



Customer Presentation

CoolSET™ SiP

June 2026



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What is auxiliary power supply?

Aux power supplies ...

- Convert AC input (i.e., 230 V AC) into DC output (i.e. 12 V DC) to power electronic circuitries e.g. MCUs, LV BLDC motors, fans, WLAN, etc.

Can be found everywhere ...

- Houses
- Offices
- Commercial and industrial buildings
- Data centers

Future trends ...

- Lower component count
- Higher power delivery
- Higher efficiency
- Lower standby power



Home appliance



Heating



Server



Industrial SMPS



Home & building automation

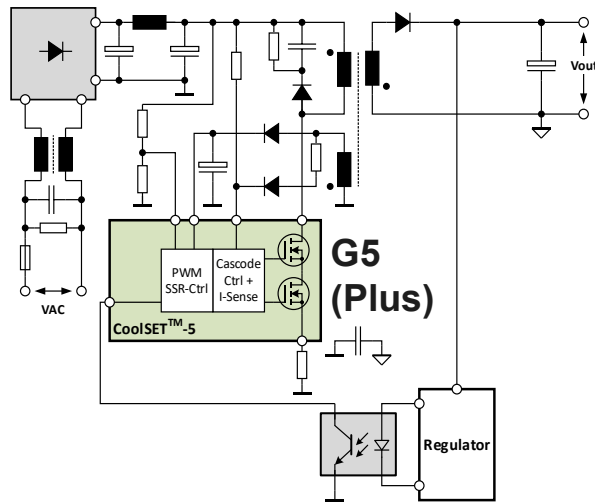
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CoolSET™ System in Package (SiP)

New CoolSET™ family to meet higher power and efficiency demands

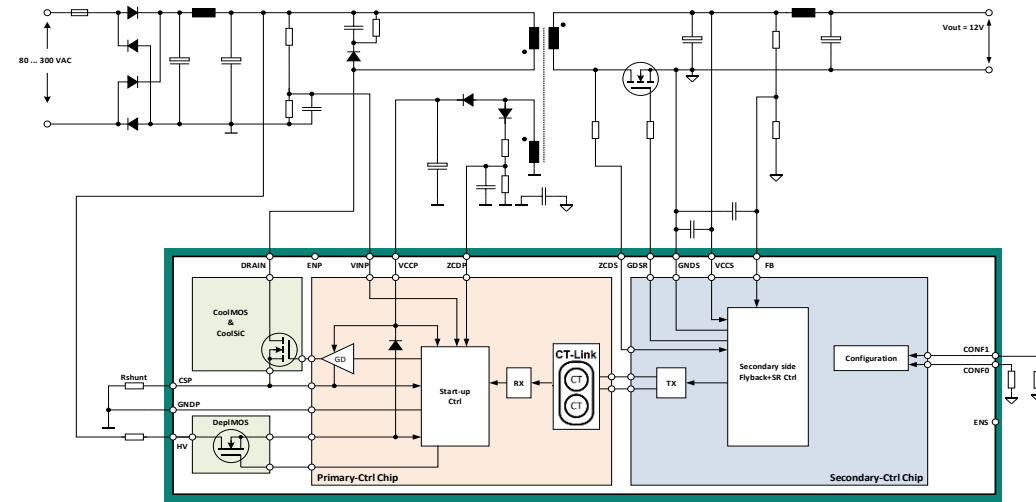
CoolSET™ Switch IC family (existing)



Integrated power switch - primary side

- CoolMOS™ + PWM controller
- Aux power supply up to **42 W**
- Topology: QR/FF flyback
- Selectable entry/exit ABM profile

New CoolSET™ System in Package (SiP) family



System in package (SiP) - primary and secondary side integration

- CoolMOS™ P7 or CoolSiC™ + PWM controller + CT Link isolated communication + SR controller + secondary-side regulation for **lower component count**
- **Higher power delivery** up to **145 W** (universal input) or **210 W** (385 V_{DC} input)
- Topology: novel ZVS flyback operation with advanced SR control algorithm up to 150 kHz for **higher efficiency**
- **Lower standby power** with optimized low supply currents for hysteretic mode operation

CoolSET™ System in Package (SiP)

Integrates HV switch and isolated secondary side control

- Primary side integration:

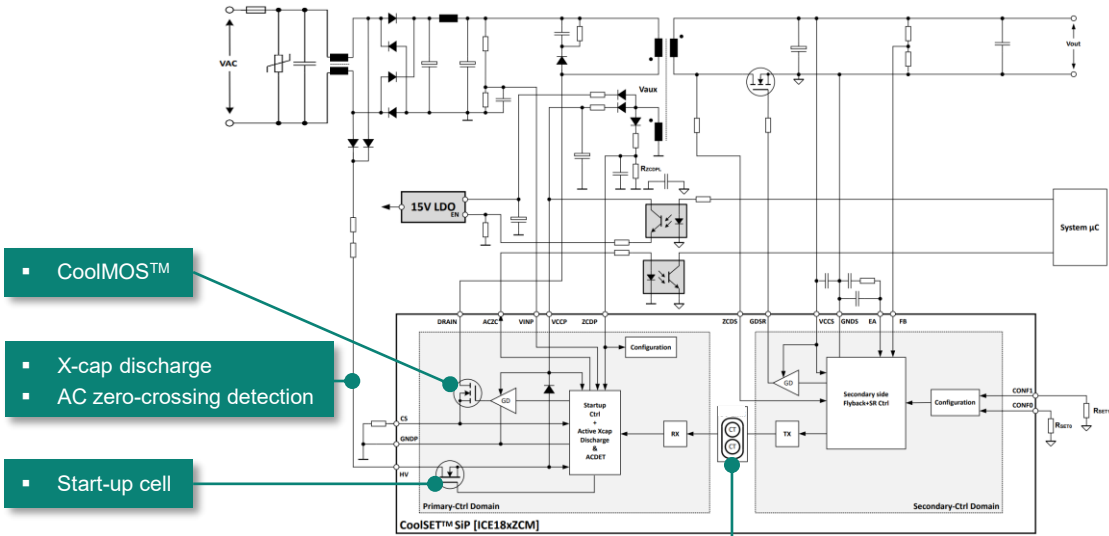
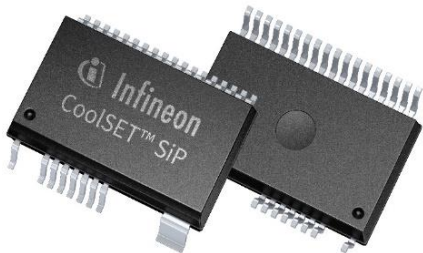
 - Flyback
 - Fast 950 V start-up cell
 - 800 V or 950 V CoolMOS™ P7 power switch
 - Comprehensive protection functions
- Secondary side integration:

 - QR ZVS control of primary side
 - Synchronous Rectifier control
 - 10 V SynchRec MOSFET driver output
- Reinforced galvanic isolation integrated:

 - > 8 mm CRP & CLR, 20-pin DSO package
 - 8 kV_{pk} V_{IoTM} (IEC 60747-17, UL, CQC: pending)
 - 50 V/ns CMTI_{min}
 - 100 V/m radiated EMI (ISO 11452-8)
 - 1175 A/m impulse MFI (EN 61000-4-9)
- Scalable output power:

 - 30 W, 48 W, 64 W
- Options:

 - Isolated enable from μC ← Least STBY power
 - Integrated X-cap discharge ← IEC 60335-1
 - AC zero-crossing feedback to μC ← Inrush current limitation / phase-angle control



- CoolMOS™
- X-cap discharge
 ■ AC zero-crossing detection
- Start-up cell
- Galvanic isolation

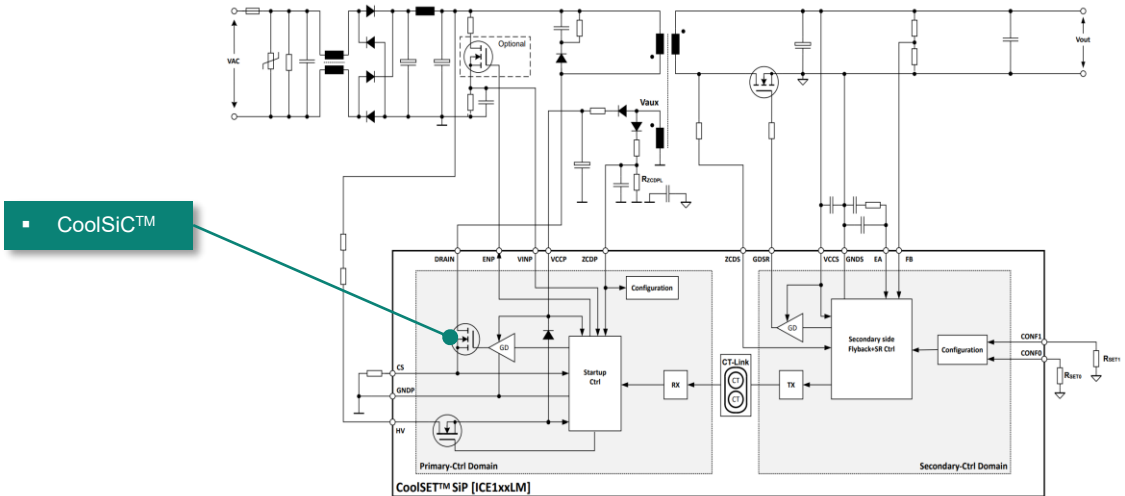
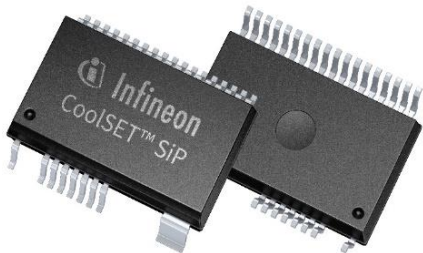
Variant	Type	V _{BRDSS}	P _{out}		Isolated enable from μC	Integrated X-Cap Discharge	AC Zero Crossing feedback to μC
			85 to 320 V _{AC} , open frame	230 V _{AC} ± 15%, open frame	LDO on/off control by μC and across internal isolation	Saves discrete circuitry	Saves discrete circuitry
L	ICE193LM	950V	35 W	50 W	--	--	--
	ICE183LM		35 W	50 W			
	ICE184LM		60 W	85 W			
	ICE186LM		75 W	110 W			
E	ICE183EM	800V	35 W	50 W	Yes	--	--
	ICE184EM		60 W	85 W			
	ICE186EM		75 W	110 W			
X	ICE183XM		35 W	50 W	Yes	Yes	--
	ICE184XM		60 W	85 W			
	ICE186XM		75 W	110 W			
Z	ICE183ZCM		35 W	50 W	--	Yes	Yes
	ICE184ZCM		60 W	85 W			
	ICE186ZCM		75 W	110 W			

CoolSET™ System in Package (SiP)

Integrates HV switch and isolated secondary side control



- Primary side integration:
 - Flyback (synchronized PWM)
 - Fast 950 V start-up cell
 - 800 V **CoolSiC™** power switch **← higher output power**
 - Comprehensive protection functions
 - Secondary side integration:
 - Synchronous Rectifier control
 - QR ZVS control of primary side
 - 10 V SynchRec MOSFET driver output
 - Galvanic isolation integrated:
 - > 8 mm CRP & CLR, 20-pin DSO package
 - 8 kV_{pk} V_{IO}™ (IEC 60747-17, CQC, UL: pending)
 - 50 V/ns CMTI_{min}
 - 100 V/m radiated EMI (ISO 11452-8)
 - 1175 A/m impulse MFI (EN 61000-4-9)
 - Scalable output power:
 - 90 W, 110 W, 150 W **← higher output power**



Variant	Type	V _{BRDSS}	P _{out}	
			85 to 320 V _{AC} , open frame	230 V _{AC} ± 15%, open frame
L	ICE188LM		110 W	145 W
	ICE189LM		120 W	155 W
	ICE180LM		145 W	180 W

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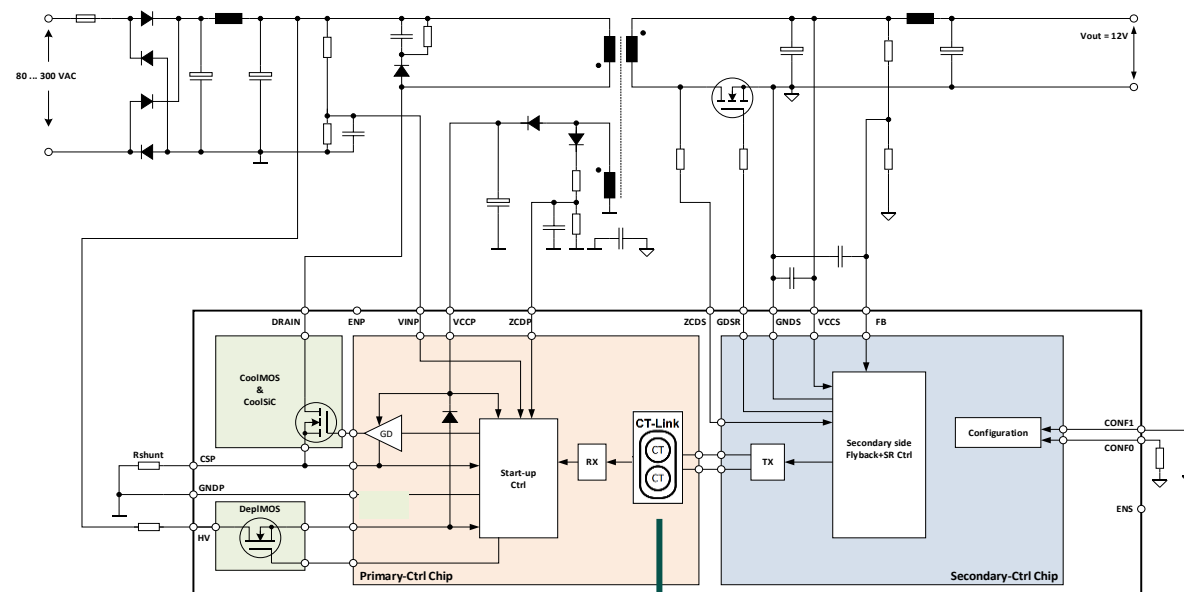
Robust isolated communication inside CoolSET™ SiP

Infiniteon's proprietary CT Link technology

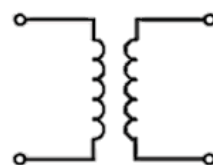
Features and functions

- **High magnetic field immunity galvanic isolation** communication from secondary to primary
- Chip's **metal layers used for coils**
- **Silicon dioxide (SiO₂) to isolate** primary and secondary windings
- Coils designed to **maximize magnetic flux in vertical direction**
- **Peripheral seal-ring for EMI and MFI robustness**
- **20+ years** in volume **production**
- **4th generation** in production, today
 - > 8 mm CRP & CLR, 20-pin DSO package
 - 8 kVpk V_{IO}™ (IEC 60747-17, CQC, UL: pending)
 - 50 V/ns CMTI_{min}
 - 100 V/m radiated EMI (ISO 11452-8)
 - 1175 A/m impulse MFI (EN 61000-4-9)

CT Link communication technology inside CoolSET™ SiP



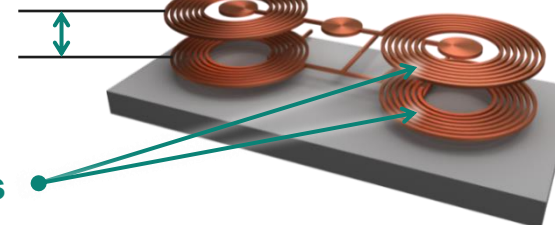
Magnetic coupling



SiO₂



Coils



CoolSET™ System in Package (SiP) – ICE18x

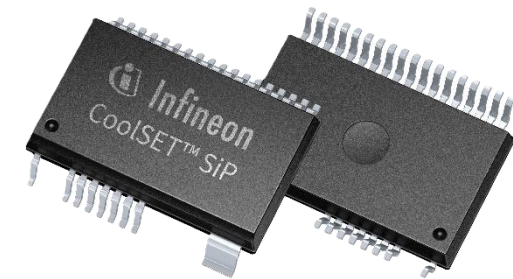
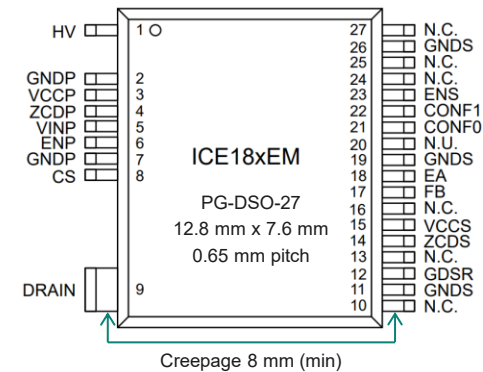
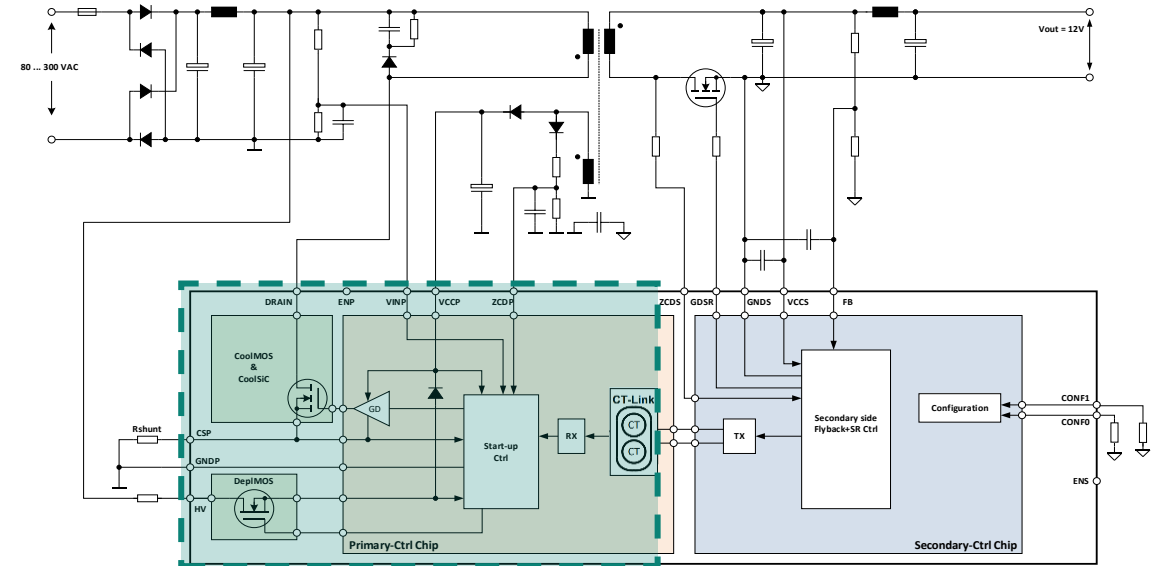
Primary controller features and functions



Features and functions

- Supports wide **V_{CC} operating range up to 32 V**
- Built-in digital quasi-resonant (QR) **soft-start**
- Cost-effective disable function via ENP pin to **disable/enable primary-side LDO (ICE18xEM)**
- **Reduces external bus voltage sensing resistor losses** via ENP pin (**ICE18xLM**)
- **Comprehensive primary-side protection features:**
 - AC line OVP by sensing bus capacitor voltage through VINP pin
 - VCCP OVP and UVP
 - VCCP short to GNDP protection
 - Primary peak current limitation OCP1 and OCP2
 - CS pin floating and short-to-GND protection
 - Primary controller overtemperature protection
 - Brown-in and brown-out protection via HV pin
 - Output over/undervoltage protection via ZCDP pin
 - ZCDP pin short-to-GNDP protection
 - Primary close-loop timeout protection

Schematic



CoolSET™ System in Package (SiP) – ICE18x

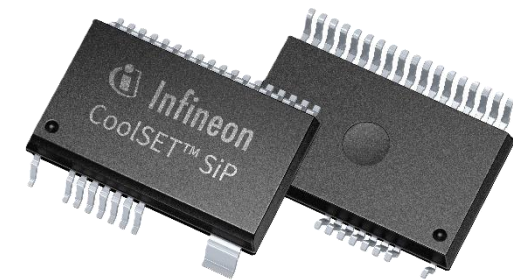
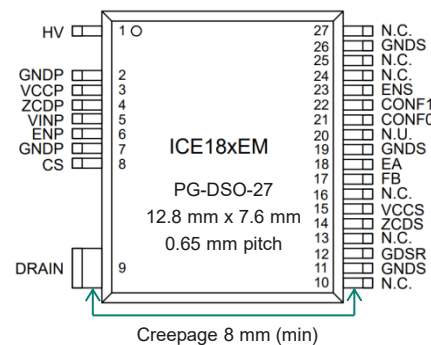
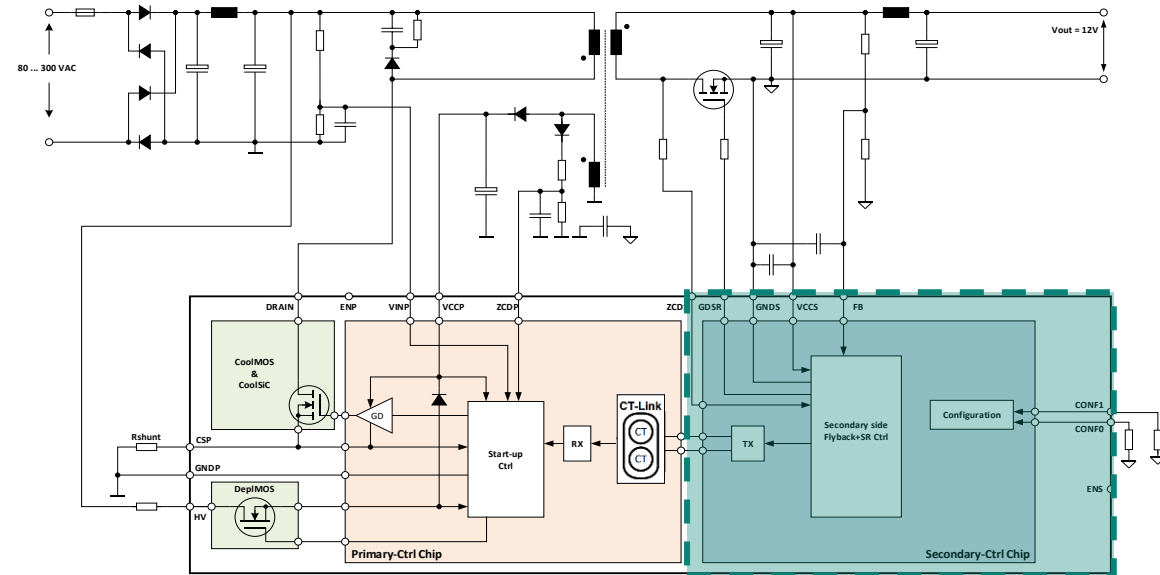
Secondary controller features and functions



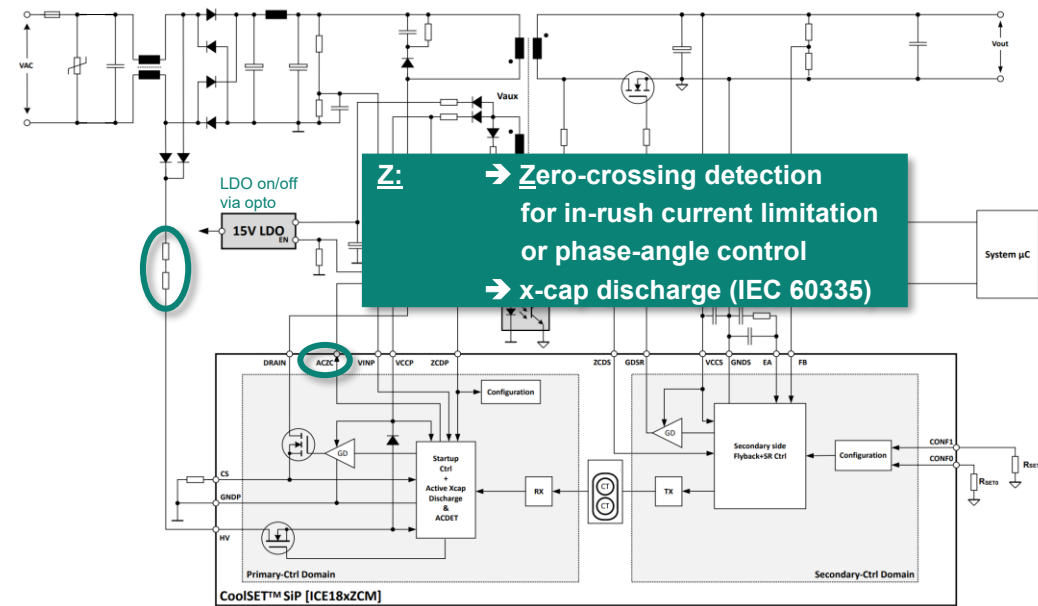
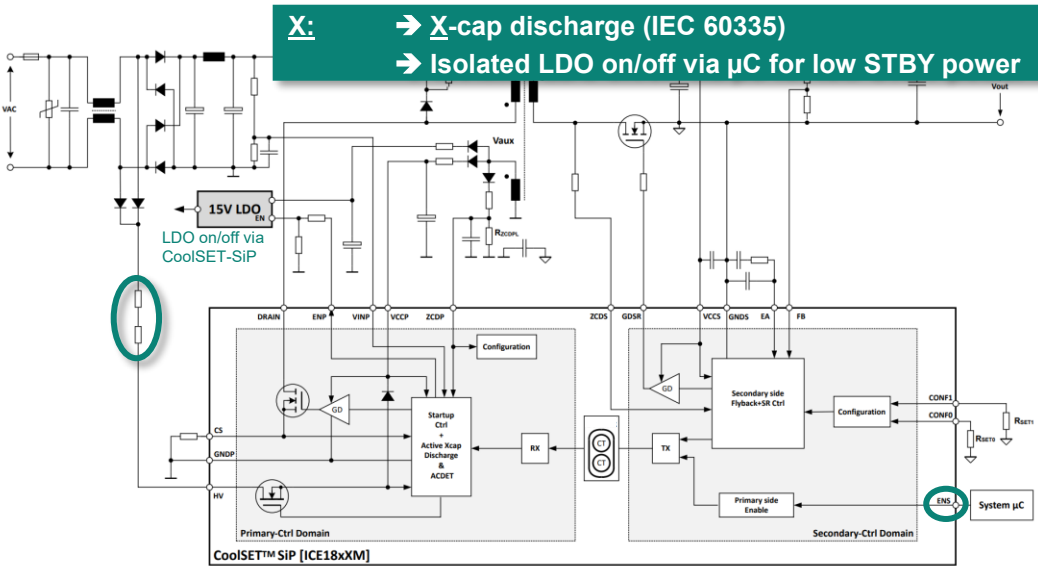
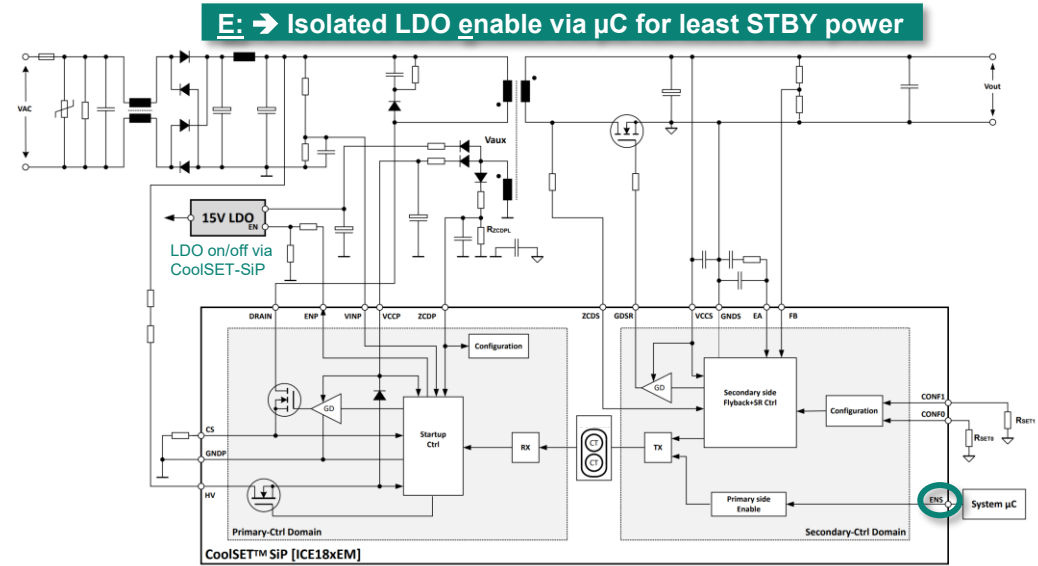
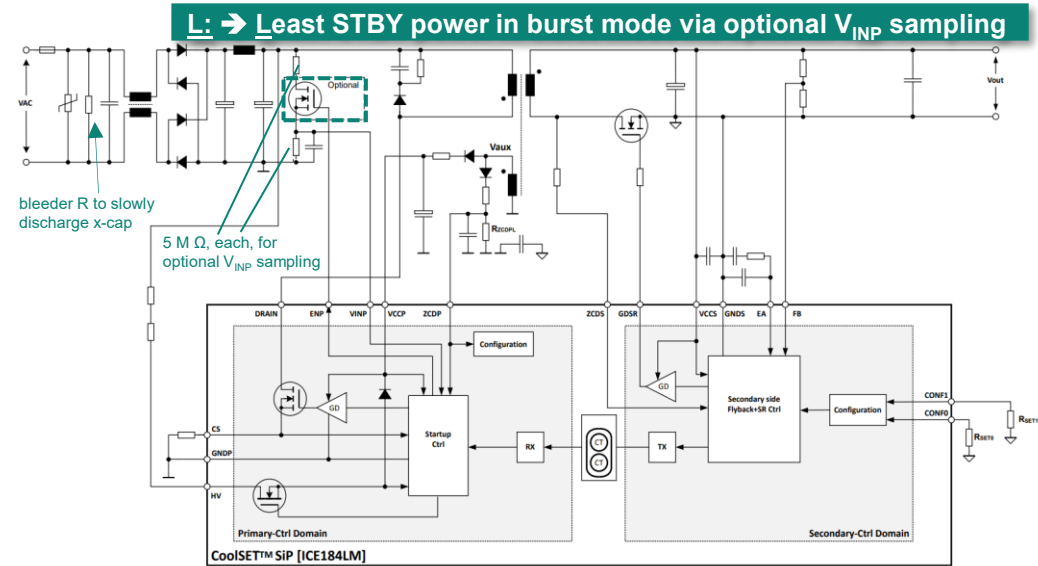
Features and functions

- **Synchronous rectification** controller **sensing SR MOSFET drain** via ZCDS pin to **achieve optimum efficiency**
- Primary MOSFET **valley switching** with **secondary-side peak detection** via ZCDS pin
- **Disable SR operation during hysteretic mode**
- **Self-adapting current injection** by additional SR MOSFET turn-on pulse to **achieve ZVS operation**
- Integrated reference and error amplifier
- **Configurable hysteretic mode** operation via CONF1 pin
- High gate drive **voltage clamp to 10 V** enables **use of normal-level SR MOSFET**
- **Isolated communication input** via ENS pin (**ICE18xEM**)
- **Secondary-side protection features**
 - VCCS OVP and UVP
 - Secondary-side overload/open-loop protection

Schematic



CoolSET™ SiP Configuration Options



CoolSET™ System in Package (SiP)

Portfolio Overview



Variant	Type	V _{BRDSS}	P _{out}		Isolated enable from μC	Integrated X-Cap Discharge	AC Zero Crossing feedback to μC	Eval board	V _{out_1}	V _{out_non-isolated}	η at 230V _{AC} @ full load
			85 to 320 V _{AC} , open frame	230 V _{AC} ± 15%, open frame	LDO on/off control by μC and across internal isolation	Saves discrete circuitry	Saves discrete circuitry				
L	ICE193LM	950V	35 W	50 W	--	--	--				
	ICE183LM	800V	35 W	50 W				REF_30W1_ZVS_183LM	12V / 2.5A		> 92%
	ICE184LM		60 W	85 W				REF_45W1_ZVS_184LM	12V / 3.75A		> 92%
	ICE186LM		75 W	110 W				EVAL_100W1S_ZVS_186LM	420V _{DC} / 8.33A		>93%
	ICE188LM		110 W	145 W				EVAL_75W1_ZVS_188LM	12V / 6.25A		> 93%
	ICE189LM		120 W	155 W				EVAL_85W1_ZVS_189LM	12V / 7.08A		> 93%
	ICE180LM		145 W	180 W				EVAL_100W1_ZVS_180LM	12V / 8.33A		>93%
E	ICE183EM	800V	35 W	50 W	Yes	--	--				
	ICE184EM		60 W	85 W				REF_45W1_ZVS_184EM	12V / 3.75A	15V / 0.15A	> 92%
	ICE186EM		75 W	110 W				REF_60W1_ZVS_186EM*	12V / 5A	15V / 0.15A	> 93%
X	ICE183XM	800V	35 W	50 W	Yes	Yes	--				
	ICE184XM		60 W	85 W				REF_45W1_ZVS_184XM	12V / 3.75A	15V / 0.15A	> 92%
	ICE186XM		75 W	110 W							
Z	ICE183ZCM	800V	35 W	50 W	--	Yes	Yes				
	ICE184ZCM		60 W	85 W				REF_45W1_ZVS_184ZCM	12V / 3.75A	15V / 0.15A	> 92%
	ICE186ZCM		75 W	110 W							

Least STBY power consumption	Any high-power appliance with electrical connection plug	Inrush current limitation or phase-angle control
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* [Dual output variant also available](#)

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CoolSET™ System in Package (SiP)

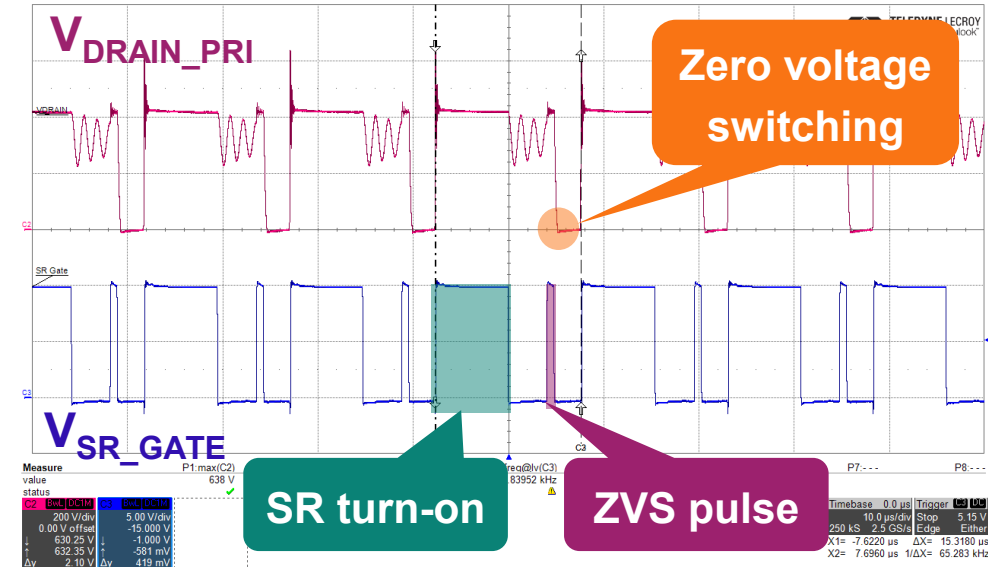
Advantage of novel zero voltage switching (ZVS) flyback

Without ZVS



- With ZVS disabled, the system operates in normal valley switching
- C_{OSS} charge of the primary MOSFET is discharged across the MOSFET itself and becomes switching loss

With ZVS

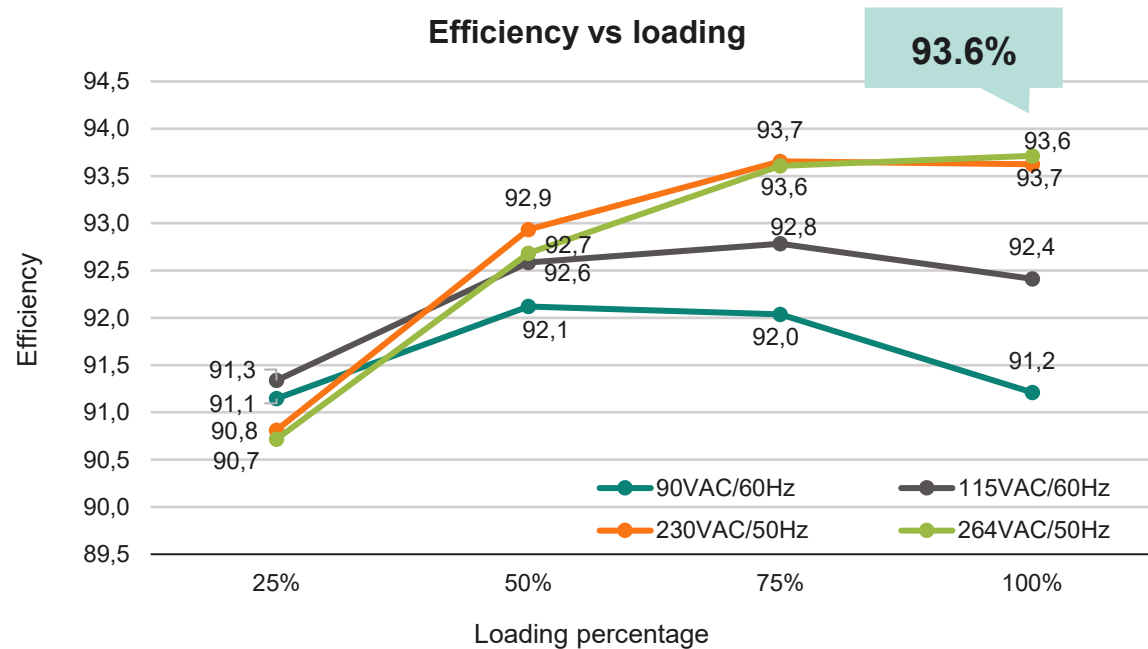


- With ZVS enabled, ZVS pulse is introduced to turn on SR MOSFET to achieve zero voltage switching
- ZVS pulse create a negative current through magnetizing inductance to recycle C_{OSS} charge of the primary MOSFET back to input bulk capacitor

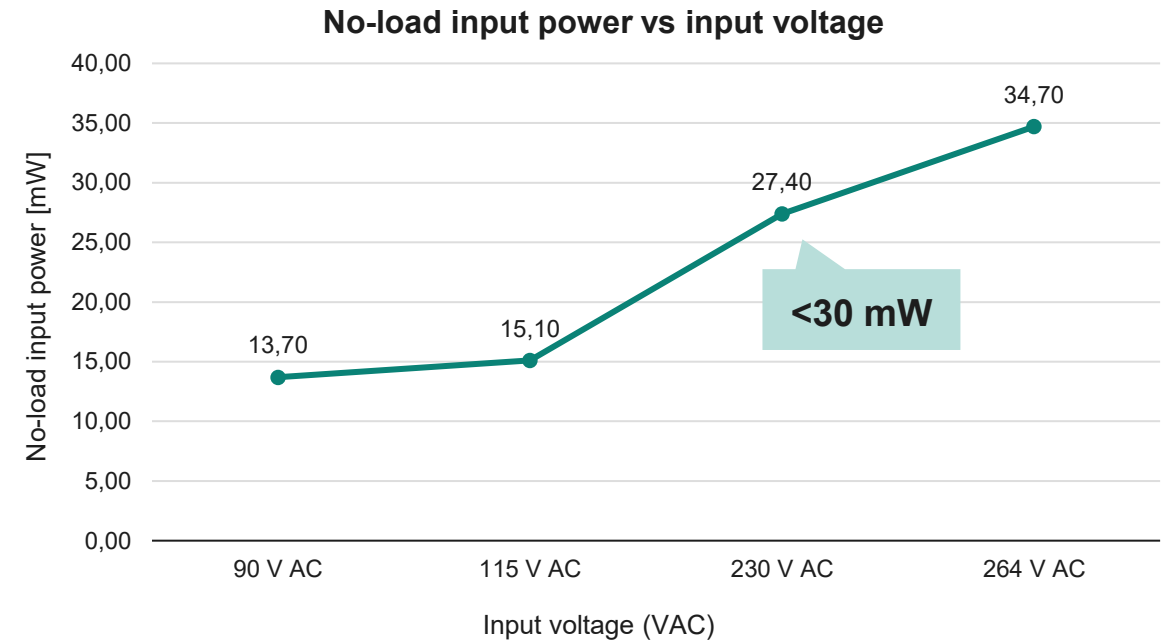
✓ CoolSET™ SiP's novel ZVS flyback operation recycling C_{OSS} charge to minimize switching loss

Efficiency curve and no-load input power (REF_60W1_ZVS_186EM)

Efficiency curve



No-load input power at 230 VAC



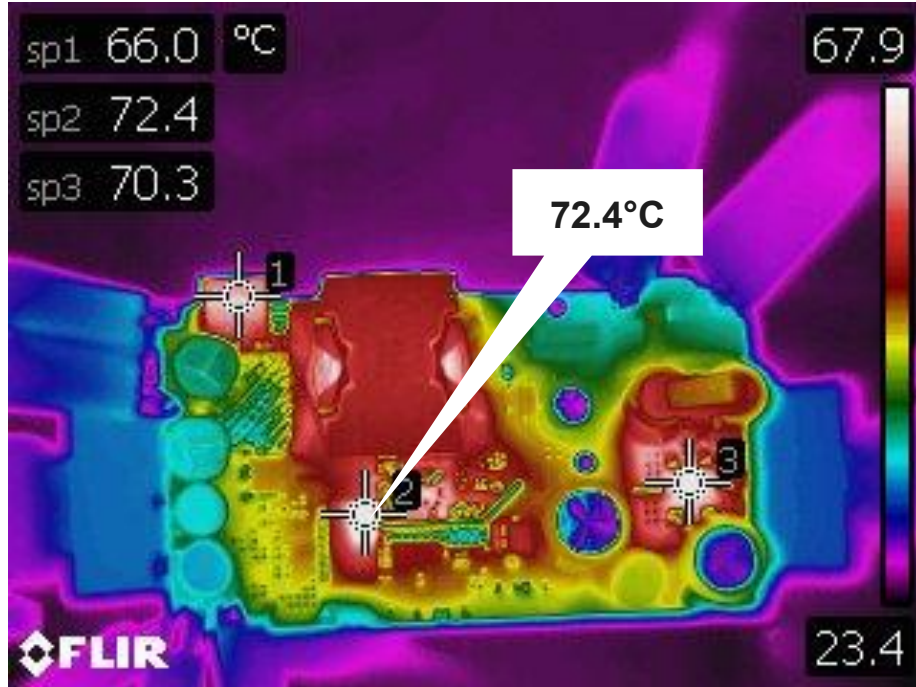
No-load input power at 230 VAC **<30 mW**
(*LDO and discharge resistor removed)

CoolSET™ SiP's optimized operation enables higher efficiency and lower standby power

60 W reference board thermal performance

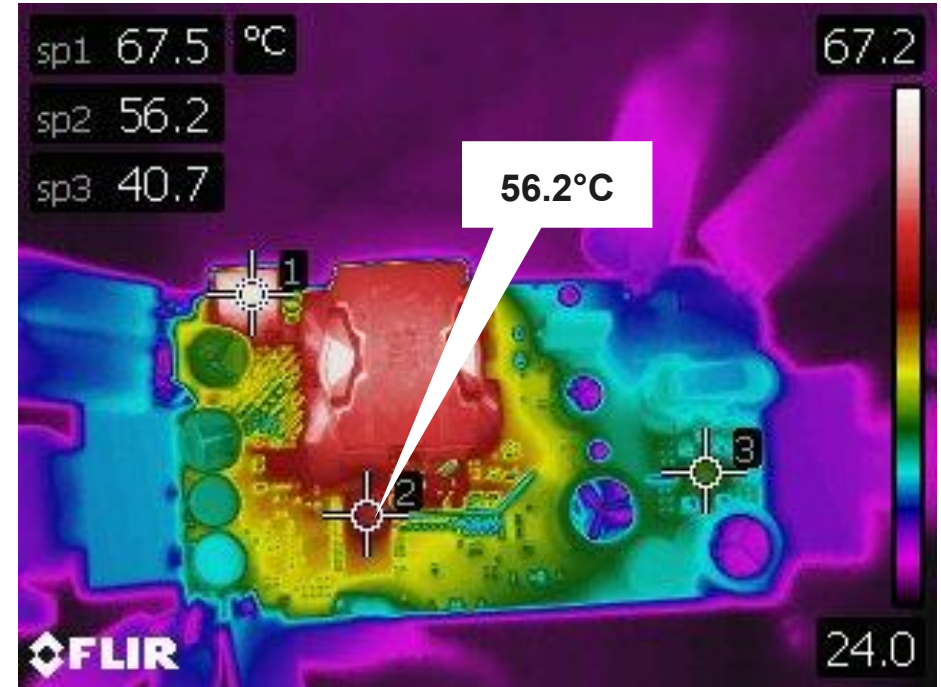
(REF_60WD1_ZVS_186EM, open case, $T_{amb} = 25^{\circ}\text{C}$)

90 VAC



CoolSET™ SiP top package temperature = **72.4°C**

230 VAC



CoolSET™ SiP top package temperature = **56.2°C**

CoolSET™ System in Package (SiP) can deliver higher power in a small PG-DSO-27 SMD package

Superior EMI performance of CoolSET™ SiP Flyback ICs

IEC 61000-4-3: Radiated EM field immunity

Frequency range	Test level	Antenna Polarization	Performance Criterion	Verdict
80 MHz to 1000 MHz	30 V/m	Horizontal	A	Pass
	30 V/m	Vertical	A	Pass
	30 V/m	Horizontal	A	Pass
	30 V/m	Vertical	A	Pass
1000 MHz to 6000 MHz	30 V/m	Horizontal	A	Pass
	30 V/m	Vertical	A	Pass

DUT: ICE186EM

No fail or missing gate signal observed
➔ 30 V/m @ 50/100/150 Hz passed with criterion “A”

ISO 11452-8: Radiated EM field immunity

Frequency range	Test level	Antenna Polarization	Performance Criterion	Verdict
80 MHz to 1000 MHz	100 V/m	Horizontal	A	Pass
	100 V/m	Vertical	A	Pass
	100 V/m	Horizontal	A	Pass
	100 V/m	Vertical	A	Pass
1000 MHz to 2000 MHz	80 V/m	Horizontal /Vertical	A	Pass
2000 MHz to 4000 MHz	60 V/m	Horizontal /Vertical	A	Pass
4000 MHz to 6000 MHz	50 V/m	Horizontal /Vertical	A	Pass

DUT: ICE186EM

ISO 11452-8 (Automotive)

No fail or missing gate signal observed
➔ 30 V/m @ 50/100/150 Hz passed with criterion “A”

Performance Criteria

A: Performance within specification limits

B: Temporary degradation which is self-recoverable

C: Temporary degradation which requires intervention

D: Loss of function which is not recoverable

Superior MFI Robustness of CoolSET™ SiP Flyback ICs

IEC 61000-4-8: Power Frequency MFI

Frequency	Test level	ENP signal (gate) frequency	Performance Criterion	Verdict
50 Hz	1000 A/m	50 kHz	A	Pass
	1000 A/m	100 kHz	A	Pass
	1000 A/m	150 kHz	A	Pass

DUT: ICE186EM

No fail or missing gate signal observed
➔ 1000 A/m @ 50 Hz passed with criterion “A”

IEC 61000-4-9: Impulse MFI

Condition	Test level	ENP signal (Gate) frequency	Performance Criterion	Verdict
5 positive pulse, 5 negative pulse, 30s between each pulse	1175 A/m	50 kHz	A	Pass
	1175 A/m	100 kHz	A	Pass
	1175 A/m	150 kHz	A	Pass

DUT: ICE186EM

No fail or missing gate signal observed
➔ 1175 A/m passed with criterion “A”

Performance Criteria

A: Performance within specification limits

B: Temporary degradation which is self-recoverable

C: Temporary degradation which requires intervention

D: Loss of function which is not recoverable

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CoolSET™ System in Package (SiP)

Key features and benefits



Key features

- **Zero-voltage switching (“ZVS”)** of integrated 800 V CoolMOS™ P7 or 800 V CoolSiC™
- Integrated **950 V CoolMOS™ P7** (option)
- **Robust galvanic isolation** integrated IEC 60747-17, CQC, UL
- Isolated primary side **enable** via μ C (option)
- Integrated **X-cap discharge** (option)
- Integrated **zero voltage crossing** feedback (option)
- **100% of wafer production inhouse**
- **Infineon is a market leader in power**



Key benefits

- GaN-like low switching losses using CoolMOS™ P7, up to 150 kHz f_{sw}
- Headroom against grid in-stability
- Passes MFI IEC 61000-4 criterion „A“
- 50 V/ns CMTI
- Least stand-by power consumption
- Meet IEC 60335
- Inrush current limitation
- Phase-angle control
- Direct operational control
- “1-stop shopping”
- Understanding the supplier



Value proposition to customer

- **Proven high reliability silicon MOSFET**
- **End-product design for global use**
- **Robust end-product**
- **Meet energy classes, e.g. EPREL**
- **Lower system cost**
- **Lower system cost**
- **Long-term supply**
- **Lower transaction expenses**
- **Leverage**

CoolSET™ SiP

Design in support material



- › [PowerEsim](#)
 - › General simulation/calculation tool
 - › Currently possible calculations for flyback & buck with all available CoolSET™ devices
- › Design guide and calculation tool for SiP
 - › [Calculation tool](#)
 - › [Design guide](#)

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Documents

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Additional Technical Information Language Reset all

Document	Type	Details
Design Guide Quasi Resonant CoolSET™ Generation 5	Additional Technical Information	PDF 01_00 EN 2.43MB Apr 22, 2020
General description evaluation board EVAL_3KW_2LLC_PT_47	Additional Technical Information	PDF 01_00 EN 1.76MB Apr 10, 2017
第五代准谐振反激式变换器设计指南——ICE5Q5xG 和 ICE5QRxxxxx	Additional Technical Information	PDF 01_00 CN 2.98MB Aug 31, 2021
CoolSET™ ICE5QRxx80BG-1 design guide for quasi-resonant flyback topology	Additional Technical Information	PDF 01_00 EN 1.00MB Nov 15, 2024

