

**Комплексное
решение проблемы
надежного питания автоэлектроники
на элементной базе
Texas Instruments**

Основные потребители

Power Train / Engine Control

- ◆ Transmission Control
- ◆ Power Management
- ◆ Fuel Injector Drivers
- ◆ Sensor Signal Conditioning

Dashboard/Cluster

- ◆ LED Drivers
- ◆ Power Management

Body

- ◆ Window Lifter / Mirror Drivers
- ◆ Door Lock Solenoid Drivers
- ◆ Passive/Keyless Entry
- ◆ Relay Driver
- ◆ Vehicle Lighting



Safety Systems

- ◆ Airbags
- ◆ Passenger Recognition
- ◆ Adaptive Cruise Control

Chassis Systems

- ◆ ABS Control
- ◆ Vehicle Stability
- ◆ Electronic Power Steering
- ◆ Collision Avoidance

Infotainment

- ◆ Performance Audio
- ◆ Power Management

Energy Management

- ◆ Hybrid Vehicle
- ◆ Advanced Alternator System
- ◆ Motor Management

Vehicle Networking

- ◆ LIN
- ◆ CAN
- ◆ System Base Chips

Массовый рынок России: навигаторы, иммобилайзеры, датчики топлива

Специфичные проблемы бортсети



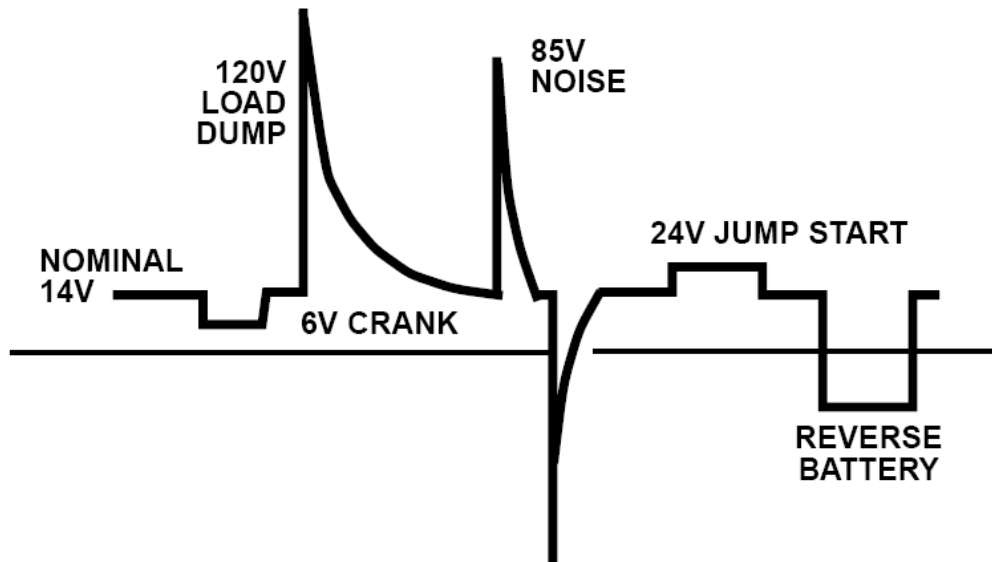
Автомобильные бортсети:

- 12VDC – легковые
- 24VDC – грузовые
- Стабильность: $\pm 40\%$
- Рабочий диапазон напряжений на аккумуляторе под постоянной нагрузкой: 7...17VDC – легковые (35V – грузовые)
- При запуске двигателя до 4-5V
- Допустимые пульсации при подключении/ отключении электрооборудования: +200...-300V peak (до -600V – грузовые, согласно ISO 7637)

Основные проблемы:

- Высоковольтные пульсации требуют тщательной проработки схем защиты
- Широкий диапазон рабочих напряжений снижает КПД и приводит к большим размерам источника
- Жесткие требования сертификации по ЭМС в полосе частот 450 kHz to 30 MHz (Conducted) и 30 MHz to 1 GHz (Radiated EMI).

Реальность в 12V автомобильной бортсети



Transients and voltage levels

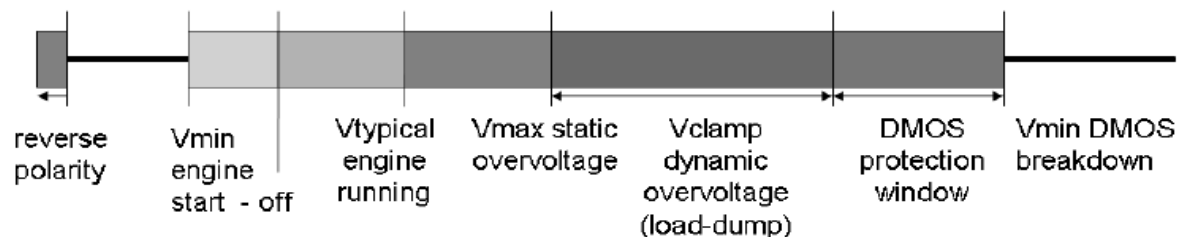
Voltage levels and required function at these levels depends on customer

14V net

0V 9V 11V 14V 20V 42V 60V

42V net

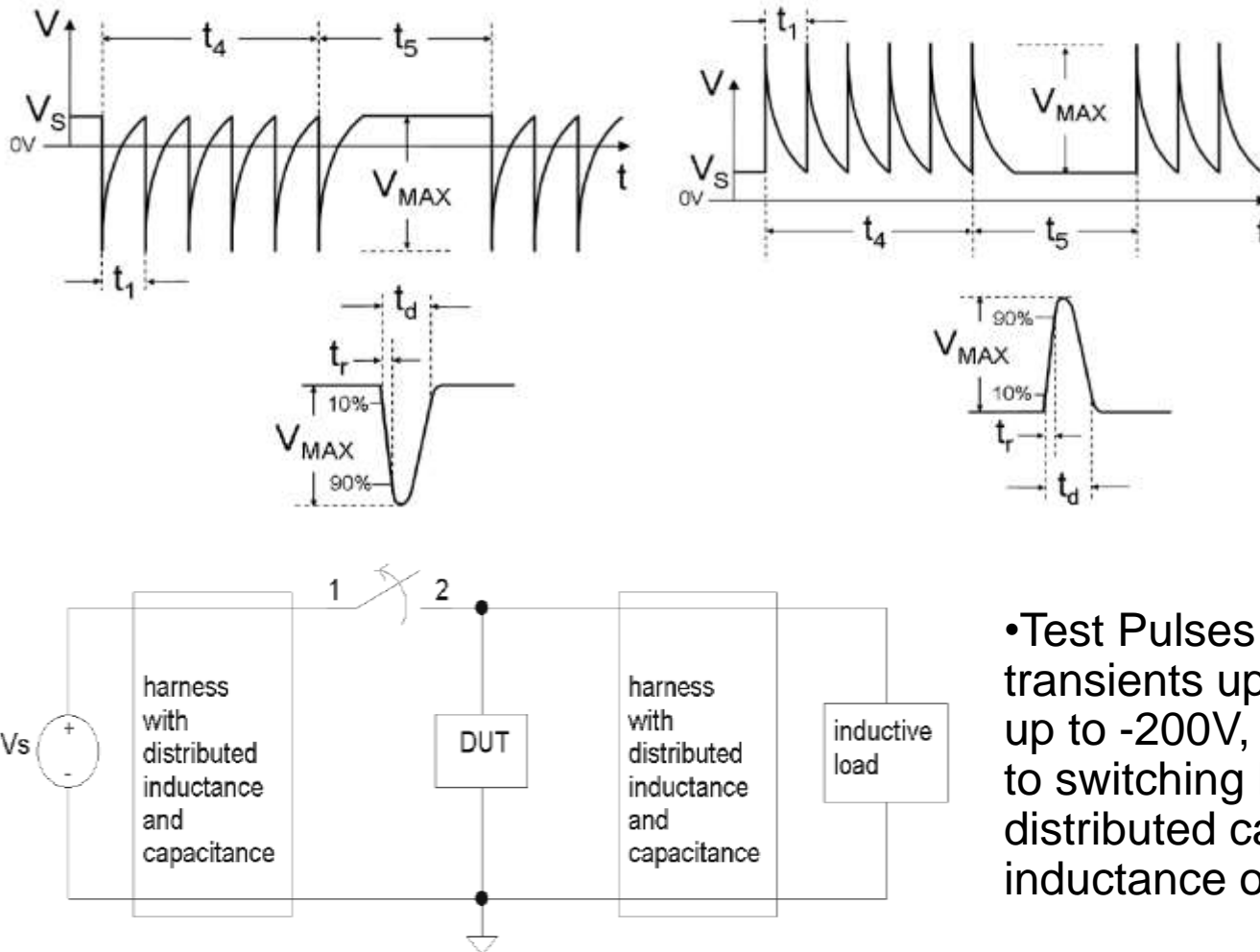
0V 25V 33V 42V 52V 58V 75V



Сертификация по стандарту ISO 7637

- **Test pulse 1-** Negative voltage transients -25V to **-300V** (for 2ms in 12V system) and -150V to **-600V** (for 1ms in 24V system). This is due to supply disconnection from and inductive load. The part is still connected in parallel to the inductive load
- **Test pulses 2a, 2b** - Positive voltage transients up to 150V (12V system). This is due to interruption of current through an inductance switched in series with an electronic device. The component connected in parallel will be subjected to the transients due to inductance of the wiring harness. Nature of the source could be inductive load switching or after ignition OFF the DC motors continue to rotate due to there interia , acting as generators.
- **Test Pulses 3a, 3b** – Positive transients up to **+200V** and negative up to -200V, transients. This is due to switching loads, influenced by distributed capacitance and inductance of the wiring harness
- **Test pulse 4** – Low battery cranking. This is due to voltage reduction when energizing the starter-motor circuits for the combustion engine.
- **Test pulse 5** – Positive transients up to 87V (12V system) and 174V (24V system). This is due to battery cable being disconnected from the alternator while the engine is running.
- **Reverse battery connection** - Terminals are swapped due to ignorance. Electronics is needed to either prevent current path or limit current by clamping

Fast electrical transients - ISO 7637 Pulses

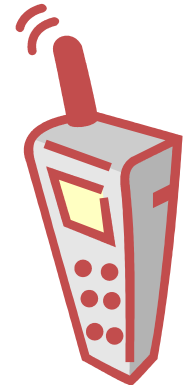


- Test Pulses 3a, 3b – Positive transients up to +200V and negative up to -200V, transients. This is due to switching loads, influenced by distributed capacitance and inductance of the wiring harness

Специфичные проблемы потребителей

Типовые потребители: навигаторы, иммобилайзеры

- Процессор и интерфейсы:
 - ✓ 3,3VDC x 200mA peak
 - ✓ 10mA standby
 - ✓ 100mA RMS
- GPRS модем Class 8-12 :
 - ✓ 3,8VDC x 2(3)A peak (0,6 ms)
 - ✓ 100mA pause (5 ms)
 - ✓ 1A RMS
- Максимальная продолжительность автономной работы от Li-ion батареи:
2.5...4.2VDC x 2A/h



Основные проблемы:

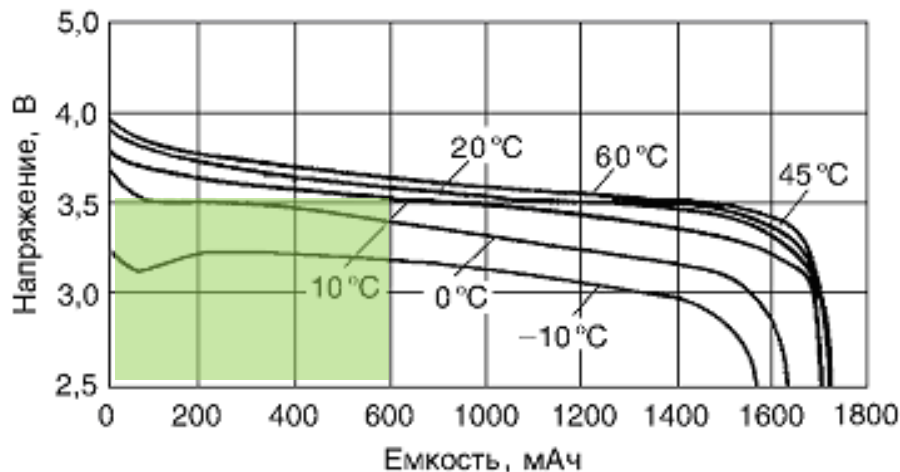
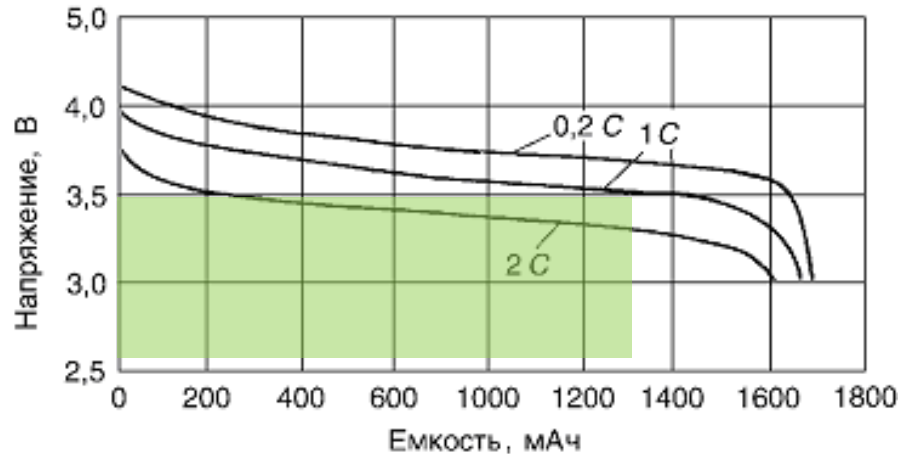
- Напряжение бортсети или батареи может быть как больше, так и меньше требуемого выходного напряжения.
- Существенные пиковые токи и необходимость гарантированного питания от литиевой батареи в широком диапазоне температур приводят к сложности источника

Power Supply Requirements

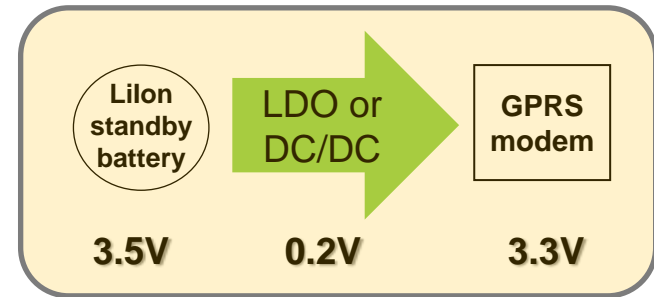
Типовой GSM/ GPRS модем

Condition	Value
Nominal Supply Voltage	3.80 V
Normal operating Voltage Range	3.40 V - 4.20 V
Extended operating Voltage Range	3.22 V – 4.50 V

Проблемы литиевых батарей



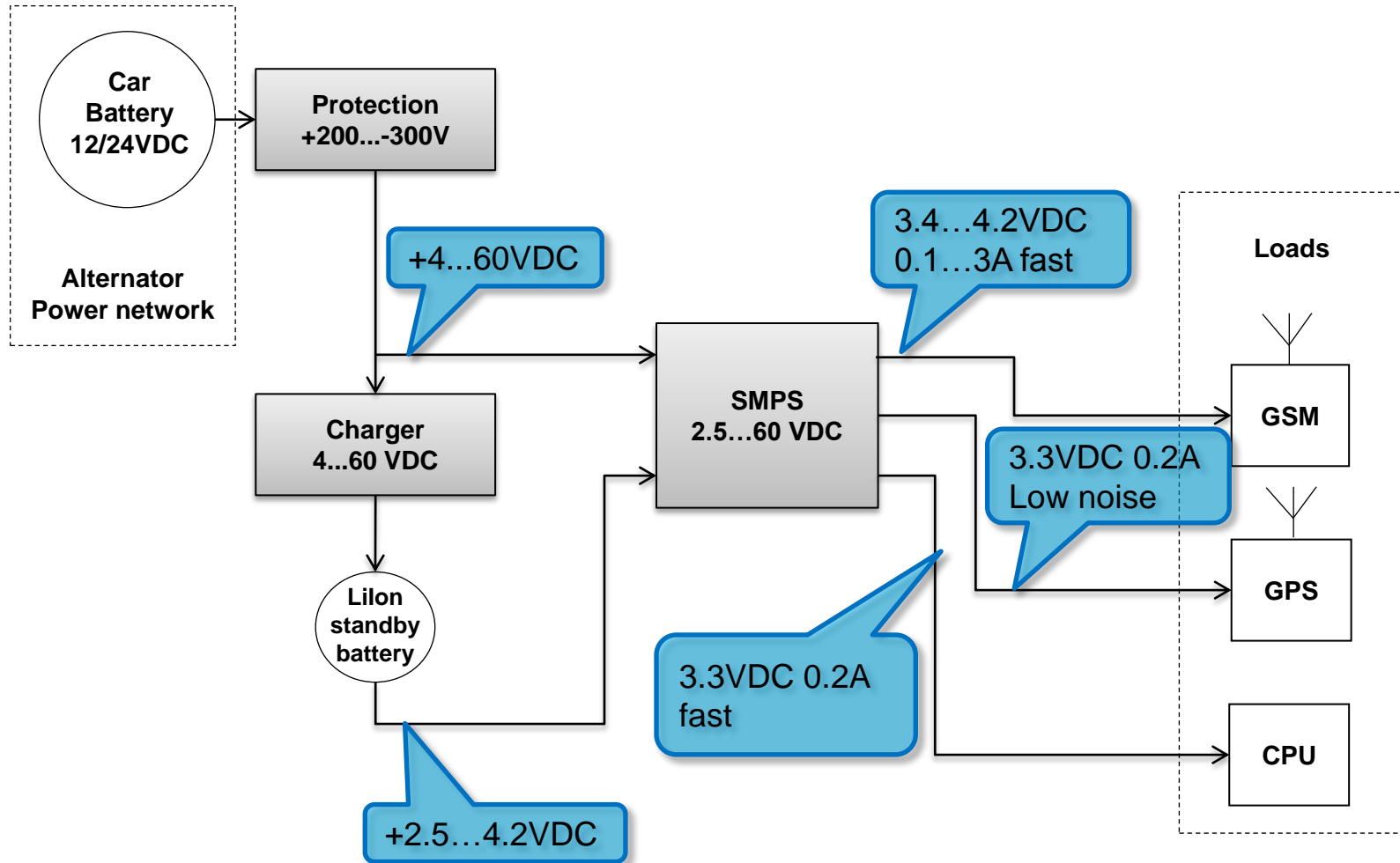
- Значительное внутреннее сопротивление
- Зависимость емкости от тока разряда
- Зависимость емкости и остаточного напряжения температуры
- Старение



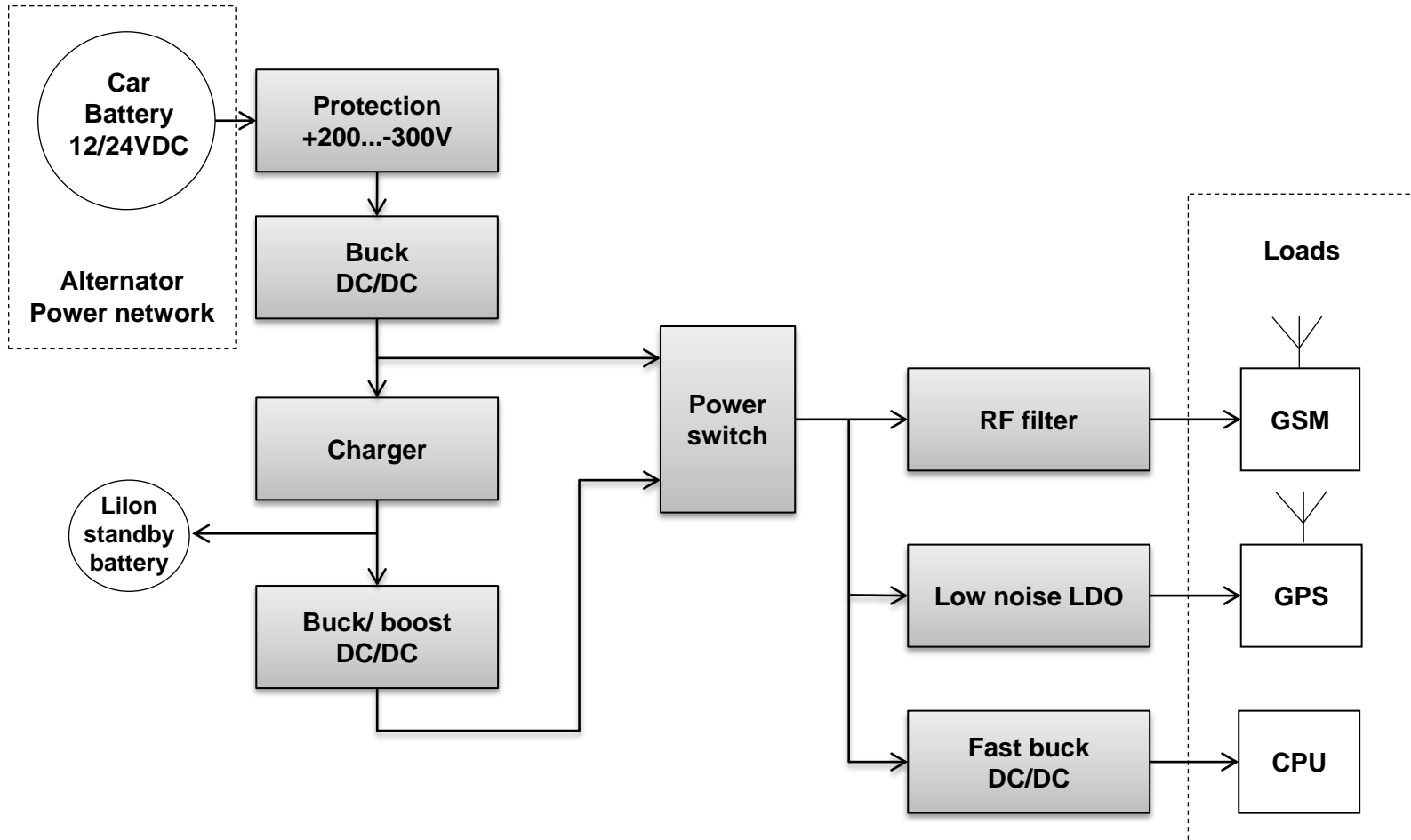
**Понижающий преобразователь
– стандартное решение**

- В идеальных условиях – использует не более 70% емкости батареи
- При температуре +10 C, или старой батарее – использует не более 30% емкости.

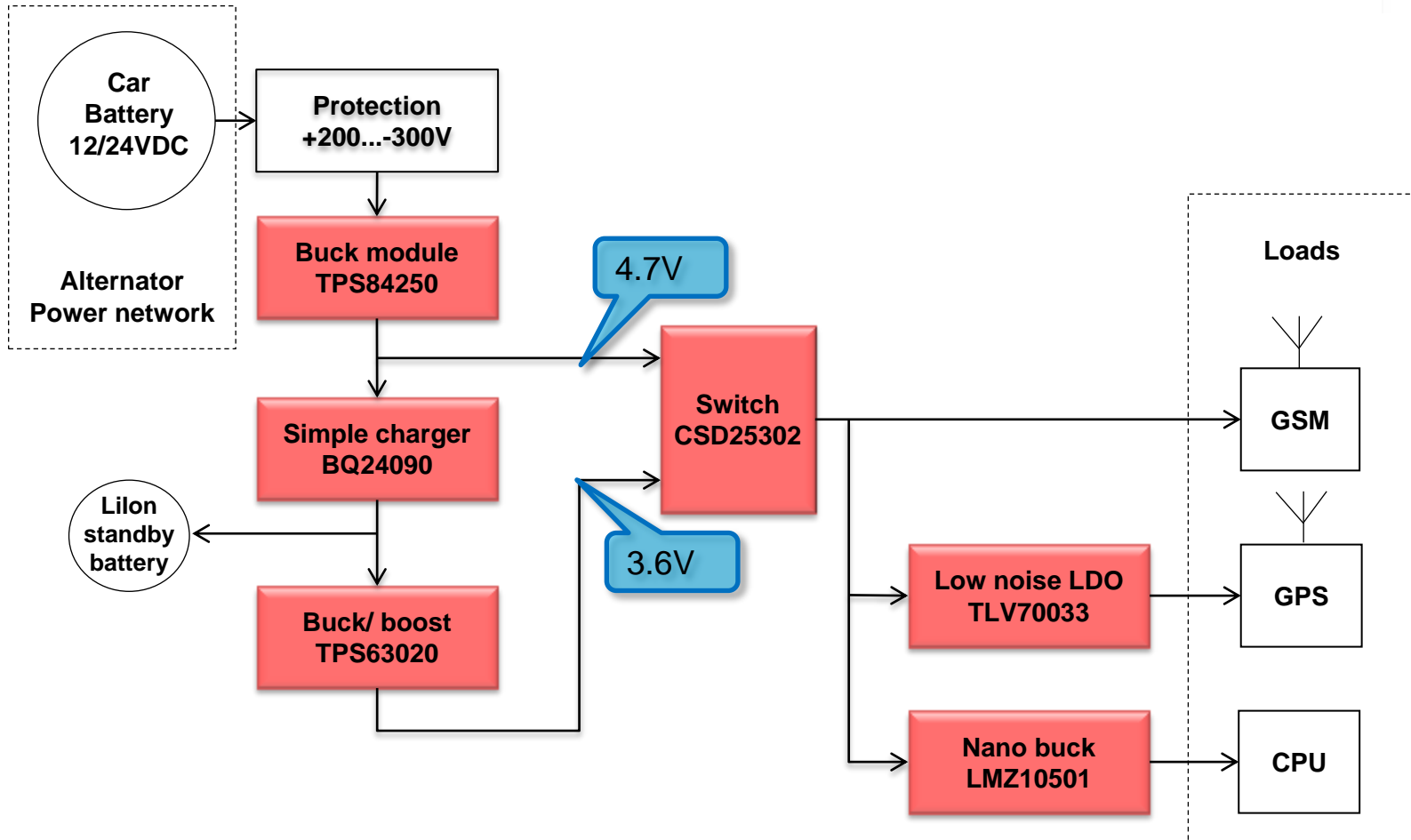
Каким должен быть источник питания для автомобильных применений?



Каково минимальное количество компонентов?



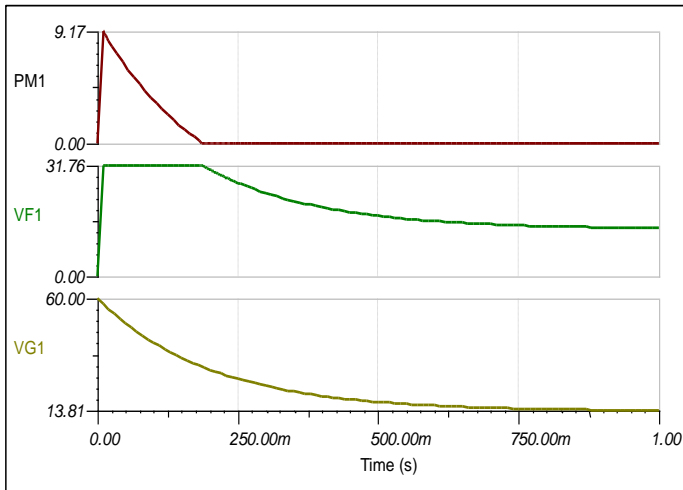
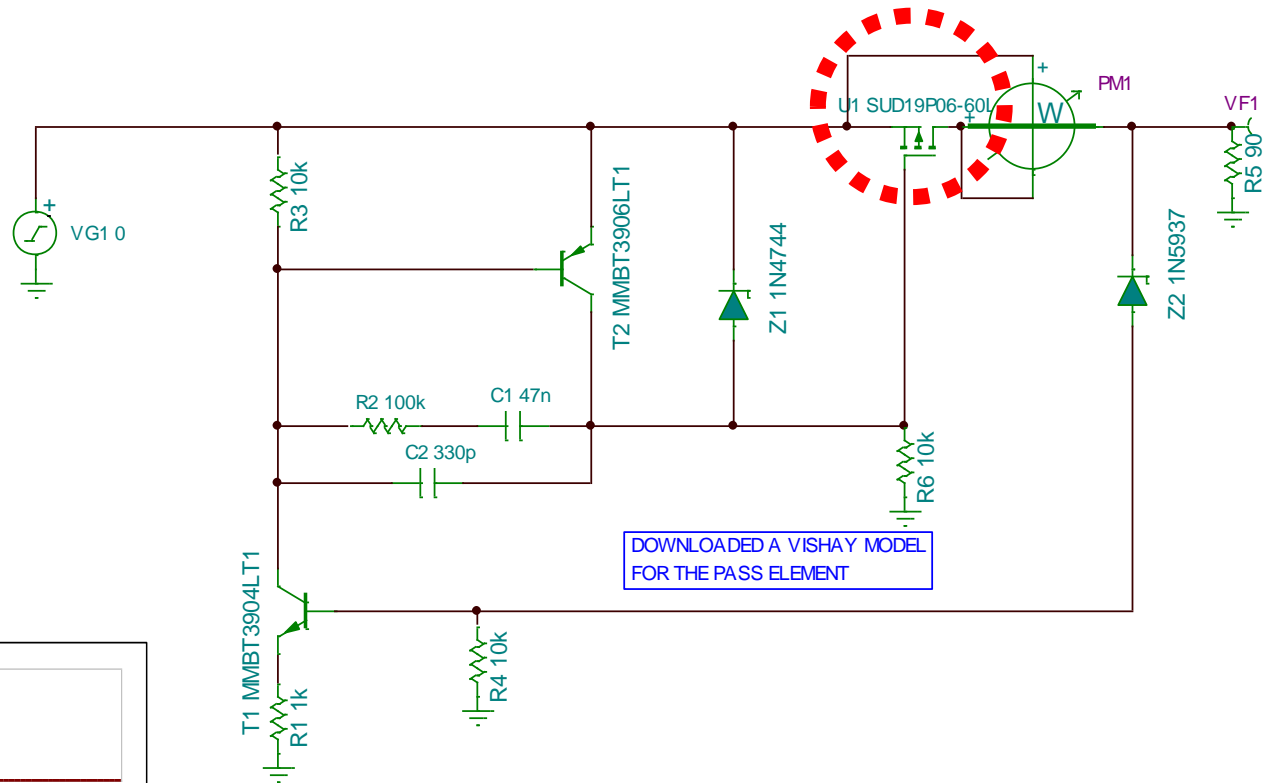
Оптимизированный домен питания



Protection: HV P-ch MOSFET

Первый каскад защиты:

- Само-восстанавливающийся предохранитель
- Варистор
- Обратно-смещенный диод



Второй каскад защиты:

- Ограничивает пики, но не отключает питание выше 60V
- Максимальный КПД в рабочем режиме

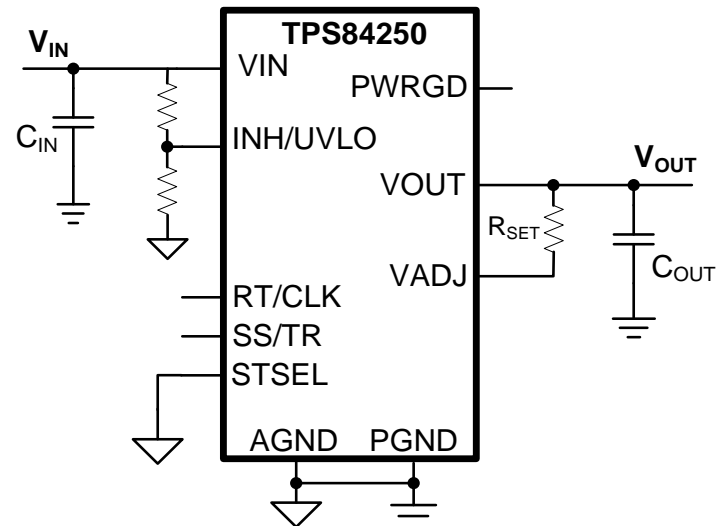
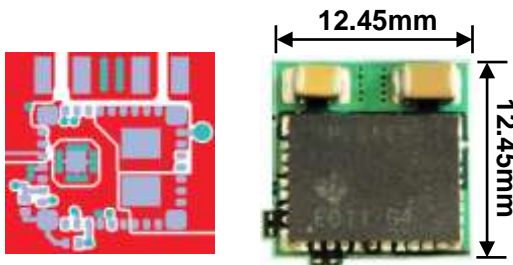
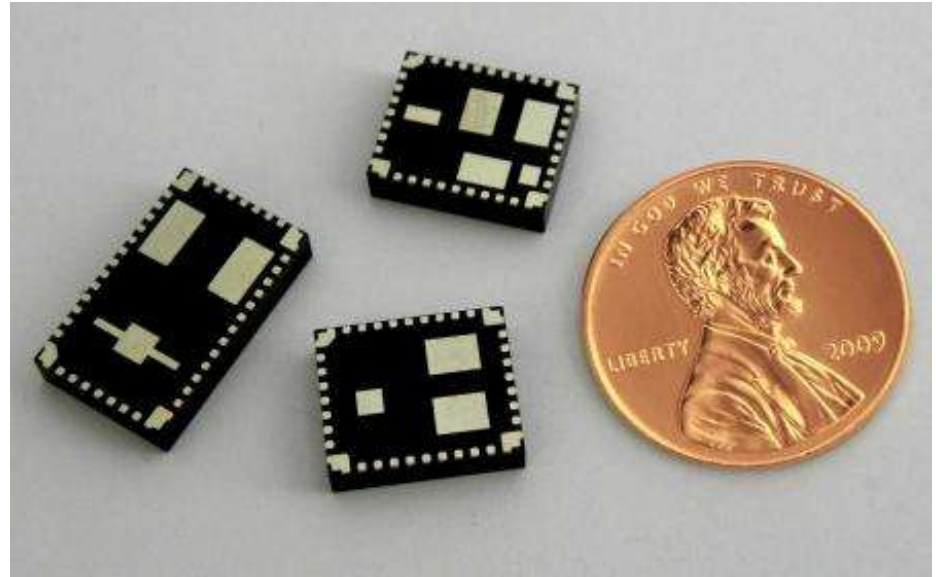
Рекомендовано



Buck module TPS84250: 7...50V Input, 2.5A with 65V Transient Protection

new

- Integrated Inductor and Passives
- 5A current limit
- Withstands 65V Line Transients
- 400kHz to 1MHz Operating Frequency
- Adjustable Soft Start & UVLO with Track, Clock and PG pins
- Meets EN55022 Class B Emissions
- Easy to Mount 9x11x3 mm QFN

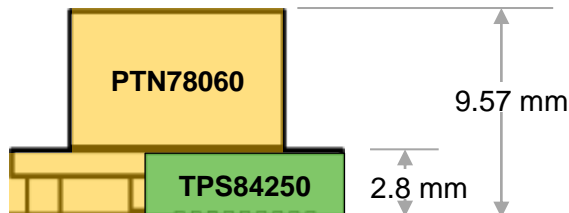
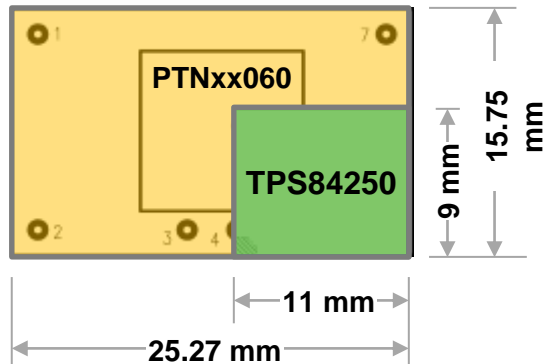


TPS84250: Smaller & Better Performance vs. 1-st generation 3A module (PTN78060W)

Tiny Size

TPS84250

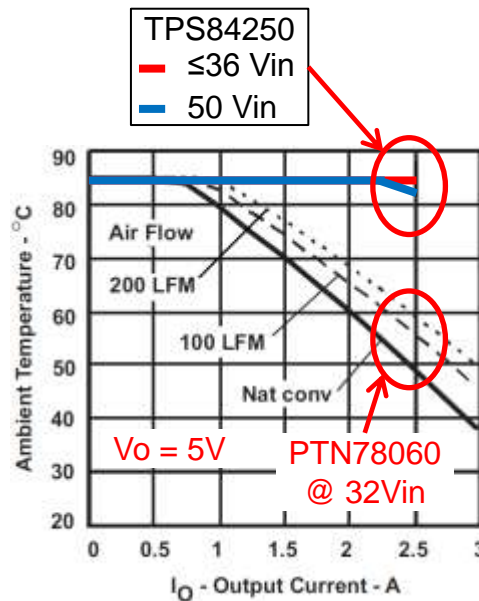
- 75% Reduction in Area
- 93% Reduction in Volume



Great Thermal Performance

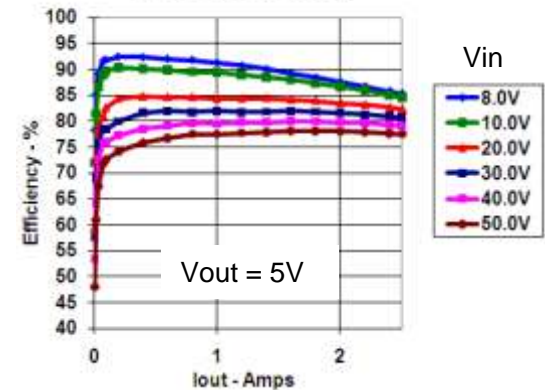
No Derating

for $\leq 36V_{in} \rightarrow 5V_{out}$ @ 85°C ,
Natural Convection

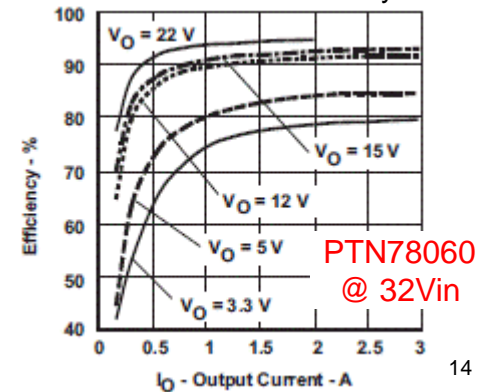


High Efficiency Across Wider Vin

TPS84250 Efficiency



PTN78060 Efficiency



TPS54061

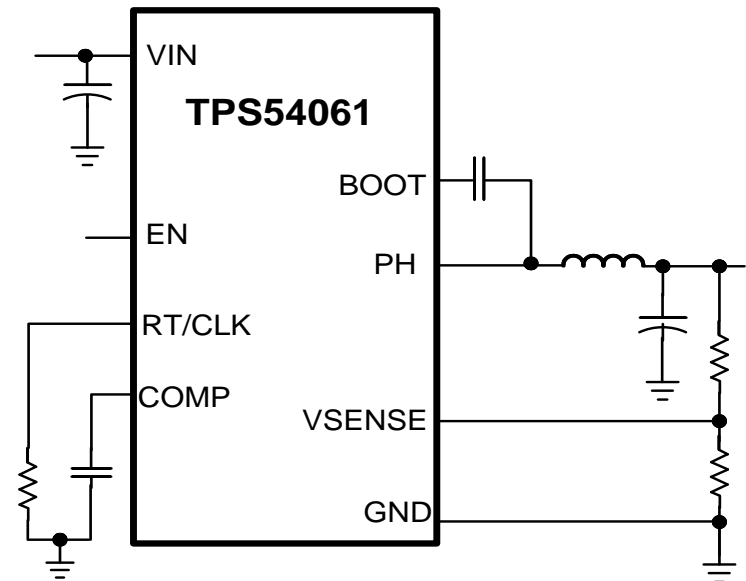
4.7...60V Input, 0.2A Synchronous Step-Down Converter

Features

- Fully Synchronous with Integrated 1.5/0.8 Ω Power MOSFETs
- 90 μ A Operating Quiescent Current and High Light Load Efficiency
- 50kHz to 1.1MHz Adjustable Frequency
- Optimize for Small Size
- Low Duty Cycle
- Synchronization Pin
- 0.8V Reference at 2% Accuracy

Benefits

- Useful in Battery Powered Applications. Saves Energy under Light Load Conditions
- Reduces Noise by Eliminating Beat Frequency
- Supports Low Output Voltage

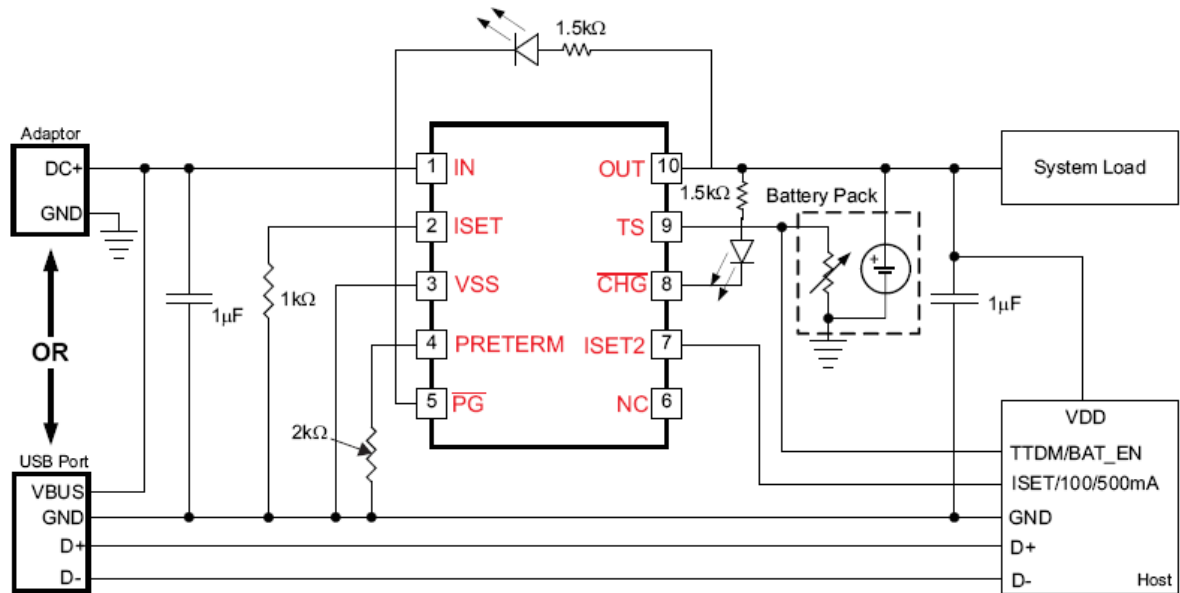


3x3mm 8SON Package

Simple charger BQ24090: 1-cell Li-Ion/ Li-Pol battery

SYSTEM

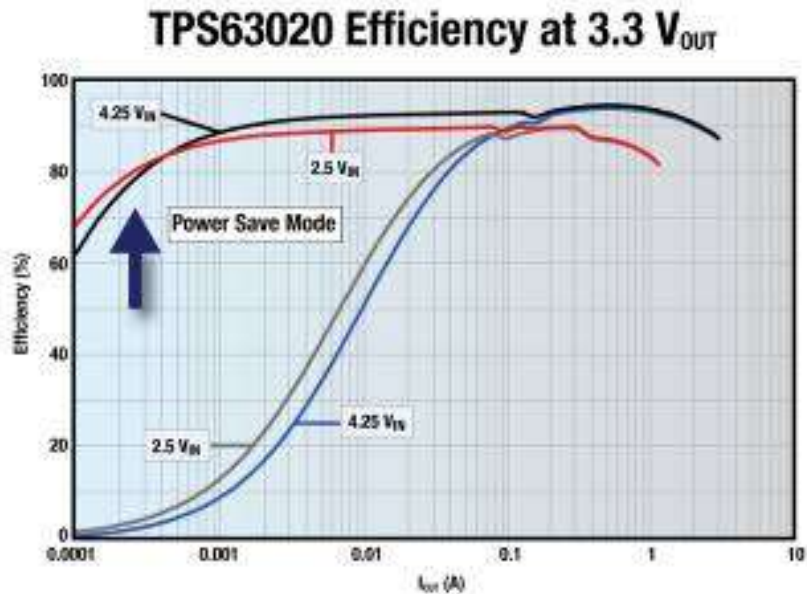
- Status Indication – Charging/Done
- Input voltage dynamic power management
- Selectable 100mA or 500mA current limit
- Adjustable precharge and termination current
- Small 10-Pin MSOP Package



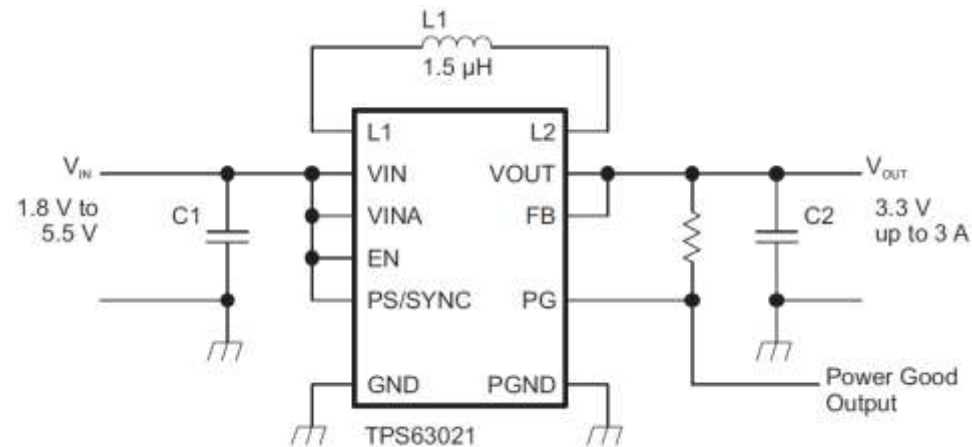
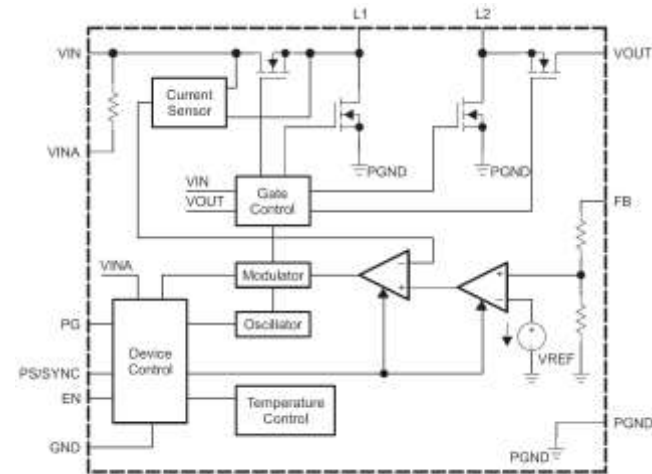
PROTECTION

- Automatic Termination and Timer Disable Mode (TTDM) for Absent Battery Pack With Thermistor
- Fixed 10 Hour Safety Timer
- 6.6V input over-voltage protection
- TS pin to monitor pack temperature

Buck/ boost TPS63020: 4A Switch, 96% Efficiency

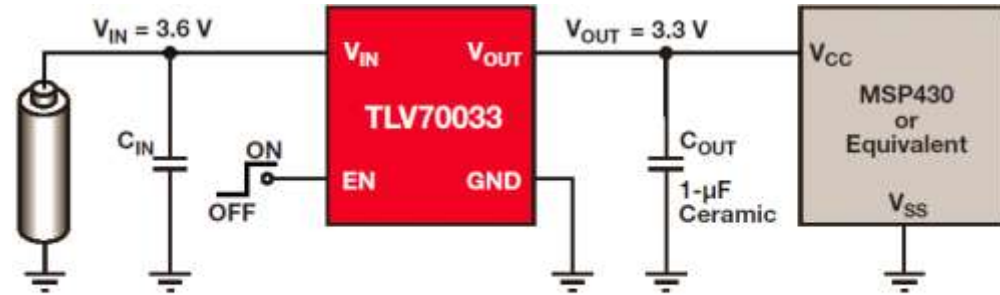


- Vin: 1.8V to 5.5V
- Vout: 1.2V to 5.5V
- Typical quiescent current 30μA
- 3A output at 3.3V in step-down mode (Vin = 3.6V to 5.5V)
- More than 2A output at 3.3V in boost mode (Vin >2.5V)
- Dynamic input current limit
- Power Save Mode
- Power Good (PG) increases system reliability

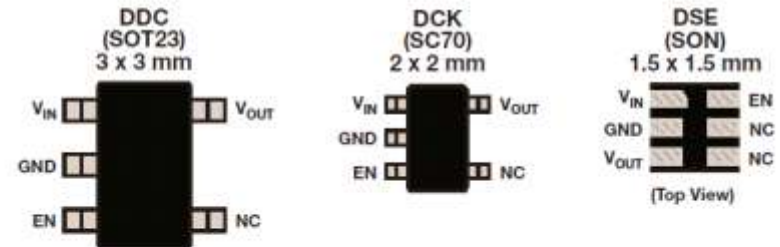


Low noise LDO TLV70033: Low IQ, High PSRR

- Оптимизирован по цене
- Требуется только дешевого керамического конденсатора 1 μF на выходе и 0.1 μF на входе
- Низкое собственное потребление $I_Q = 31 \mu\text{A}$
- Высокая точность 2%
- Значительное подавление ВЧ помех PSRR: 70 dB на 1 kHz
- Низкий собственный шум 48 $\mu\text{V RMS}$



TLV700xx typical portable application.



TLV700xx package options.

For more information, visit:

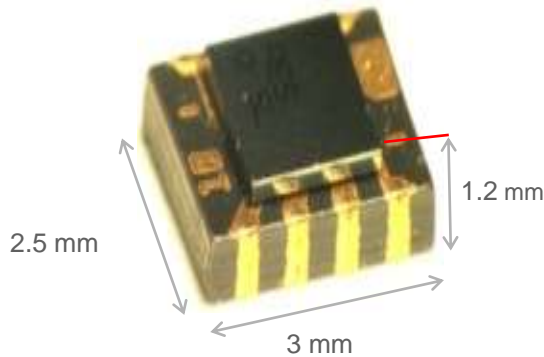
www.ti.com/tlv700xx or power.ti.com

Device	V_{IN} (V)	I_{OUT} (mA)	V_{OUT} Options (V)	V_{DO} (mV)	I_Q (μA)	Package Options	Resale Price (USD)	
							Qty: 1ku	Qty: 100ku
TLV700xx*	2.0 to 5.5	200	1.2, 1.5, 1.8, 2.8, 3.0, 3.3	175	31	DDC, DCK, DSE	\$0.18	\$0.096

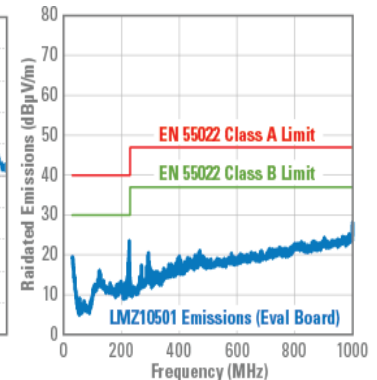
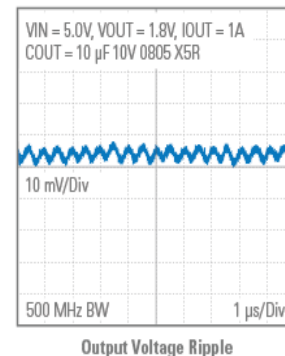
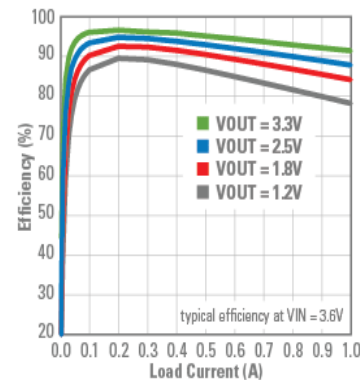
*xx = 12, 15, 18, 28, 30 or 33 to correspond with V_{OUT} voltage options.

Buck LMZ10501: 1A Simple Switcher Nano Module

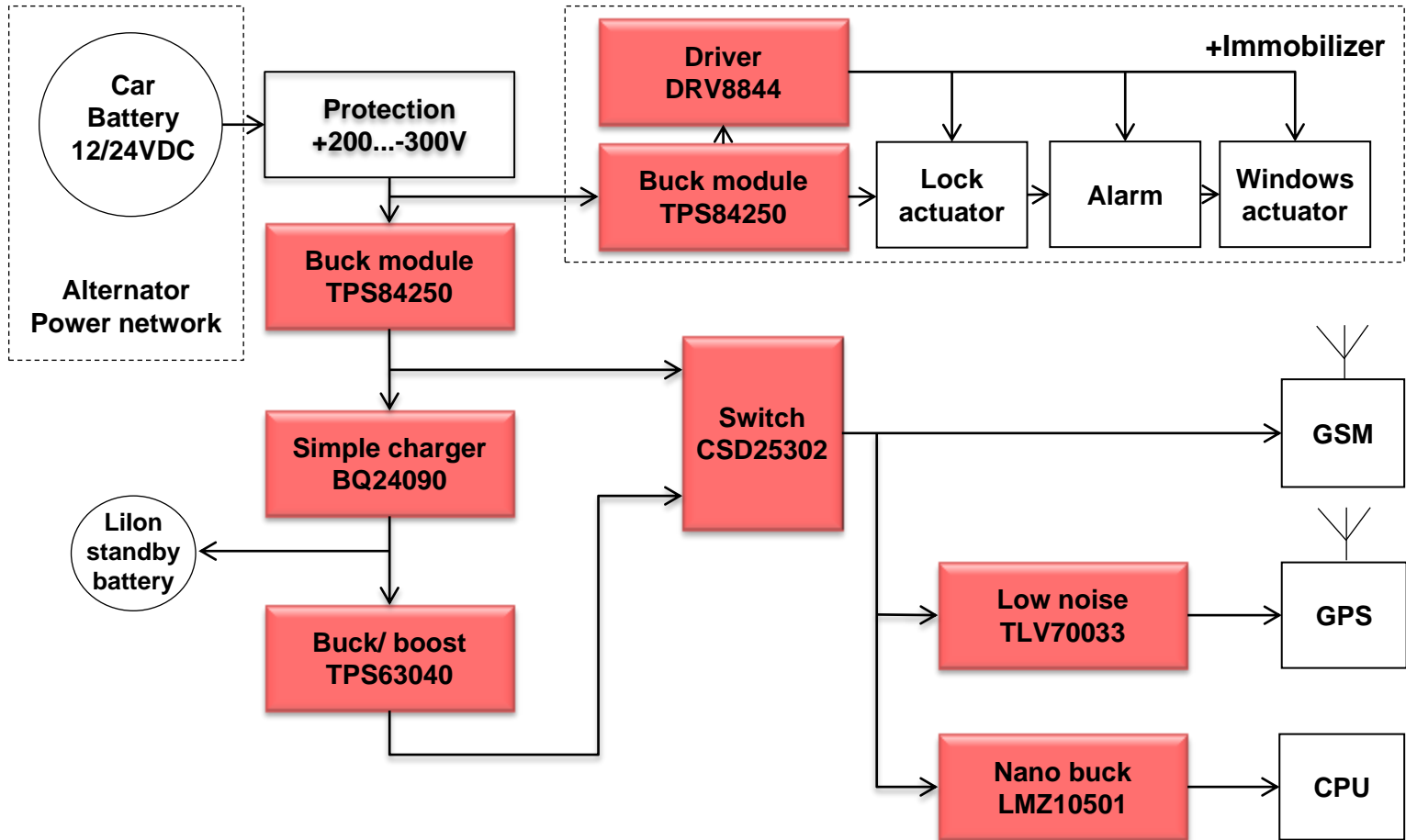
new



- **Integrated inductor**
- Input voltage range 2.7V to 5.5V
- Output voltage range 0.6V to 3.6V
- Output current up to 1A
- Peak efficiency up to 95%
- LMZ10500/1 pin compatible
- **Tiny packaging (2.5 x 3 x 1.2mm)**
- Input under voltage lockout (UVLO)
- Integrated compensation
- Current limit protection
- WEBENCH® enabled



Оптимизированный домен питания +



DRV8844: 5A Brushed DC or Quad Solenoid Driver

Features

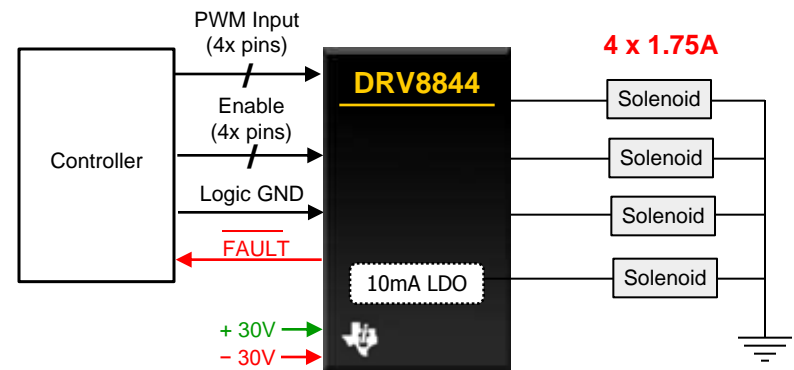
- Quad $\frac{1}{2}$ H-Bridge driver
 - Supply voltage: 8 to 60V
 - Current per $\frac{1}{2}$ bridge: 1.75A cont / 2.5A peak
 - Low RDSON: 240m Ω per FET
- Outputs can be paralleled for higher output current or better thermal performance.
- PWM control interface with independent enables
- +/- 30V split-rail support with “floating” control inputs
- On-chip 3.3V LDO (10mA)
- Integrated protection features including over-current, thermal, shoot-through and UVLO protection



28-pin HTSSOP
(9.7 x 6.4mm)

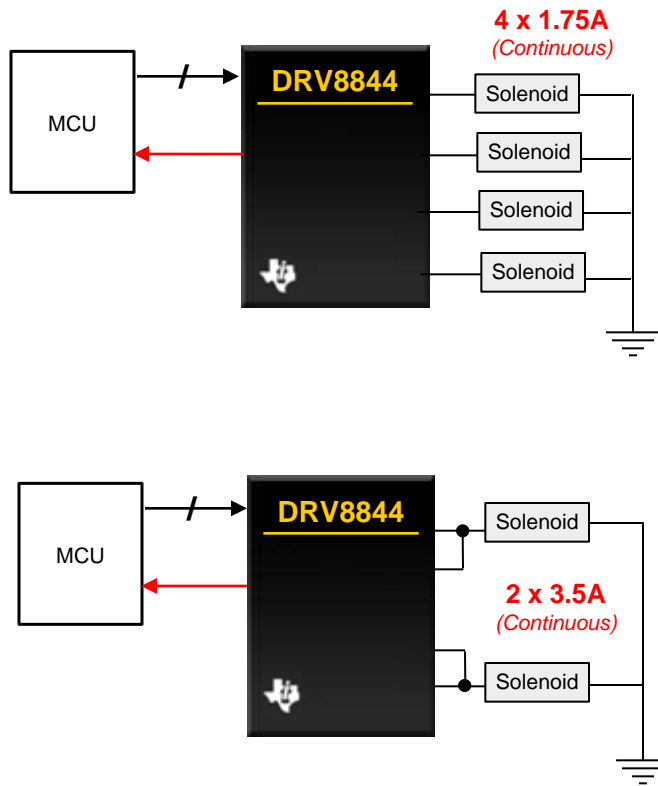
Benefits

- Wide supply range supports industry standard +24V and +48V supplies.
- Flexibility to support multiple output configurations
- Independent control of each half bridge w/ independent enables supports solenoid/relays by providing full control over the outputs (high, low, and tri-state)
- Split rail supports industrial applications; floating control I/F provides noise isolation from high voltage drive stage
- Reduced system cost; LDO provides enough current to power external MCU or combinational logic
- Advanced on-chip protection reduces design complexity and enables higher system reliability



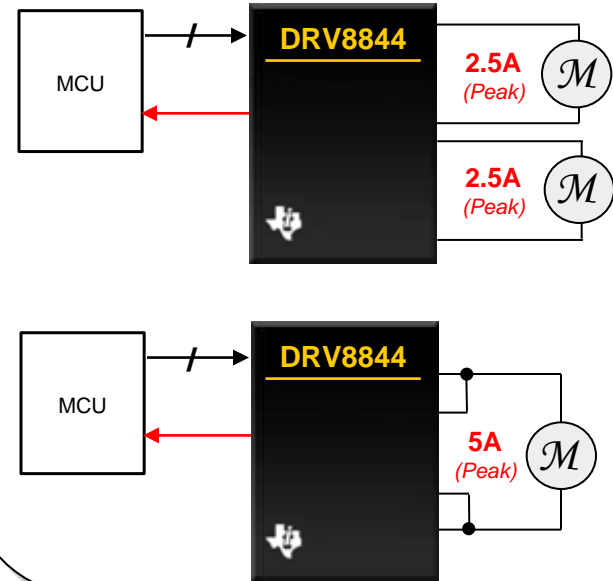
DRV8844: привод исполнительных механизмов

Dual or Quad Solenoid / Relay

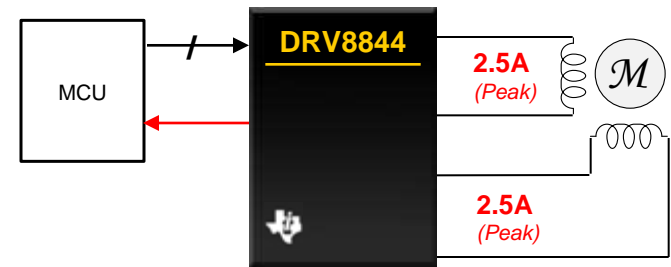


Integrated Catch/Freewheel Diodes!

Single or Dual Brushed DC



Single Bipolar Stepper





Вопросы ?