



Long Life, High PF for LED Driver with ST solutions

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Oct. 2008



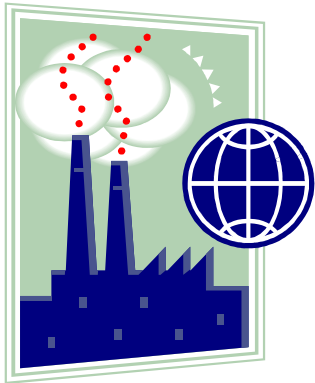
Presentation outline

1. LED Drivers with DC-DC converters
 - ① LED7706, LED7707
 - ② L6920D/DB
2. LED Drivers with AC-DC converters
 - ① Viper Families: Power smaller than 10W
 - ② L6562A: Power larger than 10W



LED Drivers Questions

Energy
saving
?



Life-time
?



Safety
?



LED Drivers *What Regulation says.....*



Solutions seen in the former pages are cheap, small, simple but not compliant with Regulations and not addressing the requirements coming from the market. Lighting Power Supplies > 25W must have PFC but also for very low power market requires solution with PFC to solve the problems related to harmonic distortion in multi power systems.

ENERGY STAR Program Requirements for Solid State Lighting Luminaries, Version 1.0, says that Power Supplies must have PF > 0.7 and > 0.9 respectively for Residential and Commercial.

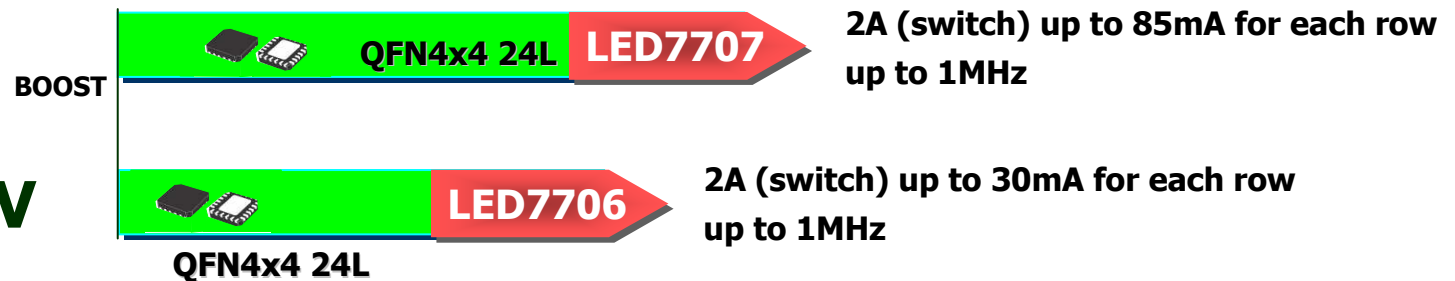
Furthermore, in order to avoid that Power Supply affect one of the main advantage of LEDs, the lifetime and MTBF, it is strongly recommended NOT using electrolytic capacitors, especially that ones placed at the Power Supply input which have to be capable of withstanding high voltage stress.

How to do?

LED Drivers with DC-DC converters

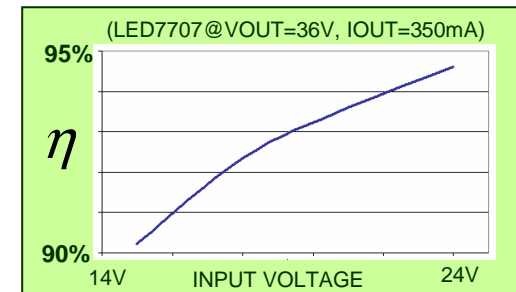
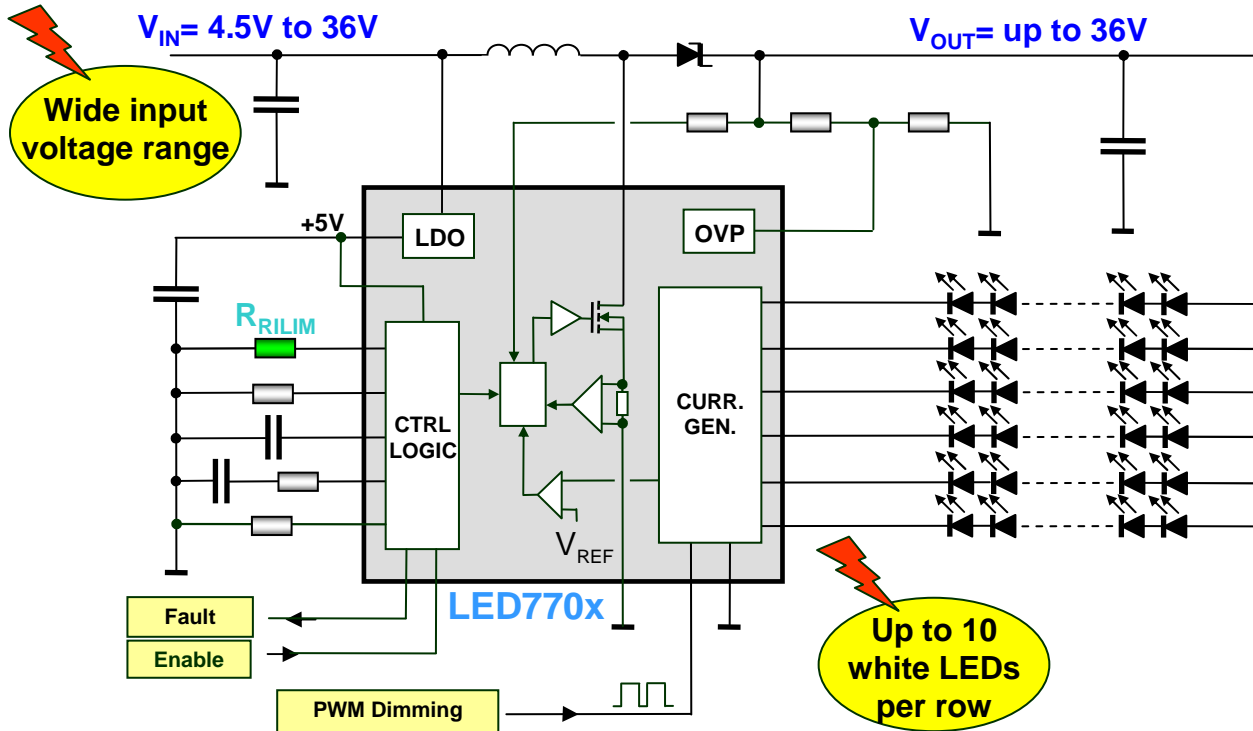
LED7706/7 family - Boost

**VIN from
4.5V to 36V**



LED Drivers with DC-DC converters

LED7706/7 family - Boost



Input voltage: 4.5V to 36V
 Maximum RMS switch current: 2.5A
 Parallellable channels for higher current (LED7707)

$$I_{LED} = \frac{K_R}{R_{RILIM}}$$

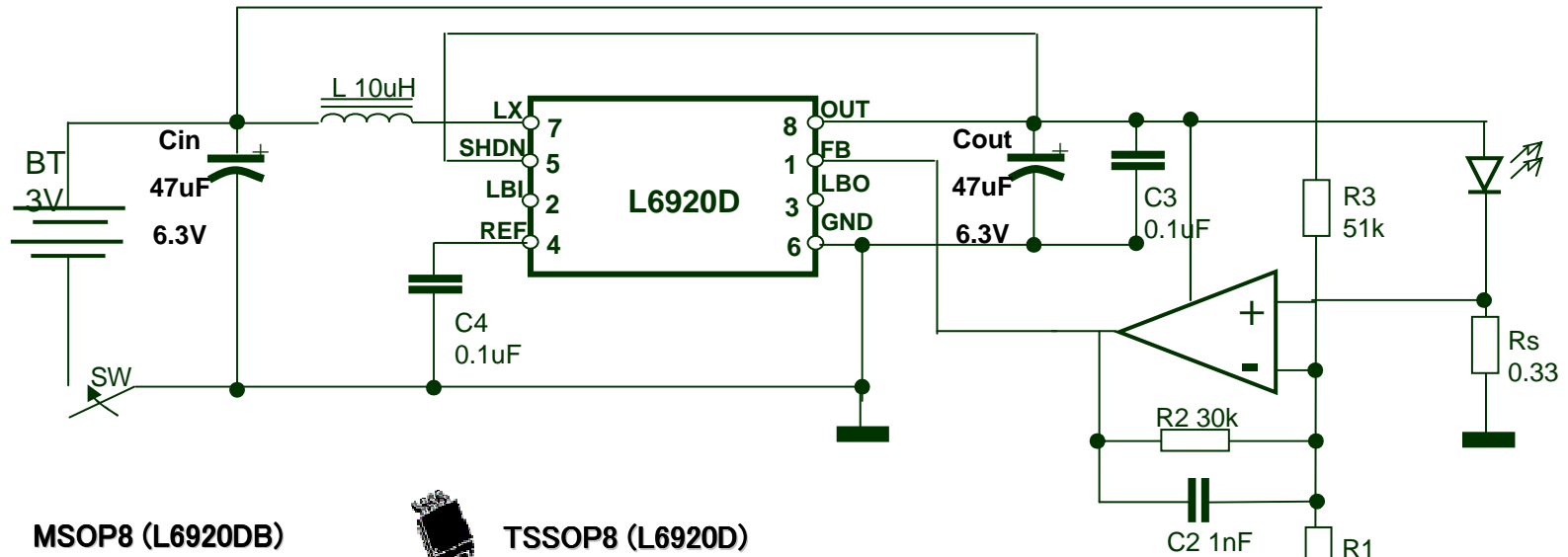
LED current:
 up to 85mA/ch (LED7707)

Channel to channel current mismatch: $\pm 2\%$
 Up to 20kHz PWM dimming (1%-100%, LED7706)



LED Drivers with DC-DC converters

L6920D/DB - Boost



MSOP8 (L6920DB)



TSSOP8 (L6920D)

#LED limited by: $I_{LED,MAX} = (1 - D_A) \cdot I_{SW,MAX}$

$V_{OUT,MAX} = 5.2V \Rightarrow 1 \text{ wLED}$

$$I_{LED} = \frac{V_{FB}}{R_1} \cdot \left(\frac{R_1}{R_1 + R_2} \right)$$

$I_{SW,MAX} = 0.8A \Rightarrow R_1 + R_2$

LED Accuracy: $\pm 5.24\%$ with $V_{SENSE} = 238mV$
(LM351 $VOS = \pm 5mV$)

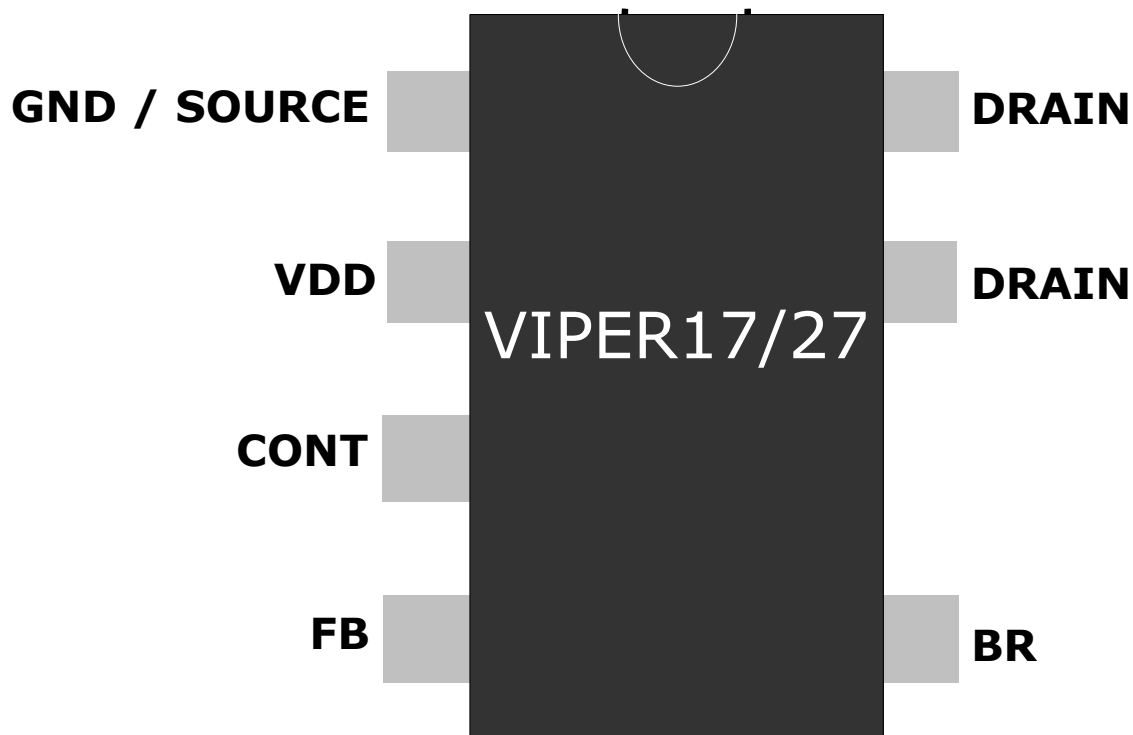
D_A is the actual duty cycles considering power losses

	$V_{in} = 1.2V$	$V_{in} = 2.4V$
$Max I_{LED}$		
1 wLED ($V_F = 3.5V$)	200mA	400mA



LED Drivers with AC-DC converters

Viper families – High PF Flyback



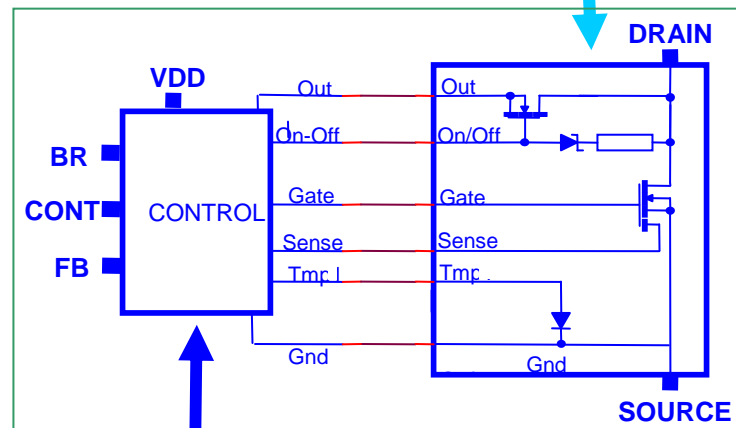
+ *Technology*
+ *Functionalities*
+ *Protections*

LED Drivers with AC-DC converters

Viper families – High PF Flyback



800V Avalanche Ruggedness Power MOSFET in SuperMESH Technology



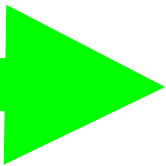
BCD6 controller technology

+ Technology

LED Drivers with AC-DC converters

Viper families – High PF Flyback

+ Functionalities



- ◆ *Current mode converter with ADJUSTABLE IDLIM set point*
- ◆ *Fixed frequency (60kHz or 115kHz) with JITTERING for EMI reduction*
- ◆ **SOFT START UP: IDLIM** increased cycle by cycle
- ◆ **BURST MODE** in low load condition with **IDLIM** fixed up to 100 mA
- ◆ **STAND BY** consumption < **40 mW**

LED Drivers with AC-DC converters

Viper families – High PF Flyback

+ Protections



- ◆ Over voltage protection (**OVP**)
- ◆ 2nd over current protection (**2nd OCP**)
- ◆ Over load protection (**OLP**)
- ◆ Over temperature protection + hysteresis (**OTP**)
- ◆ Brown out protection
- ◆ Max Duty Cycle: 70%

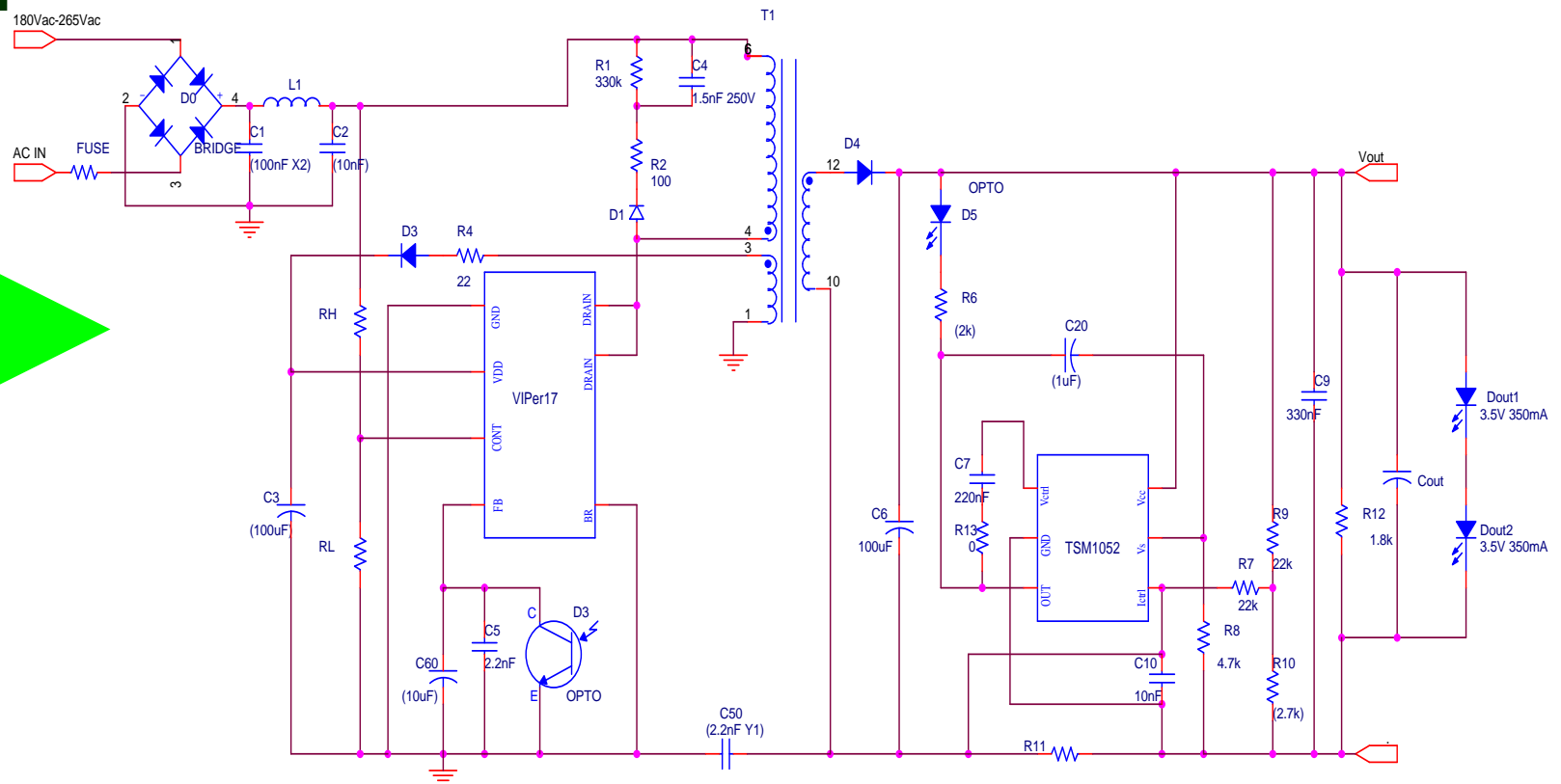
**AUTO RESTART
MODE**
after every fault
condition

LED Drivers with AC-DC converters

Viper families – High PF Flyback

Viper17+TSM1052

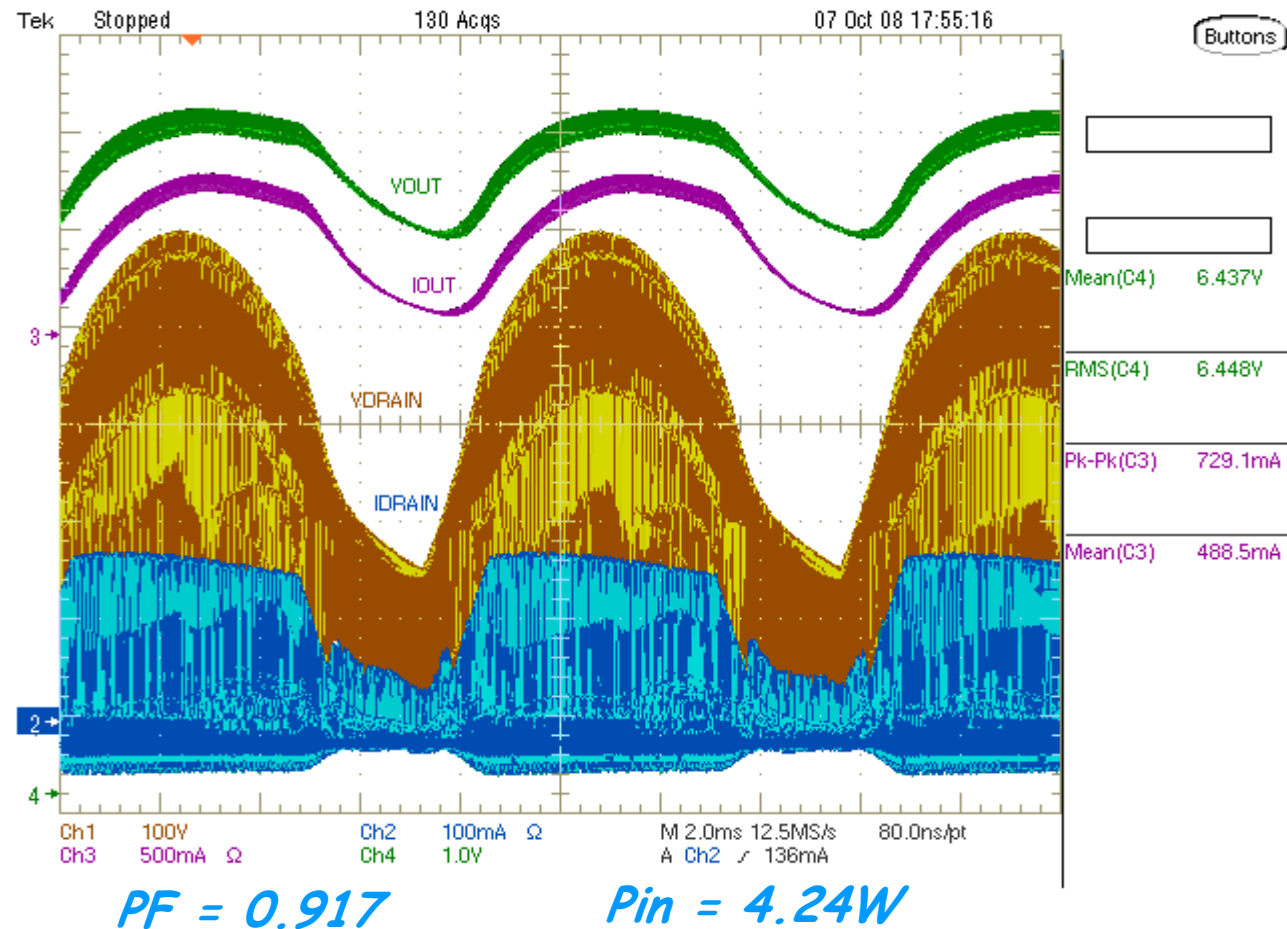
Schematic



LED Drivers with AC-DC converters

Viper families – High PF Flyback

$V_{in}=230Vac$

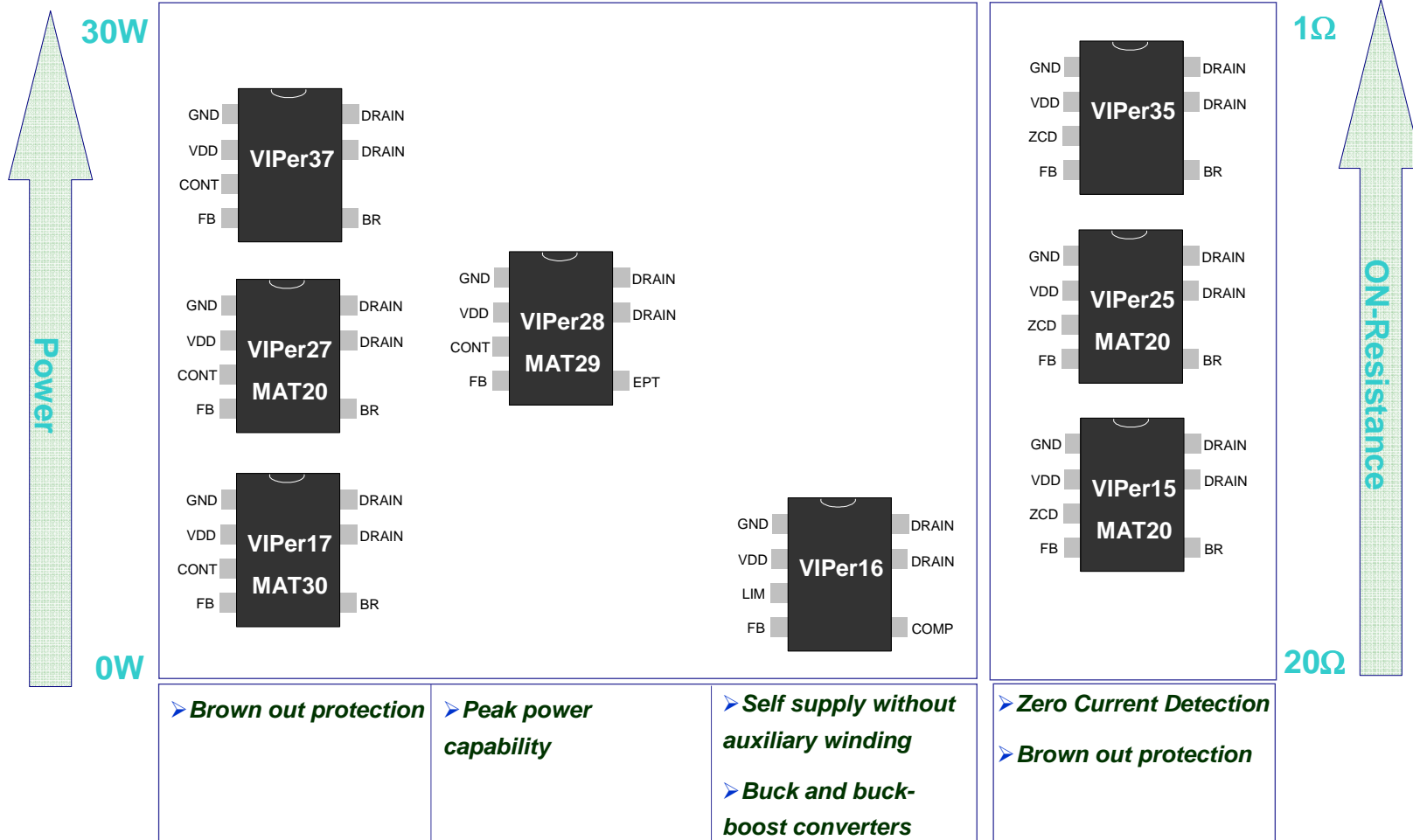


LED Drivers with AC-DC converters

New VIPer Plus Product Portfolio

FIXED FREQUENCY

QUASI RESONANT



LED Drivers with AC-DC converters

Viper families – High PF Flyback

VIPer™ Market Matrix

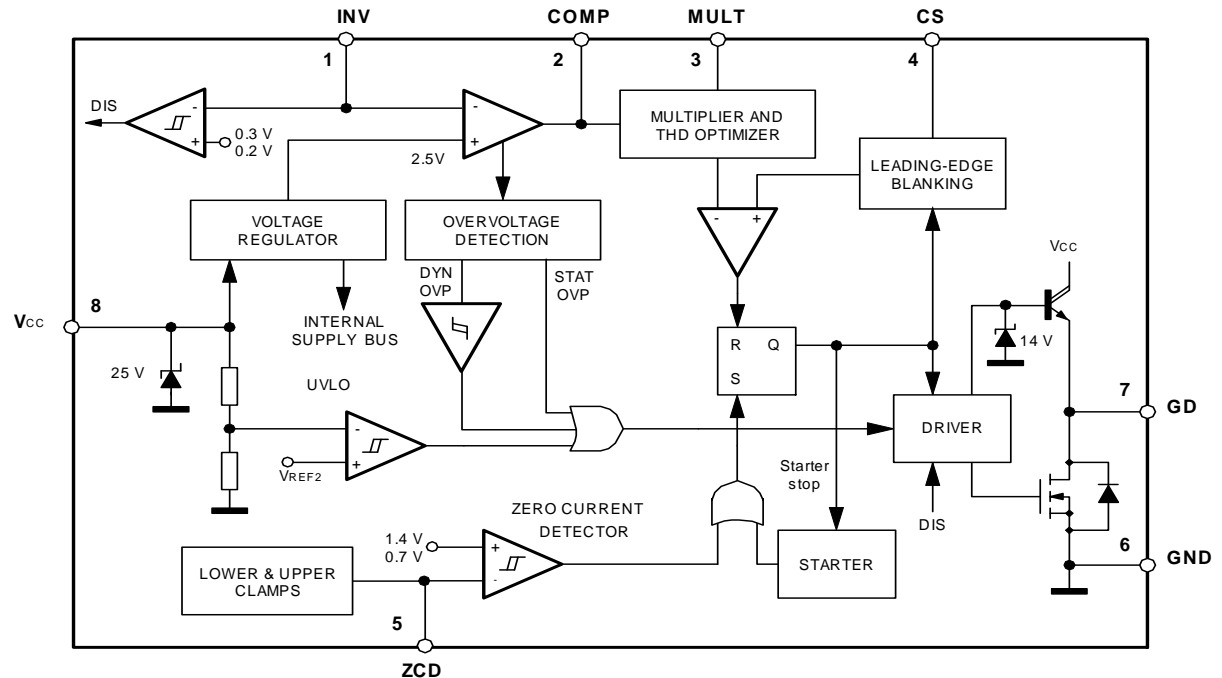
Home appliances	Consumer equipments	Metering equipments	Battery Charger	Lighting
2-10W	5-40W	4-8W	4-6W	2-8 Leds
VIPer16	VIPer16	VIPer16	VIPer16	VIPer16
VIPer17	VIPer17	VIPer17	VIPer17	VIPer17
VIPer27	VIPer15	VIPer15	VIPer15	VIPer27
VIPer28	VIPer27	VIPer27	VIPer12A	VIPer28
VIPer15	VIPer28	VIPer28	VIPer22A	VIPer15
VIPer12A	VIPer12A	VIPer12A		VIPer12A
VIPer22A	VIPer22A	VIPer22A		VIPer22A
VIPer20A	VIPer20A			
	VIPer53x			
	VIPer50A			
	VIPer100A			



LED Drivers with AC-DC converters

L6562A – High PF Flyback

- Transition Mode PFC Controller
- **Ultra Low Start-up Current (<60µA)**
- Low Quiescent Current (2.5mA typ.)
- **Precise Internal Reference (1% @25° C)**
- ZCD input for TM
- Two-level OVP Protection
- **1.1V Current Sense threshold**
- **DIGITAL Leading-edge blanking on Current Sense**
- Package: DIP-8/SO-8
- THD optimizer circuit
- **Disable function on FB input**
- Extended supply voltage range
- -600 / +800mA totem pole gate driver with pull-down and voltage clamp



APPLICATIONS:

PFC PRE-REGULATORS FOR:

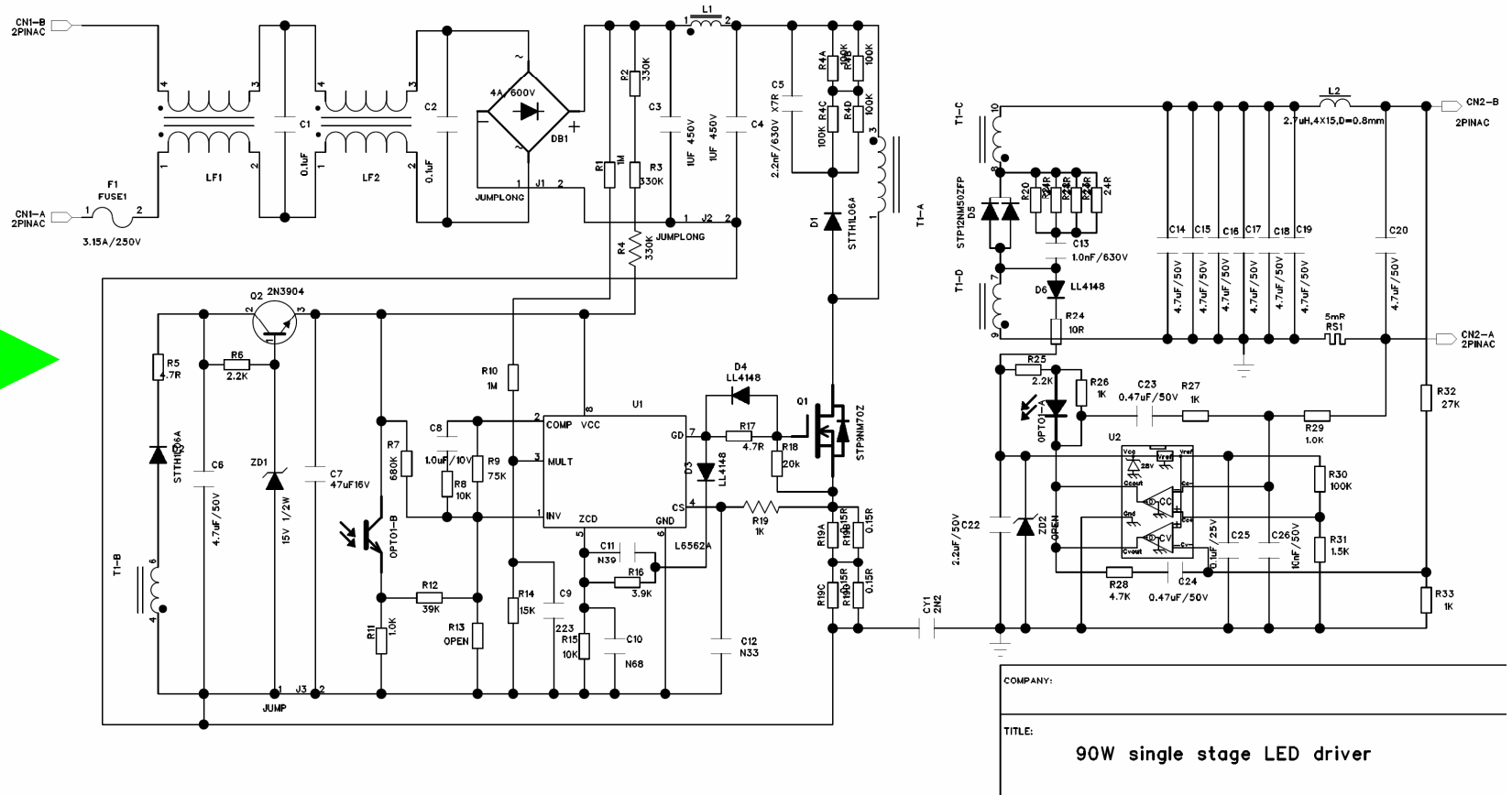
- ELECTRONIC BALLAST
- EC61000-3-2 COMPLIANT SMPS (FLAT-TV, DESKTOP PC, MONITOR, GAMES)
- HI-END AC-DC ADAPTER/CHARGER



LED Drivers with AC-DC converters

L6562A – High PF Flyback

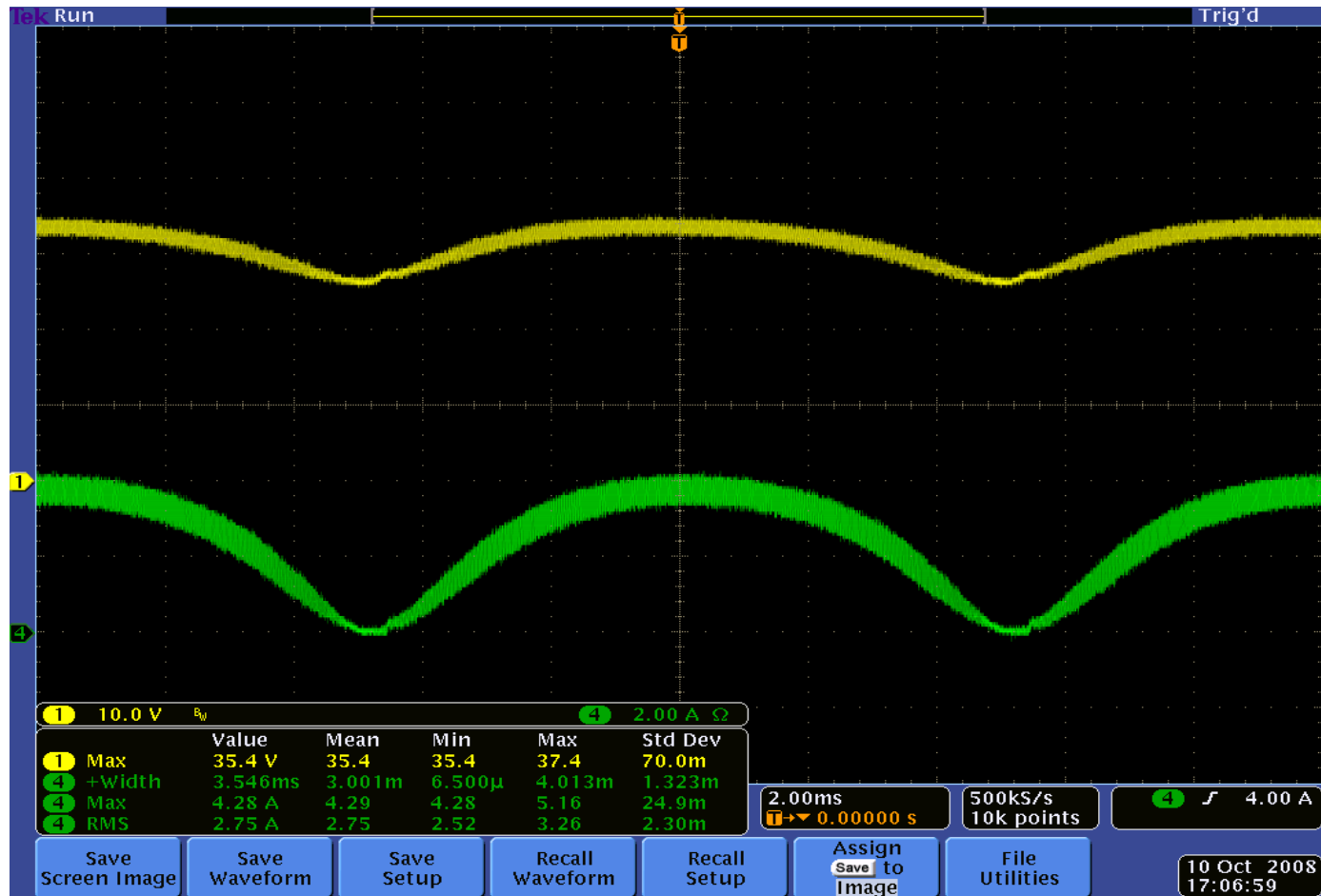
Schematic



LED Drivers with AC-DC converters

$V_{in} = 230V_{ac}$

$PF > 0.95$



$Ch1 = V_{out}$
 $Ch4 = I_{out}$

$P_{in} = 90W$
 $P_{out} = CV 30V$



LED Drivers with AC-DC converters

L6562A – High PF Flyback

L6562A PFC Fly back Summary

1. *It is the only low cost solution to obtain single stage insulated PFC*
2. *Doesn't need input electrolytic capacitors*
3. *The Quasi-resonant topology reduces the capacitive switching losses*
4. *The frequency jitter due the input voltage ripple helps the system to pass the EMC tests.*
5. *The L6562A current sense stage achieves High frequency operation.*
6. *Quasi-resonant operation prevents transformer saturation problems (potentially occurring with CCM topology)*
7. *Easy short circuit protection*
8. *Compliant with the European regulation EN61000-3-2 Class-C and Japanese regulation JEIDA-MITI Class-C.*

LED Drivers Answers

Energy Saving

High Efficiency
High PF
Dimmable
PFC and converter combined
Low Costing

Life-time

>100K Hours – YES:
No Input E-cap,
Output E-cap can be disabled

Safety

Low input voltage can be: 3- 4.5V for DC-DC
Safety isolated for AC-DC
Protections are available
Max output voltage, output current limited



Solutions:

DC-DC: LED7706/LED7707; L6920D/DB

AC-DC: Viper Families; L6562/A



- Q & A -

THANK YOU!

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