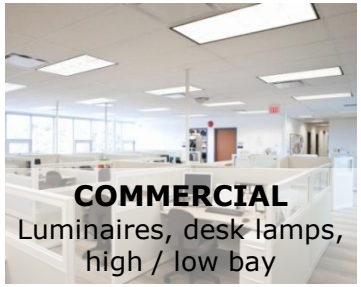
# LED Lighting Proposal with IFX solution

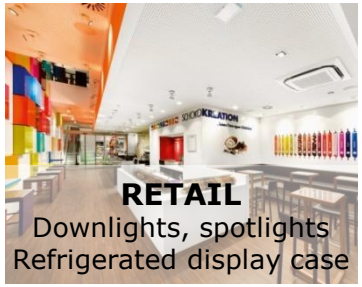
2014-08-26

# Our Application Focus is mainly General Lighting

## Professional Lighting



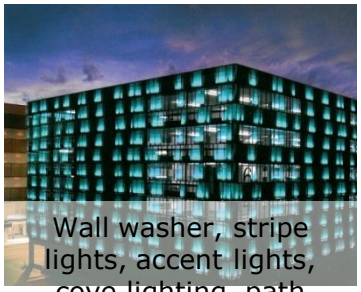
**COMMERCIAL**
Luminaires, desk lamps, high / low bay



**RETAIL**
Downlights, spotlights
Refrigerated display case

**RESIDENTIAL**
Recessed downlights
Pendants, under cabinet, decorative

## Architectural & Entertainment



Wall washer, stripe lights, accent lights, cove lighting, path lights, stage lighting

## Outdoor area lighting

Street, tunnel, parking lot

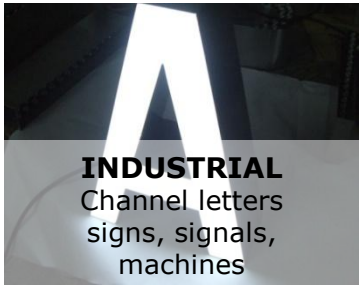
## Replacement Lamps

MR16

Linear tubes

## Others

**CONSUMER**
Home appliances projectors



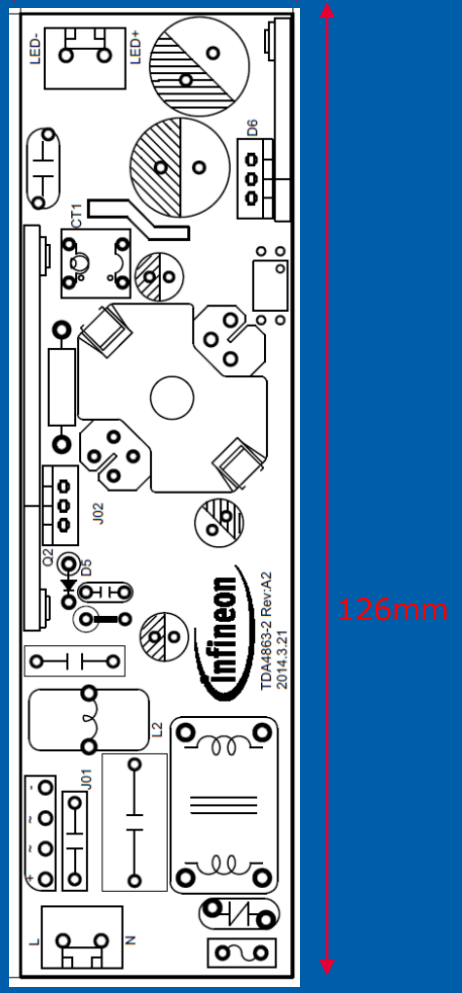
**INDUSTRIAL**
Channel letters signs, signals, machines

**AUTOMOTIVE**
Interior lighing,tail Light

# INDEX

# TDA4863-2G

## Demo board




**Operation**

Single stage PFC/Flyback

**Flexibility**

- Universal input voltage range 85Vac – 305Vac
- Wide output voltage range 24V – 48V

**Output current**

- 1000mA ouput crrent
- High accuracy : 3.5%

**Efficiency**

Benchmark AC/DC efficiency up to 88.5%

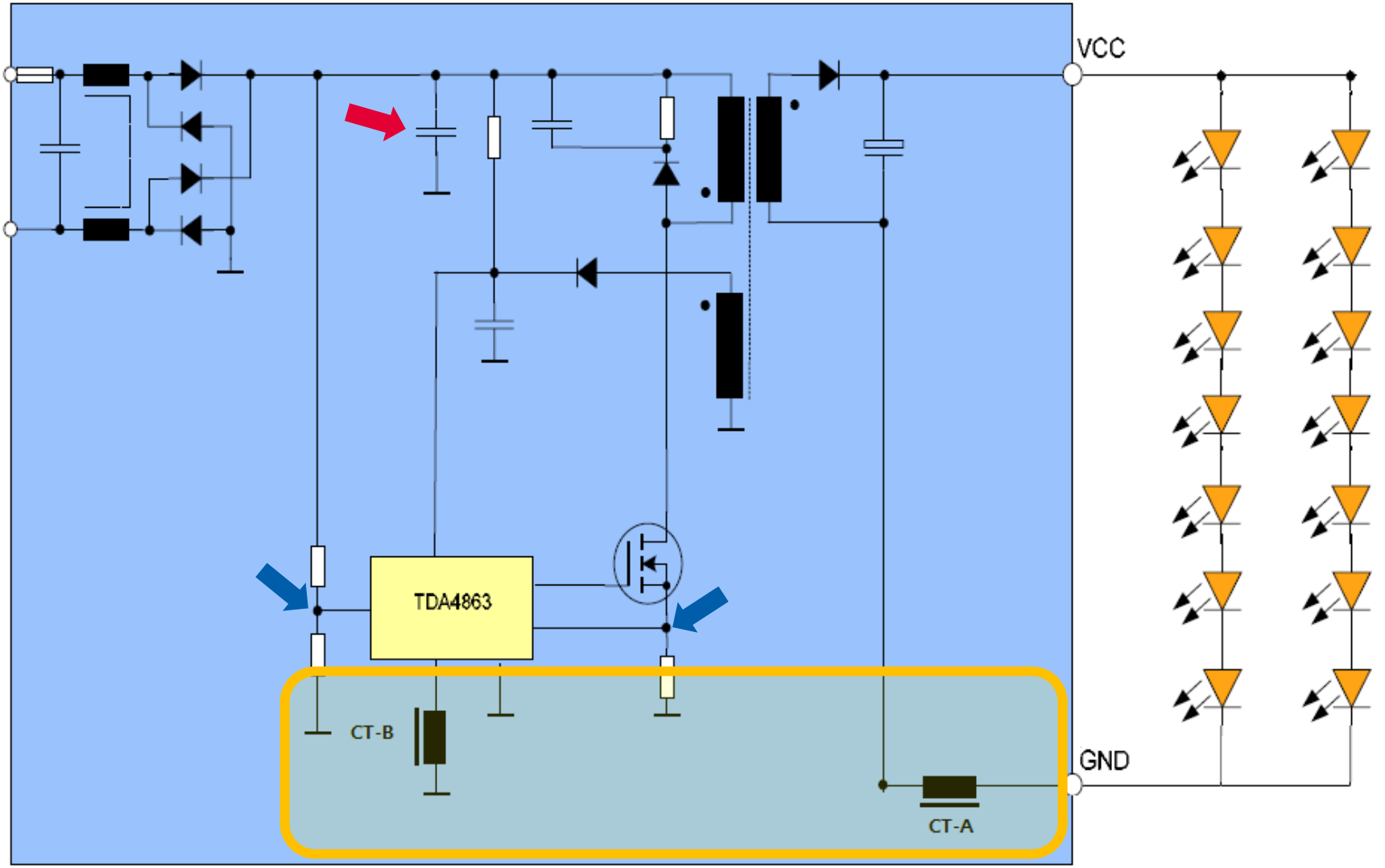
**PF/THD**

- PF up to 0.97
- THD below to 18%

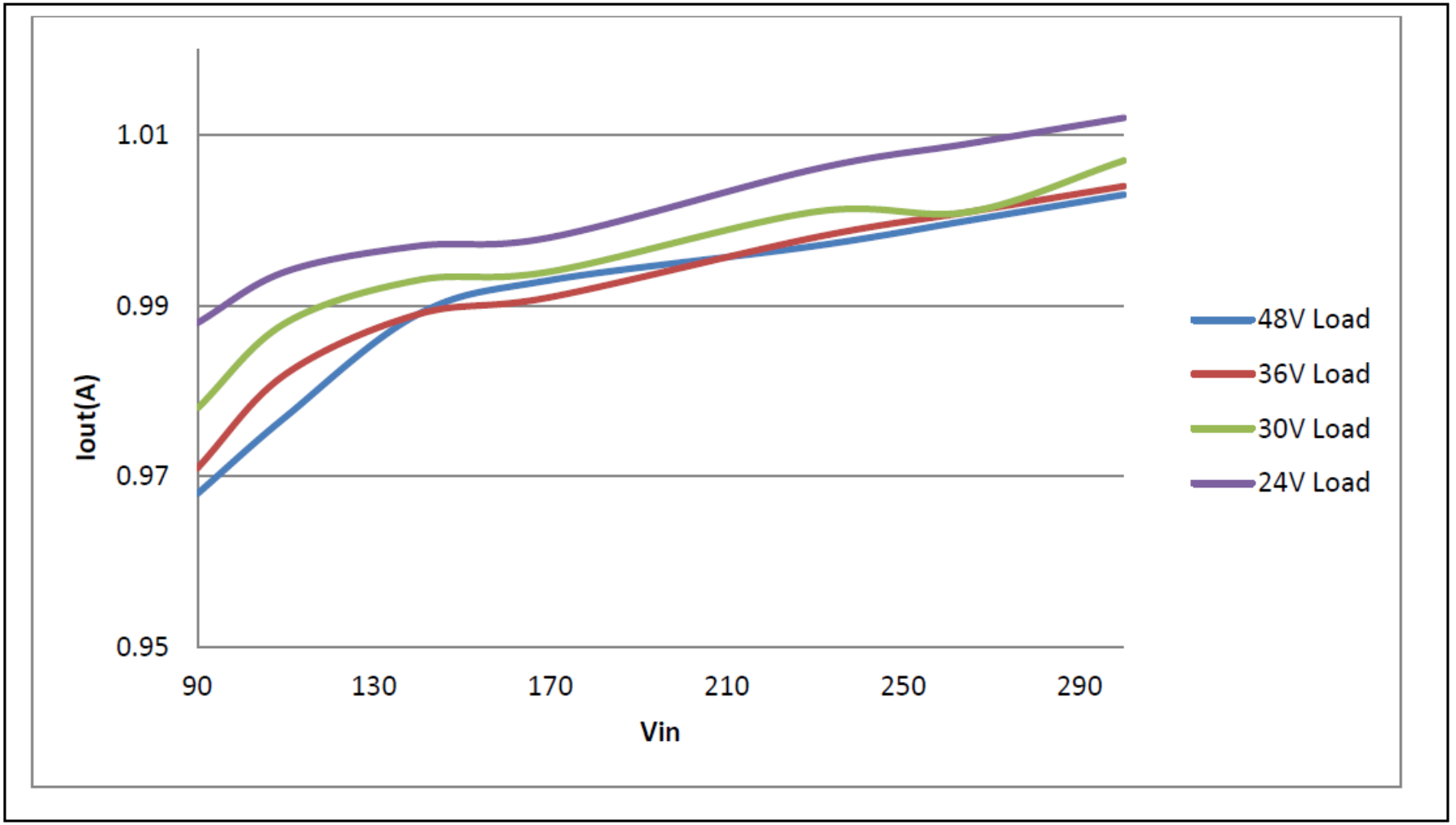
**Protection**

- Over Voltage protection
- Short Vircuit Protection
- Over Power Protection

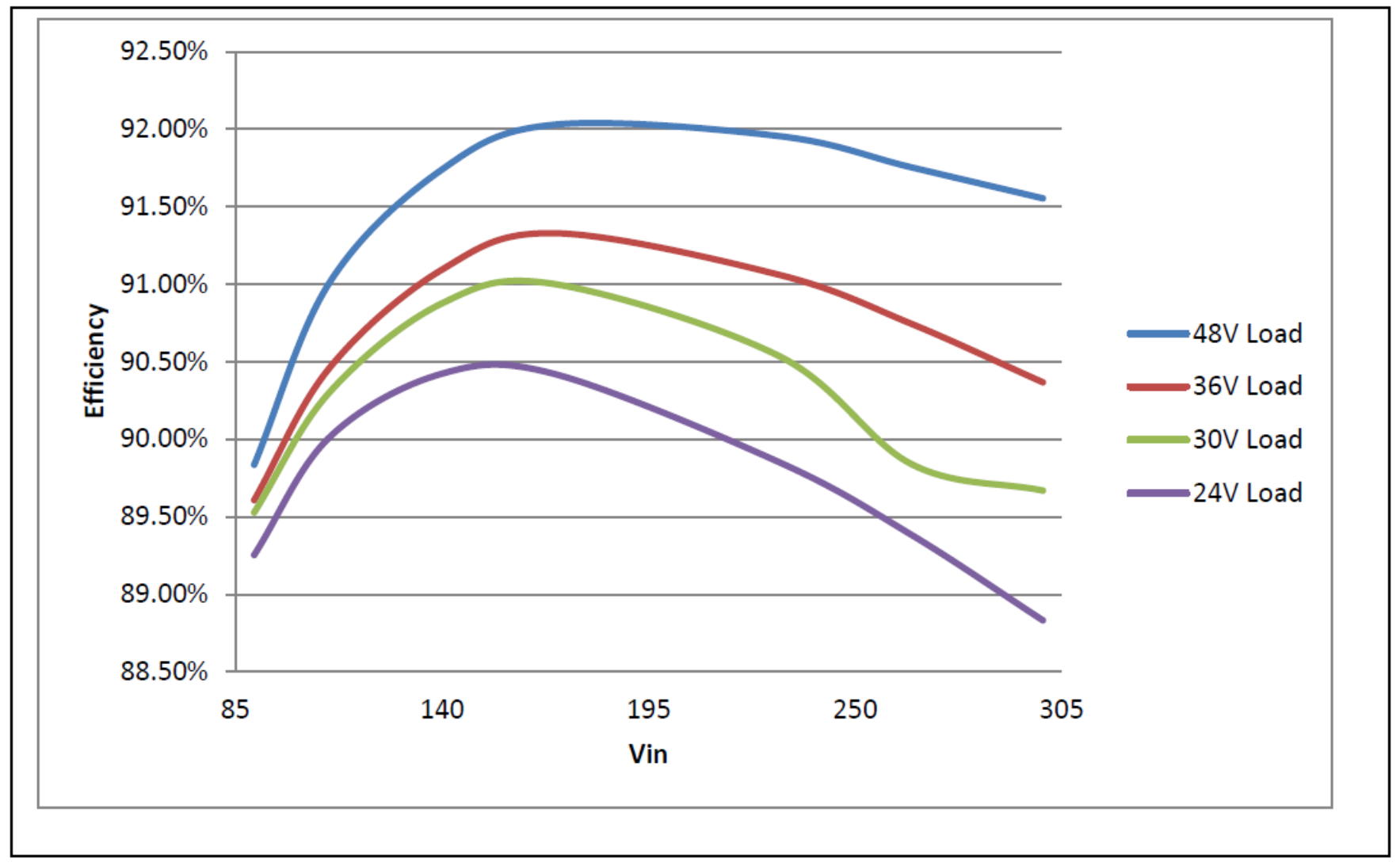
# Typical Application Circuit



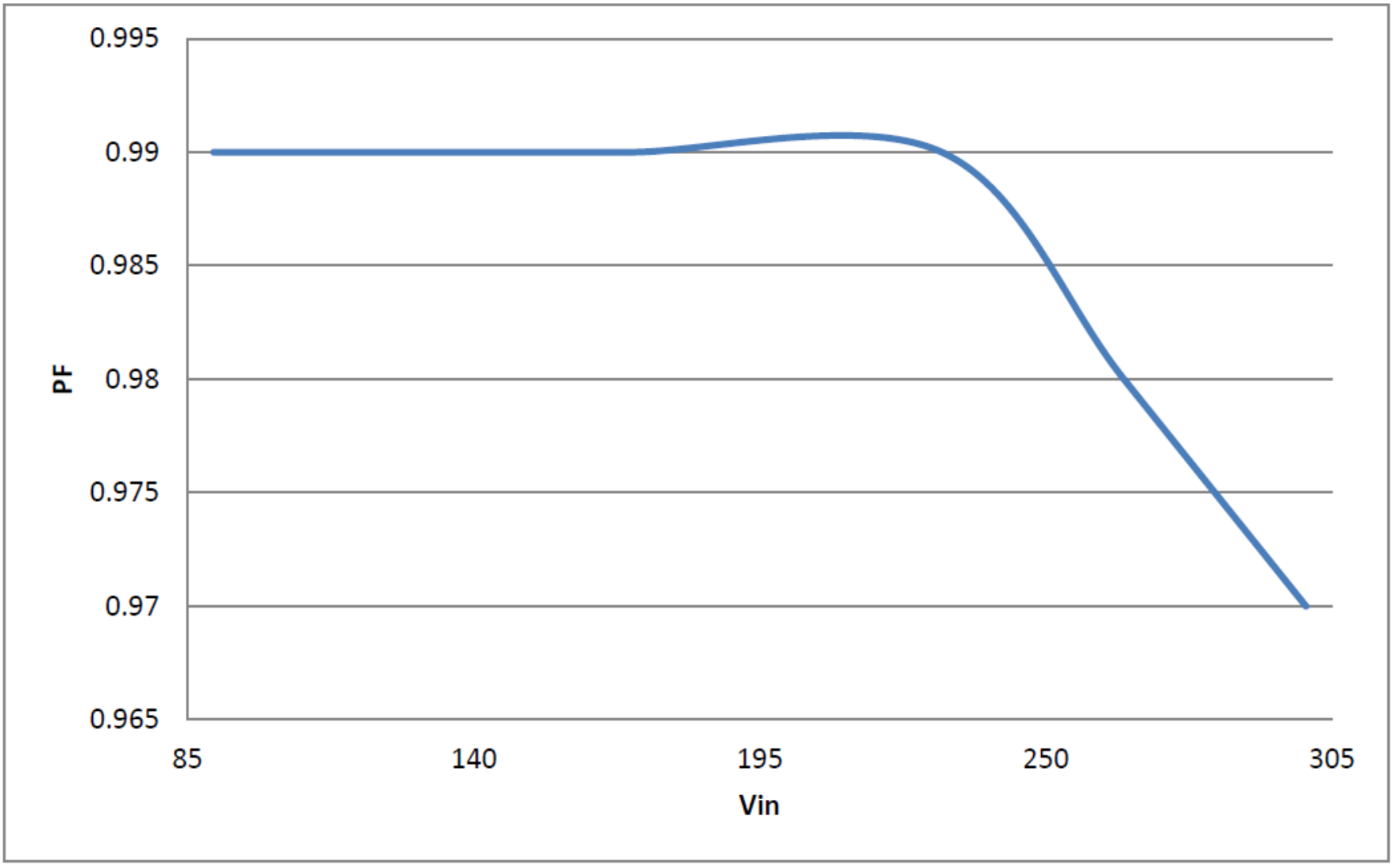
# Load regulation



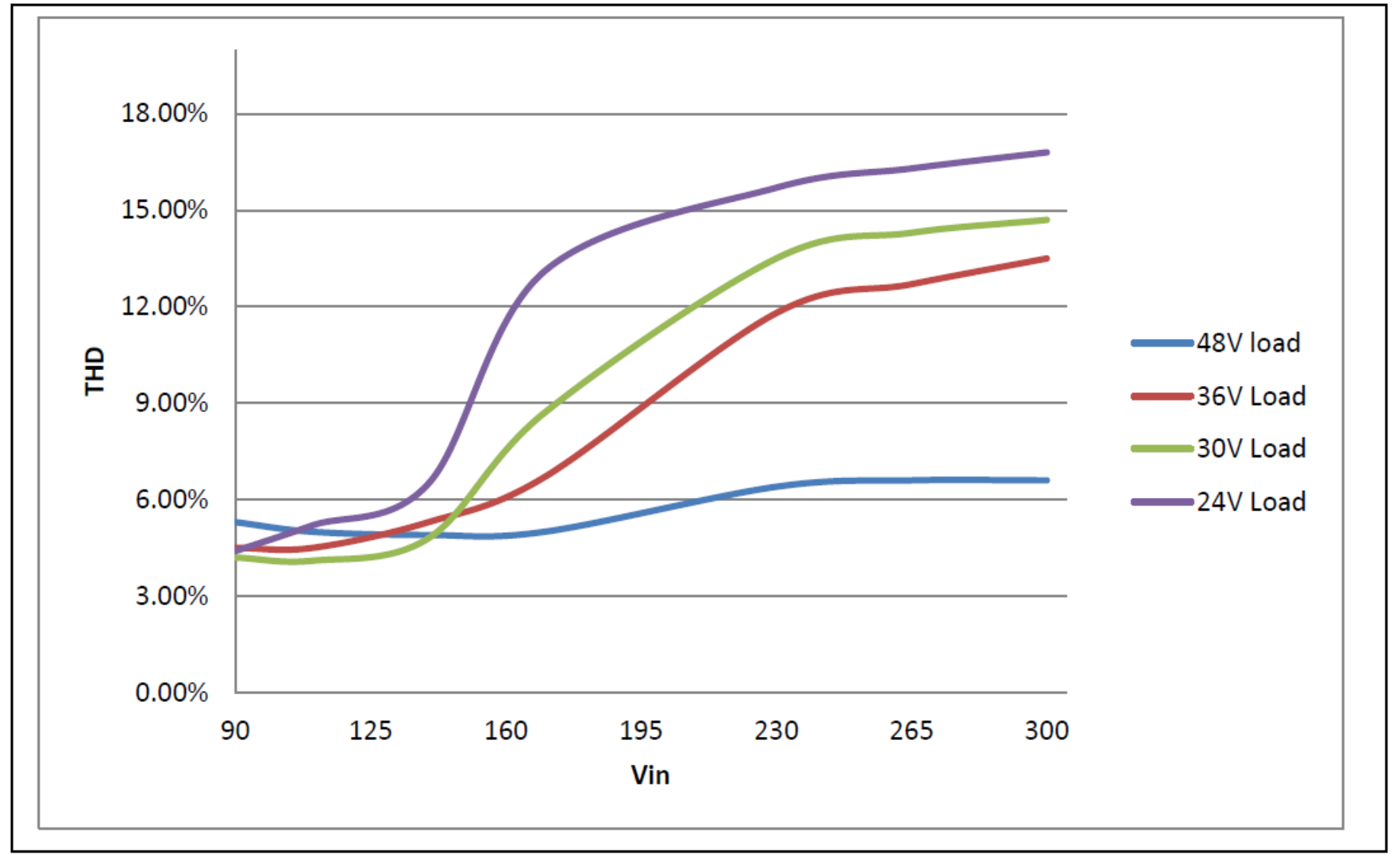
# Efficiency Vs Vin at various loading



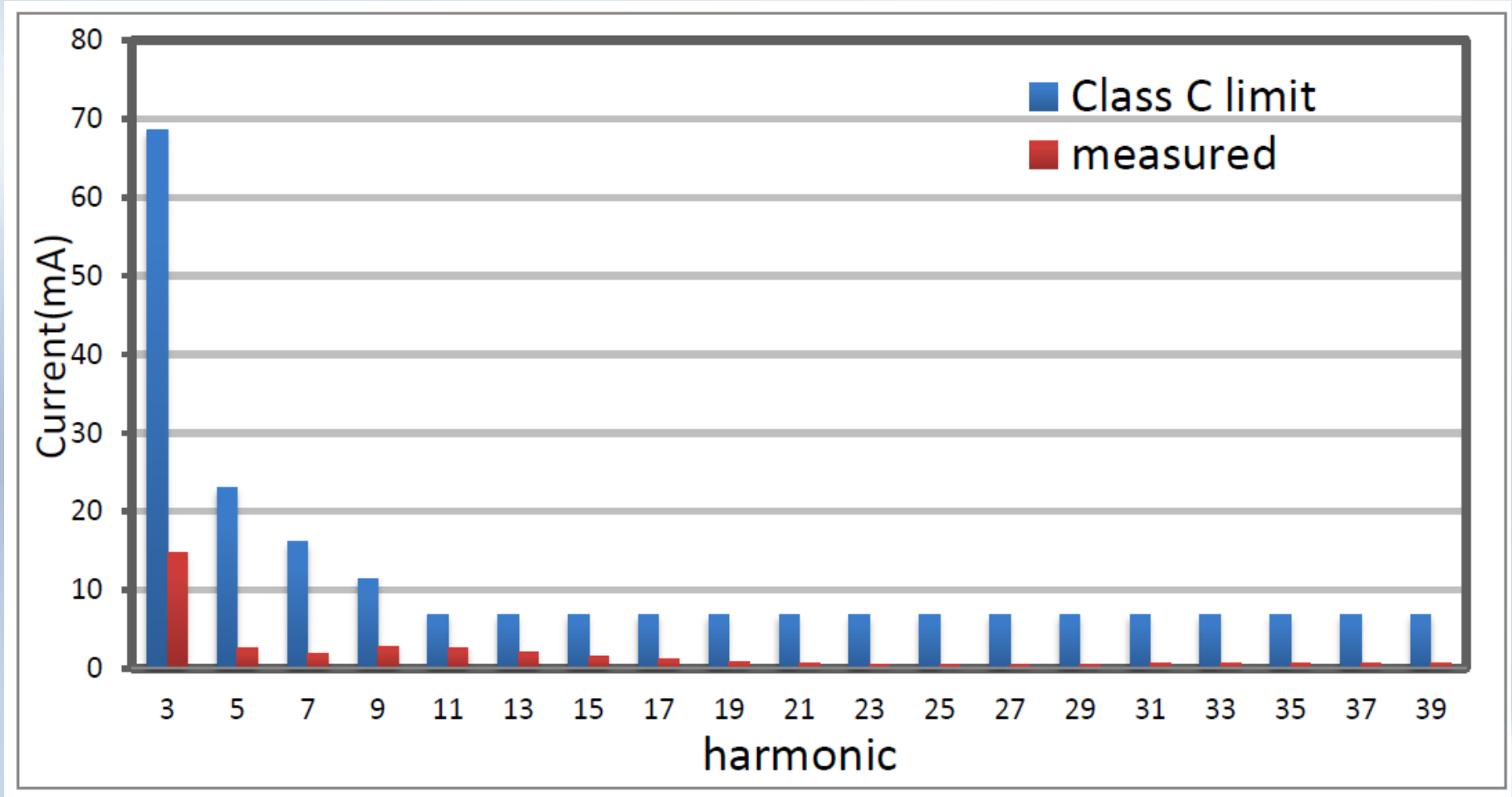
# PF vs Vin



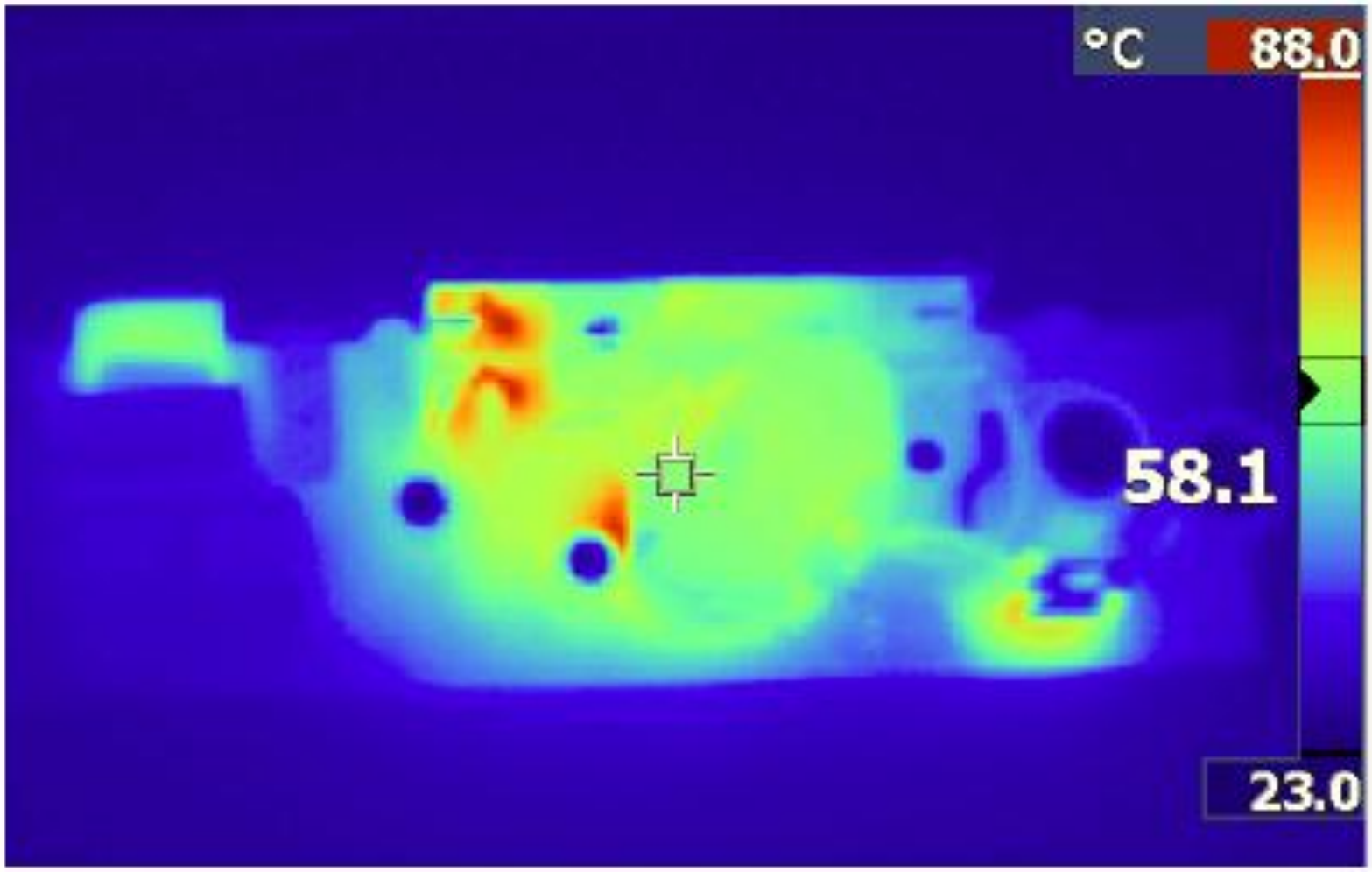
# THD vs Vin at full load



# THD vs Vin at full load

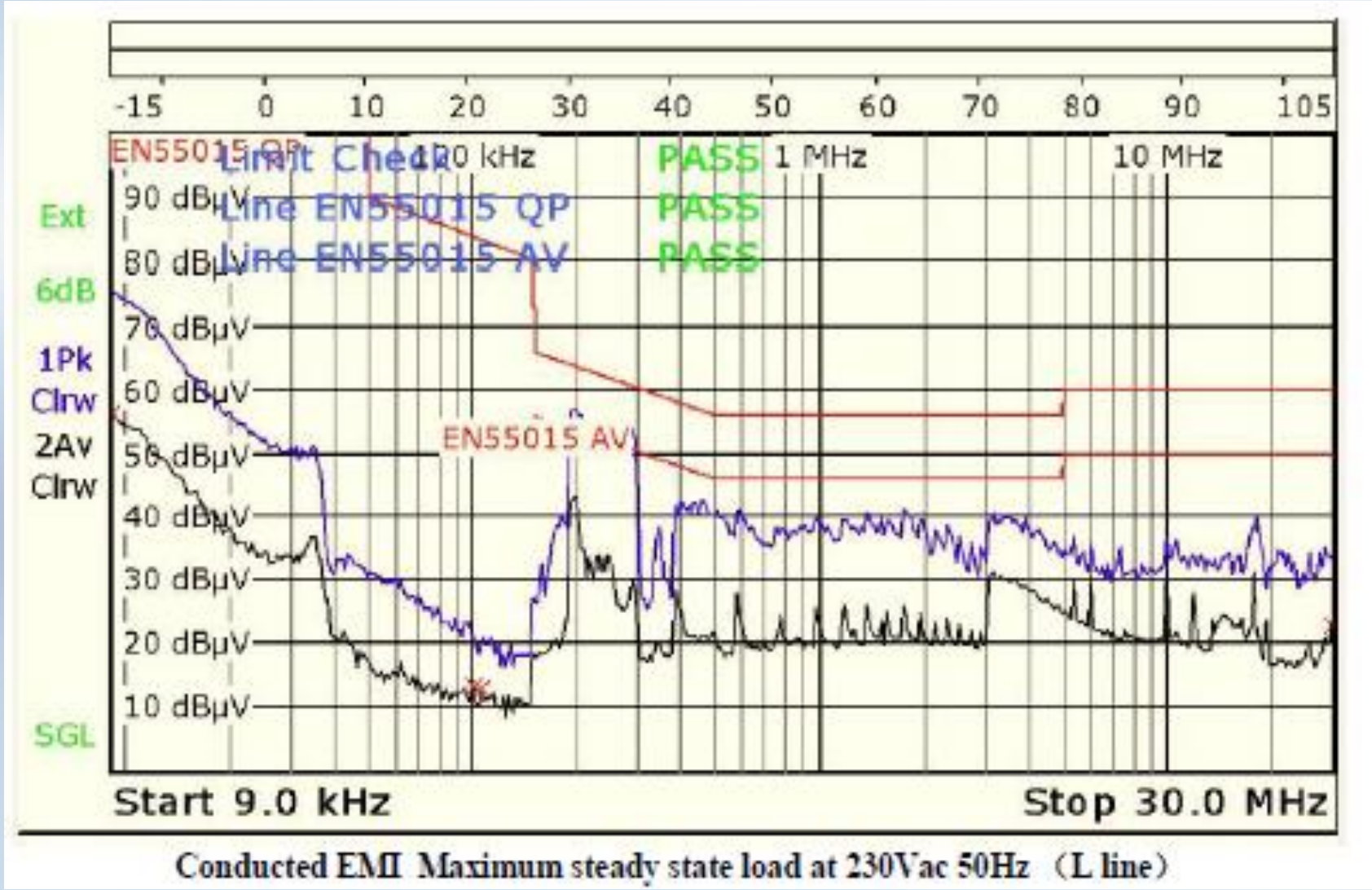


# Thermal and Conducted EMI




VIN=110VAC

# Thermal and Conducted EMI

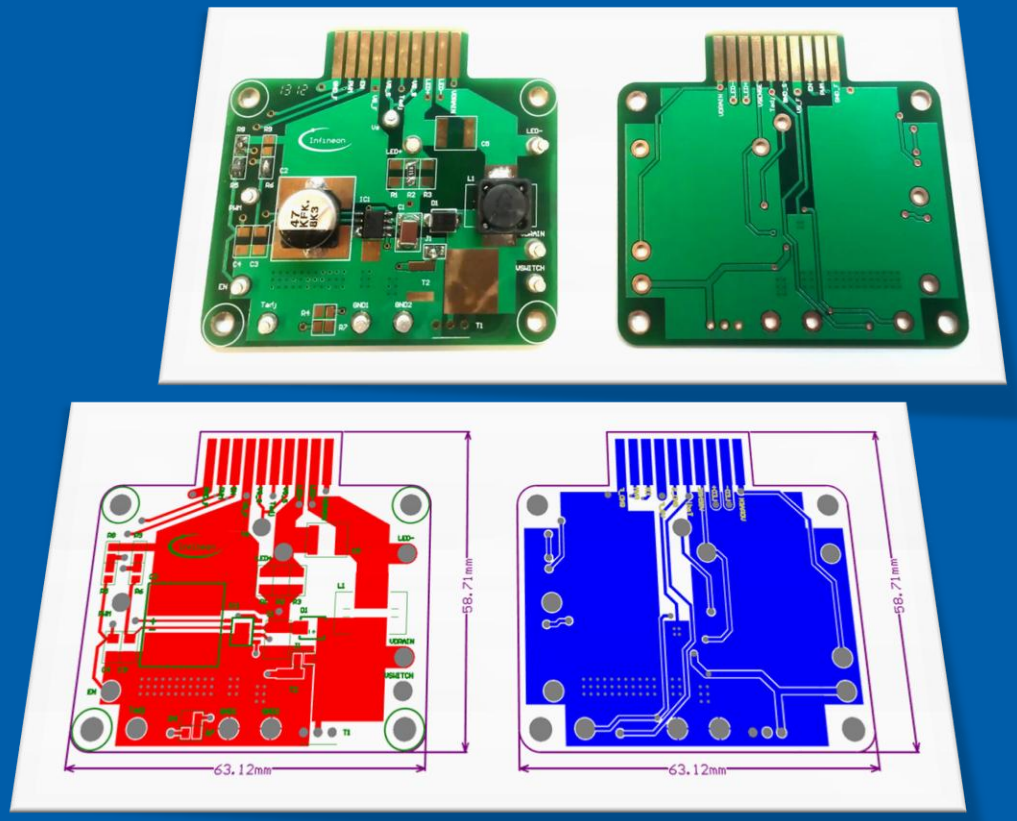



Conducted EMI Maximum steady state load at 230Vac 50Hz （L line）

# INDEX

# ILD6070 / ILD6150

## Demo boards




**Operation**

Buck topology
- Max 1MHz $f_{sw}$
- Low quiescence current

**Flexibility**

- Wide usable input voltage range from 4.5V – 60V
- Current accuracy ± 3%

**Output current**

Integrated MOSFET rated up to 700 / 1.500 mA

**Efficiency**

Benchmark DC/DC efficiency up to 98%

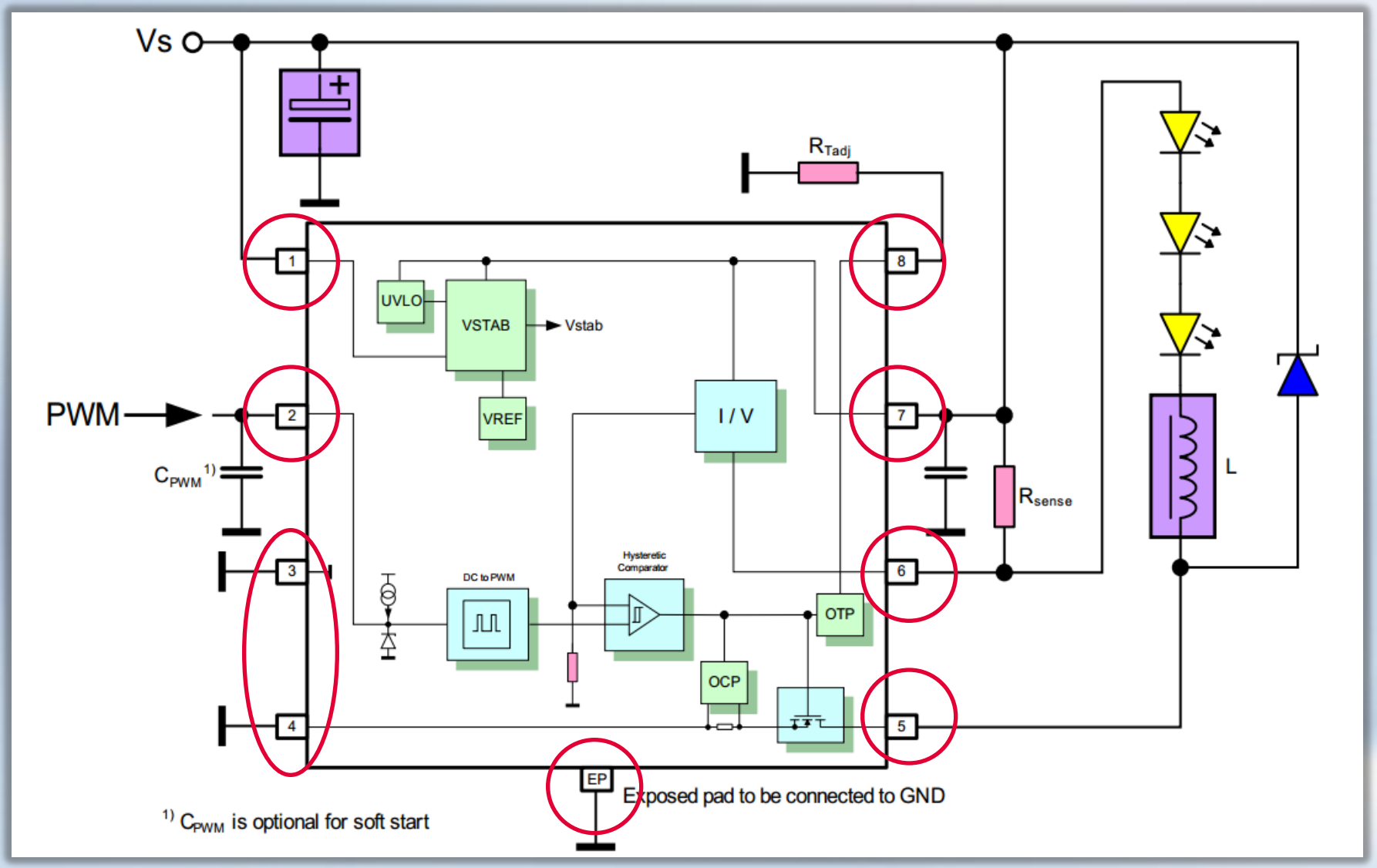
**Dimming**

- PWM & analog dimming
- Int. PWM generator for analog dimming
- 3000:1 contrast ratio

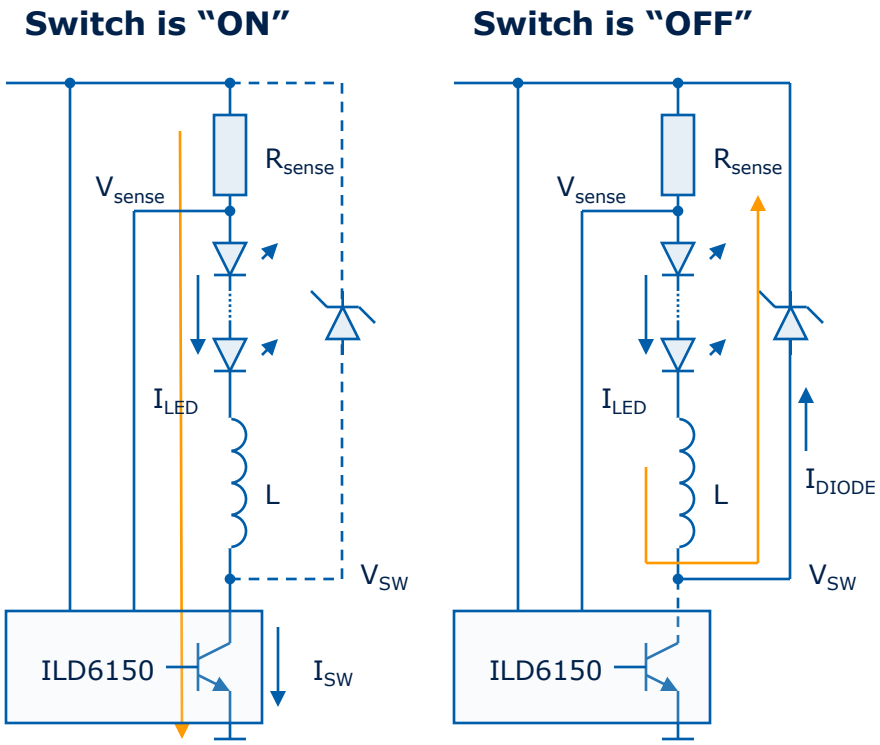
**Protection**

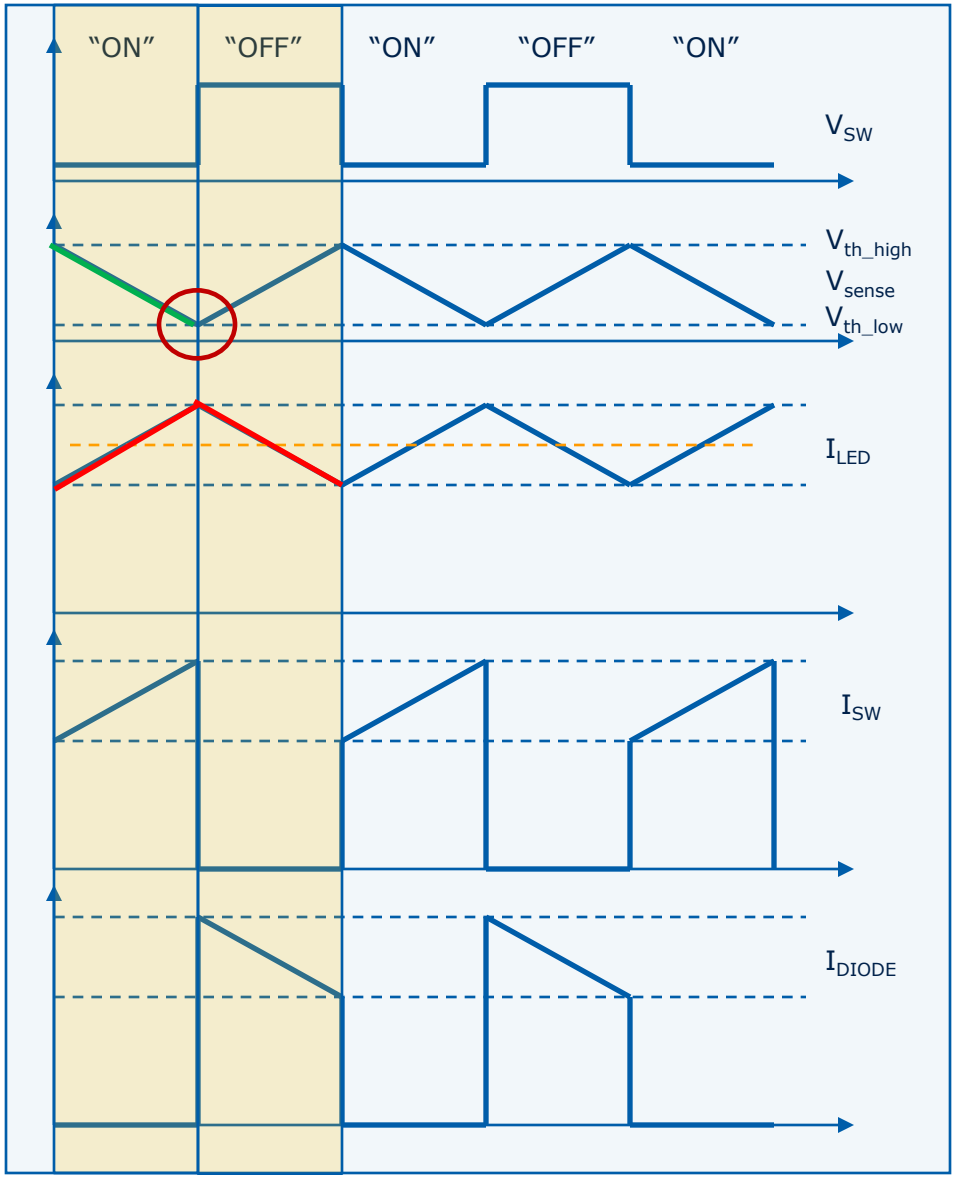
- Adjustable over temperature protection
- Over current protection

# ILD6070 / ILD6150 Typical Application Circuit



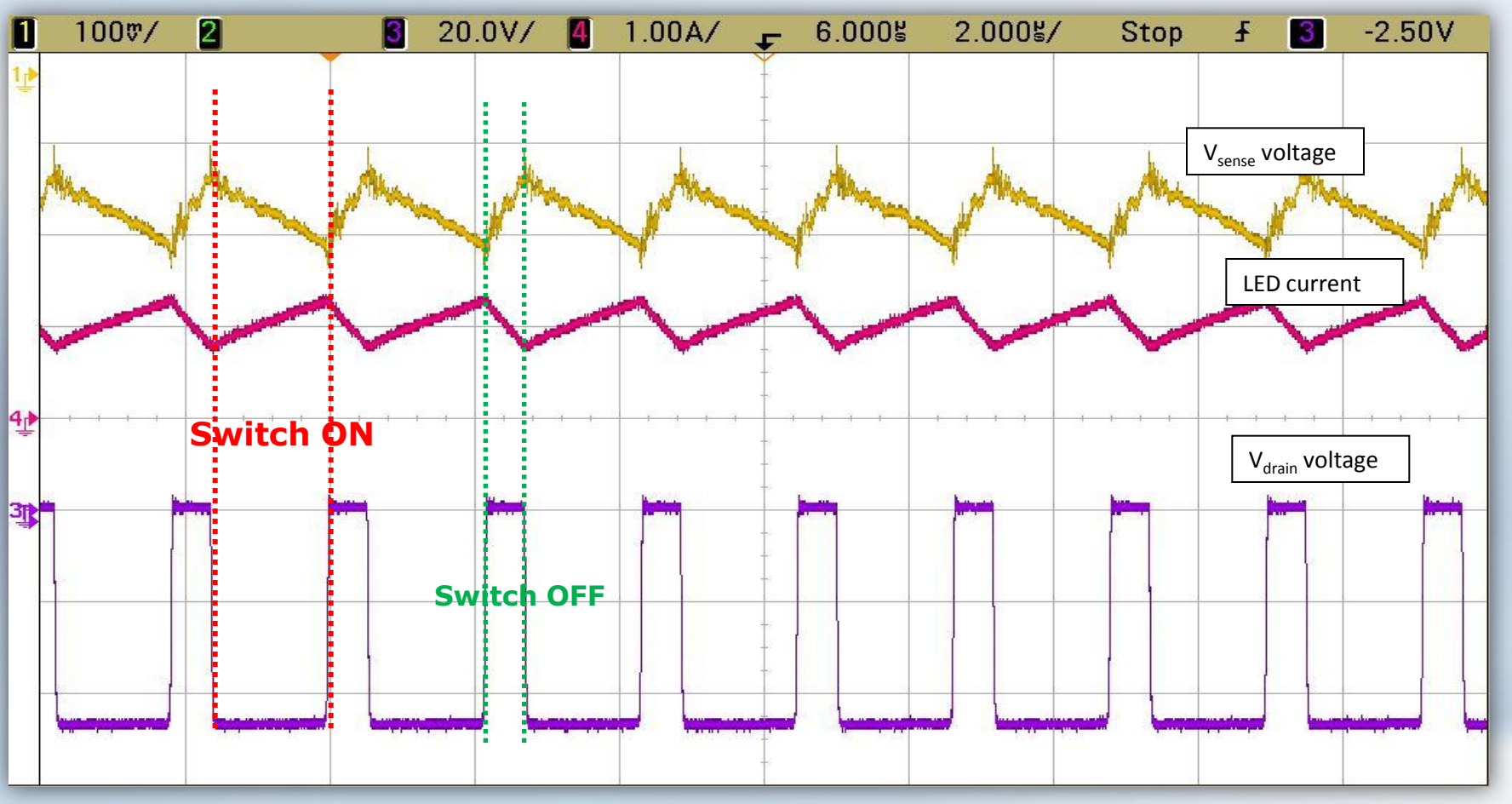
# Hysteretic Buck Driver



# ILD6150 Measurement Results

- Typical signal waveform




- Frequency = 467 kHz, Duty = 73.8%

# Power losses of switch mode driver

- The efficiency of the switch mode driver is known to be better than linear mode driver. This is due to if the voltage drop on the linear driver is higher, the power loss is larger.

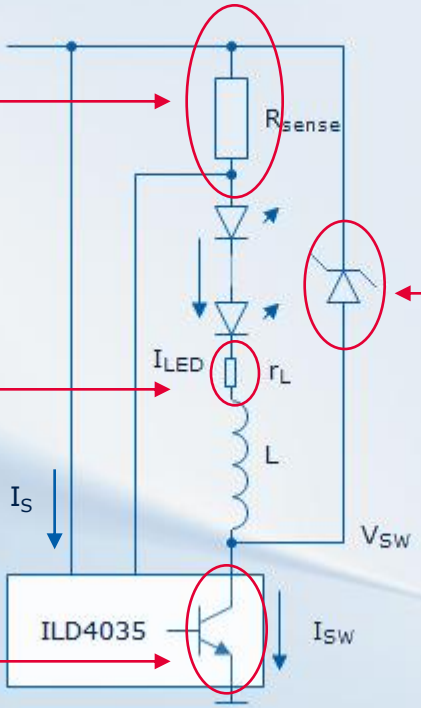
$$P_{Rsense} = I_{LED}{}^2 \times R_{sense}$$

$$P_{r_L} = I_{LED}{}^2 \times r_L$$

$$P_{IC} = V_S \times I_S$$

$$P_{SW} = \left(\frac{1}{2} \times (V_s + V_T)\right) \times I_{LED} \times t_{fall} \times freq$$

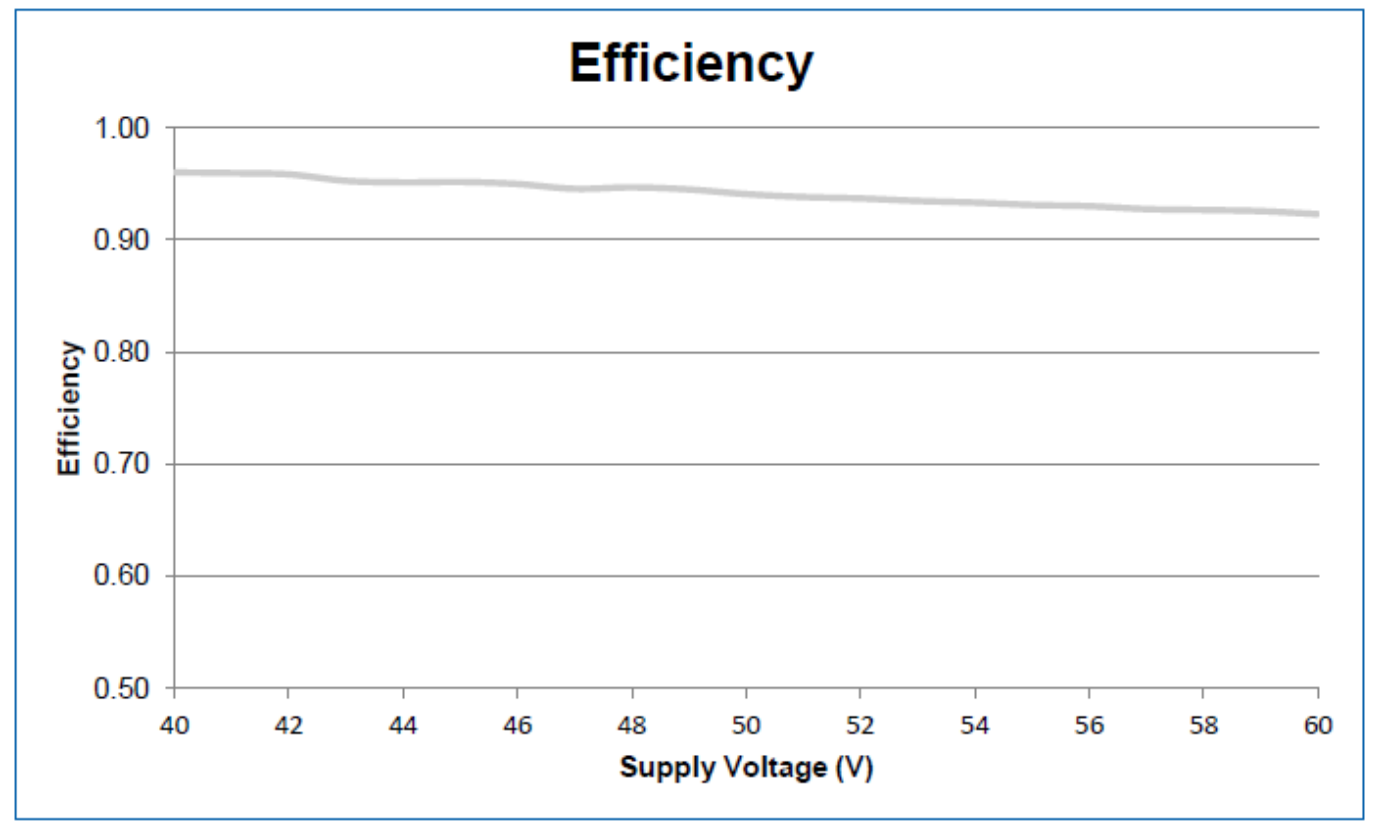
$$P_{TR} = V_T \times I_{LED} \times D_{ON}$$




$$P_{DIODE} = V_{DIODE} \times I_{LED} \times (1 - D_{ON})$$

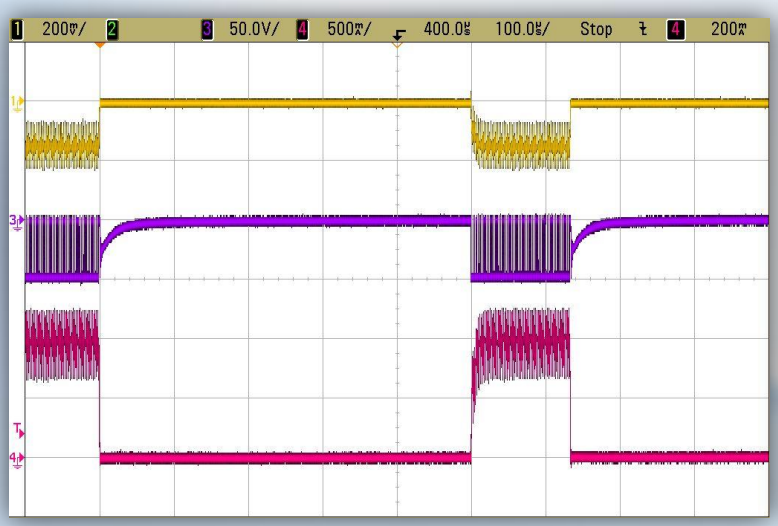
# ILD6150 Measurement Results

- Efficiency
  - Efficiency figure shows total efficiency of the application board including losses of external components as inductor and Schottky diode.

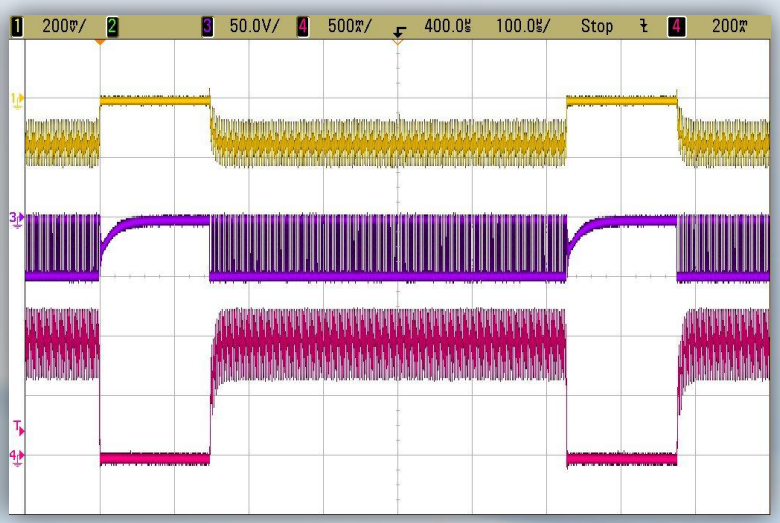


# ILD6150 Measurement Results

- Analog Dimming
  - The analog DC voltage is converted to a 1.6 kHz PWM signal modulating the LED current.
  - Linear range of analog dimming : 0.67 V ~ 2.43 V




Output waveform at $V_{PWM}$ = 1 V




Output waveform at $V_{PWM}$ = 2 V

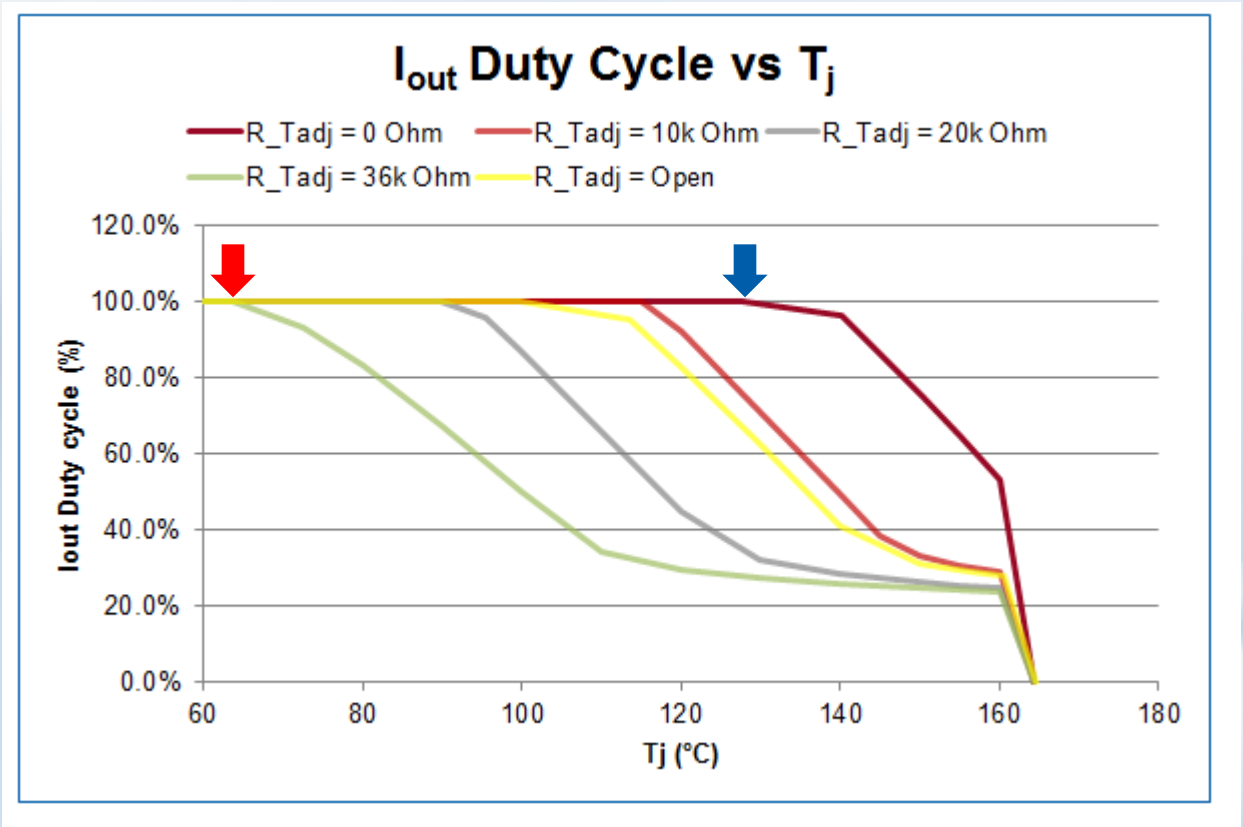
$V_{sense}$ voltage

$V_{drain}$ voltage

LED current

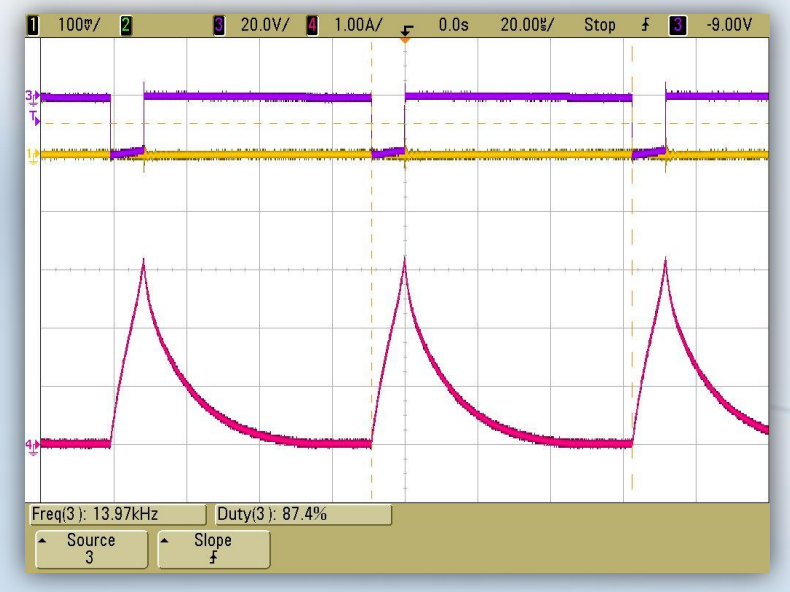
# ILD6150 Measurement Results

- Over Temperature Protection
  - ILD6150 feature with an integrated OTP will reduce the current by internal PWM modulation once the junction temperature of the IC is exceeded.



# ILD6150 Measurement Results

- Over current protection
  - The ILD6150 feature with over current protection where the current threshold is 2.5 A. The MOSFET will be turned off for 60 us when OCP is triggered.
  - Waveforms below shows the OCP in operation when the $R_{sense}$ is shorted and the LED load replaced by a 3 Ω resistive load.




$V_{drain}$ voltage

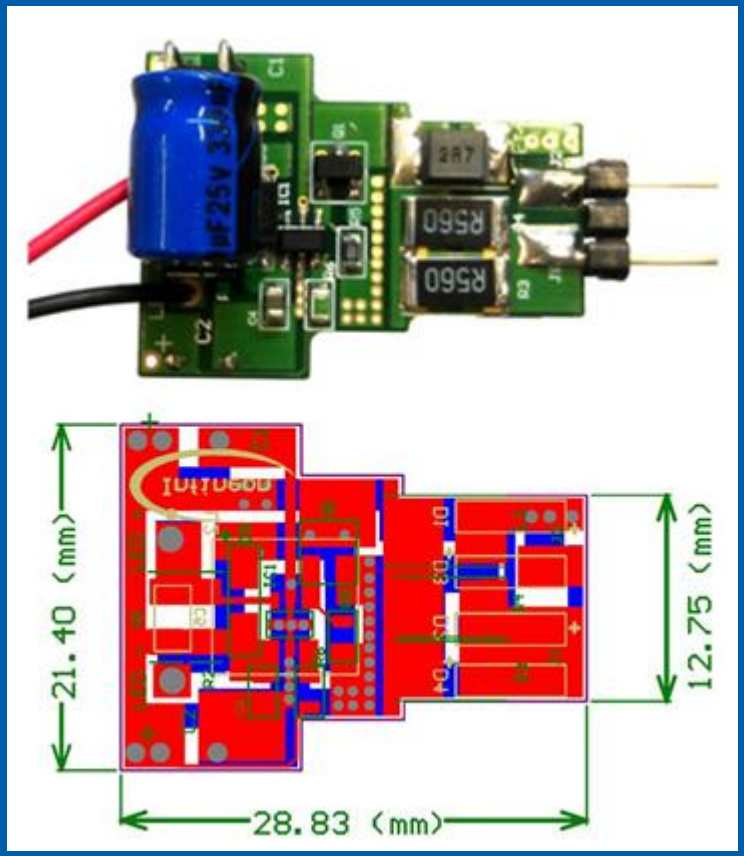
$V_{sense}$ voltage

LED current

# INDEX

# ILD4001

## Demo board




Recommended MOSFET BSR 302N (30V, SC59), BSP 318S (60V, SOT223)

Operation — Step-down topology

Flexibility — Wide input voltage range from 4.5V – 40V

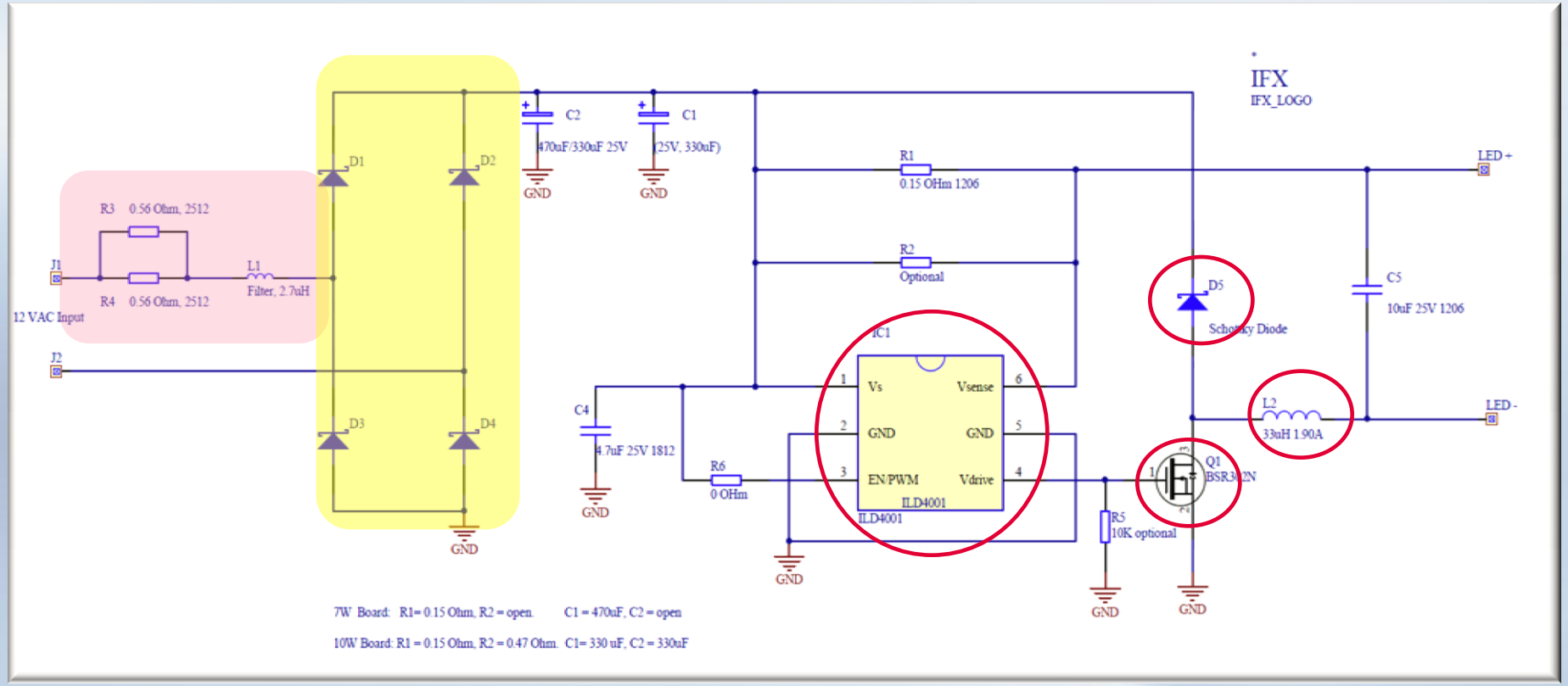
Output current — Scalability from 10mA – 3.000mA easily allows replication to new designs

Efficiency — DC/DC efficiency up to 98%

Dimming — Choice of dimming concept: Analog or digital

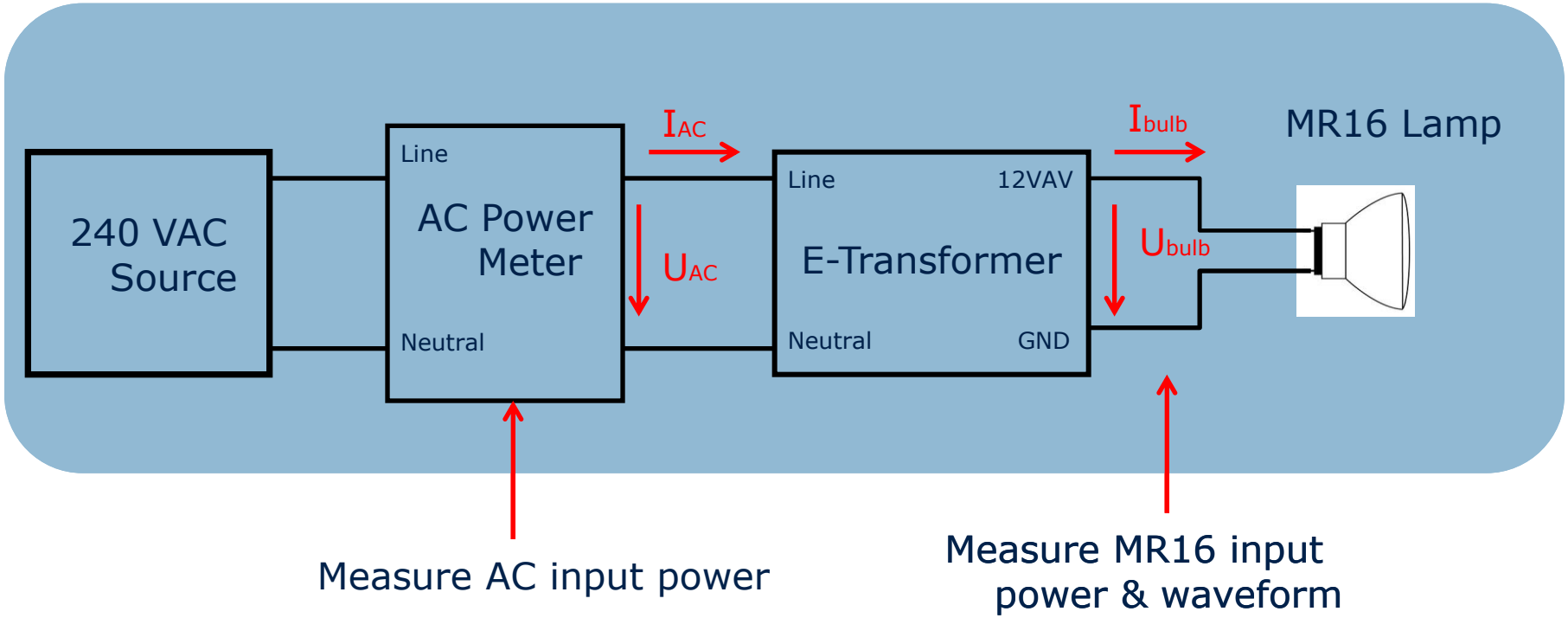
Protection — Thermal protection

# MR16 solution Circuit



# MR16 Test Condition

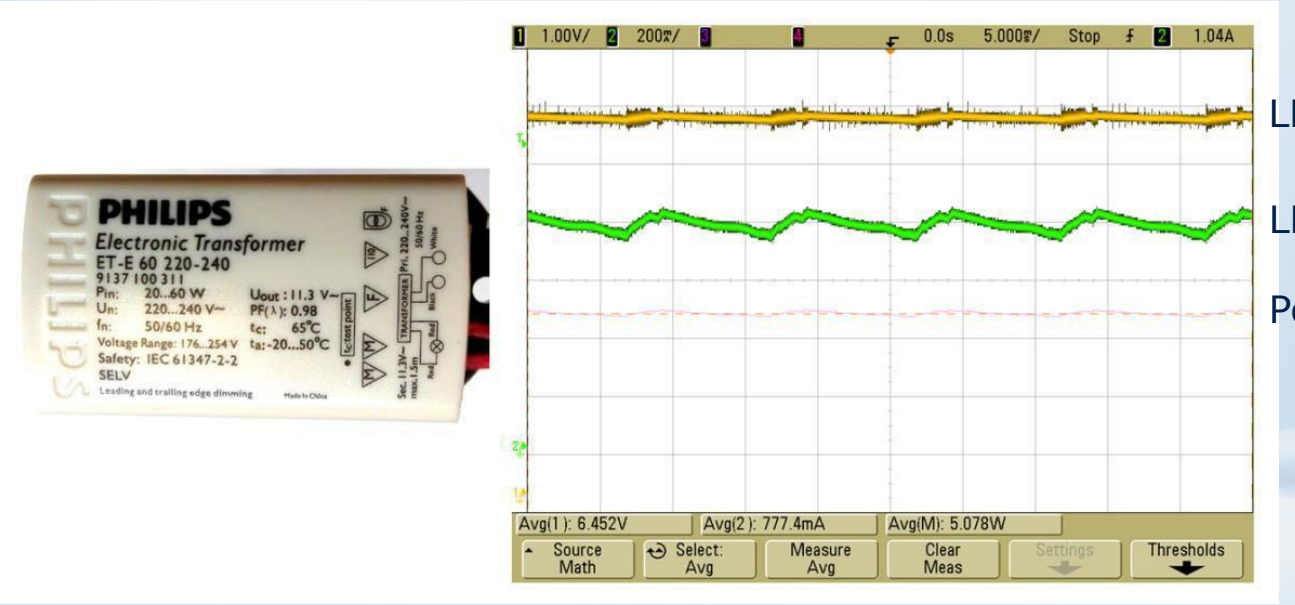
## Test setup



# E-transfomer compatibility

**7 W board measurement results with Philips ET-E60.**

| Input voltage to electronic transformer | 230 $V_{AC}$ |
|---|---|
| Vf(avg) | 6.45 V |
| ILED(avg) | 777 mA |
| Pin | 6.94 W |
| Pout | 5.08 W |
| Efficiency | 73.2 % |

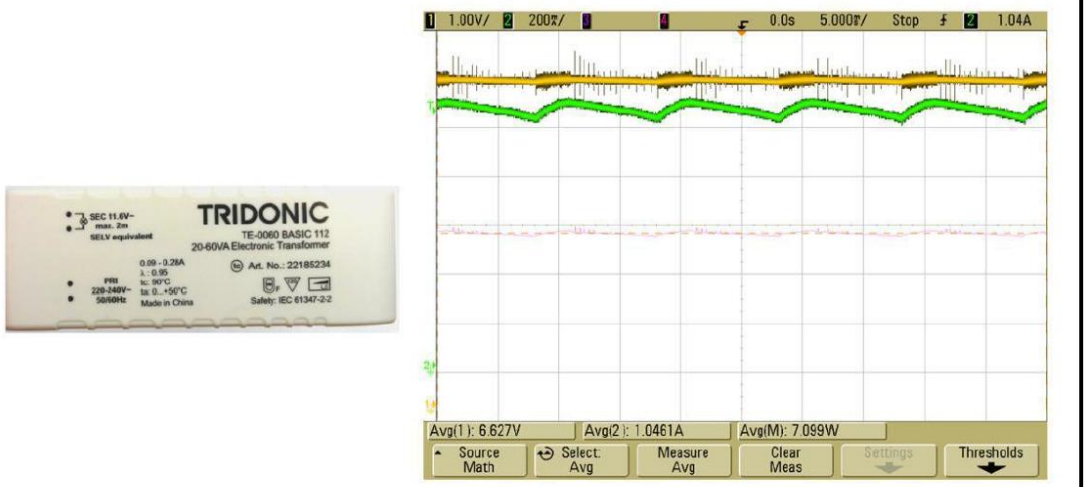



**Output waveform for the 7 W MR16 board driven by Philips ET-E60.**

# E-transfomer compatibility

**10 W board measurement results with Tridonic TE0060.**

| Input voltage to electronic transformer | 230 $V_{AC}$ |
|---|---|
| $V_{f(avg)}$ | 6.63 V |
| $I_{LED(avg)}$ | 1.05 A |
| $P_{in}$ | 9.8 W |
| $P_{out}$ | 7.1 W |
| Efficiency | 72.4 % |



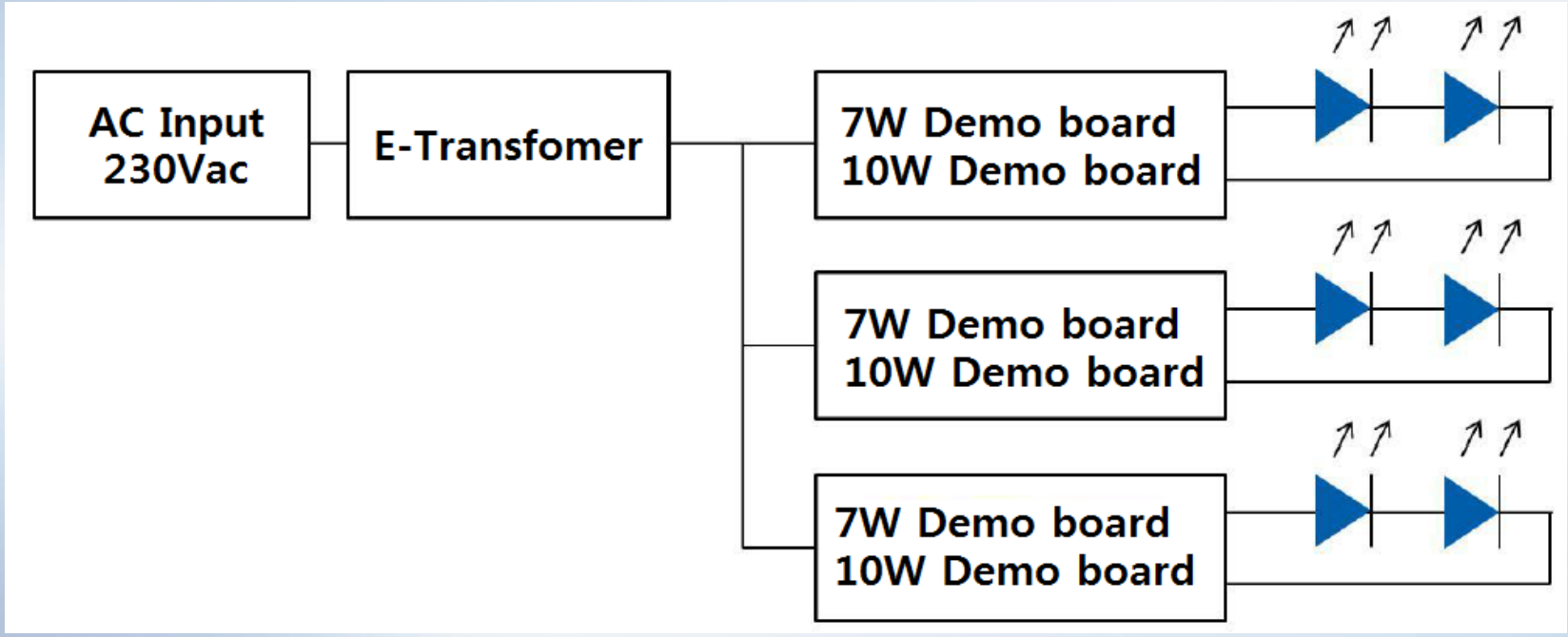

LED Vf

LED If

Pout

**Output waveform for the 10 W MR16 board driven by Tridonic TE0060.**

# E-transfomer compatibility

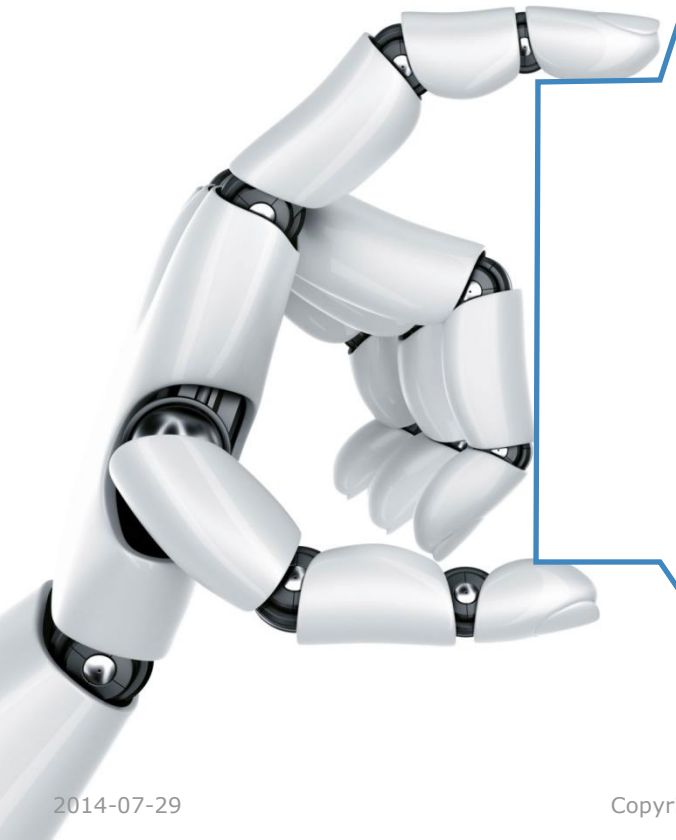



**Electronic transformers list**

| E- transformer Model | 7 W MR16 | 10 W MR16 |
|---|---|---|
| Philips ET-E60 | 1 | 1 |
| Osram ET-A60 | 1 | 1 |
| Osram HTM 105 | 1,2 or 3 | 1 or 2 |
| Tridonic TE-0060 | 1 | 1 |

# INDEX

# Summary



1. Infineon's **48W Flat panel & MR16 solution** enable customers to reduce development cycle with high performance.

2. **ILD6xxx** series can support the highest dimming performance & efficiency and long life time of LED with Slope current reduction.

3. Infineon offers an **innovative products portfolio** of general lighting.

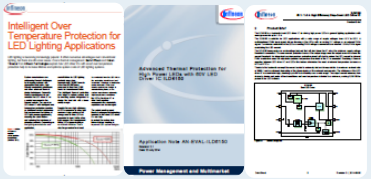
# Support Material LED Lighting

## LED Lighting

- Application Brochure
- Application Examples
- Application Notes

- www.infineon.com/cms/en/product/applications/lighting/led-lighting/

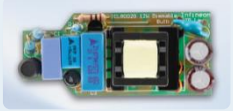
## Technical Material




- Products + Datasheets
- Simulation Models
- PCB Design Data
- App Notes, White Paper

- www.infineon.com/lowcostleddriver
- www.infineon.com/ledoffline
- www.infineon.com/led.documents

## Evaluation Boards



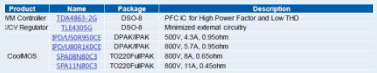
- Evaluation Boards
- Reference Designs

- www.infineon.com/led.evalboards
- www.infineon.com/led.appnotes


- LED Driver Online Design Tool

- www.infineon.com/lightdesk

## Selection Guide



- Selection Guide

Selection guide

# 감사합니다.

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# ENERGY EFFICIENCY
# MOBILITY
# SECURITY

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