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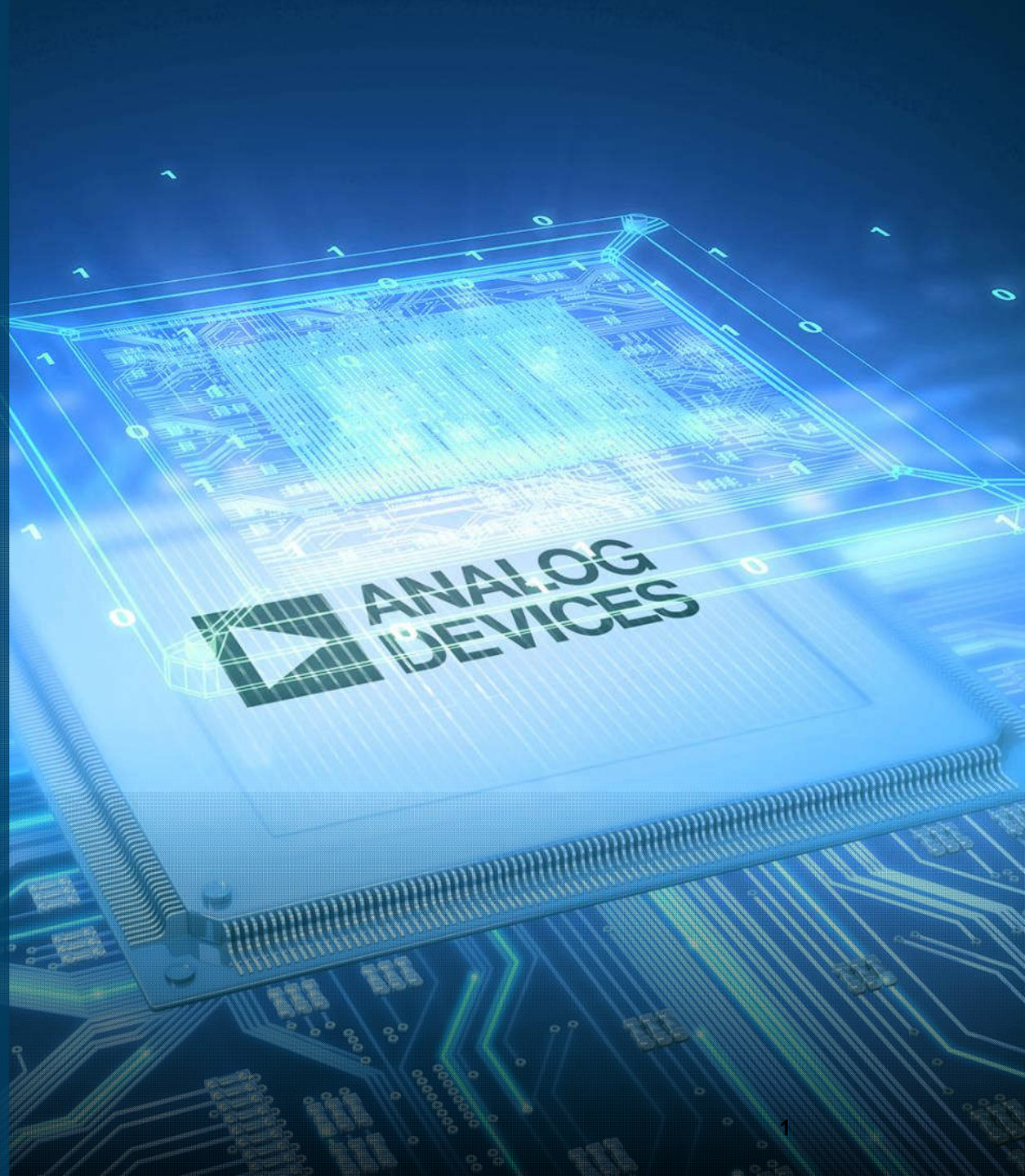
POWER BY LINEAR

ADI leading High-performance Power Innovation

LORRY LIANG

POWER PRODUCT MARKETING DIRECTOR



Technologies for Today and Tomorrow's Innovations

Autonomous Transportation and Machines

Automotive Electrification

Next-Generation Connectivity

Remote Healthcare

Industry 4.0 and Smart Energy

Immersive Consumer Experiences

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ADI + LTC : High Performance Analog Industry Leader …

On March 10,2017, Linear Technology Corporation officially became part of Analog Devices,Inc. This powerful combination creates the premier global high performance analog industry leader.

Over **80% of sales** from:

INDUSTRIAL | COMMUNICATIONS | AUTOMOTIVE

Combined worldwide patents granted = **4700**

Combined enterprise value **$30 Billion**

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LINEAR TECHNOLOGY

Combined history of **87 YEARS**

1965 — 1981 — 2017 + Beyond

$4.9 Billion

$3.4 Billion ADI + **$1.5 Billion** LTC

Now powered by

10,000 ADI Employees + **5,000** LTC Employees

Combined number of products = **43,000**

20,000 ADI + **23,000** LTC

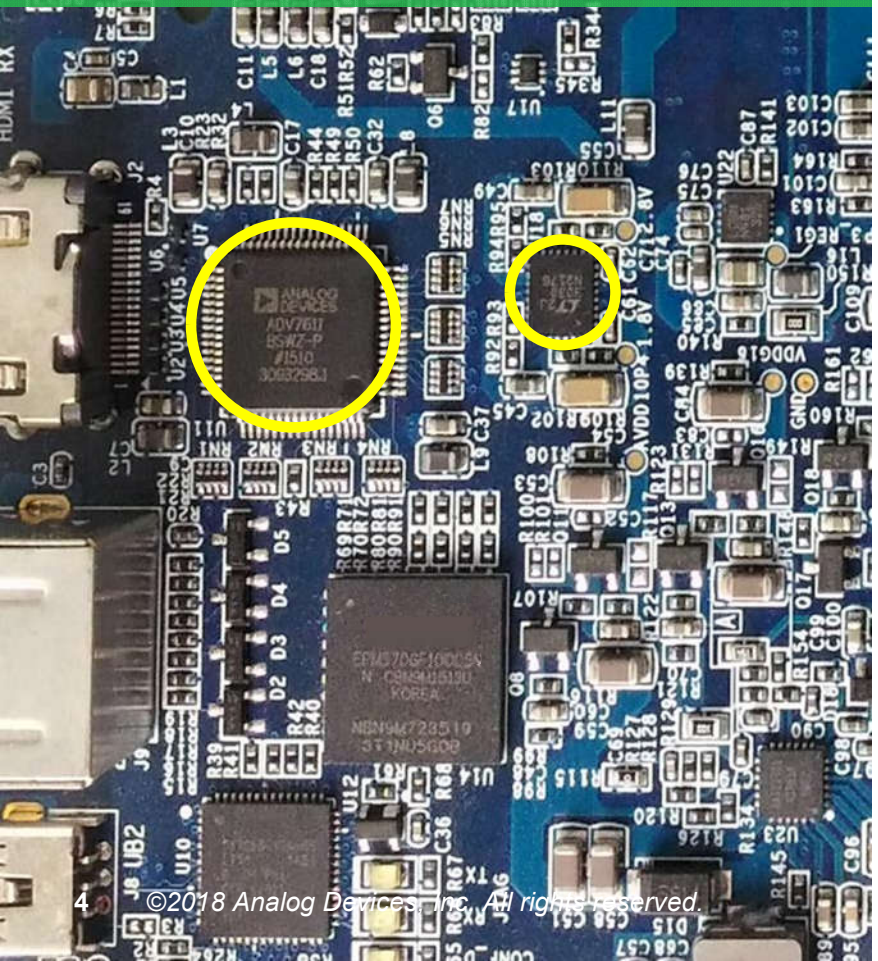
44 design centers worldwide

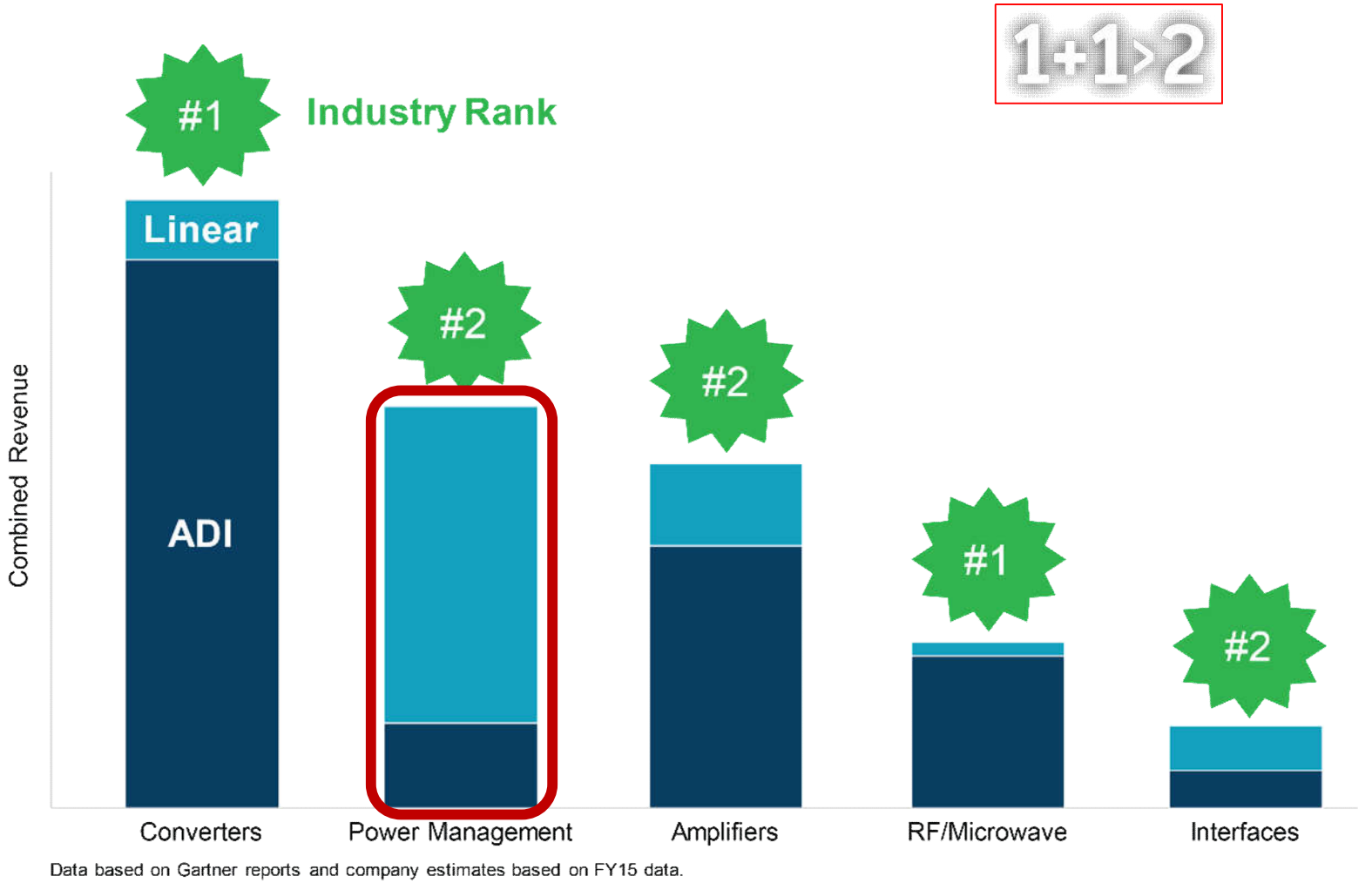
30 ADI

14 LTC

ADI + LTC : High Performance Analog Industry Leader …

Broad and Highly Complementary Portfolio of Leading Long Lifecycle, High Value Products





Data based on Gartner reports and company estimates based on FY15 data.

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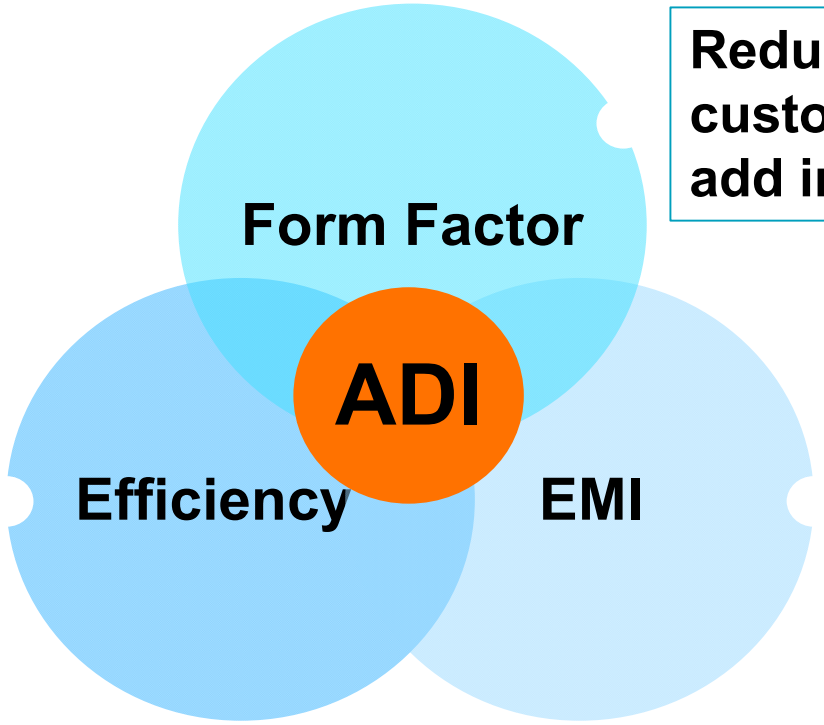
Power Innovation Technologies

Performance 3 Key Metrics



Reduce form factor enabling customers to reduce PCB space or add incremental functionality

Manage power dissipation (heat) in the smallest of form factors

Reduce electromagnetic interference (noise)


Autonomous Transportation and Machines


Automotive Electrification

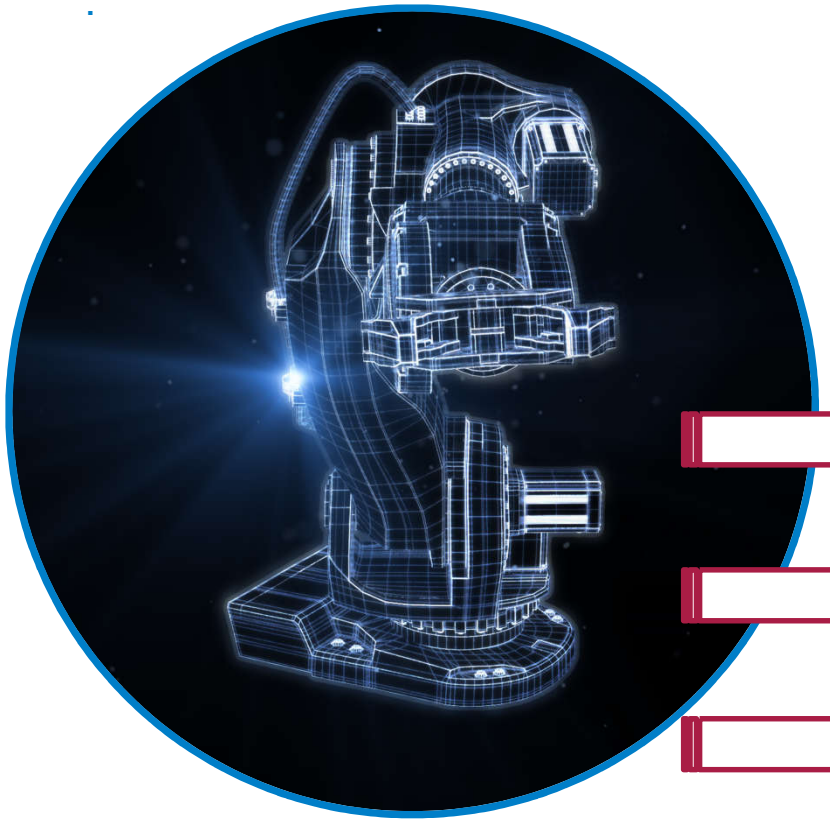

Industry 4.0 and Smart Energy


Next-Generation Connectivity


Immersive Consumer Experiences

Industrial

Accelerating the Path to Industry 4.0



Deep Domain Expertise Across the Factory

- Motion Control
- Robotics and Cobots
- Industrial Ethernet
- Condition-Based Monitoring
- Functional Safety
- Security

Key Industry 4.0 Accelerators

Real-Time Deterministic Ethernet

Multiprotocol switching enabling true determinism to the edge

Software Configurable I/O

Flexibility, space savings, and cost savings

Condition-Based Monitoring for Machine Health

Reliable analytics for predictive maintenance

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Industry 4.0 Delivers on Increased Productivity

See where ADI is accelerating the transition to the secure connected enterprise

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Flexibility

The shift to more flexible architectures allows for greater capacity and faster reconfiguration. Using universal analog I/O (input/output) brings integration, robustness, flexibility, and efficiency with significant time and cost savings. All of which create opportunities for virtualization utilizing AI and digital twin technologies.

Efficiency

Even a 1% reduction in energy use can bring tremendous savings to a factory operator. These savings can be realized through the adoption of inherently lower power solutions that are then augmented by condition-based machine monitoring analytics.

Communications

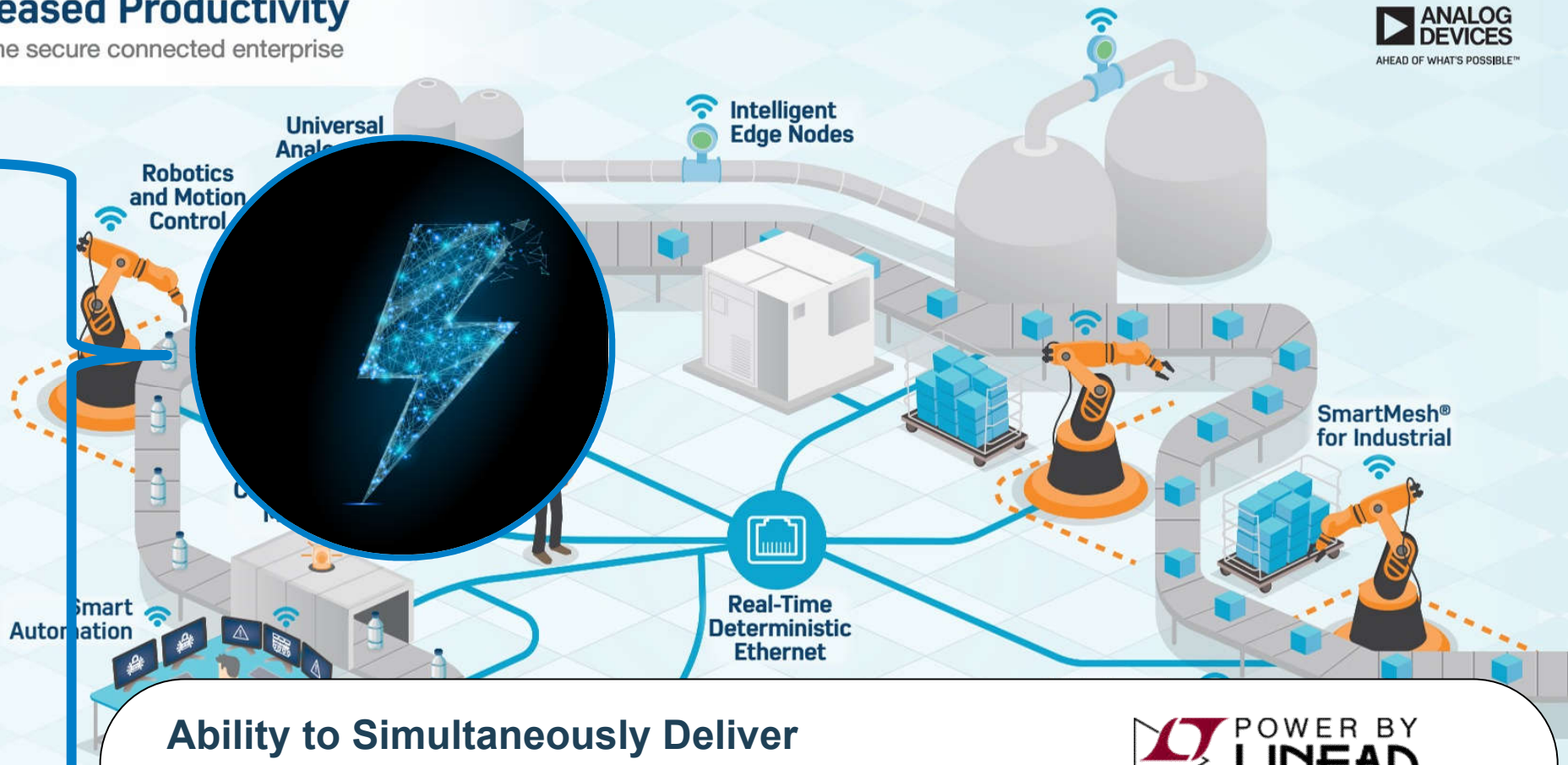
Central to the execution of Industry 4.0 is robust and secure wired and wireless communication that must support legacy standards and provide a clear path to Ethernet to the Edge and Time Sensitive Networks (TSN).

Safety

A system is not smart if it is not safe. Functional safety is ubiquitous in automation systems with strict standardization and certifications requirements.

Security

Greater connectivity of smart machines with Industry 4.0 brings with it risks from cyber attacks. Factory operators and solution providers need to develop stronger cybersecurity strategies that are more vigilant and resilient to attack.



Ability to Simultaneously Deliver Three Performance Metrics

POWER BY LINEAR™

High Power Efficiency

Manage heat dissipation in the smallest form factors to improve quality and reliability

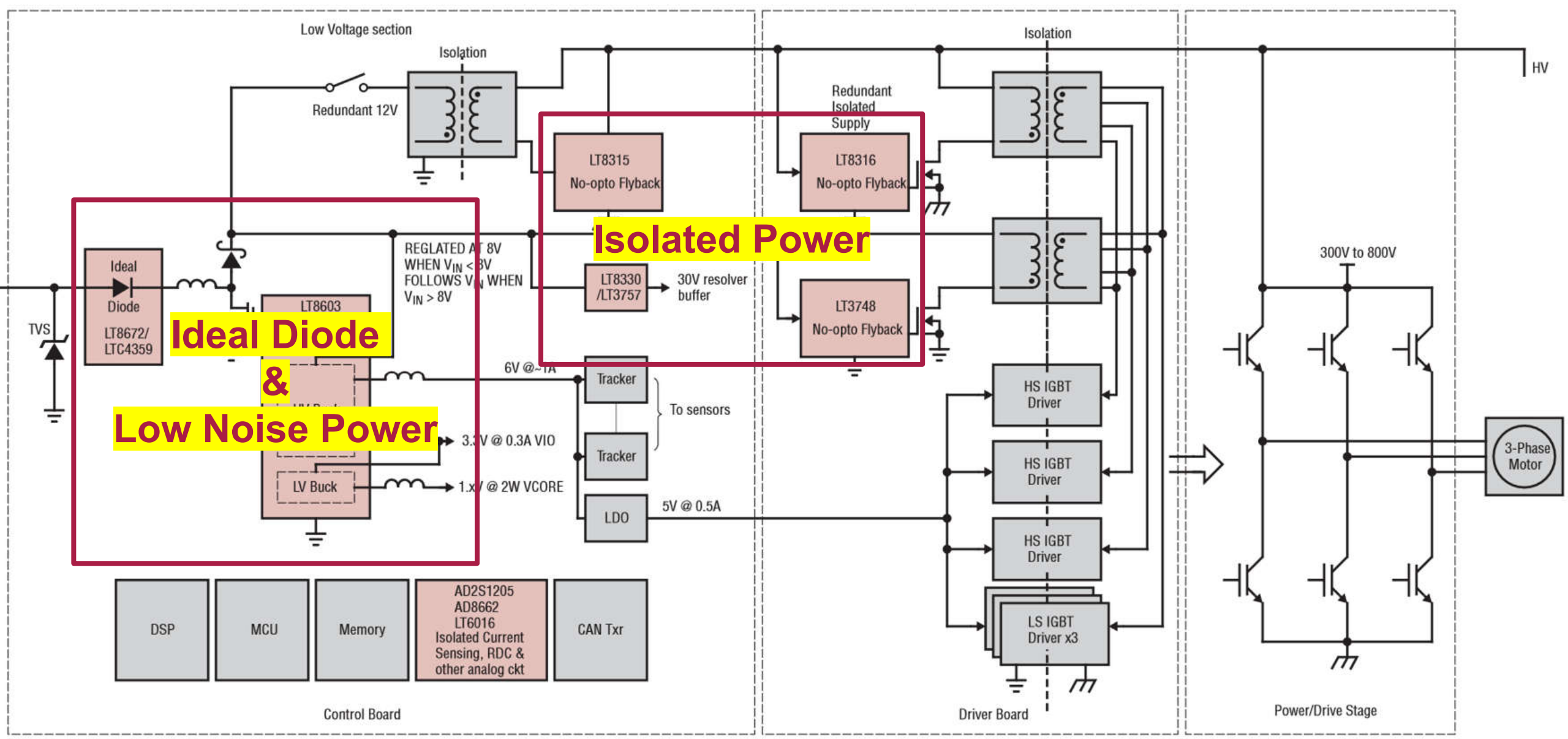
Small Form Factor

Reduce form factor to reduce PCB space while adding functionality

Low EMI

Reduce electromagnetic interference (noise) and improve accuracy

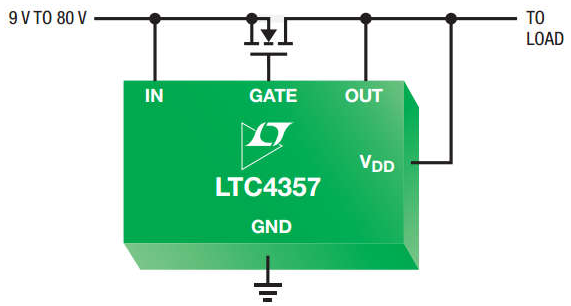
Generalized 3-Phase Inverter/Motor System

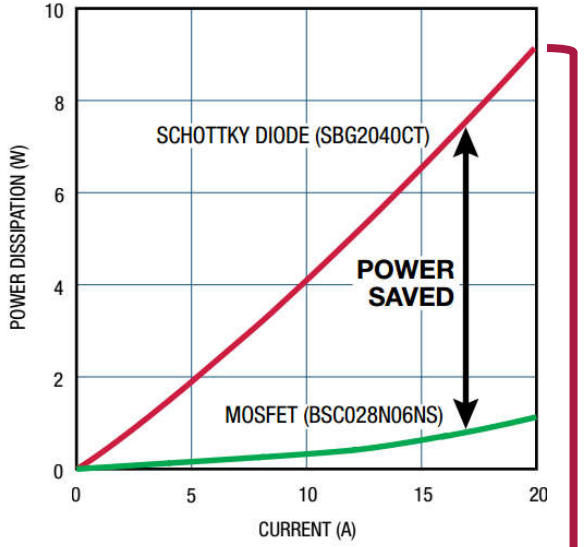


Innovation – Ideal Diode

Ideal Diode Controller

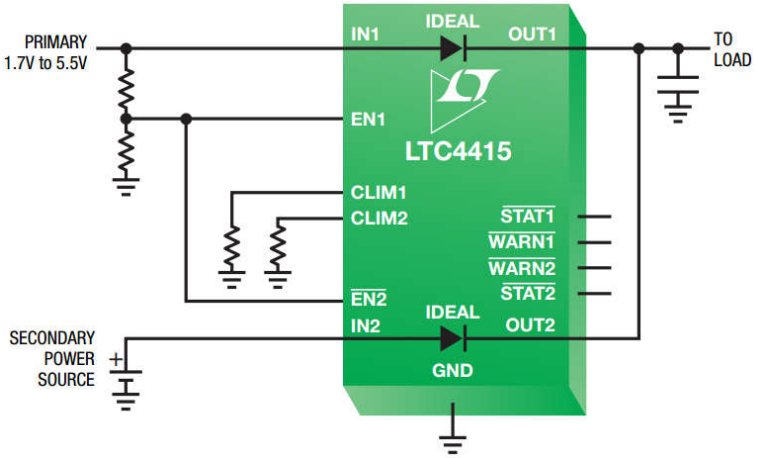
- Connects highest voltage supply to output
- Low forward turn-on voltage (< 50 mV)
- Controls external N-channel or P-channel MOSFETs
- Linear regulation of MOSFET forward voltage drop
- Conserves voltage and power over Schottky diodes
- Minimizes or eliminates heat sinks
- Works as high side load switch with back-to-back MOSFETs
- Blocks reversed inputs from load

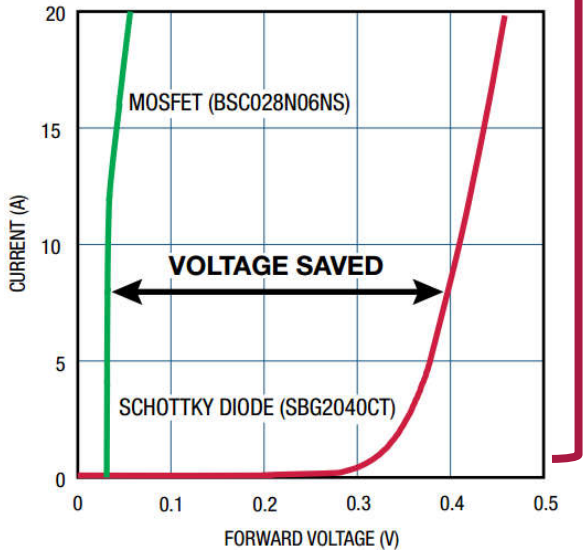




Ideal Diode

- Internal power MOSFET for compact solution footprint
- Load currents up to 5 A
- Low reverse leakage current (< 1 µA at 25°C, < 10 µA at 125°C)





- **Low power lose**
- **No heatsink**
- **High reliability**
- **High efficiency**

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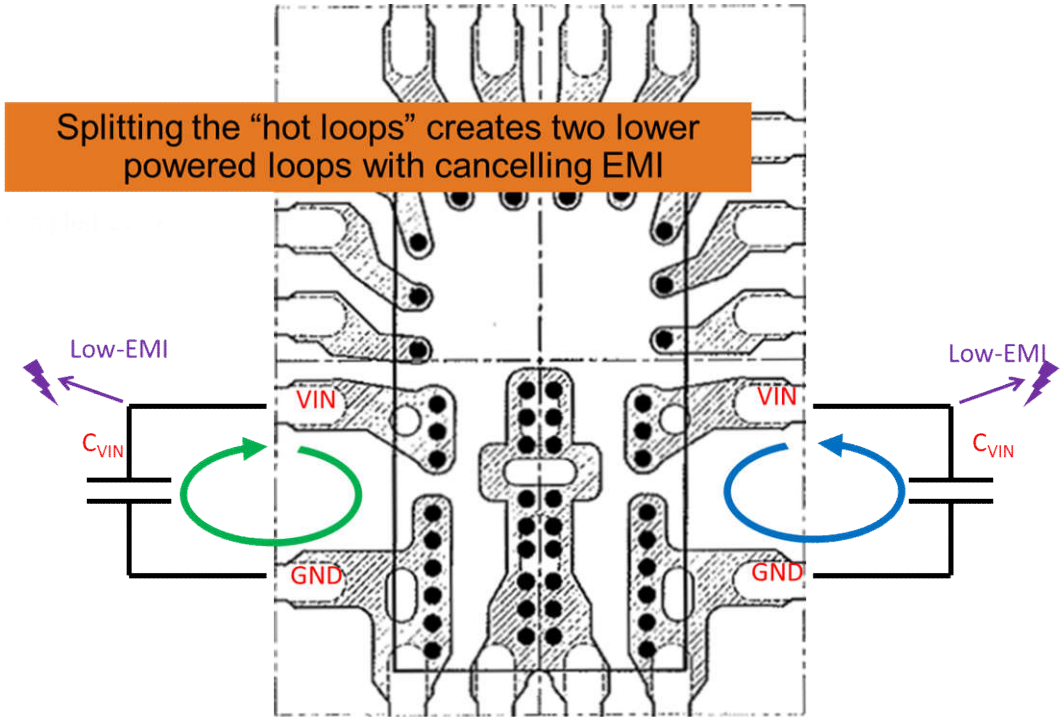
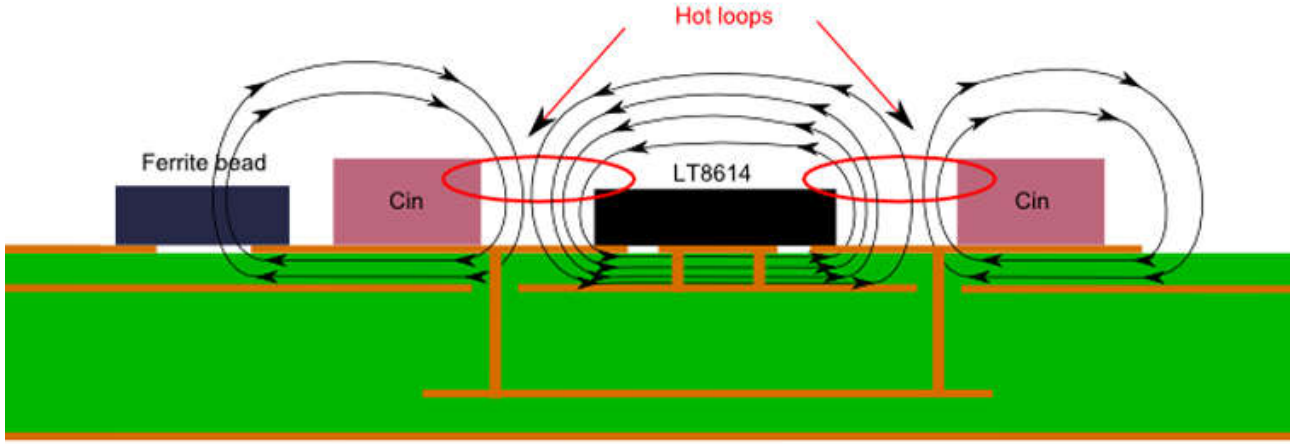
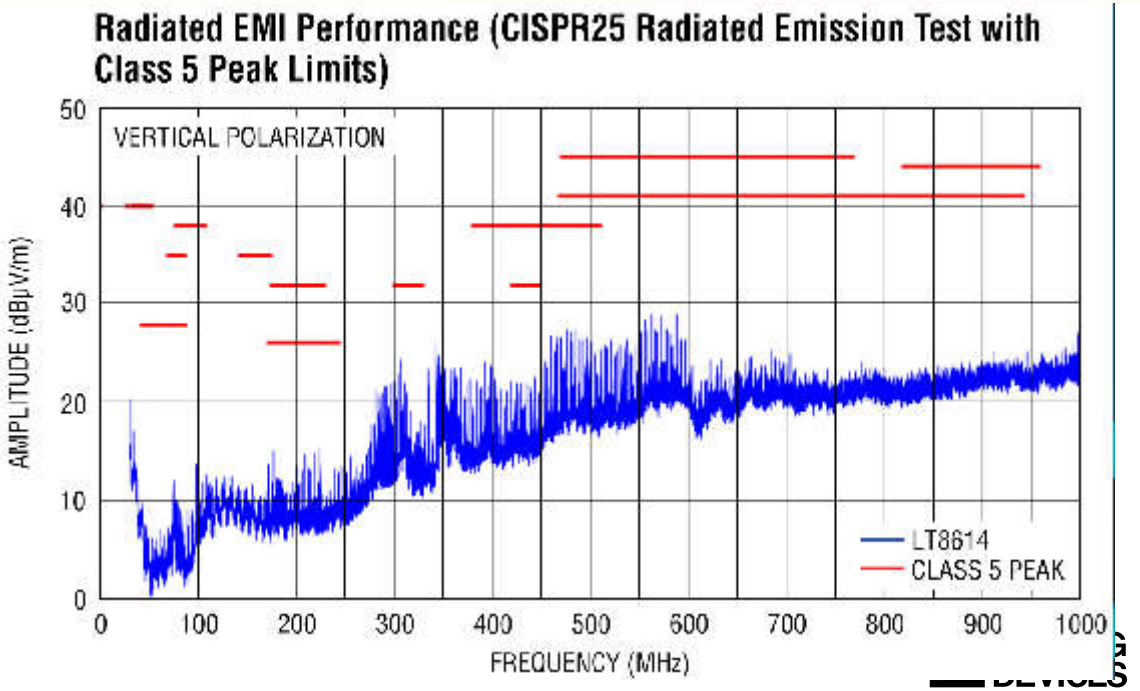
Innovation - Silent Switcher



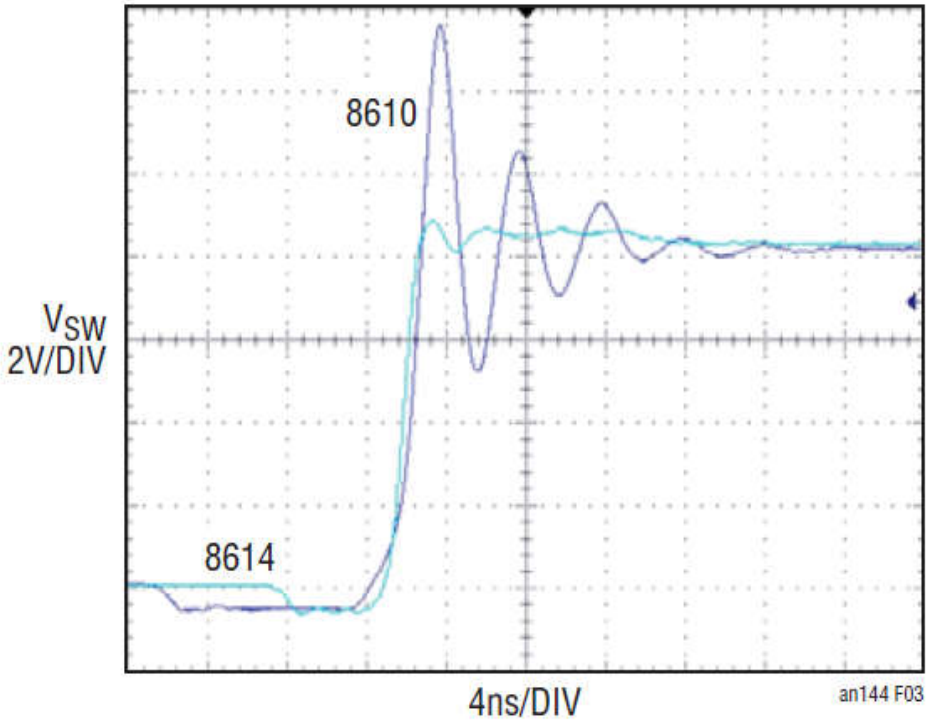


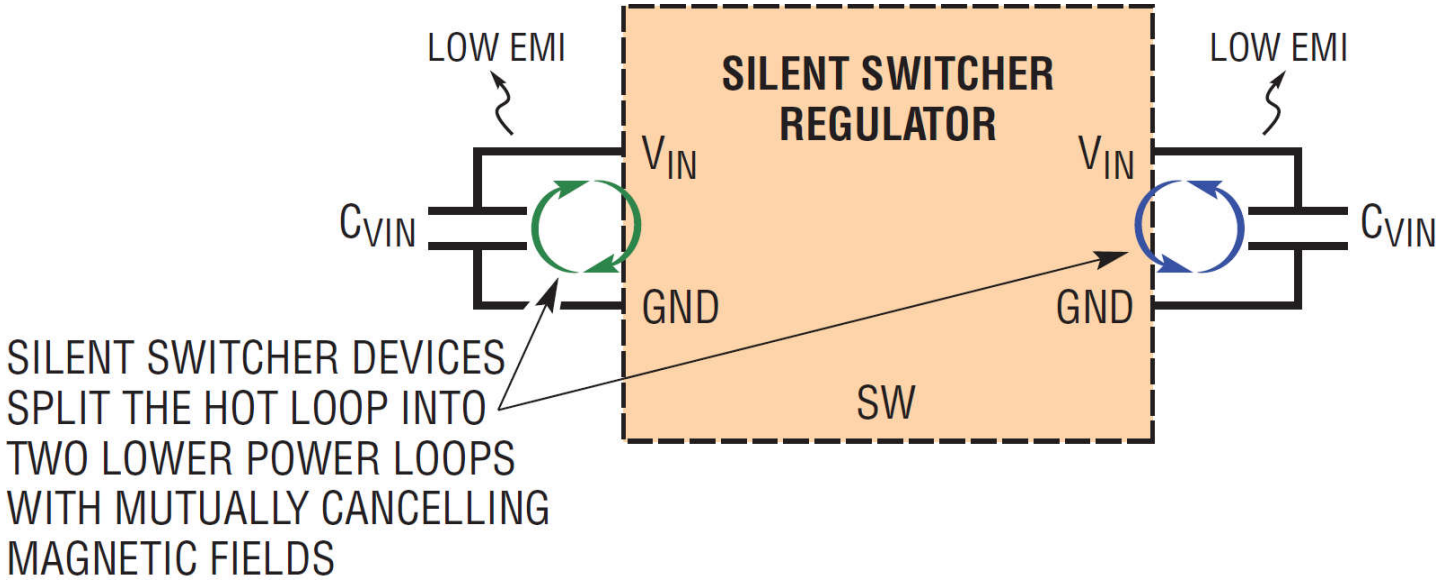


- The two high current loops cancel each others magnetic field, almost like enclosing the circuit in a metal box

Silent Switcher Eliminates Switch Ringing

- Better EMI
- Lower voltage stress
- Higher efficiency with possibility of faster switching edges





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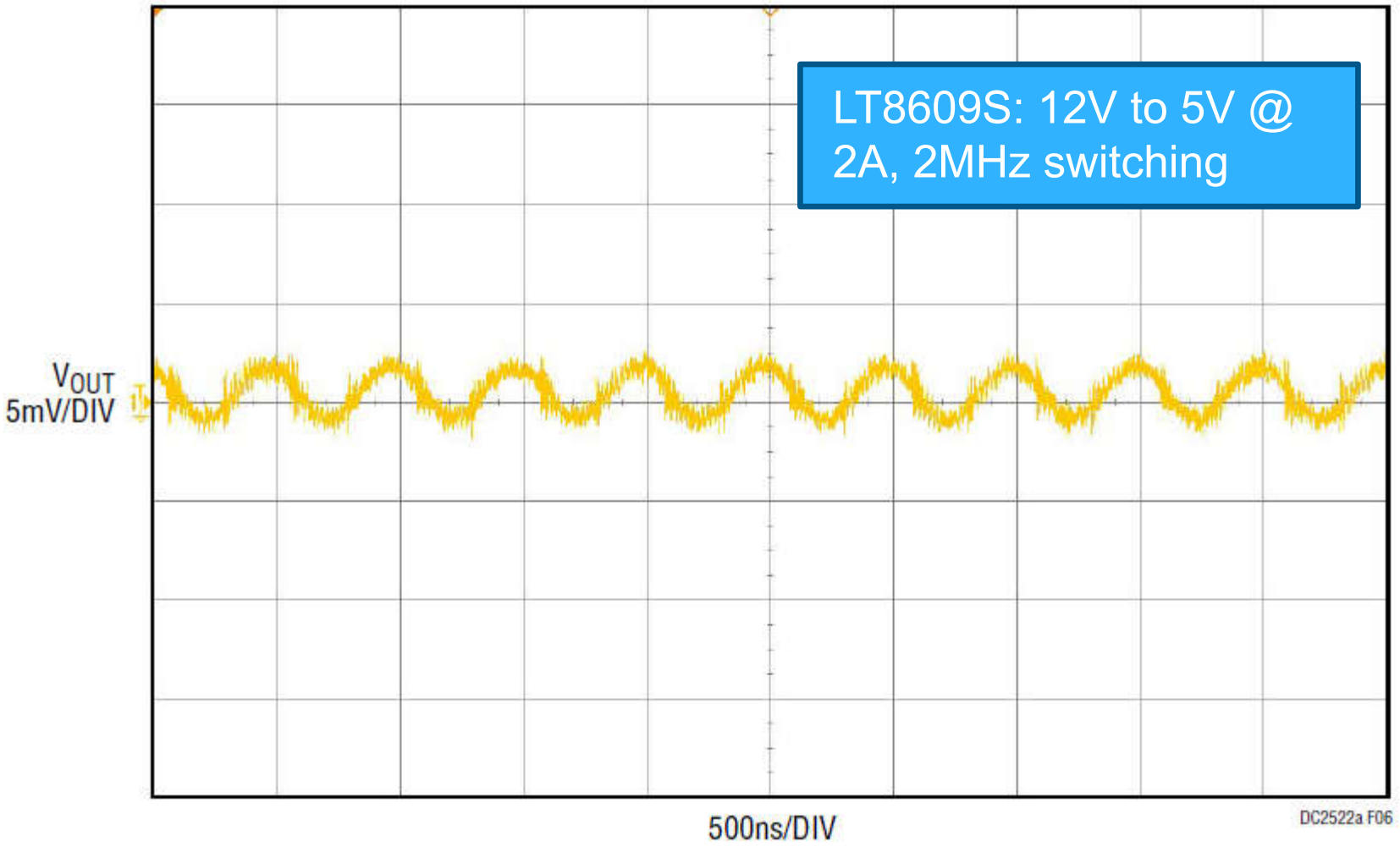
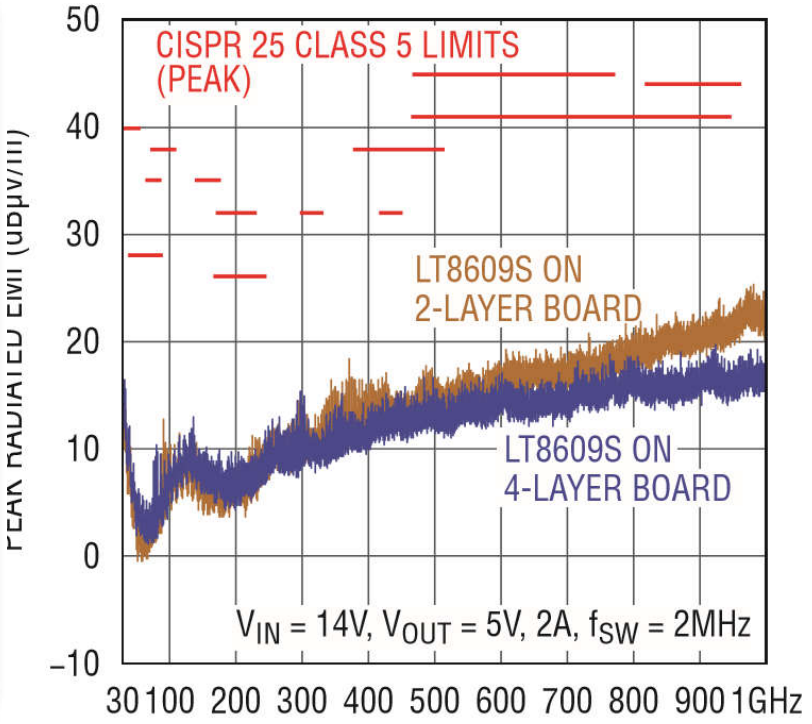
Silent Switcher 2 Also Provides Low Output Ripple



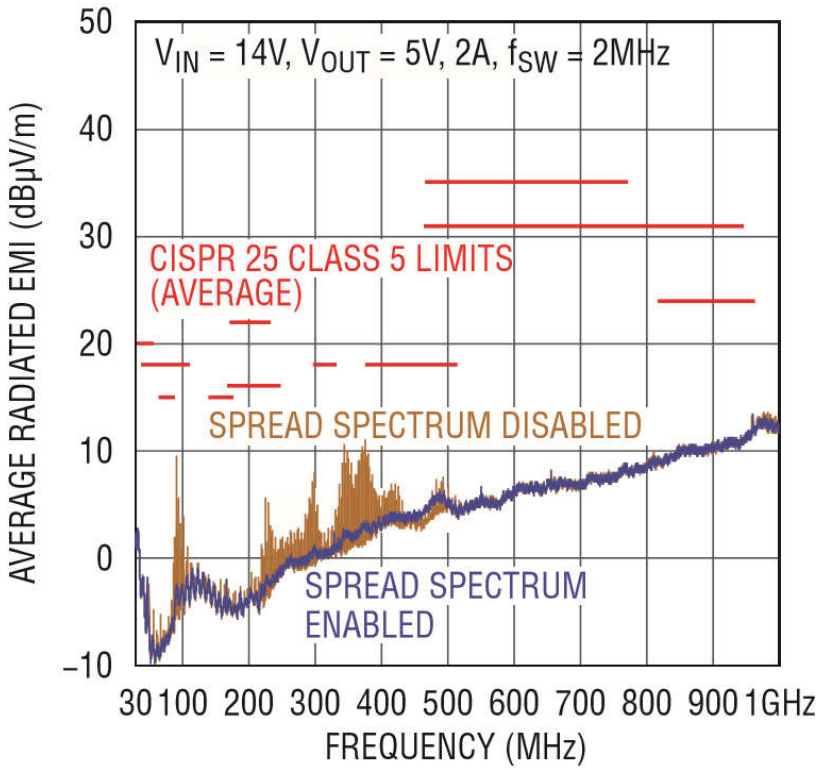
Silent Switcher 2 Can Have Low EMI with 2 Layer PCBs
Spacing Between Layer 1 and GND Layer 2 is not as Critical

LT8609S 2-Layer Demonstration Circuit

EMI is low on both 2-layer LT8609S and 4-layer LT8609S solutions.



2-layer Average EMI passes CISPR 25 Class 5 with room to spare.



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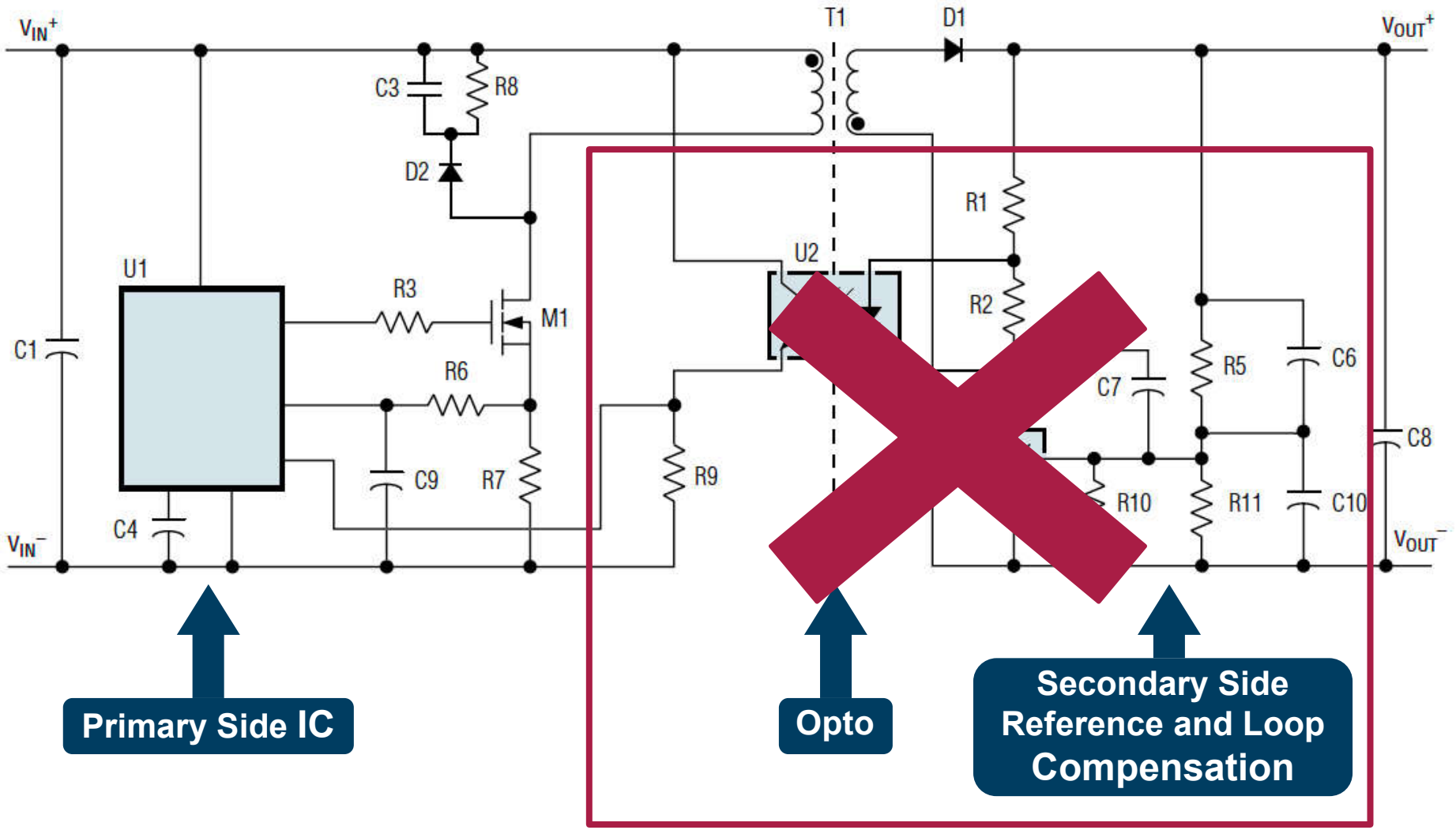
Typical Isolated Flyback Schematic



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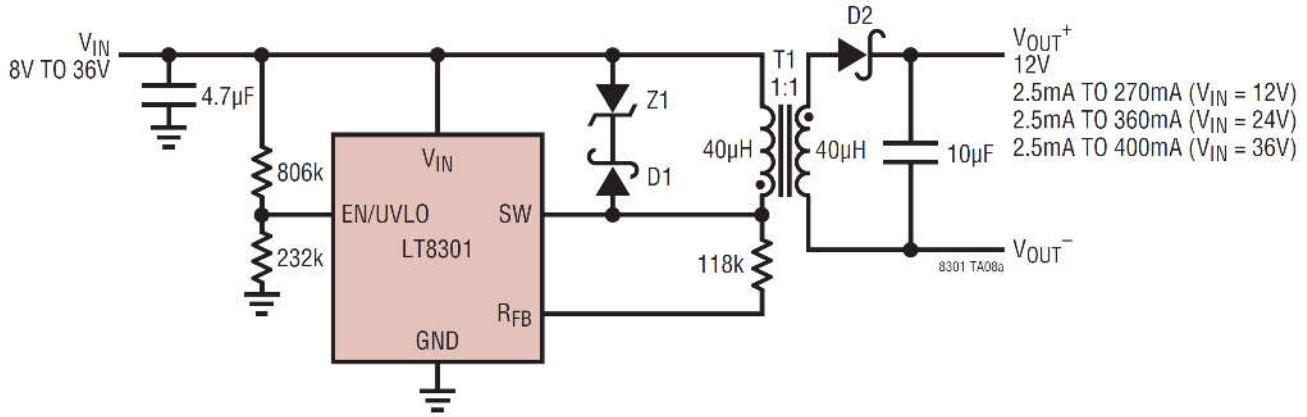
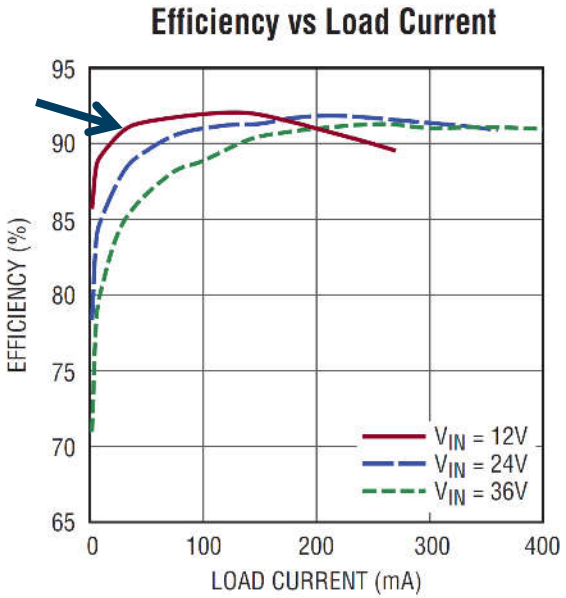
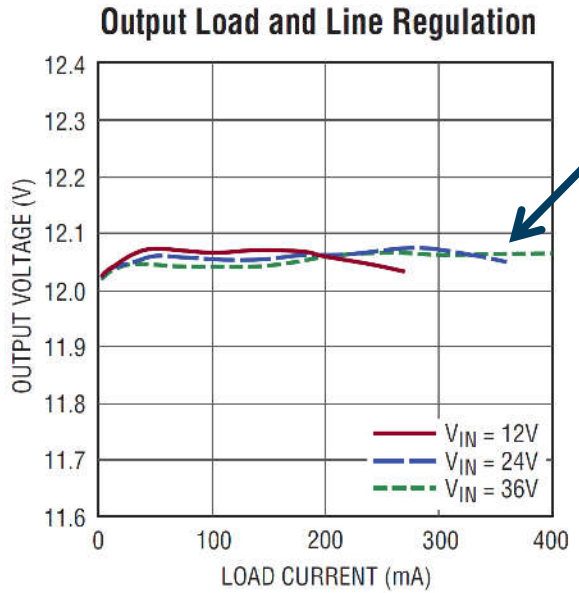
Isolated Flyback – Simple, but with Great Performance



>90% efficiency





+/- 0.5% regulation

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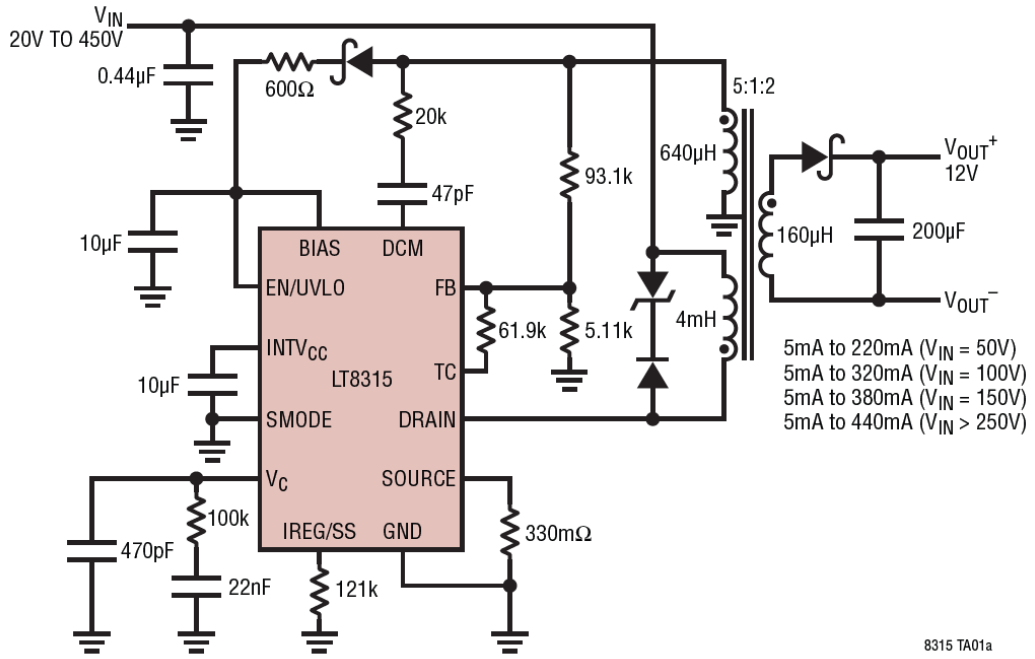
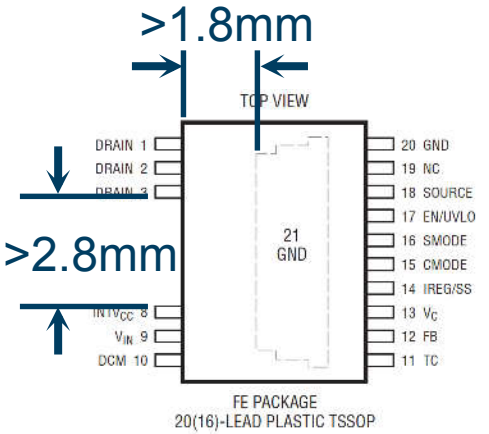
EVs and EHVs need many isolated supplies

Very-wide-V_{IN} Isolated 6W, $12V_{OUT}$



- V_{IN} Range: 20V to 540V
- 300mA, 630V Internal Power Switch
- Delivers up to ~10W from 250-450V_{IN}



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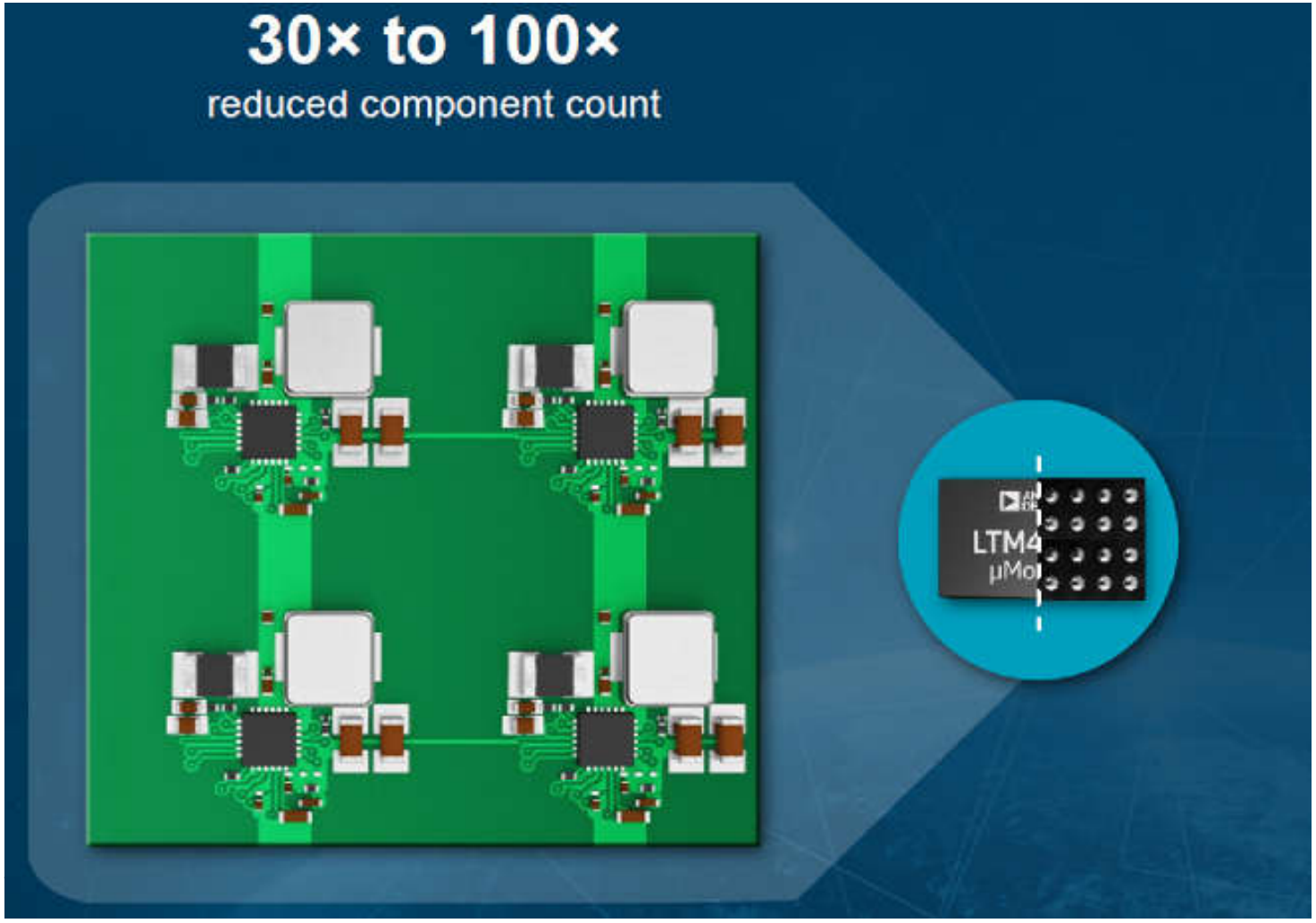
Power Innovation Technologies

Reduce form factor enabling customers to reduce PCB space or add incremental functionality



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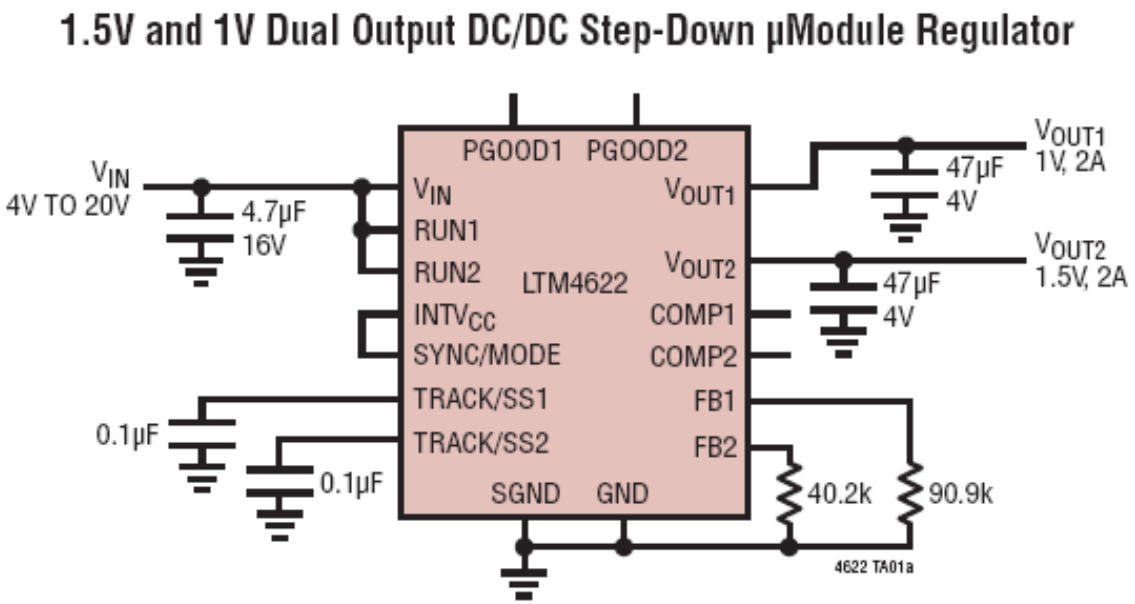
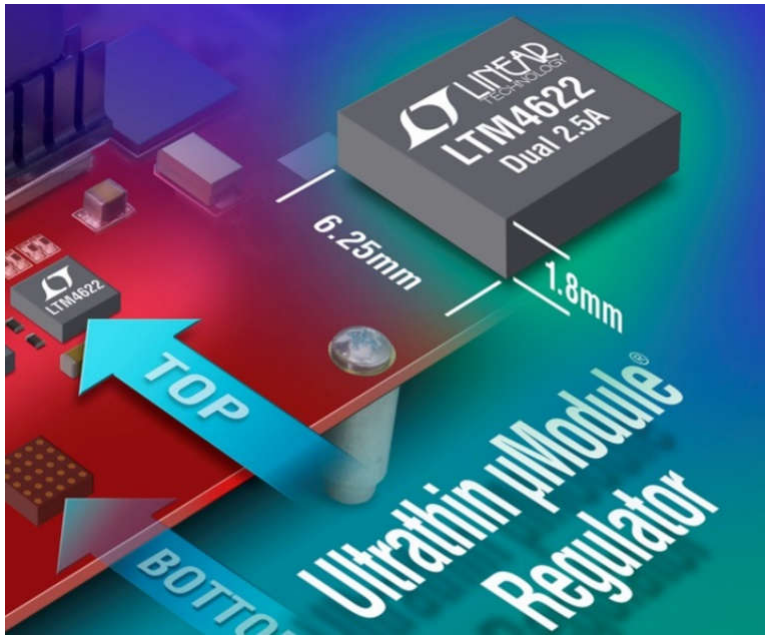
LTM4622 Dual 2.5A Power Module 6.25mm x 6.25mm





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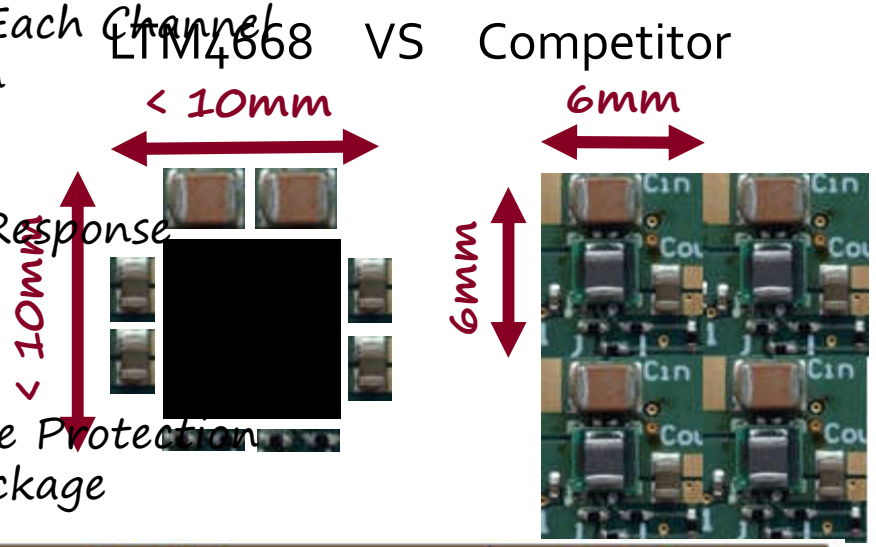
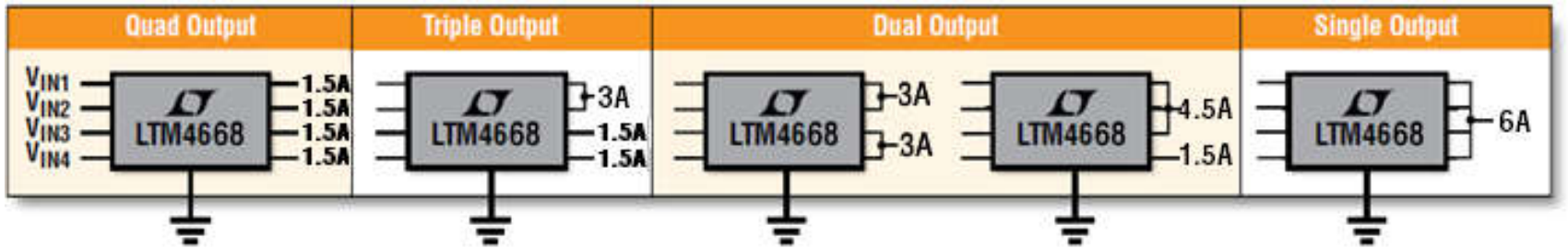
LTM4668 Quad 1.5A Power Module

FEATURES

- **Quad Output Step-Down µModule Regulator with 1.5A per Output Channel**
- Wide Input Voltage Range: 2.7V to 17V
- 0.6V to 1.8V Output Voltage (LTM4668A for 1.8V to 5.5V)
- 1.5A DC Parallelable, Output Current Each Channel
- ±1.5% Total Output Voltage Regulation
- 100% Duty Cycle Operation
- Low IQ<5uA for Each Channel
- Current Mode Control, Fast Transient Response
- External Frequency Synchronization
- Selectable Burst Mode
- Power Good Indicator
- Over Voltage, Current and Temperature Protection
- 6.25mm x 6.25mm x 2.1mm BGA Package





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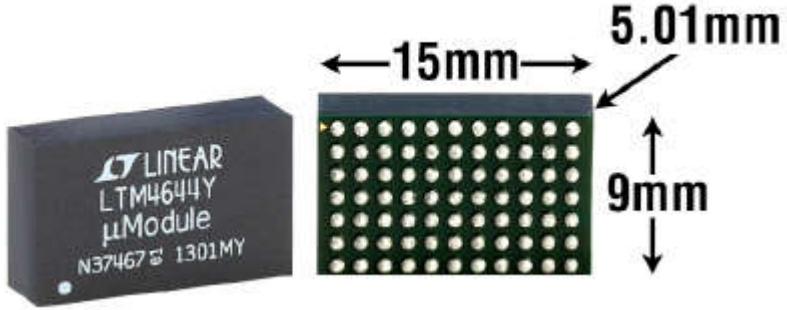
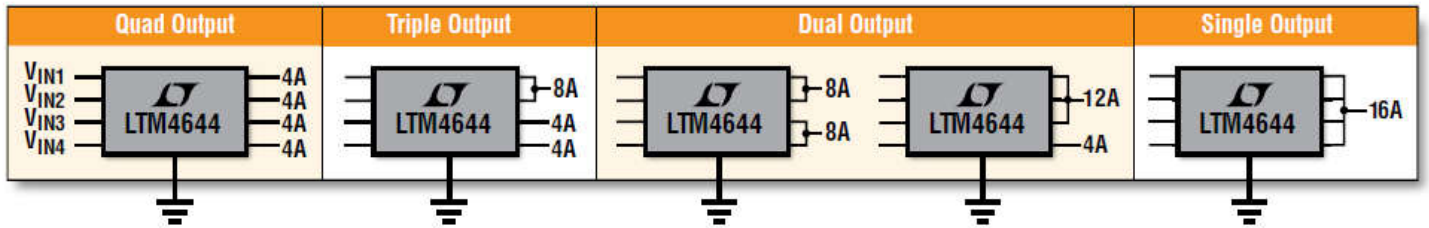
LTM4644 Quad 4A Power Module

FEATURES

- Quad Output Step-Down µModule® Regulator with 4A per Output
- Wide Input Voltage Range: 4V to 14V
  - 2.375V to 14V with External Bias
- 0.6V to 5.5V Output Voltage
- 4A DC, 5A Peak Output Current Each Channel
- Up to 5.5W Power Dissipation (T_A = 60°C, 200 LFM, No Heat Sink)
- ±1.5% Total Output Voltage Regulation
- Current Mode Control, Fast Transient Response
- Parallelable for Higher Output Current
- Output Voltage Tracking
- Internal Temperature Sensing Diode Output
- External Frequency Synchronization
- Overvoltage, Current and Temperature Protection
- 9mm × 15mm × 5.01mm BGA Package



LTM4644's Outputs Are Configurable from Four 4A Outputs to a Single 16A



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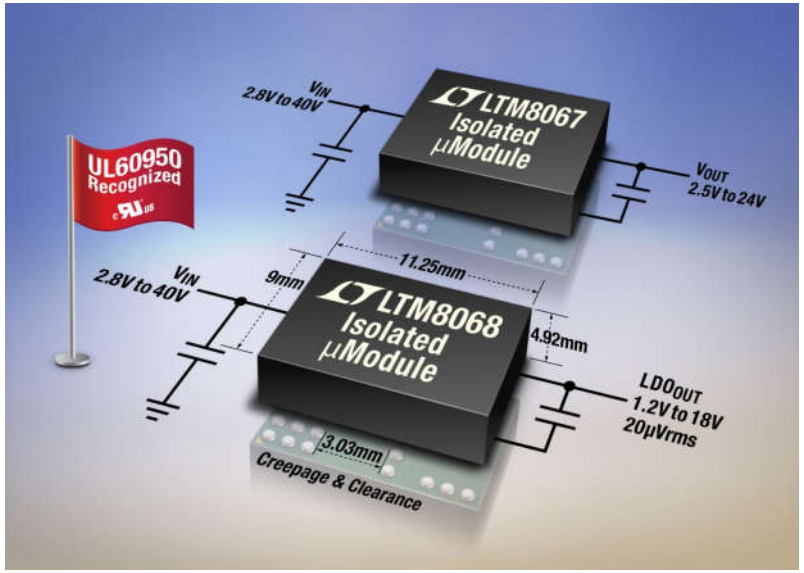
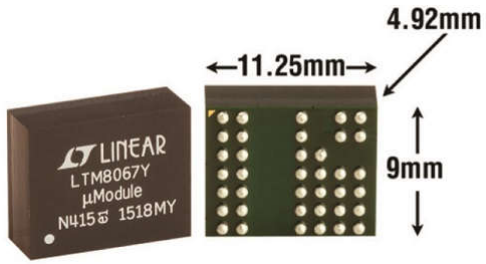
Isolated power module serial

Part Number	Isolation Voltage	Output Channels	Output LDO Out	Input Voltage (V) Min	Input Voltage (V) Max	Output Voltage (V) Min	Output Voltage (V) Max	Output Ripple	Output Power (24V to 5V)	UL Recognized	BGA Package Dimensions (mm)
LTM8047	725VDC	1	×	3.1	32	2.5	12	20mVRMS	1.5W	–	9 x 11.25 x 4.92
LTM8048		2	○	3.1	32	1.2	12	20µVRMS	1.5W Combined *	–	9 x 11.25 x 4.92
LTM8057	2kVAC (3kVDC)	1	×	3.1	31	2.5	12	20mVRMS	1.5W	UL60950	9 x 11.25 x 4.92
LTM8058		2	○	3.1	31	1.2	12	20µVRMS	1.5W Combined *	UL60950	9 x 11.25 x 4.92
LTM8067		1	×	2.8	40	2.5	24	30mVRMS	2.25W	UL60950	9 x 11.25 x 4.92
LTM8068		2	○	2.8	40	1.2	18	20µVRMS	2.25W Combined*	UL60950	9 x 11.25 x 4.92
LTM8046		1	×	3.1	31	1.8	12	20mVRMS	2.75W	UL60950	9 x 15 x 4.92

*combine isolated output and LDO output





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Power Management for Industrial

Ideal Diode

Silent Switch DC/DC

Isolated Power

Power uModule

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Autonomous Transportation

Enabling a Safer Autonomous Future

Safety Expertise in Automated and Autonomous Applications

- Self Driving Cars
- Drones
- Marine and Rail
- Agriculture (Tractor)
- Industrial Robotics
- Driver Assistance Systems
- Airbag Systems

Drive360™ Portfolio of Perception and Navigation Technologies

Drive360™ AUTONOMOUS DRIVING SOLUTIONS

Radar

Leading-edge 24 GHz and 77 GHz/79 GHz RF transceiver solutions

Lidar

Nonmechanical, cost-effective photonic technology

Inertial Measurement Units

Navigation, guidance, localization, system health monitoring, sensor focused dead reckoning

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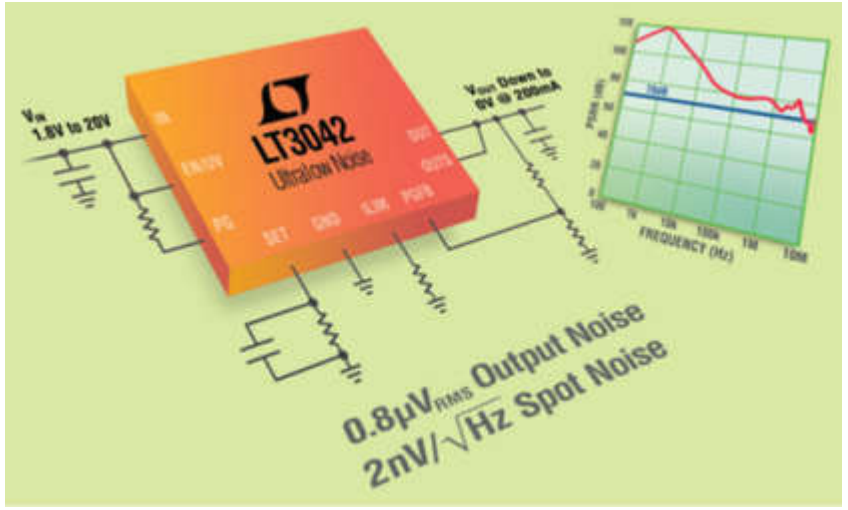
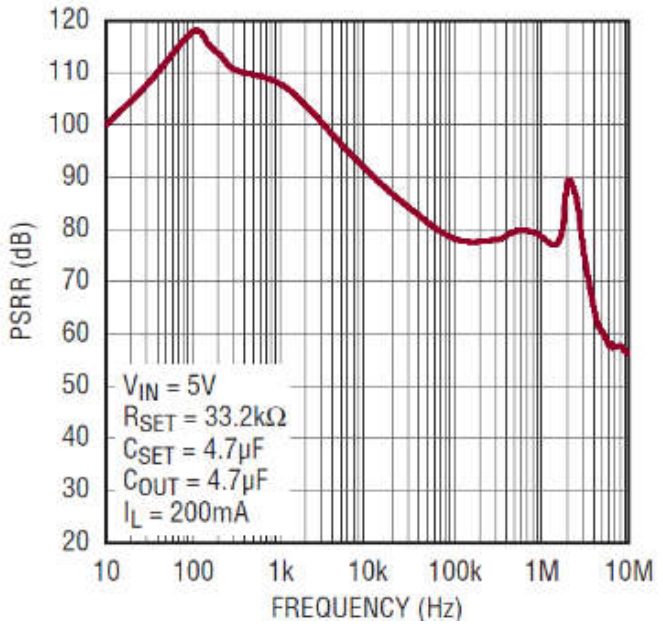
LDOs – Ultralow Noise, Ultrahigh PSRR family

- **Ideal for 77/79GHz automotive radar applications**
- Ideal for RF applications
  - Reduces phase noise for PLLs and synthesizers
- Industry's lowest noise and highest PSRR
  - **LT3042** (200mA) **LT3045** (500mA)
    - RMS Noise: 0.8μV_{RMS} (10Hz to 100kHz)
    - Spot Noise: 2nV/$\sqrt{Hz}$ at 10kHz
    - PSRR: ≥76 dB at 1MHz
  - **LT3094** (500mA, negative-V_{OUT})
    - Similar Noise and PSRR specs





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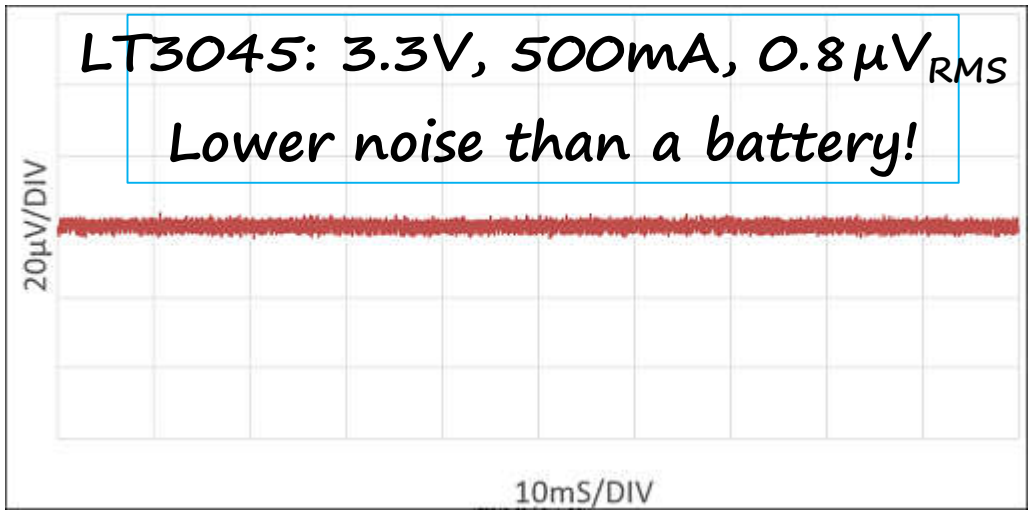
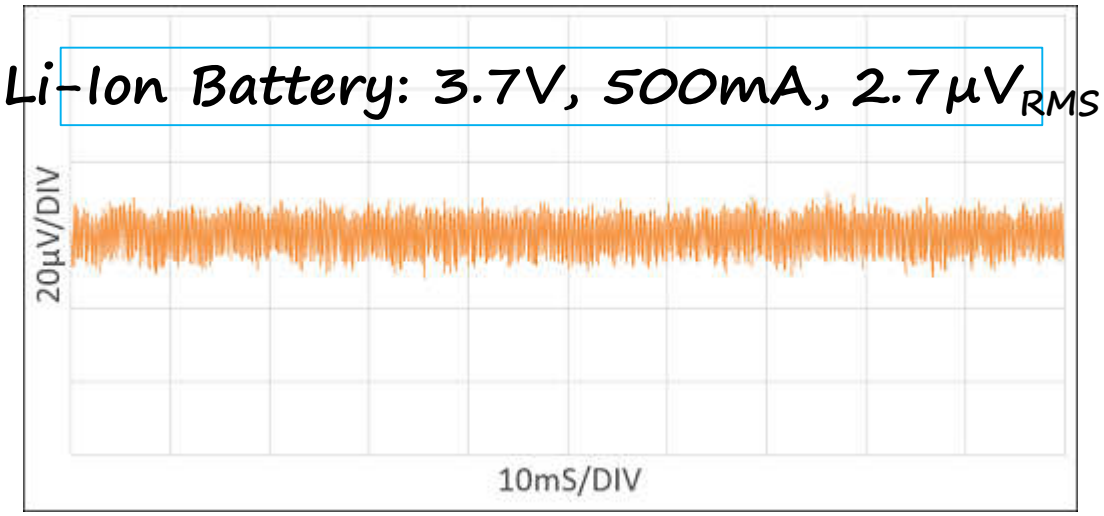
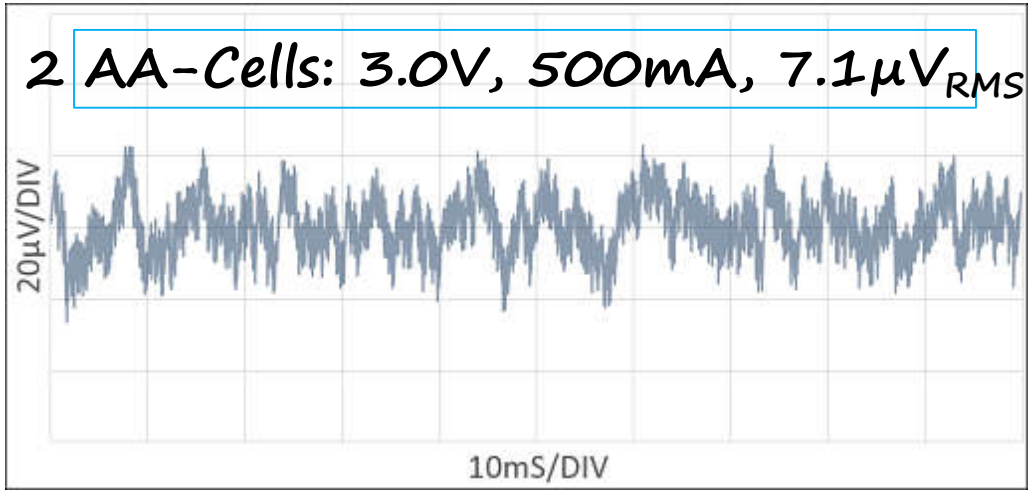
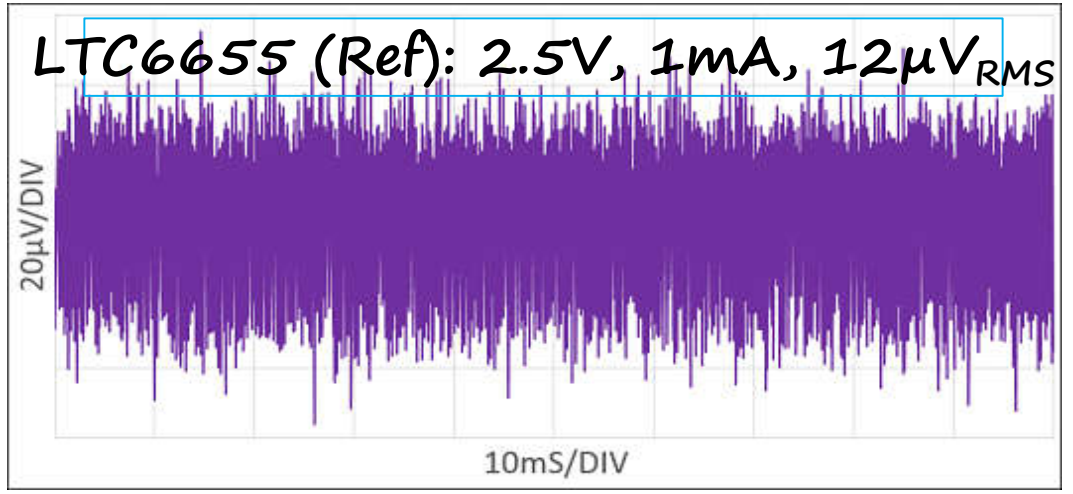
Innovation-Low noise power









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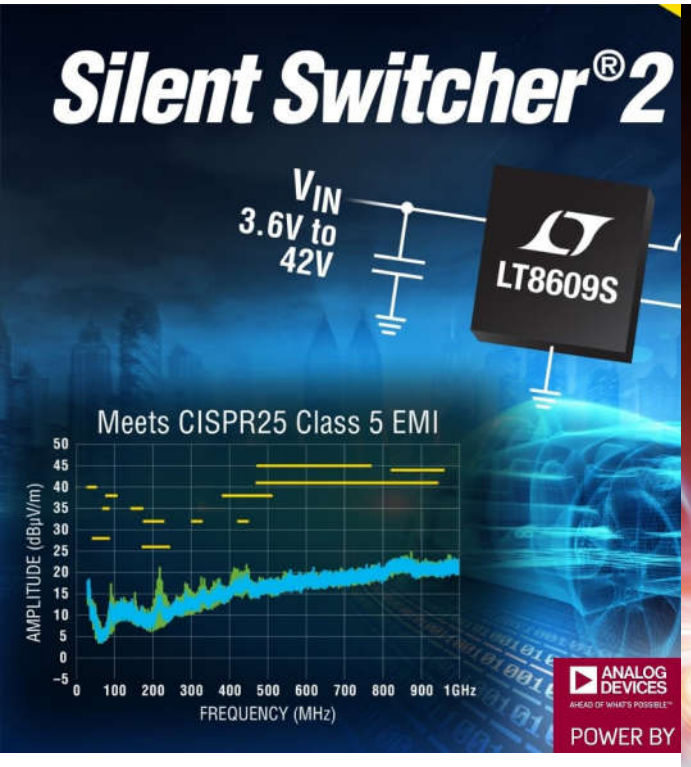
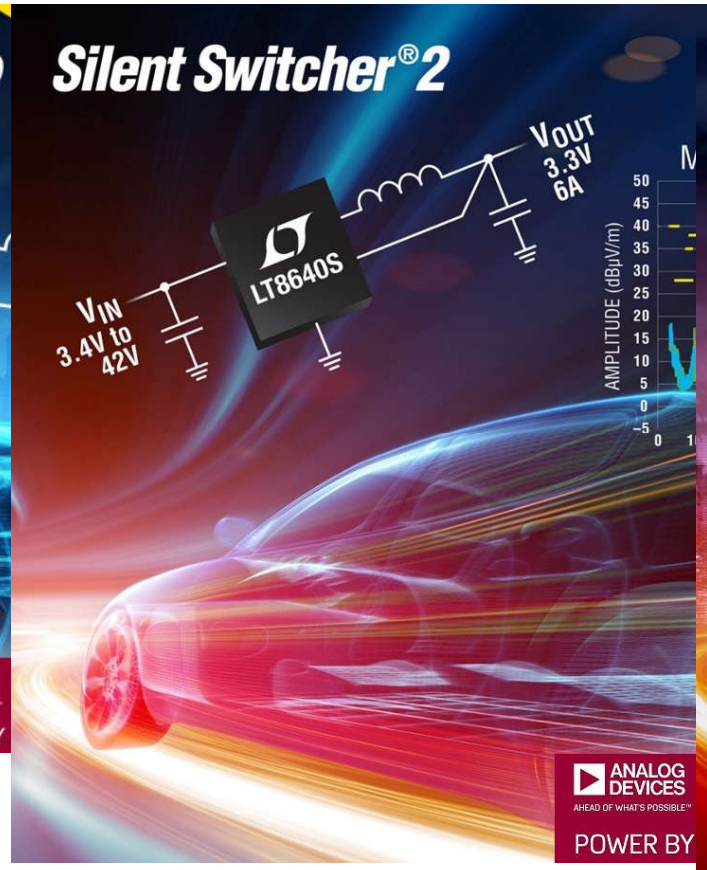
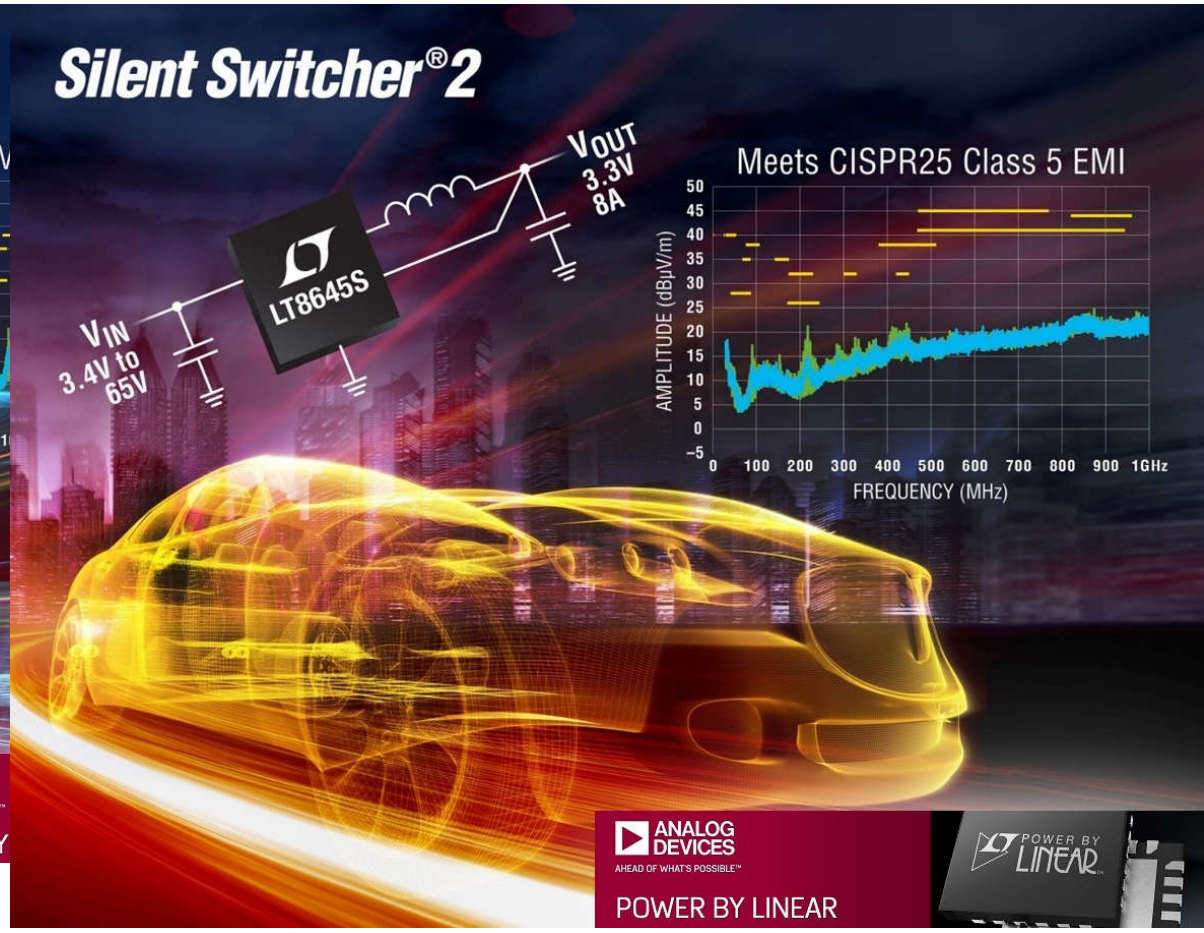
Power Innovation Technologies







Reduce electromagnetic interference (noise)

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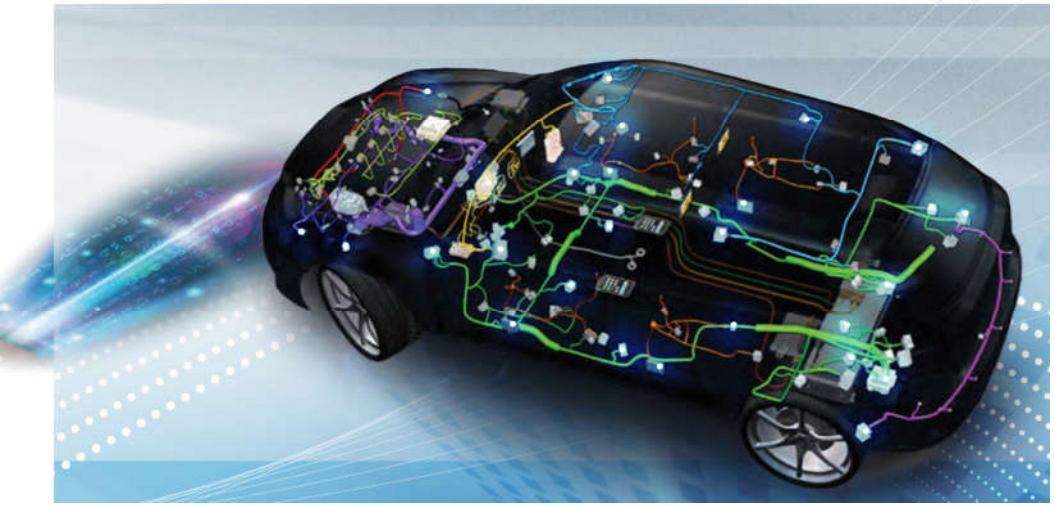
Power Innovation Technologies

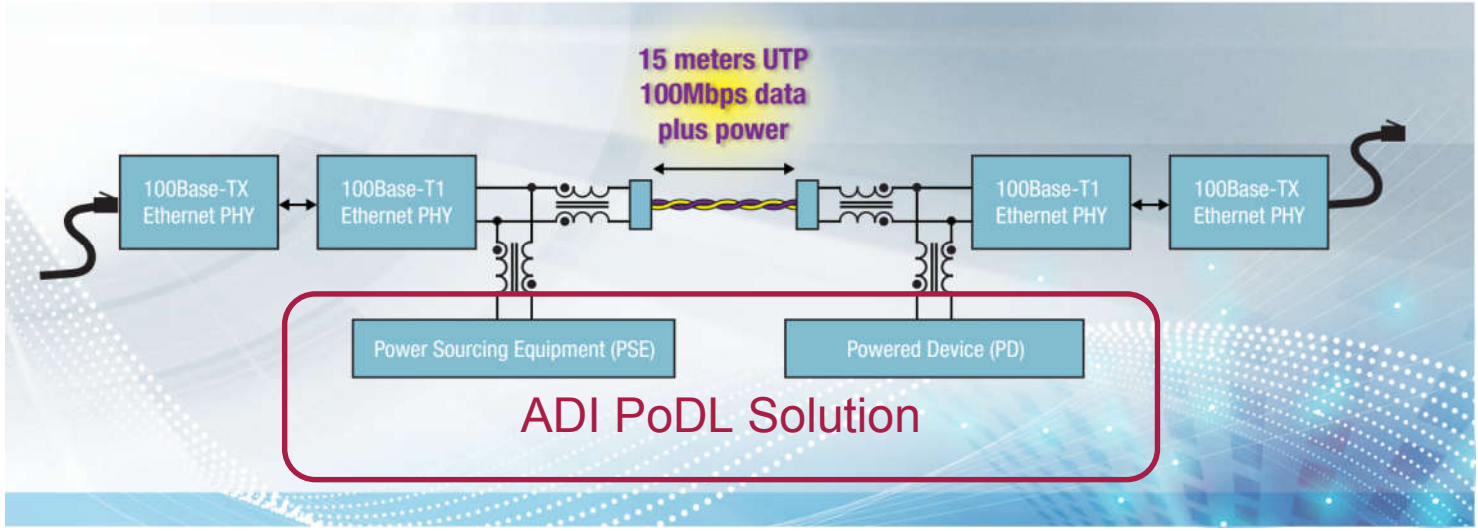
PoDL Power Over Data Line

The future of autonomously driven vehicles is around the next bend

High Bandwidth Automotive Ethernet Combined with PoDL Will Solve Many of Today's Interconnectivity Challenges, Enabling a Fully Networked Vehicle, in Addition to Bringing Significant Weight and Cost Advantages.



Save Vehicle Weight and Cabling Cost Using UTP/PoDL



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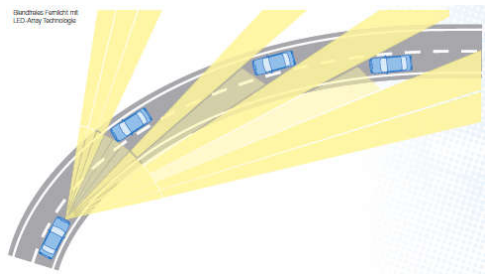
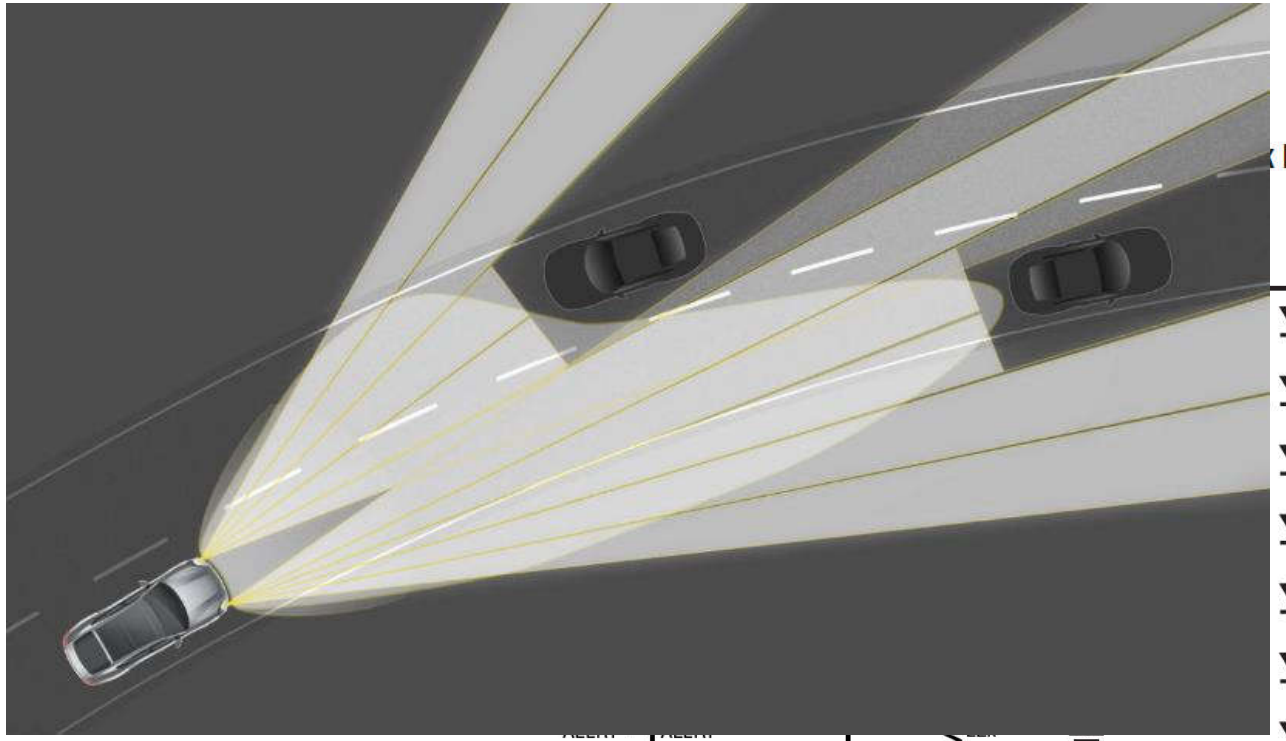
Innovation Care about your safety

- LED Headlamps now provide style and greater safety





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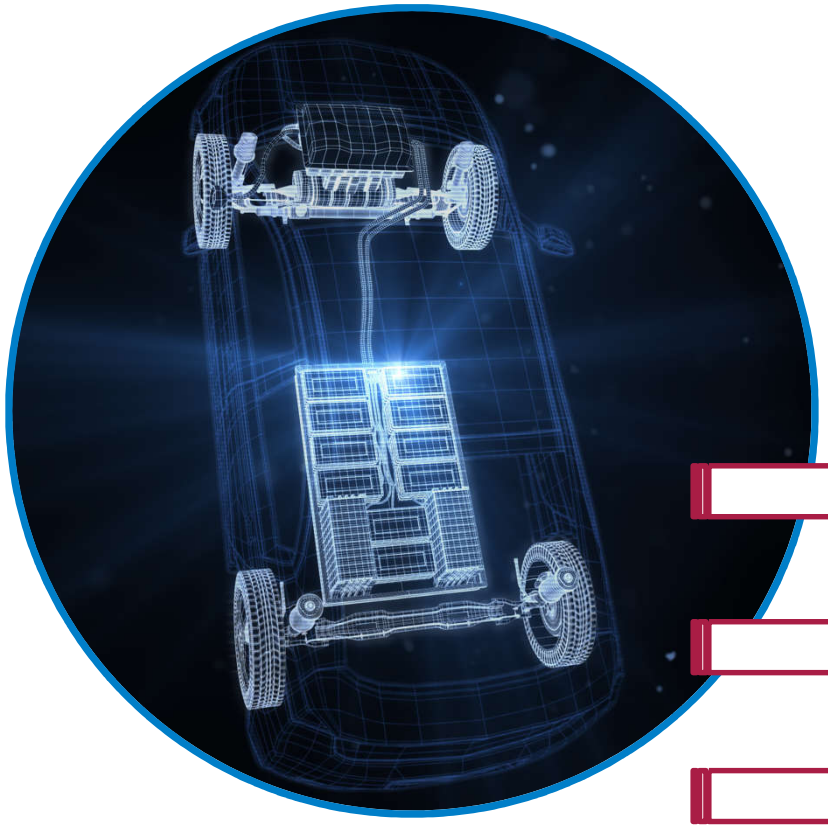
Automotive Electrification

Making Tomorrow's Cars Greener and More Efficient



Extensive Experience in Car Electrification

- Electric and Hybrid Battery Management
- Automotive Powertrain
- Cabin Infotainment

Leading Solutions for Increased Electronic Content Power Management

Power Management

Battery management systems, power distribution network, xMR sensors

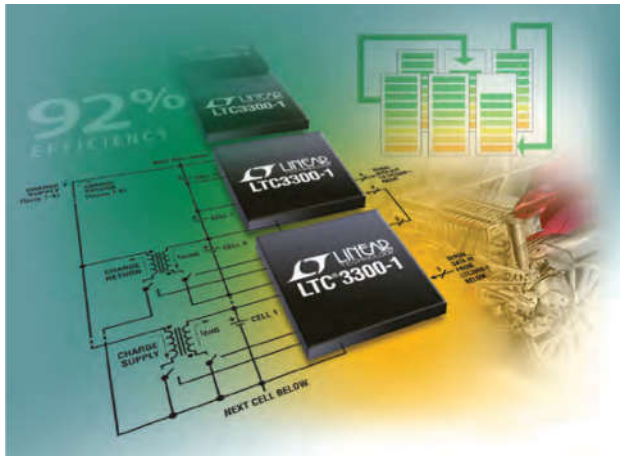
Power Train

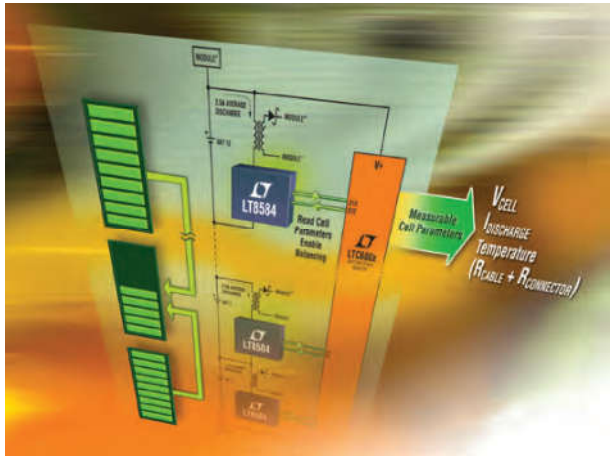
Motor control, chassis control, start-stop, electric drive

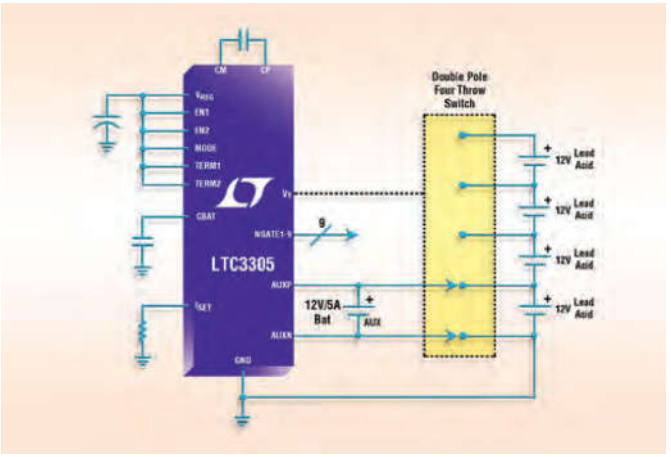
Infotainment

Audio video processing, telematics, driver monitoring

Battery Active Balanceing







Battery energy optimization

Safe drive longer distance

ANALOG DEVICES
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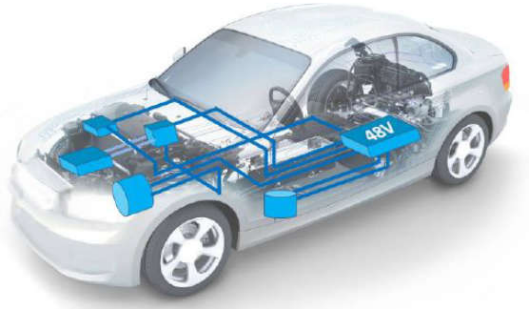
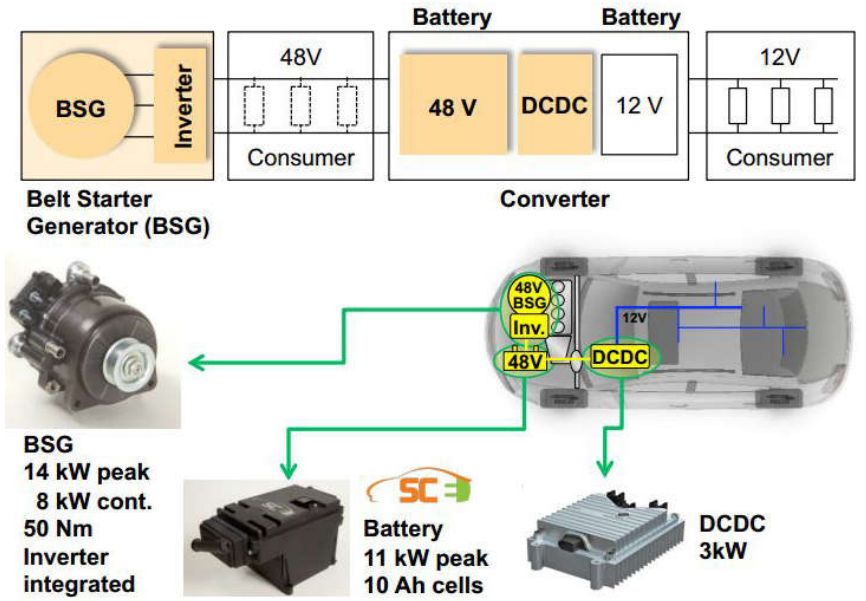
LTC3871 – Bidirectional Multi-Phase Synchronous Buck or Boost Controller

- Targeted 48V/12V Dual Battery Applications:
  - Automotive Internal Combustion Engines
  - Hybrid Electric Vehicles
  - Mild Hybrid Electric Vehicles





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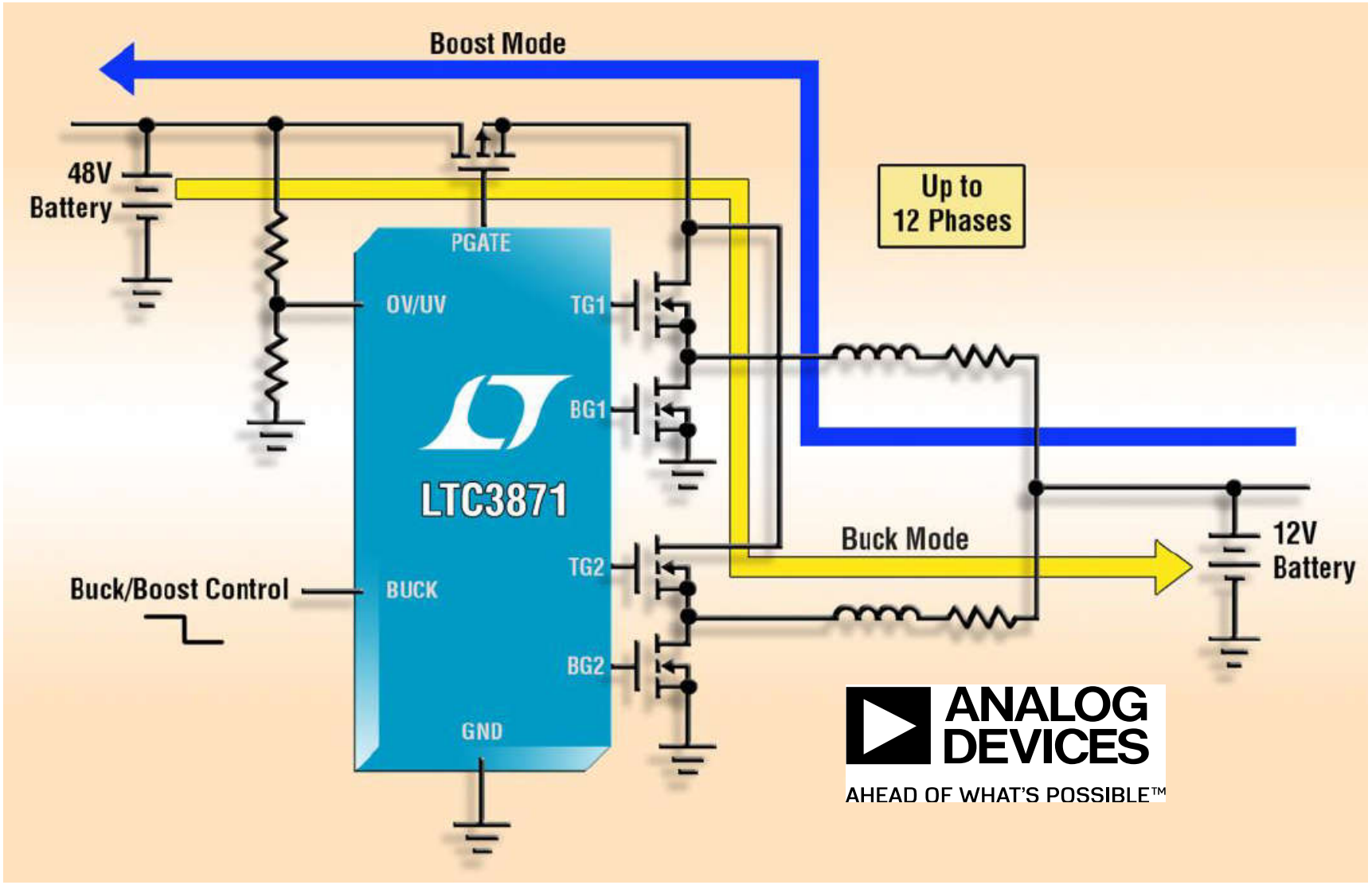
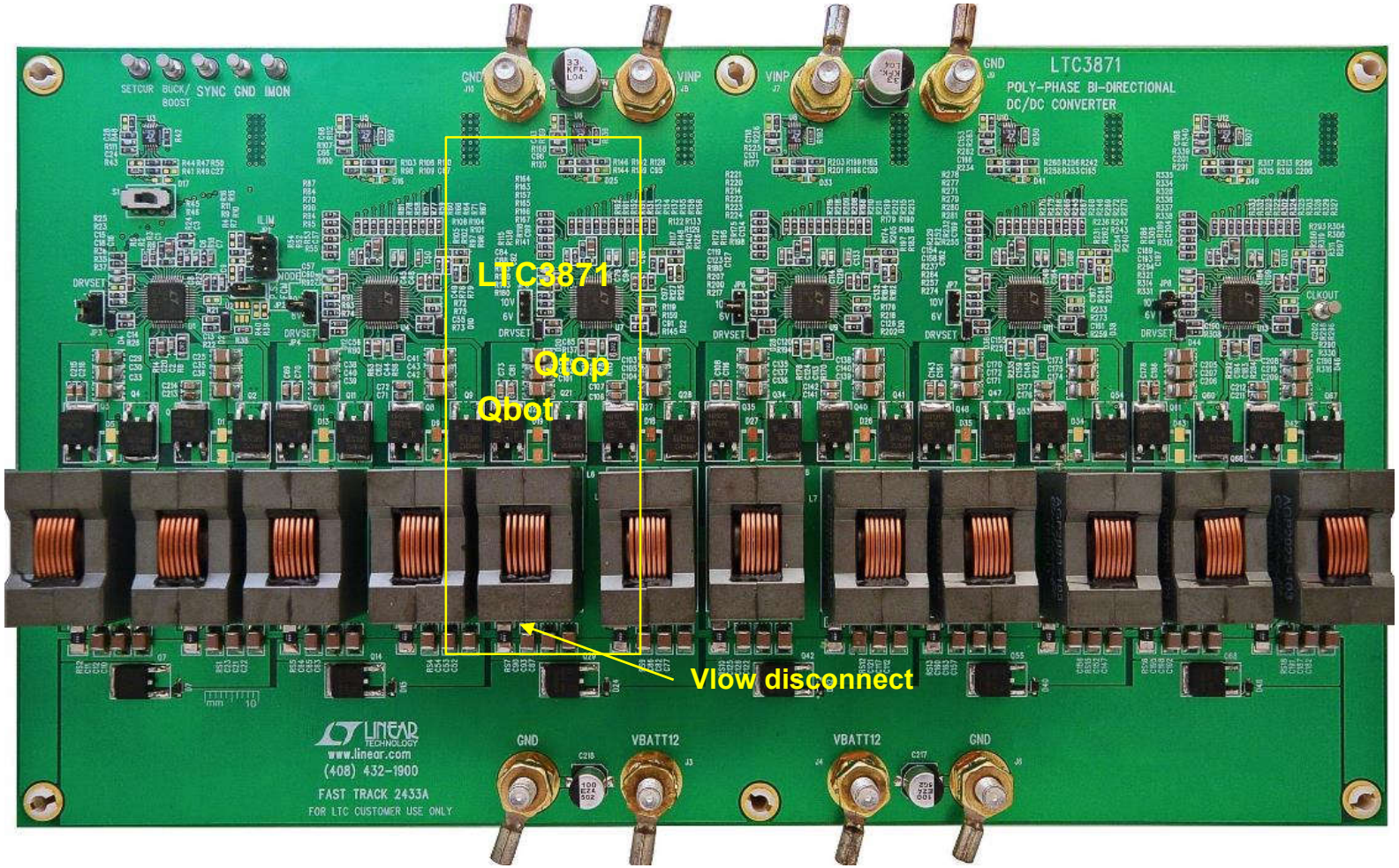
Concept of the LTC3871
Bi-directional DC/DC Converter



Concept of the LTC3871 Bi-directional DC/DC Converter



- Designed for 2.5kW (14V*180A, 15A/ph)
- Compact layout, cannot mount a heatsink
- Steady-state power 2kW (12A/ph) limited by thermal

ANALOG DEVICES
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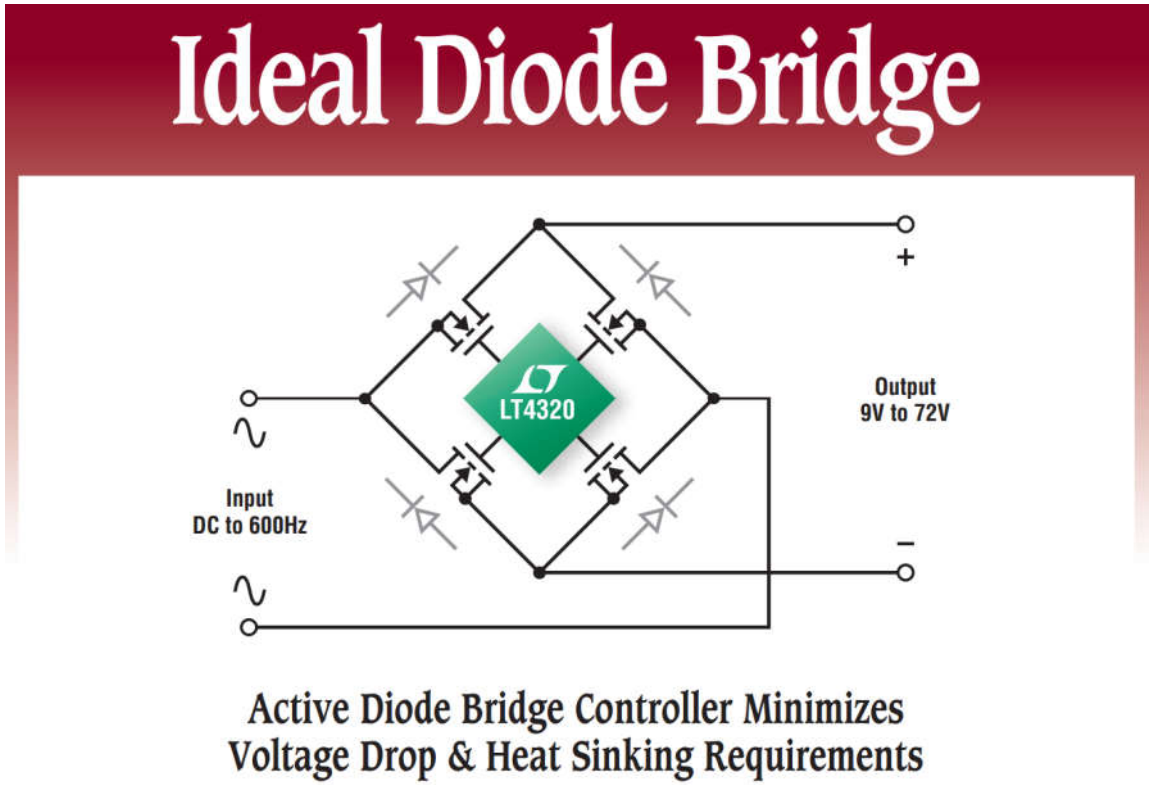
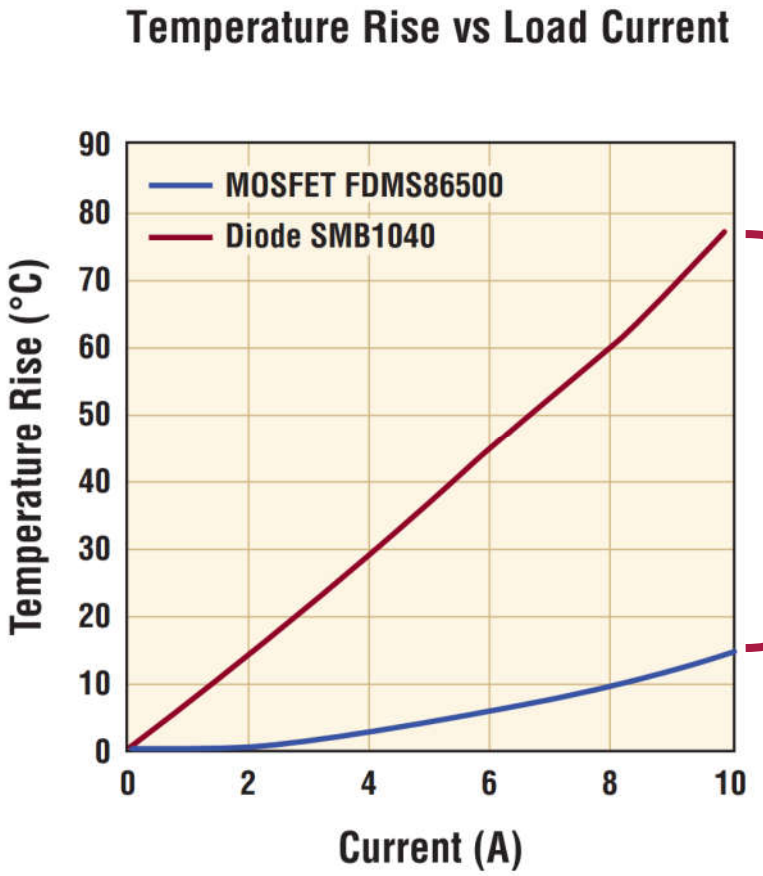
Power Innovation Technologies – Ideal diode Bridge





- Low power lose
- No heatsink
- High reliability
- High efficiency

ANALOG DEVICES
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Automotive Applications Need Surge Stoppers and OV/OC Protection Controllers to Protect Vulnerable Systems

Harsh Environment

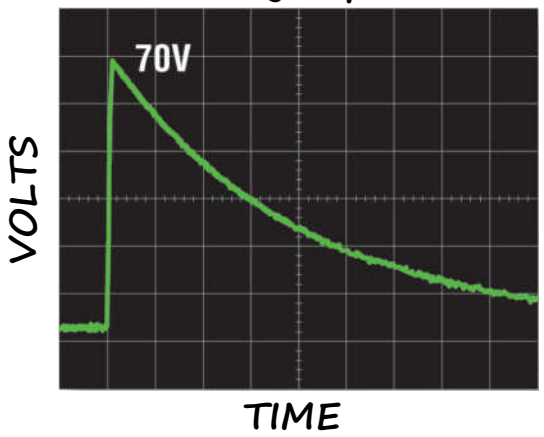
Power Flow

Protection Controller

Surge Stopper

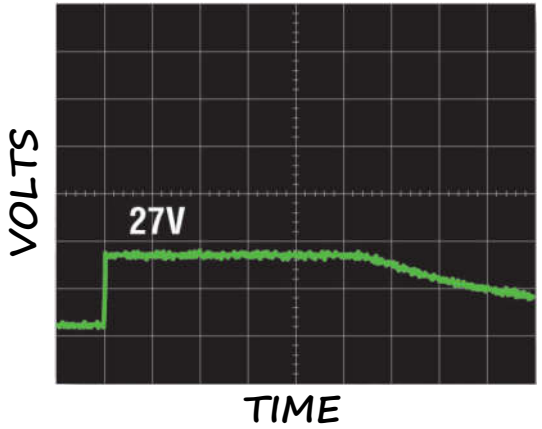
Protected Environment

Voltage Spike

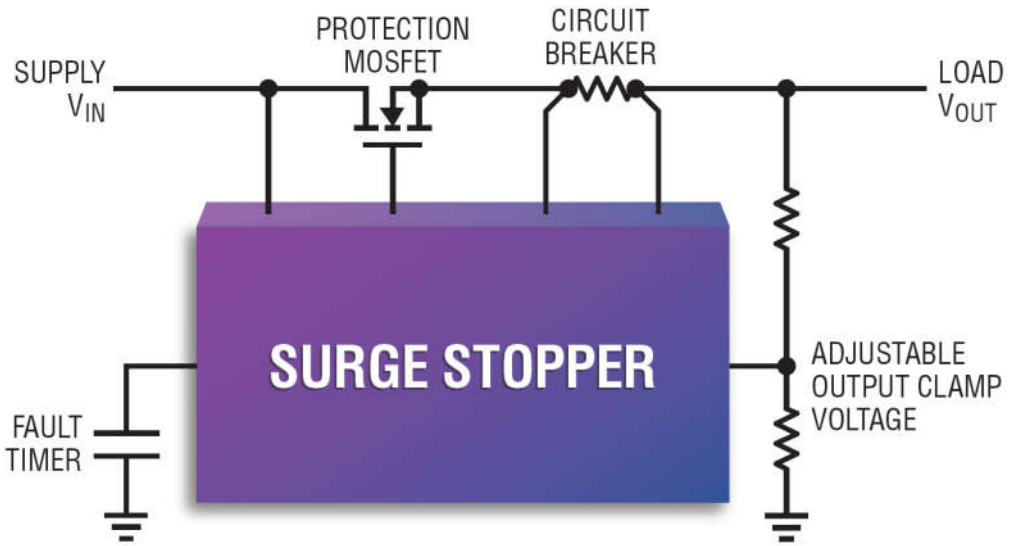


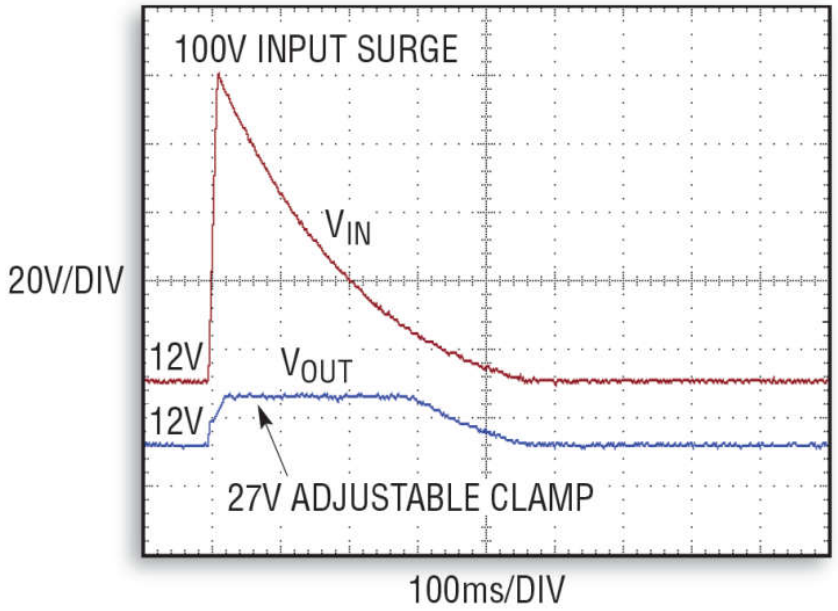
Suppresses Voltage Spikes

Voltage Clamped



ADI Surge Stoppers and OV/OC Protection Controllers: Value Proposition





Replaces TVS and/or Fuse

- Compact Solution
- Protects Load from Input OV/UV & Supply from Overload/Short-Circuit
- Disconnects Load from Supply for Sustained/DC Faults
- Adjustability Eases Design Changes and Reuse
- Tight Accuracy Minimizes Overdesign & Reduces Cost

ANALOG DEVICES
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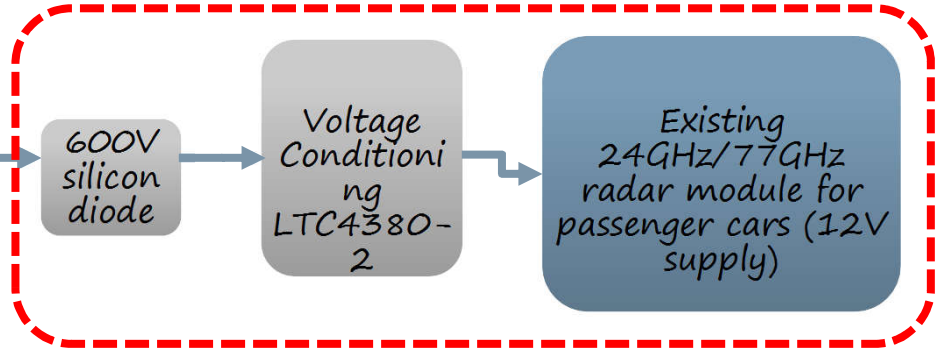
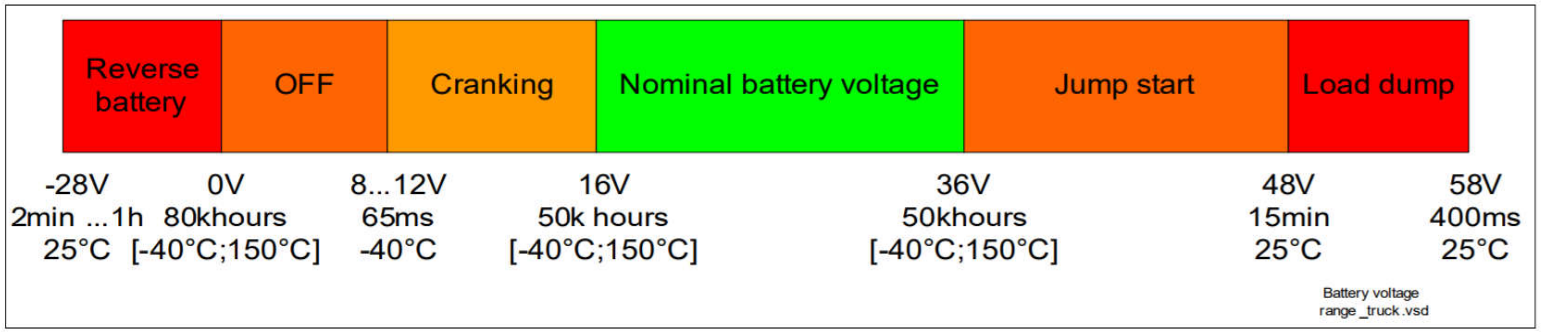
LTC4380-2: Low Iq Surge Stopper Protects Expensive Electronics From High Voltage Surges

Vsupply [-28V...+58V]

peak -600V for 1 ms



Typical mission profile



Function: Surge Stopper

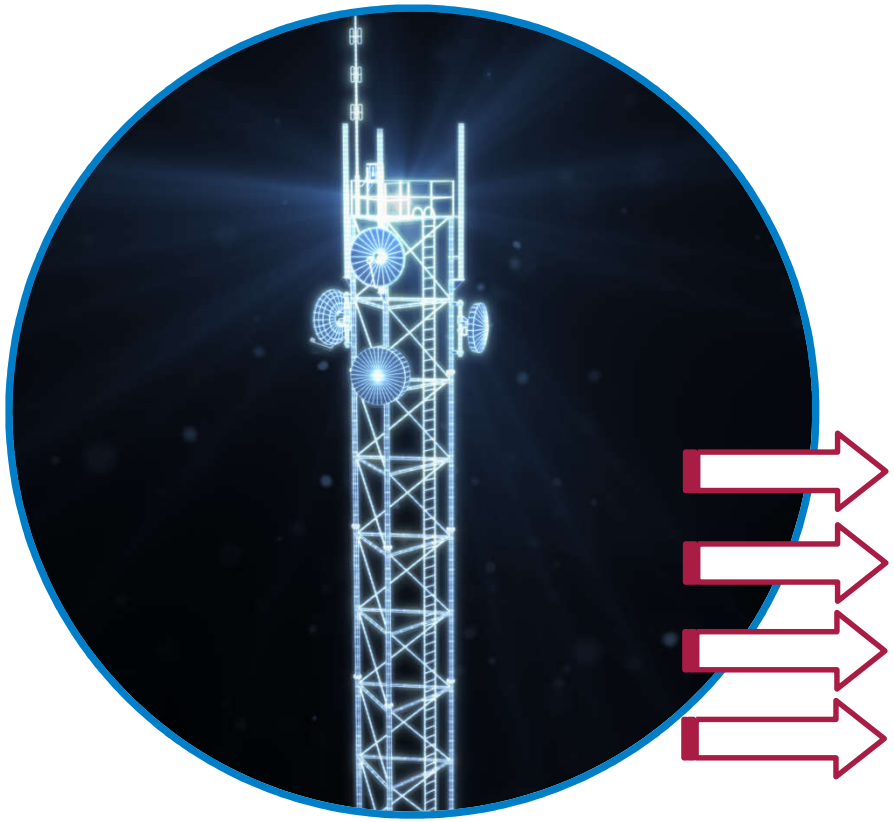
Application: Automotive Radar Application

Solution: LTC4380-2

The customer will choose the LTC4380-2 because it will protect the radar module from the hazardous voltages present in automotive applications and has low quiescent current

Communications

Driving Innovation for Next-Generation Communications



Connectivity Solutions for 5G and Beyond

- 5G and 6G Networks
- Aerospace and Defense
- Instrumentation
- Drones
- Point-to-Point, Satellites
- Data Centers
- Cable Networks

Get to Market Faster with Best-in-Class Expertise Coupled with Design Capabilities, Tools, and Software

RadioVerse™

- Wireless: Market leading solutions for radio head and base station processing
- Cable Access: Leading technology for 5G cable including full duplex solutions
- Optical Networking: Optical transceivers solutions, high speed converters, power
- Satellite/Point-to-Point: Deep portfolio plus market leading solutions for high frequency 5G wireless solutions

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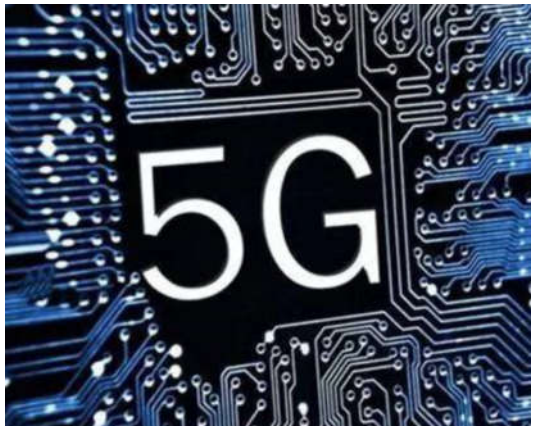
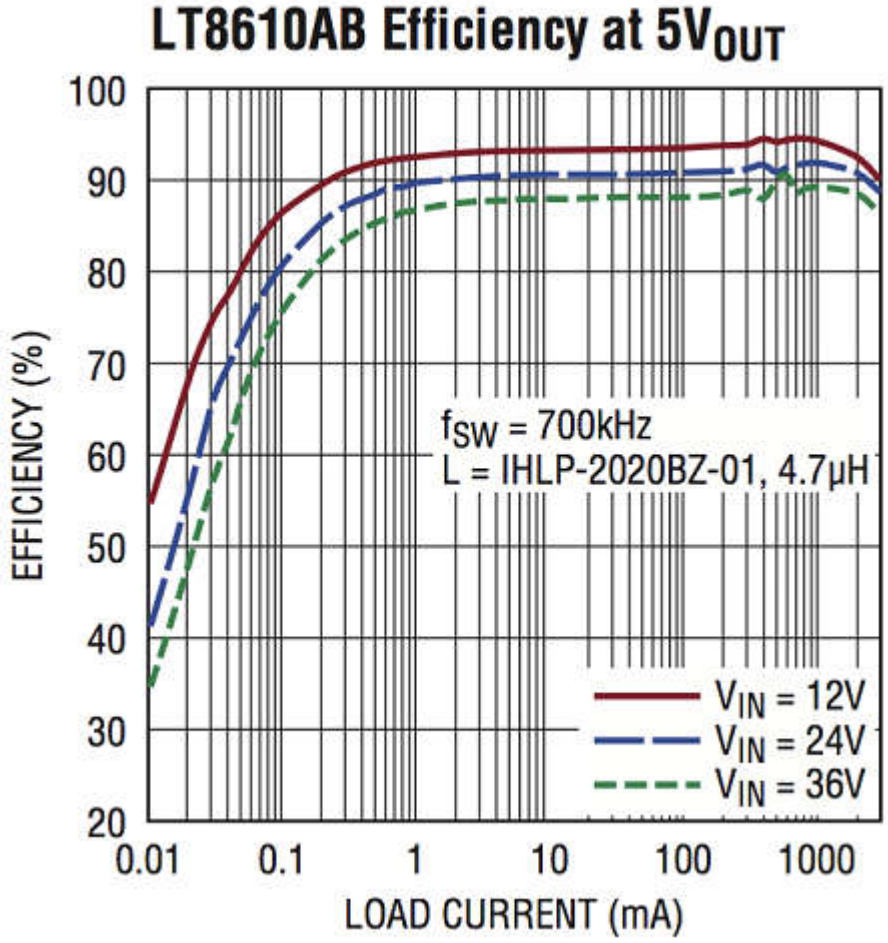
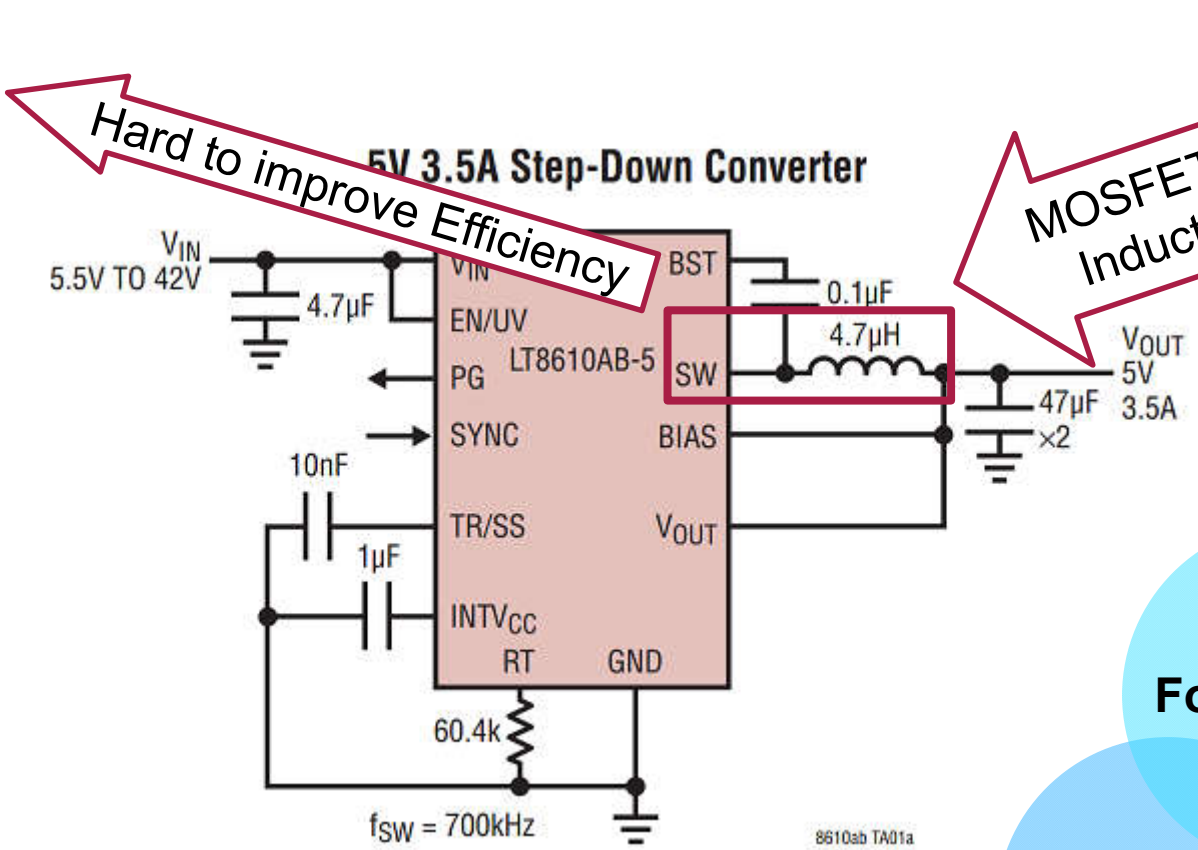
Power Innovation Technologies

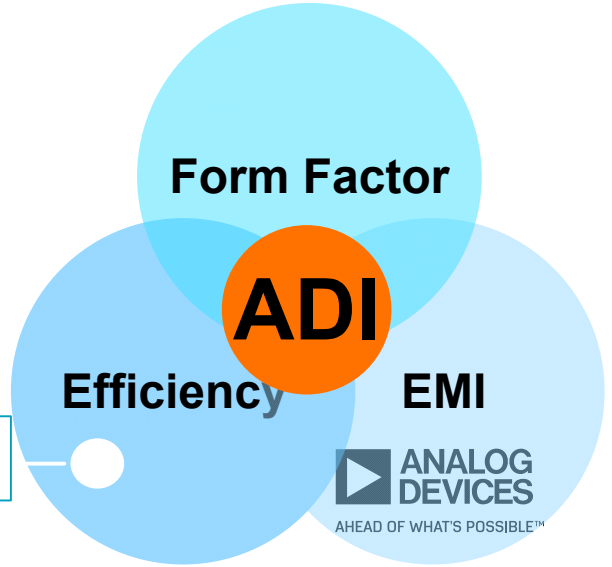


- High Power Density
- Need High efficiency
- Need High reliability

Power Innovation Technologies

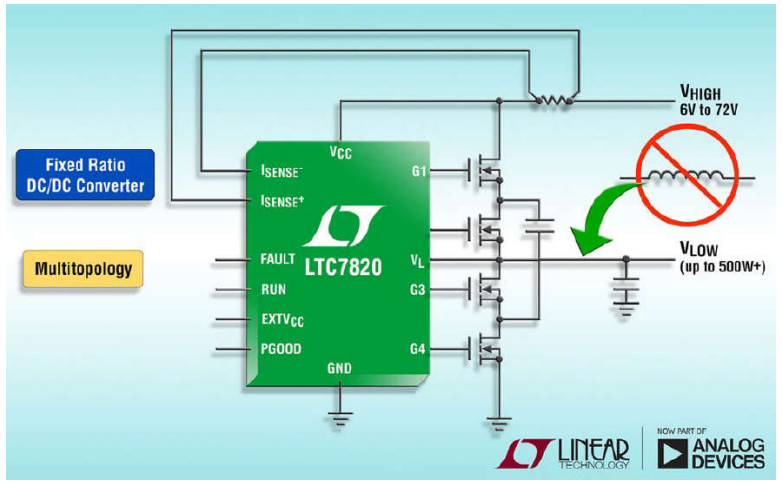




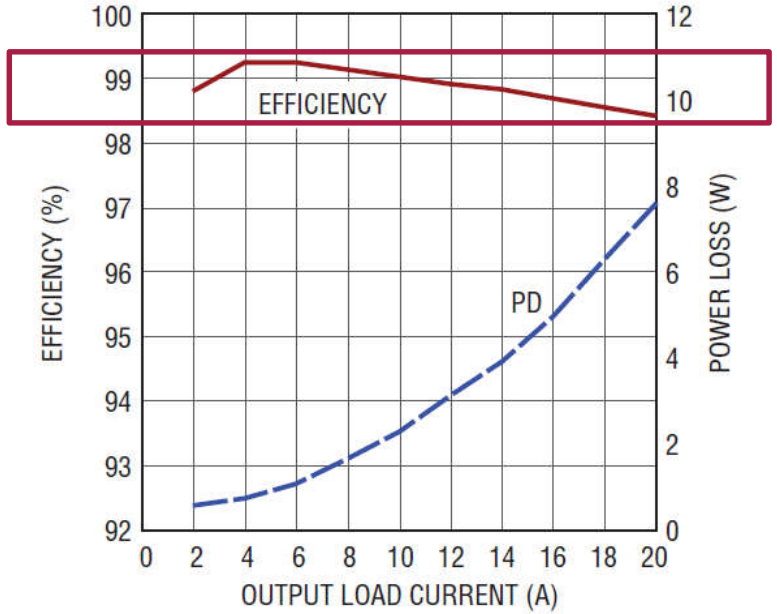


Manage power dissipation (heat) in the smallest of form factors

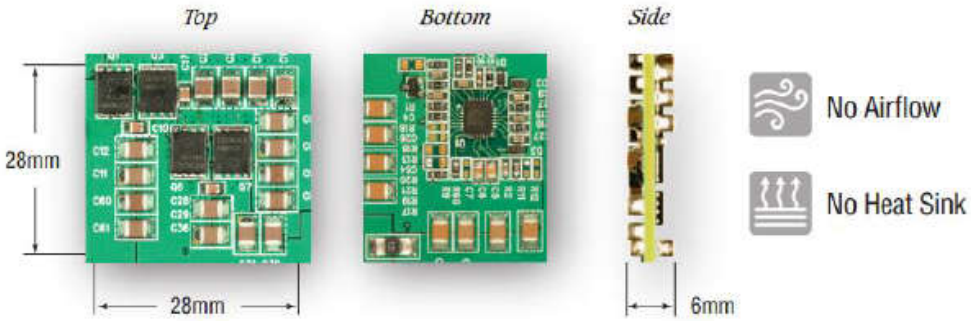
Power Innovation Technologies Inductorless Converter LTC7820



48V to 24V 500W



Inductorless Bus Converter



99% Efficient Step-Down, Step-Up or Invert

ANALOG DEVICES
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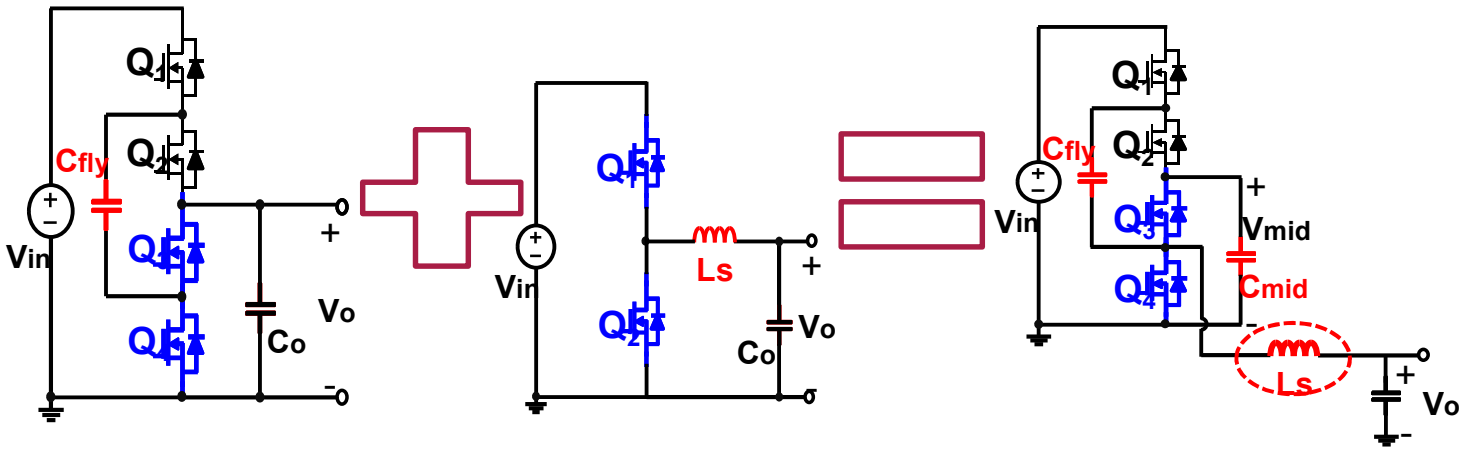
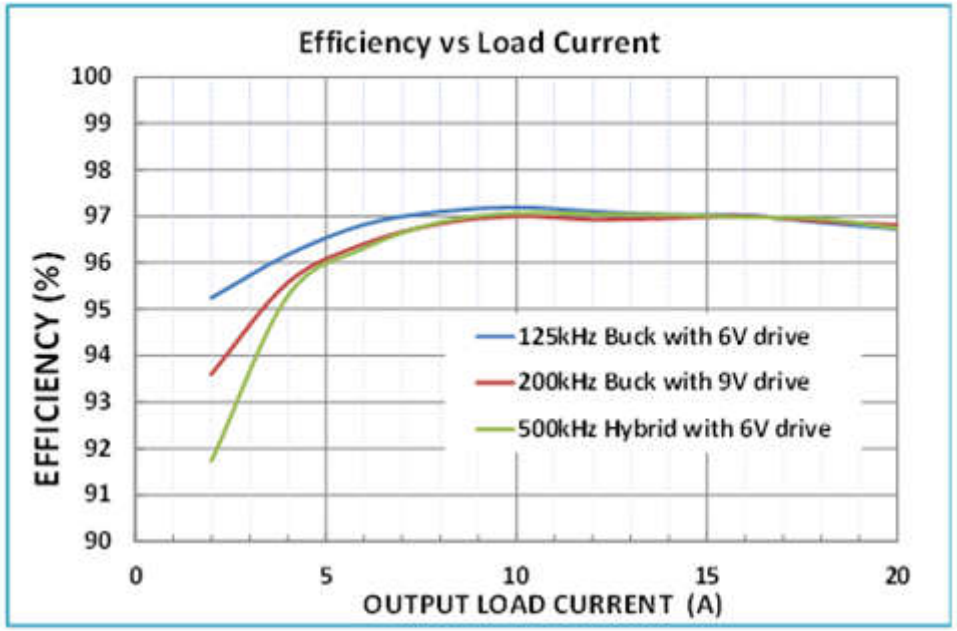
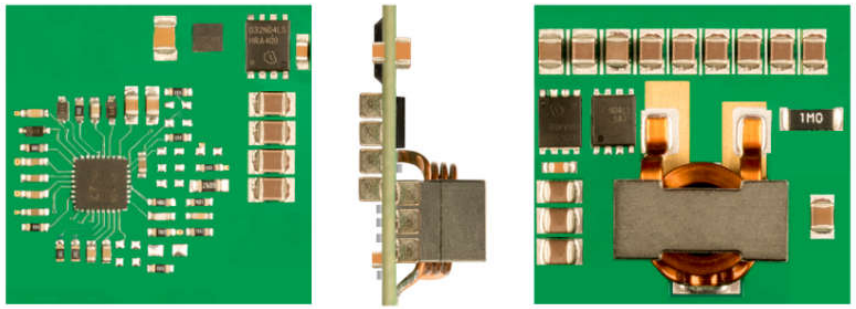
Power Innovation Technologies Hybrid Converter LTC7821

Switched Capacitor **Synchronous Buck** ❖ **Hybrid Converter**







Non-Isolated Distributed Power Architecture Using LTC7821

48V to 24V 500W

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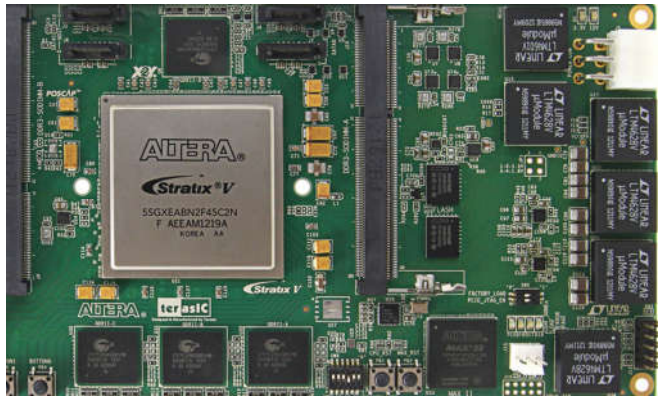
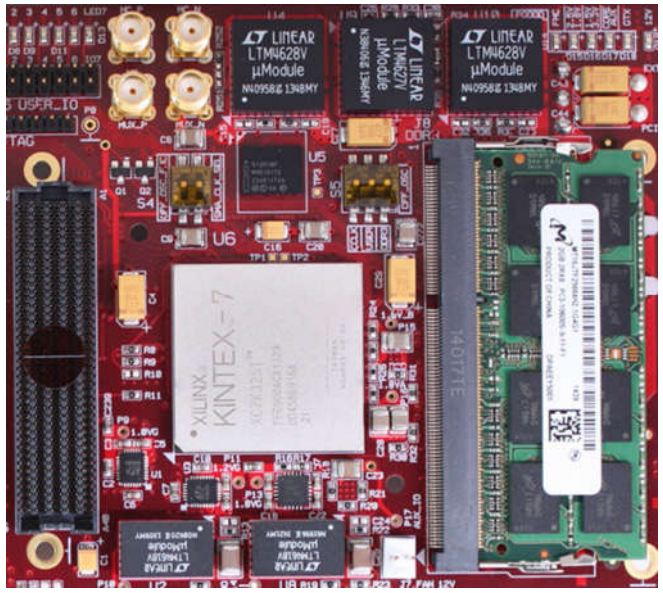
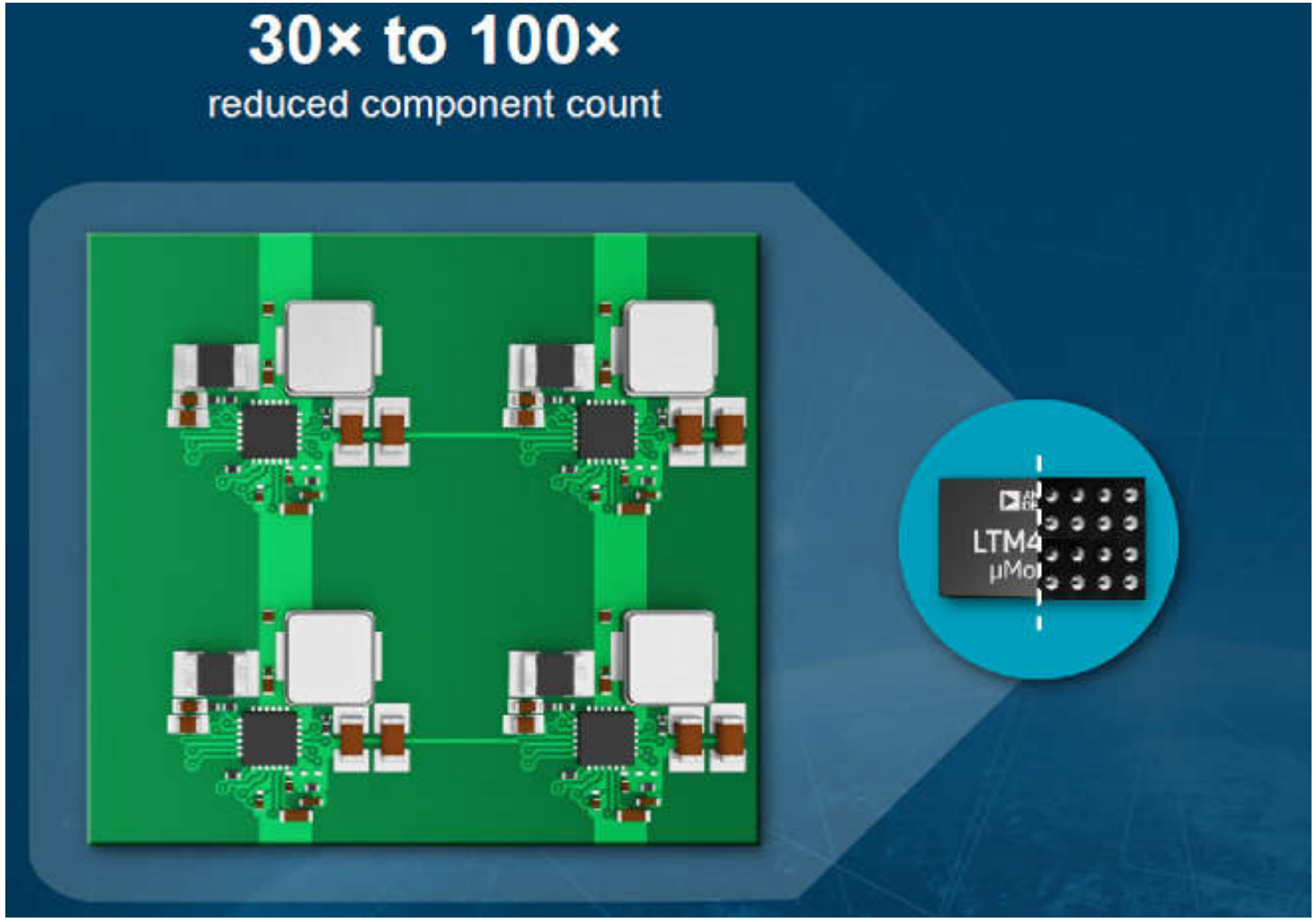
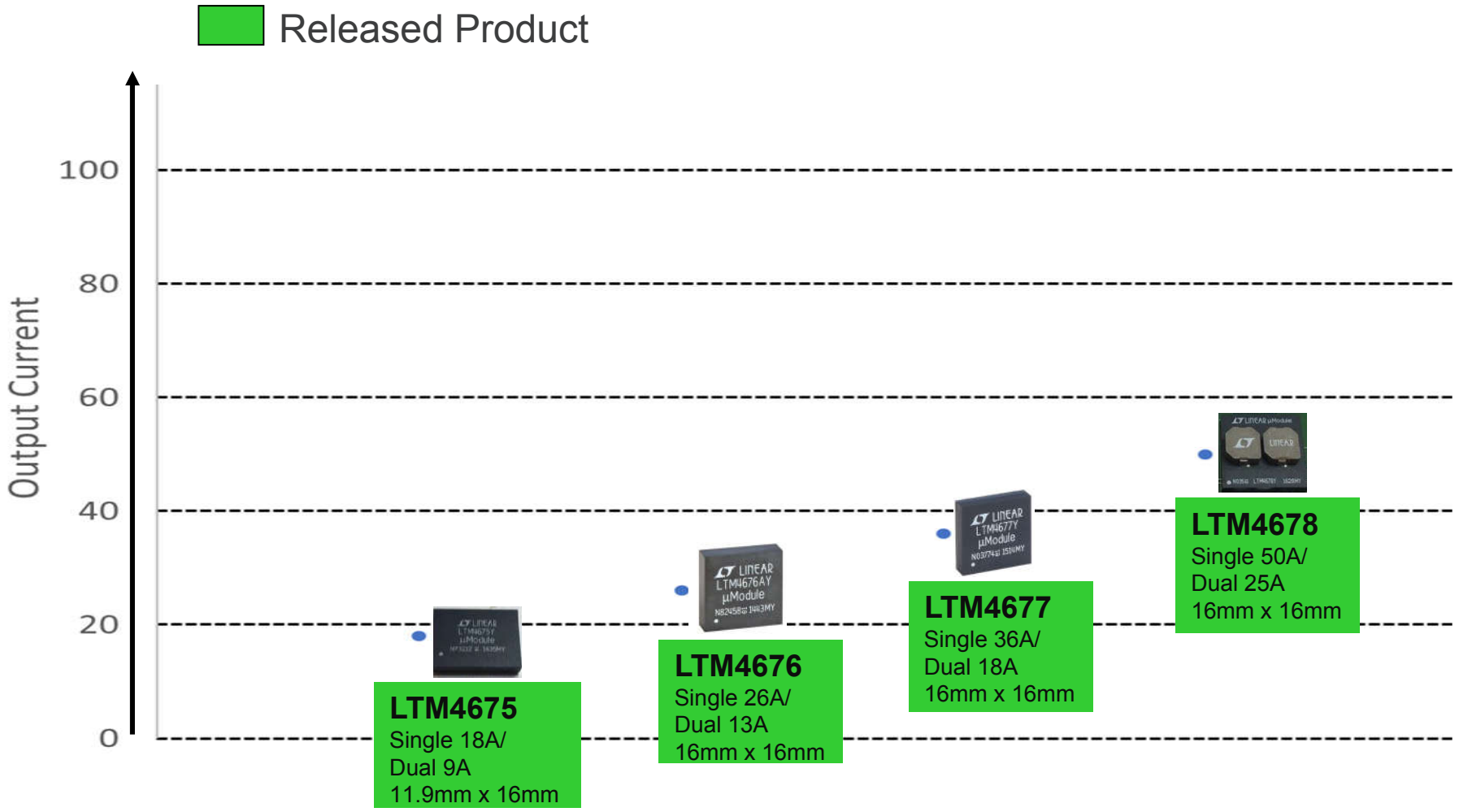




Reduce form factor enabling customers to reduce PCB space or add incremental functionality



High Current µModule Regulator Roadmap with Power System Management (PSM)



ANALOG DEVICES
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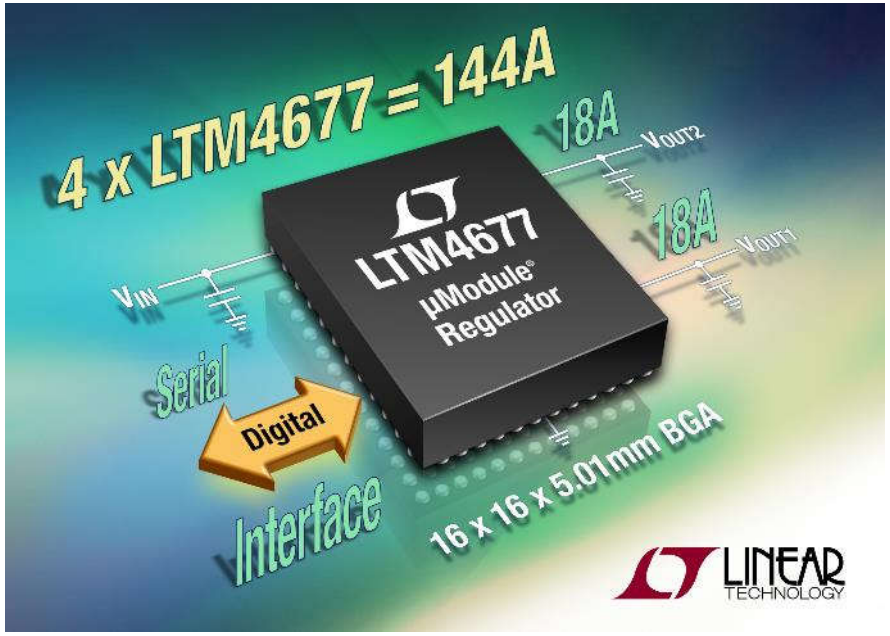
LTM4677 Dual 18A or Single 36A µModule Regulator with Digital PSM

Performance

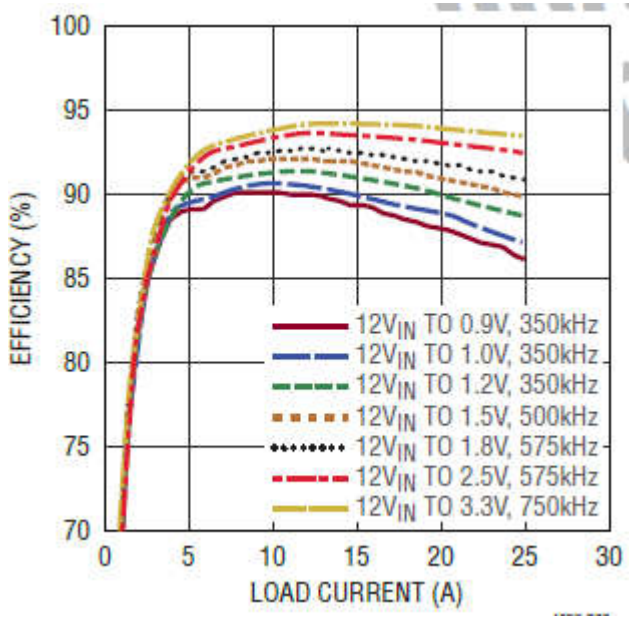
- Vin: 4.5V to 16V
- Vout: 0.5V to 1.8V
- +/-0.5% Max total DC output error
- PMBus-compliant I²C interface
  - Sequencing / tracking, Vout, Supervisory levels
- 16 bit-capable telemetry
  - Vin, Iin, Vout, Iout, Temp, Faults
- Fast response to line and load transients
  - Constant frequency current mode control
- Nonvolatile configuration and fault log
- 16mm x 16mm x 5mm BGA



LTM4678 Dual 25A or Single 50A µModule Regulator with Digital PSM

FEATURES

- Dual Digitally Adjustable Analog Loops with Digital Interface for Control and Monitoring
- Wide Input Voltage Range: 4.5V to 16V
- Output Voltage Range: 0.5V to 1.8V
- ±0.5% Maximum DC Output Error Over Temperature
- ±2.5% Current Readback Accuracy
- Sub-Milliohm DCR Current Sensing
- Integrated Input Current Sense Amplifier
- 400kHz PMBus-Compliant I^2C Serial Interface
- Supports Telemetry Polling Rates up to 125Hz
- Integrated 16-Bit ΔΣ ADC
- Constant Frequency Current Mode Control
- Parallel and Current Share Multiple Modules
- 16mm × 16mm × 5.74mm BGA Package



ANALOG DEVICES
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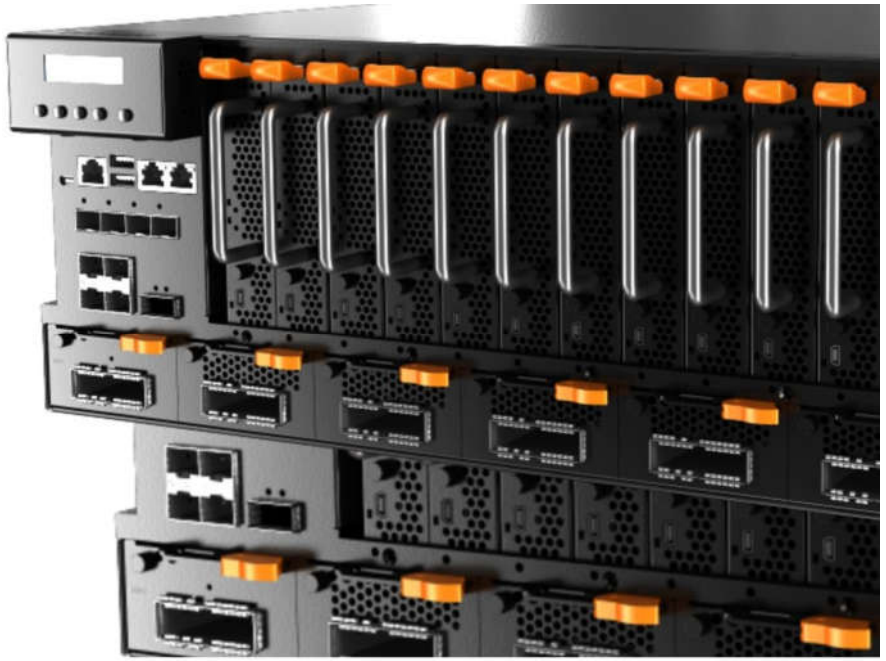
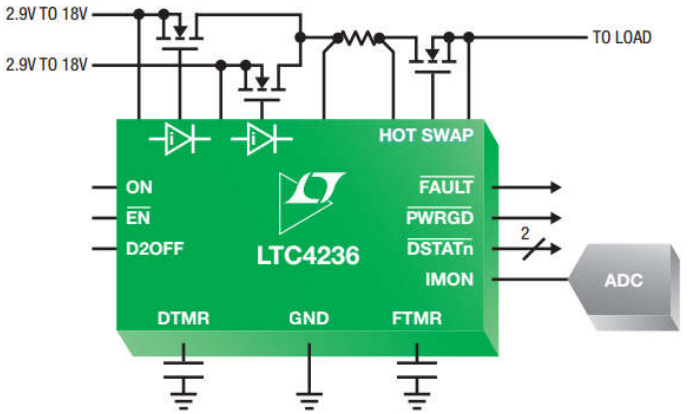
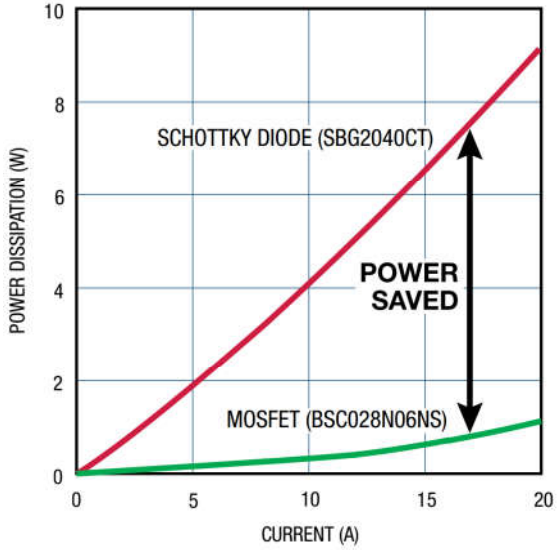
Power Innovation Technologies

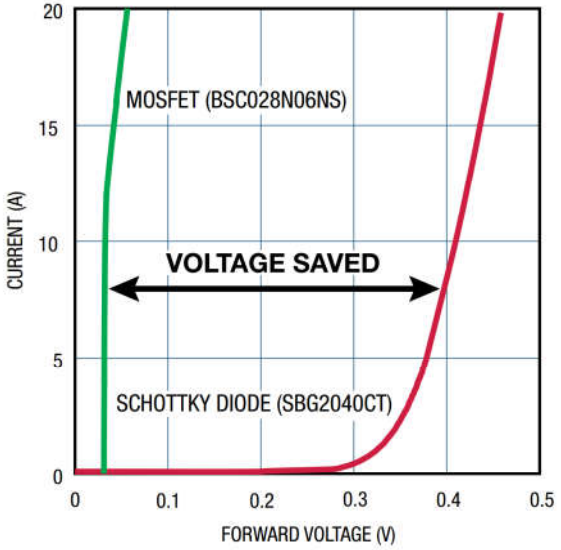


Ideal Diode and Hot Swap Controller

- Ideal Diode (ID) for redundant supply active ORing, reverse current blocking, and supply holdup
- Hot Swap (HS) for inrush current control, overcurrent and under/overvoltage protection (UV/OV)
- Fast 0.5 µs ideal diode turn-on and turn-off time
- Current-limited circuit breaker with adjustable delay
- Current monitoring (CM), power good, circuit breaker fault, and diode status (DS) outputs







ANALOG DEVICES
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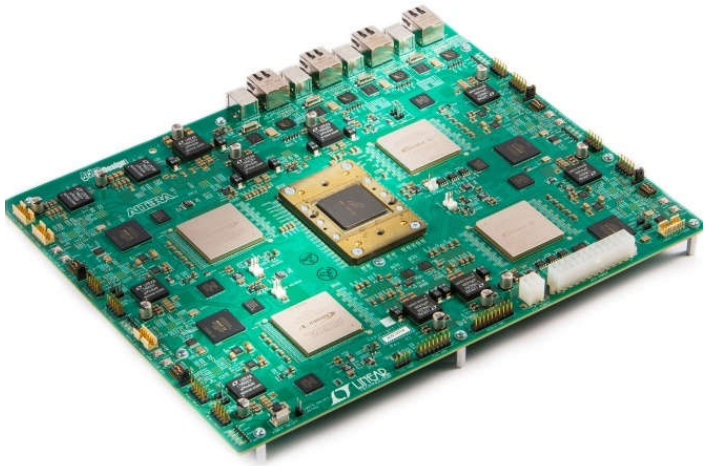
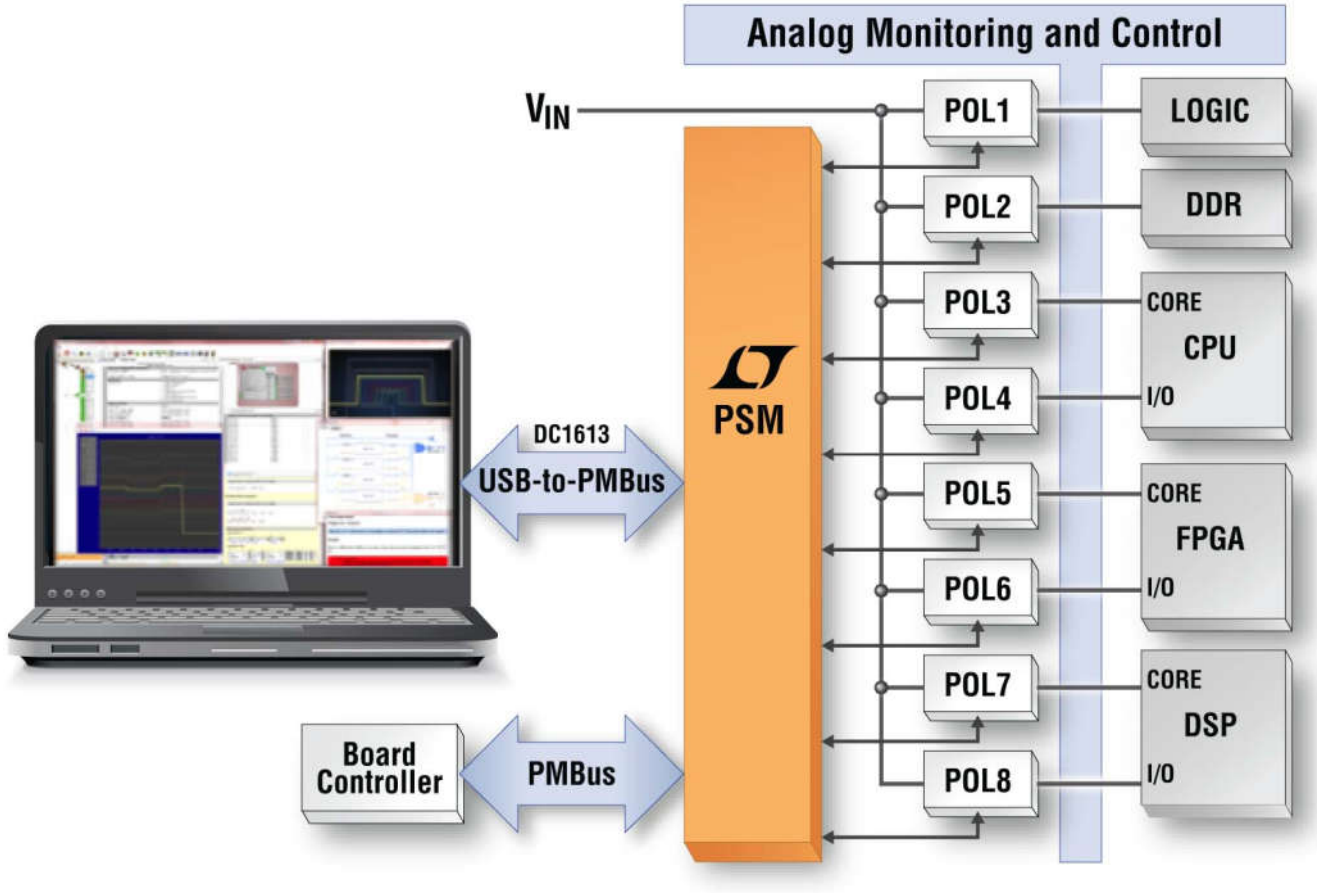
High Performance FPGA Designs Need Digital Power System Management

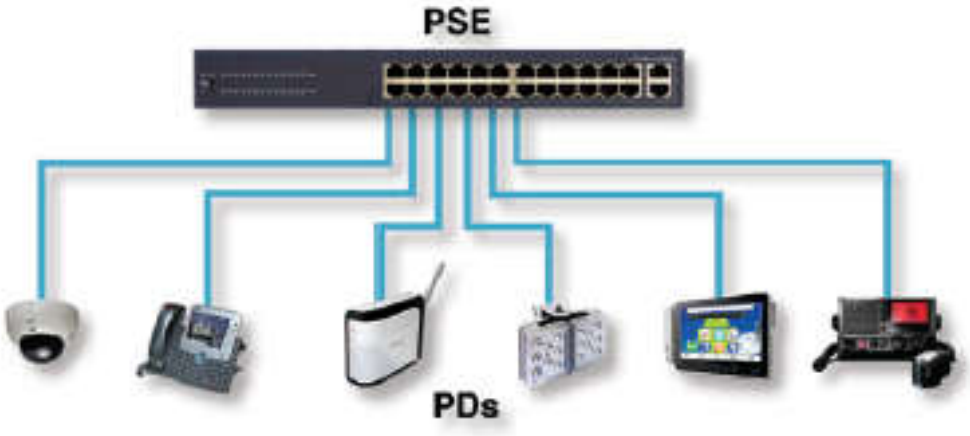


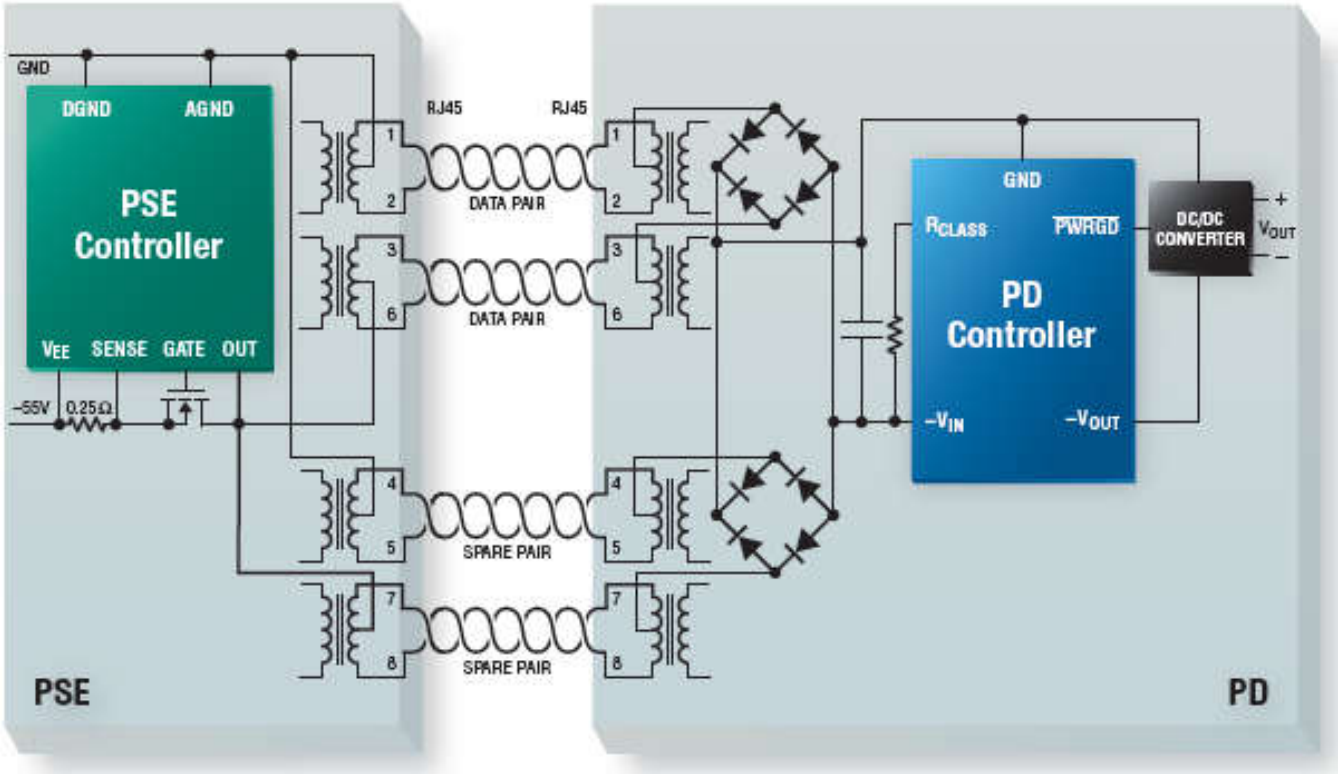
Power Supply Features Needed

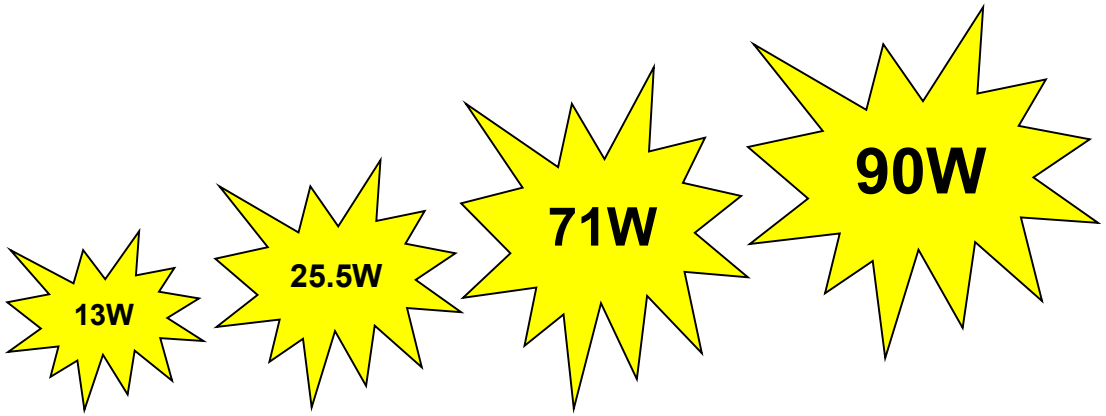
- Accurate Regulated Voltage
- Supply Sequencing
- VOUT Adjustment & Margining
- Measure
  - Voltage, Current, Power, Temperature
- Manage & Respond to Faults
  - Record Faults in NVM (Fault Log)



Power over Ethernet







at af bt LTPoE++

LTPoE++ PSE and PD Deliver Up To 150W Over Ethernet Cable

150W POE Solution

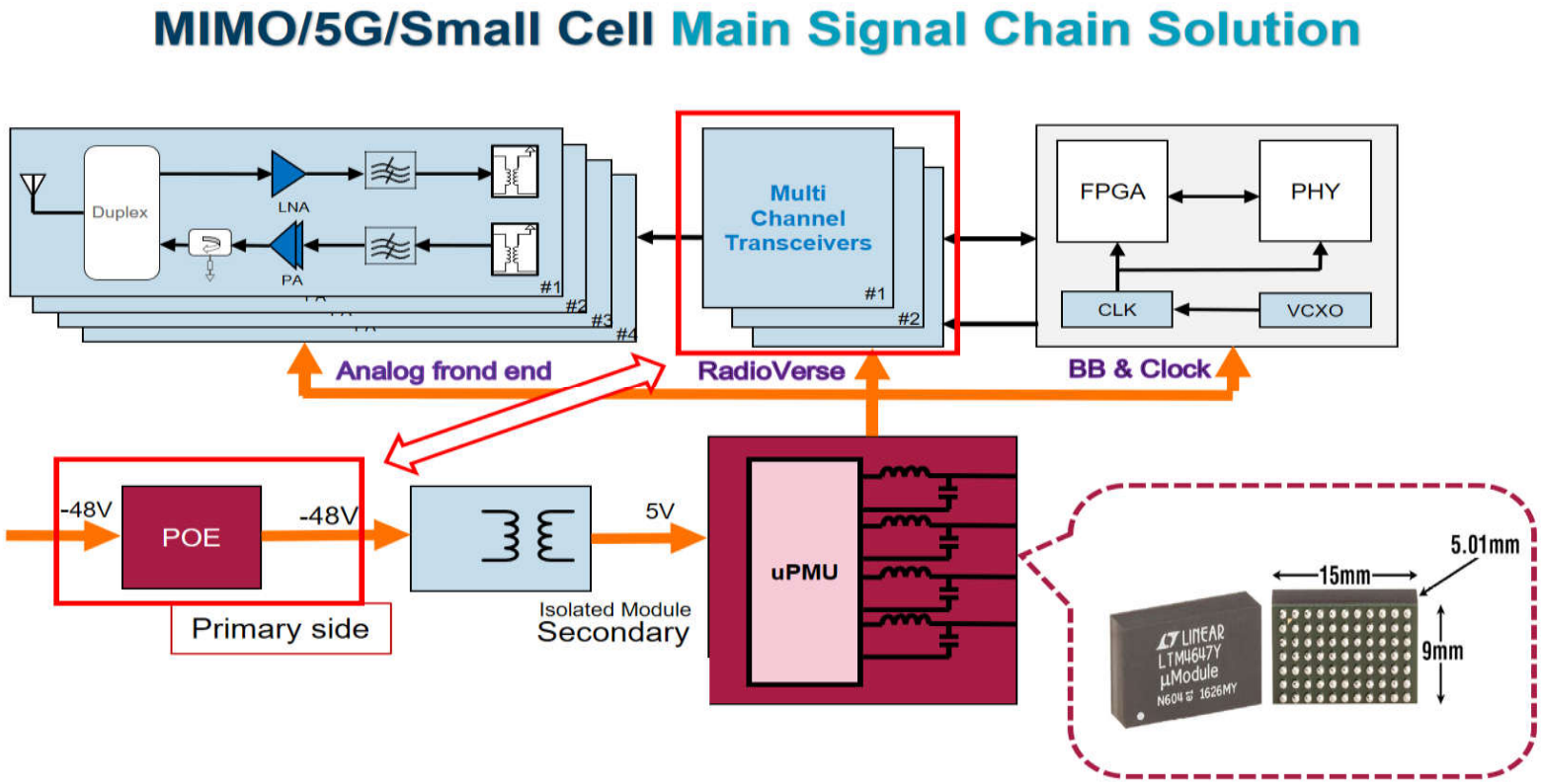
Function: PSE and PD

Application: PoE for Small Cell Application

Solution: LTC4291 + LTC4292+ LT4294

The customer will choose the LTC4292 & LTC4291 & LTC4294 to deliver 150W to MIMO/5G/Small Cell base station over CAT5 cable.

Firmware will provide interoperability between af, at and bt and higher power modes.



ANALOG DEVICES
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Energy

Enabling the Transition to Efficient, Clean, and Reliable Energy

Improving Energy Management Applications

- Real-Time Accuracy Monitoring
- Tamper Detection
- Renewable Energy Generation and System Integration
- Advanced Diagnostics and Analytics

Intelligent Energy Technologies

Utility Smart Grid

Meter, substation equipment, low voltage distribution

Renewable Generation and Storage

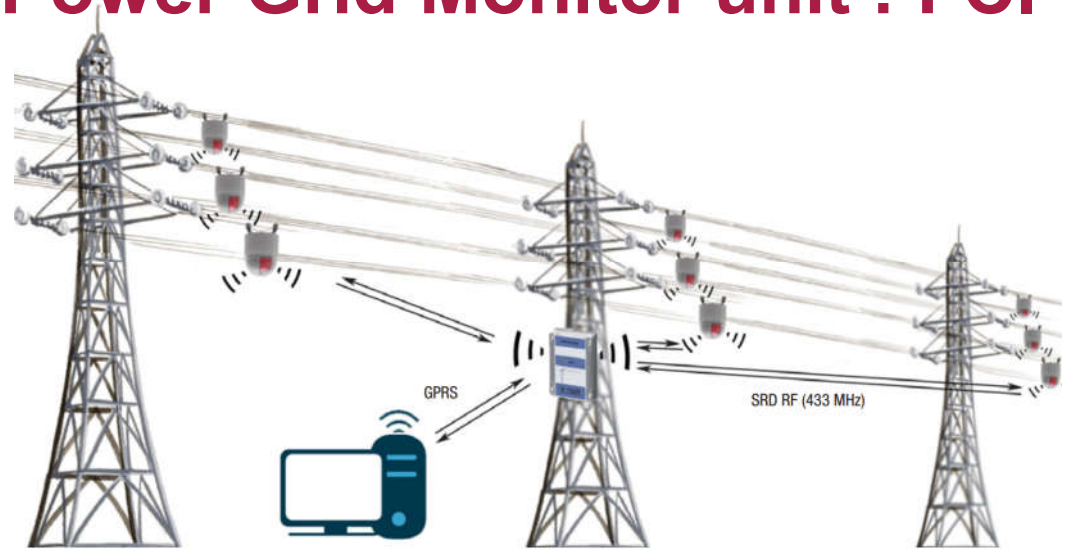
Solar and storage inverters, battery management, EV charging infrastructure

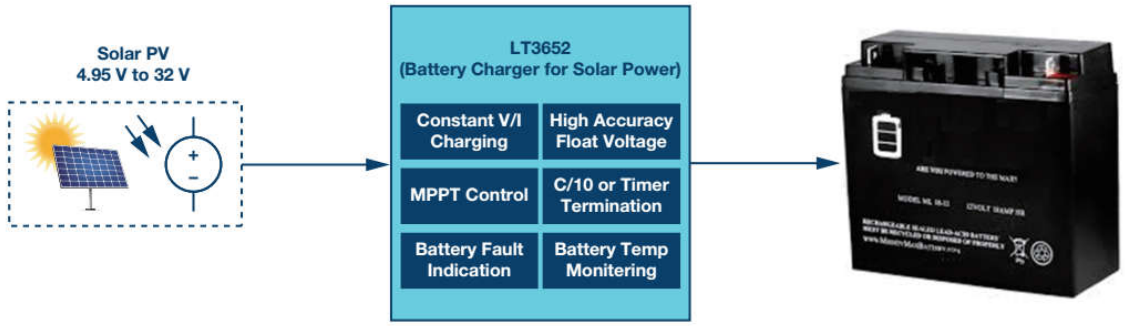
Enterprise Energy Management

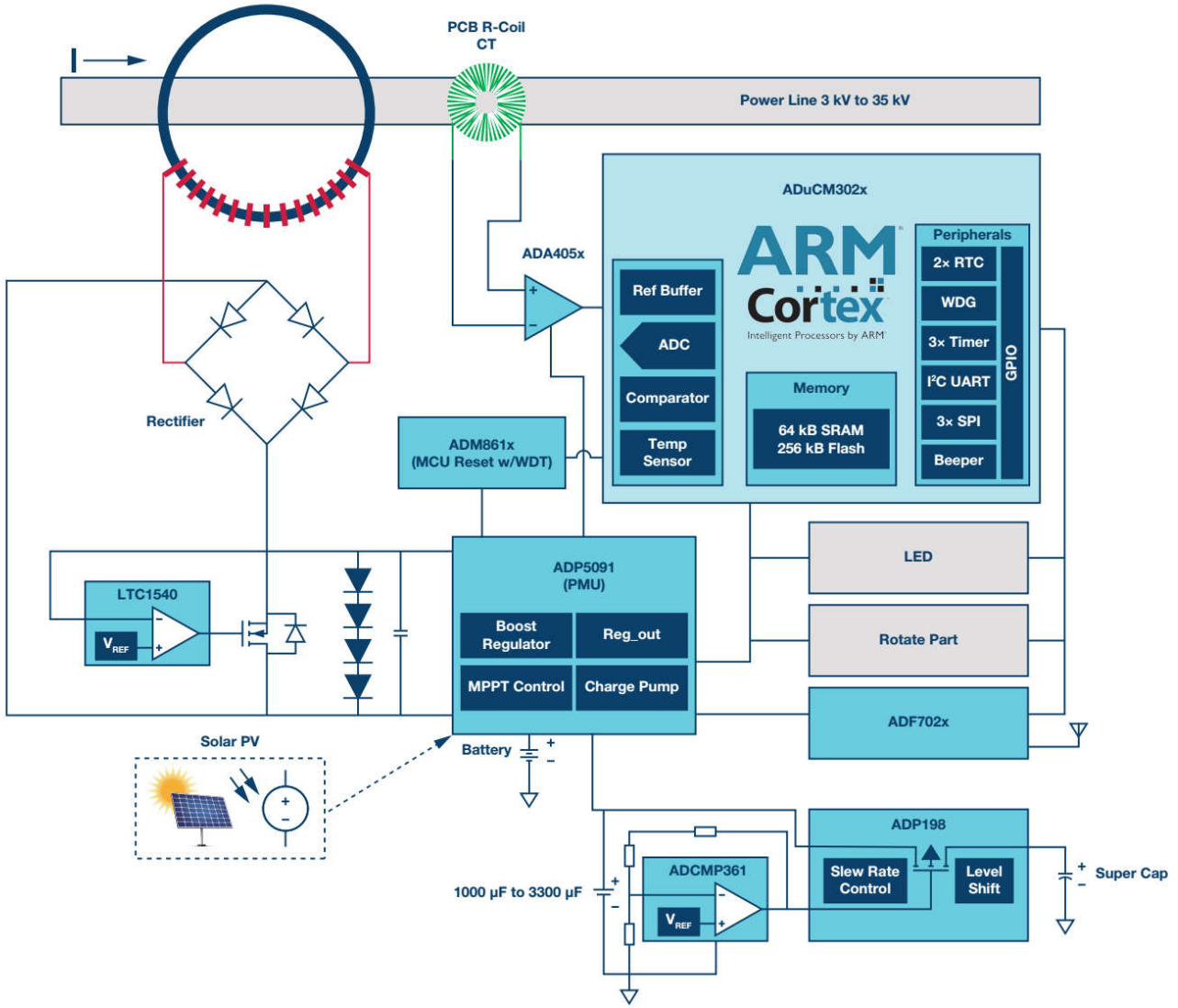
Data centers, factory power, machine health monitoring

Power Innovation Technologies

Power Grid Monitor unit : FCI







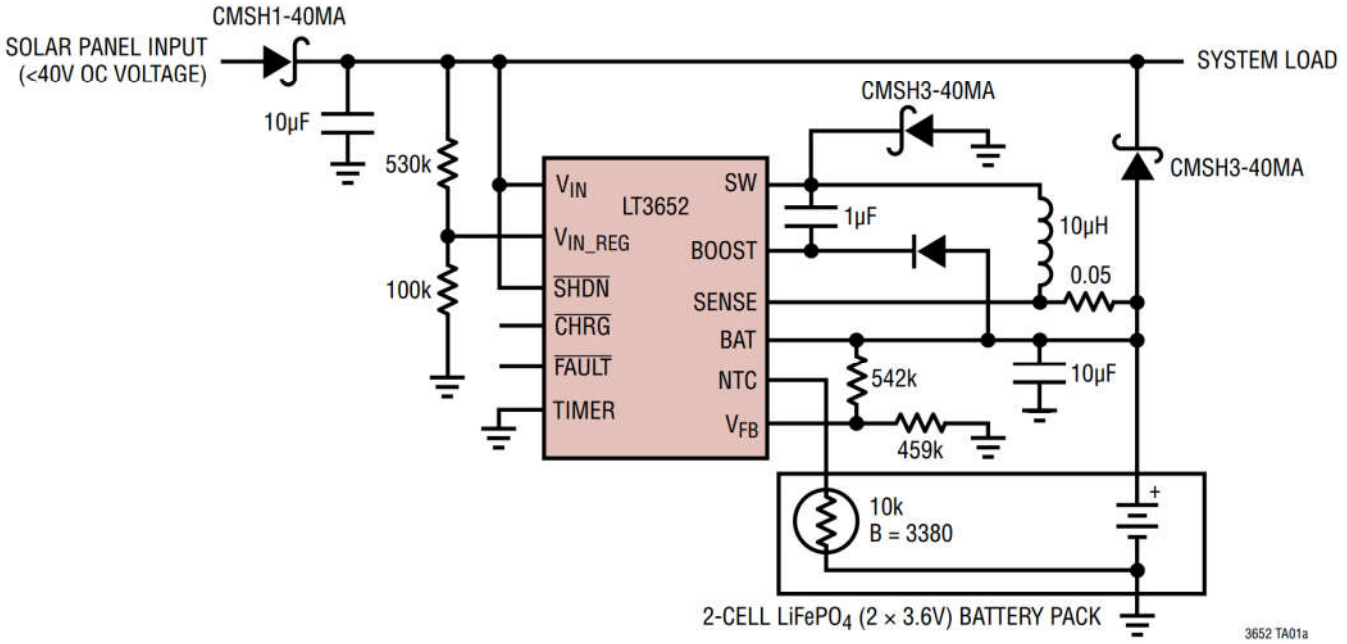
LT3652 – Solar source battery charge with MPPT

Features

- **Input Supply Voltage Regulation Loop for Peak Power Tracking in (MPPT) Solar Applications**
- **Wide Input Voltage Range: 4.95V to 32V (40V Abs Max)**
- **Programmable Charge Rate Up to 2A**
- **User Selectable Termination: C/10 or On-Board Termination Timer**
- **Resistor Programmable Float Voltage Up to 14.4V Accommodates Li-Ion/Polymer, $LiFePO_4$, SLA Chemistries**
- **No V_{IN} Blocking Diode Required for Battery Voltages ≤ 4.2V**
- 1MHz Fixed Frequency
- 0.5% Float Voltage Reference Accuracy
- 5% Charge Current Accuracy
- 2.5% C/10 Detection Accuracy
- Binary-Coded Open-Collector Status Pins
- Thermally Enhanced 12-Lead 3mm × 3mm DFN and MSE Packages

TYPICAL APPLICATION

2A Solar Panel Power Manager With 7.2V $LiFePO_4$ Battery and 17V Peak Power Tracking



LTC3350 High Current Super Cap backup controller & monitor

LTC3350: High Current Supercapacitor Backup Controller and System Monitor

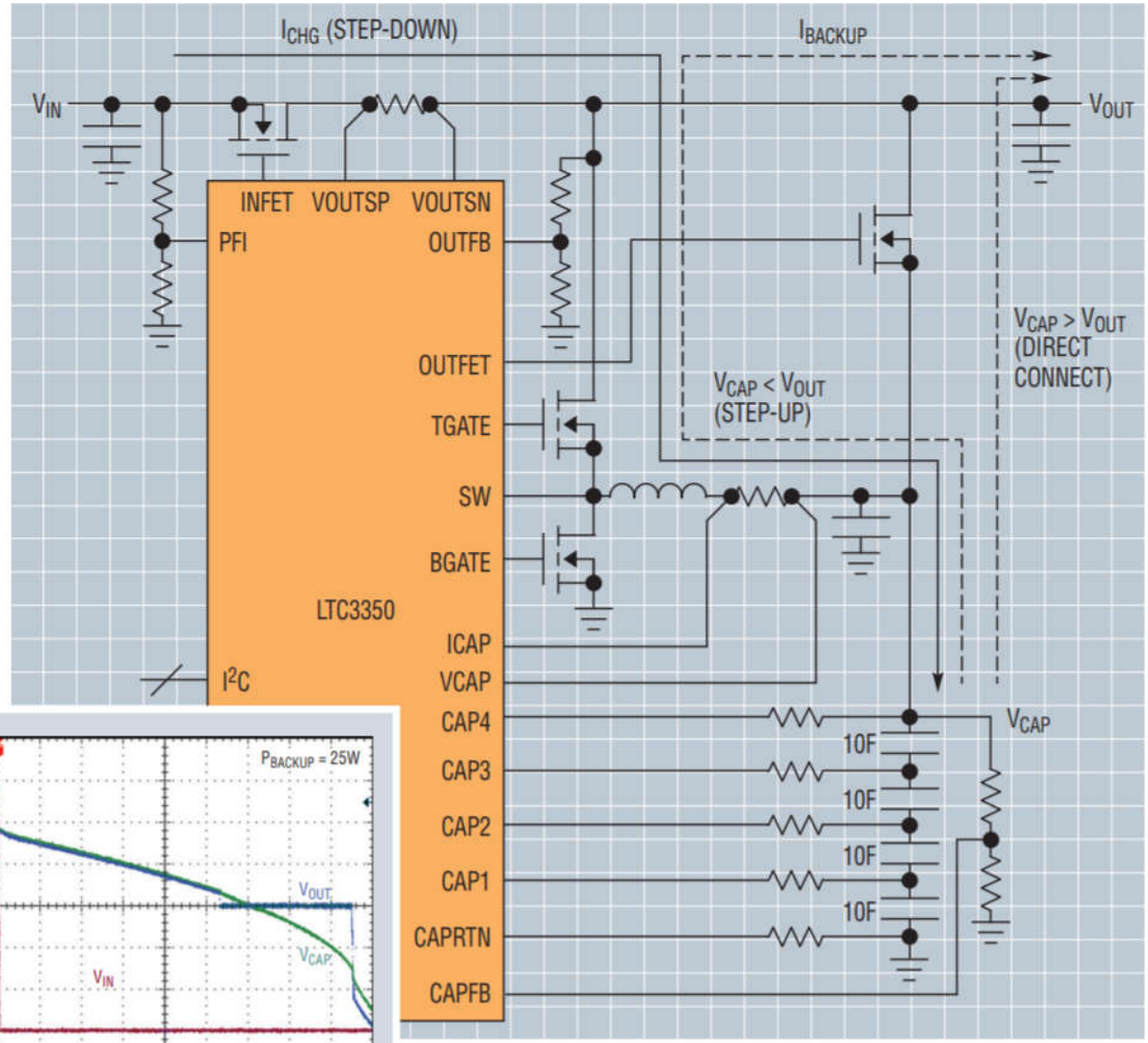
Features

- High Efficiency Synchronous Step-Down CC/CV Charging of One to Four Series Supercapacitors
- Step-Up Mode in Backup Provides Greater Utilization of Stored Energy in Supercapacitors
- 14-Bit ADC for Monitoring System Voltages/ Currents, Capacitance and ESR
- Active Overvoltage Protection Shunts
- Internal Active Balancers—No Balance Resistors
- V_{IN}: 4.5V to 35V, $V_{CAP(n)}$: Up to 5V per Capacitor, Charge/Backup Current: 10+A
- Programmable Input Current Limit Prioritizes System Load Over Capacitor Charge Current
- Dual Ideal Diode PowerPath™ Controller
- All NFET Charger Controller and PowerPath Controller
- Compact 38-Lead 5mm × 7mm QFN Package

Applications

- High Current 12V Ride-Through UPS
- Servers/Mass Storage/High Availability Systems

High Current Supercapacitor Charger and Backup Supply



← Backup Profile if Power Is Lost

ANALOG DEVICES
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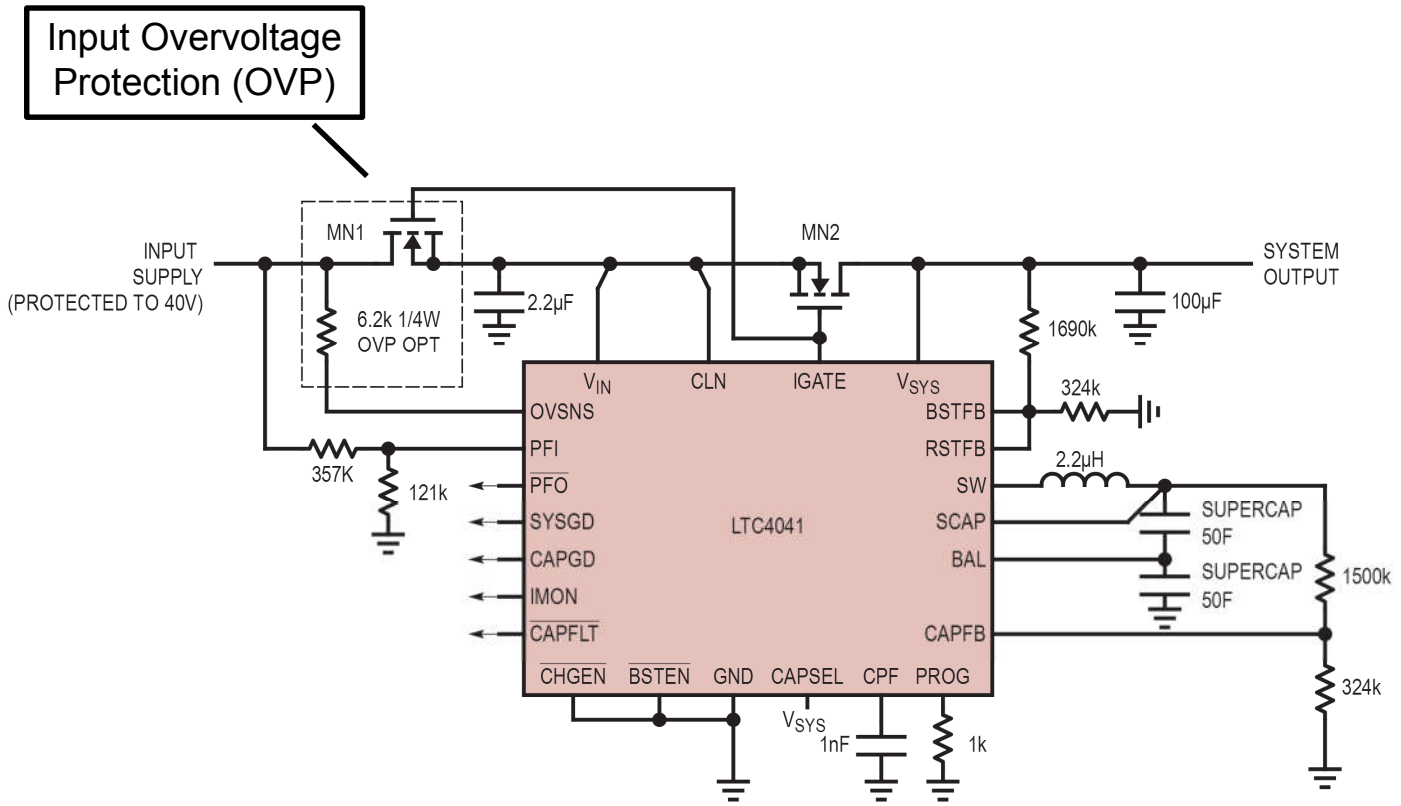
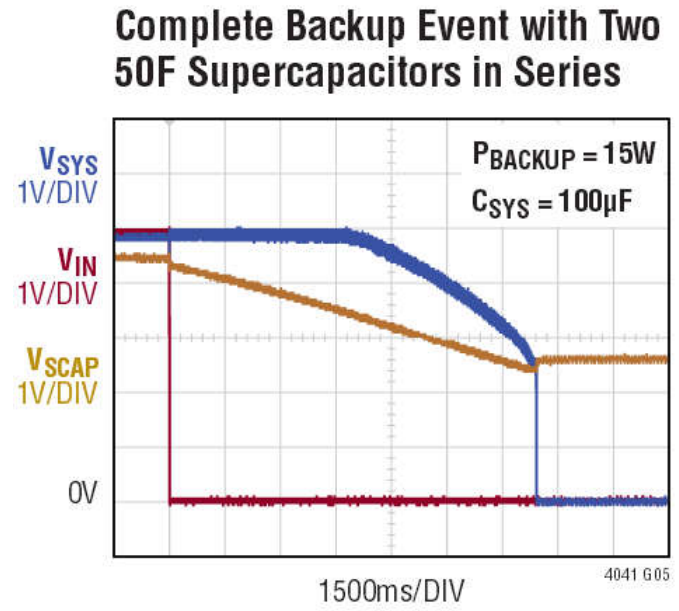
LTC4041 Backup Power application (Option OVP function)

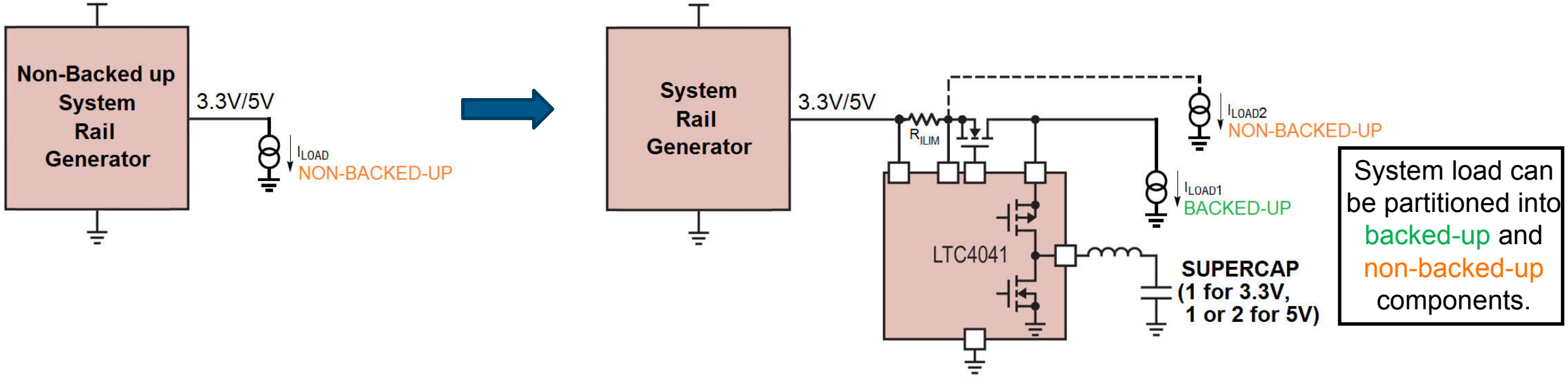
- 15W Backup Power Application with two 50F Supercapacitors in series
  - LTC4041 can backup 5V/3A system load for about 4.5 seconds.





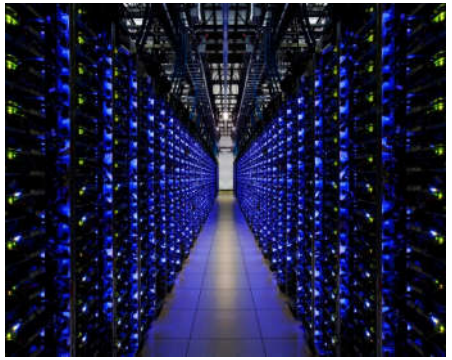
LTC4041 backup power application

Think of the LTC4041 as a “mini-UPS” for a 3.3V or 5V system rail.



APPLICATIONS

- Ride-Through “Dying Gasp” Supplies
- High Current Ride-Through 3V-5V UPS
- Power Meters/Industrial Alarms
- Servers/Solid State Drives



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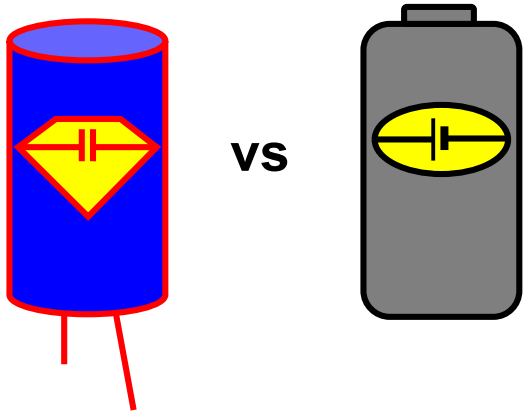
Super Cap VS Li-Polymer : LTC4041 VS LTC4040?

- Calculate the Joules:
  - Backup Energy Required = Average Power x Total Backup Time
  - $E = P_{AVG} \times t_{BACKUP}$
- Supercapacitor vs Battery:

	Two 2.5V, 10F Supercapacitors	3.7V, 450mAh Li-polymer
Energy	60J	6000J
Volume	4700mm^3	4800mm^3
Backup Time for 15mW	1 Hour	100 Hours
Backup Time for 1W	1 Minute	100 Minutes
Backup Time for 20W	1-2 Seconds	Probably Not Possible
	use LTC4041	use LTC4040

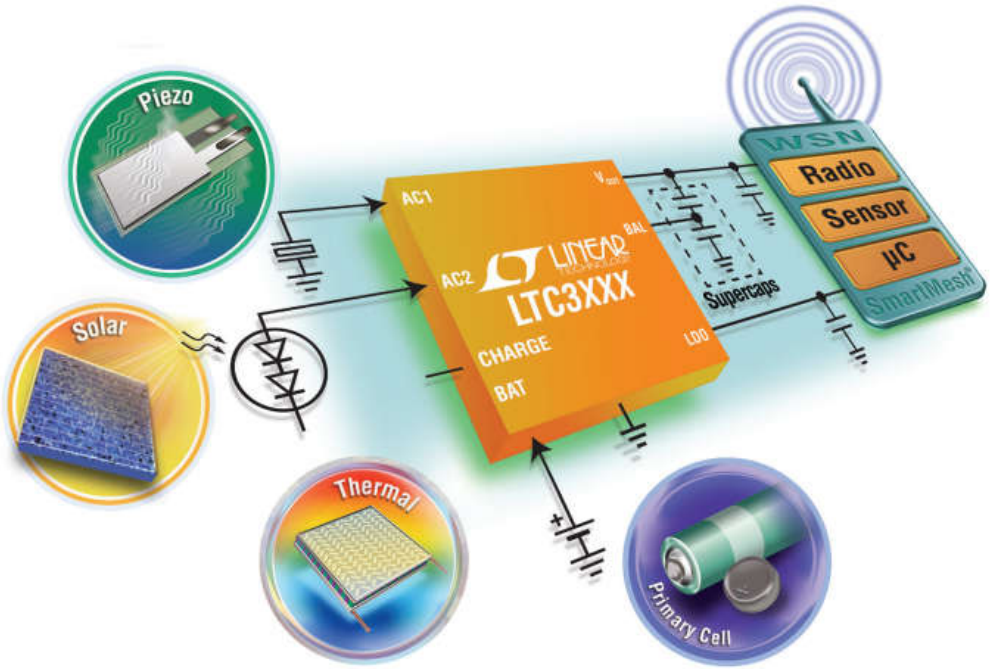


Summary

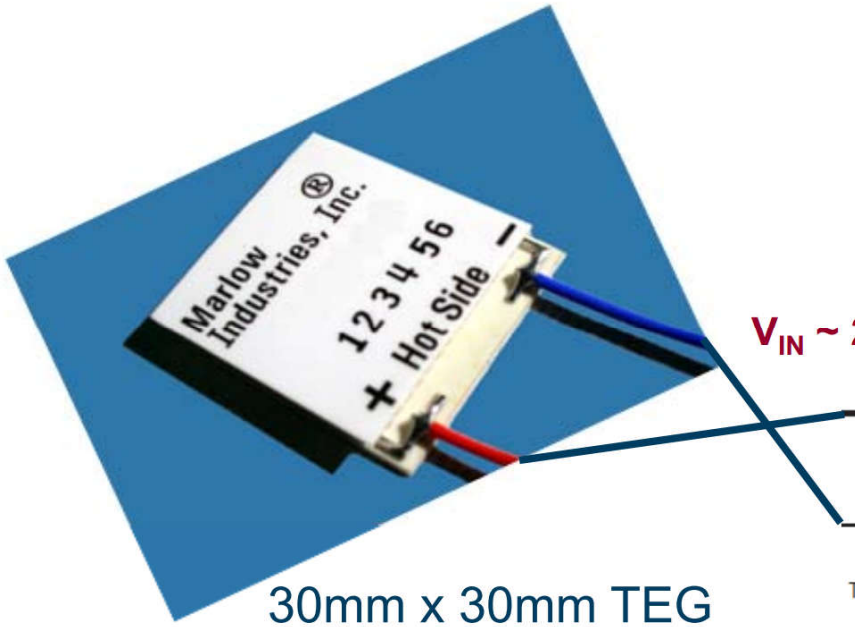
- Supercapacitors are better for short, high current backups.
- Batteries are better for long, low current backups.

Power innovation： Energy Harvest

Part Number	Energy Source	Description
LTC®3105		400mA boost converter with MPP control and 250mV start-up
LTC3106		300mA buck-boost converter and power manager with MPPC
LTC3107		Ultralow voltage converter and primary battery life extender
LTC3108		Ultralow voltage boost converter and system manager
LTC3109		Auto-polarity version of LTC3108
LTC3330/31		Energy harvesting DC/DC converter with battery life extender
LTC3588		Piezoelectric energy harvesting power supply
LT®3652/HV		Power tracking 2A solar battery charger
LTC4070/71		Nanoamp operating current shunt Li-Ion battery charger



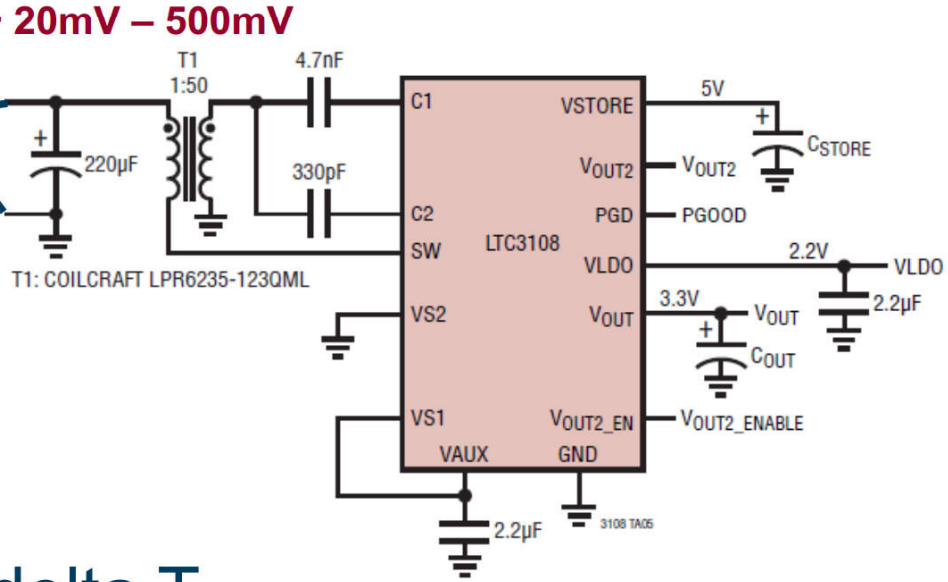
Power Innovation Technologies



30mm x 30mm TEG

LTC3108

Ultralow Voltage Step-Up Converter
And Power Manager
(min V_{IN} = 20mV)



LTC3108 Output:

V_{OUT} = 3.3V

I_{OUT} = 60uA @ 10°C delta T

I_{OUT} = 400uA @ 30°C delta T

ANALOG DEVICES

ANALOG DEVICES
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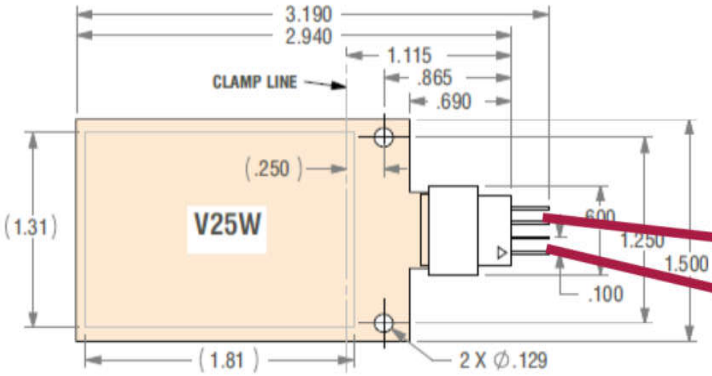
Power Innovation Technologies



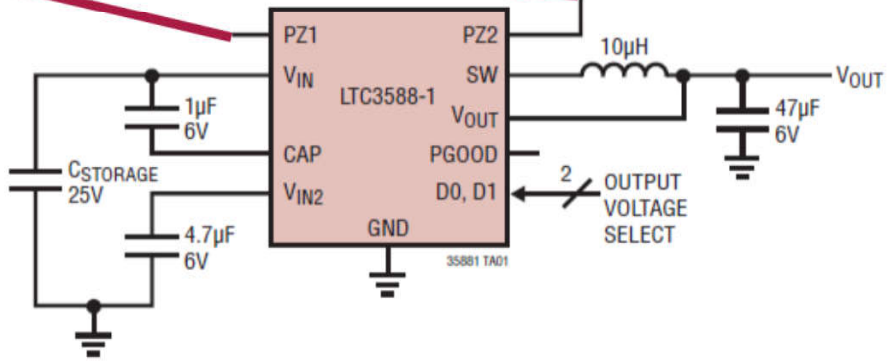
MIDE

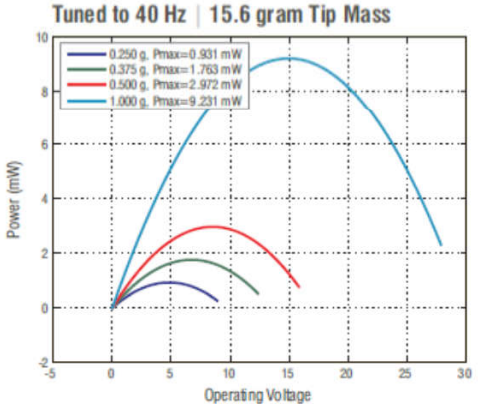
Volture™

LTC3588

Piezoelectric Energy Harvesting Power Supply

(I_{CC} = 900nA)





LTC3588 Output:

V_{OUT} = 3.3V

I_{OUT} = 200uA @ 0.25g / 40Hz

ANALOG DEVICES
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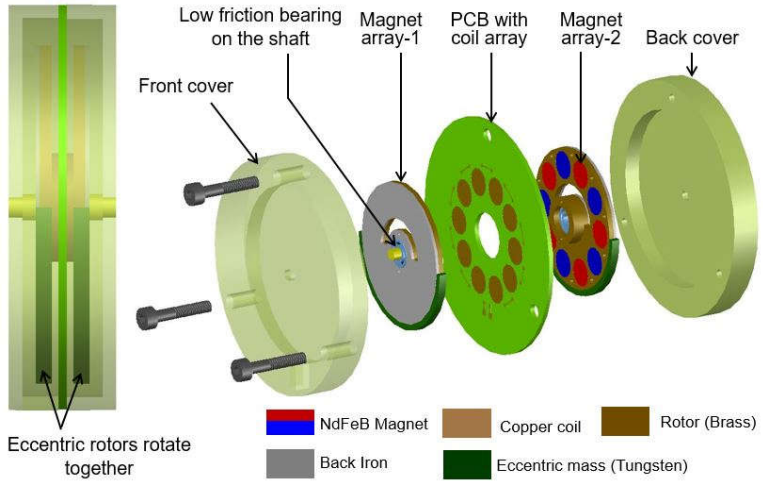
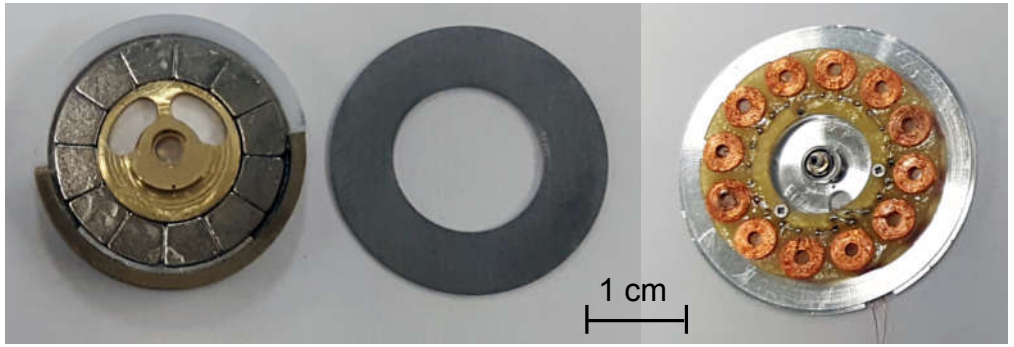
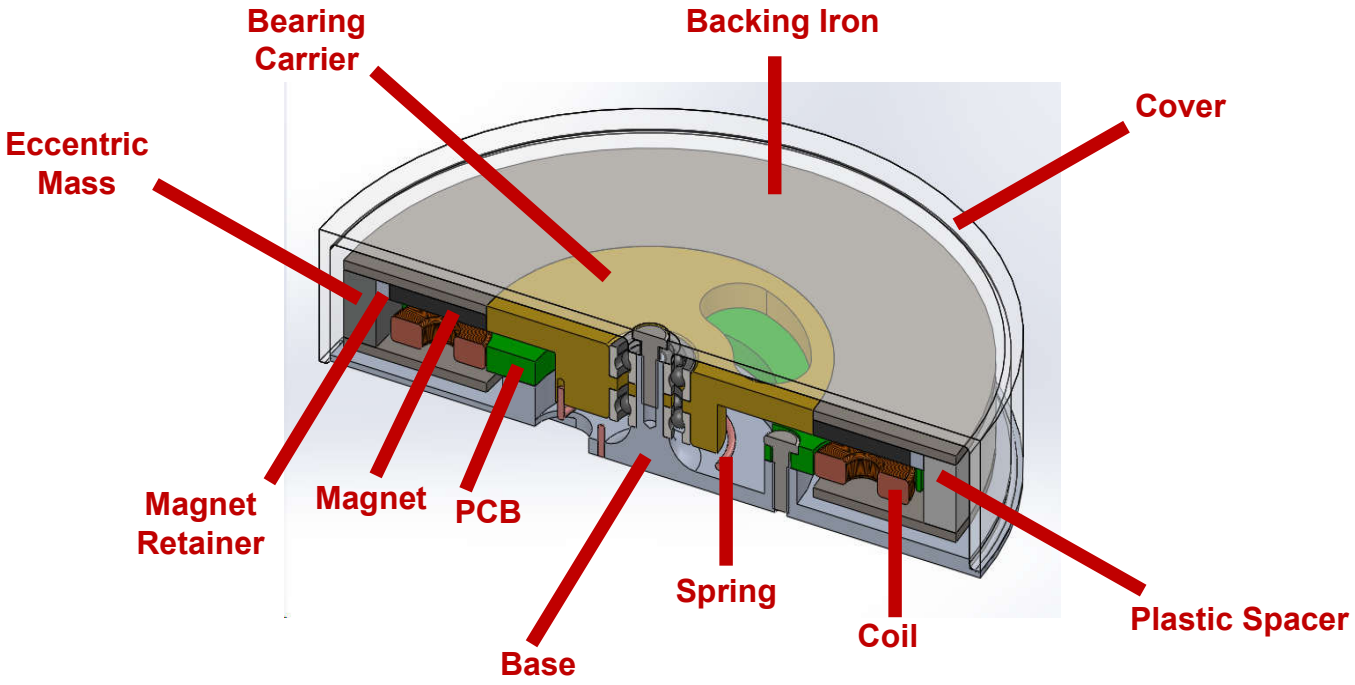
Electromagnetic Prototype



Schematic of electromagnetic energy harvester



Components of the electromagnetic prototype



- **Magnet and back iron rotate together to change the magnetic flux through coils**
- **Near constant magnetic field (~0.5T)**

Power Management (Regulators)

Quality and Realibility

ANALOG DEVICES
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Test Guaranteed VS Design Guaranteed

Features

- Low 20µA Quiescent Current
- +3.5V to +30V Wide Input Voltage Range, +45V Tolerant
- Operates Through Cold-Crank Conditions
- Low-Dropout Voltage of 280mV at 200mA
- Up to 200mA Output Current Capability
- Stable Operation with Tiny 4.7µF Output Capacitor
- User-
  - +3.
  - +1.
  - Re
- Open
- Fixed
- High-
- Therm
- Opera
- Auto

LTC3803

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating junction temperature range, otherwise specifications are at T_A = 25°C. V_{CC} = 8V, unless otherwise noted. (Note 2)

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
$V_{CLAMP1mA}$	V_{CC} Shunt Regulator Voltage at 1mA	I_{CC} = 1mA, $V_{ITH/RUN}$ = 0V					
		LTC3803E	●	8.3	9.4	10.3	V
		LTC3803H, LTC3803I	●	8.3	9.4	10.5	V
		LTC3803MP	●	8	9.4	10.5	V
$V_{CLAMP25mA}$	V_{CC} Shunt Regulator Voltage at 25mA	I_{CC} = 25mA, $V_{ITH/RUN}$ = 0V					
		LTC3803E	●	8.4	9.5	10.5	V
		LTC3803H, LTC3803I	●	8.4	9.5	10.7	V
		LTC3803MP	●	8.1	9.5	10.7	V
V_{MARGIN}	$V_{CLAMP1mA}$ – V_{TURNON} Margin	LTC3803E	●	0.05	0.6		V
		LTC3803H, LTC3803I, LTC3803MP	●	0.03	0.6		V

200mA, Automotive Quiescent Current,

ELECTRICAL CHARACTERISTICS (

(V_{IN} = V_{ENABLE} = +14V, $C_{TIMEOUT}$ = open, C_{IN} = 1µ
otherwise noted. Typical values are T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
SETOV INPUT (TRI-MODE)						
SETOV Input Leakage Current		SET = HIGH, V_{SETOV} = 5V or SET = GND, V_{SETOV} = 5V		1		µA
SETOV Low-Level Input Voltage	$V_{ILSETOV}$	SET = GND, V_{SETOV} < $V_{ILSETOV}$ or places device in +3.3V fixed output-voltage mode			0.4	V
SETOV High-Level Input Voltage	$V_{IHSETOV}$	SET = GND, V_{SETOV} > $V_{IHSETOV}$ or places device in +5V fixed output-voltage mode	V_{OUT} - 0.4			V

Note 2: Production tested at T_A = +25°C. Overtemperature limits are guaranteed by design.

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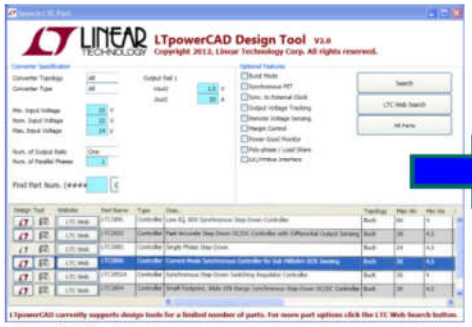
QA Testing Before Shipping

Temp Grade	COLD	ROOM	HOT	~PPM
C	0 degC Sample	+25 degC Sample	+70 degC Sample	< 50
E	0 degC Sample	+25 degC Sample	+85 degC Sample	< 25
I	-40 degC Larger Sample	+25 degC Sample	+85 to +125 degC Larger Sample	< 2
H	-40 degC Larger Sample	+25 degC Sample	+125 to +150 degC 100% Tested	< 1
A1	-40 degC Larger Sample	+25 degC Sample	+85 or +125 degC 100% Tested	< 0.3
3ZZ	-40 degC 100% Tested	+25 degC Sample	+85 or +125 degC 100% Tested	< 0.1

Please see Data Sheet for actual test and temperature guarantees

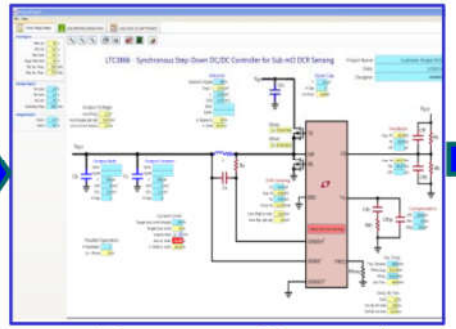
If 1 part in the sample fails, then the whole lot is 100% tested

Design Tools: Step-by-Step Power Supply Design



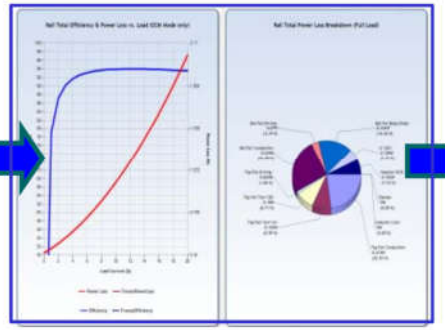
Enter specs,

search solution.



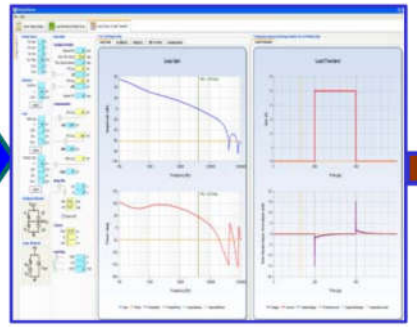
Power Supply

Schematic.



Efficiency &

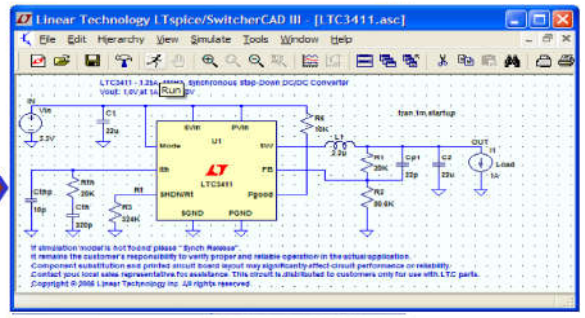
Power Loss



Loop Stability

& Transient

LTpowerCAD

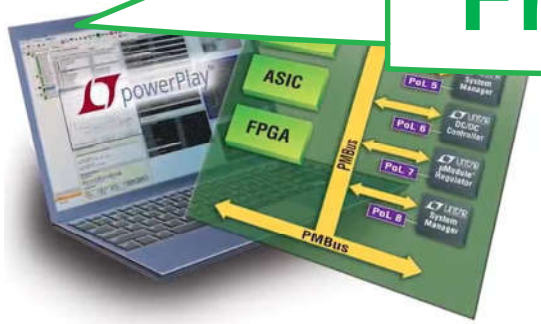


LTspice™

Simulation

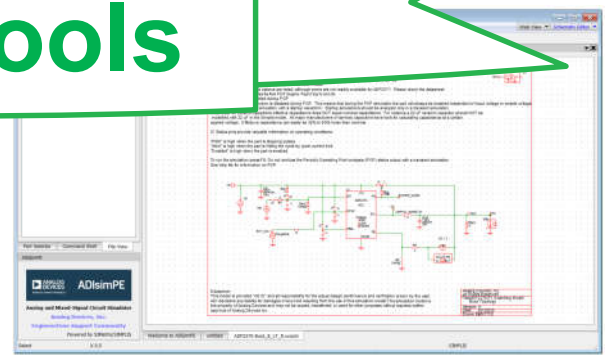
LTspice

Free Tools



Develop tools for PSM

LTpowerPlay



ADI power Simulation

ADIsimPE

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The Value We Deliver

Innovative, High Performance Solutions with Outstanding Price/Performance

Expert Worldwide Technical Support

Best Quality and Reliability

ADI Leading High-Performance Power Technology Innovation

Thanks!