined power output
- Inhibit, remote adjust, power good output
- Isolated sync input, 500 kHz
- Less than 1% accuracy over temp and radiation
- >86% efficient full load
- 2” L × 2” W × 0.5” H envelope goal
- Total dose rating of 100 krad(Si) at LDR
- SEE (all effects) >80 MeV-cm2/mg (H version)
- Thermal resistance= 0.041 ° C in^2/W (measured at 55 ° C)
- NASA outgassing compliant: (TML)= 1% max,(CVCM)= 0.1% max
- Synchronous rectification minimizes conduction losses
- Patented sequencing of switching, minimizes switching losses
- Meets MIL-STD-461 conducted emission requirements
- Effective decoupling between payload modules

Benefits

- Single stage isolated power solution for digital loads
- No external EMI filtering needed saving valuable real estate
- Individual PWM for each load
- Optimal output voltage accuracy through internal reference
- Peak efficiency at full load
- Best in class radiation performance and accuracy
- EAR99 Solution
- Flight proven architecture from SA50

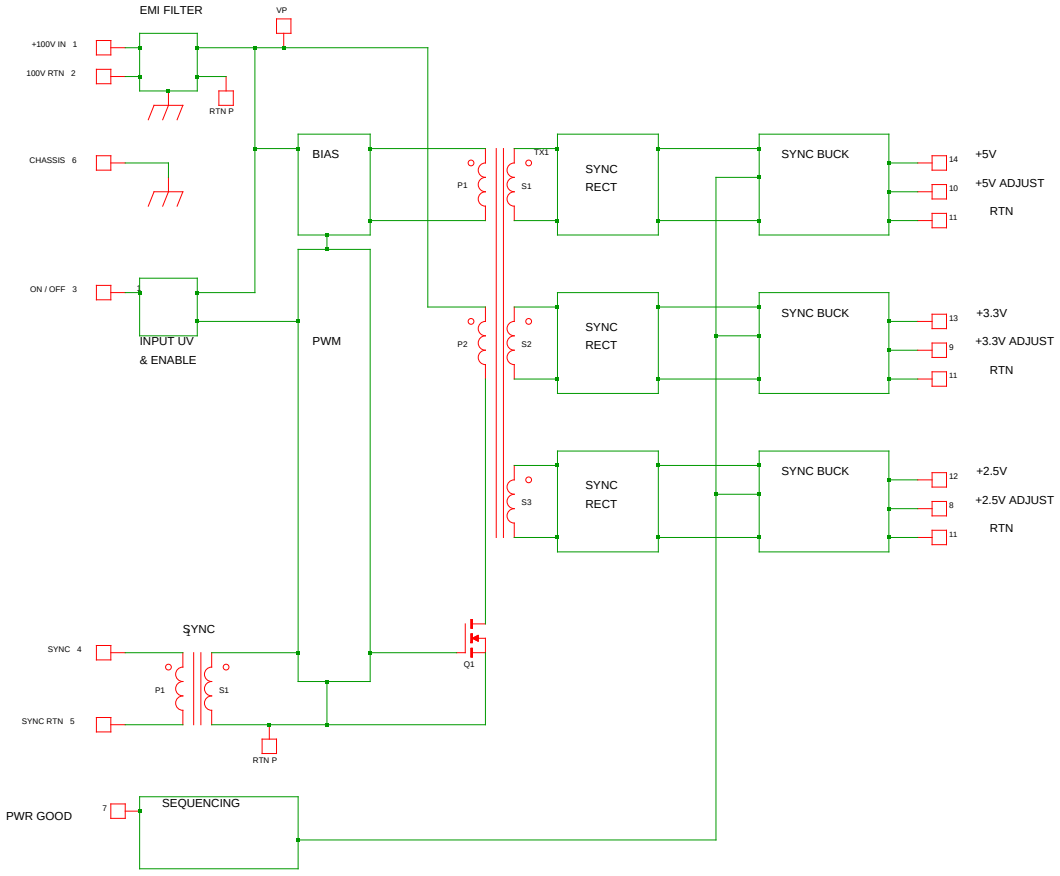
Planned Design Support

- Radiation analysis
- Worse case analysis
- Reliability analysis
- FEMA
- First article qualification test report
- EMI test report
- Structural analysis
- Stress analysis
- Thermal analysis

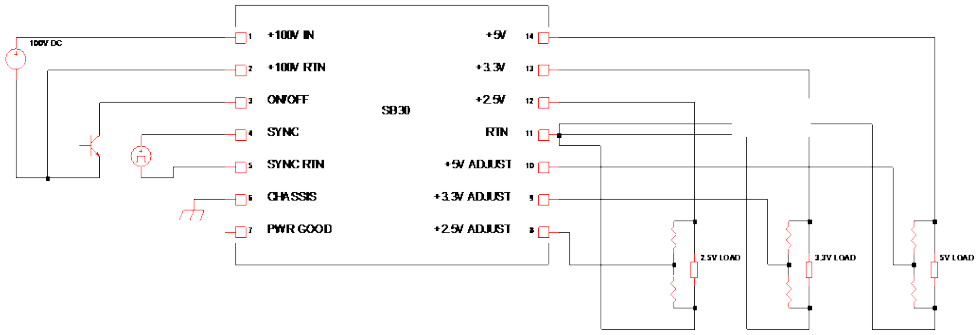
SB30 Triple DC-DC

All SB30 Outputs are Externally Trim-able
Each Output Is Adjustable ±10%

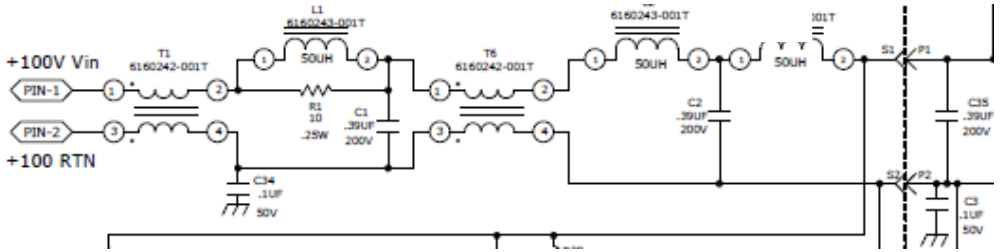
Schematic



Pinout



Built-In EMI Filter



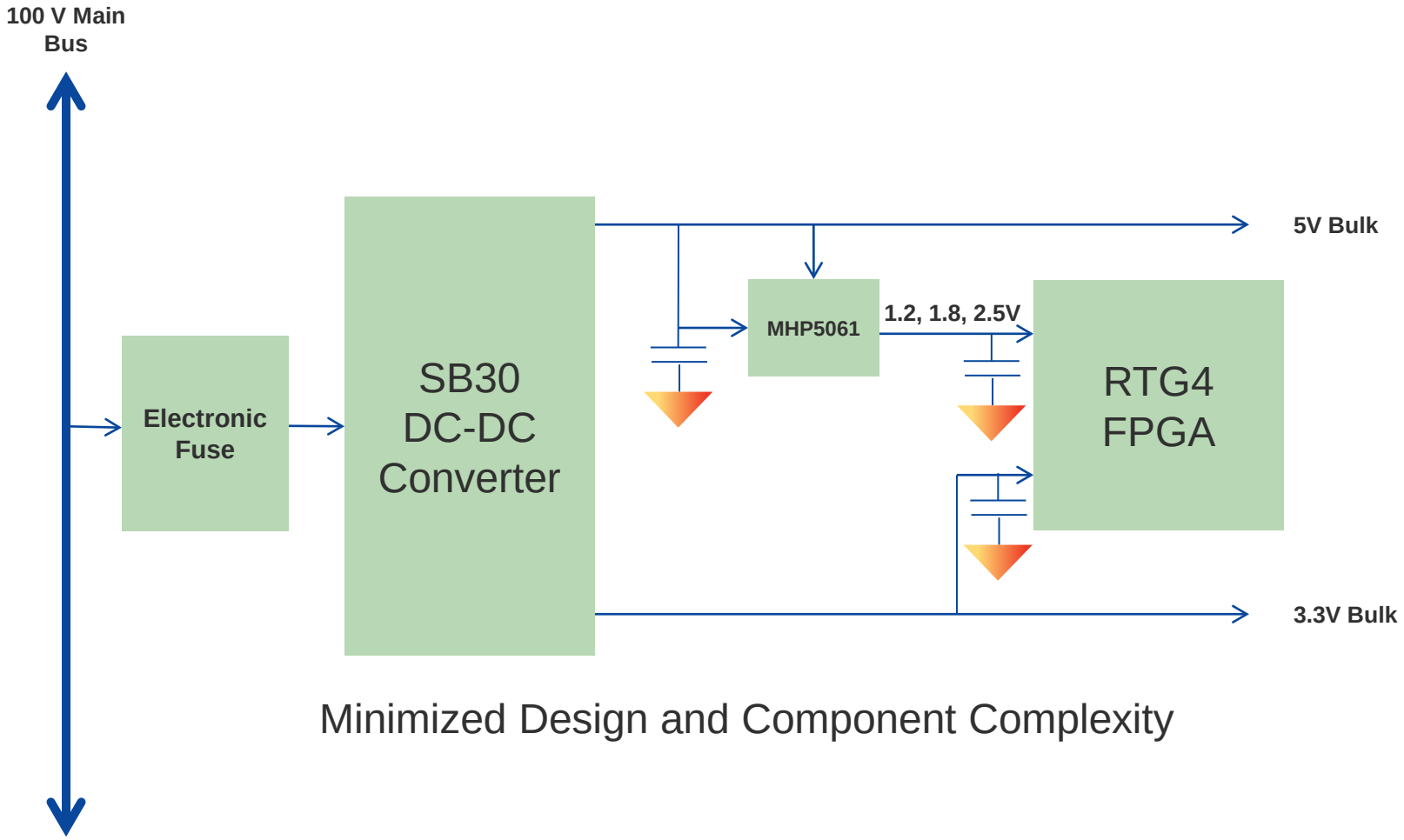
- Multistage filter with differential and common mode filtering
- Meets MIL-STD-461 conducted emission requirements
- Effective decoupling between payload modules

System Efficiency with Next Generation SB30 Triple

	CASE EXAMPLE -- Mixed Signal Payload with Embedded FPGA					
	Power in	SB30 Eff %	POL Eff %	Power Delivered	Voltage Delivered (V)	Current delivered (A)
	2.78	90%	100%	2.50	5.0	0.5
	3.84	86%	100%	3.30	3.3	1.0
	1.52	82%	100%	1.25	2.5	0.5
	0.96	90%	87%	0.75	1.5	0.5
	10.84	90%	82%	8.00	1.0	8.0
Totals	19.94			15.80		
	Overall Efficiency			79%		

- Next generation SB30 with three channels configured as 5 V + 3.3 V + 2.5 V with all outputs at 2 A achieves 86% efficiency (projected)
- Downstream POL would be 5 V converted to range 0.8 V to 1.5 V with efficiencies of 78% to 85%, respectively
- Overall conversion from main bus to POL is in the region of 79% vs 72% for traditional distributed power conversion
- Point of Module converter meets size and efficiency targets for effective integration

Smaller More Efficient Power Distribution Solutions



Minimized Design and Component Complexity

- Point of Module advantages for satellite power distribution
  - Eliminates noise decoupling between payload systems
  - Maximum efficiency by minimizing power conversion stages
  - Excellent fault isolation and fault effects containment
  - Reduction in size, weight, and cost on a system basis
  - SB30 could be taken to a hybrid for further size reduction
- Point of Load
  - Ultra small and efficient complete point of load solutions
  - Excellent transient response for dynamic current needs
  - EAR99 solution for ease of use

Summary

- DC to DC and point of load power solutions
- Power bottlenecks and system issues
  - High current, low voltage
  - Size and efficiency
- Increasing SWAP advantages through point of loads and modules
- Next Steps
  - Working with customers on optimization of the SB30
  - Definition of next generation point of loads

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Thank You

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