# Power Conversion

**Modena, 15 Aprile 2014**


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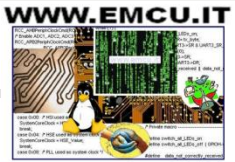
Power 'n More
SILICA Power Solutions




# ST's new strategy: Leadership in…

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**Sense & Power and Automotive Products**

**Embedded Processing Solutions**

**Addressing a $140 billion market, ST gaining share**

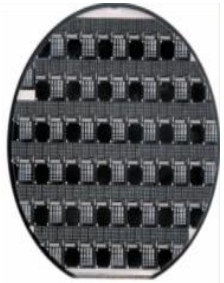
Source : WSTS

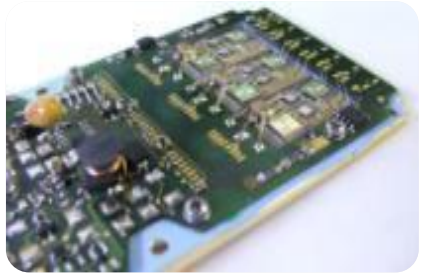
# ST strategy for Power

SMART POWER

POWER
DISCRETE & NEW
MATERIALS

ADVANCED
SOLUTIONS





# Smart Power Conversion



## Advanced Solutions on Power Management

### ST has the solution for…

#### Power Conversion

- **SMPS ICs**
- LED drivers & controllers
- **Digital Power platform**
- **DC-DC converters**

#### Linear Conversion

- **High performance LDOs**
- High performance VRef.
- Hot Swap Reg. (E-Fuse)

#### Battery operated devices & power management


- Power management IC
- Battery chargers and products for hand-held devices

# DC/DC conversion

# What is an LDO? Where can you find it?

Here!

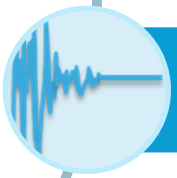
**ST lands on Mars**

Mars - 06-Aug-2012: The Mars Rover Curiosity touched down on the surface of Mars this morning. The first images from Mars have been received on earth. Curiosity, the car-size, one-ton rover is a well-equipped mobile laboratory. ST provides several components aboard the rover. Here are just a few: Diverse logics IC's (Radhard 54ACMOS, CMOS 4000B); Low Drop Voltage regulators (RHFL4913); and, Bipolar transistors

# Selecting an LDO: LDOs Families@ST

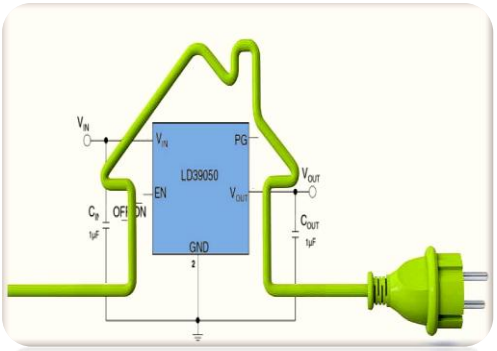
Ultra Low dropout

Low quiescent current



Low noise/High PSRR

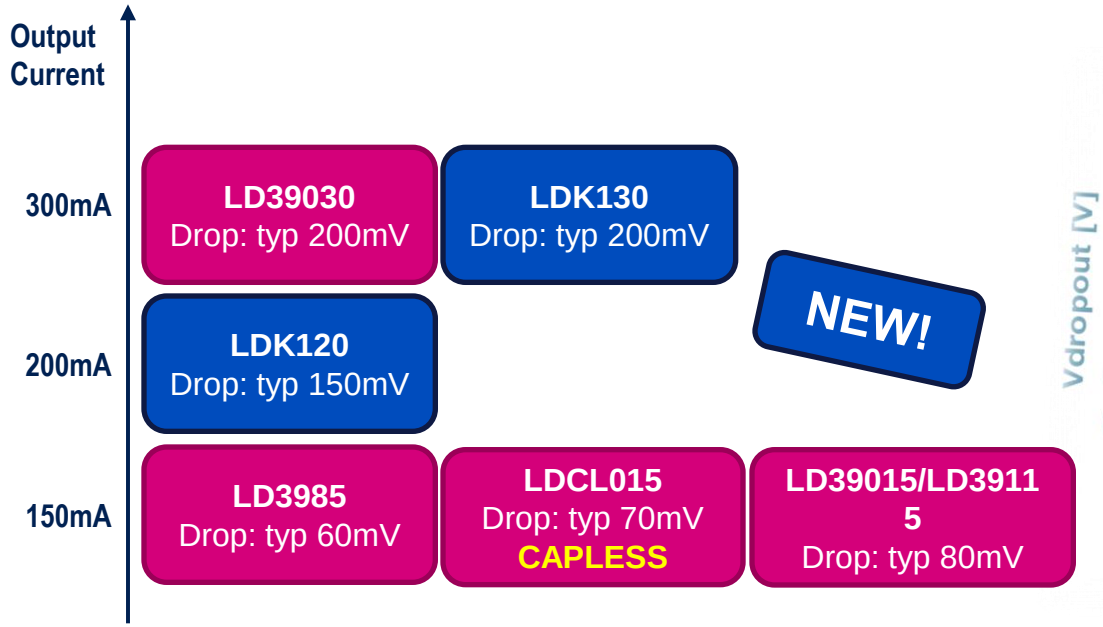
Miniature




***ST offers a complete portfolio of high performance LDOs, with state-of-the-art figures on the key merit parameters***

# Ultra low DropOut:

## Low voltage (5.5V), Low current (<300mA)





## Main benefits

- Higher efficiency, lower power dissipation
- Fast transient response
- **Low quiescent current**
- **Good dynamic performances (PSRR and Noise)**
- SOT23-5L, SC70, DFN1.2x1.3 and CSP packages

## Applications

- **Low power µC supply (STM32, etc)**
- Cell Phones and Cordless
- Game consoles and accessories
- Battery powered equipments

# Ultra Low DropOut:

## Low voltage (5.5V), Medium current (>300mA)

Output Current

3A

2A

1.5A

1A

500mA

**LD39300**
Drop: typ 200mV

**LD49300**
Drop: typ 220mV

**LD39200**
Drop: typ 130mV LOW VIN, HIGH PSRR

NEW!

**LD39150**
Drop: typ 200mV

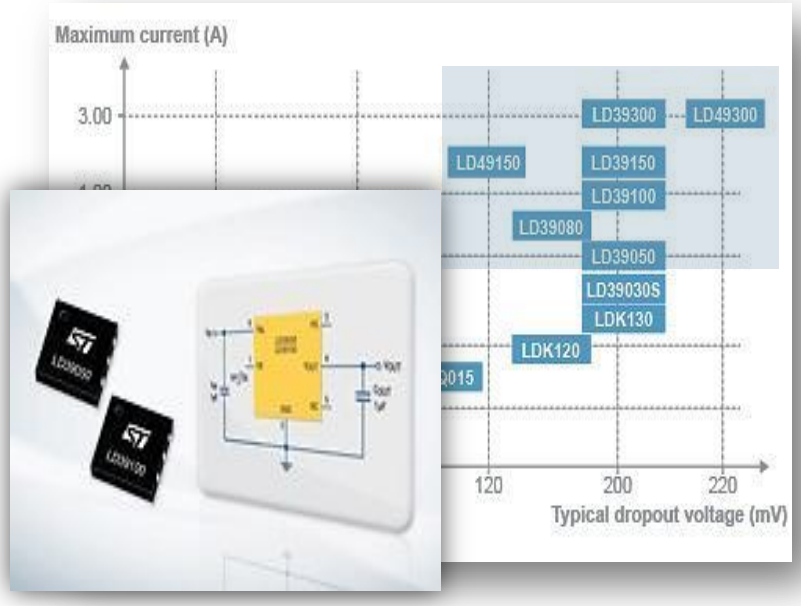
**LD39100**
Drop: typ 200mV

**LDF**
Drop: typ 200mV
**16V VIN**

**LD39080**
Drop: typ 150mV

**LD39050**
Drop: typ 200mV

**LDFM**
Drop: typ 150mV
**16V VIN**




## Main benefits

- Higher efficiency, lower power dissipation
- Fast transient response
- **Low quiescent current**
- **Good dynamic performances (PSRR and Noise)**
- DFN 3x3 and 4x4 , DPAK and PPAK packages

## Applications

- **DSP and FPGA power supply (STM32, etc)**
- TV and STB
- Computer and Data storage
- Game consoles and accessories
- Telecom infrastructure

# Ultra Low DropOut:

# LD39200 – 2A high performance LDO

**LD39200**

**2A Ultra Low dropout ,Low Voltage**
**Very low noise – Very high PSRR**
**With Reverse current protection**
**in 3x3 DFN6 and 4x4 DFN8 Packages**

**NEW!**

- Very low startup voltage: from **1.25 to 6 V**
- Very low output voltage: from 0.5V
- Guaranteed output current: 2A
- **Ultra low drop: 130 mV typ. At 2A**
- **High PSRR: 70 dB @ 1kHz, 40 dB @ 1MHz**
- **Very low noise: 45µ$V_{RMS}$/$V_{OUT}$**
- **Low quiescent current: 100 µA typ @ no load**
- Enable and Power Good functions
- **Reverse current protection**
- Packages: DFN6 3x3 and DFN8 4x4

## Main benefits and Applications

- This high performance, medium power LDO is designed for demanding applications.
- It offers a best-in-class dropout performance without the need of additional biasing voltage.
- It is designed to provide the maximum efficiency in those environment where DC-DC switching regulation is not allowed.

Typical applications are

- Digital IC Power Supply
- Telecom infrastructures
- Consumer and Industrial Equipments POL
- **FPGA, DSP, ASIC dedicated Power Supply**




# Low quiescent current LDOs: the Battery's Ally

## Key Features

- **Ultra low quiescent current (Iq) (down to 1.4µA)**
- Very low dropout
- Wide range of miniaturized packages
- Output current from 50 to 150mA
- Extended input voltage range (up to 24V on ST715)

## Main Benefit

- Maximize battery life
- Reduce standby power consumption
- Minimized PCB area occupation
- Easy design and implementation

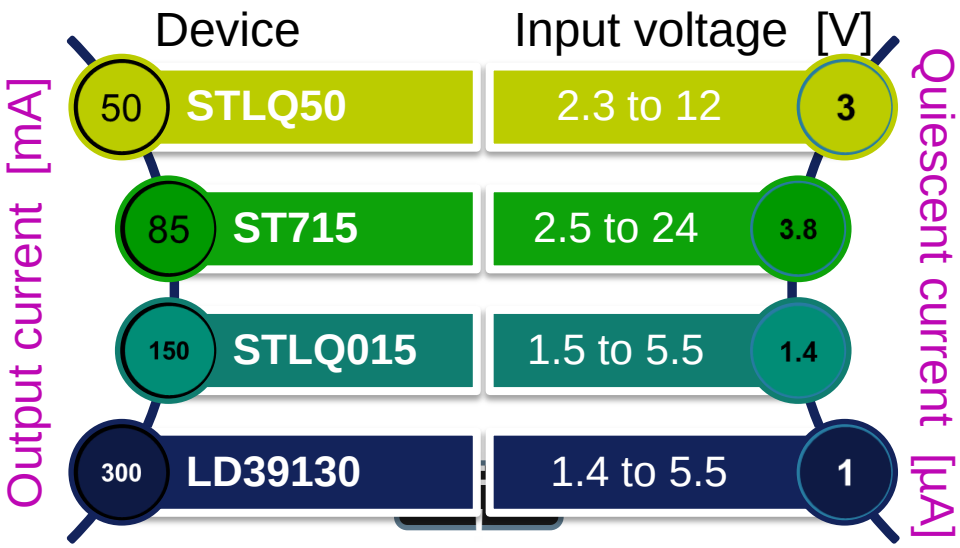

## Applications

This family of LDOs is designed for those applications where power consumption is at a premium:

- Medical/Health care equipments
- Smoke detectors and alarms
- Real-time clock backup power
- Electronic sensors
- Portable Consumer

# Low quiescent current LDOs: the Battery's Ally







## Key Benefits

- Maximize battery life
- Reduce standby power consumption
- Wide VIN range offer, for maximum Flexibility
- LD39130: Automatic Green Mode operation

## Packages

- STLQ50: SC70 (2x2 mm2)
- STLQ015: SOT666 (1.6x1.6 mm2)
- ST715: SOT23-5L (2x2 mm2) & DFN8 (3x3 mm2)
- LD39130: CSP4 bumps (0.69x0.69mm2) & DFN6 - 1.2x1.3 mm2

# Low quiescent current LDOs: the Battery's Ally

## LD39130S

**New 300mA High performance LDO With automatic GREEN MODE in 0.69x0.69 CSP 4 bumps and DFN6L 1.2x1.3**

**SMART efficiency**

- Input voltage: from 1.4 to 5.5 V
- Guaranteed output current: 300 mA
- Automatic *green mode* for low consumption at light loads:
  - **1 µA typ in low power mode**
  - **55 µA typ @ 300 mA load**
  - **0.1 µA typ in off mode**
- High PSRR: 70dB @ 1kHz, 65dB @ 10kHz
- Very low dropout voltage: 300 mV typ @ 300 mA
- Internal soft start
- Packages:

**CSP 4 bumps 0.69 mm x 0.69 mm**

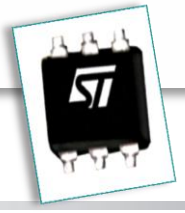
**DFN 6 leads - 1.2 mm x 1.3 mm**

**Stand-by power reduction**

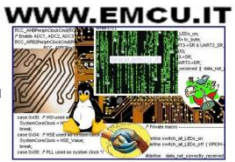

## STLQ015

**150mA Ultra low quiescent current LDO In SOT666 1.6x1.6 package**

- Input Voltage from 1.5V to 5.5V
- Guaranteed output current: 150 mA
- Ultra Low and constant quiescent current:
  - **1 µA (typ) at no load**
  - **1.4 µA (typ) at 150 mA load**
  - **1 nA (typ) in OFF mode**
- Logic controlled enable pin
- Internal Current and Thermal Limit
- Compatible with ceramic capacitor
- Package:



**SOT666-6leads 1.6 mm x 1.6 mm**



# Low noise & High PSRR LDOs:

## Make your DC more silent

### Key Features

- **Ultra low noise (down to 6.3µVRMS)**
- **Very High PSRR (up to 92dB)**
- Fast transient response
- Low quiescent current (20µA)
- Wide range of miniaturized packages


### Main Benefits

- Excellent output signal quality
- Minimized PCB area occupation
- Easy design and implementation
- Low current consumption

### Applications

This family of LDOs is designed for noise sensitive applications:

- **RF modules, LNA, IF and VCO**
- **Signal conditioning, ADC**
- Instrumentation, Medical equipments
- DC-DC low noise post-regulation
- Mobile phones and tablets

# Low noise & High PSRR LDOs:

## Make your DC more silent

**LDLN015**

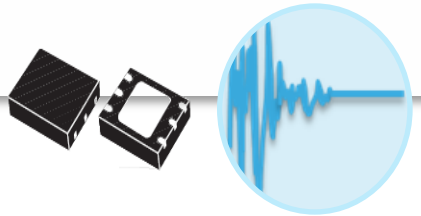
**BEST-IN-CLASS**

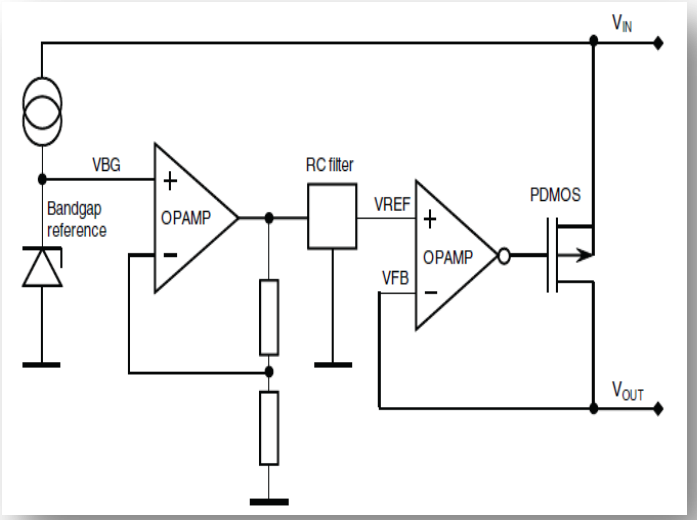
**Ultra low noise – very high PSRR**

**150mA LDO in 2x2 DFN6L Package**

**Ultra low noise**

- Input voltage: from 2.1 to 5.5 V
- Guaranteed output current: 150 mA
- **Ultra low noise: 6.3 µVRMS from 10 Hz to 100 kHz**
- **Very high PSRR: 92 dB up to 10kHz**
- **Low quiescent current: 17 µA typ @ no load**
- Logic controlled enable pin
- **Very low dropout voltage: 90 mV typ @ 150 mA**
- Packages:






**ULTRA low-noise Architecture**

## Main benefits

Thanks to the ultra low noise design, together with a very high PSRR figure, the device provides best-in-class voltage regulation.
**It is perfect as a post-regulator for noise-sensitive application,** as well as a simple linear power supply for low noise-battery powered devices.

# Low noise & High PSRR LDOs:

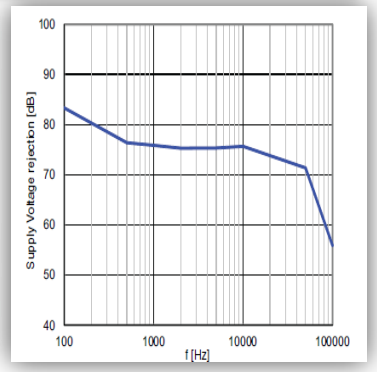
## Make your DC more silent

### LD59015

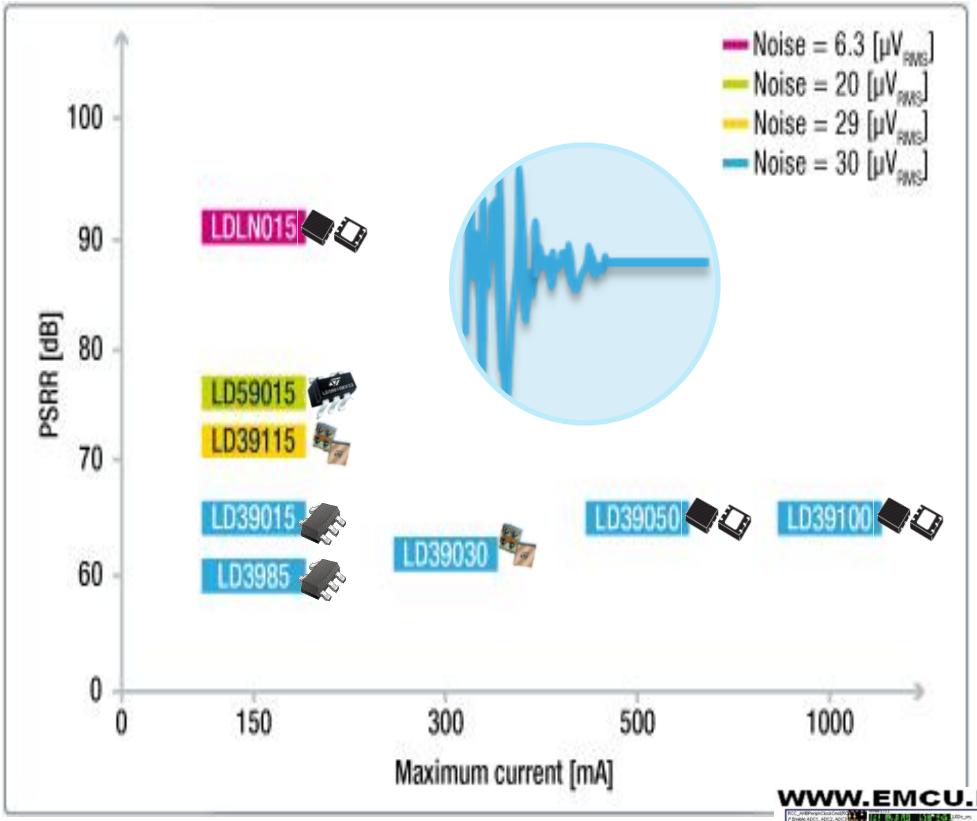
**Very low noise – very high PS**
**150mA LDO in 2x2 SC-70 Pa**

**High PSRR**

- Input voltage: from 2.3 to 5.5 V
- Guaranteed output current: 150 mA
- Very low noise: 20 µVRMS/VOUT from 10 Hz to 100 kHz
- Very high PSRR: 76 dB up to 10kHz
- Low quiescent current: 31 µA typ @ no load
- Logic controlled enable pin
- Very low dropout voltage: 150 mV typ @ 150 mA

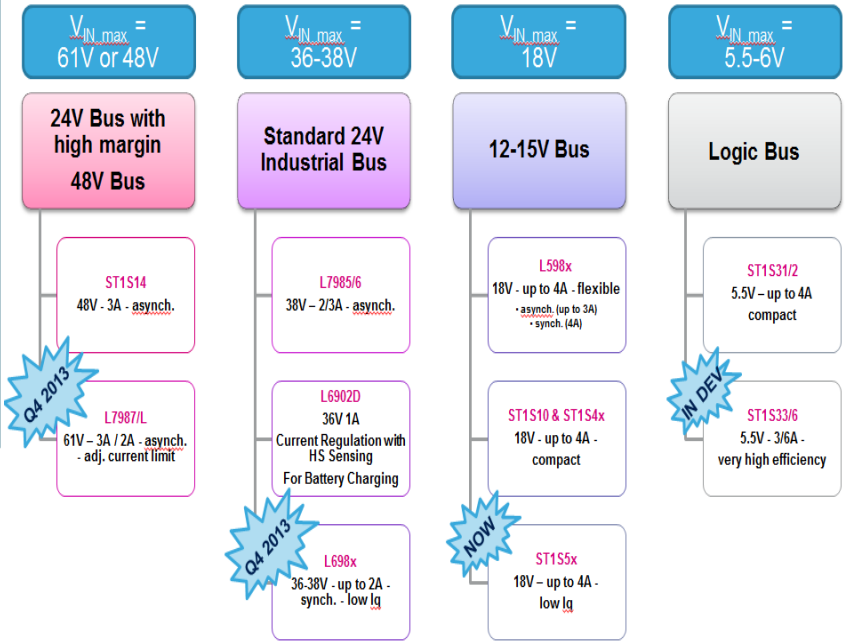




### Low noise & High PSRR LDOs:



# DC-DC conversion is everywhere

## DC/DC: from 5.5V to 61V for multiple Applications

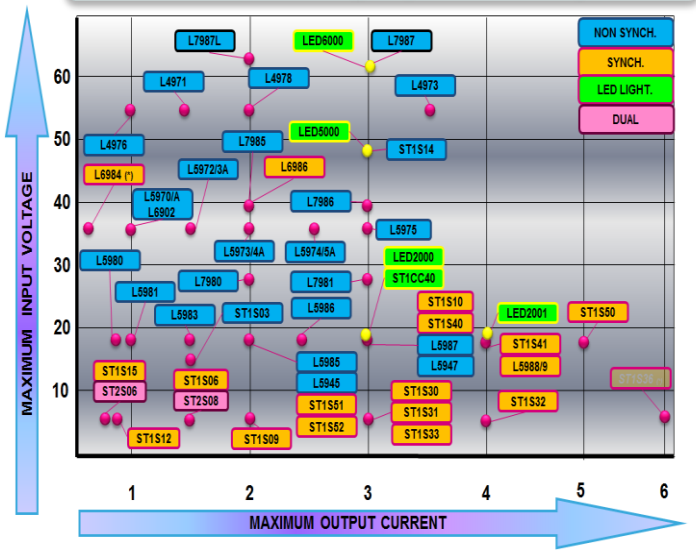



## Why ST DC/DC converter?

- Smaller Solution → DFN / QFN
- Higher Fsw → up to 2MHz
- More efficient → multi trade-off
- Higher Input Voltage → up to 61V

→ The new industrial DC/DC from ST

## Industrial Range by Functionality




## 5 new Innovative products:

**L7987** → $61V_{IN}$ / $3A_{OUT}$
**L7987L** → $61V_{IN}$ / $2A_{OUT}$

**L6986** → $38V_{IN}$ / $2A_{OUT}$ / high eff.
**L6984** → $36V_{IN}$ / $350mA_{OUT}$ / high eff.

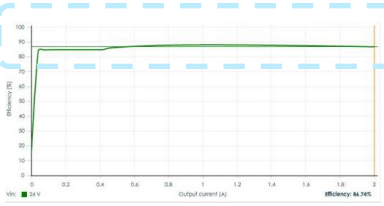
**ST1S50** → $18V_{IN}$ / $4A_{OUT}$ / low stand-by

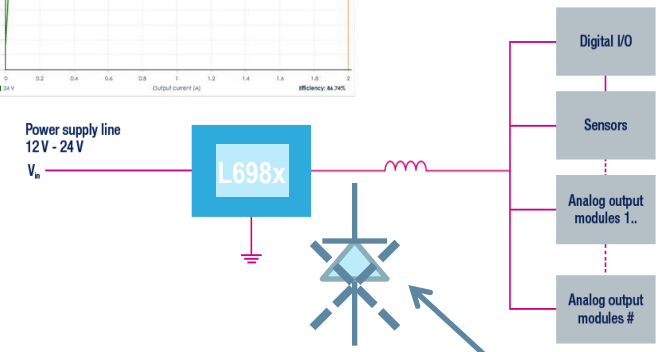
# New DC-DC for Industrial

NEW!

**New Arrival 1: L698x**
**36-38V, synch. rect., low stand-by**

**High Efficiency at full & light load**






**L6986: 2A**
**L6984: 350mA**
**(optimized for low current)**

**Save Ext. Diode**

NEW!

➔ Q2 2014

**New Arrival 2: L7987(L)**
**61V, 3A (2A), Adj. Current Limit**

**Up to 61V**
**High Safety Margin**

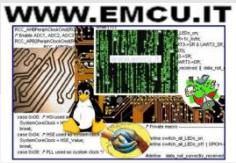

**Passive components optimization thanks to adj. current limit**

**Space & Cost Saving**

**All with full set of features for maximum flexibility:**

- **Adj. $F_{SW}$**
- **Power Good**
- **Adj. Soft Start *(L6986 & L7987/L)***

# L6986 positioning



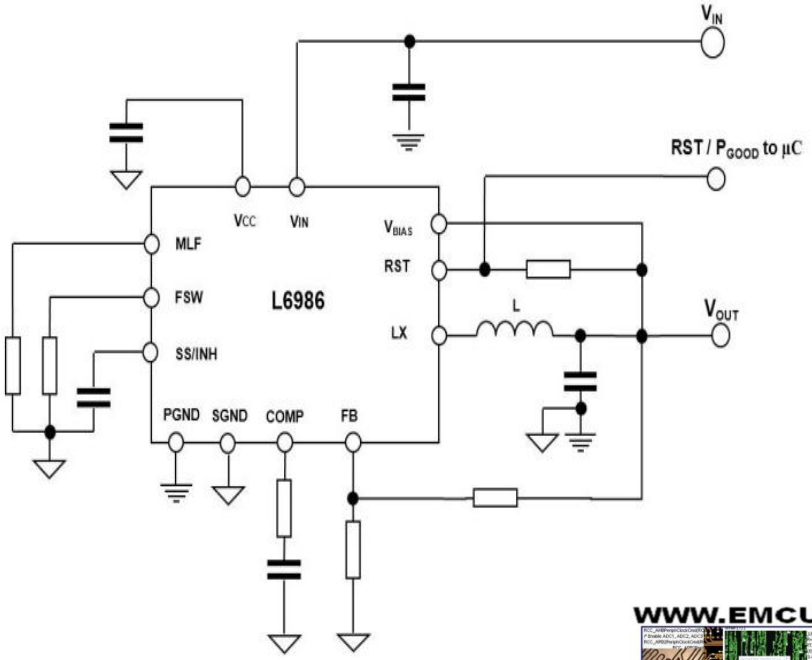

- **Compact & Efficient** solution for DC-DC buck
  - Integrated synch. MOSFET allows saving external diode
  - Up to 90% Efficiency at high loads
- Best-in-class **quiescent** current for minimum stand-by & high efficiency at low load
  - Max 30uA consumption at no load
  - > 80% Efficiency from 10mA-load
- Adjustable parameters for **maximum flexibility**
  - $F_{SW}$ (up to 2MHz → *reduce passive components size*)
  - Soft Start
  - PG with adj. Delay

| | L597x | L7985/6 | L6986 |
|---|---|---|---|
| Input Voltage (V) | 4.4 to 36 | 4.5 - 38 | 4 - 38 |
| $I_{OUT}$ (A) | Up to 3 | 2 / 3 | 2 |
| Package | SO8<br>HSOP8 | DFN 3x3-10L<br>HSOP8 | HTSSOP16<br>DFN planned |
| Synchronous Rectification | No | No | Yes NEW |
| $R_{DSon}$ (typ. mΩ) | 250 | 200<br>(p-channel) | 180 (HS p-ch.)<br>150 (LS) |
| fsw (kHz) | 250 or 500 | Adj.: 250<br>to 1000 | Adj.: 250<br>to 2000 |
| Soft Start | No | Yes | Yes, adjustable |
| Synchronization Capability | Yes | Yes, with phase shift 180° | Yes, with phase shift 180° |
| Ceramic Cout | Not recommended | Yes | Yes |
| Power Good | No | No | Yes NEW |
| Low Iq | No | No | Yes, 30 µA |

# L6986 tech features

- $V_{IN}$ : 4V – 38V
- $V_{OUT}$ : 0.85V – $V_{IN}$
- $I_{OUT}$: 2A
- $F_{SW}$: adj. (250kHz – 2MHz) + synch. capability
- **Synchronous rectification**
- Low load settable behavior:
  - Low consumption mode **($I_Q$ = 30µA)**
  - low noise mode (where high $V_{OUT}$ precision is required also at low load)
- Inhibit & low shut-down current (5µA)
- **Power Good with adj. delay** (Reset for µC)
- **Adjustable soft start**
- $V_{BIAS}$ : self-supply to improve efficiency at light loads

- **Buck-boost also supported (pos. & neg.)**
- Ceramic $C_{OUT}$ allowed
- Protections: OC, OV and thermal
- Package: HTSSOP-16L



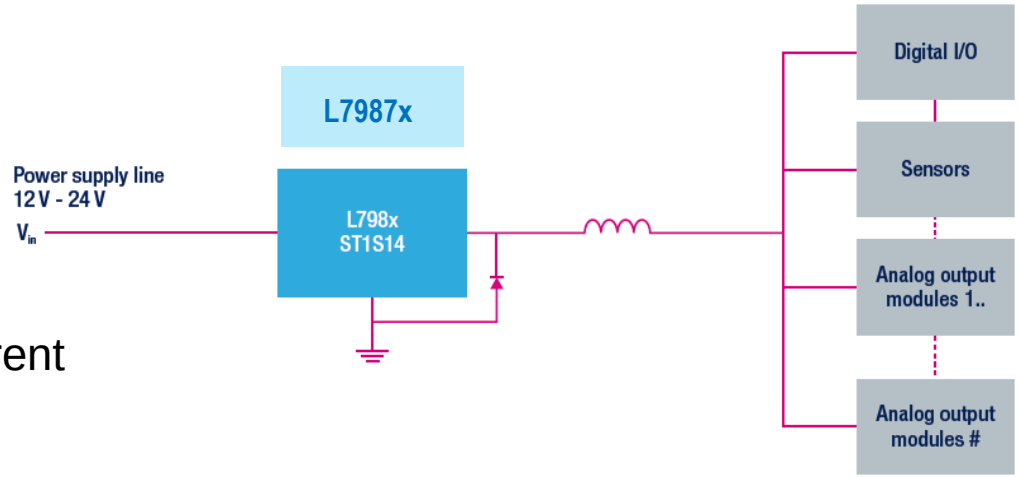
# L7987/L



**ES Available (final silicon)**
**MP Q2 2014**

## High Input Voltage for High Reliability

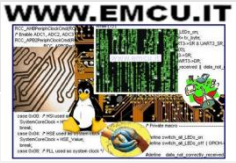
- **61V** input
  - Suitable for **Fail Safe Applications**
  - Suitable for **48V bus**
- Power **passive components optimization** thanks to adjustable current limit
- Adjustable parameters for **maximum flexibility**
  - $F_{SW}$
  - Soft Start




| | $V_{IN}$ (V) | $I_{OUT}$ (A) | PG |
|---|---|---|---|
| L7987 | 61 | 3 | YES |
| L7987L | 61 | 2 | YES |

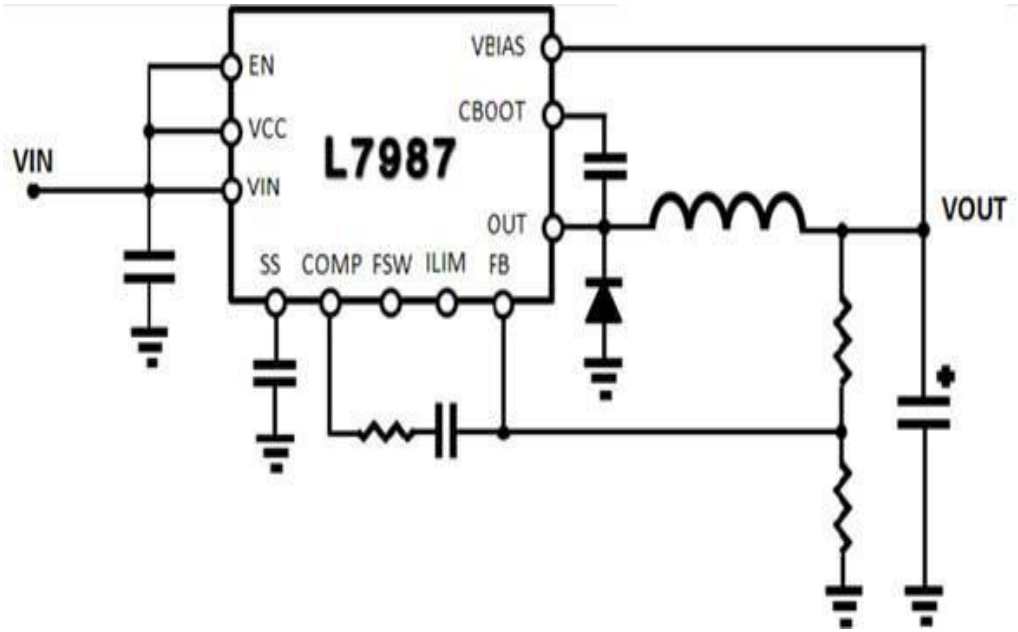
HTSSOP16 ($R_{TH}$ = 40 °C/W)

# L7987/L: Tech features




- **$V_{IN}$ : 4.5V – 61V**
- $V_{OUT}$ : 0.6V – ~ $V_{IN}$
- $I_{OUT}$:
  - up to 3A (L7987)
  - up to 2A (L7987L)
- $F_{SW}$: adj. (250kHz – 1.5MHz) + synch. capability
- **Adjustable current limit up**
- Enable & Power Good
- Adjustable soft start
- Low shut-down current (5µA)
- $V_{BIAS}$ to improve efficiency at light loads

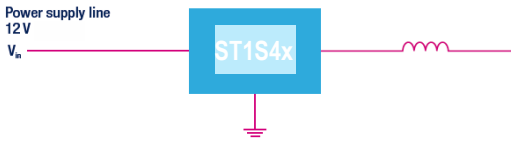
- Ceramic $C_{OUT}$ allowed
- Protections: OC and thermal
- Package: HTSSOP-16L




**ES Available (final silicon)**
**MP Q2 2014**

# Focus DC-DC for 12V bus

**ST1S4x**
**compact & cost effective**

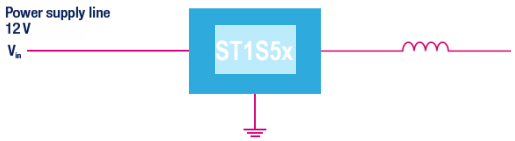



## Space & Cost Saving

- Low BOM
- Multiple package option:
  - Low cost SO8 (ST1S40 only)
  - Small DFN-4x4
  - HSOP8 for best thermal performance

ST1S40: 3A
ST1S41: 4A

**ST1S5x**
**low stand-by & high flexibility**




## High Efficiency at Full & Light Load

- Low stand-by current
- Features for increased flexibility:
  - Adj. Soft Start
  - Power Good

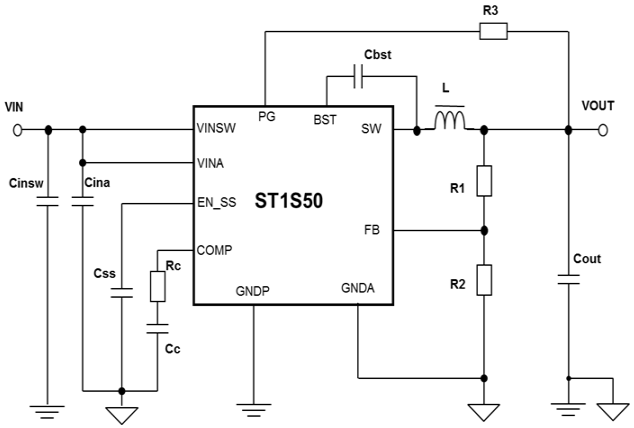
NEW! ST1S50: 4A

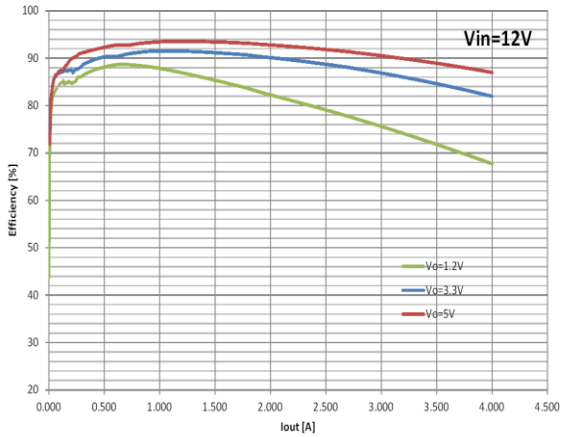
# ST1S50

- **Compact &** Efficient solution for 4A DC-DC buck
  - Up to 93% Efficiency at high loads
  - Integrated synch. MOSFET allows saving external diode
- **Reduced Quiescent Current** to optimize low load efficiency
  - > 87% Efficiency from 10mA-load
- **Increased** Flexibility thanks to
  - Adj. Soft start
  - Power Good *(ST1S50/1)*

$V_{IN}$=12V $V_{OUT}$=5V
**η > 90%** from 20-mA load

$V_{IN}$=12V $V_{OUT}$=3.3V
**η > 87%** from 20-mA load

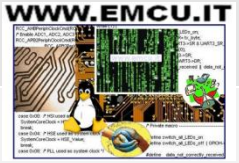



NEW

| | $V_{IN}$ (V) | $I_{OUT}$ (A) | max $I_Q$ (µA) | $F_{SW}$ (kHz) | Compensation | PG | Adj. SS | Package |
|---|---|---|---|---|---|---|---|---|
| ST1S50 | 18 | 4 | 600 | 500 | External | YES | YES, shared with EN | DFN3x3-10L |

# DC-DC list of demoboards




| DC-DC | $V_{IN}$ (V) | $I_{OUT}$ (A) | Topology | Order code |
|---|---|---|---|---|
| L7987 | Up to 61 | Up to 3 | HTSSOP16 | STEVAL-ISA152V1 |
| ST1S14 | Up to 48 | Up to 3 | HSOP8 | STEVAL-ISA104V1 |
| L6986 | Up to 38 | Up to 2 | HTSSOP16 | EVAL6986 |
| L7985 | Up to 38 | Up to 2 | DFN3x3-10L | STEVAL-ISA097V1 |
| L7985A | Up to 38 | Up to 2 | HSOP8 | STEVAL-ISA098V1 |
| L7986 | Up to 38 | Up to 3 | DFN3x3-10L | STEVAL-ISA099V1 |
| L7986A | Up to 38 | Up to 3 | HSOP8 | STEVAL-ISA100V1 |
| L6984 | Up to 36 | Up to 0.35 | DFN4x4-10L | EVAL6984 |
| L6984A | Up to 36 | Up to 0.35 | DFN3x3-10L | EVAL6984A |
| ST1S40IPHR | Up to 18 | Up to 3 | HSOP8 | STEVAL-ISA082V1 |
| ST1S40IPUR | Up to 18 | Up to 3 | DFN4x4-8L | STEVAL-ISA083V1 |
| ST1S40DR | Up to 18 | Up to 3 | SO8 | STEVAL-ISA084V1 |
| ST1S41IPHR | Up to 18 | Up to 4 | HSOP8 | STEVAL-ISA107V1 |
| ST1S41IPUR | Up to 18 | Up to 4 | DFN4x4-8L | STEVAL-ISA108V1 |
| ST1S31PUR | Up to 5.5 | Up to 3 | DFN3x3-8L | STEVAL-ISA069V1 |
| ST1S31DR | Up to 5.5 | Up to 3 | SO8 | STEVAL-ISA070V1 |
| ST1S32PUR | Up to 5.5 | Up to 4 | DFN4x4-8L | STEVAL-ISA068V1 |

NEW

NEW

NEW

# REMEMBER: also Automotive versions

**DC-DC for 24V Battery**
(truck)

- **A7987x**
  **61V – up to 3A – asynch.**
  In dev.

**DC-DC for 12V Battery**
(car)

- **A597x & A798x**
  **36-38V – up to 3A – asynch.**
- **A698x**
  **36V – up to 2A – synch. with low Iq**
  Q2
- **A6902D**
  **36V – 1A – asynch.**
  **Current Regulation with HS Sensing**
  **For Battery Charging**

**DC-DC from Logic Bus**

- **AST1S31 / AST1S31HF**
  **4V – 3A**
  **1.5MHz / 2.3MHz**
  **for 3.3V Logic Bus**
  NEW!
- **AST1S33/6**
  **5.5V – 3/6A**
  **for 3.3V & 5V Logic Bus**
  **with Low $R_{DS\_ON}$ (17 mΩ)**
  Q3

# Digital power conversion

# STLUX385A

## World's first digital controller for lighting & NOT ONLY!!!

## FEATURES

- 6 PWMs easy configurable to achieve up to 1.3 ns PWM resolution
- customizable algorithms enable higher conversion efficiency
- 4 analog comparators & analog-to-digital converters (ADCs)
- Flash and E²PROM with "read while write" (RWW) and error correction code (ECC)
- Internal 96 MHz PLL

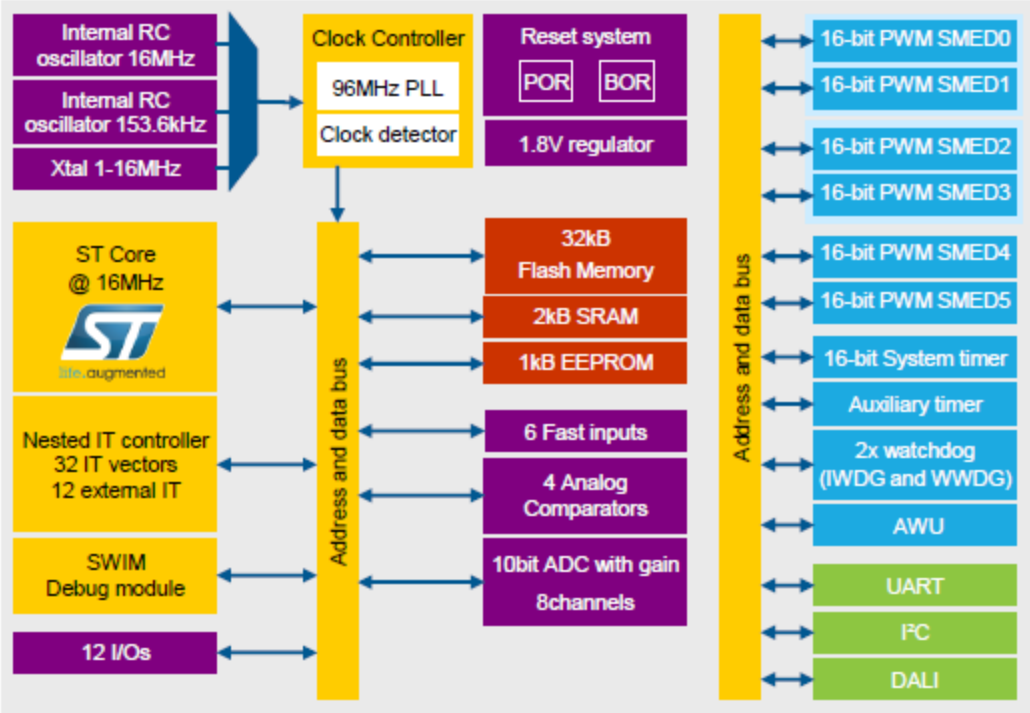
## TOOLS

- STEVAL-ILH007V1 150W HID digital ballast NEW!
- STEVAL-ILL057V1 200W 4-LED strings
- STEVAL385LEDPSR 100W LED street lighting NEW!
  - configurable solution driving a single dimmable high brightness LED string
  - primary side regulation
  - Compliant with physical communication interfaces: DALI, insulated 0-10, Wi-Fi, power line modems, Bluetooth® and Zigbee®.

## APPLICATIONS

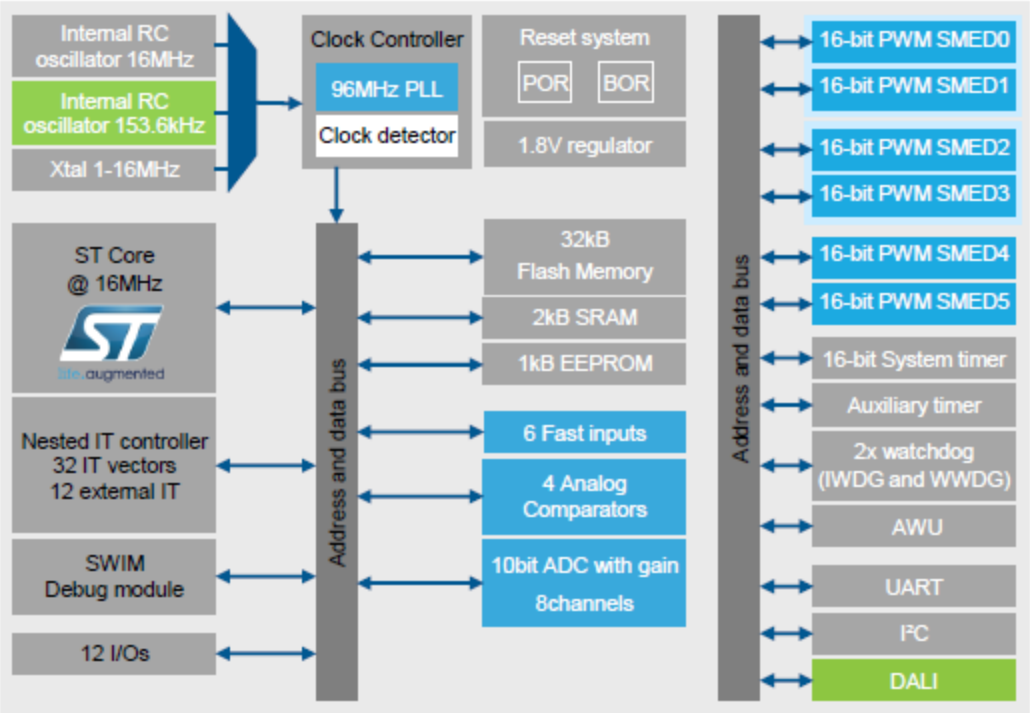
- LED street-lighting
- LED power supplies
- HID lighting
- Digital power conversion
- (PFC+LLC)

# STLUX385: Block Diagram (1/2)



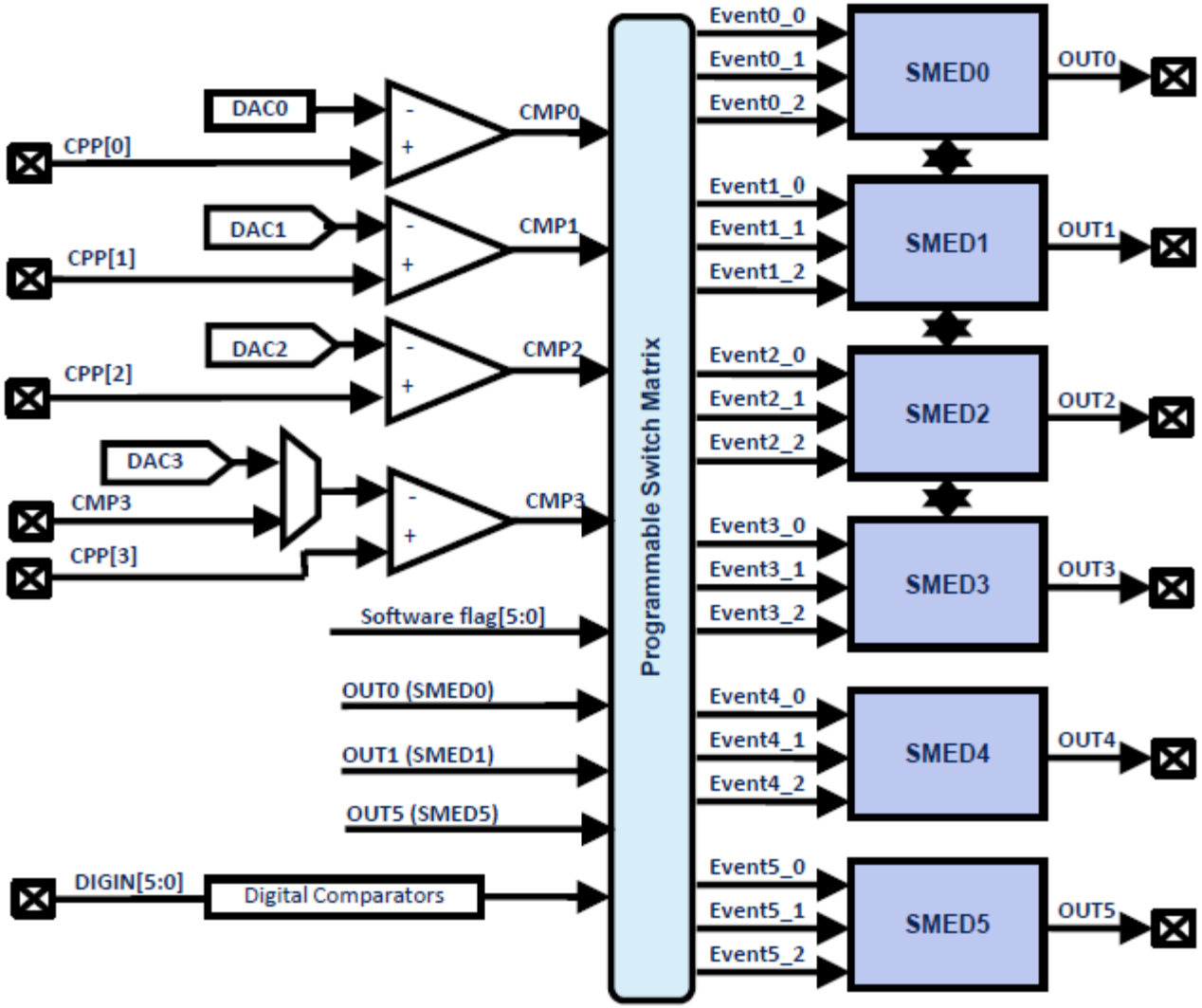

- **SIX** configurable PWM **S**tate **M**achine **E**vent **D**riven (SMED) 10.4ns resolution (up to 1.3ns using automatic dithering)
- 8 channels 10 bit ADC with programmable op amp GAIN, 2.4 µs conversion time,
- 4 Analog Comparators and 6 fast digital inputs synchronized with 96MHz clock
- ST core based (up to 20 MIPS)
  - 16-bit/8-bit and 16-bit/16-bit divisions
  - Faster 8-bit*8-bit multiplication, signed arithmetic operation
- 3V to 5.5V DC voltage supply (IC performances are optimized for 3.3V)
- -40 °C to 105 °C temperature range
- TSSOP38

# STLUX385: Block Diagram (2/2)




- **SIX** configurable PWM **S**tate **M**achine **E**vent **D**riven (SMED) 10.4ns resolution (up to 1.3ns using automatic dithering)
- 4 Analog Comparators and 6 fast digital inputs synchronized with 96MHz clock
- 8 channels 10 bit ADC with programmable op amp GAIN resolution), 2.4 µs conversion time,

# Input Events

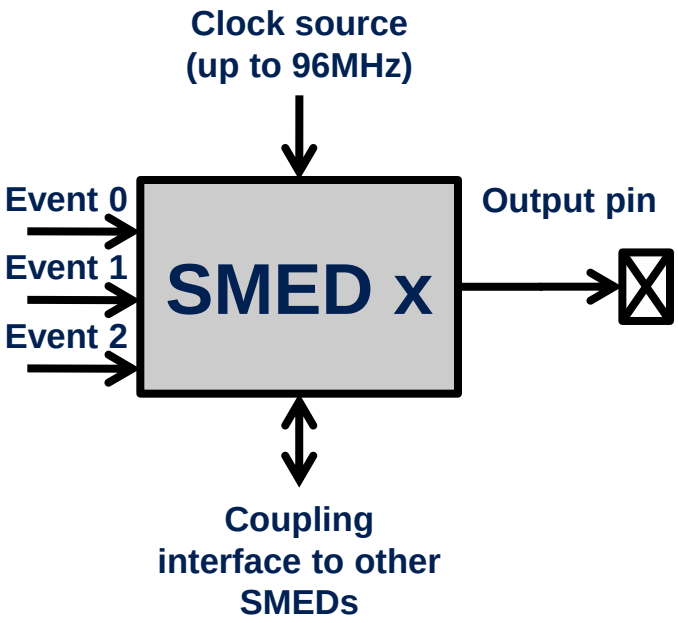


# Up to 6 independent PWM generators

## Let's call them SMED's = State Machines Event Driven

Software Configurable peripherals

Easy coupling for different topologies optimization (e.g. half-bridge)




- Output status defined by:
  - 3 programmable event inputs on Edge or level (selectable)
  - Another SMED output
- 16bits counter
- Clock frequency up to 96MHz

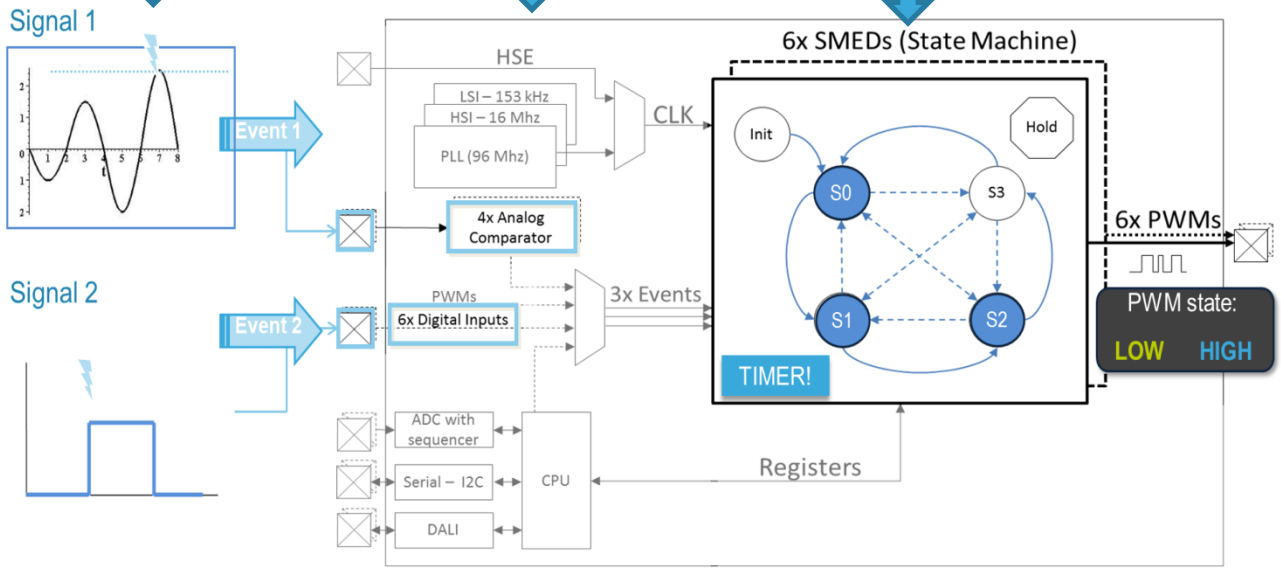
# SMED – how it works

1. Parameters detection/measure in the application

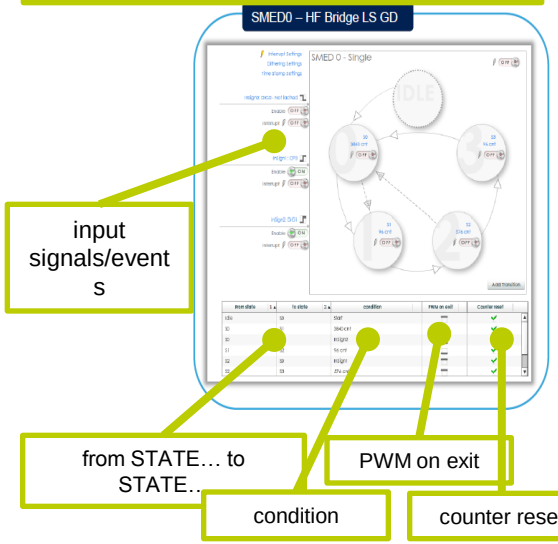
2. Signal elaboration

3. State machine evolution

4. PWM output generation

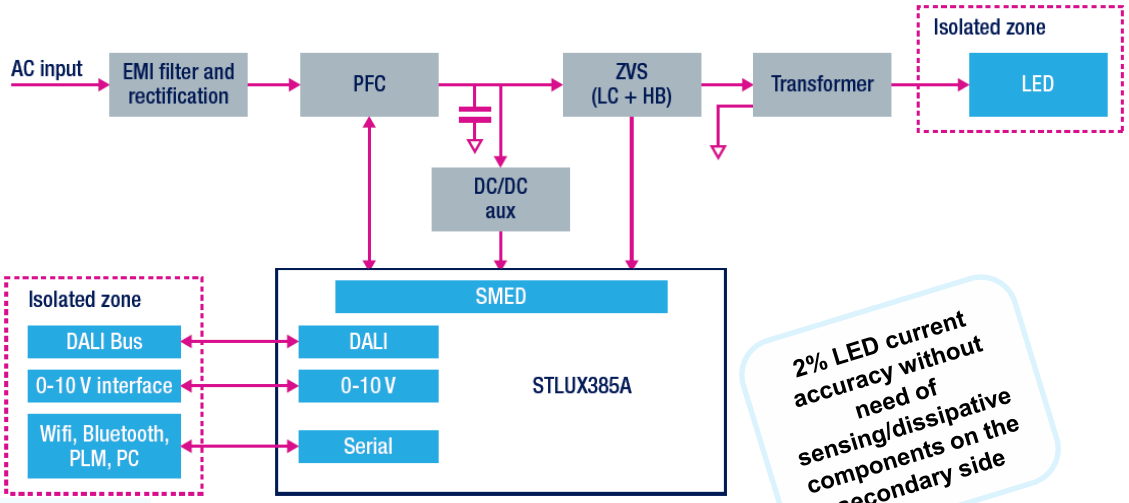



Make it easy by the **SMED configurator**




**WITHOUT NEED OF CORE INTERVENTION**

# 100W for LED Street or Interior Lighting

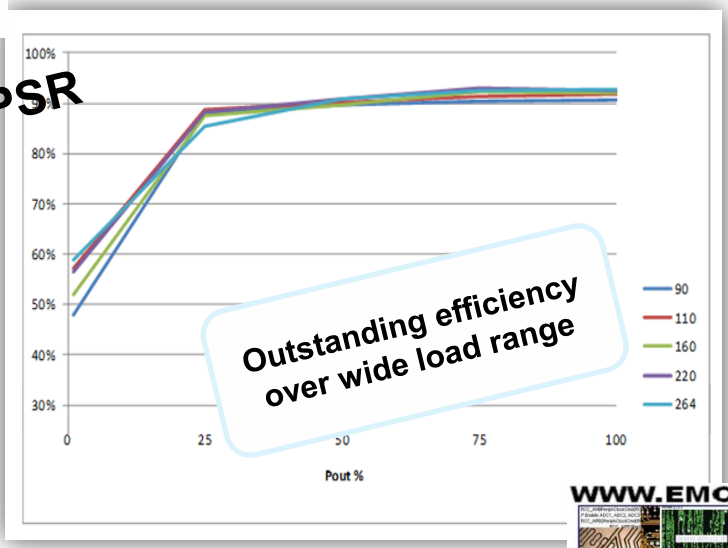



2% LED current accuracy without need of sensing/dissipative components on the secondary side

## Performances

- INPUT = 90~265Vac
- OUTPUT = single LED string / 2 ranges
  - 30V to 100V @ 10mA to 1A
  - 60V to 200V @ 5mA to 500mA
- Analog/digital dimming 10mA steps, 2% precision
- PFC + PWM (ZVS) by single chip
- Primary Side Regulation (PSR)
- Communication
  - DALI (HW) compliant with IEC62386-201
  - 0-10V
  - Serial for PLM / Wireless modules

**STEVAL385LEDPSR**



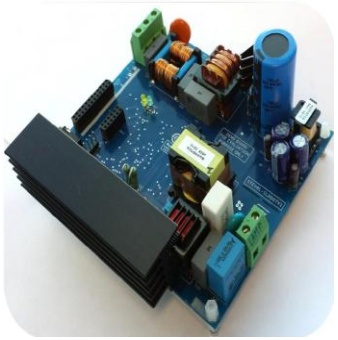

Outstanding efficiency over wide load range

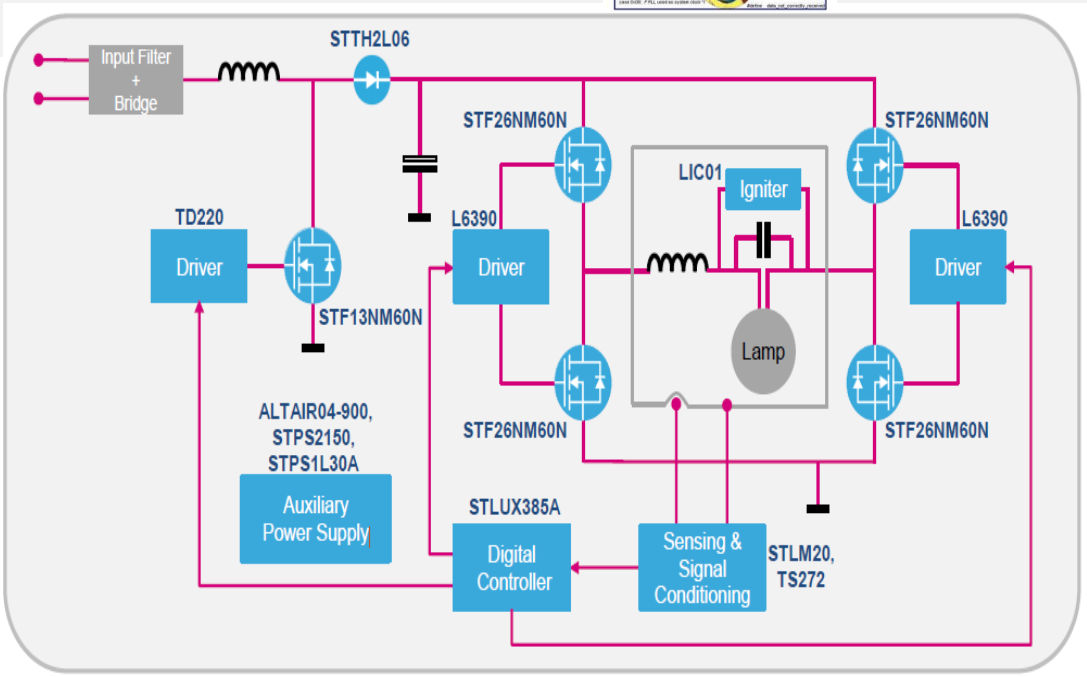
# 150W HID lamp control

## STEVAL-ILH007V1

## Performances

- INPUT = 185~265Vac
- OUTPUT = 150W
- PFC + full bridge stages
  - STLUX385A controlling both stages






### Comparison between electronic and magnetic ballast (230 Vac, 50 Hz – 150 W HPS Lamp)

| | STEVAL-ILH007V1 | Previous ST Solution (Mixed Analog-Digital) | Magnetic Ballast |
|---|---|---|---|
| Pout (W) | 144.5 W | 144.5 W | 144.5 W |
| Pin (W) | 156 W | 160 W | 167.1 W |
| Efficiency | 92.5 % | 90.3 % | 86.5 % |
| Power factor | 0.996 | 0.996 | 0.965 |
| Current THD | 7.5% | 6.3% | 21.3% |

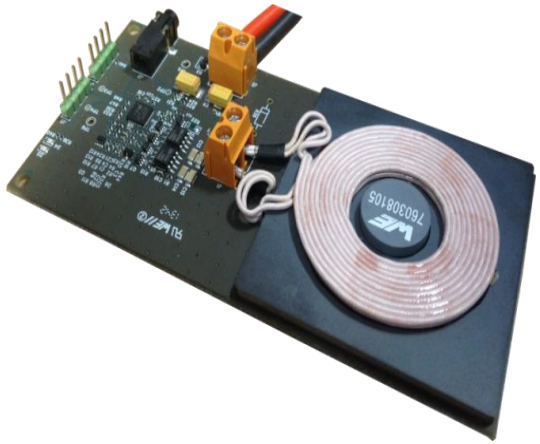
# STLUX385A: In the domain of digital power conversion

## Based on the platform extension

- **STLUX** Lower number of PWM for lighting
- **STNRG** addressing power applications
- **STWBC** wireless battery chargers

within H1 2014

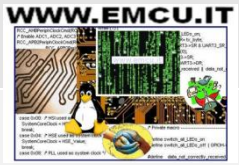
1kW interleaved charger



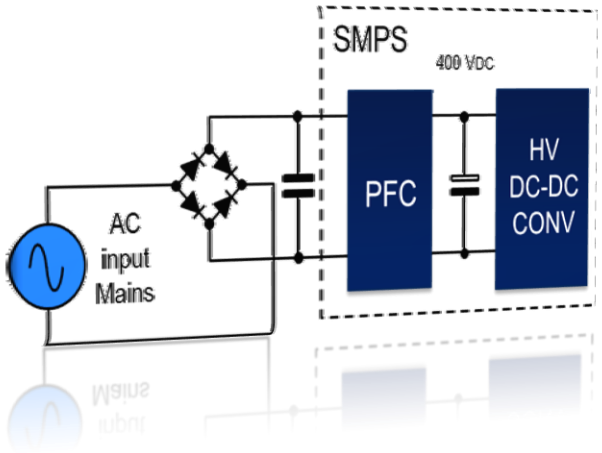
Wireless battery charger

# AC/DC conversion

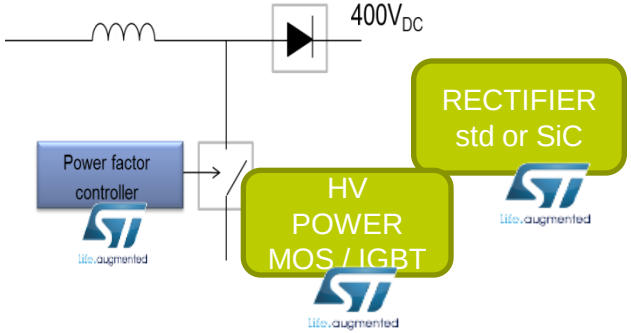
# Power Factor Control




**PFC mainly in SMPS & LIGHTING**




**PFC means you can associate to**
**Rectifier**
**PFC controller**
**HV Mosfet**





**Competition on L6562A**

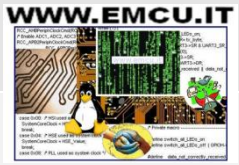
- TI
- Fairchild
- Infineon
- OnSemi

**Competition on L6564H**

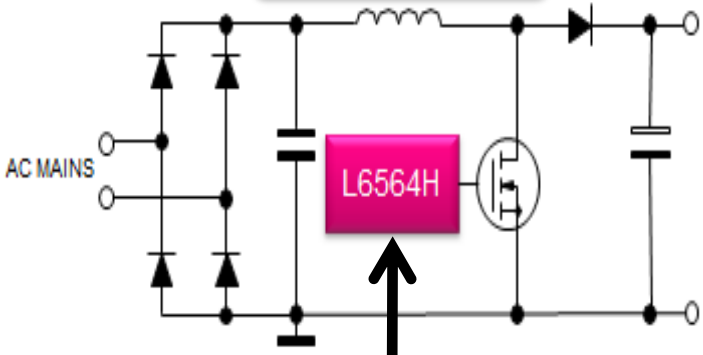
**NO!**

- The internal 700V HV start-up is unique
- -40°C to +125°C for Outdoor application

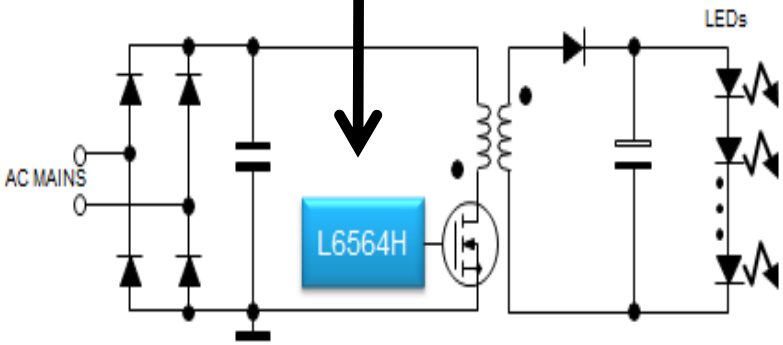
# L6564H key feature




Industrial SMPS




LED Lighting SMPS




L6564H Evaluation Boards

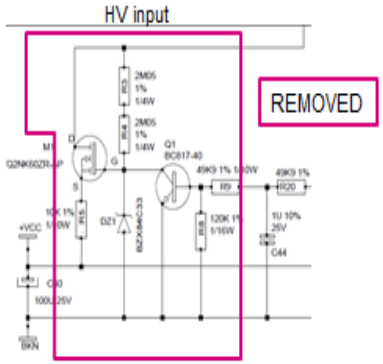
- EVL6564H-100W reference design for standard PFC
- STEVAL-ISA142V4: 50W wide range high power factor flyback converter
- EVL6564H-25W-BB: 25W, 80V$_{OUT}$ for LED based on L6564H

PWM control for high power factor & isolated LED SMPS

## ▶ Can the high voltage start-up be a value?

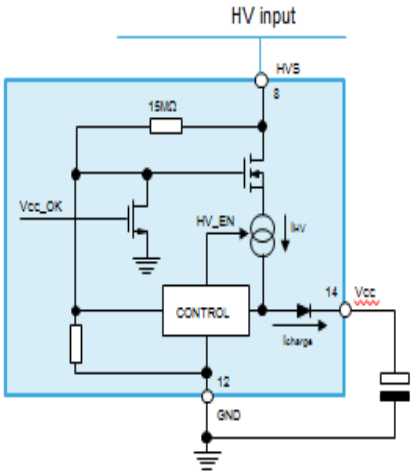
No need of external components

Standard solution (external components)

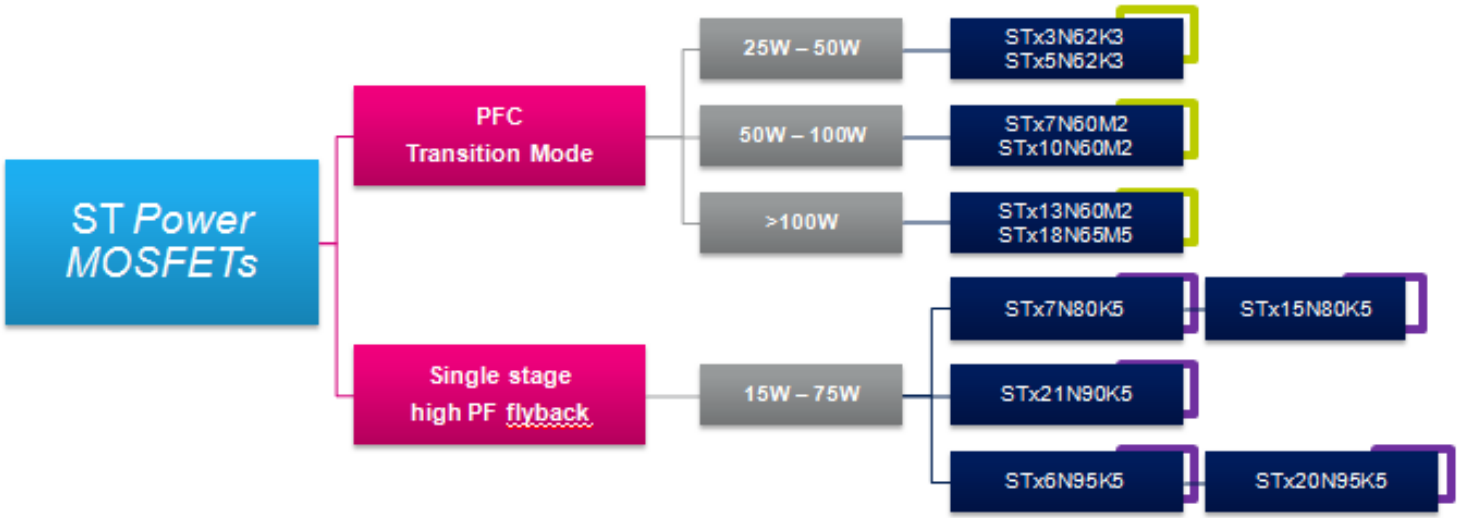



L6564H

No need for:
HV Mosfet
Zener
Resistors
Capacitors



# PFC companion Mosfet <150W




DIFFERENT TECHNOLOGIES for BEST PERFORMANCES

SuperMESH5 ™

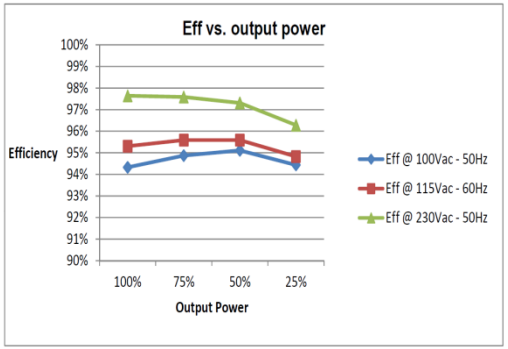
- Outstanding static and dynamics performances at 800V-950V

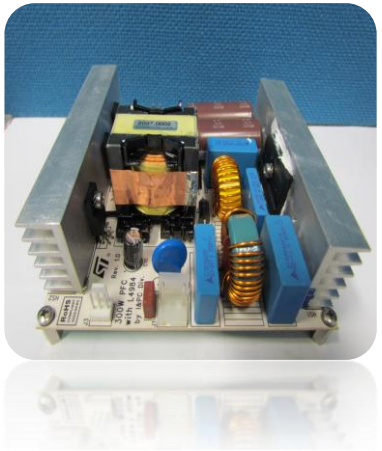
SuperMESH3, MDmesh II Plus Low Qg, MDmesh V

- Low Rdson(on), best in class in dV/dt, Available in PowerFLAT packages

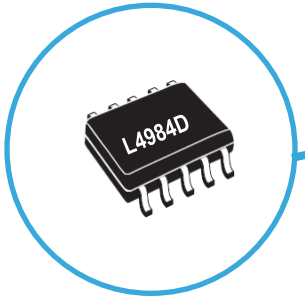
# L4984D: tools

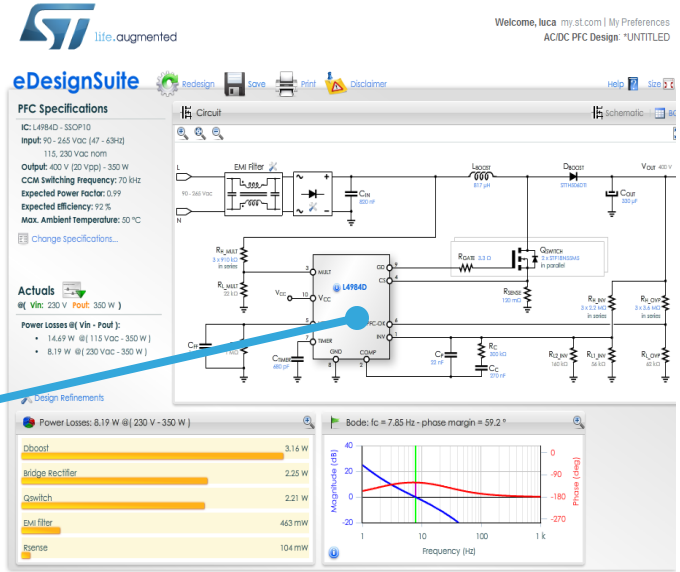
- **350W reference design (EVL4984-350W)**
  - **Efficiency > 94% on 85VAC – 264VAC input range**
  - **THD<10% at full load on 85VAC – 264VAC input range**



- **Design your PFC stage on st.com**
  - **www.st.com/edesignsuite**



# SiC diodes in PFC (…but not only)

**Gen 2 does NOT replace Gen 1!!**

## Generation 1 600 V diodes

**Single diodes**

STPSC xx 06 yy

- SiC Schottky
- $I_{F(AV)}$
- $V_{RRM}$
- Package

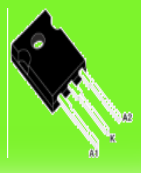
4A, 6A, 8A, 10A, 12A


**Dual diodes / common cathode**

STPSC xx 06 C yy

**Common cathode**

2 x 10A, 600V



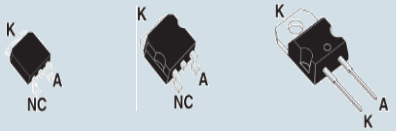
## Generation 2 650 V diodes

**Single diodes**

STPSC xx H 065 yy

- SiC Schottky
- $I_{F(AV)}$
- Gen 2
- $V_{RRM}$
- Package

4A, 6A, 8A, 10A, 12A

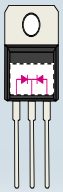



**Dual diodes Common cathode**

**Dual diodes**

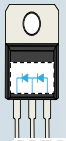
STPSCxxH065Cyy

2 x 4A, 650V
2 x 6A, 650V
2 x 8A, 650V
2 x 10A, 650V



STPSCxxTH13TI

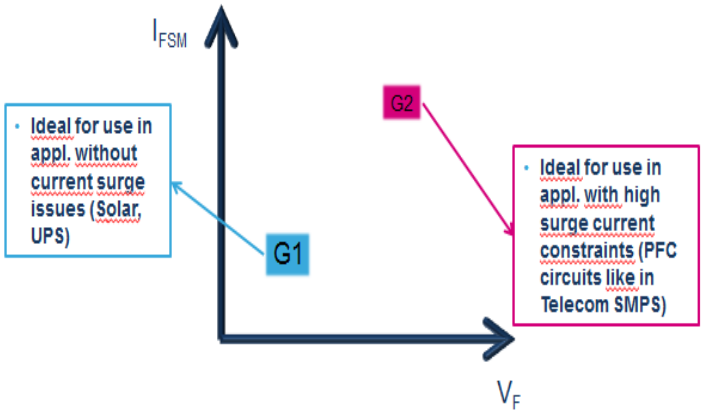
6A, 2 x 650V
8A, 2 x 650V
10A, 2 x 650V



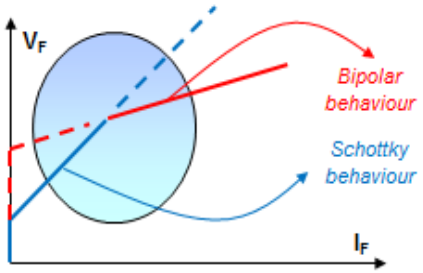


# SiC diodes in PFC (…but not only)

## Gen1 or Gen 2? Vf or IFSM trade off




## The BEST out of 2 Technologies




The addition of P+ implantation in the schottky structure creates P/N junctions.The surge forward current capability can be increased while keeping $T_J < T_{J(MAX)}$

## 10 times better Surge Capability

- Datasheet:

New voltage rating for higher reverse safety margin

Gen 2

| Symbol | Parameter | | Value | Unit |
|---|---|---|---|---|
| $V_{RRM}$ | Repetitive peak reverse voltage | | 650 | V |
| $I_{F(RMS)}$ | Forward rms current | | 21 | A |
| $I_{F(AV)}$ | Average forward current | DPAK, $T_c$ = TBD °C, δ = 0.5 | 6 | A |
| | | TO-220AC, $T_c$ = 122 °C, δ = 0.5 | | |
| | | $D^2PAK$, $T_c$ = TBD °C, δ = 0.5 | | |
| $I_{FSM}$ | Surge non repetitive forward current | $t_p$ = 10 ms sinusoidal, $T_c$ = 25 °C | 60 | A |
| | | $t_p$ = 10 ms sinusoidal, $T_c$ = 125 °C | 52 | |
| | | $t_p$ = 10 µs square, $T_c$ = 25 °C | 400 | |
| $T_{stg}$ | Storage temperature range | | -55 to +175 | °C |

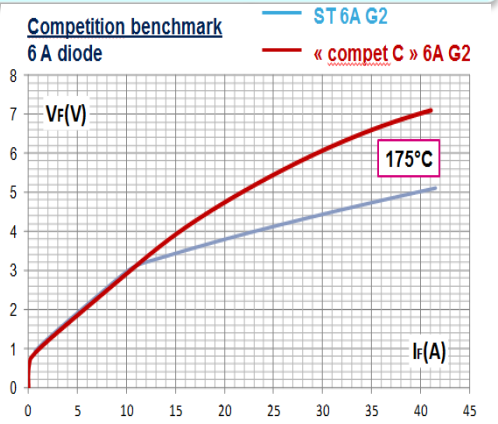
Improved surge capability $I_{FSM}$ = 10x $I_{F(AV)}$

Gen 1

Table 2. ngs (limiting values at 25 °C unless otherwise specified)

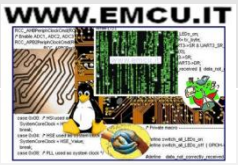
| Symbol | Parameter | | Value | Unit |
|---|---|---|---|---|
| $V_{RRM}$ | Repetitive peak reverse voltage | | 600 | V |
| $I_{F(RMS)}$ | Forward rms current | | 18 | A |
| $I_{F(AV)}$ | Average forward current | $T_c$ = 125 °C, δ = 0.5 | 6 | A |
| $I_{FSM}$ | Surge non repetitive forward current | $t_p$ = 10 ms sinusoidal, $T_c$ = 25 °C | 27 | A |
| | | $t_p$ = 10 ms sinusoidal, $T_c$ = 125 °C | 22 | |
| | | $t_p$ = 10 µs square, $T_c$ = 25 °C | 110 | |
| $I_{FRM}$ | Repetitive peak forward current | δ = 0.1, $T_c$ = 110 °C, $T_j$ = 150 °C | 27 | A |
| $T_{stg}$ | Storage temperature range | | -55 to +175 | °C |
| $T_j$ | Operating junction temperature range | | -40 to +175 | °C |

## Better Vf in surge conditions

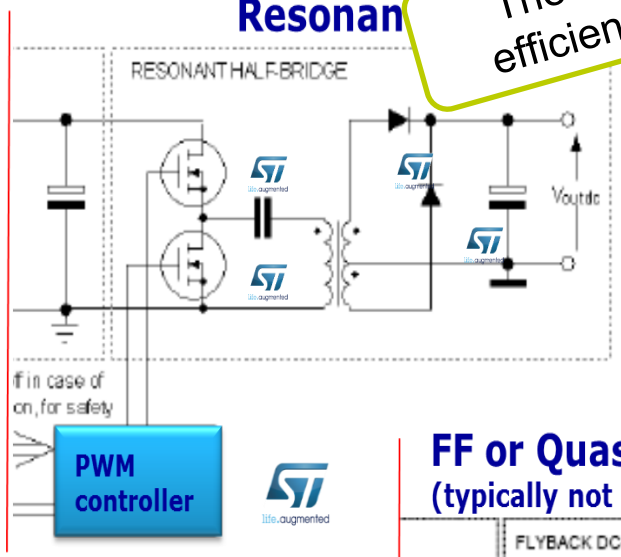


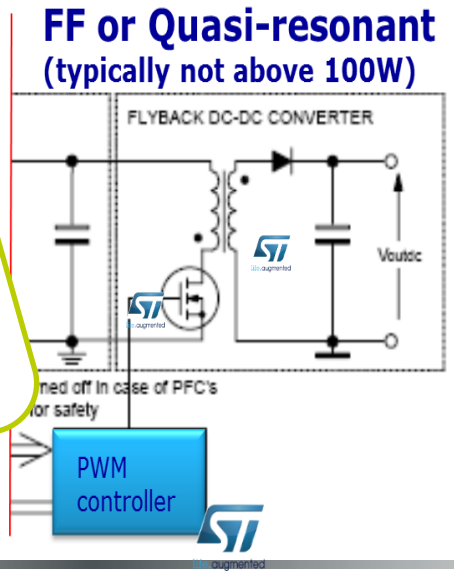
# The kit for industrial SMPS

## green and good




The answer to top efficiency challenge



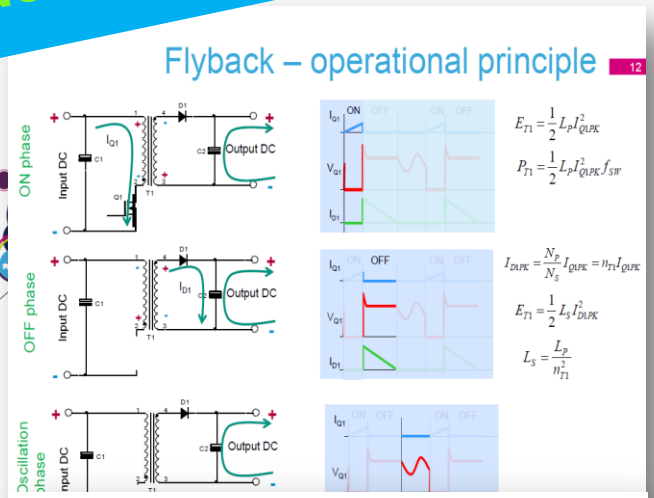



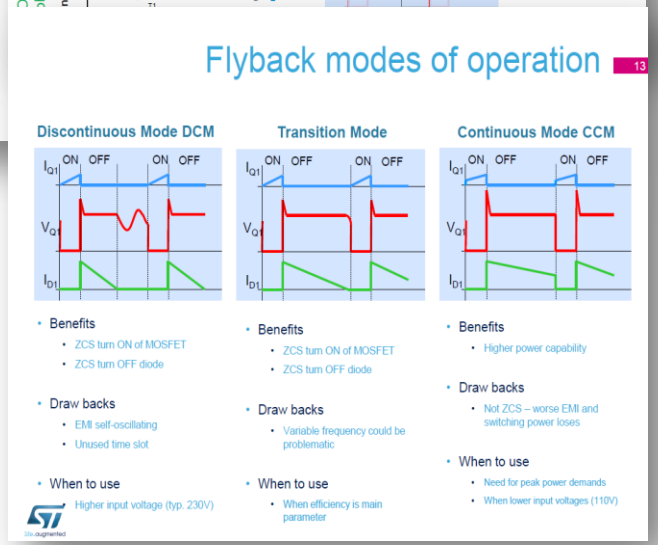

Simple solution also for **380Vac input aux SMPS (industrial and metering)**

| topology | LLC resonant KIT (from 80W up) | Flyback KIT Fixed Freq or QR (up to 80-100W) |
|---|---|---|
| Primary side PWM controller | **L6599A / L6699** | • **L6566B**<br>• **L6566BH for 3ph input** |
| Primary side mosfet | 2 HV Mosfet **MDMesh low Qg** (500/600/650V) | 1 HV Mosfet **SuperMESH K3 or K5** (starting from 800V) |
| Secondary side rectification | **Standard solution**<br>2 power Schottky | **Standard solution**<br>1 power Schottky |
| | **Synch. Rectification**<br>SRK2000<br>2 LV Mosfet (F7) for outstanding efficiency | **Synch. Rectification**<br>STSR<br>1 HV/LV Mosfet |

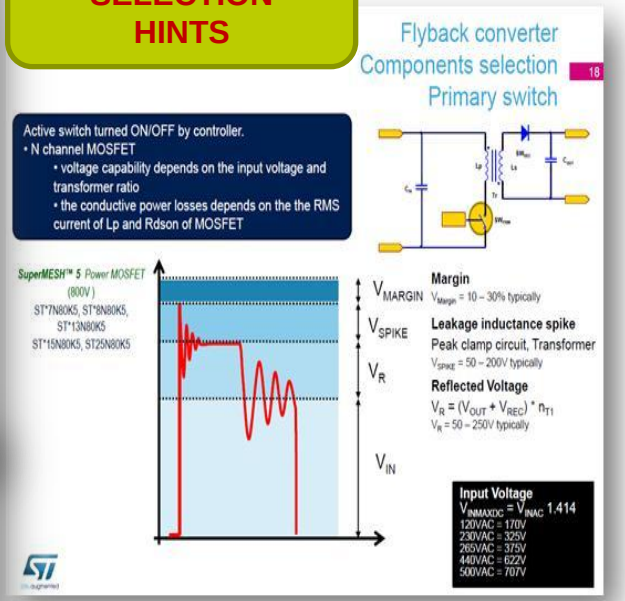
# Application RtM: we help you

New supporting tool


COMPONENT SELECTION HINTS

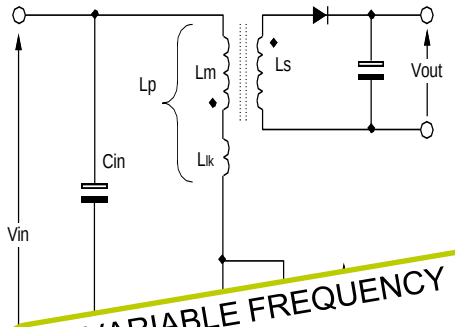



TECHNICAL GUIDELINES

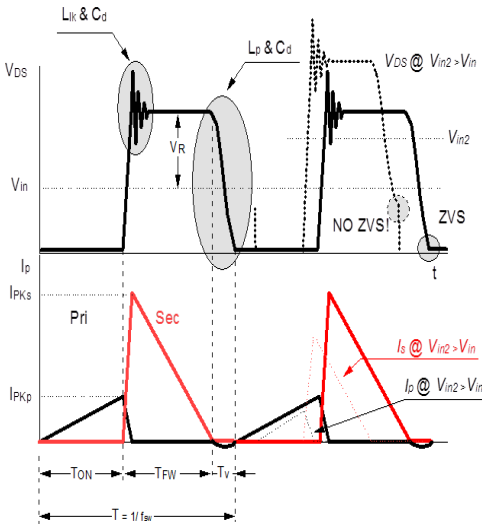
# L6566B / L6566BH



## The quasi-resonant concept with a plus from ST

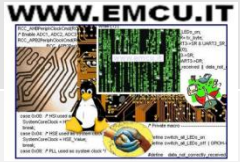



- VARIABLE FREQUENCY OPERATION
- ZVS OPERATION/ZCS AT TURN ON
  - **HIGHER EFFICIENCY**
  - **LESS EMI GENERATED**




| FROM FEATURES TO BENEFIT | |
|---|---|
| **Flexibility** | • SELECTABLE QR / FF OPERATION |
| **Consumption optimization** | • ON-BOARD HV START-UP GEN. (700 / 840V) UNIQUE<br>• BURST MODE @ LIGHT LOAD |
| **Safety** | • PULSE-BY-PULSE OCP<br>• TRANSFORMER SAT. DETECTION<br>• LATCHED OR AUTORESTART OVP<br>• BROWNOUT PROTECTION<br>• ADAPTIVE UVLO<br>• LINE FEEDFORWARD |
| **EMI reduction** | • FREQUENCY MODULATION |

# SuperMESH 5 (K5 – series)




## The FIRST & BEST reference in the Power MOSFET market above 800V

**Just a Snapshot:**

| $BV_{DSS}$ [V] | $R_{DS}$ [Ω] | Qg [nC] | Sales Type |
|---|---|---|---|
| 800 | 4.5 | 3 | STx2N80K5 |
| | 0.95 | 13 | STx8N80K5 |
| | 0.375 | 30 | STx15N80K5 |
| 850 | 0.275 | 35 | STW23N85K5 |
| 900 | 0.299 | 43 | STx21N90K5 |
| 950 | 1.250 | 13 | **STx6N95K5** |
| | 0.8 | 20 | STx10N95K5 |

1050V, 1200V & 1500V arrive in Q1 and Q2 2014

***Best Silicon performance on the Market!***

***Most safe & flexible HV Packages on the Market !***

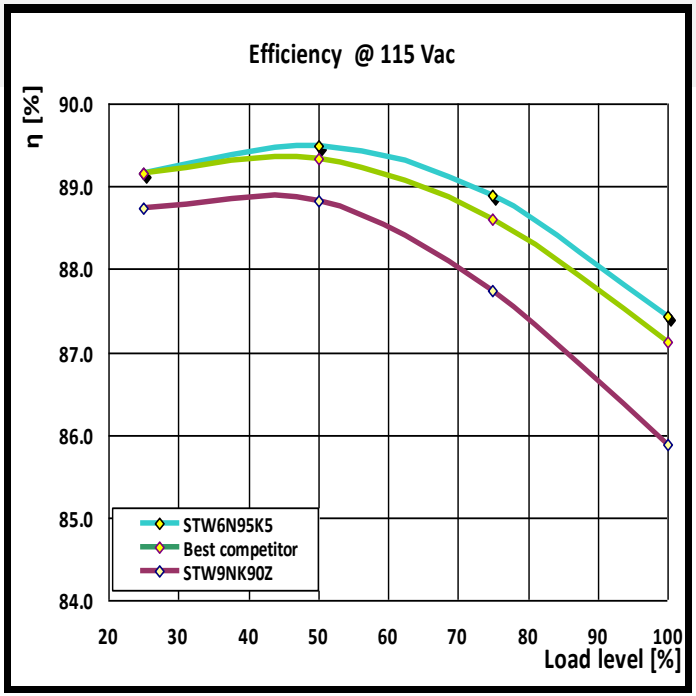
***…the Market !***

**Key Features**

- 800V-1500V lowest $R_{DS(on)}$ x area
- Lowest FOM ($R_{DS(on)}$*$Q_g$)
- Designed for highest efficiency
- High Voltage package TO-3PF


- **Lighting**
  - HF (Fluorescent) ballasts, wide input range
  - HID ballasts, High Powers, Outdoor
  - LED drivers, Outdoor, Street Lighting
- **Solar converters**
  - Boost for Solar Converter
- **SMPS**
  - Welding
  - 3-phase input and 3-phase auxiliary PSU
  - LCD TV, quasi resonant flyback converter
- **Industrial Drives & Factory Automation**

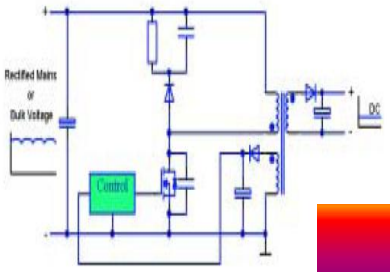
# SuperMESH 5 test benchmark




EVL6566B_65W_QR board

| Main Parameters | | Max Value T=25° C | | | | Unit |
|---|---|---|---|---|---|---|
| | | STP21N90K5 | STP20N95K5 | STW25N95K3 | Comp I | |
| Technology Family | | ST SuperMESH 5 | ST SuperMESH 5 | ST SuperMESH3 | Comp best device | |
| BVDSS | | 900 | 950 | 950 | 900 | V |
| RDS(ON) | $V_{DS}$= 10V, | 299 | 330 | 360 | 340 | mΩ |
| Id | | 18.5 | 17.5 | 22 | 15 | A |
| Qg | Vdd=450/760/760/400/V | 43 | 40 | 105 | 94 | nC |
| Ciss | VDS=100V | 1645 | 1500 | 3680 | 2400 | pF |
| Coss | VDS=100V | 112 | 80 | 246 | 120 | pF |
| Crss | VDS=100V | 2 | 5 | 2 | 2 | pF |
| Co(tr) | VDS = 0 to 720/760/500/ V | 133 | 170 | 198 | 280 | pF |
| Co(er) | VDS = 0 to 720/760/500/ V | 16 | 65 | 278 | 71 | pF |
| Rg | | 4 | 3.5 | 3 | 1.3 | Ω |

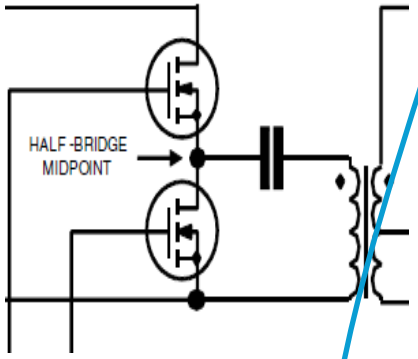
Quasi resonant Flyback converter




SuperMESH 5 **STW6N95K5** shows **better efficiency and thermal profile** vs
- Competition S-J same class RDS(on) & ST planar MOSFET same RDS(on)

➔ due to **better Eoff** and the **impact of lower parasitic capacitances**

# High efficiency green SMPS

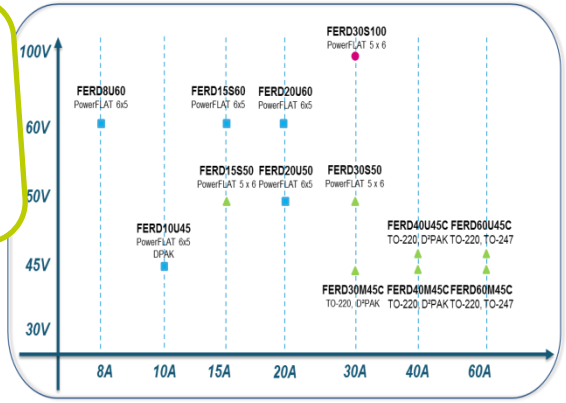


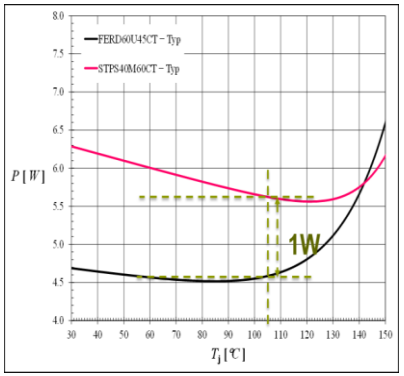

## L6599A / L6699
Advanced LLC primary controller

| L6699 Additional Features | L6699 Additional Benefits |
|---|---|
| Anti-capacitive protection | Higher system reliability |
| Self-adjustable dead-time | Improved efficiency even at light load<br>Optimized transformer design |
| Extra-smooth Startup | Prevents forbiden capacitive mode and hard switching at start-up. |
| Soft burst mode | No audible noise at light load |

STANDARD RECTIFICATION

FERD diodes for best trade-off direct/reverse losses



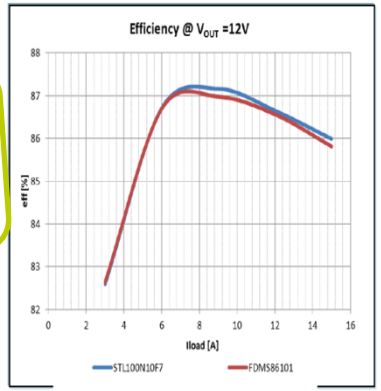




→ STx310N10F7 shows highest efficiency

→ Especially at medium- and high-loads

SYNCH. RECTIFICATION

SRK2000 (driver) + F7 low voltage mosfet series




PRIMARY SIDE

SECONDARY SIDE

# Primary side: MDMeshII Low Qg series

## RDSon alone means nothing!

- Same $R_{DS(on)}$ x area
- Same Cycle-Time
- Same ruggedness

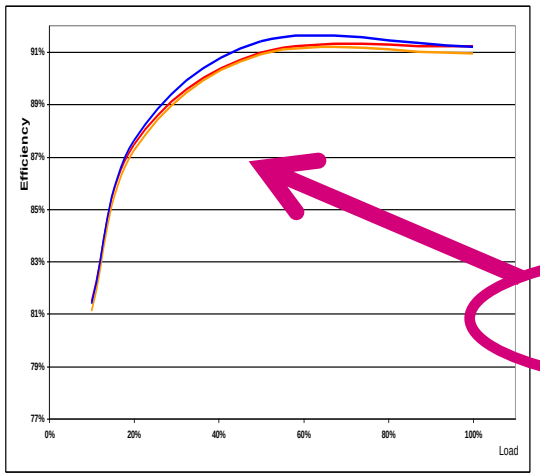
→ Same price positioning than MDmesh II

- Improved $Q_g$: -30%
- Improved $C_{iss}$: -15%
- Improved $C_{oss}$: -50%

→ Faster switching capabilities than MDmesh II

**➔ Higher Efficiency at optimized cost / performance ratio!**

**Efficiency comparison between M2 and best competition**




achievement

- Best efficiency vs direct competiton in LLC topologies

**STD7N60M2**
- $BV_{DSS}$ = 600 V
- Qg = 6nC
- $R_{DS(on)}$ = 950 mΩ
- DPAK

**STP24N60M2**
- $BV_{DSS}$ = 600 V
- Qg = 29nC
- $R_{DS(on)}$ = 190 mΩ
- TO-220

**STL24N60M2**
- $BV_{DSS}$ = 600 V
- Qg = 29nC
- $R_{DS(on)}$ = 210 mΩ
- PowerFLAT 8x8 HV

**STB33N60M2**
- $BV_{DSS}$ = 600 V
- Qg = 47nC
- $R_{DS(on)}$ = 120 mΩ
- D2PAK

Nov'13

**STD10N60M2**
- $BV_{DSS}$ = 600 V
- Qg = 10nC
- $R_{DS(on)}$ = 600 mΩ
- DPAK

M2 series

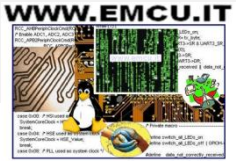
**STP40N60M2**
- $BV_{DSS}$ = 600 V
- Qg = 75nC
- $R_{DS(on)}$ = 88 mΩ
- TO-220

NOW

**STF13N60M2**
- $BV_{DSS}$ = 600 V
- Qg = 16nC
- $R_{DS(on)}$ = 380 mΩ
- TO-220FP

**STL13N60M2**
- $BV_{DSS}$ = 600 V
- Qg = 16nC
- $R_{DS(on)}$ = 420 mΩ
- PowerFLAT 5x6 HV

# Primary side: MDMeshII Low Qg series




## more than 150 P/Ns to fit specific ctm targets

| $BV_{DSS}$[V] | Max $R_{DS}$ [Ω] | Max $I_D$ [A] | Qg [nC] | P/N | Main application | Packages | Eng. Samples/ Data sheet | Production/ Data sheet |
|---|---|---|---|---|---|---|---|---|
| 400 | 0.80 | 6 | 5 | STD4N40M2 | LED TV driving | DPAK | Dec '13 | Q1'14 |
| 500 | 0.53 | 9 | 10 | STD11N50M2 | | | | |
| | 0.38 | 10 | 14 | STD12N50M2 | | | | |
| | 0.28 | 12 | 18 | STD16N50M2 | | | | |
| 600 | 1.4 | 3.7 | 4.5 | STx5N60M2 | | | | |
| | 1.200 | 4.5 | 5 | STx6N60M2 | | | | |
| | 0.950/ 1.05 (**) | 5 | 6 | STx7N60M2 | | | | |
| | 0.780 / 0.860(**) | 5.5 | 8 | STx9N60M2 | | | | |
| | 0.600/ 0.66(**) | 8 | 10 | STx10N60M2 | | | | |
| | 0.450/ 0.498(**) | 10 | 14 | STx12N60M2 | | | | |
| | 0.380/ 0.420(**) | 11 | 16 | STx13N60M2 | | | | |
| | 0.320/ 0.355(**) | 12 | 18 | STx16N60M2 | | | | |

(*2) Value for PowerFLAT package

| $BV_{DSS}$[V] | Max $R_{DS}$ [Ω] | Max $I_D$ [A] | Qg [nC] | Sales Type | Main application | Packages | Eng. Samples / Data sheet | Production/ Data sheet |
|---|---|---|---|---|---|---|---|---|
| 600 | 0.280/ 0.308(**) | 13 | 21 | STx18/19N60M2 | SMPS, LED driver, Adapters | TO-220 / FP /TO-247/D2PAK/ | | Now / |
| | 0.190/ 0.210(**) | 18 | 29 | STx24N60M2 | SM Se dri | | | |
| | 0.150 | 24 | 39 | STx28N60M2 | SM Se dri | | | |
| | 0.125/ 0.135(**) | 26 | 45 | STx33N60M2 | SM Se dri | | | |
| | 0.088 | 34 | 75 | STx40N60M2 | SM Se Sc | | | |
| | 0.070 | 40 | 95 | STW48N60M2 | SM Se | | | |
| | 0.055 | 50 | 110 | STW56N60M2 | SM Se | | | |
| | 0.040 | 68 | 130 | STW70N60M2 | SM Se | | | |

| $BV_{DSS}$[V] | Max $R_{DS}$ [Ω] | Max $I_D$ [A] | Qg [nC] | Sales Type | Main application | Packages | Eng. Samples/ Data sheet | Production/ Data sheet |
|---|---|---|---|---|---|---|---|---|
| 650 | 1.3 | 3.5 | 5.5 | STx6N65M2 | SMPS, LED driver | IPAK / DPAK/ D2PAK/TO-220/ TO- | | |
| | 1 | 4.5 | 6.5 | STx7N65M2 | | | | |
| | 1.1 | TBD | 6.5 | STL8N65M2 | | | | |
| | 0.900 | 5 | 8 | STx9N65M2 | | | | |
| | 1 | TBD | 8 | STL9N65M2 STL10N65M2 | | | | |
| | 0.820 | 6 | 8.5 | STD9HN65M2 | | | | |
| | 0.900 | TBD | 8.5 | STL10HN65M2 | | | | |
| | 0.680 | 7 | 11 | STx11N65M2 | | | | |
| | 0.750 | TBD | 11 | STL11N65M2 STL12N65M2 | | | | |
| | 0.500 | 9 | 14 | STx12N65M2 | | | | |
| | 0.550 | TBD | 14 | STL12HN65M2 | | | | |
| | 0.430 | 10 | 16 | STx13N65M2 | | | | |

| $BV_{DSS}$[V] | Max $R_{DS}$ [Ω] | Max $I_D$ [A] | Qg [nC] | Sales Type | Main application | Packages | Eng. Samples/ Data sheet | Production/ Data sheet |
|---|---|---|---|---|---|---|---|---|
| 650 | 0.475 | TBD | 16 | STL13N65M2 | SMPS, LED driver, Adapters | PowerFLAT 5x6 HV | Q1'14 | Q2'14 |
| | 0.360 | 12 | 19 | STx16N65M2 | SMPS, LED driver, Adapters | IPAK / DPAK / TO-2200/FP | Q1'14 | Q2'14 |
| | 0.395 | TBD | 19 | STL16N65M2 | SMPS, LED driver, Adapters | PowerFLAT 5x6 HV | Q1'14 | Q2'14 |
| | 0.330 | 14 | 22 | STx18N65M2 | SMPS, LED driver, Adapters | I2PAK / TO-220/ TO-220FP | Q1'14 | Q2'14 |
| | 0.365 | TBD | 22 | STL18N65M2 | SMPS, LED driver, Adapters | PowerFLAT 5x6 HV | Q1'14 | Q2'14 |
| | 0.230 | 16 | 35 | STx24N65M2 | SMPS, LED driver, Adapters | I2PAK / TO-220FP/TO-220 | Q1'14 | Q2'14 |
| | 0.255 | TBD | 35 | STL24N65M2 | SMPS, LED driver, Adapters, Micro inverter | PowerFLAT 8x8 HV | Q1'14 | Q2'14 |
| | 0.180 | 22 | 40 | STx28N65M2 | SMPS, LED driver, Adapters | I2PAK / TO-220FP/TO-220 | Q1'14 | Q2'14 |
| | 0.140 | 24 | 50 | STx33N65M2 | SMPS, LED driver, Adapters | I2PAK / TO-220FP/TO-220 | Q1'14 | Q2'14 |
| | 0.155 | TBD | 50 | STL33N65M2 | SMPS, LED driver, Adapters, Micro inverter | PowerFLAT 8x8 HV | Q1'14 | Q2'14 |
| | 0.099 | 30 | 72 | STW40N65M2 | Servers, SMPS, Solar | TO-247/ I2PAK / TO-220/TO-220FP | Q1'14 | Q2'14 |
| | 0.062 | 48 | 110 | STW56N65M2 | Servers, SMPS, Solar | TO-247 , TO247-4 | Q1'14 | Q2'14 |
| | 0.046 | 65 | 135 | STW70N65M2 | Servers, SMPS, Solar | TO-247 | Q1'14 | Q2'14 |
| 700 | 1.25 | N/A | TBD | STU7N70M2 | Battery charger | IPAK / Short IPAK | Q1'14 | Q2'14 |
| | 1.35 | N/A | TBD | STL7N70M2 STL8N70M2 | Battery charger | PowerFLAT 5x5 PowerFLAT 5x6 HV | Q1'14 | Q2'14 |
| | 0.850 | N/A | TBD | STU11N70M2 | Battery charger | IPAK / Short IPAK | Q1'14 | Q2'14 |
| | 0.950 | N/A | TBD | STL11N70M2 STL12N70M2 | Battery charger | PowerFLAT 5x5 PowerFLAT 5x6 HV | Q1'14 | Q2'14 |

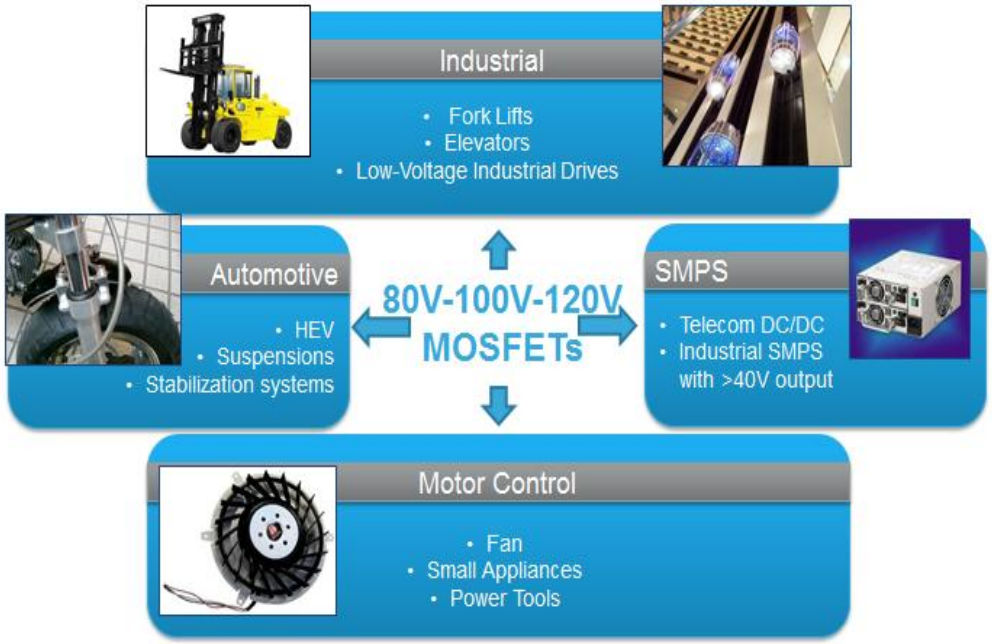
# Low voltage F7 Mosfet

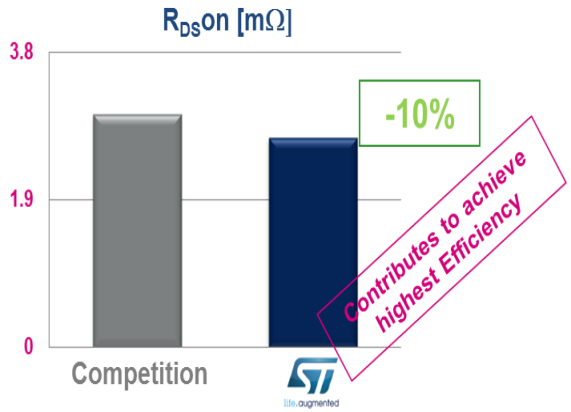
## DeepGATE (F7 – series)

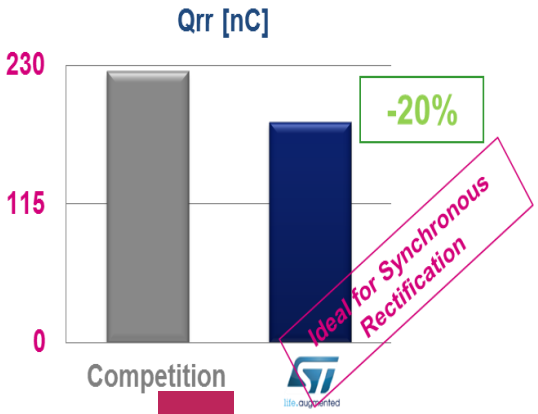
**A revolutionary Newcomer touching the edge of his class**

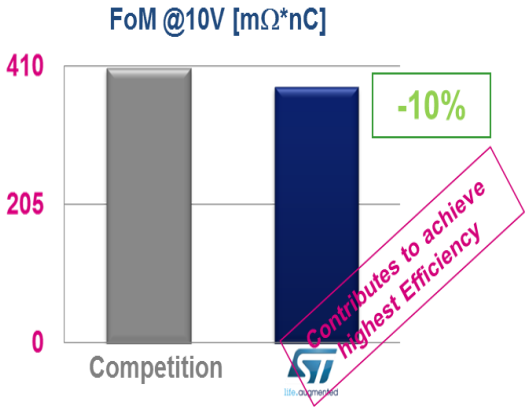
### Benefits

- Lowest conduction losses
- Small form factor of final system
- No EMI issues
- Robust design for Industrial & Automotive environment

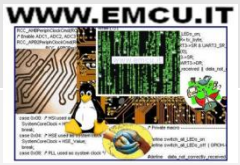


# Low voltage F7 Mosfet




| Part number | BV [V] | $R_{DS}$ [mΩ] max SMD | $R_{DS}$ [mΩ] max TH | Qg [nC] 10V | Package H²PAK | Package TO-220 | Package TO-220FP | Package 5 x 6 | Samples Prel. DS | Prod. DS |
|---|---|---|---|---|---|---|---|---|---|---|
| **STripFET VII DeepGATE (80V "F7" series)** | | | | | | | | | | |
| STx270N8F7 | 80 | 2.1 | 2.5 | 193 | | | | | √ | √ |
| STx170N8F7 | | 3.6 | 4.1 | 120 | | | | | Jan '14 | Q1 '14 |
| STx140N8F7 | | 4 | 4.3 | 96 | | | | | √ | √ |
| STL130N8F7 | | 3.6 | | | | | | | √ | √ |
| STxyN8F7 | | 6.5 | 6.9 | 60 | | | | | Q2 '14 | Q3 '14 |
| STxyN8F7 | | 7.1 | 7.5 | | | | | | Q2 '14 | Q3 '14 |

| Part number | BV [V] | $R_{DS}$ [mΩ] max SMD | $R_{DS}$ [mΩ] max TH | Qg [nC] 10V | Package H²PAK | Package TO-220 | Package TO-220FP | Package DPAK | Package 5 x 6 | Samples Prel. DS | Prod. DS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **STripFET VII DeepGATE (100V "F7" series)** | | | | | | | | | | | |
| STx310N10F7 | 100 | 2.3 | 2.7 | 180 | | | | | | √ | √ |
| STx240N10F7 | | 3 | 3.2 | 176 | | | | | | Q1 '14 | Q1 '14 |
| STx150N10F7 | | 3.9 | 4.2 | 117 | | | | | | √ | Q1 '14 |
| STL110N10F7 | | 6 | | 72 | | | | | | √ | √ |
| STx110N10F7 | | 6.7 | 7 | | | | | | | √ | √ |
| STL100N10F7 | | 7.3 | | 61 | | | | | | √ | √ |
| STx100N10F7 | | 8 | 8 | | | | | | | √ | √ |

| Part number | BV [V] | $R_{DS}$ [mΩ] max SMD | $R_{DS}$ [mΩ] max TH | Qg [nC] 10V | Package H²PAK | Package TO-220 | Package TO-220FP | Package DPAK | Package 5 x 6 | Package 5 x 6 D.I. | Package 3.3 x 3.3 | Package 2 x 2 | Samples Prel. DS | Prod. DS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **STripFET VII DeepGATE (100V "F7" series)** | | | | | | | | | | | | | | |
| STL90N10F7 | 100 | 9.5 | | 39 | | | | | | | | | √ | √ |
| STx80N10F7 | | 9.5 | 10 | | | | | | | | | | √ | √ |
| STL60N10F7 | | 16.5 | | 25 | | | | | | | | | √ | √ |
| STx45N10F7 | | 16 | 16 | | | | | | | | | | √ | √ |
| STL8N10F7 | | 20 | | | | | | | | | | | √ | Q1 '14 |
| STL40N10F7 | | 24 | | 19 | | | | | | | | | √ | √ |
| STx30N10F7 | | 24 | 24 | | | | | | | | | | √ | √ |
| STL30N10F7 | | 35 | | 14 | | | | | | | | | √ | √ |
| STx25N10F7 | | 35 | 35 | | | | | | | | | | √ | √ |
| STL7N10F7 | | 35 | | | | | | | | | | | √ | Q1 '14 |
| STL20DN10F7 | | 80 | | 8 | | | | | | | | | √ | |
| STL4N10F7 | | 80 | | | | | | | | | | | √ | |
| STL3N10F7 | | 80 | | | | | | | | | | | √ | |

| Part number | BV [V] | $R_{DS}$ [mΩ] max SMD | $R_{DS}$ [mΩ] max TH | Qg [nC] 10V | Package H²PAK | Package TO-220 | Package TO-220FP | Package 5 x 6 | Samples Prel. DS | Prod. DS |
|---|---|---|---|---|---|---|---|---|---|---|
| **STripFET VII DeepGATE (120V "F7" series)** | | | | | | | | | | |
| STx200N12F7 | 120 | 3.8 | 4.1 | 130 | | | | | Q1 '14 | Q3 '14 |
| STL100N12F7 | | 7.5 | | 65 | | | | | | |
| STxxN12F7 | | 8.2 | 8.5 | | | | | | | |
| STLyN12F7 | | 11.5 | | 45 | | | | | Q2 '14 | Q3 '14 |
| STxyN12F7 | | 12.1 | 12.5 | | | | | | | |

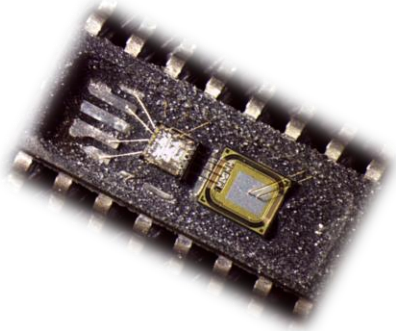
# HV Converters
# VIPer Plus & Altair

# Smart Low Power

## …towards zero standby

APPLICATION: AC-DC SMPS up to 30W

- **Advanced controller with embedded 800V / 900V Power MOSFET**
- **Complete set of protections**
- **No load consumption <30mW**



Metering

Home Appliances

Home Automation

Lighting

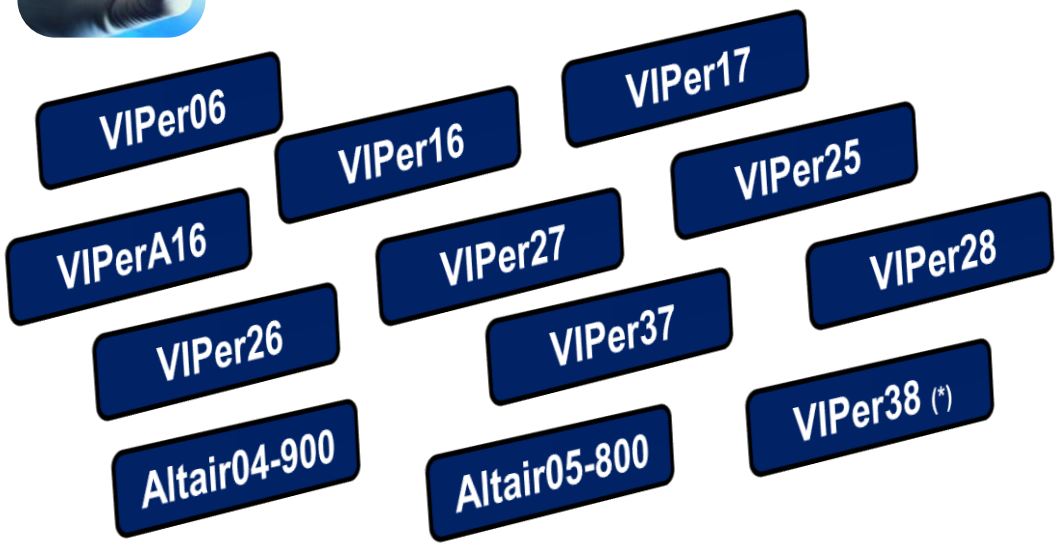
Automotive

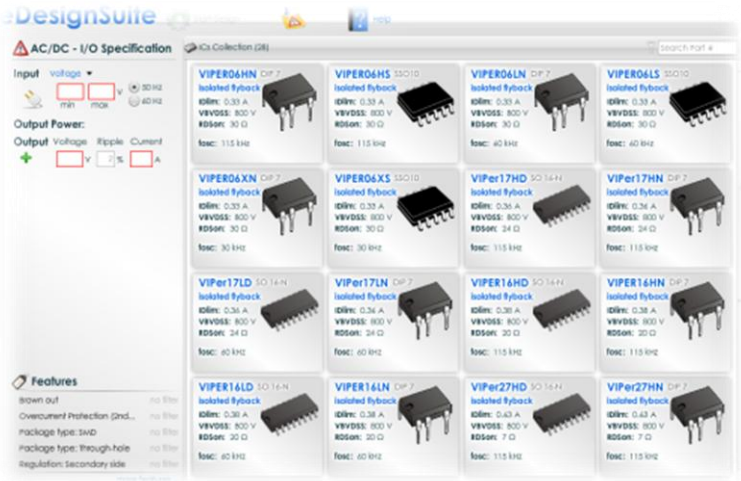
# AC-DC conversion

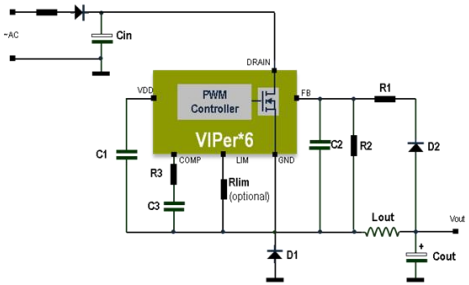
## VIPerPLUS and Altair families

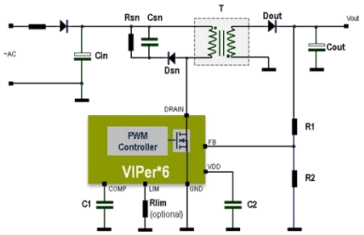
**Never so easy to design a SMPS**

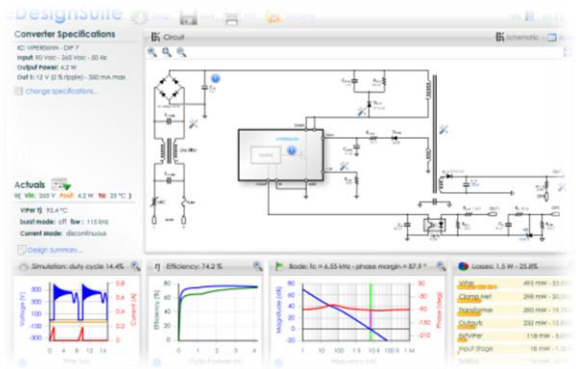
www.st.com/edesignsuite




(*) in MP by eof 2013

# Why VIPer & Altair

| FROM FEATURES TO BENEFIT | |
|---|---|
| 800V / 900V avalanche rugged MOSFET | • Market benchmark<br>• Application cost reduction & superior reliability |
| Optimized internal MOSFET | • Cost-effective replacement of capacitive power supplies (refrigerators, home automation…) |
| Op-Amp embedded for feedback loop (VIPer*6 only) | • Versatile & cheap solution for both isolated / not isolated topologies |
| Primary side regulation (Altair only) | • High voltage/current precision in isolated solutions without need of optocoupler |
| Multiple switching frequencies | • Flexible solution to optimize EMI filtering |

# HV Converters portfolio

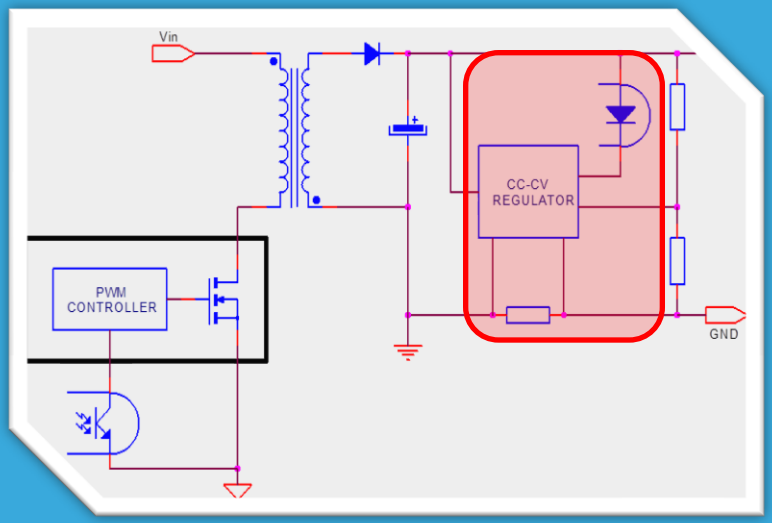
Production


| | | | | |
|---|---|---|---|---|
| **Power:**<br>(1) 230V$_{AC}$±20%<br>(2) 85-265 V$_{AC}$ | 8 W (1)<br>4 W (2) | 10 W (1)<br>6 W (2) | 16 W (1)<br>12 W (2) | 20 W (1)<br>15 W (2) |
| **Packages:**<br>Halogen FREE | SSO10<br>DIP-7 | SO16N<br>DIP-7 | SO16N<br>DIP-7<br>SDIP-10 | SDIP-10 |
| **Power MOSFET:** | BV$_{DSS}$ 800V<br>R$_{DSON}$ 32 Ω | BV$_{DSS}$ 800V<br>R$_{DSON}$ 24 Ω | BV$_{DSS}$ 800V<br>R$_{DSON}$ 7 Ω | BV$_{DSS}$ 800V<br>R$_{DSON}$ 4.5 Ω |
| **Controller 5** quasi resonant | *n.a.* | | VIPer25 | |
| **Controller 6** fixed frequency (jitter) | VIPer06 | VIPer16<br>VIPerA16 | VIPer26 | *n.a.* |
| **Controller 7** fixed frequency (Jitter) | *n.a.* | VIPer17 | VIPer27 | VIPer37 |
| **Controller 8** fixed frequency (Jitter) | *n.a.* | *n.a.* | VIPer28 | VIPer38 |

Embedded EA, self supply, feedback disconnection detection

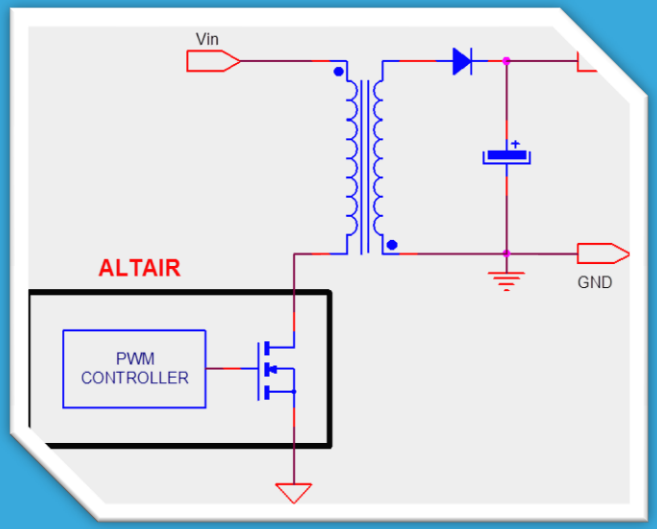
# Altair family: primary side regulation

## Standard solution




- dedicated CV-CC controller and optocoupler
- Sense resistor and relevant dissipation

## ALTAIR solution




- Cost effective solution

# Altair04-900 Target Applications


- Energy metering SMPS
- Power supply for 3-phase input industrial system

# ALTAIR04-900

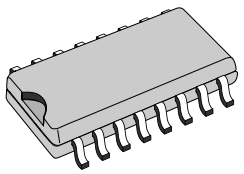
## Main Features

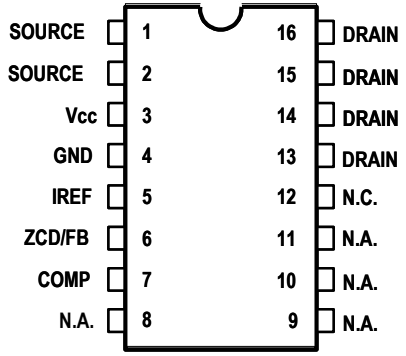
- 900V, avalanche rugged power section
- QR current-mode PWM controller in BCD6 technology
- Constant voltage and constant current output regulation (CV/CC) with no optocoupler
- High performance for stand-by & efficiency
- Integrated protections: 2nd OCP, open loop protection (brownout) OLP, high OCP
- Automatic auto restart after fault

| MAIN PARAMETERS | Power MOSFET (SuperMESH) | CONTROLLER (BCD6S) |
|---|---|---|
| Break down voltage [V] | 900 | |
| $R_{DSon}$ [Ohm] | 16 | |
| $V_{DD}$ [V] | | 11.5 ÷ 23 |
| $F_{OSC}$ [KHz] | | Up to 166 kHz |
| Restart time during burst mode | | 500us |
| $R_{THJ-A}$ [° C/W] (1) | 50 | |
| $P_{OUT}$ [W] @ 85-265$V_{AC}$ | 5 | |

## Pin description

SO16






- SOURCE: Power section Source
- Vcc: Controller supply voltage / ICHARGE output current
- GND: Controller ground
- IREF: Current loop reference
- ZCD/FB: Zero Current Detection, CV regulation, FF compensation
- COMP: Compensation network
- DRAIN: Power section Drain

# LED6001



## Dimmable single channel LED driver with integrated boost controller

## LED CURRENT CONTROL

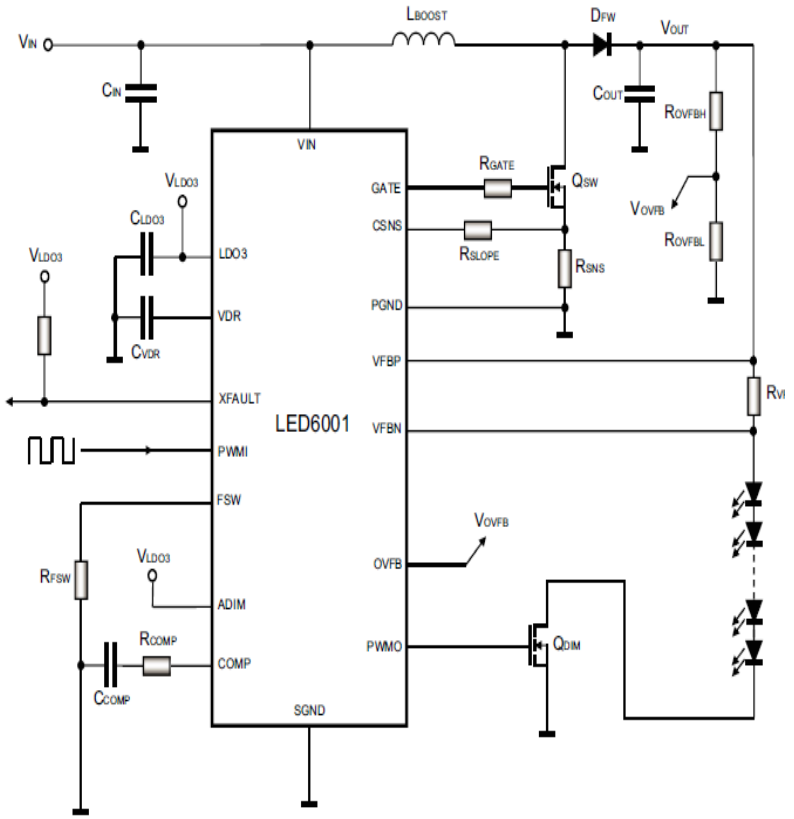
- **Boost controller with high-side current sensing circuitry with 4% precision over temperature**

## FLEXIBILITY

- **Support boost, SEPIC and floating buck-boost**
- **Independent inputs for analog and PWM dimming**
- **Programmable current sensing reference**
  - **down to 30mV to reduce dissipation**
  - **up to 300mV for higher accuracy**

## ROBUSTNESS

- **Overcurrent, overvoltage & thermal shutdown**
- **Reliable short circuit protection thanks to high side sensing**



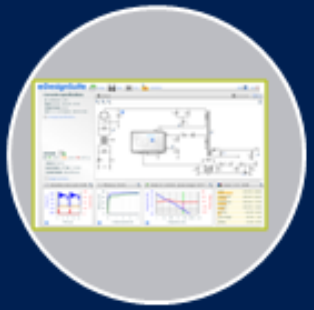
# Tools

## Product focus and RtM

- Focus of the year, competition benchmark, FAE/FSE messages

## New boards

- Simple to be used



## eDesignSuite

- Continuously enhanced with new products (PFC, DC-DC…)

Product promotion supported by a wide offer of tools

# Thanks

life.augmented

We manage the Power