DC/DC Module Technology and Trend

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2008-10-20

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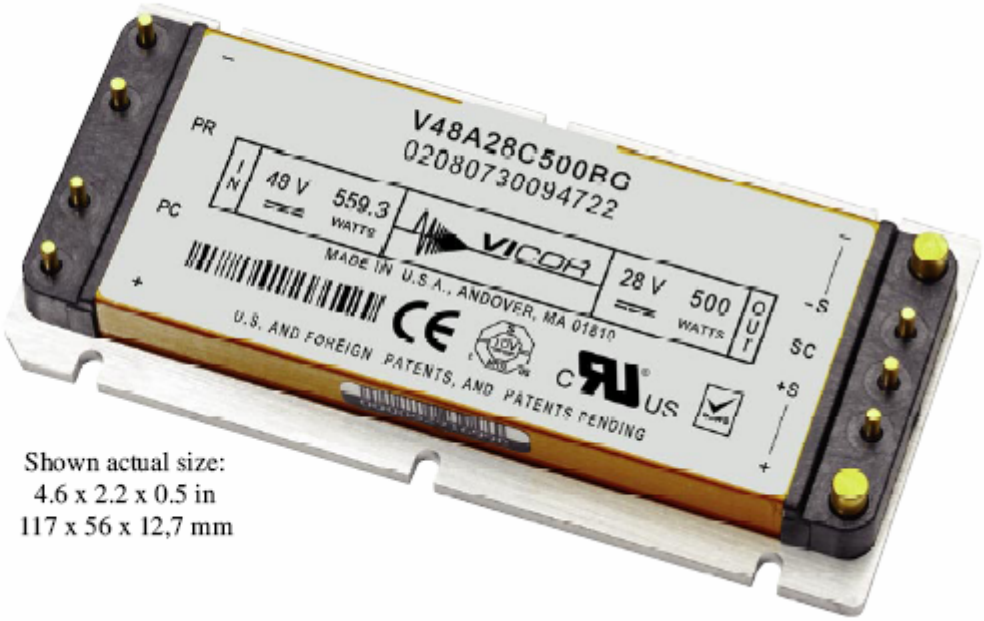
First. History of DC/DC Module

1、Vicor：first full brick module

Features

- RoHS Compliant (with F or G pin option)
- DC input range: 36 – 75 V
- Input surge withstand: 100 V for 100 ms
- DC output: 3.3 – 48 V
- Programmable output: 10 to 110%
- Regulation: ±0.3% no load to full load
- Efficiency: Up to 89%
- Maximum operating temp: 100°C, full load
- Power density: up to 100 W per cubic inch
- Height above board: 0.43 in. (10,9 mm)
- Parallelable, with N+M fault tolerance
- Low noise ZCS/ZVS architecture



Shown actual size:
4.6 x 2.2 x 0.5 in
117 x 56 x 12,7 mm

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First. History of DC/DC Module

2、Lucent : first half brick module before 20 years

size: 61.0 mm x 57.9 mm x 12.7 mm
(2.40 in. x 2.28 in. x 0.50 in.)

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First. History of DC/DC Module

3、Then 1/4、1/8 brick

size: 1.45″ x 2.3″ (36.8x58.4mm)

Size(inches) (2.28"X0.9"X0.35")

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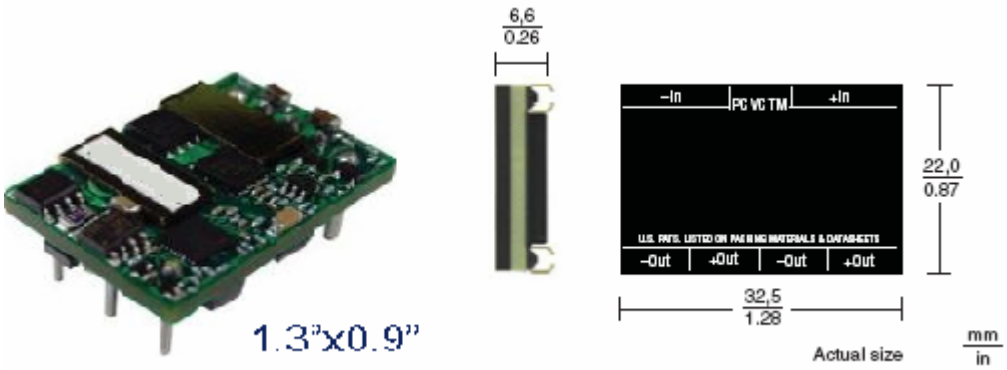
First. History of DC/DC Module

4、1/16 brick before one or two years



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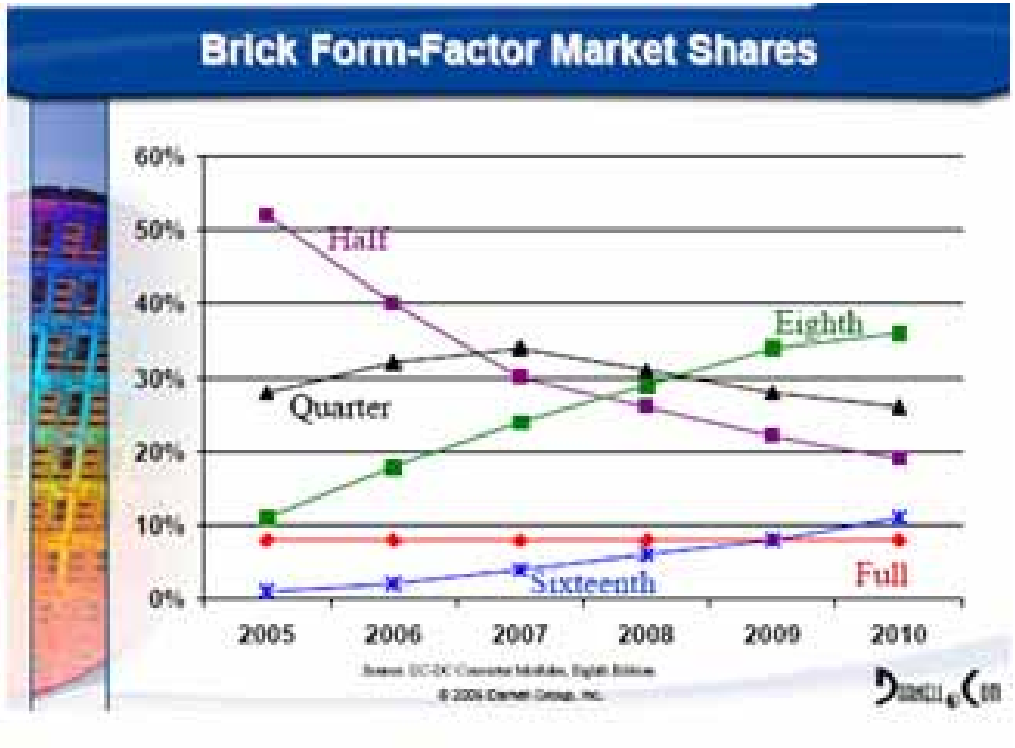
Second. Marketing information



From Market forecast:

Eighth /Sixeteen brick rise

Others fall

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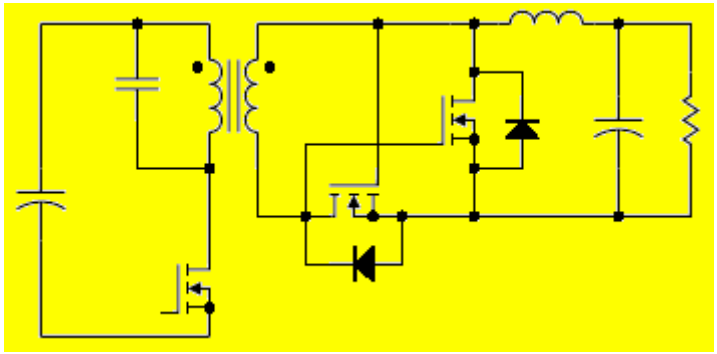
Third. Technology & Products

First: Topology

1、Resonant Tech1: forward resonant

Lm & C resonant

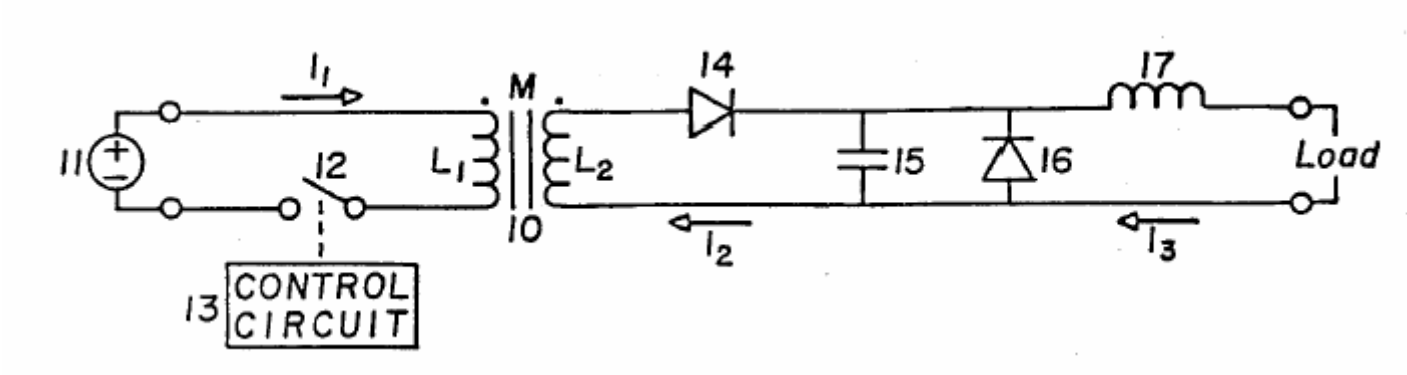


Old tech：fsw low，or else power loss much larger

Third. Technology & Products

1、Resonant Tech2:

Vicor Patent, US4415959
Patent Expired



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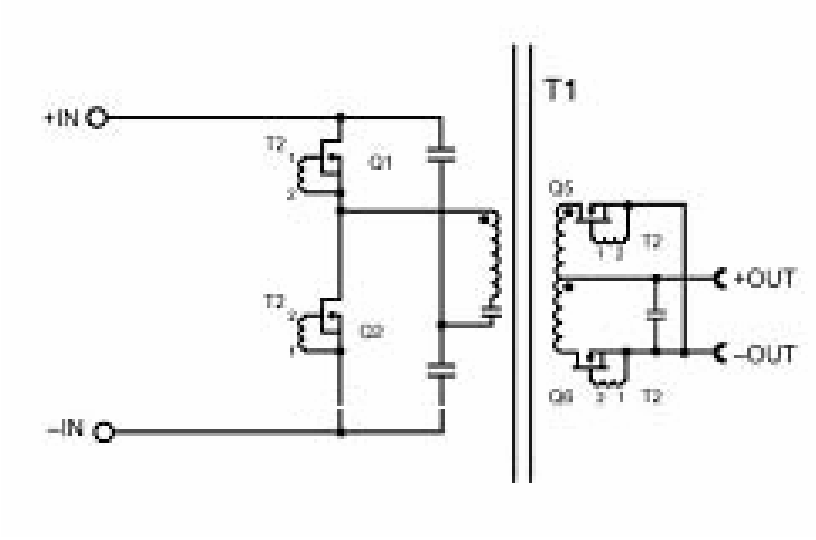
Third. Technology & Products

1、Resonant Tech3: LLC resonant



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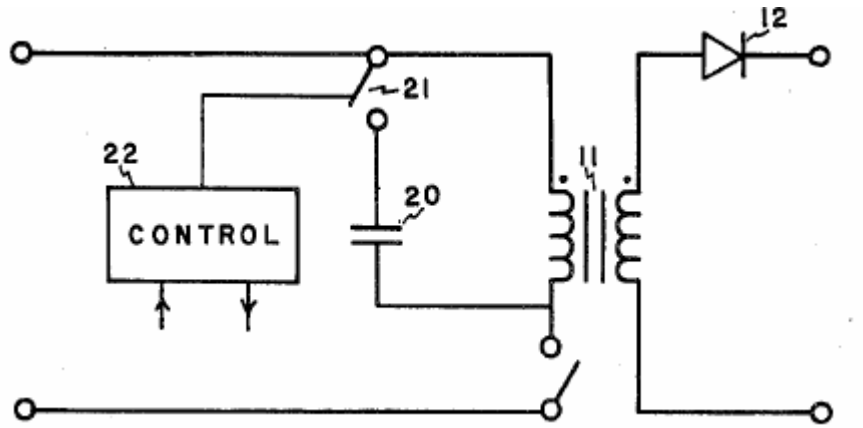
Third. Technology & Products

2、Active Clamp: G1

Vicor patent，US4441146，Apr.3,1984
Patent Expired ；



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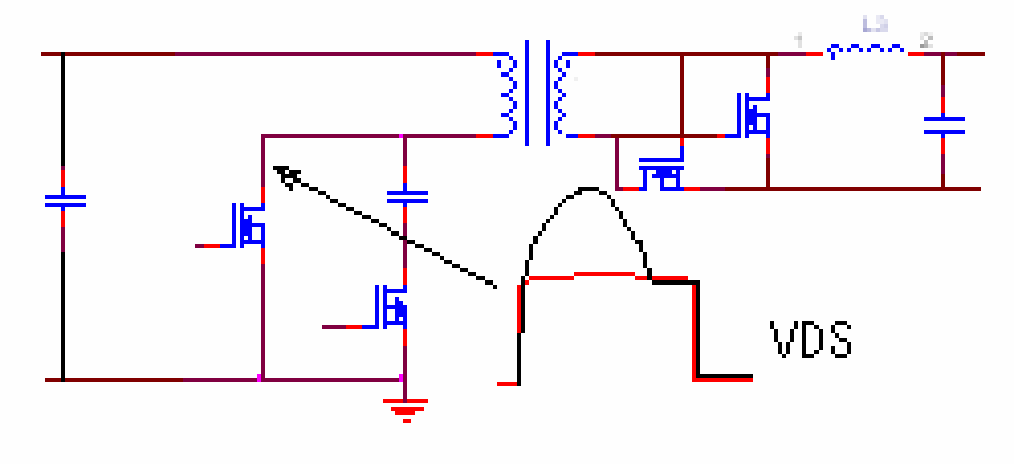
Third. Technology & Products

2、Active Clamp: drive from Active clamp G1

Gores/Tyco/Lucent patent，US5303138



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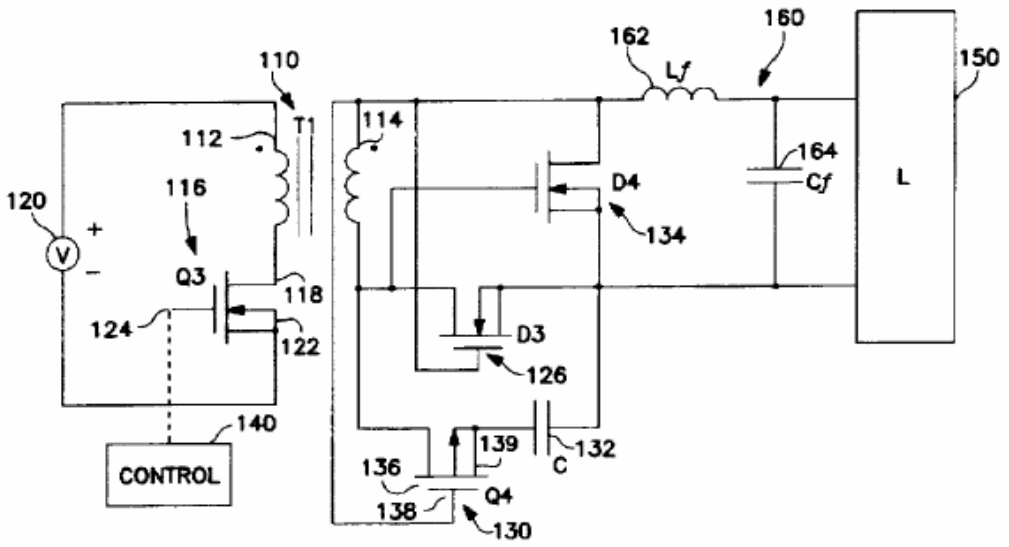
Third. Technology & Products

2、Active Clamp: G2

IPD patent，US5781420/6278621，Jul.14,1998



Bibliographic Data			
Application Number:	08/730,684	Customer Number:	-
Filing or 371 (c) Date:	10-11-1996	Status:	Patent Expired Due to NonPayment of Maintenance Fees Under 37 CFR 1.362
Application Type:	Utility	Status Date:	08-16-2006
Examiner Name:	JARDIEU, DEREK	Location:	FILE REPOSITORY (FRANCONIA)
Group Art Unit:	2838	Location Date:	12-30-1999
Confirmation Number:	5690	Earliest Publication No:	-
Attorney Docket Number:	IPD-001	Earliest Publication Date:	-
Class / Subclass:	363/021	Patent Number:	5,781,420
First Named Inventor:	GANG XIA , BEDFORD, MA (US)	Issue Date of Patent:	07-14-1998

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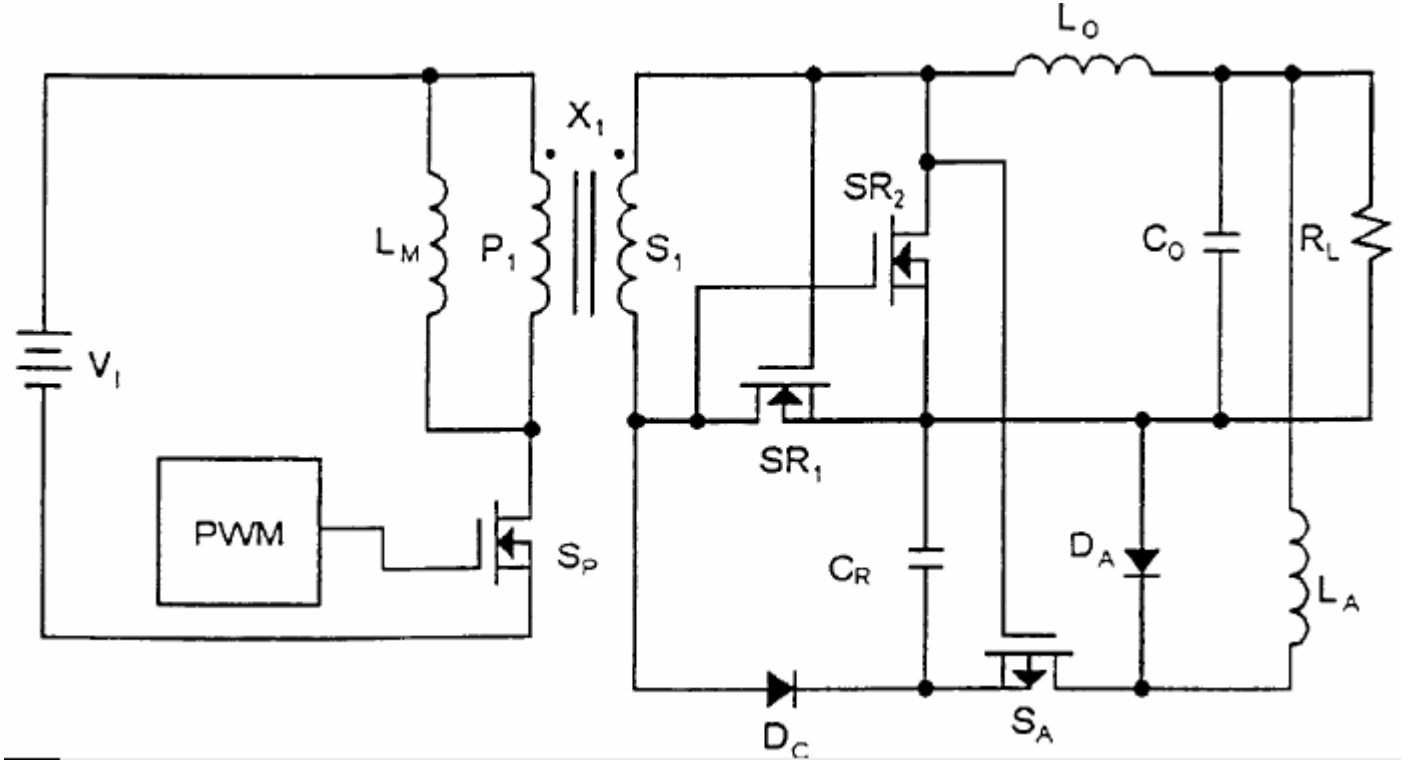
Third. Technology & Products

2、Active Clamp: G3

US6239989，May，29，2001；



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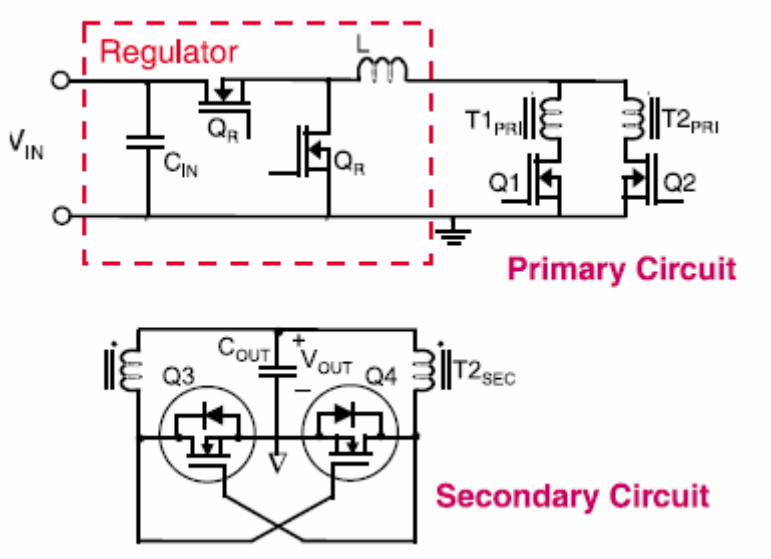
Third. Technology & Products

3、Two stage 1

Key Technologies: Two-stage buck and current-driven push-pull converter topology, synchronous rectifiers, ZVS and ZCS on output rectifiers, PCB , magnetics. (Synqor patent)



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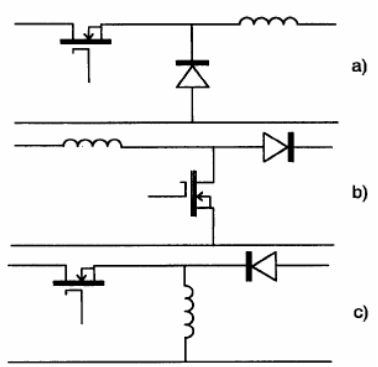
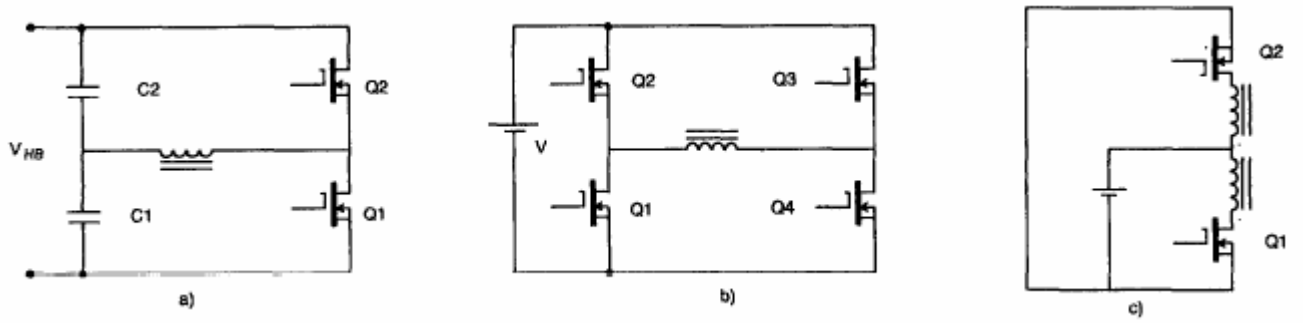
3、Two stage 2



1)fsw of second stage is larger
2)fixed frequency resonant



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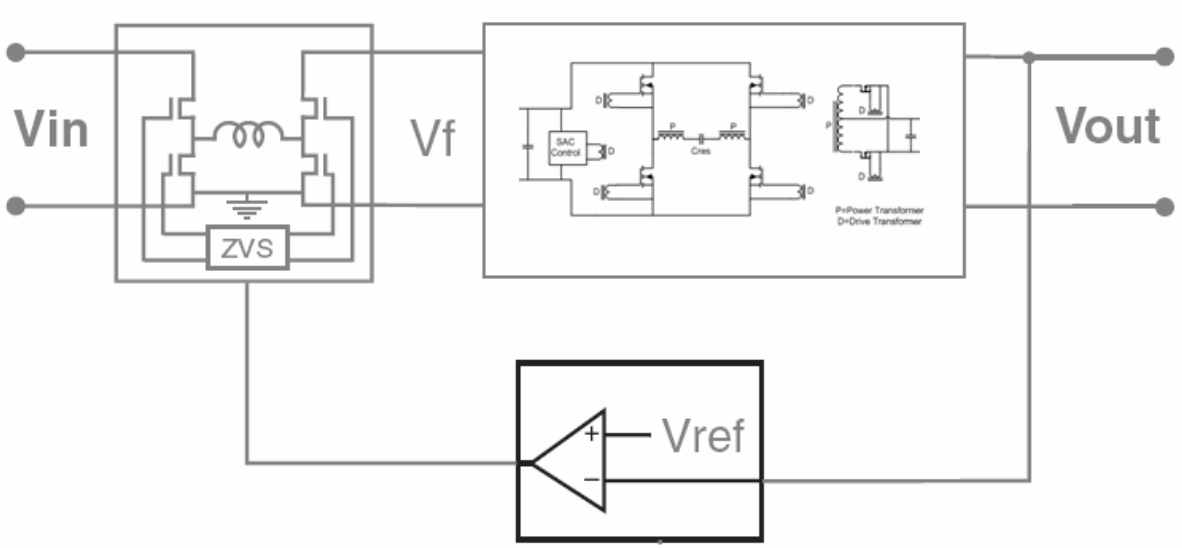
3、Two stage 3：

Pre regulator+LLC resonant，fsw=?MHZ



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4、Other topology:

Shift phase full bridge: Duty lose

AHB: narrow source and load

Double Current: Magnetic Intergration { L&L / L&T

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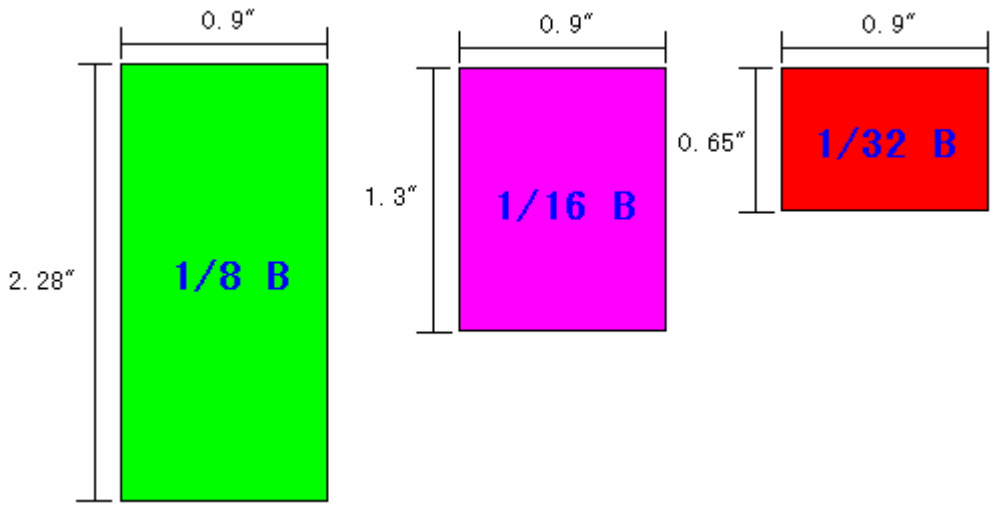
Second: Product

1、1/8 B-rick——>1/16 Brick——>1/32 Brick



Reference: Digital Control Technologies for Modular DC-DC Converters

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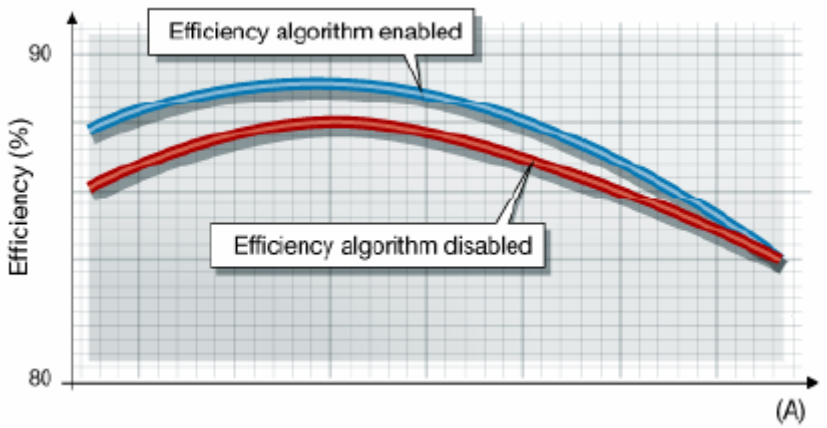
Third. Technology & Products

2、Digital control

- Reduced power dissipation due to adaptive dead-time control
- Ability to adjust the output voltage
- Programmable droop for enhanced current sharing performance
- Increased flexibility and faster implementation of design changes
- Option of digital power management interface without size penalty



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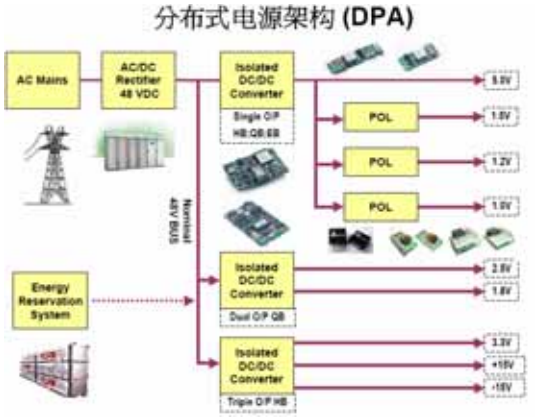
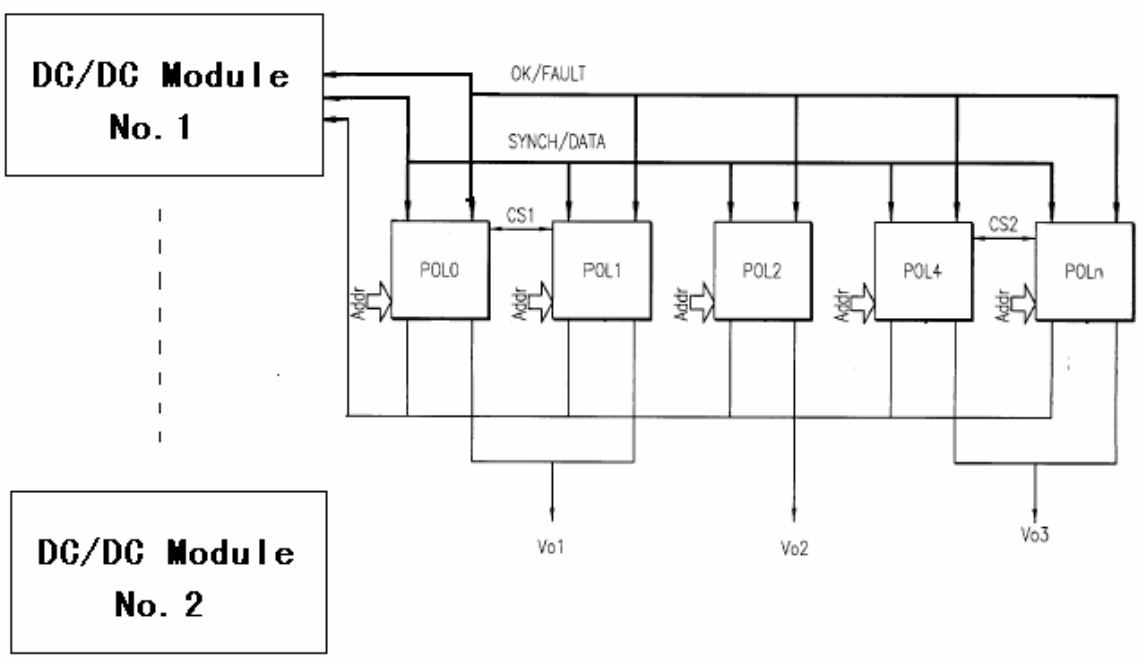
Third. Technology & Products

Easy to comunication : BUS<->POL BUS<->BUS





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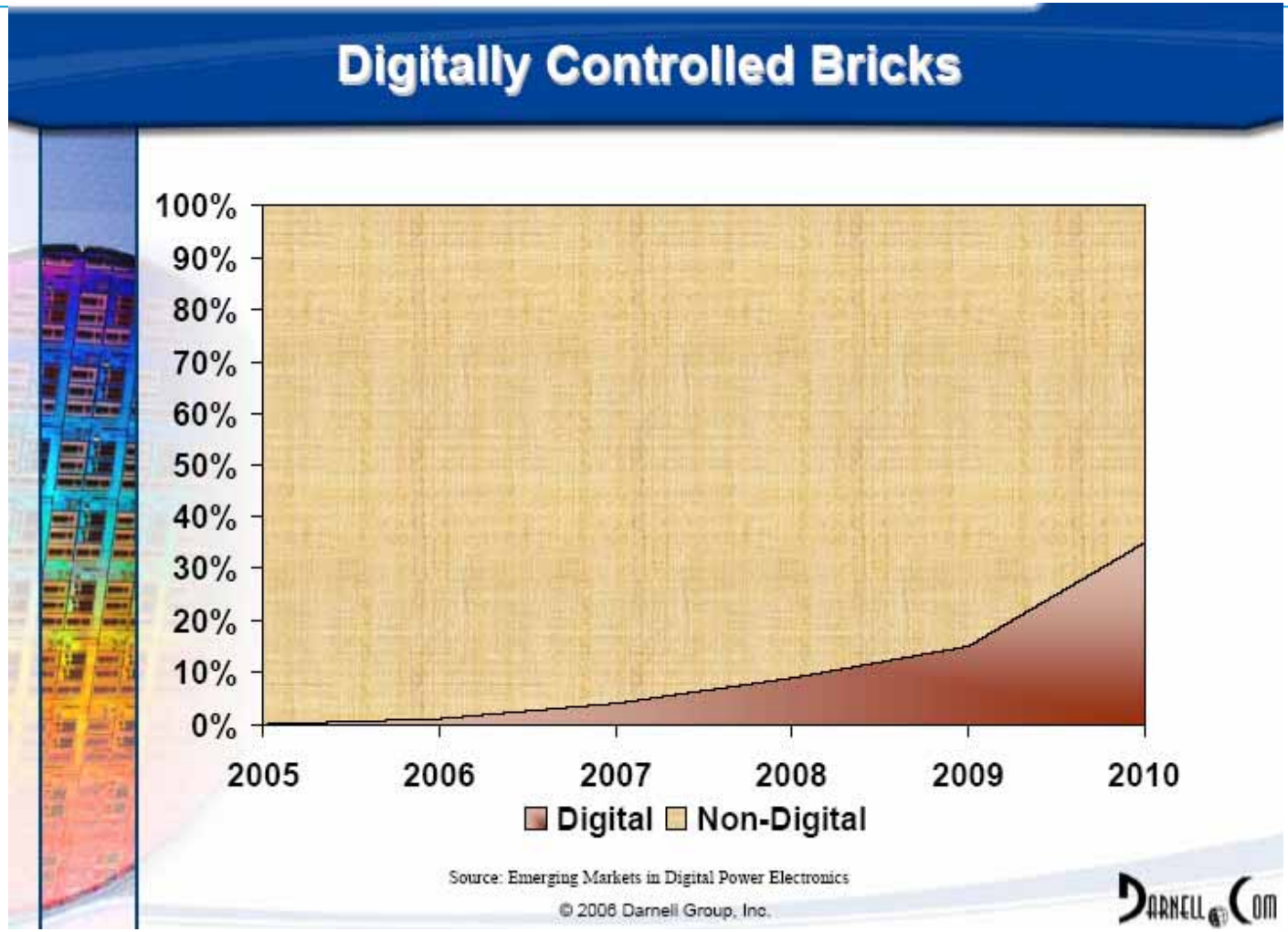
Third. Technology & Products



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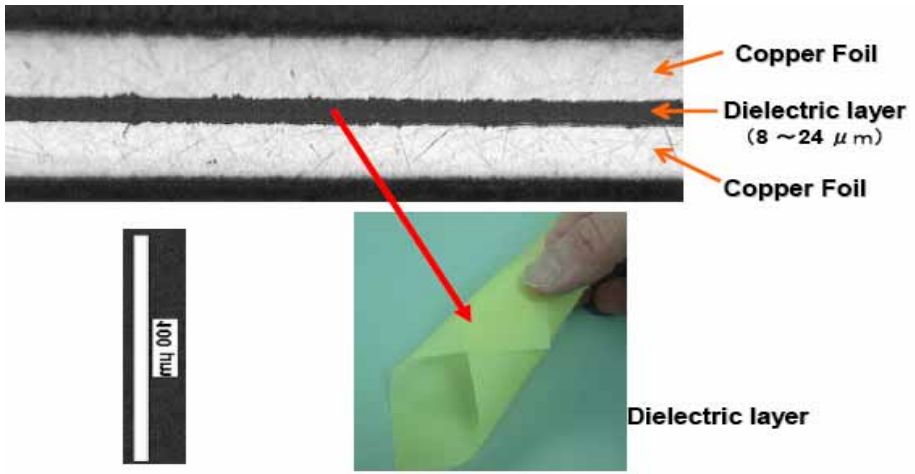
Third. Technology & Products

3、Advanced PCB Material

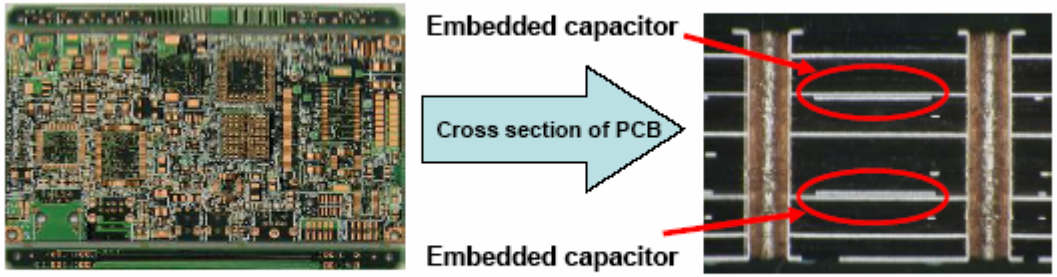


1)super thin PCB

Fr4_24um,16um,8um
Copper foil_2oz

buried resister and capacitor

PCB
(PCB with embedded components)



※Embedded capacitor is constructed into PCB as a condenser.

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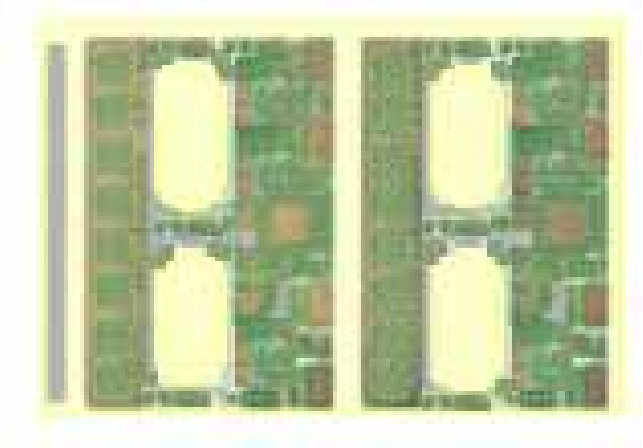
Third. Technology & Products

2)high thermal conductivity coefficient

FR4:0.2-0.3

RT1755:0.6-0.7

Arlon99:1.0



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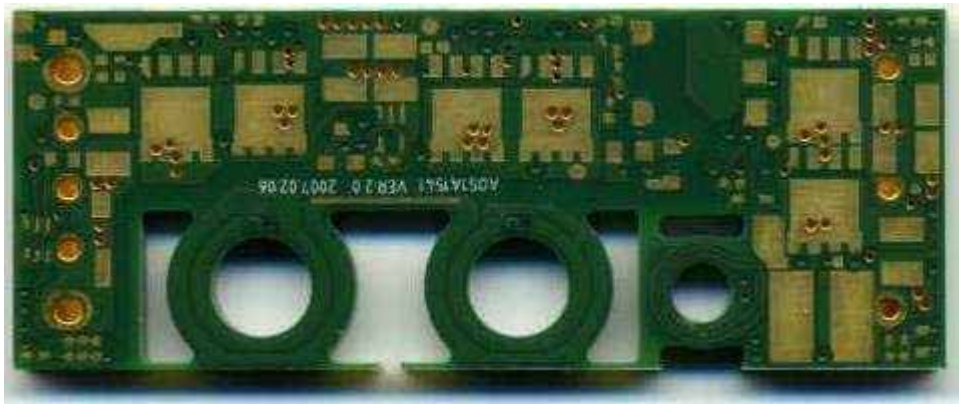
3)Heavy copper PCBs：3oz-6oz

for High current density



Pic from：http://www.somacisgraphic.com/cn/msg.php?id=13

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Third. Technology & Products

4、Module package

1)distributing hot point

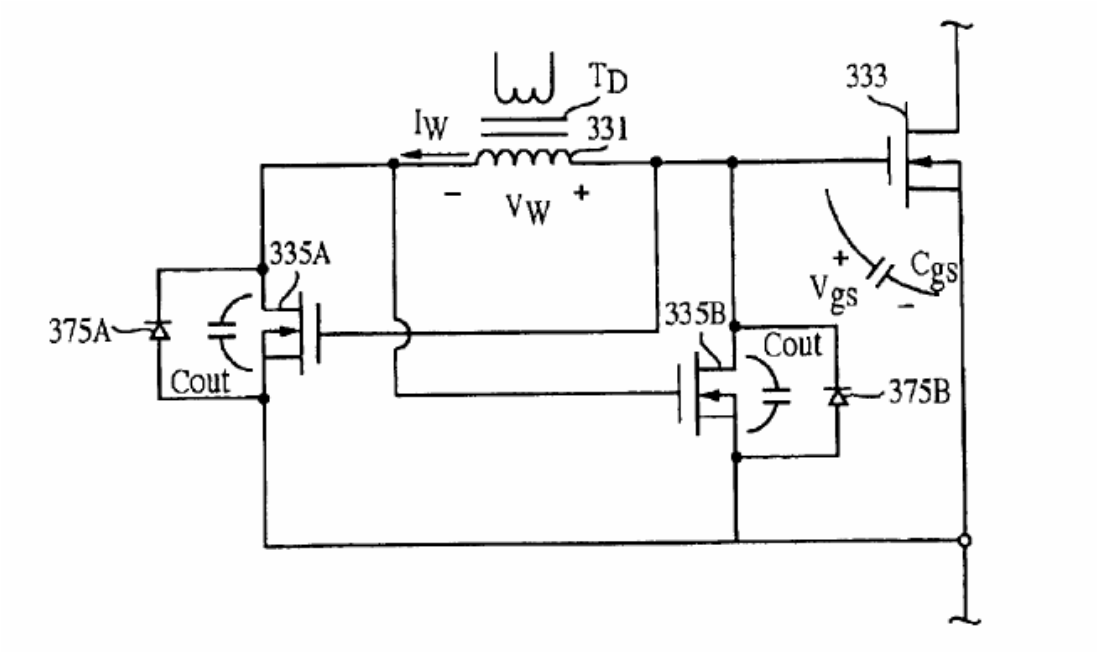
2)minimizing the size

3)ease the safty standard

Third. Technology & Products

5、Low loss gate drive

Vicor patent，US6911848



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Third. Technology & Products

6、Magnetic Integration

1)minimizing magnetic core size

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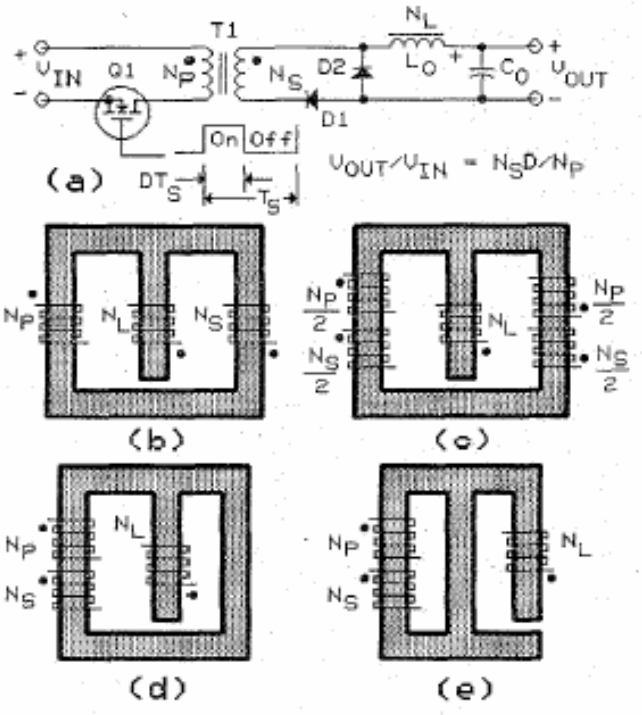
2)other benefits: efficiecy /current ripple/parasitical parameters



Reference:

IEEE TRANSACTIONS ON MAGNETICS, VOL. 34, NO. 4, JULY 1998

New Multi-Chambered Power Magnetics Concepts

Gordon E. Bloom
e/j BLOOM associates Inc., Product Engineering Division
4340 Redwood Highway, Office E356
San Rafael, CA 94903 U.S.A.

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Fourth. Summary

Trend 1: High frequency

1/16 B->1/32 B; soft switch & low-loss gate drive

Trend 2: Digital control

efficiency; analogy parts number; improve power density;

advanced Loop control; intelligence power manager (efficiency & fault)

Trend 3: Advanced package & materials

minimizing size and improve heat performance

buried resister and capacitor; minimizing parasitical parameters

Trend 4: Flat Magnetic & magnetic integration

minimizing core size; improve efficiency and others

Thanks !

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