500 W Gaming Power PSU Evaluation Board User's Manual

EVBUM2875/D

SPECIFICATION

onsemi's Device	Application	Input Voltage	Output Power	Topology
NCP1681DR2G NCP13994AXDR2G NCP4318BLC	Gaming PSU	90−264 Vac	500 W	CCM/DCM multi−mode totem pole PFC Half bridge LLC

	Output Specification
Output Voltage	12.8 V
Nominal Current	39 A

Avg. Efficiency	>93.5% @ 12.8 V 39 A at board end, 115 & 230 Vac
Ripple	<200 mV
Standby Power	< 300 mW @ 12 V & 230 Vac (No cable plug in)
Power Density	1 W/cm^3; 16 W/inch^3
Protection	Bulk UVP, OVP, SCP, OTP
Size	183 mm x 93 mm x 30 mm

Overview

This demo board uses NCP1681 CCM multi−mode PFC controller, latest current mode LLC controller NCP13994, and NCP4318 SR controller for low profile and small dimension design, enabling high power density PSU without FAN cooling.

The NCP1681 is a PFC controller IC designed to drive the bridgeless totem pole PFC topology. The bridgeless totem pole PFC is a power factor correction architecture that consists of a fast leg driven at the PWM switching frequency and slow leg that operates at the AC line frequency. This topology eliminates the diode bridge and significant improvement in the power stage efficiency, especially at low line. The controller can be configured to operate in continuous conduction mode (CCM) or multi−mode (CrM−CCM) operation.

The NCP13994 is a high performance current mode controller for half bridge resonant converters. This controller implements 700 V gate drivers, simplifying layout and reducing external component count. The built−in Brown−Out input function eases implementation of the controller in all applications. In applications where a PFC front stage is needed, the NCP13994 features a dedicated output to drive the PFC controller. This feature together with quiet skip mode technique further improves light load efficiency of the whole application.

NCP4318 is an advanced Synchronous Rectification (SR) controller for LLC resonant converter with minimum external components. It has two driver stages for driving the SR MOSFETs which are rectifying the outputs of the secondary transformer windings. The two gate driver stages have their own Drain and Source sensing inputs and operate independently of each other. The advanced adaptive dead time control compensates parasitic inductance voltage to minimize the body diode conduction and maximize the efficiency. The advanced turn−off control algorithm allows stable SR operation over entire load range.

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Key Features

- Universal AC input range (90−264 Vac)
- No−Load Power Consumption < 300 mW
- Avg. Efficiency: >93.5% @ 12.8 V/ 39 A at board end, 115 & 230 Vac
- Full Load Efficiency *93.9 % @ 115 Vac; 95.4 % @ 230 Vac*
- High power density: 1 W/cm^3; 16 W/ inch^3 without FAN cooling
- Protection: OVP, OCP, SCP, Bulk UVP
- PFC stage: NCP1681 for multi−mode totem pole PFC
- FCCrM to improve load range efficiency
- Frequency fold back to improve light load efficiency
- Fast Line/Load transient compensation
- Dedicate pin PFCok to inform LLC startup
- Totem pole PFC to implement best PFC efficiency
- No STDBY or AUX Power Stage
- LLC stage: NCP13994 implements current mode with fast response
- Automatic Dead Time, and Dead Time maximum clamp
- Light load mode to improve efficiency
- Quiet skip mode to improve Acoustic noise
- Normal operating VPFC keeps 395 V, and No load trigger green mode then VPFC hiccup between 395 V to 410 V
- Board size: 183 mm x 93 mm x 30 mm

Block Diagram and BOARD Photos

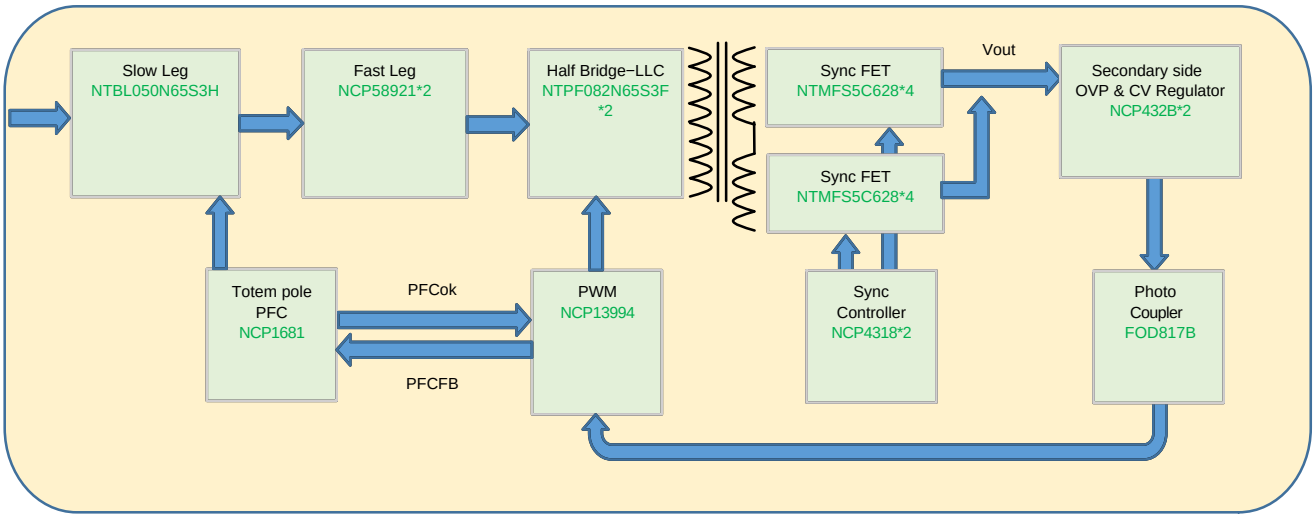


Figure 1. Overall Block Diagram of 500 W Gaming PSU Solution

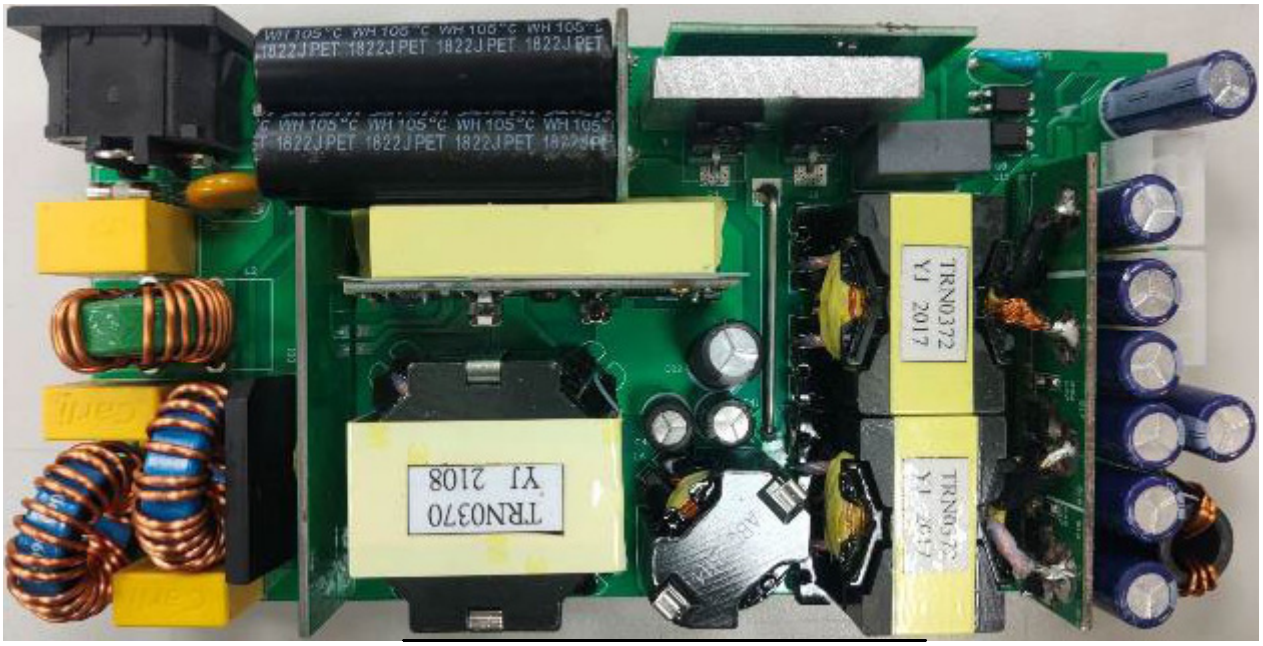


Figure 2. Side View 1 of Demo Board

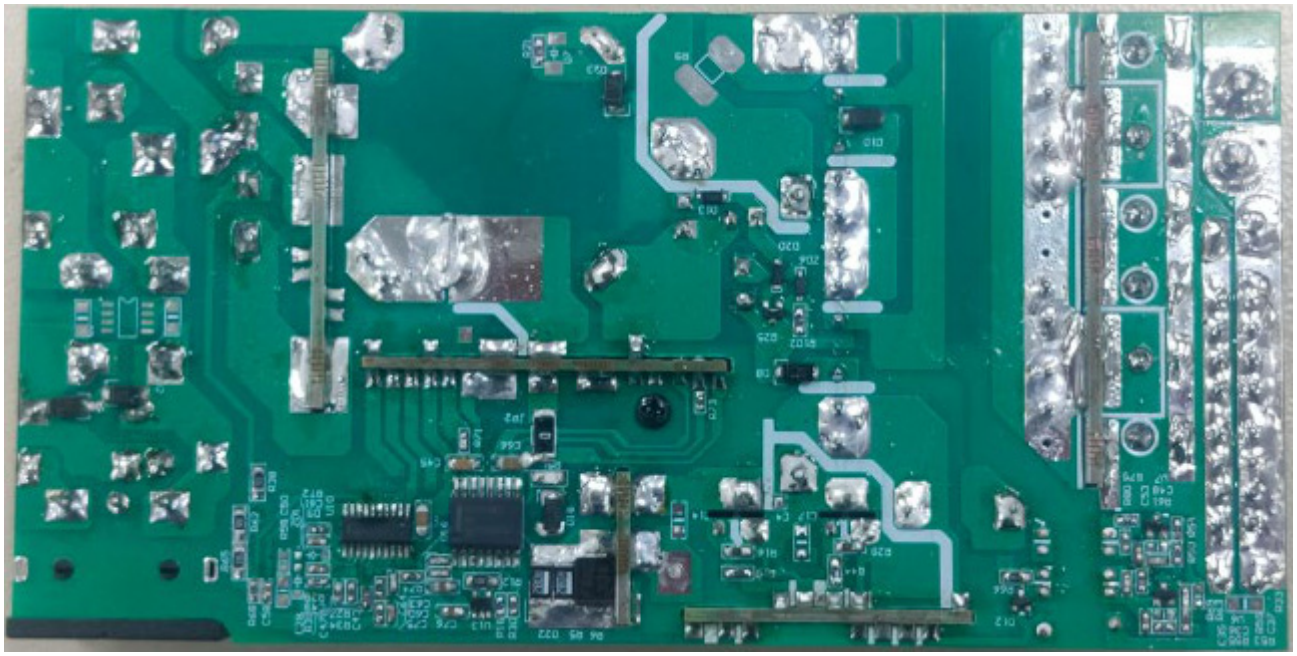


Figure 3. Side View 1 of Demo Board

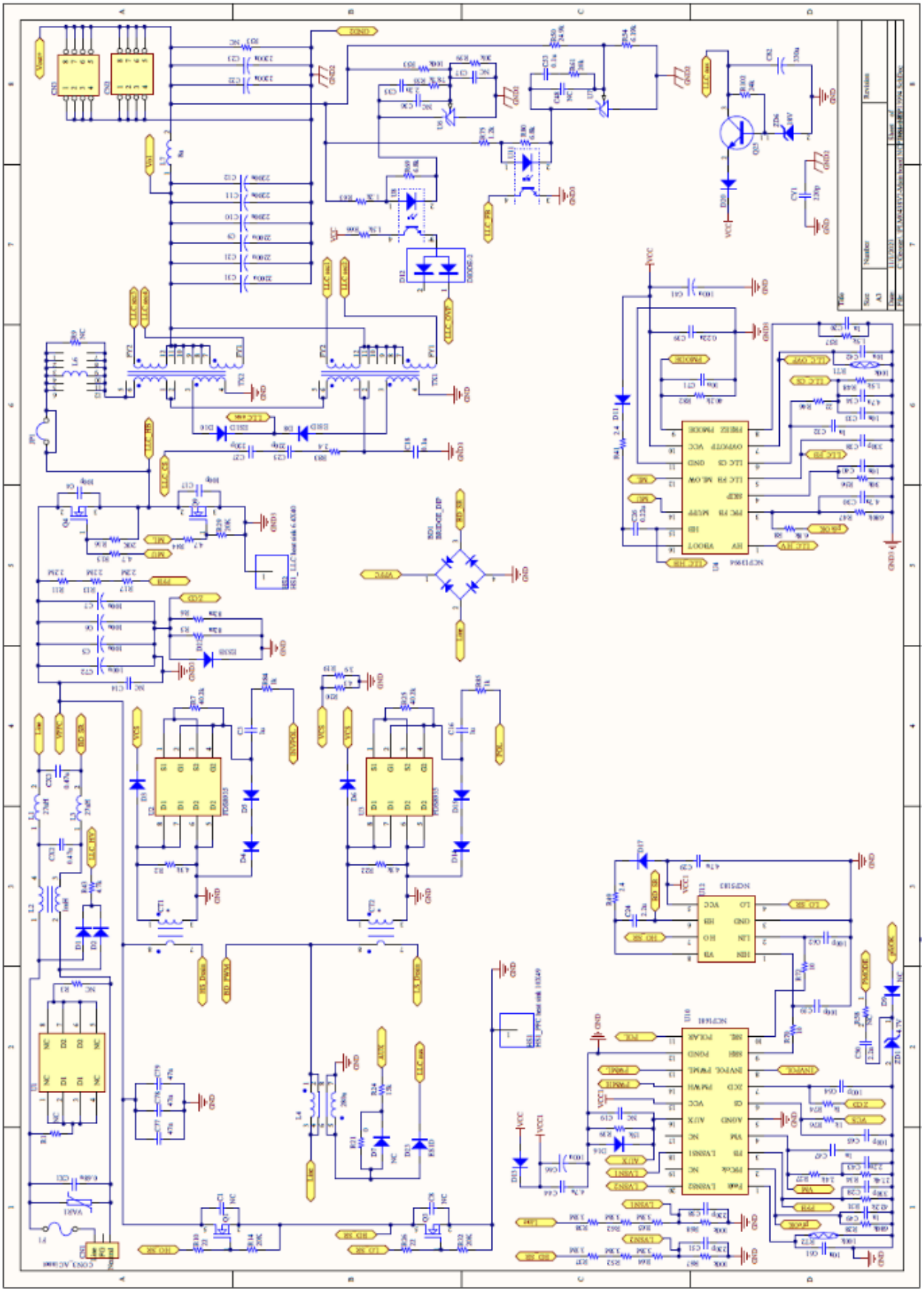


Figure 4. Circuit Schematic − 1

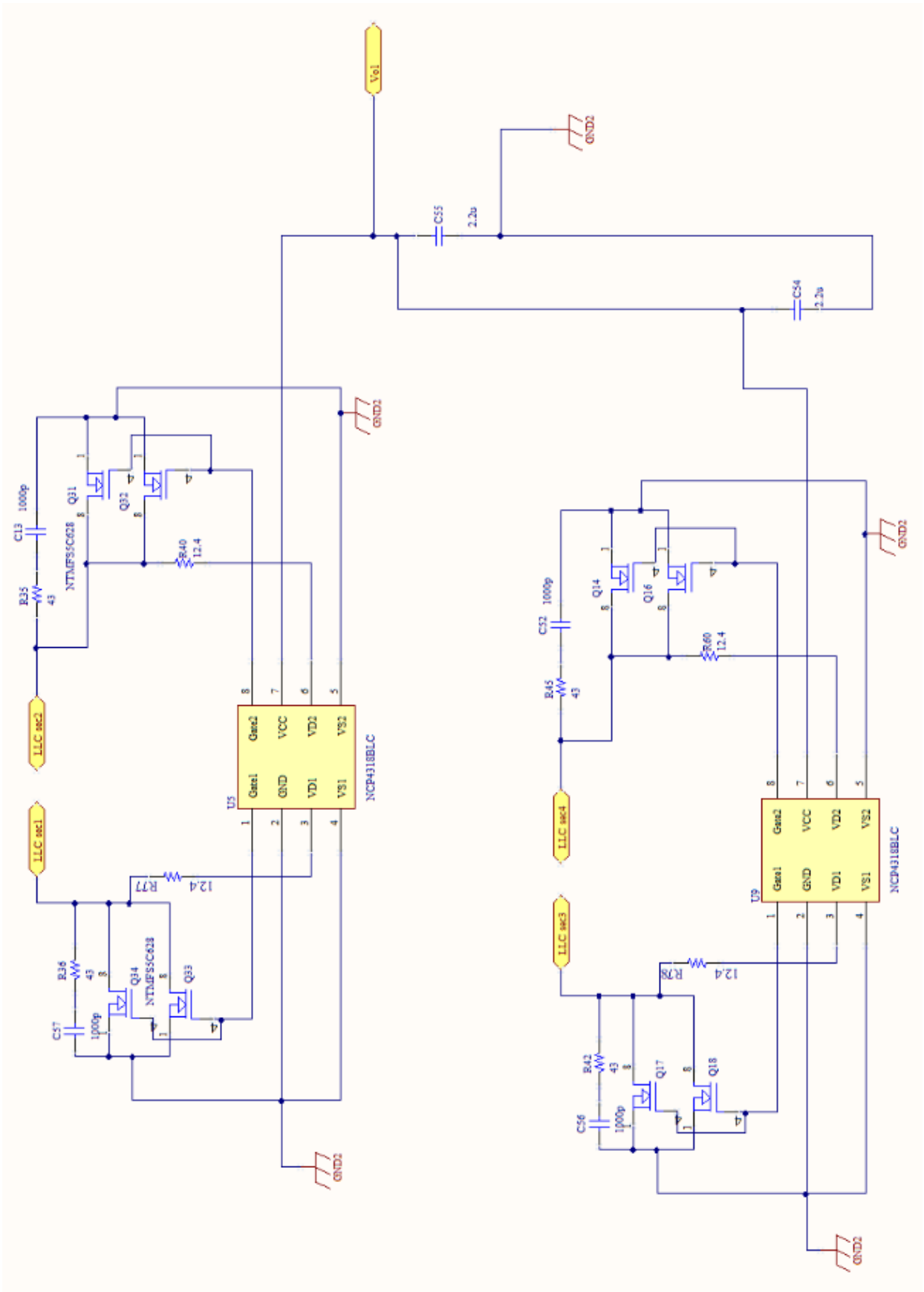


Figure 5. Circuit Schematic − 2

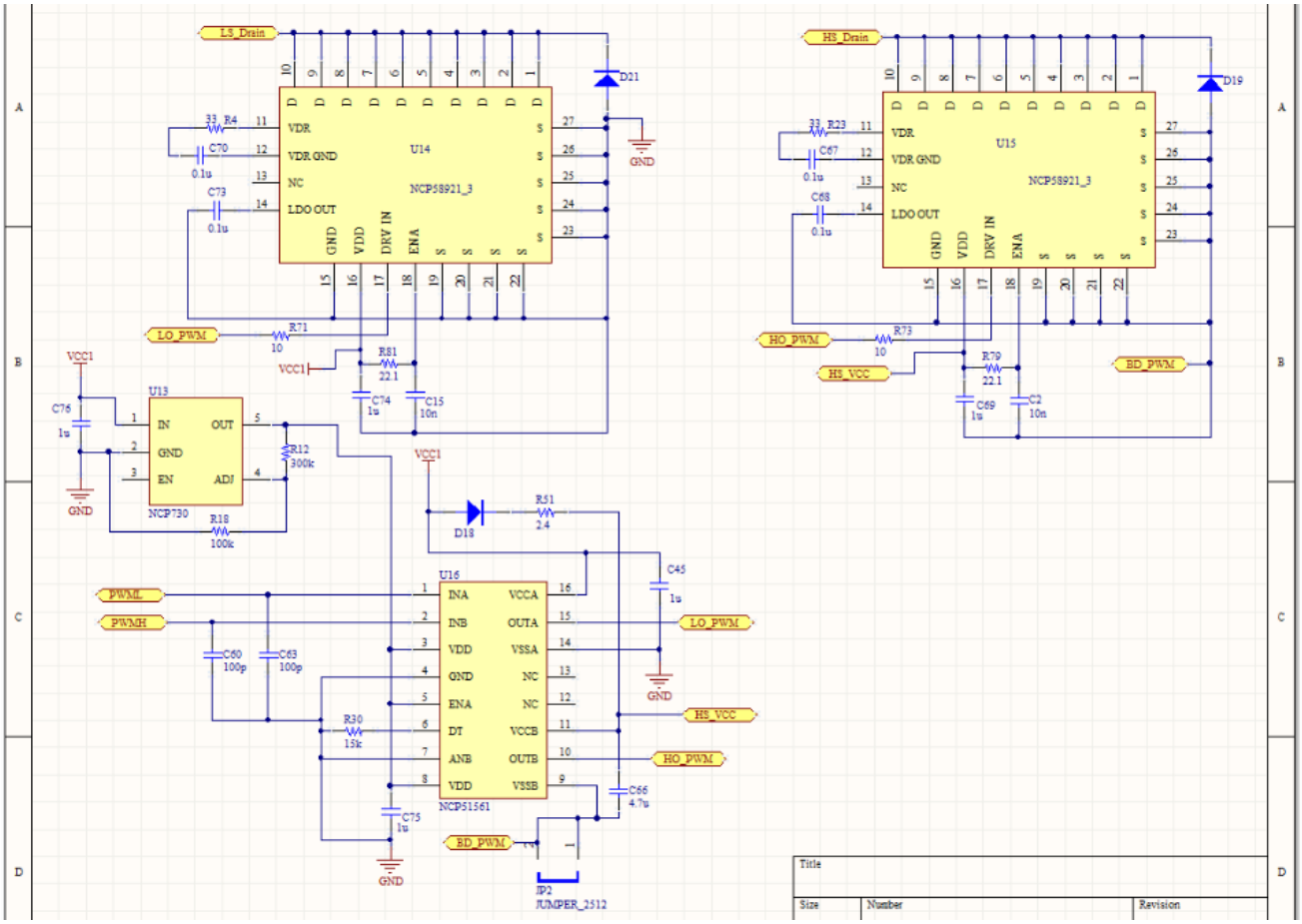


Figure 6. Circuit Schematic − 3

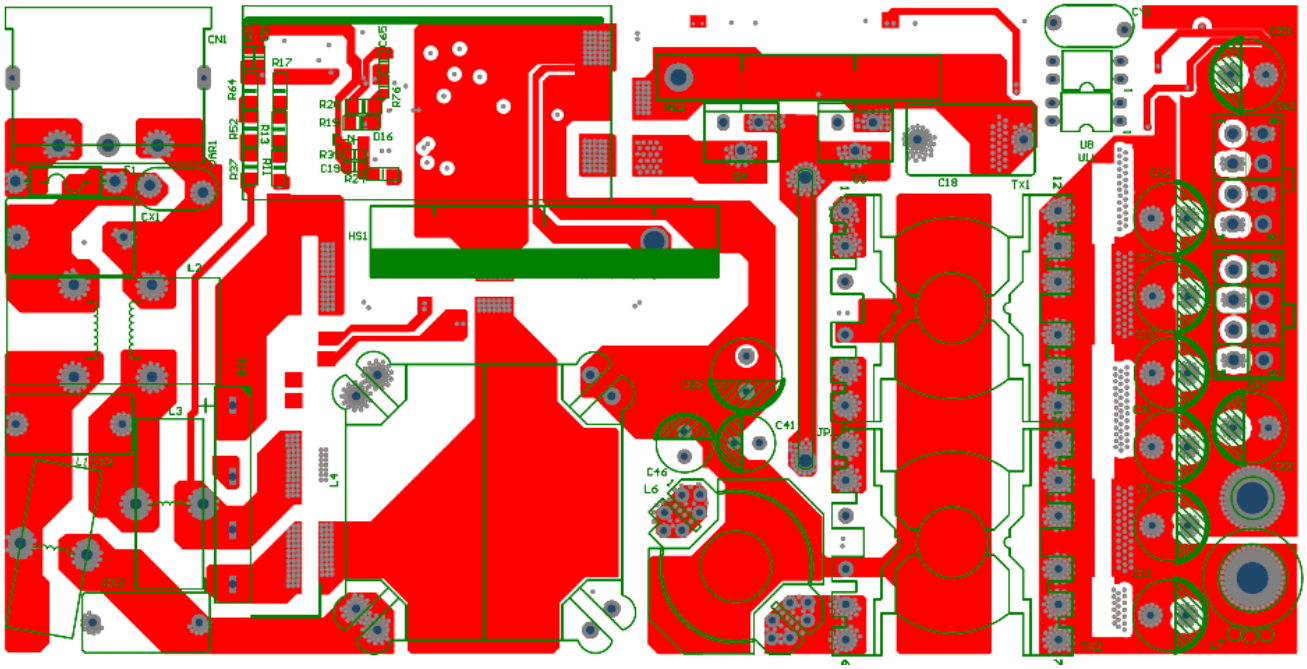


Figure 7. Top View of Mainboard's PCB

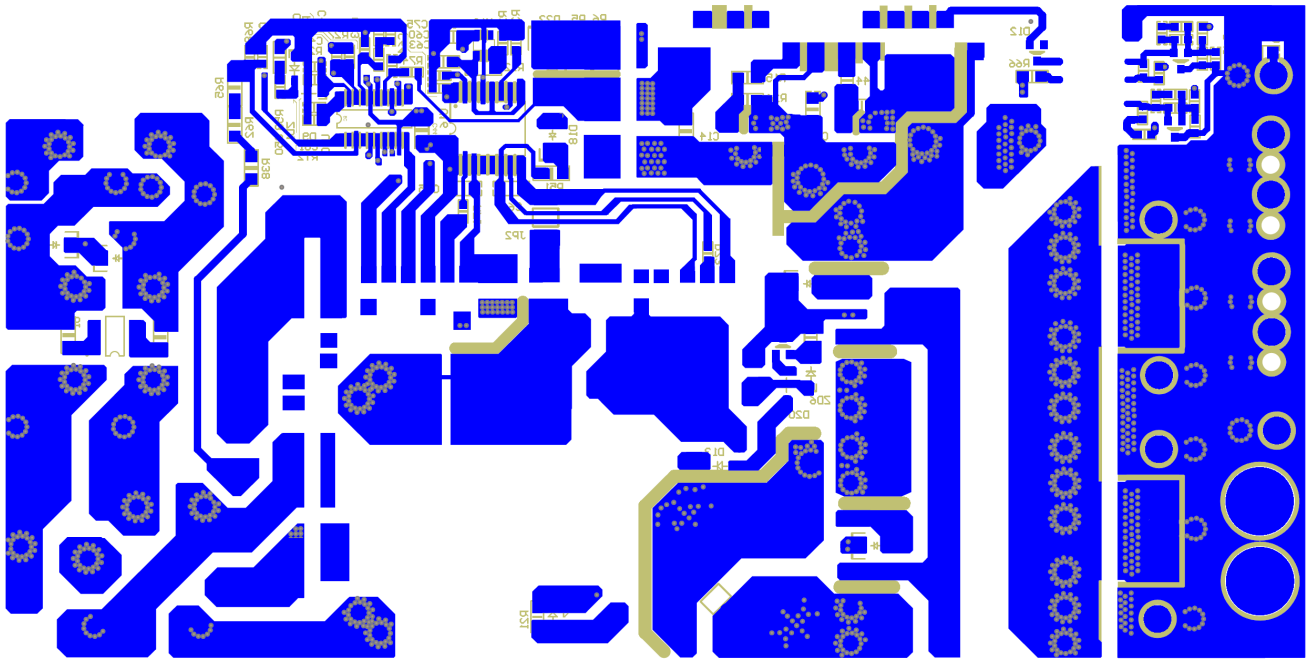


Figure 8. Bottom View of PWM Control Board's PCB

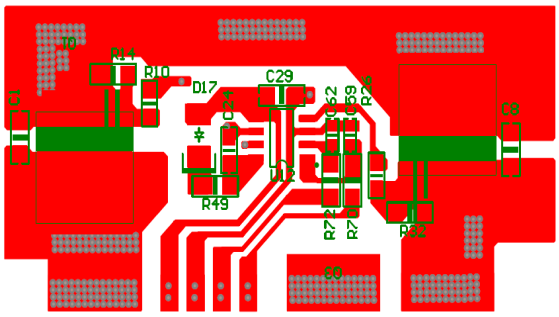


Figure 9. Top View of Slow Leg Daughter Card PCB

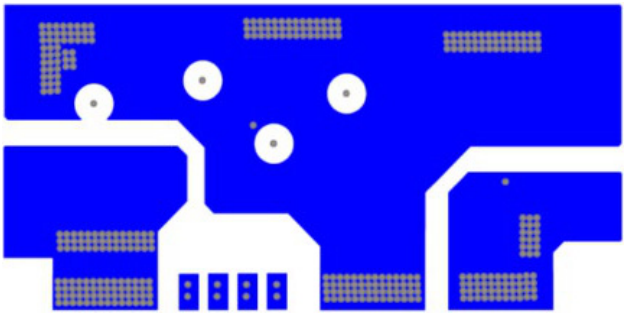


Figure 10. Bottom View of Slow Leg Daughter Card PCB

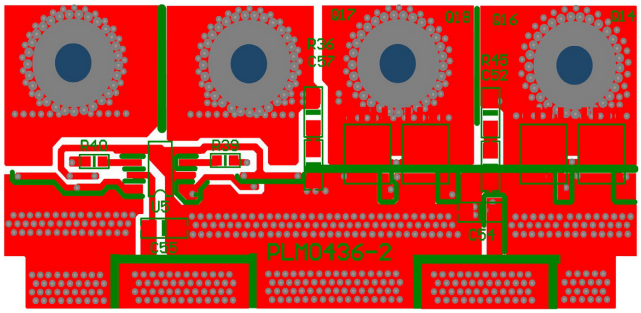


Figure 11. Top View of SR Daughter Card PCB

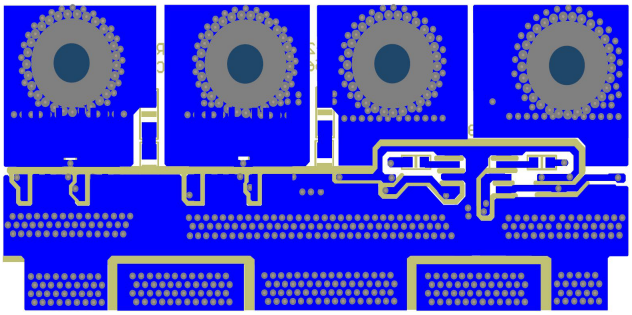


Figure 12. Bottom View of SR Daughter Card PCB

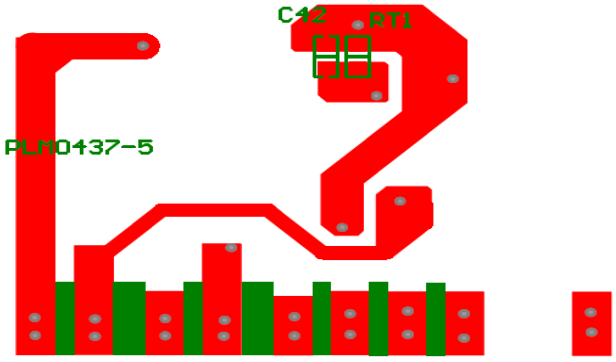


Figure 13. Top View of LLC Daughter Card PCB

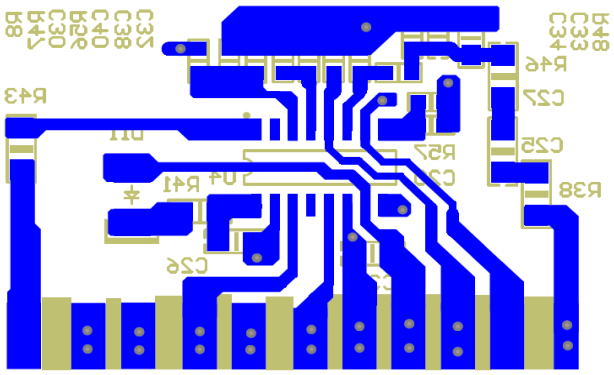


Figure 14. Bottom View of LLC Daughter Card PCB

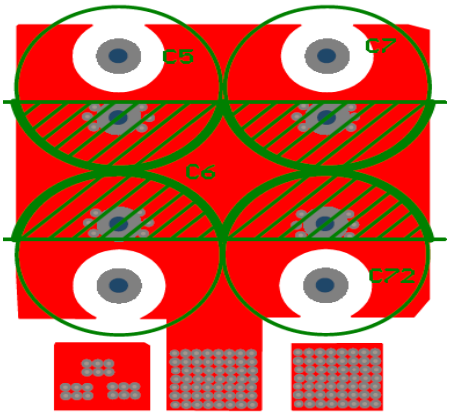


Figure 15. Top View of Bulk Cap Daughter Card PCB

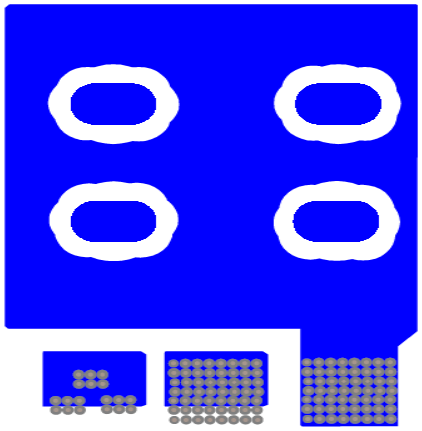


Figure 16. Bottom View of Bulk Cap Daughter Card PCB

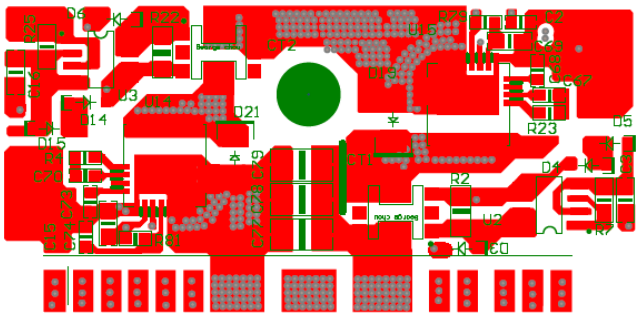


Figure 17. Top View of Fast Leg Daughter Card PCB

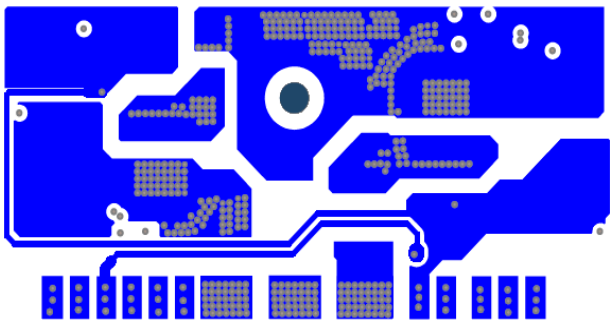


Figure 18. Bottom View of Fast Leg Daughter Card PCB

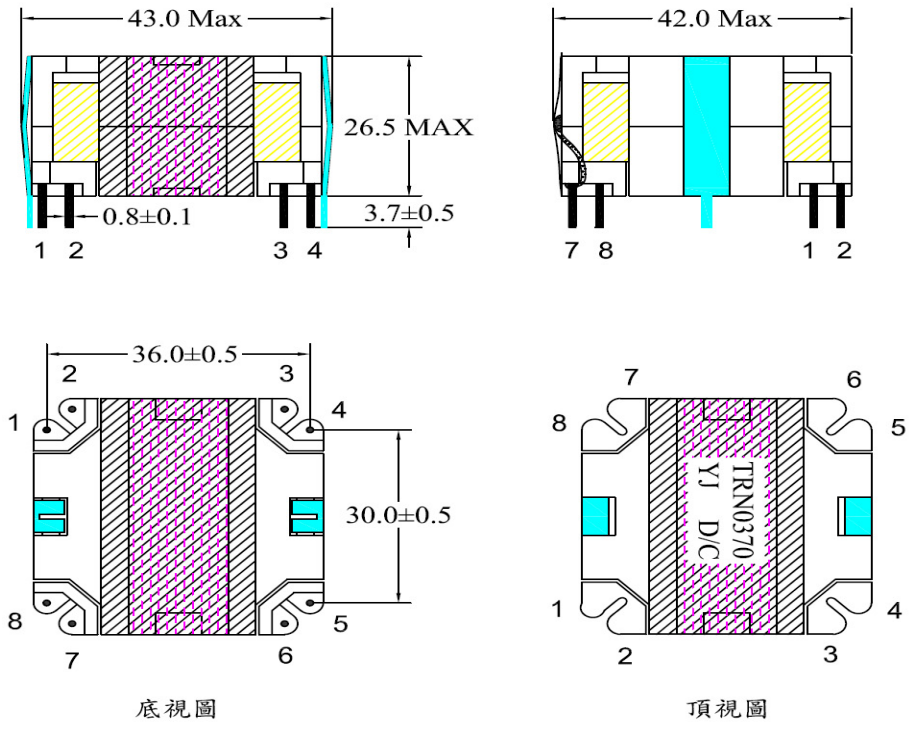
TRN0370 PFC Choke Designs

YUJING

SPECIFICATION

CUSTOMER	安森美	PART NO.	TRN0370	DESCRIPTION		QP-3925V (8P)	
MODEL NO.	11054-125V400210	DATE	2019-11-30	REV.	1.0	SHEET	2 OF 4

1.MECHANICAL DIMENSION (UNIT:mm)



NOTE:
1. CORE需GAP, GAP CORE組裝於PIN端.
2. CORE中柱需點膠.
3. CORE兩端用2PCS有PIN CLIP固定(C1, 8和C4, 5), CLIP位置必須端正.
4. 沿PIN2, 3-PIN6, 7方向包0.025(t)*14(w)自粘銅箔1.1Ts,
   銅箔於PIN6, 7側焊錫短路, 並焊接一條0.3Φ引線加透明TUBE接至PIN7.
5. 成品含浸後, 沿銅箔方向包22mm*1L TAPE 2Ts.
6. 鍍錫點不可超過BOBBIN支點.

TAPE
SOLDER
CLIP
COPPER

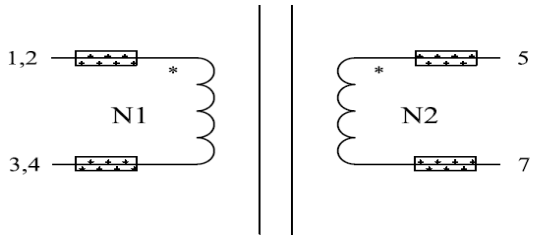
Figure 19.

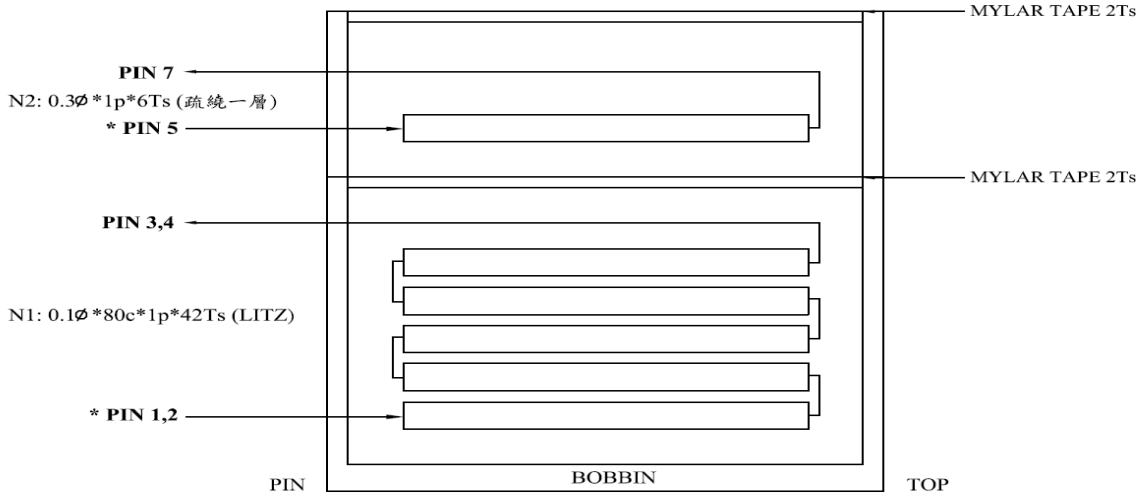
YUJING

SPECIFICATION

CUSTOMER	安森美	PART NO.	TRN0370	DESCRIPTION		QP-3925V (8P)	
MODEL NO.	11054-125V400210	DATE	2019-11-30	REV.	1.0	SHEET	3 OF 4

2.WINDING ORDER





NOTE :
1. 出入線加TEFLON TUBE.
2. 繞線時PIN朝機臺外.

TEFLON TUBE

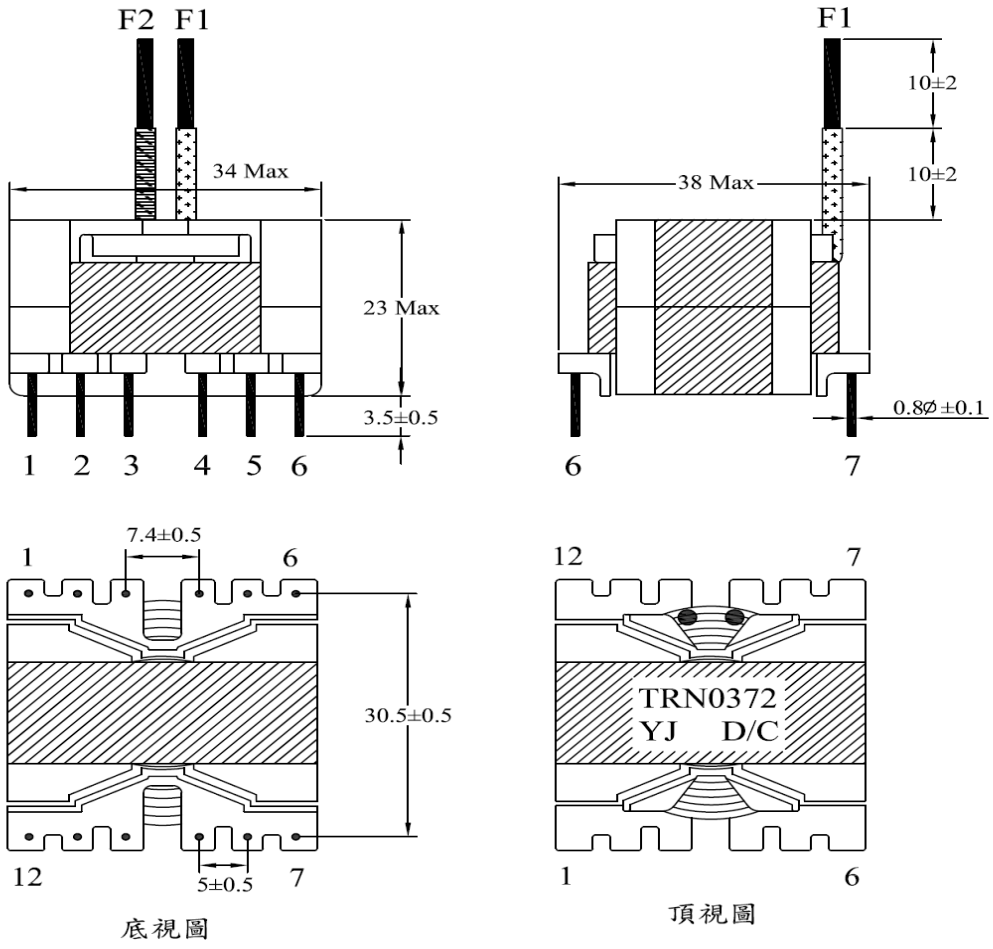
Figure 20.

TRN0372 LLC−Lm Transformer Designs

YUJING SPECIFICATION

CUSTOMER	安森美	PARTS NO.	TRN0372	DESCRIPTION		PQ-3220V(12P)	
MODEL	11054-407V400110	DATE	2020-01-06	REV.	1.0	SHEET	2 OF 4

1.MECHANICAL DIMENSION (UNIT:mm)



NOTE:
1. CORE需GAP, GAP CORE組裝於PIN端.
2. CORE中柱點膠.
3. CORE外用TAPE 3Ts固定.
4. F1, F2為飛線, 飛線長度從頂部CORE量起, TUBE長度為10±2mm, 鍍錫長度為10±2mm.
5. 成品含浸.
6. 錫點勿超出BOBBIN支點.

SOLDER
MYLAR TAPE

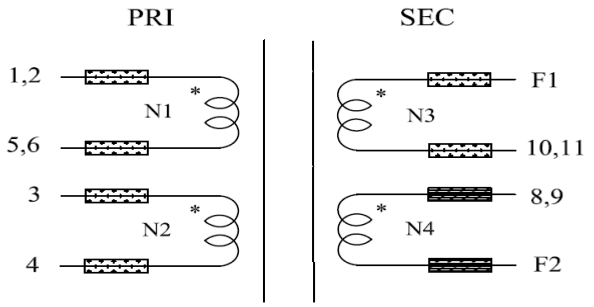
Figure 21.

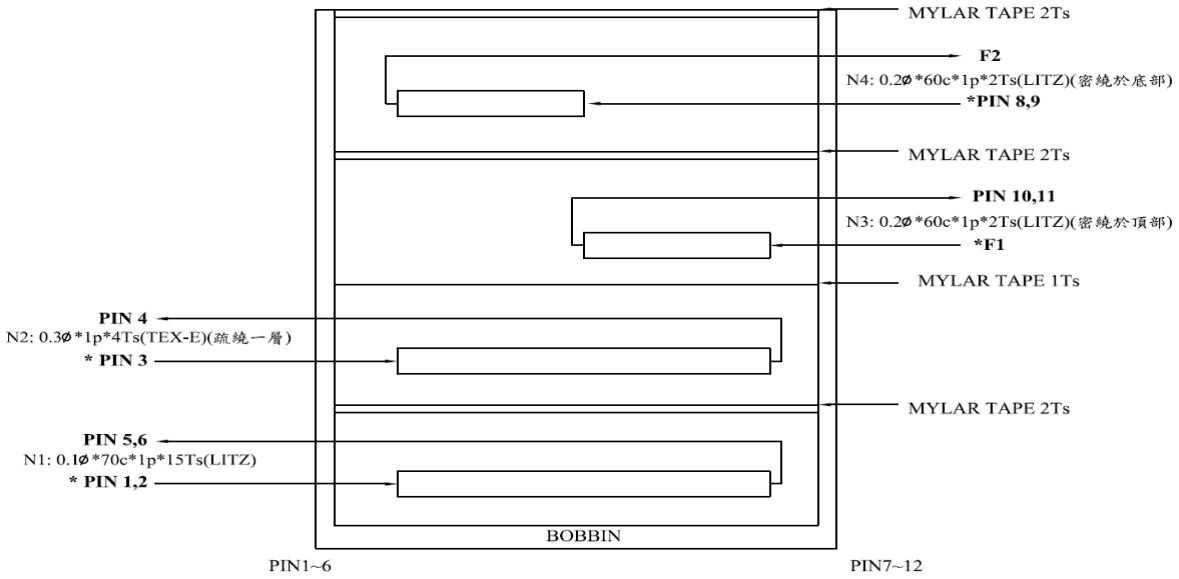
YUJING

SPECIFICATION

CUSTOMER	安森美	PARTS NO.	TRN0372	DESCRIPTION		PQ-3220V(12P)	
MODEL	11054-407V400110	DATE	2020-01-06	REV.	1.0	SHEET	3 OF 4

2.WINDING ORDER





NOTE:

1. 所有出入線需加套管(N4加黑色TUBE, 其餘加透明TUBE).
2. N2用三層絕緣線繞制.
3. N3密繞於頂部, N4密繞於底部, F1, F2為飛線,
   從次級側頂部中間進出線, 飛線長度如外觀圖所示.
4. 繞線時PIN朝機臺外.

透明TUBE
黑色TUBE

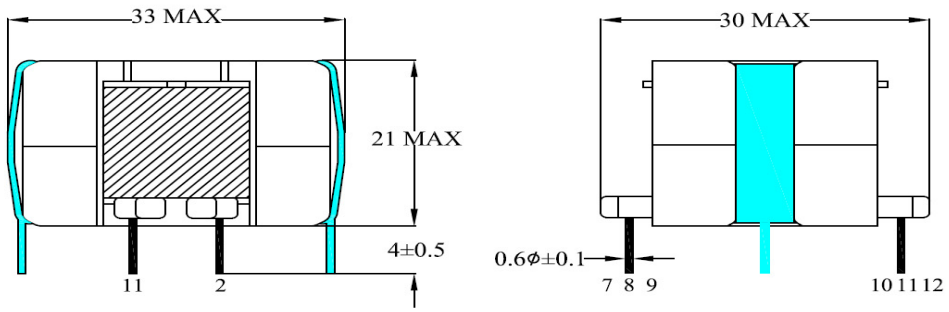
Figure 22.

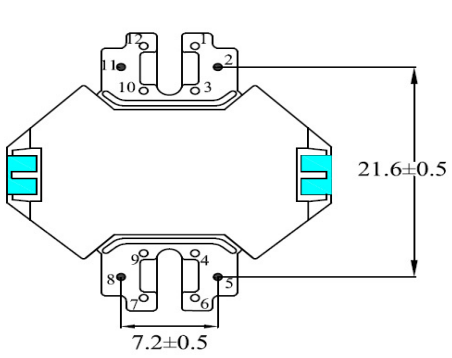
TRN0371 LLC−Ls Transformer Designs

YUJING SPECIFICATION

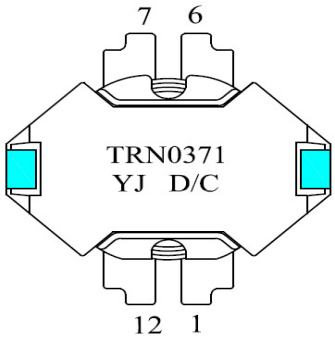
CUSTOMER	安森美	PARTS NO.	TRN0371	DESCRIPTION		RM-10V (12P)	
MODEL	11054-408V400110	DATE	2020-01-06	REV.	1.0	SHEET	2 OF 4

1.MECHANICAL DIMENSION (UNIT:mm)





底視圖



頂視圖

NOTE:
1. PIN1, 3, 4, 6, 7, 9, 10, 12 CUT OFF.
2. CORE需GAP, GAP CORE組裝於PIN端.
3. CORE中柱需點膠.
4. CORE需用2PCS CLIP固定.
5. 成品含浸.
6. 鍍錫點不可超過BOBBIN支點.

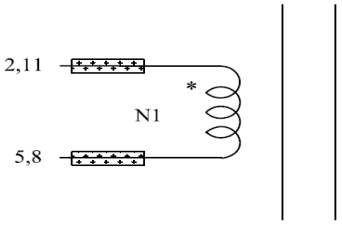
SOLDER
MYLAR TAPE
CLIP

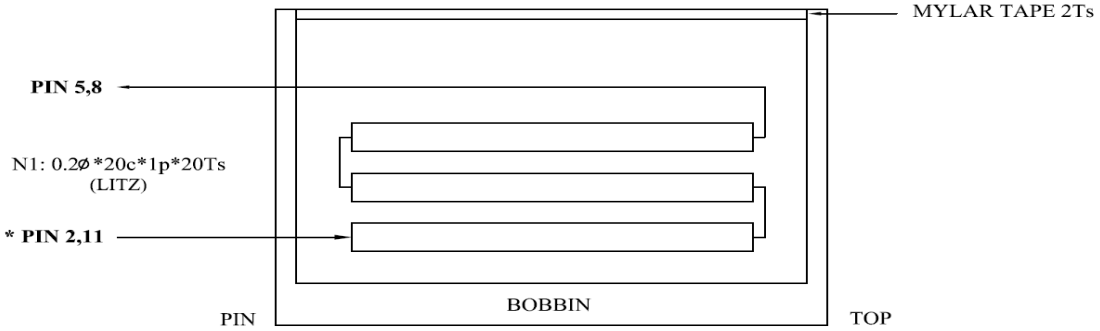
Figure 23.

YUJING SPECIFICATION

CUSTOMER	安森美	PARTS NO.	TRN0371	DESCRIPTION		RM-10V (12P)	
MODEL	11054-408V400110	DATE	2020-01-06	REV.	1.0	SHEET	3 OF 4

2.WINDING ORDER





NOTE:
1. 所有出入線需加TUBE.
2. 繞線時PIN朝幾台外.

透明TUBE

Figure 24.

Standby Power & Efficiency @ 115 Vac / 230 Vac Input

Test condition: all efficiency are tested at board end

Vac	Pin (W)	THD	PF	Vo (V)	Iout1 (A)	Iout2 (A)	Po (W)	% Load	Efficiency
115	**134 mW**	–	–	–	0.000	0.000	0	0%	–
115	0.459	–	–	12.733	0.0223	0	0.284	0%	61.86%
115	30.447	–	–	12.733	2.092	0	26.64	5%	87.49%
115	58.1	–	0.68	12.734	3.935	0	50.11	10%	86.24%
115	83	5	0.48	12.734	5.902	0	75.16	15%	90.55%
115	107.5	8	0.981	12.735	7.867	0	100.2	20%	93.20%
115	**133.4**	**6.6**	**0.98**	**12.736**	**9.849**	**0**	**125.4**	**25%**	**94.03%**
115	158.9	7	0.989	12.736	11.797	0	150.2	30%	94.55%
115	184.6	6.53	0.99	12.737	13.749	0	175.1	35%	94.87%
115	211.1	6	0.988	12.737	15.701	0	200	40%	94.73%
115	238.2	6	0.987	12.738	17.683	0	225.2	45%	94.56%
115	**265.5**	**5.8**	**0.988**	**12.737**	**19.653**	**0**	**250.3**	**50%**	**94.28%**
115	291.2	5.3	0.989	12.745	10.79	10.796	275.1	55%	94.48%
115	317.6	4.82	0.992	12.746	11.761	11.767	299.9	60%	94.42%
115	344	4.8	0.992	12.748	12.744	12.736	324.8	65%	94.42%
115	370.8	4.7	0.993	12.749	13.734	13.726	350.1	70%	94.41%
115	**397.3**	**4.7**	**0.993**	**12.75**	**14.709**	**14.701**	**375**	**75%**	**94.38%**
115	424.4	4.6	0.993	12.751	15.691	15.701	400.3	80%	94.32%
115	451.4	4.6	0.993	12.752	16.681	16.676	425.4	85%	94.23%
115	478.3	4.6	0.993	12.755	17.651	17.656	450.3	90%	94.15%
115	505.3	4.6	0.993	12.756	18.631	18.628	475.3	95%	94.06%
115	**532.4**	**4.6**	**0.993**	**12.757**	**19.603**	**19.605**	**500.2**	**100%**	**93.95%**
								AVG	**0.9416**

Figure 25.

Efficiency vs. Output Load Curves

Test condition: all efficiency are tested at board end

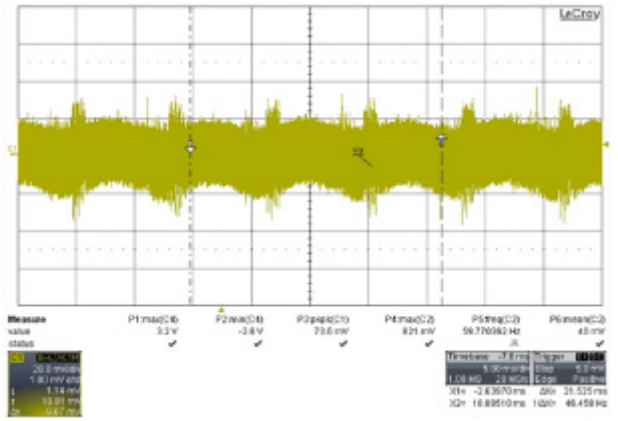
Vac	Pin (W)	THD	PF	Vo (V)	Iout1 (A)	Iout2 (A)	Po (W)	% Load	Efficiency
230	186 mW	–	–	–	0.000	0.000	0	0%	–
230	0.52	–	–	12.733	0.0223	0	0.284	0%	54.60%
230	31.833	–	–	12.733	2.098	0	26.71	5%	83.92%
230	57.534		0.134	12.734	3.941	0	50.18	10%	87.23%
230	85.4	5.6	0.15	12.734	5.908	0	75.23	15%	88.09%
230	111	9	0.19	12.735	7.888	0	100.5	20%	90.50%
230	**133.7**	**–**	**0.35**	**12.736**	**9.853**	**0**	**125.5**	**25%**	**93.86%**
230	159.6	76	0.388	12.736	11.803	0	150.3	30%	94.19%
230	184.5	4.1	0.984	12.737	13.753	0	175.2	35%	94.94%
230	209.6	3.8	0.987	12.737	15.705	0	200	40%	95.44%
230	235.5	3.9	0.986	12.738	17.685	0	225.3	45%	95.66%
230	**261.3**	**5.5**	**0.968**	**12.739**	**19.648**	**0**	**250.3**	**50%**	**95.79%**
230	288	15	0.972	12.745	10.796	10.796	275.2	55%	95.55%
230	314	14.3	0.975	12.746	11.769	11.767	300	60%	95.54%
230	340	14	0.976	12.748	12.746	12.757	325.1	65%	95.62%
230	366.4	13.5	0.978	12.749	13.745	13.736	350.4	70%	95.62%
230	**392.1**	**13**	**0.985**	**12.75**	**14.713**	**14.718**	**375.2**	**75%**	**95.70%**
230	418.2	7.7	0.985	12.751	15.695	15.703	400.4	80%	95.73%
230	445	11	0.985	12.752	16.693	16.685	425.6	85%	95.65%
230	471.6	7.3	0.984	12.754	17.673	17.683	450.9	90%	95.62%
230	497.7	9.4	0.987	12.755	18.645	18.648	475.7	95%	95.57%
230	**523.6**	**9**	**0.987**	**12.758**	**19.603**	**19.605**	**500.2**	**100%**	**95.53%**
								AVG	**0.9522**

Figure 26.

Ripple Noise − 1

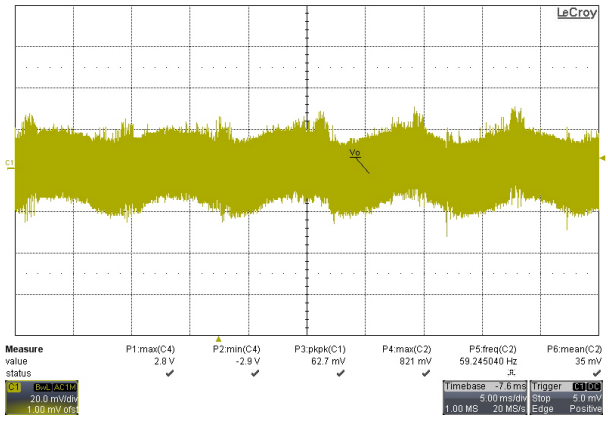
Test condition: 100% load ripple noise

Vac	Load	CH1	CH2	CH3	CH4
115	100%	Vo	X	X	ML



Vo_pkpk = 74 mV

Vac	Load	CH1	CH2	CH3	CH4
230	100%	Vo	X	X	X



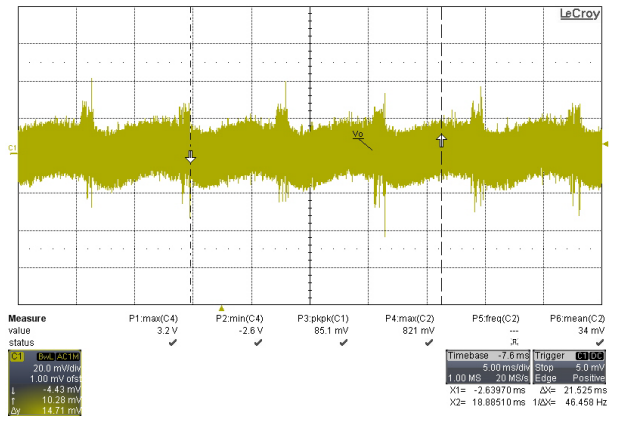
Vo_pkpk = 83 mV

Figure 27.

Ripple Noise − 2

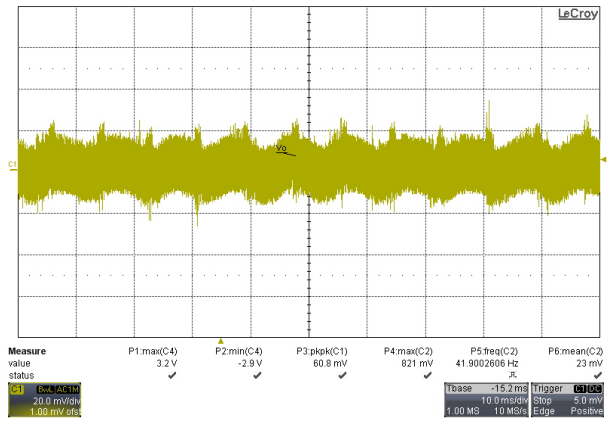
Test condition: 75% load ripple noise

Vac	Load	CH1	CH2	CH3	CH4
115	75%	Vo	X	X	X



Vo_pkpk = 85 mV

Vac	Load	CH1	CH2	CH3	CH4
230	75%	Vo	X	X	X



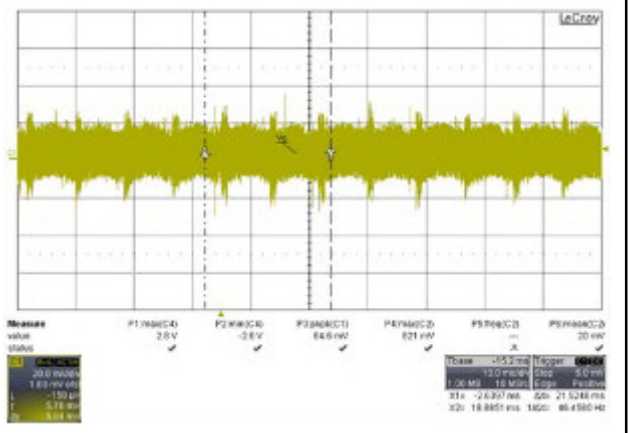
Vo_pkpk = 61 mV

Figure 28.

Ripple Noise − 3

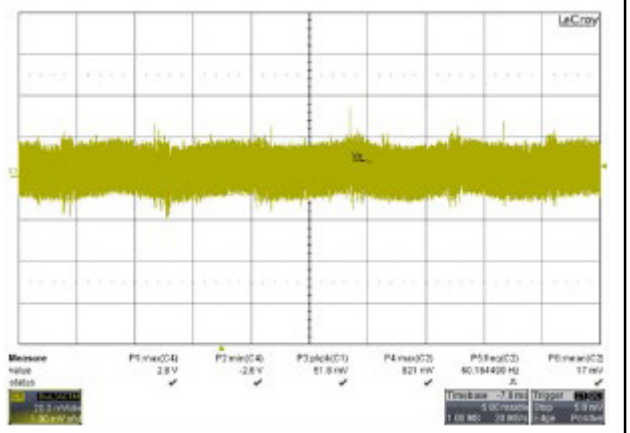
Test condition: 50% load ripple noise

Vac	Load	CH1	CH2	CH3	CH4
115	50%	Vo	X	X	ML



Vo_pkpk = 65 mV

Vac	Load	CH1	CH2	CH3	CH4
230	50%	Vo	X	X	X



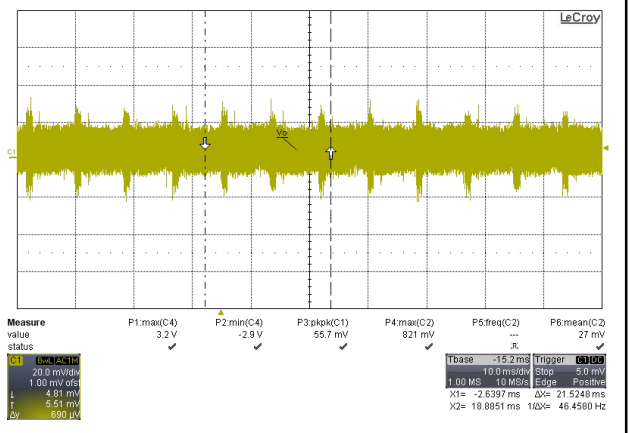
Vo_pkpk = 52 mV

Figure 29.

Ripple Noise − 4

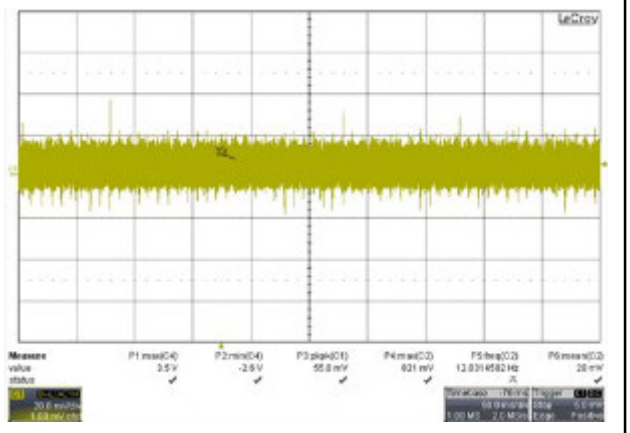
Test condition: 25% load ripple noise

Vac	Load	CH1	CH2	CH3	CH4
115	25%	Vo	X	X	X



Vo_pkpk = 56 mV

Vac	Load	CH1	CH2	CH3	CH4
230	25%	Vo	X	X	X



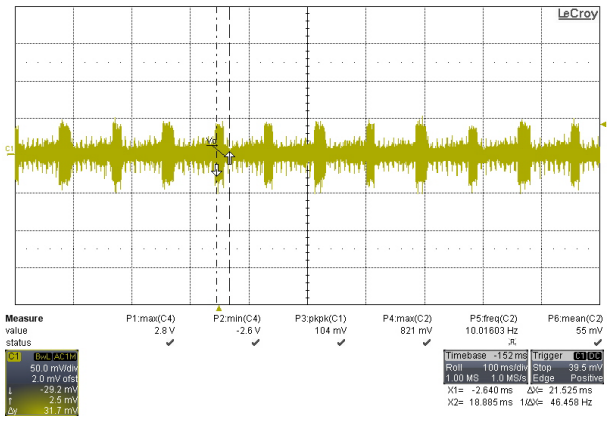
Vo_pkpk = 55 mV

Figure 30.

Ripple Noise − 5

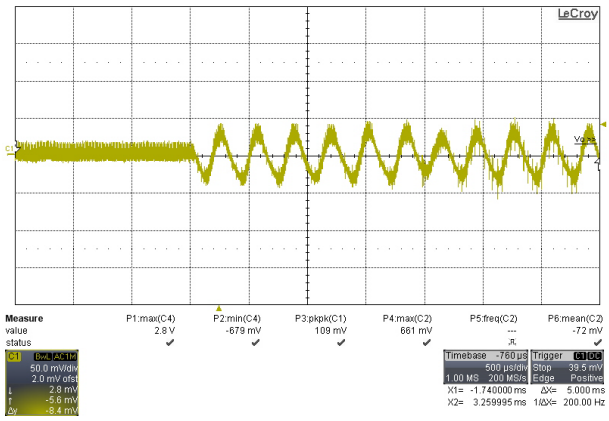
Test condition: burst mode ripple noise

Vac	Load	CH1	CH2	CH3	CH4
115	4.8 A	Vo	X	X	X



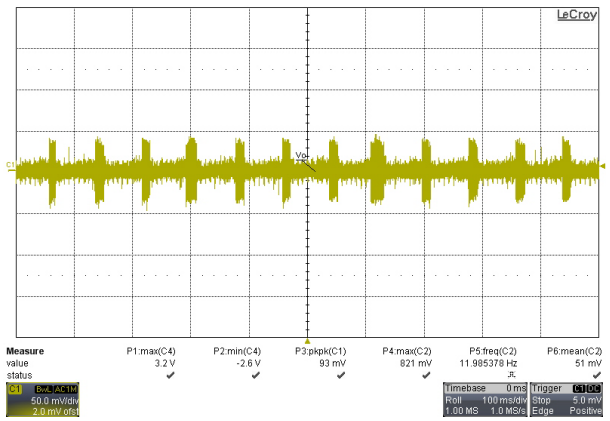
Vo_pkpk = 104 mV

Vac	Load	CH1	CH2	CH3	CH4
115	4.8 A	Vo	X	X	X



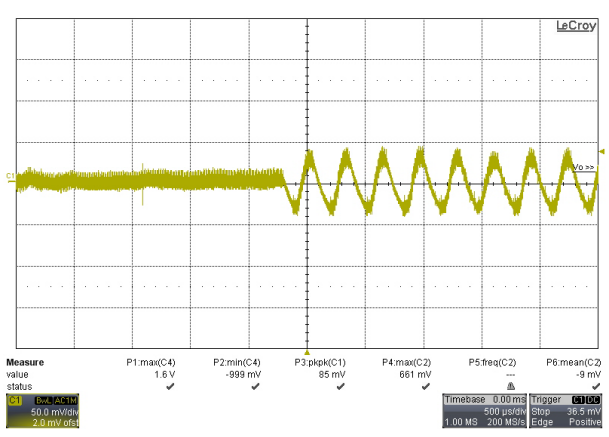
Vo_pkpk = 109 mV

Vac	Load	CH1	CH2	CH3	CH4
230	4.8 A	Vo	X	X	X



Vo_pkpk = 93 mV

Vac	Load	CH1	CH2	CH3	CH4
230	4.8 A	Vo	X	X	X



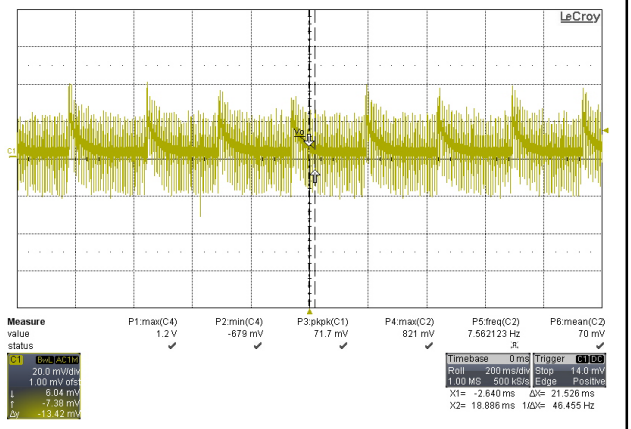
Vo_pkpk = 85 mV

Figure 31.

Ripple Noise − 6

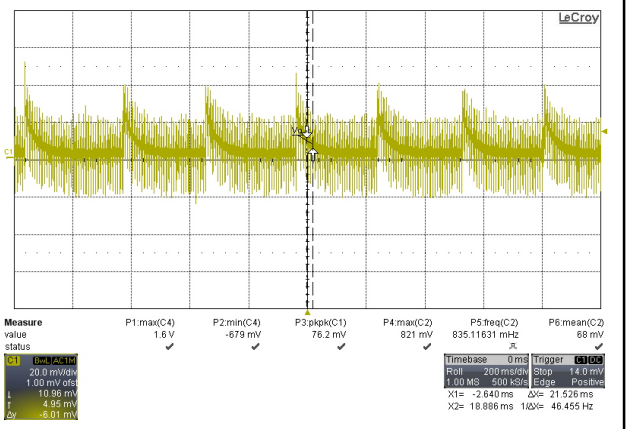
Test condition: burst mode ripple noise

Vac	Load	CH1	CH2	CH3	CH4
115	0 A	Vo	X	X	X



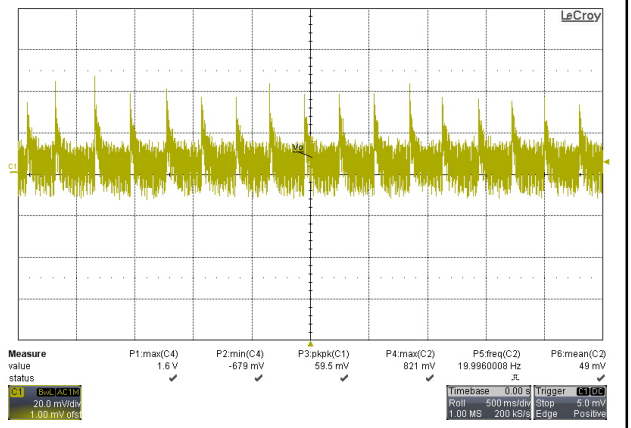
Vo_pkpk = 72 mV

Vac	Load	CH1	CH2	CH3	CH4
115	0 A	Vo	X	X	X



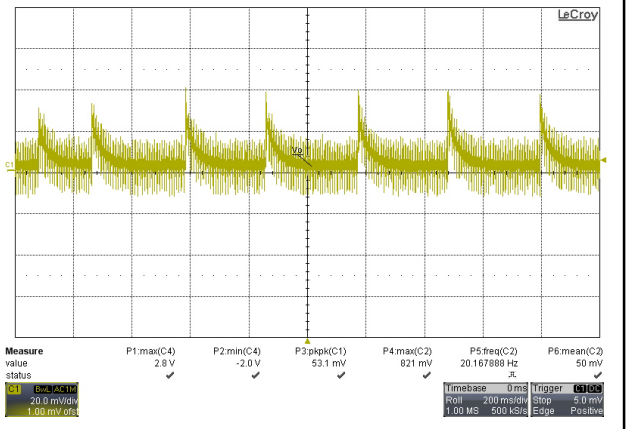
Vo_pkpk = 76 mV

Vac	Load	CH1	CH2	CH3	CH4
230	0 A	Vo	X	X	X



Vo_pkpk = 60 mV

Vac	Load	CH1	CH2	CH3	CH4
230	0 A	Vo	X	X	X



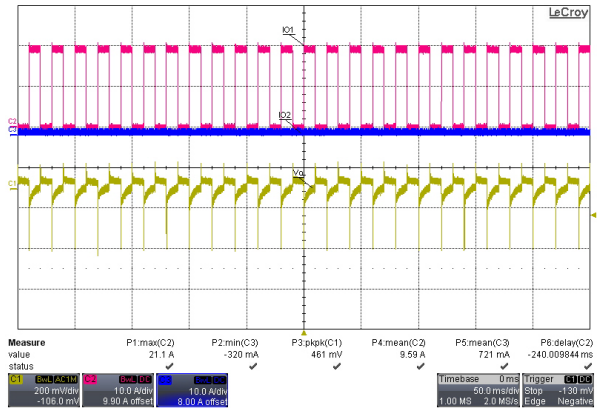
Vo_pkpk = 53 mV

Figure 32.

Dynamic Load − 1

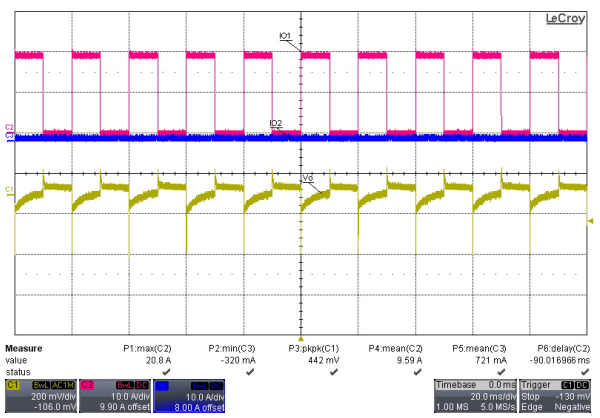
Test condition: 0% load to 50% dynamic load ripple, 15 ms cycle, 2.5 A/μs

Vac	Dynamic Load	CH1	CH2	CH3	CH4
115	0%−50%	Vo	IO1	IO2	X



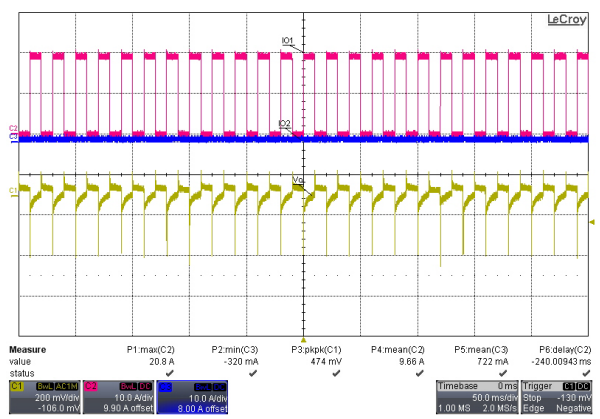
Vo_pkpk = 461 mV

Vac	Dynamic Load	CH1	CH2	CH3	CH4
115	0%−50%	Vo	IO1	IO2	X



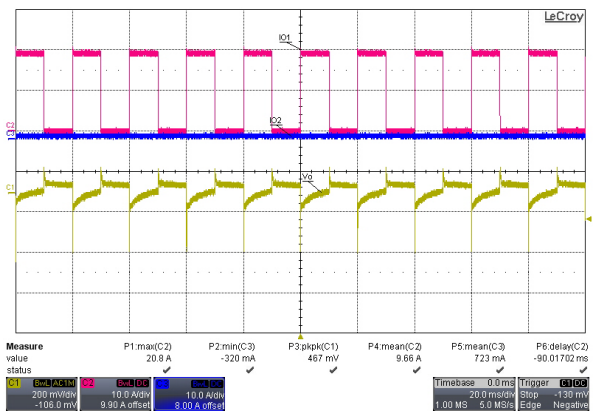
Vo_pkpk = 442 mV

Vac	Dynamic Load	CH1	CH2	CH3	CH4
230	0%−50%	Vo	IO1	IO2	X



Vo_pkpk = 474 mV

Vac	Dynamic Load	CH1	CH2	CH3	CH4
230	0%−50%	Vo	IO1	IO2	X



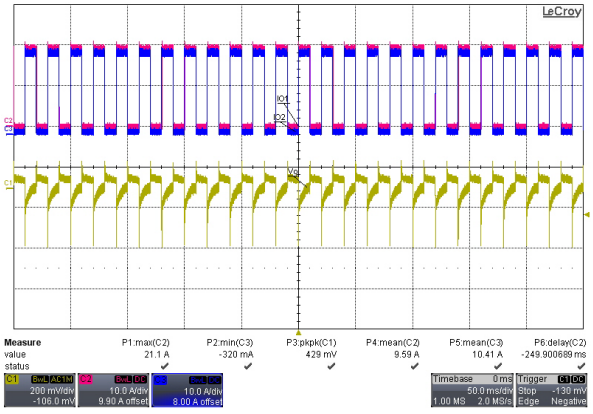
Vo_pkpk = 467 mV

Figure 33.

Dynamic Load − 2

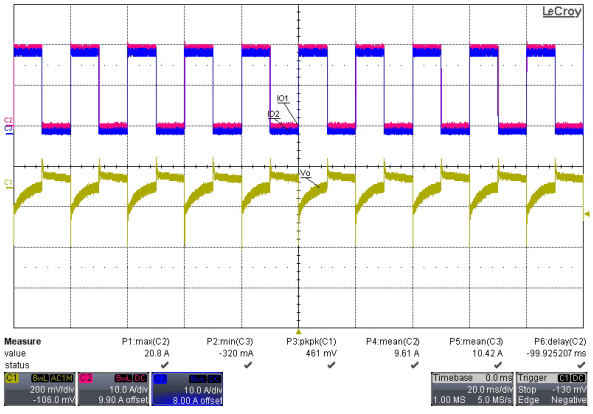
Test condition: 0% load to 100% dynamic load ripple, 15 ms cycle, 2.5 A/μs

Vac	Dynamic Load	CH1	CH2	CH3	CH4
115	0%−100%	Vo	IO1	IO2	X



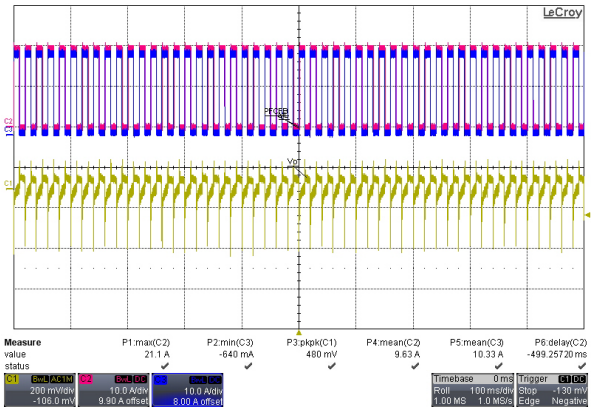
Vo_pkpk = 429 mV

Vac	Dynamic Load	CH1	CH2	CH3	CH4
115	0%−100%	Vo	IO1	IO2	X



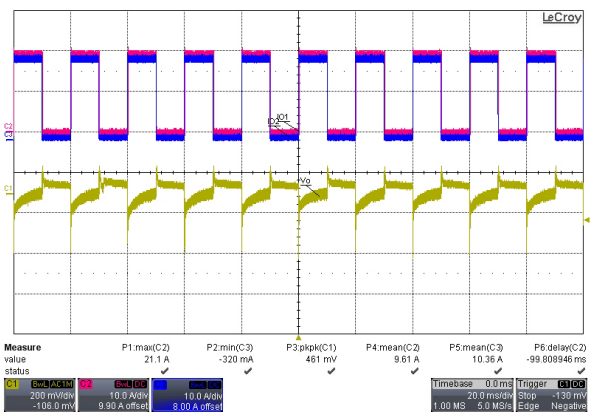
Vo_pkpk = 461 mV

Vac	Dynamic Load	CH1	CH2	CH3	CH4
230	0%−100%	Vo	IO1	IO2	X



Vo_pkpk = 480 mV

Vac	Dynamic Load	CH1	CH2	CH3	CH4
230	0%−100%	Vo	IO1	IO2	X



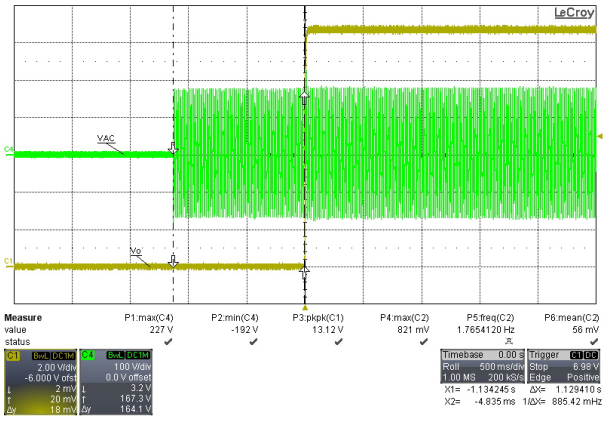
Vo_pkpk = 461 mV

Figure 34.

Startup − 1

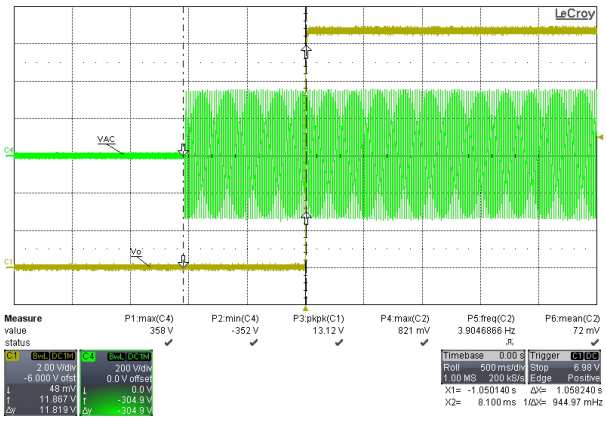
Test condition: 100% load power on start up time

Vac	Load	CH1	CH2	CH3	CH4
115	100%	Vo	X	X	VAC



Start up time 1.1 s

Vac	Load	CH1	CH2	CH3	CH4
230	100%	Vo	X	X	VAC



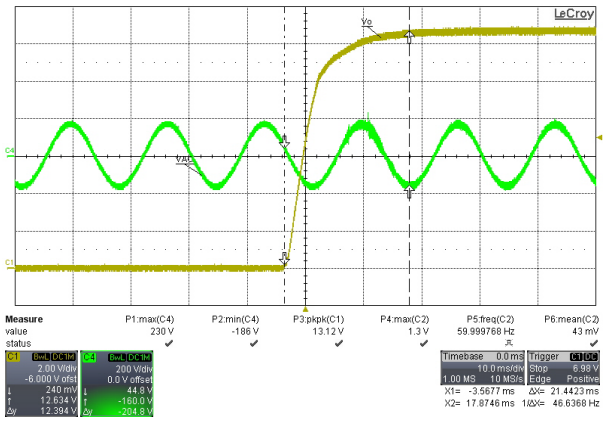
Start up time 1.05 s

Figure 35.

Rise Time − 1

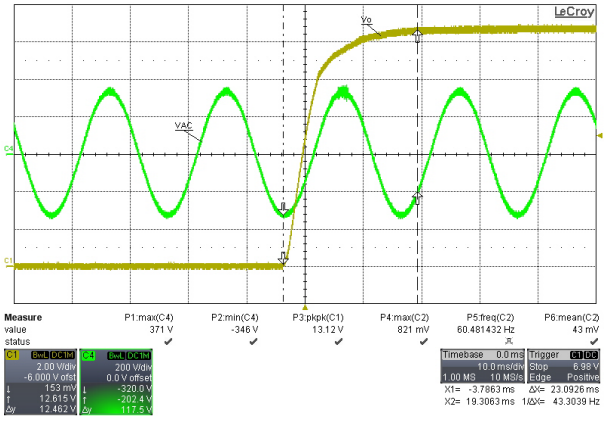
Test condition: 100% load power on rise time

Vac	Load	CH1	CH2	CH3	CH4
115	100%	Vo	X	X	X



Rise time 21.4 ms

Vac	Load	CH1	CH2	CH3	CH4
230	100%	Vo	X	X	X



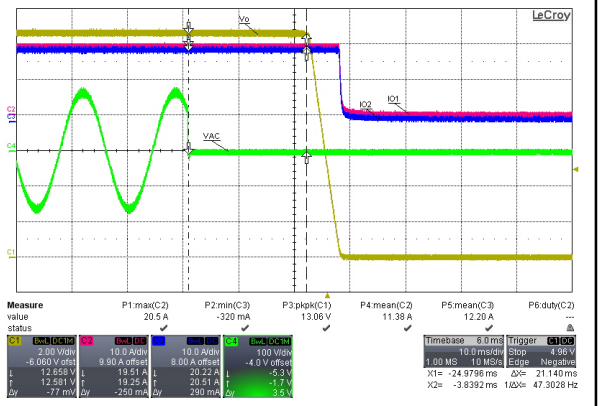
Rise time 23 ms

Figure 36.

Hold Up Time − 1

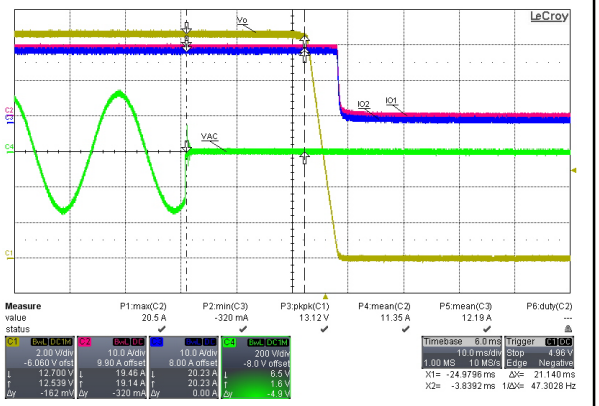
Test condition: 100% load power off hold up time

Vac	Load	CH1	CH2	CH3	CH4
115	100%	Vo	IO1	IO2	VAC



Hold up time 21 ms

Vac	Load	CH1	CH2	CH3	CH4
230	100%	Vo	IO1	IO2	VAC



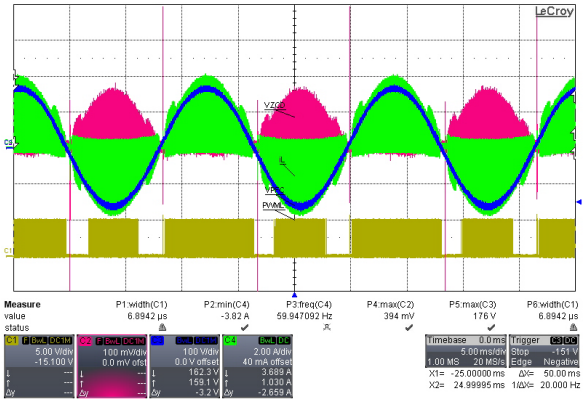
Hold up time 21 ms

Figure 37.

PFC Stage Fast Leg − 1

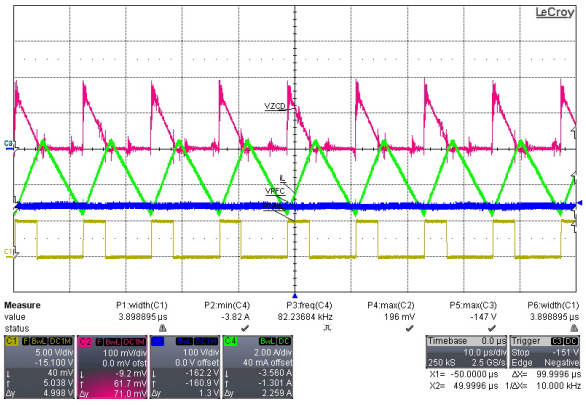
Test condition: 115 Vac 25% load

Vac	Load	CH1	CH2	CH3	CH4
115	125 W	PWML	Vzcd	Vac	iL



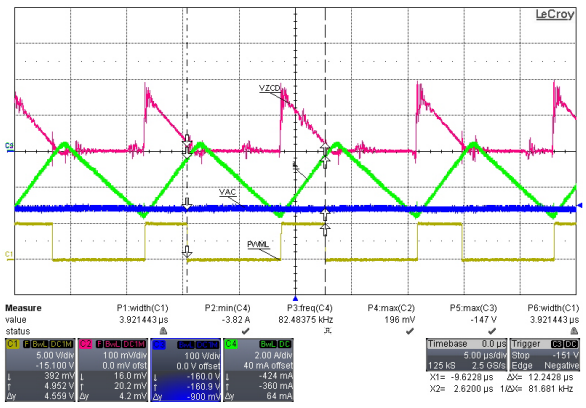
115 Vac 125 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
115	125 W	PWML	Vzcd	Vac	iL



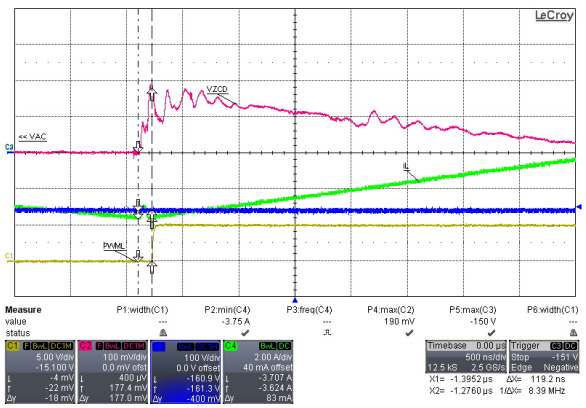
115 Vac 125 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
115	125 W	PWML	Vzcd	Vac	iL



115 Vac 125 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
115	125 W	PWML	Vzcd	Vac	iL



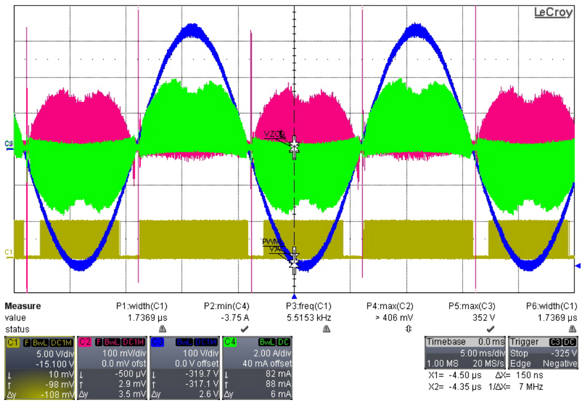
115 Vac 125 W output; ZCD_arm is 100 mV
1−D dead time is 119 ns

Figure 38.

PFC Stage Fast Leg − 2

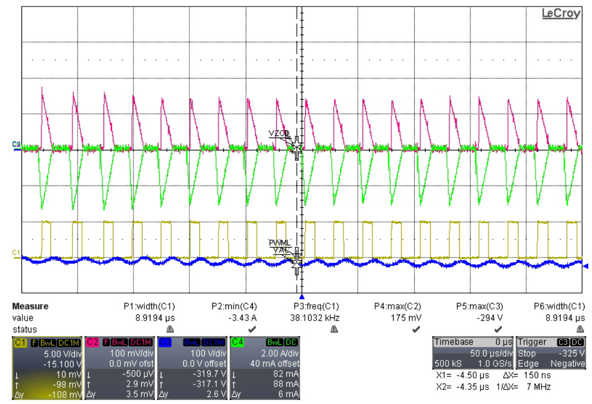
Test condition: 230 Vac 25% load

Vac	Load	CH1	CH2	CH3	CH4
230	125 W	PWML	Vzcd	Vac	iL



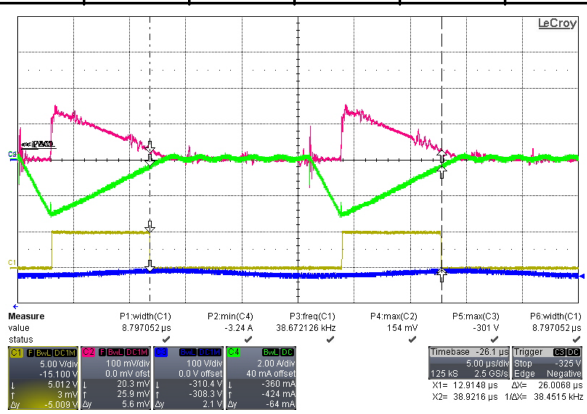
230 Vac 125 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
230	125 W	PWML	Vzcd	Vac	iL



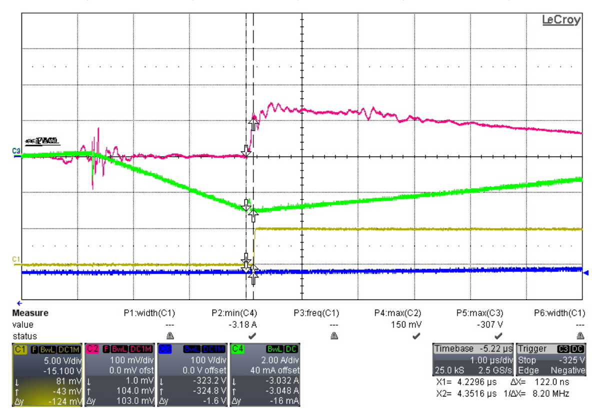
230 Vac 125 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
230	125 W	PWML	Vzcd	Vac	iL



230 Vac 125 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
230	125 W	PWML	Vzcd	Vac	iL



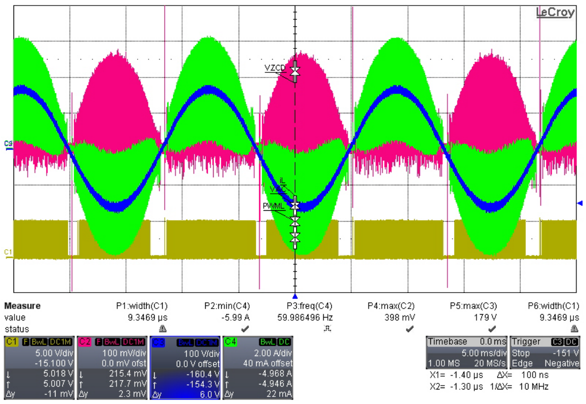
230 Vac 125 W output; ZCD_arm is 100 mV
1−D dead time is around 122 ns

Figure 39.

PFC Stage Fast Leg − 3

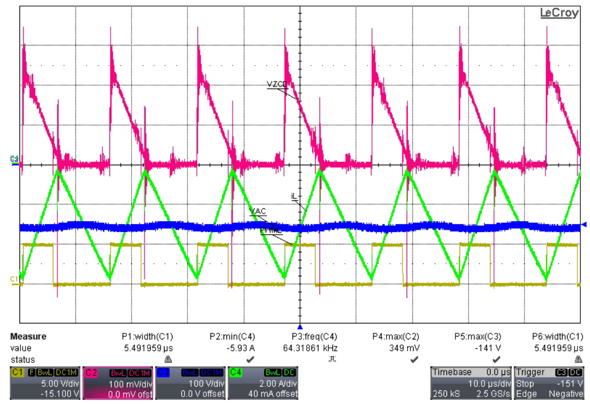
Test condition: 115 Vac 50% load

Vac	Load	CH1	CH2	CH3	CH4
115	250 W	PWML	Vzcd	Vac	iL



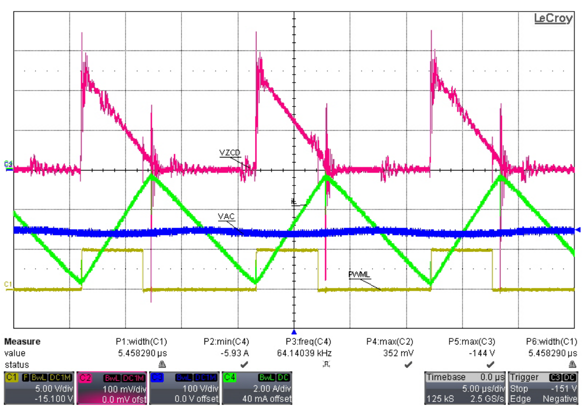
115 Vac 250 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
115	250 W	PWML	Vzcd	Vac	iL



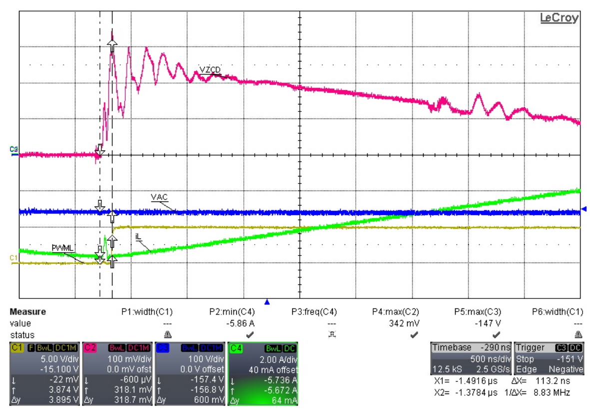
115 Vac 250 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
115	250 W	PWML	Vzcd	Vac	iL



115 Vac 250 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
115	250 W	PWML	Vzcd	Vac	iL



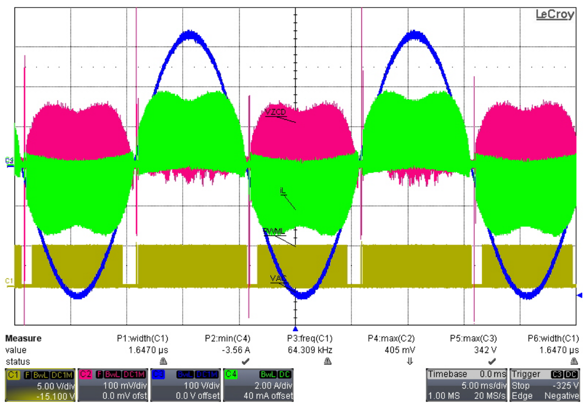
115 Vac 250 W output; ZCD_arm is 100 mV
1−D dead time is 113 ns

Figure 40.

PFC Stage Fast Leg − 4

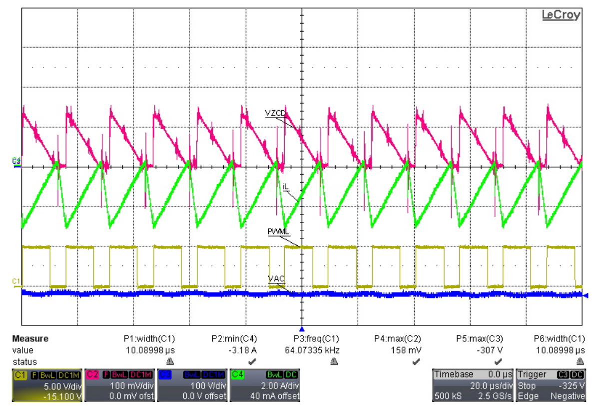
Test condition: 230 Vac 50% load

Vac	Load	CH1	CH2	CH3	CH4
230	250 W	PWML	Vzcd	Vac	iL



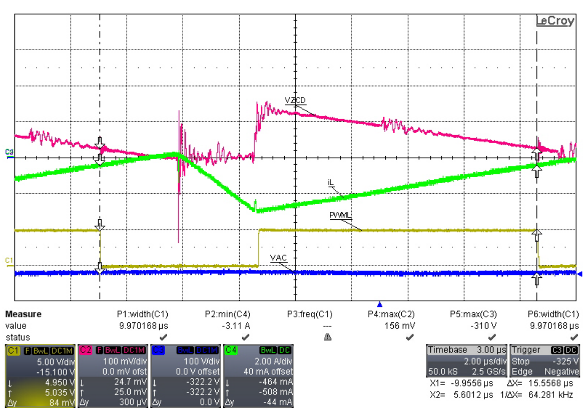
230 Vac 250 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
230	250 W	PWML	Vzcd	Vac	iL



230 Vac 250 W output; ZCD_arm is 100 mV

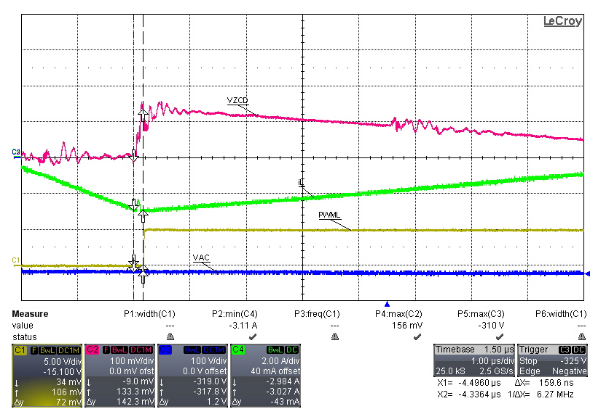
Vac	Load	CH1	CH2	CH3	CH4
230	250 W	PWML	Vzcd	Vac	iL



230 Vac 250 W output; ZCD_arm is 100 mV

1−D turn off threshould is around 25 mV (Vilimit = 0.6 V/30 mV)

Vac	Load	CH1	CH2	CH3	CH4
230	250 W	PWML	Vzcd	Vac	iL



230 Vac 250 W output; ZCD_arm is 100 mV

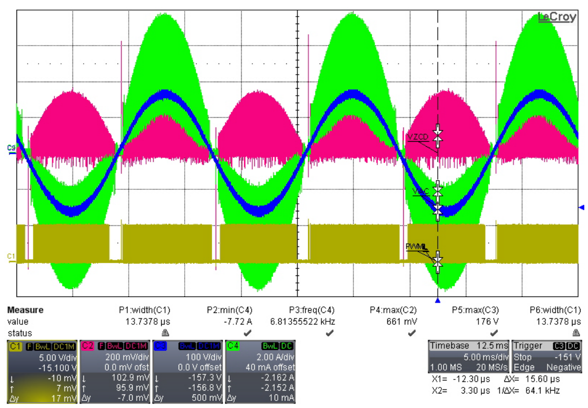
1−D dead time is around 159 ns

Figure 41.

PFC Stage Fast Leg − 5

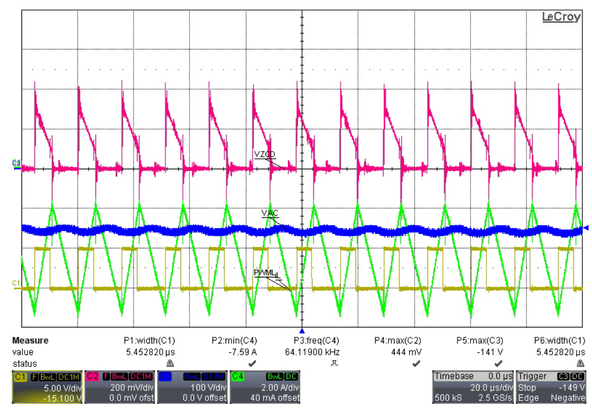
Test condition: 115 Vac 75% load

Vac	Load	CH1	CH2	CH3	CH4
115	375 W	PWML	Vzcd	Vac	iL



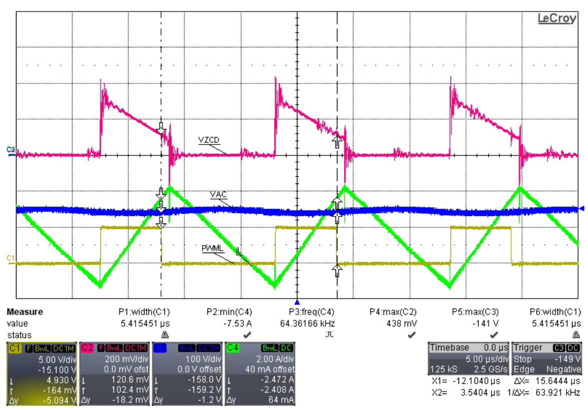
115 Vac 375 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
115	375 W	PWML	Vzcd	Vac	iL



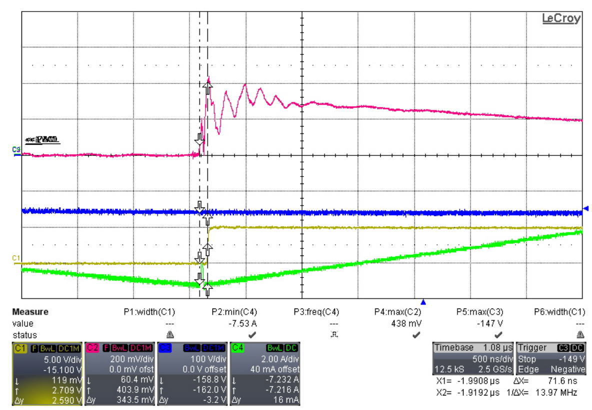
115 Vac 375 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
115	375 W	PWML	Vzcd	Vac	iL



115 Vac 375 W output; ZCD_arm is 100 mV
1−D turn off threshold becomes 100 mV, because Maximum duty clamp 96% x (1 / 65 kHz) = 14.77 μs

Vac	Load	CH1	CH2	CH3	CH4
115	375 W	PWML	Vzcd	Vac	iL



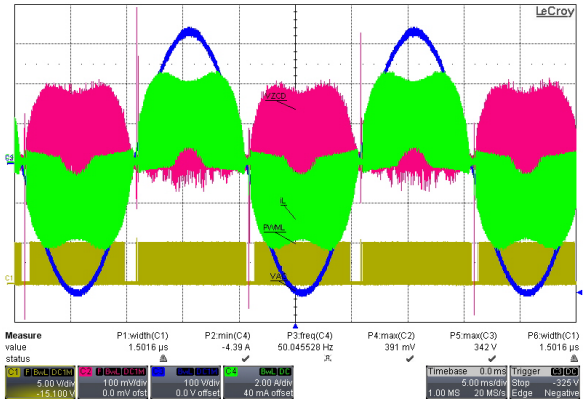
115 Vac 375 W output; ZCD_arm is 100 mV
1−D dead time is around 71 ns

Figure 42.

PFC Stage Fast Leg − 6

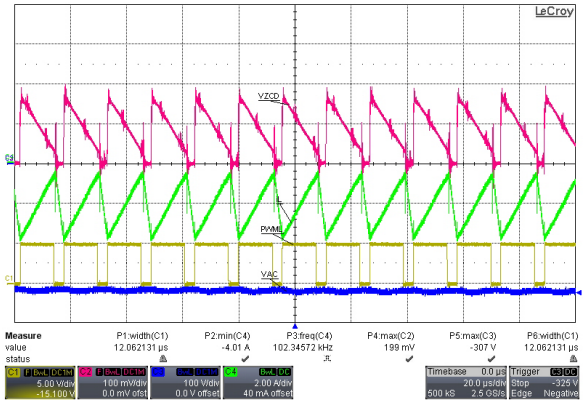
Test condition: 230 Vac 75% load

Vac	Load	CH1	CH2	CH3	CH4
230	375 W	PWML	Vzcd	Vac	iL



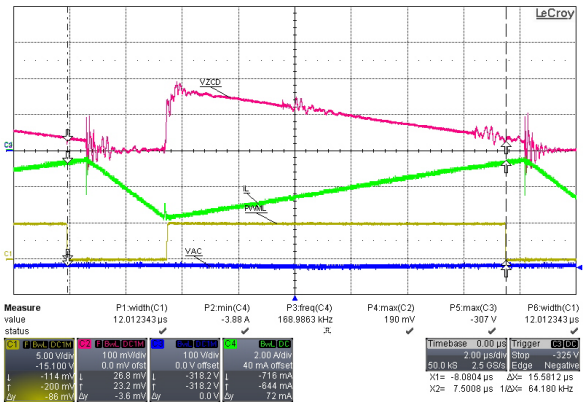
230 Vac 375 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
230	375 W	PWML	Vzcd	Vac	iL



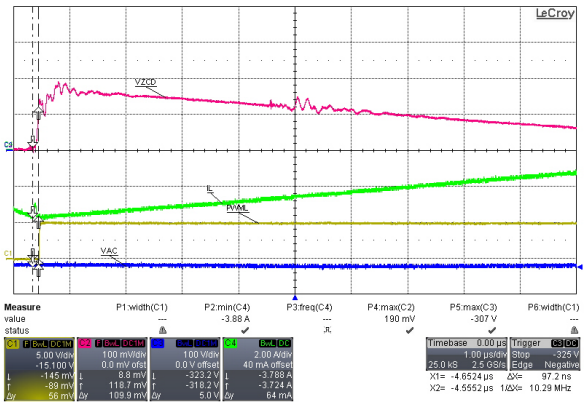
230 Vac 375 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
230	375 W	PWML	Vzcd	Vac	iL



230 Vac 375 W output; ZCD_arm is 100 mV
1−D turn off threshold is around 25 mV (Vilimit = 0.6 V / 30 mV)

Vac	Load	CH1	CH2	CH3	CH4
230	375 W	PWML	Vzcd	Vac	iL



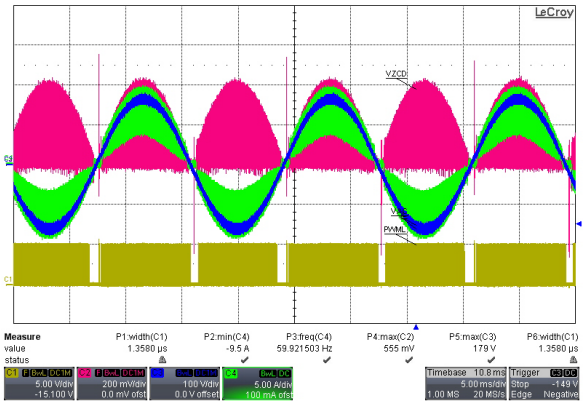
230 Vac 375 W output; ZCD_arm is 100 mV
1−D dead time is around 97 ns

Figure 43.

PFC Stage Fast Leg − 7

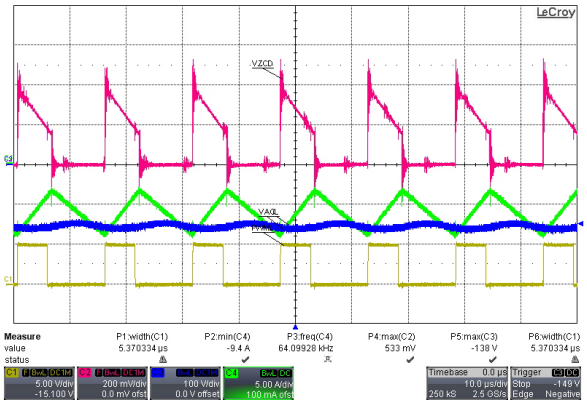
Test condition: 115 Vac 100% load

Vac	Load	CH1	CH2	CH3	CH4
115	500 W	PWML	Vzcd	Vac	iL



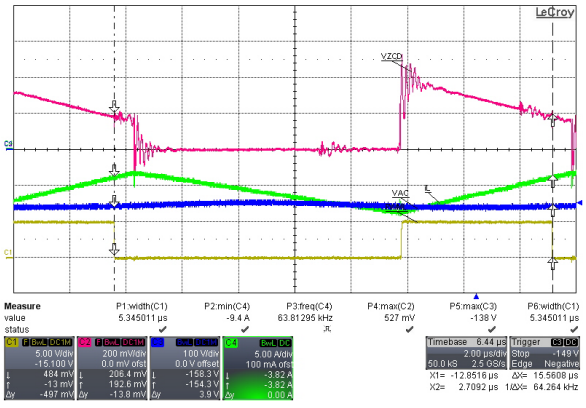
115 Vac 500 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
115	500 W	PWML	Vzcd	Vac	iL



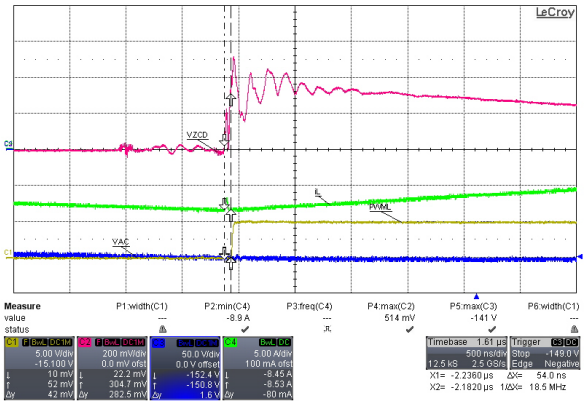
115 Vac 500 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
115	500 W	PWML	Vzcd	Vac	iL



115 Vac 500 W output; ZCD_arm is 100 mV
1−D turn off threshold becomes 200 mV, because Maximum duty clamp 96% x (1 / 65 kHz) = 14.77 μs

Vac	Load	CH1	CH2	CH3	CH4
115	500 W	PWML	Vzcd	Vac	iL



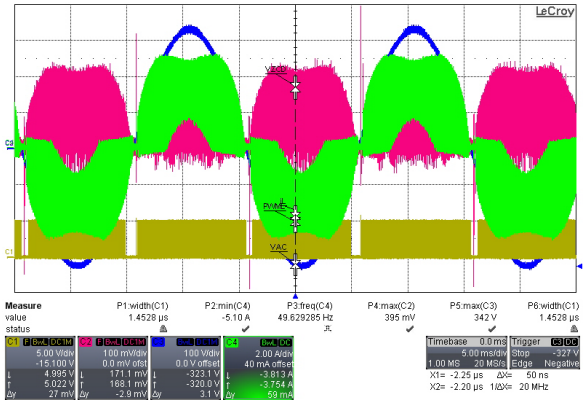
115 Vac 500 W output; ZCD_arm is 100 mV
1−D dead time is around 54 ns

Figure 44.

PFC Stage Fast Leg − 8

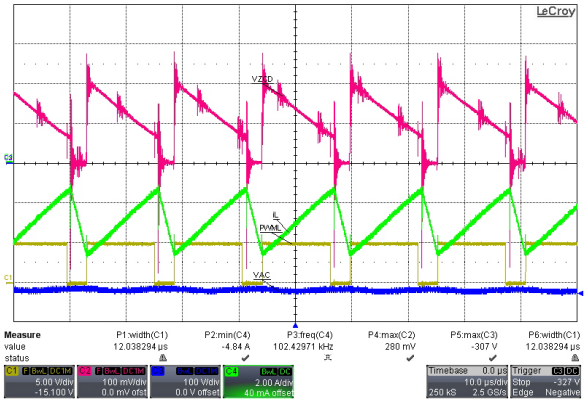
Test condition: 230 Vac 100% load

Vac	Load	CH1	CH2	CH3	CH4
230	500 W	PWML	Vzcd	Vac	iL



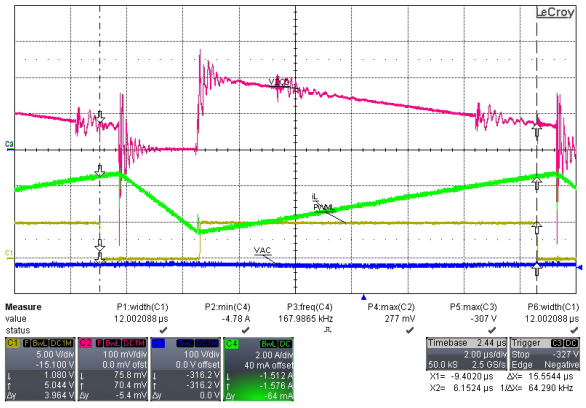
230 Vac 500 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
230	500 W	PWML	Vzcd	Vac	iL



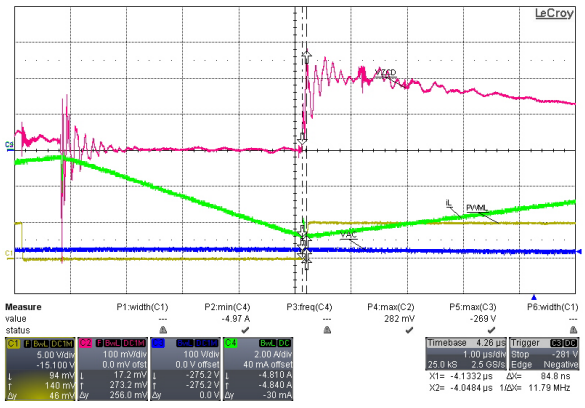
230 Vac 500 W output; ZCD_arm is 100 mV

Vac	Load	CH1	CH2	CH3	CH4
230	500 W	PWML	Vzcd	Vac	iL



230 Vac 500 W output; ZCD_arm is 100 mV
1−D turn off threshold becomes 75 mV, because Maximum duty clamp 96% x (1 / 65 kHz) = 14.77 μs

Vac	Load	CH1	CH2	CH3	CH4
230	500 W	PWML	Vzcd	Vac	iL



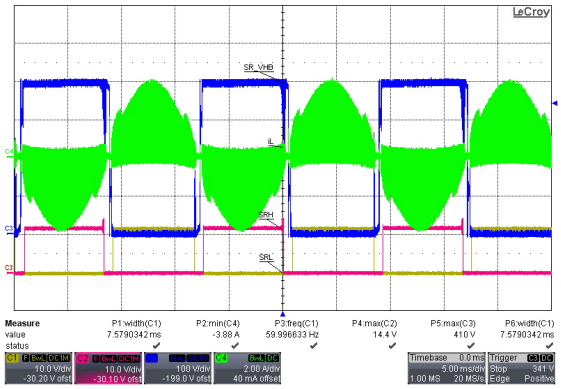
230 Vac 500 W output; ZCD_arm is 100 mV
1−D dead time is around 84ns

Figure 45.

PFC Stage Slow Leg − 1

Test condition: 115 Vac 25% load

Vac	Load	CH1	CH2	CH3	CH4
115	125 W	SRL	SRH	SR_HB	IL



Vac	Load	CH1	CH2	CH3	CH4
115	125 W	SRL	SRH	SR_HB	IL

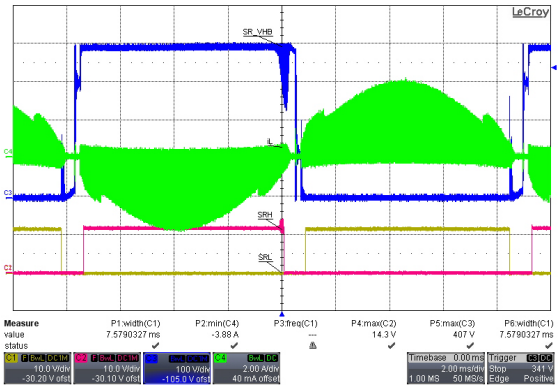
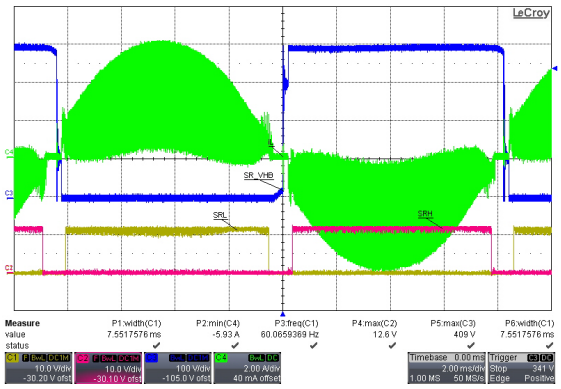


Figure 46.

PFC Stage Slow Leg − 2

Test condition: 115 Vac 50% load

Vac	Load	CH1	CH2	CH3	CH4
115	250 W	SRL	SRH	SR_HB	IL



Vac	Load	CH1	CH2	CH3	CH4
115	250 W	SRL	SRH	SR_HB	IL

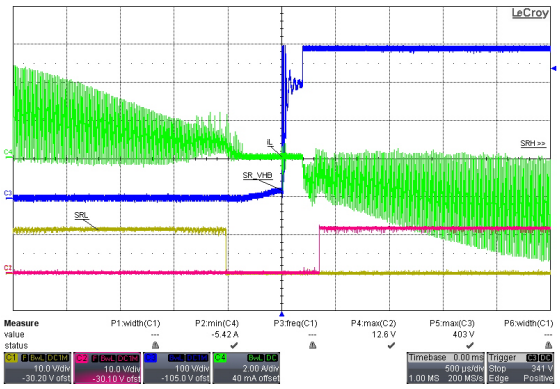
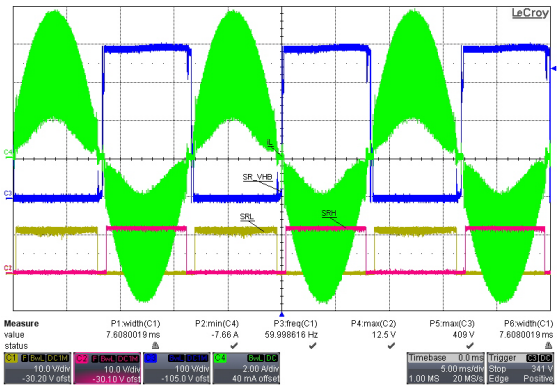


Figure 47.

PFC Stage Slow Leg − 3

Test condition: 115 Vac 75% load

Vac	Load	CH1	CH2	CH3	CH4
115	375 W	SRL	SRH	SR_HB	IL



Vac	Load	CH1	CH2	CH3	CH4
115	375 W	SRL	SRH	SR_HB	IL

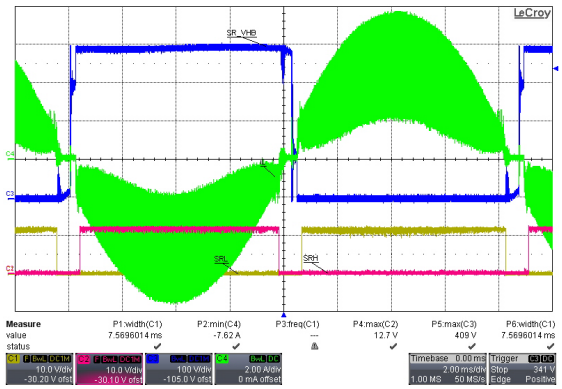
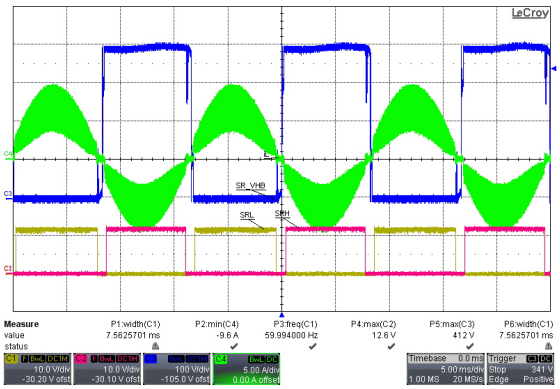


Figure 48.

PFC Stage Slow Leg − 4

Test condition: 115 Vac 100% load

Vac	Load	CH1	CH2	CH3	CH4
115	500 W	SRL	SRH	SR_HB	IL



Vac	Load	CH1	CH2	CH3	CH4
115	500 W	SRL	SRH	SR_HB	IL

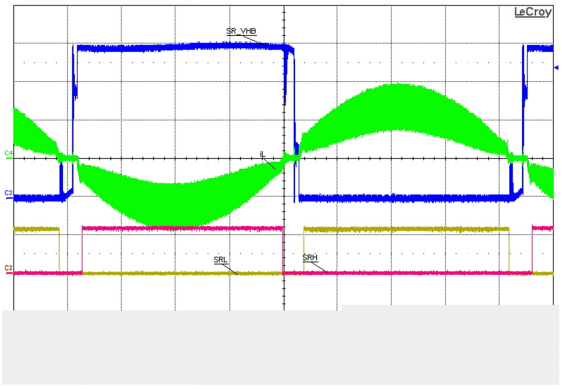
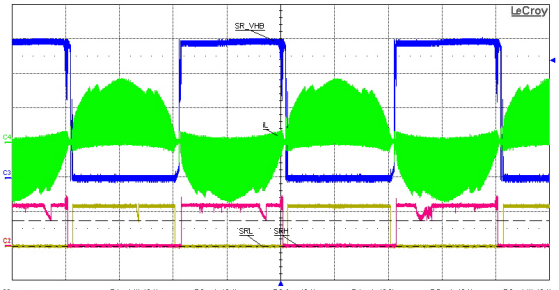


Figure 49.

PFC Stage Slow Leg − 5

Test condition: 230 Vac 25% load

Vac	Load	CH1	CH2	CH3	CH4
230	125 W	SRL	SRH	SR_HB	IL



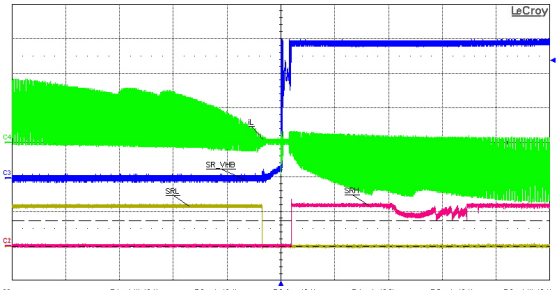
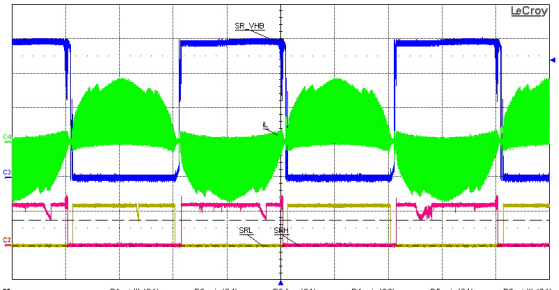


Figure 50.

PFC Stage Slow Leg − 6

Test condition: 230 Vac 50% load

Vac	Load	CH1	CH2	CH3	CH4
230	250 W	SRL	SRH	SR_HB	IL



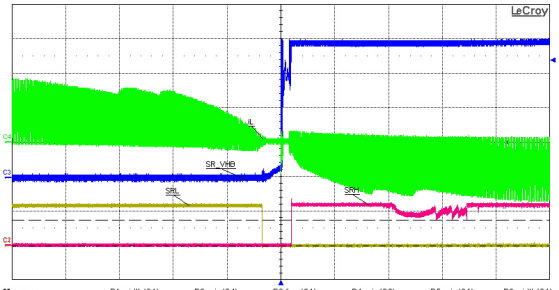
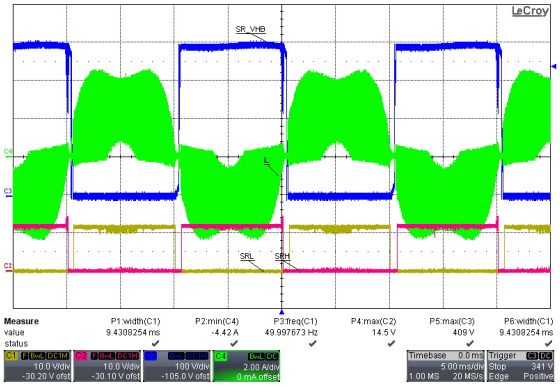


Figure 51.

PFC Stage Slow Leg − 7

Test condition: 230 Vac 75% load

Vac	Load	CH1	CH2	CH3	CH4
230	375 W	SRL	SRH	SR_HB	IL



Vac	Load	CH1	CH2	CH3	CH4
230	375 W	SRL	SRH	SR_HB	IL

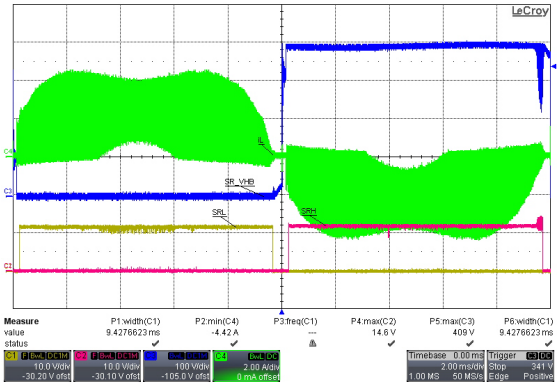
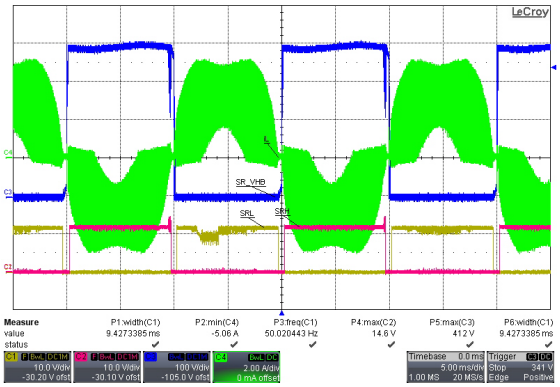


Figure 52.

PFC Stage Slow Leg − 8

Test condition: 230 Vac 100% load

Vac	Load	CH1	CH2	CH3	CH4
230	500 W	SRL	SRH	SR_HB	IL



Vac	Load	CH1	CH2	CH3	CH4
230	500 W	SRL	SRH	SR_HB	IL

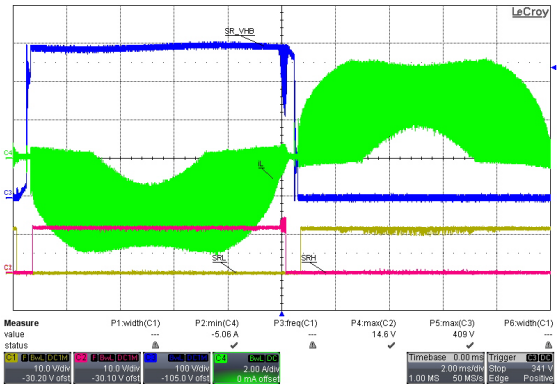
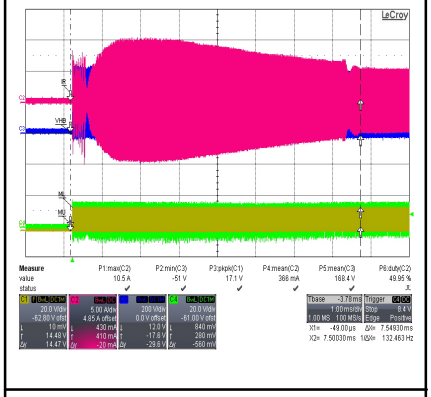


Figure 53.

LLC Stage − 1

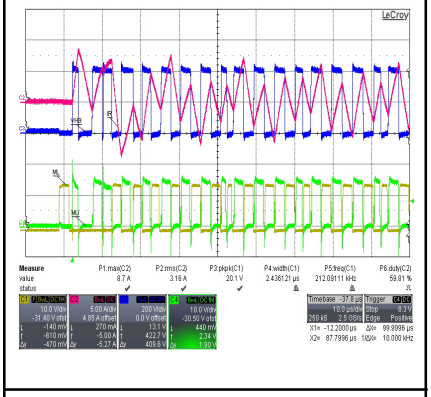
Test condition: 115 Vac / 230 Vac 100% load

Vac	Load	CH1	CH2	CH3	CH4
115	100%	ML	IR	VHB	MU



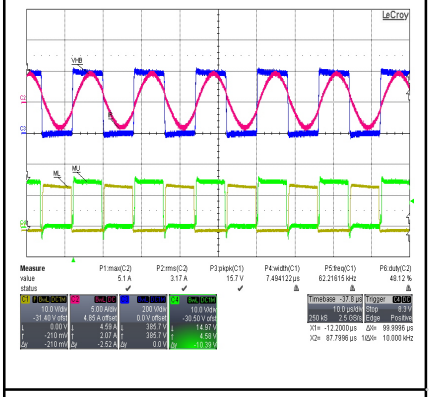
Start up

Vac	Load	CH1	CH2	CH3	CH4
115	100%	ML	IR	VHB	MU



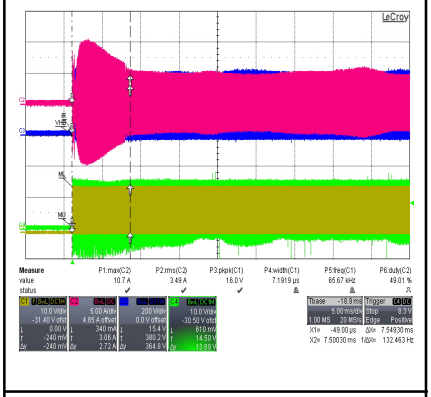
Soft start sequence

Vac	Load	CH1	CH2	CH3	CH4
115	100%	ML	IR	VHB	MU



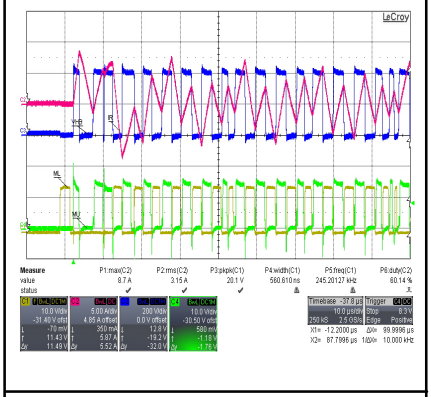
Static state

Vac	Load	CH1	CH2	CH3	CH4
230	100%	ML	IR	VHB	MU



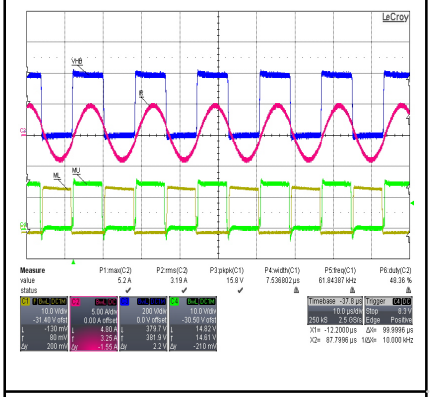
Start up

Vac	Load	CH1	CH2	CH3	CH4
230	100%	ML	IR	VHB	MU



Soft start sequence

Vac	Load	CH1	CH2	CH3	CH4
230	100%	ML	IR	VHB	MU



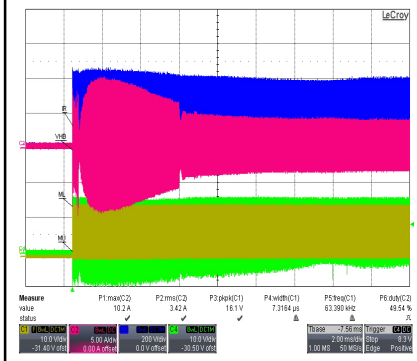
Static state

Figure 54.

LLC Stage − 2

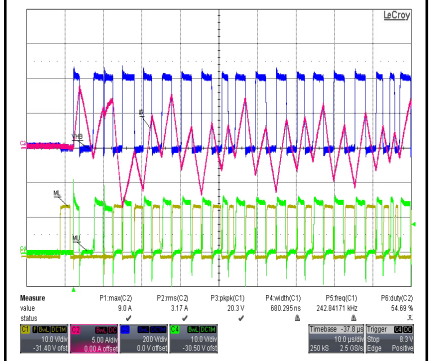
Test condition: 115 Vac / 230 Vac 75% load

Vac	Load	CH1	CH2	CH3	CH4
115	75%	ML	IR	VHB	MU



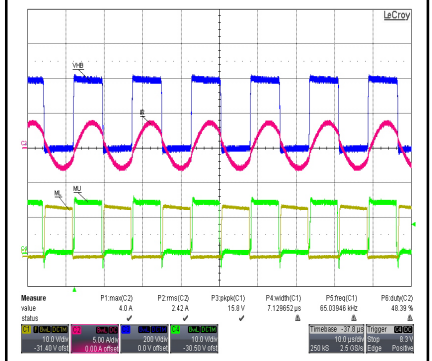
Start up

Vac	Load	CH1	CH2	CH3	CH4
115	75%	ML	IR	VHB	MU



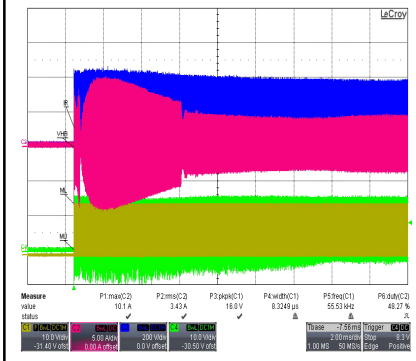
Soft start sequence

Vac	Load	CH1	CH2	CH3	CH4
115	75%	ML	IR	VHB	MU



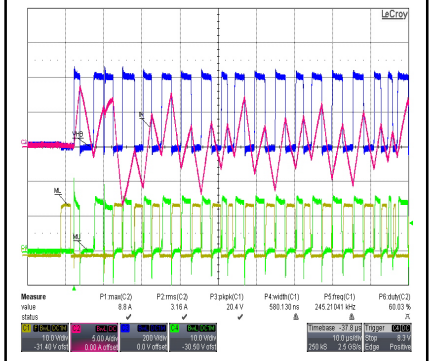
Static state

Vac	Load	CH1	CH2	CH3	CH4
230	75%	ML	IR	VHB	MU



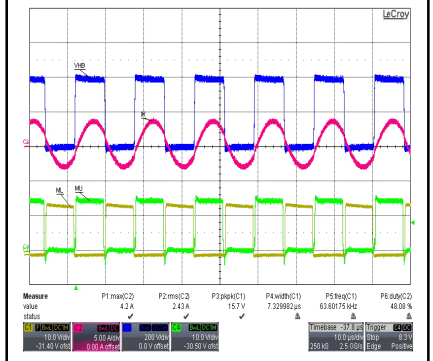
Start up

Vac	Load	CH1	CH2	CH3	CH4
230	75%	ML	IR	VHB	MU



Soft start sequence

Vac	Load	CH1	CH2	CH3	CH4
230	75%	ML	IR	VHB	MU



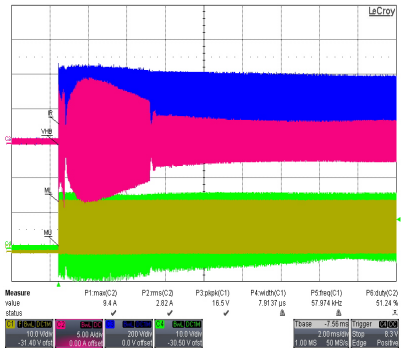
Static state

Figure 55.

LLC Stage − 3

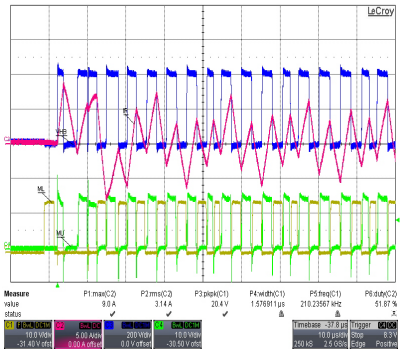
Test condition: 115 Vac / 230 Vac 50% load

Vac	Load	CH1	CH2	CH3	CH4
115	50%	ML	IR	VHB	MU



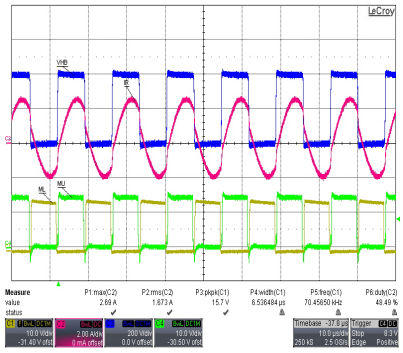
Start up

Vac	Load	CH1	CH2	CH3	CH4
115	50%	ML	IR	VHB	MU



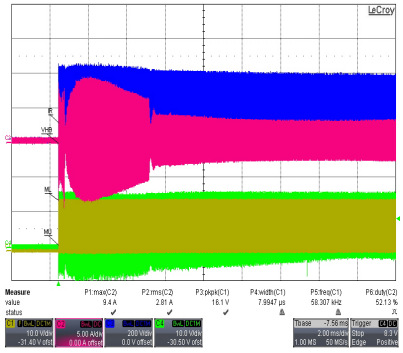
Soft start sequence

Vac	Load	CH1	CH2	CH3	CH4
115	50%	ML	IR	VHB	MU



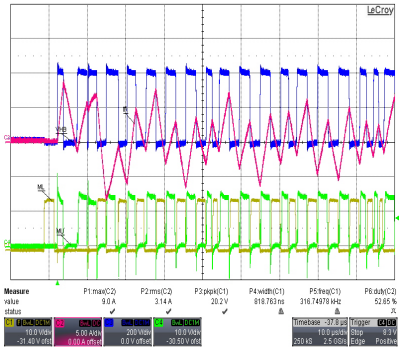
Static state

Vac	Load	CH1	CH2	CH3	CH4
230	50%	ML	IR	VHB	MU



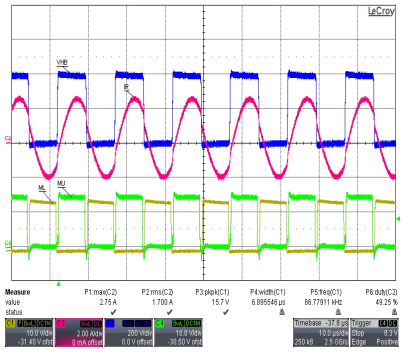
Start up

Vac	Load	CH1	CH2	CH3	CH4
230	50%	ML	IR	VHB	MU



Soft start sequence

Vac	Load	CH1	CH2	CH3	CH4
230	50%	ML	IR	VHB	MU



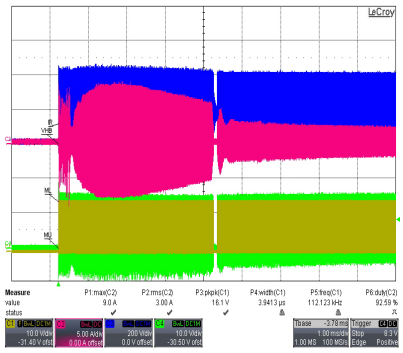
Static state

Figure 56.

LLC Stage − 4

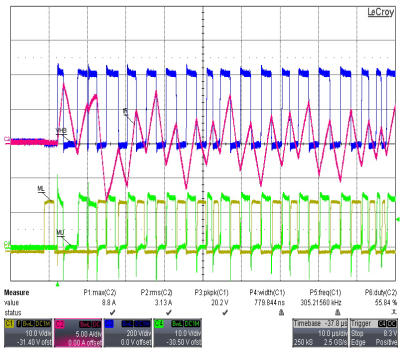
Test condition: 115 Vac / 230 Vac 25% load

Vac	Load	CH1	CH2	CH3	CH4
115	25%	ML	IR	VHB	MU



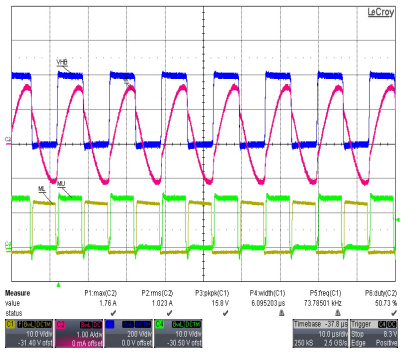
Start up

Vac	Load	CH1	CH2	CH3	CH4
115	25%	ML	IR	VHB	MU



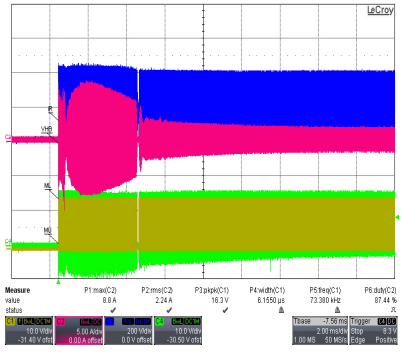
Soft start sequence

Vac	Load	CH1	CH2	CH3	CH4
115	25%	ML	IR	VHB	MU



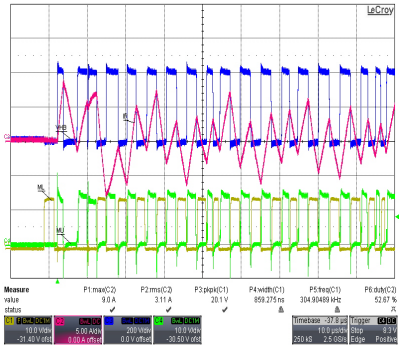
Static state

Vac	Load	CH1	CH2	CH3	CH4
230	25%	ML	IR	VHB	MU



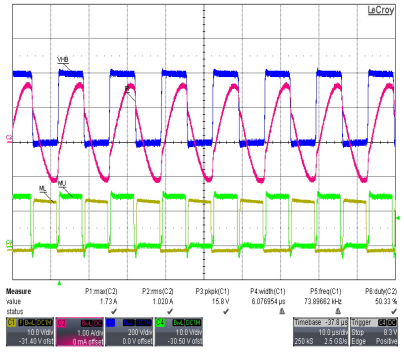
Start up

Vac	Load	CH1	CH2	CH3	CH4
230	25%	ML	IR	VHB	MU



Soft start sequence

Vac	Load	CH1	CH2	CH3	CH4
230	25%	ML	IR	VHB	MU



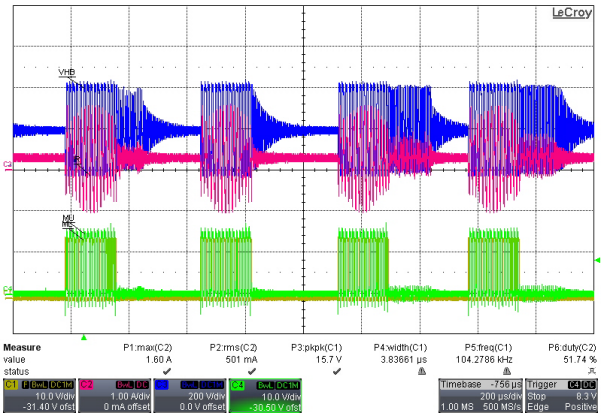
Static state

Figure 57.

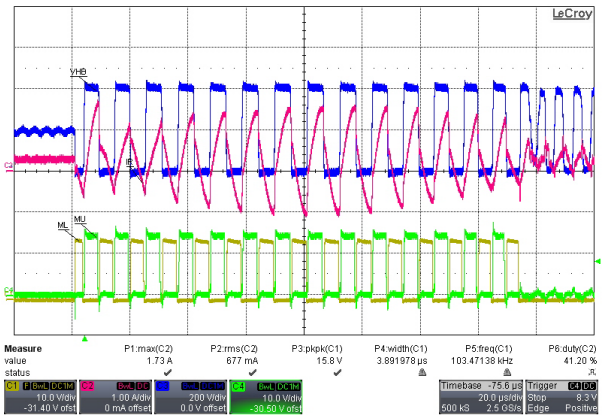
LLC Stage − 5

Test condition: 115 Vac / 230 Vac 2 A load

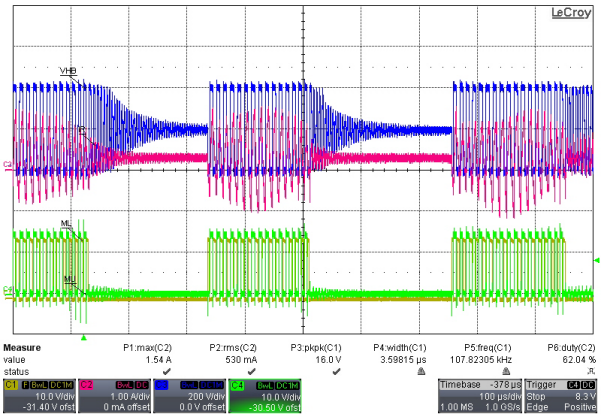
Vac	Load	CH1	CH2	CH3	CH4
115	2 A	ML	IR	VHB	MU



Vac	Load	CH1	CH2	CH3	CH4
115	2 A	ML	IR	VHB	MU



Vac	Load	CH1	CH2	CH3	CH4
230	2 A	ML	IR	VHB	MU



Vac	Load	CH1	CH2	CH3	CH4
230	2 A	ML	IR	VHB	MU

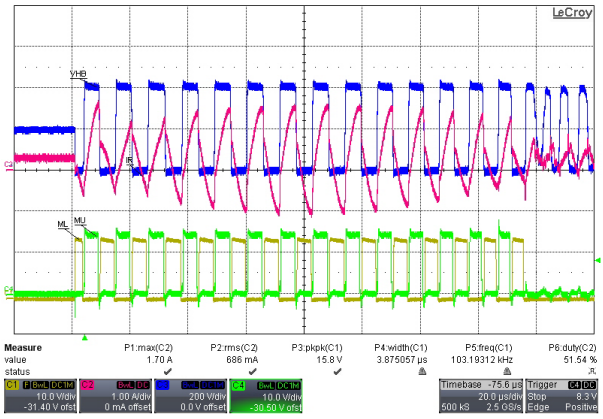
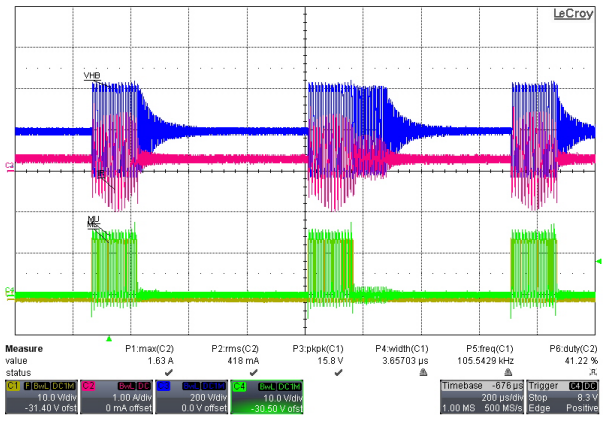


Figure 58.

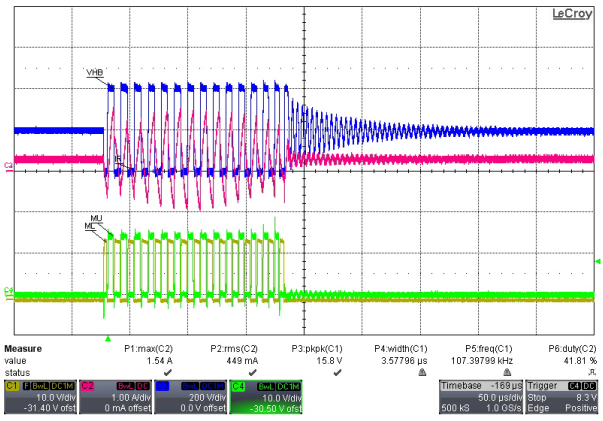
LLC Stage − 6

Test condition: 115 Vac / 230 Vac 1 A load

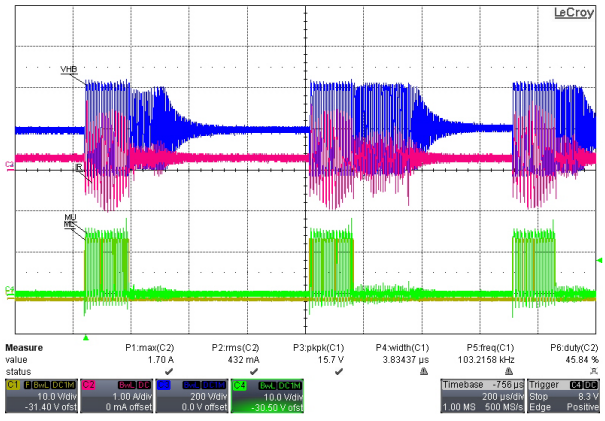
Vac	Load	CH1	CH2	CH3	CH4
115	1 A	ML	IR	VHB	MU



Vac	Load	CH1	CH2	CH3	CH4
115	1 A	ML	IR	VHB	MU



Vac	Load	CH1	CH2	CH3	CH4
230	1 A	ML	IR	VHB	MU



Vac	Load	CH1	CH2	CH3	CH4
230	1 A	ML	IR	VHB	MU

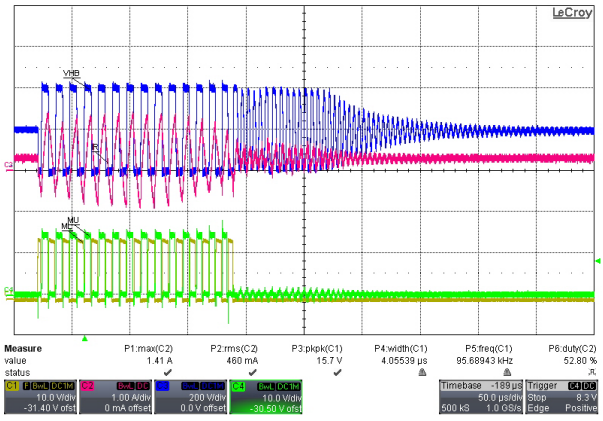
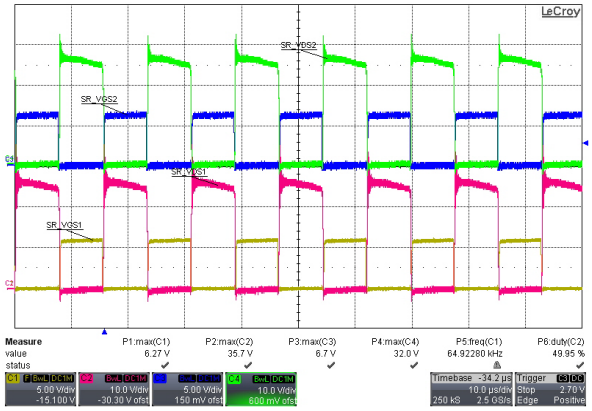


Figure 59.

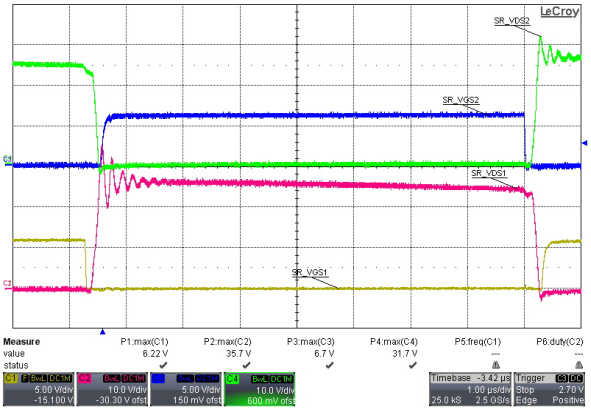
SR Stage − 1

Test condition: 115 Vac / 230 Vac 100% load

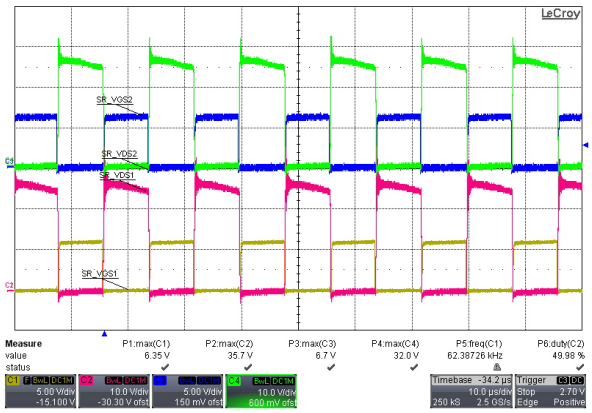
Vac	Load	CH1	CH2	CH3	CH4
115	100%	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
115	100%	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
230	100%	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
230	100%	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2

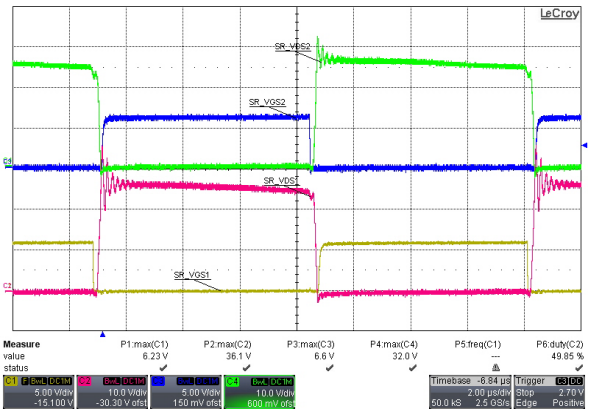
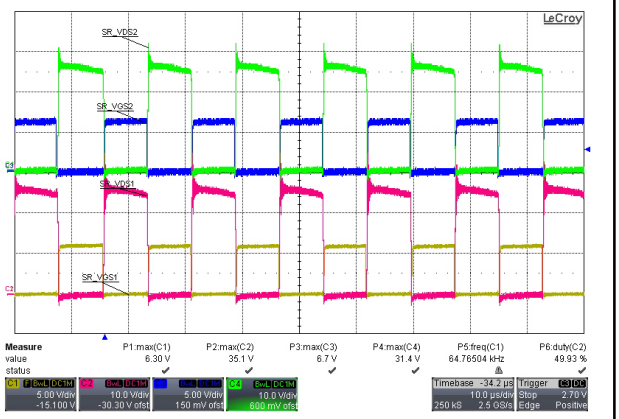


Figure 60.

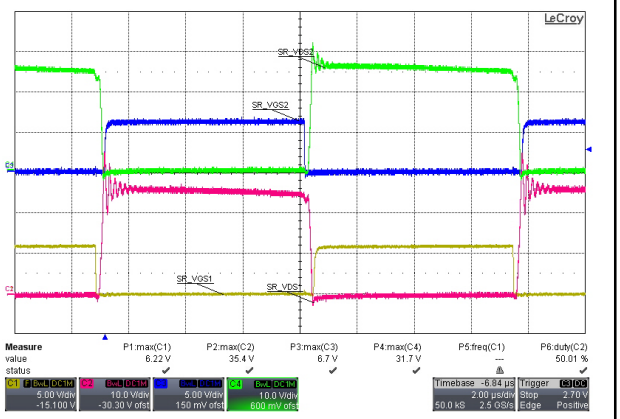
SR Stage − 2

Test condition: 115 Vac / 230 Vac 75% load

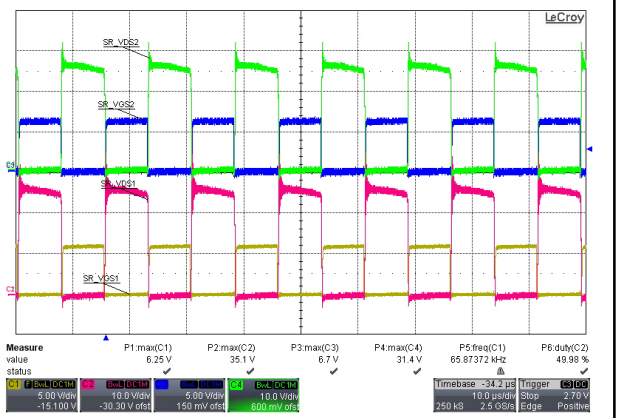
Vac	Load	CH1	CH2	CH3	CH4
115	75%	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
115	75%	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
230	75%	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
230	75%	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2

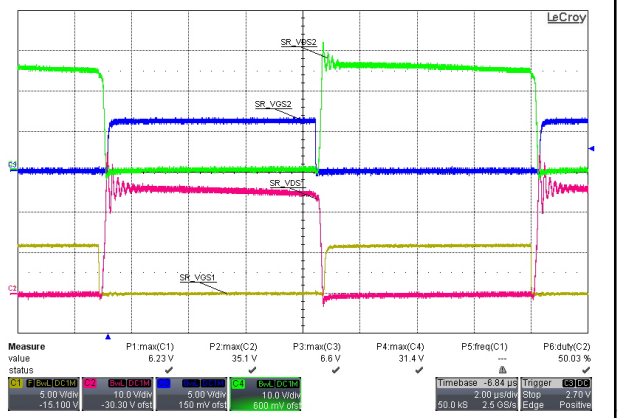
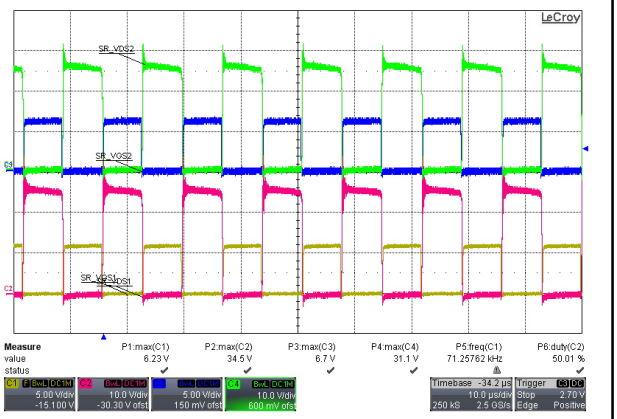


Figure 61.

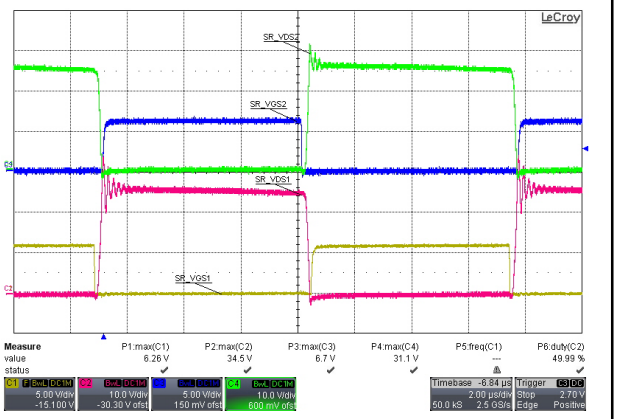
SR Stage − 3

Test condition: 115 Vac / 230 Vac 50% load

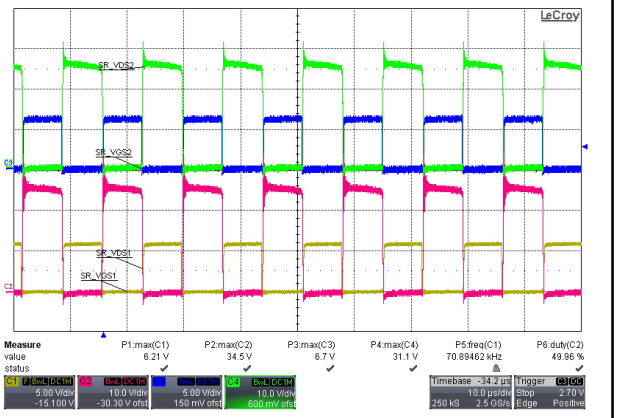
Vac	Load	CH1	CH2	CH3	CH4
115	50%	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
115	50%	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
230	50%	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
230	50%	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2

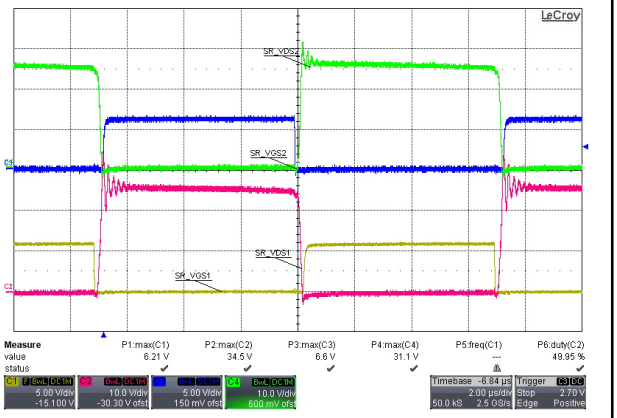
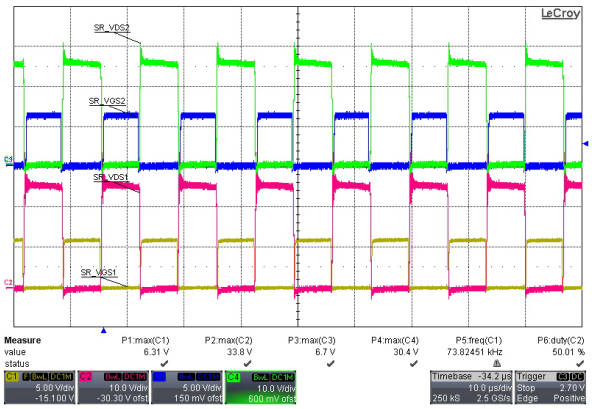


Figure 62.

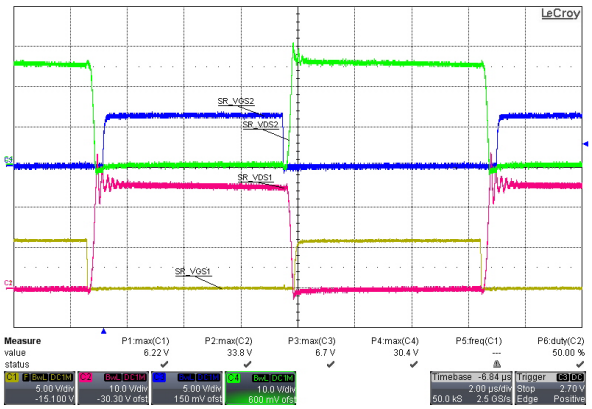
SR Stage − 4

Test condition: 115 Vac / 230 Vac 25% load

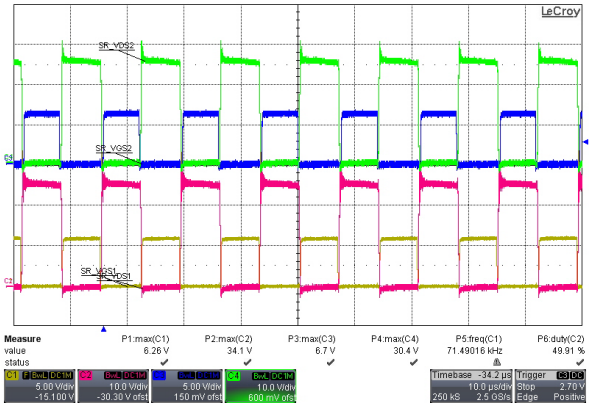
Vac	Load	CH1	CH2	CH3	CH4
115	25%	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
115	25%	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
230	25%	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
230	25%	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2

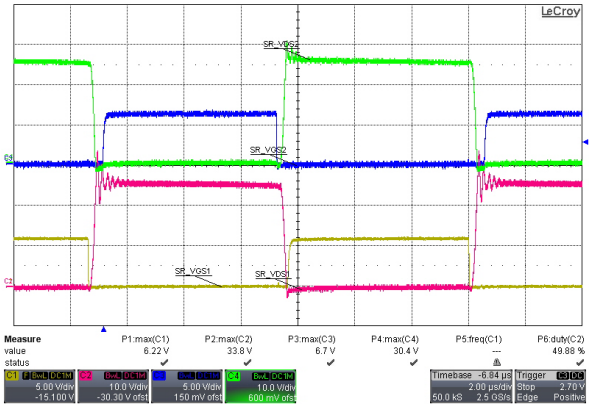
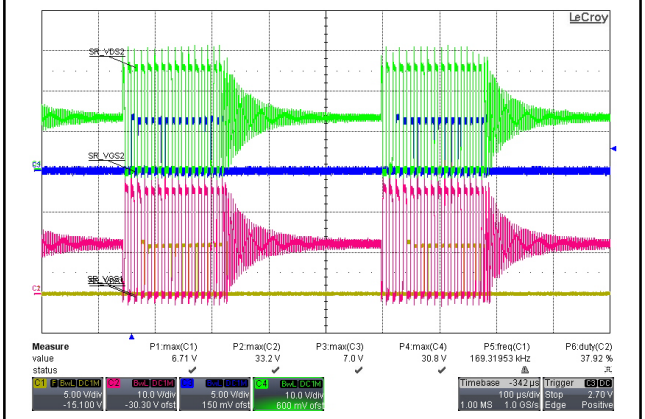


Figure 63.

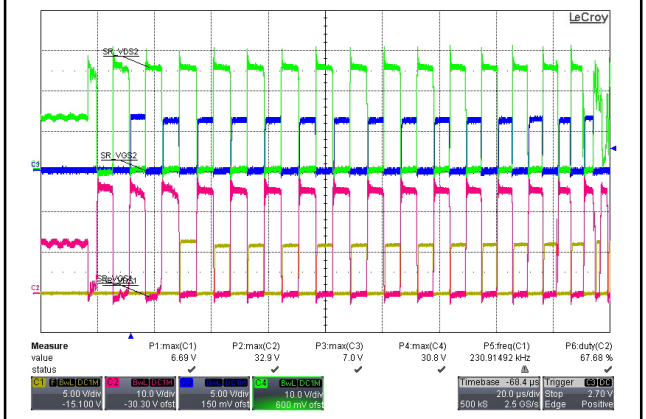
SR Stage − 5

Test condition: 115 Vac / 230 Vac 2 A load

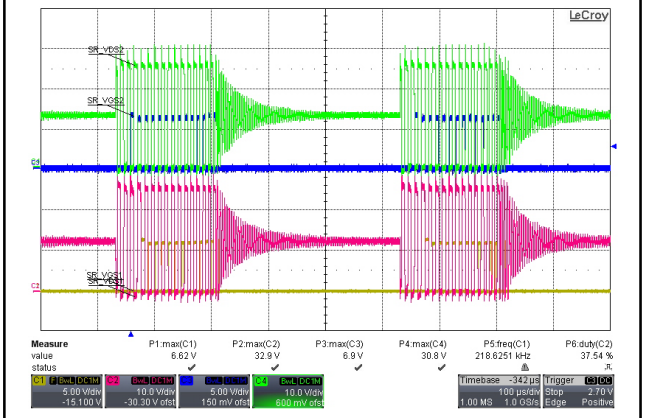
Vac	Load	CH1	CH2	CH3	CH4
115	2 A	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
115	2 A	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
230	2 A	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
230	2 A	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2

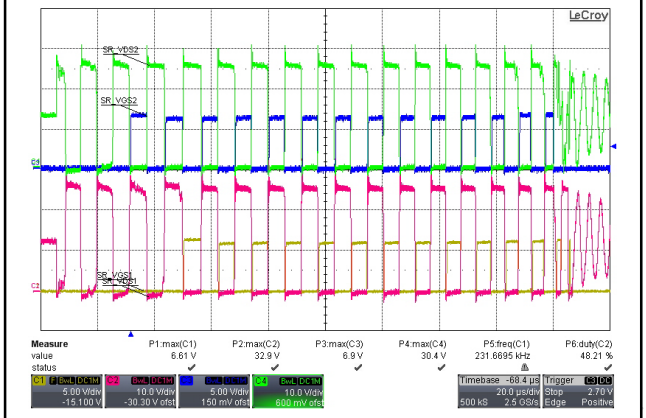
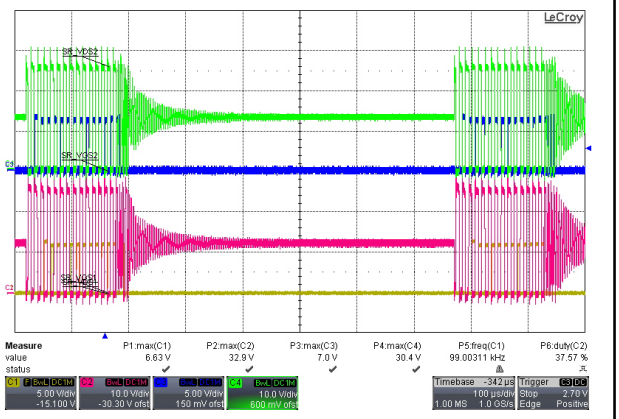


Figure 64.

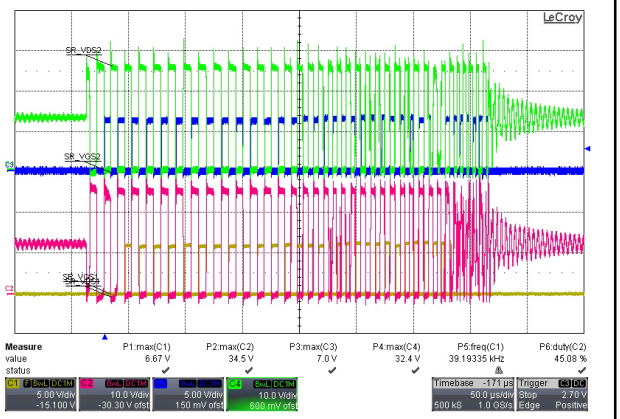
SR Stage − 6

Test condition: 115 Vac / 230 Vac 1 A load

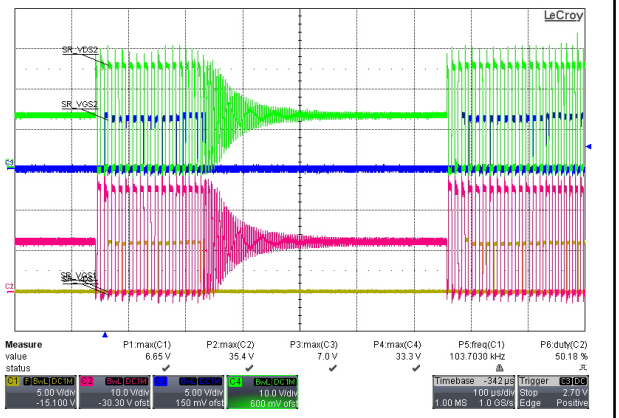
Vac	Load	CH1	CH2	CH3	CH4
115	1 A	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
115	1 A	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
230	1 A	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2



Vac	Load	CH1	CH2	CH3	CH4
230	1 A	SR_VGS1	SR_VDS1	SR_VGS2	SR_VDS2

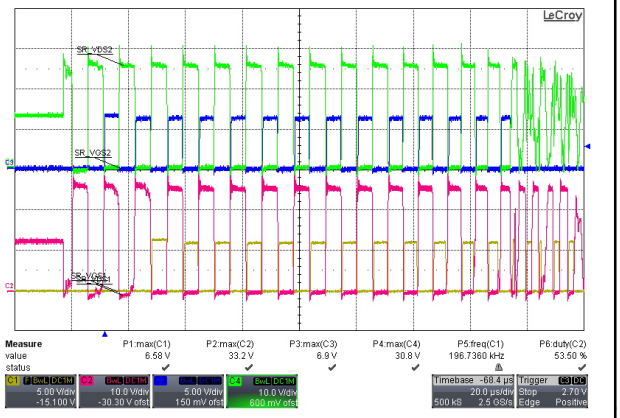
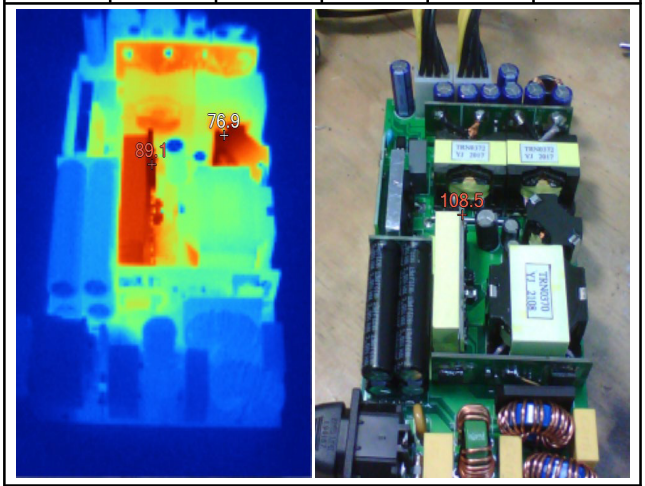


Figure 65.

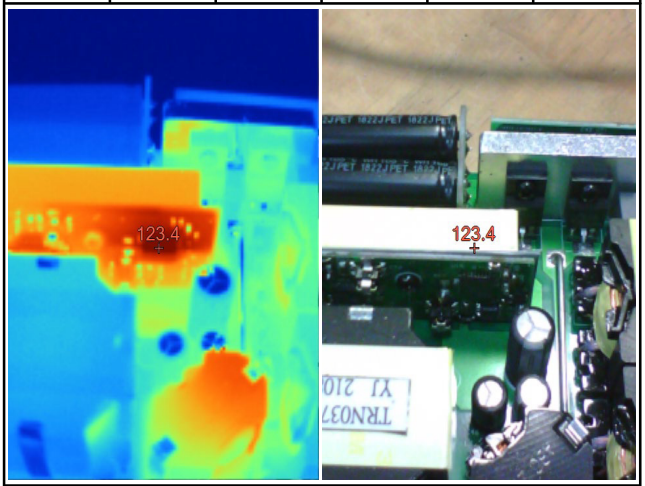
Thermal − 1

Test condition: 115 Vac 100% load @ room temp

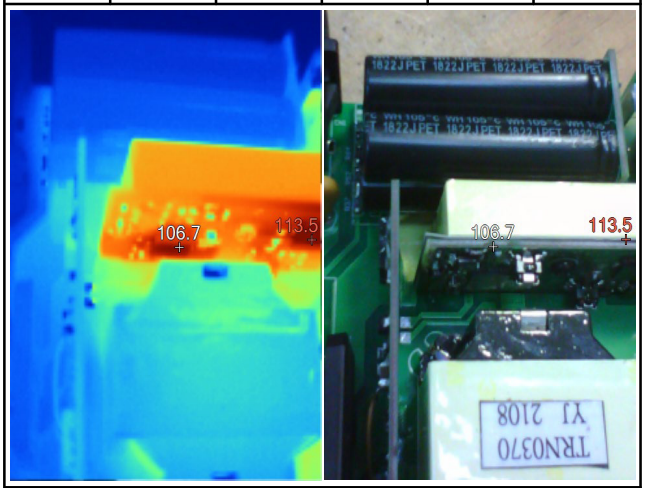
Vac	Load	CH1	CH2	CH3	CH4
115	100%	X	X	X	X



Vac	Load	CH1	CH2	CH3	CH4
115	100%	X	X	X	X



Vac	Load	CH1	CH2	CH3	CH4
115	100%	X	X	X	X



Vac	Load	CH1	CH2	CH3	CH4
115	100%	X	X	X	X

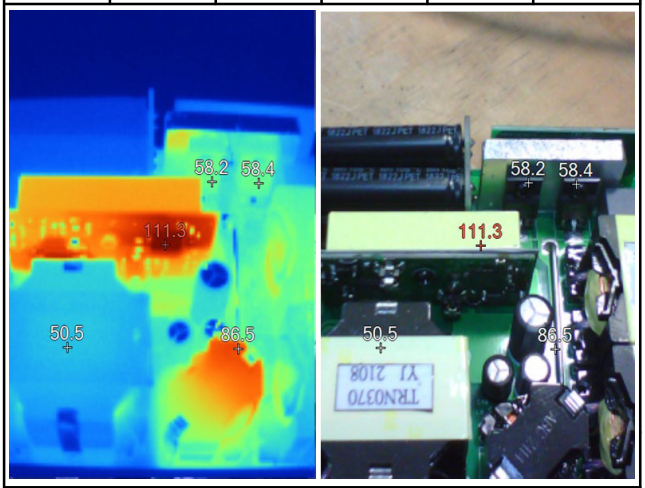
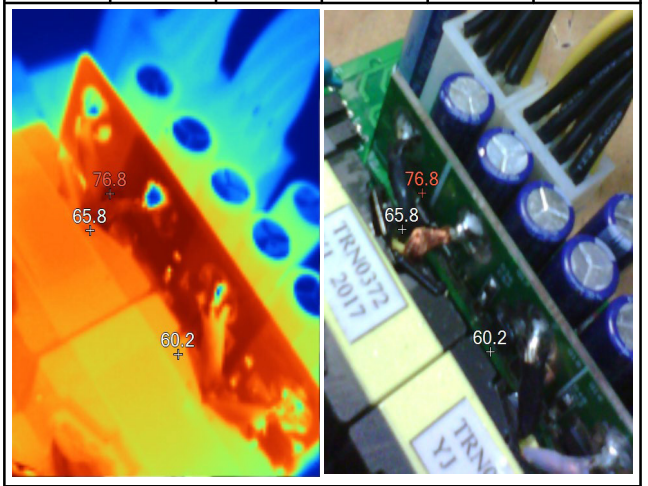


Figure 66.

Thermal − 2

Test condition: 115 Vac 100% load @ room temp

Vac	Load	CH1	CH2	CH3	CH4
115	100%	X	X	X	X



Vac	Load	CH1	CH2	CH3	CH4
115	100%	X	X	X	X

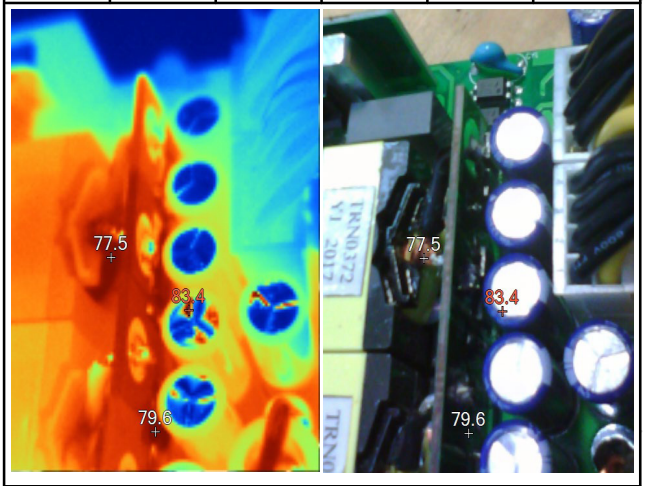


Figure 67.

Table 1.

Key Components	Thermal	Unit
Totem pole PFC Fast leg Dr.GaN	124	°C
Totem pole PFC Slow leg MOS	60	°C
LLC High Low side MOS	60	°C
PFC choke	50	°C
LLC main transformer	77	°C
LLC Leakage inductor	87	°C
SR MOS	83	°C

Bill of Materials

Table 2. BOM

	Description	Package	Vendor	Vendor P/N	QPA	Parts
1	INLET 3P 90° R−301SN (B13)		富灣	R−301SN (12B)	1	CN1
2	Wafer.4.2 mm. 2x4P 5102−07003L				2	CN2, CN3
3	FUSE CERAMIC 10 A / 250 V Time lag	5 Ψ 10 mm	呈乙	28−1001B11−00	1	F1
4	MOV DIP, TVR10471KSV, 470 V ±10%	10 mm ϕ	興勤	TVR10471KSV	1	VAR1
5	CAP X2 MP PC 275 VAC 0.68 μF K S15	11.5 x 19.5 x 17.5 mm Pitch = 15 mm	富之餘	HQX684KS275I	1	CX1
6	CAP X2 MP PC 275 VAC 0.47 μF K S15	18 x 8.5 x 16.5 mm, Pitch = 15 mm	凱恩傑	PX474K3ID42H200D9R	2	CX2, CX3
7	CAP Y1/X1 CD 250 VAC 220 pF K		萬宇	CC−CD85−B2GA221KYAS	1	CY1
8	CAP AL 100 μF 420 V 105°C 12.5 x 50 mm	12.5 x 50 mm ,RADIAL	AISHI	EWH2TM101W50OT	4	C5, C6, C7, C72 (PLM0438−4 daughter card)
9	CAP AL 2200 μF 16 V 105°C 10 x 25 mm GM	10 x 25,RADIAL 散裝 RR	AISHI	ERR1CM222G25OT	8	C9, C10, C11, C12, C21, C22, C23, C31
10	CAP AL 100 μF 50 V 105°C 8 x 11 mm WH	8 x 11 ,RADIAL 散裝	AISHI	EWH1HM101F11OPT	2	C41, C46
11	CAP AL 330 μF 50 V 105°C 10 x 16 mm WH	10 x 16 RADIAL 散裝	AISHI	EWH1HM331G16OT	1	C82
12	CAP MKP 0.1 μF 630 V 125°C ±10%	0.1 μF DC630v 18 x 16 x 10 P = 15 L = 17	KEMET	R76PI31005050J	1	C18
13	CAP SMD MC 1210 473P/630 V ±10% X7R	SMD 1210			3	C77, C78, C79 (PLM0438−6 daughter card)
14	CAP SMD MC 1206 101 pF/1 kV ±10% X7R	SMD 1206			2	C4, C17
15	CAP SMD MC 1206 221 pF/1 kV ±10% X7R	SMD 1206			2	C25, C27 (PLM0438−5 daughter card)
16	CAP SMD MC 1206 102 pF/1 kV ±10% X7R	SMD 1206			4	C13, C52, C56, C57 (PLM0438−2 daughter card)
17	CAP SMD MC 1206 105 pF/25 V ±10% X7R	SMD 1206			1	C45
18	CAP SMD MC 1206 225 pF/25 V ±10% X7R	SMD 1206			2	C54, C55 (PLM0438−2 daughter card)
19	CAP SMD MC 1206 475 pF/50 V ±10% X7R	SMD 1206			3	C44, C66 C29 (PLM0438−3 daughter card)
20	CAP SMD MC 0805 224 pF/50 V ±10% X7R	SMD 0805			2	C26, C39 (PLM0438−5 daughter card)
21	CAP SMD MC 0805 105 pF/50 V ±10% X7R	SMD 0805			6	C3, C16, C69, C74 (PLM0438−6 daughter card) C75, C76
22	CAP SMD MC 0805 225 pF/50 V ±10% X7R	SMD 0805			1	C24 (PLM0438−3 daughter card)
23	CAP SMD MC 0603 101 pF/50 V ±10% X7R	SMD 0603			6	C59, C62 (PLM0438−3 daughter card) C60, C63, C64, C65
24	CAP SMD MC 0603 221 pF/50 V ±10% X7R	SMD 0603			2	C51, C58
25	CAP SMD MC 0603 331 pF/50 V ±10% X7R	SMD 0603			2	C28 C38 (PLM0438−5 daughter card)
26	CAP SMD MC 0603 102 pF/50 V ±10% X7R	SMD 0603			4	C20, C32 (PLM0438−5 daughter card) C47, C49
27	CAP SMD MC 0603 222 pF/50 V ±10% X7R	SMD 0603			2	C35, C43
28	CAP SMD MC 0603 472 pF/50 V ±10% X7R	SMD 0603			2	C30, C34 (PLM0438−5 daughter card)
29	CAP SMD MC 0603 103 pF/50 V ±10% X7R	SMD 0603			7	C33, C40, C42, C71 (PLM0438−5 daughter card) C61 C2, C15 (PLM0438−6 daughter card)
30	CAP SMD MC 0603 104 pF/50 V ±10% X7R	SMD 0603			5	C53 C67, C68, C70, C73 (PLM0438−6 daughter card)
31	BRIDGE DIODE 25 A 600 V	TS−6P	**onsemi**	DFB2560	1	BD1
32	N−CH Power MOSFET 75 A/60 V 2.8 mΩ	Power PAK 5 x 6	**onsemi**	NTMFS5C628NL	8	Q14, Q16, Q17, Q18, Q31, Q32, Q33, Q34 (PLM0438−2 daughter card)
33	N−CH SF3 650 V 82 mΩ FRFET	TO−220F	**onsemi**	NTPF082N65S3F	2	Q4, Q9
34	Super FET3 650 V 50 mΩ	TOLL	**onsemi**	NTBL050N65S3H	2	Q1, Q3 (PLM0438−3 daughter card)
35	NPN BJT 2 A/60 V Low Saturation Transistor	SOT−23	**onsemi**	FSB560	1	Q25
36	600 V / 1.0 A Fast Recovery Rectifier	SMA	**onsemi**	RS1J	5	D1, D2, D18 D11 (PLM0438−5 daughter card) D17 (PLM0438−3 daughter card)
37	200 V/ 0.8 A Fast Recovery Rectifier	SOD−123	**onsemi**	RS1DFA	9	D3, D4, D5, D6, D14, D15 (PLM0438−6 daughter card) D13, D16, D20
38	UltraFast Power Rectifier 1 A/200 V	SMA	**onsemi**	ES1D	3	D8, D10, D23

Table 2. BOM (continued)

	Description	Package	Vendor	Vendor P/N	QPA	Parts
39	UltraFast Power Rectifier 3 A/200 V	SMC	**onsemi**	ES3B	1	D22
40	Dual Switching Diode 100 mA/ 35 V	SOT−23	**onsemi**	MMBD2835LT1G	1	D12
41	Diode Zener 4.7 V	SOD−123	**onsemi**	MMSZ5230BT1G	1	ZD1
42	Diode Zener 16 V	SOD−123	**onsemi**	MMSZ5246BT1G	1	ZD6
43	Dual PMOS −80 V, −2.1 A, 183 mΩ	SO8	**onsemi**	FDS8935	2	U2, U3 (PLM0438−6 daughter card)
44	Totem pole PFC controller	SO20	**onsemi**	NCP1681	1	U10
45	LLC controller	SO16	**onsemi**	NCP13994	1	U4 (PLM0438−5 daughter card)
46	Programmable Precision Reference	SOT−23	**onsemi**	NCP432BVSNT1G	2	U6, U7
47	Photo Coupler	DIP4	**onsemi**	FOD817B	2	U8, U11
48	Dual Driver SR controller	SO8	**onsemi**	NCP4318BLCDR2G	2	U5, U9 (PLM0438−2 daughter card)
49	Driver GaN 50 mΩ 600 V	QFN26	**onsemi**	NCP58921	2	U14, U15 (PLM0438−6 daughter card)
50	High low side Driver	SO8	**onsemi**	NCP5183	1	U12 (PLM0438−3 daughter card)
51	Isolated high low side gate driver	SO16 WB	**onsemi**	NCP51561	1	U16
52	LDO Regulator, 150 mA, 38 V	TSOP5	**onsemi**	NCP730ASNADJT1G	1	U13
53	Differential choke 27 μH				2	L1, L3 (TBD)
54	Common mode choke 1 mH	L27 x W14.5 mm _ 1 ϕ x 2 pin pitch 10 mm	台灣電感		1	L2
55	Differential choke 10 μH	L 24 x W14 x H20 mm _ 1.5 ϕ x 3 pin pitch 11 mm	台灣電感		1	L7
56	PFC choke 280 μH	QP3925V	YUJING	11054−125v400210	1	L4
57	LLC leakage inductor 55 μH	RM10	WE	750344733	1	L6
58	LLC main transformer 280 μH	PQ3220	WE	750344731	2	TX1, TX2
59	SMT Current Sense Transformer	749251050	WE	749251050	2	CT1, CT2 (PLM0438−6 daughter card)
60	RES SMD R2512 0 Ω ±5%	SMD 2512			1	JP2
61	RES SMD R2512 82 mΩ ±1%	SMD 2512			2	R5, R6
62	RES SMD R1206 2.4 Ω ±5%	SMD 1206			4	R41, R83 (PLM0438−5 daughter card) R49 (PLM0438−3 daughter card) R51
63	RES SMD R1206 3.9 Ω ±1%	SMD 1206			1	R19
64	RES SMD R1206 4.3 Ω ±1%	SMD 1206			1	R20
65	RES SMD R1206 10 Ω ±5%	SMD 1206			2	R70, R72 (PLM0438−3 daughter card)
66	RES SMD R1206 47 Ω ±5%	SMD 1206			4	R35, R36, R42, R45 (PLM0438−2 daughter card)
67	RES SMD R1206 4.3 kΩ ±5%	SMD 1206			2	R2, R22 (PLM0438−6 daughter card)
68	RES SMD R1206 4.7 kΩ ±5%	SMD 1206			1	R43 (PLM0438−5 daughter card)
69	RES SMD R1206 20 kΩ ±5%	SMD 1206			2	R14, R32 (PLM0438−3 daughter card)
70	RES SMD R1206 300 kΩ ±5%	SMD 1206			1	R12
71	RES SMD R1206 2.21 MΩ ±1%	SMD 1206			3	R11, R13, R17
72	RES SMD R1206 3.3 MΩ ±5%	SMD 1206			6	R37, R38, R52, R62, R64, R65
73	RES SMD R0805 0 Ω ±5%	SMD 0805			1	R21
74	RES SMD R0805 4.7 Ω ±5%	SMD 0805			2	R15, R44
75	RES SMD R0805 22 Ω ±5%	SMD 0805			2	R10, R26 (PLM0438−3 daughter card)
76	RES SMD R0805 1.5 kΩ ±5%	SMD 0805			2	R48 (PLM0438−5 daughter card) R66
77	RES SMD R0805 15 kΩ ±5%	SMD 0805			1	R24
78	RES SMD R0805 20 kΩ ±5%	SMD 0805			2	R16, R29
79	RES SMD R0805 24 kΩ ±5%	SMD 0805			1	R102
80	RES SMD R0805 40.2 kΩ ±5%	SMD 0805			2	R7, R25 (PLM0438−6 daughter card)
81	RES SMD R0603 10 Ω ±5%	SMD 0603			2	R71, R73
82	RES SMD R0603 12.4 Ω ±1%	SMD 0603			4	R40, R60, R77, R78 (PLM0438−2 daughter card)
83	RES SMD R0603 22.1 Ω ±5%	SMD 0603			3	R46 (PLM0438−5 daughter card) R79, R81 (PLM0438−6 daughter card)

Table 2. BOM (continued)

	Description	Package	Vendor	Vendor P/N	QPA	Parts
84	RES SMD R0603 33 Ω ±5%	SMD 0603			2	R4, R23 (PLM0438−6 daughter card)
85	RES SMD R0603 1 kΩ ±5%	SMD 0603			2	R74, R76
86	RES SMD R0603 1.24 kΩ ±1%	SMD 0603			2	R63, R75
87	RES SMD R0603 1.5 kΩ ±5%	SMD 0603			1	R57 (PLM0438−5 daughter card)
88	RES SMD R0603 2.4 kΩ ±5%	SMD 0603			1	R27
89	RES SMD R0603 6.19 kΩ ±1%	SMD 0603			1	R54
90	RES SMD R0603 6.81 kΩ ±1%	SMD 0603			3	R8, R69, R80
91	RES SMD R0603 15 kΩ ±5%	SMD 0603			2	R30, R39
92	RES SMD R0603 20 kΩ ±5%	SMD 0603			2	R59, R61
93	RES SMD R0603 24.9 kΩ ±1%	SMD 0603			1	R50
94	RES SMD R0603 27.4 kΩ ±1%	SMD 0603			1	R34
95	RES SMD R0603 30 kΩ ±5%	SMD 0603			1	R56 (PLM0438−5 daughter card)
96	RES SMD R0603 40.2 kΩ ±1%	SMD 0603			1	R82
97	RES SMD R0603 42.2 kΩ ±1%	SMD 0603			1	R31
98	RES SMD R0603 78.7 kΩ ±1%	SMD 0603			1	R55
99	RES SMD R0603 100 kΩ ±5%	SMD 0603			4	R18, R53, R67, R68
100	RES SMD R0603 680 kΩ ±5%	SMD 0603			2	R28, R47 (PLM0438−5 daughter card)
101	NTC SMD 0603 100 kΩ ±1%	SMD 0603	THINKING	TSM2A104J455	2	RT1 (PLM0438−5 daughter card) RT2
102	JUMP WIRE CU 1.5 x 40				1	JP1
103	MCH0672 L 49 mm x H 25 mm x W 10 mm	L 49 mm x H 25 mm x W 10 mm	瓏騰澧	MCH0672	1	HS1
104	MCH0673 L 40 mm x H 25 mm x W 6.4 mm	L 40 mm x H 25 mm x W 6.4 mm	瓏騰澧	MCH0673	1	HS2
105	SCREW 3 x 8	M3 SCREW x 8 mm			4	Q4, Q9, HS1 *2
106	矽膠片 size = MCH0672 heat sink (Silicon pad)				1	MCH0672 heat sink
107						PCB PLM0438V2

References

onsemi Datasheet for NCP1681, NCP13992, NCP13994, NCP4318, NCP431A
onsemi Design Note DN05104/D

ADDITIONAL INFORMATION

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