

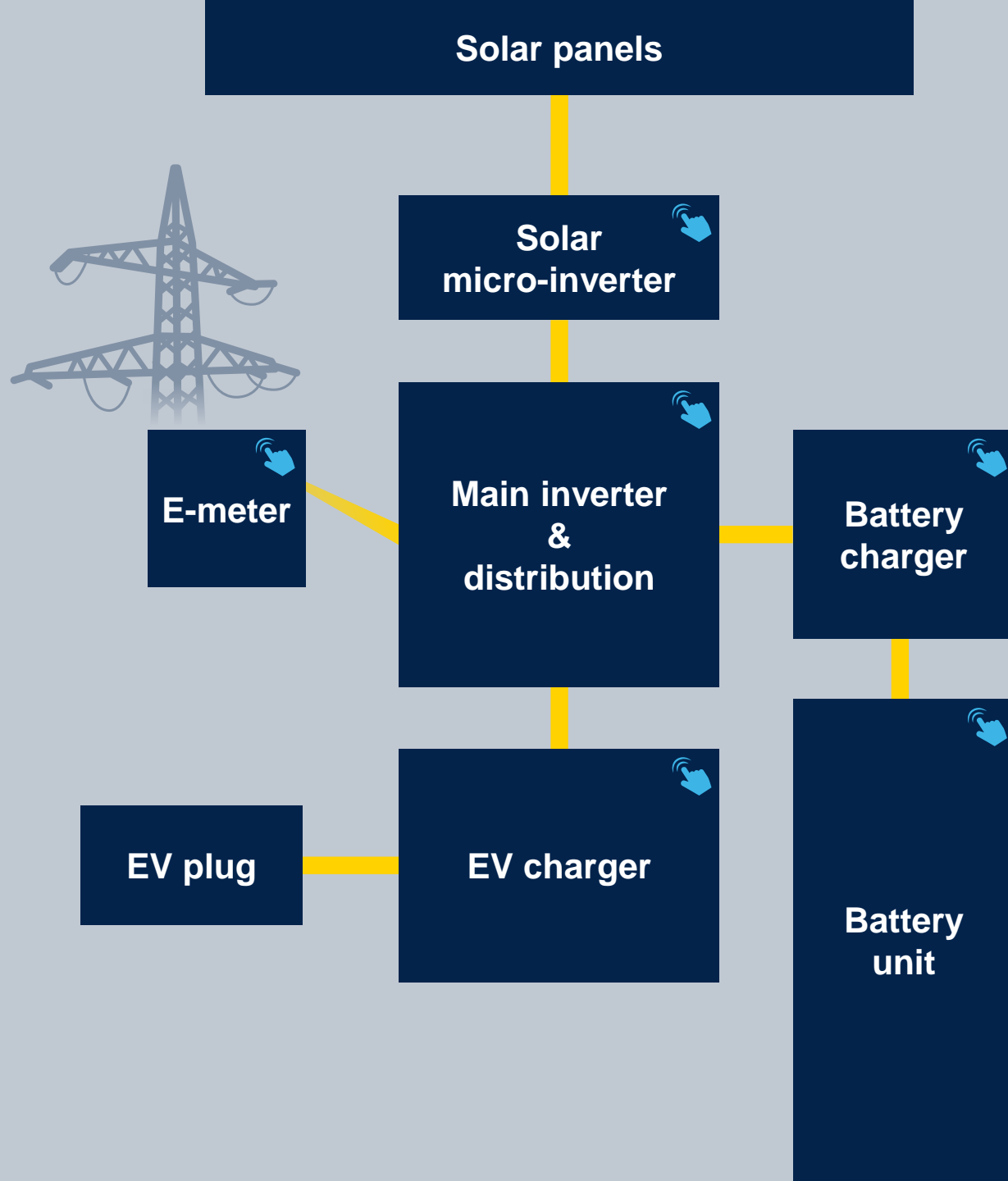
Efficient solutions for hybrid energy systems

A modern, single-story building with a flat roof. The roof is covered with solar panels. A covered walkway with a dark metal frame and glass panels runs along the side of the building. The building has large windows and doors. The sky is blue with some clouds. There are trees in the background.

Enabling our customer to increase
energy efficiency everywhere

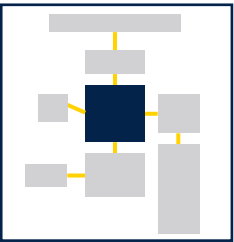
Discover ST
solutions in details





Creating technology
for a sustainable
world by designing
innovative products
and solutions that
power the world



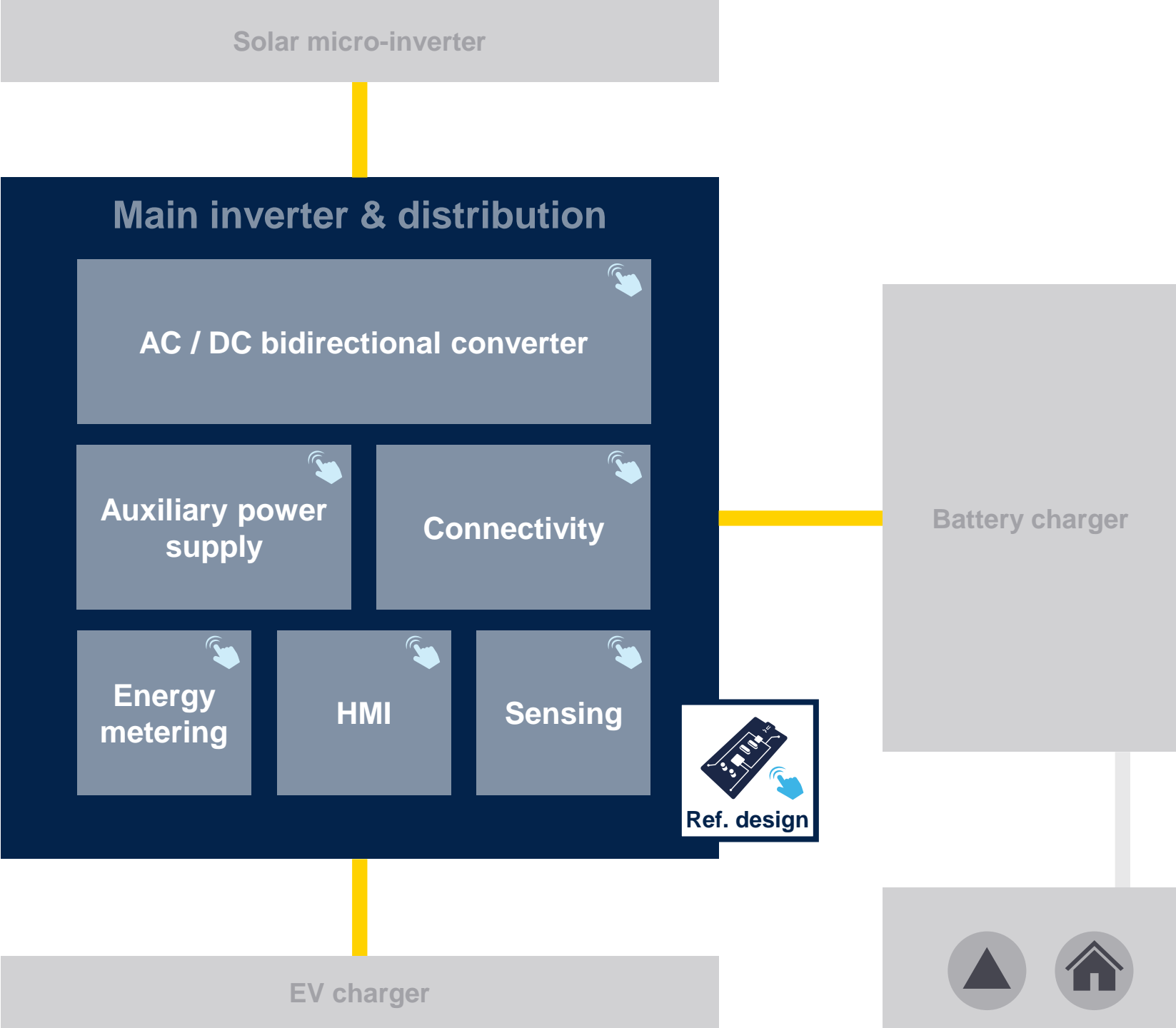


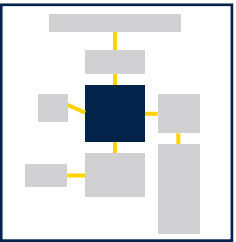
Maximize **system efficiency**
with ST technologies

Thousands of **reference designs** and evaluation tools

System support
from silicon to solution

Analog and digital **expertise**







AC / DC bidirectional converter

- Third generation SiC MOSFETs
- STGAP galvanic isolated gate drivers
- VIPER auxiliary power supply
- Digital power SDKs
- Turnkey reference designs
- Schematics, GERBERS, and firmware

Power transistors




IGBT
600 V to 1200 V

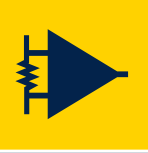


SiC MOSFET
650 V / 1200 V

Signal conditioning



Operational amplifiers
and comparators




Current sensing
amplifiers

Driving stage




Galvanically isolated
gate drivers

Protections




400 W TVS protection
device

Control unit




STM32
microcontroller




EEPROM memories

Isolated I/F and ADC




6 kV galvanic digital
isolator

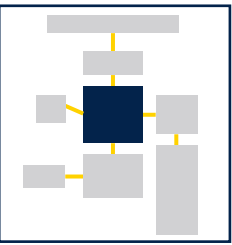


Delta-Sigma ADC

DC/DC



LDOs
ISO-Buck DC/DC




Auxiliary power supply

- Supporting the complete power tree
- VIPER family of integrated AC/DC converters now with GaN
- Quasi-resonant and resonant converters (L6566 / L6599)
- Power factor correction controllers (L4985, L6563/4)
- PFC + Resonant combo-controllers
- DC/DC controllers to 75 V (L3751)
- 40 V Iso-Buck (L6983i)


Power transistors

	Low power MOSFET 60 V
	MOSFET 1500 V / 1700 V

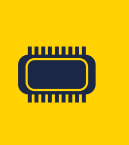
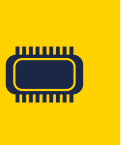
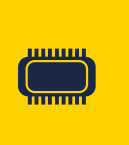
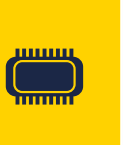
Diodes

	Ultrafast, Schottky and FER diodes
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Power conversion

	Buck DC-DC converters and controllers
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Controllers

Primary Side		Analog and digital AC/DC controllers		Integrated AC/DC converters
	Secondary Side		Synch rectification controller	

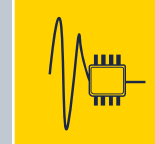
Signal conditioning

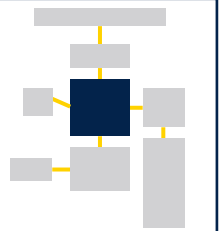
	Operational amplifiers and comparators		Current sensing amplifiers
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Protections

	TVS protections 400 / 600 / 1500 W
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LDOs

	Broad portfolio of LDOs
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Connectivity solutions

- ST8500 Turnkey G3 and Prime PLC solutions
- Hybrid PLC / Sub-1 GHz mesh connectivity
- Sub-1 GHz long range connectivity
- 2.4 GHz mesh connectivity
- Secure infrastructure
- NFC to simplify configuration
- Fully supported ecosystems for development

PLC



Power line
transceivers and
modems



Hybrid PLC Sub-GHz
modems

NFC tags & reader



Dynamic NFC tags &
ESD protections



NFC readers
EMVCo support

Wireless MCU



STM32WB / WBA &
BlueNRG SoC



STM32WB / WBA
Multiprotocol SoC



SubGHz STM32WL
SoC, S2-LP
transceivers

Secure element



STSAFE
authentication ICs

Transceivers & protections



CAN transceivers

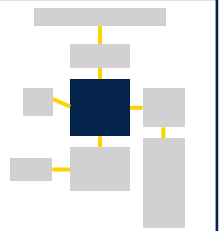


Filters & protections







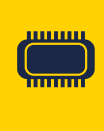






RS232 & RS485
interfaces





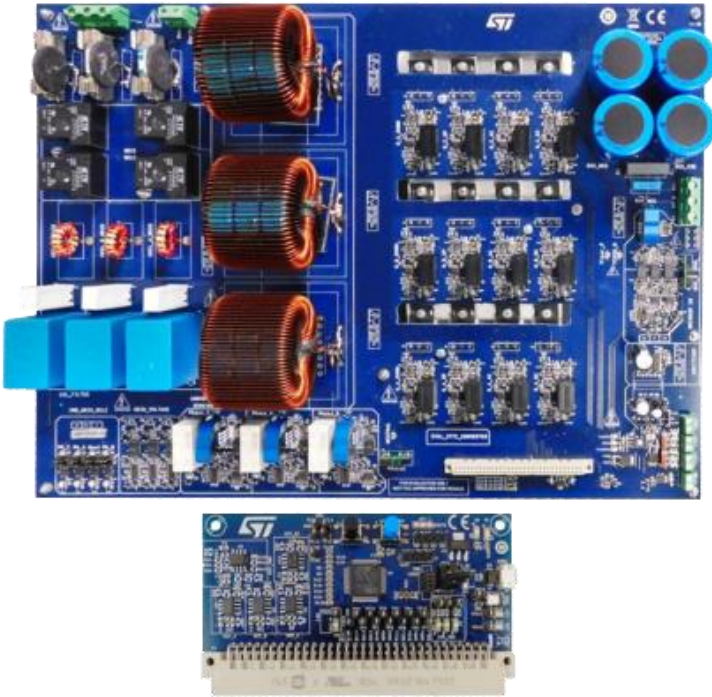
Metering – HMI – Sensing – Cooling

- DSP based metrology ICs
- Digital isolators to 6kV
- LED family of devices for display arrays & backlighting
- Machine learning capable sensing solutions
- TouchGFX framework for advanced HMI development
- STSPIN family for smart fan and motor drives

Metrology and isolated I/F	LED management	Motion & temperature
 Metering ICs up to 4ch	 LED array drivers and boost current regulators	 3-axis vibration sensors and accelerometers
 STISO620/1, ISOSD61 isolated digital interface & Delta-Sigma ADC	 LED front panel controller	 Infrared (IR) sensors
Protections	Graphics	 Digital & analog temperature sensors
 Transil for ESD protection	 Advanced touchscreen graphic interfaces	Cooling
 EMI filters		 Integrated motor controllers

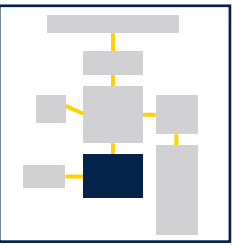
Our reference design

15 kW, three-phase, three-level Active Front End (AFE) bidirectional PFC converter



STDES-PFCBIDIR

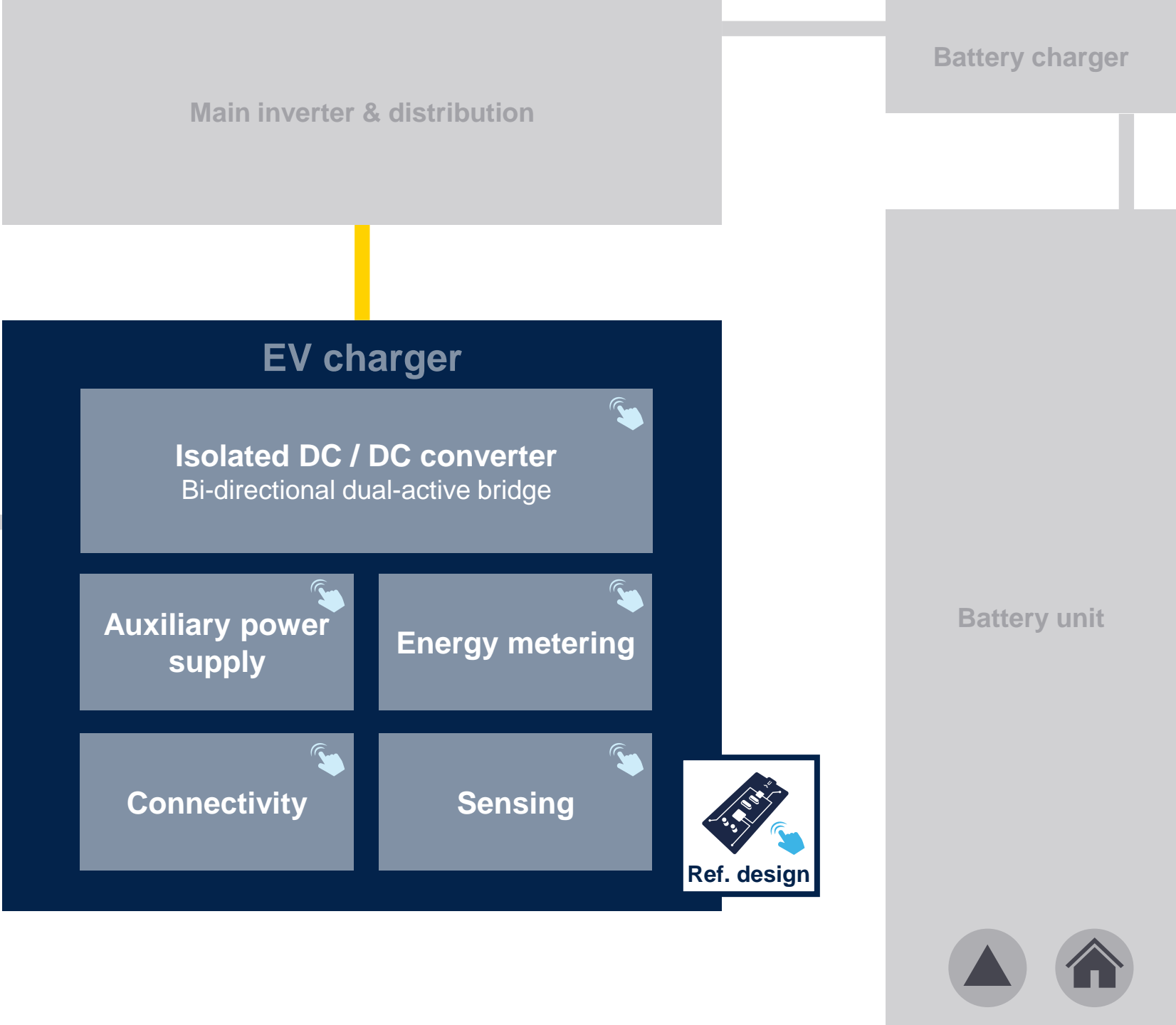
- **High efficiency** ($\eta > 98\%$)
- **High frequency operation** (70 kHz)
- **Passive components weight and size reduction**
- **High performance**
 - Rated nominal voltages: 800 V_{DC} / 400 V_{AC} @ 50 Hz
 - Power factor control PF > 0.98 (AC to DC)
 - THD < 5% (AC to DC)
 - Active and reactive power control (DC to AC)
 - Integrated grid connection solution (DC to AC)
 - V_{OUT_RIPPLE}: 10 V_{pp}, I_{RIPPLE}: 2.5 A



High efficiency solutions
for EV charging

Supporting the migration to
vehicle electrification

Analog and digital **expertise**



Isolated DC / DC converter

Bi-directional dual-active bridge

- Third generation SiC MOSFETs
- STGAP2SIC galvanic isolated gate drivers
- STM32G4 MCU
- VIPER auxiliary power supply
- Turnkey reference design
- Schematics, GERBERS, and firmware

Power transistors



MDmesh MOSFET
600 V to 1050 V



SiC MOSFET
650 V / 1200 V

Power module



ACEPACK module
(1200 V SiC MOSFET)

Driving stage



High-side & low-side
isolated gate drivers



ISO-buck DC-DC
converter

Control unit

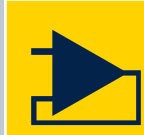


STM32
microcontroller

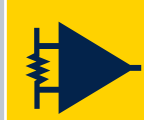


EEPROM memories

Signal conditioning



Operational amplifiers
and comparators



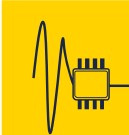
Current sensing
amplifier

Protections

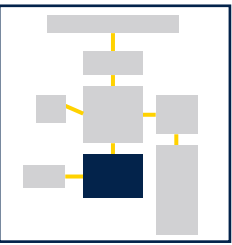


400 W TVS protection
and eFuse

LDOs




Broad portfolio of
LDOs




Auxiliary power supply

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- VIPER family of integrated AC/DC converters now with GaN
- Quasi-resonant and resonant converters (L6566 / L6599)
- Power factor correction controllers (L4985, L6563/4)
- PFC + Resonant combo-controllers
- DC/DC controllers to 75 V (L3751)
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Power transistors

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	MOSFET 1500 V / 1700 V

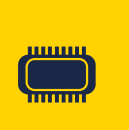
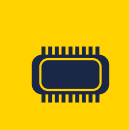
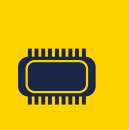

Diodes

	Ultrafast, Schottky and FER diodes
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Power conversion

	Buck DC-DC converters and controllers
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Controllers

Primary Side		Analog and digital AC/DC controllers		Integrated AC/DC converters
	Secondary Side		Synch rectification controller	

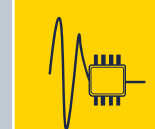
Signal conditioning

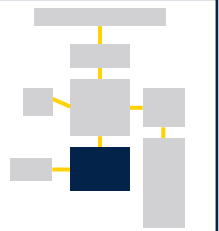
	Operational amplifiers and comparators		Current sensing amplifiers
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Protections

	TVS protections 400 / 600 / 1500 W
---	---------------------------------------

LDOs

	Broad portfolio of LDOs
---	-------------------------



Connectivity solutions

- ST8500 Turnkey G3 and Prime PLC solutions
- Hybrid PLC / Sub-1 GHz mesh connectivity
- Sub-1 GHz long range connectivity
- 2.4 GHz mesh connectivity
- Secure infrastructure
- NFC to simplify configuration
- Fully supported ecosystems for development

PLC



Power line transceivers and modems



Hybrid PLC Sub-GHz modems

NFC tags & reader



Dynamic NFC tags & ESD protections



NFC readers
EMVCo support

Wireless MCU



STM32WB / WBA & BlueNRG SoC



STM32WB / WBA Multiprotocol SoC



SubGHz STM32WL SoC, S2-LP transceivers

Secure element



STSAFE authentication ICs

Transceivers & protections



CAN transceivers



Filters & protections



RS232 & RS485 interfaces

Metering – Sensing – Cooling

- DSP based metrology ICs
- Digital isolators to 6kV
- LED family of devices for display arrays & backlighting
- Machine learning capable sensing solutions
- STSPIN family for smart fan and motor drives

Metrology and isolated I/F



Metering ICs up to 4ch



STISO620/1, ISOSD61
isolated digital interface &
Delta-Sigma ADC

Protections



Transil for ESD
protection



EMI filters

Motion & temperature



3-axis vibration
sensors and
accelerometers



Infrared (IR) sensors



Digital & analog
temperature sensors

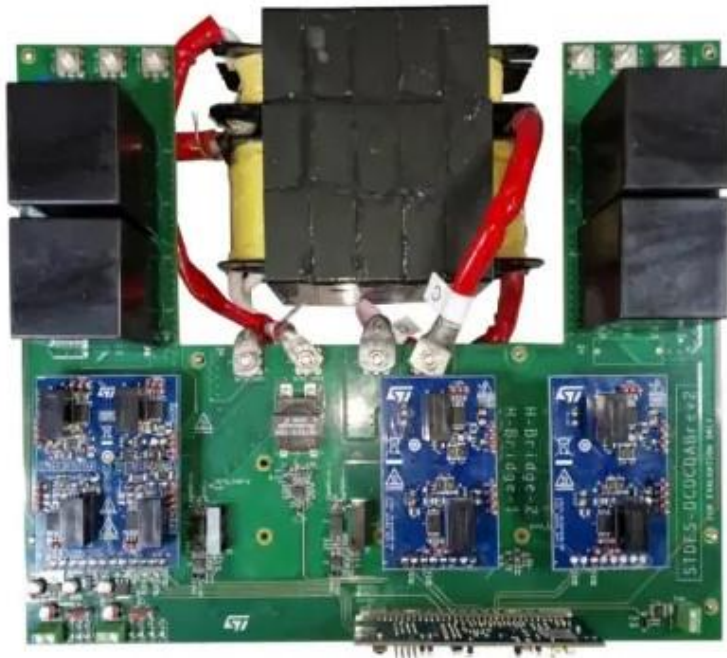
Cooling



Integrated motor
controllers

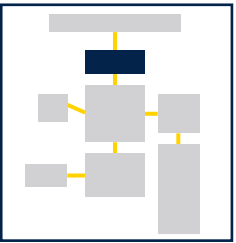
Our reference design

25 kW, dual active bridge bidirectional power converter for EV charging and battery energy storage systems



STDES-DABBIDIR

- **High efficiency** ($\eta > 98\%$)
- **High frequency operation** (100 kHz)
- **Modular approach for high flexibility in system development. AcePack 2 half bridge modules**
- **DPC (digital power conversion) firmware library architecture**
- **High performance**
 - Input Voltage: 800 V (720 - 880 V)
 - Output Voltage: 250 – 500 V
 - Output power: 25 kW (28 kW max)



Solar panels

Solar micro-inverter

AC / DC
conversion



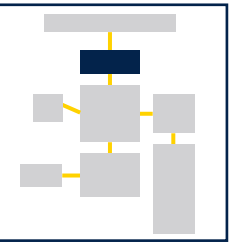
Connectivity



Ref. design

Main inverter & distribution

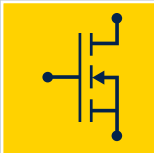




AC / DC conversion

- MasterGaN integrated GaN half bridge + drivers
- STGAP galvanic isolated gate drivers
- Digital power SDKs
- Turnkey reference designs
- Schematics, GERBERS, and firmware
- Supporting the full power tree

Power transistors

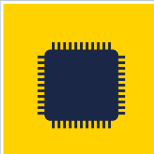


Si MOSFET

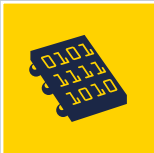


GaN HEMT MOSFET
650 V / 1200 V

Control unit

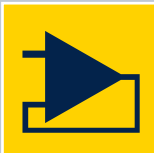


STM32
microcontroller

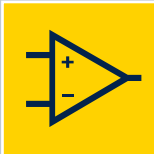


EEPROM memories

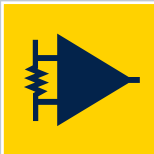
Signal conditioning



Operational amplifiers



Comparators



Current sensing
amplifiers

Isolated I/F and ADC



6 kV galvanic digital
isolator
& Delta-Sigma ADC

Driving stage



High and low side
gate drivers



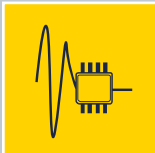
MasterGaN with
integrated gate drive

Protections

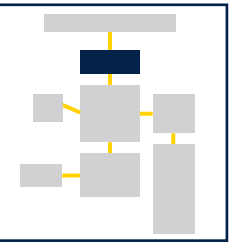


400 W TVS protection
device

DC/DC

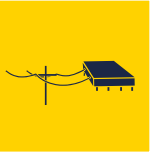






LDOs
ISO-Buck DC/DC





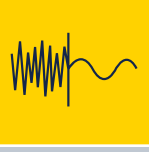

Connectivity solutions

- ST8500 Turnkey G3 and Prime PLC solutions
- Smart solar shutdown with PLC
- Sub-1 GHz long range connectivity
- 2.4GHz mesh connectivity
- Secure infrastructure
- Fully supported ecosystems for development

PLC	
	Power line transceivers and modems
	Hybrid PLC Sub-GHz modems

Wireless MCU	
	STM32WB / WBA & BlueNRG SoC
	STM32WB / WBA Multiprotocol SoC
	SubGHz STM32WL SoC, S2-LP transceivers

Secure element	
	STSAFE authentication ICs

Transceivers & protections	
	CAN transceivers
	Filters & protections
	RS232 & RS485 interfaces

Our reference design

GaN based solar micro-inverter for high density and efficiency.



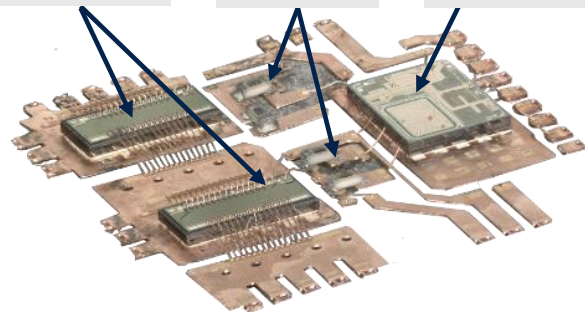
**Custom GAN inverter
EVLMG1LPBRDR1**



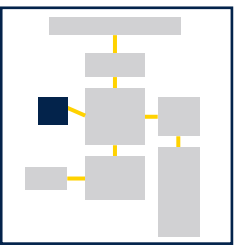
GaN power
HEMTs

Resistors

600 V BCD
offline driver



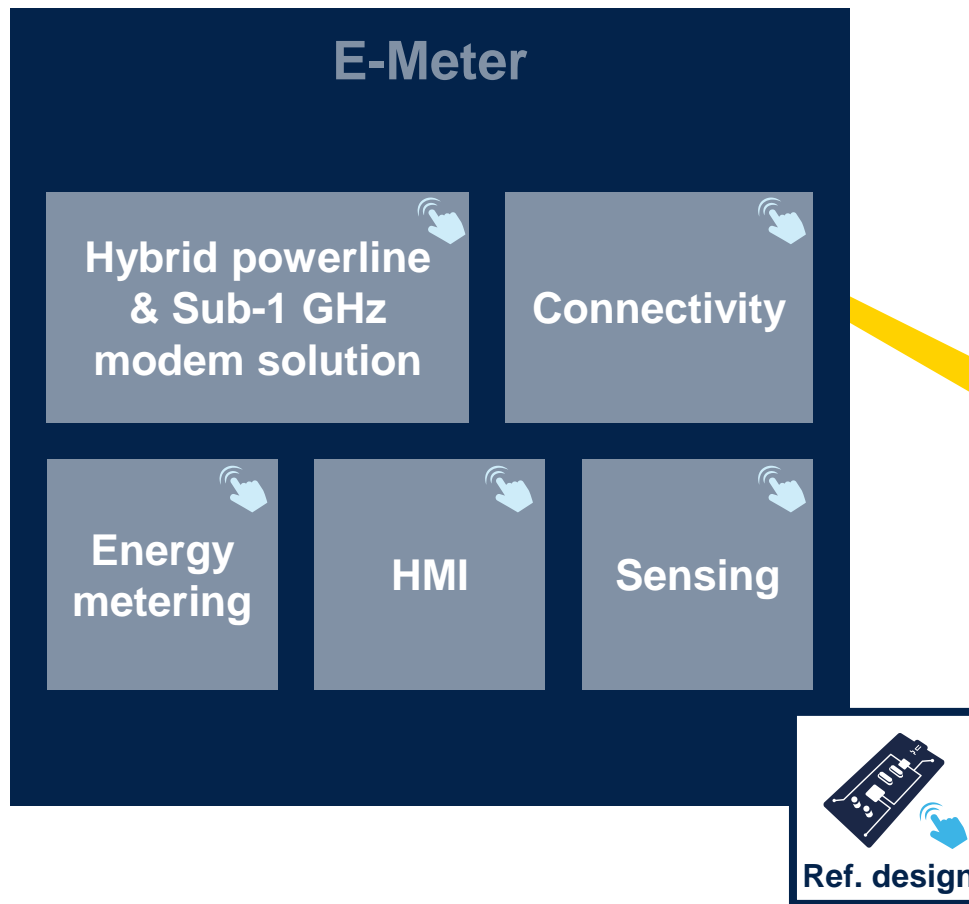
- High efficiency ($\eta > 97\%$)
- High frequency operation (100 kHz)
- GaN based power stage with integrated gate drivers
- STM32 DPC (digital power conversion) firmware library architecture
- High performance
 - Solar Input Voltage: 12 - 42 V (36VNom)
 - Output Voltage: 120 V_{AC} / 230 V_{AC}
 - Output power: 300 W



165 million meters
with **ST inside**

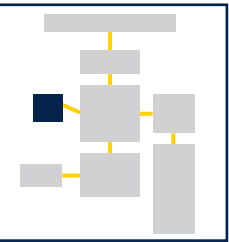
Leadership in power line
communication

30 years experience
in smart grid



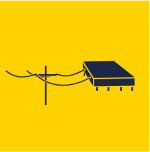

Solar
micro-inverter




Main inverter
&
distribution





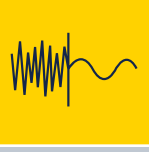

Connectivity solutions

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PLC	
	Power line transceivers and modems
	Hybrid PLC Sub-GHz modems

Wireless MCU	
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	STM32WB / WBA Multiprotocol SoC
	SubGHz STM32WL SoC, S2-LP transceivers

Secure element	
	STSAFE authentication ICs

Transceivers & protections	
	CAN transceivers
	Filters & protections
	RS232 & RS485 interfaces

Metering – HMI – Sensing

- DSP based metrology ICs
- Digital isolators to 6kV
- LED family of devices for display arrays & backlighting
- Machine learning capable sensing solutions
- TouchGFX framework for advanced HMI development
- STSPIN for smart cooling solutions

Metrology and isolated I/F



Metering ICs up to 4ch



STISO620/1, ISOSD61
isolated digital interface &
Delta-Sigma ADC

Protections



Transil for ESD
protection



EMI filters

LED management



LED array drivers and
boost current
regulators



LED front panel
controller

Graphics



Advanced
touchscreen graphic
interfaces

Motion & temperature



3-axis vibration
sensors and
accelerometers



Infrared (IR) sensors



Digital & analog
temperature sensors

Our reference design

Complete hardware, software, and firmware tools for developing powerline and hybrid wireless solutions



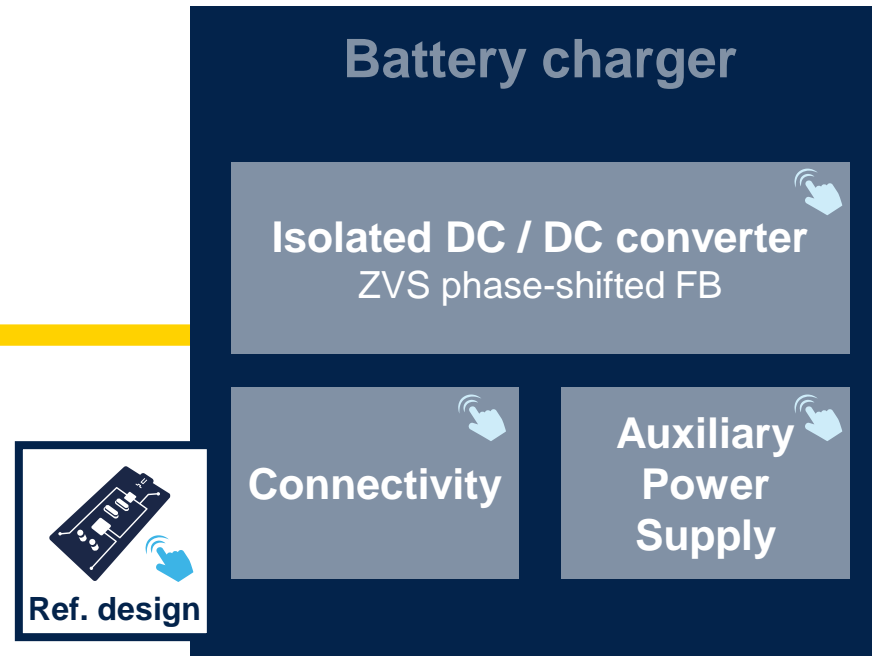
EVLKST8500GH-2

Certified Turn-key PLC and hybrid wireless solutions

- Programmable certified protocols: G3, PRIME...
- ST8500 as PLC modem and PLC-RF hybrid protocol processor
- Turn-key firmware selects RF Sub-1 GHz link or PLC link depending on network quality conditions
- Based on 6LoWPAN and IPv6

Complete ecosystem for platform development

- Evaluation boards
- Firmware protocol packages
- Application specific software packages
- Physical design resources



High efficiency solutions
for energy storage

Analog and digital **expertise**

System support
from silicon to solution

Isolated DC / DC converter

Zero voltage switching (ZVS) phase-shifted FB

- Third generation SiC MOSFETs
- STGAP galvanic isolated gate drivers
- ISO-Buck
- Digital power SDKs
- Turnkey reference designs
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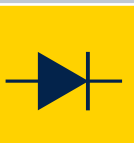
Power transistors



MDmesh MOSFET
600 V to 900 V



SiC MOSFET
650 V / 1200 V



Si and SiC diodes
600 V to 900 V

Signal conditioning



Operational amplifiers
and comparators



Current sensing
amplifier

Isolated I/F and ADC



6 kV galvanic digital
isolator
& Delta-Sigma ADC

Driving stage



High-side & low-side
gate drivers



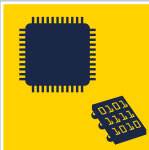
Iso-buck DC-DC
converter

Protections



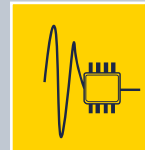
400 / 600 / 3000 W
TVS protection
devices

Control unit

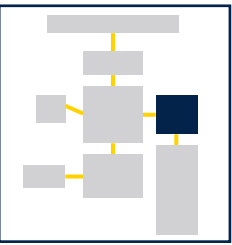


STM32 MCU and
EEPROM memories

LDOs



Broad portfolio of
LDOs




Auxiliary power supply

- Supporting the complete power tree
- VIPER family of integrated AC/DC converters now with GaN
- Quasi-resonant and resonant converters (L6566 / L6599)
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	Low power MOSFET 60 V
	MOSFET 1500 V / 1700 V

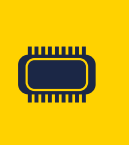
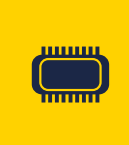
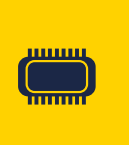
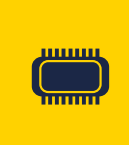
Diodes

	Ultrafast, Schottky and FER diodes
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Power conversion

	Buck DC-DC converters and controllers
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Controllers

Primary Side		Analog and digital AC/DC controllers		Integrated AC/DC converters
Secondary Side		Synch rectification controller		CC / CV controller and references


Signal conditioning

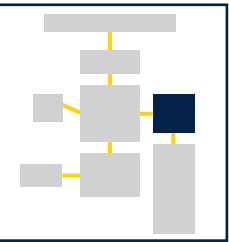
	Operational amplifiers and comparators		Current sensing amplifiers
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Protections

	TVS protections 400 / 600 / 1500 W
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LDOs

	Broad portfolio of LDOs
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Connectivity solutions

- ST8500 Turnkey G3 and Prime PLC solutions
- Bluetooth LE for maintenance and control
- 2.4 GHz mesh for smart home connectivity
- Sub-1 GHz long range connectivity
- Secure infrastructure
- Fully supported ecosystems for development

Powerline modem



Power line transceivers and modems



Hybrid PLC Sub-GHz modems

Wireless MCU



STM32WB / WBA & BlueNRG SoC



STM32WB / WBA Multiprotocol SoC



SubGHz STM32WL SoC, S2-LP transceivers

Secure element



STSAFE authentication ICs

Transceivers & protections



CAN transceivers



Filters & protections



RS232 & RS485 interfaces

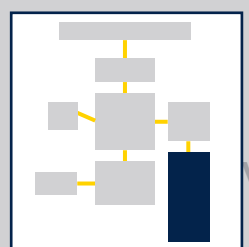
Our reference design

6 kW high voltage DC-DC converter for HV battery charging



STDES-6KWHVDCDC

- 2 variants: dual transformer (smaller core) for limited voltage, single transformer for wide output
- Same PCB to accommodate different magnetics for each variant
- Unique patented control scheme to address output voltage ranging from 200–1000 V DC, with 12 A maximum limit
- 700–800 V DC input voltage range
- Peak efficiency: 98% with super-junction silicon MOSFETs
- Complete ST solution both analog and digital
- Comprehensive safety mechanism



verter & distribution

Battery charger

EV charger

Battery unit

Battery management system

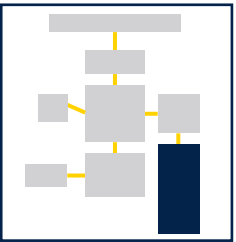


High accuracy cell measurement with **0 us desynchronization delay** between samples

Daisy chain capable for high- voltage applications in the EV and energy storage space

Comprehensive **fault detection** and **diagnostics** to meet **functional safety** requirements

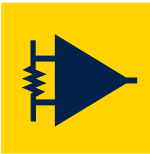




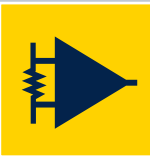
Battery management system

- Accurate I/V/T monitoring via configurable AFE
- Isolated transceiver for communication between HV/LV domains
- Wide array of power management options
- Comprehensive and flexible system solutions
- Fully supported ecosystem for development

AFE & communication



Current sensing amplifier

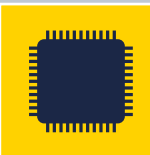


Digital I/V/T monitoring AFE



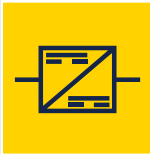
Isolated transceiver

Control unit



STM32 MCU

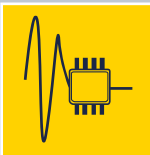
Power management



PMICs



System Basis Chips



Broad Portfolio of LDOs

Protections

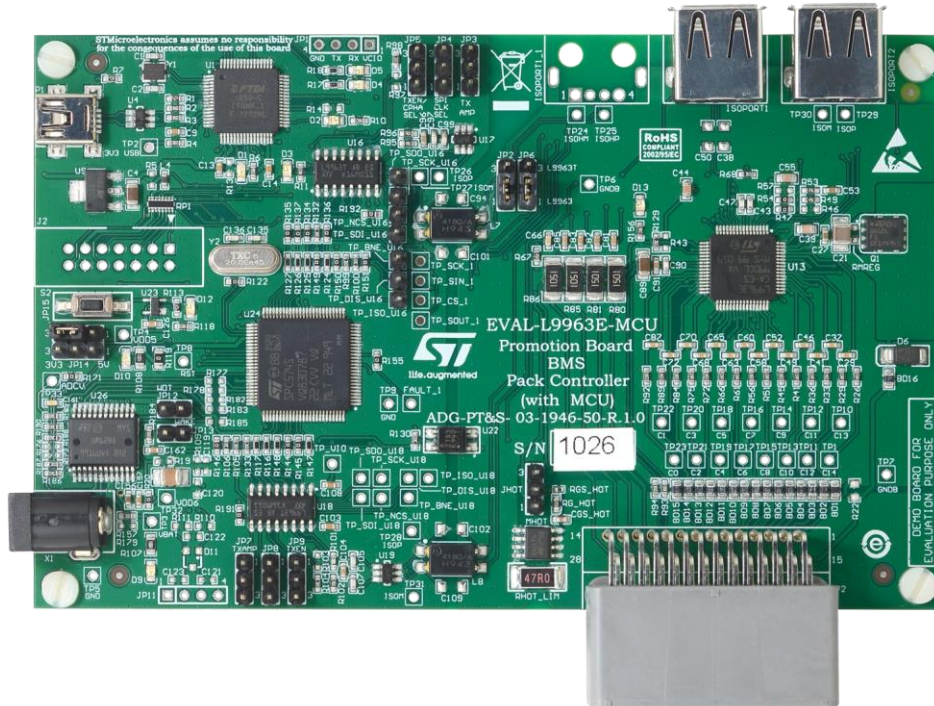


TVS protections



Our reference design

Battery management IC for 4 to 14 cells. Daisy chain up to 31 L9963E supporting high voltage batteries



EVAL-L9963E-MCU

- Coulomb counter supporting pack overcurrent detection
- Fully synchronized current and voltage samples
- 16-bit voltage measurement with $\pm 2\text{mV}$ max. error
- 2.66 Mbps isolated serial communication with regenerative buffer, supporting dual access ring
- Transformer based isolation
- Up to 4 analog inputs for NTC sensing, plus PCB temperature sensing
- Robust hot plug performance
- Full ISO26262 Safety compliant, ASIL-D systems ready