


嘉兴斯达半导体高性能功率器件携手家电产业 共创美好未来



Norman Day
Technology Division
Vice President



- 
1. 电力电子的过去,现在与未来
 2. 嘉兴斯达半导的技术平台与产品线
 3. 家电产品的要求与解决方案



Philosophy V.S. Technology

物竞天择,适者生存,不适者淘汰

达尔文进化论

我们无法驾驭变革,我们只能走在变革之前

管理大师P. F. Drucker

人法地,地法天,天法道,道法自然

道德经. 二十五章. 老子



01

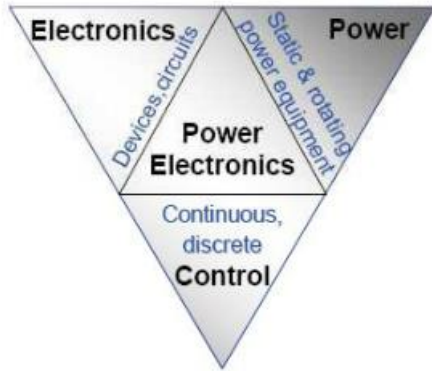
Part One

电力电子的过去，
现在与未来

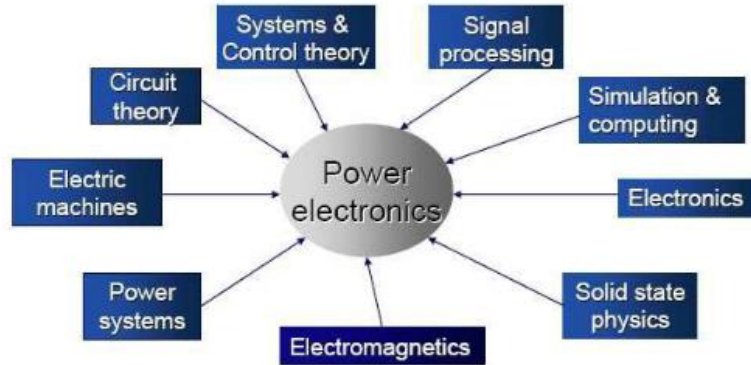


What is Power Electronics?

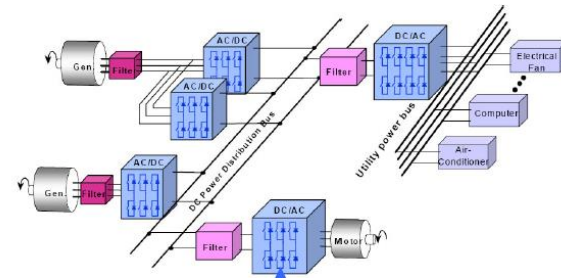
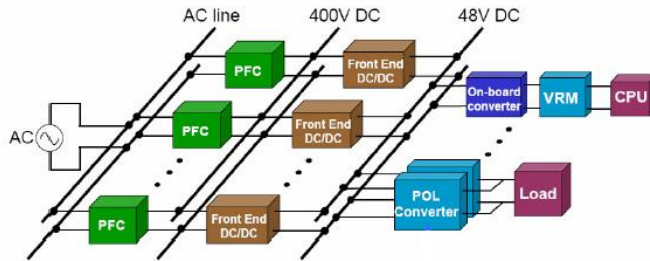
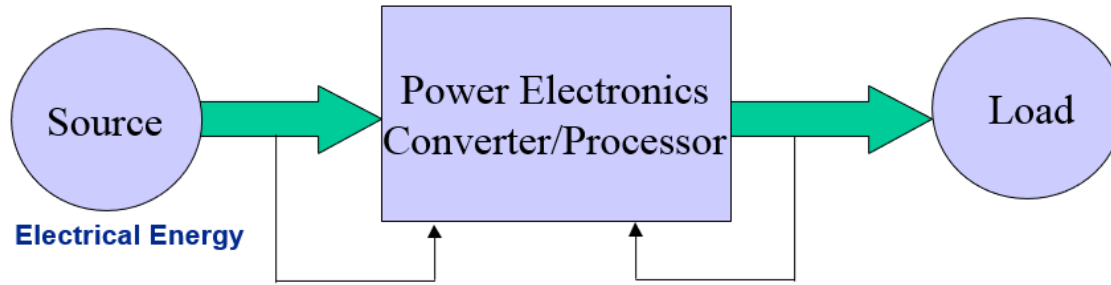
电力电子学(Power Electronics)这一名称是在上世纪60年代出现的。1974年，美国的W.Newell用一个倒三角形对电力电子学进行了描述，认为它是由电力学、电子学和控制理论三个学科交叉而形成的。



Something is missing?



Power Electronics Realization



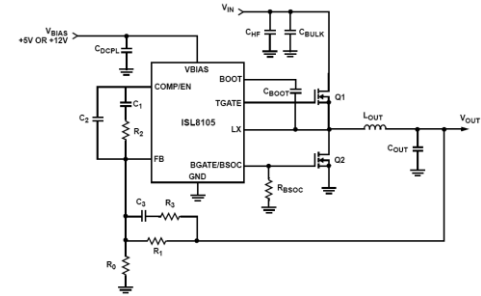
Technology Trend For DC to DC Converter

• Effects of Switching Frequency

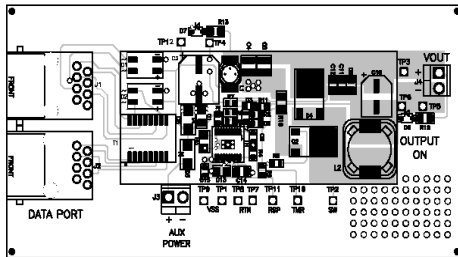
- Inductance $\propto 1/f \rightarrow f \uparrow \rightarrow$ inductor size \downarrow
- $f \uparrow \rightarrow$ converting efficiency \downarrow

• Technology Trend

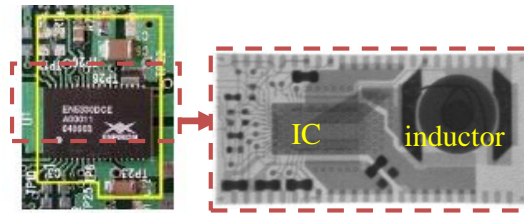
- FoM of Power devices will be never come to the end
- Small and low profile inductor is necessary



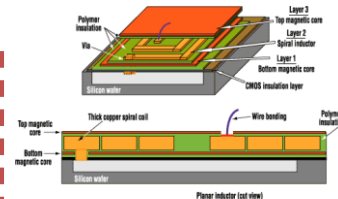
Past



Now



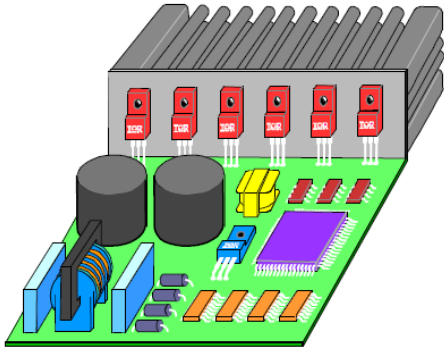
In the future



4. Key to the dc-dc converter's ability to have such a small form factor is a MEMS inductor that sits atop the switching electronics.

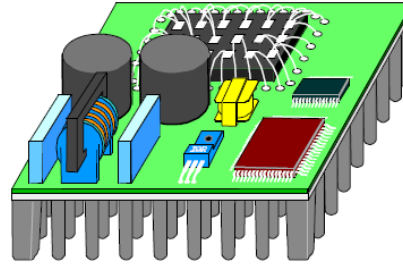


Technology Trend For Motor Drive



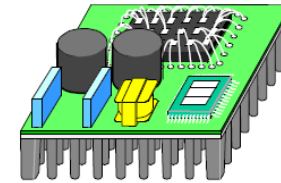
Discrete solution with mature topology and devices technology.

Modularized, driving algorithm and overall system cost effective solution are the main driving force



Power semiconductors integrated more function, packaging platform is not limited, system size further reduction.

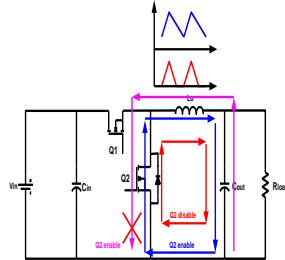
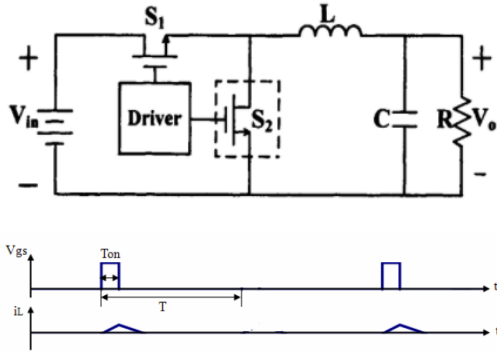
Power density, and higher reliability are the main driving force



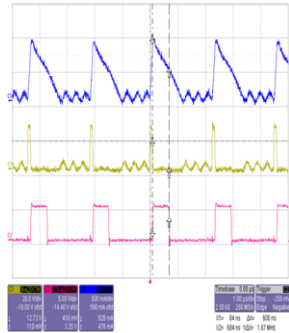
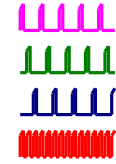
Integrated power devices with sensing circuit in wafer level except for energy storage components.

Re-allocated circuitry design concept, packaging and revolution design are the main driving force

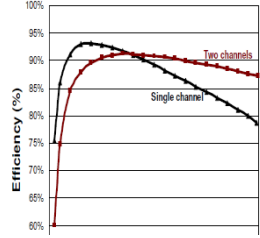
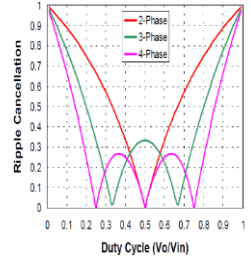
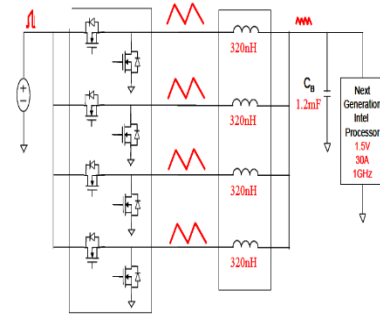
Intelligent Control Algorithm for Efficiency Improvement



Low-side MOSFET was disabled when inductor current below certain load.



Inductor current
High-side MOSFET Vgs
Low-side MOSFET Vgs



The concept is also available for PFC (boost converter).

Energy saving mode(Burst mode)

Conventional Buck ↔ Synchronized Buck

Single Phase → Multi-phases



Technology Trend for Power Electronics

3 /

Integration, Intelligent, Innovation



02

Part One

嘉兴斯达半导体的
技术平台与产
品线



Company Profile

- Established: on April 27, 2005
- Campus: 70,700 m²
- Total employees: 640
- Revenue in 2018: \$ 120 million USD



- Mass Production_ over 10 years
- Monthly output_ over 600 thousands of IGBT modules



- Advanced production equipment
- Main equipments _ purchased from Germany, American and Japan
- Clean Room_ 4500 square meters



- 100% on-line monitoring_ on each technological step
- ERP system traceability for each module in production and after shipment

Shanghai Dosemi



- Located in Shanghai New Energy Vehicle Science Park
- Focus on IGBT modules for EV application
- Start production in Q4, 2017



- Products including rectifier modules, FRD modules, discrete products etc...
- In production since 2013.

StarPower Europe R&D Center (Nurnberg)



1. 10 senior power semiconductor chips and module R&D engineers
2. Advanced process and analysis equipment in the lab ;



IGBT Module Market Share in Global-Year 2015

Table 4.15 - World Total IGBT-based Module Supplier Market Share Estimates
(US \$ Revenues)

2015 Rank	Manufacturer	2014r share	2015 share	Change
1	Infineon Technologies*	21.9%	24.5%	2.6%
2	Mitsubishi (inc. Powerex)	25.8%	24.4%	-1.4%
3	Fuji Electric	12.3%	12.2%	0.0%
4	Semikron	9.2%	9.7%	0.5%
5	Hitachi	2.9%	3.2%	0.4%
6	ON Semiconductor	3.1%	3.1%	0.0%
7	Vincotech	2.4%	2.9%	0.5%
8	ABB Semiconductors	2.2%	2.6%	0.4%
9	Fairchild Semiconductor	2.4%	2.5%	0.1%
10	Danfoss	1.5%	1.7%	0.2%
11	Starpower Semiconductor	1.6%	1.6%	0.0%
12	Toshiba	2.4%	1.4%	-1.0%
13	Bosch	0.5%	1.2%	0.7%
14	IXYS	1.0%	1.2%	0.2%
15	CRRC Times Electric (inc. Dynex)	0.2%	0.6%	0.4%
	International Rectifier*	2.2%	N/A	N/A
	Others	8.3%	7.1%	-1.2%
	Total Market Size =	\$3,558.9 m	\$3,091.9 m	-13.1%

Notes

* Infineon Technologies acquired International Rectifier in Jan 2015. Both companies are reported separately in 2014 and combined as Infineon in 2015.

r= revised since 2015 edition

Source:
IHS

© 2016
IHS



IGBT Module Market Share in China- Year 2015

Power Semiconductor Intelligence Service - 2016

**Table 4.18 - China Total IGBT-based Module Supplier Market Share Estimates
(US \$ Revenues)**

2015 Rank	Manufacturer	2014r share	2015 share	Change
1	Infineon Technologies*	29.2%	23.4%	-5.8%
2	Mitsubishi (inc. Powerex)	19.9%	19.0%	-0.9%
3	Fuji Electric	13.2%	15.5%	2.3%
4	Semikron	9.3%	11.8%	2.5%
5	Starpower Semiconductor	4.5%	4.5%	0.1%
6	ON Semiconductor	4.7%	4.4%	-0.3%
7	ABB Semiconductors	2.6%	3.9%	1.4%
8	Vincotech	2.5%	3.9%	1.4%
9	IXYS	1.5%	1.8%	0.3%
10	CRRC Times Electric (inc. Dynex)***	0.4%	1.6%	1.2%
11	Fairchild Semiconductor	1.2%	1.3%	0.1%
12	Hitachi	0.2%	1.1%	0.9%
13	Danfoss	0.7%	1.0%	0.3%
	International Rectifier*	2.2%	N/A	N/A
	LS Power Semitech**	1.1%	N/A	N/A
	Others	7.0%	6.8%	-0.2%
	Total Market Size =	\$1,082.9 m	\$962.5 m	-11.1%

Notes

* Infineon Technologies acquired International Rectifier in Jan 2015. Both companies are reported separately in 2014 and combined as Infineon in 2015.

** Infineon also took a controlling interest in former JV company LS Power Semitech part way through 2014.

*** Zhuzhou CSR Times Electric Co., Ltd (the owners of Dynex Semiconductor Ltd.) and China CNR Corporation merged in June 2015 to form Zhuzhou CRRC Times Electric Co., Ltd.

r= revised since 2015 edition

Source: IHS

2016 Global IGBT Module Market Share

4.1 The world market for power modules

The power module market was worth an estimated \$4.12 billion in 2016, an increase of 3.5% from 2015. Standard IGBT modules accounted for the most revenues, an estimated 45.7% of the 2016 total.

Revenues increased for four of the six power module product types in 2016; revenues for two declined.

The products with growing markets were MOSFET modules (by 31.5%), MOSFET-IPMs (by 19.3%), PIM/CIBs (by 3.3%), and Standard IGBT modules (by 2.2%, slightly less than overall average).

The products with declining markets were thyristor-diode modules (-2.7%) and IGBT-IPMs (-0.5%).

Infinion Technologies had overtaken Mitsubishi Electric to become the leading power module manufacturer in 2015. In 2016, it extended its lead, increasing its share by 0.9 percentage points.

Mitsubishi lost market share due, in part, to the temporary closure of its Kumamoto power module production plant following an earthquake in April 2016.

Once again, the top 4 suppliers took almost 60% of the total power module market. However, having acquired Fairchild, ON Semiconductor has established itself firmly in 5th place in the power module market ranks.

World power modules supplier market share estimates

(Percentage of total \$ revenues)

	2015*	2016	15-16
1 Infineon Technologies	20.5%	21.4%	0.9%
2 Mitsubishi (inc. Powerex)	19.4%	17.8%	-1.6%
3 Fuji Electric	9.5%	9.6%	0.1%
4 Semikron	10.0%	9.3%	-0.7%
5 ON Semiconductor	2.4%	6.0%	3.6%
6 Vincotech	2.5%	3.4%	0.9%
7 IXYS	2.7%	2.7%	0.0%
8 Danfoss	2.4%	2.7%	0.3%
9 Starpower Semiconductor	2.1%	2.5%	0.3%
10 Bosch	1.5%	2.0%	0.5%
Others	27.1%	22.8%	-4.3%
Total market size =	\$3.98 billion	\$4.12 billion	3.5%



Partail Customers in China



Partail Customers in Oversea

Lenze

Danfoss

SMA

BOMBARDIER
the evolution of mobility

EATON
Powering Business Worldwide

Rexroth
The Drive & Control Company
Bosch Group

TDE 

ABB
Power and productivity
for a better world™

GEFRAN

riello ups

EFD
INDUCTION

BAUMULLER

EEL
EQUIPAGGIAMENTI
ELETTRONICI INDUSTRIALI

schenckprocess 

MEDCOM

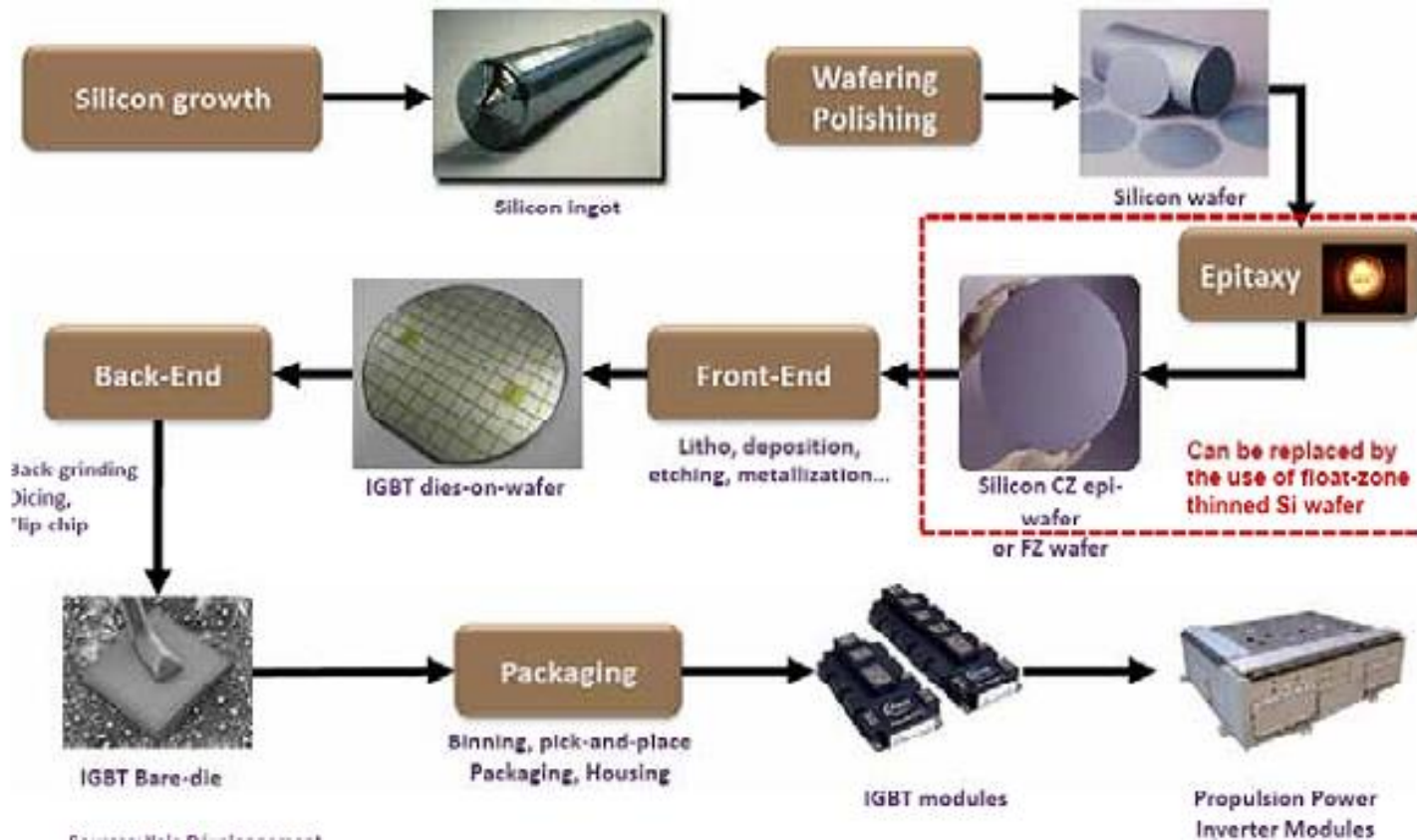
ENERCON
ENERGY FOR THE WORLD

POWERTECH

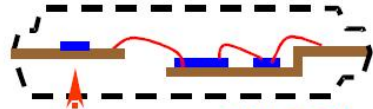
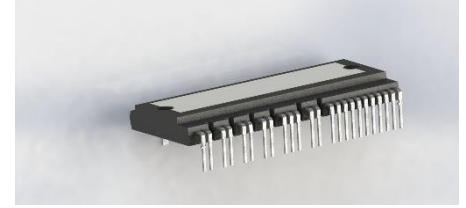
KEMPPPI

starpower

Process Flow of Power Semiconductor Packaging

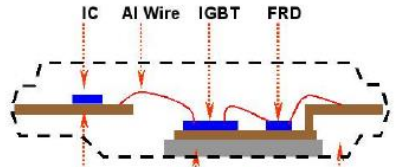


Power Packaging Platform(Transfer Molding)



Full pack

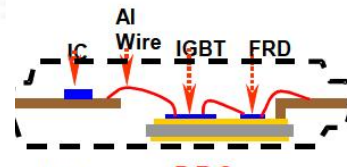
Epoxy Molding Compound



Ceramic

Lead Frame

Epoxy Molding Compound



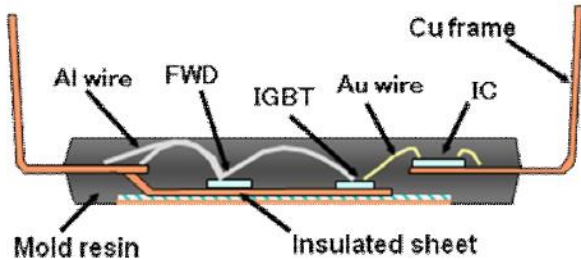
DBC

Lead Frame



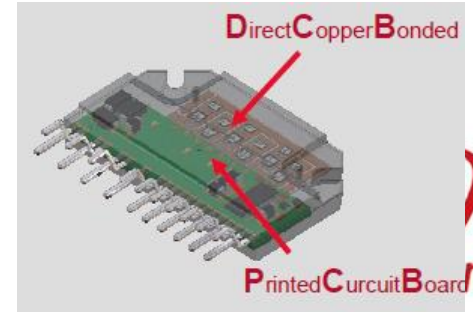
Base-plate

DBC



Mold resin

Insulated sheet



Direct Copper Bonded

Printed Circuit Board

Product Portfolio

小功率IGBT模块系列



中等功率IGBT模块系列



碳化硅模块及IPM模块



大功率IGBT模块系列



电动汽车用IGBT 模块



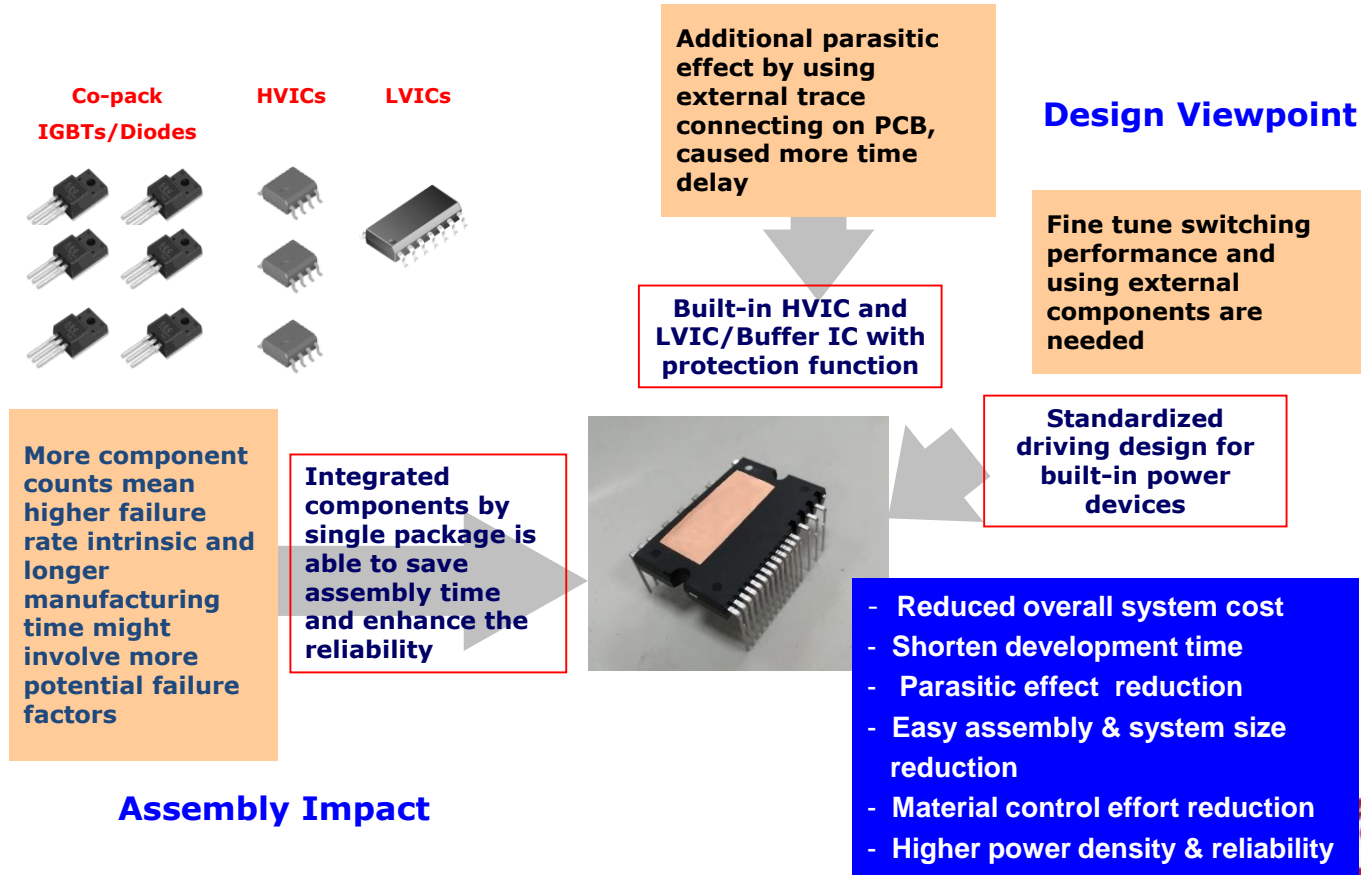
03

Part Two

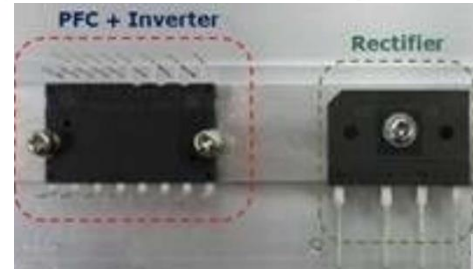
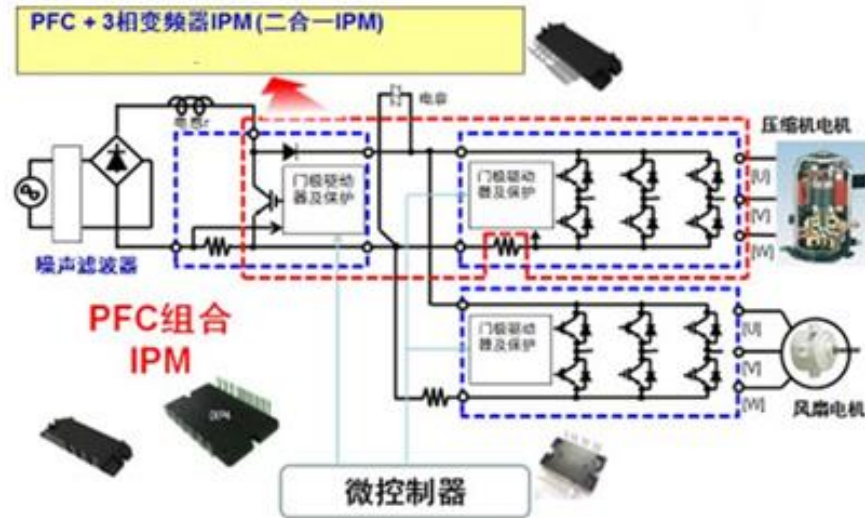
家电系统的要求 及解决方案



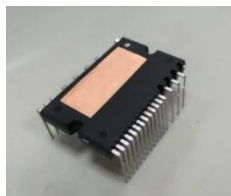
Why IPM ?



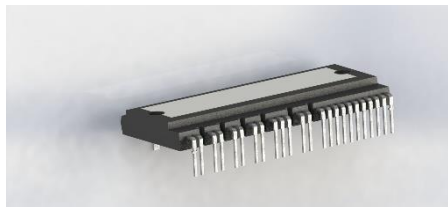
Not Just Power Integration



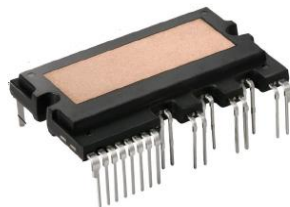
Available Solution for Home Appliance



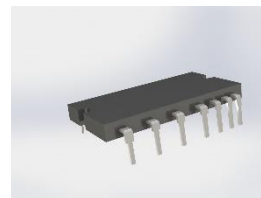
U1



U2



U3



U4

封装类别	电路拓扑	电压等级	电流范围
U1	3 Phases IPM	600V	10~30A
U2	3 Phases IPM	600V	50A ~ 75A
U3	3 Phases IPM	600V	20A~30A
U4	3 Phases PIM	600V	5A ~ 15A



洗衣机

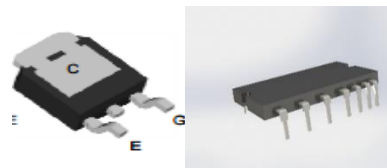
冰箱



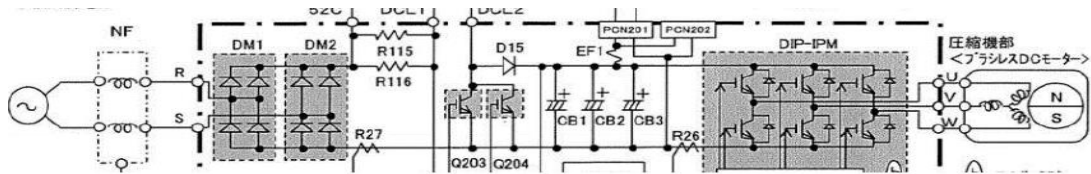
变频洗衣机	
斯达产品	ID10FFT60U1S, GD08FFX60U4
规格参数	10A 600V IPM
技术特点	Main stream packaging compliance, low thermal resistance



变频冰箱	
斯达产品	GD08FFX60U4, DG5F06T3
规格参数	5A 600V
技术特点	Low profile, optional for PCB or heat-sink

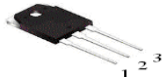


空调

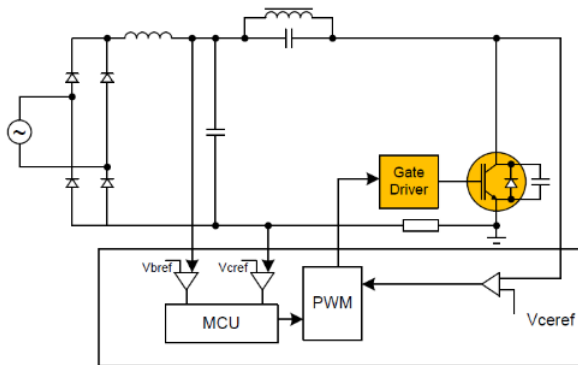


家用变频空调	
IPM	ID15FFT60U1S/ID30FFT60U1S/ID50FFT60U2S
IGBT	DG30F06T2/DG40F06T2
FRD	DK60H06T3

变频多联机	
IPM	ID50FFT60U2S
PIM	GD50PIT120C5SN/GD75PIT120C6SN
Rectifier	RD50FFS180K1S/RD75FFS180K1S
IGBT	DG40F06T2



家用电磁炉 (感应加热)

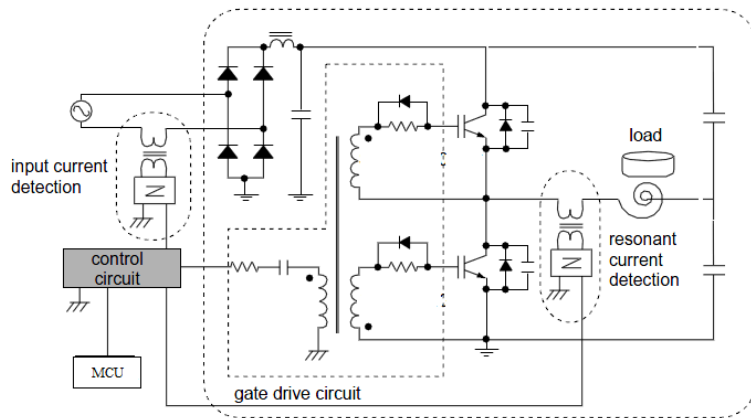


SEPR Converter Operation(Induction Cooker)

感应加热	
斯达产品	DG20R12T2
规格参数	20A 1200V 分离器件
技术特点	RC IGBT to reduce the conduction loss of the diode. High Breakdown Voltage, easily for replacement



商用电磁炉 (感应加热)



感应加热	
斯达产品	GD400HFU120C2 / GD100HFU120C1
规格参数	400A 1200V 100A 1200V
技术特点	High Ruggedness, Not easy to get thermal runaway



We Offer

Quality

Price

Delivery

Service



Starpower Confidential

Web Site



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嘉兴斯达

嘉兴斯达半导体股份有限公司成立于2005年4月，是一家专业从事功率半导体元件尤其是IGBT研发、生产和销售服务的国家级高新技术企业，注册资金1.2亿元。总部位于浙江嘉兴，占地106亩。在国内和欧洲均设有研发中心，是国内IGBT领域的领军企业。

公司主要产品为功率半导体元件，包括IGBT、MOSFET、IPM、FRD、SiC等等。公司已成功开发近6000种IGBT模块产品，电压等级涵盖100V~3300V，电流等级涵盖几安培到几千安培。产品广泛应用于变频器、逆变器、UPS、光伏/风力发电、SVG、白色家电等。

公司在全球拥有500多位员工（其中科研人员100多名）且极具创新意识、创新激励和创新能力的国际型人才队伍。在IGBT芯片和模块领域有着5~20年的研发和生产经验。公司拥有可靠性实验室和工况模拟实验室等等，可实现IGBT模块的可靠性测试。此外，公司也十分重视技术人员的培养，与浙江大学、中科院等高校建立了紧密的合作关系。



P1/P2 IGBT modules for solar and wind power applications

Typical applications

- High power solar inverters
- Wind power converters
- Medium voltage high power inverters

Features

- Industry standard packages
- 175°C junction temperature
- Soft switch waveform, suitable for high power paralleling



嘉兴斯达半导体

品质成就梦想 创新引领未来



Thank you

