power integrations™

Power Solutions for Automotive

ac-dc converters led drivers gate drivers motor drivers

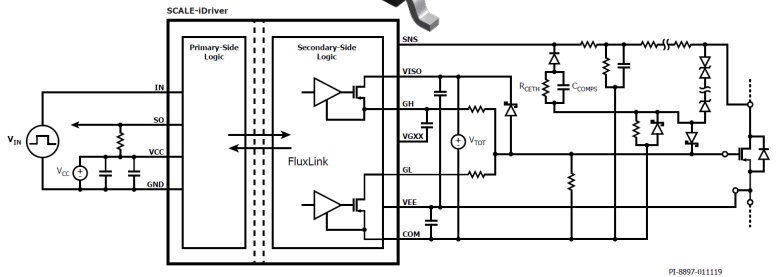
PI is an Established Automotive Supplier

- **Started shipping AEC qualified parts in 2016**
- **Wafer fab and assembly sites are IATF16949 certified**
- **FMEA compliant designs**
- **AEC Q100 (temp. grade 1) & Q101 qualified portfolio**
  - Isolated gate driver ICs for IGBT & SiC modules
  - Power supply ICs with integrated high voltage MOSFET
  - High performance 200 V & 600V diodes

SCALE-iDriver Family for Driving SiC MOSFETs in Automotive Applications

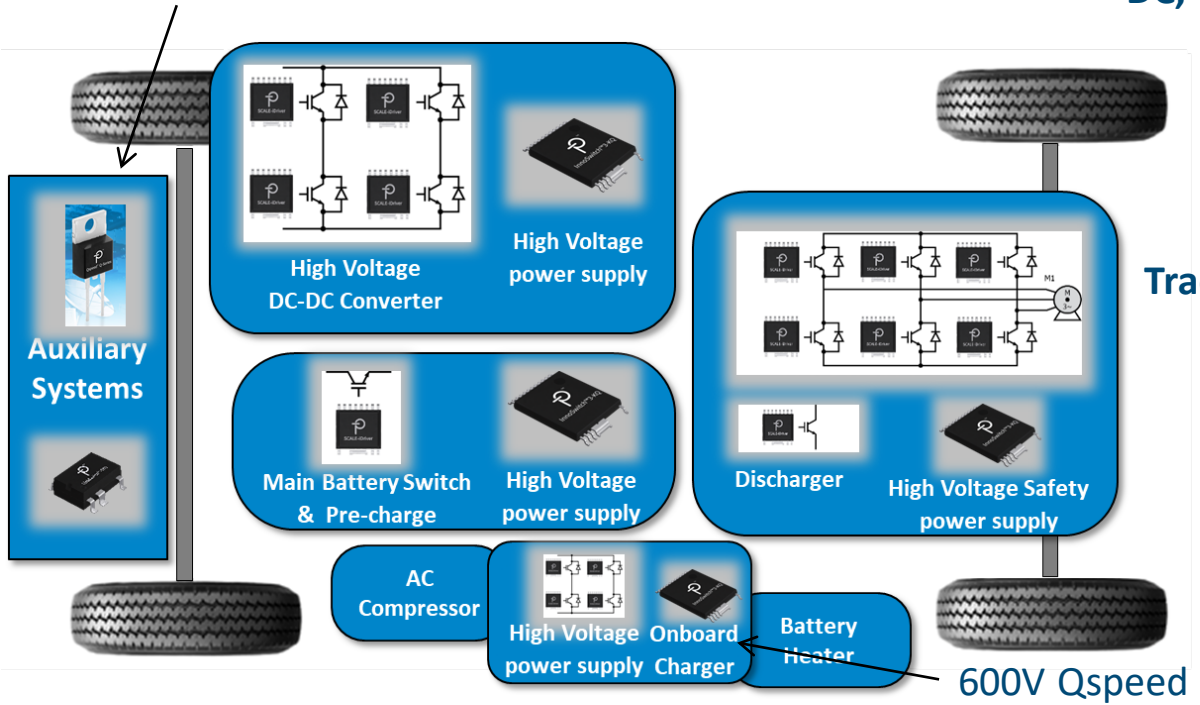
- **±8 A peak gate output current**
- **Very fast shut-down in short-circuit**
  - Advanced Active Clamping (AAC) <3 µs
  - AROC function to remove TVS
- **FluxLink™ magneto-inductive coupling**
  - Rugged isolated communication
- **AEC-Q100 qualified**
- **IGBT Optimized gate drivers**
  - SID11XXKQ

Product	Peak Output Drive Current	Switch Rating	Bus Voltage
SIC1181KQ	8 A	750 V	400 V
SIC1182KQ	8 A	1200 V	1200 V



PI Power Devices are Widely Used in an EV

200V Qspeed for audio



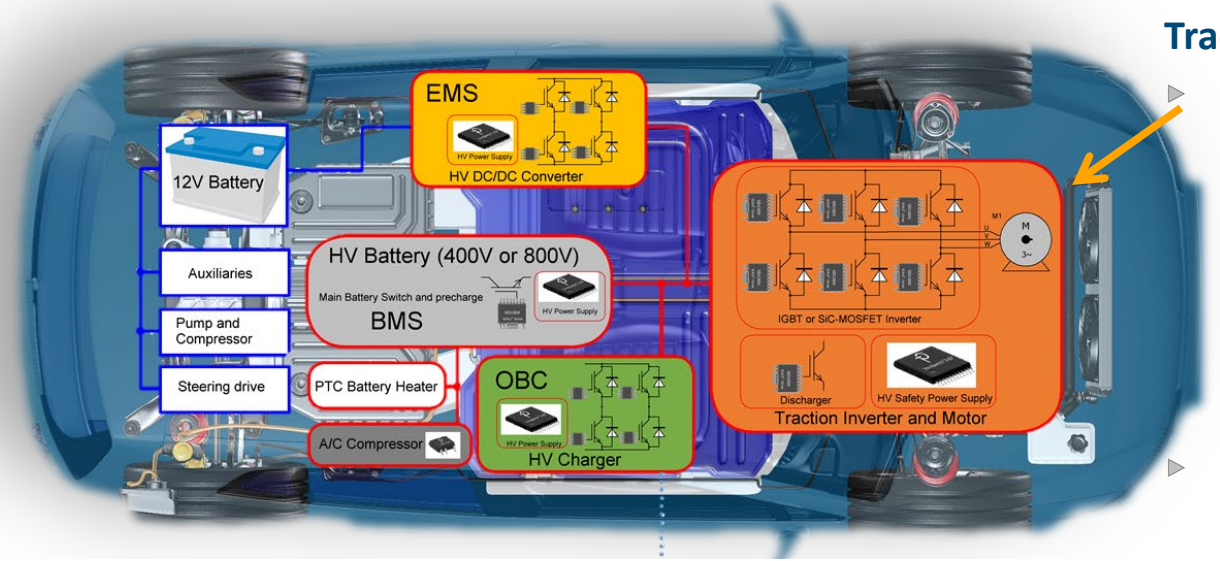
High voltage aux. power supplies for DC-DC, Battery disconnect BMS, HVAC, OBC

- Isolated flyback
  - 35W InnoSwitch3-AQ + Qspeed
  - 7W LinkSwitch-TN2
- Non-isolated Buck
  - 5W LinkSwitch-TN2

Traction Inverter

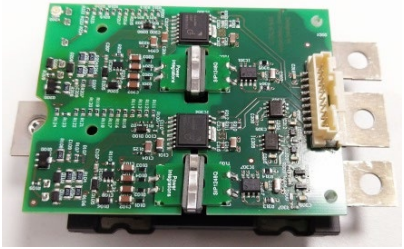
- Wide input emergency power supply
  - 35W InnoSwitch3-AQ + Qspeed
  - 7W LinkSwitch-TN2 flyback
- Non-isolated for active short-circuit
  - 5W LinkSwitch-TN2 Buck
- Gate Driver IC
  - SIC118XKQ & SID11XKQ

ISO 26262 Necessitates Use of an Emergency Power Supply for Traction Inverter – InnoSwitch3

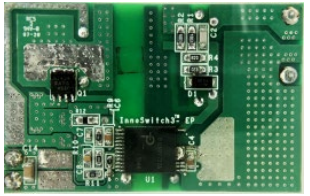


Traction Inverter

- **Gate drivers for SiC MOSFET or IGBT**
  - SCALE-iDriver



- **Emergency power supply**
  - InnoSwitch3-AQ

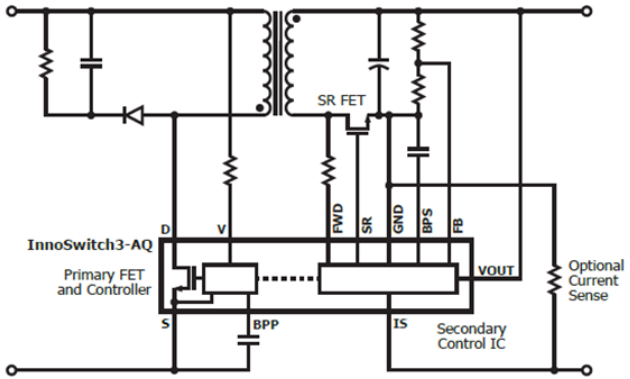


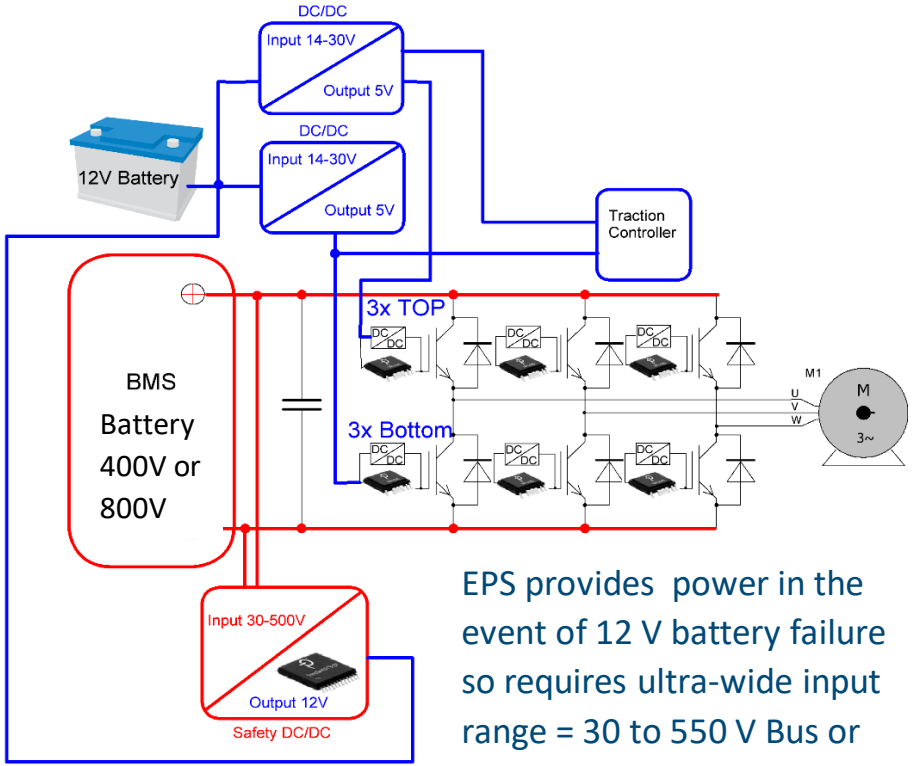
ISO 26262 "Road vehicles – Functional safety"

- International standard for functional safety of electrical and/or electronic systems in automobiles

InnoSwitch3-AQ Emergency Power Supply (EPS) for 400 V or 800 V Bus

- InnoSwitch3-AQ for emergency PS
- AEC-Q100 compliant
- Integrated 750 V MOSFET INN3977CQ
- Integrated 900 V MOSFET INN3996CQ
  - No optocoupler





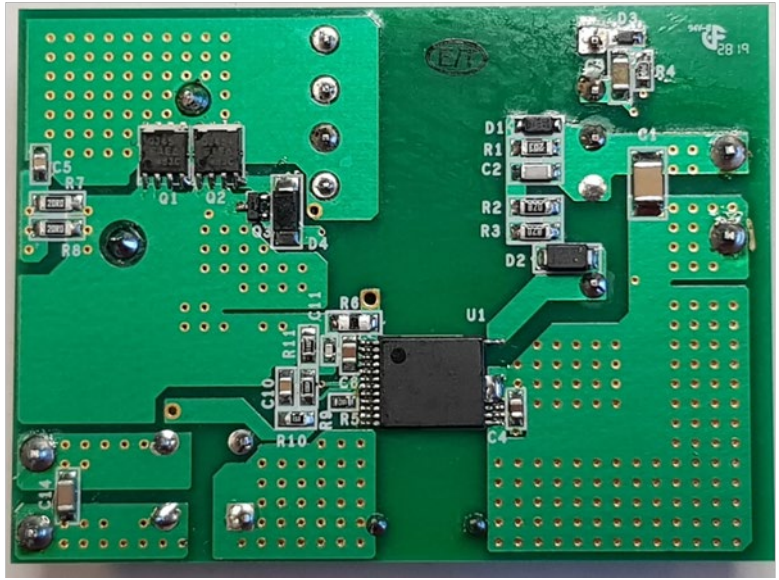
EPS provides power in the event of 12 V battery failure so requires ultra-wide input range = 30 to 550 V Bus or 30 to 921 V Bus with Stack FET

EPS DERs for 400 V or 800 V Bus

Application	750 V INN3977CQ 30W DER-840Q 30W DER-859Q	900 V INN3996CQ 20 W DER889Q
Bus Voltage	30 to 550 V DER-840Q 30 to 925 V DER-859Q	30 to 1200 V
Traction Inverter	✓	✓
EMS (DC-DC)	✓	✓
BMS	✓	✓
OBC	✓	✓

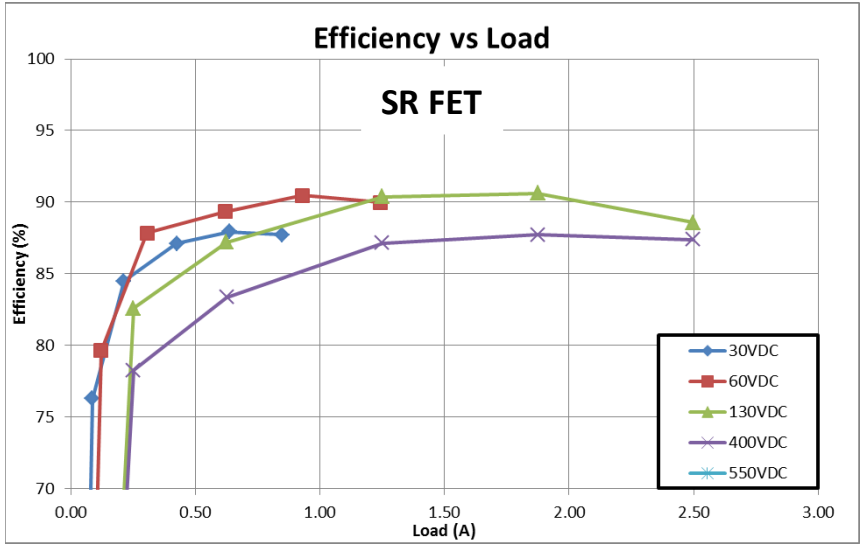
DER-840Q: 30 W Emergency Power Supply

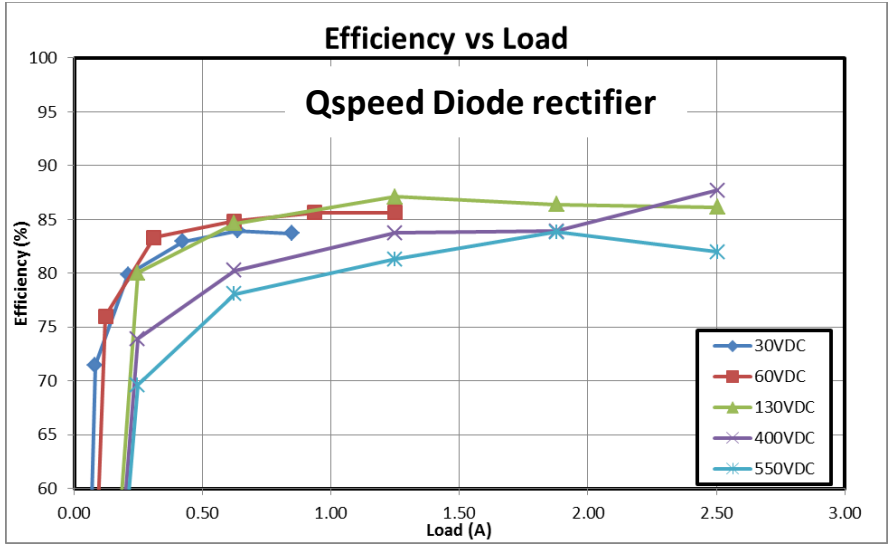
- **Wide input range: 30 VDC to 550 VDC input with 12 VDC output**
  - Board has option to use an SR FET or 200 VQspeed diode



High Efficiency 12 VDC Out for 550 V EWR I/P Opportunity for Qspeed Rectifier Diodes

- With 2 X SR FET or 200 V Qspeed





Ultra-Wide 30 - 1200 V Input EPS Specification

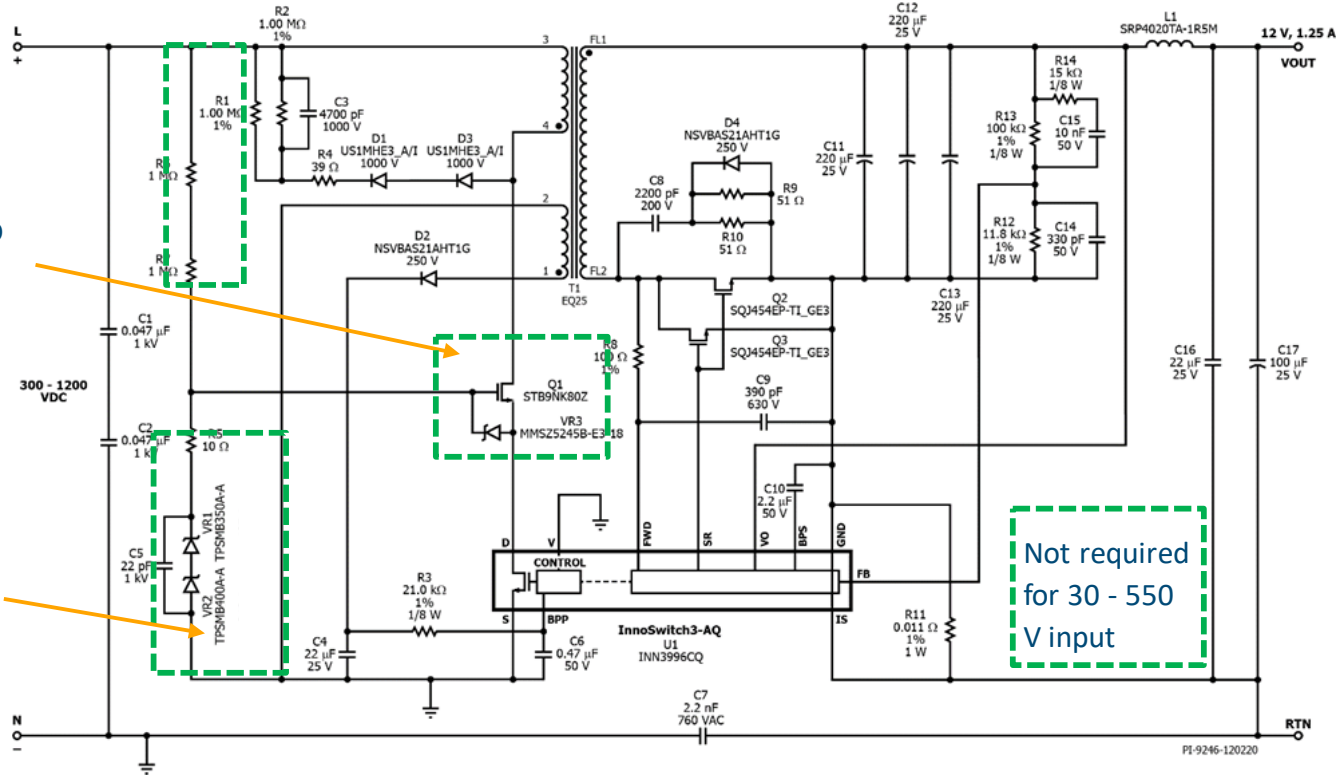
Description	Symbol	Min	Typ	Max	Units	Comment
Input						
Voltage	V_{IN}	30	800	1200	VDC	For Electric Vehicle Emergency PSU.
Maximum Output Power						
	P_{OUT}			2.2	W	V_{IN} of 30 VDC.
	P_{OUT}			15	W	V_{IN} of 60 VDC to 1200 VDC.
Output						
Output Voltage	V_{OUT}		12		V	±5% (V_{IN} > 400 VDC).
Output Current	I_{OUT}			1.25	A	
Output Ripple Voltage	V_{RIPPLE}			300	mV	On Board.
Isolation						Meets IEC 60664-1 as a Minimum. Reinforce Better.
Ambient Temperature	T_{AMB}	-40			W	

IN3996CQ + StackFET Supports V_{DS} of Up to 1700 V

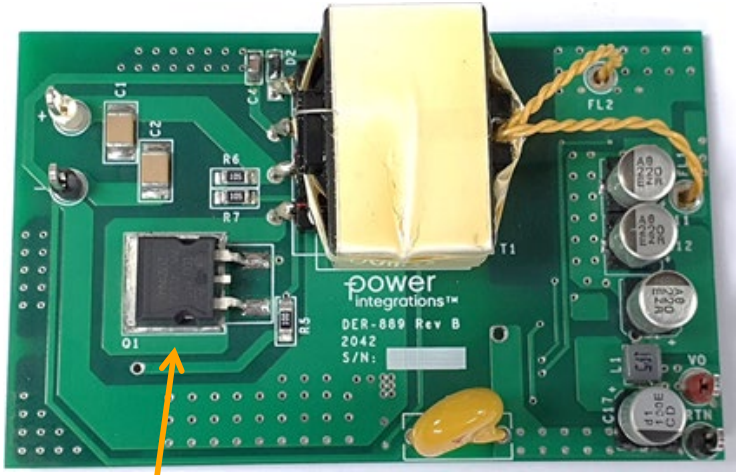
800 V StackFET

- Increases voltage rating to accommodate higher bus voltage

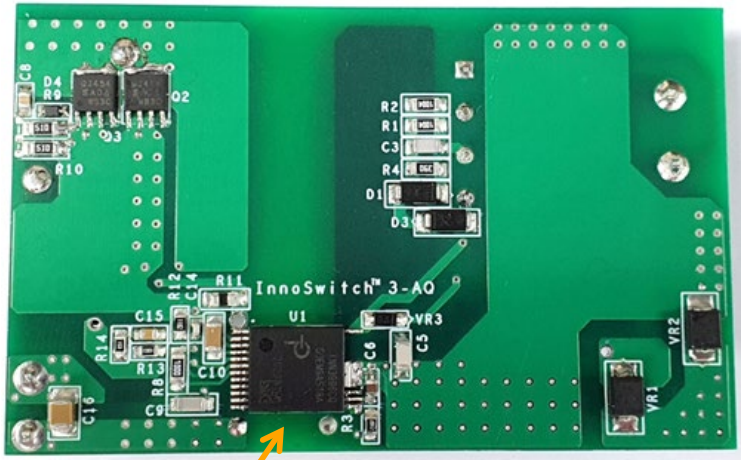
VR2 + VR3 sets voltage on INN3996CQ



Compact: Very Low Component Count



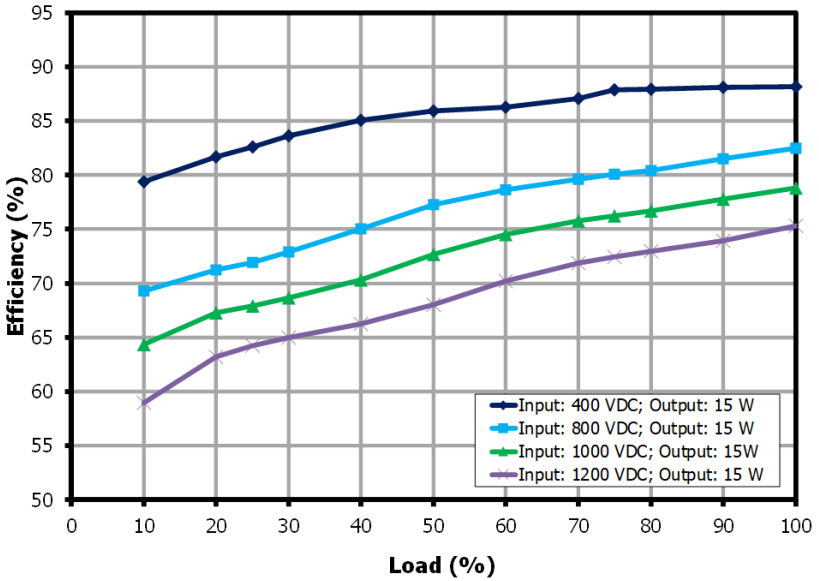
StackFET



InnoSwitch3-AQ INN3996CQ

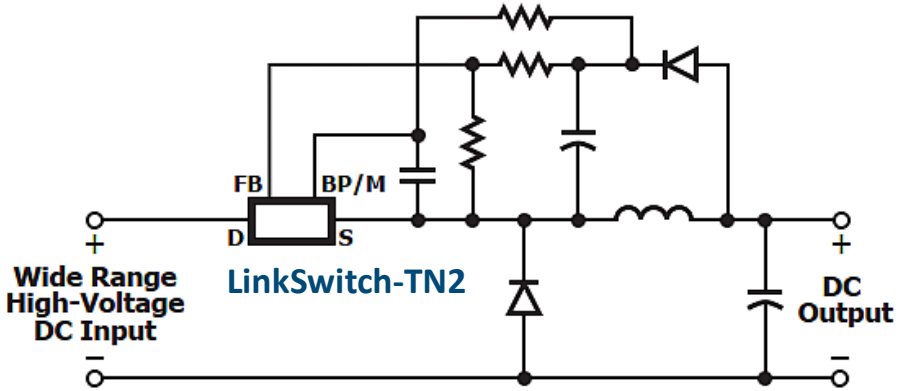
High Efficiency, Low Thermal Loss

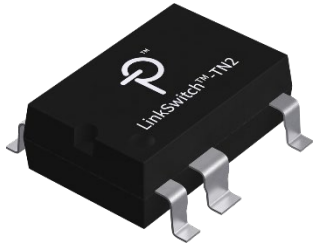
- **StackFET increases flexibility**
  - Set stress & thermals of INN3977CQ
- **Meets derating requirement and achieves high efficiency**
- **Option to use lower 500 V StackFET**
  - Optimize cost
- **Scalable solution**
  - 400 V bus use INN3996CQ/INN3977CQ
  - 800 V bus & up use INN3996CQ/INN3977CQ + StackFET



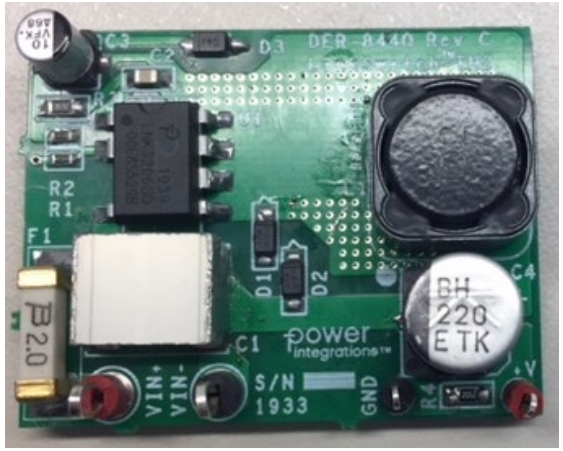
LinkSwitch-TN2 for Automotive Non-Isolated & Isolated Power Supplies

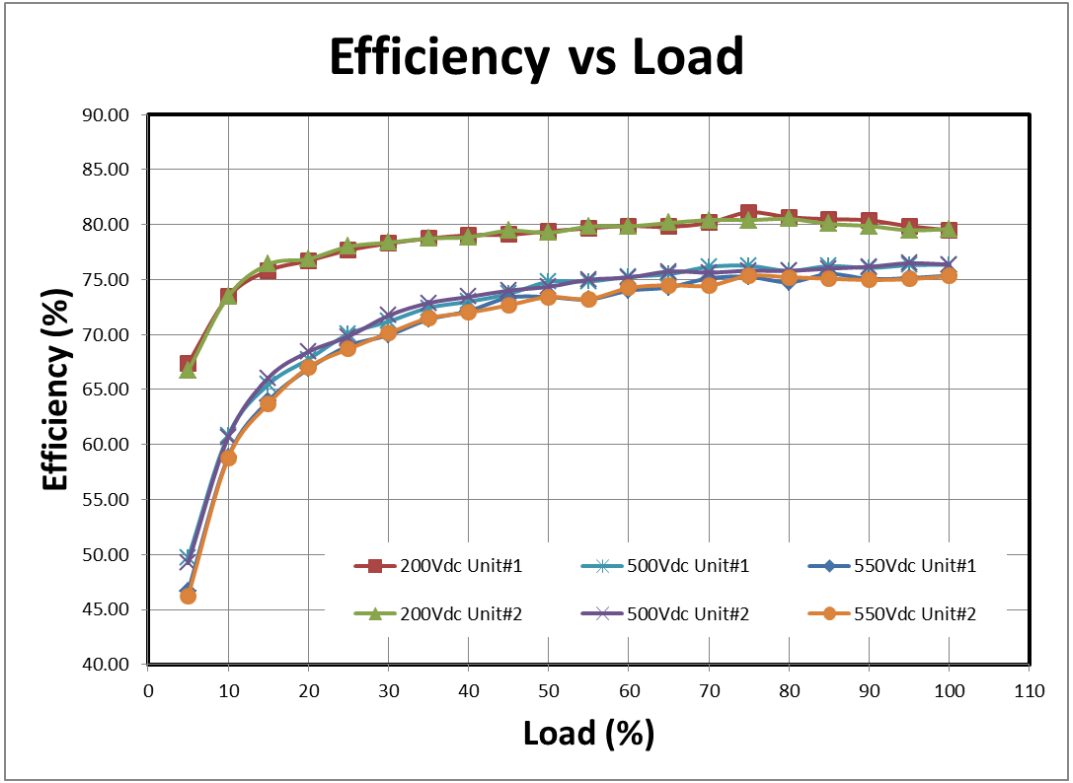
- **LNK3206GQ with 750 V power MOSFET**
  - 360 mA output current
  - SMD-8C package
  - 60 to 550 VDC input range
    - 500 VDC with 80% derating
  - AEC-Q100 compliant
  - Lowest component count
  - >3 mm drain-source spacing
  - Meets 2 KV ESD
  - Configurable as isolated Flyback or buck converter



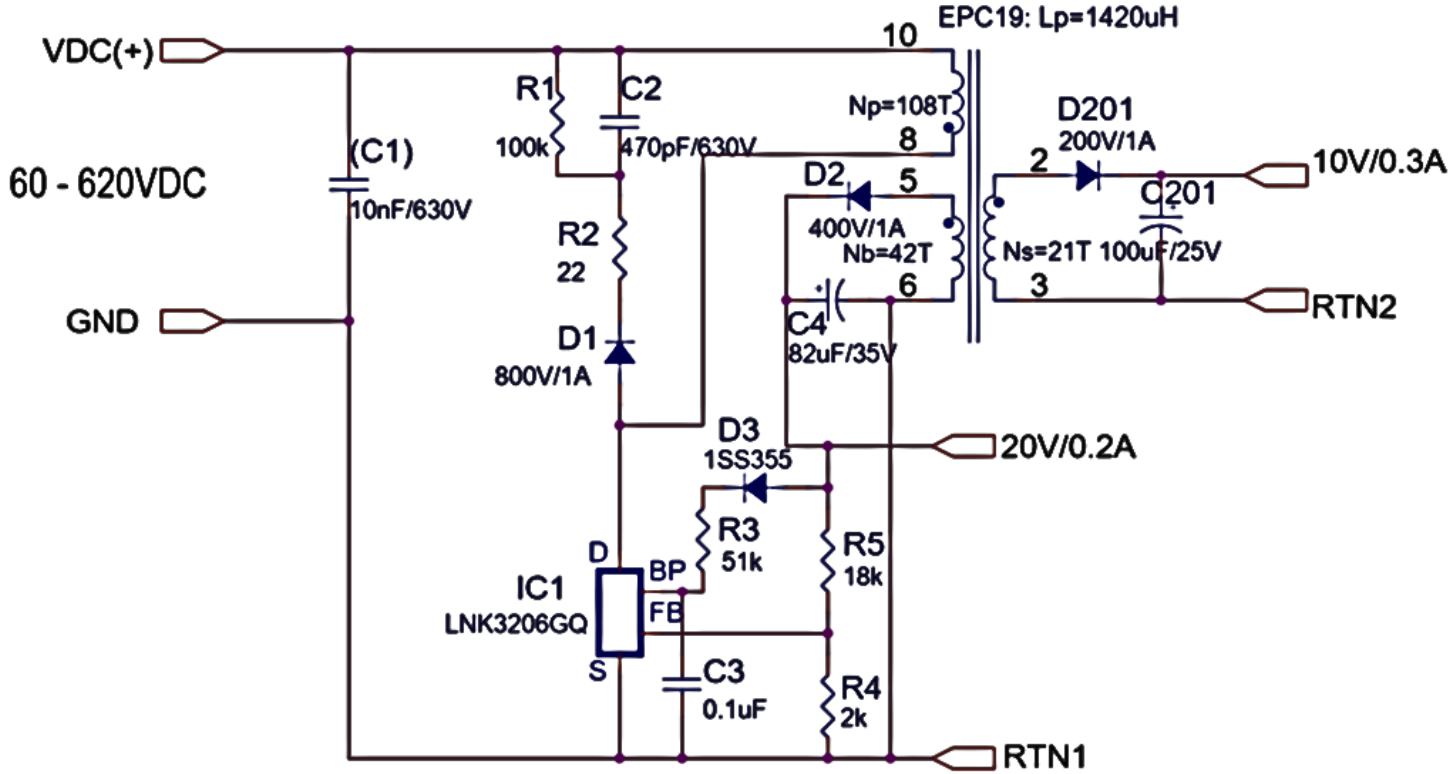


DER-844Q: 15 V 300 mA Non-Isolated Buck



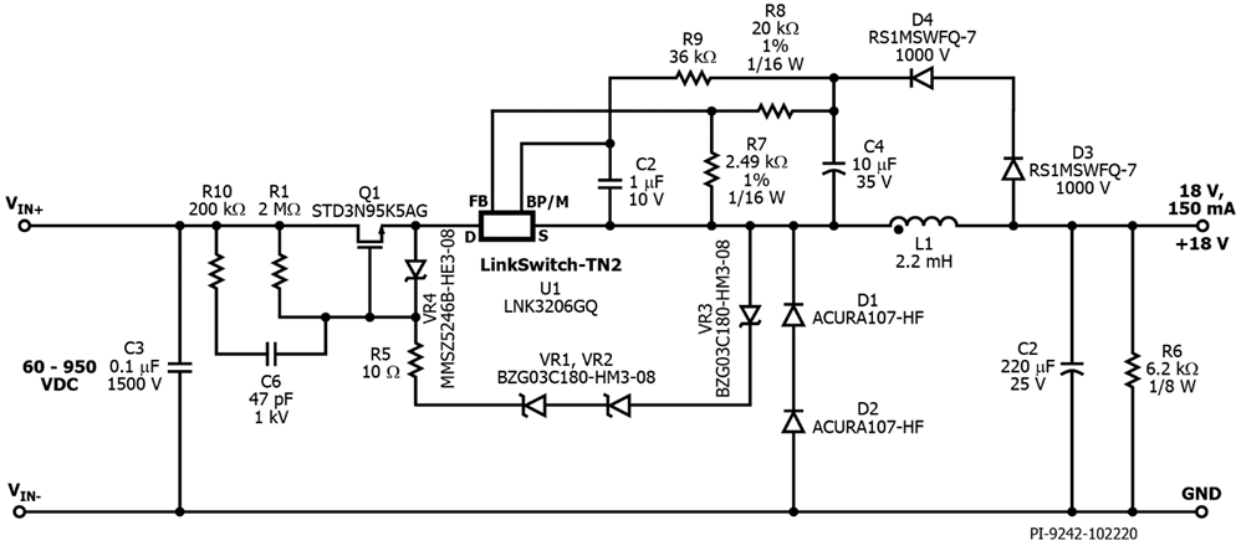


Flyback Example 60 to 620 VDC Input, 7 W, 2 O/P



Non-Isolated 800 V Power Supply LNK3206GQ + Stack FET

- **2.7 W DER-719Q**
  - 60 V to 950 V input
  - 18 V output 150 mA

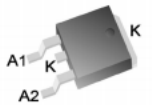


PI Parts for Automotive Power Supply

PI Part Number	750V INN3977CQ/900V INN3996CQ	750V LNK3206GQ
P_{OUT} for Isolated Power Supply	30 W & 20 W	7 W
I_{OUT} Buck Converter	N.A.	360 mA
Input Range	30 V to 550 V & 30 V to 925 V with Stack FET	60 V to 550 V & 60 V to 1 KV with Stack FET
DERs	30 W DER-840Q 30 V to 550 V input 30 W DER-859Q 30 V to 925 V input 20 W DER-907Q 30 V to 550 V input planar 20 W DER-889Q INN3996CQ 30 V to 1.2 KV input	DER-844Q 15 V 300mA 60 V to 550 V Buck input DER-719Q 18 V 150mA 60 V to 1KV Buck input

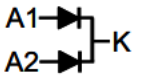
Qspeed: High Performance Diodes for Automotive

- **Automotive audio amplifiers (regular & electric vehicles) AECQ101 qualified**
  - 200V low Qrr diodes: LQ10N200CQ & LQ20N200CQ in DPAK package
    - The soft switching of this diode dramatically reduces overshoot and EMI
    - Eliminate snubbers across these diodes when used in output rectification applications
    - 80% less Qrr compared to Schottky diodes for faster switching and lower switching losses
- **EV chargers with 600 V QH12TZ600Q (SiC replacement) AEC-Q101 qualified**
  - Ultra-low reverse recovery charge (Qrr) lower than SiC diode
  - Lower cost than SiC with almost similar performance at high switching freq. applications
  - Use as PFC and/or output rectifier diodes in on-board chargers



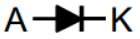
TO-252 DPAK

LQ10N200CQ



TO-220AC

QH12TZ600Q



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