78 W Auxiliary power supply for 22 KW drive using Infineon 1700 V SiC MOSFET

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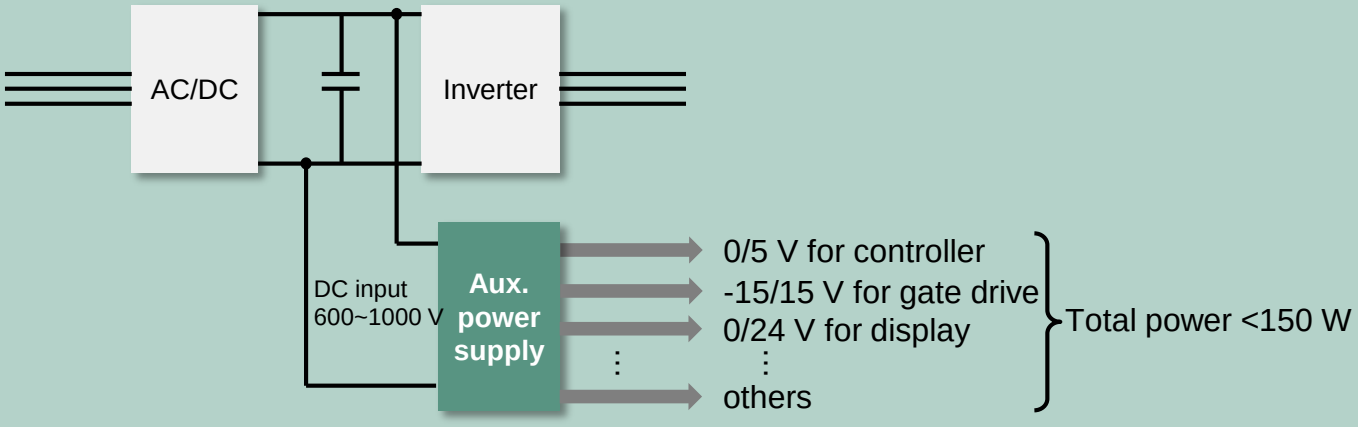
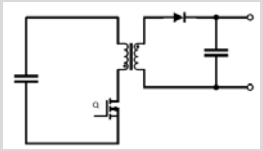
CoolSiC™ MOSFET 1700 V discrete

Auxiliary power supply for:

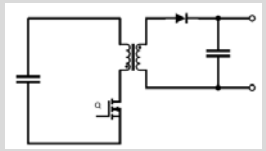


1700 V SiC MOSFET meets the preferred industry practice in low-power auxiliary circuits

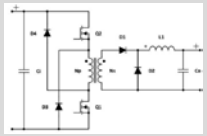
preferred	reality with silicon devices	1700 V SiC simplicity

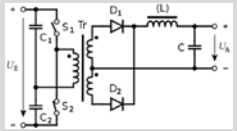


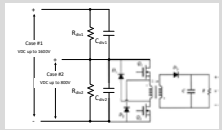
Simple converter
but needs a high V_{DSS} low-loss device
V_{DS} derating margin > 10%



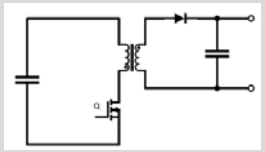
Low efficiency and challenges with **V_{DS} derating margin** limit the use







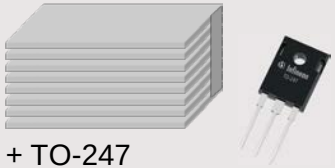
Complex work-around designs for efficiency, V_{DS} derating margin limits the use to $V_{DC} \leqslant$ 800 V systems



Simple converter at high efficiency
Up to V_{DC} 1000 V systems
V_{DS} derating margin up to 15%

CoolSiC™

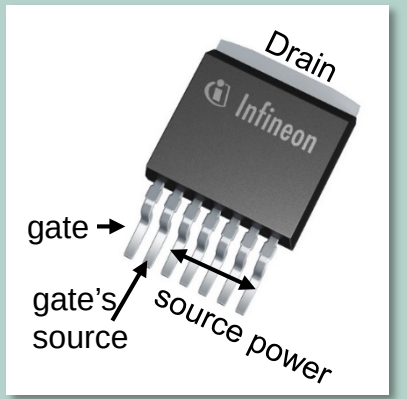
Enabled by 2.5% higher efficiency vs. silicon - SMD package simplifies the main switch assembly

DC/DC flyback converter	Main switch assembly	Remarks
Single-switch in SMD	 TO-263-7 extended creepage version	SMD soldering, thermal vias in PCB
Single-switch in TO-247	 Heatsink + TO-247	THD needs heatsink
Two-switch in TO-247	 Heatsink + 2 pcs TO-247 + 2 pcs TIM	Needs two TIM and a heatsink

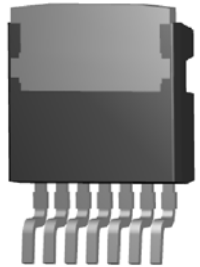
… but it needs a bit more than putting a SiC MOSFET into a SMD package

The new Infineon D²PAK 7L package

Special designed packages for each voltage class

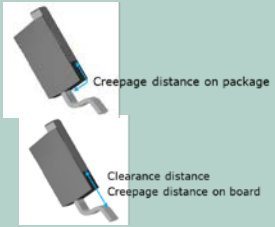


1700 V package



Creepage: >7.1 mm

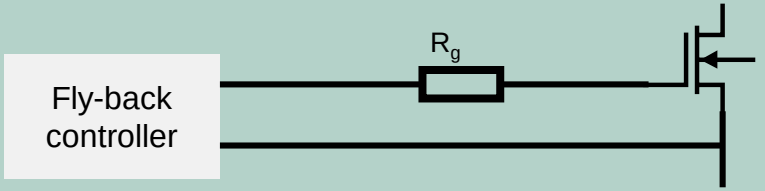
Clearance: >7.1 mm



- Dedicated and technology to enable reflow soldering w/o delamination between chip and mold
- New die attached compensating for the higher R_{th} usually being in place in SMD packages vs. THD
- Chip technology with new gate control conditions

Optimized gate voltage for direct drive from controller

Typical fly-back controller	Output gate voltage
NCP1207	Change with V_{cc}
NCP1339	0/12 V
NCP1379	0/13 V
FAN604H	0/14.5 V
L6565	0/V_{cc} – 2 V
UCC28600	0/13 V
UCC28C44	Change with V_{cc}
LM5023	0/12.9 V



Perfectly fitting gate voltage

SiC MOSFETs	Recommended gate voltage
CoolSiC™	**0/12~15 V**

Infineon's CoolSiC™ MOSFET 1700 V is the SiC MOSFET that could be directly driven by most fly-back controllers

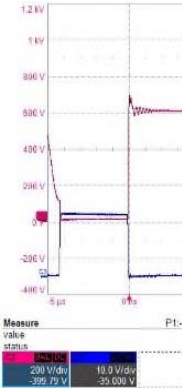
The game changing technology in reality

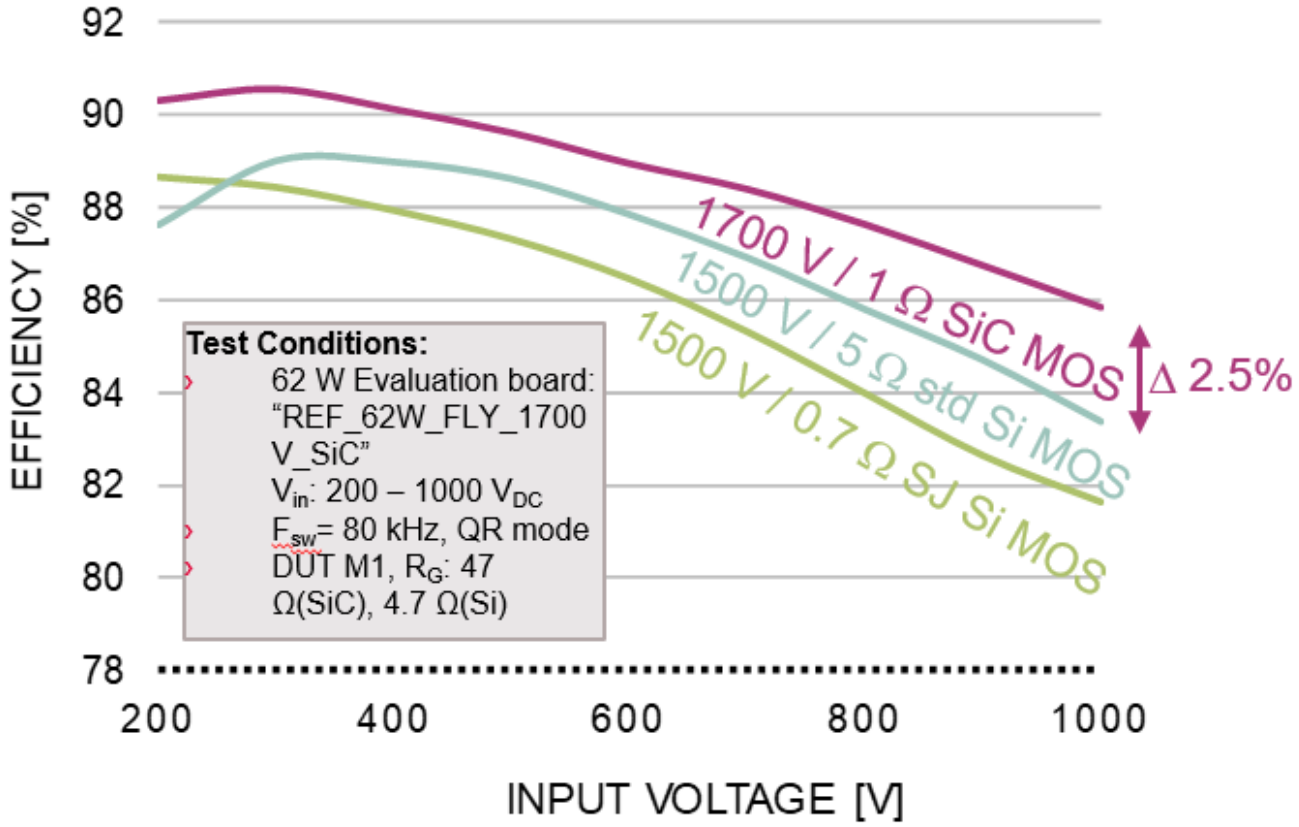
CoolSiC™
with quasi-resonant controller

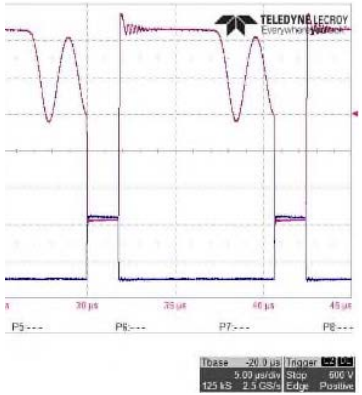
CoolSiC™
with fixed frequency controller

- Ultra low switching loss of CoolSiC™ MOSFET 1700 V discrete:
  - Natural convection cooled
  - SMD soldered directly on the PCB
  - Operated directly from flyback controller

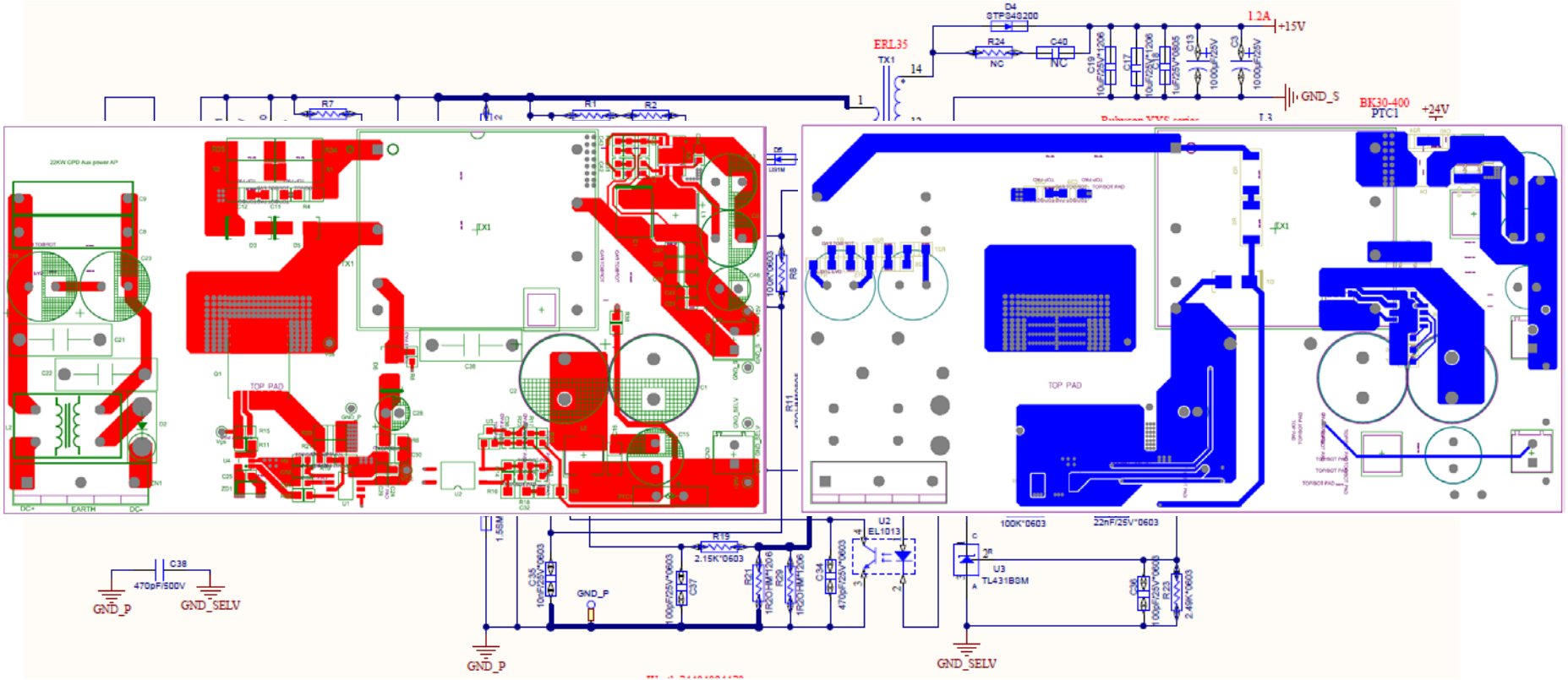
Functional test result



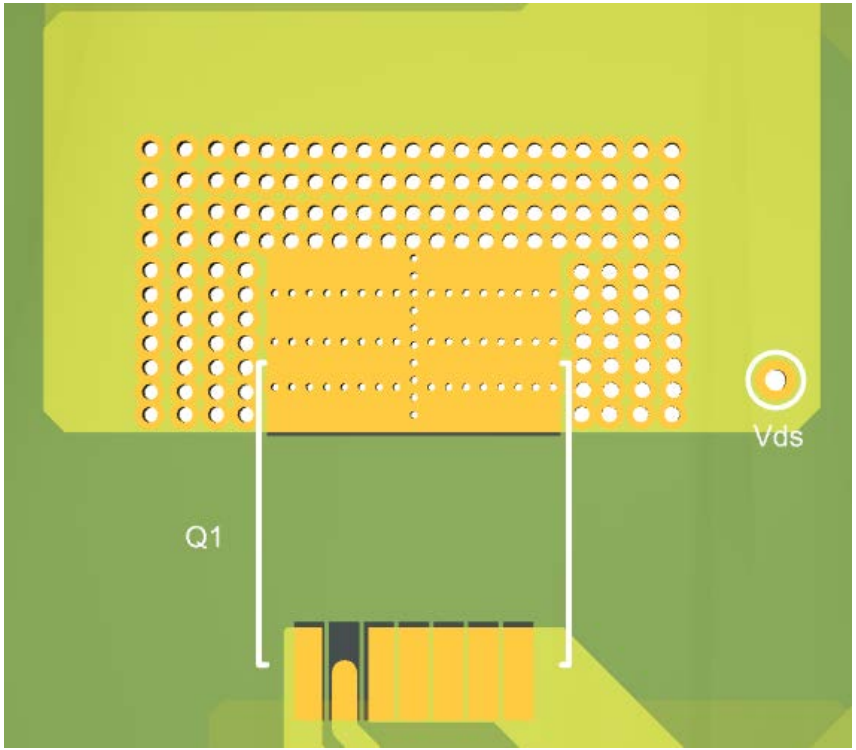




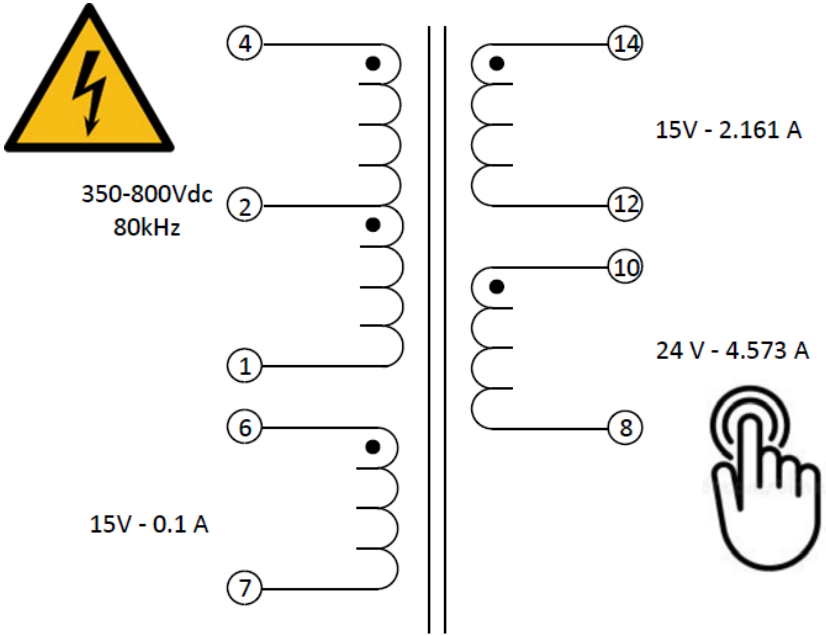
Schematic and PCB layout



Thermal consideration



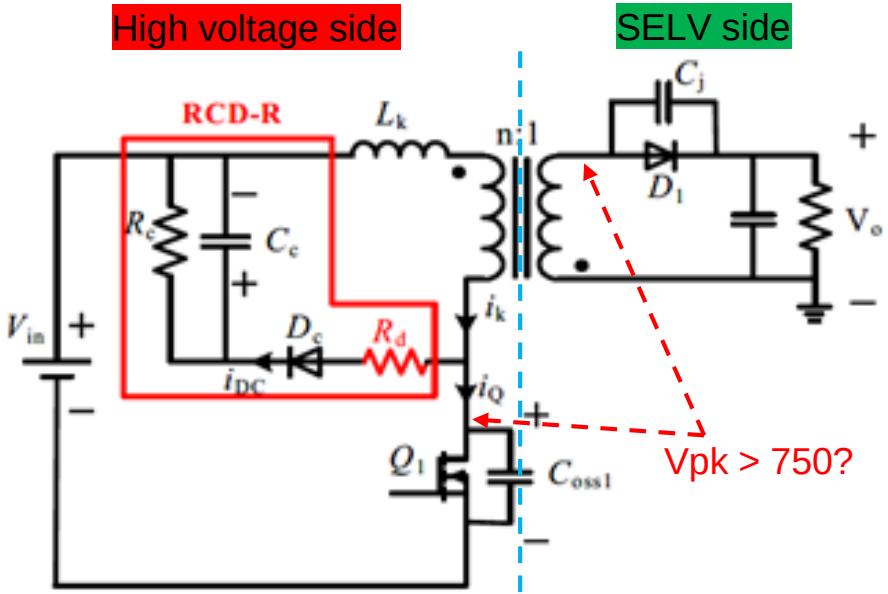
Reinforced insulation for transformer

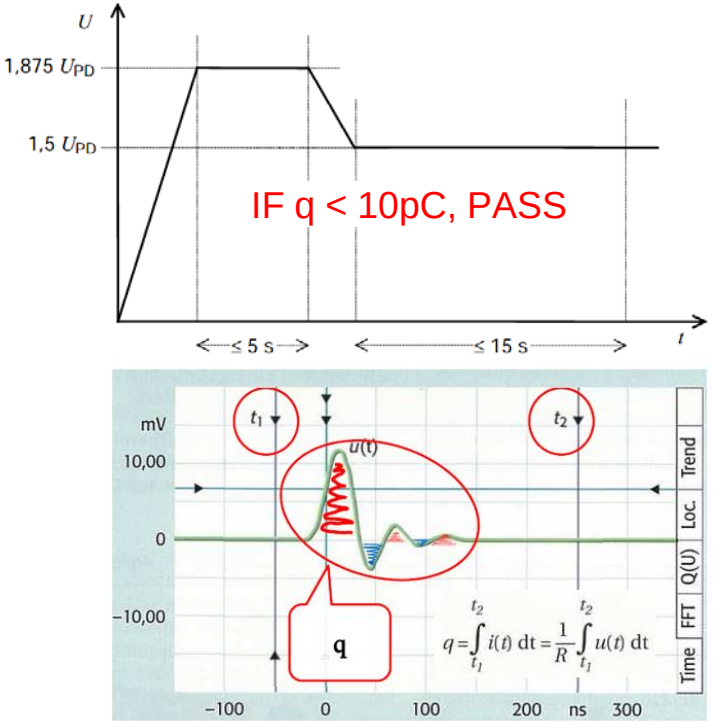


- Increase the physical distance between primary - secondary windings.
- Fully insulated wire
- Remove voids in the transformer
- Change the material with higher CTI

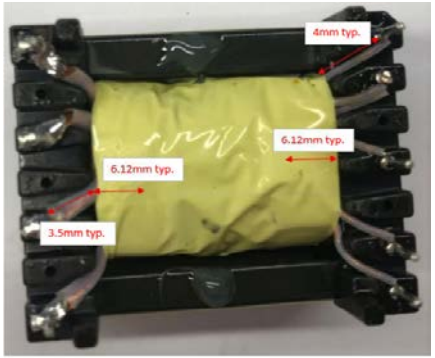
PD test – IEC 60664-1

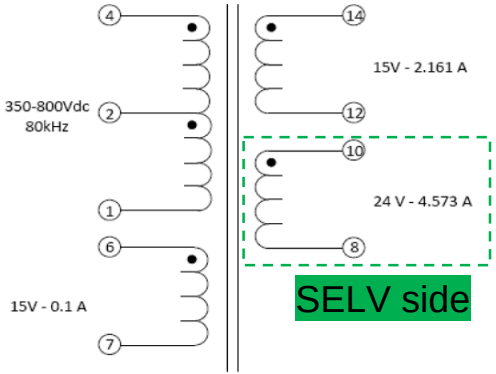
if the recurring peak working voltage across the insulation is greater than 750 V and the voltage stress on the insulation is greater than 1 kV/mm, PD test is mandatory.



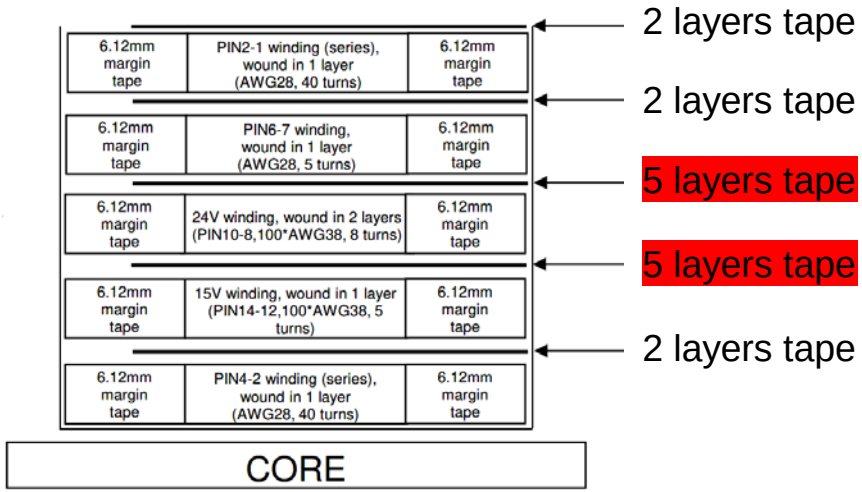


Transformer optimization and PD result





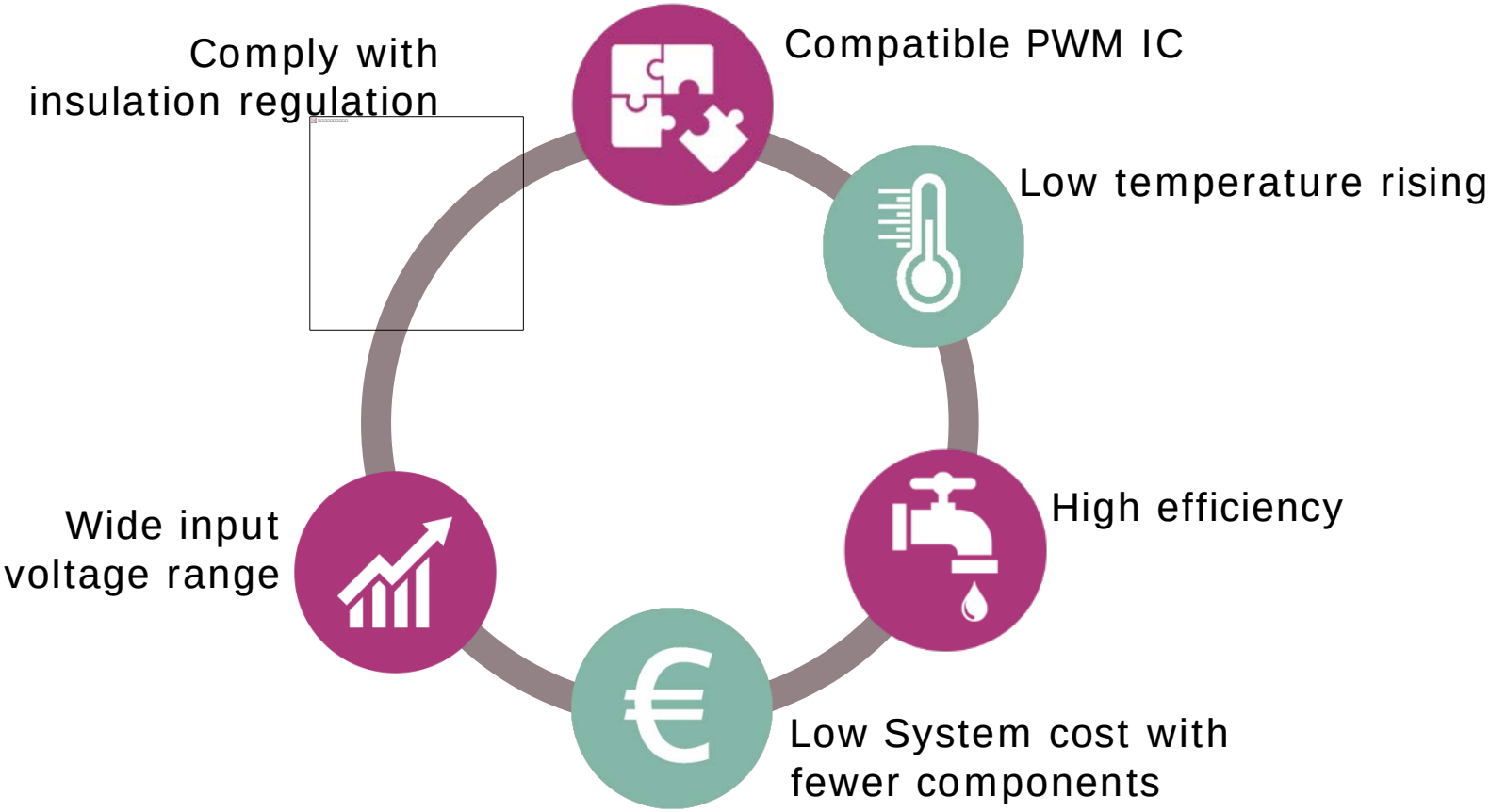
- Increase creepage distance between high voltage winding and SELV winding to 12.24mm
- Increase thickness of insulation tape
- Replace transformer bobbin material with CTI 1 material



Sample #2 Pass Average PD= 3.36pC Max PD= 9.36pC Average Voltage= .675806 kV

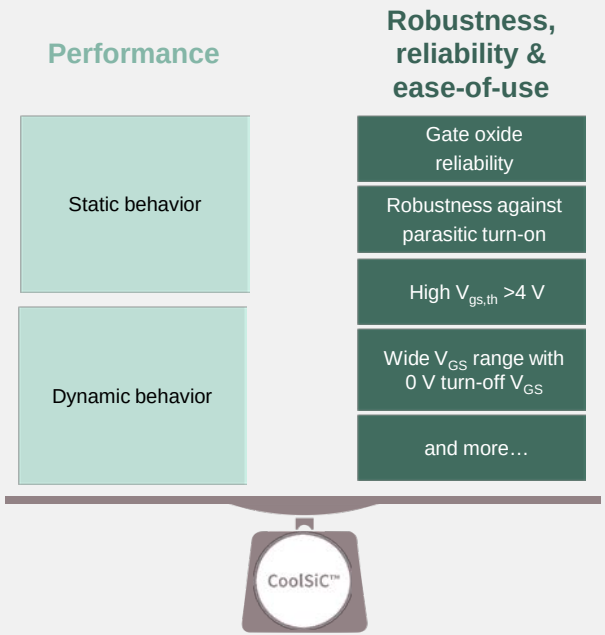
Sample #2 Manual Mode Max Inception 1.23kV Max Extinction 1.07kV

Summary

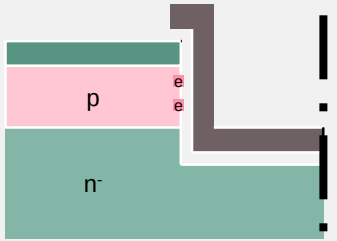


CoolSiC™ - a revolution to rely on!

Striving for a SiCMOS technology with optimal balance between performance and robustness …



… has led Infineon to choose a trench based structure for our CoolSiC™



Infineon trench technology

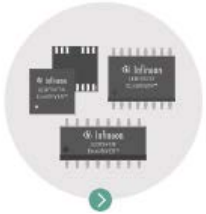
- Superior **gate oxide reliability**
- Allows for an **effective screening of defects**
- Ideally suited for further **Ron x A reduction** in future
- Enables flexible parameter set for **application-specific products**
- **Industry is gradually moving to trench**

1700 V SiC MOSFET is new addition in Infineon´s CoolSiC™ portfolio

SiC MOSFETs	TO-247-4	TO-247-3	D²PAK-7
650 V	27,48,72,107 mΩ	27,48,72,107 mΩ	1200 V 1700 V ext. creepage
1200 V	30, 45, 60,90, 140, 220, 350 mΩ	30, 45, 60,90, 140, 220, 350 mΩ	30, 45, 60,90, 140, 220, 350 mΩ[1]
1700 V	New		**450, 650, 1000 mΩ**

SiC Schottky diodes	TO-220 R2L	DDPAK	TO-247-3	TO-247	D²PAK R2L	ThinPAK 8x8	TO-247 dual die	DPAK R2L
650 V	2,-20 A	2,4,6,8,10,12,16, 20 A	10,12,16, 20, 30, 40 A	10,12,16,20, 30, 40 A	2,3,4,5,6,8,9,10,12 A	2,4,6,8,10, 12 A	20,24,32, 40 A	3,4,5,6,8,9,10,12 A
1200 V	2,5,8,10,16,20 A			10,15,20,30,40 A				2,4,8,10 A

Orange: also available in automotive grade products



Gate drivers IC

Modules

Evaluation boards

Contact

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