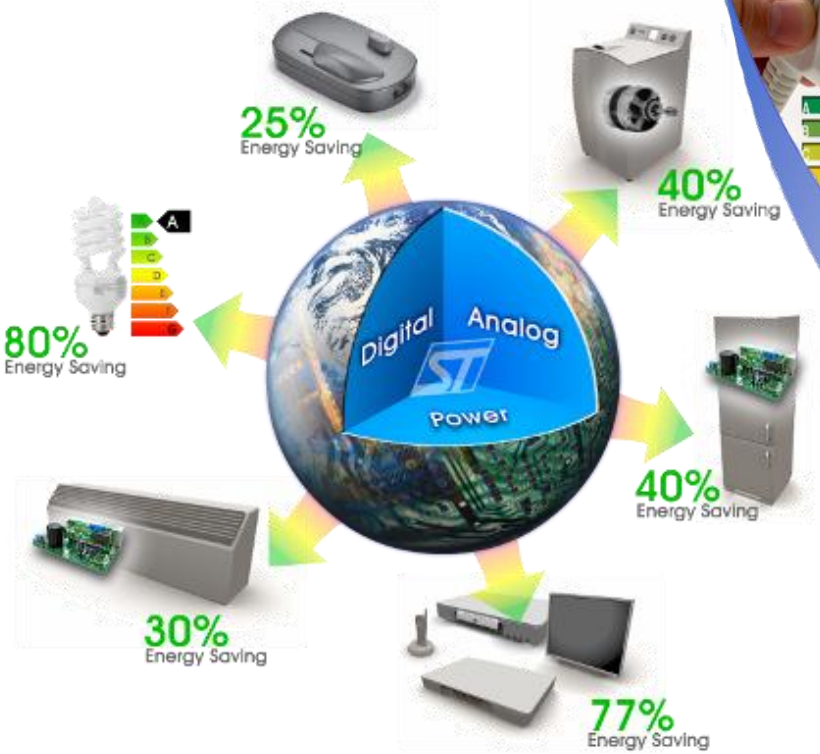
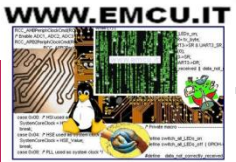


Microelectronics

MONOLITHIC DC-DC CONVERTER



DC/DC converter by market

	APPLICATION	REQUIREMENTS	SUGGESTED PRODUCT FAMILY
Consumer	LCD and PDP TV, STB, Gateway, HDD, DVD/BlueRay player, Gaming	12V & 5V typ input buses Output current up to 4A Cost effective solution Adequate performance Easy to use	ST1S31-2 ST1S40-1 L598x L7980-1 ST1S50(*)
Automotive	Car infotainement, Dashboard Camera module, BCM Exterior & Interior lighting	Vin 4V to 36V AEC-Q100 High efficiency High reliability & robustness	A597x A7985A-6A A6986(*)
Industrial	Factory automation, Metering Home Appliances	Wide Vin up to 60V Extended temperature range High efficiency High reliability & robustness	L597x ST1S14 L7985-6 L6986(*),L7987(*)
LED lighting	Torch, Street lighting, General Lighting, Emergency lighting	Wide Vin up to 60V PWM dimming Low power dissipation	LED2000-1 ST1CC40 LED5000(*) LED6000(*)

(*) UNDER DEVELOPMENT

Consumer market segment

- Vin ranges from 3V to 14V (3.3V, 5V, 12V buses)
- Easy to use
- Cost effective
- Good performance
- Low stand-by power consumption

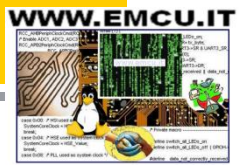
- ST1S40-1 Vin from 4V to 18V (12V)
- ST1S31-2 Vin from 2.5V to 5.5V (3.3V and 5V)
- Full embedded fault protection
  Internal compensation network
- Small external components count
- ST1S40-1: Iout up to 4A
  R_{dsonHS}=95mΩ
  R_{dsonLS}=70mΩ
  fsw=850kHz
  ST1S31-2: Iout up to 4A
  R_{dsonHS}=60mΩ
  R_{dsonLS}=40mΩ
  fsw=1500kHz
- ST1S50(*) high efficiency at light load thanks to low Iq

(*) UNDER DEVELOPMENT

Automotive market segment

• Vin ranges from 4V (cold crank) to 36V (load dump)	• A597x Vin from 4V to 36V A7985-6 Vin from 4.5V to 38V
• AEC-Q100 compliance	• Extended operating temperature range (-40°C to 150°C) Parameters guaranteed over -40°C to 125°C
• High reliability & robustness	• Full embedded fault protection Burn-in test for high reliability (B5973D)
• Synchronization capability to avoid beating noise	• Sync pin for master/slave synchronization
• Low operating quiescent current for car body application	• A6986(*) very low quiescent current

(*) UNDER DEVELOPMENT



Industrial market segment

- **Vin up to**
  - **36V-40V for Factory Automation, Home Appliances, Metering**
  - **60V for Fail Safe Systems**
- **Extended temperature range**
- **High reliability & robustness**
- **HB LED driving**

- **ST1S14 Vin up to 48V**
  L7985-6/L6986(*) Vin up to 38V
  L7987(*) Vin up to 61V
- **Extended operating temperature range (-40°C to 150°C)**
  L7986TA Parameters guaranteed over -40°C to 125°C
- **Full embedded fault protection**
- **LED2000-1 V_{IN} up to 18V, I_{LED} up to 4A with dimming capability**
  ST1CC40 V_{IN} up to 18V, I_{LED} up to 3A
  LED5000(*) V_{IN} up to 48V, I_{LED} up to 3A with dimming capability
  LED6000(*) V_{IN} up to 61V, I_{LED} up to 3A with dimming capability

(*) UNDER DEVELOPMENT

LED lighting market segment

• Vin up to
  • 18V for torch, flashlight and emergency lighting
  • 60V for Street & general lighting
	• ST1CC40-LED2000-1 Vin up to 18V
	LED5000(*) Vin up to 48V
	LED6000(*) Vin up to 61V

• PWM dimming	• Dimming Depth down to 5% at F_{DIM}=1kHz Dimming Depth down to 5% at F_{DIM}=1kHz
• HB LEDs driver	• I_{LED} up to 4A
• Low power dissipation	• LED2000-1- ST1CC40 V_{SENSE}=100mV LED5000(*) V_{SENSE}=200mV LED6000(*) V_{SENSE}=150mV

(*) UNDER DEVELOPMENT

INPUT VOLTAGE UP TO 18V

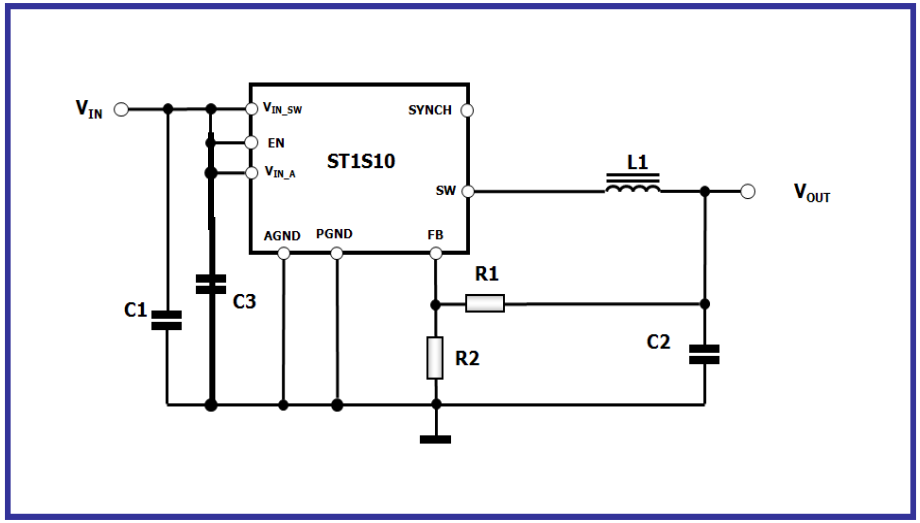
Up to 18V Family

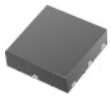
	Vin_max	Iout	fsw_max	Synchronous rectification	Automotive
ST1S03	16V	1,5A	1,5MHz	NO	NO
ST1S10	18V	3A	1,2MHz	YES	NO
L5988	16V	4A	1MHz	YES	NO
ST1S30	6V	3A	1,5MHz	YES	NO
ST1S31/2	6V	3/4A	1,5MHz	YES	NO
ST1S40/1	18V	3/4A	850KHz	YES	NO
LED2001	18V	4A	850KHz	YES	NO
LED2000	18V	3A	850KHz	YES	NO
ST1CC40	18V	3A	850KHz	YES	NO

Dedicated to HB-LED driving

ST1S10 Key Features

- Max Operating Input voltage up to 18V
- Output Current Capability: 3A max over all operating conditions
- PWM fixed frequency 900KHz. It can be ext synch from 0.4 to 1.2MHz
- Output Voltage: Adjustable from 0.8V feedback voltage
- HS R_{DSon}=120mΩ, LS R_{DSon}=100mΩ (Typ)
- Ceramic Capacitors and small Inductor
- Soft-Start integrated circuit
- Enable pin





DFN – 8L
4x4mm

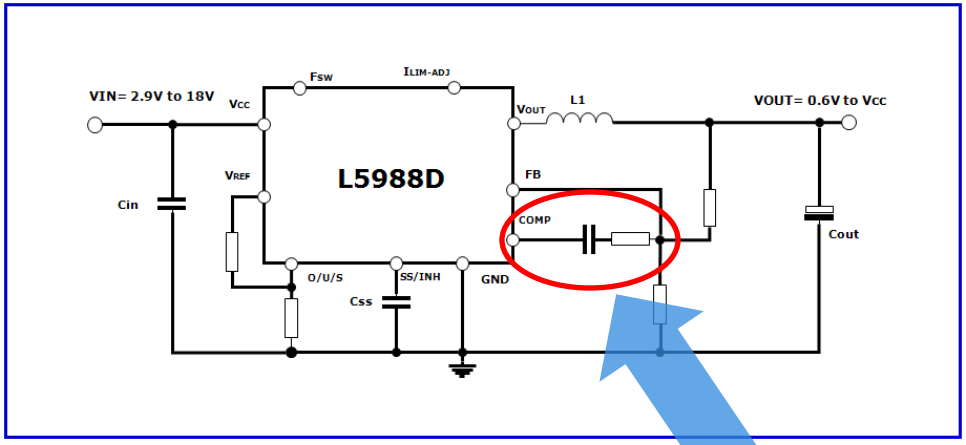
HSOP8

Package	Commercial Code
HSOP8	ST1S10PHR
DFN4x4 – 8L	ST1S10PUR

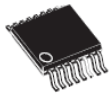
3A Step-Down DC-DC with Synchronous Rectification

L5988-9D Key Features

- Up to 4A in small HTSSOP 16
- Synchronous rectification with P-channel power MOS: no bootstrap capacitor
- Wide input Vin range (2.9V up to 18V)
- High switching frequency (400KHz, adjustable up to 1MHz)
- Adj Soft-start and Inhibit function
- Embedded over current (adj threshold), over voltage and thermal protection
- PGood signal (L5989D) Synchronization capability(180° out of phase) (L5988D)
- Multifunction pin (adj UVLO, latched/ no latched OVP and sink-mode capability)
- 1.8v ± 2% reference voltage
- Suitable for MLCC output filter



External feedback comp.



HTSSOP 16 – Rth j–amb 40° C/W

Device	Package	Ipk [A]	Iout [A]	Vin [V]	Vout [V]	Fsw [KHz]	Extra Functions
L5988D	HTSSOP16	5	4	2.9 to 18	0.6 to Vin	400 -1000	Synchronization
L5989D	HTSSOP16	5	4	2.9 to 18	0.6 to Vin	400 - 1000	Pgood

LED2001 LED Driving

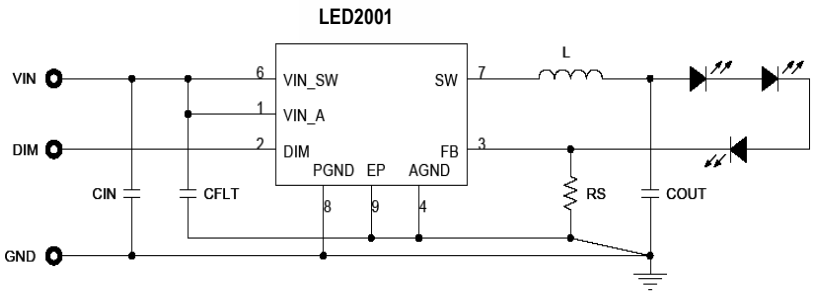
Dedicated to HB-LED driving

- HB LED current source
- Input Voltage: from 3V to 18V
- Switching Frequency: 850kHz
- Adjustable output current up to 4A
- FB voltage 100mV
- Features PWM dimming
- Integrated 70mOhm Low side RDSon Mosfet
- Integrated 90mOhm High side RDSon Mosfet
- Fast Transient Response

LED2001 — **4A / 850kHz**

DFN – 8L
4x4mm

HSOP-8



Package	Output Current	Commercial Code
HSOP8	4A	LED2001PHR
DFN4x4 – 8L	4A	LED2001PUR

UNDER DEVELOPMENT!!!

NEW COMERS UP TO 18V

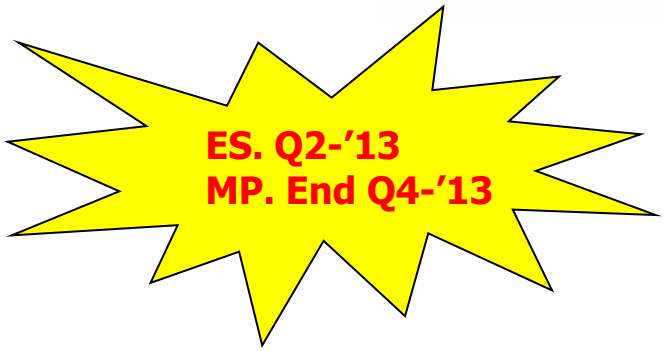
New comers up to 18V

	Vin_max	Iout	fsw_max	Synchronous rectification	Automotive
ST1S33/6	5,5V	3/6A	2,2MHz	YES	NO
ST1S50	18V	4A	500Khz	YES	NO
ST1S51/2	18V	2A	500Khz	YES	NO

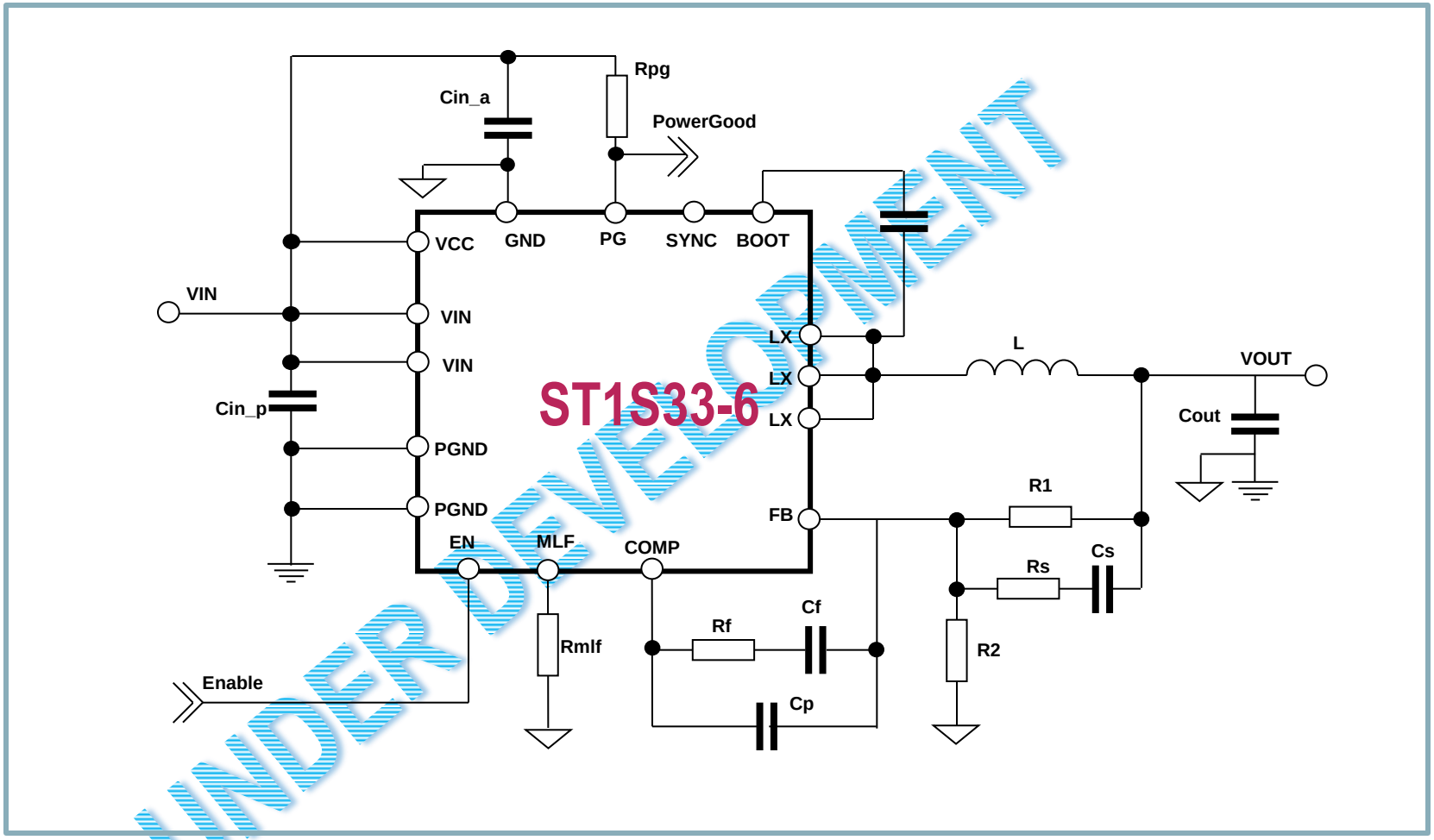
ST1S33-6 Key Features

- Input Voltage: from 2.9V to 5.5V
- Output Current Capability: 3-6A
- Output Voltage: Adjustable from 0.6V up to Vin
- High Efficiency (LCM) or constant switching frequency (LNM) at light load
- Programmable switching Frequency: 500kHz, 1MHz, 2MHz
- LNM supports M/S synchronization
- Programmable soft-start circuit to reduce inrush current
- Integrated 17 mOhm typ. RDSon MOSFETs for HS and LS
- Power good
- Enable pin
- Short Circuit and Thermal Protection

DFN – 16L 3x3



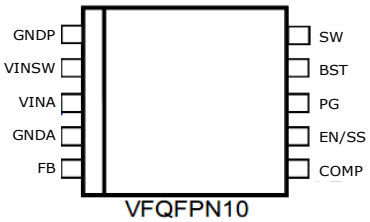
ST1S33-6 Application Test Circuit



ST1S50 Key Features

- Input voltage: from 4V to 18V
- Output current capability: 4A
- Output voltage: adjustable from 0.8V up to 0.85*Vin
- Switching frequency: 500 kHz
- High efficiency at light load
- Adjustable soft-start to reduce inrush current
- Integrated 95 and 65mOhm RDSon MOSFETs
- External compensation network
- Power good
- Enable pin
- Short Circuit and Thermal Protection

ST1S50 4A / 500kHz

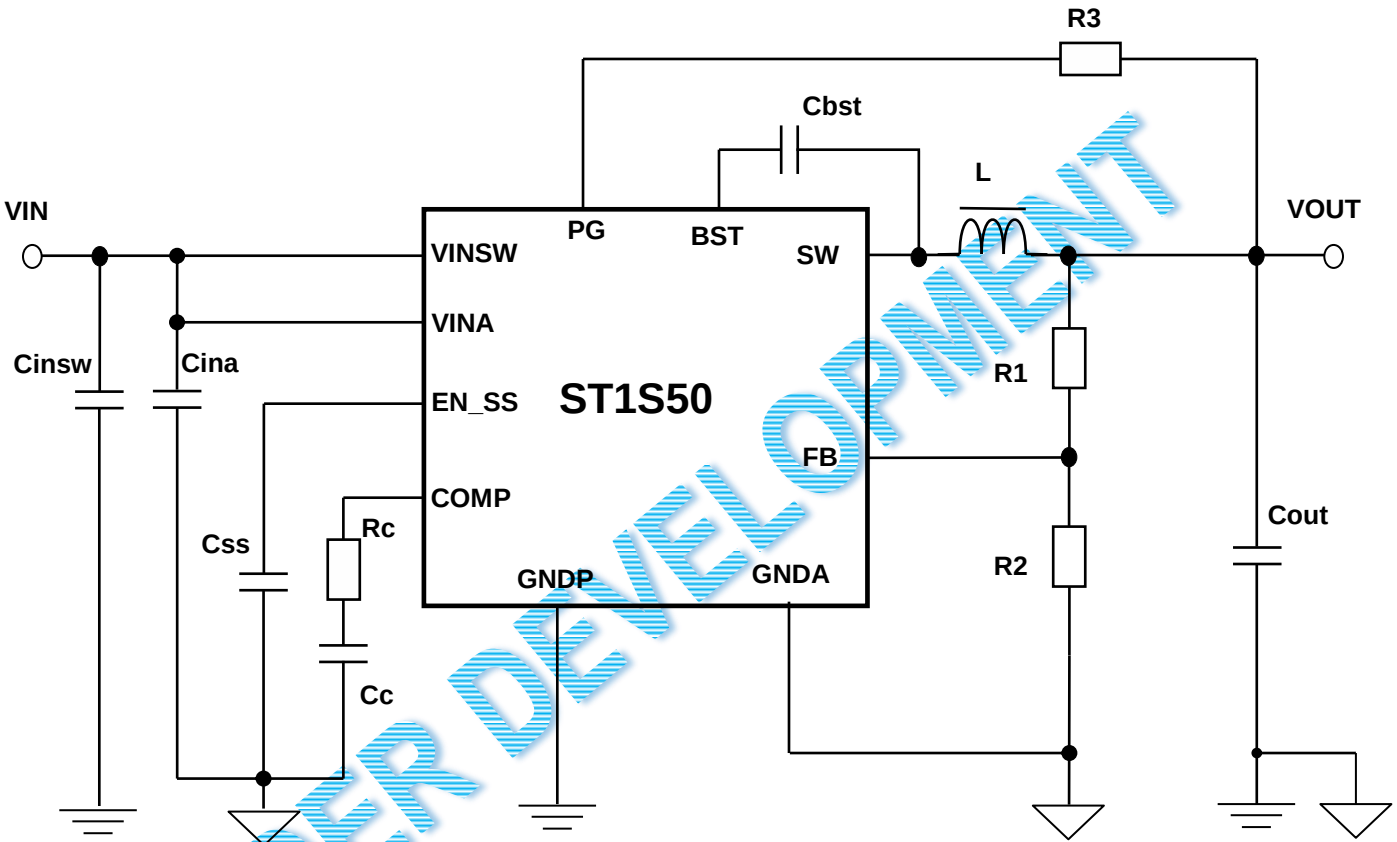


Mass Prod. Q1-'13
ES available

DFN – 10L 3x3

Package	Output Current	Commercial Code
DFN 3x3 10L	4A	ST1S50PUR

ST1S50 Application Test Circuit



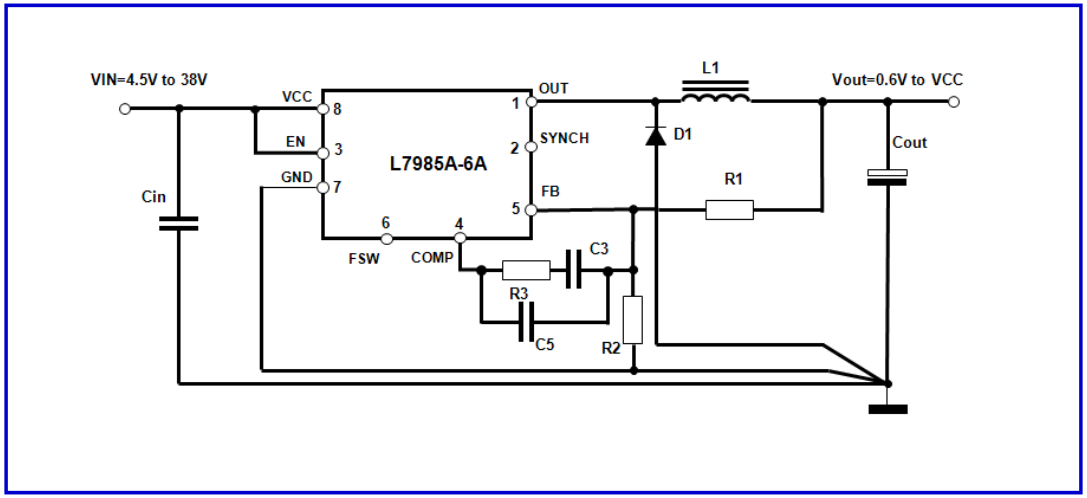
INPUT VOLTAGE FROM 18V UP TO 38V

Up to 38V Family

	Vin_max	Iout	fsw_max	Synchronous rectification	Automotive
A/B/L597x	36V	1/1,5/2/2,5/3A	500Khz	NO	YES
A/L6902	36V	1A - adj	500Khz	NO	YES
L7980/1	28V	2/3A	1MHz	NO	NO
A/L7985/6	38V	2/3A	1,5MHz	NO	YES

L7985/A-6/A Key Features

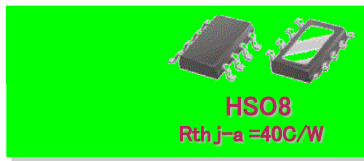
- More than 3A in both small QFN3x3-10L and HSOP8 packages with minimum external component count
- P-channel power MOS: no bootstrap capacitor
- Wide input voltage range (4.5V up to 38V)
- High switching frequency (250KHz, adjustable up to 1MHz) with Synchronization capability (180° out of phase)
- Internal Soft-start
- Enable pin
- Embedded protection features
- Suitable for MLCC output filter
- Typ RDSon=200mΩ
- All Parameters tested over the -40°C to + 125°C junction temperature range (L7986TA)



Device	Package	Ipk (A)	Iout (A)	Vin (V)	Vout (V)	Fsw (kHz)	Extra Functions
L7985/A	QFN3x3-10L/HSOP8	2.5	2	4.5V to 38V	0.6V to Vin	250	En, AdjFsw, Sync
L7986/A	QFN3x3-10L/HSOP8	3.5	3	4.5V to 38V	0.6V to Vin	250	En, AdjFsw, Sync

A7985A-6A Key Features

- Up to 3A in a small HSOP8 package with minimum external component count
- P-channel power MOS: no bootstrap capacitor
- Wide input voltage range (4.5V up to 38V)
- High switching frequency (250KHz, adjustable up to 1MHz) with Synchronization capability (180° out of phase)
- Internal Soft-start
- Enable pin
- Embedded protection features
- Suitable for MLCC output filter
- Typ RDSon=200mΩ
- All Parameters tested over the -40°C to + 125°C junction temperature range



A7986A 3A / up to 1MHz

A7985A 2A / up to 1MHz

Device	Package	Ipk (A)	Iout (A)	Vin (V)	Vout (V)	Fsw (kHz)	Extra Functions
A7985A	HSOP8	2.5	2	4.5V to 38V	0.6V to Vin	250	En, AdjFsw, Sync
A7986A	HSOP8	3.5	3	4.5V to 38V	0.6V to Vin	250	En, AdjFsw, Sync

UNDER DEVELOPMENT!!!

NEW COMERS FROM 18V UP TO 38V

New comers up to 38V

	Vin_max	Iout	fsw_max	Synchronous Rectification	Automotive
A/L6986	38V	2A	500Khz	YES	YES
A/L6984	36V	350mA	600KHz	YES	YES

L6986 Key Features

- 4V TO 38V INPUT VOLTAGE
- 2A DC OUTPUT CURRENT
- SYNCHRONOUS RECTIFICATION
- LOW QUIESCENT CURRENT (30µA)
- HIGH EFFICIENCY OR CONSTANT SWITCHING FREQUENCY AT LIGHT LOAD
- LOW DROPOUT OPERATION: UP TO 100% DUTY CYCLE
- 250 KHz SWITCHING FREQUENCY, PROGRAMMABLE UP TO 2MHz
- PROGRAMMABLE OUTPUT VOLTAGE MONITORING CIRCUITRY
- PREBIAS START-UP CAPABILITY
- MLCC OUTPUT CAP COMPLIANT
- THERMAL SHUTDOWN
- OVERVOLTAGE AND OVERCURRENT PROTECTION (PEAK AND VALLEY CURRENT SENSE)
- ADJUSTABLE SOFT-START

Mass Prod. Q2-'13

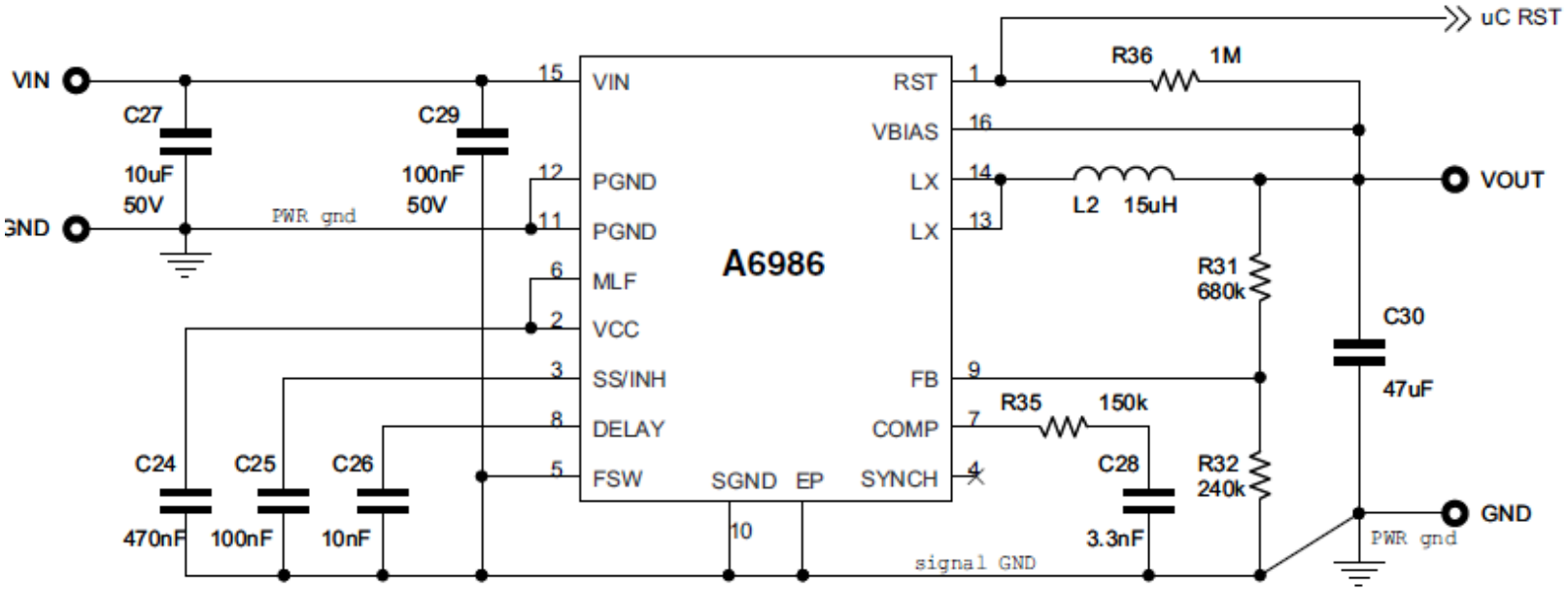
✓BCD8 40V technology

✓Qualified following AEC-Q100 (A6986)

AUTOMOTIVE/INDUSTRIAL

- Body/ (Int./ext. lighting, junction box, dashboard)
- PLC, factory automation
- Car infotainment (car audio, Navigation, telematics box)

L6986 A6986(Automotive)



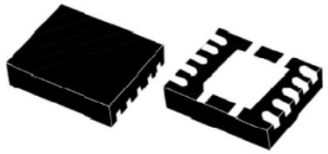
HTSSOP16 (R_{TH} = 40 °C/W)

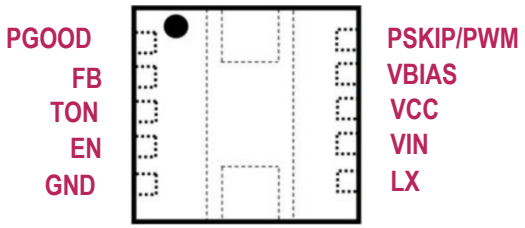
L6984 – A6984 (Automotive)

350mA synchronous buck converter

Low current optimized buck converter

- 4.5V TO 36V INPUT VOLTAGE
- SYNCHRONOUS RECTIFICATION
- UP TO 350mA DC OUTPUT CURRENT
- 100µA IQ (VIN 12V – VOUT 3.3V – PSKIP - SWO)
- PULSE SKIPPING OR FORCED PWM AT LIGHT LOAD
- PROGRAMMABLE SWITCHING FREQUENCY: 200KHz – 600KHz
- PREBIAS START-UP CAPABILITY
- VBIAS MAXIMIZES EFFICIENCY AT LIGHT LOAD (PSKIP)
- PGOOD OUTPUT
- NO VOLTAGE DIVIDER REQUIRED FOR VOUT 3V3
- COT ARCHITECTURE IMPLEMENTS FREQUENCY FF OVER VIN RANGE
- MLCC OUTPUT CAPACITOR COMPLIANT
- THERMAL SHUTDOWN
- OVERVOLTAGE AND OVERCURRENT PROTECTION
- AEC-Q100 COMPLIANT (A6984)

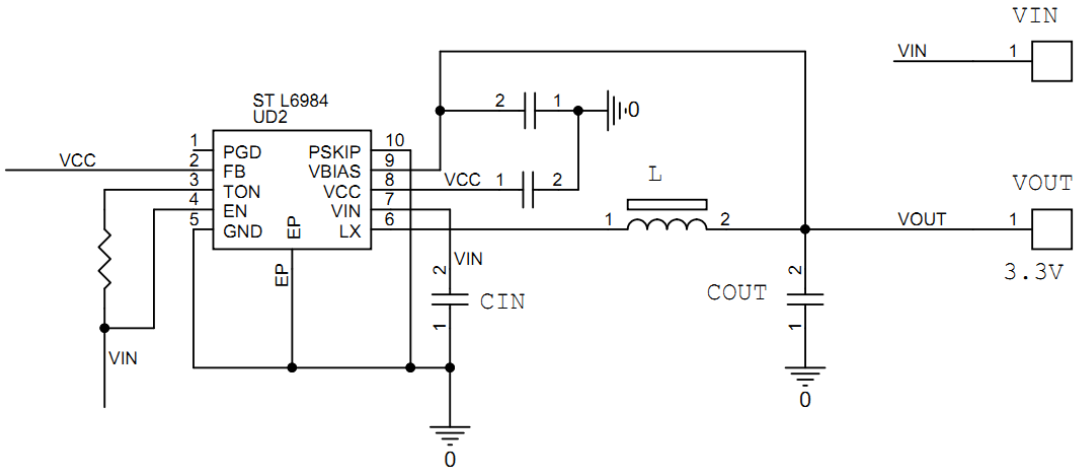




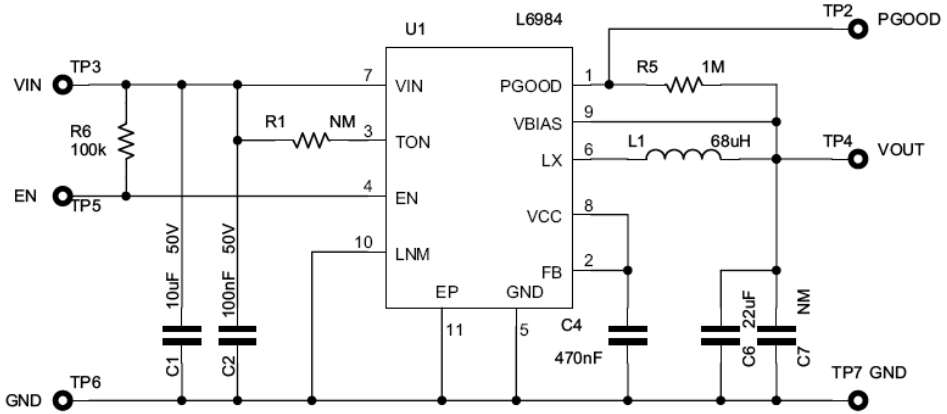
ES. End Q1-'13

350mA synchronous buck converter

Low current optimized buck converter



L6984 test circuit



L6984 test circuit (V_{OUT} 3.3V)

INPUT VOLTAGE > 38V

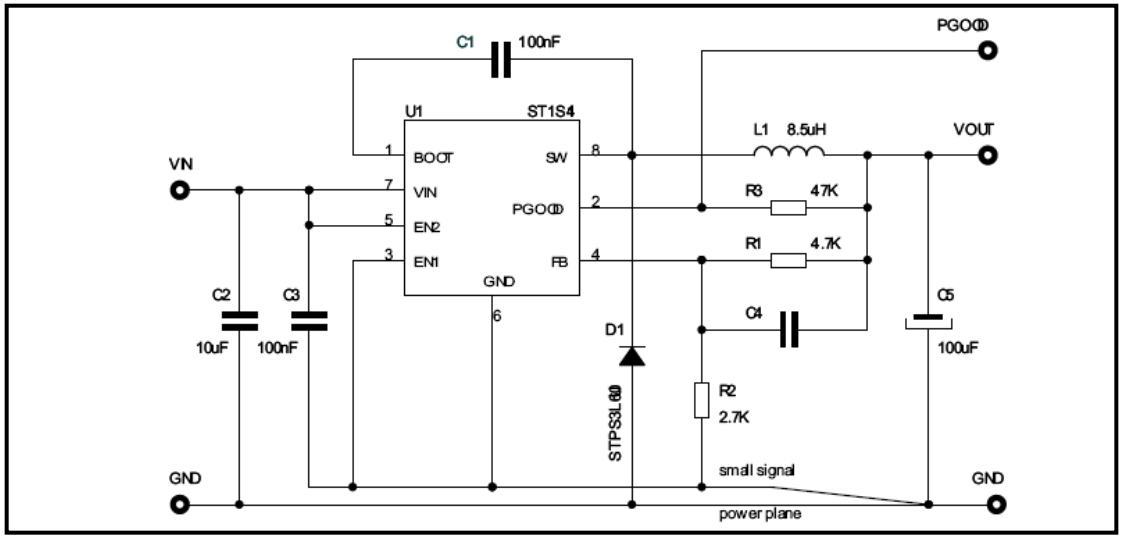
> 38V Family

	Vin_max	Iout	fsw_max	Synchronous Rectification	Automotive
ST1S14	48V	3A	850Khz	NO	NO
LED5000	48V	3A	850Khz	NO	NO

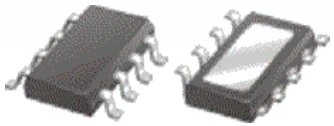
Dedicated to HB-LED driving

ST1S14 Key Features

- PWM fixed frequency 0.85MHz.
- Output Current Capability: 3A max over all operating conditions
- Output Voltage: Adjustable from 1.22V to 90% of max Vin
- Input Voltage: from 5.5V to 48V
- Power Good
- Soft-Start circuit to reduce inrush current
- Efficiency: up to 95%
- Fast Transient Response
- Both Enable and inhibit pins available



HSOP8



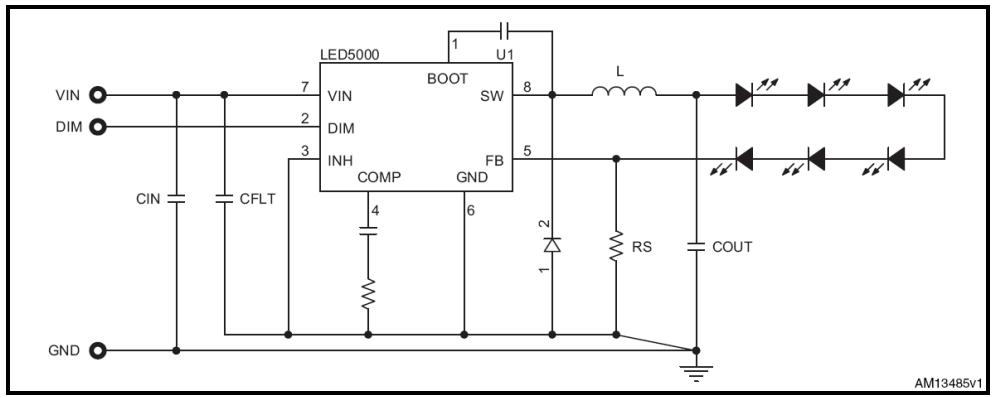
Package	Commercial Code
HSOP8	ST1S14PHR

LED5000 Key Features

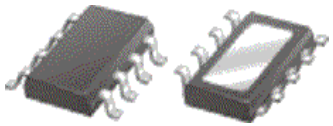
Dedicated to HB-LED driving

- HB LED current source
- Input Voltage: from 5.5V to 48V
- PWM fixed frequency 0.85MHz
- Adjustable output current up to 3A
- Buck / Boost / Buck boost topologies supported
- 200mV sensing voltage
- Features PWM dimming

LED5000 3A / 0.85MHz



HSOP8



Package	Commercial Code
HSOP8	LED5000

UNDER DEVELOPMENT!!!

NEW COMERS > 38V

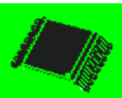
New Comers > 38V

	Vin_max	Iout	fsw_max	Synchronous Rectification	Automotive
A/L7987	61V	3A-Adj	1.5Mhz	NO	YES
LED6000	61V	3A-Adj	1.5Khz	NO	NO

Dedicated to HB-LED driving

L7987 Key Features

- Up to 3A in HTSSOP16 packages with minimum external component count
- Wide input voltage range (4V up to 61V)
- High switching frequency (250KHz, adjustable up to 1.5MHz) with Synchronization capability
- Vout adjustable from 0.6V
- Adjustable current limit
- Adjustable Soft-start
- Enable pin
- PGOOD pin
- Vbias improved efficiency at light load
- LOW IQ-SHTDWN (5 µA max.)
- LOW IQ-OPERATING (2 mA)
- Embedded protection features
- Suitable for MLCC output filter
- Typ RDSon=200mΩ

HTSSOP16  L7987

Up to 3A / up to 1.5MHz

Mass Prod. End Q3-'13

✓BCD6s 70V technology
✓Vbias improves Eff at light load

INDUSTRIAL

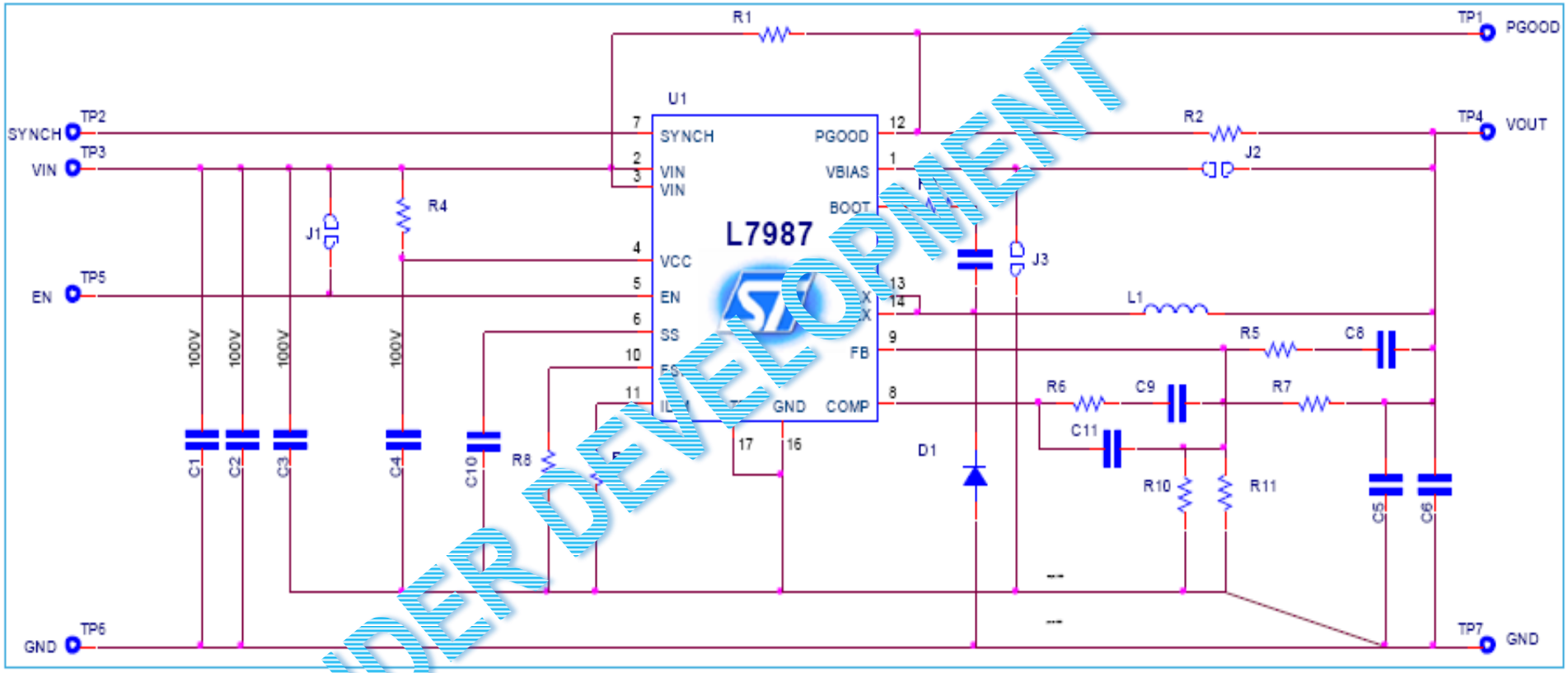
- Industrial (PLC, factory automation)
- **Automotive (extended load dump, Truck vehicles)**

A7987 Key Features

- Up to 3A in HTSSOP16 packages with minimum external component count
- Wide input voltage range (4V up to 61V)
- High switching frequency (250KHz, adjustable up to 1.5MHz) with Synchronization capability
- Vout adjustable from 0.6V
- Adjustable current limit
- Adjustable Soft-start
- Enable pin
- PGOOD pin
- Vbias improved efficiency at light load
- LOW IQ-SHTDWN (5 µA max.)
- LOW IQ-OPERATING (2 mA)
- Embedded protection features
- Suitable for MLCC output filter
- Typ RDSon=200mΩ

MP. Q1-'14
Industrial version MP Q3-'13

L7987 Application Test Circuit

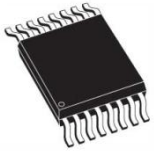


LED6000 Key Features

- Up to 3A in HTSSOP16 packages with minimum external component count
- Wide input voltage range (4V up to 61V)
- High switching frequency (250KHz, adjustable up to 1.5MHz) with Synchronization capability
- FB voltage of 150mV
- PWM Dimming pin
- Adjustable Soft-start
- Enable pin
- Embedded protection features
- Suitable for MLCC output filter
- Typ RDSon=200mΩ

Dedicated to HB-LED driving

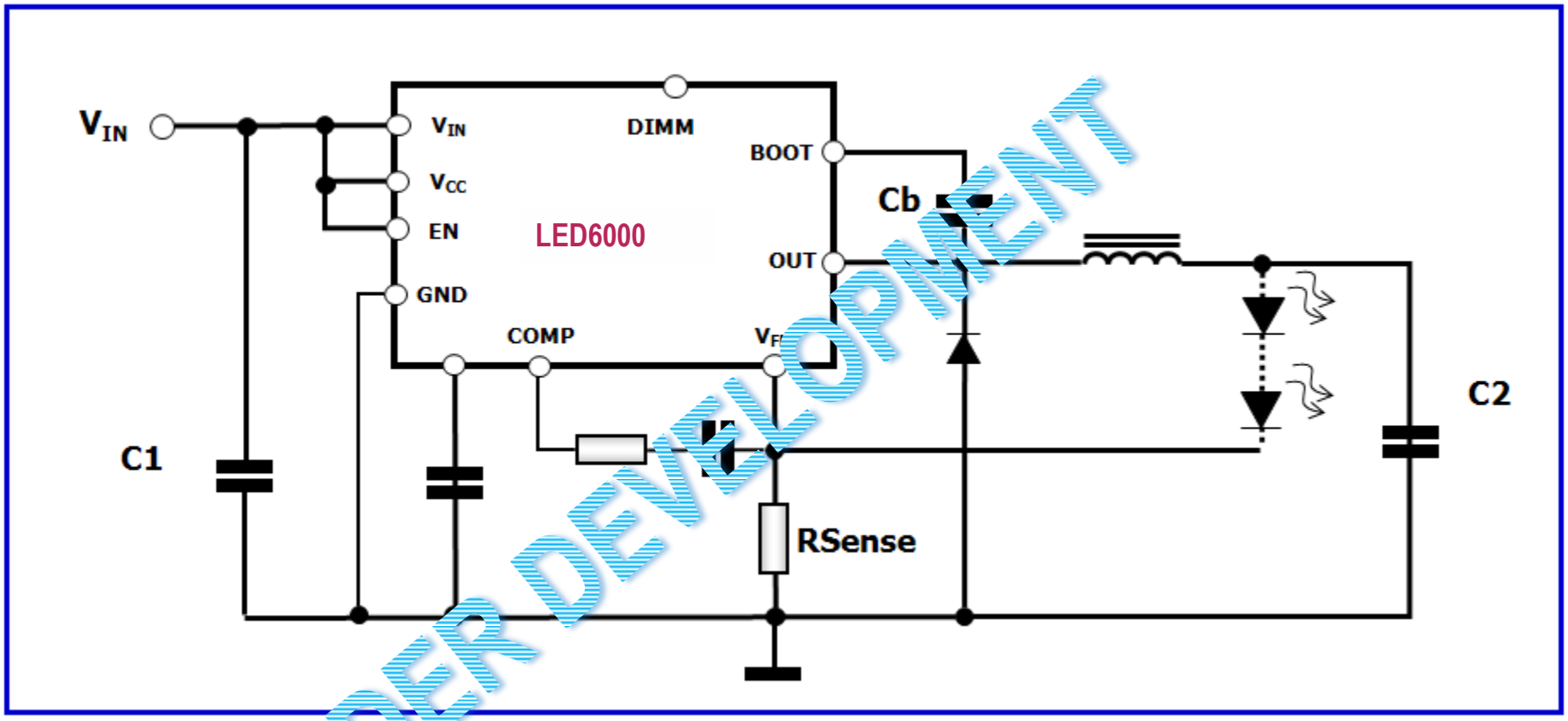
LED6000 3A / 0.75MHz



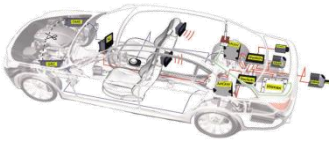
HTSSOP16

MP. End Q4-'13

LED6000 Application Test Circuit



UNDER DEVELOPMENT!!!
AUTOMOTIVE DEVICE



New Comers Automotive

	Vin_max	Iout	fsw_max	Synchronous Rectification	Automotive
A/L6986	38V	2A	500Khz	YES	YES
AST1S31	4V	3A	2.3Mhz	YES	YES
AST1S33/36	5.5V	3/6A	2Mhz	YES	YES
LED6001	36V	Adj			YES

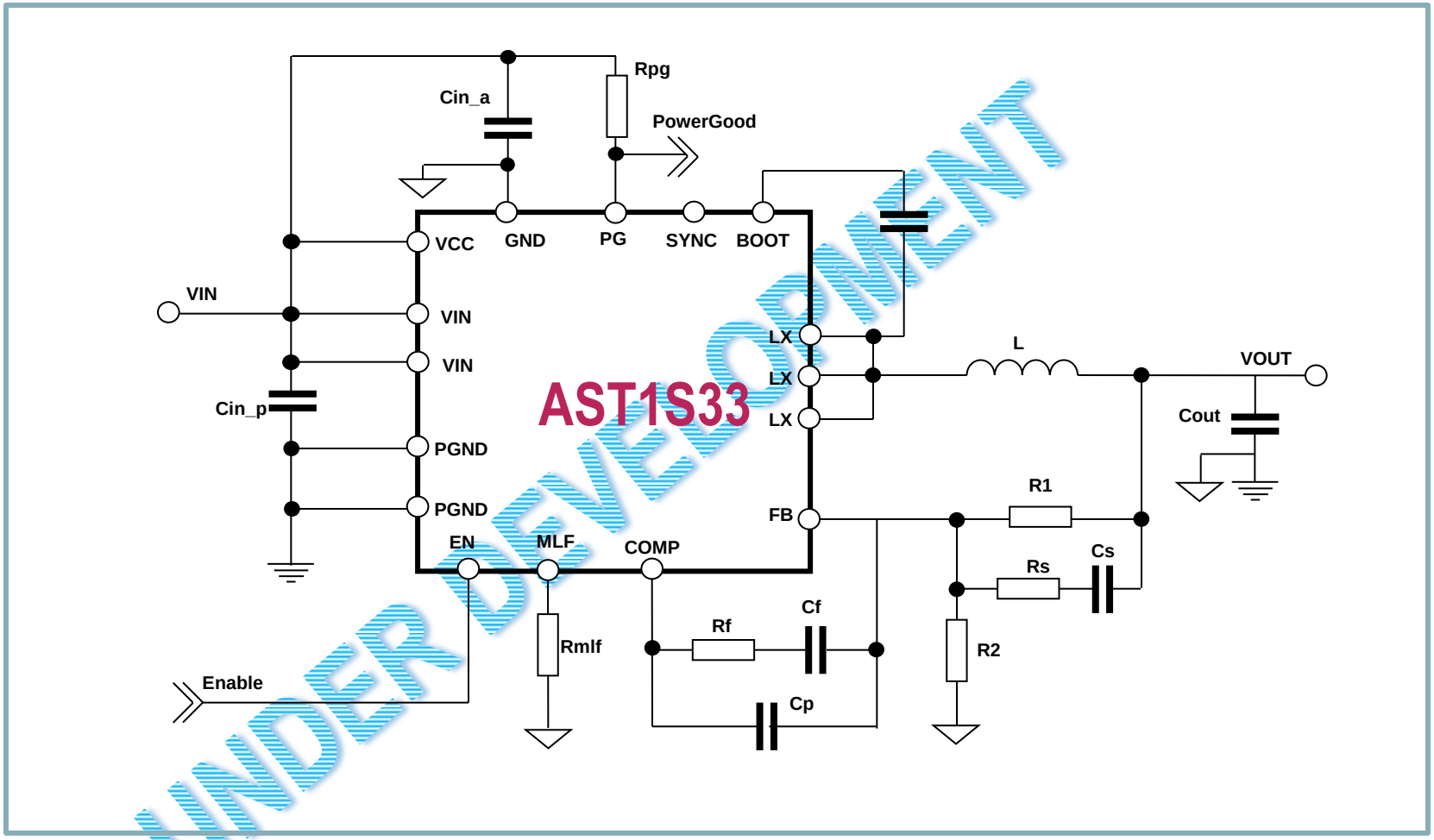
AST1S33/6 Key Features

- Input Voltage: from 2.9V to 5.5V
- Output Current Capability: 3/6A
- Output Voltage: Adjustable from 0.6V up to Vin
- High Efficiency (LCM) or constant switching frequency (LNM) at light load
- Programmable switching Frequency: 500kHz, 1MHz, 2MHz
- LNM supports M/S synchronization
- Programmable soft-start circuit to reduce inrush current
- Integrated 15 mOhm typ. RDSon MOSFETs for HS and LS
- Power good
- Enable pin
- Short Circuit and Thermal Protection

DFN – 16L 3x3

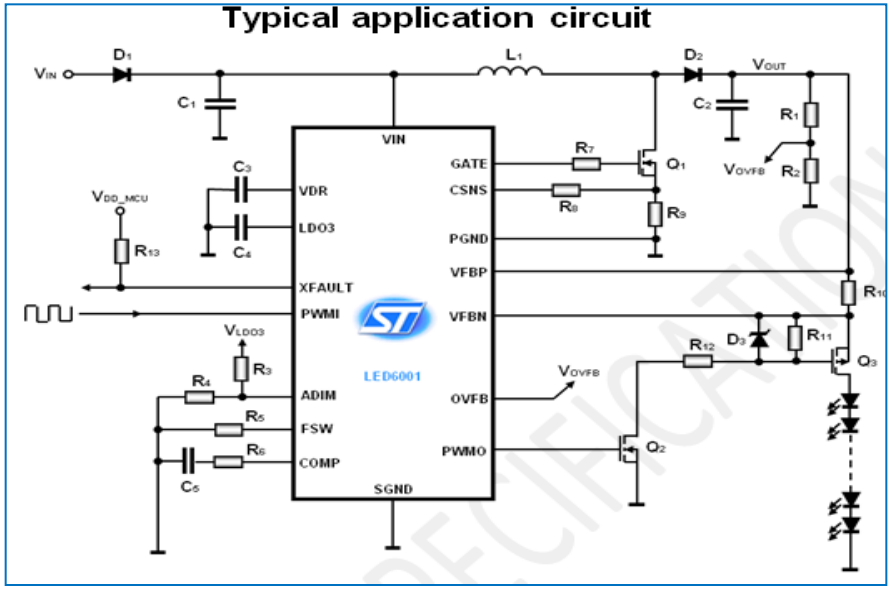
MP. End Q1-'14

AST1S33/6 Application Test Circuit



LED6001(prod 2013)

- BCD6s 70V technology
- Switching controller :
- boost, Buck-boost and SEPIC topologies
- 4.4V to 36V input voltage
- Multi-device sync
- Gate Driver for ext. MOSFET
- Ouput short detection
- LED Control :
- Up to 60V output voltage
- Analog and PWM dimming
- Constant current control loop

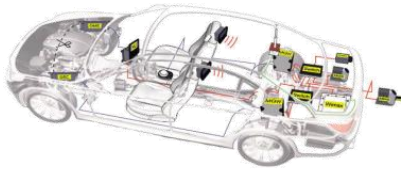


Key Applications

AUTOMOTIVE- Exterior lighting

- **Front L. (DTRL, HB, LB)**
- **Blinkers**
- **Rear Lighting**

Industrial: General Lighting



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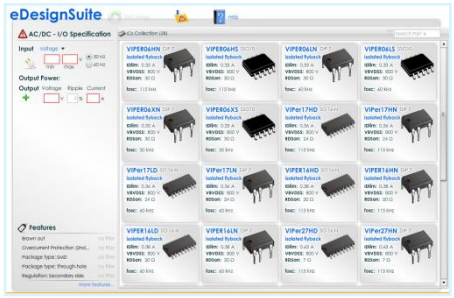
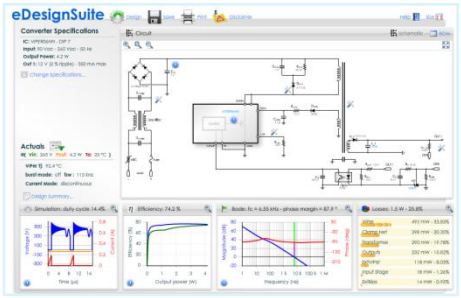


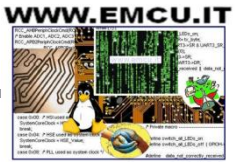
Insert your I/O specifications and
select one of the proposed Viper**



The design is ready!

1 → 2 → 3 → 4

A complete design in a few steps



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I/O Specifications

Input Voltage: 12 min – 18 max V

Output Voltage: 5 V; Current: 1 A; Ripple: 2 %

Actuals

@(Vin: 18 V Iout: 1 A)

Vout: 5 V **ripple:** 40 mV - 0.8 %

IL ripple: 151.11 mA - 15.1 %

fsw: 250 kHz **Ton:** 1.2 µs

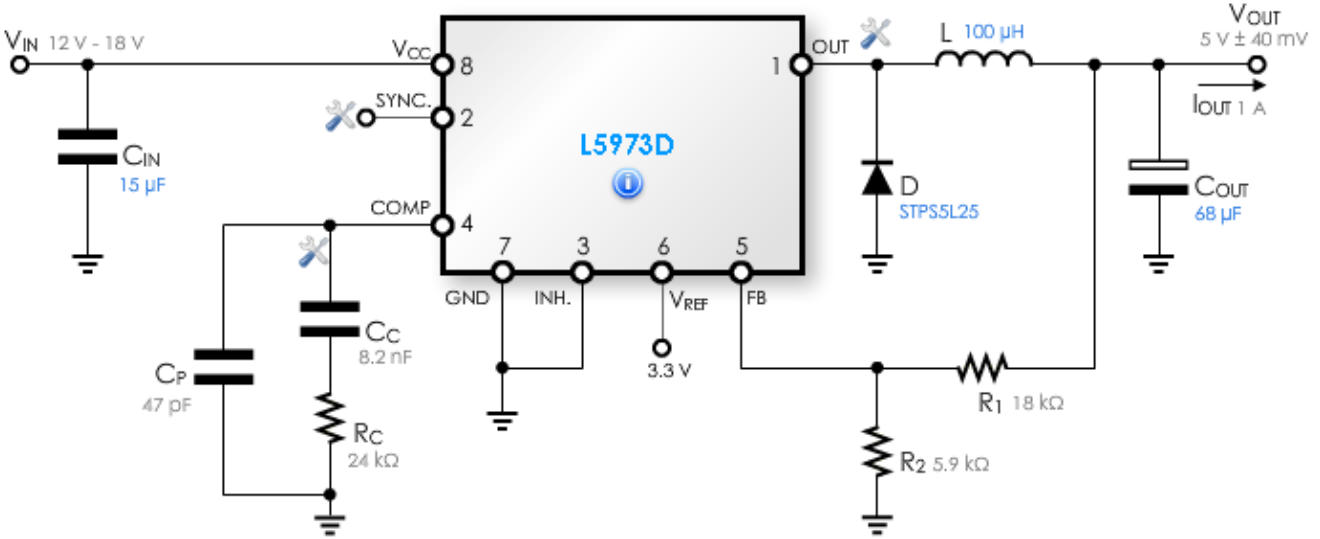
bandwidth: 41.18 kHz

phase margin: 52.55 °

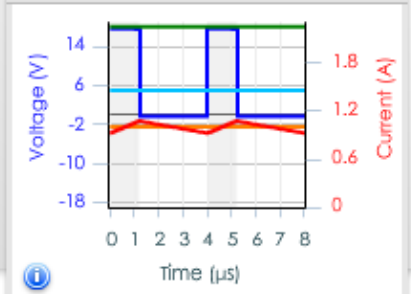
Design refinements...

Circuit | Schematic | BOM

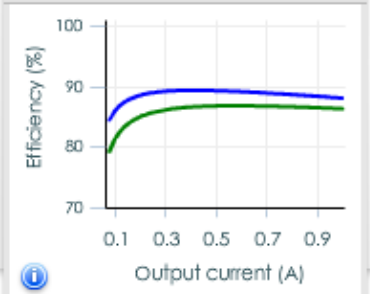
DISCLAIMER...



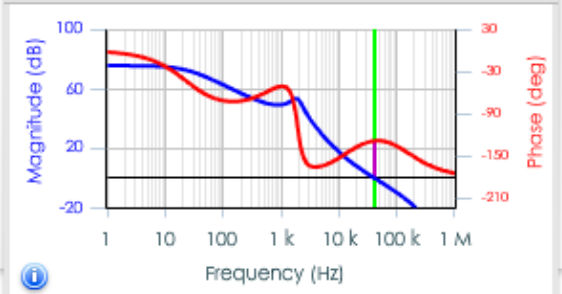
Simulation: duty cycle 30.1 %



Efficiency: 86.4 %



Bode: fc = 41.18 kHz - phase margin = 52.5 °



Losses: 788.7 mW - 13.6 %

IC	489.46 mW - 62.06 %
Diode	244.59 mW - 31.01 %
Inductor	53.1 mW - 6.73 %
Other	1.54 mW - 0.2 %

Thanks for your attention

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