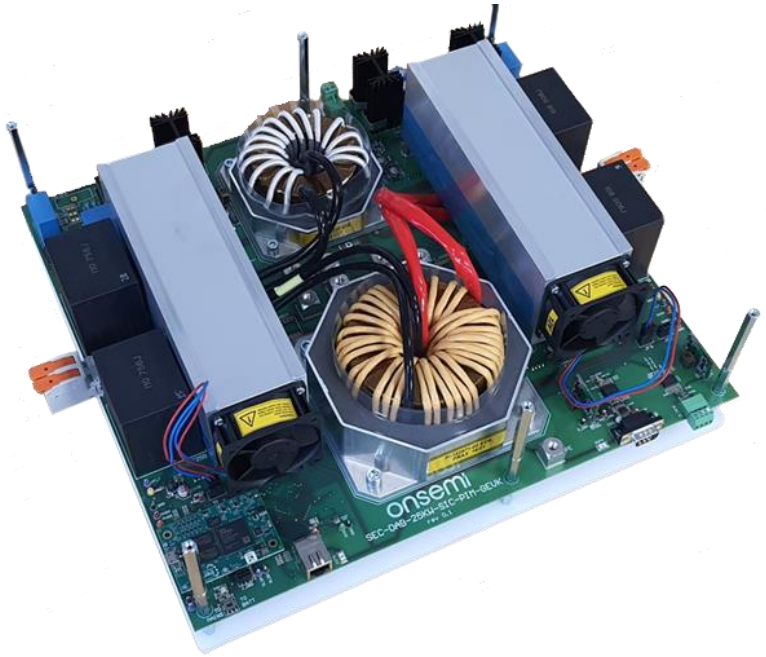

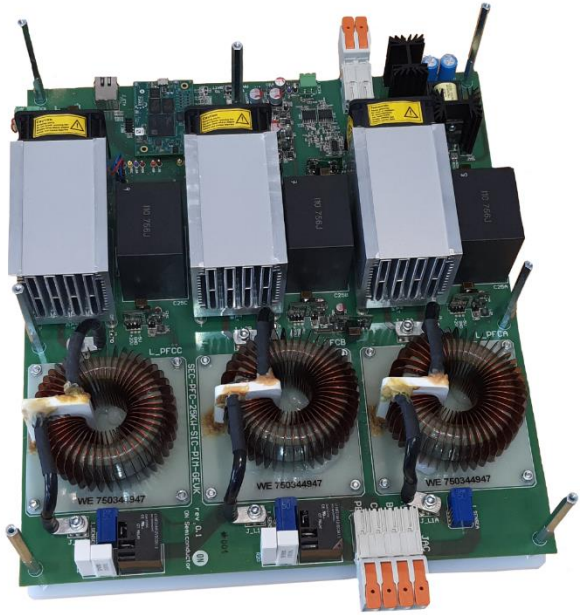

FAST EV CHARGING - 25KW SIC REFERENCE DESIGN

Didier Balocco
EMEA Business Marketing Engineer

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WEBINAR 02.05.2023

DIDIER BALOCCO

- Diploma :
  - Engineering degree from "École Nationale Supérieure d'Électronique et de RadioÉlectricité de Bordeaux", France in 1992
  - Ph.D. degree in Power Electronics from the University of Bordeaux in 1997.
- Experience :
  - Research engineer for dc-dc, ac-dc and dc-ac converters for telecom equipment and solar from 1 W to 150 kW from 1996 to 2014.
  - Field Application Engineer (FAE) supporting South of France, Spain and Portugal in Fairchild Semiconductor from 2014 to 2016 and until 2018 with **onsemi**.
  - EMEA Business Marketing Engineer in **onsemi** since 2018.

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FAST EV CHARGING – 25KW SIC REFERENCE DESIGN

- Introduction
- Review of the Key High-Power Blocks
  - 6-Pack, x-NPC, Vienna, DBC, LLC, CLLC, …
- 25-kW building Block
- Why Modules ?
- Identified Sockets
- Measurement and Results
- Conclusion

Review of the Key High-Power Blocks

6-Pack, x-NPC, Vienna, DBC, LLC, CLLC, …

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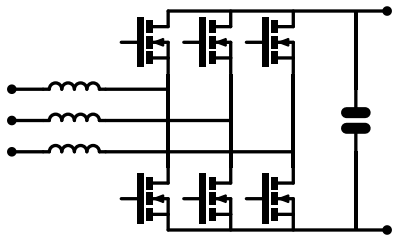
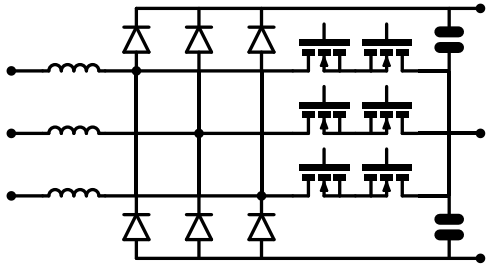
TOPOLOGIES

3-phase Active Front End of PFC

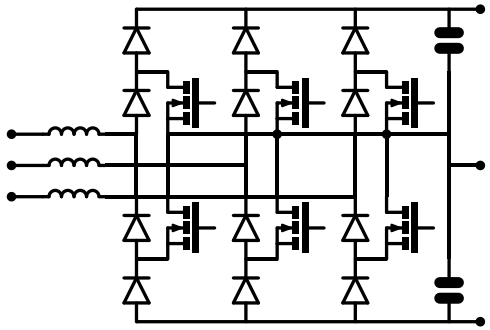
6 Pack Boost



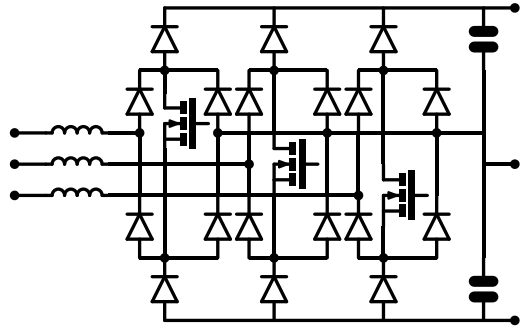
T-NPC Boost



NPC Boost

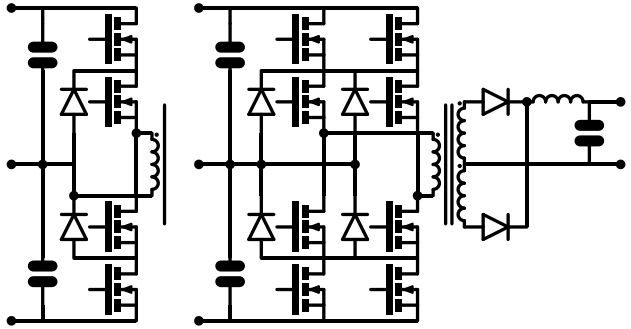


Vienna

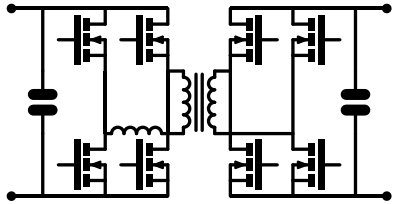


Isolated DC/DC

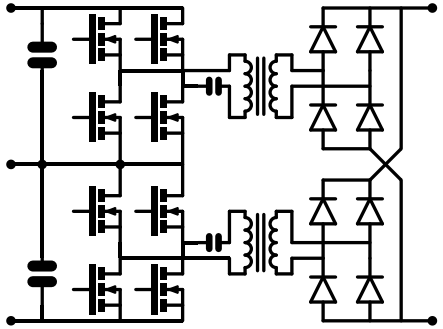
NPC Half-Bridge or Full-Bridge



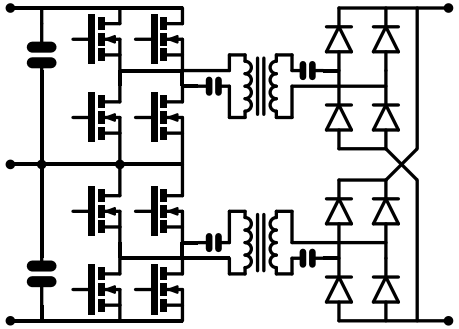
Dual Active Bridge (DAB)



Stacked LLC



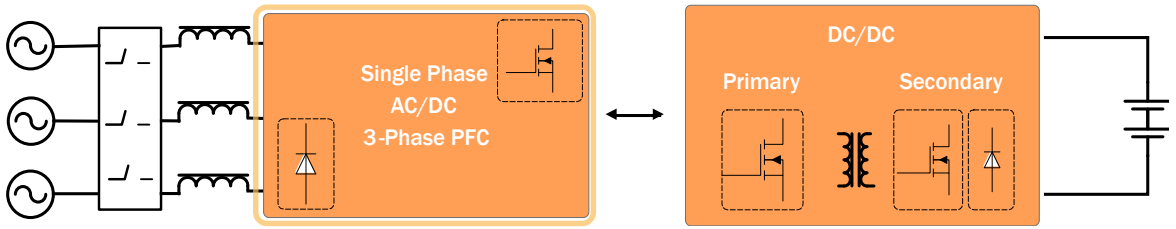
Stacked CLLC



EV CHARGING STATIONS

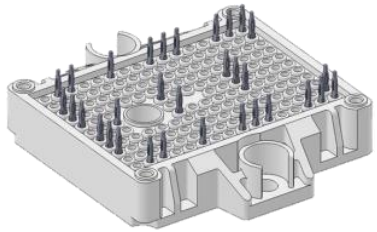
Active Rectification Stage or Active Front End (or PFC)

- **Vienna Rectifier Version**



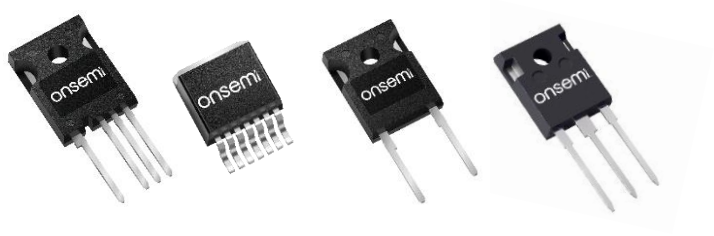
Module

F2 Vienna Rectifier



Discrete

SiC Diodes + SiC MOSFETs



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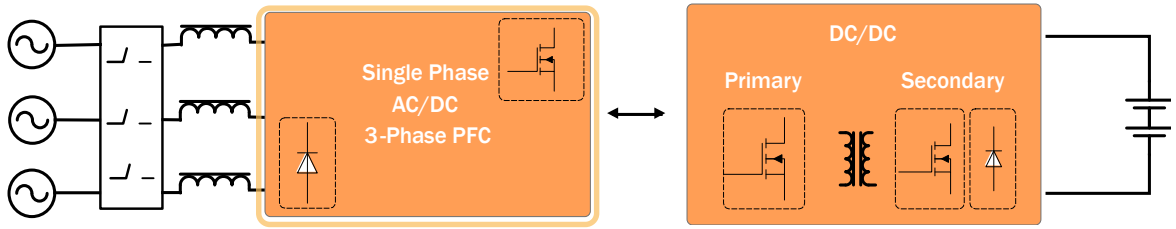
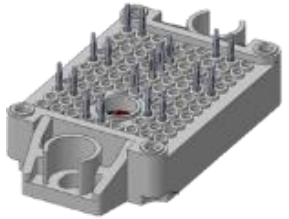
High Efficiency

- **Six Switch Converter Version**



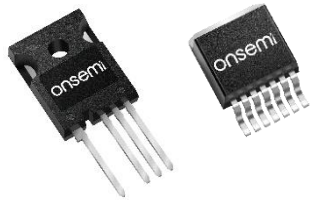
Module

F1 2-PACK Module



Discrete

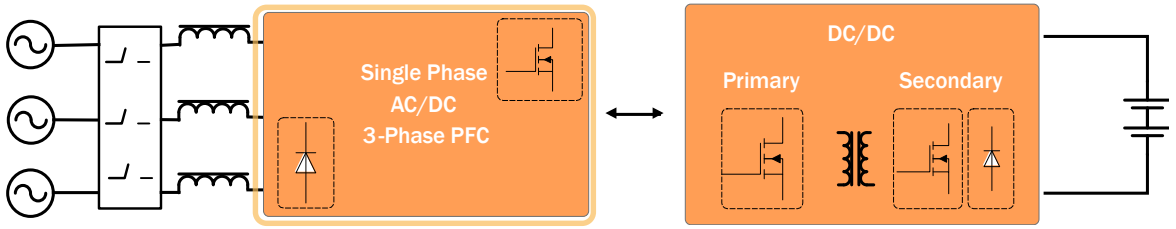
SiC MOSFETs



EV CHARGING STATIONS

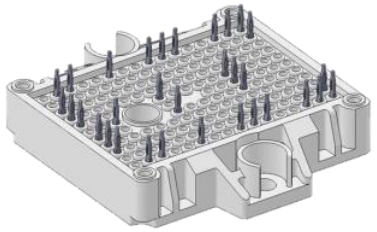
Active Rectification Stage or Active Front End (or PFC)

- **Bidirectional TNPC Version**



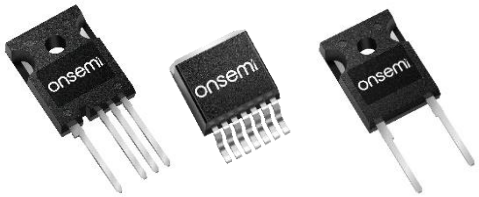
Module

F2 (Concept)



Discrete

SiC Diodes + SiC MOSFETs



Robust

Avalanche Rated

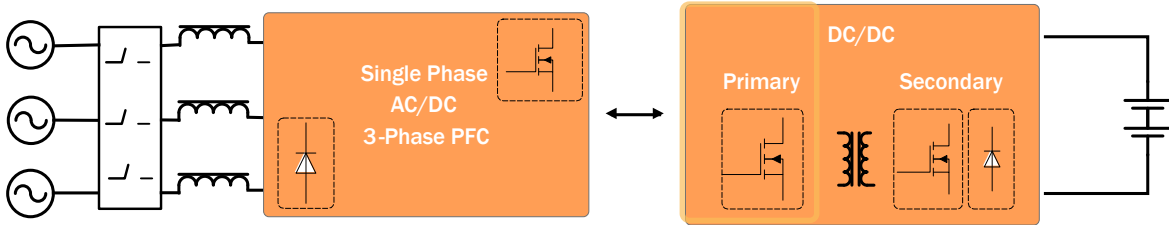
High Efficiency

- **Comments on bidirectional**
- Vienna: not bidirectional
- TNPC, Six switch: bidirectional

- **Where bidirectional is used**
  1. Provide reactive power support to grid. Often used where the maker of the EV charger is a utility.
  2. Allow energy to be taken from car battery to grid.

EV CHARGING STATIONS – DC-DC STAGE

- **DAB, DC-DC, CLLC, … Primary Stage**

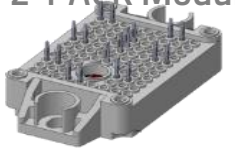


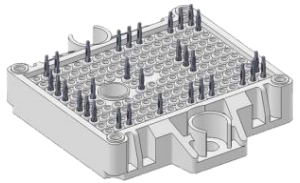
Module

F1 2-PACK Module

F1 4-PACK Module

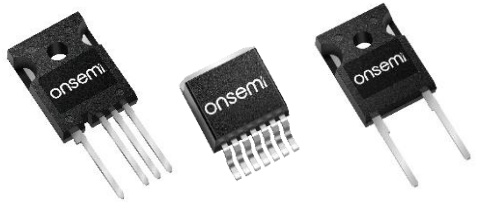
F2 2-PACK Module



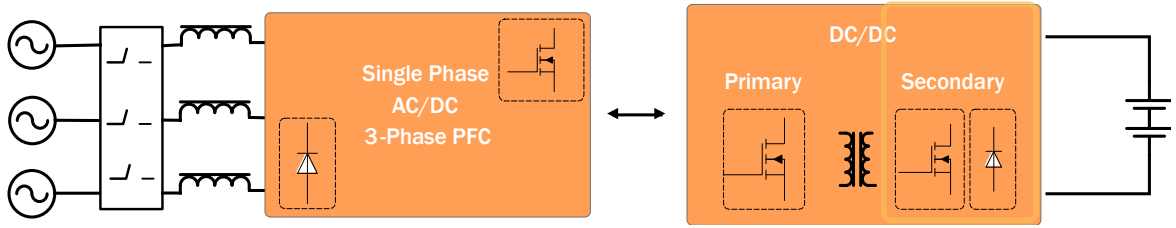


Discrete

SiC Diodes + SiC MOSFETs

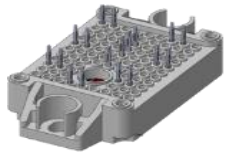


- **Diode Output Bridge**



Module

F1 4-PACK Module



Discrete

SiC Diodes

Single or Dual

SiC MOSFETs

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High Efficiency

25kW building Block

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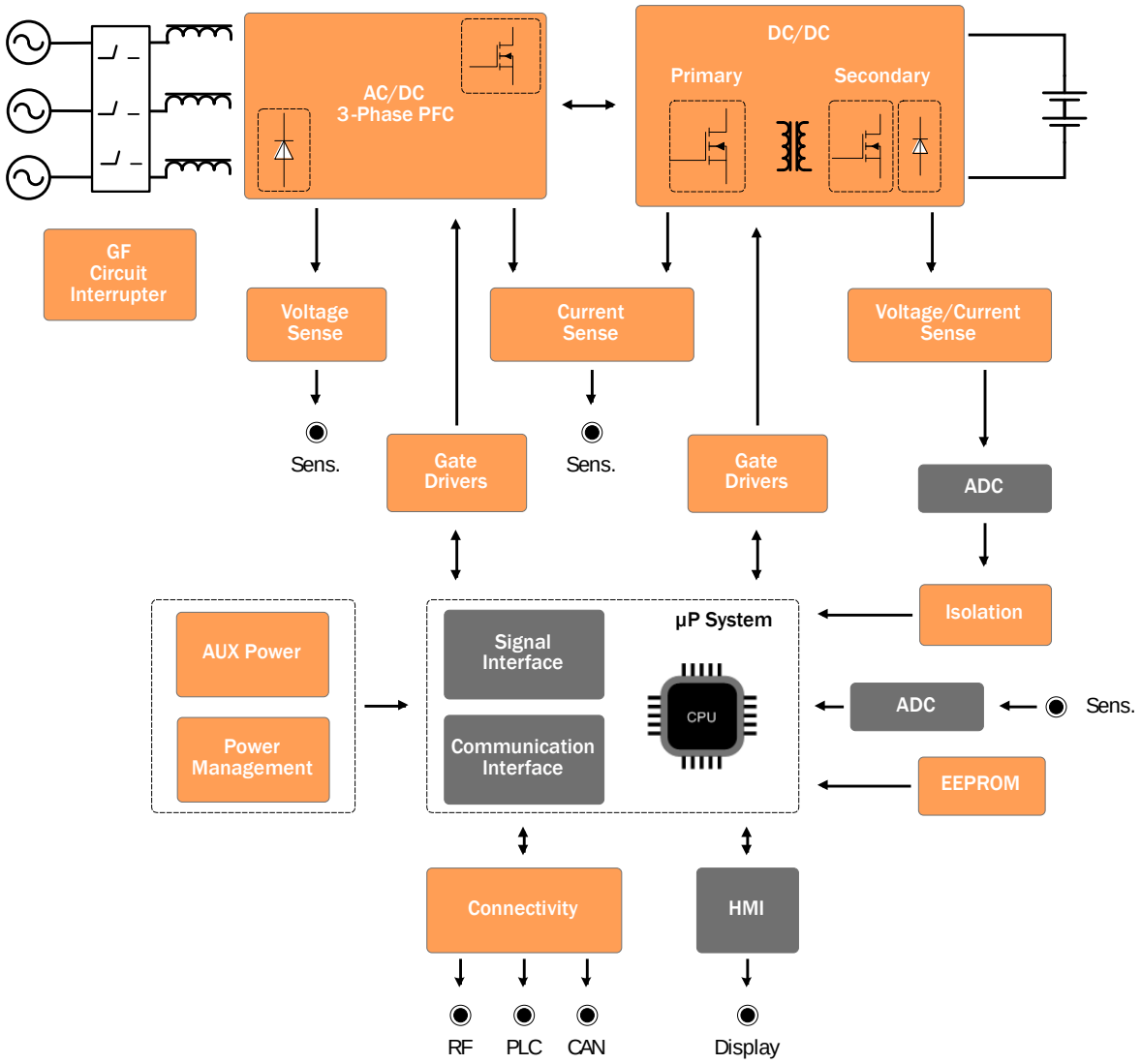
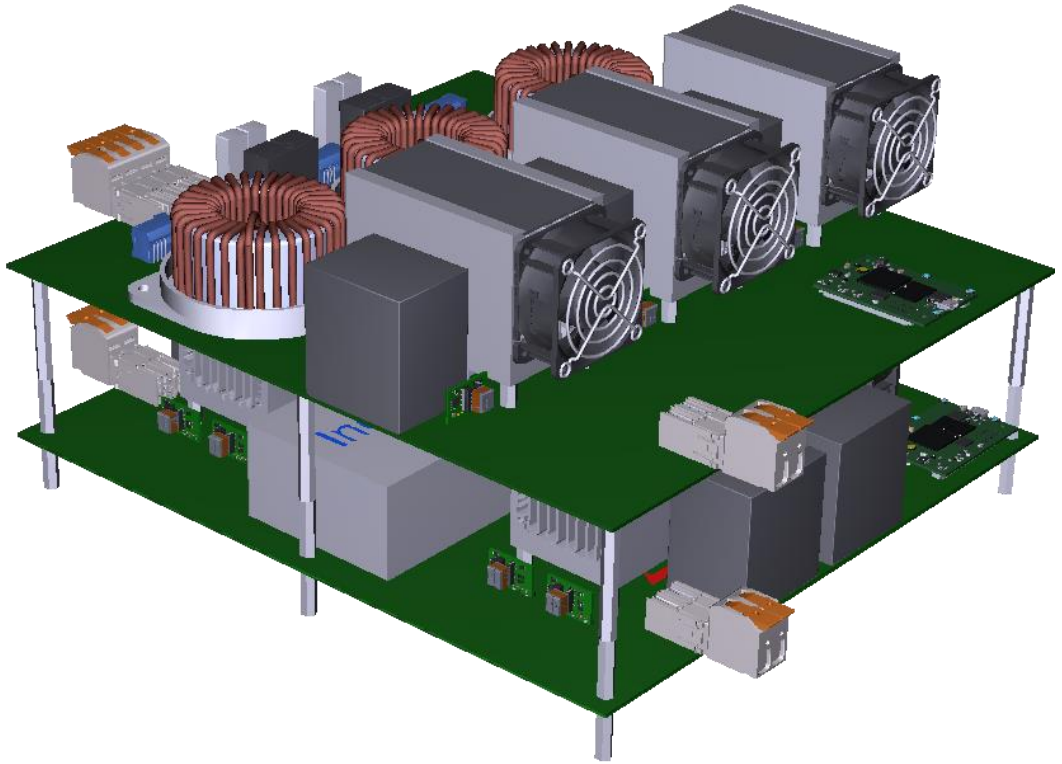
FAST EV CHARGING – BLOCK DIAGRAM



- Active Frontend (PFC)
- Resonant Full Bridge Stage
- Output Rectification
- Voltage Sense
- Current Sense
- LEM Sensor Interface
- AC-DC Regulator/Controller
- DC-DC Regulator/Controller
- CAN Interface
- BLE Interface

FAST DC CHARGING STRUCTURE

- For DC fast EV charger to deliver power above 100kW :
  - Paralleling is used,
  - Building blocks are typically in the range of 12kW to 75kW…



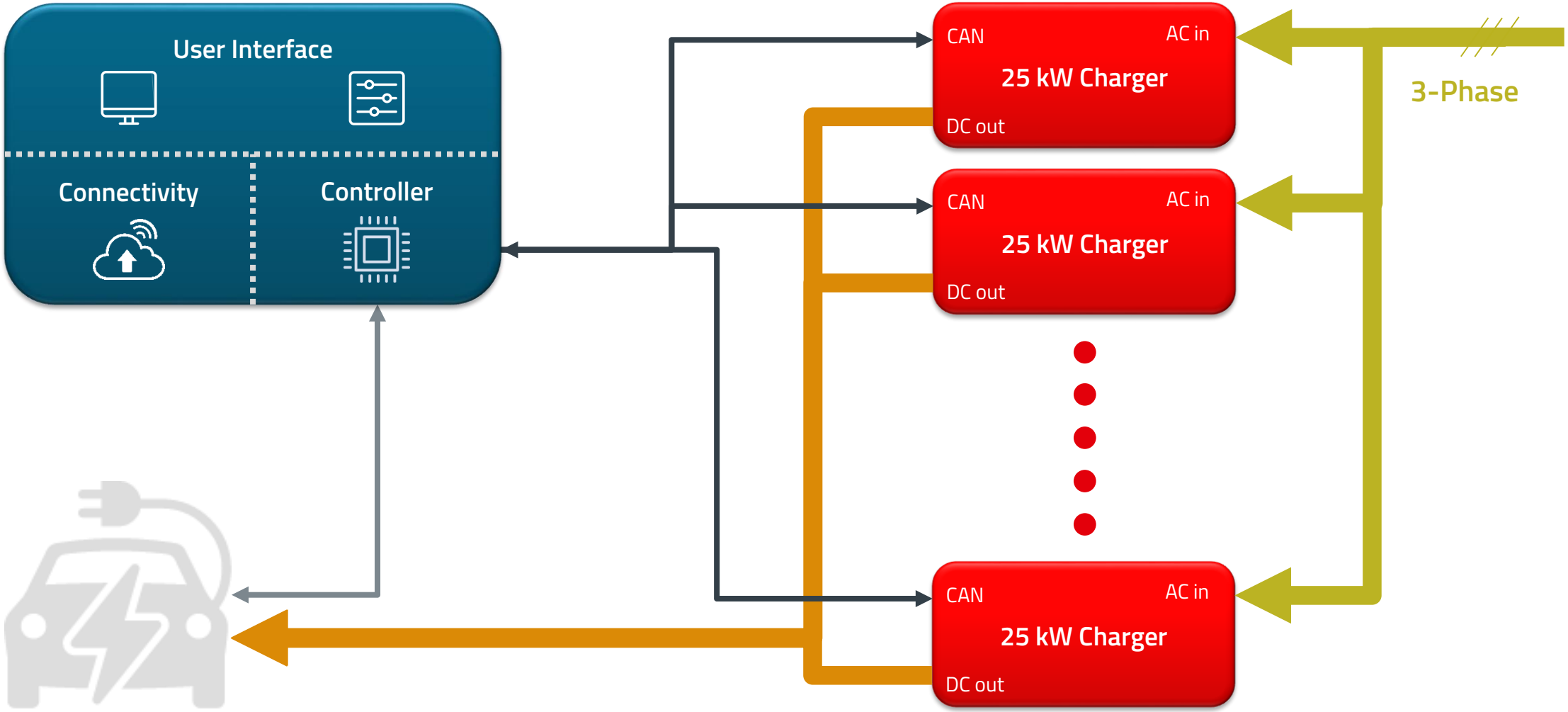
15-75 kW #1

15-75 kW #2

15-75 kW #3

15-75 kW #4

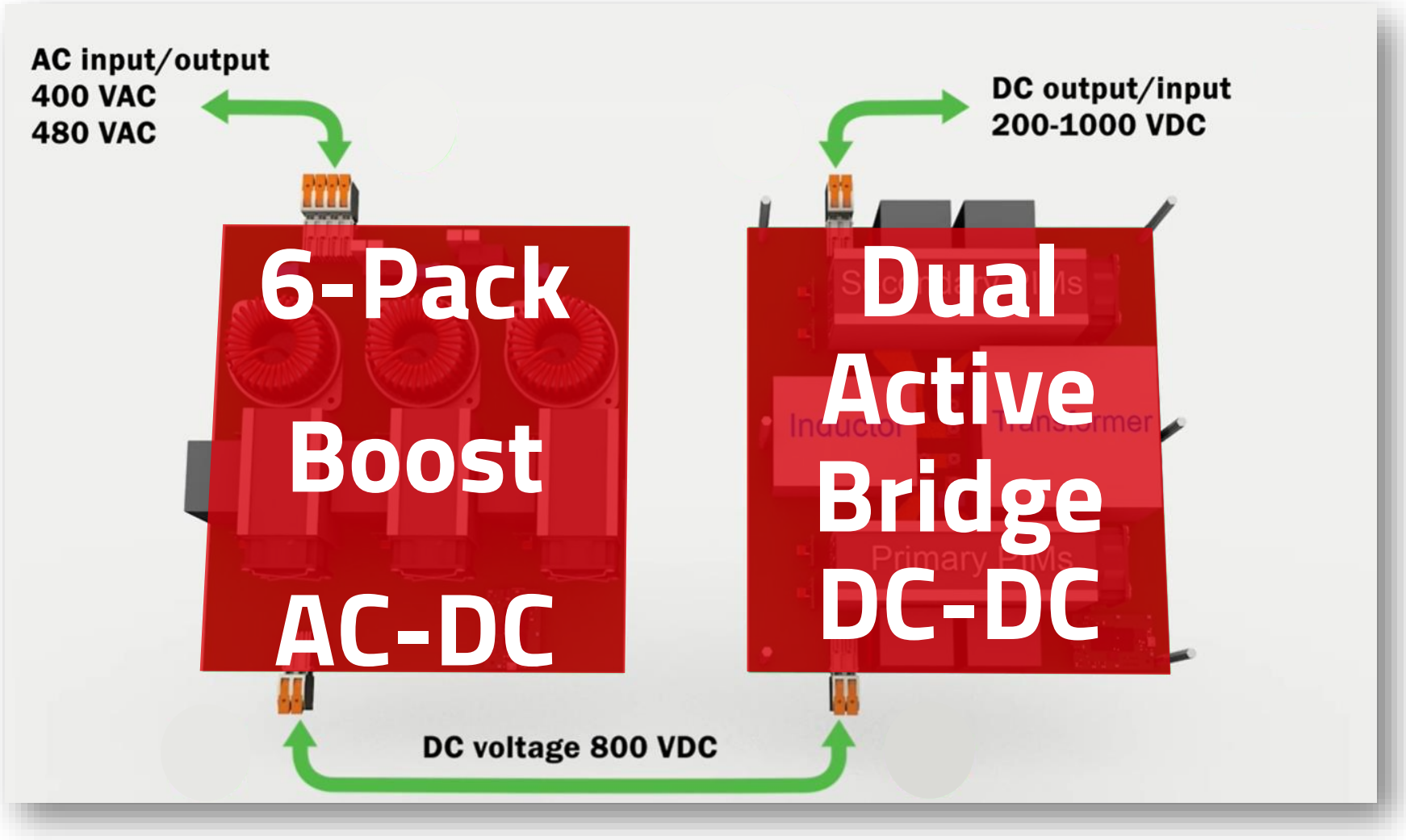
CHARGING CABINET SOLUTION EXAMPLE



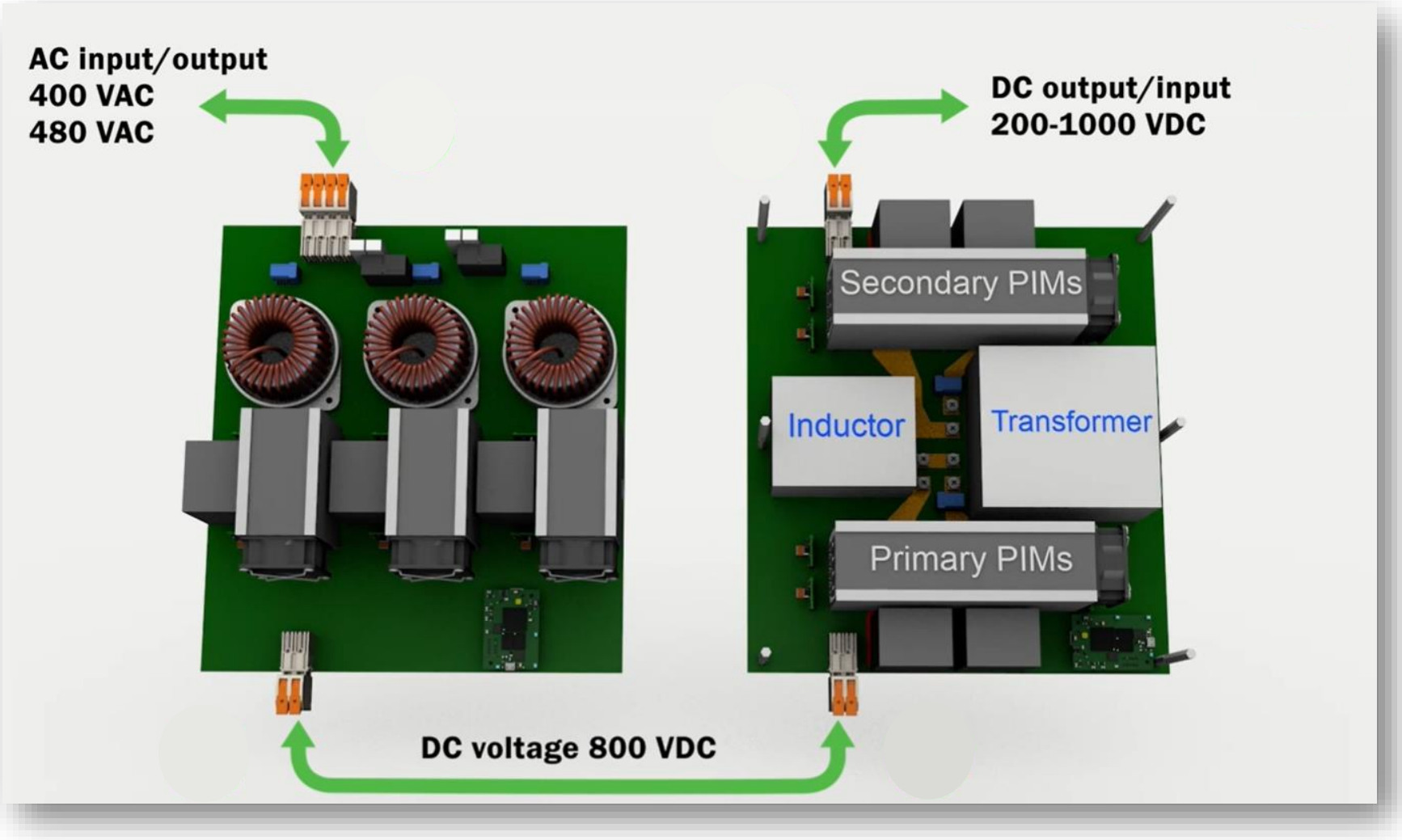
COMPLETE CHARGER (PFC + DC-DC CONVERTER) SPECIFICATION

AC input	Voltage input rating	Three-phase 400 Vac (EU), 480 Vac (US)
	Max. input current	40 A
	Frequency	50/60 Hz
	Power factor	>0.99
	Efficiency	>96%
DC output	Output voltage	200 V to 1000 V
	Max. output power	25 kW
	Max. output current	50 A
Protections	Output	OVP, OCP, SC
	Input	UVP, OVP, inrush current
	Internal	Desat (gate driver), thermal (NTC on power device)
User Interface	Push buttons	Yes
	GUI	Yes.
Communication buses	Internal	SPI, I^2C
	External	Isolated CAN, USB, UART
Environmental	Operating temperature	0 °C to 40 °C
	Operating mode	Fully **Bidirectional**
Max. dimensions	PCB	450 x 300 x 280 mm (PFC and dc-dc stacked)
Standards	Regulation	Following guidelines described in EN55011 Class A **Will not be tested**
	EV systems	Following guidelines described in IEC 61851 **Will not be tested**

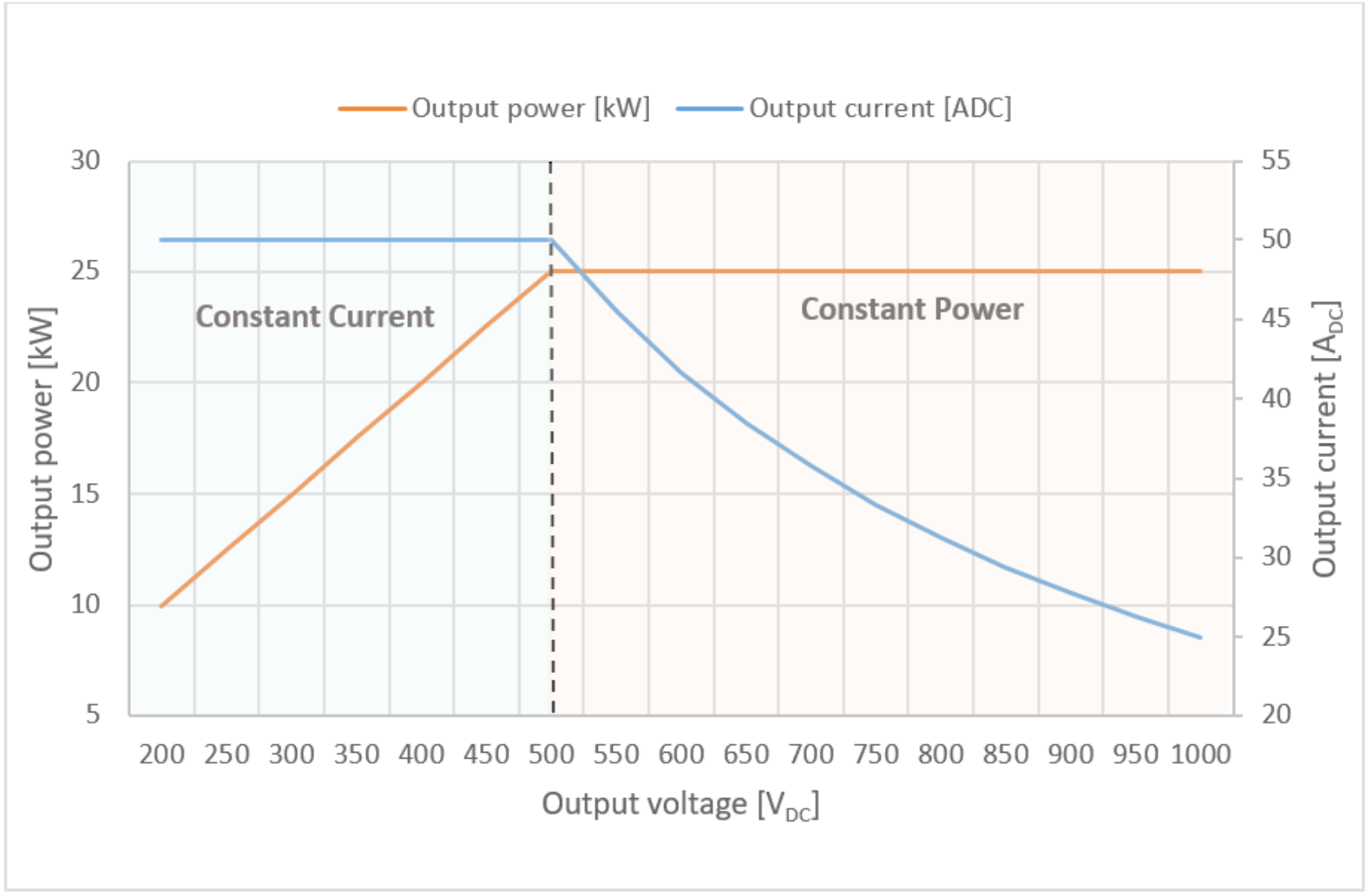
SYSTEM BOARDS : PFC + DC-DC MECHANICAL SKETCH



SYSTEM BOARDS : PFC + DC-DC MECHANICAL SKETCH



OUTPUT CHARACTERISTICS



Products available in onsemi portfolio

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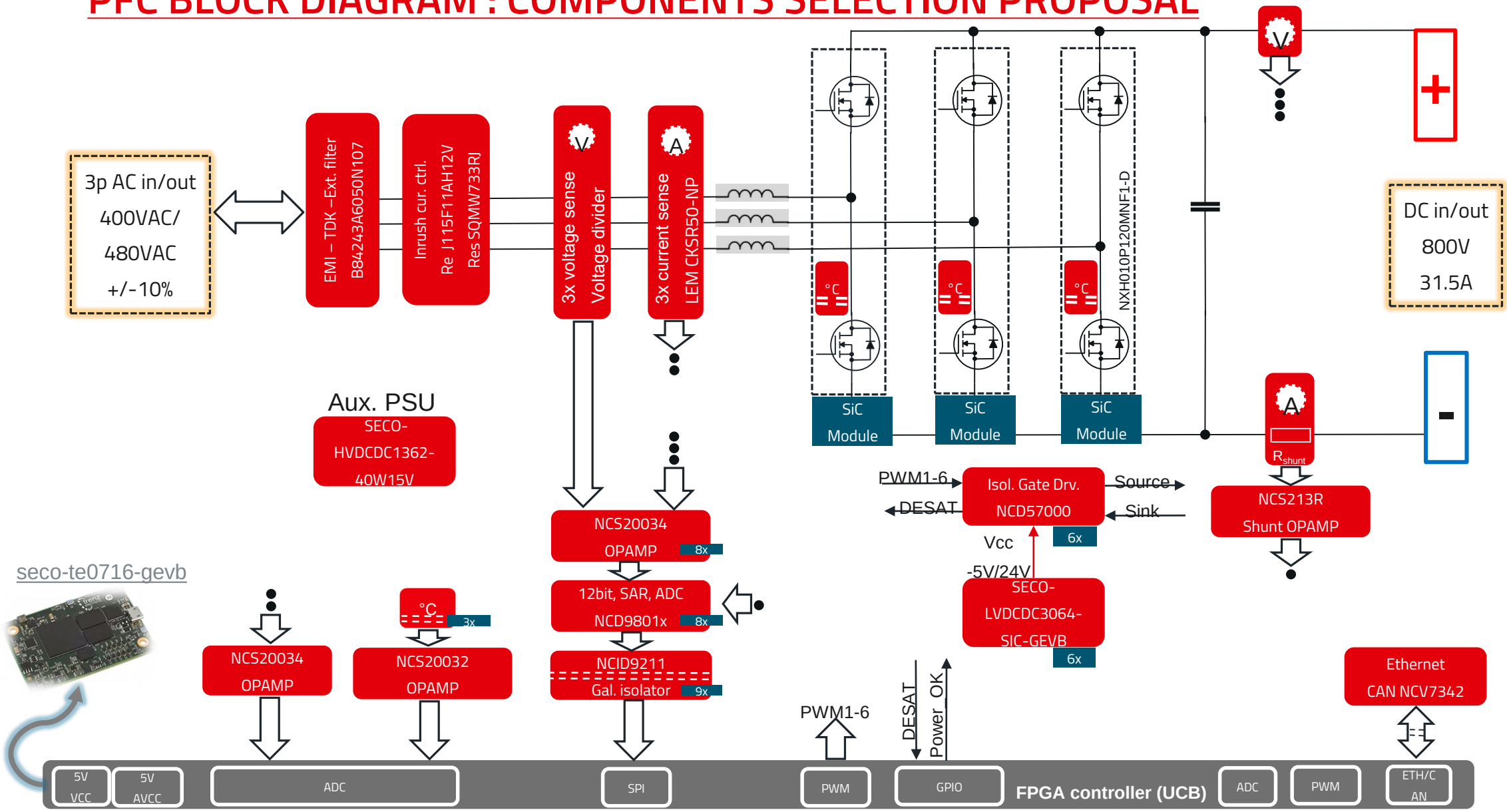
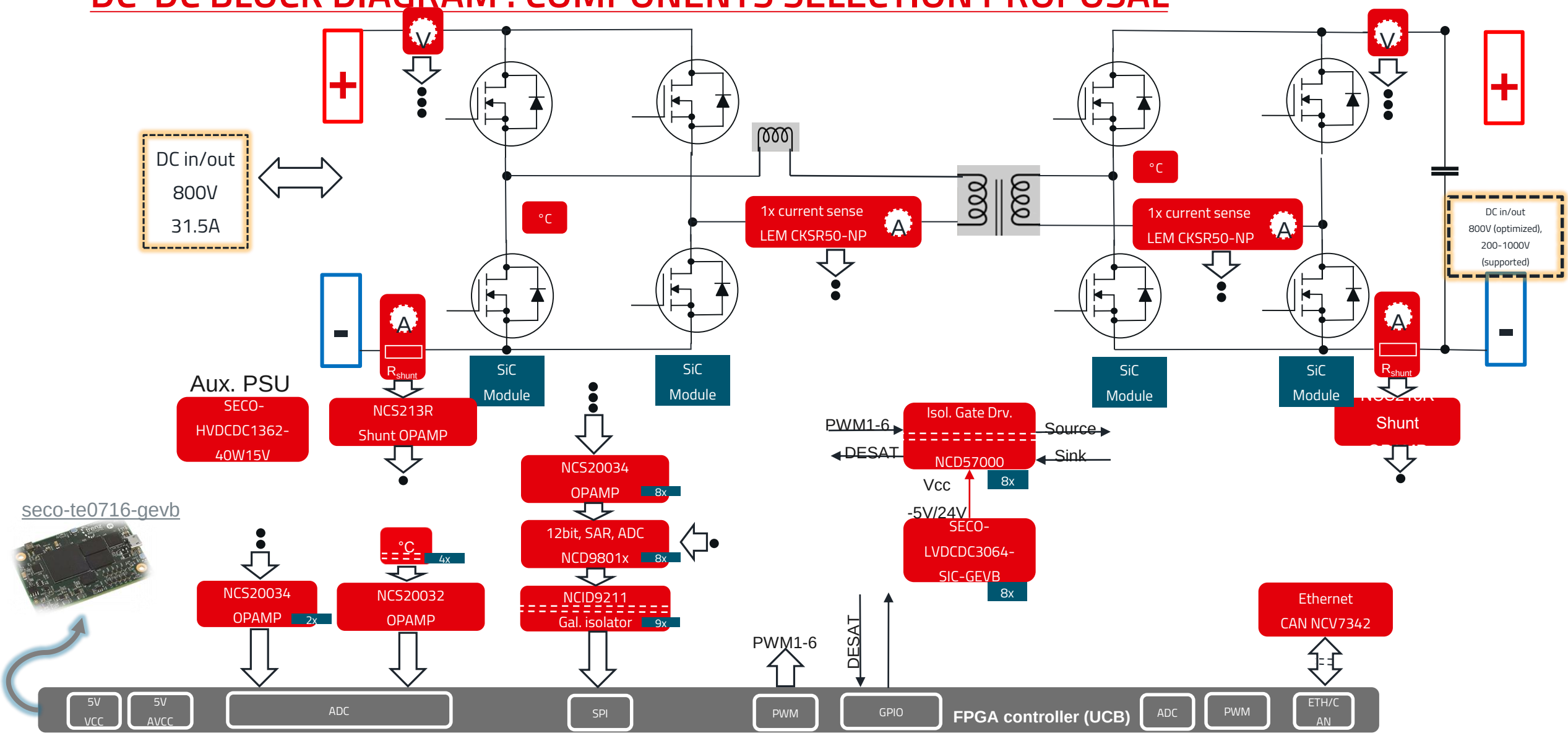
PFC BLOCK DIAGRAM : COMPONENTS SELECTION PROPOSAL



BILL OF MATERIAL

Function	Part Number
Power Module	NXH010P120MNF1 **X3**
SiC Gate Driver	NCD57000 **X6**
Voltage Amplifier	NCS20034
Current Amplifier	NCS213R
General Purpose Amplifier	NCS20032 NCS20034
Digital Isolator	NCID9211
SAR ADC	NCD9801x
Ethernet - CAN	NCV7342
Aux HV PSU	SECO-HVDCDC1362-40W15V with NCP1362
Aux LV PSU	SECO-LVDCDC3064-SIC-GEVB with NCV3064MNTXG

DC-DC BLOCK DIAGRAM : COMPONENTS SELECTION PROPOSAL



BILL OF MATERIAL

Function	Part Number
Power Module	NXH010P120MNF1 **X4**
SiC Gate Driver	NCD57000 **X8**
Voltage Amplifier	NCS20034
Current Amplifier	NCS213R
General Purpose Amplifier	NCS20032 NCS20034
Digital Isolator	NCID9211
SAR ADC	NCD9801x
Ethernet - CAN	NCV7342
Aux HV PSU	SECO-HVDCDC1362-40W15V with NCP1362
Aux LV PSU	SECO-LVDCDC3064-SIC-GEVB with NCV3064MNTXG

Modules

For high power applications' scaling

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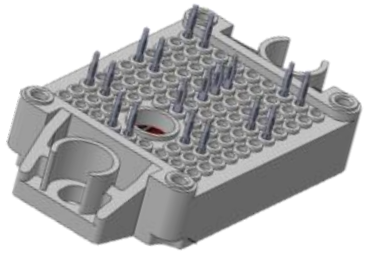
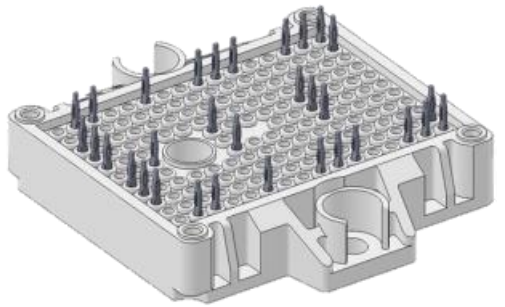
POWER SCALING VS MODULE FOR HALF-BRIDGE MODULES

Output Power	Part number	Description
~ 6 kW	NXH040P120MNF1	Half Bridge 2-PACK 1200V 40mohm SiC MOSFET
~ 12 kW	NXH020P120MNF1	Half Bridge 2-PACK 1200V 20mohm SiC MOSFET
~ 25 kW	NXH010P120MNF1	Half Bridge 2-PACK 1200V 10mohm SiC MOSFET
~ 50 kW	NXH006P120MNF2	Half Bridge 2-PACK 1200V 6mohm SiC MOSFET

F1



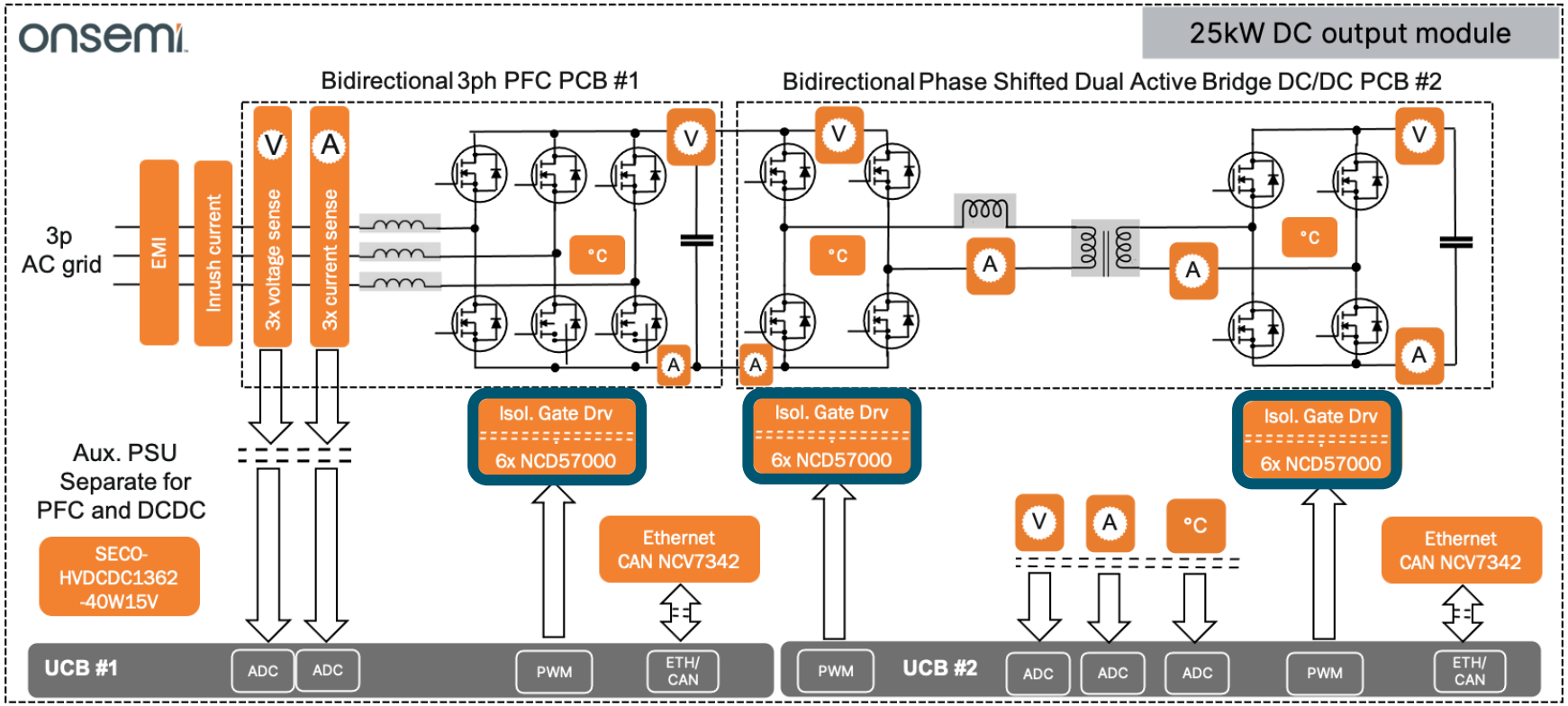
F2



Gate drivers

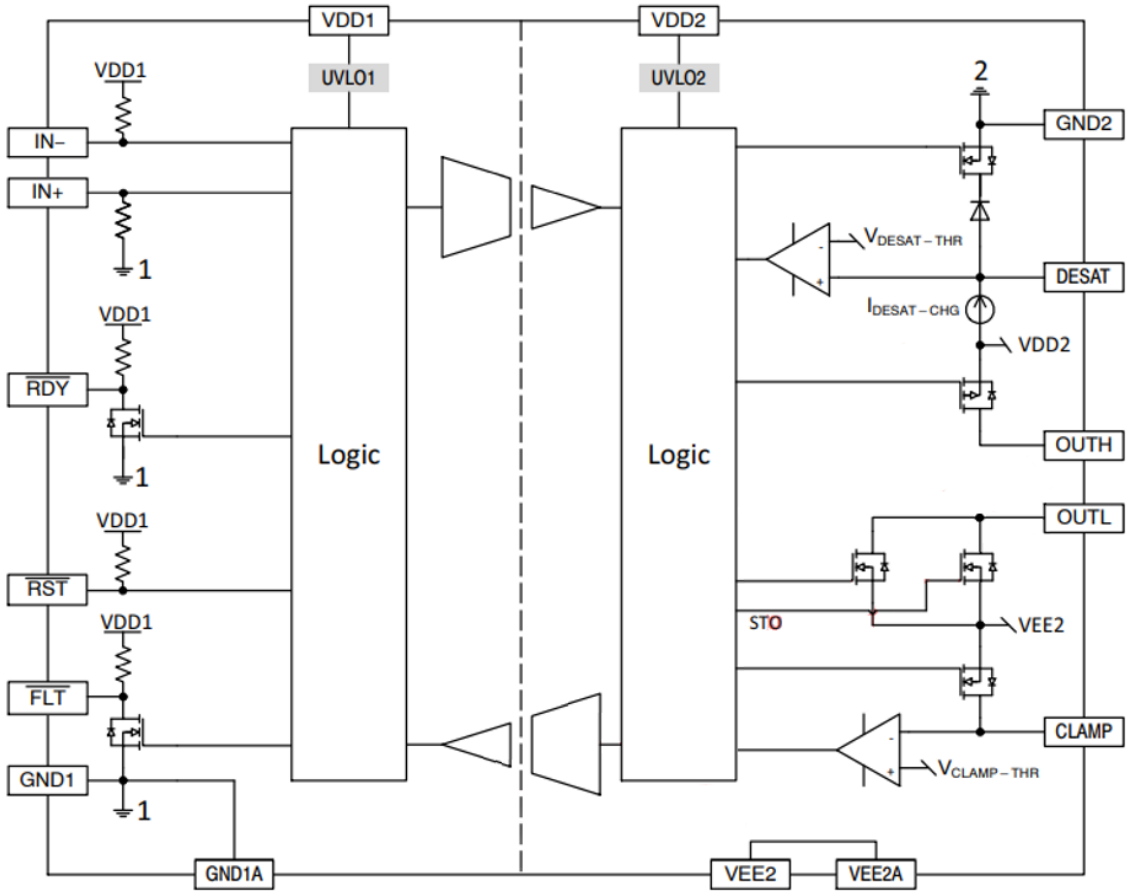
DRIVERS SELECTION FOR THE 25KW POWER STAGE

- The NCD57000 was selected because it offers the following features :
  - 50 ns Propagation delay and 10 ns delay mismatch,
  - Low output internal impedance
  - +4 A / -6 A capability
  - 25-V output range
  - 100-V/ns Immunity
  - Active Miller Clamp
  - DESAT protection
  - 5-kVrms isolation
  - 8-mm creepage



INTRODUCING NCD(V)57100 / 101

- **Highlights**
  - Pin2Pin Drop-In Replacement to NCD(V)57000/001
  - Addresses all known issues in NCD(V)57000/001
  - Identified root cause, fixed & verified all issues
  - VDD2-VEE2 (VMAX2) increased from 25 V to 32 V
  - Improved RSTb Function
  - New DESAT Diagnostics Test (Patent Pending)
  - Rev A Samples Available (Require Errata)
  - Rev B Samples Available Q2/End
  - Production Q3'2022
  - NCD(V)57000 will not be EOL'd



Auxiliary Supply sockets

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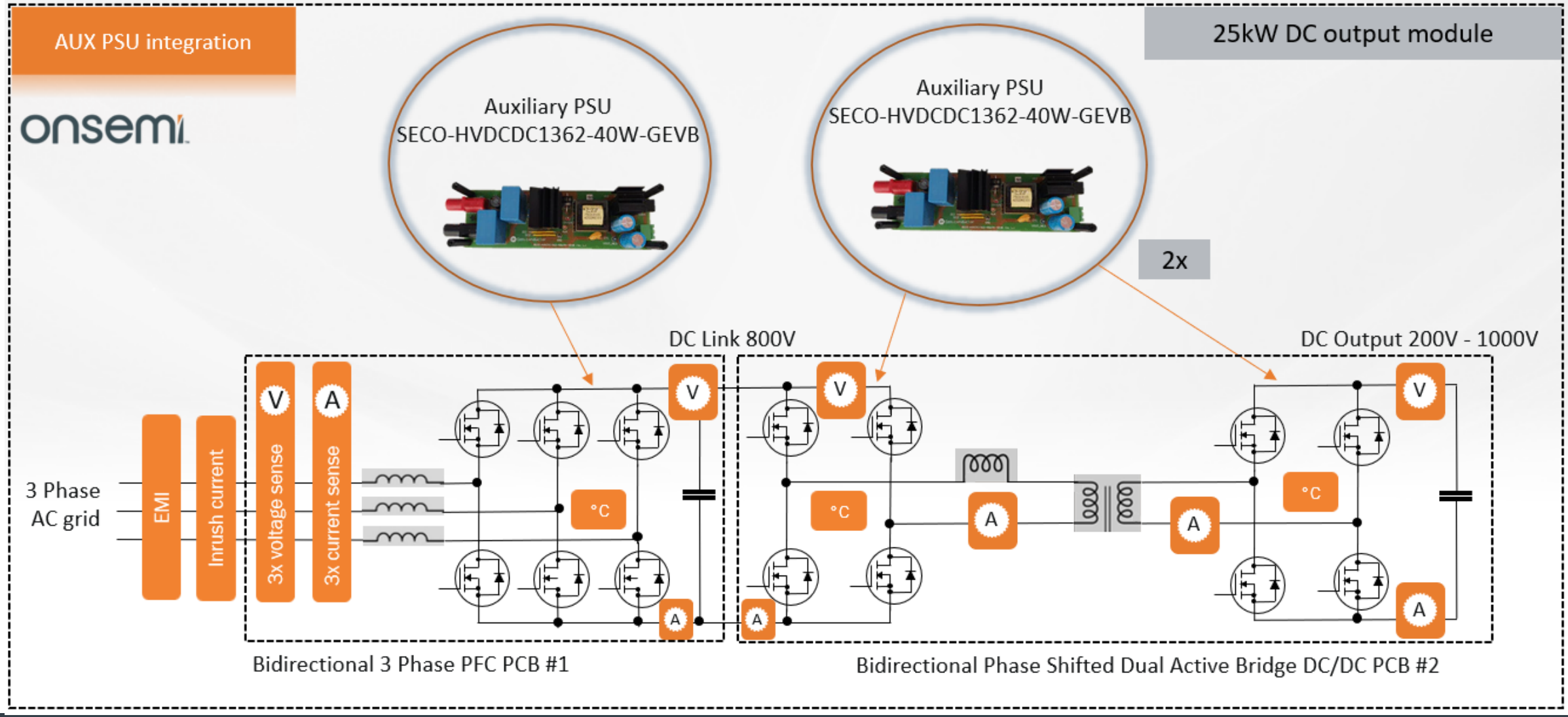
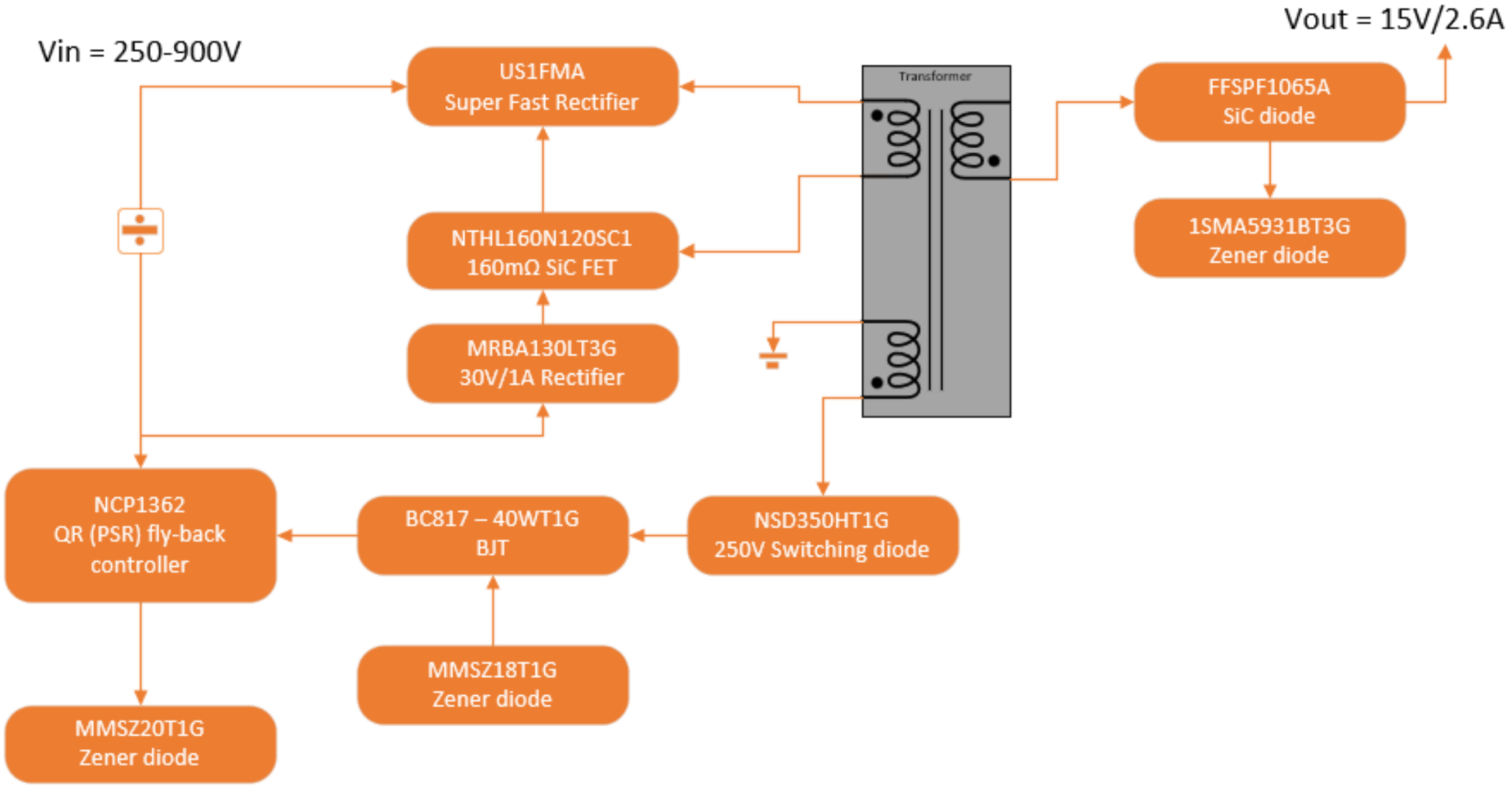
AUXILIARY SUPPLIES NEED



SECO-HVDCDC1362-40W-GEVB BLOCK DIAGRAM



AUXILIARY SUPPLY DESIGN : SECO-HVDCDC1362-40W-GEVB

- Topology : **40 W - 15 V / 2.6 A** Flyback boundary conduction mode + ZCD clamp
  - PWM : NCP1362 driving SiC MOSFET with 0 V - 12 V gate drive
    - (no external dedicated SiC MOSFET driver helps saving cost)
  - Main Switch : 1200 V, 160 mW NTHL160N120SC1 SiC MOSFET
    - We keep 100 V headroom for the SiC MOSFET.
    - For more headroom : 1700 V, 1 W SiC MOSFET
  - ZCD clamp : US1FM1 Super Fast diode / 160V TVS
  - Secondary rectifier diode : FFSP0665B
    - Due to large input swing

Amplifier (Voltage and Current)

EV CHARGING STATIONS – SENSING CIRCUITS

Voltage Sensing

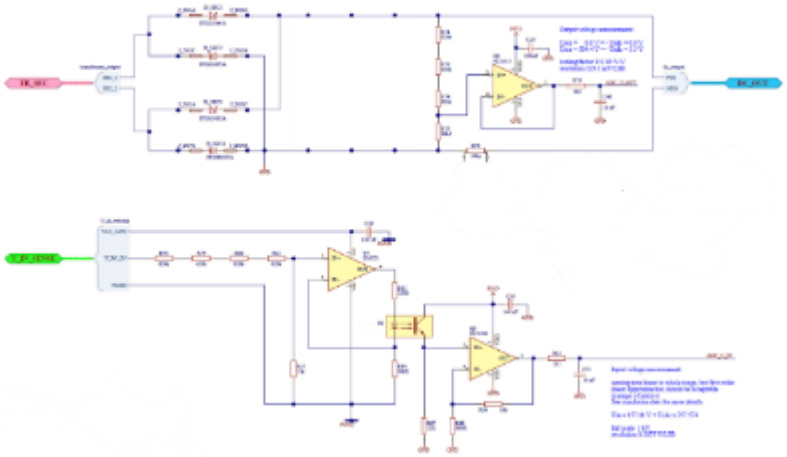
Medium signal bandwidth

High accuracy needed

Solution based on NCS333/2333/4333

Output Voltage Sensing

Input Voltage Sensing



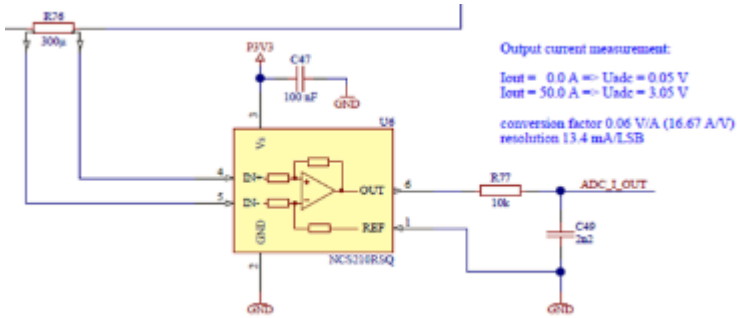
Current Sensing with Resistor

High signal bandwidth

High speed needed

Solution based on NCS210RSQ

LLC Output Current Sensing



Current Sensing with LEM Sensor

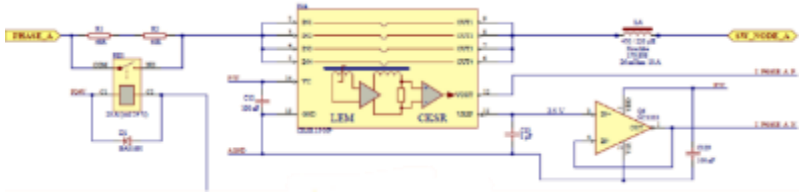
High signal bandwidth

High speed needed

Solution based on NCS333

Interface to LEM sensor

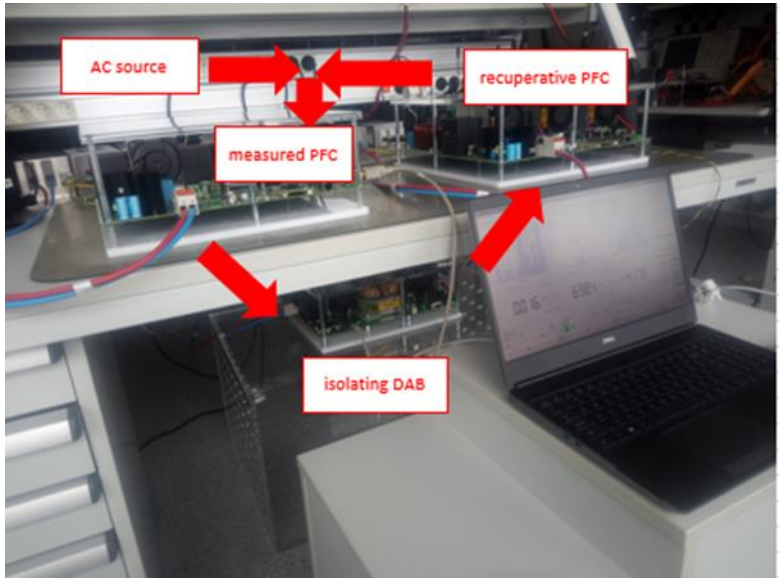
used for inrush current detection



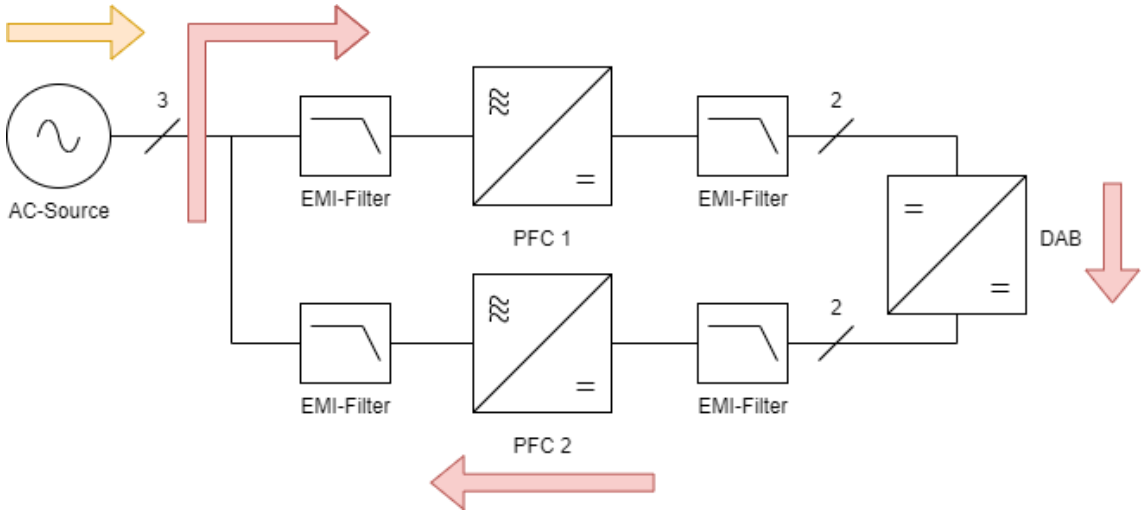
onsemi Advantages: Verified function and layout in lab evaluation board

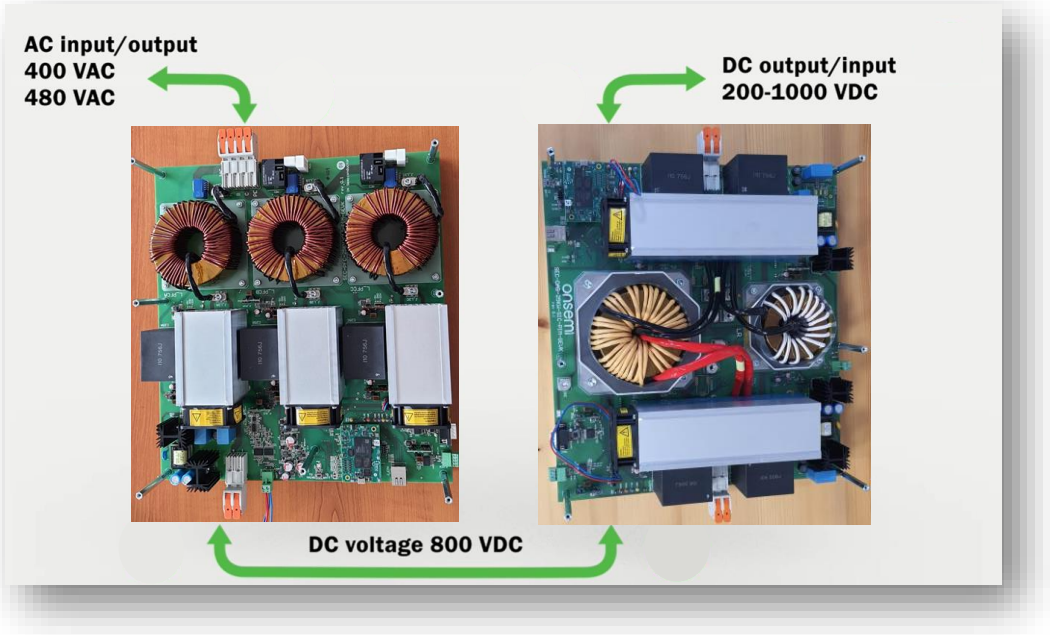
Measurement and Results

MEASUREMENT – BLOCK DIAGRAM

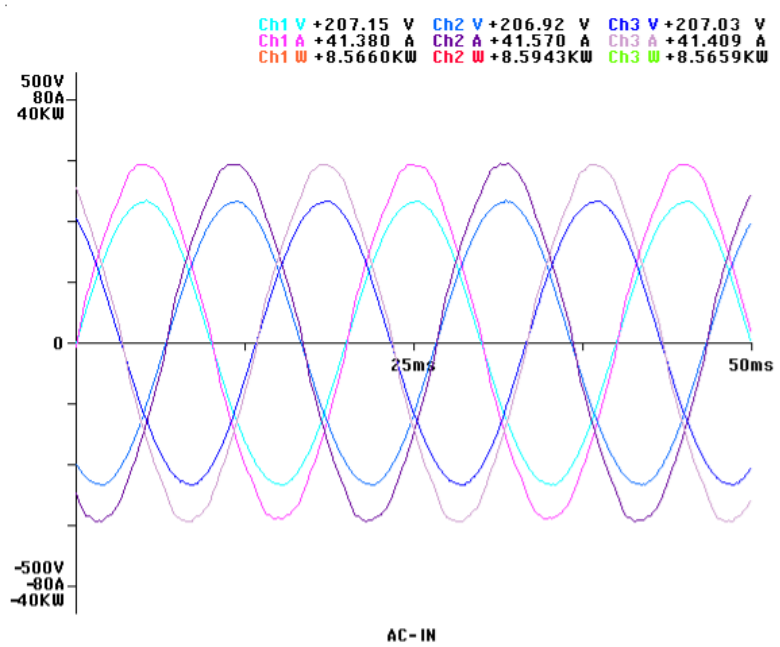


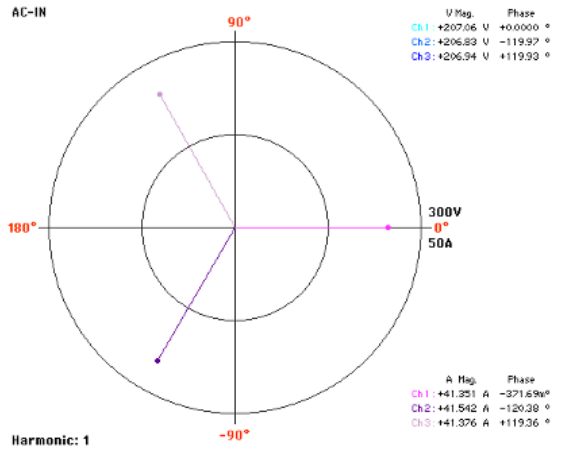
- To reduce power consumption, we use the bidirectional operation to load a first stage with a second stage operating reverse and re-inject the first stage output power into the grid.





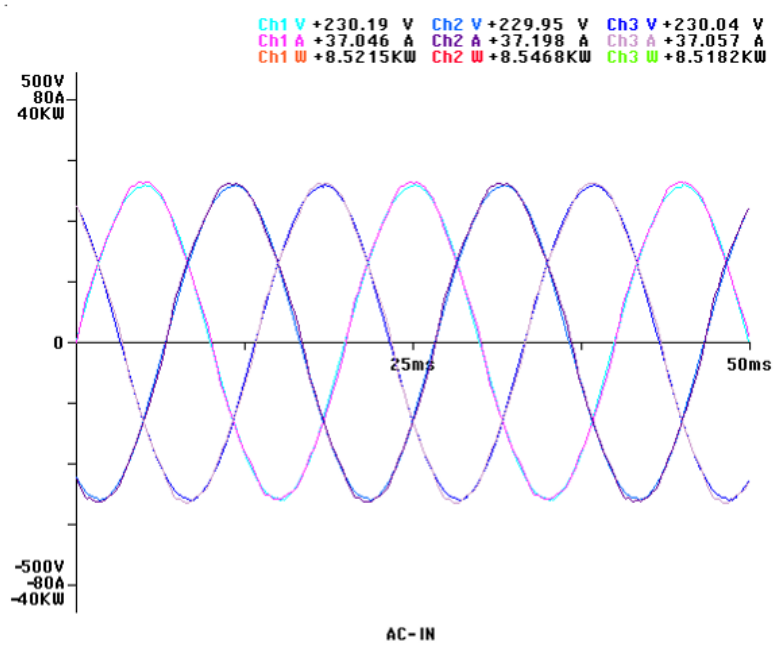
INPUT VOLTAGE AND CURRENT

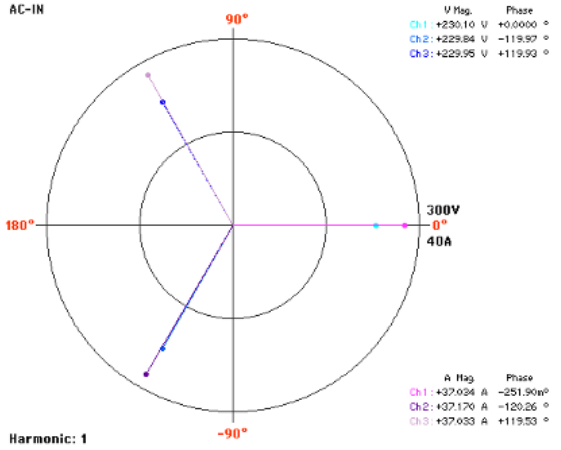




Low line

207VAC

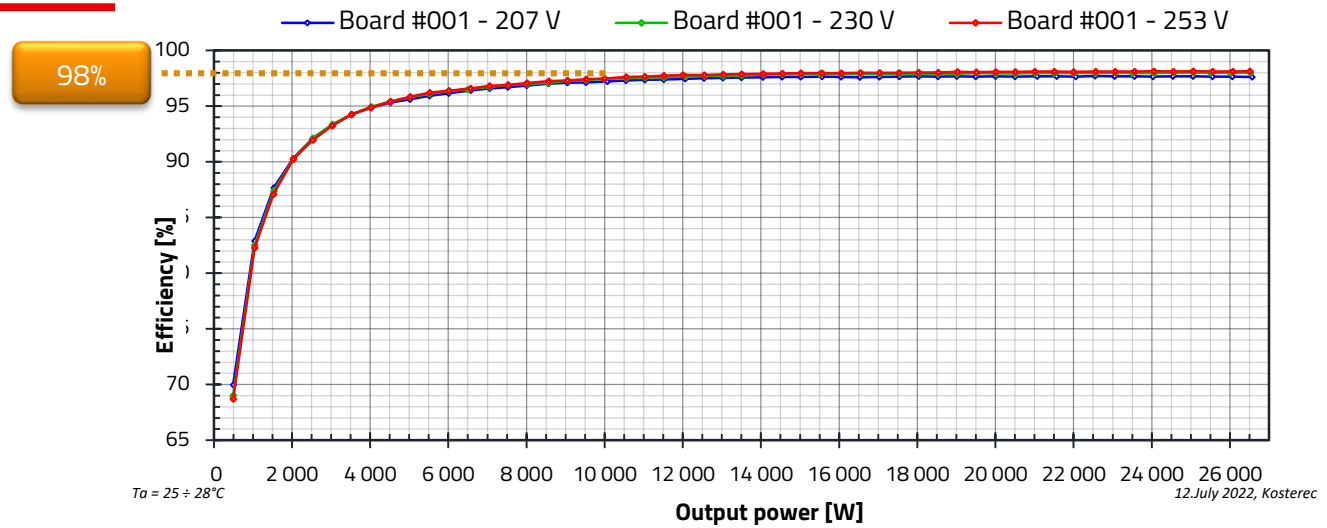




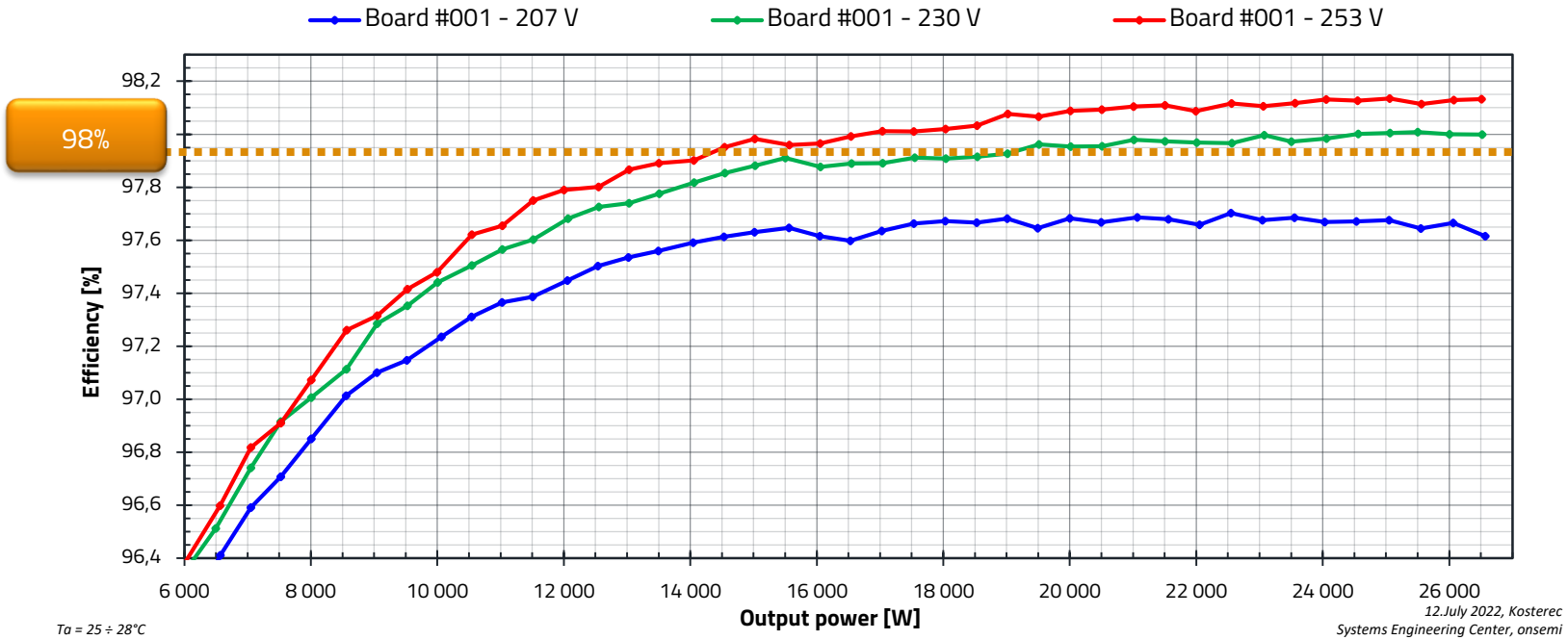
Nominal line

230VAC

ACTIVE FRONT END - EFFICIENCY



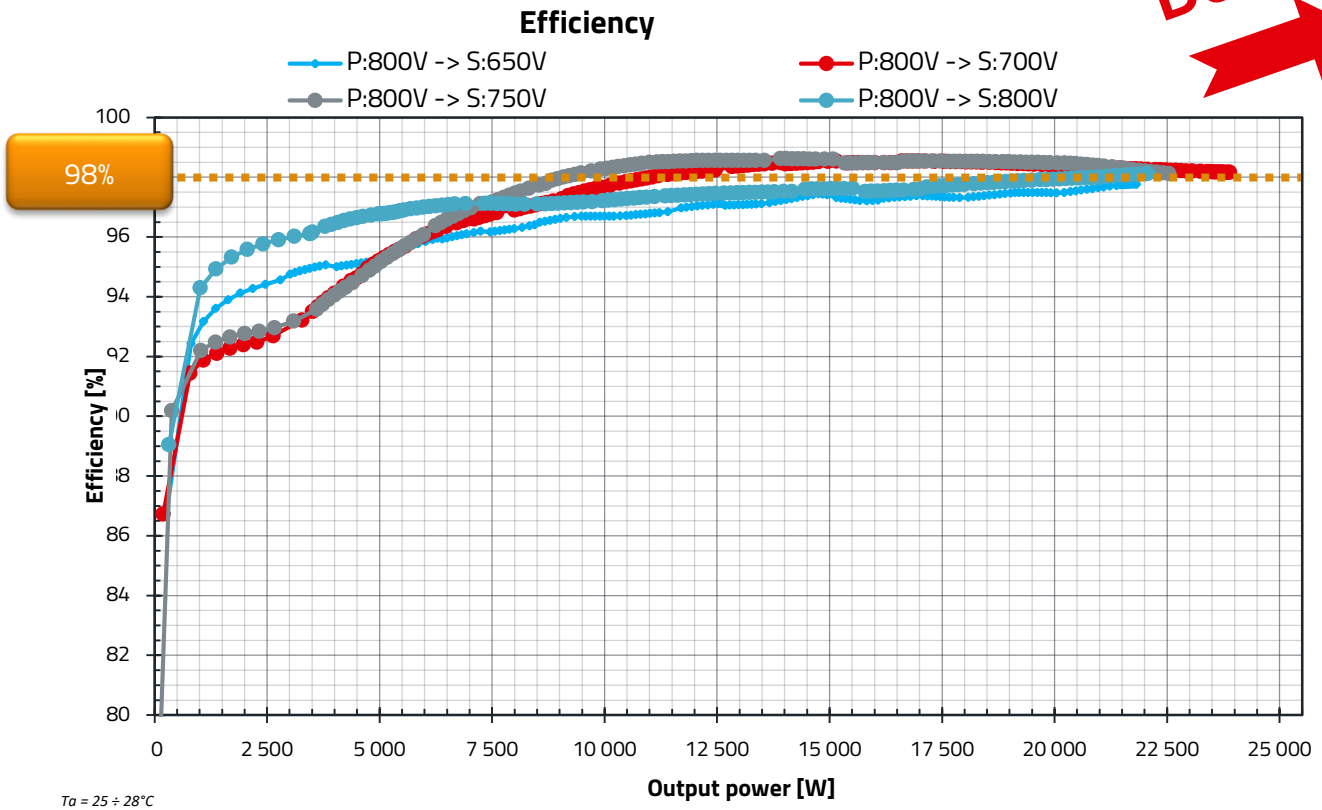
Detail from 6-26.5kW



25kW power range

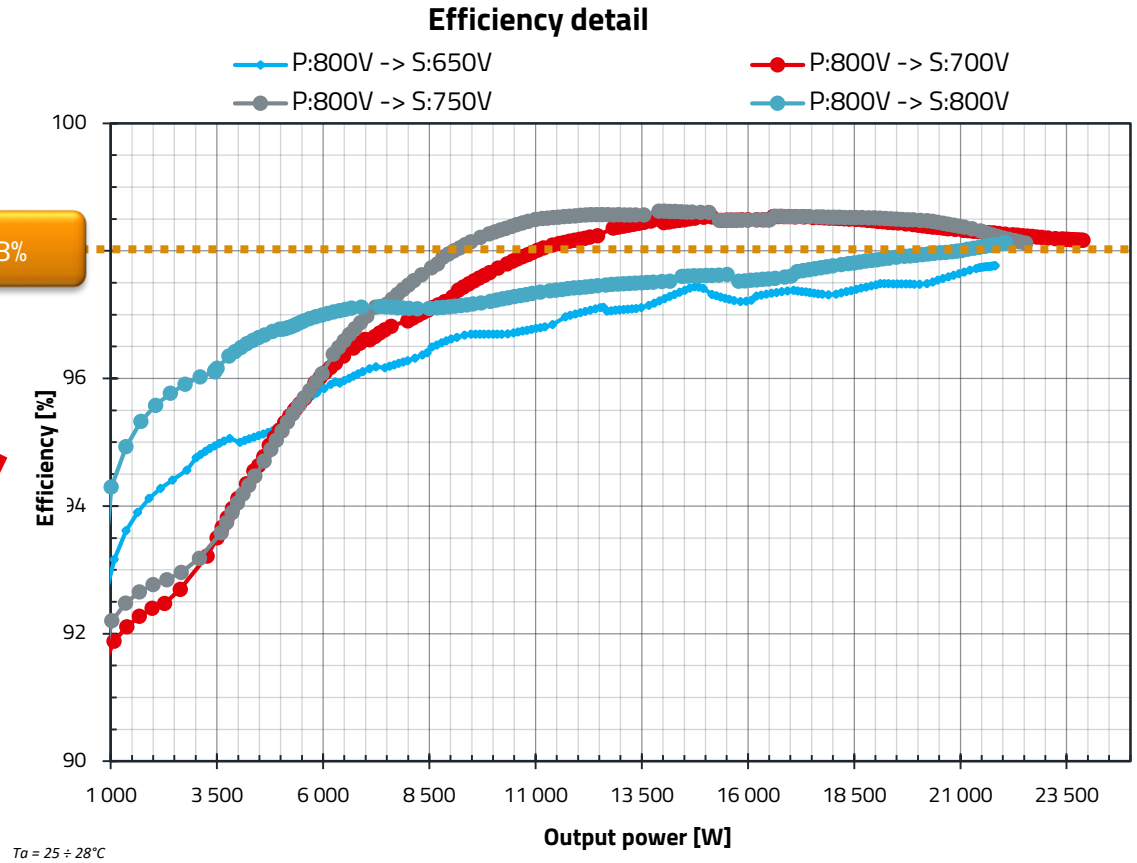
Note: Efficiency is with included losses in input and output EMI filter

DUAL ACTIVE BRIDGE EFFICIENCY



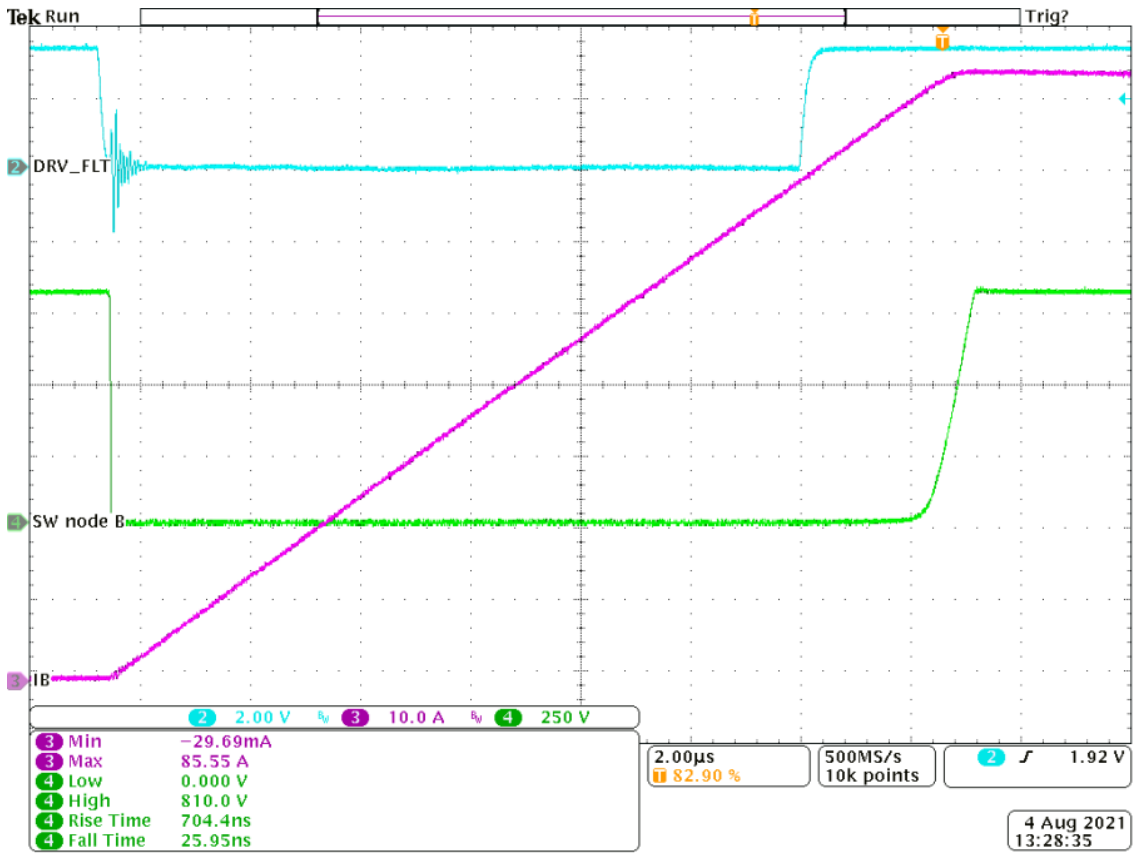
Ta = 25 ÷ 28°C

Detail

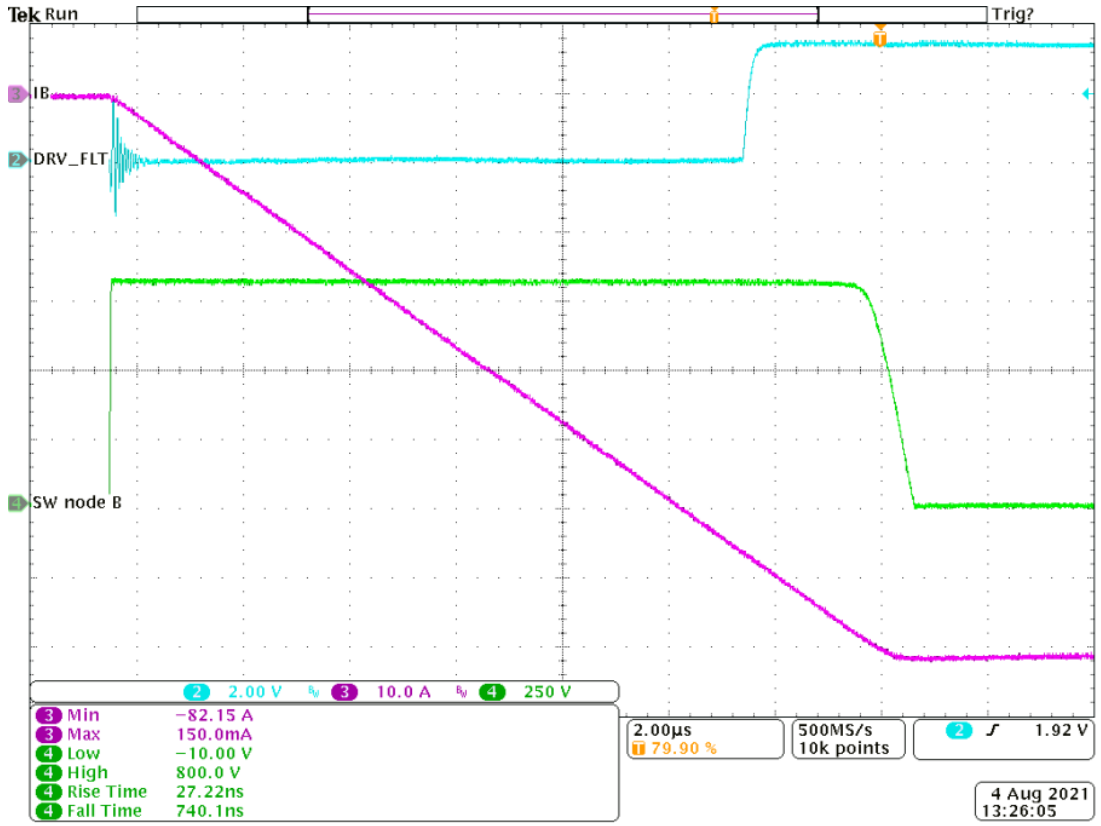


Ta = 25 ÷ 28°C

DESAT FUNCTION THRESHOLD AND OPERATION



LowSideB_DESAT_800V_25degC



HighSideB_DESAT_800V_25degC

Theoretical calculated DESAT threshold current : 85A to 115A

Measurement on several samples resulted to range : 68A to 118A

✓DESAT can be used

to protect SiC MOSFET

Conclusion

WÜRTH ELEKTRONIK
MORE THAN YOU EXPECT

onsemi

CONCLUSION

- Various high-power topologies can be used for Fast EV Charger
- For that power level, Modules is the best way to go

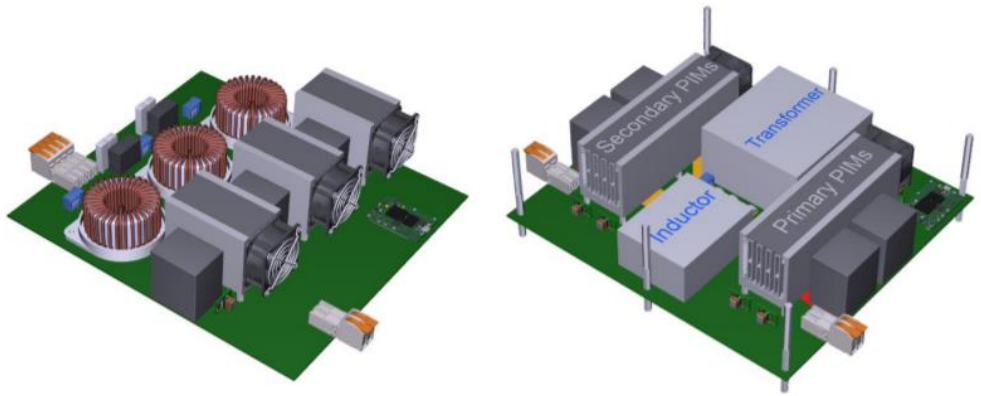
- More than 10 product famillies can be addressed with **onsemi** portfolio
  - Modules,
  - Gate drivers,
  - Operational Amplifiers and Current Sensing Amplifiers,
  - Isolators,
  - Auxiliary Supplies,
  - Communication interface, …

ONSEMI EV CHARGING STATION

25kW building block solution support

Developing A 25-kW SiC-Based Fast DC Landing page :

https://www.onsemi.com/design/tools-software/evaluation-board/SEC-25KW-SIC-PIM-GEVK



PFC stage and DC-DC stage for **onsemi**

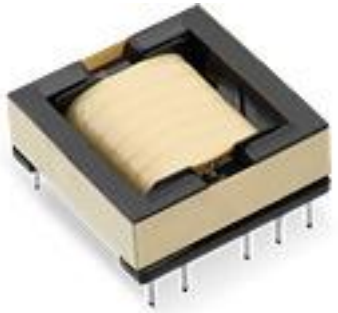
25kW EV Charging Station Solution

25 kW building block	25 kW building block	300kW EV Charging Station
25 kW building block	25 kW building block	
25 kW building block	25 kW building block	
25 kW building block	25 kW building block	
25 kW building block	25 kW building block	
25 kW building block	25 kW building block	

12 x 25kW building blocks

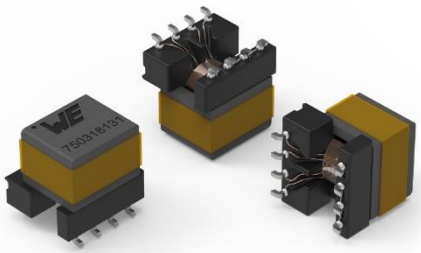
used in 300kW EV Charging Station

EV Charging landing page : www.onsemi.com/dc-fast-charging



NEW!

EXTENDED!



PFC CHOKE
AUXILIARY GATE DRIVE TRANSFORMER SPECIFICATION AND APPLICATION

Stroe Octavian Tudor
Product Definition Engineer Eastern Europe

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

WEBINAR 02.05.2023

OCTAVIAN-TUDOR STROE

- **Diploma**
  - Audio Systems BSc degree, Electronics specialization from University of Huddersfield, UK
  - Optical Compression MSc from University of Huddersfield

- **Experience**
  - Background in Power and Audio Electronics design and testing
  - High Voltage, High Current PoL converters
  - PCB Layout and 3D Design
  - Product Definition Engineer at Wurth Elektronik since 2022
  - Responsible for EMC support to IC Houses in Europe

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

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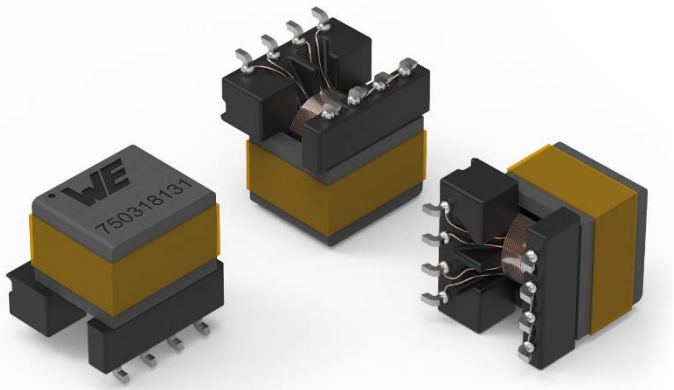
AGENDA

- Extended WE-AGDT Transformers
  - New parts and characteristics
  - Application in onsemi 25kW charger
  - Typical applications and interwinding capacitance
- New WE-TORPFC Overview
  - Product family and characteristics
  - Application in onsemi 25kW charger
  - Specification and measurements
- Why flat wire?
  - Skin and proximity effects
  - Round vs Flat wire measurements
  - Conclusion and equivalent circuit

WE-AGDT EXTENDED SERIES OVERVIEW

Auxiliary Gate Drive Transformers

AEC – Q200 Qualified



- 14x Catalogue parts in stock – No MOQ
  - Up to 6W output power
  - Wide Input voltage: 6-36V
  - Flyback, LLC, Half-Bridge Topologies
  - AEC-Q200 Grade 1
- Characteristics
  - Interwinding capacitance down to <1 pF
  - Tiny surface mount EP7 package
  - Dielectric insulation up to 4 kV AC
  - Basic insulation for 568 Vrms / 800 Vpk
  - Safety: IEC62368-1 / IEC61558-2-16
- Applications
  - Industrial drives
  - AC motor inverters
  - HEV/EV charging station
  - Battery chargers
  - Solar inverters
  - Data centers

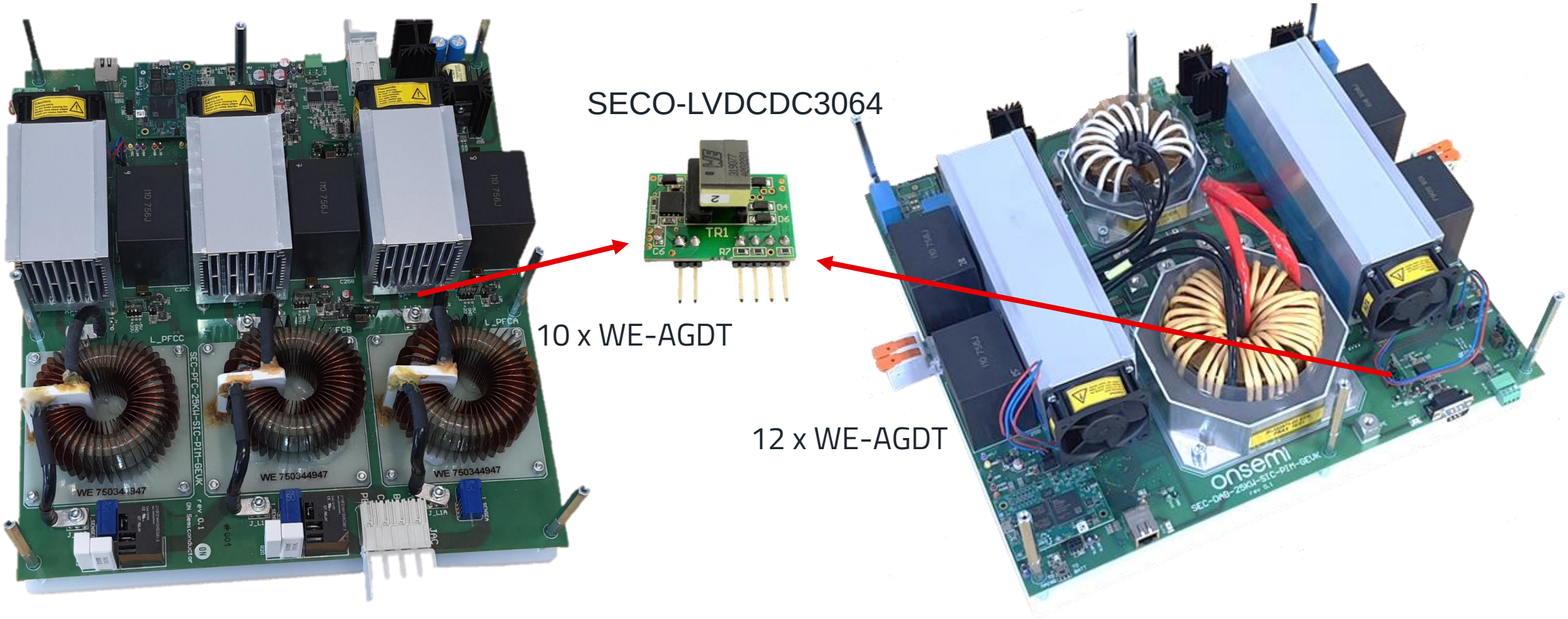
EXTENDED SERIES OVERVIEW

P/Ns and Values

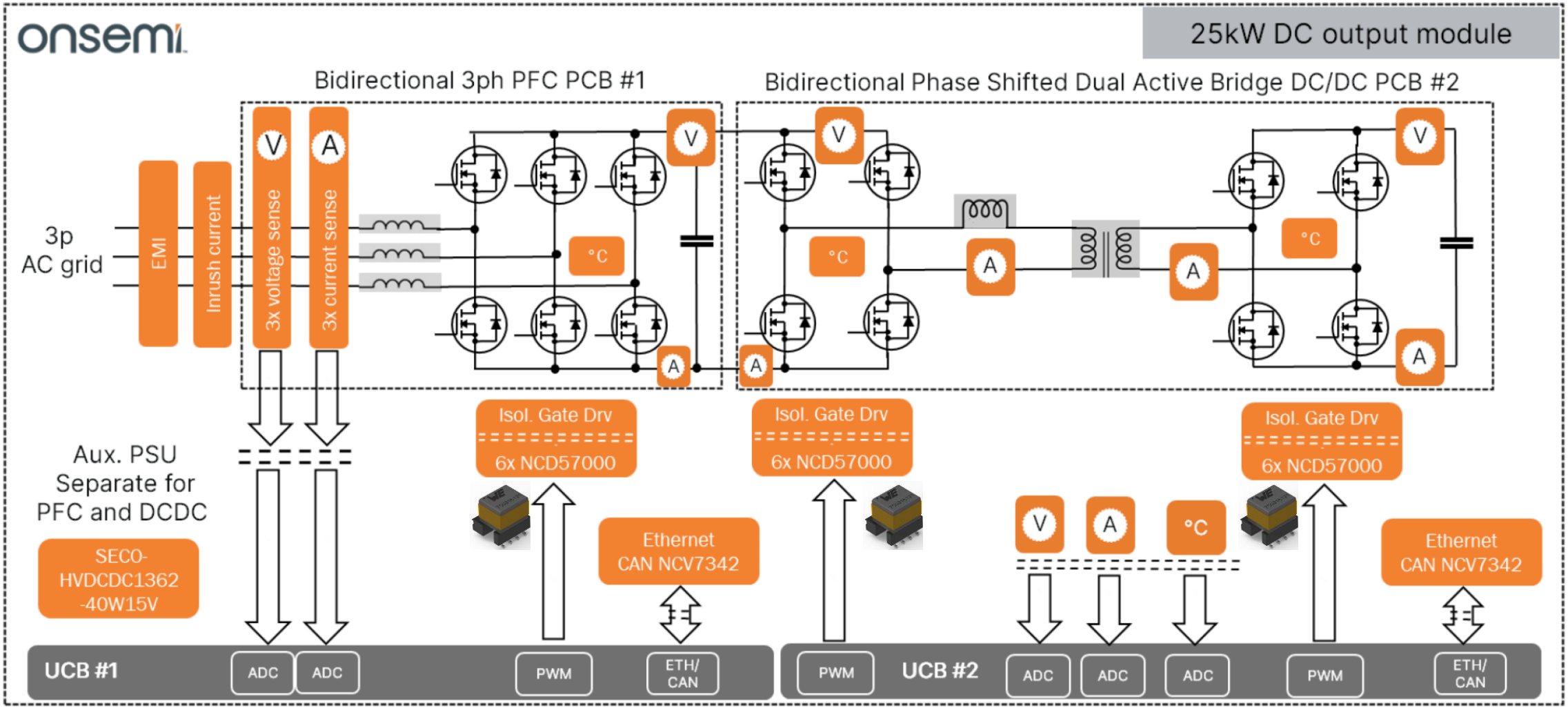
P/N	Vin (V)	Vout1 (V)	Vout2 (V)	Vout3 (V)	Vaux (V)	Pout (W)
750319565	15	30				3
750319497	9-18	19	4			6
750319496	9-18	20	5			6
750319331	13	11.5				6
750319282	6-18	20	5	5	5	1.5
750319177	7.5	13				4.55
750319077	12-18	15	7.5	7.5	5	1.5
750318616	7-31	27			13	2.7

APPLICATIONS

onsemi Reference Design – 25kW Fast Bidirectional Charger – PFC Stage



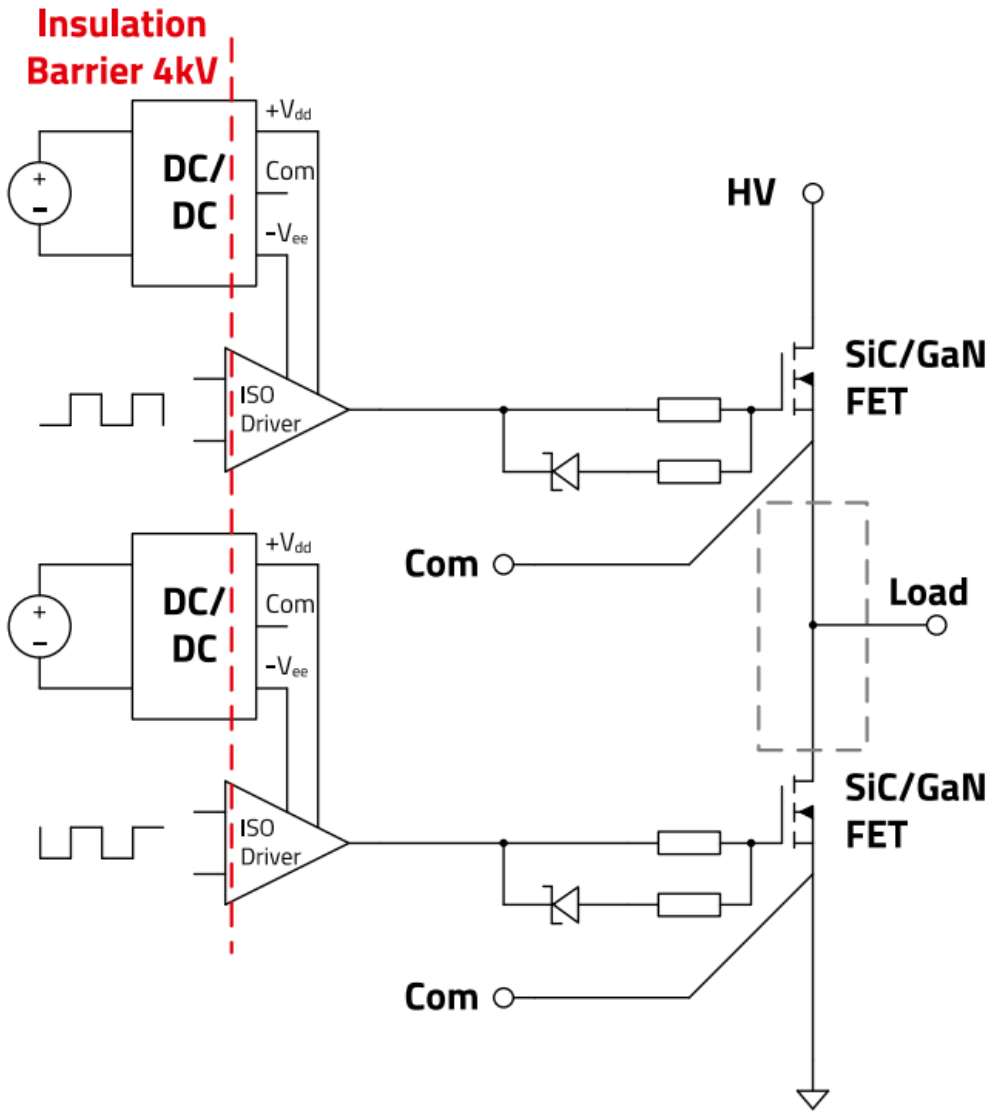
APPLICATIONS



AUXILIARY GATE DRIVE TRANSFORMERS

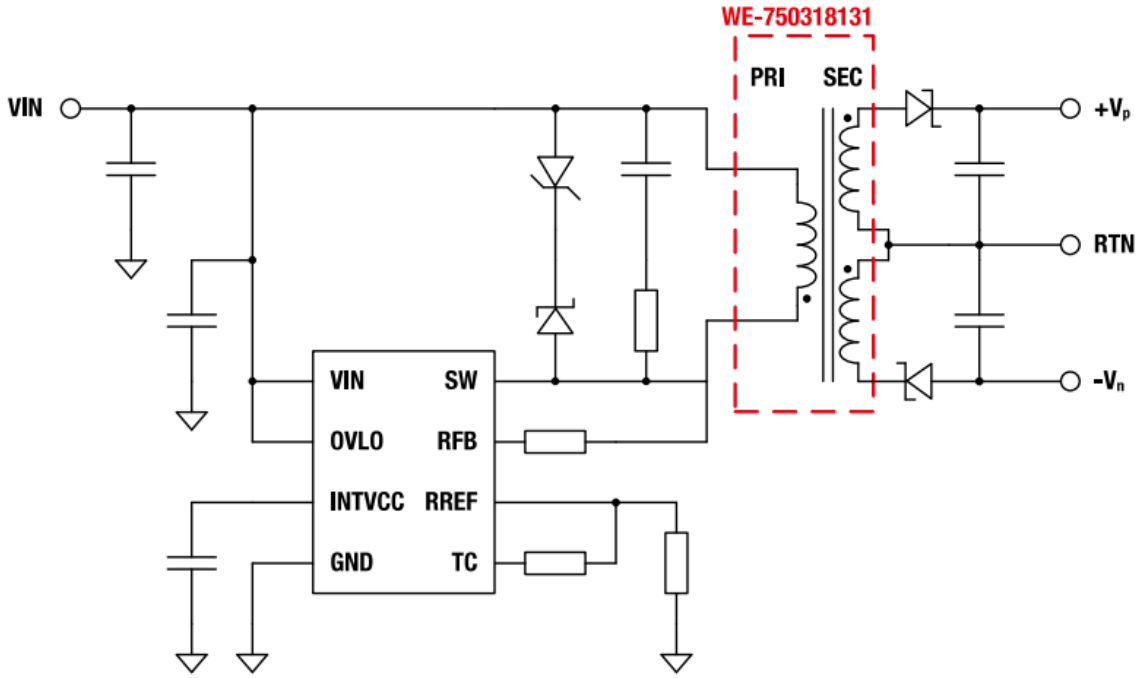
Isolated supply for gate driving circuits

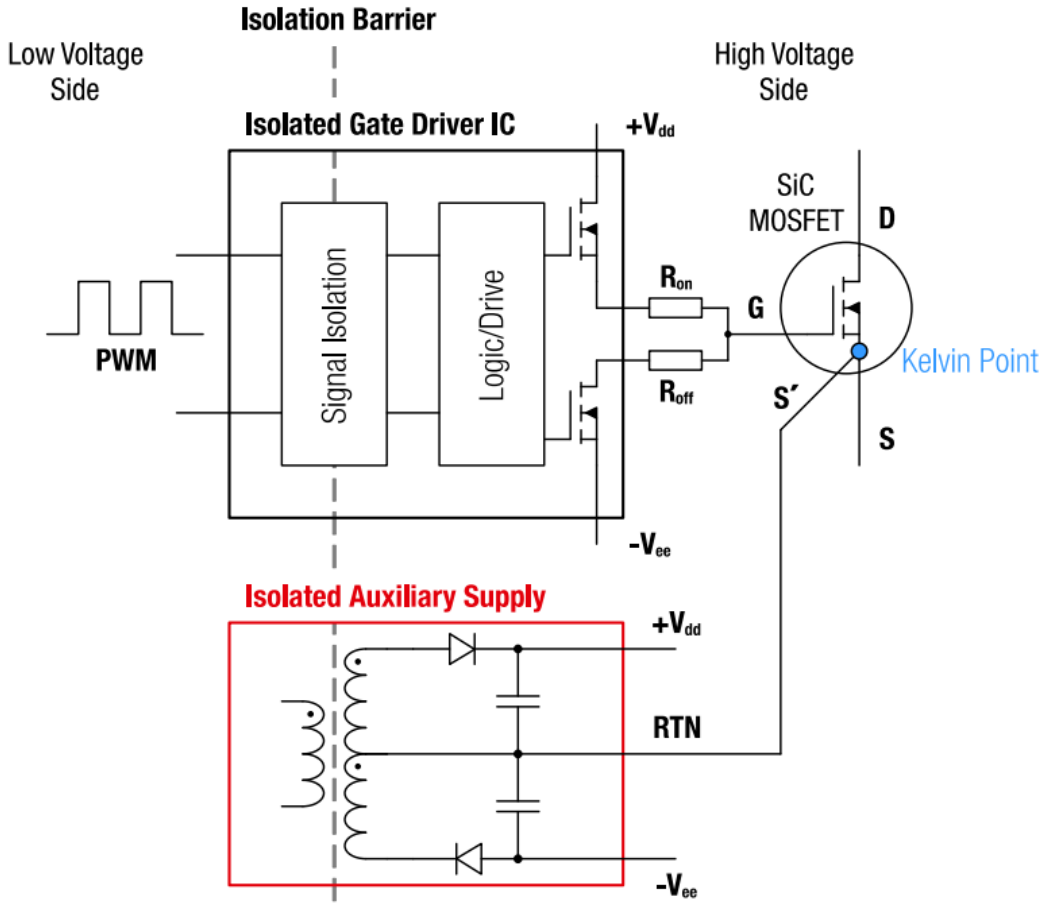
- Used to power the gate driving IC
- High voltage and high switch frequency – requirement for galvanic isolation, compliance with safety standards and EMI performance
- SiC MOSFETs
  - +15 V to +20 V to fully turn on
  - 0 V to -5 V to reliably turn off.
- GaN
  - +5 V to 0 V are required.
  - a small negative voltage to turn off



AUXILIARY GATE DRIVE TRANSFORMERS

Typical Application – Bipolar auxiliary supply

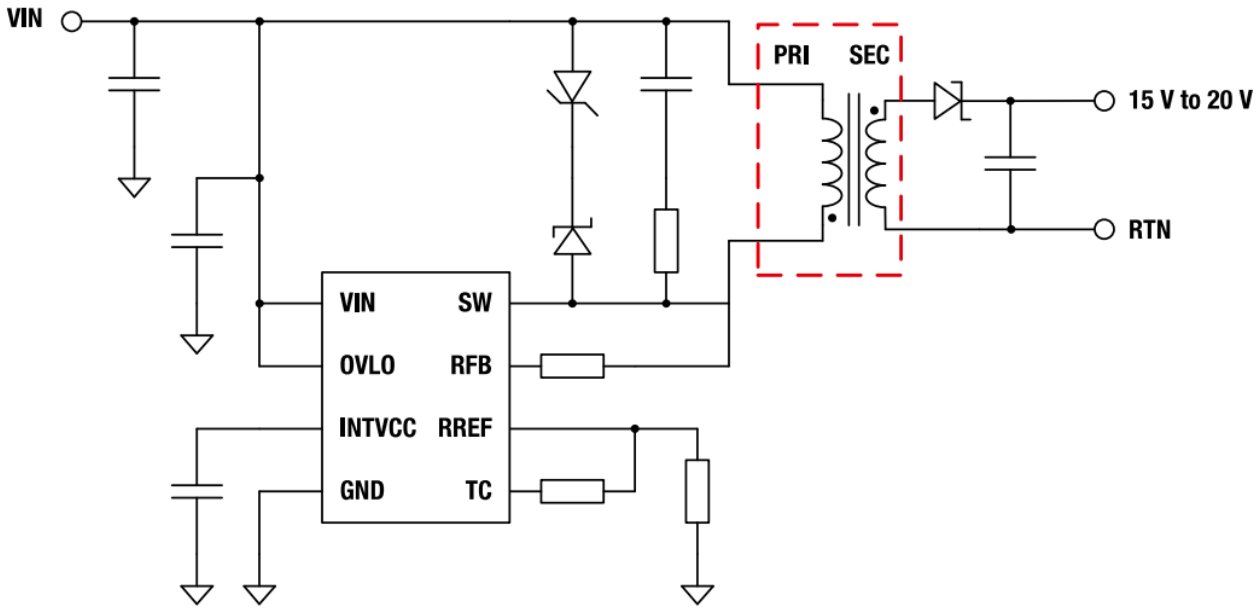


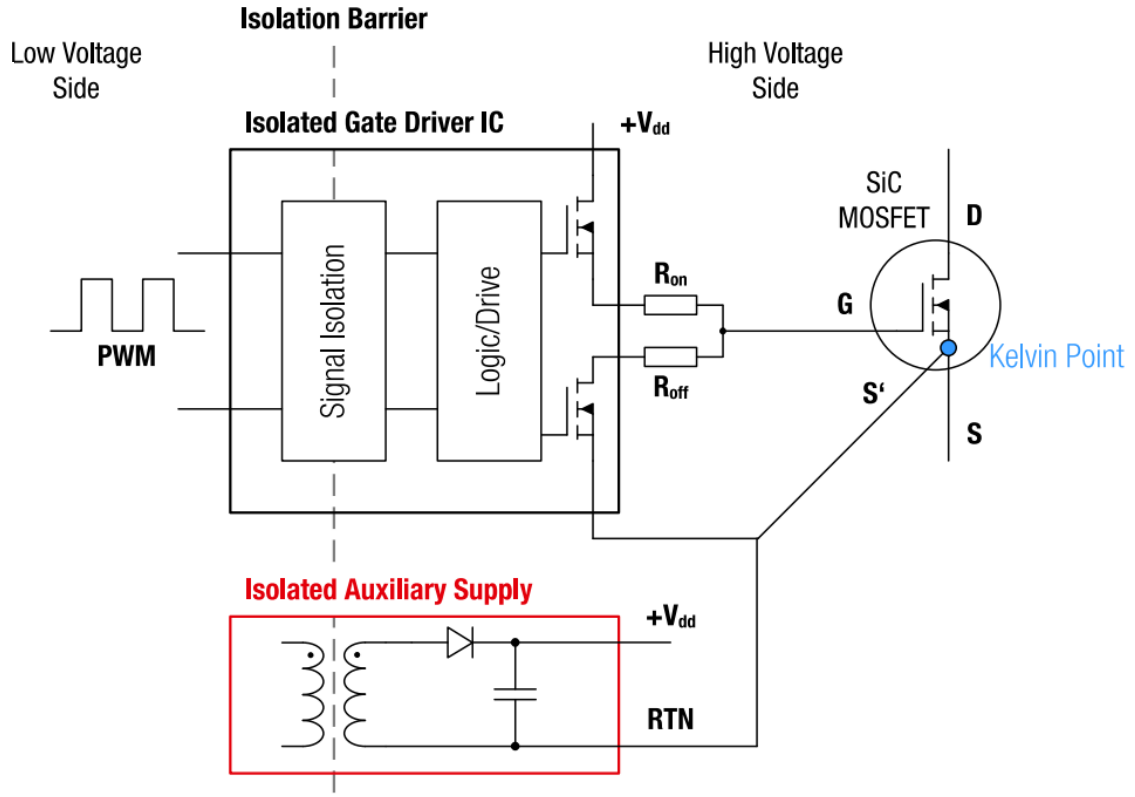


- Isolation provides not only functional safety, but provides robustness for gate driving and reduces noisy loop area, improving EMC (with good return implementation)

AUXILIARY GATE DRIVE TRANSFORMERS

Typical Application – Unipolar auxiliary supply

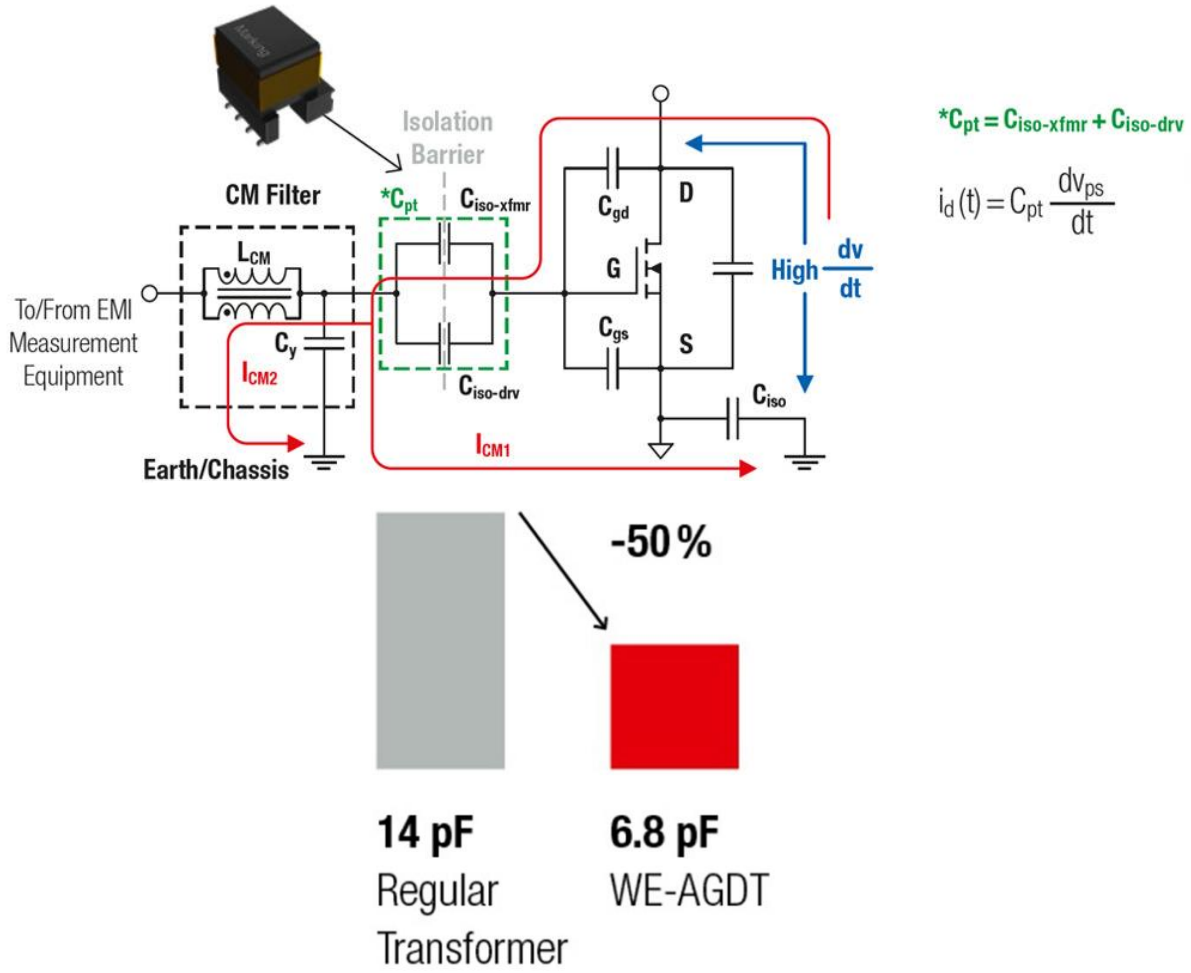




AUXILIARY GATE DRIVE TRANSFORMERS

Why Low Interwinding Capacitance Matters

- High dV/dT across device terminals while switching
  - High common-mode displacement currents generated
  - EMI Issues
- The capacitive parasitics are summed
  - Parasitic from the IC isolation barrier
  - Parasitic of the transformer isolation
- Very high CMTI



NEW SERIES OVERVIEW

Introducing WE-TORPFC

AEC – Q200 Qualified

- 17x Catalogue parts in stock – No MOQ
  - Inductance: 118uH up to 720uH
  - Voltage: up to 1000VDC
  - High saturation current up to 105A
  - Temperature: -40°C up to 155°C
  - Outer diameter sizes: 53mm – 99mm
  - Height sizes: 28mm – 62mm
  - AEC-Q200 Grade 1
- Flat Wire Windings
  - Very low intra-winding capacitance
  - Minimized Skin Effect
  - Lower DCR
  - Mechanically stable
- Applications
  - External EV Chargers
  - Solar Inverters
  - Industrial/Medical AC-DC
  - Telecom PSU

NEW SERIES OVERVIEW

P/Ns and Values

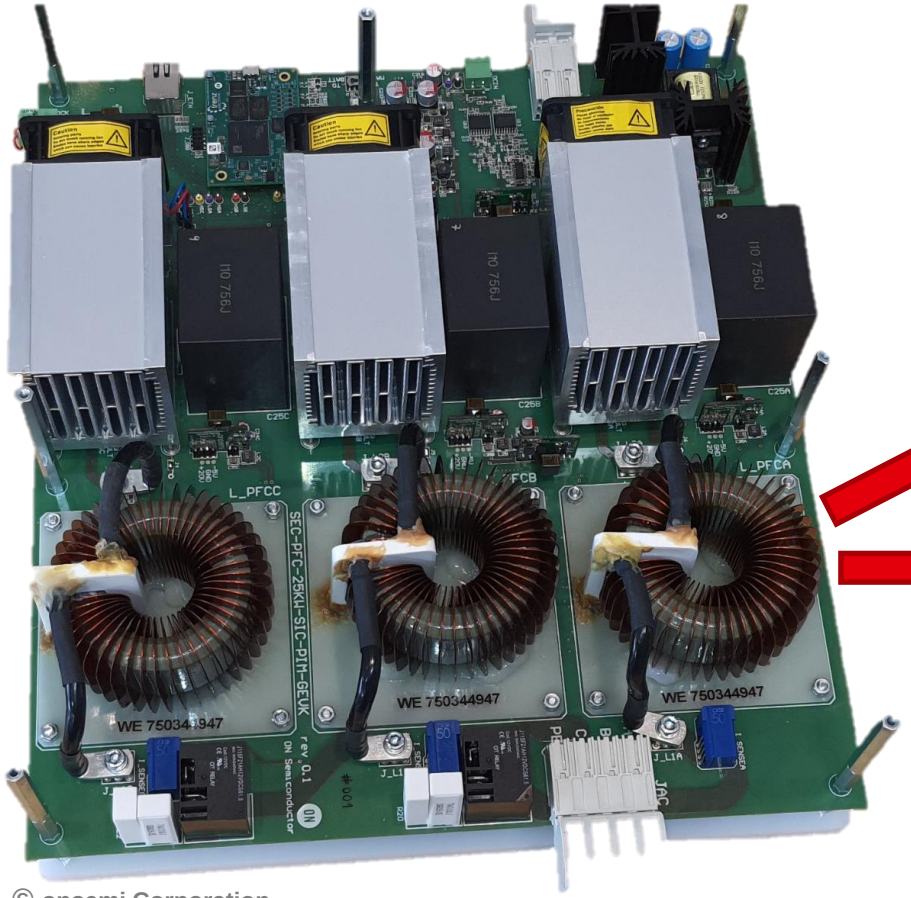
- Typical Inductance values
- Specification of rated current with airflow
- Smaller parts for same inductance and current compared to competition

Part Number	Max O.D. (mm)	Max Height (mm)	Inductance (±20%)	Max DCR (mΩ)	Rated Current (40°C Temp Rise)				Saturation Current (30% ΔL)
					No Air Flow	1 m/s Air Flow	2 m/s Air Flow	4 m/s Air Flow	
760800401	53	28	118µH	22	13.9A	19.7A	23.4A	27.5A	9.5A
760800403	53	47	355µH	35	12.3A	18.6A	22A	24.7A	9.5A
760800101	60	34	255µH	36	11.2A	16.1A	18.3A	21.7A	10.5A
760800102	60	54.5	510µH	55	9.8A	15A	17.4A	20.8A	10.5A
760800201	72	31	194uH	40	12.5A	16.5A	18.4A	21.9A	19A
760800202	72	45	389µH	50	11.5A	16.1A	18.2A	20A	19A
760800203	72	60	584µH	65	11.8A	16.8A	19.5A	22A	19A
760800301	99	62	180µH	20	24.5A	34A	42A	48A	43A
760801401	53	28	118µH	22	13.9A	19.7A	23.4A	27.5A	23A
760801403	53	47	355µH	35	12.3A	18.6A	22A	24.7A	23A
760801101	60	34	255µH	36	11.2A	16.1A	18.3A	21.7A	24A
760801102	60	54.5	510µH	55	9.8A	15A	17.4A	20.8A	24A
760801201	72	31	194µH	40	12.5A	16.5A	18.4A	21.9A	37A
760801202	72	45	389µH	50	11.5A	16.1A	18.2A	20A	37A
760801203	72	60	584µH	65	11.8A	16.8A	19.5A	22A	37A
760801301	99	62	180µH	20	24.5A	34A	42A	48A	105A
760801321	99	62	720uH	42	17A	23A	25.5A	32A	38A

APPLICATIONS

onsemi Reference Design – 25kW Fast Bidirectional Charger – PFC Stage

3-Phase Rectifier + PFC

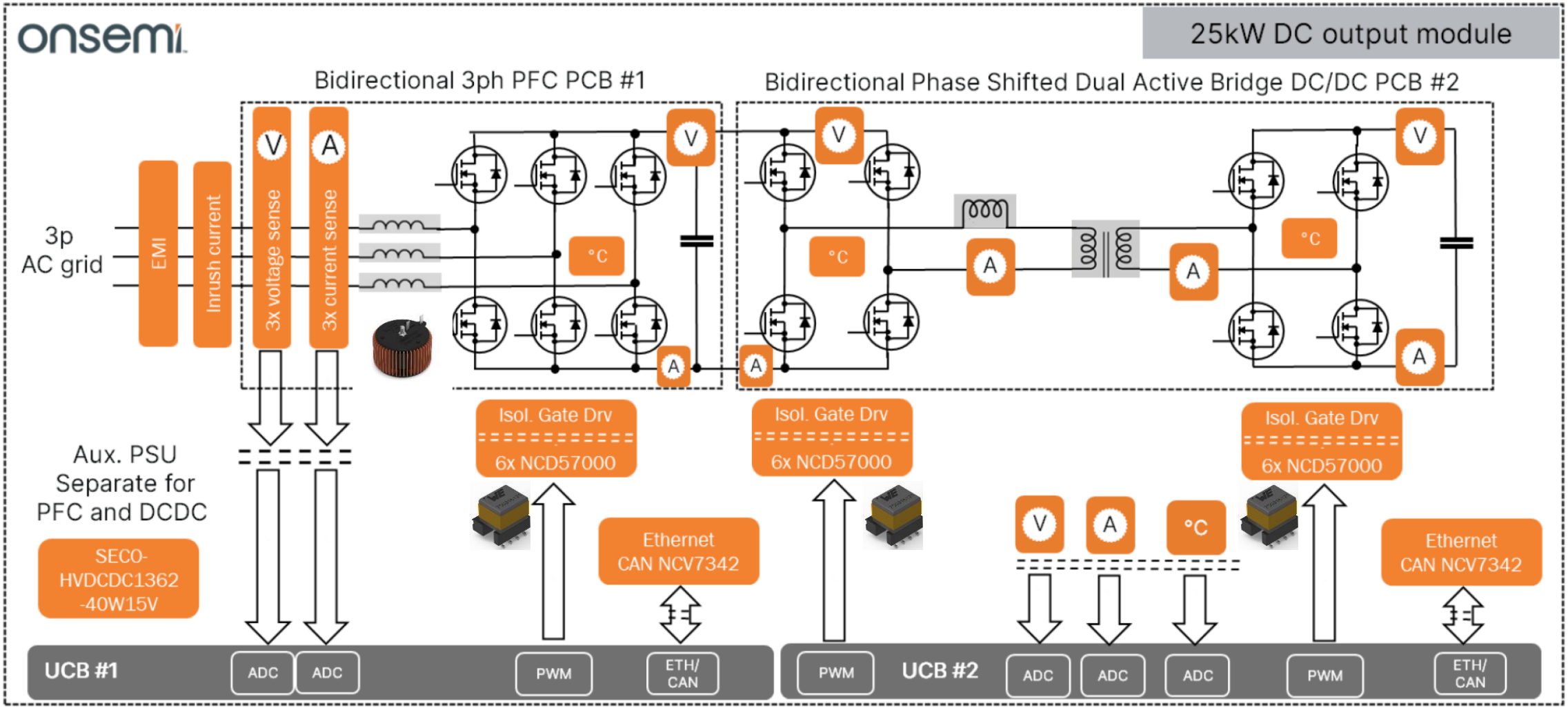


P/N: 3 x 760801301 L:180uH; Isat:105A

No flying leads, direct connection.
Optimization of EMC

Initial samples for validation purposes

APPLICATIONS

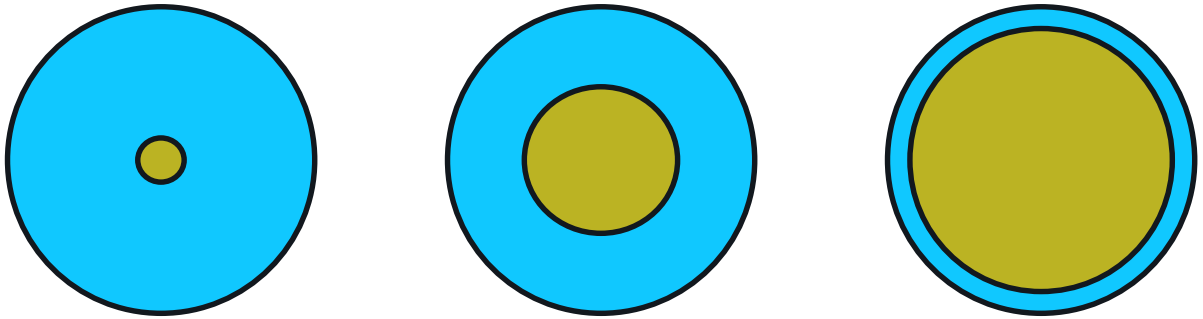


WHY FLAT WIRE?

Theory and measurements

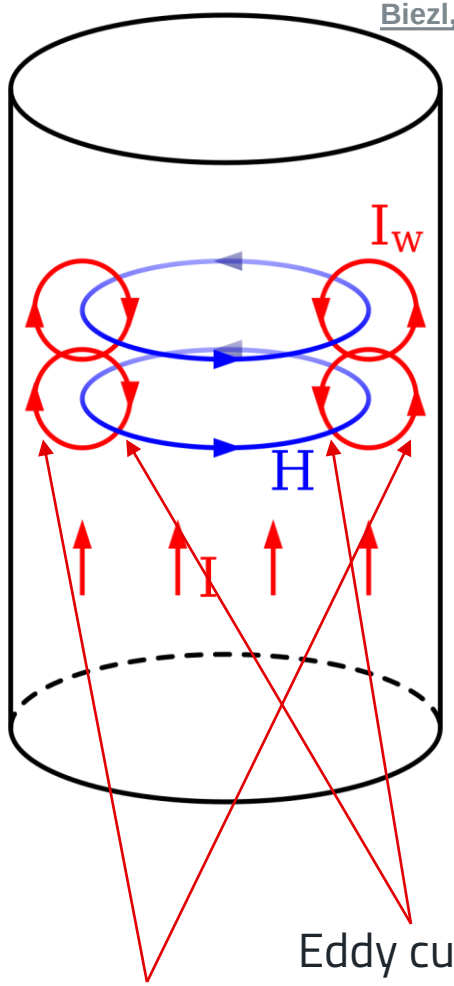
- Skin Effect
  - Tendency of the current density in alternating current to become distributed towards the surface of the conductor
  - The higher the frequency, the more the current is pushed towards the surface
  - Effective cross-section is reduced resulting in higher AC resistance
  - Skin Depth – the depth at which current density is 37% of the value at the surface

$$R \approx \frac{l\rho}{\pi D \delta}$$



60Hz 1000Hz 400kHz

Biezl, Wikipedia



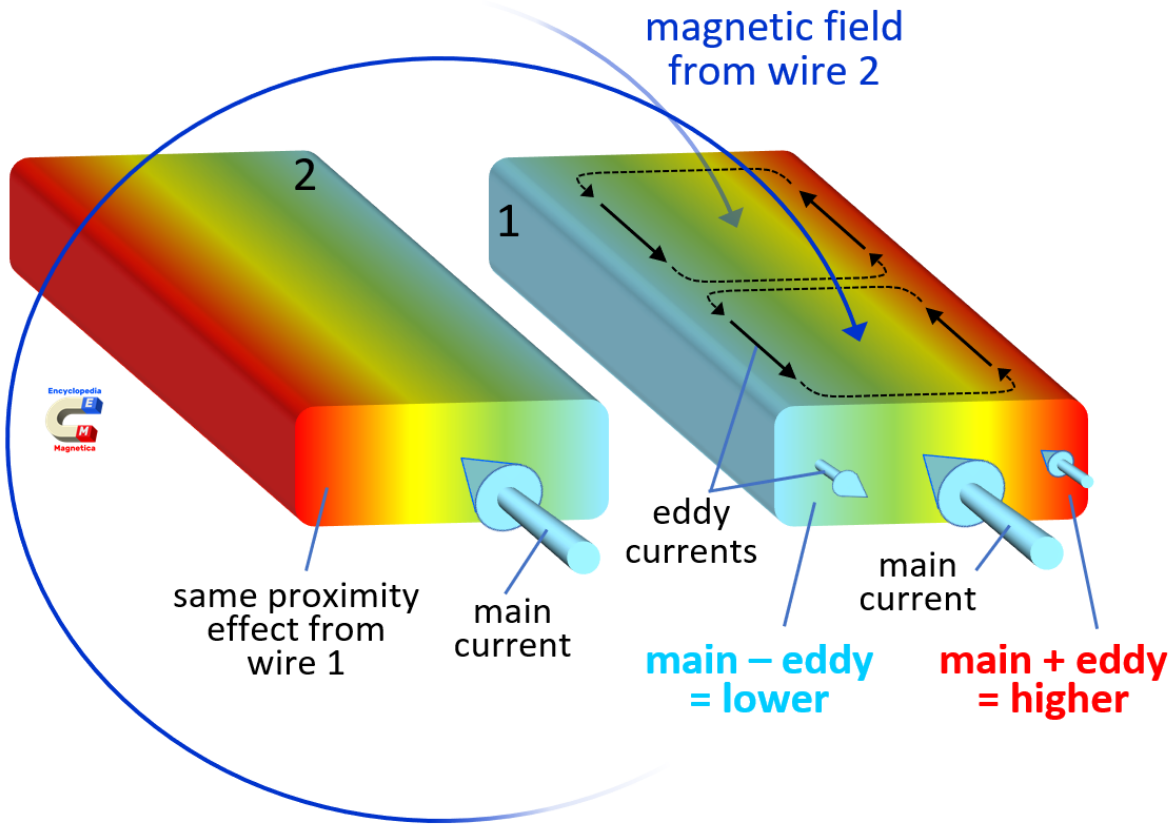
Current flow reinforced towards outer surface

Eddy currents cancel current flow in center

WHY FLAT WIRE?

Theory and measurements

- Proximity effect
  - Current redistribution in conductors running in parallel and carrying alternating current
  - Conductors carrying current in same direction have current density distributed to the opposite sides
  - Conductors carrying current in opposite direction have current density distributed to the neighboring sides
  - Increase in AC resistance
  - Increased effect with higher frequency



Stan Zurek, Encyclopedia Magnetica

WHY FLAT WIRE?

Theory and measurements

- For this testing, 760800201 standard flat wire part was used and then hand wound a similar round wire sample. To wind a similar round wire part, the same core as 760800201 was used, same number of turns, and used equivalent sized round wires to obtain a similar DCR.

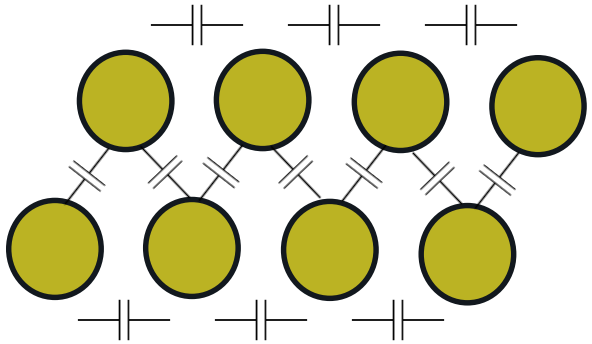
Characteristics	Round Wire	Flat Wire	760800201 Datasheet Specifications
Inductance (uH)	204	197	194
DCR (mΩ)	27.7	27.1	40mΩ max
Interwinding Cap (pF)	154	2.99	-
Rated I. ΔT=40K	11	12.4	12.4

WHY FLAT WIRE?

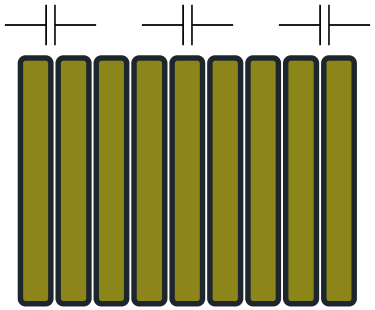
Capacitance matters

- Round conductor normal winding with all the parasitic capacitances shown – Parasitic capacitances are not just between adjacent horizontal layers, but also between vertical layers as well and between multiple inductors

- Flat wire, due to winding nature only has series parasitic capacitance



Series and parallel parasitic capacitance

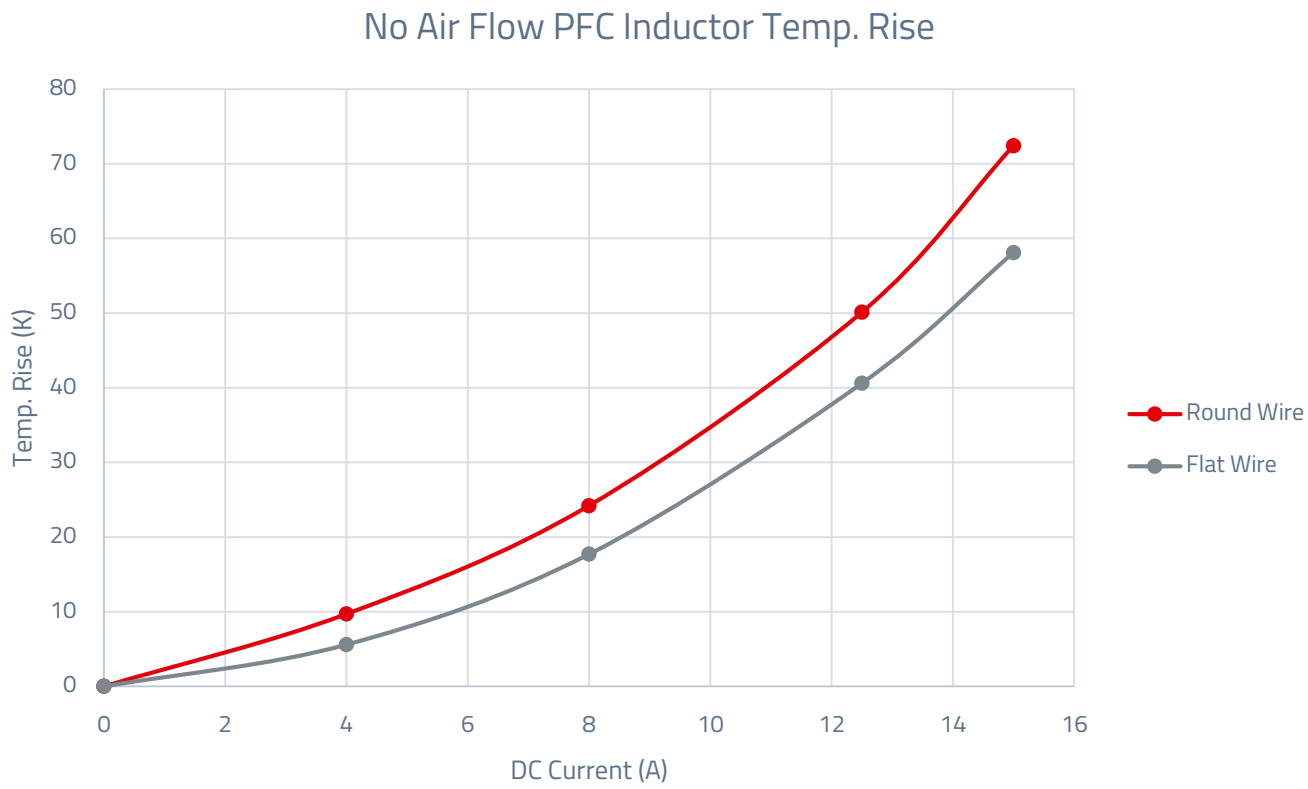


Cpar = C/n

WHY FLAT WIRE?

Theory and measurements

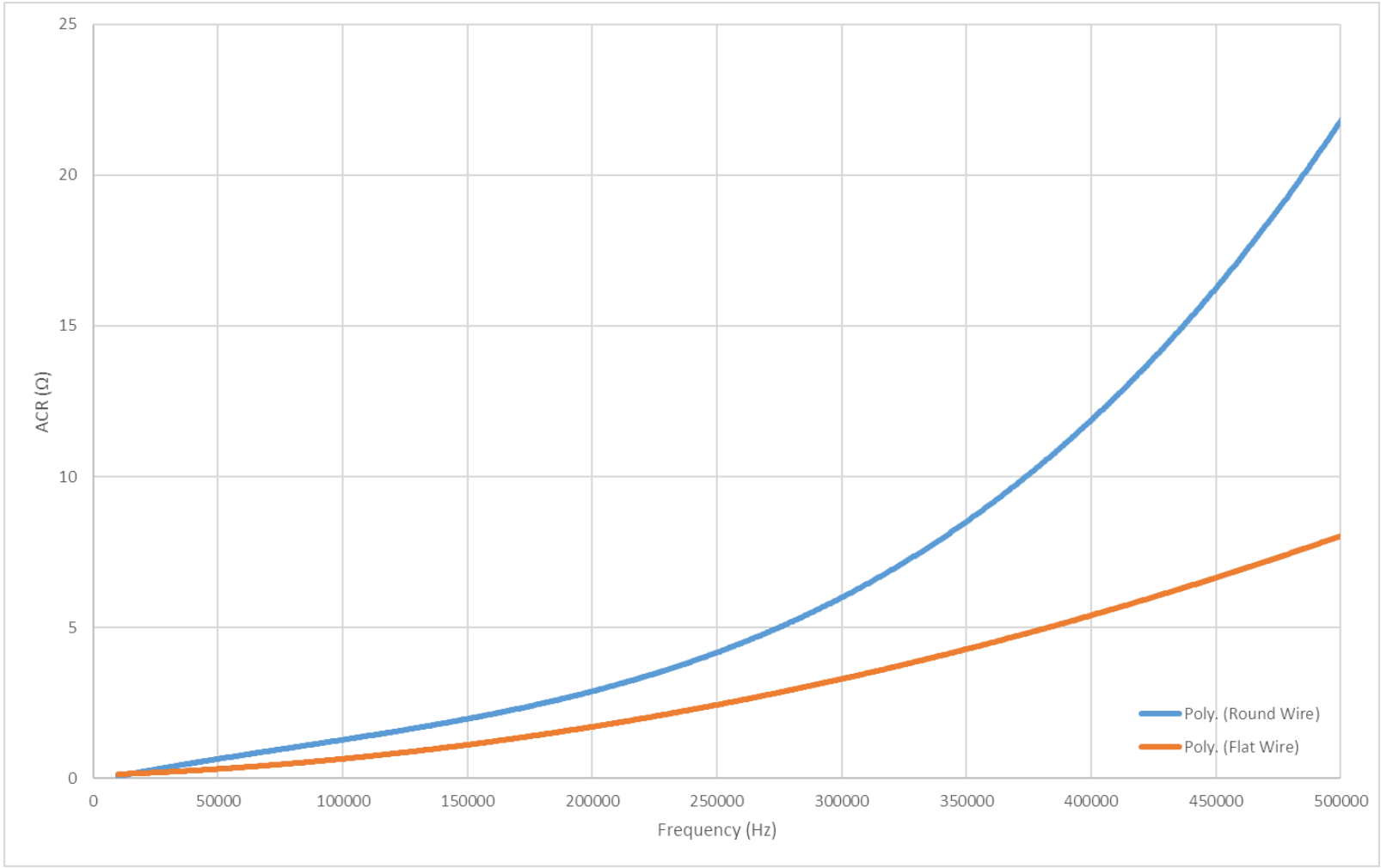
- For something as small as 0.6mΩ difference in DCR, at 15A we have 14.3 degrees difference.
- The difference comes from the better heat dissipation capabilities of the flat wire increased surface area.



WHY FLAT WIRE?

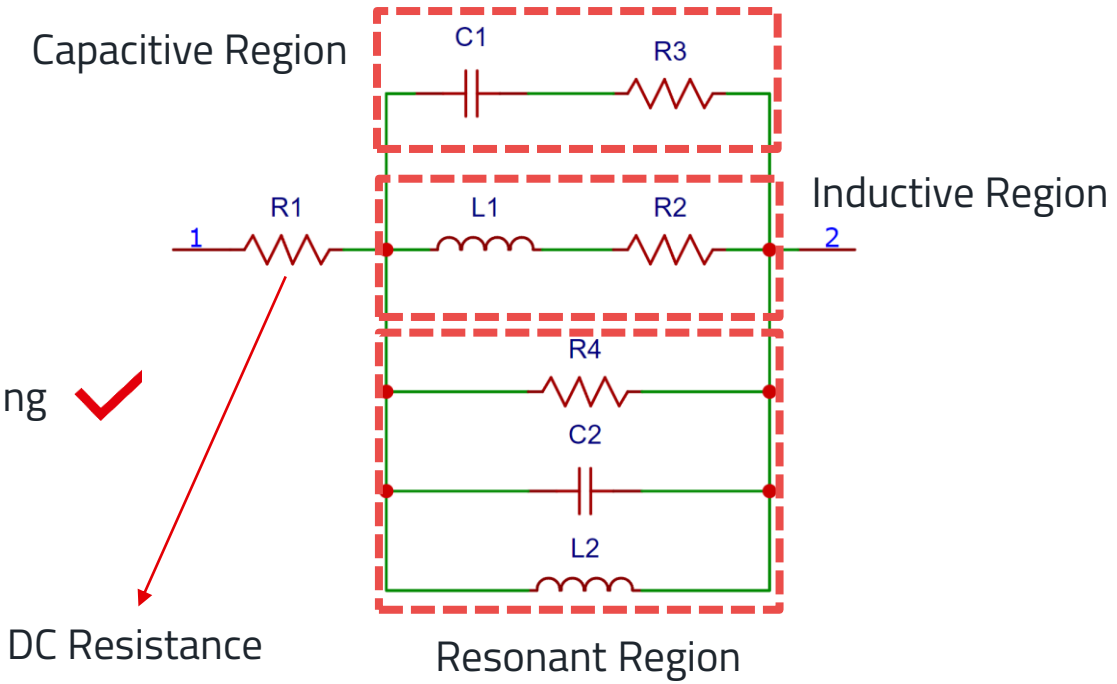
Theory and measurements

- Difference in measured AC resistance between 10kHz to 50kHz
- Linearity in increase to 250kHz
- Exponential increase for round wire above 250kHz – remember skin effect.



FLAT WIRE CONCLUSION

- Less interwinding capacitance – higher frequency ✓
- Lower DCR – lower losses ✓
- Skin effect reduced – reduced AC losses ✓
- Space between windings – proximity effect reduced + better cooling ✓
- Flat wire – higher mechanical stability ✓



Real equivalent circuit of inductor

DC-LINK CAPACITOR FOR THE 25 KW BIDIRECTIONAL CHARGER

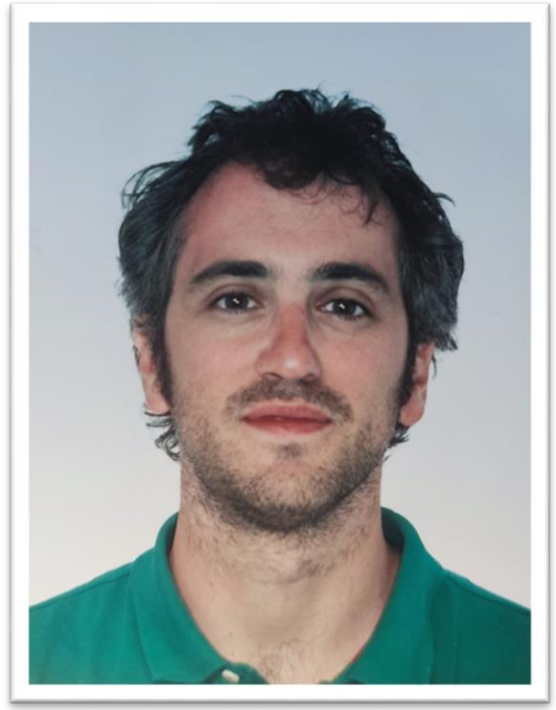
Jon Izkue Rodriguez
Hardware Engineer for Capacitors & Resistors
Product Management

WEBINAR 02.05.2023

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

JON IZKUE RODRIGUEZ

Hardware Engineer
Capacitors & Resistors Product Unit



- Since 2018 in the Technical Engineering team in the Capacitors and Resistors Division at Würth Elektronik eiSos GmbH & Co. KG
- Background in Electronics Design & Measurement technology
- Writing Technical Application Documentation
- Definition and automation of measurement procedures
- Responsible for REDEXPERT Capacitor & Resistor Modules

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

onsemi

DC-LINK CAPACITOR FOR THE 25 KW BIDIRECTIONAL CHARGER FROM ONSEMI

- WCAP-FTDB Series Film Capacitors
- DC-Link Capacitor for the 25 kW bidirectional DC charger from Onsemi
- Characteristics
- Project Parts – Tailored to your needs
- Additional resources

WCAP-FTDB: DC-LINK FILM CAPACITOR

Introducing new series WCAP-FTDB

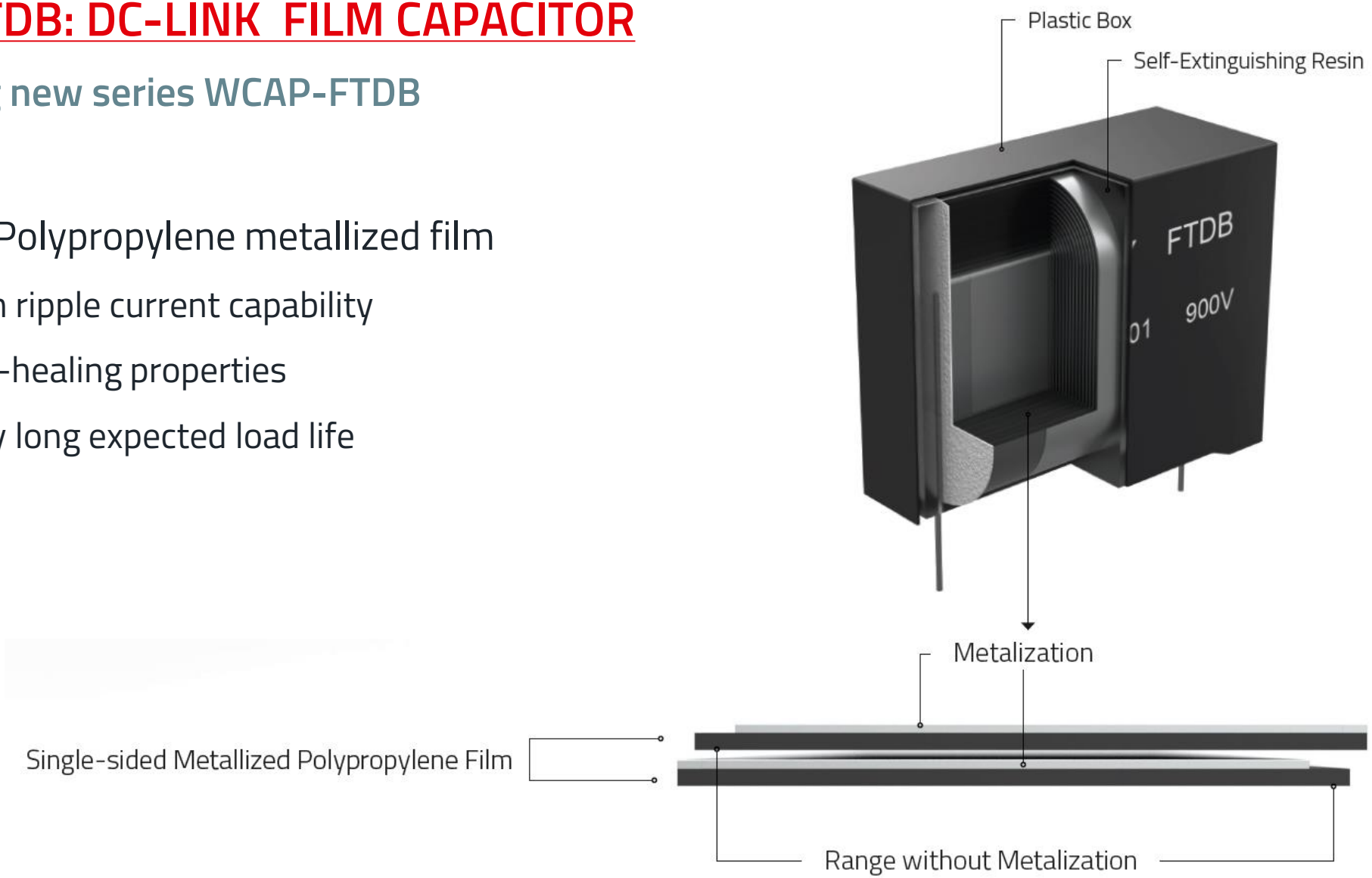
Würth Elektronik WCAP-FTDB DC-Link Film capacitors
Boxed THT - MKP Film Capacitors

- 24x catalogue parts in stock – no MOQ
  - Capacitance: 1 µF up to 75 µF
  - Voltage: 500 V_{DC} up to 1200 V_{DC}
  - Temperature: -40 °C up to 105 °C
  - Pitch / Pin distance: 27.5, 37.5 and 52.5 mm

WCAP-FTDB: DC-LINK FILM CAPACITOR

Introducing new series WCAP-FTDB

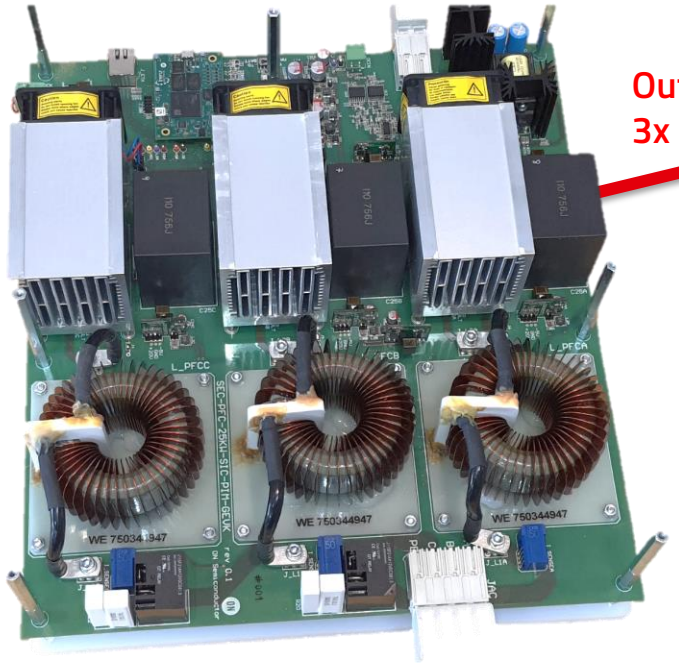
- MKP: Polypropylene metallized film
  - High ripple current capability
  - Self-healing properties
  - Very long expected load life



WCAP-FTDB IN THE APPLICATION

Onsemi Reference Design - 25 kW Fast DC Bidirectional Charger incl. PFC

3-Phase Rectifier + PFC



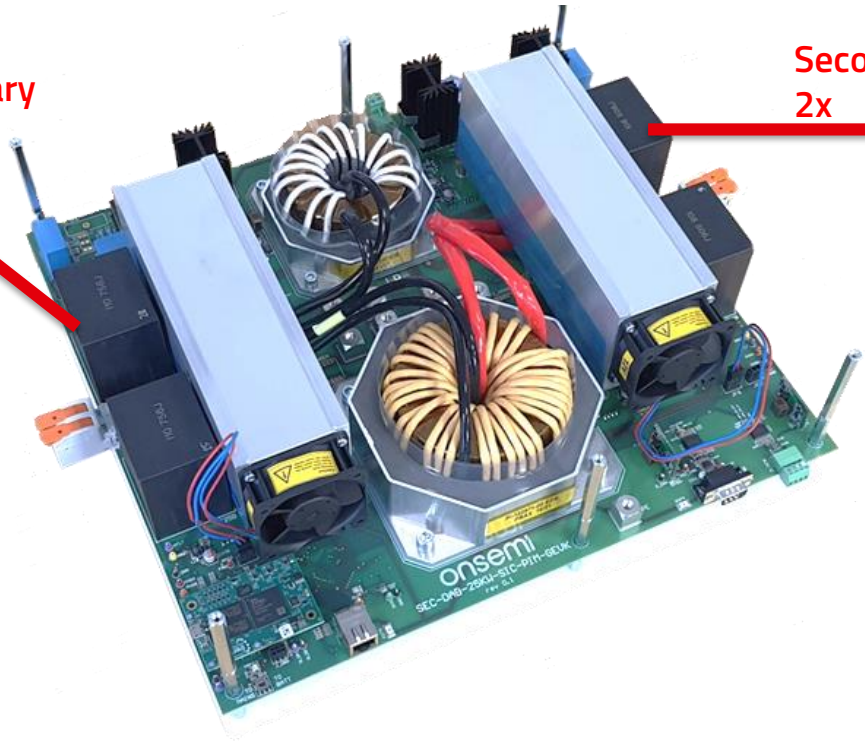
Output
3x

WCAP-FTDB
890724429010CS

75 µF - 900 V

Bidirectional DC-DC – Dual Active Bridge (DAB)

Primary
2x



Secondary
2x

WCAP-FTDB
890734429007CS

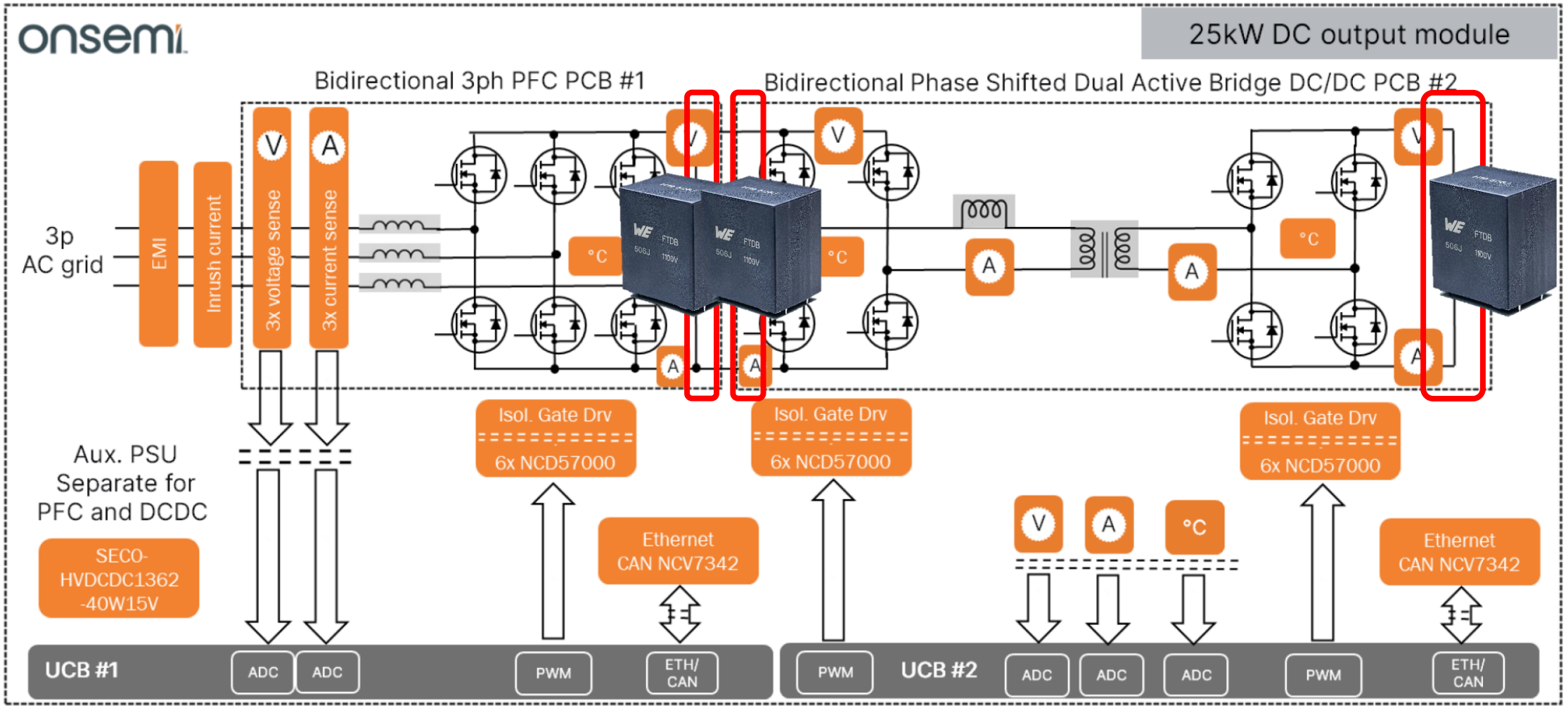
50 µF - 1100 V

© ON Semiconductor Corporation

WCAP-FTDB IN THE APPLICATION

WCAP-FTDB
890724429010CS
75 µF - 900 V

WCAP-FTDB
890734429007CS
50 µF - 1100 V



DC LINK CAPACITOR TECHNOLOGIES

Onsemi Reference Design - 25 kW Fast DC Bidirectional Charger incl. PFC

Film DC Link Capacitors

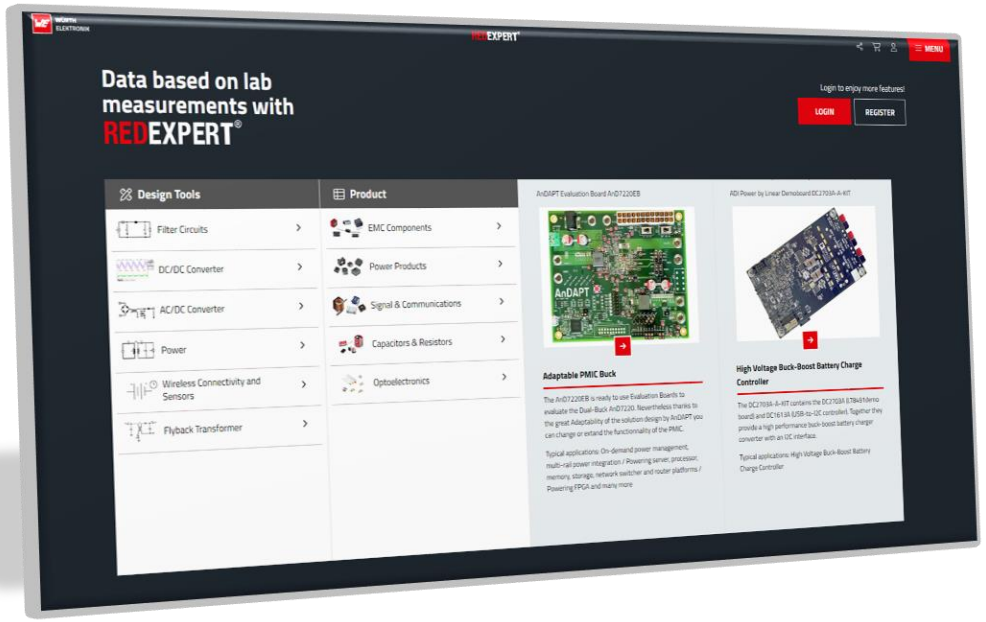
- Rated voltages up to 1,200 V
  - Perfect for the used SiC Modules
- Very low ESR - High RMS current capabilities
  - Ripple current: several A_{RMS} per µF
- Low capacitance may cause high voltage ripple
- No liquid inside - long storage and load life
- Self-healing properties

Aluminum Electrolytic Capacitors

- Rated voltages up to 650 V
  - Series connection necessary!
- Relatively high ESR internal resistance
  - Depends on the part 1 mA/µF…20 mA/µF or higher
- High capacitance values
  - Highest capacitance per volume (µF / mm³)
- Get large bulk capacitance for low voltage ripple

REDEXPERT®

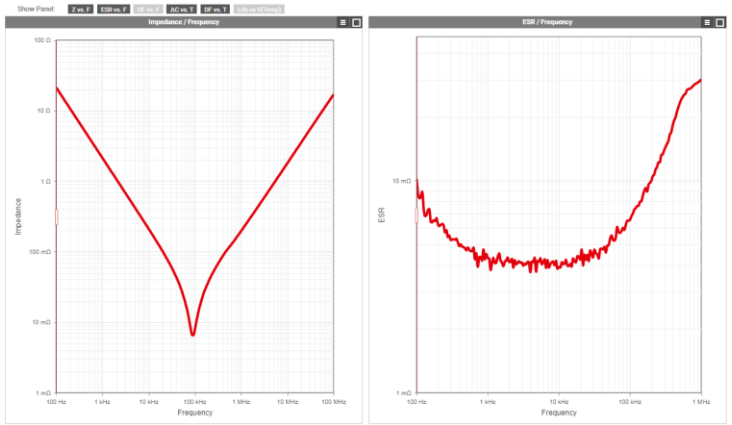
Free browser platform optimized for component selection



Scan for DC-Link Module!

Find all standard specifications and following curves:

- Z vs Freq. (Impedance spectrum)
- ESR vs Freq.
- D (tan δ) vs Freq.
- Capacitance vs Temperature
- D (tan δ) vs Temperature
- Temperature /Voltage vs Lifetime (Derating curve)

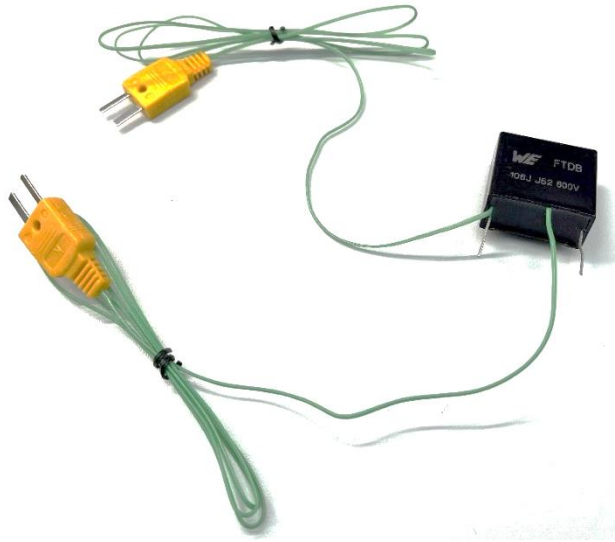


PROJECT PARTS – TAILORED TO YOUR NEEDS

- 24x catalogue parts available from stock
  - Free samples service
  - No MOQ – Minimal order quantity
  - Available measurements, simulation models and CAD files

- Project parts available for orders with MOQ
  - Additional configurations available in the family:
    - Capacitance 0.68 µF to 100 µF
    - Voltage Rating 500 V_{DC} to 1200 V_{DC}
    - Pitch: 27.5 mm, 37.5 mm or 52.5 mm
    - Height from 18 mm to 65 mm
    - Other terminal options

  - Measurements, Simulation and CAD files may be provided after order and production cycle
  - Additional features available*



eiCapHotline@we-online.de

MORE INFORMATION

- E-mail:
Jon.Izkue Rodriguez@we-online.com

- Webinar (Youtube) - DC-Link Capacitor, Specification and Application

- Webinar (Youtube) - The Effects of Harsh Environmental Conditions on Film Capacitors

- Application Note: Impedance Spectra of Different Capacitor Technologies

  - ***Register for our next Webinar about this topic on 11.07.2023***

Scan to go to Webinar registration!

Questions

& Answers

Online Catalogue
WCAP-FTDB

Online Catalogue
PFC Chokes