CoolMOS™ CE and LED driver ICs The ideal combination from LED tubes to LED drivers

Eva Gabriel (IFAT PMM ACDC HVC PM)
Stefan Preimel (IFAT PMM ACDC AE)

Today’s topics

1. Introducing CoolMOS™ CE
2. High voltage solutions for LED Lighting
3. Latest Infineon demoboards

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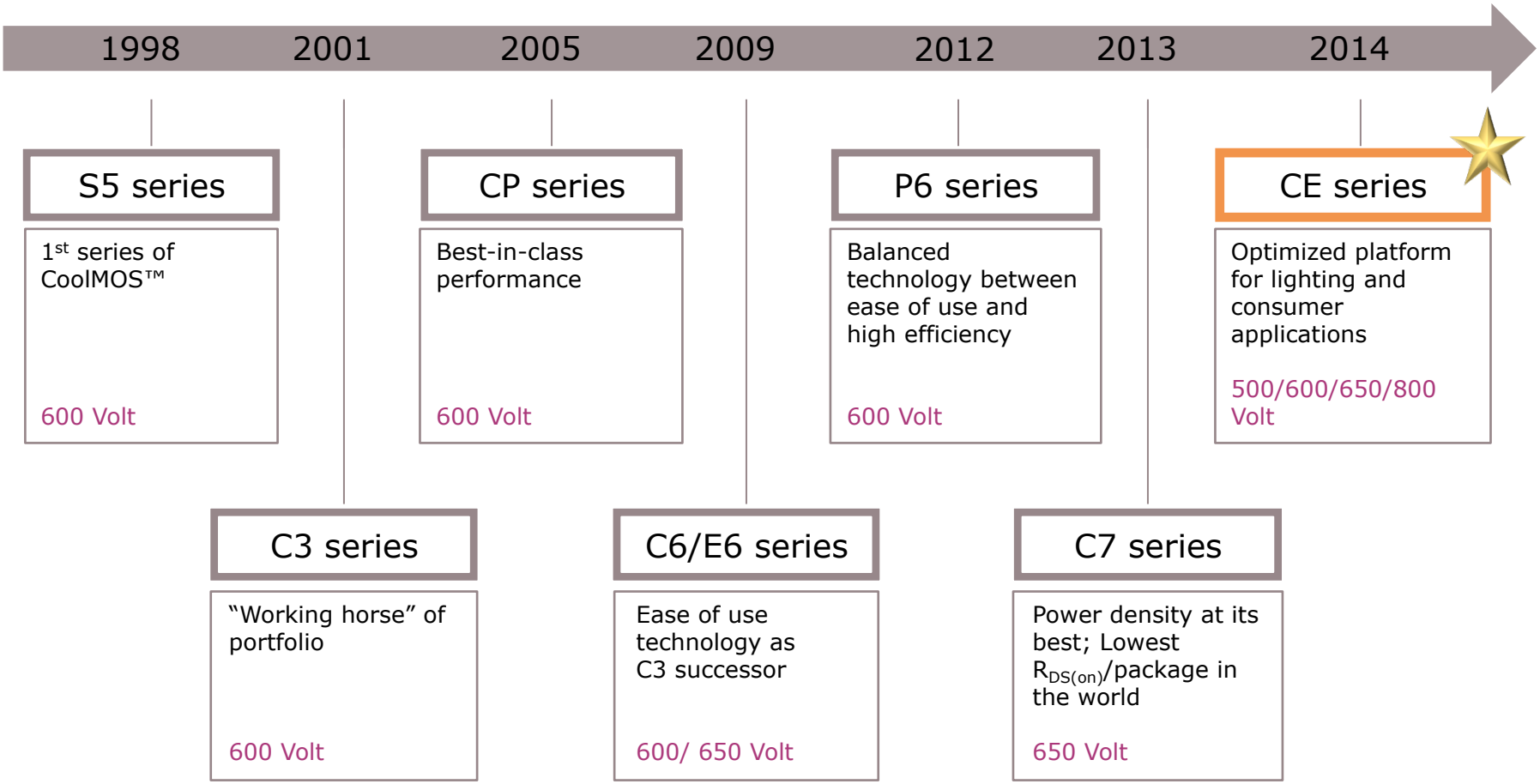
Infineon as the inventor of superjunction has long-standing experience for the last 15 years

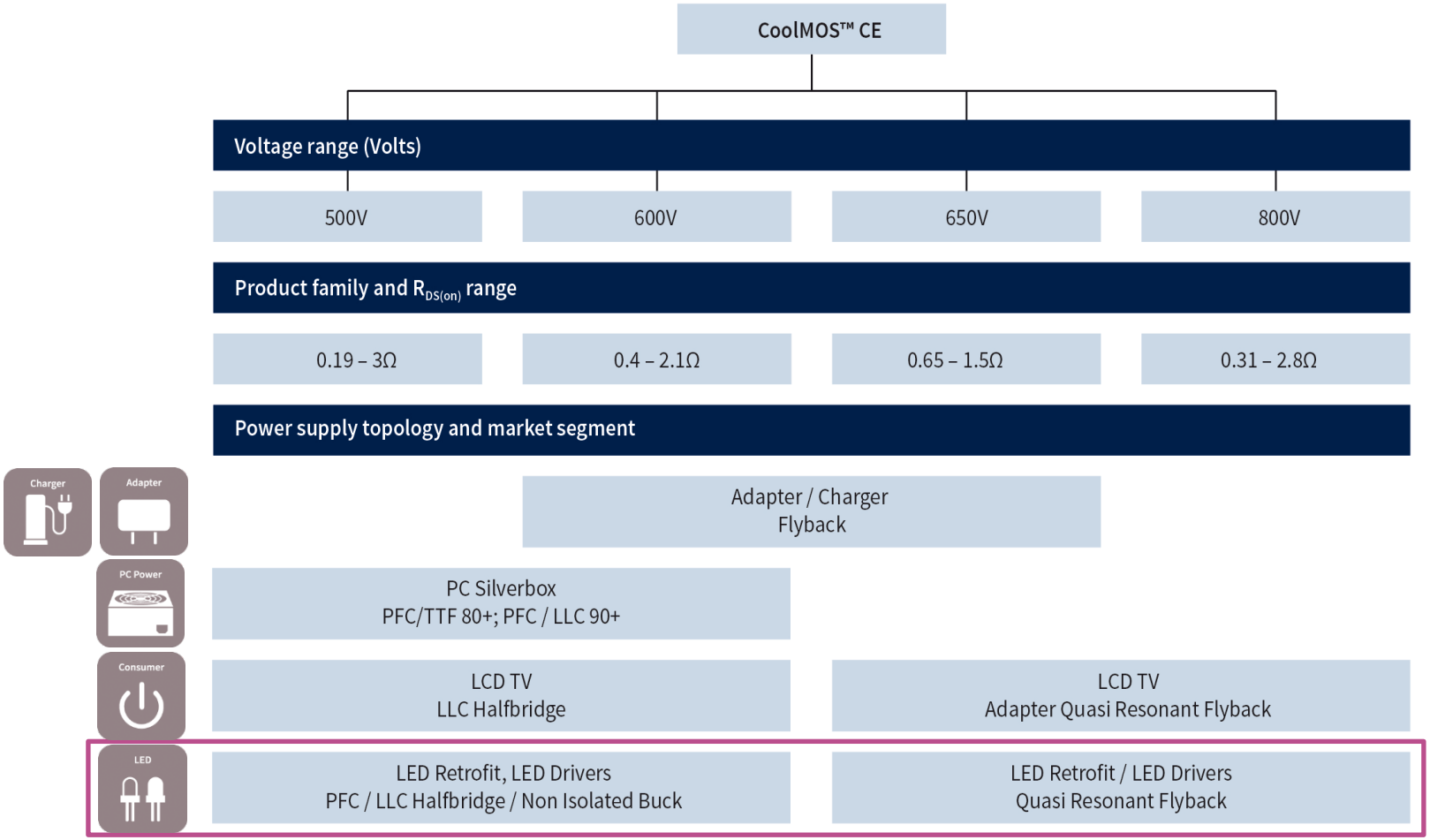


Superjunction technology at the price of a planar MOSFET

Why CoolMOS™ CE ?

- **Superjunction device** (SJ): as such it delivers low conduction and switching losses, improves efficiency and ultimately reduces power consumption
- **Broad portfolio**: 500V, 600V, 650V and 800V devices available, ideally fitting LED lighting, LCD/ LED TV and many other low power chargers, adapters, power tools applications
- **Attractive price position:** with no compromise on proven CoolMOS™ quality and reliability
- **Flexibility:** suitable for hard and soft switching applications
- **Fast design-in:** ease of use enables customers to reduce the design in cycle and compete in dynamic markets

CoolMOS™ CE targets a broad range of price-driven applications



Top 7 reasons for choosing Infineon beyond product performance

Benefits	Provided by our CE solution…
1 Product Portfolio	› We own a broad portfolio covering 4 voltage classes in both TH and SMD packages and exceed by **3 times** our closest competitor
2 Capacity	› We own the world's largest capacity for power devices, with **3** dedicated frontends and **4** backends › We secure supply during market upswing
3 Lead times	› We understand **lighting** market's dynamics and offer **≤ 6 weeks** lead time
4 Delivery performance	› Our CSD performance is constantly **≥ 95%**
5 Quality	› Our field failure rates are on average < **0.2 PPM***
6 Price competitiveness	› With full implementation in 300 mm we gained economy of scale and improved our cost structure
7 Design-in support	› We have a large field application engineering team to provide professional & flexible support for your design

Note: *1 PPM = 1 failure per 1 Million pcs shipped

Why buy from Infineon: our production network secures your supply security

300mm

Infineon CoolMOS™
3 frontend sites and 4 backends
to ensure capacity to our customers
and support growth during market upswing

Dresden

Kulim

TSHT

ASE

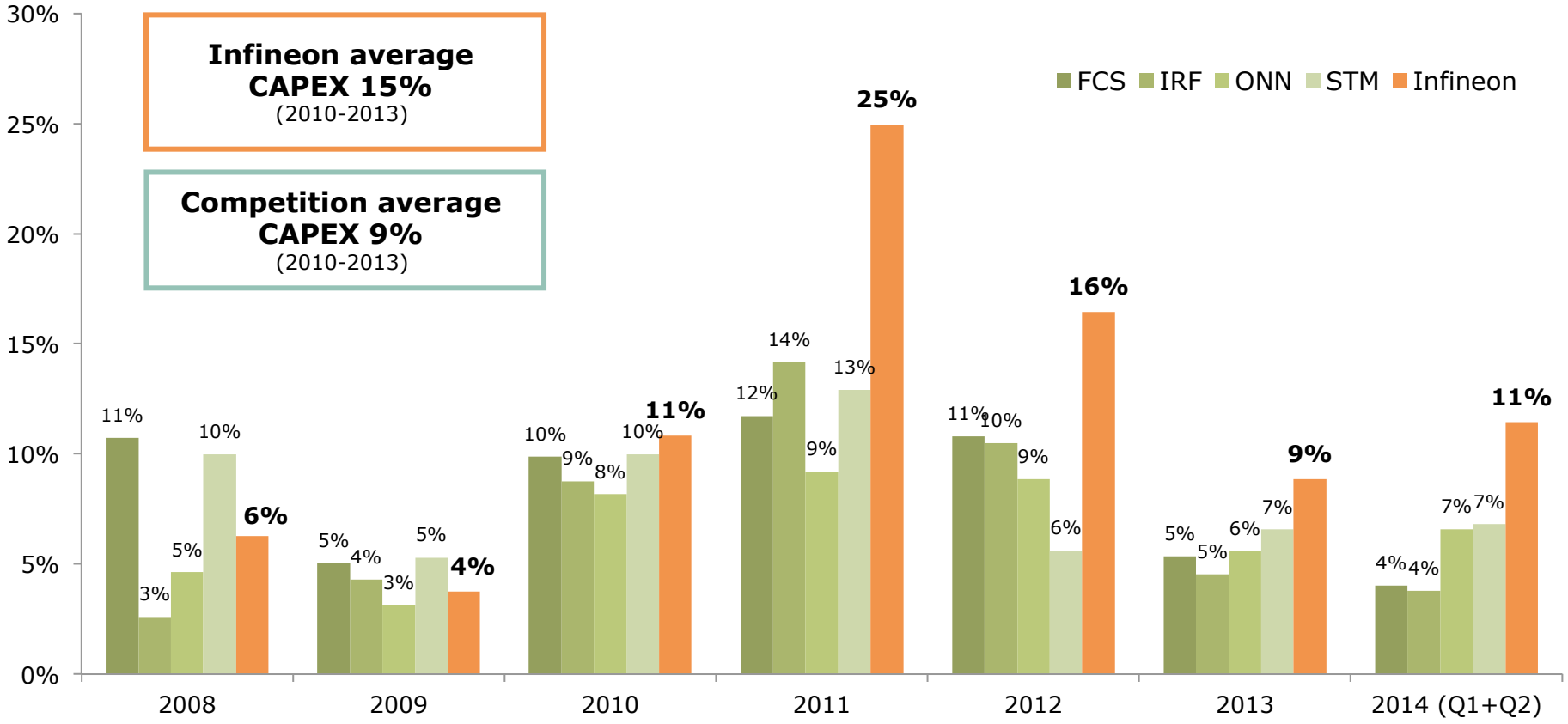
Villach

Malacca

Nantong

Frontend Backend

Infineon leads investments in power semi capacity



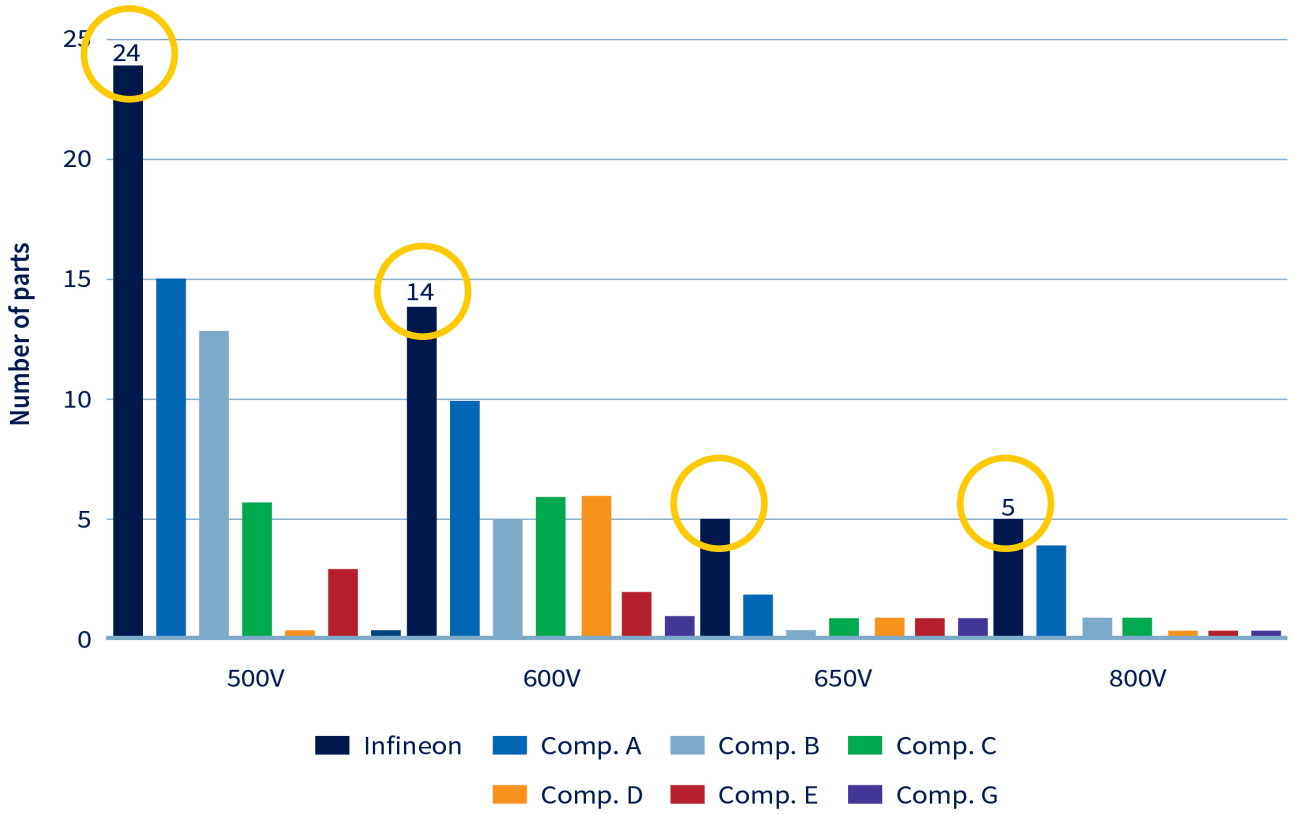
› **Infineon continues to lead in CAPEX investments** supporting power semiconductor growth rates

› We secure supply to our strategic customers and partner for mutual growth

Source: IHS Power Discrete & Module Market Report 2013 & 2014;
Internal Industry Data Base based on Competitors reports

Infineon provides the broadest CoolMOS™ portfolio for consumer and lighting applications

CoolMOS™ CE is available in 4 voltage classes and 6 packages providing highest design flexibility to our customers



Note: *Portfolio status November 2014

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ICL8201 buck controller with high power factor for LED tubes

Application

› Retail

› Residential

Operation

- Primary side controlled constant current
- High power quality PF> 0.90,THD <20%
- Avg. output current max. 500 mA

Efficiency

- Highest efficiency up to 90% by quasi-resonant operation with valley detection

Flexibility

- IC concept supports single inductors without aux winding
- Advanced cascode topology eliminating the need for a HV cell at universal input

Input

- Supports universal input from 90 – 305 Vac
- Operate both at AC and DC input

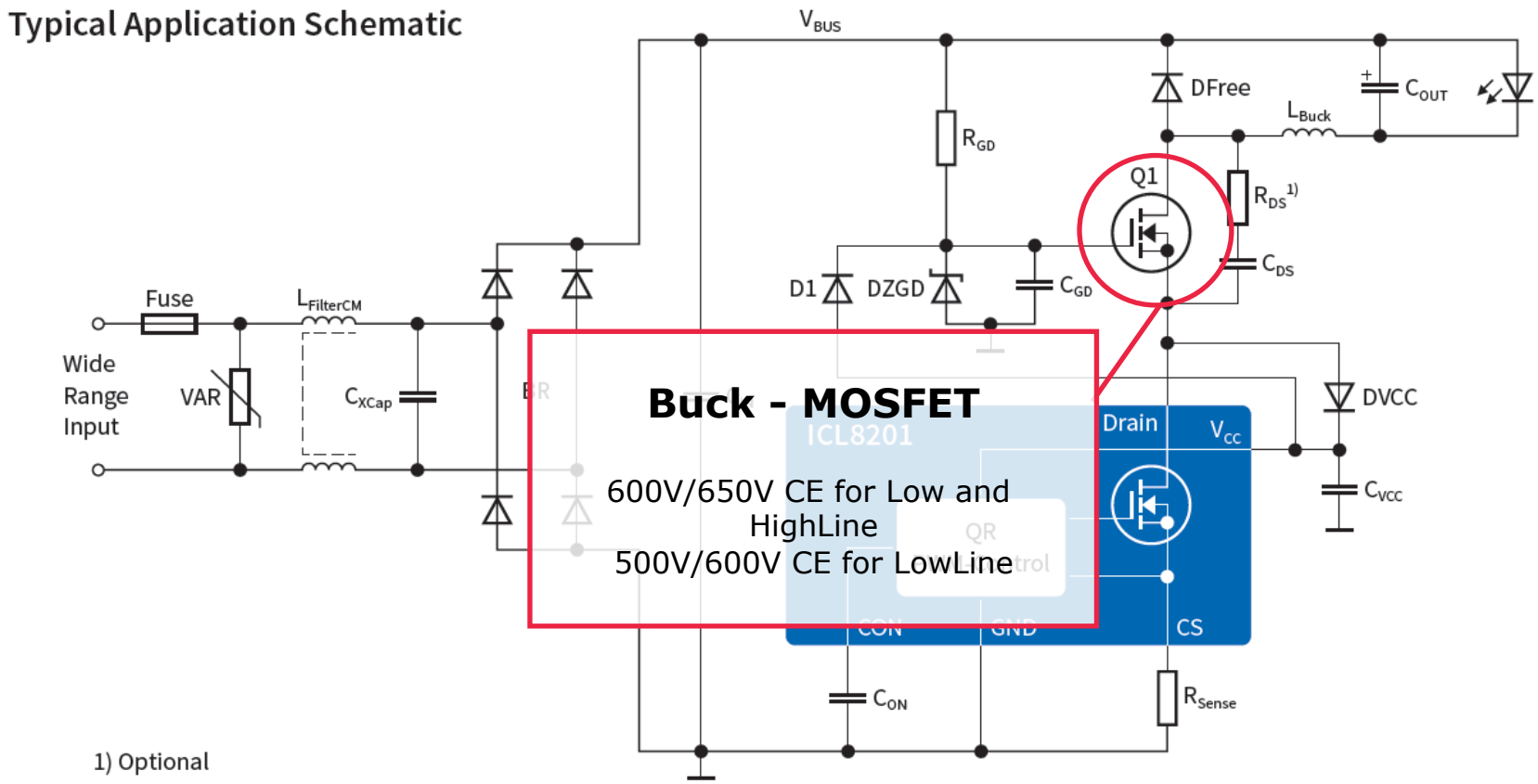
Protection

- Full set of protection features
- Intelligent over temperature protection
- Voltage transient compensation

Cost

- Minimum external components required supporting small form factors
- Designed for lowest cost

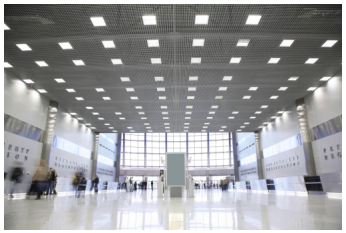
Non-dimming ICL8201 reference application circuit



* 500V CE can be used in some cases

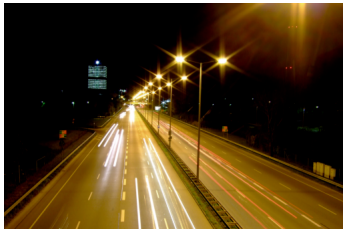
ICL5101
ACDC 2-stage PFC and LLC or LCC controller

Application



› Industrial

› Office



› Outdoor

Operation

- Secondary side CV or CC control
- PFC:
  CCM mode during nominal load
  DCM mode in light load down to 0.1%
  operation without audible noise
- Self-adaptive HB dead time of 500…1000 ns
- High power quality with **PF> 0.96,THD <10%**

Efficiency

- Highest efficiency up to **94%** by resonant topology
- Low quiescence current of 130 µA during startup and failure mode

Flexibility

- **Allows dimming down to 0%**
- PFC/LLC combo IC allows best matching of PFC stage and LLC stage timing control

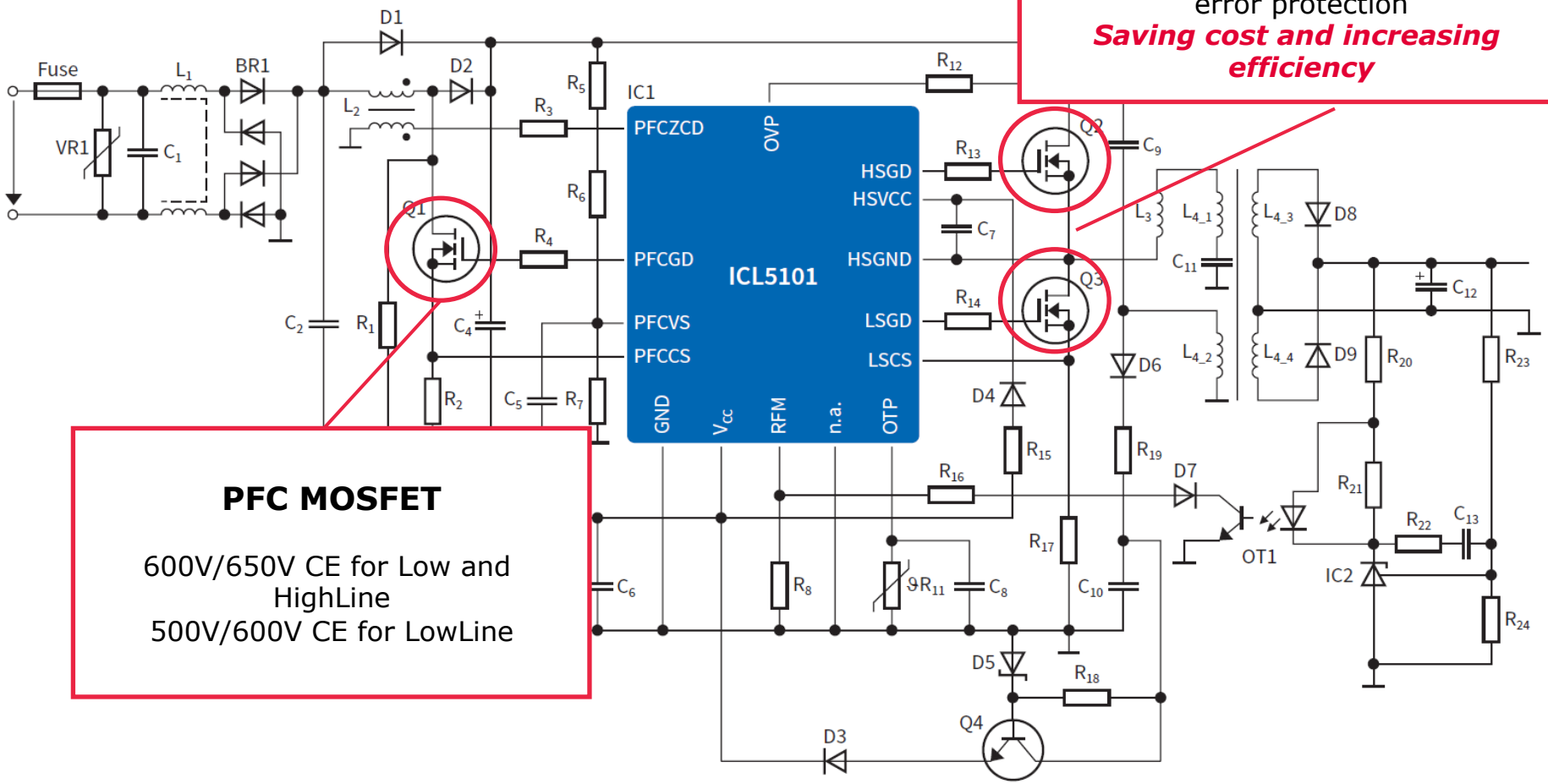
Input

- Supports **universal input from 80 – 325 V**
- Ultra fast time to light <100 ms

Protection

- Thermal protection with external PTC
- Soft-start capability
- Short winding protection
- Short load protection
- Dimmer safe operation
- Overvoltage and open loop protection
- Under voltage lockout

ICL5101
2-stage PFC and resonant controller



ICL8105 offers high performance features in combination with convenient digital configuration

Application

› Retail

› Industrial

› Office

Input

- Universal AC 85 – 305 VAC or DC input voltage
- Integrated 600 V cell for fast startup

Operation

- High primary side controlled output current constant accuracy
- High power quality (typ. PF >0.90 and THD <10%)
- Wide output voltage range to light up all type of LED loads

Efficiency

- Efficiency up to 91%

Dimming

- Support of isolated 0-10V dimming
- Extended dimming range
- Adjustable dimming curve (linear, non-linear)

Configure

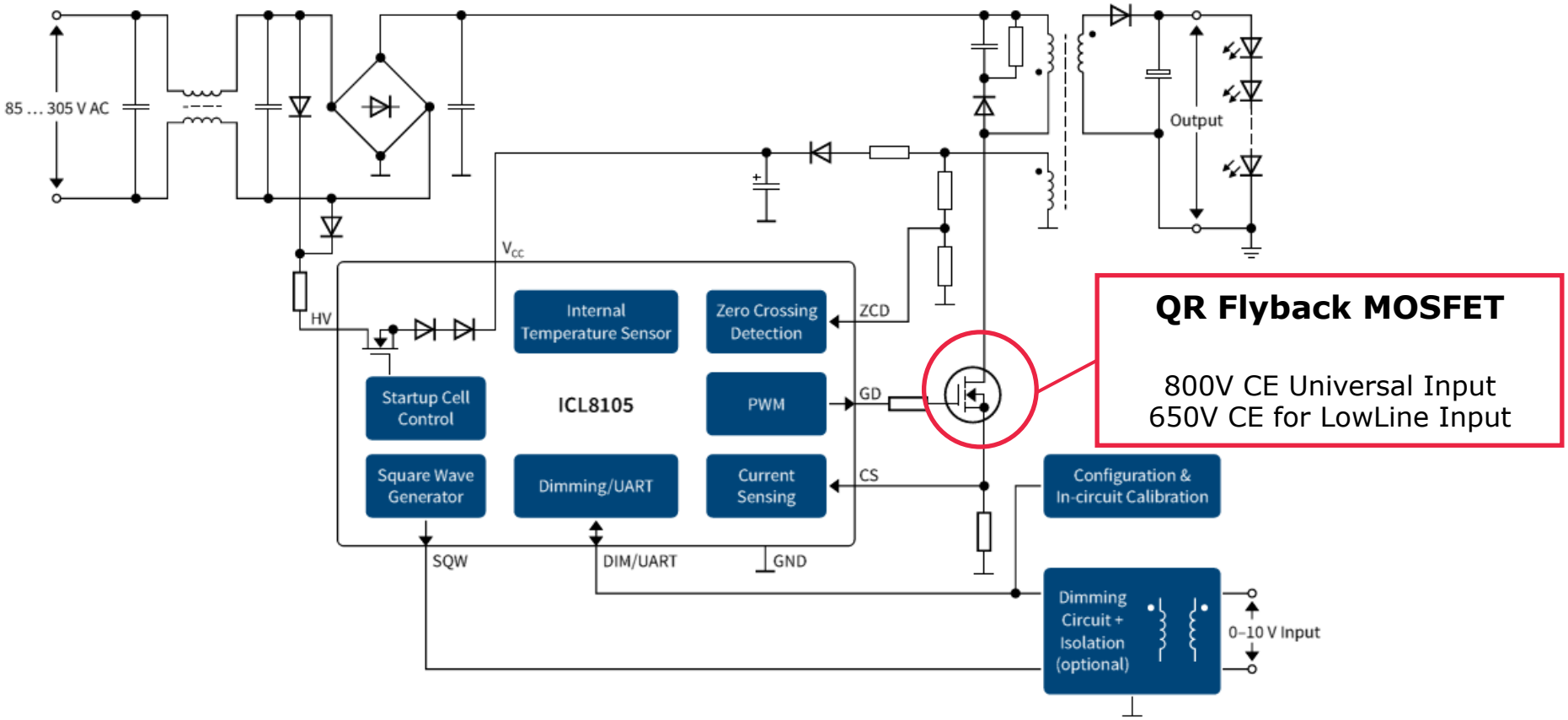
- Digital parameter configuration with convenient GUI tool .dp vision
  Hardware configuration, output current protections, temperature handling, startup & shutdown, dimming, power factor correction, operation fine tuning

Protection

- Fully configurable protection modes
- Intelligent thermal management

Small BoM due to smart system partitioning

› With its integrated functionality the ICL8105 enables an increased set of features with a minimum of external parts



Recommendations for PFC applications

	$R_{DS(ON)}$ [mΩ]	 TO-220 FullPAK	 TO-252 DPAK	 TO-251 IPAK
600V	2100		IPD60R2K1CE	IPU60R2K1CE
	1500		IPD60R1K5CE	IPU60R1K5CE
	1000		IPD60R1K0CE	IPU60R1K0CE
	800	IPA60R800CE	IPD60R800CE	
	650	IPA60R650CE	IPD60R650CE	
	460	IPA60R460CE	IPD60R460CE	
	400	IPA60R400CE	IPD60R400CE	

	$R_{DS(ON)}$ [mΩ]	 TO-220 FullPAK	 TO-252 DPAK	 TO-251 IPAK SL
650V	1500			IPS65R1K5CE
	1000			IPS65R1K0CE
	650	IPA65R650CE	IPD65R650CE	

› Suitable as well for QR Flyback with LowLine Input and buck topology with universal/wide range input.

Recommendations for high power LLC topologies

	$R_{DS(ON)}$ [mΩ]	 TO-220 FullPAK	 TO-252 DPAK	 TO-220	 TO-247	 TO-251 IPAK
500V	3000		IPD50R3K0CE			IPU50R3K0CE
	2000		IPD50R2K0CE			IPU50R2K0CE
	1400		IPD50R1K4CE			IPU50R1K4CE
	950	IPA50R950CE	IPD50R950CE			IPU50R950CE
	800	IPA50R800CE	IPD50R800CE			
	650	IPA50R650CE	IPD50R650CE			
	500	IPA50R500CE	IPD50R500CE	IPP50R500CE		
	380	IPA50R380CE	IPD50R380CE	IPP50R380CE		
	280	IPA50R280CE	IPD50R280CE	IPP50R280CE	IPW50R280CE	
	190	IPA50R190CE		IPP50R190CE	IPW50R190CE	

- Suitable as well for buck topology with universal/ wide range input.

Recommendations for mid & low power QR flyback topologies

	$R_{DS(ON)}$ [mΩ]	 TO-220 FullPAK	 TO-252 DPAK	 TO-251 IPAK
800V	2800		IPD80R2K8CE	IPU80R2K8CE
	1400	IPA80R1K4CE	IPD80R1K4CE	IPU80R1K4CE
	1000	IPA80R1K0CE	IPD80R1K0CE	IPU80R1K0CE
	650	IPA80R650CE		
	460	IPA80R460CE		
	310	IPA80R310CE		

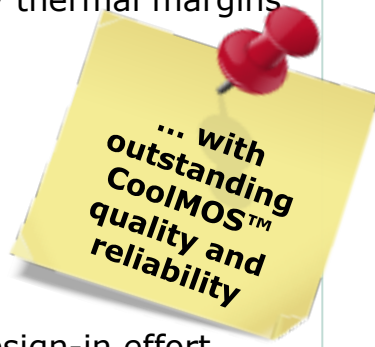
CoolMOS™ CE

CoolMOS™ CE is an optimized platform addressing and meeting customers needs

Customer concerning factors in low power	*CoolMOS™ value proposition (600 V and 650 V for flyback)*	*Customer benefits*

› Thermal behavior
  › ≤ 90°C on device, open case
  › ≤ 50°C/70°C closed case temperature
	› Low conduction losses from large margin between $R_{DS(on)}$ typical to nominal	› High efficiency and consequent reduction of power consumption within large safety thermal margins

	› Low switching losses from optimized output capacitance (E_{oss})	
› EMI within EN55022B standard	› Optimized EMI to balance switching speed and EMI behavior	› Reduced design-in effort
› Ease of use and fast design-in	› Good controllability given the integrated R_g	› Reduced design-in effort



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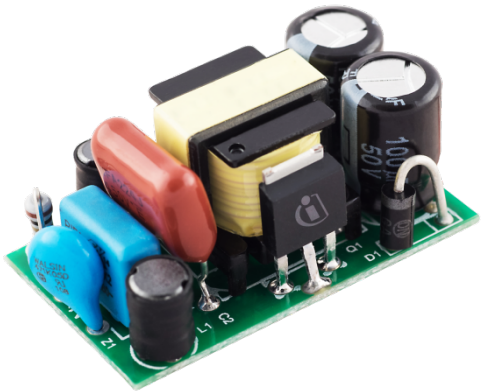
ICL8201 demoboard with 500 V CoolMOS™



› GU10 Solution

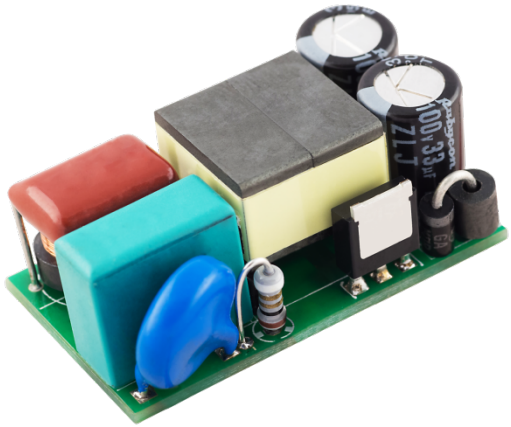
› Products

Parameter	Value
Input Voltage	90 Vac – 265 Vac
Frequency	50 Hz/60 Hz
Power Factor	>0.95@low line
	>0.80@high line
THD	<20%@low line
	<30%@high line
Efficiency	85%
Output Voltage	33 Vdc – 47 Vdc
Output Current	180 mA
Output Power	7.5 W

› Specification

› Infineon Order Code: EVALLEDICL8201F1 / SP001339448

ICL8201 demoboard with 650 V CoolMOS™



› T8 LED (Single End Cap)

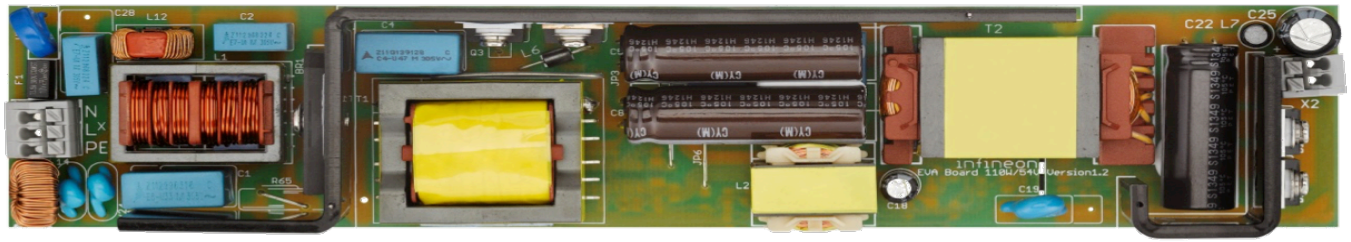
› Products

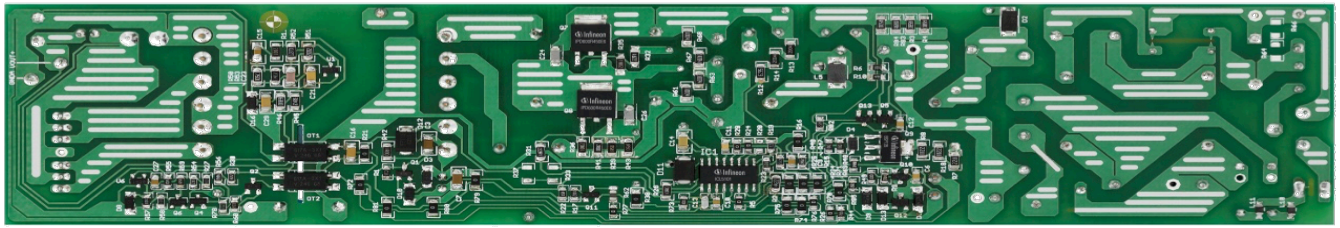
Parameter	Value
Input Voltage	170 Vac-277 Vac
Frequency	50 Hz
Power Factor	>0.95
THD	<20%
Efficiency	>90%
Output Voltage	55 Vdc-75 Vdc
Output Current	270 mA
Output Power	18 W

› Specification

› Infineon Order Code: EVALLEDICL8102F2 / SP001339450

ICL5101 demoboard with 600 V CoolMOS™





Parameter	Value	Unit
Input Voltage	85 – 305	Vac
Output Voltage	54	Vdc
Output Current	2060	mA
Output Power	110	W
Efficiency	~ 94	%
Power factor	> 99	%
THD	< 10	%
TAmbient	80 -100	°C

- Special surge protection with auto restart functionality allowing 500 V MOSFETs in HB instead of 600 V

- Infineon Order Code: EVALLEDICL5101E1 / SP001296078

ICL8105 demoboard with 800V CoolMOS™

Parameter	Symbol	Value	Unit
Nominal input voltage	V_{in}	90 – 300	V~
Input overvoltage	$V_{in,OV}$	310	V~
Output power	P_o	40	W
Output voltage	V_{out}	15 – 45	V
Output overvoltage threshold	$V_{out,OV}$	50	V
Output current	$I_{out,set}$	880	mA
Efficiency	η	< 91	%
Power factor		> 0.95	
THD		< 16	%

› Infineon Order Code: EVALLEDICL8105F2 / SP001296076

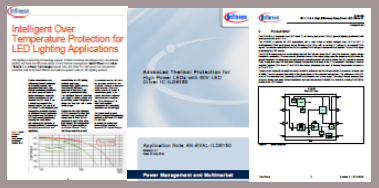
Support Material
LED Lighting

LED Lighting

- Application Brochure
- Application Examples
- Application Notes
- On Demand Webinars

- www.infineon.com/lighting
- www.infineon.com/webinar

Technical Material



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

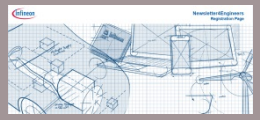
- www.infineon.com/lowcostleddriver
- www.infineon.com/ledoffline
- www.infineon.com/led.documents

Evaluation Boards

- Evaluation Boards
- Demoboards
- Reference Designs

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

Newsletter



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CoolMOS™ Nomenclature Guide