

# EVAL\_3KW\_2LLC\_CFD7

3 kW dual-phase LLC evaluation board  
with 600 V CoolMOS™ CFD7 SJ MOSFET

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# Table of contents

1

General description

2

Efficiency results

3

Design concept

# Agenda

1

General description

2

Efficiency results

3

Design concept

# General

## Description:

- › The "[EVAL\\_3kW\\_2LLC\\_CFD7](#)" evaluation board shows how to design a dual-phase LLC system solution of a server SMPS with the target to meet **80+ Titanium Standard** efficiency requirements. For this purpose the following technologies have been used: the latest 600 V CoolMOS™ CFD7 SJ MOSFET technology ([IPW60R031CFD7](#)) on the primary side and OptiMOS™ 5 150 V low voltage power MOSFET in SuperSO8 ([BSC093N15NS5](#)) in the synchronous rectification secondary stage, in combination with QR CoolSET™ ([ICE2QR2280Z](#)), high voltage gate driver EiceDRIVER™ 1EDI ([1EDI60N12AF](#)), high speed driver ICs for high voltage MOSFETs, low side gate driver EiceDRIVER™ 2EDN ([2EDN7524R](#)) for synchronous rectification MOSFETs and a digital LLC microcontroller ([XMC4400-F64K512 AB](#)).

## Summary of features:

- › Output voltage: 44 – 58 V<sub>DC</sub>
- › Output current max: 55 A
- › Peak efficiency @ 50% load > 98.4%
- › Efficiency @ 10% load > 97%



## The following variants are available:

- › EVAL\_3kW\_2LLC\_CFD7 version with 600 V CoolMOS™ CFD7 in **TO-247** (IPW60R031CFD7)
  - › Order code: EVAL\_3kW\_2LLC\_CFD7 (SP001783688, SA001783696)

# Example of system understanding: Infineon demo solution for Titanium high voltage DC-DC stage

## Half-bridge LLC with synchronous rectification in center tap configuration

|               |                           |
|---------------|---------------------------|
| $V_{in}$      | 350 – 400 V <sub>DC</sub> |
| $V_{in\_nom}$ | 380 V <sub>DC</sub>       |
| $V_{out}$     | 44 – 58 V <sub>DC</sub>   |
| $I_{out}$     | 55 A                      |
| $P_o$         | 3 kW                      |
| $C_r$         | 66 nF                     |
| $L_r$         | 12 $\mu$ H                |
| $L_m$         | 62 $\mu$ H                |

### Primary HV MOSFETs

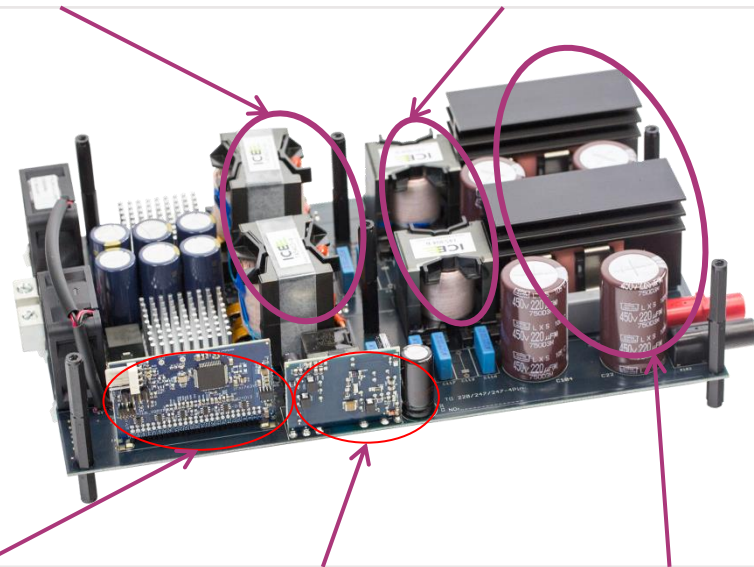
- > 600 V CoolMOS™ CFD7 (IPW60R031CFD7)
- > Reduced gate charge ( $Q_g$ )
- > Reduced  $E_{off}$
- > High body diode ruggedness

### SR MOSFETs

- > OptiMOS™ (BSC093N15NS5)
- > New generation
- > Best FOM  $R_{DS(on)} \times Q_g$
- > Best FOM  $R_{DS(on)} \times Q_{oss}$

**Transformer**  
SP-PQ 40/40 core

**Resonant inductor**  
SP-PQ 35/35 core



**LLC controller**  
**Digital**  
XMC4400-F64K512 AB

**Bias QR flyback**  
**controller**  
ICE2QR2280Z

**High voltage**  
**MOSFETs**  
IPW60R037P7 TO-247

# Digital control card – Infineon's solution to control the 3 kW dual-phase LLC evaluation board

## XMC4400-F64K512 AB

### Summary of features:

- › ARM® Cortex®-M4, 120 MHz, incl. single cycle DSP MAC and floating point unit (FPU)
- › 8-channel DMA + dedicated DMAs for USB and Ethernet
- › USB 2.0 full-speed on-the-go
- › CPU frequency: 120 MHz
- › eFlash: 512 kB including hardware ECC
- › 80 kB SRAM
- › Package: PG-LQFP-64

### Target applications:

#### Motor control

- › Position detection
- › IO devices
- › HMI
- › Solar inverters
- › SMPS
- › Sense and control systems
- › PLC
- › UPS
- › Light networks

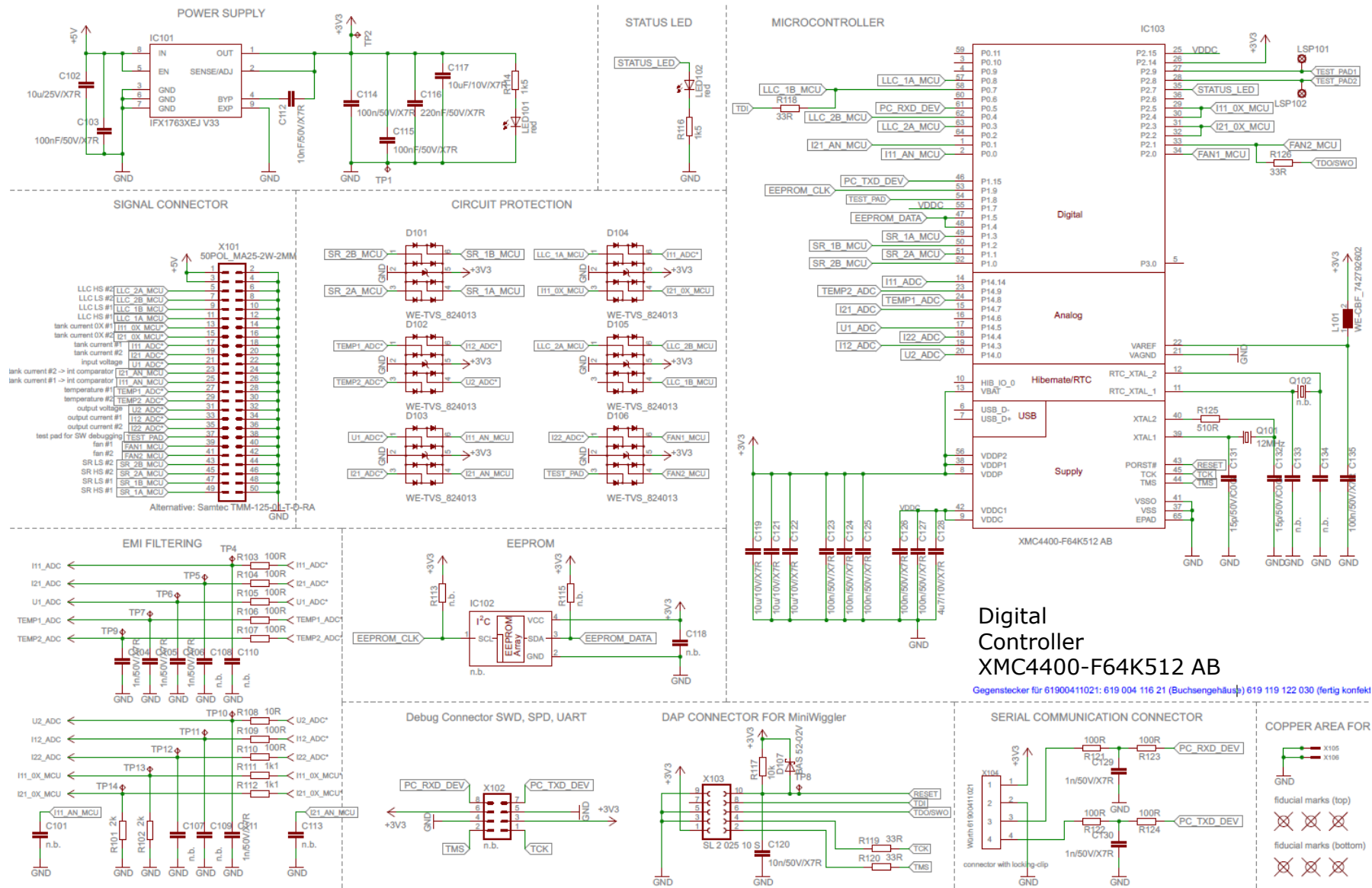




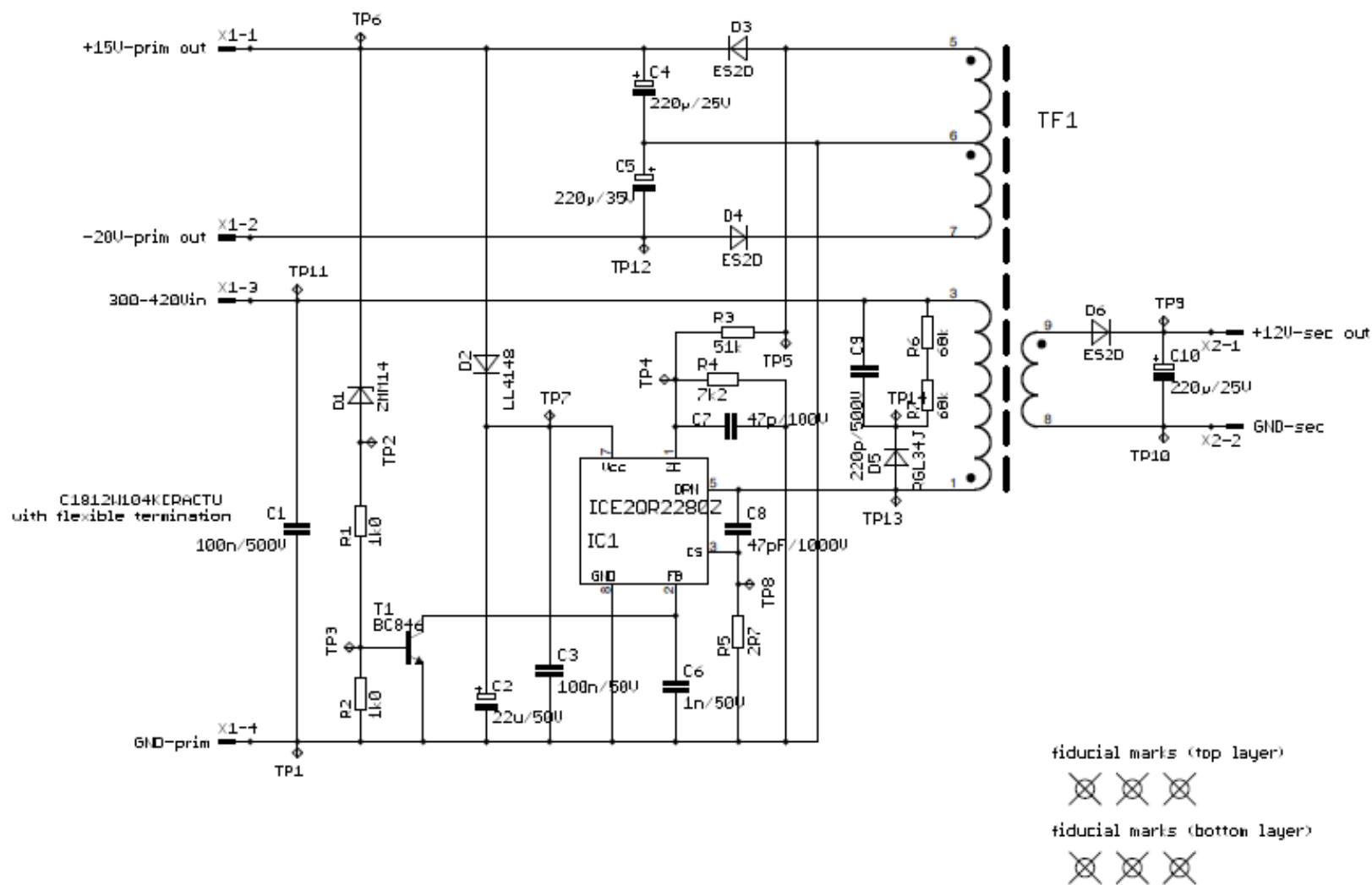




# Digital control board schematic



# Bias board schematic



# Connection instruction



# Agenda

1

General description

2

Efficiency results

3

Design concept

# Automated efficiency measurement

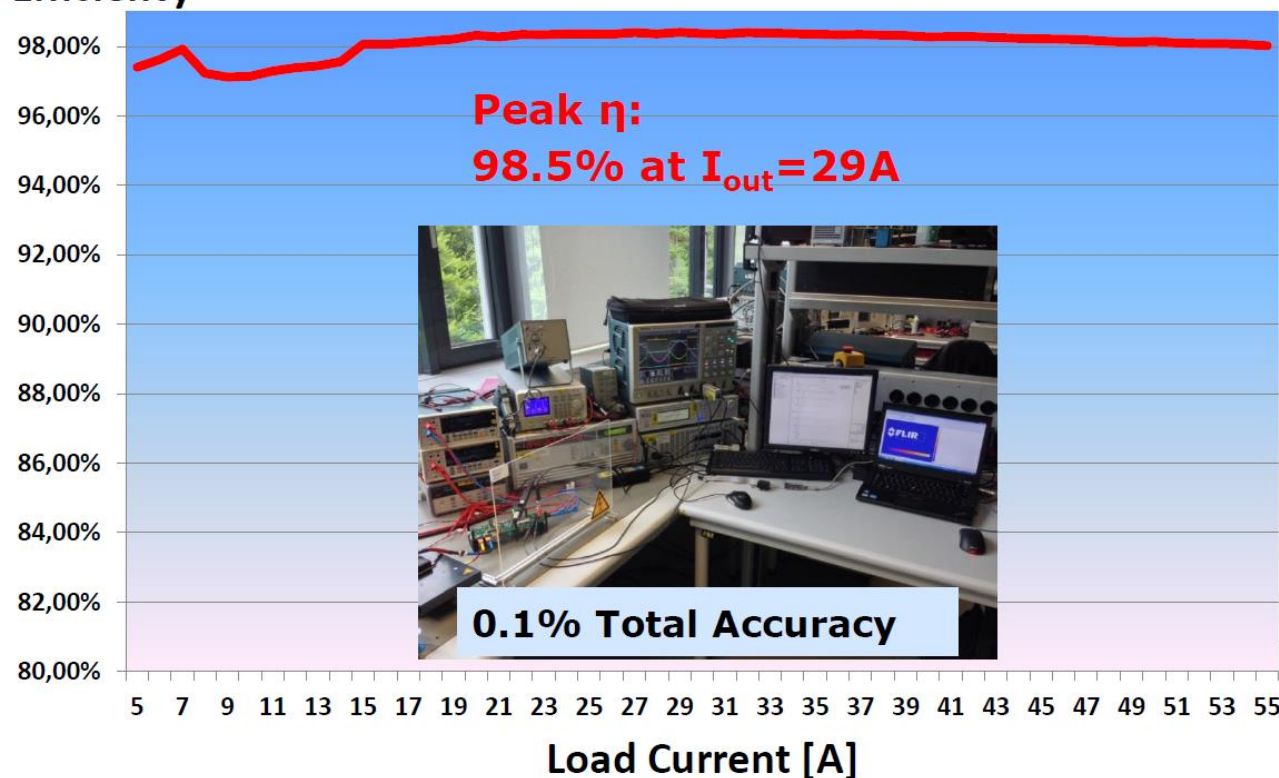
Combination of converter design (resonant tank, transformer) and proper high voltage device selection

Proper selection of SR low voltage device and secondary side design

## 3kW Dual Phase LLC Efficiency

(without Bias & fans absorption)

Efficiency



— 3kW Dual Phase LLC

@  $V_{in\_nom}=380VDC$ ,  
 $V_{out\_nom}=54.3VDC$

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1

General description

2

Efficiency results

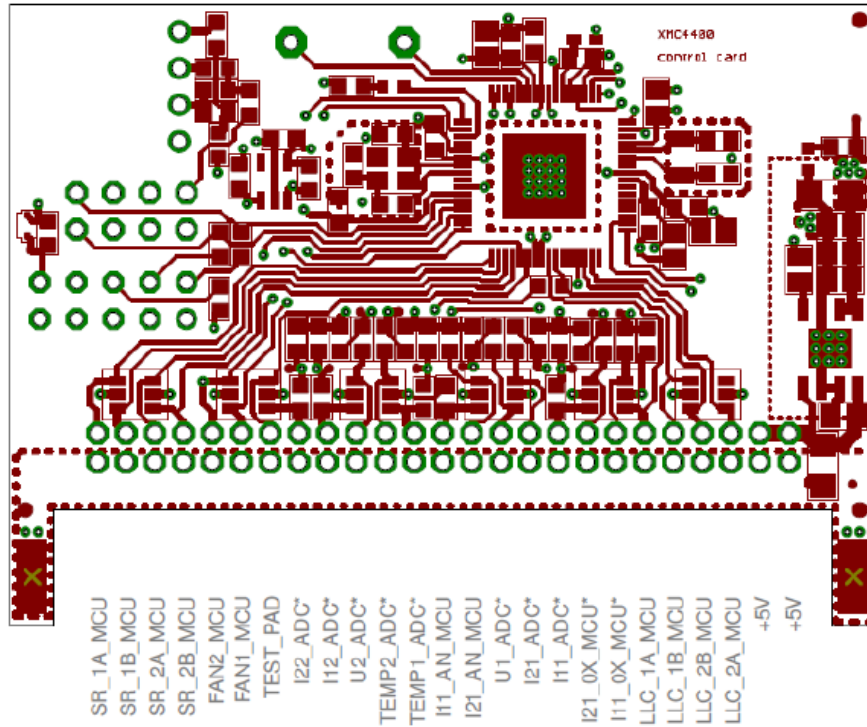
3

Design concept

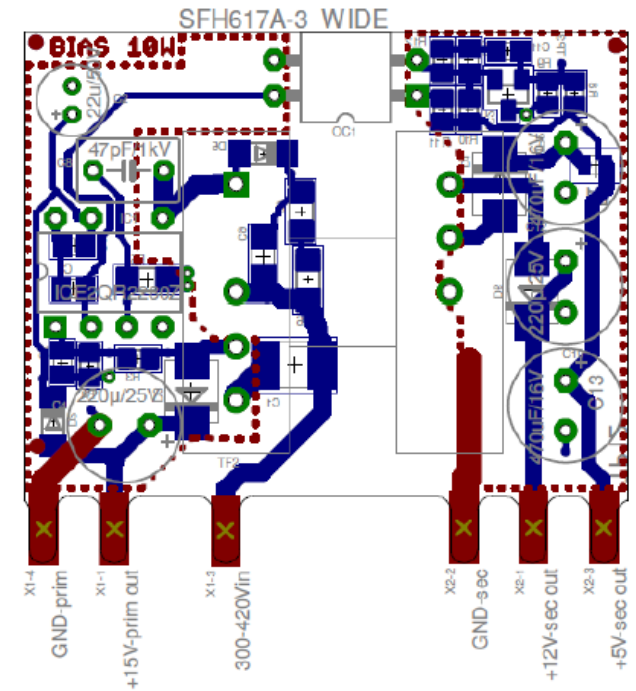
# Design concept



## Two daughter boards



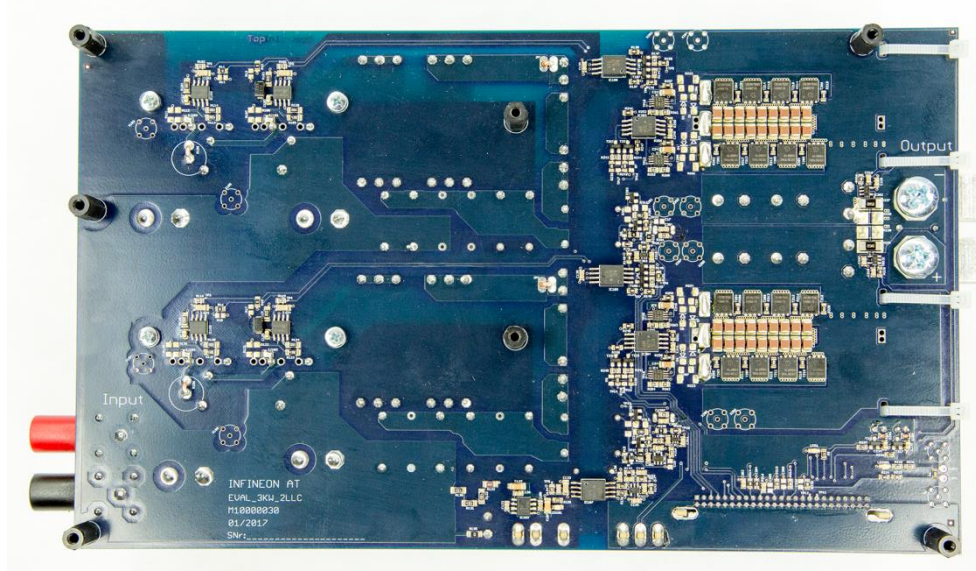
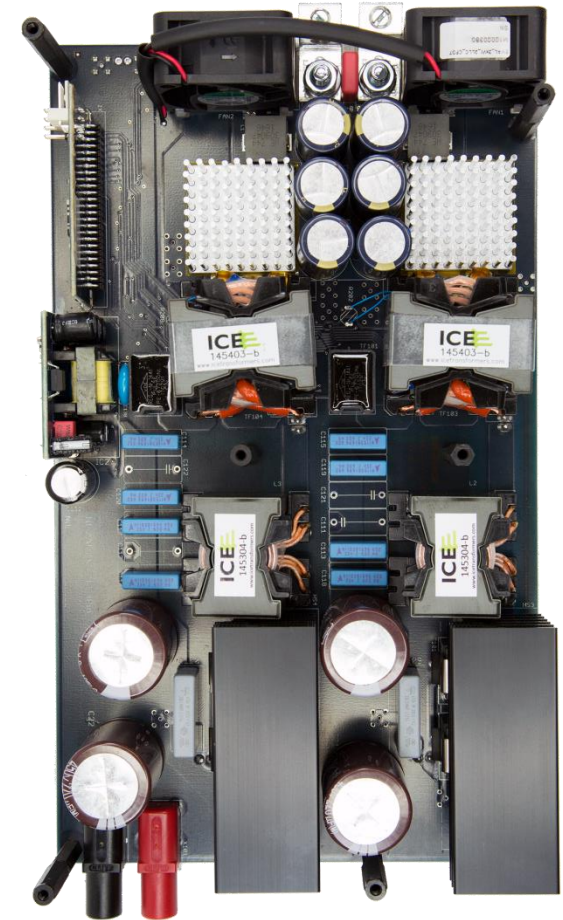
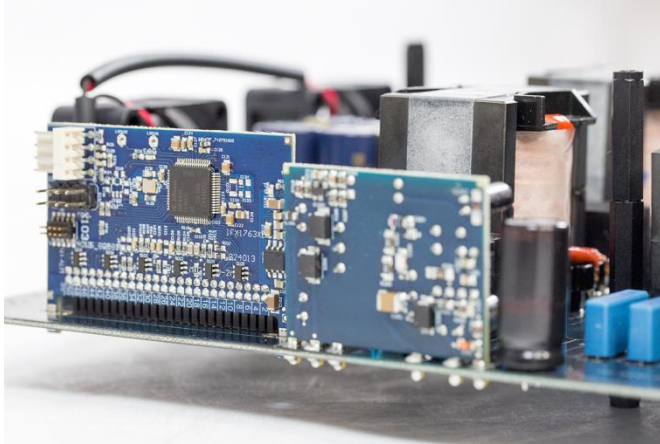
## Microcontroller Board



## Auxiliary Converter Board



# Evaluation board EVAL\_3KW\_2LLC\_CFD7





## Technical Material

- > Application Notes
- > Simulation Models
- > Datasheets
- > PCB Design Data

- > [www.infineon.com/3kw-llc-eval-cfd7](http://www.infineon.com/3kw-llc-eval-cfd7)
- > [www.infineon.com/cfd7](http://www.infineon.com/cfd7)

## Evaluation Boards

- > Evaluation Boards
- > Demoboards
- > Reference Designs

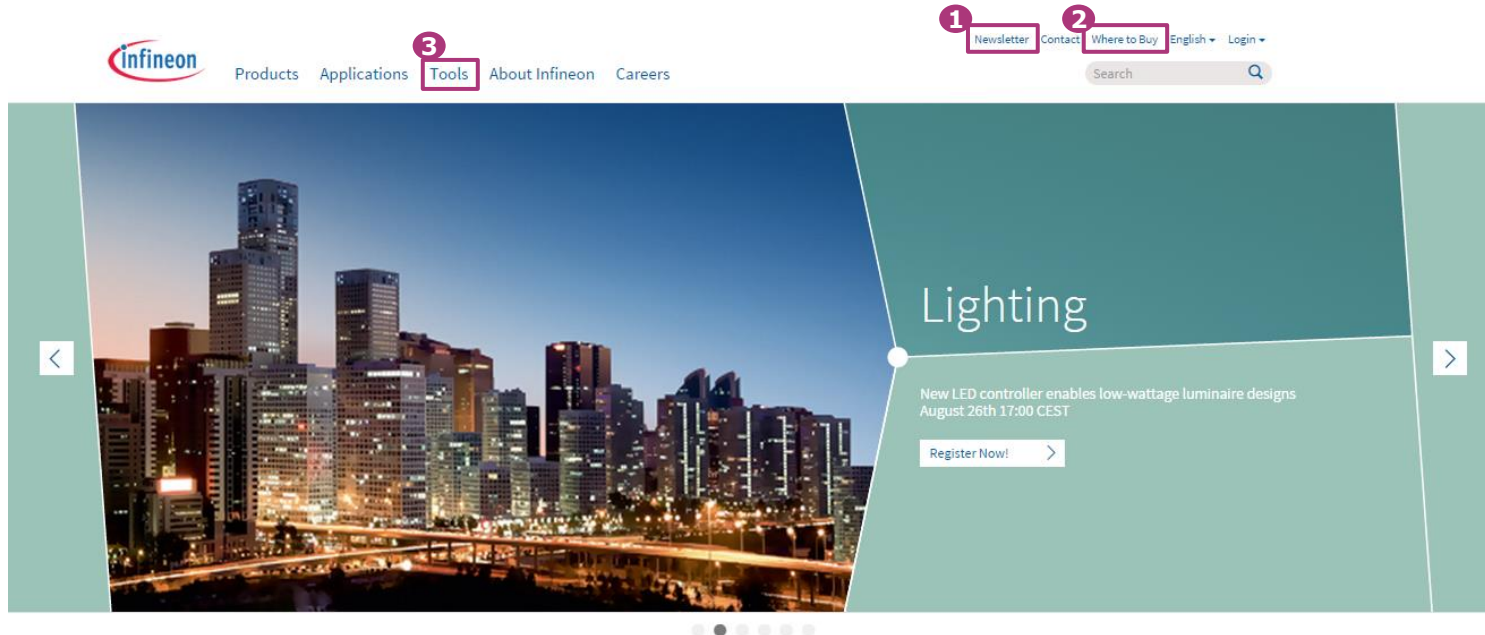
- > [www.infineon.com/evaluationboards](http://www.infineon.com/evaluationboards)

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