

3300 W 54 V bi-directional phase-shift full-bridge with 600 V CoolMOS™ CFD7 and XMC™

EVAL_3K3W_BIDI_PSFB

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General description

Introduction

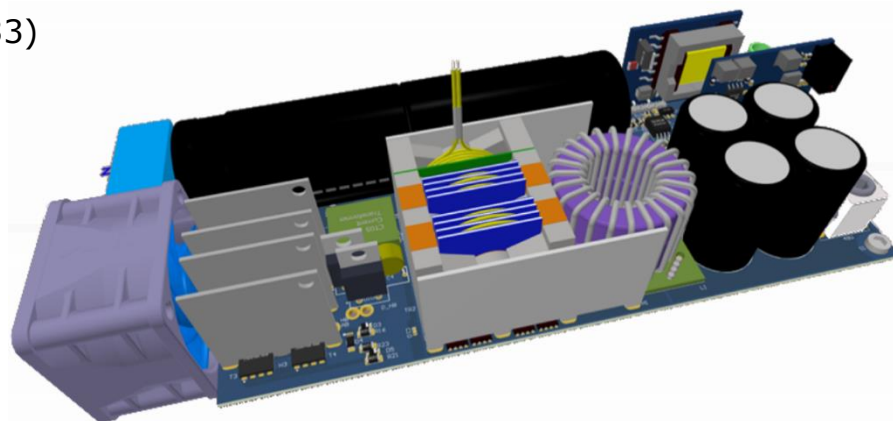
This Infineon evaluation board (EVAL_3K3W_BIDI_PSFb) represents a complete system solution for a 3300 W telecom or battery charging DC-DC converter, which achieves 98 percent efficiency peak. The DC-DC converter comprises a ZVS PSFB with bi-directional capability (patent pending).

To achieve the high efficiency results the evaluation board features several Infineon components:

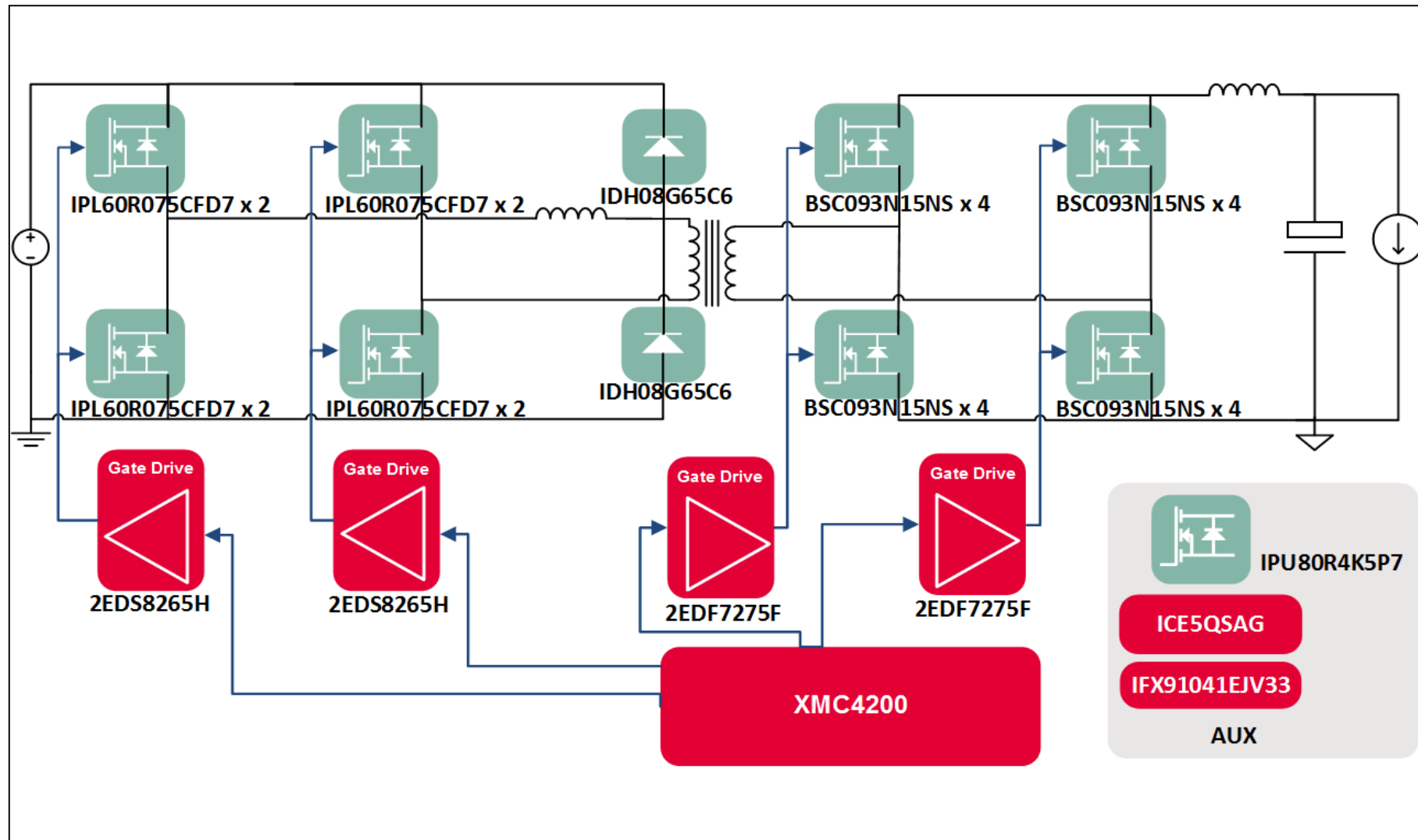
- › 75 mΩ 600 V CoolMOS™ CFD7 (IPL60R075CFD7) in the high voltage (HV) bridge
- › 9.3 mΩ OptiMOS™ 5 150 V in Super SO-8 package (BSC093N15NS5) in the low voltage (LV) bridge
- › EiceDRIVER™ gate driver IC (2EDS8265H safety isolated and 2EDF7275F functional isolated)
- › XMC™ microcontroller for control implementation (XMC4200-F64k256 BA)
- › Quasi-resonant flyback controller (ICE5QSAG) with external 800 V CoolMOS™ P7 4.5 Ω (IPU80R4K5P7)
- › CoolSiC™ Schottky diode 650V G6 (IDH08G65C6)
- › Medium power Schottky diode (BAT165)
- › DC-DC step-down voltage regulator (IFX91041EJV33)

Board parametrics:

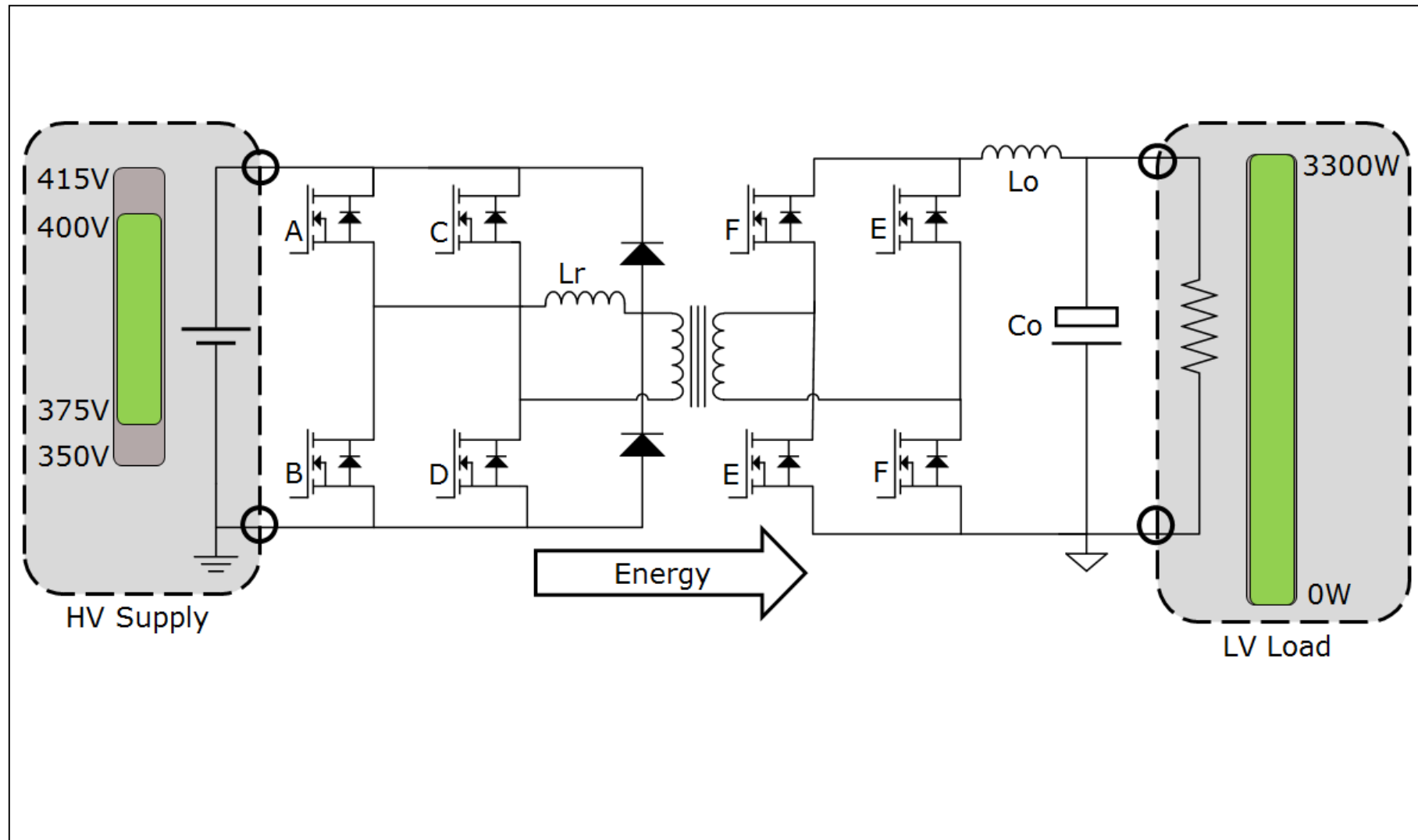
- › Input voltage: 350 V_{DC} – 415 V_{DC}
- › Output voltage: 60 V_{DC} – 40 V_{DC}
- › Output power: 3300 W
- › Switching frequency: 100 kHz
- › Peak efficiency: 98%



Simplified diagram

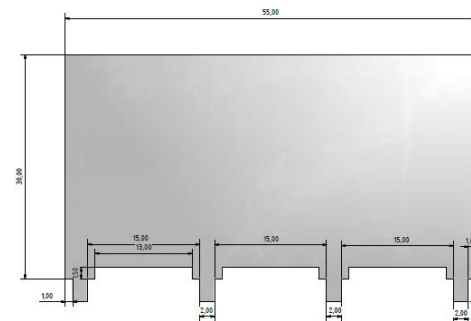
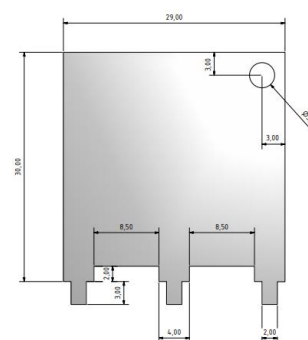
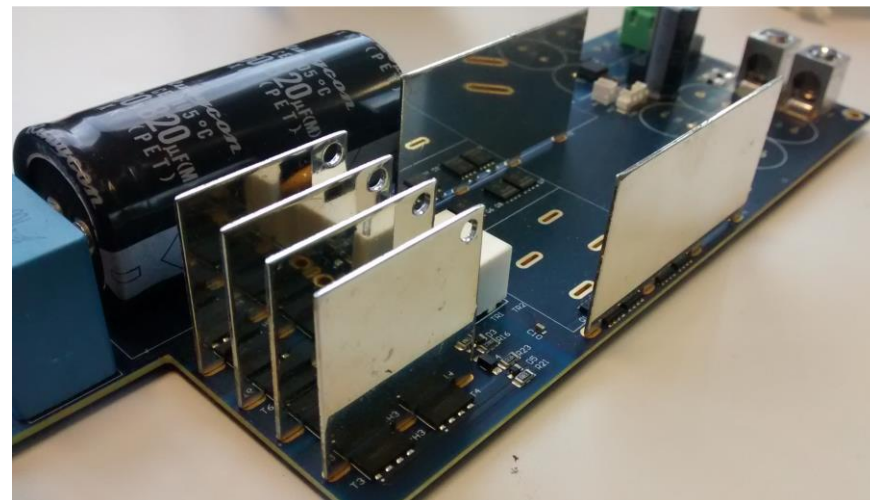
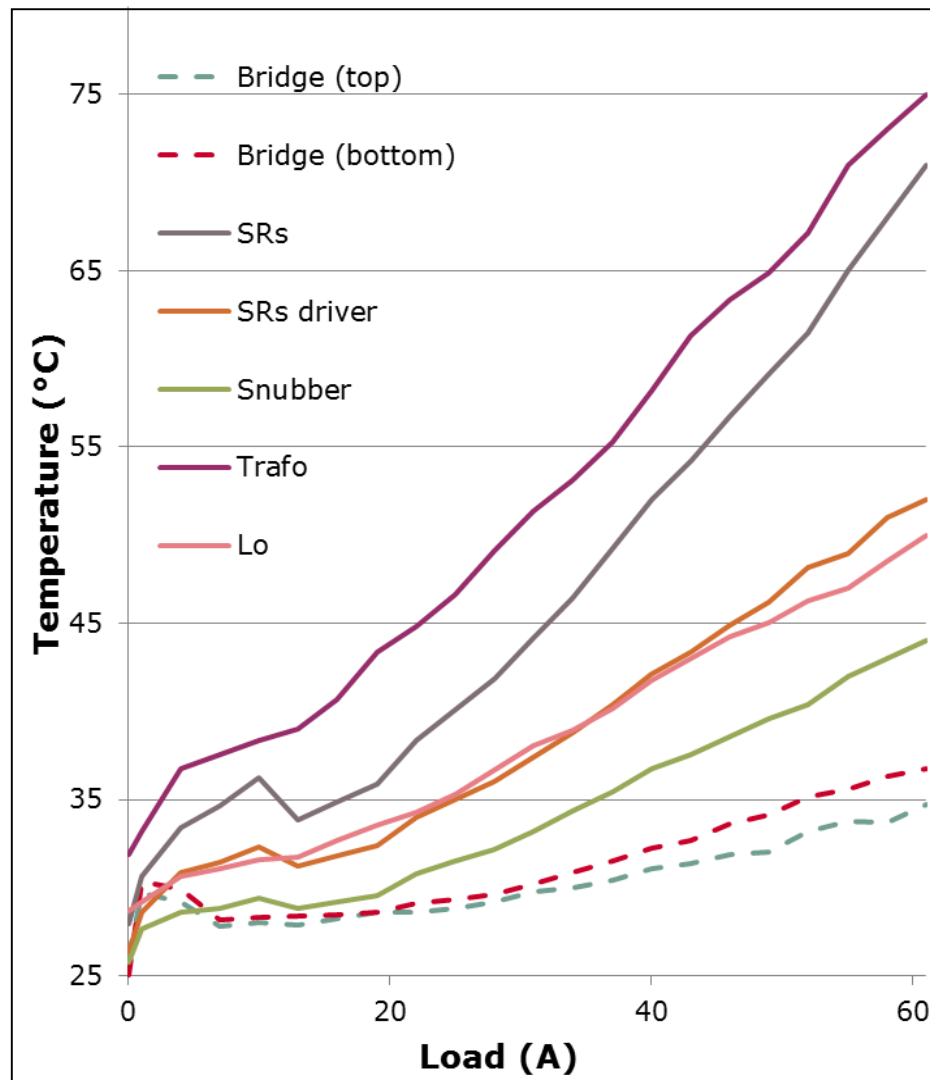


Buck operation



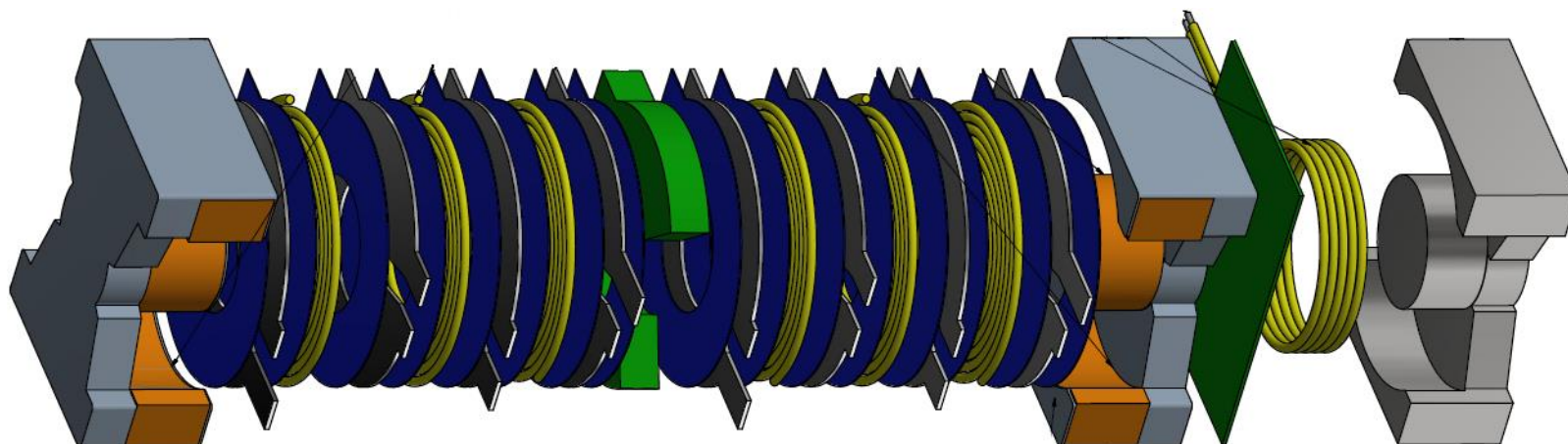
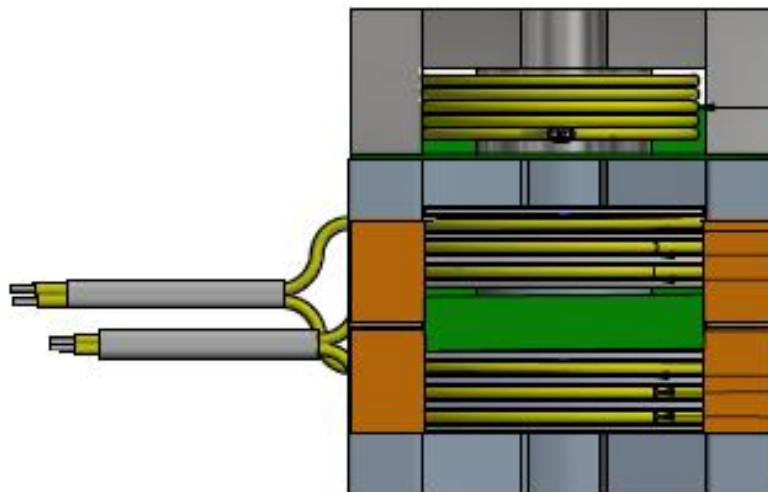


Innovative cooling for SMD devices

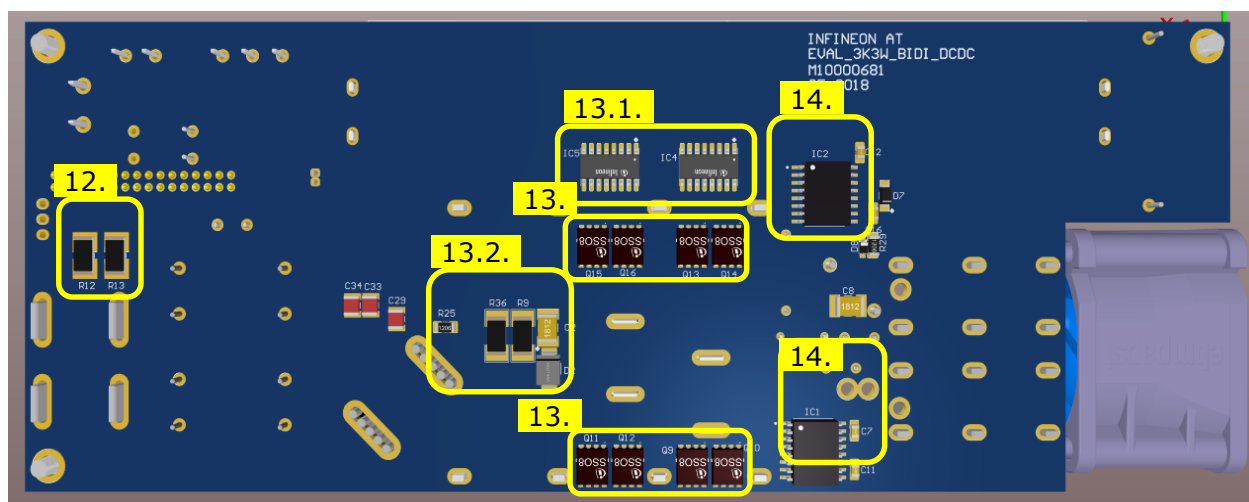
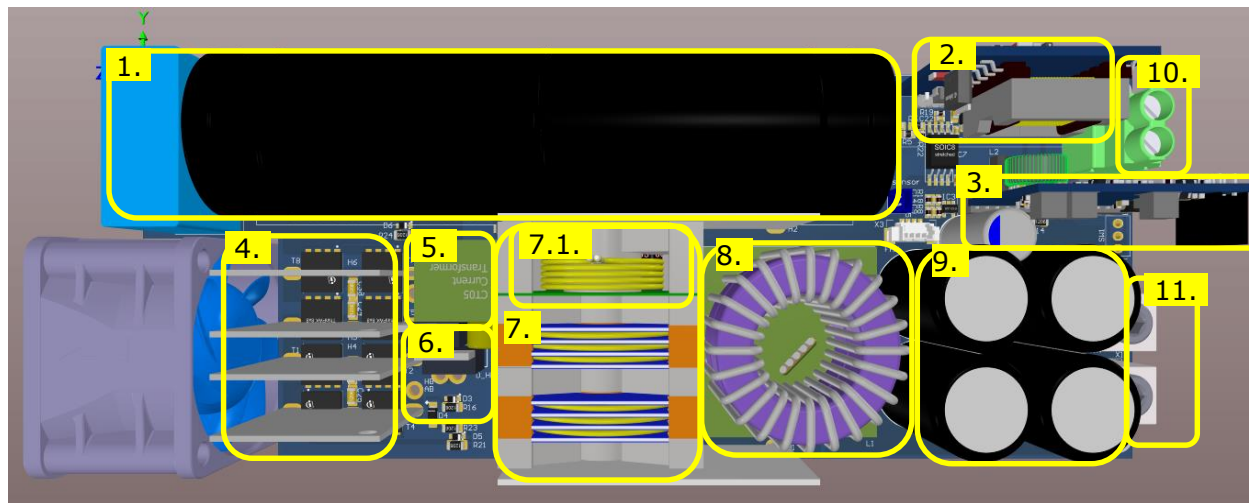


Stacked magnetic structure

Item	Value	Manufacturer
Lm	650 μ H	ICE
Lr	11 μ H	ICE
Transformer core	PQ35 / 28	DMR95 DMGC
Lr core	PQI35 / 23	DMR95 DMGC
Primary wire	7 x 0.3 mm Litz	Furukawa
Lr wire	120 x 0.1 mm Litz	
Secondary wire	0.5 mm copper plate	



Board distribution

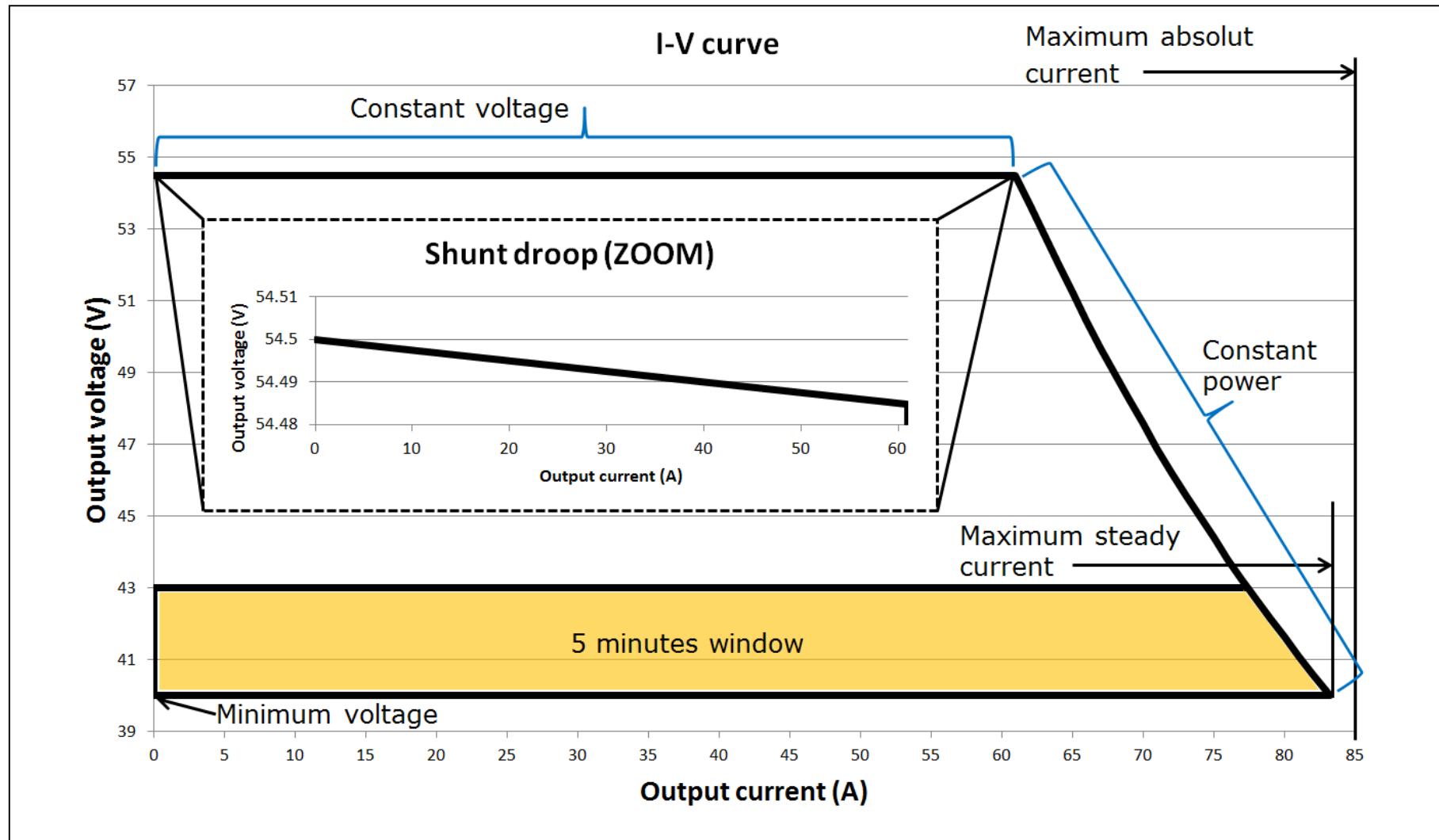


Functional blocks

1. HV Bulk
2. Bias supply
3. Control card
4. HV bridge
5. C. Sence
6. C. Diodes
7. Maintransformer
 - 7.1. LR
8. Output choke
9. Output capacitor
10. Input connector
11. Output connector
12. Output shunt
13. Synchronous Rectification
 - 13.1. Functional isolated Driver (SR)
 - 13.2. Snubber (SR)
14. Reinforced isolated Drivers (Bridge)

*SR - Synchronous Rectification

Buck operation current-voltage curve



User interface

The screenshot displays the Infineon SMPS user interface, a software tool for configuring a power supply system. The interface is organized into several functional areas:

- Top Bar:** Includes a menu bar (FILE), fields for MOSFET, Board, Converter (PSFB 3300W), and Soft Version (1.0).
- VOLTAGES:** A panel for setting output and brown-in voltages. Output voltage is 13878 ADC units, and Brown in voltage is 9991 ADC units.
- BRIDGE:** A panel for configuring the power bridge. It includes settings for Dead time AB (337.5 ns), Dead time CD (400 ns), AB factor (0.005), CD factor (0.006), and Current ratio (10 power of 2).
- SYNCHRONOUS:** A panel for synchronous mode settings. It includes ON DCM delay (62.5 ns), ON delay (50 ns), OFF delay (250 ns), ON factor (0.000), OFF factor (0.006), DCM limit (280 ADC units), and SYNC OFF limit (280 ADC units).
- BURST:** A panel for burst mode settings. It includes BURST stop (39%), BURST low thr. (49%), BURST high thr. (59%), MIN phase (20%), BURST phase (20%), BURST skip cyc. (50 pulses), BURST length (50 pulses), and BURST frq. (1.00 kHz).
- STATUS and FAULTS:** A panel showing the current status (ENABLED, SOFT START, BURST, SYNC_MODE_2 UV/OV, SYNC_MODE_1 FAN FAIL, SYNC_DIODES, OVERTEMP, BOOST, TEMP. WARNING) and fault conditions (OFF or UVLO, HICCUP, SOFT START FAIL).
- PROTECTIONS:** A panel with a large warning icon and checkboxes for Soft start, Input UVLO, and Fan detection.
- ON/OFF Controls:** Buttons for turning the system ON or OFF, and a lightning bolt warning icon.
- Receive/Send/Store:** Buttons for data transfer and saving configurations.
- Connect/Disconnect:** Buttons for connecting to the hardware.
- Circuit Diagram:** A detailed schematic of the PSFB 3300W converter, showing the HV Load, HV Supply (380V, 330V, 1A, 0A), and LV Supply (58V, 57.5V, 43V, 42.5V).
- Home:** A button to return to the main screen.
- Input/Output/TEMPERATURE:** A panel at the bottom showing real-time measurements for Current, Voltage, and Power for both HV and LV inputs, as well as NTC and Ambient temperatures.

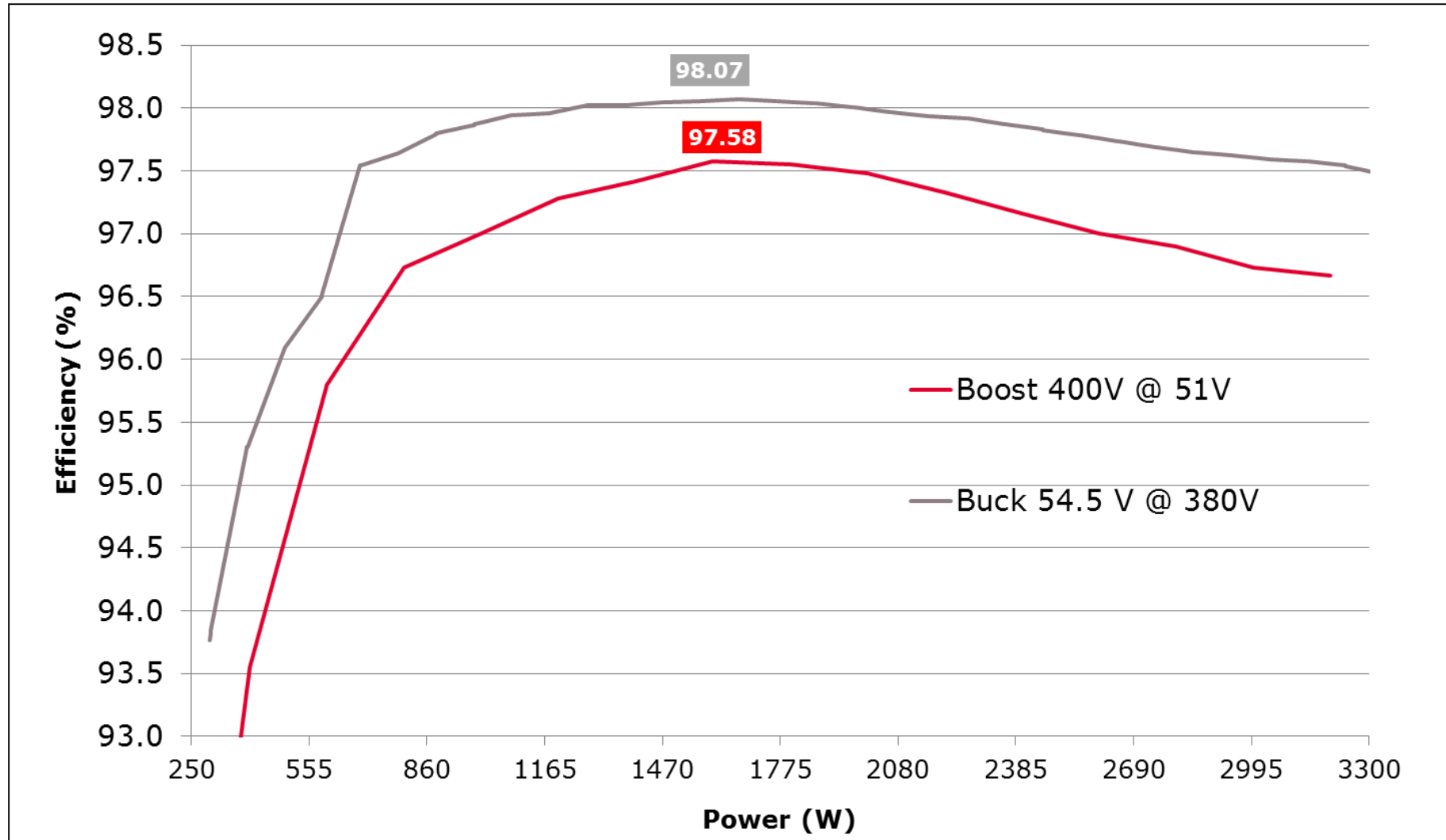
At the bottom left, a status message indicates: "Adapter plugged-in and ON (COM11)".

Summary of specifications

Test	Conditions	Specification
Efficiency test	380 V input, 54.5 V output	$\eta_{pk} = 98\%$ at 1500 W (50% load)
Output voltage		60 V – 40 V
Steady-state V_{out} ripple	380 V input, 54.5 V output	$ \Delta V_{out} $ less than 200 mV _{pk-pk}
Brown-out		370 V on – 350 V off 415 V off – 390 V on
Load transient	5 A $\leftrightarrow$ 31 A, 0.5 A/ μ s	$ \Delta V_{out} $ less than 450 mV _{pk}
	31 A $\leftrightarrow$ 61 A, 0.5 A/ μ s	
OCP	5 min. at 77 A - 83 A	Shut down and resume after 5 min.
	1 ms at 83 -85 A	
	20 μ s at 85 A	Shut down and latch
	Output terminals in short-circuit	Detection within switching cycle Shut down and latch

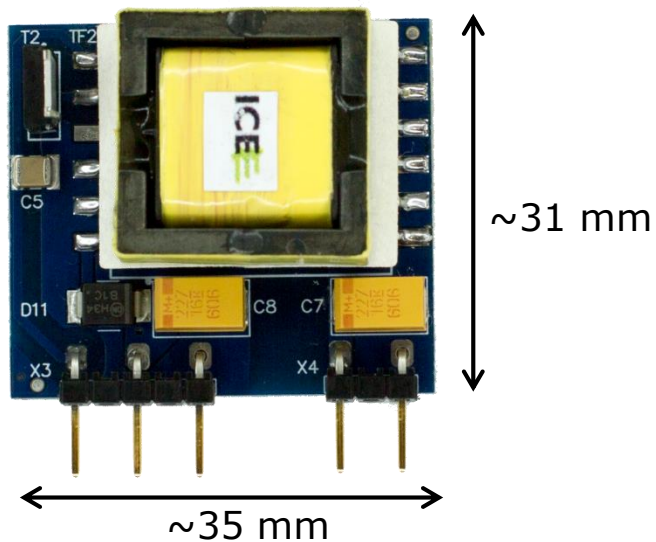
Efficiency

Bias and fan included



Bias board

KIT_6W_12V_P7_950V



Ordering code:
KIT_6W_12V_P7_950V

Board components

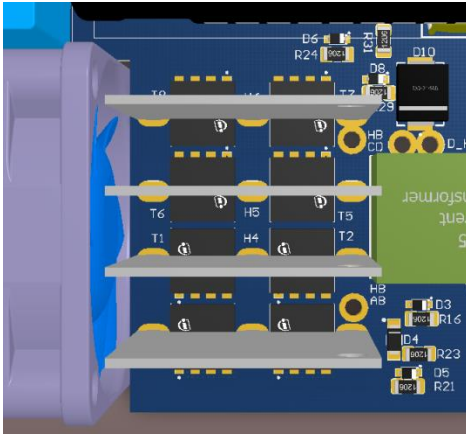
- › CoolSET™ standalone controller (ICE5QSAG)
- › 950 V CoolMOS™ P7 SJ MOSFET (IPU95R3K7P7)

Board specifications

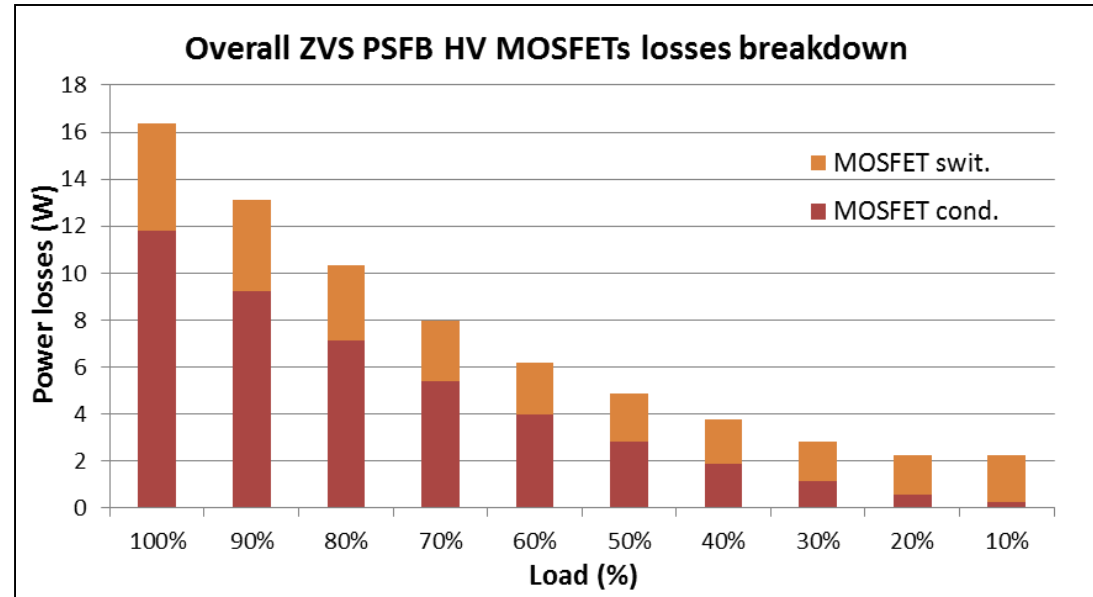
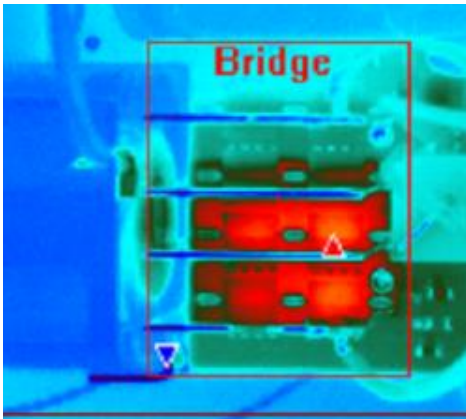
- › Input voltage: 90 V_{DC} - 400 V_{DC}
- › Output voltage: 12 V_{DC} (prim. and sec. side)
- › Output power max.: 6 W (prim. + sec. side)

Auxiliary supply solution featuring off-line SMPS current mode controller IC with an 950 V CoolMOS™ SJ MOSFET

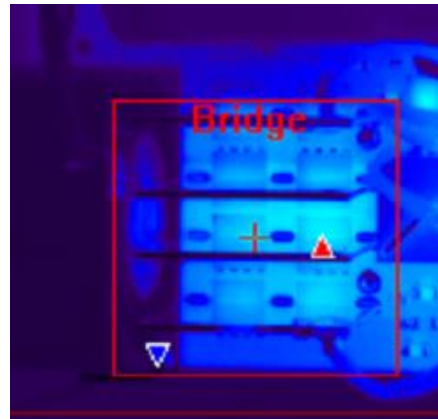
600 V CoolMOS™ CFD7 (IPL60R075CFD7) HV bridge MOSFETs



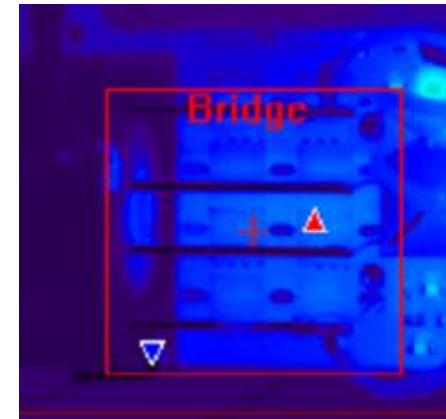
36°C @ 1A



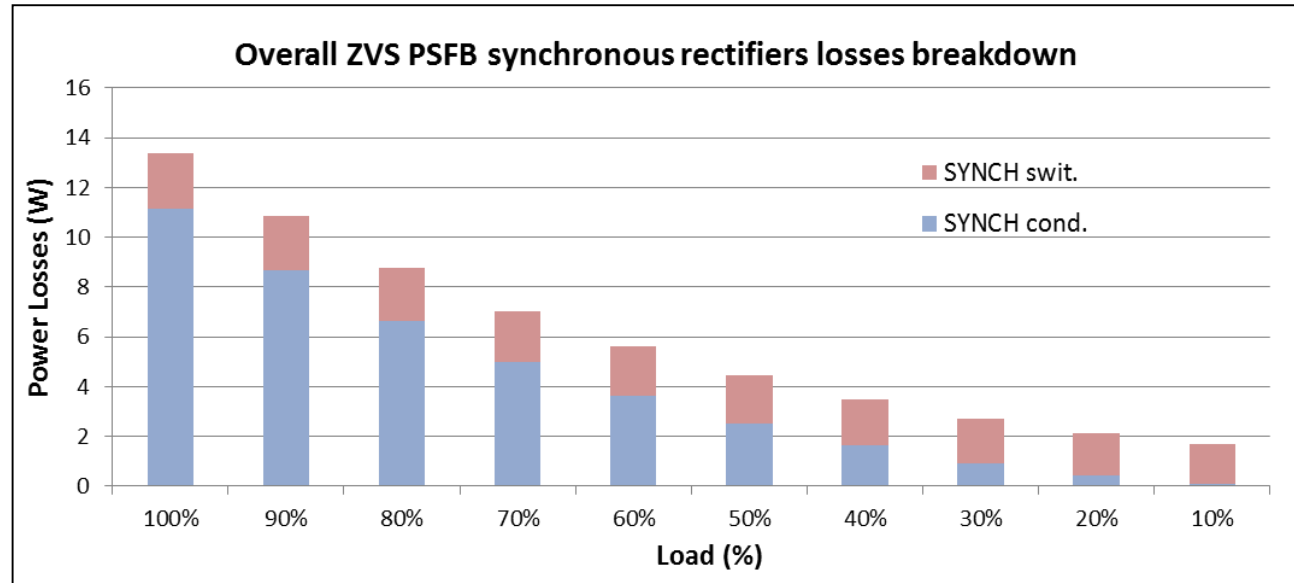
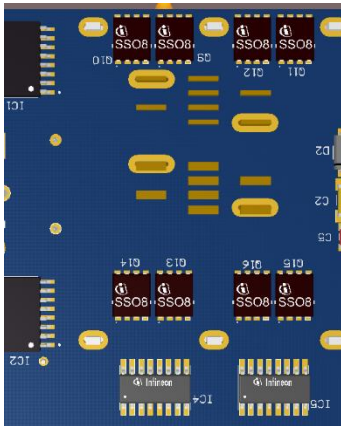
34°C @ 34A



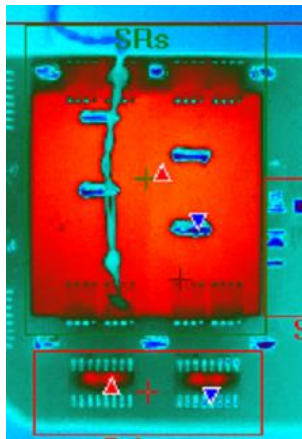
43°C @ 61A



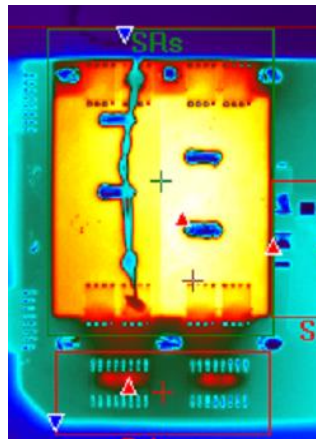
OptiMOS™ 5 150 V (BSC093N15NS) SR bridge MOSFETs



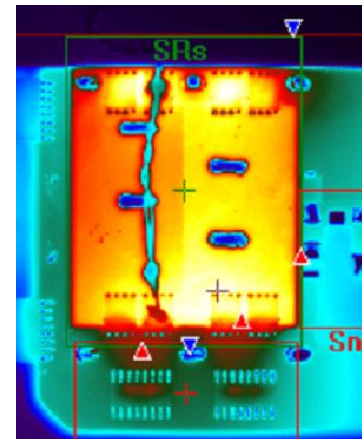
33°C @ 1A



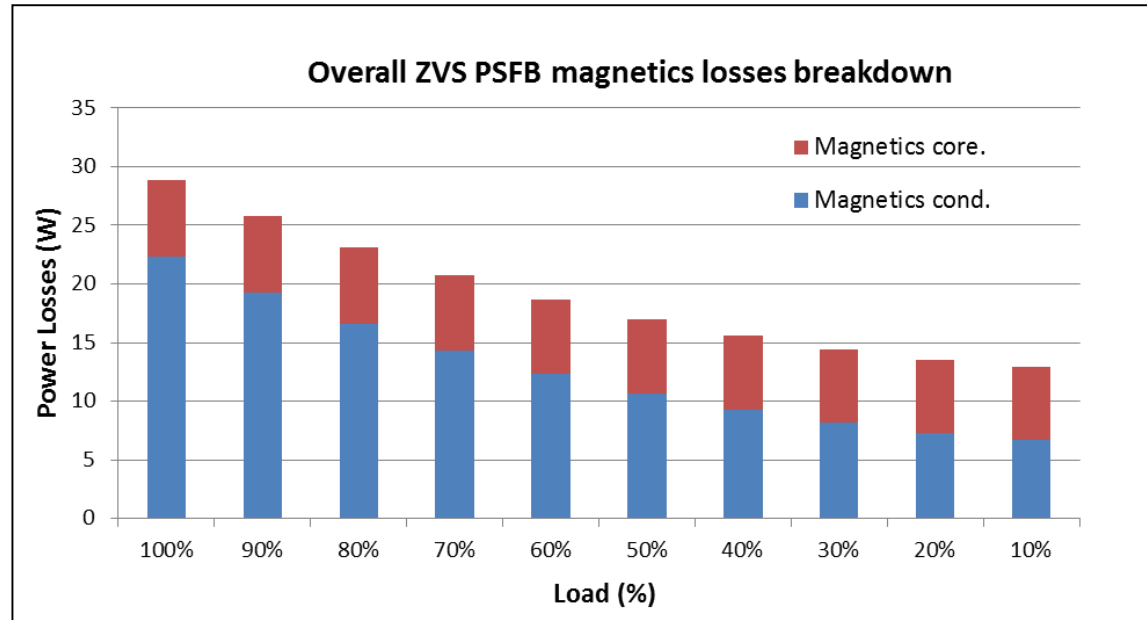
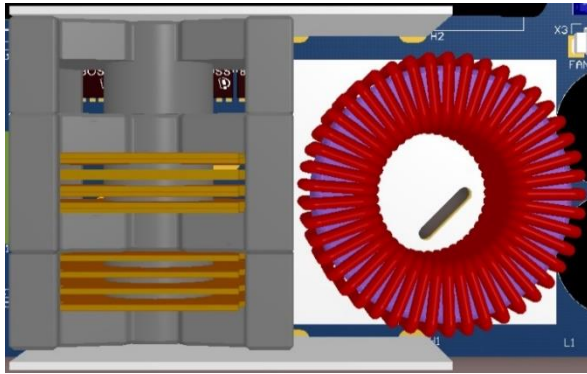
53°C @ 34A



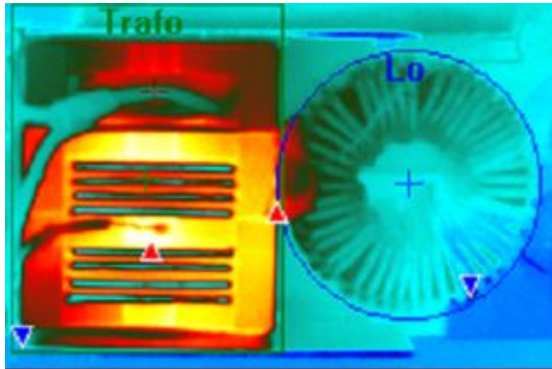
76°C @ 61A



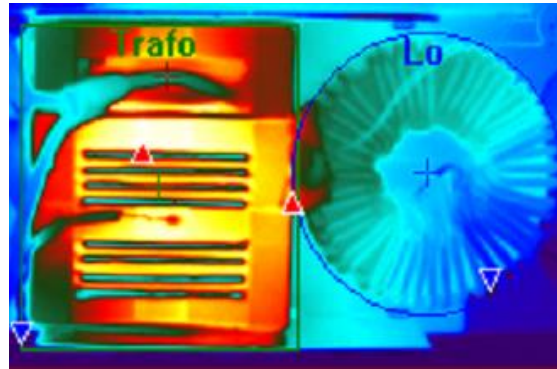
Magnetics: Transformer, resonant inductance and output choke



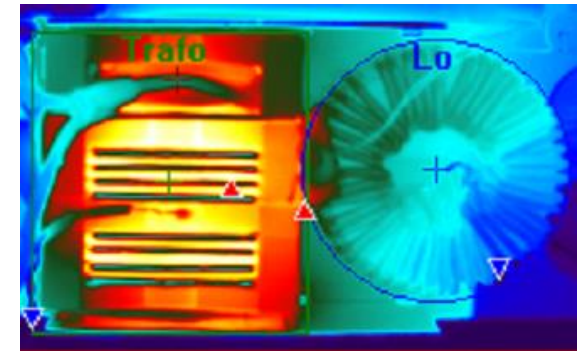
39°C @ 1A 36°C @ 1A



70°C @ 34A 58°C @ 34A



86°C @ 61A 68°C @ 61A



Summary

- › The trend in the field of switched mode power supplies (SMPS) in the last years moves towards the increase of power density with an optimized cost. In order to achieve this higher power density, high efficiency is a key parameter since heat dissipation must be minimized
- › The 3300 W DC-DC converter evaluation board developed with Infineon semiconductors, is a good example of how to achieve high efficiency level and high power density in telecom and battery charging applications
- › Fully resonant topologies, like LLC, are traditionally considered best possible solution for high power, high voltage DC-DC converters. The EVAL_3K3W_BIDI_PSFB demonstrates PSFB topology can achieve similar or equal levels of performance
- › Unlike the bi-directional operation in other resonant topologies, the proposed bi-directional operation of PSFB in EVAL_3K3W_BIDI_PSFB does not constrain the design, does not have any impact on efficiency nor requires any additional components
- › This telecom or battery charging DC-DC converter allows as well the implementation and test of future Infineon devices and technologies



Technical Material

- > Application Notes
- > Simulation Models
- > Datasheets

> [EVAL_3K3W_BIDI_PSFb](#)

Evaluation Boards

- > Evaluation Boards
- > Demoboards
- > Reference Designs

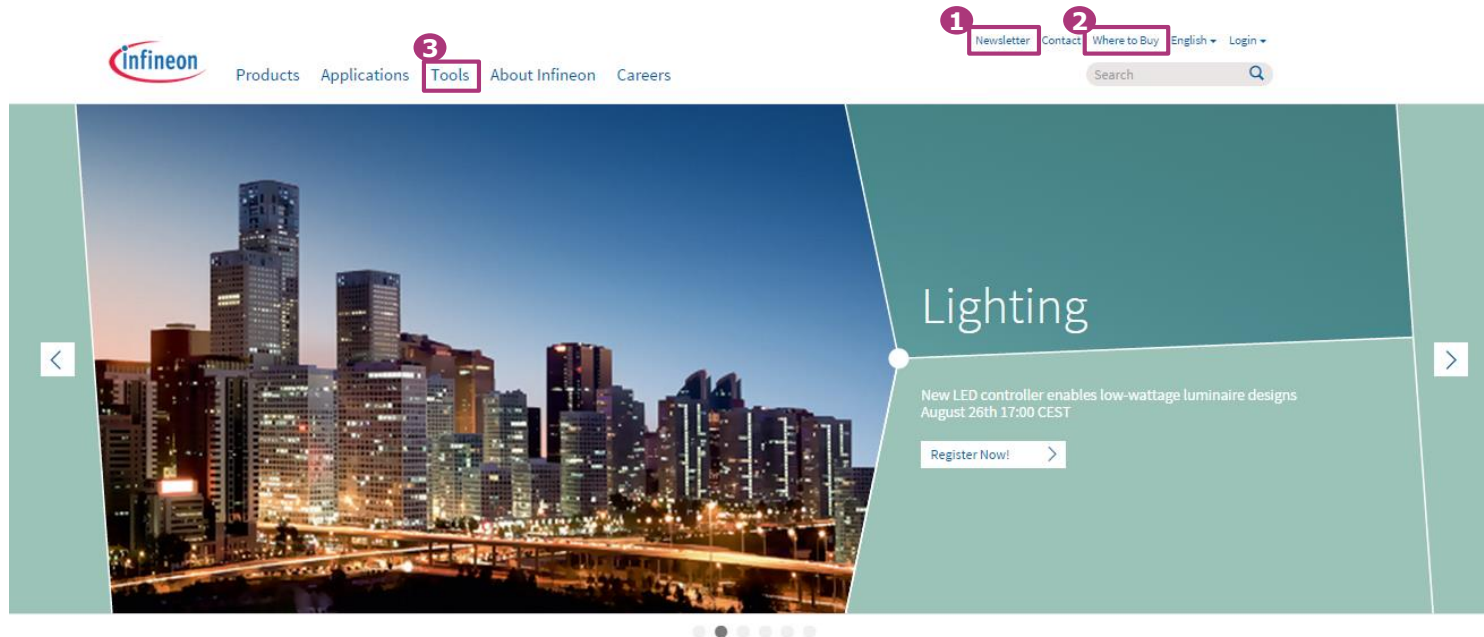
> www.infineon.com/evaluationboards

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Sensor
Smart Card IC
Interface
Transistor & Diode

Power Overview
Power MOSFET
IGBT
Smart Low-Side & High-Side Switches
Linear Voltage Regulator
DC-DC Converter
LED Driver | Lighting ICs
Silicon Carbide (SiC)
High Power Thyristors & Diodes
Motor Control & Gate Driver
AC-DC Supply



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