

100 W power supply using CoolSET™ SiP ICE180LM

EVAL_100W1_ZVS_180LM

About this document

Scope and purpose

This engineering report describes the EVAL_100W1_ZVS_180LM Evaluation Board for a flyback converter with an isolated 12 V, 8.33 A output using the latest Infineon CoolSET™ ICE180LM System in Package (SiP) zero-voltage switching (ZVS) flyback integrated solution with CoolSiC™ MOSFET. This 100 W evaluation board serves the purpose of understanding the technical features and capabilities of the CoolSET™ ICE180LM. For detailed features and power delivery capability, see the device datasheet [\[1\]](#).

Highlights of this power supply:

- Overall high efficiency to meet energy efficiency requirement
- Simplified circuitry with high-level integration of power control and protection features
- Auto-restart protection scheme to minimize interruption and enhance the user experience
- Zero-voltage switching (ZVS) technology to boost efficiency
- CoolSiC™ MOSFET to enable higher output power

Intended audience

This document is intended for power supply design, application engineers, or others who want to design efficient and reliable auxiliary power supplies.

CoolSET™

Infineon's CoolSET™ AC-DC integrated power stages in fixed frequency and quasi-resonant switching schemes offer increased robustness and outstanding performance. This family offers superior energy efficiency, comprehensive protective features, and reduced system costs and is ideally suited for auxiliary power supply applications in a wide variety of potential applications such as:

- [SMPS](#)
- [Home appliances](#)
- [Server](#)
- [Telecom](#)

Table of contents

Table of contents

About this document	1
Table of contents	2
1 Introduction	3
2 EVAL_100W1_ZVS_180LM Evaluation Board	4
3 Specifications of evaluation board	5
4 Schematic	6
5 Circuit description	7
6 PCB layout	10
6.1 Top-side layout.....	10
6.2 Bottom-side layout.....	10
7 Bill of materials	11
8 Transformer specifications	14
8.1 Electrical diagram and coil build	14
9 Test results	15
9.1 Efficiency.....	15
9.2 ESD immunity (EN 61000-4-2)	16
9.3 Surge immunity (EN 61000-4-5)	16
9.4 Conducted emissions (EN 55022 Class B).....	17
9.5 Thermal measurement.....	17
10 Waveforms and scope plots	19
10.1 Start-up with maximum load	19
10.2 Soft-start.....	19
10.3 Switching waveform at full load	20
10.4 SR FET voltage at full load.....	20
10.5 Output ripple voltage at maximum load	21
10.6 Hysteretic mode operation	21
10.7 Overload protection	22
10.8 Line OVP.....	22
10.9 Brown-in and brown-out.....	23
Design support	24
References	25
Revision history	26
Disclaimer	27

1 Introduction

1 Introduction

This engineering report describes the EVAL_100W1_ZVS_180LM Evaluation Board designed in a zero-voltage switching (ZVS) quasi-resonant (QR) flyback converter using CoolSET™ ICE180LM System in Package (SiP) from Infineon's first fully integrated controller. The evaluation board provides 100 W output at 12 V and 8.33 A, with an input range of 90 VAC to 264 VAC. The evaluation board can achieve 93.7% peak efficiency.

The CoolSET™ ICE180LM is ideally targeted for auxiliary power supplies for SMPS, home appliances, servers, and telecom applications. The SiP integration includes an 800 V CoolSiC™ MOSFET, primary and a secondary controller, and isolated communication. An advanced PWM switching pattern forces a zero-voltage switching (ZVS) quasi-resonant (QR) operation, reducing the turn-on switching losses and optimizing the EMI signature. A comprehensive set of protection features supports ease of design-in.

[Table 1](#) lists the general system requirements for a power supply and the corresponding Infineon solution using ICE180LM.

Table 1 General system requirement and proposed design solution

	General system requirements	Proposed design solution - ICE180LM
1	High efficiency to meet energy efficiency requirements	Primary zero-voltage switching and secondary optimal synchronous rectifier (SR) control
2	Simplified circuitry with high-level integration	Primary 800 V CoolSiC™ MOSFET, primary and secondary controller, and communication integrated in a DSO-27 package
3	Minimize interruption to enhance user experience	All protections are defined to enter auto-restart mode

100 W power supply using CoolSET™ SiP ICE180LM

EVAL_100W1_ZVS_180LM

2 EVAL_100W1_ZVS_180LM Evaluation Board

2 EVAL_100W1_ZVS_180LM Evaluation Board

This document contains the list of features, power supply specifications, schematics, bill of materials (BOM), and performance data. Typical operating characteristics, such as performance curve and scope waveforms are shown at the later sections of this document.

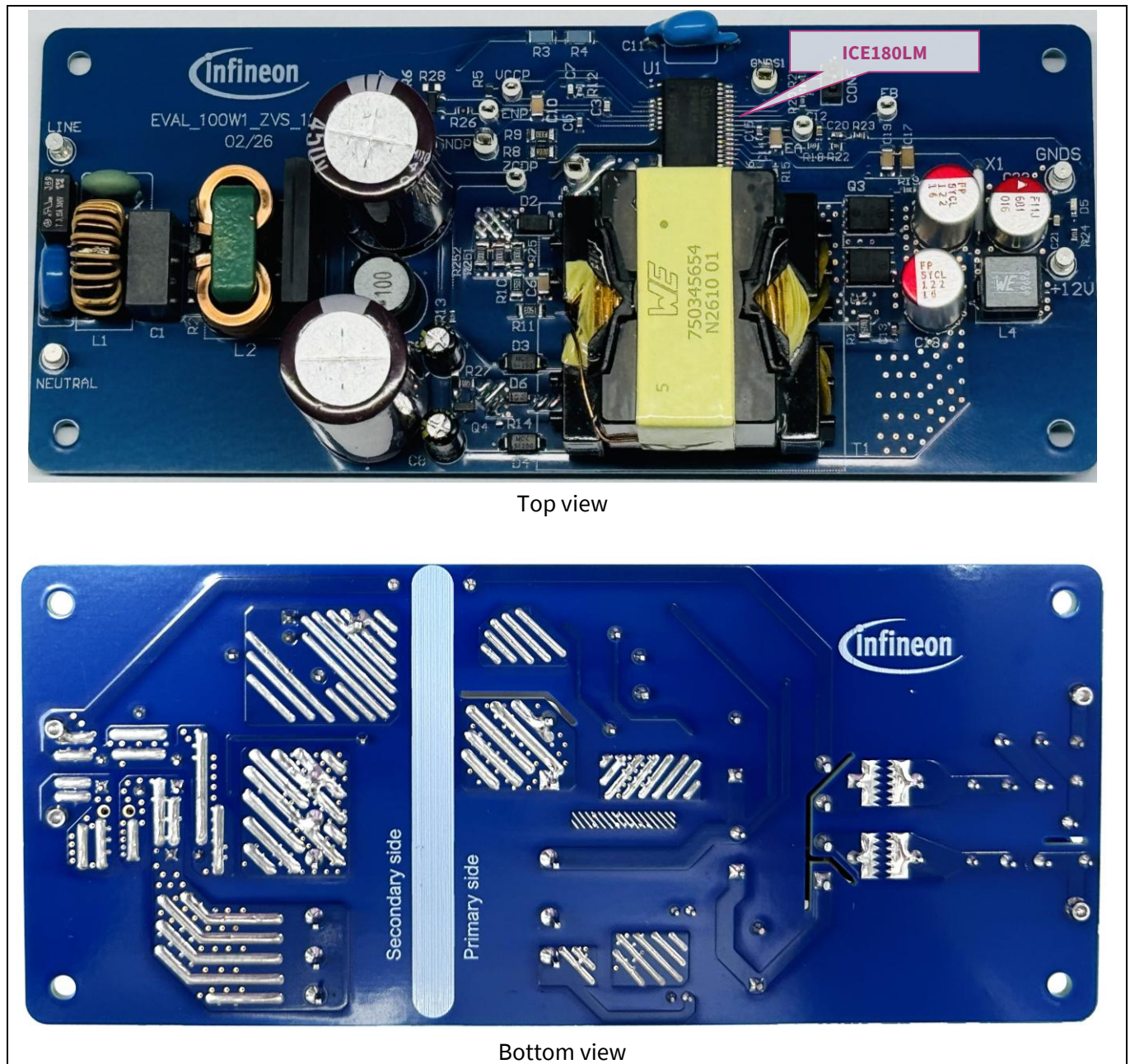


Figure 1 EVAL_100W1_ZVS_180LM Evaluation Board

3 Specifications of evaluation board

3 Specifications of evaluation board

Table 2 Specifications of EVAL_100W1_ZVS_180LM

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions/notes
Input						
Voltage	V_{IN}	90	–	264	VAC	2-wire (no P.E.)
Frequency	f_{LINE}	47	50/60	64	Hz	–
Output						
Voltage	V_{OUT}	12			V	–
Current	I_{OUT}	8.33			A	–
Output power	P_{OUT}	100			W	–
Ripple	V_{pk-pk}	150			mV	–
Overcurrent protection	I_{OCP}	10			A	–
Environmental						
Conducted EMI	–	6			dB	EN55022, Class B
Surge immunity – Differential mode (DM)	–	±2			kV	EN 61000-4-2
Surge immunity – Common mode (CM)	–	±4			kV	
ESD – Contact discharge	–	±8			kV	EN 61000-4-5
ESD – Air discharge	–	±15			kV	
Ambient temperature	T_{amb}	–20	–	50	°C	Free convection, sea level
Size	–	140 × 60 × 38.5			mm	L × W × H

Note: The table above represents the minimum acceptable performance of the design. Actual measurement results are listed in the [Test results](#) section.

100 W power supply using CoolSET™ SiP ICE180LM

EVAL_100W1_ZVS_180LM

4 Schematic

4 Schematic

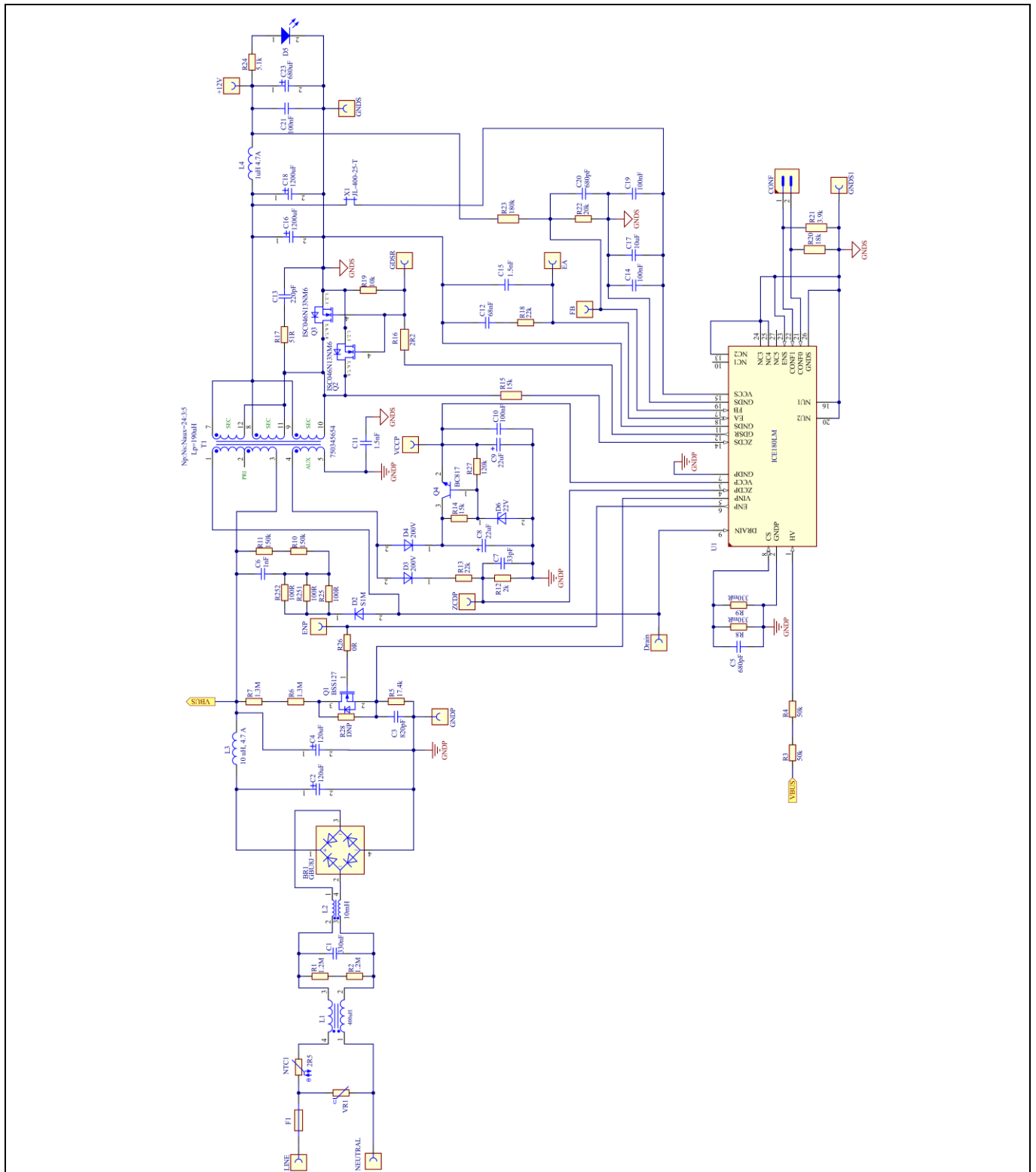


Figure 2 Schematic of EVAL_100W1_ZVS_180LM

100 W power supply using CoolSET™ SiP ICE180LM

EVAL_100W1_ZVS_180LM

5 Circuit description

5 Circuit description

This section briefly describes the proposed design circuit by different functional blocks. For details of the design procedure and component selection for the flyback circuitry, see the IC datasheet [1] and design guide [2].

5.1 EMI filtering and line rectification

The input of the power supply is taken from the AC power grid, which is in the 90 V AC ~ 264 VAC range. The fuse (F1) is at the input to protect the system in case of excess current entering the system circuit due to a fault. Following is the varistor (VR1), which is connected across L and N to absorb the line surge transient.

Common mode choke L1, L2, and the X-capacitor C1 form a basic filter to reduce the EMI noise. The bridge rectifier (BR1) rectifies the AC input into DC voltage, filtered by the π filter (C2, C4, and L3). R1 and R2 resistors discharge C1 when the power supply is disconnected from the AC mains. NTC1 is used to suppress the inrush current when the AC is connected to the board.

5.2 CoolSET™ SiP power stage

The flyback converter power stage consists of a power transformer, primary power MOSFET, secondary synchronous rectifier (SR) MOSFET, secondary output capacitors, etc.

Primary and secondary sides power management are separated for isolated power supply domains (VCCP, GNDD and VCCS, GNDS). ICE180LM provides reinforced isolation and safe communication between primary and secondary sides.

5.2.1 CoolSET™ SiP primary side

The CoolSET™ ICE180LM SiP integrates a 950 V startup cell at the primary side. The IC self-starts through the startup resistors (R3 and R4) in series with this startup cell to charge the VCCP pin capacitors (C9, C10) when DC supply is applied. These startup resistors, together with ZCDP pin external configuration resistor R_{ZCDPL} (R12), determine the brown-in and brown-out protection, as shown in Table 3.

Table 3 Primary-side configuration options

Option	$R_{ZCDPL(min)}$; $R_{ZCDPL(max)}$	Brown-in current threshold I_{HV_BI}	Brown-out current threshold I_{HV_BO}	Internal shunt resistor $R_{HVshunt}$
1	[1.00 k Ω ; 1.05 k Ω]	2.00 mA	1.40 mA	0.5 k Ω
2	[1.87 k Ω ; 2.70 k Ω]	1.00 mA	0.70 mA	1.0 k Ω
3	[4.30 k Ω ; 5.00 k Ω]	0.67 mA	0.47 mA	1.5 k Ω
4	[9.20 k Ω ; 9.50 k Ω]	0.50 mA	0.35 mA	2.0 k Ω

Option 2 is selected with R_{ZCDPL} (R12) = 2 k Ω , the brown-in voltage can be estimated as:

$$V_{BI} = (R_{HV} + R_{HVshunt}) \times I_{HV_BI} = (100 \text{ k}\Omega + 1 \text{ k}\Omega) \times 1 \text{ mA} = 101 \text{ V}$$

Equation 1

And the brown-out voltage can be estimated as:

$$V_{BO} = (R_{HV} + R_{HVshunt}) \times I_{HV_BO} = (100 \text{ k}\Omega + 1 \text{ k}\Omega) \times 0.7 \text{ mA} = 70.7 \text{ V}$$

Equation 2

100 W power supply using CoolSET™ SiP ICE180LM

EVAl_100W1_ZVS_180LM

5 Circuit description

Moreover, R12 and R13 resistors offer zero-crossing detection during the soft-start period and primary-sensed output overvoltage protection.

$$\begin{aligned}
 V_{OUT_OVP} &= \left(\frac{(R_{ZCDPH} + R_{ZCDPL}) \times V_{ZCDP_OVP_min}}{R_{ZCDPL}} + V_{Daux} \right) \times \frac{N_{SEC}}{N_{AUX}} - V_{Dsec} \\
 &= \left(\frac{(22 \text{ k}\Omega + 2 \text{ k}\Omega) \times 2.05 \text{ V}}{2 \text{ k}\Omega} + 0.3 \text{ V} \right) \times \frac{3}{5} - 0.1 \text{ V} \approx 14.84 \text{ V}
 \end{aligned}$$

Equation 3

Where,

N_{SEC} : Number of secondary turns

N_{AUX} : Number of auxiliary turns

V_{Daux} : Diode forward voltage drop at auxiliary winding

V_{Dsec} : Voltage drop across SR MOSFET

$V_{ZCDP_OVP_min}$: Minimum voltage of the output overvoltage threshold

V_{OUT_OVP} : User-defined output overvoltage level

C7 is chosen to adjust the delay time, which starts when the drain-source voltage falls below the bus voltage until the ZCDP voltage falls to $V_{ZCDPthr}$ (100 mV, typ.). Therefore, the power switch can be turned on at the valley point of the drain-source voltage.

A total 44 μ F capacitor for C8, C9 is selected to ensure stable system operation and enough break time for auto-restart protection. The VCCP linear regulator (R14, R27, D6, and Q4) is placed to avoid the VCCP voltage exceeding the pin voltage rating (32 V) in case of severe voltage spike coupling from the transformer during the surge test.

DC line overvoltage protection is detected by sensing the bus capacitor voltage through the VINP pin via the divider resistor R5. Once the VINP pin voltage is higher than the line overvoltage threshold V_{VINP_LOVP} , the controller enters the line overvoltage protection and releases the protection mode when the VINP pin voltage falls below V_{VINP_LOVP} .

Typical LOVP voltage is calculated as follows:

$$V_{BUS_OVP} = V_{VINP_LOVP} \times \frac{R6+R7+R5}{R5} = 2.80 \text{ V} \times \frac{1.3\text{M}\Omega+1.3\text{M}\Omega+17.4 \text{ k}\Omega}{17.4\text{k}\Omega} = 421 \text{ V}$$

Equation 4

The primary overcurrent protection is sensed by the R8 and R9 resistor through the CS pin. The V_{CSOCP1} is 0.76 V and V_{CSOCP2} is 1.1 V. The R8 and R9 are selected to ensure the system will not enter the overcurrent protection before the targeted OCP level is hit.

A low-cost RCD clamp consisting of the D2 diode, R25, R251, R252 resistor, and the C6 capacitor is implemented to suppress the peak drain voltage when turning off the power switch inside ICE180LM. This passive snubber helps dissipate the energy stored in the transformer leakage inductance.

100 W power supply using CoolSET™ SiP ICE180LM

EVAL_100W1_ZVS_180LM

5 Circuit description

5.2.2 CoolSET™ SiP secondary side

The secondary side of CoolSET™ ICE180LM SiP starts to take over the PWM control when the output voltage reaches 95% of its regulation target. The ICE180LM PWM control is based on sensing the reflected voltage from the primary side via the ZCDS pin and the error amplifier (EA) output voltage. ICE180LM integrated PWM and SR control ensures that the timing of the SR power switch (Q2 and Q3) and the primary-side power switch is well-synchronized, which avoids the cross conduction of the two switches and provides reliable synchronous rectification. In addition, the current injection function via the SR power switch (Q2 and Q3) enables zero-voltage switching operation on the primary side.

R20 is connected to CONF0 and serves as R_{SET0} . The value of R20 is determined by the transformer turns ratio, which is a critical parameter in the design. According to [Table 4](#), the transformer turns ratio is specified as 8. Based on this value, R20 is set as 18 k Ω .

Table 4 Resistance for R_{SET0}

Turns ratio N_{MAIN}/N_{SEC}	R_{SET0}
5	3.9 k Ω
6	6.8 k Ω
7	12.0 k Ω
8	18.0 k Ω
9	27.0 k Ω
10	39.0 k Ω

R21 is connected to CONF1 and acts as R_{SET1} , defining the parameters for Hysteretic-mode operation. Choose options between 1 to 3 to finetune amount of loading for which system stays in Hysteretic mode. For this board, 3.9 k Ω (option 1 in [Table 5](#)) is chosen to keep the smallest power range operating in Hysteretic mode. For details, see the design guide [\[2\]](#).

Table 5 Resistance for R_{SET1}

Symbol	Option	1	2	3	4	5	6
	R_{SET1}	3.9 k Ω	6.8 k Ω	12.0 k Ω	18.0 k Ω	27.0 k Ω	39.0 k Ω
EA voltage for wakeup in Hysteretic mode	V_{EA_HMOH}	1.25 V	1.20 V	1.10 V	1.25 V	1.20 V	1.10 V
EA voltage for off-phase in Hysteretic mode	V_{EA_HMOFF}	0.95 V	0.9 V	0.8 V	0.95 V	0.9 V	0.8 V
EA voltage Hysteretic mode exit threshold	V_{EA_LHM}	1.4 V	1.4 V	1.4 V	1.6 V	1.6 V	1.6 V

The output voltage feedback is through the sense resistors R22 and R23 to the FB pin. The FB reference voltage is 1.2 V. A compensation network consisting of C12, C15, and R18 is implemented to stabilize the output voltage regulation. This network is carefully designed to ensure that the power supply's output voltage remains stable and within the desired range. For a detailed understanding of the compensation network's calculation, see the design guide [\[2\]](#).

To minimize output voltage ripple, the choice of output capacitors is crucial. The output capacitors C16, C18 are recommended to have low equivalent series resistance (ESR) type capacitor. A low pass filter L4 and C23 are added to further filter the output ripple. And a ceramic capacitor C21 is added to suppress the high frequency noise.

7 Bill of materials

7 Bill of materials

Table 6 BOM

No	Designator	Description	Manufacturer	Part number	Qty
1	BR1	Bridge rectifier 1 phase 600 V 8 A GBU	onsemi	GBU8J	1
2	C1	Safety capacitors 310 VAC 0.33 uF 20%	DGCX	X2334K/310V/ P=10	1
3	C13	MLCC - SMD/SMT 100 Volts 220 pF X7R 10% 0603	-	-	2
4	C3	MLCC - SMD/SMT 100 Volts 820 pF COG/NP0 1% 0603	-	-	1
5	C5, C20	MLCC - SMD/SMT 50 Volts 680 pF X7R 10% 0603	-	-	2
6	C6	MLCC - SMD/SMT 1000 pF 1 kV 10% 1206	-	-	1
7	C7	MLCC - SMD/SMT 50 Volts 33 pF X7R 10% 0603	-	-	1
8	C8, C9	Aluminium electrolytic capacitors - Radial leaded 22 uF 35 V	BERYL	RG035M220L O5*11TA- 1A1E	2
9	C10	MLCC - SMD/SMT 100 nF 50 VDC 10% 1206 X7T	-	-	1
10	C11	Safety capacitors 1500 pF 310 V 20%	KEMET	C741U152MS WDCA7317	1
11	C12	MLCC - SMD/SMT 50 Volts 68 nF X7R 10% 0603	-	-	1
12	C14, C19	MLCC - SMD/SMT 100 nF 50 V 10% 1206	-	-	2
13	C15	MLCC - SMD/SMT 50 Volts 1.5 nF X7R 10% 0603	-	-	1
14	C16, C18	CAP ALUM POLY 1200 uF 20% 16 V T/H	Nichicon	RNL1C122MD S1KX	2
15	C17	MLCC - SMD/SMT 10 uF 50 V 10% 1206	-	-	1
16	C21	MLCC - SMD/SMT 100 nF 50 V 10% 0603	-	-	1
17	D2	Surface mount rectifier 1.0 A/1000 V	onsemi	S1M	1
18	D3, D4	Diode Schottky 200 V 1 A DO214AC	Micro Commercial Co	SS1200-LTP	2
19	D5	Chip LED Waterclear, size 0603, blue	Würth Elektronik	150060BS750 03	1
20	D6	Zener Diode 22 V 500 mW ±2% surface mount SOD-123	Vishay	MMSZ5251C- E3-08	1
21	Drain, GNDP, GNDS1	Test point THT, white	Keystone Electronics Corp.	5012	3

100 W power supply using CoolSET™ SiP ICE180LM

EVAL_100W1_ZVS_180LM



7 Bill of materials

No	Designator	Description	Manufacturer	Part number	Qty
22	EA, ENP, FB, GDSR, VCCP, ZCDP	Test point THT, white	Keystone Electronics Corp.	5002	6
23	F1	Time lag fuse, 300 V, 3.15 A	Littelfuse	36913150000	1
24	GNDS, +12V, LINE, NEUTRAL	Solder terminal, double turret, .109 long	Keystone Electronics Corp.	1502-2	4
25	L1	Inductor common mode standard polarization core 4 pins, 400 uH	Endela Electronics	L-13-0100	1
26	L2	Inductor common mode standard polarization core 4 pins, 10 mH	Tenda	TD1515-10MH 0.2*1.5	1
27	L3	Radial leaded wire wound inductor WE-TI, 10 uH 4.70 A	Würth Elektronik	7447452100	1
28	NTC1	Power NTC 2.5ohm Y kink bulk	Bourns	BN- LG08Y2R5MY B	1
29	Q1	SIPMOS small-signal-transistor	Infineon Technologies	BSS127H6327 XTSA2	1
30	Q4	Bipolar transistors - SOT-23, 45 V, 800 mA, NPN	Diotec	BC817-25	1
31	R1, R2	Thick film resistors - SMD 1/4 Watt 1.2 Mohm 1206 5%	-	-	2
32	R3, R4	Thick film resistors - SMD 50 kohm 250 mW 1206 1%	-	-	2
33	R5	Thick film resistors - SMD 17.4 kohm 100 mW 0603 1%	-	-	1
34	R6, R7	Thick film resistors - SMD 1/4 Watt 1.3 Mohm 1206 1%, 500 V rating	-	-	2
35	R10, R11	Thick film resistors - SMD 1/4 Watt 150 kohm 1206 1%	-	-	2
36	R12	Thick film resistors - SMD 2 kohm 1% 0603	-	-	2
37	R13, R18	Thick film resistors - SMD 22 kohm 1% 0603	-	-	2
38	R14, R15	Thick film resistors - SMD 15 kohm 100 mW 0603 1%	-	-	1
39	R16	Thick film resistors - SMD 0603 2.2 ohm 1%	-	-	1
40	R17	Thick film resistors - SMD 1/4 Watt 51 ohm 1206 5%	-	-	2
41	R19	Thick film resistors - SMD 10 kohm 100 mW 0603 1%	-	-	1
42	R20	Thick film resistors - SMD 18 kohm 1% 0603	-	-	1

100 W power supply using CoolSET™ SiP ICE180LM

EVAL_100W1_ZVS_180LM



7 Bill of materials

No	Designator	Description	Manufacturer	Part number	Qty
43	R21	Thick film resistors - SMD 3.9 kohm 1% 0603	-	-	1
44	R22	Thick film resistors - SMD 20 kohm 100 mW 0603 1%	-	-	1
45	R23	Thick film resistors - SMD 180 kohm 0603 1%	-	-	1
46	R24	Thick film resistors - SMD 5.1 kohm 100 mW 0603 1%	--	-	1
47	R25, R251, R252	Thick film resistors - SMD 1/4 Watt 100 ohms 1206 1%	-	-	3
48	R26	Thick film resistors - SMD 0 ohm 0603	-	-	1
49	R27	Thick film resistors - SMD 120 kohm 0805	-	-	1
50	R28	Thick film resistors - SMD 0 ohm 0603	-	-	DN P
51	R251, R252	Thick film resistors - SMD 1/4 Watt 150 ohm 1206 1%	-	-	DN P
52	VR1	Varistors 275 VAC 10% 7 mm	Bourns	CV275K7BL1	1
53	X1	Through hole jumper, 10.16 mm pitch, 2 pins	Samtec	JL-400-25-T	1
54	CONF	Connector header through hole 2 position 0.100" (2.54 mm)	Samtec	TSW-102-08-G-S	1
55	C2, C4	Aluminium electrolytic capacitors - Radial leaded 120 uF 420 V	Ymin	KCMI2502T12 1MF	2
56	C23	CAP ALUM POLY 680 uF 20% 16 V T/H	AVX	RPF0811681M 016K	1
57	Q2, Q3	Power-transistor, optimized for high performance SMPS	Infineon Technologies	ISC046N13N M6ATMA1	2
58	U1	CoolSET™ SiP	Infineon Technologies	ICE180LM	1
59	L4	SMD WE-HCC HCur Cube8070 1 uH 17 A 2.95 mohm	Würth Elektronik	7443340100	1
60	T1	100 W transformer 750345654 Rev01	Würth Elektronik	750345654	1
61	R8, R9	Thick film resistors - SMD 1206 0.33 ohm 1%	Bourns	CRL1206-FW-R330ELF	2

100 W power supply using CoolSET™ SiP ICE180LM

8 Transformer specifications

8 Transformer specifications

8.1 Electrical diagram and coil build

- Manufacturer and part number: Würth Elektronik (750345654 Rev 01)

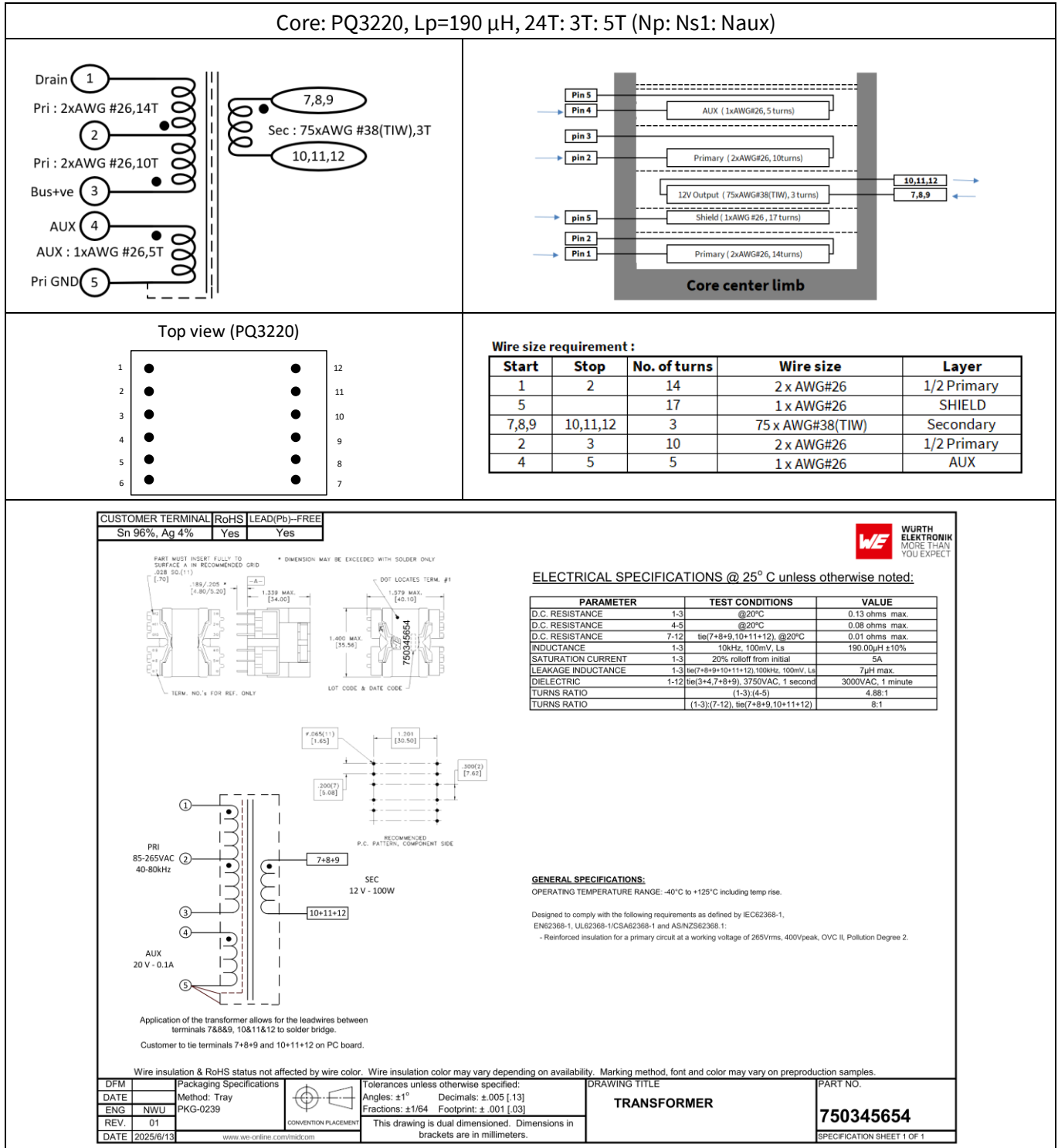


Figure 5 Electrical diagram and coil structure

100 W power supply using CoolSET™ SiP ICE180LM

EVAL_100W1_ZVS_180LM

9 Test results

9 Test results

All performance data is measured at room temperature $T_A = 25^\circ\text{C}$ unless otherwise specifically mentioned.

9.1 Efficiency

Efficiency data has been taken under +12 V load condition with NTC1 shorted and LED D5 removed. The standby power measured at 230 VAC is 77 mW.

Table 7 Efficiency

Input (VAC/Hz)	Load percentage (%)	PIN (W)	VOUT (VDC)	IOUT (A)	POUT (W)	Efficiency η (%)	Average η (%)
90/60	No load	0.02	11.99	0.00	/	/	/
	10	10.96	12.00	0.84	10.04	91.61	/
	25	26.59	11.99	2.06	24.75	93.06	91.96
	50	53.45	11.97	4.14	49.54	92.70	
	75	81.05	11.95	6.21	74.21	91.57	
	100	109.22	11.94	8.28	98.86	90.52	
115/60	No load	0.02	11.99	0.00	/	/	/
	10	11.03	12.00	0.84	10.04	91.07	/
	25	26.51	11.99	2.06	24.75	93.35	92.94
	50	52.86	11.98	4.12	49.41	93.47	
	75	80.14	11.94	6.24	74.47	92.93	
	100	106.88	11.90	8.27	98.35	92.02	
230/50	No load	0.08	11.99	0.00	/	/	/
	10	11.23	11.99	0.84	10.05	89.52	/
	25	26.67	11.98	2.06	24.72	92.68	93.32
	50	53.34	11.95	4.18	49.95	93.65	
	75	79.62	11.90	6.26	74.49	93.56	
	100	104.70	11.85	8.25	97.78	93.39	
264/50	No load	0.11	11.99	0.00	/	/	/
	10	11.31	11.99	0.84	10.04	88.72	/
	25	26.81	11.97	2.06	24.70	92.16	93.25
	50	53.42	11.95	4.18	49.96	93.52	
	75	79.69	11.92	6.27	74.71	93.76	
	100	104.85	11.87	8.26	98.09	93.56	

100 W power supply using CoolSET™ SiP ICE180LM

EVAL_100W1_ZVS_180LM

9 Test results

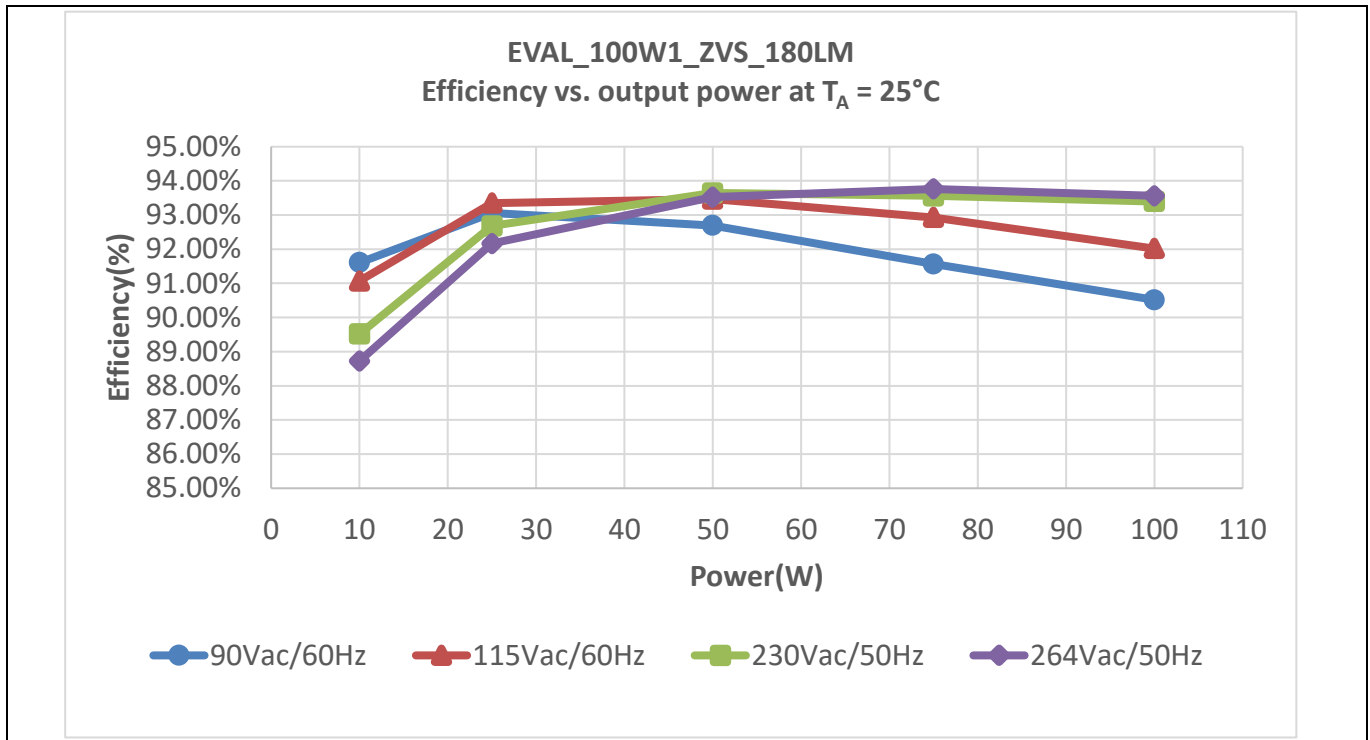


Figure 6 Efficiency vs. output power (W)

9.2 ESD immunity (EN 61000-4-2)

The evaluation board was subjected to ESD testing according to EN 61000-4-2 level 3 (±8 kV contact and ±15 kV air discharge). It was tested at full load (resistive load) and meets criteria A (normal performance within the specification limits).

Table 8 ESD immunity test result

Description	ESD test	Level	Number of strikes				Test result
			Vout	GNDS	Line	Neutral	
230 VAC, 100 W	Contact	±8 kV	10	10	10	10	Pass
	Air	±15 kV	10	10	10	10	Pass

9.3 Surge immunity (EN 61000-4-5)

The evaluation board was subjected to a surge immunity test according to EN 61000-4-5 level 4 (±2 kV Differential mode and ±4 kV Common mode). It was tested at full load (resistive load) and meets criteria A (normal performance within the specification limits).

Table 9 Surge immunity test result

Description	Test	Level		Number of strikes				Test result
				0°	90°	180°	270°	
230 VAC, 100 W	Differential mode	±2 kV	L → N	3	3	3	3	Pass
	Common mode	±4 kV	L → G	3	3	3	3	Pass
		±4 kV	N → G	3	3	3	3	Pass

100 W power supply using CoolSET™ SiP ICE180LM

EVAL_100W1_ZVS_180LM

9 Test results

9.4 Conducted emissions (EN 55022 Class B)

Conducted EMI was measured by Schaffner (SMR4503) and followed the test standard of EN 55022 (CISPR 22) Class B. The evaluation board was tested at full load (resistive load) at input voltages of 115 V AC and 230 V AC.

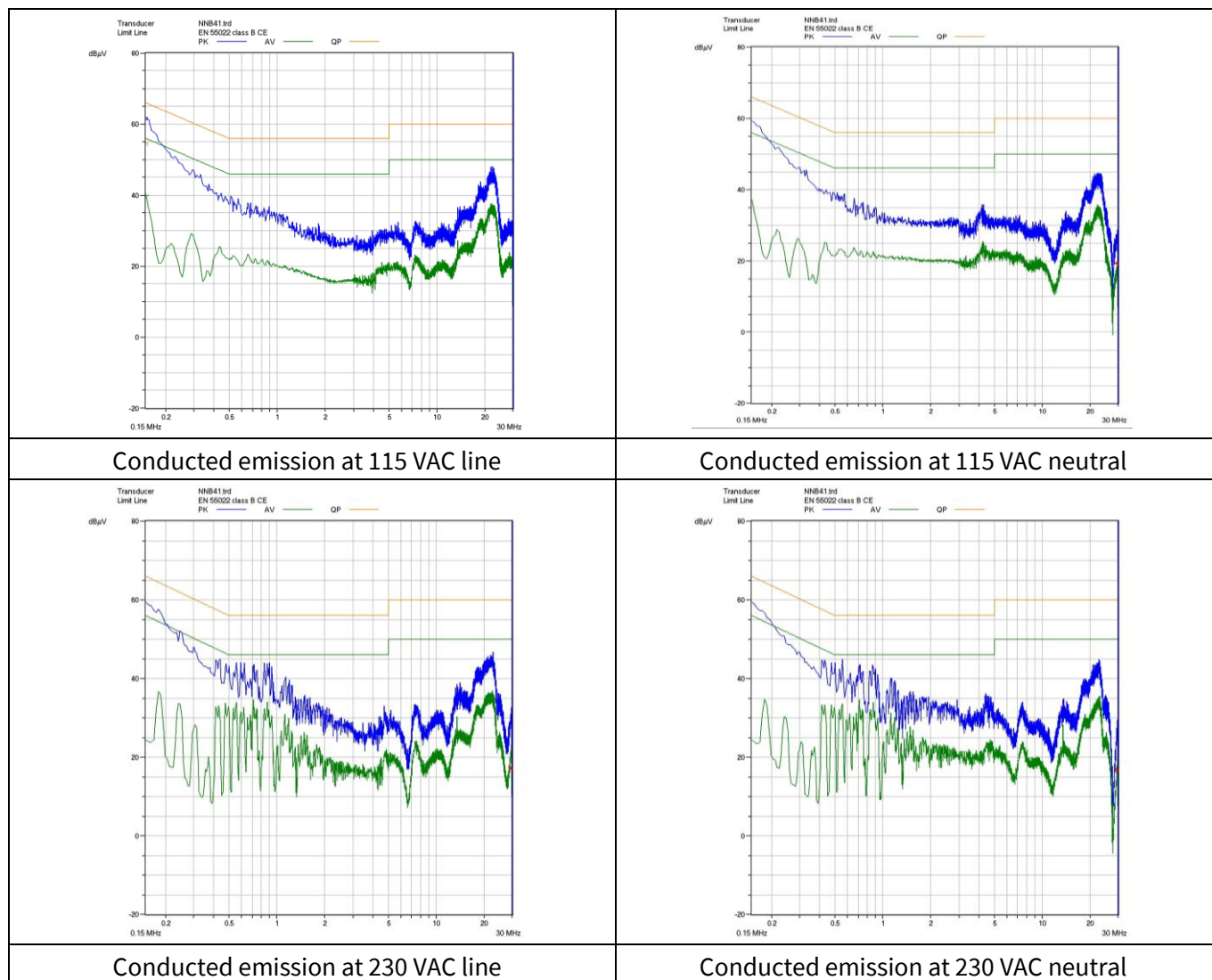


Figure 7 Conducted emissions

9.5 Thermal measurement

The thermal testing of the evaluation board was executed in open air without forced ventilation at an ambient temperature of 25°C. An infrared thermography camera (FLIR-T62101) was used to capture the thermal reading of critical components. The measurements were taken at the maximum load running for one hour with NTC1 shorted. The tested input voltages were 90 V AC and 264 V AC.

Table 10 Component temperature at full load under $T_A = 25^\circ\text{C}$

Reference designator	Major component	90 VAC (°C)	264 VAC (°C)
R25, R251, R252	Primary side RCD snubber resistor	90.4	70.5
IC1	ICE180LM	72	60.1

100 W power supply using CoolSET™ SiP ICE180LM

EVAL_100W1_ZVS_180LM

9 Test results

Reference designator	Major component	90 VAC (°C)	264 VAC (°C)
Q2	SR MOSFET	67.6	69.1
BR1	Bridge diode	86.6	46.8
T1	Main transformer core	62.9	65.1
T1	Main transformer winding	72.8	74.0

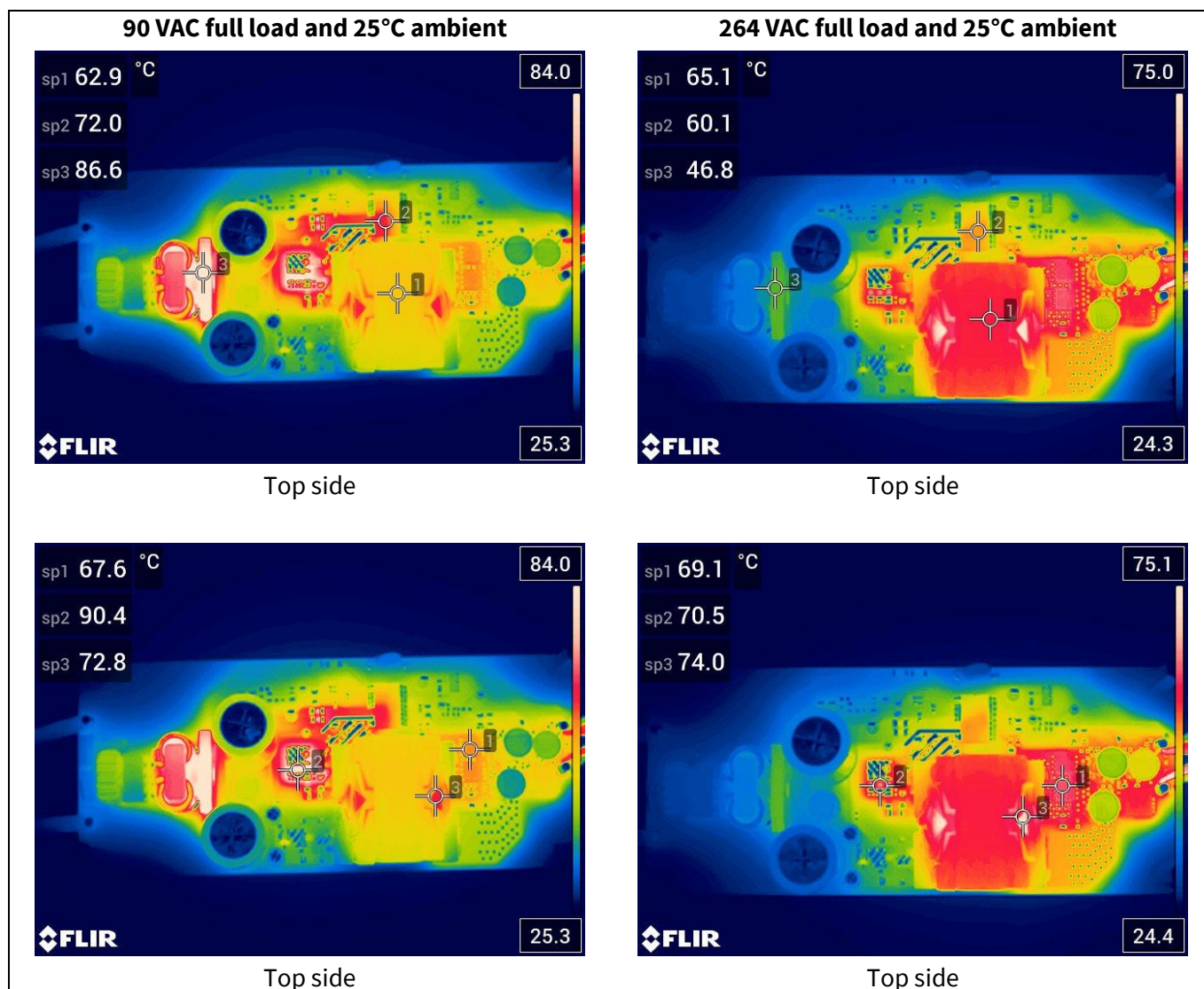


Figure 8 Infrared thermal image of EVAL_100W1_ZVS_180LM

100 W power supply using CoolSET™ SiP ICE180LM

EVAL_100W1_ZVS_180LM

10 Waveforms and scope plots

10 Waveforms and scope plots

All waveforms and scope plots were recorded with a Teledyne LeCroy HDO4034 oscilloscope.

10.1 Start-up with maximum load

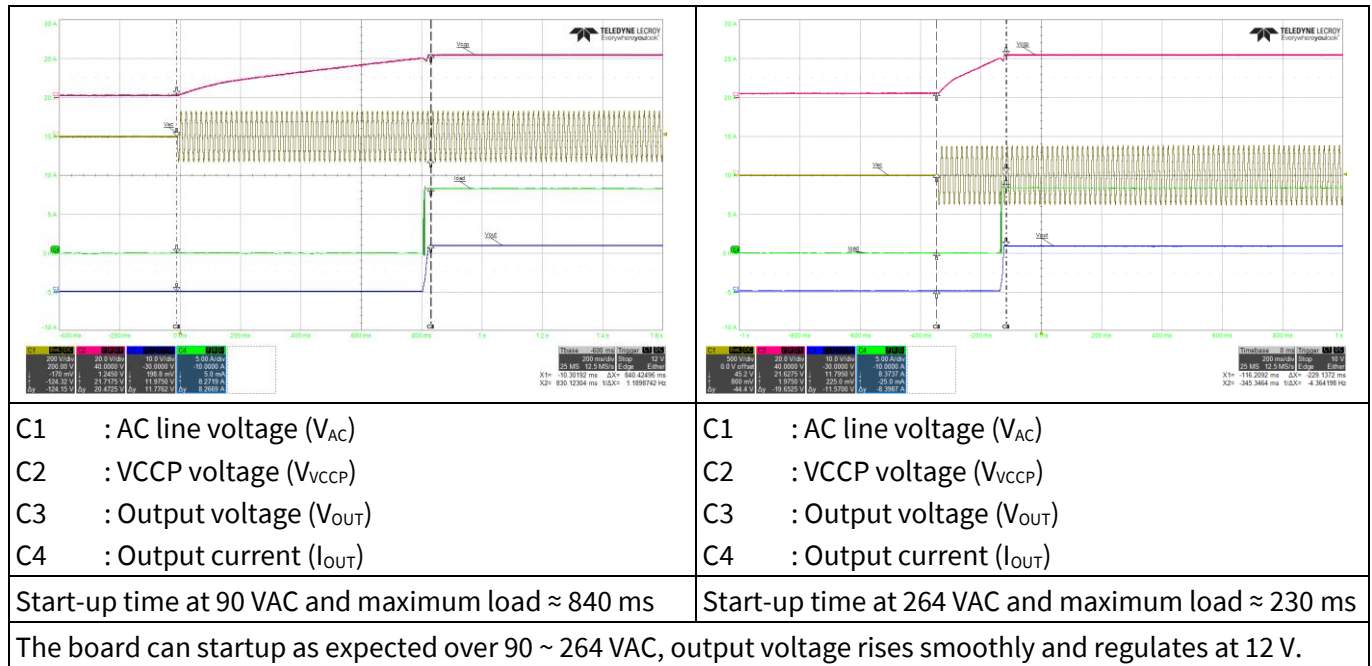


Figure 9 Start-up

10.2 Soft-start

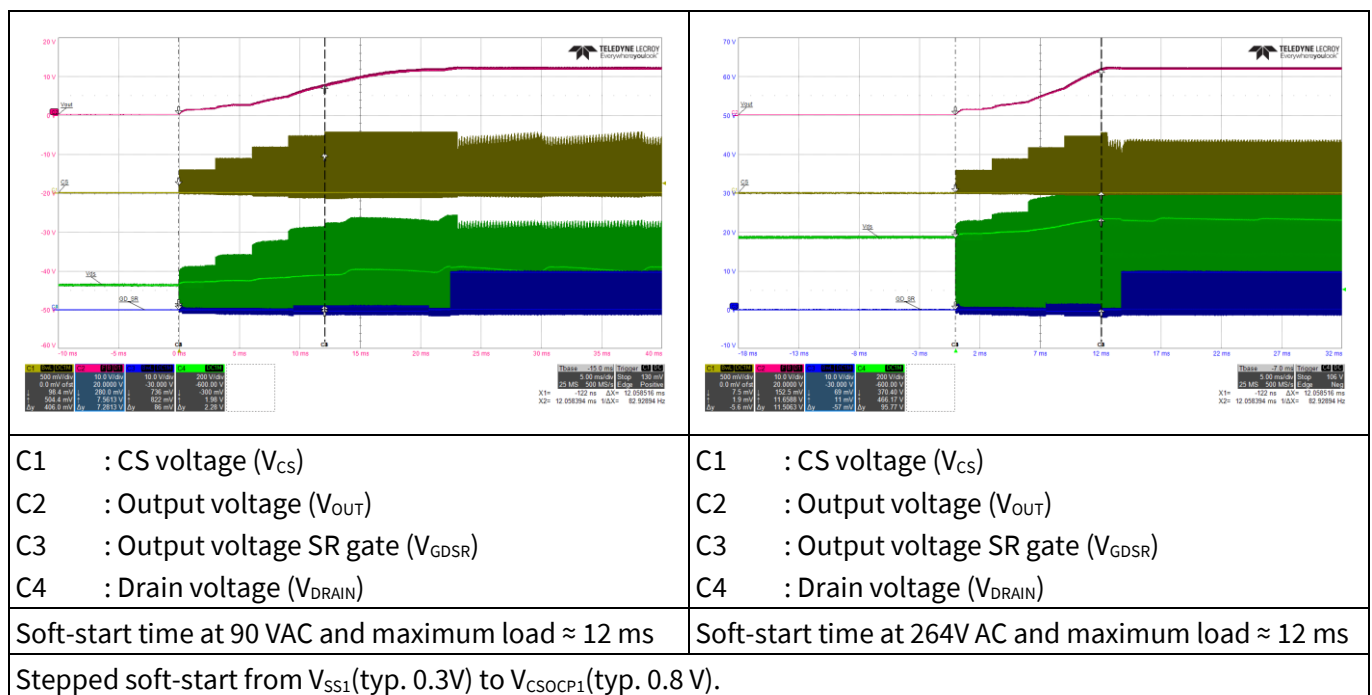


Figure 10 Soft-start

100 W power supply using CoolSET™ SiP ICE180LM

EVAL_100W1_ZVS_180LM

10 Waveforms and scope plots

10.3 Switching waveform at full load

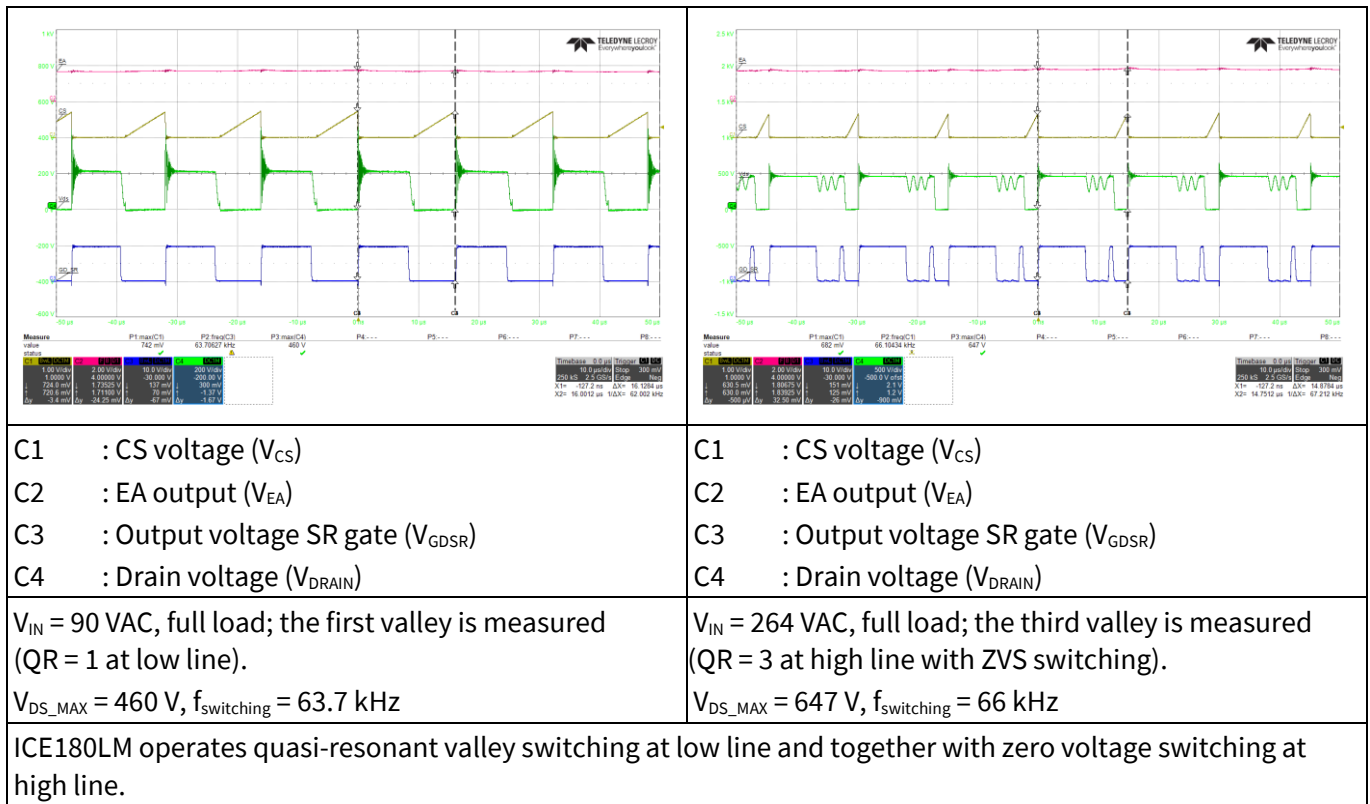


Figure 11 Drain and CS voltage at maximum load

10.4 SR FET voltage at full load

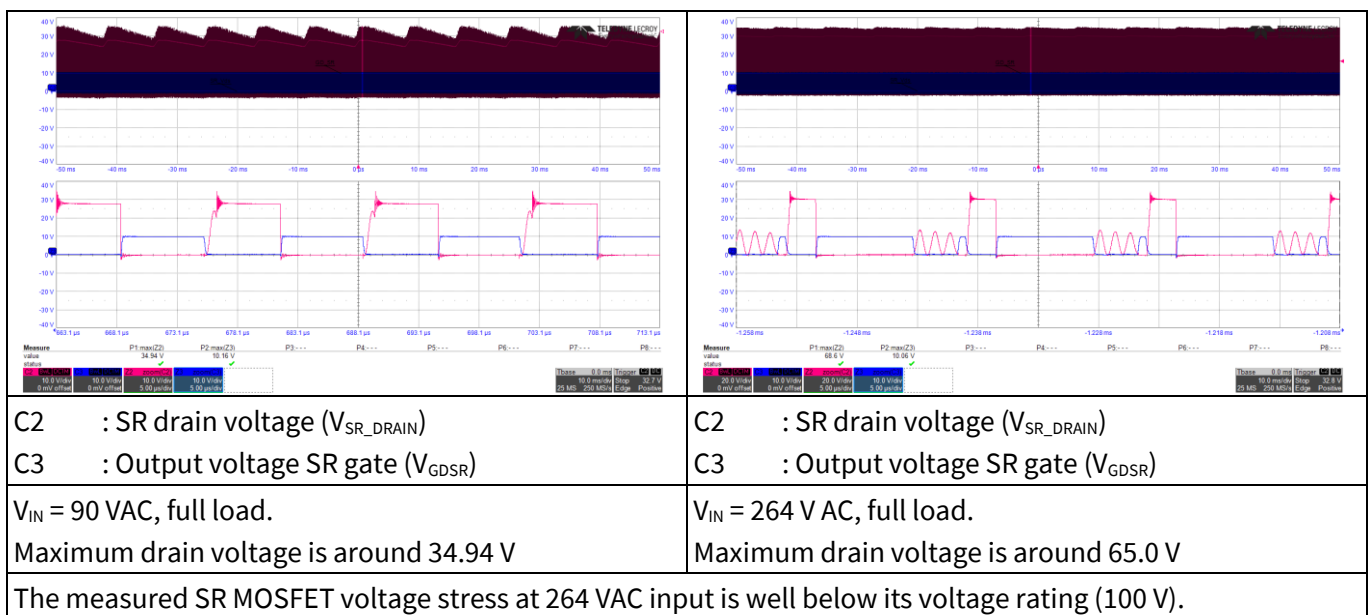


Figure 12 SR FET voltage

100 W power supply using CoolSET™ SiP ICE180LM

EVAl_100W1_ZVS_180LM

10 Waveforms and scope plots

10.5 Output ripple voltage at maximum load

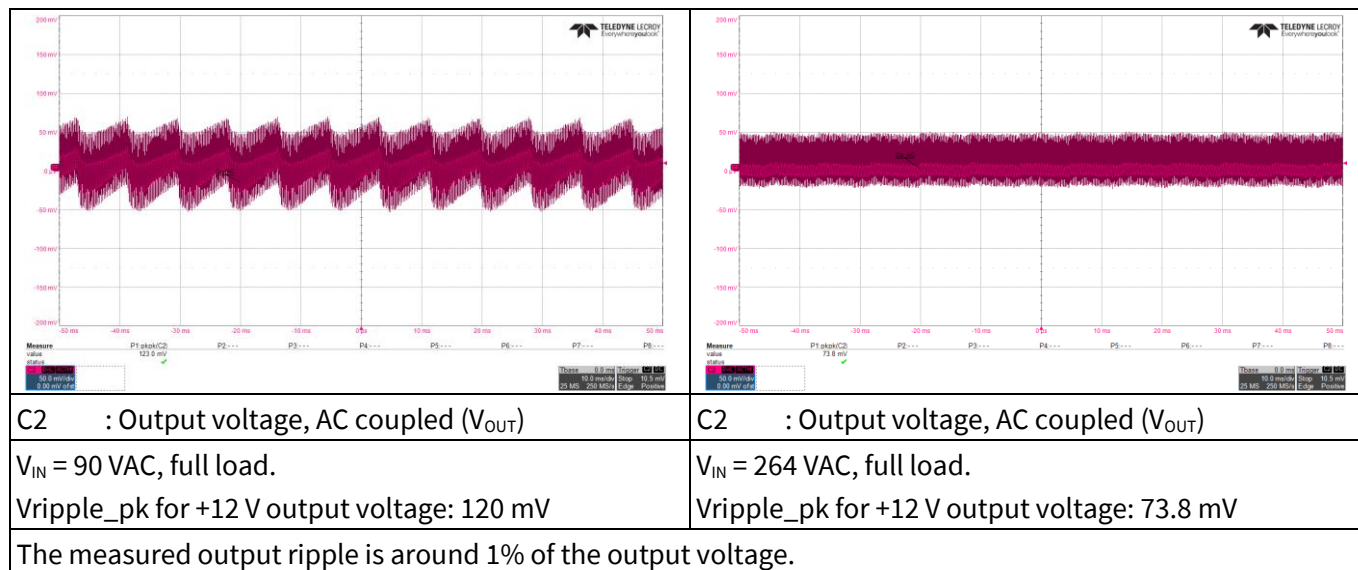


Figure 13 Output ripple voltage at full load (20 MHz bandwidth and 10 μ F electrolytic capacitor in parallel with 0.1 μ F ceramic capacitor)

10.6 Hysteretic mode operation

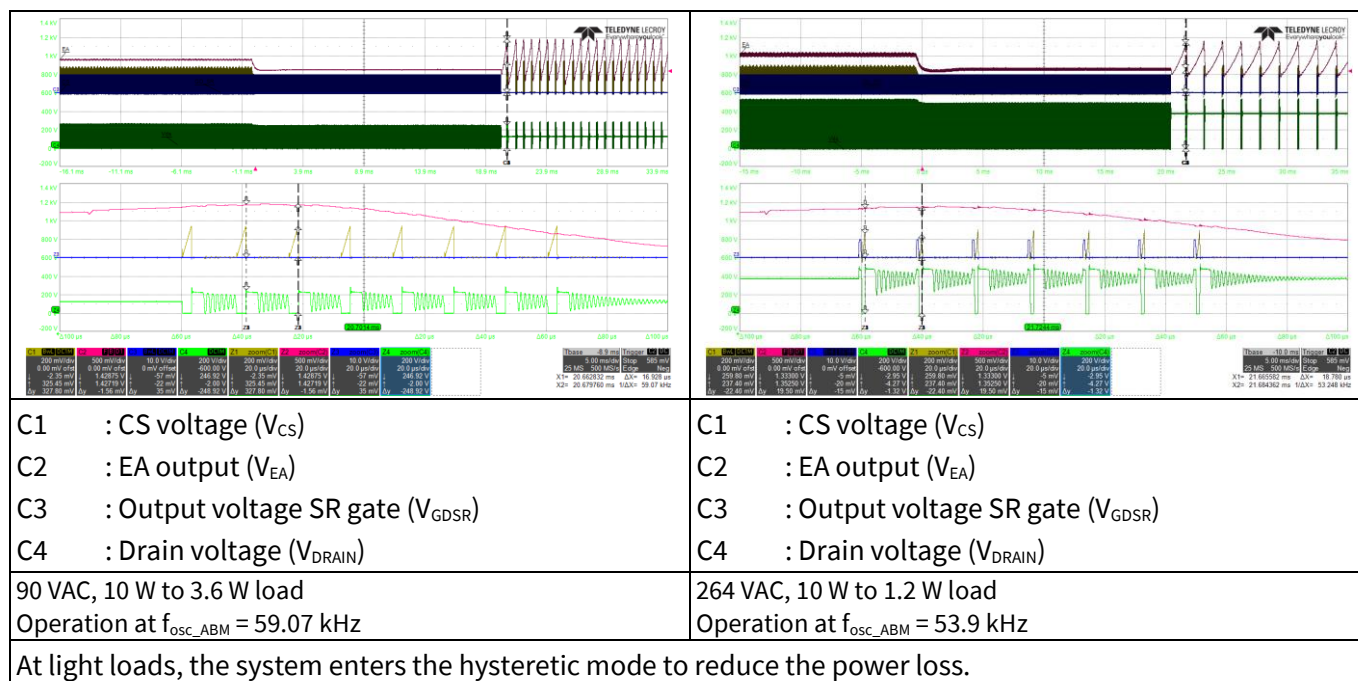


Figure 14 Hysteretic mode operation

100 W power supply using CoolSET™ SiP ICE180LM

EVAL_100W1_ZVS_180LM

10 Waveforms and scope plots

10.7 Overload protection

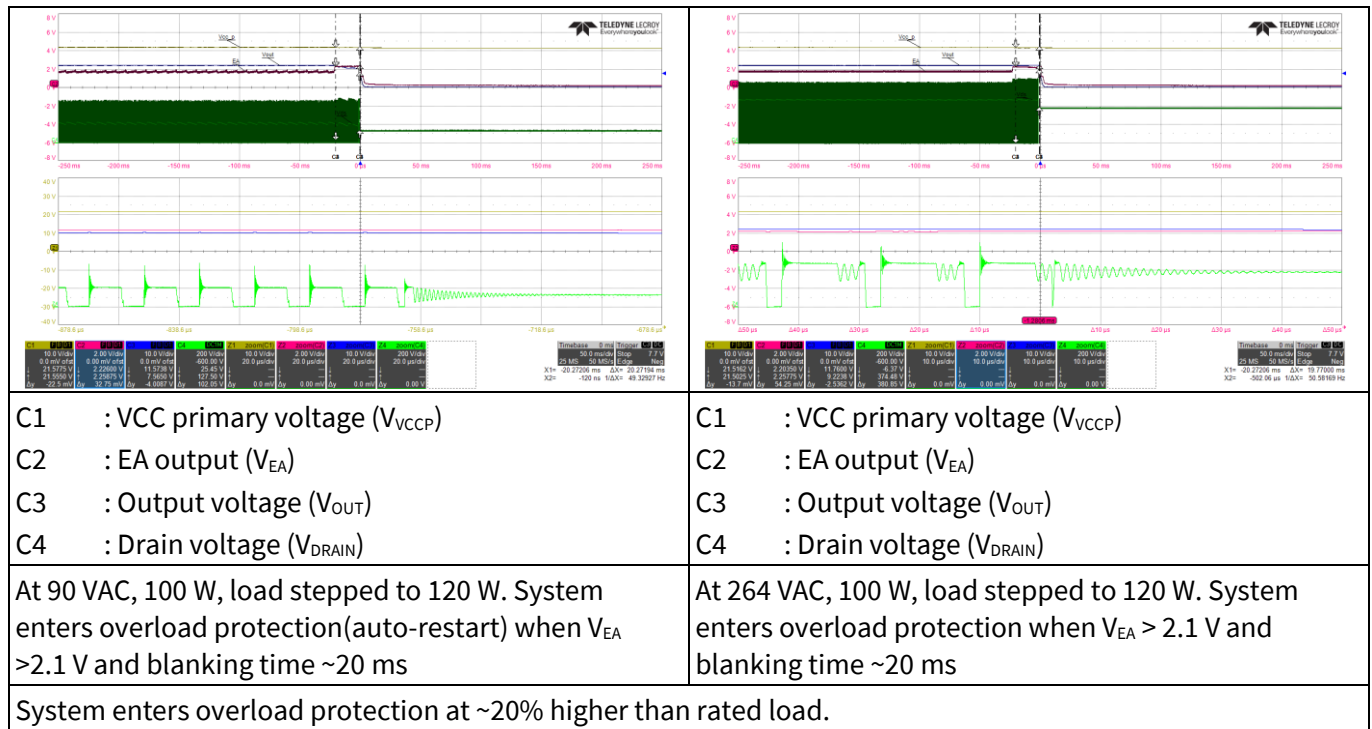


Figure 15 Overload protection

10.8 Line OVP

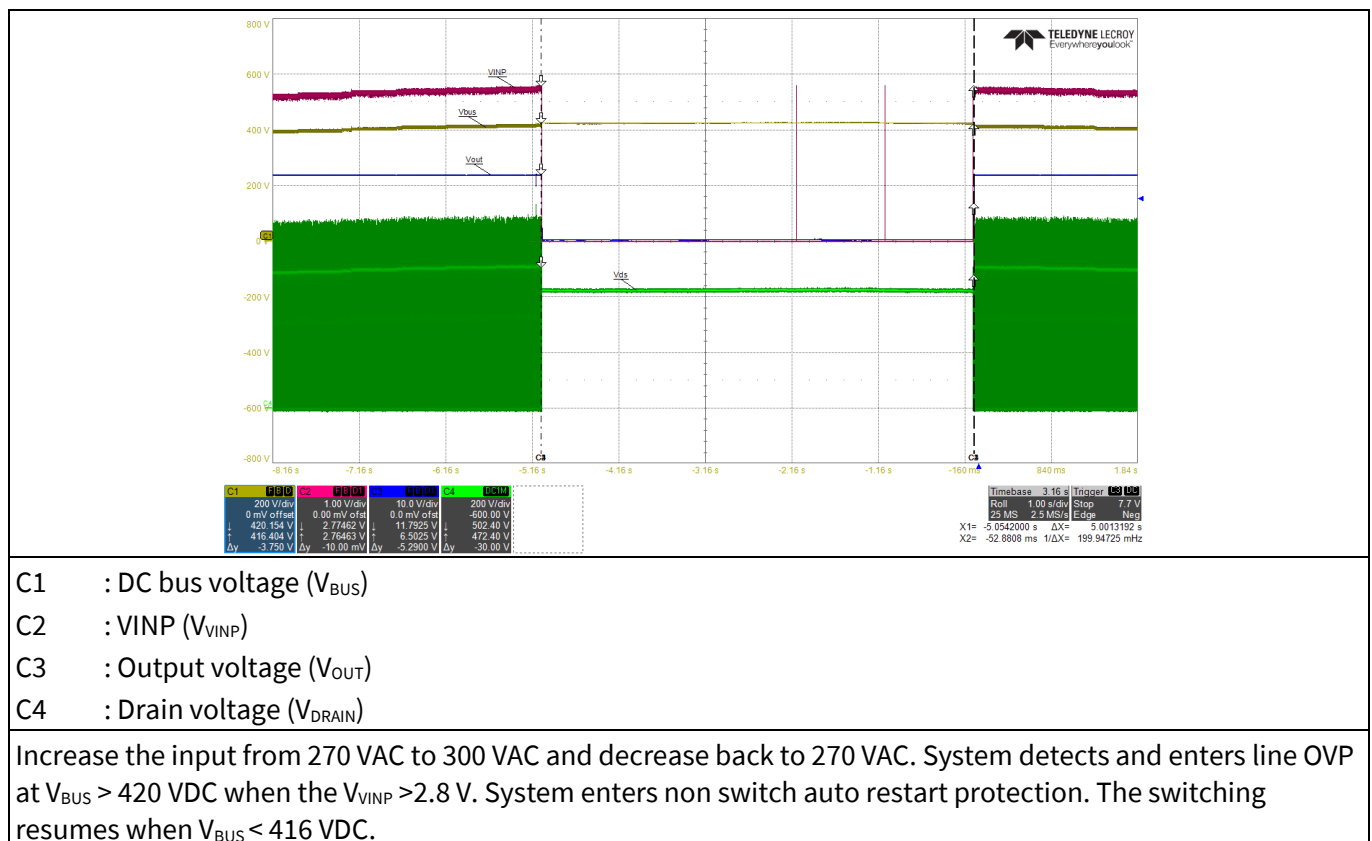


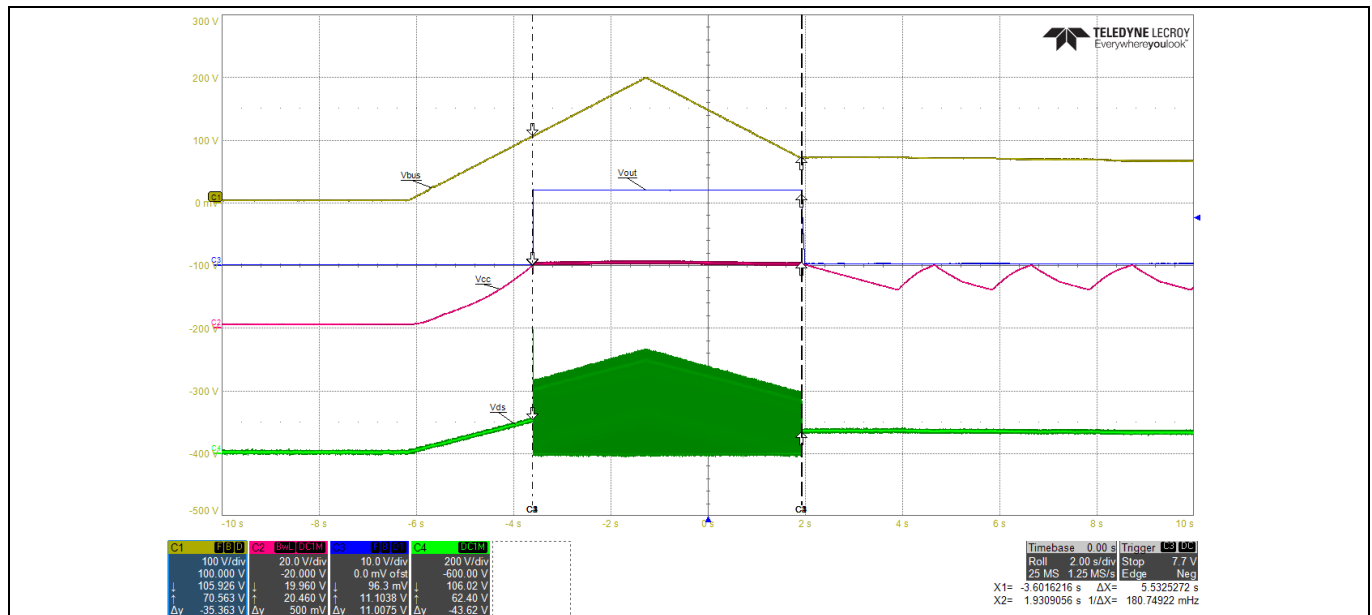
Figure 16 Line OVP

100 W power supply using CoolSET™ SiP ICE180LM

EVAL_100W1_ZVS_180LM

10 Waveforms and scope plots

10.9 Brown-in and brown-out



- C1 : DC bus (V_{BUS})
- C2 : VCC primary (V_{VCCP})
- C3 : Output voltage (V_{OUT})
- C4 : Drain voltage (V_{DRAIN})

Increase the input voltage from 0 VAC to 140 VAC and decrease back to 0 VAC. Brown-in is measured at $V_{BUS} > 105$ VDC and brown-out is measured at $V_{BUS} < 70$ VDC. When the bulk capacitor voltage drops below brown-out, non-switch auto restart is triggered.

System enters brown-in and brown-out protection as expected.

Figure 17 Brown-in and brown-out

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References

References

- [1] Infineon Technologies AG: *CoolSET™ SiP ICE180LM datasheet*; [Available online](#)
- [2] Infineon Technologies AG: *Design guide for ZVS QR flyback using CoolSET™ SiP*; [Available online](#)

Revision history

Revision history

Document revision	Date	Description of changes
V 1.0	2026-06-02	Initial release

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