

茂睿芯中大功率解决方案

Technical Marketing—周银

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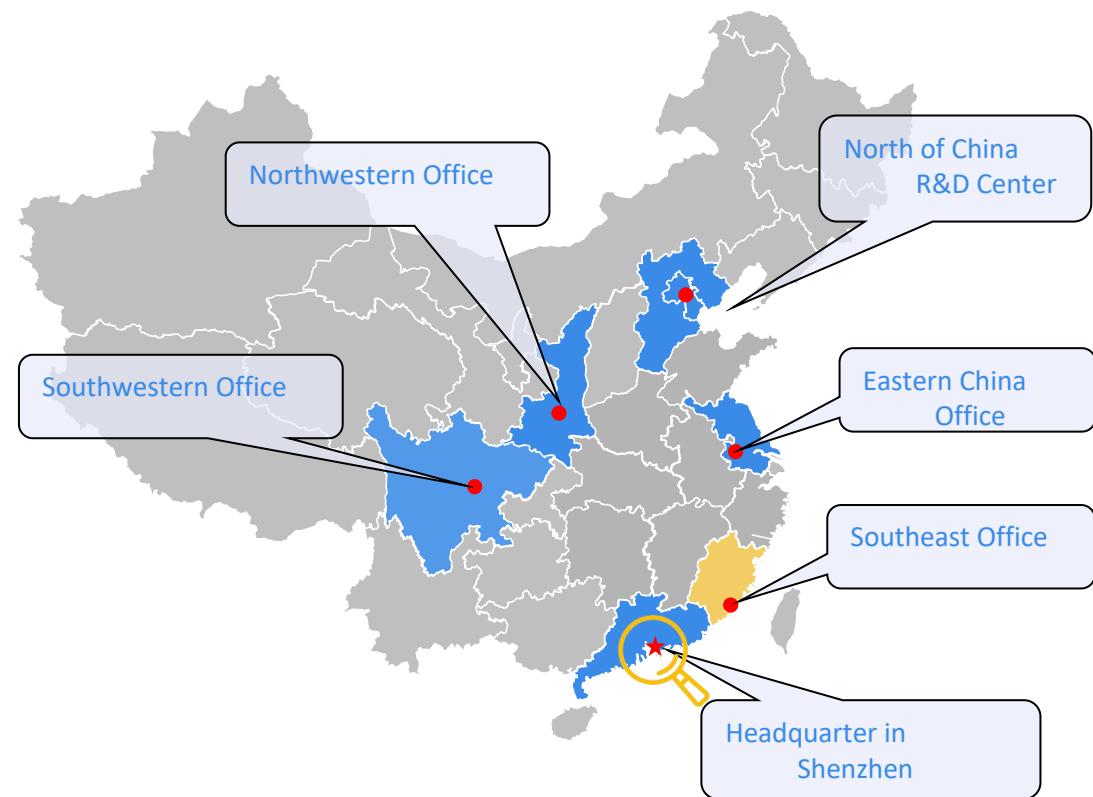
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你身边的茂睿芯



总部
深圳自贸区



北方研发中心

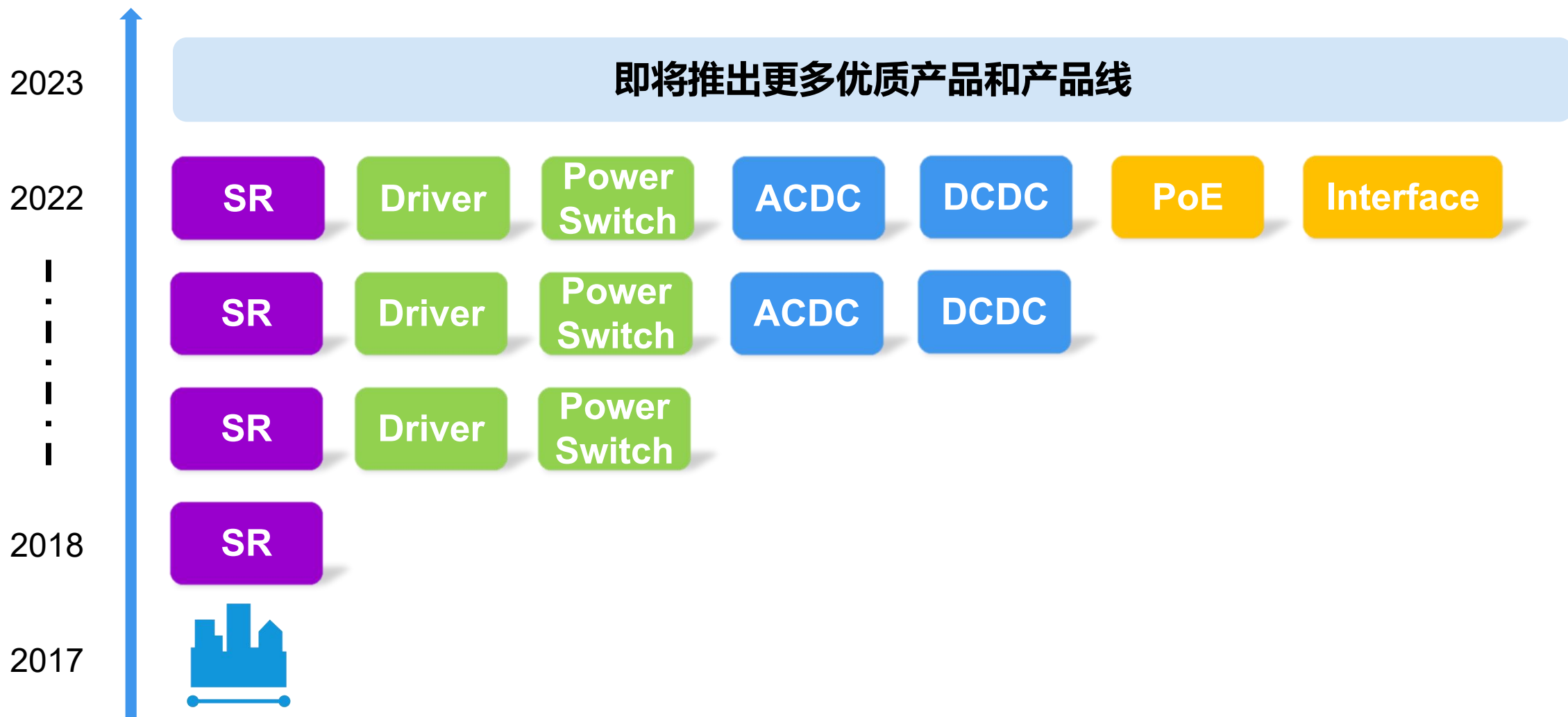
运营中心
西丽创新谷



华东服务中心

创新极客文化

打造模拟精品



助力多种新基建、新能源领域

中功率应用

锂电化设备

大功率电力电子



大功率LED



户外电源



户用光伏



直流充电桩



大型光伏电站

5G砖块电源



服务器电源



100W

1kW

10kW

100kW



PD 快充



PSE Injector



电动工具

E-BIKE



基站备电



户用储能



E-Car

化成设备



从100W到1kW

茂睿芯

千瓦级

再到3kW

完整模拟电源方案

茂睿芯首先推出了 CrM PFC MK2562系列

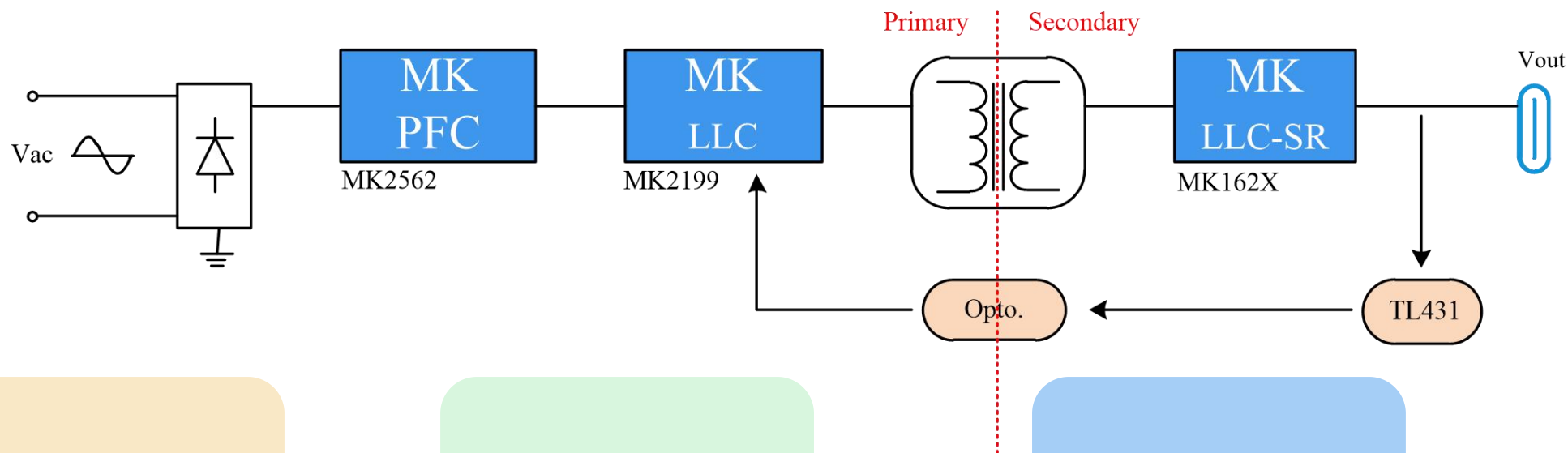
2023 Q4 即将推出 CCM PFC MK2554

2023 Q3 推出了 电压模的 LLC 控制器 MK2189

2024 Q1 即将推出新一代的 LLC 控制器 MK2199

茂睿芯率先推出了LLC SR系列芯片 MK162X

茂睿芯千瓦级模拟电源方案: PFC+LLC+LLC SR



PFC

- CrM: MK2562
- CrM: MK2562G
- CCM: MK2554*

LLC

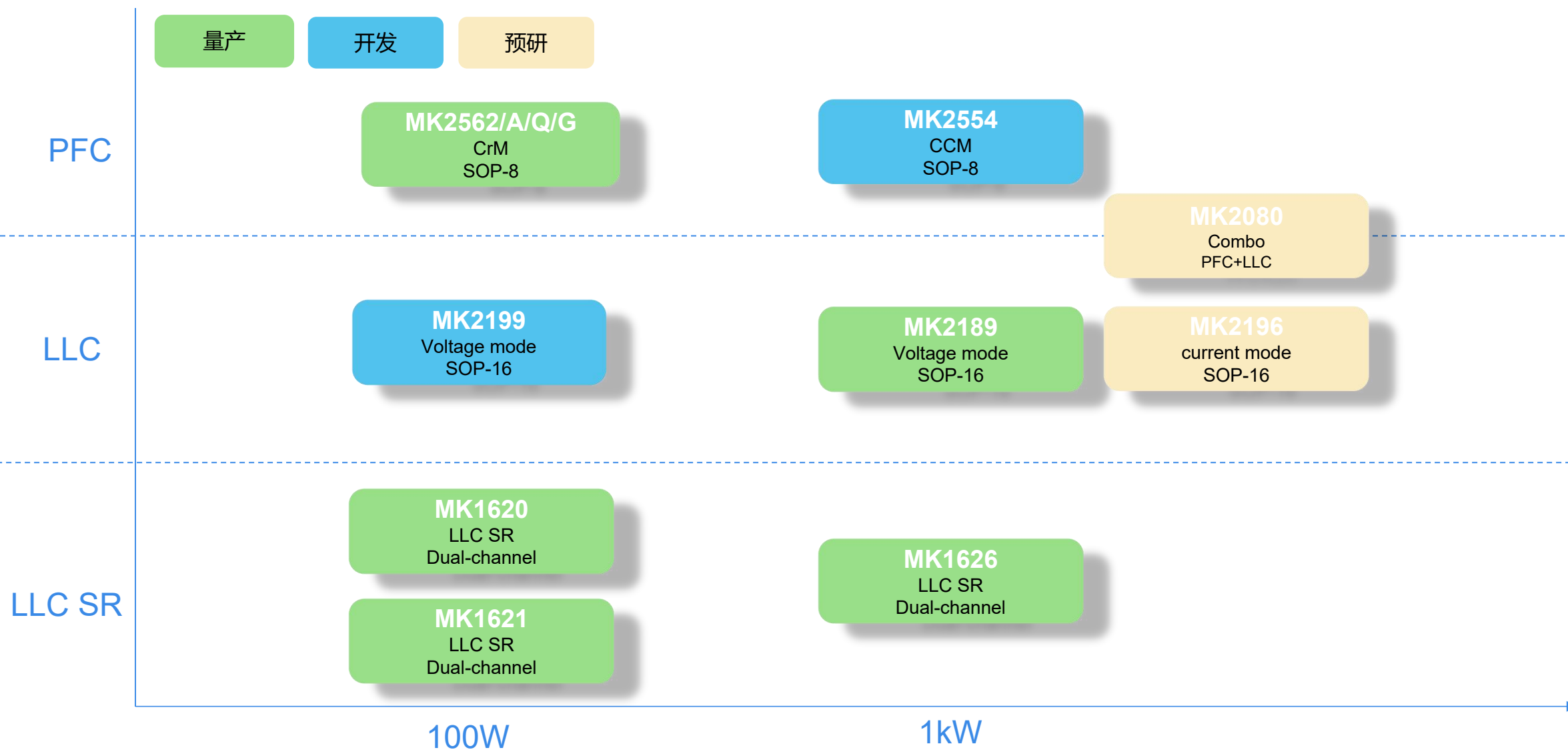
- VM: MK2189
- VM: MK2199*
- CM: MK2196*

LLC SR

- MK1620
- MK1621
- MK1626

*即将推出

茂睿芯 千瓦级模拟电源产品矩阵



Key Features

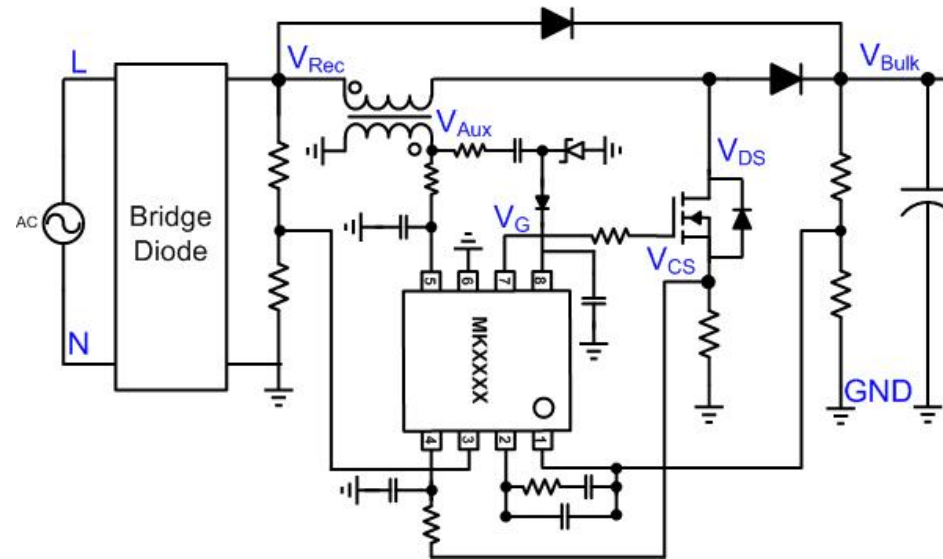
- 35V VCC Operating Voltage
- Ultra low THD & Unity Power Factor 👍
- Smart High/Low-Line Over-Power-Protection 👍
- QR mode improve efficiency 👍
- Total harmonic compensator for AC Zero-Crossing
- Brown-in Brown-out Protection 👍
- Soft start 👍
- Feedback Open Loop Protection 👍
- Gate Driving Capability +/- 0.8A

Applications

- TV Power Supplies
- Electric power tools
- PD Power Supplies
- Industrial Power Supplies

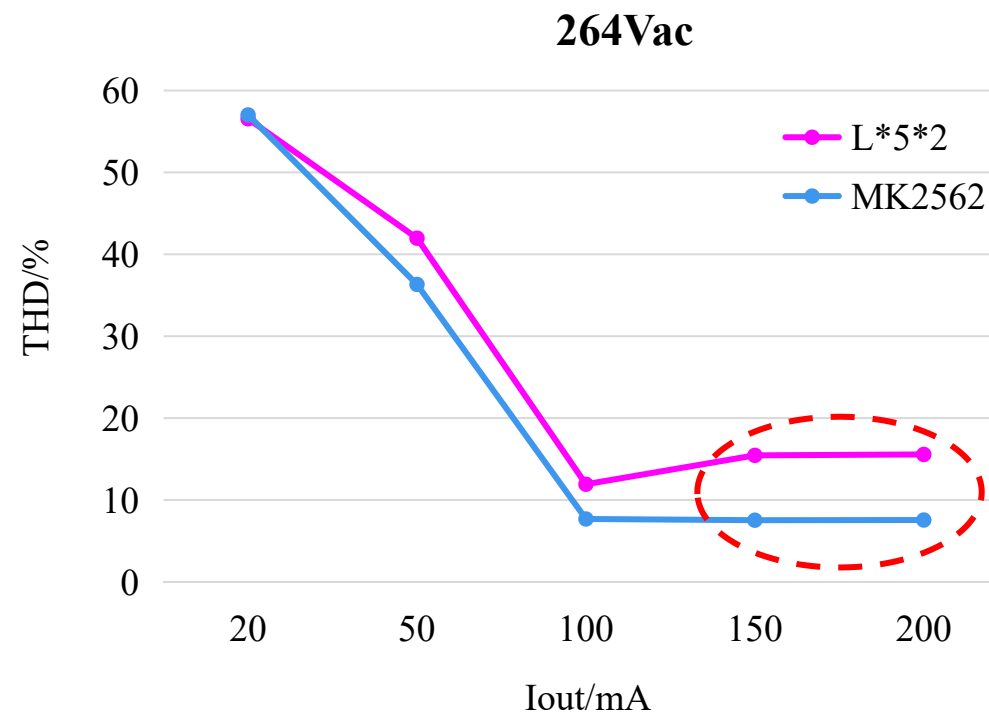
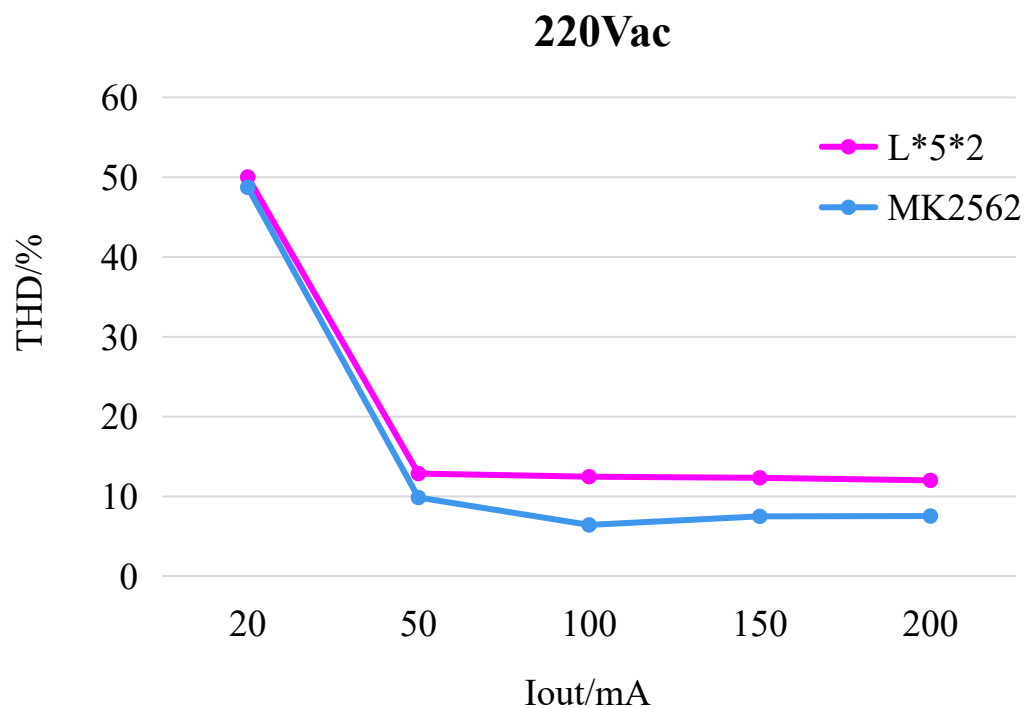
Benefits

- Ultra low THD & Unity Power Factor
- Smart High/Low-Line Over-Power-Protection
- Noise Immunity Enhancement
- Soft starter
- Simple design efforts



MK2562 引入THD优化器->降低THD

80W demo, Vout: 400V, Transformer: RM8 390uH



在高压重载时，MK2562的THD比竞品低近10%

型号	模式	限频	CS_limit	备注
MK2562	CrM	NC	1.7V	
MK2562A	CrM	NC	1.1V	
MK2562Q	QR	130kHz	1.1V	
MK2562G	QR	200kHz	1.1V	直驱E-GaN

更高的Vcc电压、自适应死区，轻载纹波优化

MK2189: 30V 高压高精度LLC控制器



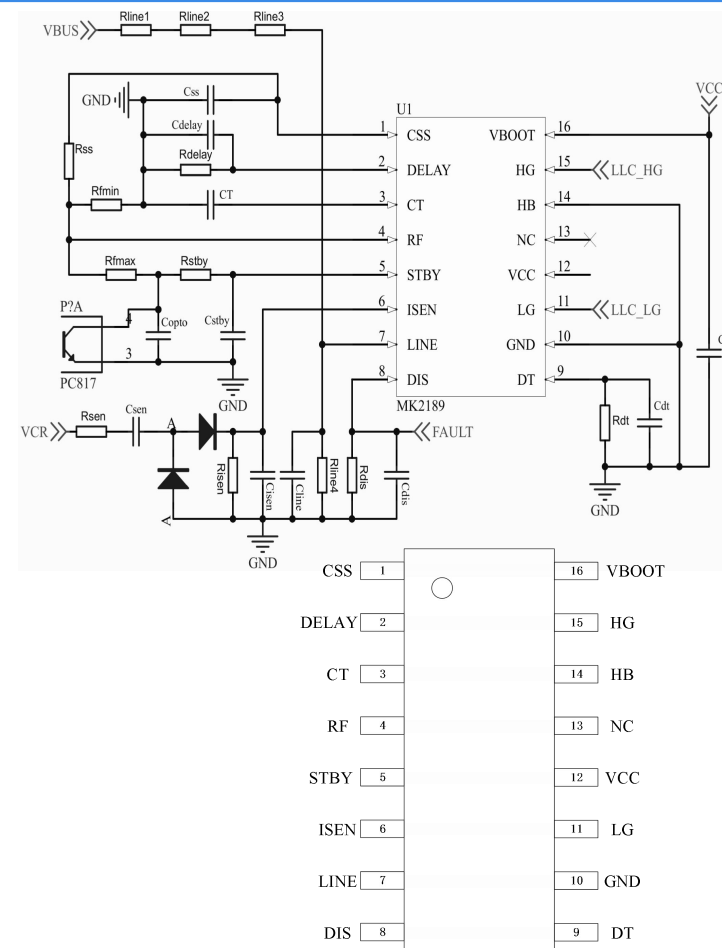
Key Features

- Wide VCC voltage support 30V 🍎
- Adjustable dead time from 250ns to 1us 🍎
- 50% duty cycle, variable frequency control
- Add burst frequency control & fast out function 🍎
- Two-level OCP: frequency-shift and restart
- Optimize the symmetry of high and low side waveforms ($50\% \pm 1\%$) 🍎
- Up to 500 kHz operating frequency
- 0.3A source and 0.8A sink driver capability
- Safe-start procedure prevents hard switching at startup

Applications

- AC – DC adapter
- High-Power density DC – DC
- Datacenter and telecom

Application Diagram



茂睿芯——中大功率模拟芯片专家

Key Features

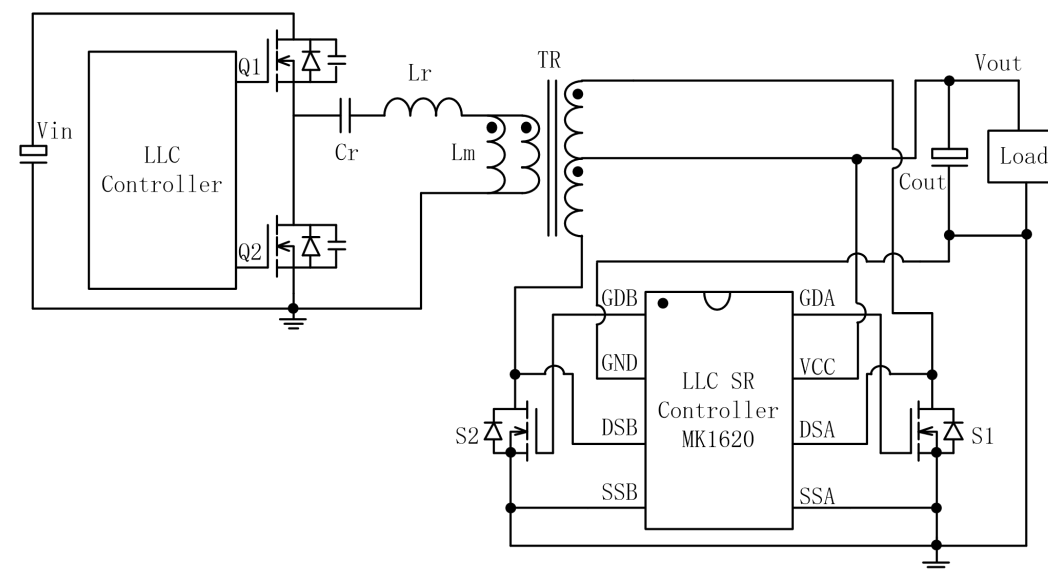
- Wide VCC range 4.7V-38V 🍎
- Ultra low quiescent current <90uA 🍎
- No false-triggering at DCM multiple resonance 🍎
- Operating frequency up to 500KHz
- Maximum voltage at VD PIN 115V
- Internal logic locked out between two channels 🍎
- Differential inputs for sensing the drain and source voltages of each SR MOSFET 🍎

Applications

- PD Adapters
- PC Power Supplies
- TV Power Supplies
- Industrial Power Supplies
- LED Power Supplies

Benefits

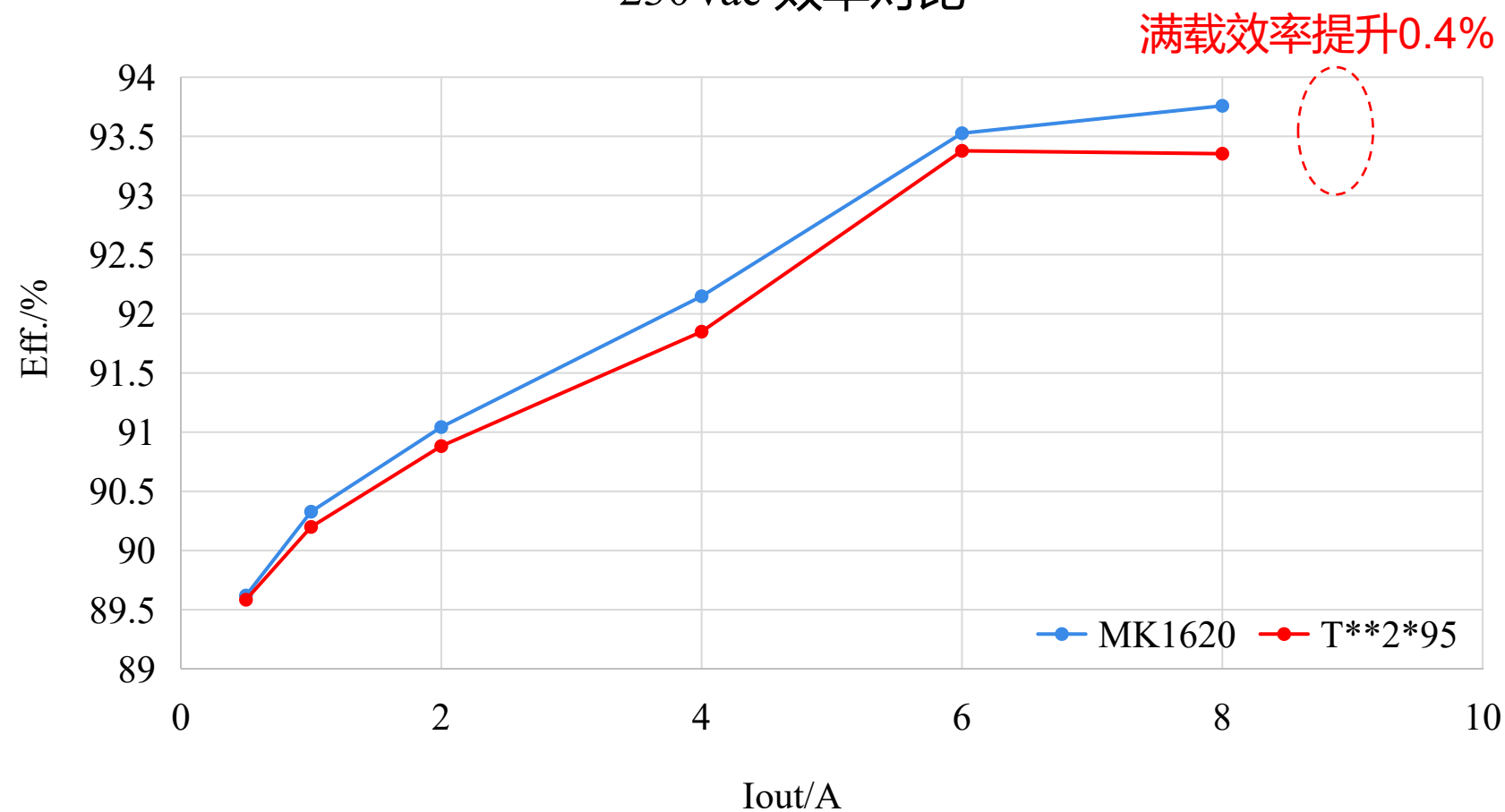
- Adaptive gate driver to end of conduction current
- No false turn-on during start-up
- 10ns turn off delay/2.5A sink current
- Internal logic locked out between two channels



MK162X 优化驱动->提升效率

Bench: 150W

230Vac 效率对比



响应**碳达峰、碳中和**的国家战略，**茂睿芯**布局了光储系统的相关模拟芯片：

隔离驱动 MD18011/23系列
高压辅源 MK2697系列
接口芯片 MCAN1042

通过485接口芯片 MRS4850* 也在开发中

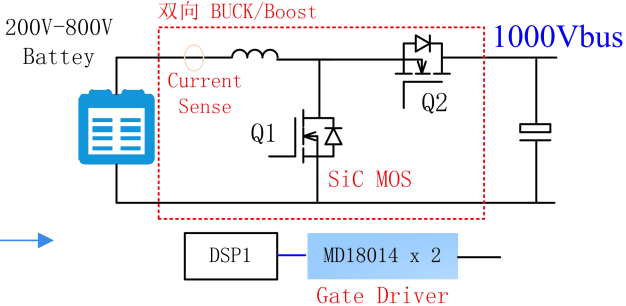
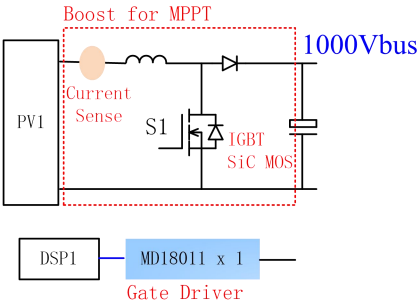
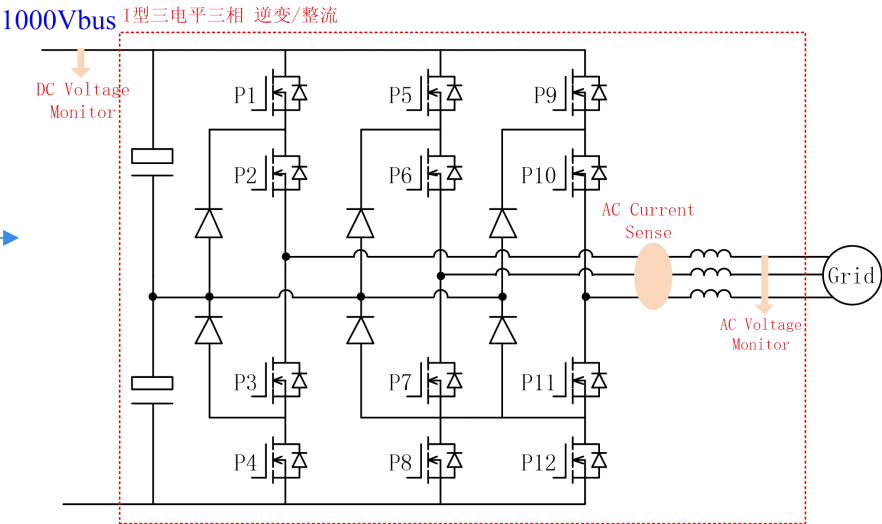
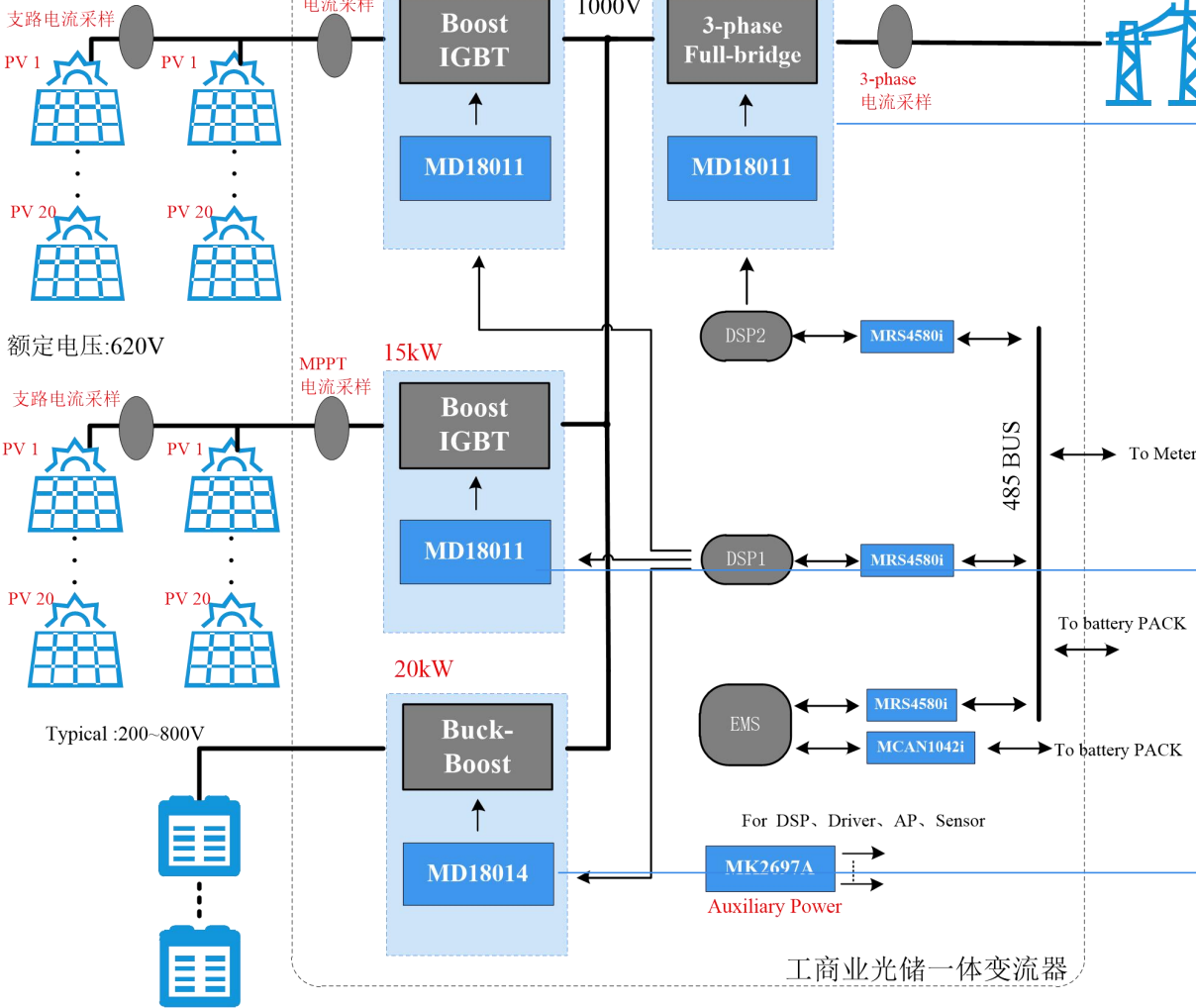
配套SiC MOS的隔离驱动器也在开发中

隔离运放和隔离采样芯片规划中

茂睿芯模拟方案 for 分布式光储系统



最大输入电压: 1000V
MPPT电压范围:200-850V



茂睿芯——中大功率模拟芯片专家

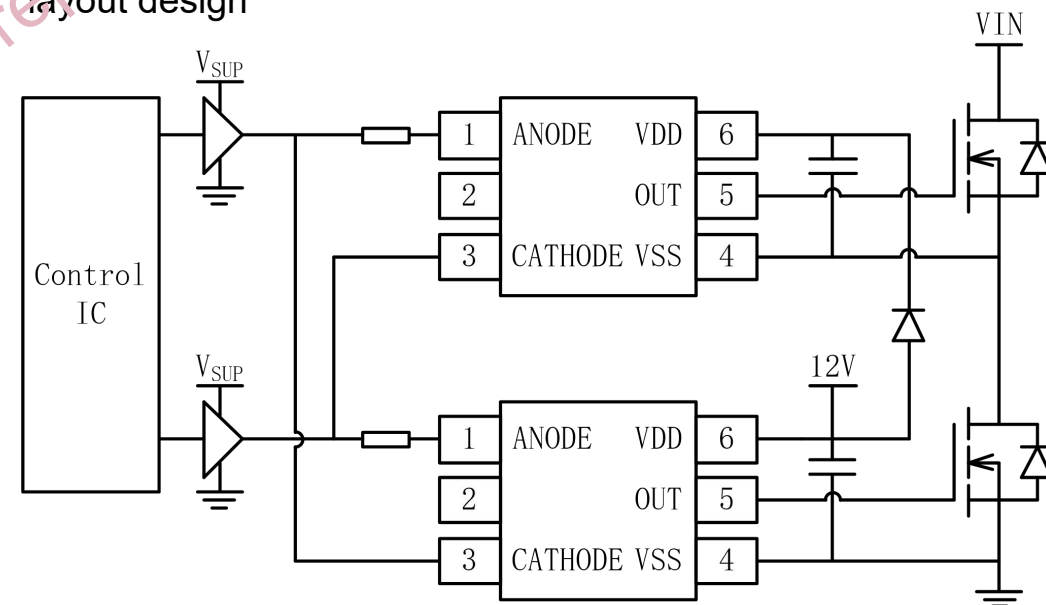
Benefits

- Pin-to-pin, drop in upgrade for opto isolated gate drivers
- 4-A Source and 6-A Sink Peak Currents
- CMTI greater than 200V/ns
- 16V reverse polarity voltage handling capability on input stage supporting interlock
- Up to 30V output side supplies: 8V and 12V UVLO options
- 5us fast UVLO
- Available in SOP-6 packages
- 5.7kV_{RMS} isolation for 1minute per UL 1577

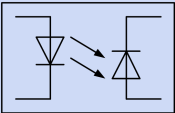
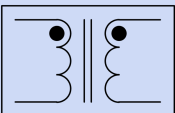
- Isolation barrier life >50 Years
- Bring significant performance and reliability upgrades over opto-coupler based gate drivers
- Maintaining pin-to-pin compatibility in both schematic and layout design

Applications

- Isolated AC-DC and DC-DC power supplies
- Sever, telecom, IT and industrial infrastructures
- HEV and EV battery chargers

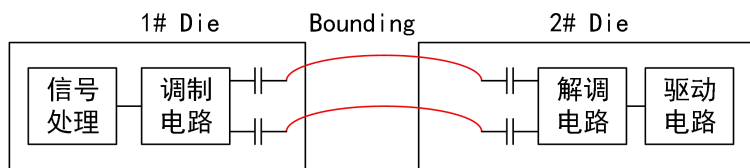


非电容隔离技术平台

隔离技术	优势	劣势
光耦隔离 	- 技术成熟 - 成本低	- 光衰导致寿命降低 - CMTI低
电容隔离 	- 较易实现 - 封装简单	- CMTI不易提高 - IMD工艺影响绝缘耐压
磁隔离 	- CMTI高 - 绝缘耐压高，可靠性高	ADI方法成本高

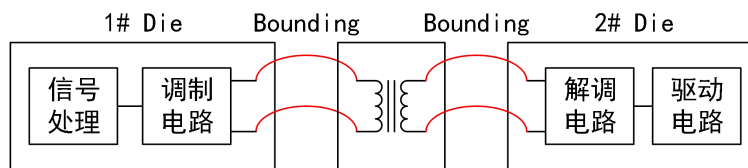
大功率、强噪声应用领域，非电容隔离更加可靠！

电容隔离



- IMD工艺限制，需要双电容保证绝缘
- 任意一颗die失效，绝缘等级降低

传统磁隔离



- 线圈制成需要单独die，芯片由3个die合封
- 任意一颗单晶粒失效后，绝缘等级不变

茂睿芯非电容隔离技术



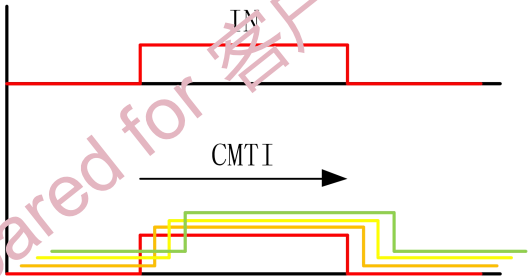
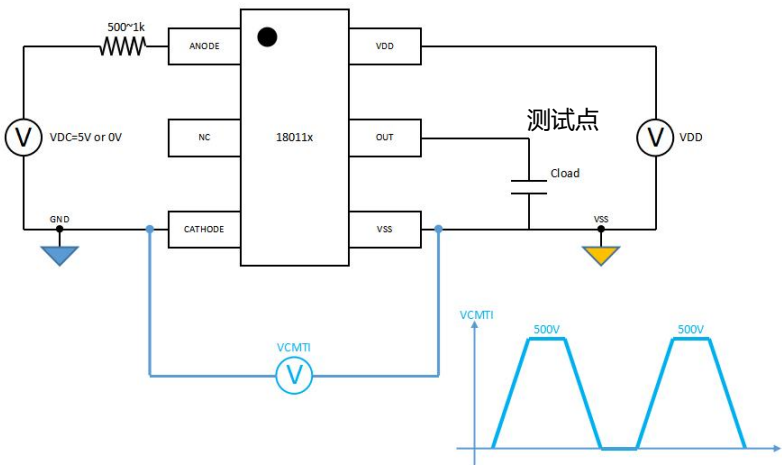
- 2个die通过非电容隔离
- 任意一颗单晶粒失效后，绝缘等级不变

茂睿芯——中大功率模拟芯片专家

MD18011 优势分析

	MD18011	友商1	友商2	友商3	友商4	友商5
驱动电流	4A/6A	1.5A/2A	4.5A/5.3A	1.8A/4A	5.2A/5.4A	1.5A/2A
VDD耐压	30V	35V	35V	30V	35V	35V
输入反相耐压	16V	14V	14V	NA	6.5V	5V
CMTI	200V/ns	150V/ns	150V/ns	50V/ns	150V/ns	25V/ns
开通延时	80ns	70ns	70ns	40ns	75ns	300ns
关断延时	80ns	70ns	70ns	30ns	69ns	300ns
Pulse Width Distortion	5ns	35ns	35ns	17ns	35ns	300ns
VDD UVLO解除延时	5us	20us	20us	16us		0.8us

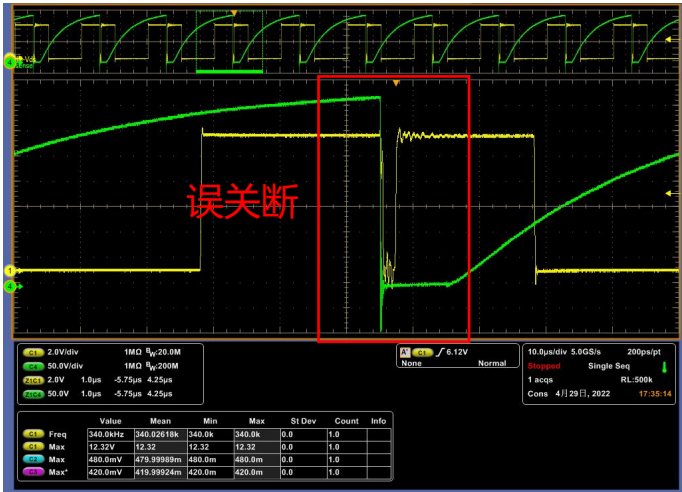
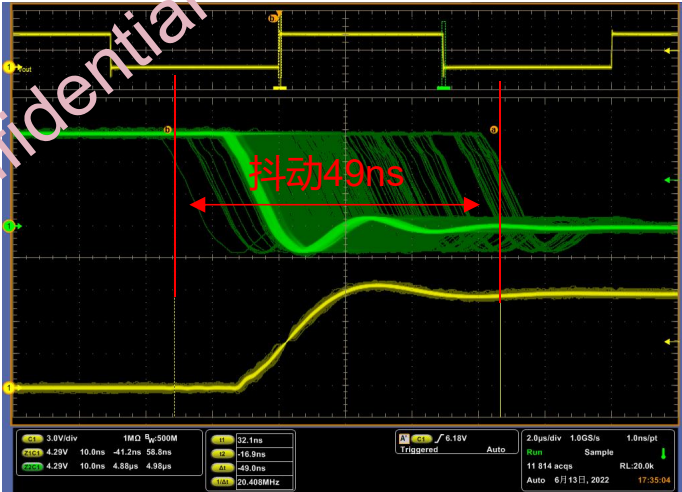
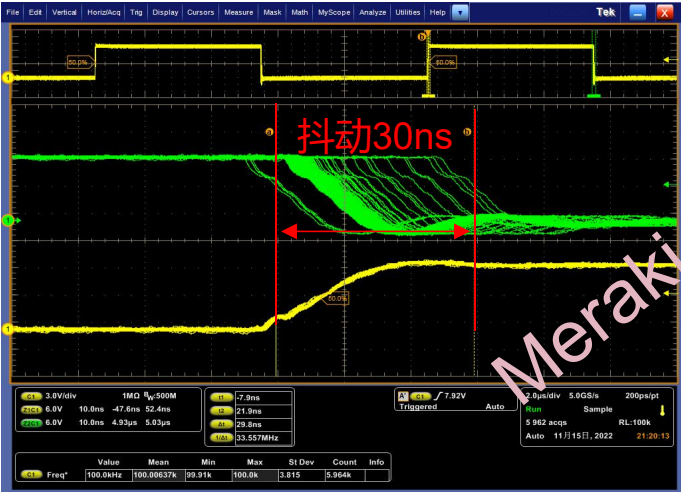
竞品动态CMTI对比-MD18011受CMTI影响最小!



MD18011

友商1

友商2



黄色:上升沿 绿色:下降沿

黄色:上升沿 绿色:下降沿

黄色:OUT 绿色:CMTI

安规耐压对比-MD18011耐压可更高!

P2P样品的短期耐压（60s）测试情况：

竞品厂商	UL1577规格	VDE0884-11规格	实测耐压值（失效）
友商1	5700V _{RMS}	8000V _{PK}	10500V _{RMS}
友商2	5700V _{RMS}	8000V _{PK}	12500V _{RMS}
友商3	5700V _{RMS}	8000V _{PK}	13500V _{RMS}
友商4	5000V _{RMS}	7000V _{PK}	6500V _{RMS}
MD18011	5700V _{RMS}	8000V _{PK}	14000V _{RMS}

✓ 物理隔离：绝缘耐压可以更高



MD18023/5: 双通道 高CMTI 隔离驱动器

对标 S*8**3/5, U**21*2*



Features

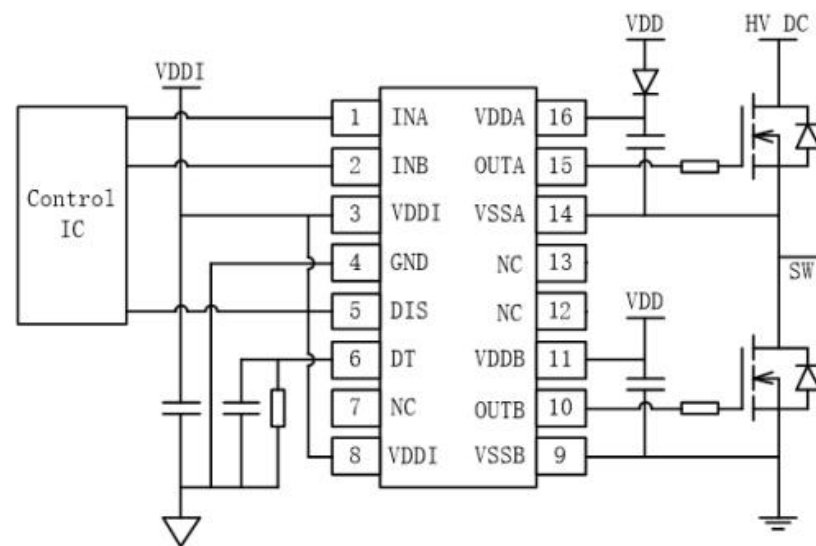
- Universal: dual low-side, dual high-side and half bridge driver
- 4-A Source and 6-A Sink Peak Currents
- CMTI greater than **200V/ns**
- Input Pins Can Tolerate **-10V to +28V**, and are Independent of Supply Voltage Range
- Fast disable for power sequencing
- TTL Compatible Inputs
- Up to 30V input side and output side supplies: 6V, 8V and 13V UVLO options
- **5us fast UVLO**
- Available in SOP-14, SOP-14 wide body and LGA-13 Packages
- 5kV_{RMS} isolation for 1minute per UL 1577

Applications

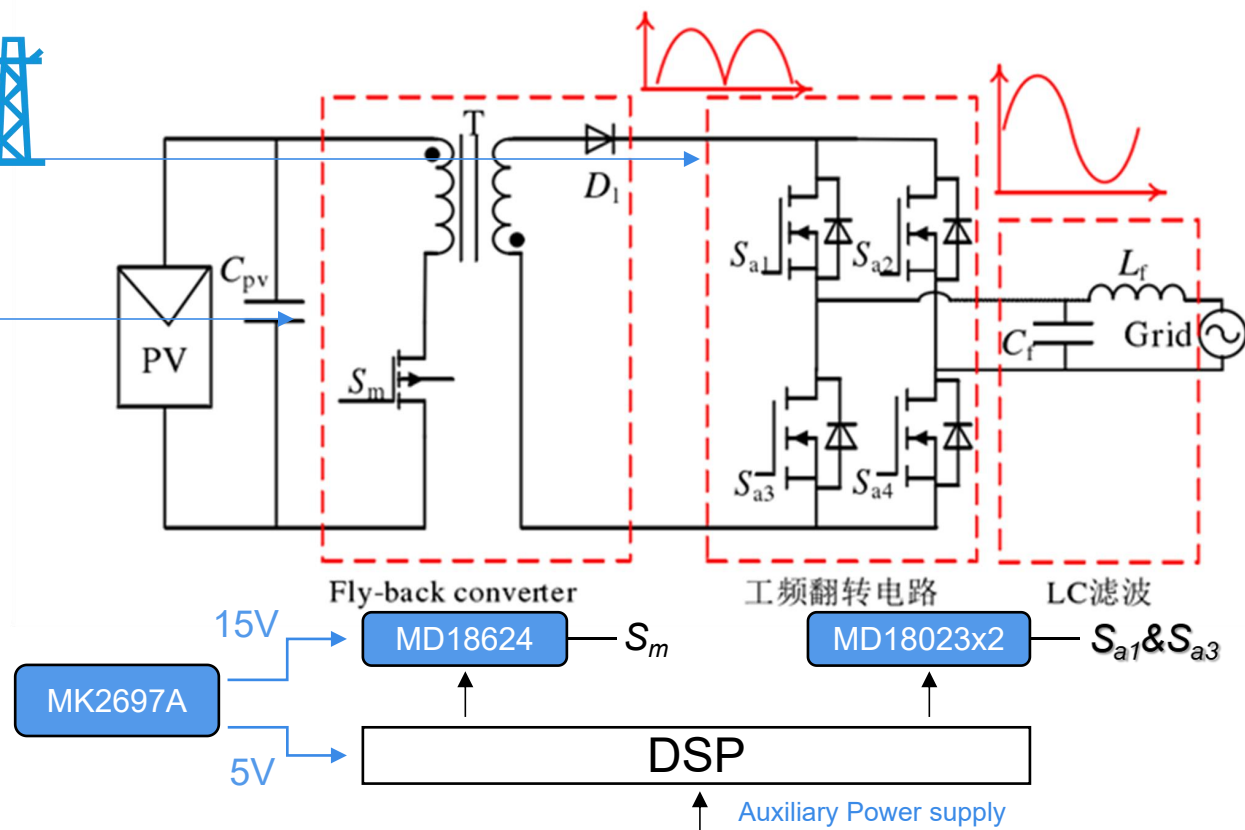
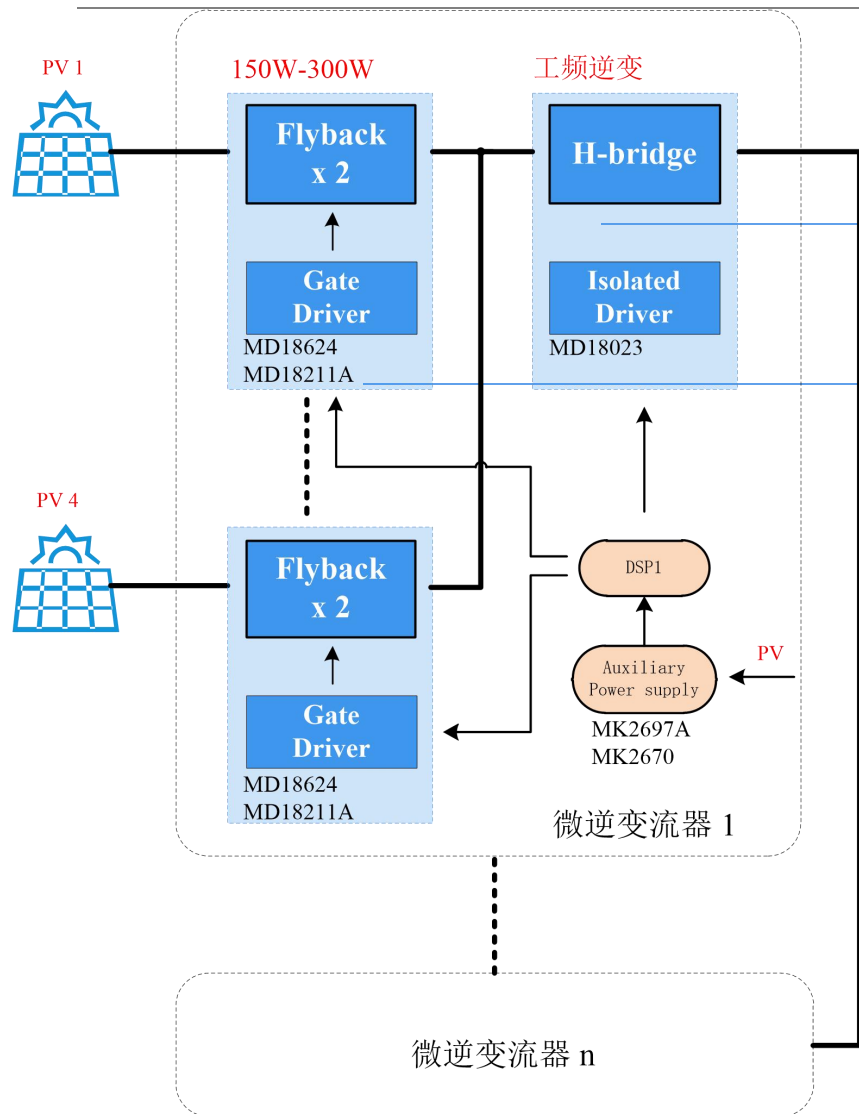
- Isolated AC-DC and DC-DC power supplies
- Server, telecom, IT and industrial infrastructures
- HEV and EV battery chargers

Benefits

- Fast UVLO, suit for deep burst mode of LLC
- Wide range voltage input and VDDI rating
- Function safety for DT pin



茂睿芯模拟方案 for 微逆



✓ MK2697A: 高频QR, SOT23-6, 高压耐压110V

✓ MD18023 : CMTI, 200V/ns

茂睿芯——中大功率模拟芯片专家

随着**新能源汽车**快速普及，**茂睿芯**推出了相关领域的芯片：

高边快关 MS1810/MSD1820

车规级接口芯片 MCAN1042/1145

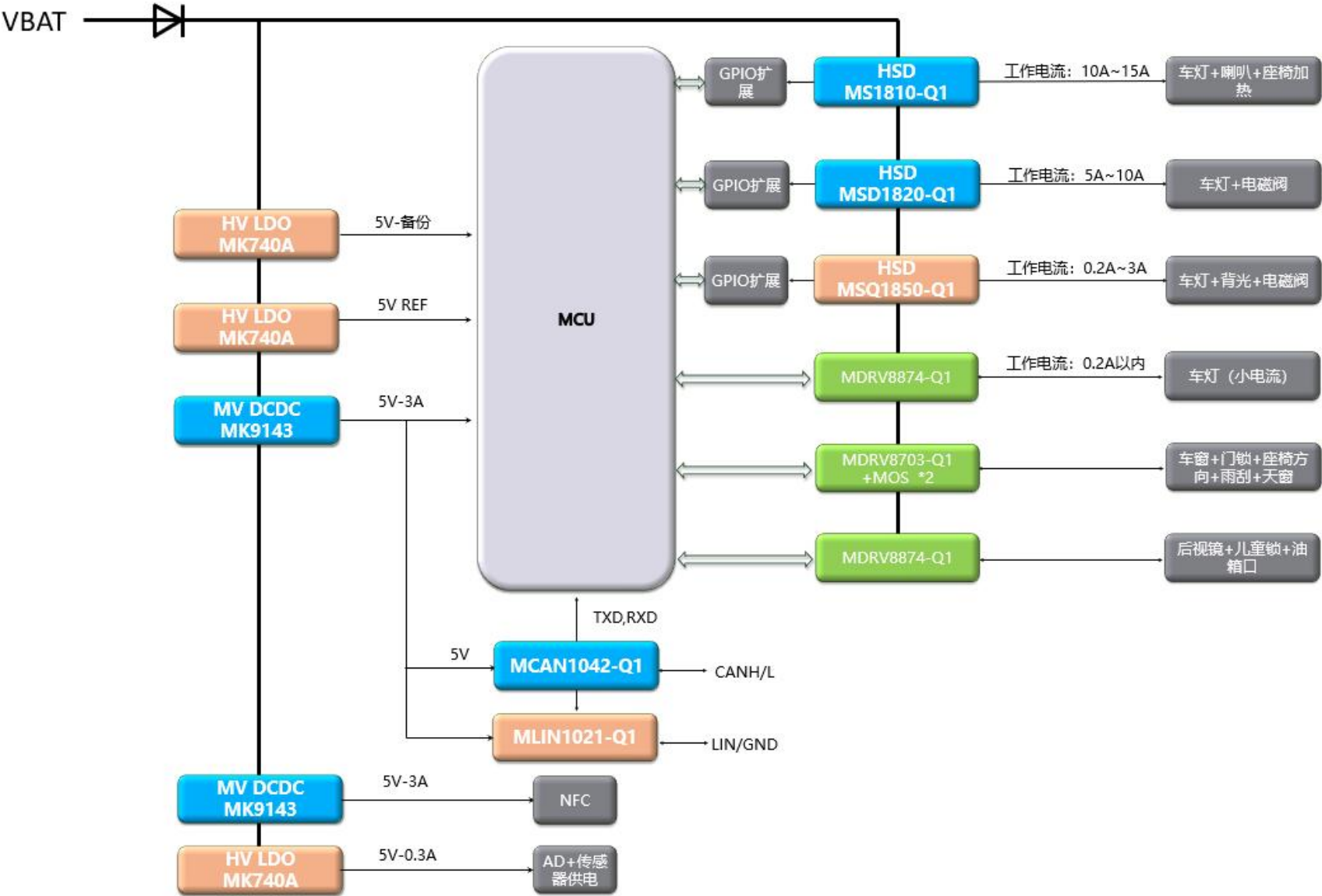
车规级驱动芯片 MD18624等

E-fuse MSF1848也在开发中

电驱所需SiC 驱动也在开发中

隔离运放和隔离采样芯片规划中

茂睿芯模拟方案 for 域控



量产

开发

预研

MSD1820-Q1

Dual 40V 7A(25°C) Load Capacity High-side Driver

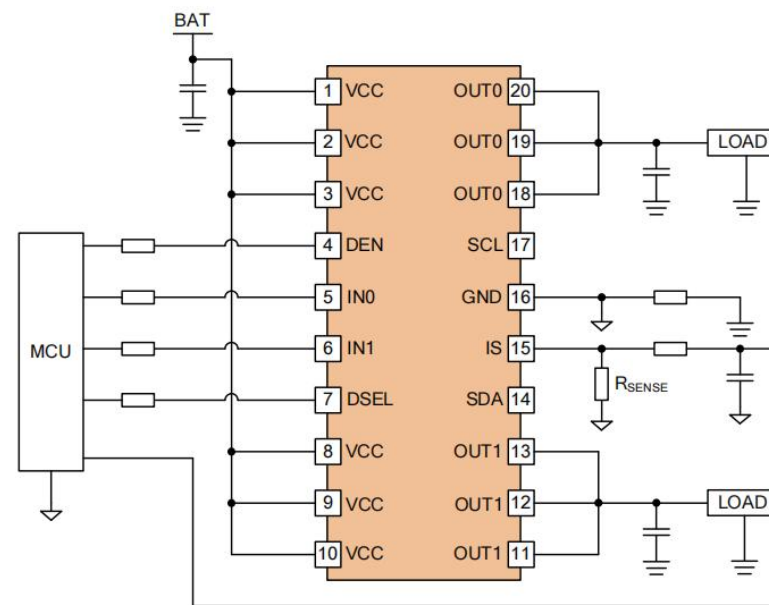


Features

- 4-28V VCC for 12V System
- **5A** (85°C Ta per CH) load capacity
- **7A** (25°C Ta per CH) load capacity
- **30mΩ** On-state resistance
- 30A Overcurrent protection
- AEC-Q100 qualified
- **Diagnostic:** Load current, Open Load, TSD, Short circuit to GND
- **Protections:** UVP, VCC Clamp, OCP, OTP, Reverse Battery

Applications

- All types of Automotive resistive, inductive and capacitive loads
- Replaces electromechanical relays, fuses and discrete circuits
- Driving capability suitable for 5 A loads and high inrush current loads such as 2 x P21W lamps or equivalent electronic loads (e.g. LED modules)



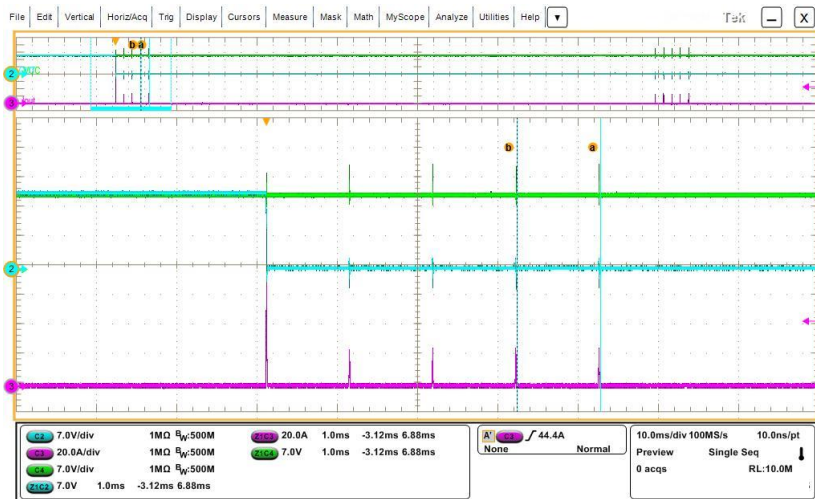
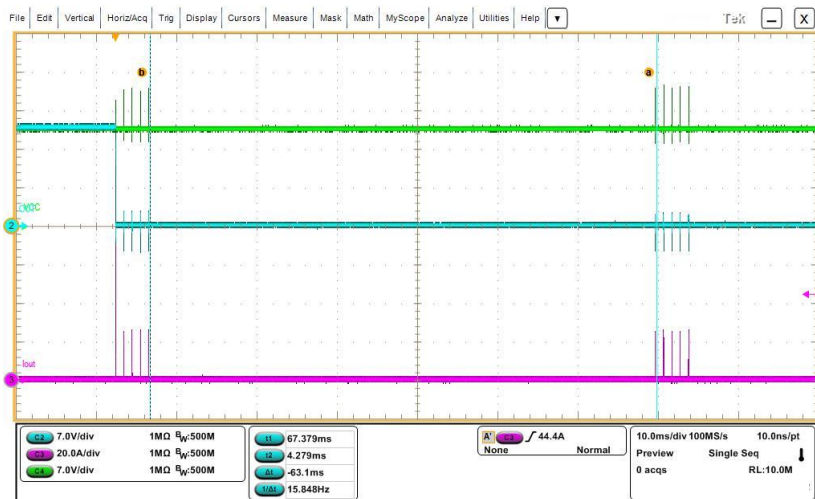
对比点	保险丝+继电器	HSD
保护功能	Y	Y
电流监测	No	Y
时序控制	Y	Y
降低待机损耗	Y	Y
浪涌电流控制	No	Y
可恢复	No	Y
占板面积小	No	Y

双通道车规高边开关 竞争分析

关键参数	MSD1820-Q1	友商S	友商I
封装	ETSSOP-20 GND热焊盘	PowerSSO-16	TSDSO-14
通道数	2	2	2
工作电压范围	4.5-28V	4-28V	4.1-28V
最大耐受电压	35V	38V	35V
$R_{ds(ON)}$	30mΩ@25°C 55mΩ@150°C	27mΩ@25°C 56mΩ@150°C	13.5mΩ@25°C 25mΩ@150°C
稳态负载电流能力	5A (per CH, Ta=85°C) 常温实测总14A负载能力	常温实测总11A负载能力	常温实测总14.4A负载能力
静态电流	0.6uA@18V, 85°C	0.5uA@13V, 85°C	0.6uA@18V, 85°C
电流检测倍率	2760 (3% - 15%)	2380 (5% - 25%)	2715 (3.8% - 23.5%)
过流保护阈值	60A	/	60A
限流保护阈值	30A	61A	/
过温保护阈值	T>175°C ΔT>70°C	T>175°C ΔT>60°C	T>175°C ΔT>80°C
开路检测阈值	Vout>3V	Vout>3V	Vds<1.8V
电池反接保护	√	×	√
电机应用 dVOUT / dt	30V/us	/	10V/us

- 散热GND焊盘, 85°C环温, 稳态 5A 负载
- 100mA-5A, 电流上报误差 <5%
- 集成限流/过流/过温保护, 过流保护时间 <2us
- 电池反接保护, 无需防反二极管
- 耐受更快输出变化斜率, 避免器件误开关

MSD1820-Q1 更可靠的保护策略



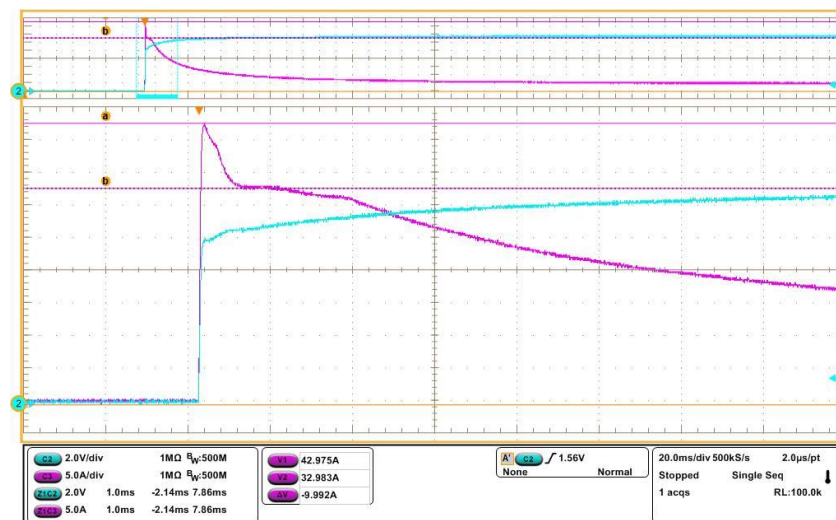
优势:

- ✓ OCP和OTP后进行1ms&64ms的retry策略如下:
- ✓ retry的间隔时间1ms, 若连续触发5次1ms的retry, 则间隔64ms, 用于产品散热, 提高运行可靠性;



实例1: 挑战10000uF容性负载
(冲击电流63A)

----1s时间OUT建立完成



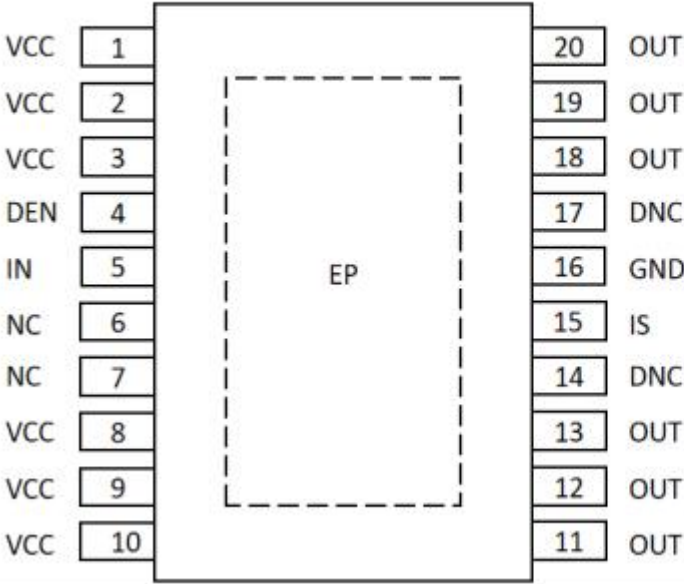
实例2: 挑战55W卤素大灯(43A冲击电流)

----高温85°C一次开启

茂睿芯——中大功率模拟芯片专家

单通道

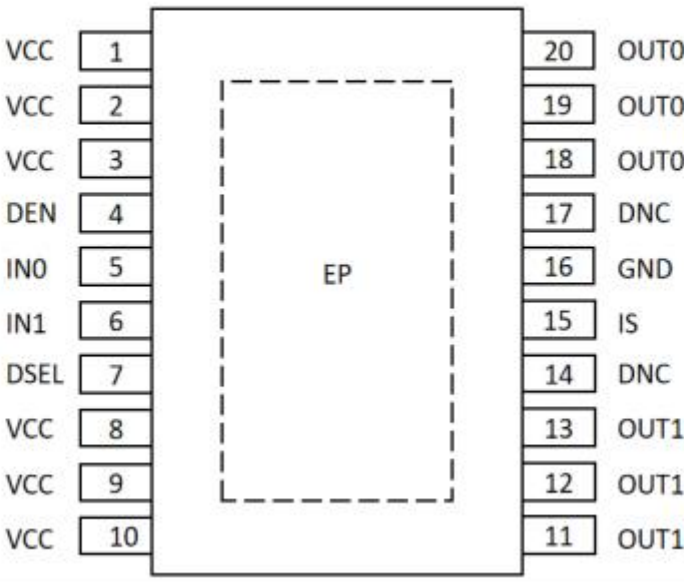
MS1810-Q1



汽车认证中

双通道

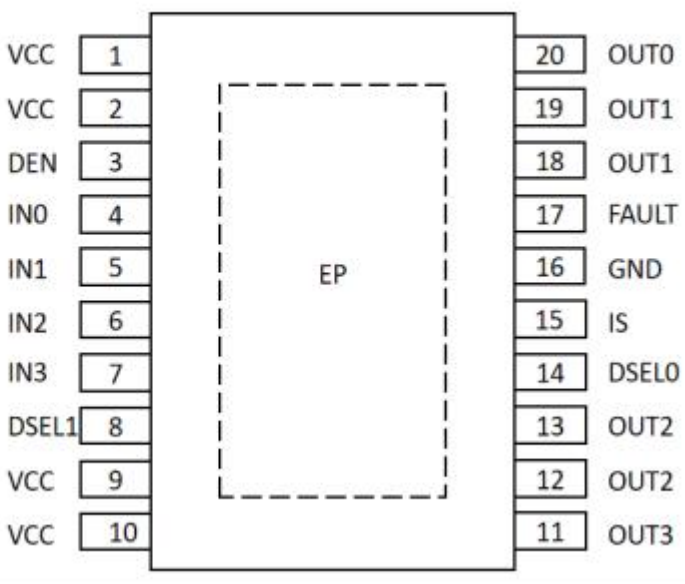
MSD1820-Q1



汽车认证中

四通道

MSQ1850-Q1



23Q4样品

*ETSSOP-20封装

茂睿芯机密

“芯”长大海 乘风破浪

更多信息，欢迎大家关注茂睿芯公众账号

