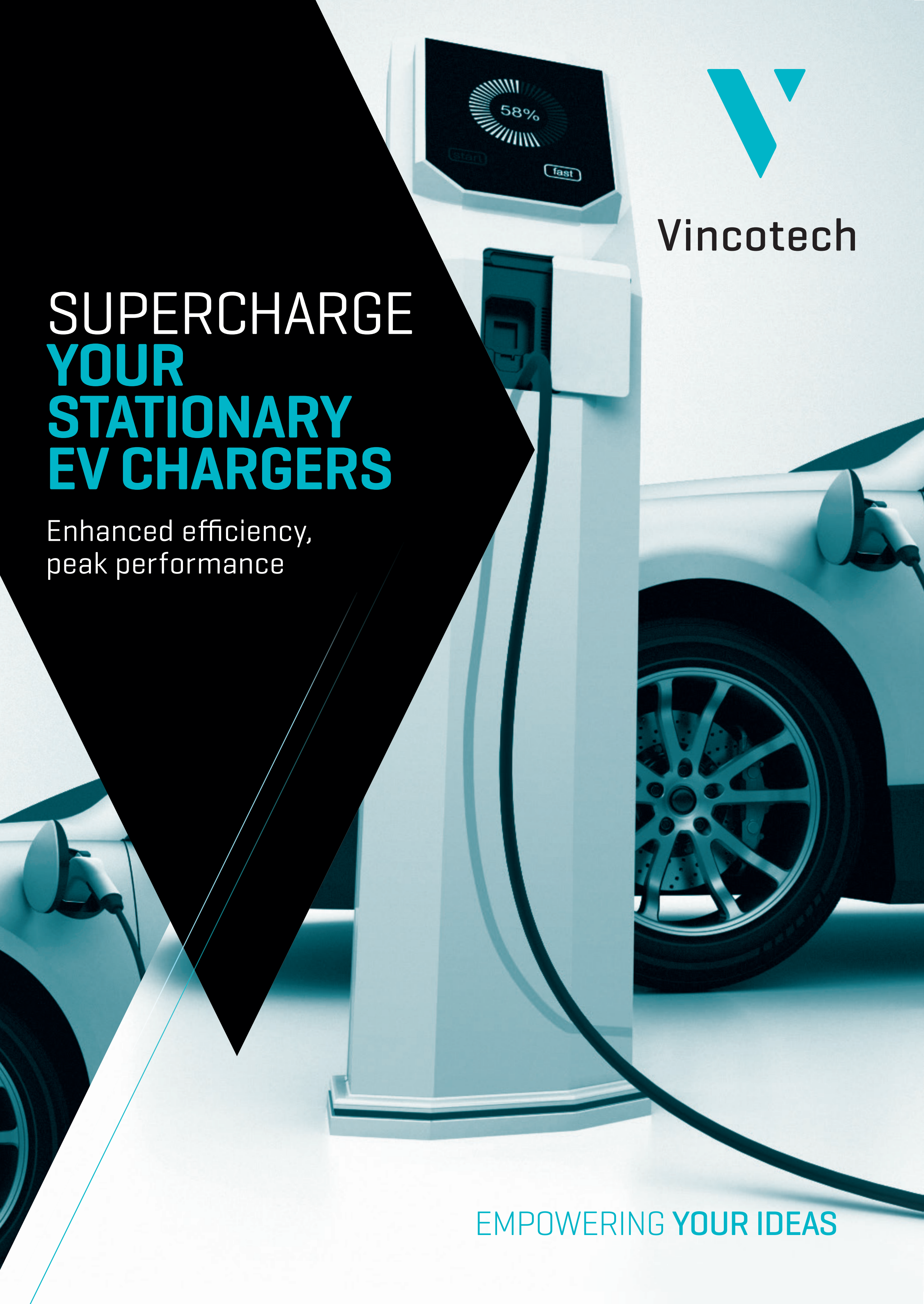
Vincotech

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.

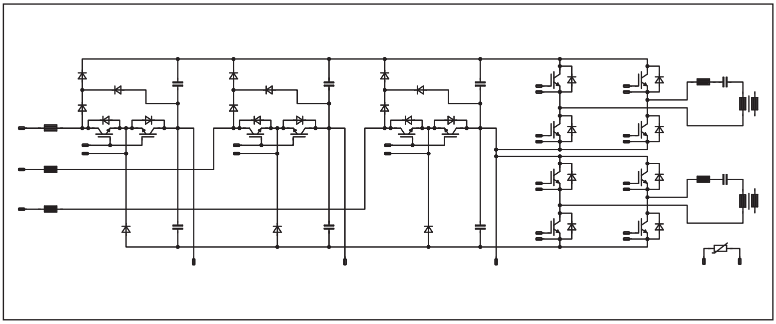


Figure 1: Block diagram of stationary charger

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.

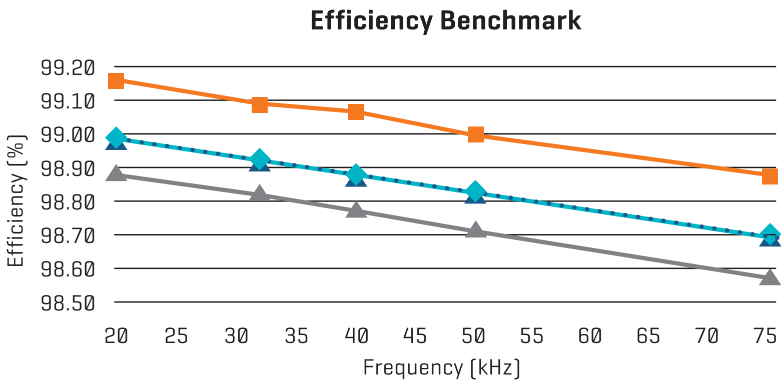


Figure 2: Efficiency Benchmark

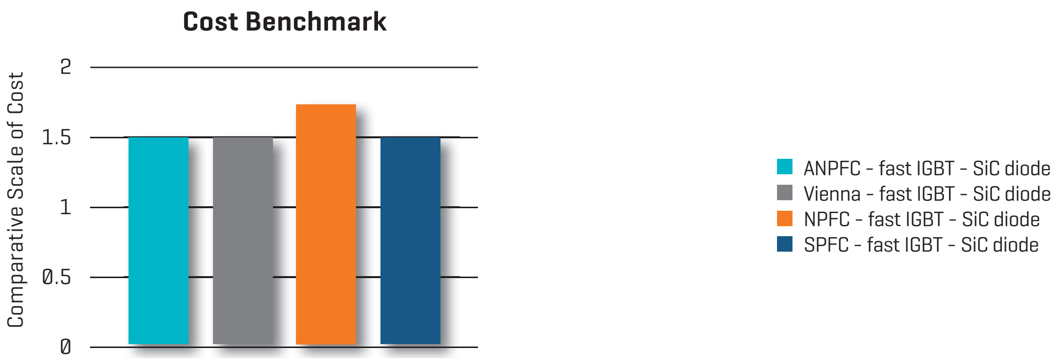


Figure 3: Cost Benchmark

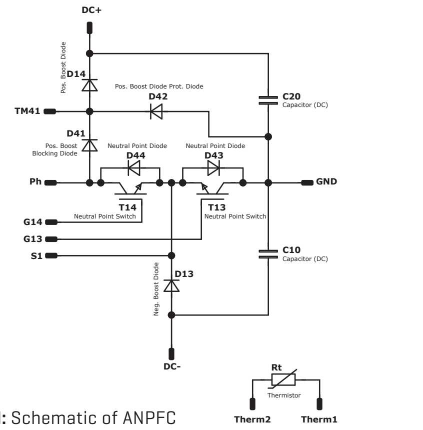


Figure 4: Schematic of ANPFC

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 semi-conductor 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.

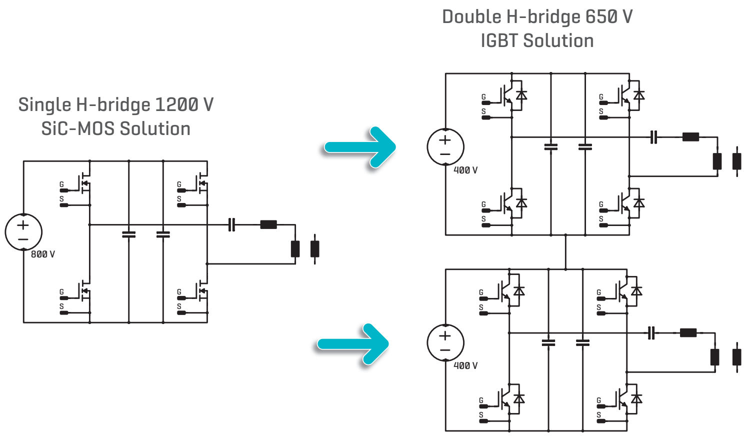


Figure 5: DC/DC converter with double H-bridge

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.

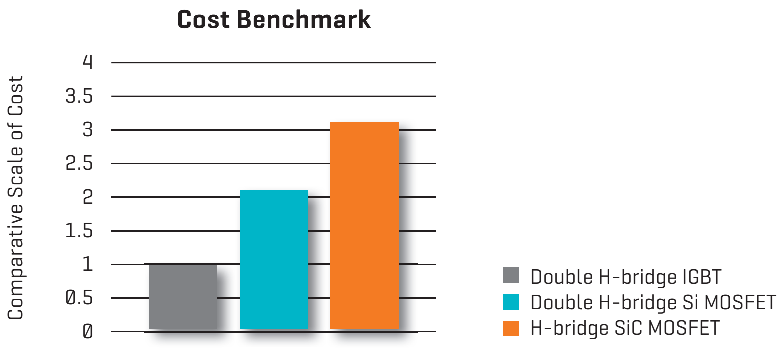


Figure 6: Cost Benchmark

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.

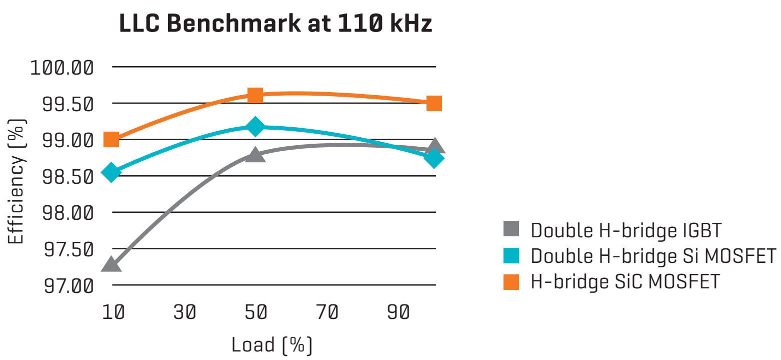
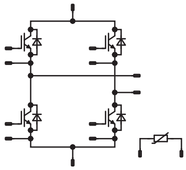
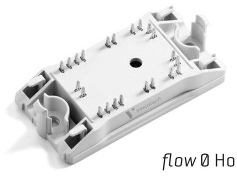


Figure 7: Efficiency Benchmark

CHARGING STATIONS
Product Portfolio



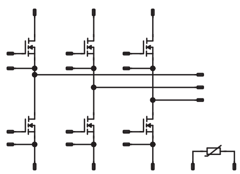


flow 0 Housing

flow 1 Housing

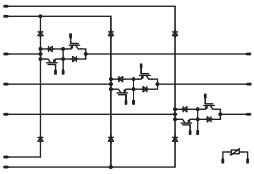
DC/DC CONVERTER H-BRIDGE TOPOLOGY

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

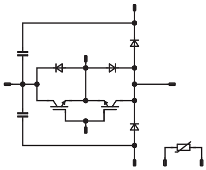
Part Number	Topology	Chip technology	Voltage	Current	Housing
10-PZ126PA080ME-M909F18Y	SIXPACK	SiC-MOSFET	1200 V	35 A	*flow* 0
10-PZ126PA080MR-M909F28Y	SIXPACK	SiC-MOSFET	1200 V	35 A	*flow* 0
10-PY126PA020ME-L227F18Y	SIXPACK	SiC-MOSFET	1200 V	65 A	*flow* 1
10-PY126PA020MR-L227F28Y	SIXPACK	SiC-MOSFET	1200 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

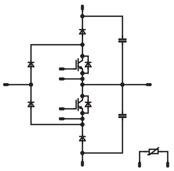
Part Number	Topology	Chip technology	Voltage	Current	Housing
10-TY12NMB030SM-L394L08	NPFC	IGBT5 H5	650 V	100 A	*flow* 0



flow 0 Housing

NPFC TOPOLOGY

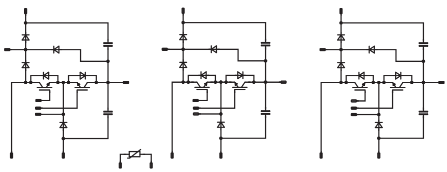
Part Number	Topology	Chip technology	Voltage	Current	Housing
10-FZ07LBA100SM03-L705L08	NPFC	IGBT5 H5	650 V	100 A	*flow* 0
10-FZ07LBA100SM01-L705L18	NPFC	IGBT5 H5	650 V	100 A	*flow* 0



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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