



**Power Supply Solutions
for small/medium/big size
LCD-PDP/TV**

BETO-PX

Content

- Classical Approach:
 - 60W SMPS (<20")
 - 200W SMPS (up to 30-32")
- Resonant Approach:
 - 70W SMPS (<20")
 - 180W SMPS (up to 30")
 - 500W SMPS (up to 50"
LCD-TV, 42" PDP-TV)



60W

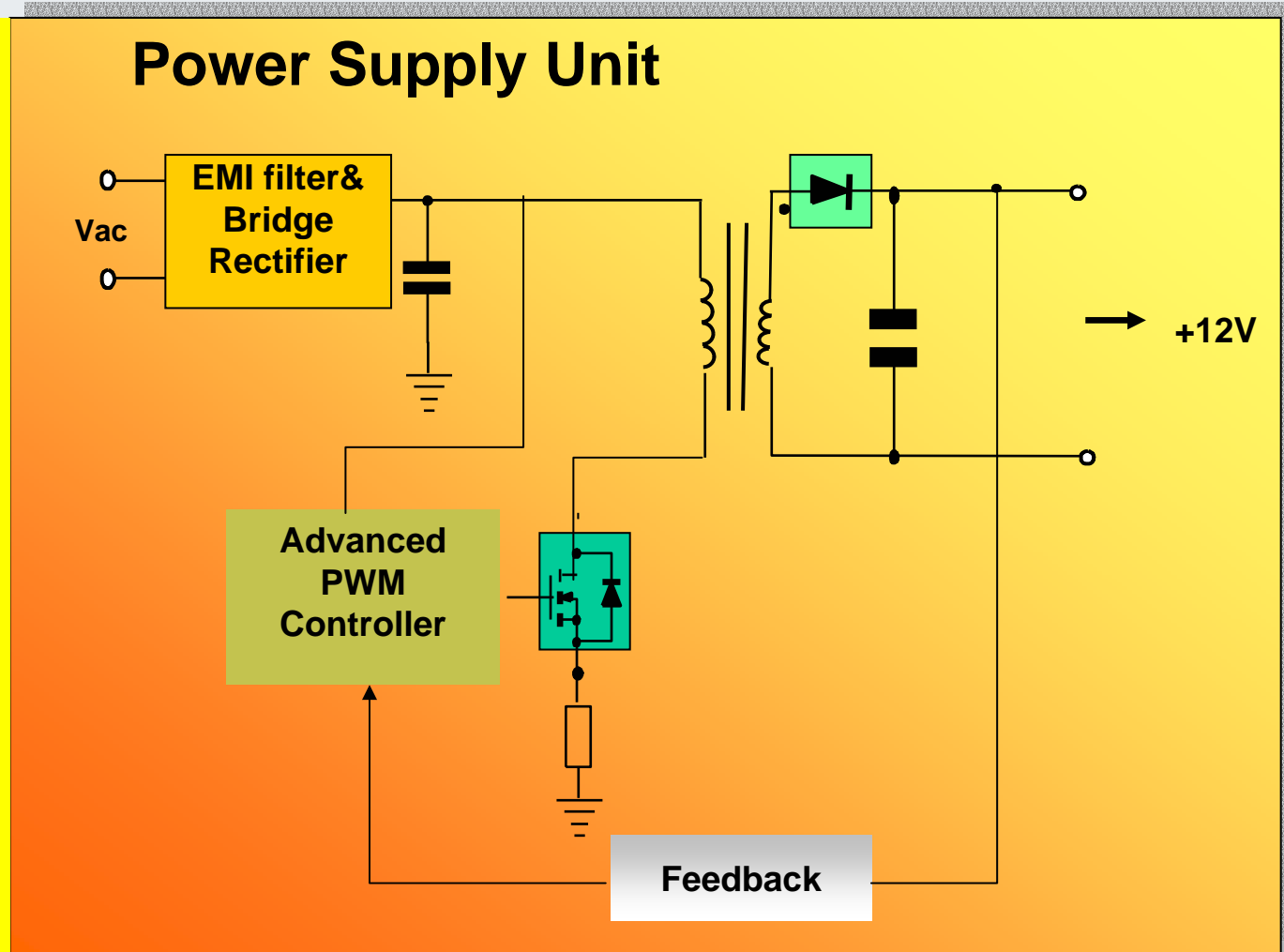


200W



60W LCD-TV Power Supply: Block Diagram

- Operation close to the boundary between CCM and DCM: variable operating frequency
- Zero Voltage/Zero Current Switching at turn-on achievable
- Less EMI generated
- Variable frequency spreads spectrum
- Stand-By function put into optional



60W LCD-TV Power Supply: Specifications

Wide Input Voltage Range: 90-265VAC		
Single Output Voltage (Vout):		
Vout	Current	Remarks
12V	5A	Accurate OCP and OVP circuit are building in the simple can be optional.
Total Output Power: 60W		



Title			
Age	Residence		Stream
Sex			
Date	13-Oct-2004	Sheet of	
Site	14.4 kilometers and 200 meters from the village of (0000000000)		

60W LCD-TV Power Supply: Testing Report

Loading efficiency

Test Loading

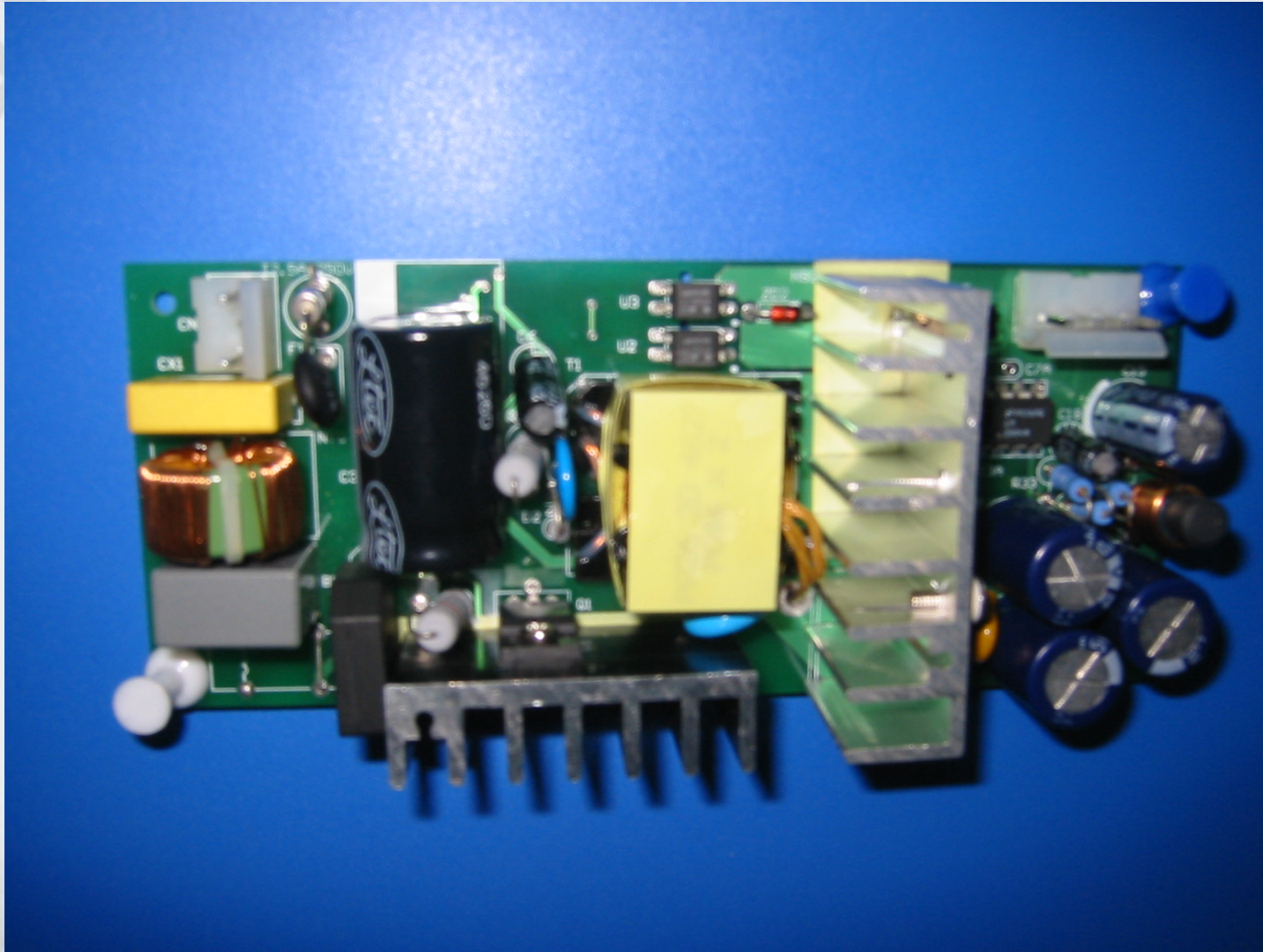
Ouput	12V
Full Load (FL)	5A
Stand By	0.0416A (0.5W)
No Load	0A

Testing Results

Input Voltage	FL Eff.	Input Power	
		Stand By	No Load
90V	81.7%		
100V	83.2%		
240V	87.0%		
264V	87.4%		



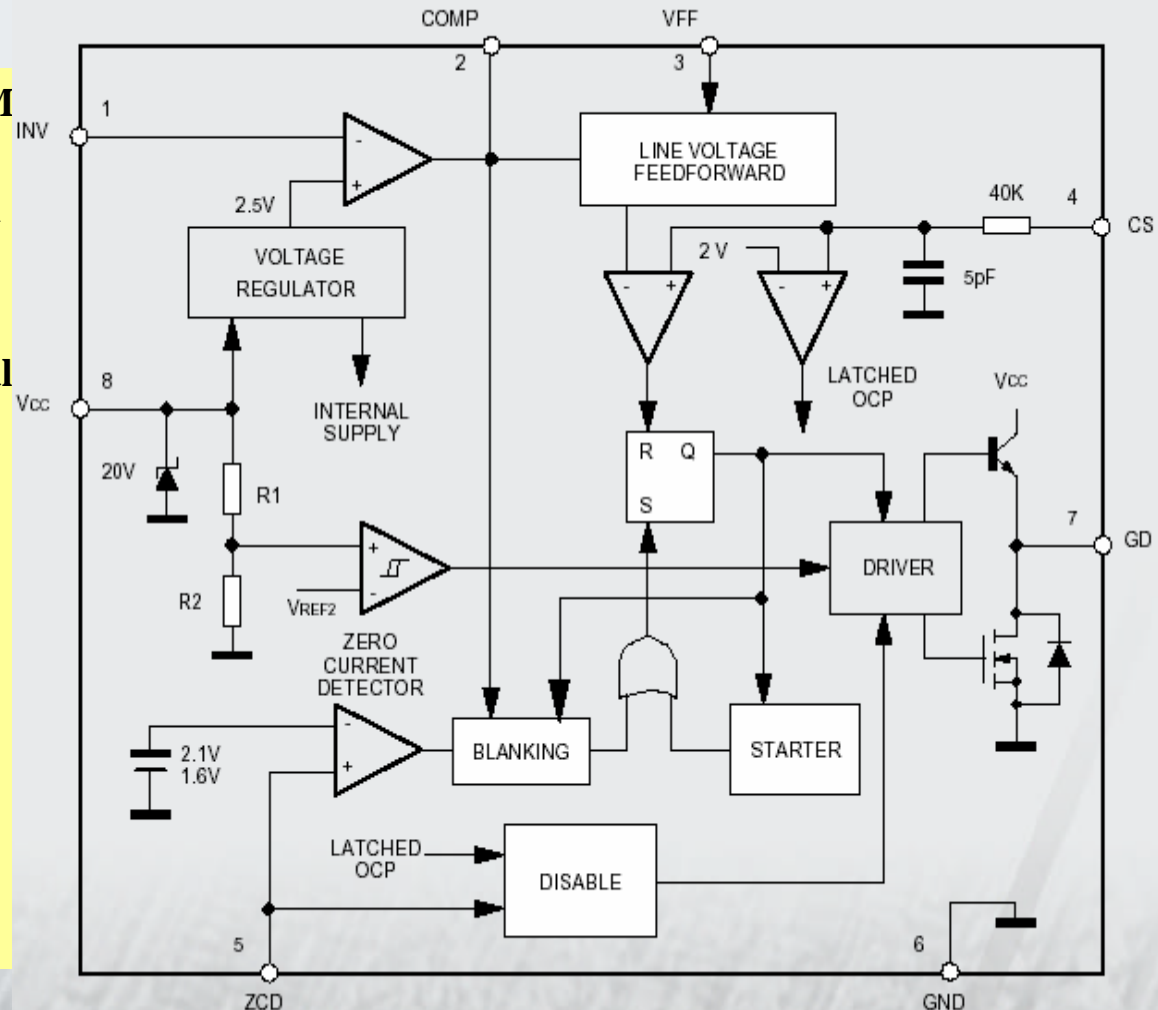
A 60W LCD-TV Power Supply



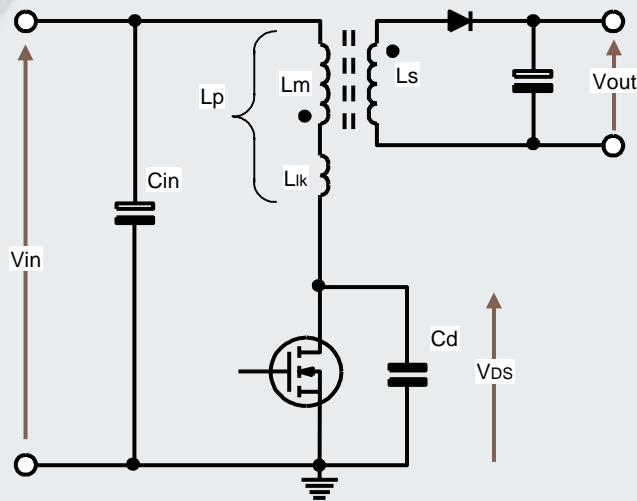
BETO-PX

L6565: Quasi-Resonant SMPS controller

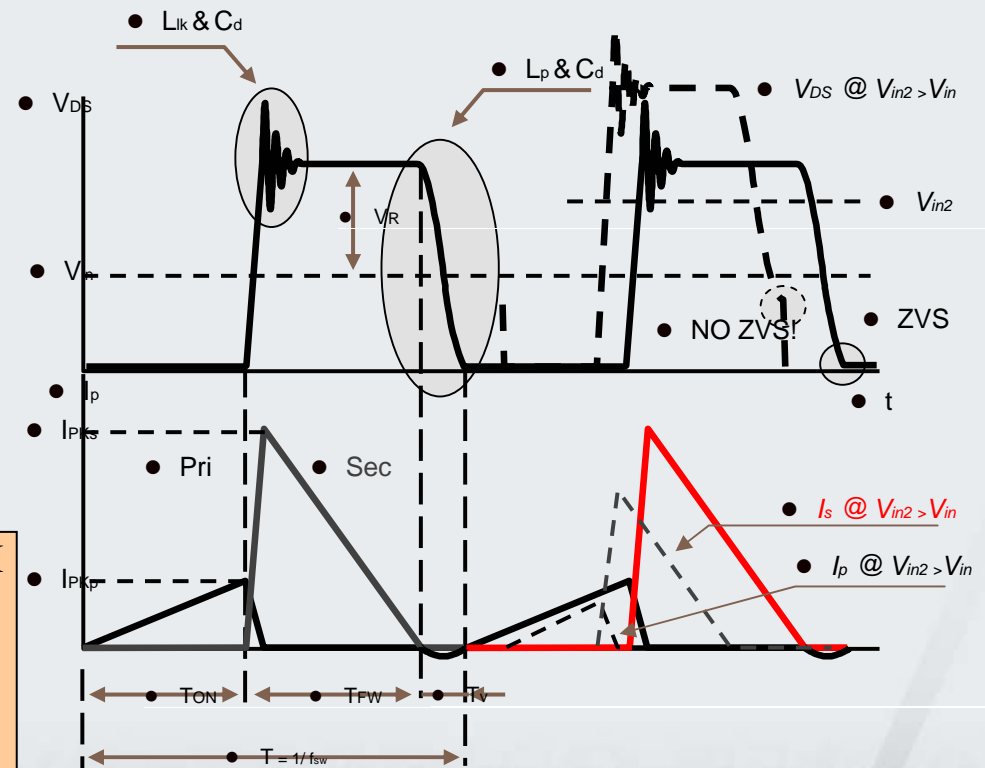
- **Current Mode Quasi-Resonant PWM controller**
- **Micropower Start-up Current (40µA typ.)**
- **Low Quiescent Current (3mA typ.)**
- **ZCD input for QR operation/external synchronization**
- **Frequency Foldback function**
- **Line Voltage Feedforward function**
- **Pulse-by-pulse overcurrent protection**
- **2nd overcurrent level with Hiccup-mode operation**
- **Disable function**
- **Internal RC filter on Current Sense**
- **Package: Minidip and SO8**



QR Conversion: Quasi-Resonant Concept



- Operation close to the boundary between CCM and DCM: variable operating frequency
- Zero Voltage/Zero Current Switching at turn-on achievable
- Less EMI generated
- Variable frequency spreads spectrum



➤ ZVS condition: $V_{in} \leq V_R$



200W LCD-TV Power Supply: Block Diagram

•PFC

200W critical control mode with ZCD function for a cost-effective application

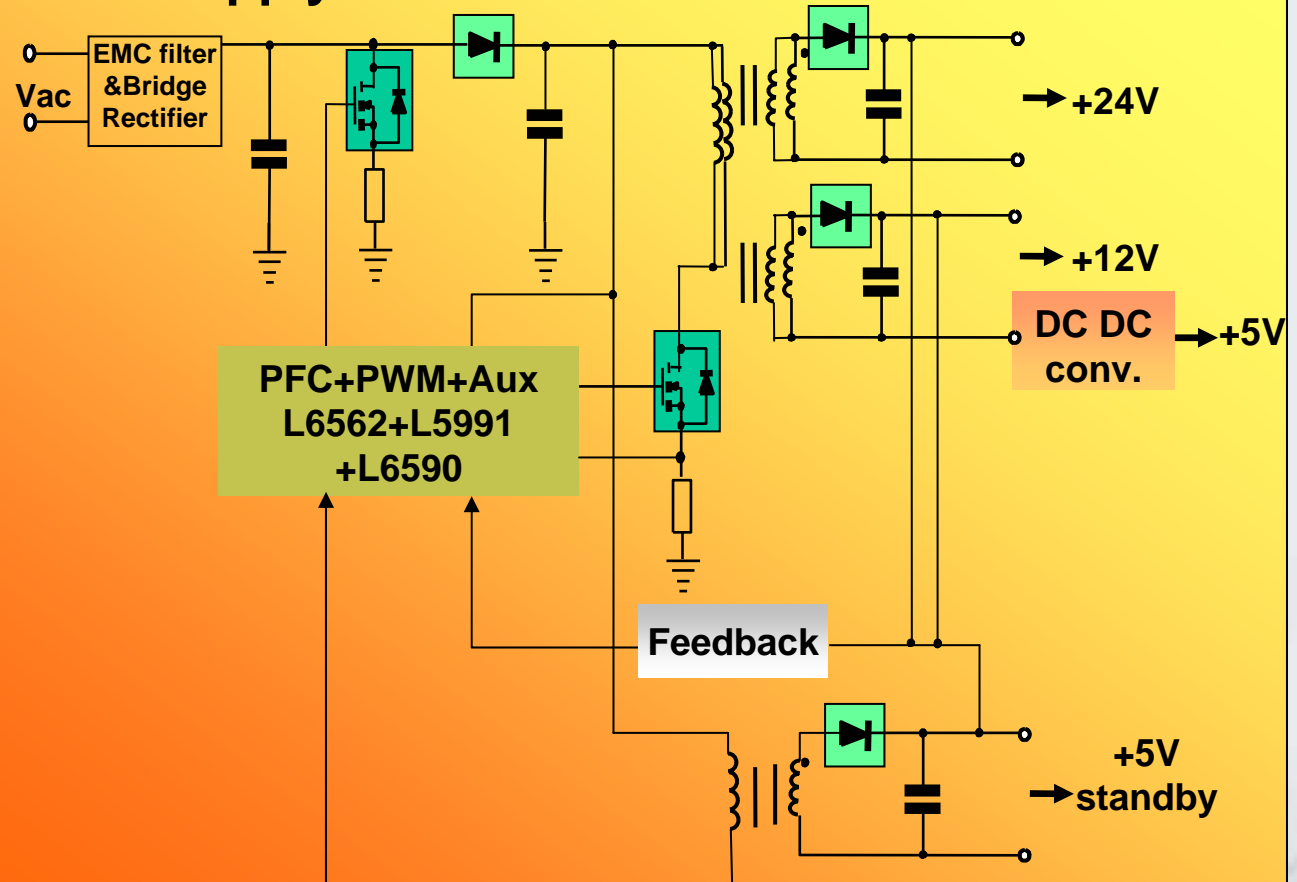
•Main Converter

200W Flyback Converter for middle size LCD-PDP/TV application

•Standby

10W Flyback converter with built-in mosfet PWM controller and circuit to switch off

Power Supply Unit



200W LCD-TV Power Supply: Specifications

Wide Input voltage range: 90-265VAC

Multi Output Voltages (Vout):

Vout	Current	Remarks
24V	6A	5V output use DC-DC converter which can be put in optional.
12V	3A	
5V	2A	
5Vsb	2A	

Total output Power : 200W



The diagram illustrates a 20W LCD TV power supply circuit. It begins with an AC input section containing a fuse and a surge protector. This is followed by a bridge rectifier and a large electrolytic capacitor for bulk storage. A feedback loop is implemented using a potentiometer and resistors connected to a control pin. The main switching stage uses a MOSFET driven by a base-emitter junction of a PNP transistor, which is controlled by a PWM signal from a microcontroller. The secondary side features a full-bridge rectifier, a filter capacitor, and a series of output filters for various voltages (e.g., +5V, +12V).

BETO-PX

200W LCD-TV Power Supply: Testing Report

Loading efficiency

Test Loading

Outputs	24V	12V	5V	5VSB
Full load (FL)	6	3	2	2
Stand by	0	0	0	0.1
No Load	0	0	0	0

Testing result

Input voltage	FL Eff.	Input Power	
		Stand by	No Load
90V	81.6%		
120V	84.3%		
220V	86.8%		
264V	87.5%		



200W LCD-TV Power Supply

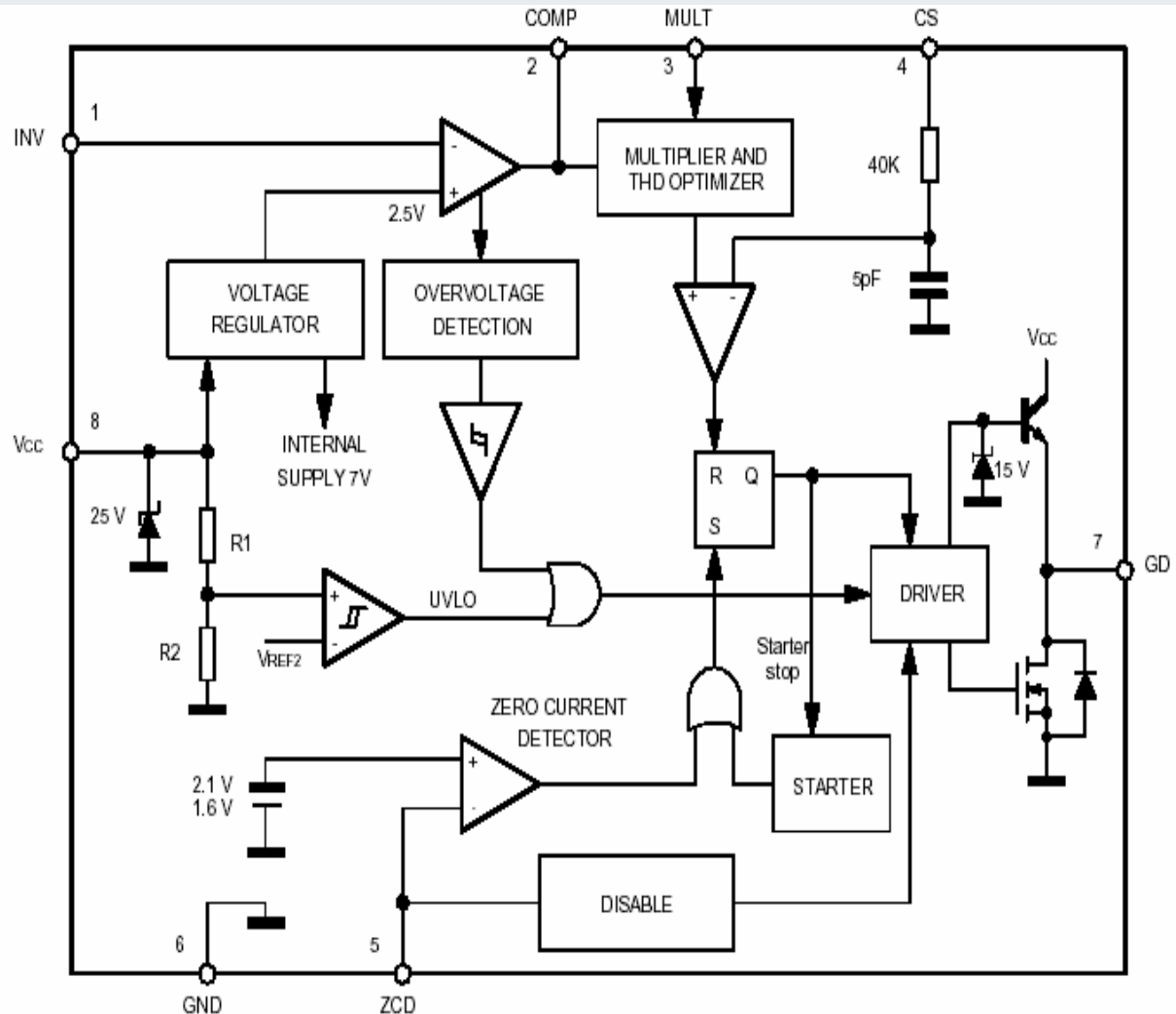


200W LCD-TV Power Supply



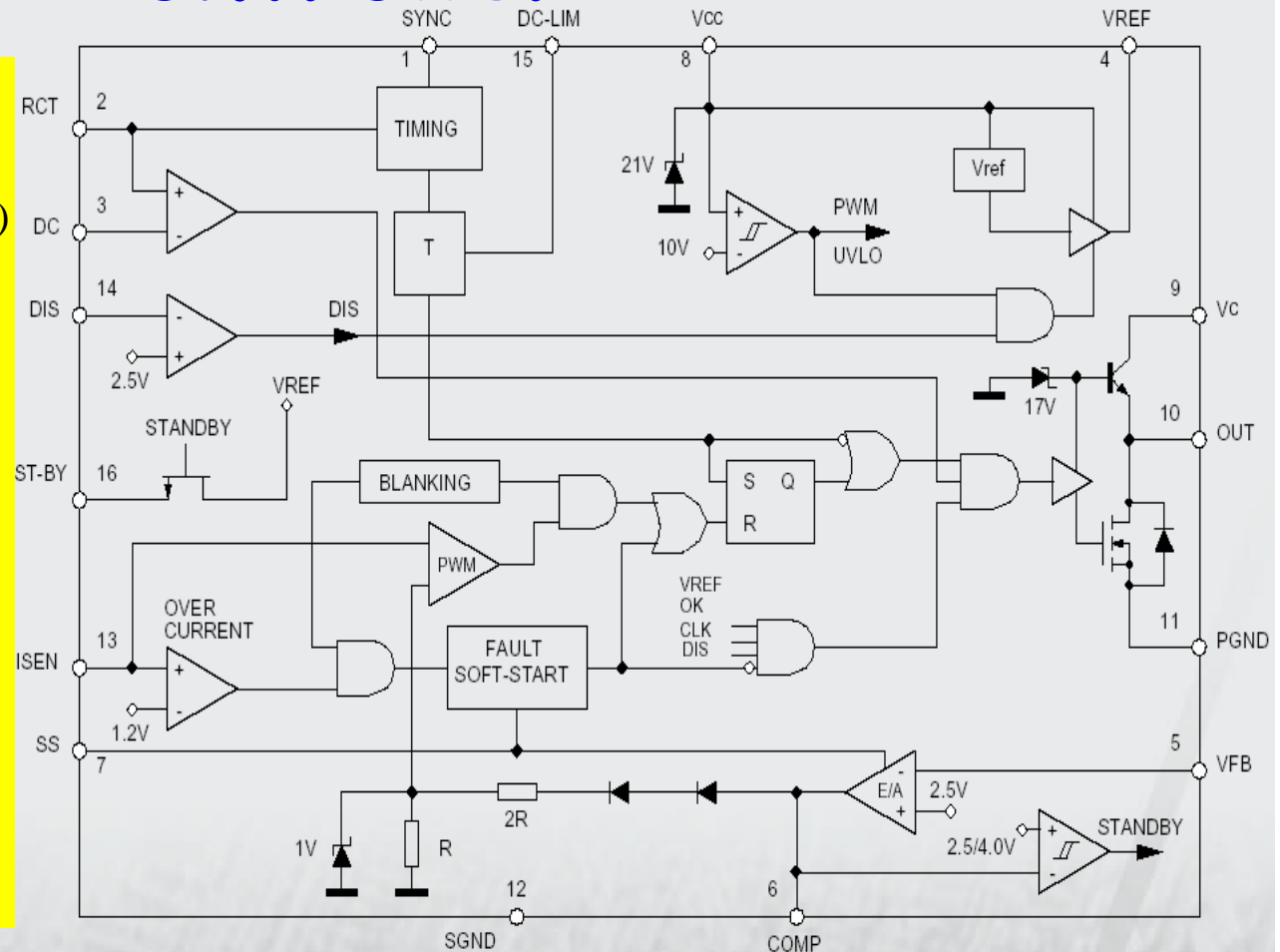
L6562 - Power Factor Corrector

- TRANSITION-MODE
- PROPRIETARY MULTIPLIER DESIGN FOR MINIMUM THD OF AC INPUT CURRENT
- LOW (<4 mA) QUIESCENT CURRENT
- ON-CHIP FILTER ON CURRENT SENSE
- 1% (@ $T_j = 25^\circ\text{C}$) INTERNAL REFERENCE VOLTAGE
- -600/+800mA TOTEM POLE GATE DRIVER WITH UVLO PULL-DOWN AND VOLTAGE CLAMP



L5991/A Primary PWM Controller

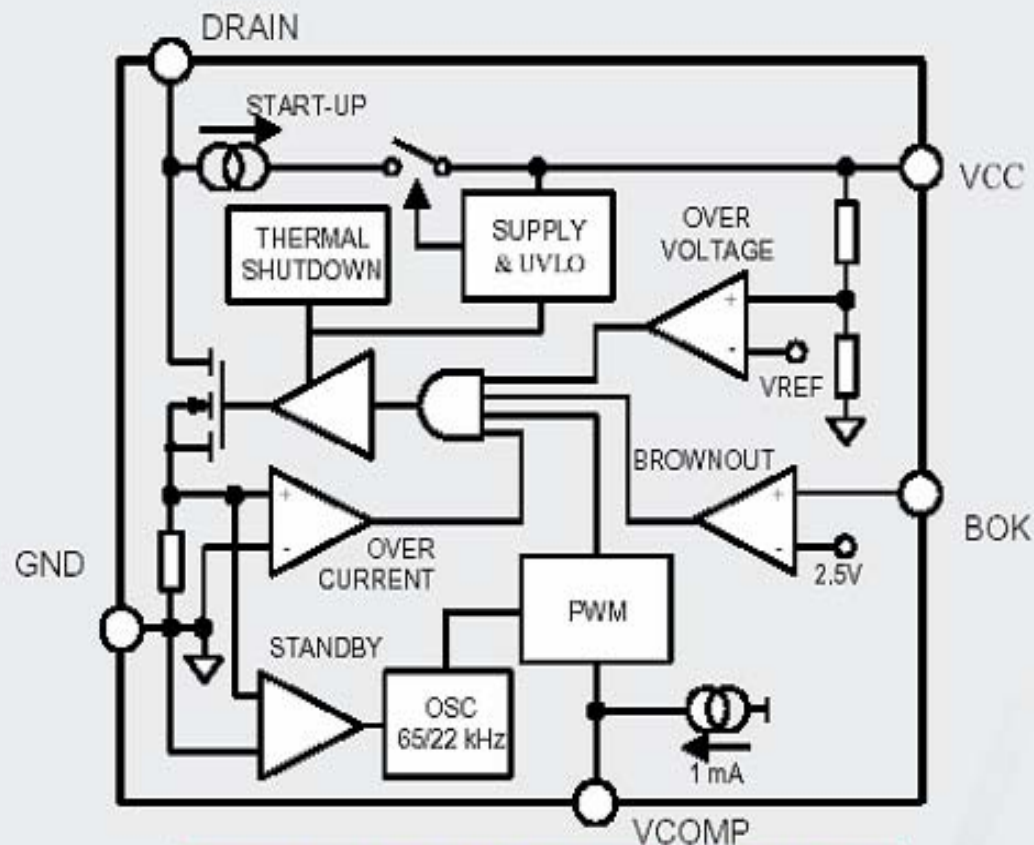
- CM 1MHz PWM Controller
- Low Start-Up Current (<150 μ A)
- Low Quiescent Current (7mA typ.)
- Standby function
- Programmable 'Hiccup' Mode
- Overcurrent Protection
- IN/OUT Synchronization
- Precise Duty Cycle Control
- Latched
- Shutdown/Oversvoltage Protection
- Programmable Soft-Start
- Internal 100 ns Leading Edge Blanking on Current Sense
- Package: DIP-16/SO-16



L6590/A Fully Integrated Power Supply

FEATURES

- On-chip 700V, 13ohm MOSFET
- 65kHz internal oscillator
- Voltage Mode Control
- Non-dissipative Internal Start-up
- Standby Function
- Latched OVP, Cycle-by-cycle OCP
- Thermal Shutdown
- Brownout Protection (L6590A & L6590D)



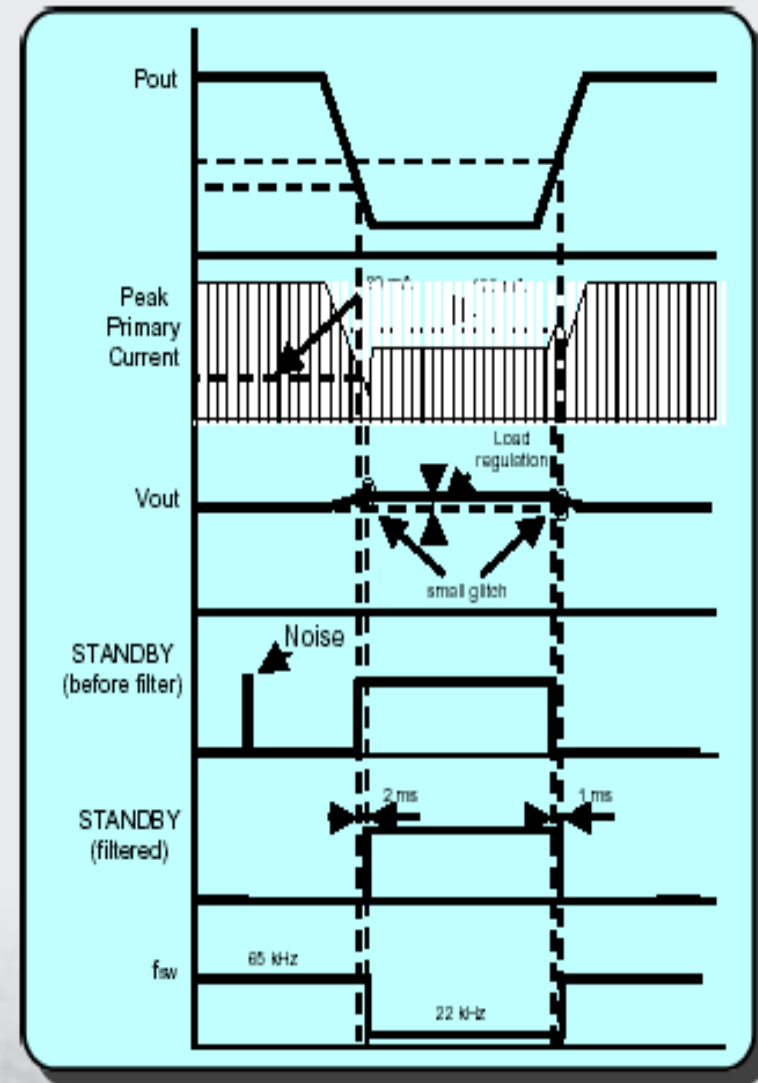
APPLICATION

- ◆ low-power AC-DC adapters, auxiliary power supplies of CRT and LCD monitors and TV's (L6590-L6590A-L6590D)
- ◆ auxiliary power supplies of desktop PC's and servers (L6590A)
- ◆ high-voltage and low-voltage DC-DC converters

MAIN VOLTAGE	OUTPUT POWER
Wide Range	10 Watts
220 Vac	up to 20 Watts

L6590 - Standby Function

- Frequency shifts from 65 to 22 kHz on light load condition detection
- Frequency shifts back to 65 kHz on heavier load condition detection
- Load detection by on-board peak primary current sensing
- About 2 ms internal delay for noise immunity
- Efficiency boost at light load
- Less than 200 mW input power (@ zero load, $V_{in}=400V$) achievable



Contact Persons in Shenzhen MMX Technical Center

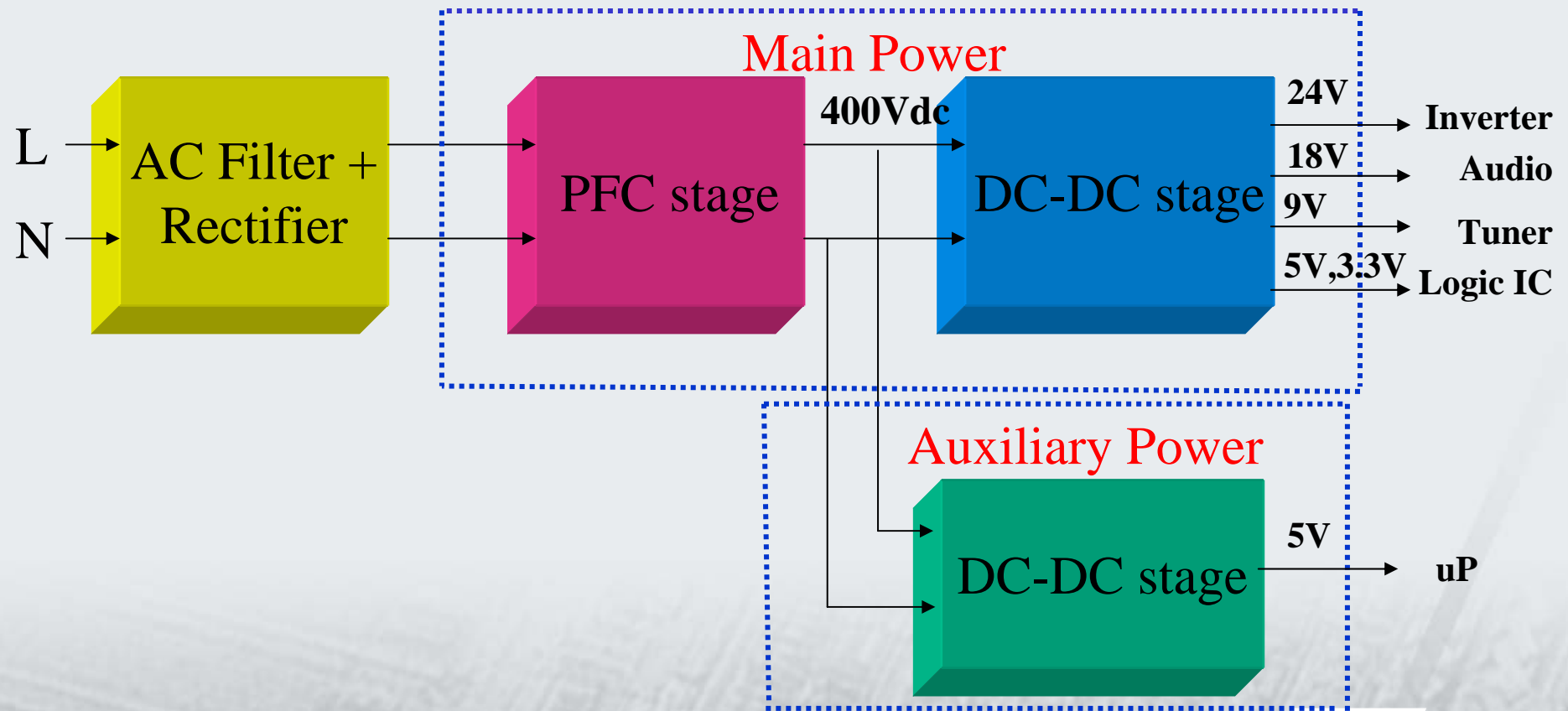
NAME	CHINESE NAME	TELEPHONE NO.	MOBILE		FUNCTION / REMARKS	
			CHINA	HONG KONG		
Operator: 8601-2000			Fax number:8601-2300			
A&P Lab, Industrial and Power Team						
HG	BANG	方弘均	8601 2306	13602 616 662	9752 1275	T/C Deputy Manager
Chao	Peng	彭 超	8601 2311			Application Engineer
Roy	Chen	陈治国	8601 2327			Senior Application Engineer
Sam	Guo	郭青山	8601 2334	13692 222 128		Senior Application Engineer
Tom	Guo	郭加总	8601 2331			Application Engineer



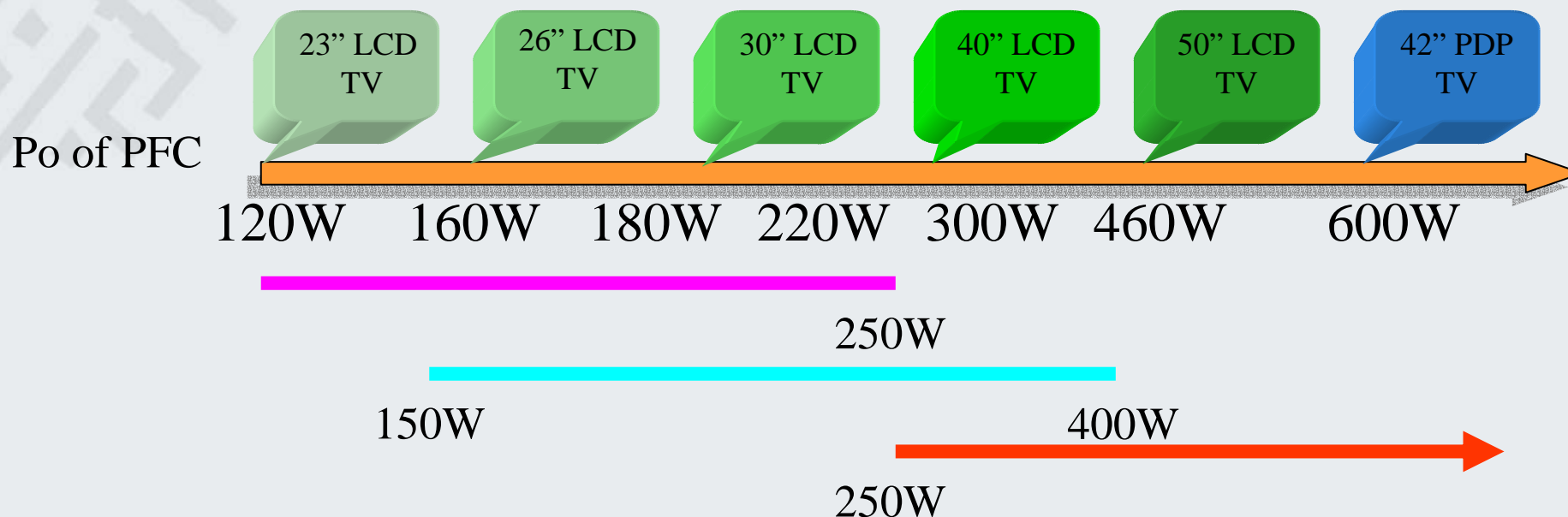
**A new approach:
Half Bridge Resonant topology
in LCD TV with ST L6598
controller**


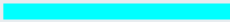



LCD TV power supply configuration



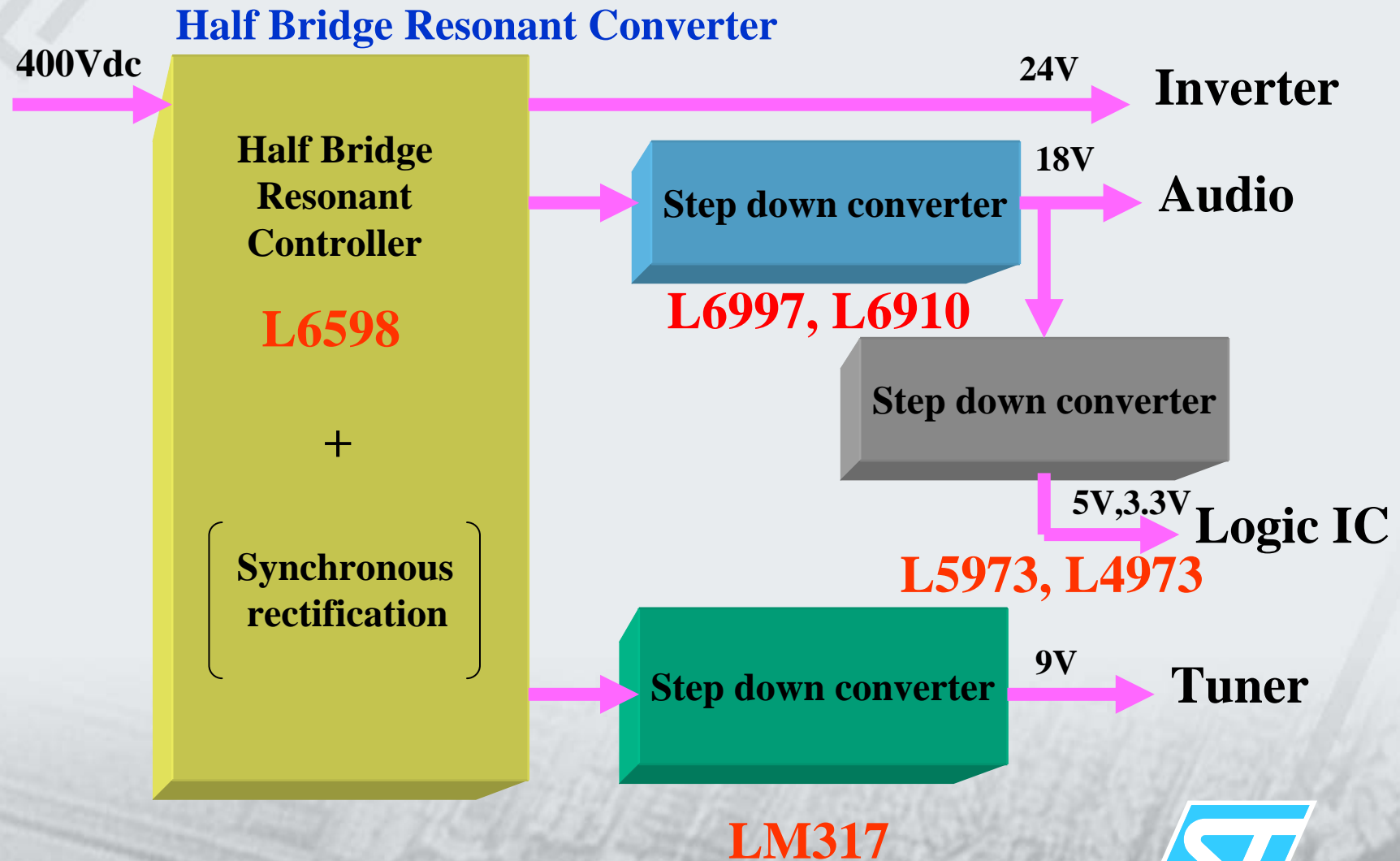
PFC stage in Main Power



-  L6561 or L6562 in Transition Mode
-  L6562 with Fixed Off-Time Control
-  L4981 in Continuous Conduction Mode



DC-DC stage in main power



Power rating for inverter, audio, tuner, and logic IC in LCD TV

Inverter : 30" - 12V/10A, 20V/6A, 24V/5A
42" - 24V/10A
50" - 120V/3A

Audio : 12V/2.5A (class D)
18V/2A (class AB)

Tuner : 8V, 9V, 30V, 33V

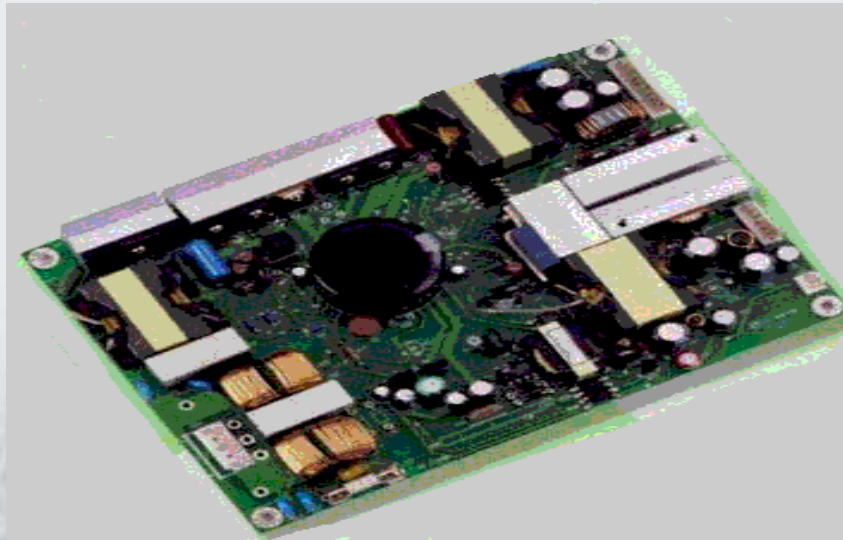
Logic IC : 5V/4A, 3.3V/3A



L6598

Half Bridge Resonant Controller

With high efficiency, low EMI, cost effectiveness and high power density, it is a good solution for built-in LCD TV power supplies

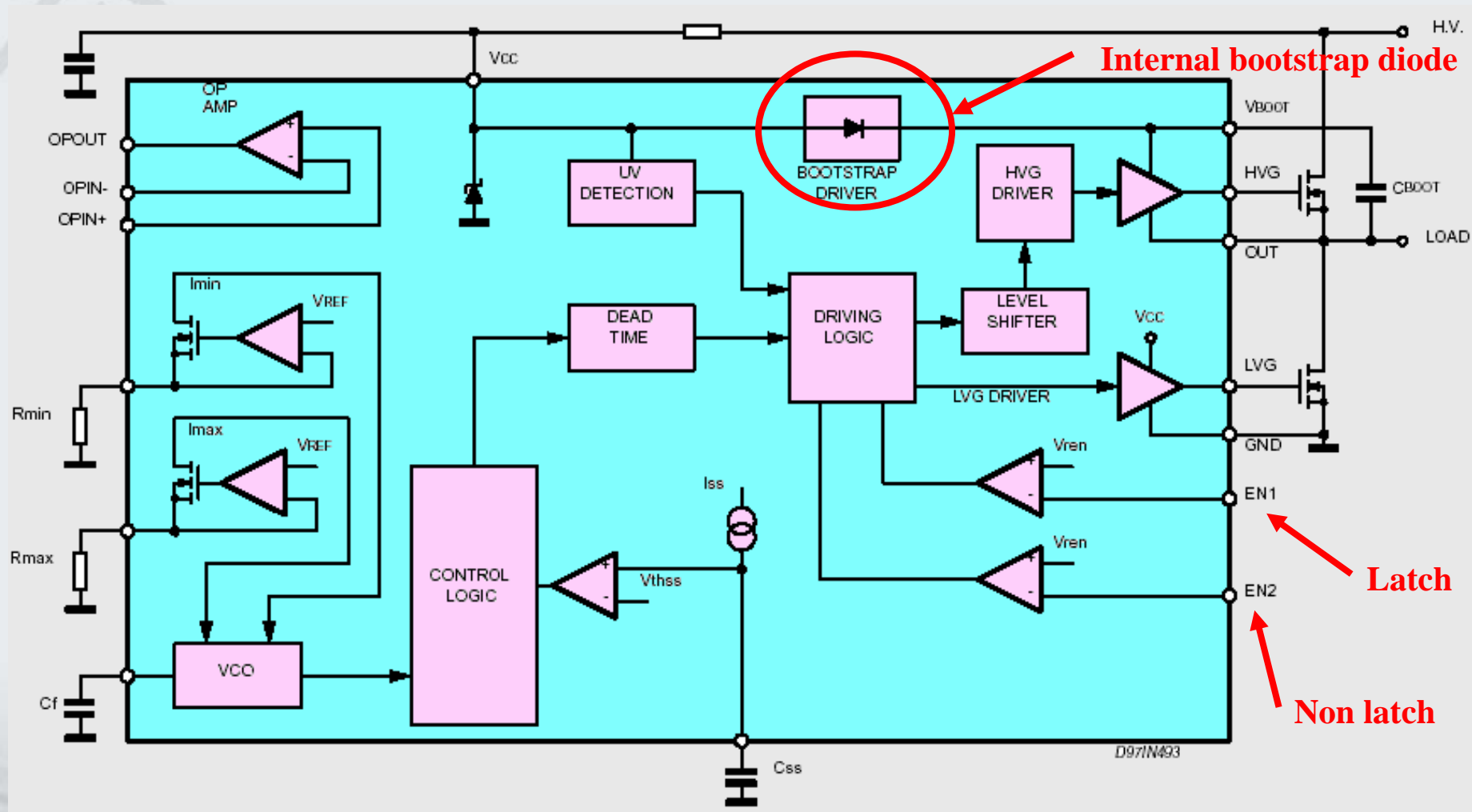


L6598 Main Features

- *Resonant controller up to 400KHz*
- High voltage rail up to 600V
- Low start up current ($< 250\mu\text{A}$)
- Low quiescent current ($< 2\text{mA}$)
- *Latched / non latched device disable*
- 50% duty cycle half bridge driver
- Programmable soft start
- *Integrated bootstrap diode*
- 350nS dead time
- OP AMP for further protections
(Brown out, OTP)
- Package : DIP16 / SO16



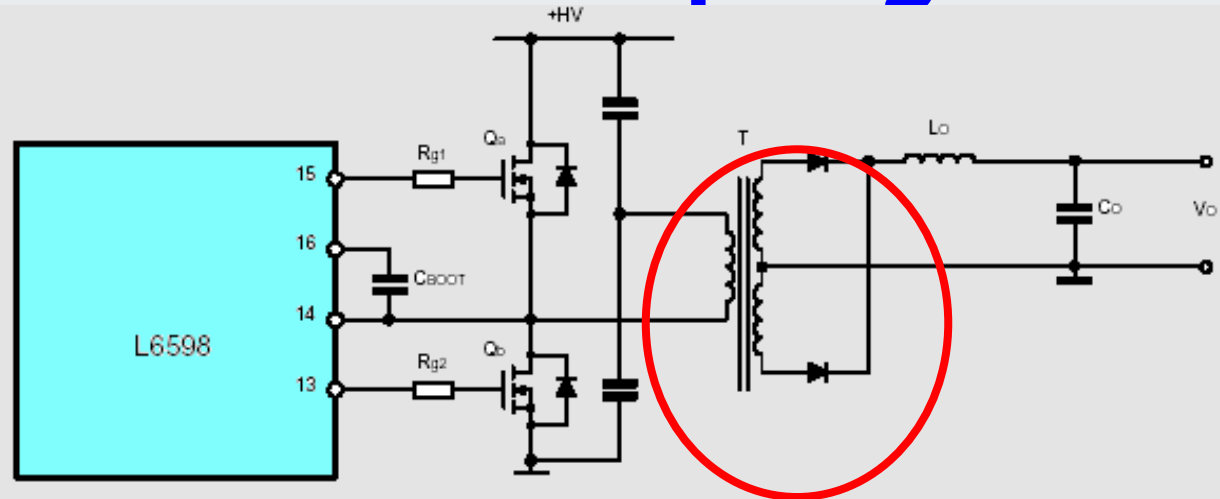
L6598 internal block diagram



L6598 transformer topologies

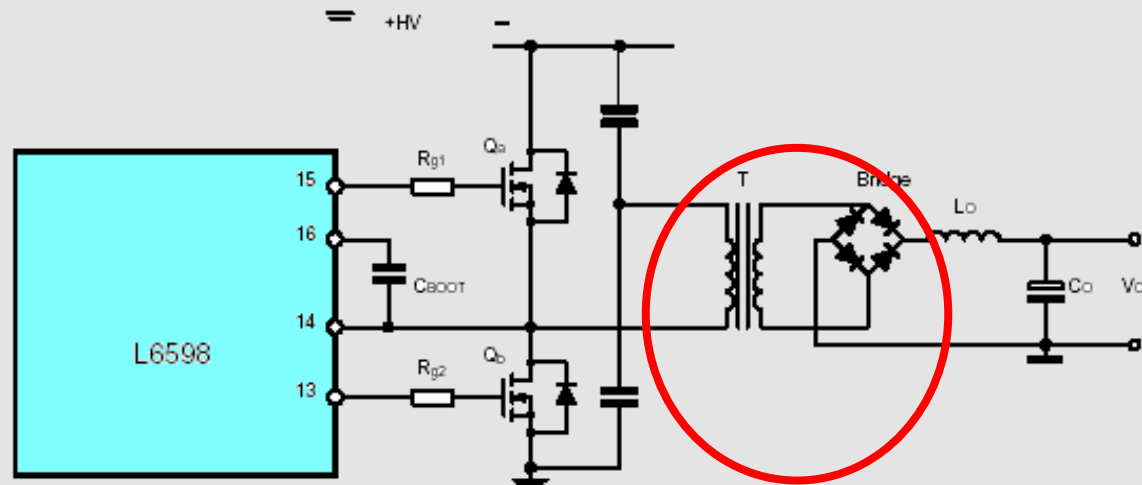
Centre-tap
Rectification

For low output voltage
and high output current



Full-bridge
Rectification

For high output voltage
and low output current



Remark : a current doubler circuit can also be used to get a small ripple at the output



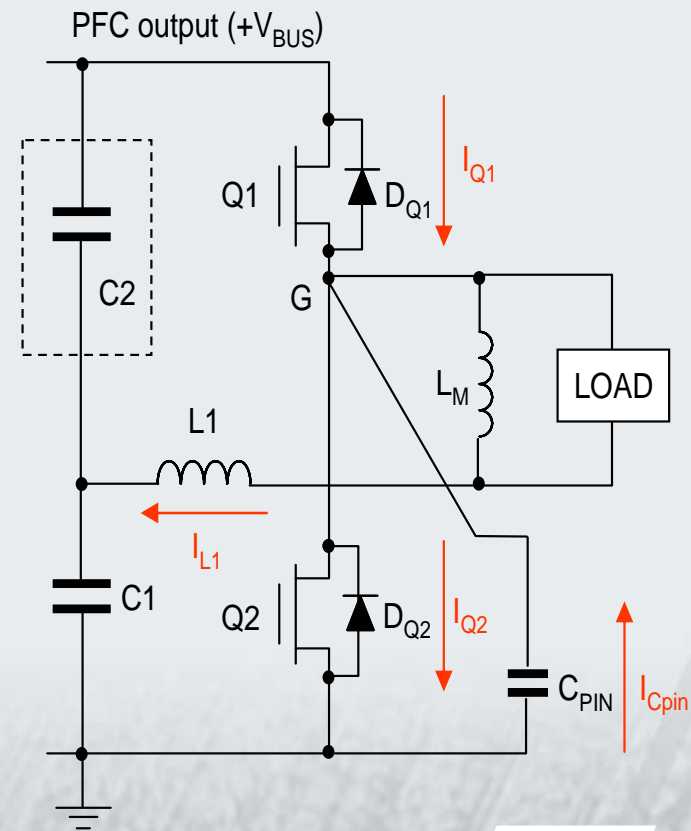
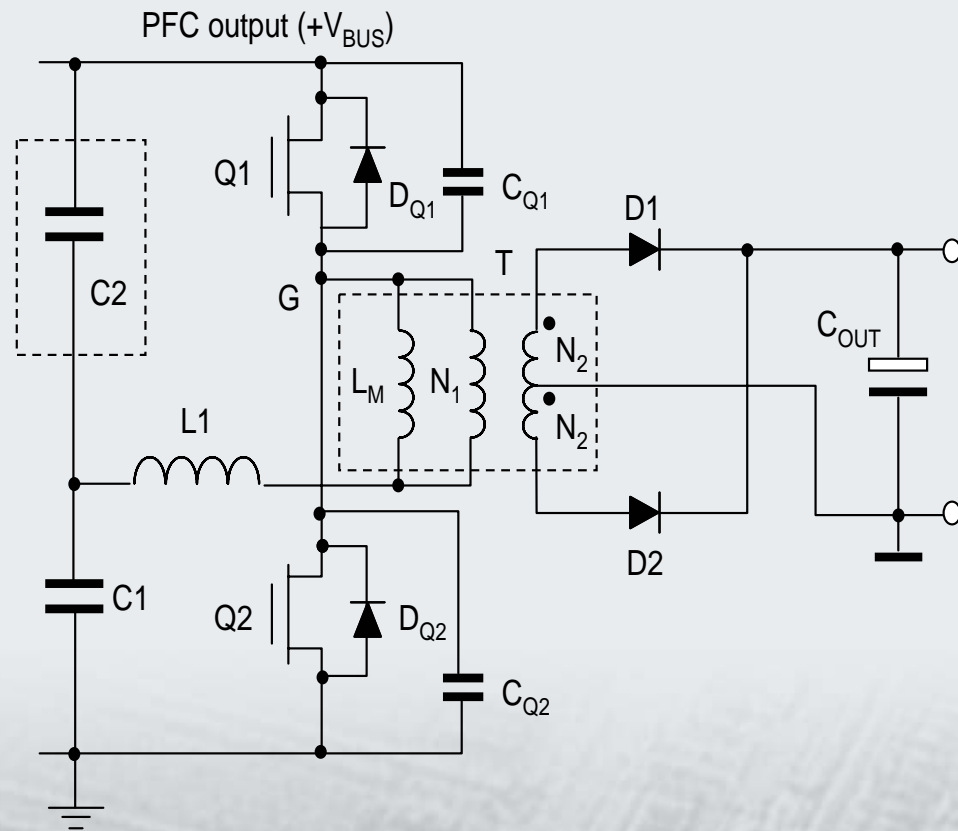
Benefits of L6598-based power supply

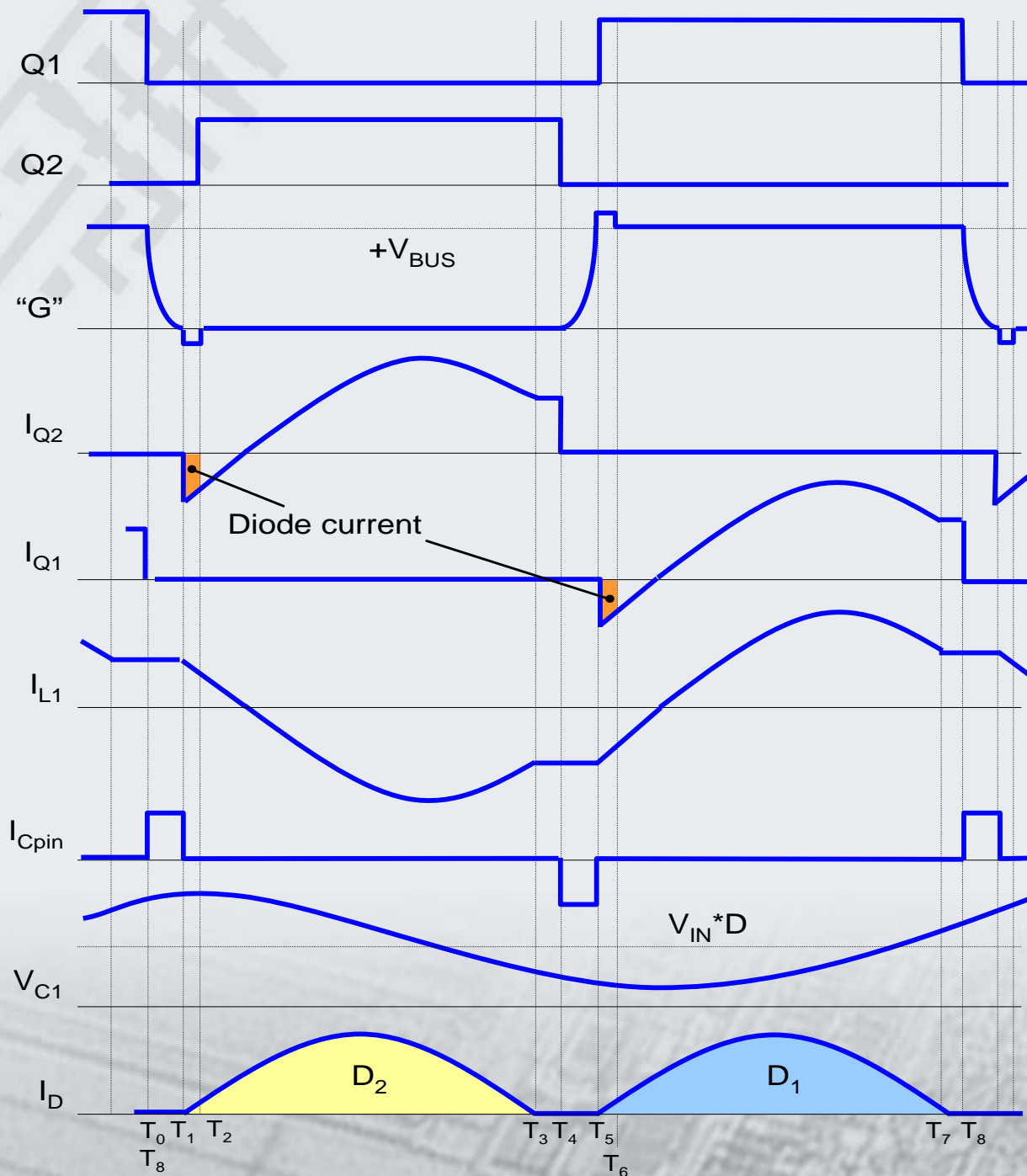
- Reduction of switching losses because of *zero voltage switching* at turn-on of power MOS
- Reduced current in the half bridge power MOS
- Reduced RMS current in secondary diodes
- *Reduced EMI filter dimension and cost*
- Reduced core loss
- Reduced size and COST



How to achieve ZVS in series resonant converter

• Resonant topology

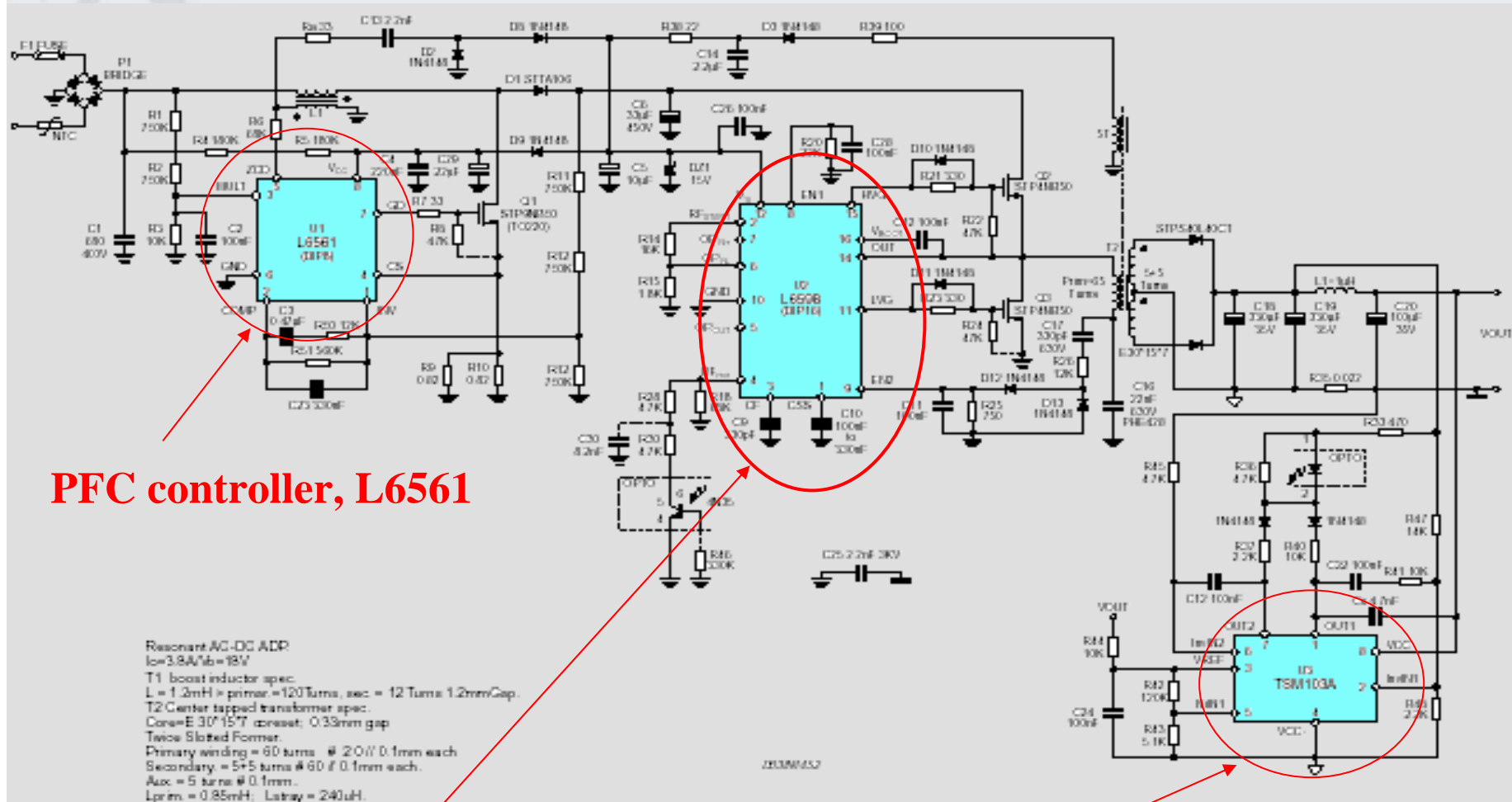




Main waveforms
in resonant circuits



Diagram of 70W demo board with L6598



PFC controller, L6561

Voltage and current controller, TSM103

Half bridge resonant controller, L6598



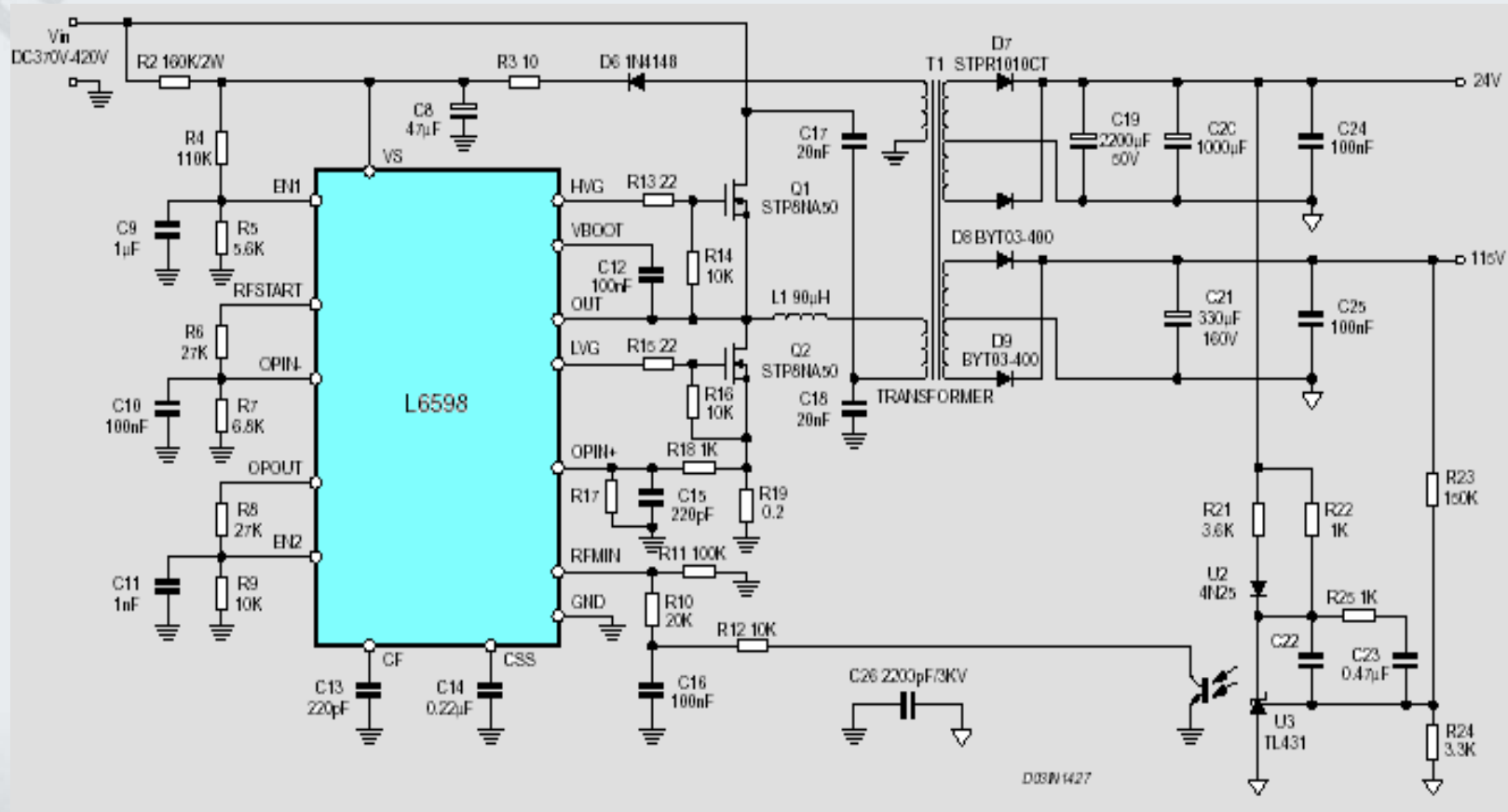
Evaluation result of 70W (18V/3.8A) demo board (L6561 + L6598)

Vin	Pi	Load	Vo	Io	Po	Eff
400Vdc	72W	Full	17.8V	3.8A	67.64W	93.9 %
400Vdc	39W	Half	17.8V	2A	35.6W	91.3 %
88Vac	77.5W	Full	17.8V	3.8A	67.64W	87.3%
110Vac	76.35W	Full	17.8V	3.8A	67.64W	88.6%
220Vac	74.7W	Full	17.8V	3.8A	67.64W	90.5%
255Vac	74.4W	Full	17.8V	3.8A	67.64W	91.%
88Vac	41W	Half	17.82V	2A	35.64W	86.93%
110Vac	40.5W	Half	17.82V	2A	35.64W	88%
220Vac	40.3W	Half	17.82V	2A	35.64W	88.4%
255Vac	40.3W	Half	17.82V	2A	35.64W	88.4%

High
efficiency



Diagram of 180W demo board with L6598



Input Voltage: 370V to 420V (PFC output)

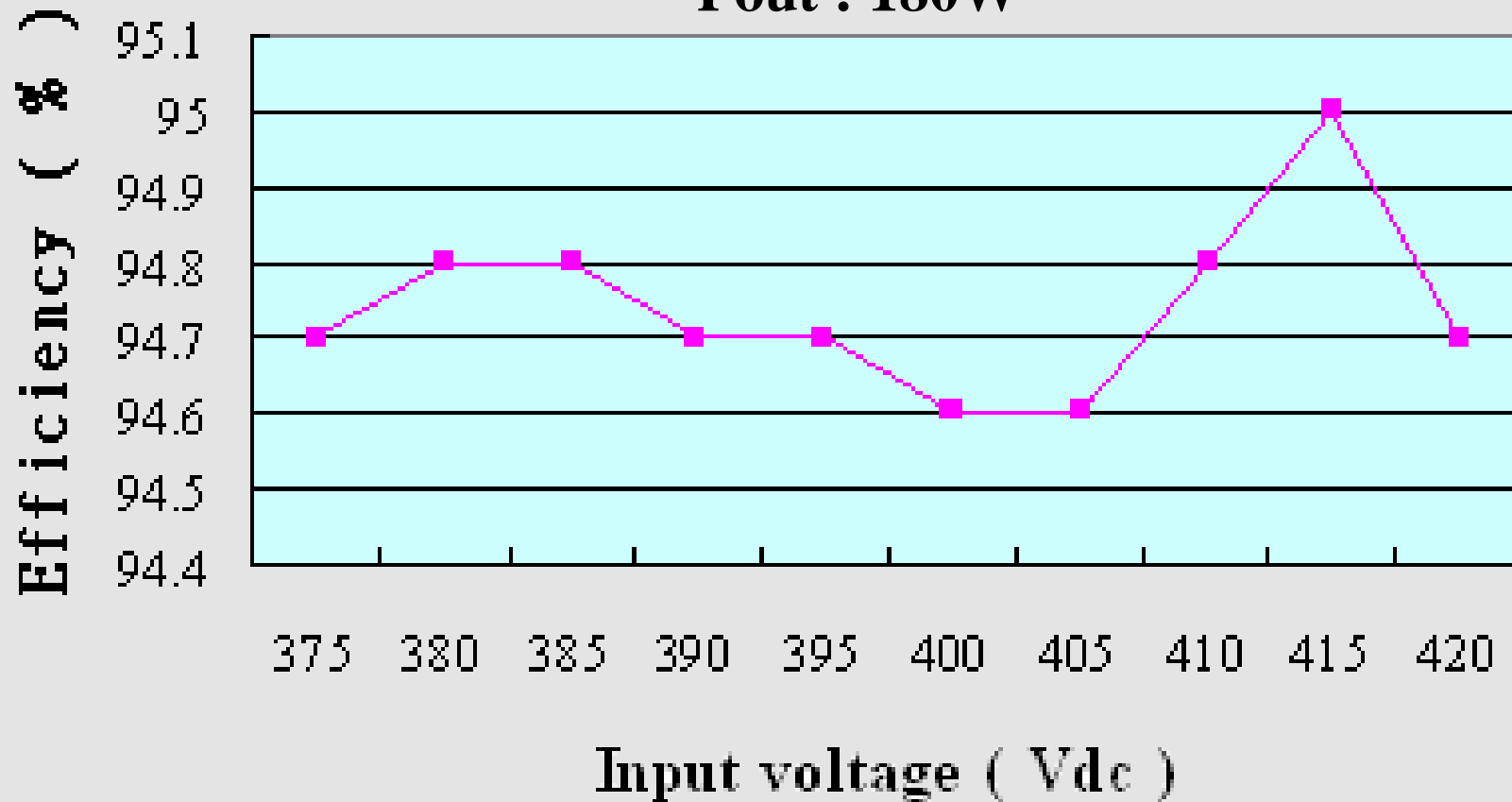
Output : 110V/1.2A, 24V/2A

Output power : 180W



Efficiency of 180W demo board with L6598

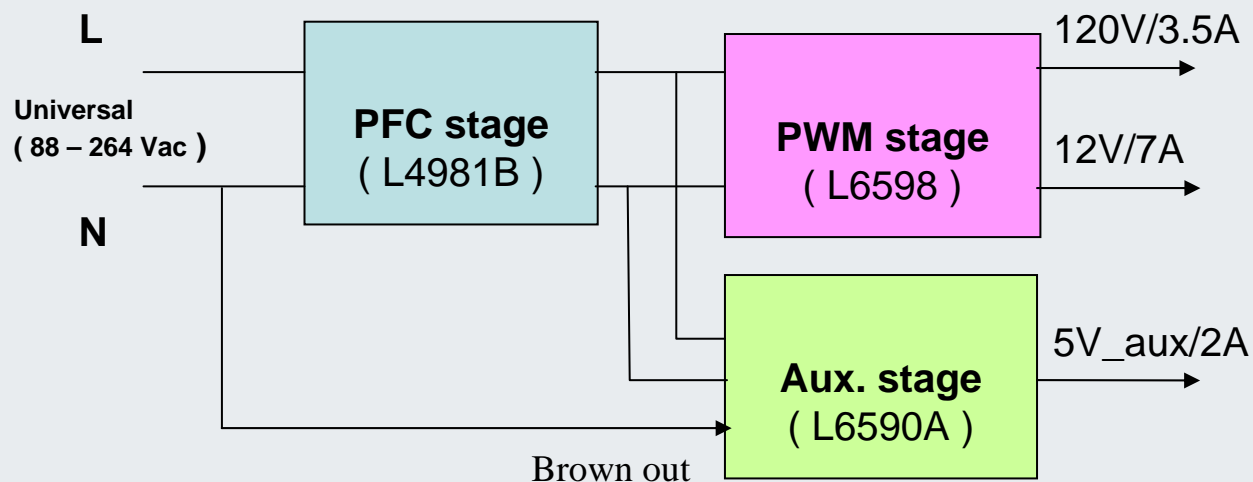
Pout : 180W



Max Efficiency is 95% at the maximum output power of 180W



500W demo board for LCD-PDP/TV power supplies



Overall Efficiency is estimated at abt. 91%

The demoboard is now under development and it will be available in Nov 2004



References

- *Documents*

1. **L6598** datasheet , February 2002
2. **AN1300**, Application Note, L6598 based 12V/3A resonant application, October 2000
3. **AN1660**, Application Note, ZVS resonant converter for consumer application using L6598 IC, March 2003
4. **AN1673**, Application Note, L6598; off line controller for resonant converter, June 2003
5. **AN 658**, Application Note, resonant converter topology

- *Hardware*

1. 70W (18V/3.8A) demo board with L6561 and L6598

