Vincotech

高效功率模块让您的充电桩动力倍增

提高效率，达到最佳性能

EMPOWERING **YOUR IDEAS**

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公路、匝道和车道旁涌现出越来越多的电动汽车（EV）充电桩。随着可用性问题的解决，EV车主们开始关注这种设备的可靠性，以及与充电相关的能源成本问题。设备厂商必须对此做出回应。

商业充电站通过低频变压器直接连接到公共中压配电网，这种变压器可以将功率等级提升到300 kW或是更高。在这种情况下，电能越多，意味着充电的速度越快。

充电桩通常由电力转换装置、控制电路、与BMS（电池管理系统）的通信和用户界面组成。电力电子设备又由PFC（功率因数校正）和DC/DC转换器两部分组成。

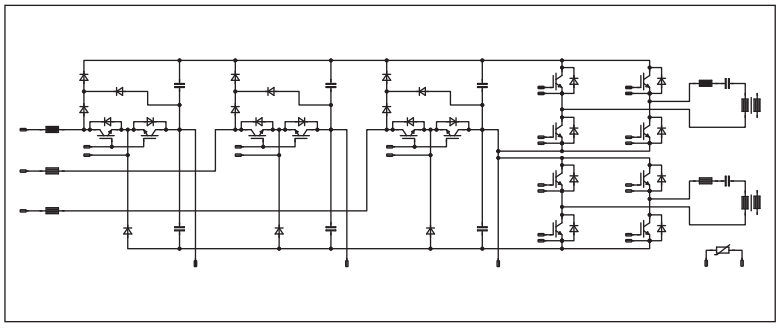


图1： 充电桩控制电路

三相功率因数校正

图4所示为三相PFC电路中的一相。PFC的主要作用有控制充电机的输入电流，使之成为与电网电压同相的正弦形状。ANPFC中的“A”代表高级，表明这是中点升压PFC（NPFC）的拓扑变种。

两个半导体开关T13和T14用于控制电流。它们可以是同步控制的。T13与T14为共源连接形式，因此这样的拓扑仅需一个栅极驱动器和一个悬浮电源。

DC+和GND之间的电压范围可达500 V，DC+和DC-之间的总输出电压高达1000 V。

ANPFC和SPFC的开关损耗和静态损耗是分别一致的，但ANPFC只需一套栅极驱动电路（驱动器IC和电源），因此模块和系统的最终成本较低。事实上，ANPFC的效率比Vienna整流的效率高15%，后者是一个众所周知且应用广泛的选择方案。

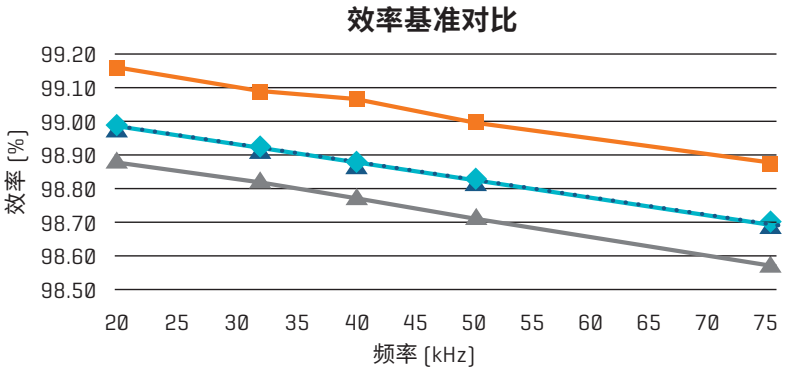


图2：效率基准对比

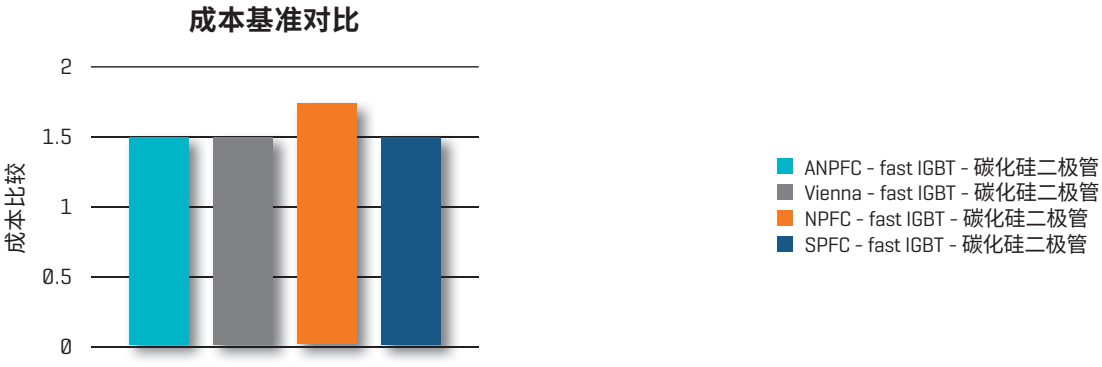


图3：成本基准对比

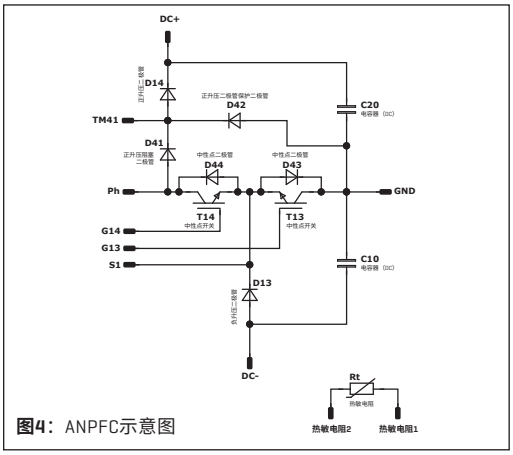


图4：ANPFC示意图

ANPFC的效率比现今被广泛应用的VIENNA整流方案的效率高出**15%**

DC/DC转换器

DC/DC转换器可提供电隔离，并将输出电压调整为电池电压，这是荷电状态（SOC）的一项功能。空电池初始以三相恒流充电开始，继而进入恒定功率状态，最终则以电池恒压控制结束。

谐振式DC/DC转换器已在电信和通讯电源中使用多年。例如，零电压切换（ZVS）移相电源转换器和LLC谐振转换器都支持零电压半导体开通，从而有助于减小开关损耗和电磁干扰（EMI）。LLC谐振转换器保持了即使在轻负载下也能进行ZVS开通的优势，因此在这些情况下效率较高。这就是近年来工程师们在充电应用中青睐LLC谐振转换器的原因。如果主变压器具有铁氧体磁芯，那么磁芯和绕组在130 kHz左右是最佳的工作点。

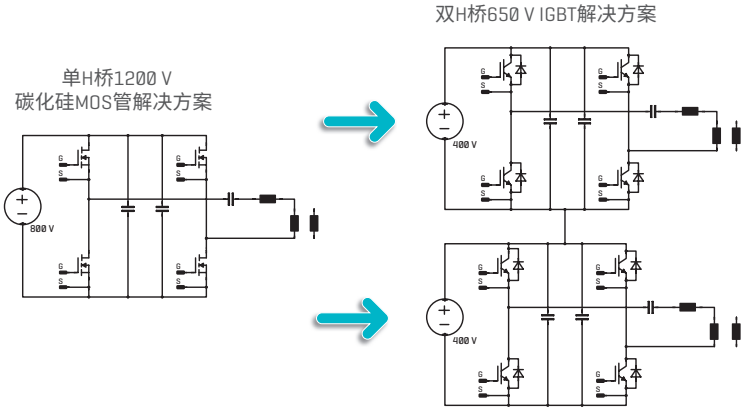


图5：具有双H桥的DC/DC转换器

在合理的目标效率下以1200 V硅半导体开关实现这种高开关频率并不容易。

尽管可以选择1200 V宽带隙碳化硅MOSFET，但它们也比标准硅器件解决方案贵得多。另外一种选择的成本则会低很多，充分考虑利用PFC半母线电压，即它到DC+和DC-均为400V，以及具有650 V MOSFET或具备快速开关能力的IGBT的两个串联半桥（H-bridge）。该双H桥配置如图5所示。

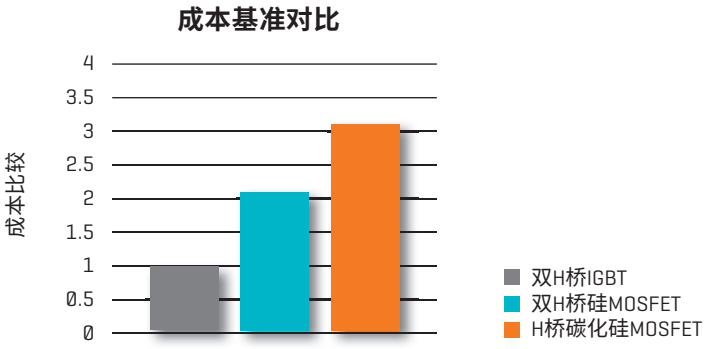


图6：成本基准对比

下图将轻负载和满载下的LLC模块效率分别与配置1200 V 碳化硅 MOSFET的单H桥效率和配置650 V MOSFET和650 V IGBT的双H桥效率进行了比较。

配置650V快速开关IGBT的双H桥与更为昂贵的具有1200 V碳化硅MOSFET的单H桥拥有几乎相同的效率。

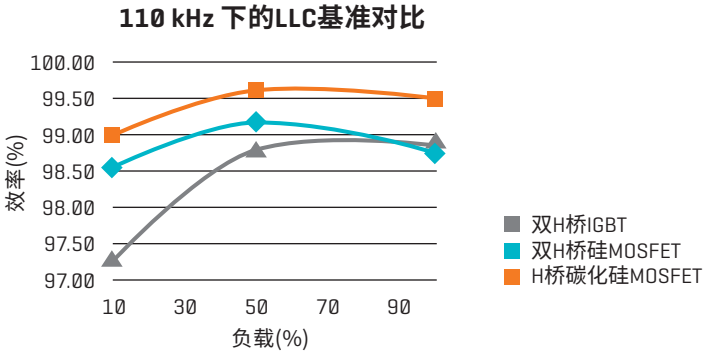
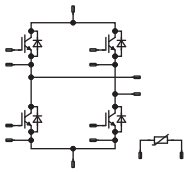
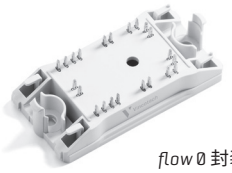


图7：效率基准对比

充电站
产品组合



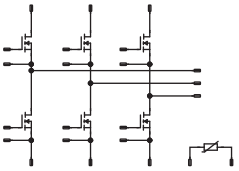


flow 0 封装

flow 1 封装

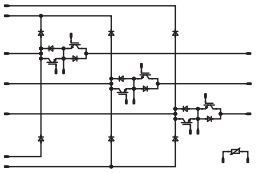
DC/DC 转换器 H桥拓扑

产品型号	拓扑	芯片技术	电压	电流	封装
10-PZ074PA030SM-L623F08Y	H-BRIDGE	IGBT H5	650 V	30 A	*flow* 0
10-PZ074PA050SM-L624F08Y	H-BRIDGE	IGBT H5	650 V	50 A	*flow* 0
10-PZ074PA075SM-L625F08Y	H-BRIDGE	IGBT H5	650 V	75 A	*flow* 0
10-PY074PA100SM-L583F08Y	H-BRIDGE	IGBT H5	650 V	100 A	*flow* 1
10-PY074PA100SM01-L583F18Y	H-BRIDGE	IGBT H5	650 V	100 A	*flow* 1
10-PY074PA020CR-L582F78Y	H-BRIDGE	Infineon CoolMOS™ CFD2	650 V	80 A	*flow* 1
10-PY074PA040CR-L581F78Y	H-BRIDGE	Infineon CoolMOS™ CFD2	650 V	40 A	*flow* 1
10-PZ074PA080CR-L622F68Y	H-BRIDGE	Infineon CoolMOS™ CFD2	650 V	20 A	*flow* 0
V23990-P627-F88-PM	H-BRIDGE	IGBT4 HS	1200 V	15 A	*flow* 0
V23990-P729-F48-PM	H-BRIDGE	IGBT4 HS	1200 V	40 A	*flow* 0
V23990-P629-F48-PM	H-BRIDGE	IGBT4 HS	1200 V	40 A	*flow* 0
10-PY124PA040SH-L588F48Y	H-BRIDGE	IGBT4 HS	1200 V	40 A	*flow* 1
10-PY124PA040FV-L588F88Y	H-BRIDGE	Trench Field Stop IGBT	1200 V	40 A	*flow* 1
10-PY124PA080SH-L589F48Y	H-BRIDGE	IGBT4 HS	1200 V	80 A	*flow* 1
10-PY124PA080FV-L589F88Y	H-BRIDGE	Trench Field Stop IGBT	1200 V	80 A	*flow* 1
10-PC124PA040MR-L638F18Y	H-BRIDGE	SiC-MOS	1200 V	35 A	*flow* 0
10-PY124PA020MR03-L227F38Y	H-BRIDGE	SiC-MOS	1200 V	50 A	*flow* 1
10-PC094PB065ME01-L637F06Y	H-BRIDGE	SiC-MOSFET	900 V	20 A	*flow* 0
10-PC094PB035ME02-L629F36Y	H-BRIDGE	SiC-MOSFET	900 V	40 A	*flow* 0
10-PC094PB017ME02-L620F36Y	H-BRIDGE	SiC-MOSFET	900 V	80 A	*flow* 0



SIXPACK拓扑

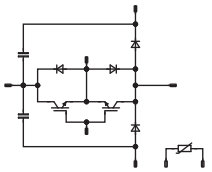
产品型号	拓扑	芯片技术	电压	电流	封装
10-PZ126PA080ME-M909F18Y	SIXPACK	SiC-MOSFET	1200 V	35 A	*flow* 0
10-PZ126PA080MR-M909F28Y	SIXPACK	SiC-MOSFET	1200 V	35 A	*flow* 0
10-PY126PA020ME-L227F18Y	SIXPACK	SiC-MOSFET	1200 V	65 A	*flow* 1
10-PY126PA020MR-L227F28Y	SIXPACK	SiC-MOSFET	1200 V	65 A	*flow* 1
10-PY126PA040MR-L226F28Y	SIXPACK	SiC-MOSFET	1200 V	35 A	*flow* 1
10-PY096PA035ME-L224F18Y	SIXPACK	SiC-MOSFET	900 V	40 A	*flow* 1
10-PH126PA010MR-L820F86T	SIXPACK	SiC-MOSFET	1200 V	100 A	*flow* 1



flow 1 封装

3XNPFC拓扑

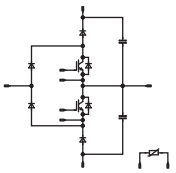
产品型号	拓扑	芯片技术	电压	电流	封装
10-TY12NMB030SM-L394L08	NPFC	IGBT5 H5	650 V	100 A	*flow* 0



flow 0 封装

NPFC拓扑

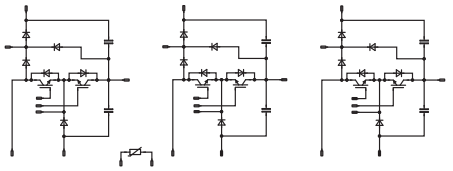
产品型号	拓扑	芯片技术	电压	电流	封装
10-FZ07LBA100SM03-L705L08	NPFC	IGBT5 H5	650 V	100 A	*flow* 0
10-FZ07LBA100SM01-L705L18	NPFC	IGBT5 H5	650 V	100 A	*flow* 0



flow 0 封装

SFC拓扑

产品型号	拓扑	芯片技术	电压	电流	封装
10-FZ071SA075S501-L525L58	SPFC	IGBT5 S5	650 V	75 A	*flow* 0
10-FZ071SA050SM02-L524L18	SPFC	IGBT5 H5	650 V	50 A	*flow* 0
10-FZ071SA075SM02-L525L18	SPFC	IGBT5 H5	650 V	75 A	*flow* 0
10-FZ071SA100SM02-L526L18	SPFC	IGBT5 H5	650 V	100 A	*flow* 0



flow 0 封装

3XANPFC / ANPFC / 整流器拓扑

产品型号	拓扑	芯片技术	电压	电流	封装
10-PY073AA050RG01-LK14L08Y	3xANPFC	IGBT FAST	650 V	50 A	*flow* 1
10-PY073AA050RG02-LK14L03Y	3xANPFC	IGBT FAST	650 V	50 A	*flow* 1
10-PZ07ANA080RV02-LK38L88Y	ANPFC	IGBT FAST	650 V	80 A	*flow* 0
10-PZ07ANA100RG02-LK39L88Y	ANPFC	IGBT FAST	650 V	100 A	*flow* 0
10-PZ07ANA100RG03-LK39L38Y	ANPFC	IGBT FAST	650 V	100 A	*flow* 0
10-PZ06O2A030FW-LH02J08Y	Rectifier	Fast Diode	600 V	30 A	*flow* 0
10-PG07ORA160RF-LJ53I88T	Rectifier	Fast Diode	650 V	160 A	*flow* 1

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Vincotech 新浪微博二维码

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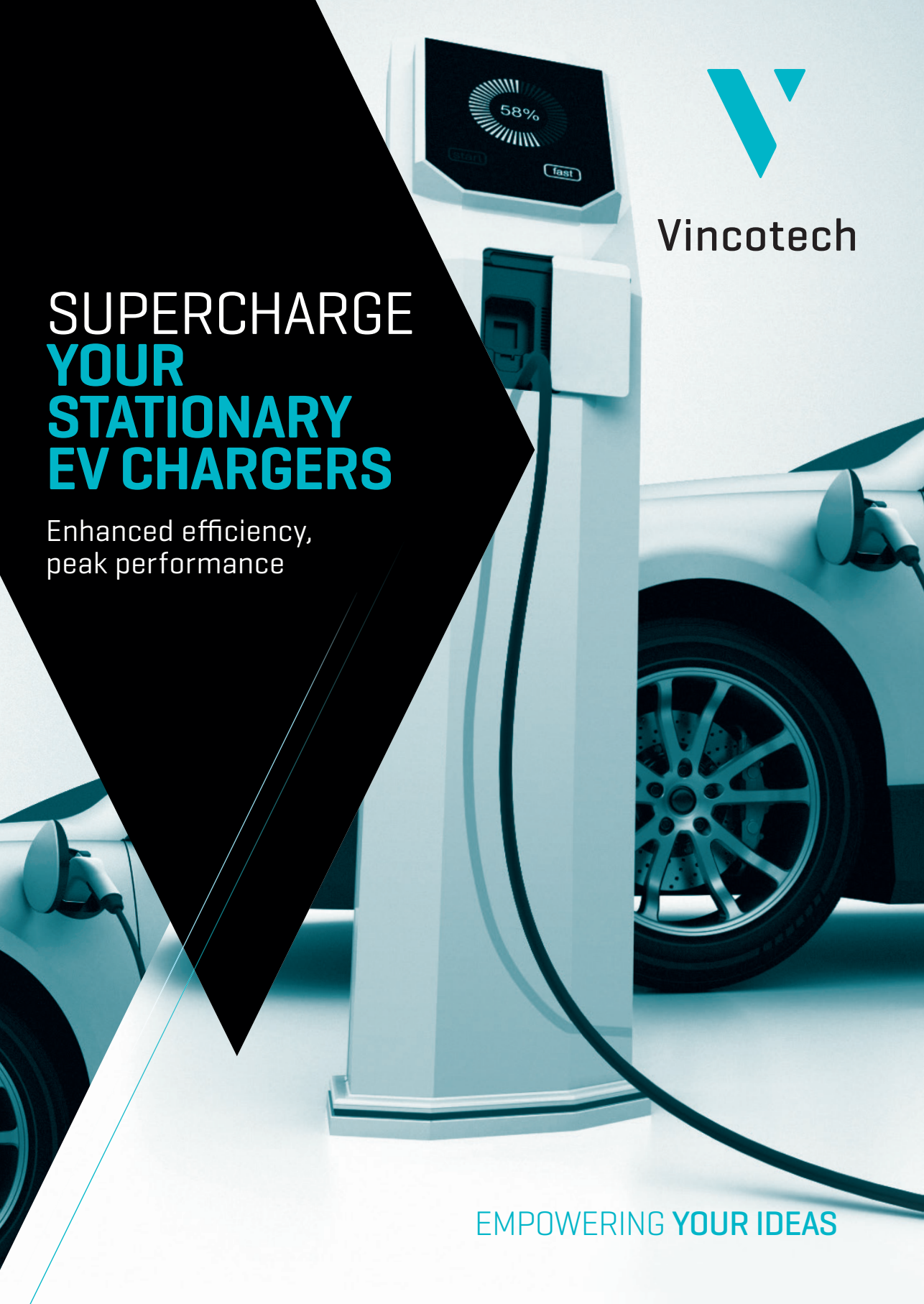


Vincotech

SUPERCHARGE YOUR STATIONARY EV CHARGERS

Enhanced efficiency,
peak performance

EMPOWERING **YOUR IDEAS**

SUPERCHARGE YOUR STATIONARY EV CHARGERS

Enhanced efficiency, peak performance

More and more electric vehicle (EV) charging points are sprouting up along highways, byways and driveways. As availability becomes less of an issue, EV owners are starting to look closer at this equipment's reliability and the energy costs associated with charging. Equipment vendors have to respond.

The commercial charger stations are connected directly to a public medium-voltage distribution network via a low frequency transformer, which increases power levels to 300 kW and beyond. In this case, more electrical power can mean faster charging.

A stationary charger unit typically consists of the power electronics, control circuitry, communication with the BMS (battery management system), and the user interface. Power electronics, in turn, consist of two parts, PFC (power factor correction) and the DC/DC converter.

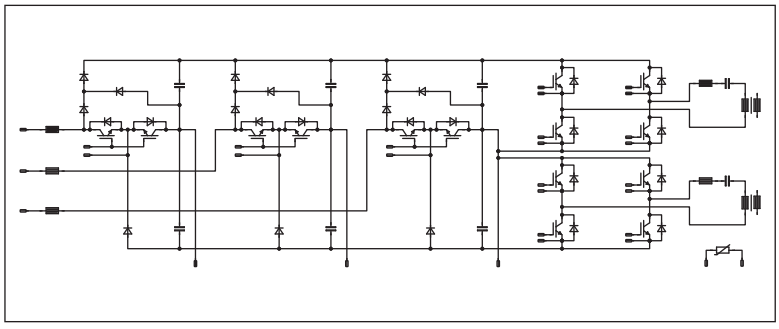


Figure 1: Block diagram of stationary charger

THREE-PHASE
Power Factor Correction

The PFC shapes the charger's input current so that it is sinusoidal and in phase with the grid voltage. Figure 4 depicts one phase of a three-phase PFC circuit. The ‚A' in ANPFC stands for advanced, indicating it is an improved variant of the neutral boost PFC (NPFC).

Two semiconductor switches, T13 and T14, control the current. They may be synchronized. T13 and T14 share a common source connection, so this variant requires just one gate driver and one floating power supply.

The voltage between DC+ and GND may range up to 500 V, and the sum output voltage between DC+ and DC- up to 1000 V.

ANPFC's and SPFC's switching and static loss are equal, but ANPFC has just one gate drive circuit (driver IC and supply), so the module and system end up costing less. In fact, ANPFC's efficiency is 15% higher than that of the Vienna rectifier, a well-known and widely used option.

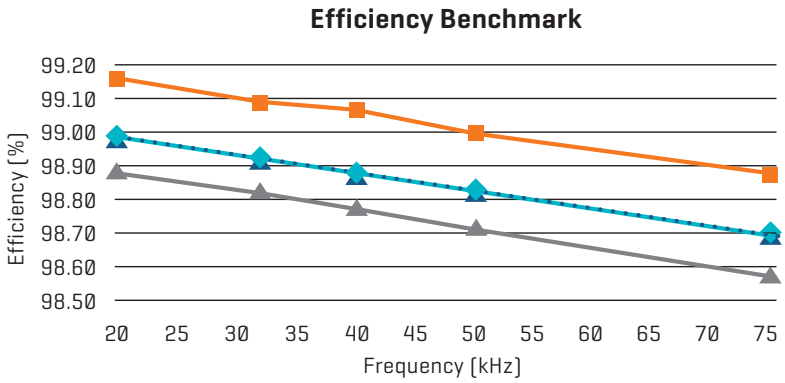


Figure 2: Efficiency Benchmark

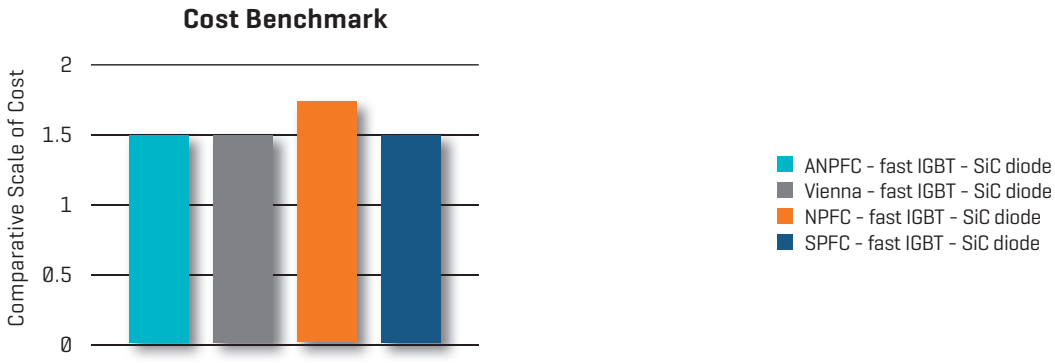


Figure 3: Cost Benchmark

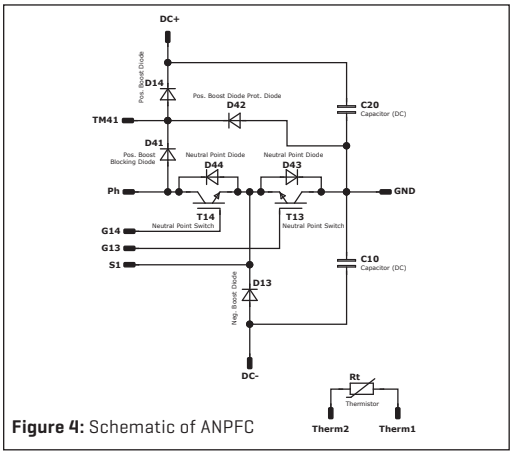


Figure 4: Schematic of ANPFC

ANPFC'S EFFICIENCY IS **15%** HIGHER THAN THAT OF THE VIENNA RECTIFIER, A WELL-KNOWN AND WIDELY USED OPTION

DC/DC Converter

The DC/DC converter provides galvanic isolation and adjusts output voltage to battery voltage, which is a function of the state of charge (SOC). An empty battery is charged in three phases starting with constant current, followed by constant power, and ending with constant control of the battery voltage.

Resonant DC/DC converters have been used for years in telecom and server power supplies. Zero voltage switching (ZVS) phase-shifted power converters and LLC resonant converters, for example, both support zero voltage semiconductor turn-on, which helps reduce switching losses and electromagnetic interference (EMI). The LLC resonant converter retains the advantage of ZVS turn-on even under light loads, so efficiency is high under these conditions. This is why engineers have lately acquired a fondness for LLC resonant converters in charging applications. If the main transformer has a ferrite core, the core and winding work best at a switching frequency of around 130 kHz.

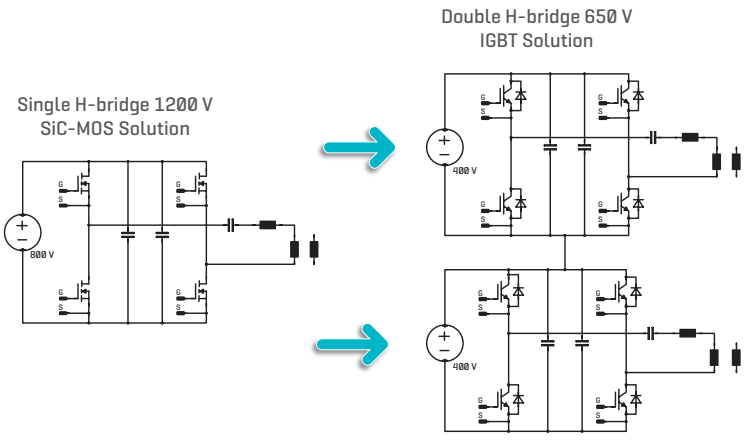


Figure 5: DC/DC converter with double H-bridge

It is not easy to achieve this high switching frequency with 1200 V silicone semiconductor switches at reasonable efficiency.

Although 1200 V wide band-gap SiC MOSFETs are an option, they are also far more expensive than a standard silicon solution. The second option costs a lot less, which is to use the midpoint of the PFC DC link, with its 400 V to DC+ and DC-, and two serial connected half-bridges (H-bridge) with 650 V MOSFETs or fast-switching IGBTs. This double H-bridge configuration is shown in figure 5.

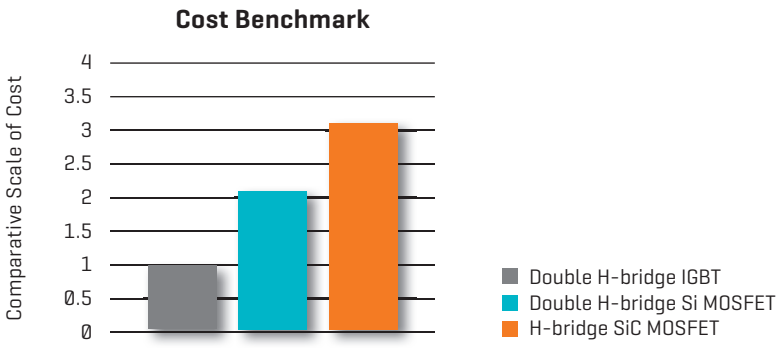


Figure 6: Cost Benchmark

The chart below compares an LLC's module efficiency at light and full load to that of a single H-bridge with 1200 V SiC MOSFETs and to that of a double H-bridge with 650 V MOSFETs and 650 V IGBTs.

The efficiency of the double H-bridge with 650 V fast-switching IGBTs is nearly the same as that of the far more expensive single H-bridge with 1200 V SiC MOSFETs.

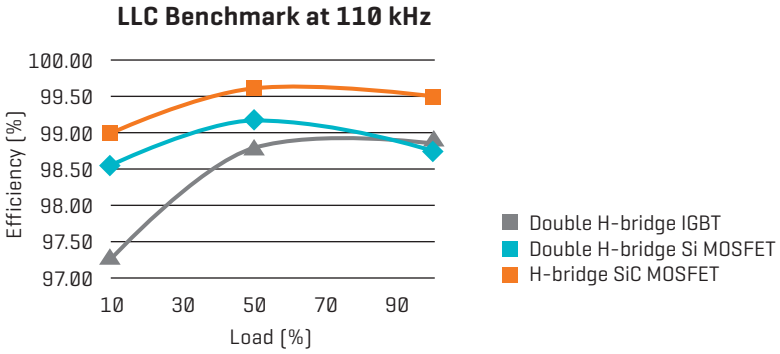
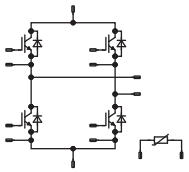
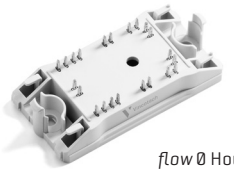


Figure 7: Efficiency Benchmark

CHARGING STATIONS
Product Portfolio



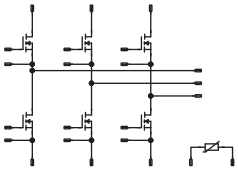


flow 0 Housing

flow 1 Housing

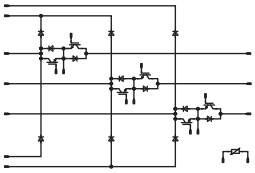
DC/DC CONVERTER H-BRIDGE TOPOLOGY

Part Number	Topology	Chip technology	Voltage	Current	Housing
10-PZ074PA030SM-L623F08Y	H-BRIDGE	IGBT H5	650 V	30 A	*flow* 0
10-PZ074PA050SM-L624F08Y	H-BRIDGE	IGBT H5	650 V	50 A	*flow* 0
10-PZ074PA075SM-L625F08Y	H-BRIDGE	IGBT H5	650 V	75 A	*flow* 0
10-PY074PA100SM-L583F08Y	H-BRIDGE	IGBT H5	650 V	100 A	*flow* 1
10-PY074PA100SM01-L583F18Y	H-BRIDGE	IGBT H5	650 V	100 A	*flow* 1
10-PY074PA020CR-L582F78Y	H-BRIDGE	Infineon CoolMOS™ CFD2	650 V	80 A	*flow* 1
10-PY074PA040CR-L581F78Y	H-BRIDGE	Infineon CoolMOS™ CFD2	650 V	40 A	*flow* 1
10-PZ074PA080CR-L622F68Y	H-BRIDGE	Infineon CoolMOS™ CFD2	650 V	20 A	*flow* 0
V23990-P627-F88-PM	H-BRIDGE	IGBT4 HS	1200 V	15 A	*flow* 0
V23990-P729-F48-PM	H-BRIDGE	IGBT4 HS	1200 V	40 A	*flow* 0
V23990-P629-F48-PM	H-BRIDGE	IGBT4 HS	1200 V	40 A	*flow* 0
10-PY124PA040SH-L588F48Y	H-BRIDGE	IGBT4 HS	1200 V	40 A	*flow* 1
10-PY124PA040FV-L588F88Y	H-BRIDGE	Trench Field Stop IGBT	1200 V	40 A	*flow* 1
10-PY124PA080SH-L589F48Y	H-BRIDGE	IGBT4 HS	1200 V	80 A	*flow* 1
10-PY124PA080FV-L589F88Y	H-BRIDGE	Trench Field Stop IGBT	1200 V	80 A	*flow* 1
10-PC124PA040MR-L638F18Y	H-BRIDGE	SiC-MOS	1200 V	35 A	*flow* 0
10-PY124PA020MR03-L227F38Y	H-BRIDGE	SiC-MOS	1200 V	50 A	*flow* 1
10-PC094PB065ME01-L637F06Y	H-BRIDGE	SiC-MOSFET	900 V	20 A	*flow* 0
10-PC094PB035ME02-L629F36Y	H-BRIDGE	SiC-MOSFET	900 V	40 A	*flow* 0
10-PC094PB017ME02-L620F36Y	H-BRIDGE	SiC-MOSFET	900 V	80 A	*flow* 0



SIXPACK TOPOLOGY

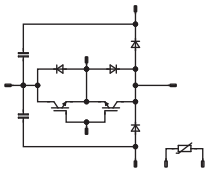
Part Number	Topology	Chip technology	Voltage	Current	Housing
10-PZ126PA080ME-M909F18Y	SIXPACK	SiC-MOSFET	1200 V	35 A	*flow* 0
10-PZ126PA080MR-M909F28Y	SIXPACK	SiC-MOSFET	1200 V	35 A	*flow* 0
10-PY126PA020ME-L227F18Y	SIXPACK	SiC-MOSFET	1200 V	65 A	*flow* 1
10-PY126PA020MR-L227F28Y	SIXPACK	SiC-MOSFET	1200 V	65 A	*flow* 1
10-PY126PA040MR-L226F28Y	SIXPACK	SiC-MOSFET	1200 V	35 A	*flow* 1
10-PY096PA035ME-L224F18Y	SIXPACK	SiC-MOSFET	900 V	40 A	*flow* 1
10-PH126PA010MR-L820F86T	SIXPACK	SiC-MOSFET	1200 V	100 A	*flow* 1

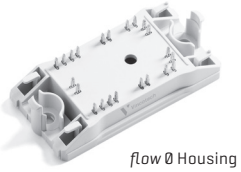


flow 1 Housing

3XNPFC TOPOLOGY

Part Number	Topology	Chip technology	Voltage	Current	Housing
10-TY12NMB030SM-L394L08	NPFC	IGBT5 H5	650 V	100 A	*flow* 0

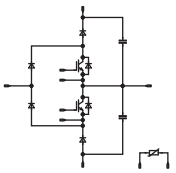


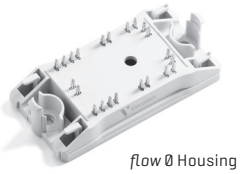


flow 0 Housing

NPFC TOPOLOGY

Part Number	Topology	Chip technology	Voltage	Current	Housing
10-FZ07LBA100SM03-L705L08	NPFC	IGBT5 H5	650 V	100 A	*flow* 0
10-FZ07LBA100SM01-L705L18	NPFC	IGBT5 H5	650 V	100 A	*flow* 0

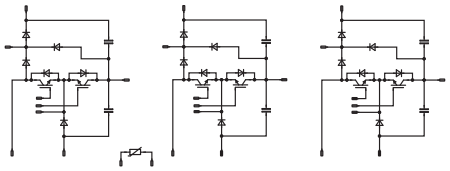


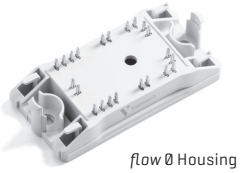


flow 0 Housing

SFC TOPOLOGY

Part Number	Topology	Chip technology	Voltage	Current	Housing
10-FZ071SA075S501-L525L58	SPFC	IGBT5 S5	650 V	75 A	*flow* 0
10-FZ071SA050SM02-L524L18	SPFC	IGBT5 H5	650 V	50 A	*flow* 0
10-FZ071SA075SM02-L525L18	SPFC	IGBT5 H5	650 V	75 A	*flow* 0
10-FZ071SA100SM02-L526L18	SPFC	IGBT5 H5	650 V	100 A	*flow* 0





flow 0 Housing

3XANPFC / ANPFC / RECTIFIER TOPOLOGY

Part Number	Topology	Chip technology	Voltage	Current	Housing
10-PY073AA050RG01-LK14L08Y	3xANPFC	IGBT FAST	650 V	50 A	*flow* 1
10-PY073AA050RG02-LK14L03Y	3xANPFC	IGBT FAST	650 V	50 A	*flow* 1
10-PZ07ANA080RV02-LK38L88Y	ANPFC	IGBT FAST	650 V	80 A	*flow* 0
10-PZ07ANA100RG02-LK39L88Y	ANPFC	IGBT FAST	650 V	100 A	*flow* 0
10-PZ07ANA100RG03-LK39L38Y	ANPFC	IGBT FAST	650 V	100 A	*flow* 0
10-PZ06O2A030FW-LH02J08Y	Rectifier	Fast Diode	600 V	30 A	*flow* 0
10-PG07ORA160RF-LJ53I88T	Rectifier	Fast Diode	650 V	160 A	*flow* 1

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