6 to 20 V/4 A flyback converter based on VIPERGAN100 and SRK1001

Introduction

This document describes the characteristics and features of an isolated 80 W Flyback SMPS demonstration board based on VIPERGAN100 and SRK1001, designed for Chargers and Industrial applications in general. The input voltage range is from 90 Vac to 135 Vac with voltage doubler, but the board can be used for full input voltage range applications by properly selecting the components of the input circuit. The output current can be adjusted/limited via external PWM signal 3.3 V/10 KHz.

VIPERGAN100 is a new advanced offline switcher by STMicroelectronics with the following features:

- Quasi-Resonant (QR) flyback controller
- 650 V E-mode Power GaN transistor
- Embedded sense FET
- Dynamic blanking time and adjustable valley synchronization delay functions to maximize efficiency at any input line and load conditions
- Valley-lock to ensure constant valley skipping
- Output OVP protection.
- Input voltage feed-forward compensation for mains independent OPP variation
- Embedded thermal shutdown
- Frequency jitter for EMI suppression

The SRK1001 controller is designed for secondary side synchronous rectification (SR) in flyback converters, suitable for operation in QR and mixed CCM/DCM fixed frequency circuits. Main features:

- Wide VCC operating voltage range 3.7 to 32 V
- CC regulation operation down to 2 V output supported
- Very low quiescent current in low consumption mode (170 µA)
- High-voltage sensing input for SR MOSFET drain-source voltage (185 V AMR)
- Operating frequency up to 300 kHz
- Fast turn-on with minimum delay time and adaptive turn-off logic
- Programmable minimum TON and TOFF
- SO8 package

1 Overview

The main features of the board are:

- Input voltage: 90 Vac to 135 Vac with 47 Hz to 63 Hz frequency
- Output voltage: 6 Vdc ~ 20 Vdc
- Output current: adjustable via external PWM 3.3 V-10 KHz. Maximum: 4 A
- Output power: 80 W maximum
- Peak efficiency: 92.33 %
- Board size: 39.12 mm x 121.92 mm
- PCB copper thickness: 2 oz
- Flyback stage based on VIPERGAN100 HV converter with optocoupler plus LM2904D feedback for voltage and current regulation
- SRK100B adaptive synchronous rectification controller to increase the system efficiency

Figure 1. Evaluation board - top

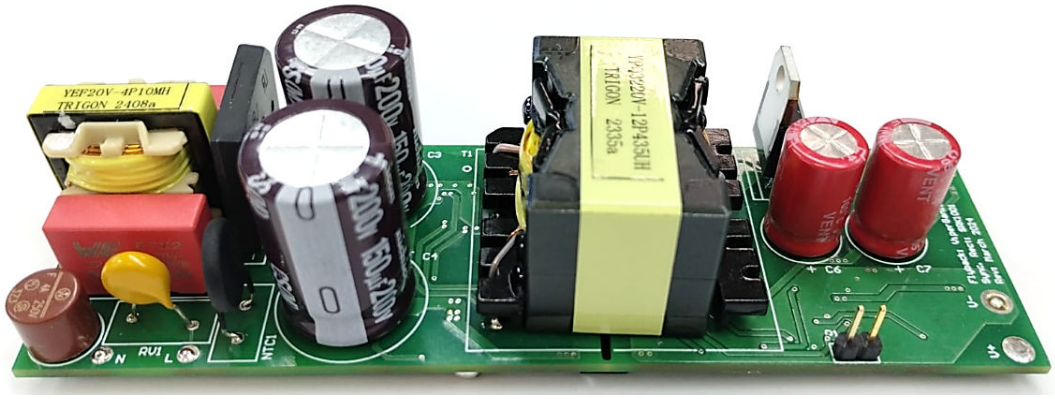


Figure 2. Evaluation board - bottom

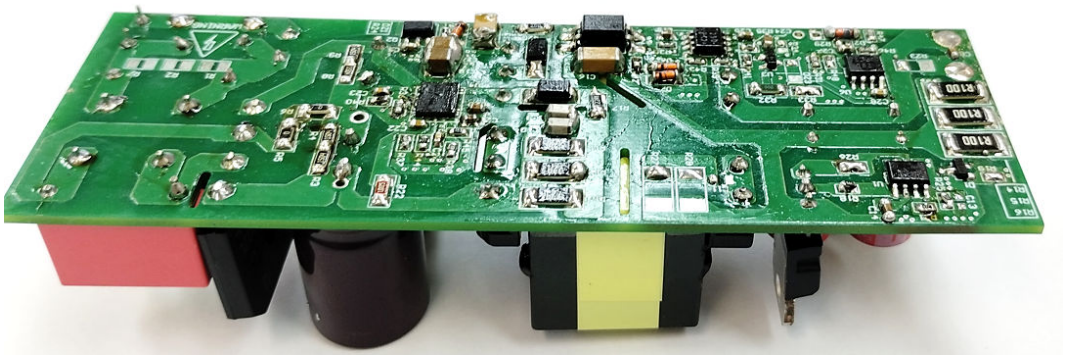


Figure 3. PCB Layout - bottom view

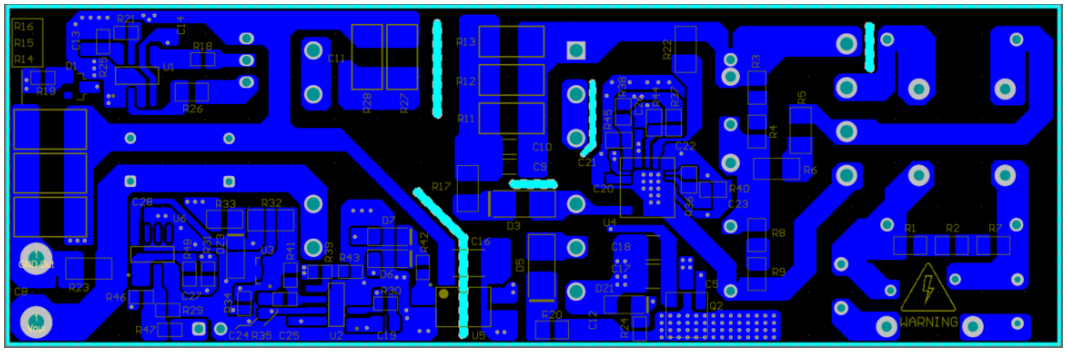
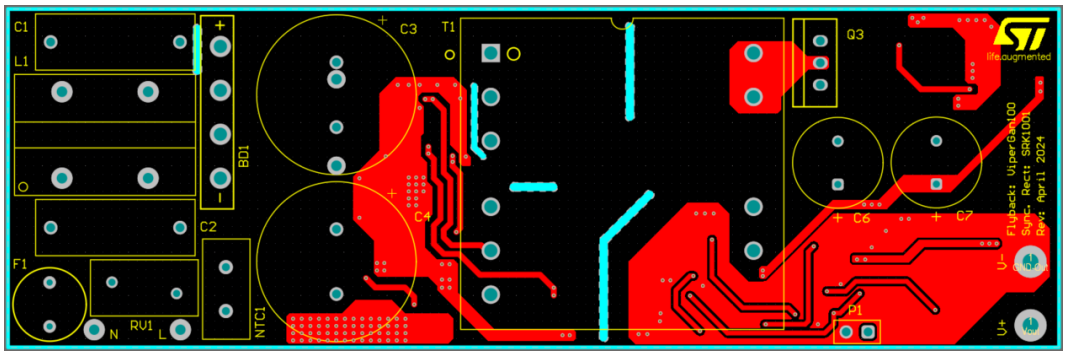


Figure 4. PCB Layout - top view



2 Specifications

The electrical specifications of the evaluation board are listed in the table below.

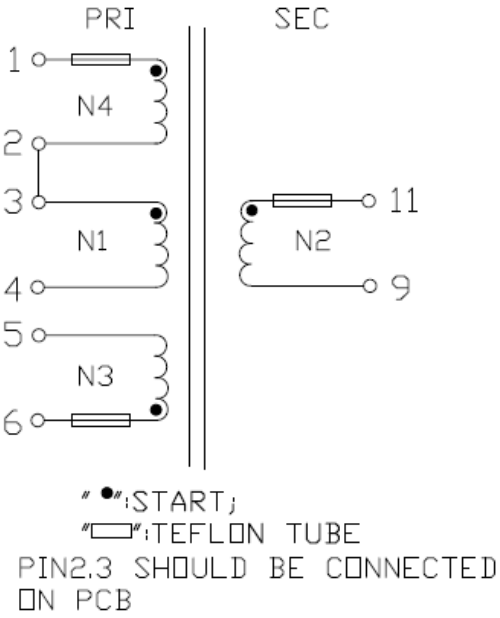
Table 1. Electrical specifications

Parameter	Min.	Typ.	Max.	Unit
AC main input voltage	90		135	Vac
Main frequency (FL)	47		63	Hz
Ambient operating temperature			50	°C
Output voltage	6		20	Vdc
Output current			4.0	A
External PWM Signal: 3.3 V-10 KHz				

Table 2. Flyback transformer characteristics

Parameter	Value
Manufacturer	Trigon Components
Part Number	YPQ3220V-12P435UH
Primary Inductance (1-4) @1 kHz/1 V - Short Pin #2, #3	435 uH ± 10%
Leakage inductance (1-4) @1 kHz/1 V - Short Pin #2, #3 and short other pins	5.5 uH Max.
Turns ratio (1-4):(11-9):(6-5)	36:7:24 ±0.5 Ts
Hi-Pot: Pri to Sec	1.5 KVac/5 mA/3 s

Figure 5. Flyback transformer schematic



3 Test setup

3.1 Efficiency measurements

The active mode efficiency is defined as the average of the efficiencies measured at 25 %, 50 %, 75 % and 100 % of the rated output power.

Note: Set the E-Load to CV mode for 6 V, 9 V, 12 V, 15 V and adjust the duty-cycle of the input PWM signal to get the desirable output current. For 20 V, set the E-Load to CC mode and the duty of the PWM to 80 % to allow max output current.

Table 3. Average efficiency at 90 Vac

Output Load (%)	PWM Duty (%)	Iout (A)	Vout (V)	Pout (W)	Pin (W)	Eff (%)
6 V output						
25 %	20.7 %	1.00	6.004	6.004	6.84	87.78 %
50 %	39.4 %	2.00	5.997	11.994	13.45	89.17 %
75 %	56.8 %	3.00	5.997	17.991	20.01	89.91 %
100 %	75.1 %	4.00	5.995	23.98	26.75	89.64 %
Average efficiency						**89.13 %**
9 V output						
25 %	21.0 %	1.00	9.011	9.011	10.14	88.87 %
50 %	39.7 %	2.00	9.003	18.006	19.87	90.62 %
75 %	57.0 %	3.00	9.008	27.024	29.54	91.48 %
100 %	75.4 %	4.00	9.008	36.032	39.48	91.27 %
Average efficiency						**90.56 %**
12 V output						
25 %	21.1 %	1.00	12.013	12.013	13.50	88.99 %
50 %	39.8 %	2.00	12.011	24.022	26.47	90.75 %
75 %	57.2 %	3.00	12.004	36.012	39.38	91.45 %
100 %	75.7 %	4.00	12.012	48.048	52.71	91.16 %
Average efficiency						**90.58 %**
15 V output						
25 %	21.4 %	1.00	15.018	15.018	16.86	89.07 %
50 %	40.1 %	2.00	15.012	30.024	33.00	90.98 %
75 %	57.7 %	3.00	15.013	45.039	49.26	91.43 %
100 %	76.4 %	4.00	15.007	60.028	65.71	91.35 %
Average efficiency						**90.71 %**
20 V output						
25 %	80 %	1.00	20.205	20.205	22.99	87.89 %
50 %	80 %	2.00	20.207	40.414	44.67	90.47 %
75 %	80 %	3.00	20.207	60.621	66.58	91.05 %
100 %	80 %	4.00	20.210	80.84	89.21	90.62 %
Average efficiency						**90.01 %**

Table 4. **Average efficiency at 115 Vac**

Output Load (%)	PWM Duty (%)	Iout (A)	Vout (V)	Pout (W)	Pin (W)	Eff (%)
6 V output						
25 %	20.8 %	1.00	6.002	6.002	7.013	85.58 %
50 %	39.6 %	2.00	6.001	12.002	13.63	88.06 %
75 %	56.9 %	3.00	6.011	18.033	20.08	89.81 %
100 %	74.8 %	4.00	6.003	24.012	26.73	89.83 %
Average efficiency						**88.32 %**
9 V output						
25 %	21.3 %	1.00	9.012	9.012	10.33	87.24 %
50 %	40.2 %	2.00	9.013	18.026	20.07	89.82 %
75 %	57.4 %	3.00	9.011	27.033	29.58	91.39 %
100 %	75.3 %	4.00	9.006	36.024	39.32	91.62 %
Average efficiency						**90.02 %**
12 V output						
25 %	21.4 %	1.00	12.011	12.011	13.65	87.99 %
50 %	40.7 %	2.00	12.010	24.02	26.58	90.37 %
75 %	57.8 %	3.00	12.013	36.039	39.31	91.68 %
100 %	75.9 %	4.00	12.007	48.028	52.24	91.94 %
Average efficiency						**90.49 %**
15 V output						
25 %	22.0 %	1.00	15.014	15.014	17.01	88.27 %
50 %	41.4 %	2.00	15.007	30.014	33.03	90.87 %
75 %	58.4 %	3.00	15.010	45.03	48.92	92.05 %
100 %	76.5 %	4.00	15.008	60.032	65.12	92.19 %
Average efficiency						**90.84 %**
20 V output						
25 %	80 %	1.00	20.214	20.214	23.06	87.66 %
50 %	80 %	2.00	20.213	40.426	44.62	90.60 %
75 %	80 %	3.00	20.212	60.636	66.18	91.62 %
100 %	80 %	4.00	20.211	80.844	88.09	91.77 %
Average efficiency						**90.41 %**

Table 5. **Average efficiency at 135 Vac**

Output Load (%)	PWM Duty (%)	Iout (A)	Vout (V)	Pout (W)	Pin (W)	Eff (%)
6 V output						
25 %	20.8 %	1.00	6.002	6.002	7.191	83.47 %
50 %	39.6 %	2.00	6.006	12.012	13.84	86.79 %
75 %	57.1 %	3.00	6.009	18.027	20.24	89.07 %
100 %	74.7 %	4.00	5.996	23.984	26.75	89.66 %
Average efficiency						**87.25 %**
9 V output						

Output Load (%)	PWM Duty (%)	Iout (A)	Vout (V)	Pout (W)	Pin (W)	Eff (%)
25 %	21.4 %	1.00	9.016	9.016	10.51	85.78 %
50 %	40.3 %	2.00	9.006	18.012	20.28	88.82 %
75 %	57.7 %	3.00	9.017	27.051	29.70	91.08 %
100 %	75.4 %	4.00	9.004	36.016	39.33	91.57 %
Average efficiency						**89.31 %**
12 V output						
25 %	21.9 %	1.00	12.013	12.013	13.84	86.80 %
50 %	41.1 %	2.00	12.009	24.018	26.85	89.45 %
75 %	58.4 %	3.00	12.009	36.027	39.42	91.39 %
100 %	75.9 %	4.00	12.005	48.02	52.20	91.99 %
Average efficiency						**89.91 %**
15 V output						
25 %	22.3 %	1.00	15.018	15.018	17.23	87.16 %
50 %	42.0 %	2.00	15.009	30.018	33.25	90.28 %
75 %	59.2 %	3.00	15.008	45.024	48.99	91.90 %
100 %	76.7 %	4.00	15.004	60.016	65.00	92.33 %
Average efficiency						**90.42 %**
20 V output						
25 %	80 %	1.00	20.218	20.218	23.21	87.11 %
50 %	80 %	2.00	20.216	40.432	44.61	90.63 %
75 %	80 %	3.00	20.215	60.645	66.04	91.83 %
100 %	80 %	4.00	20.216	80.864	87.74	92.16 %
Average efficiency						**90.43 %**

Figure 6. Efficiency at 90 Vac

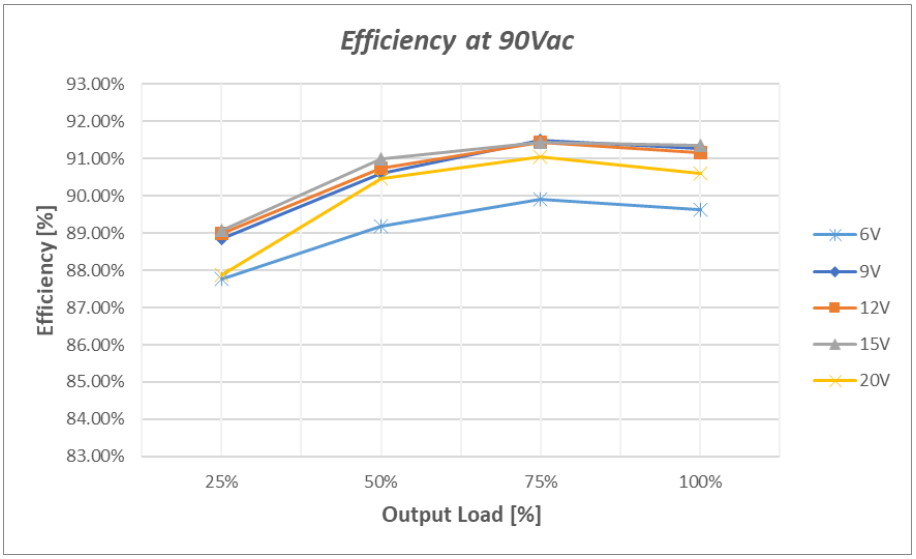


Figure 7. **Efficiency at 115 Vac**

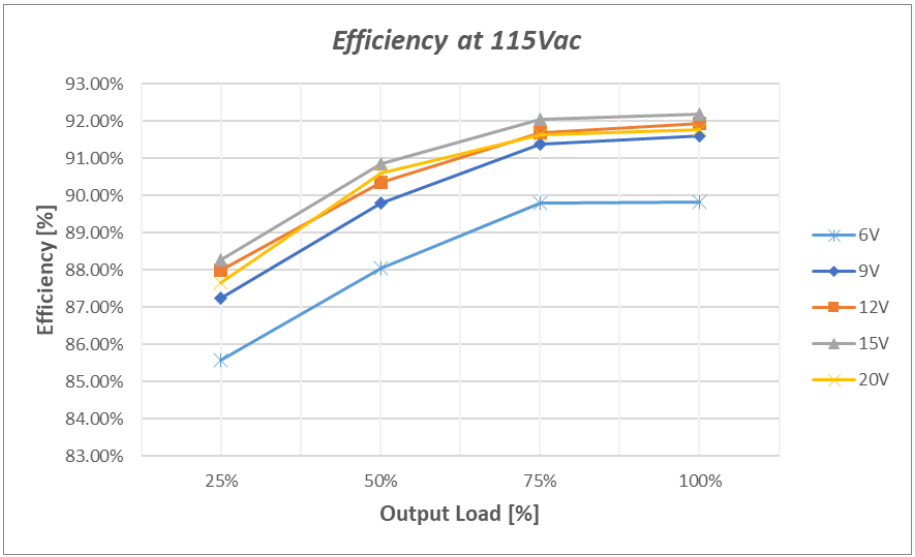
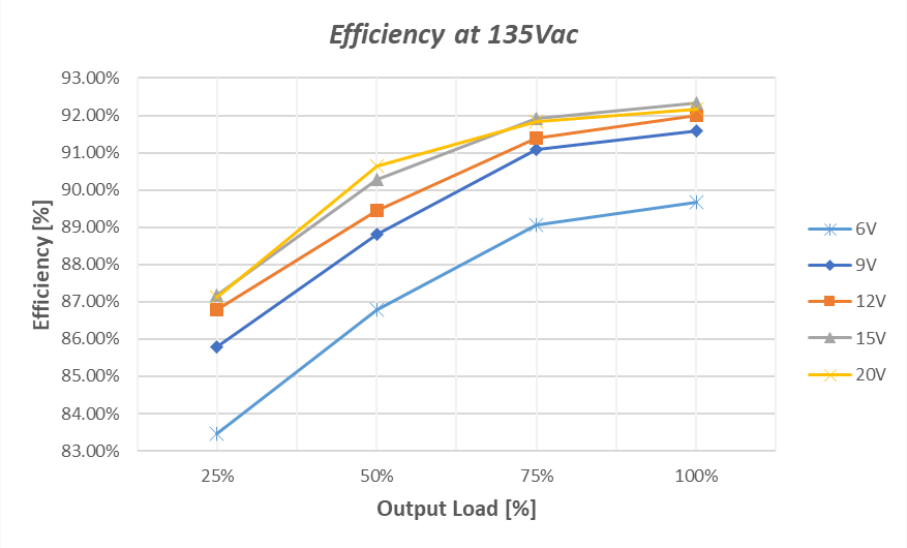


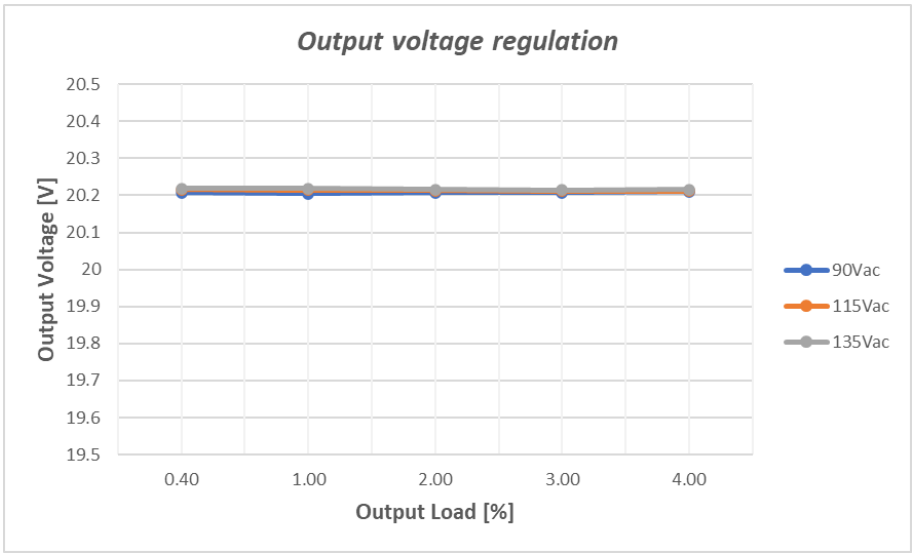
Figure 8. **Efficiency at 135 Vac**



3.2 Output voltage regulation

The output voltage regulation was measured at 90 Vac, 115 Vac and 135 Vac with load changing from 10% up to 100%. Electronic load set to CC mode and the duty cycle of PWM signal set to 80%.

Figure 9. Output voltage regulation



3.3 Dynamic step load regulation

The following figures show the load transient response when the converter is subjected to repetitive dynamic load transitions from 50 mA to 4.0 A at 90 Vac, 115 Vac and 135 Vac. The transition period is 400 ms with 50% duty cycle and slew rate of 200 mA/µs. There are no abnormal oscillations in the output voltage and the overshoot and undershoot are very low.

Figure 10. Dynamic step load - 90 Vac

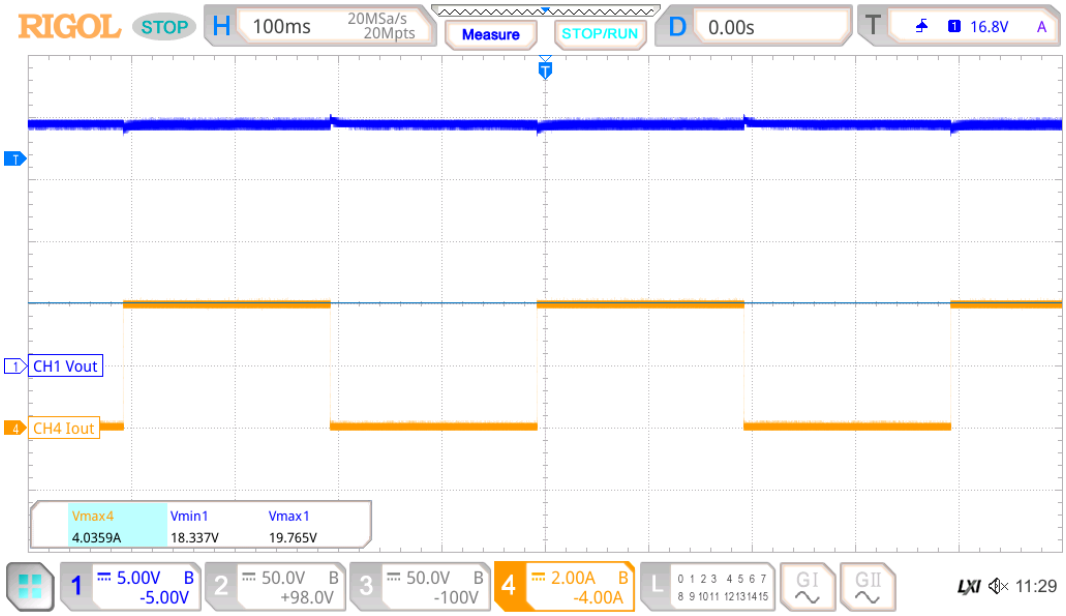


Figure 11. **Dynamic step load - 115 Vac**

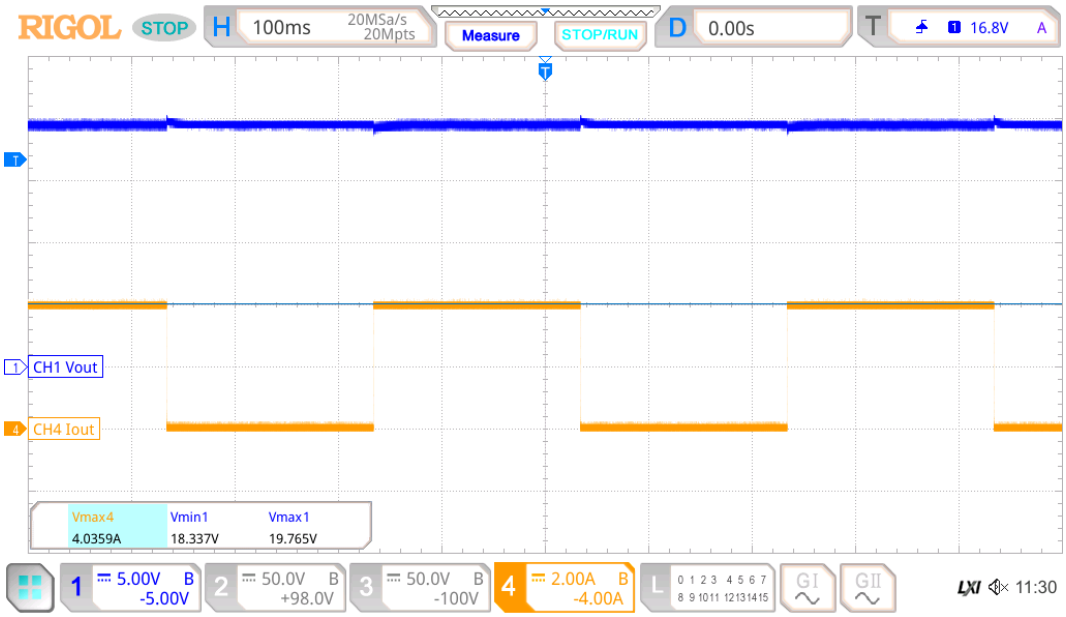
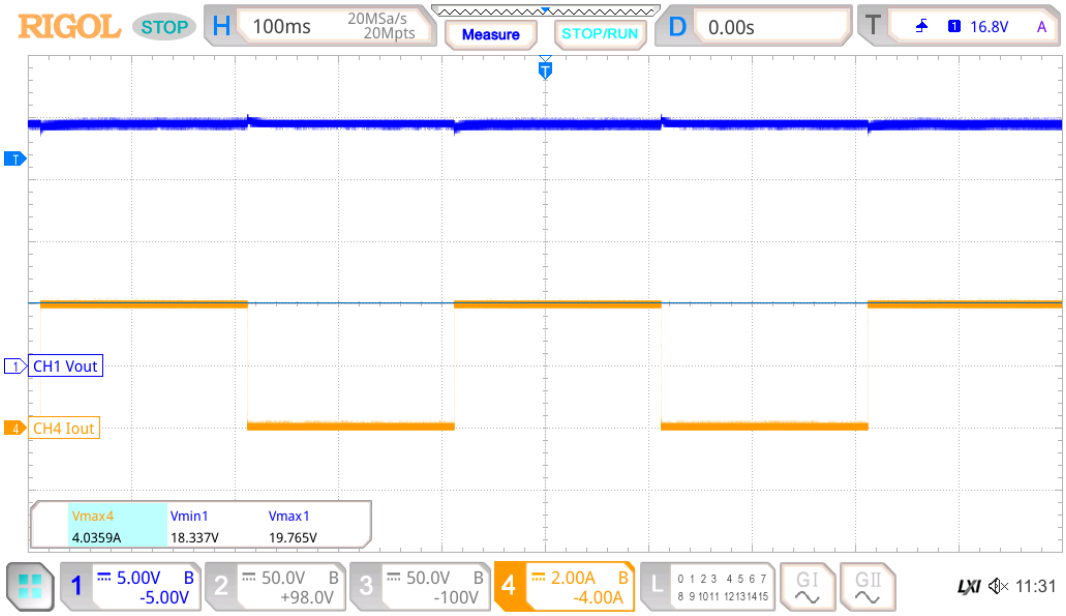


Figure 12. **Dynamic step load - 135 Vac**



3.4 Thermal measurements

A thermal analysis of the board has been performed using an IR camera module. The test was performed under full load condition for the nominal input voltage (115 Vac), Power Supply Unity (PSU) plugged-in for 60 min. The results are shown below.

Figure 13. Thermal map at 115 Vac, max load (20 V/4 A) - bottom side

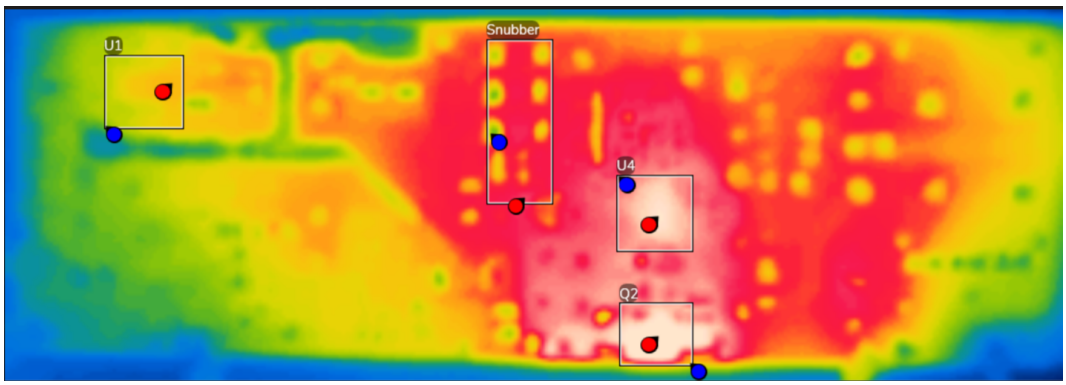


Table 6. Temperature of the key components of bottom side. Tamb = 25°C and emissivity = 0.95 for all points

Temp (°C)	Reference
99.2	Q2
69.3	Primary Snubber
56.5	U1 (SRK1001)
80.1	U4 (Vipergan100)

Figure 14. Thermal map at 115 Vac, max load (20 V/4 A) - top side

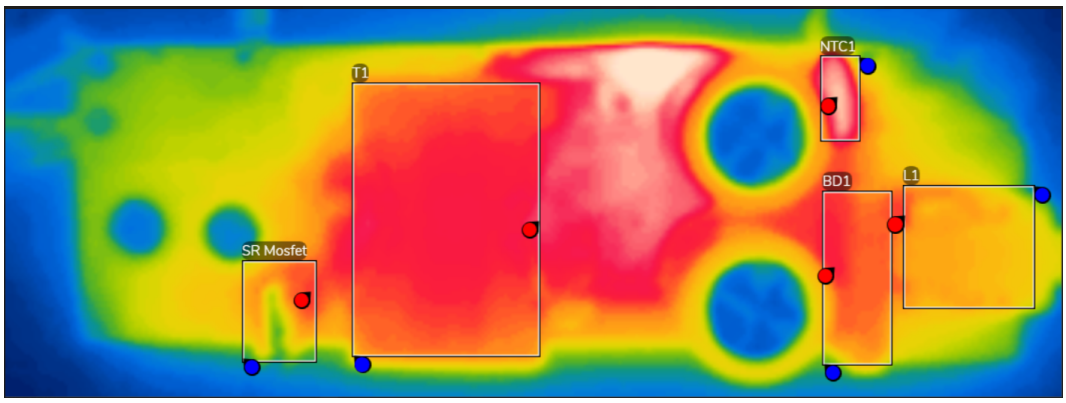


Table 7. Temperature of the key components of top side. Tamb = 25°C and emissivity = 0.95 for all points

Temp (°C)	Reference
64.3	BD1 (Bridge Rectifier)
61.8	L1 (CMC)
80.7	NTC1
62.4	SR Mosfet
70.8	T1 (Flyback Transformer)

4 Typical waveforms

4.1 Steady state operation - 6 V

The following figures show the voltage on the Drain VIPERGAN100, Vdc_Bus and the Vcc of VIPERGAN at 1 A and full load (4 A). E-Load was set to 6 V (CV mode) and the duty cycle of the PWM was adjusted to get the respective output currents.

Figure 15. **90 Vac, 6 V/1 A**

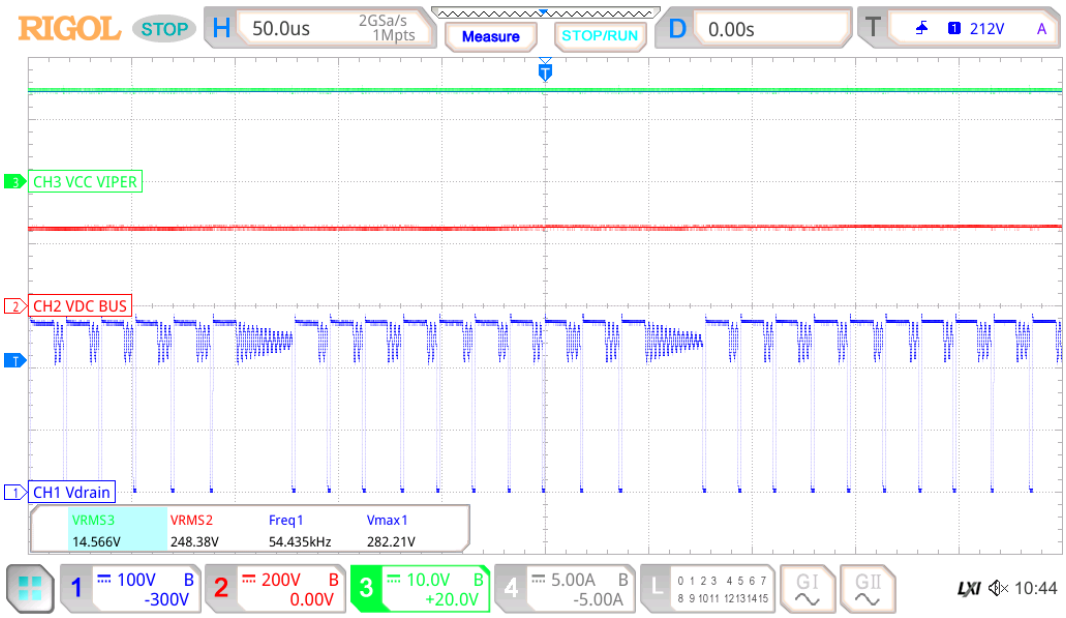


Figure 16. **90 Vac, 6 V/4 A**

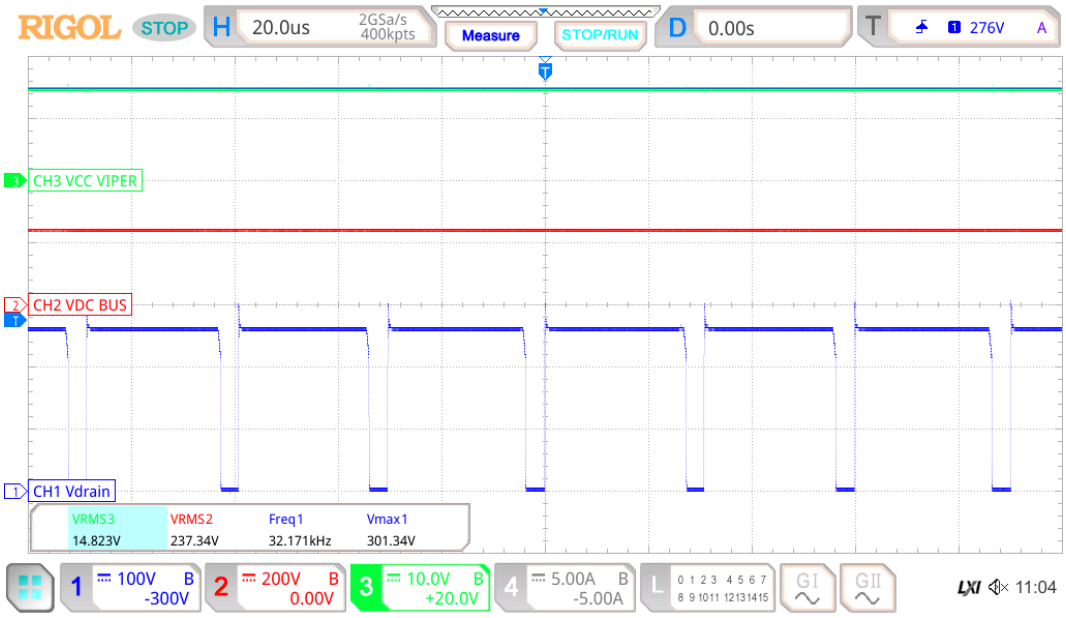


Figure 17. **115 Vac, 6 V/1 A**

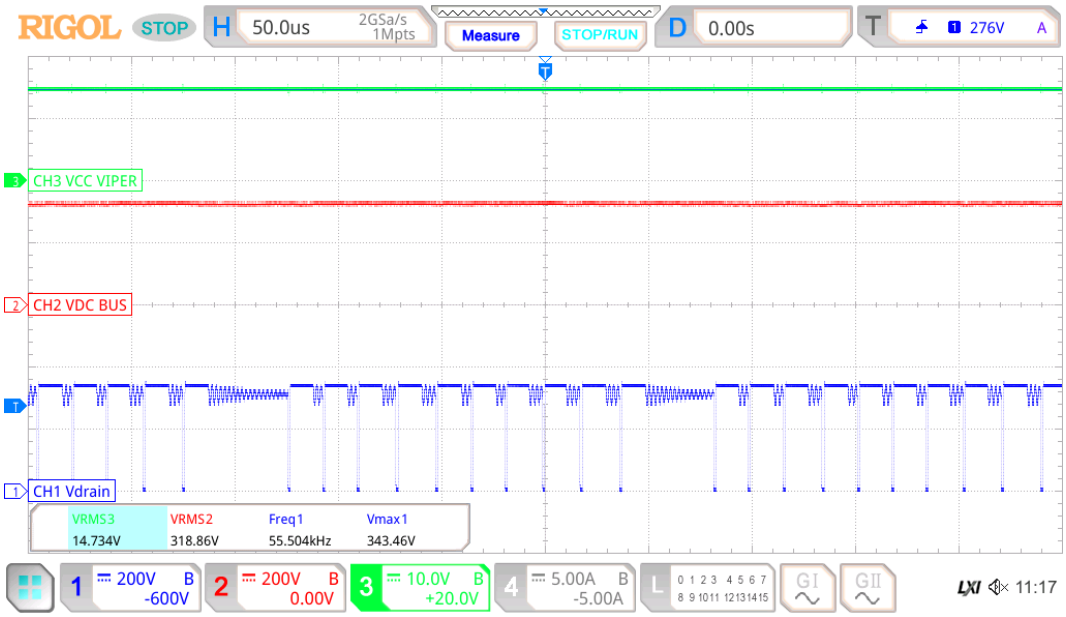


Figure 18. **115 Vac, 6 V/4 A**

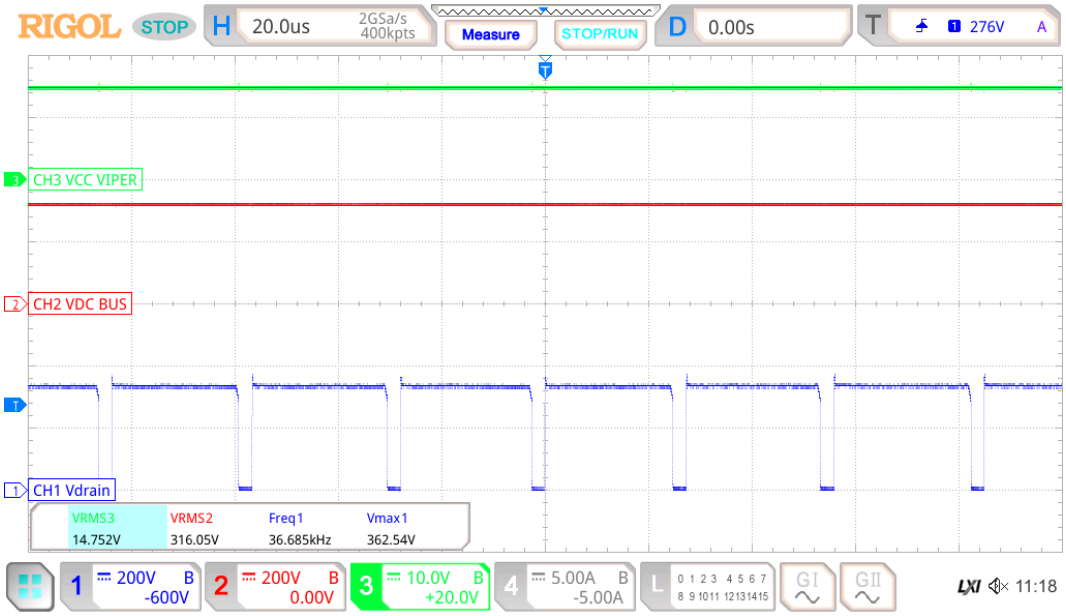


Figure 19. 135 Vac, 6 V/1 A

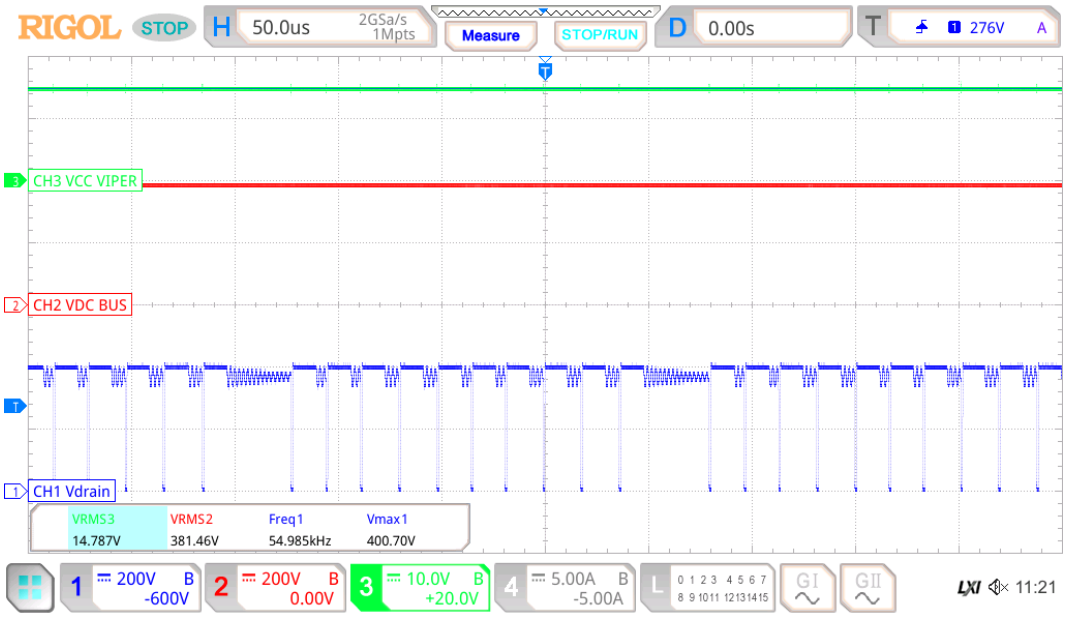
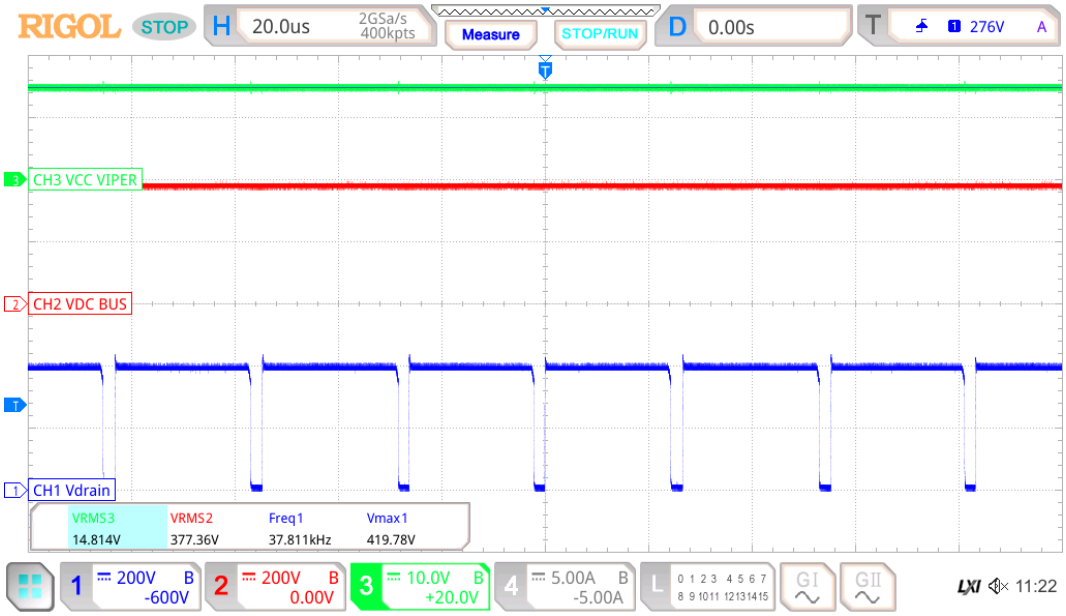


Figure 20. 135 Vac, 6 V/4 A



4.2 Steady state operation - 9 V

The following figures show the voltage on the Drain VIPERGAN100, Vdc_Bus and the Vcc of Vipergan at 1 A and full load (4 A). E-Load was set to 9 V (CV mode) and the duty cycle of the PWM was adjusted to get the respective output currents.

Figure 21. 90 Vac, 9 V/1 A

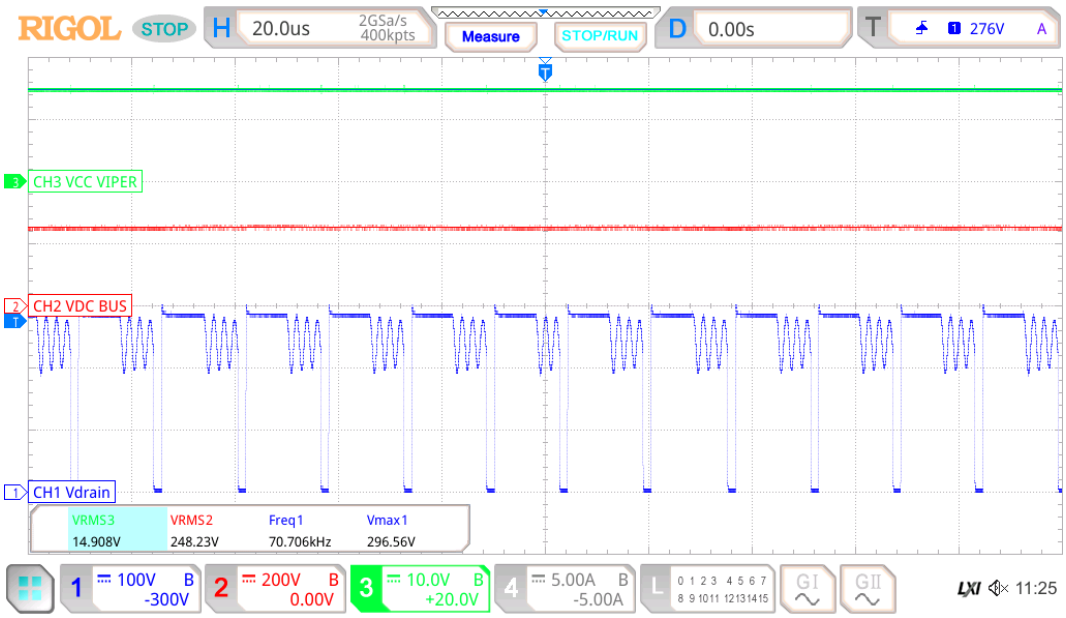


Figure 22. 90 Vac, 9 V/4 A

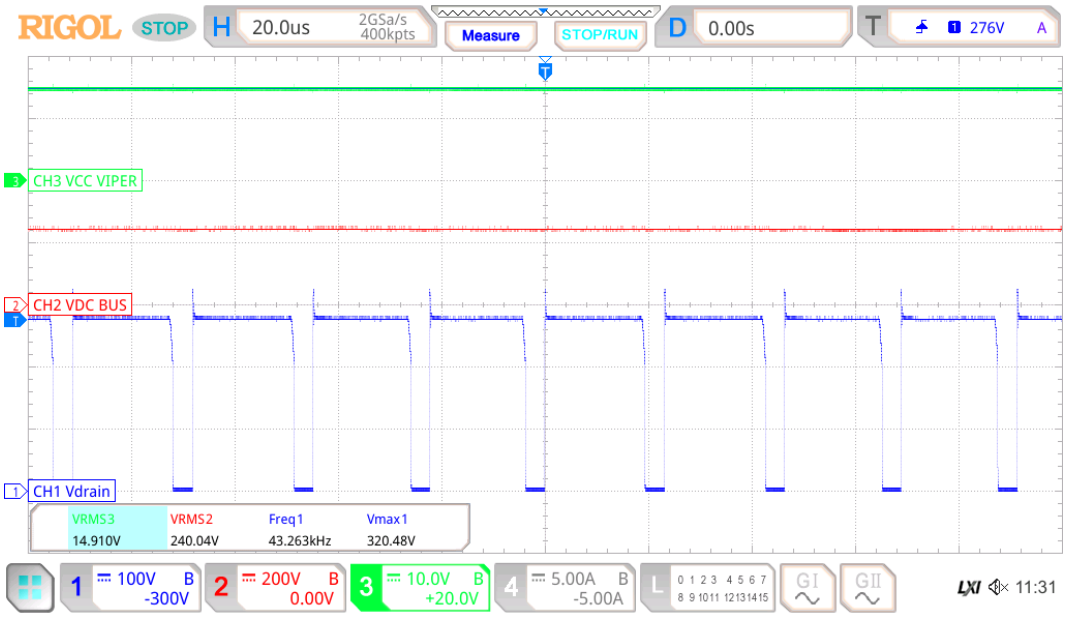


Figure 23. **115 Vac, 9 V/1 A**

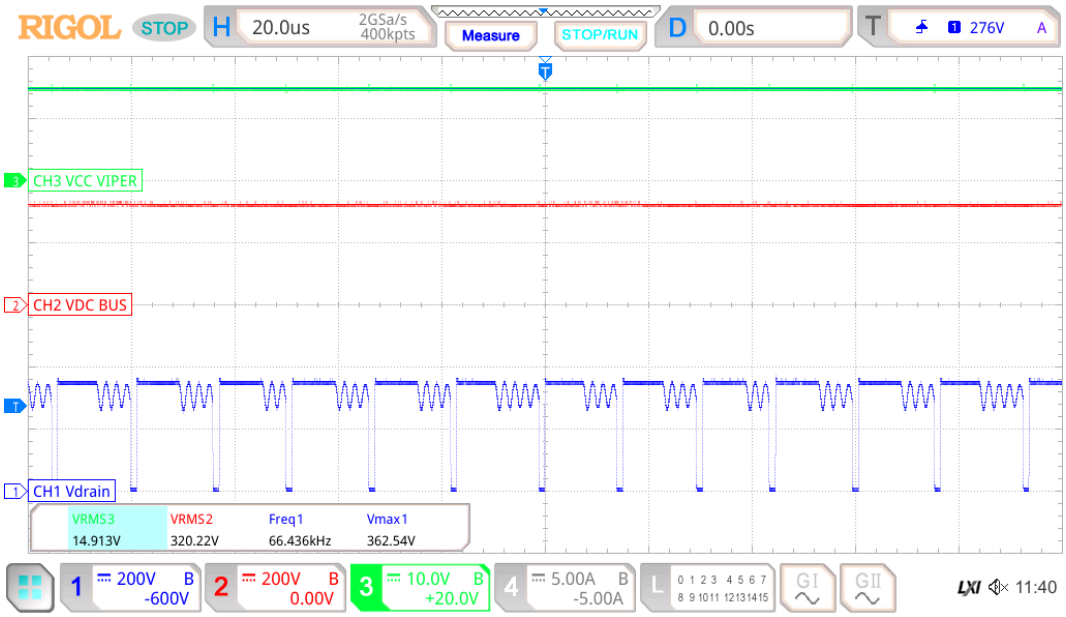


Figure 24. **115 Vac, 9 V/4 A**

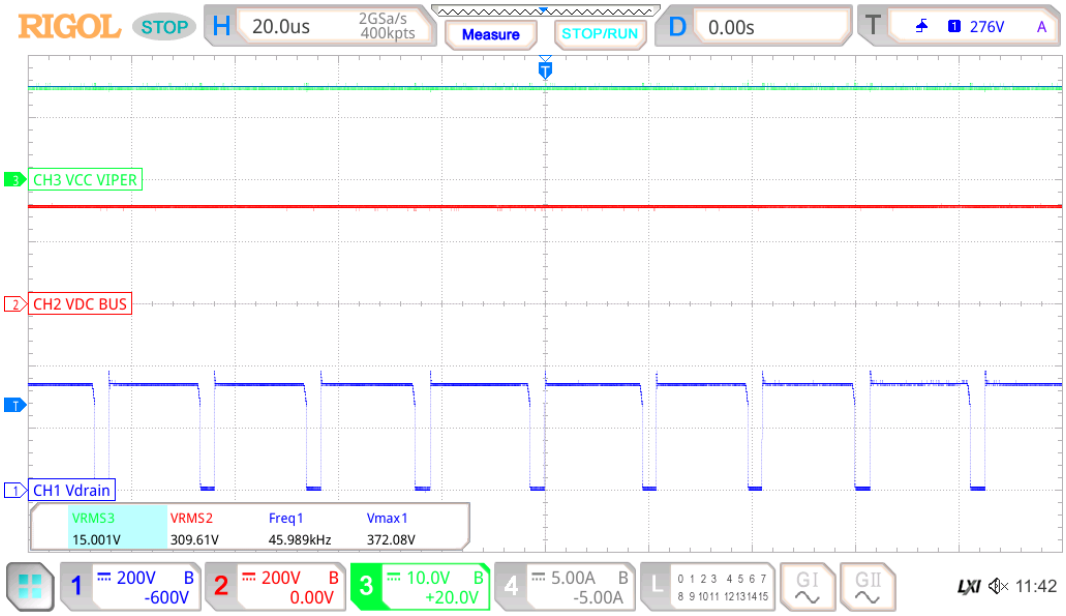


Figure 25. 135 Vac, 9 V/1 A

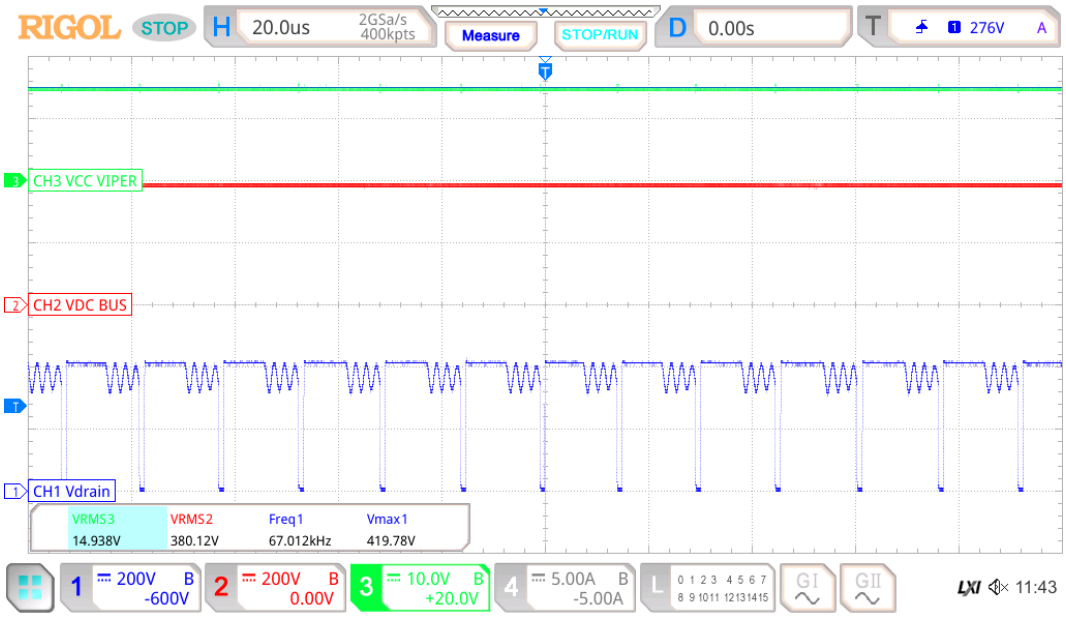
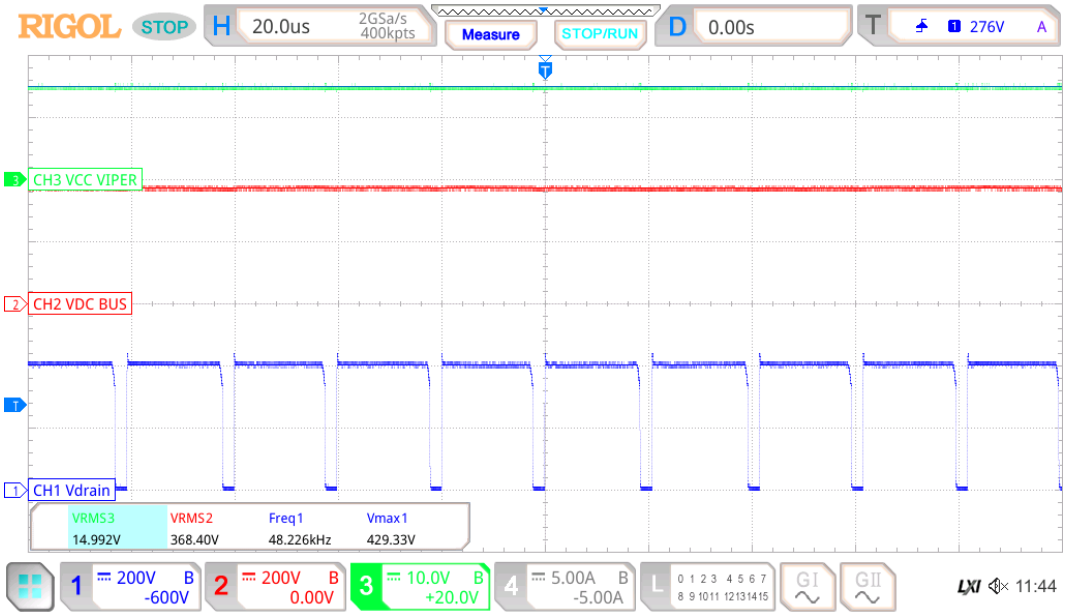


Figure 26. 135 Vac, 9 V/4 A



4.3 Steady state operation - 12 V

The following figures show the voltage on the Drain VIPERGAN100, Vdc_Bus and the Vcc of Vipergan at 1 A and full load (4 A). E-Load was set to 12 V (CV mode) and the duty cycle of the PWM was adjusted to get the respective output currents.

Figure 27. **90 Vac, 12 V/1 A**

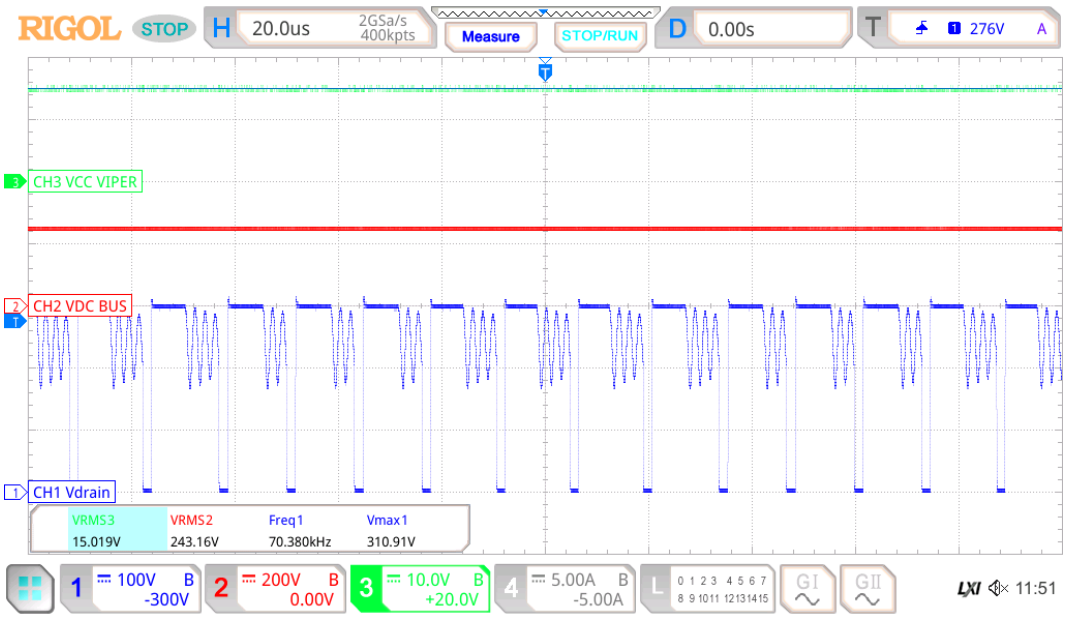


Figure 28. **90 Vac, 12 V/4 A**

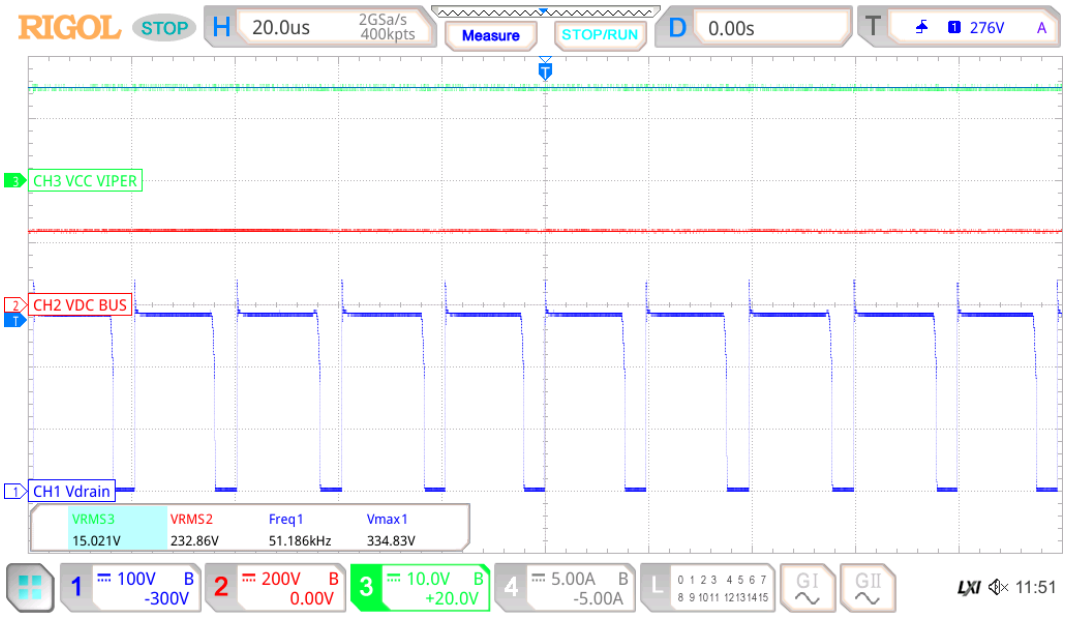


Figure 29. **115 Vac, 12 V/1 A**

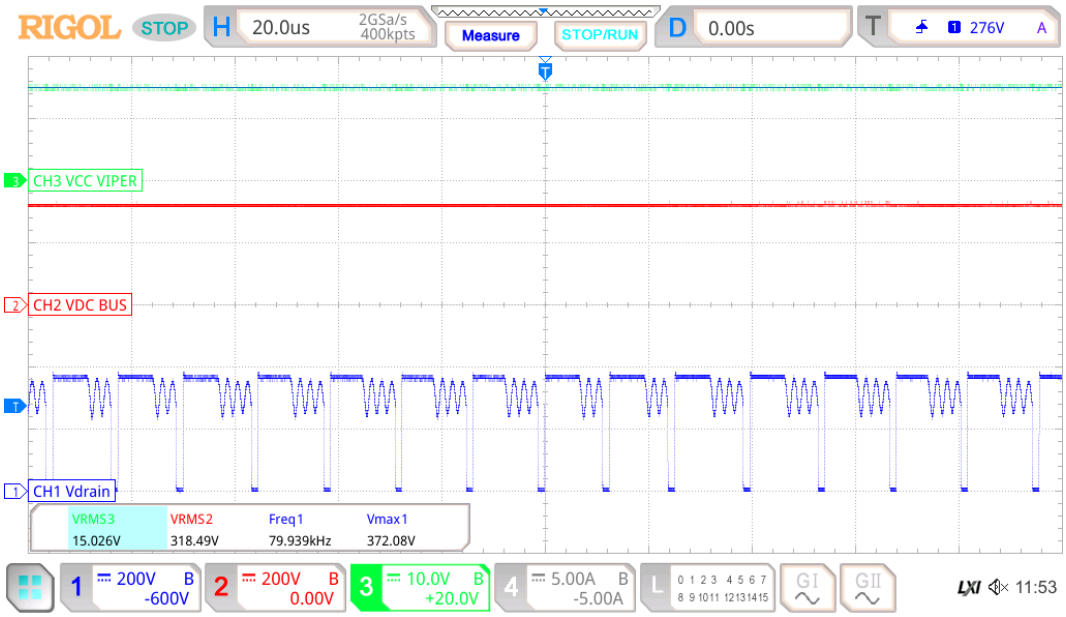


Figure 30. **115 Vac, 12 V/4 A**

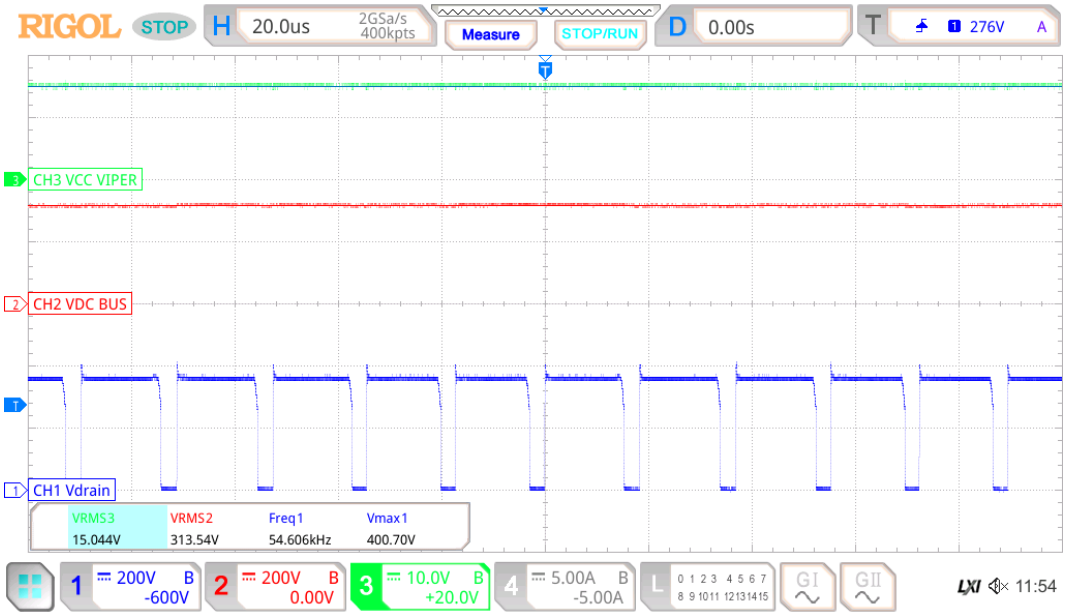


Figure 31. 135 Vac, 12 V/1 A

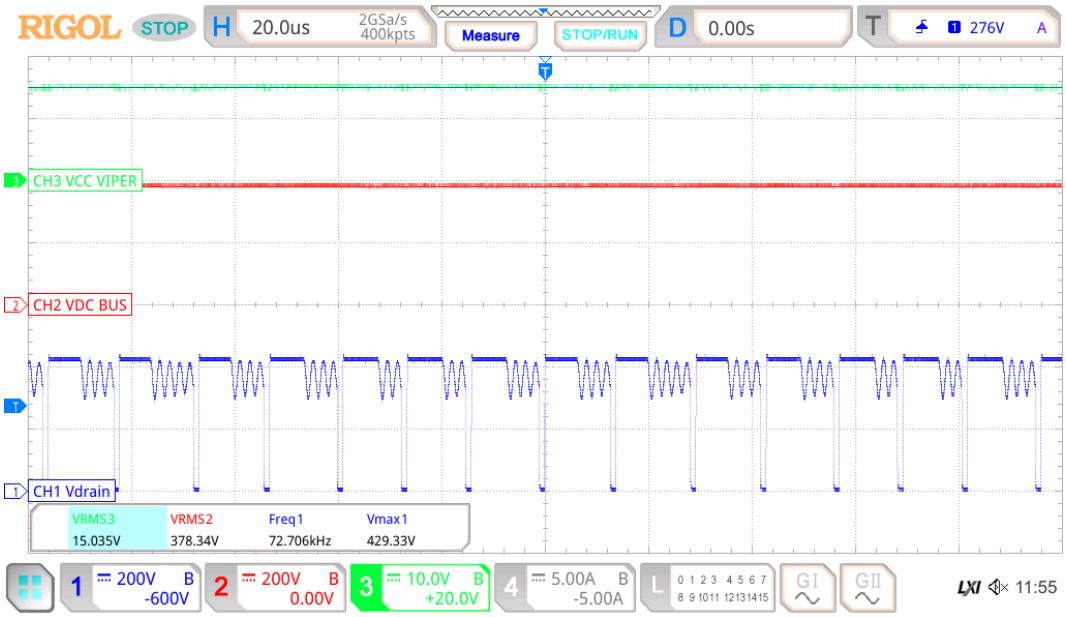
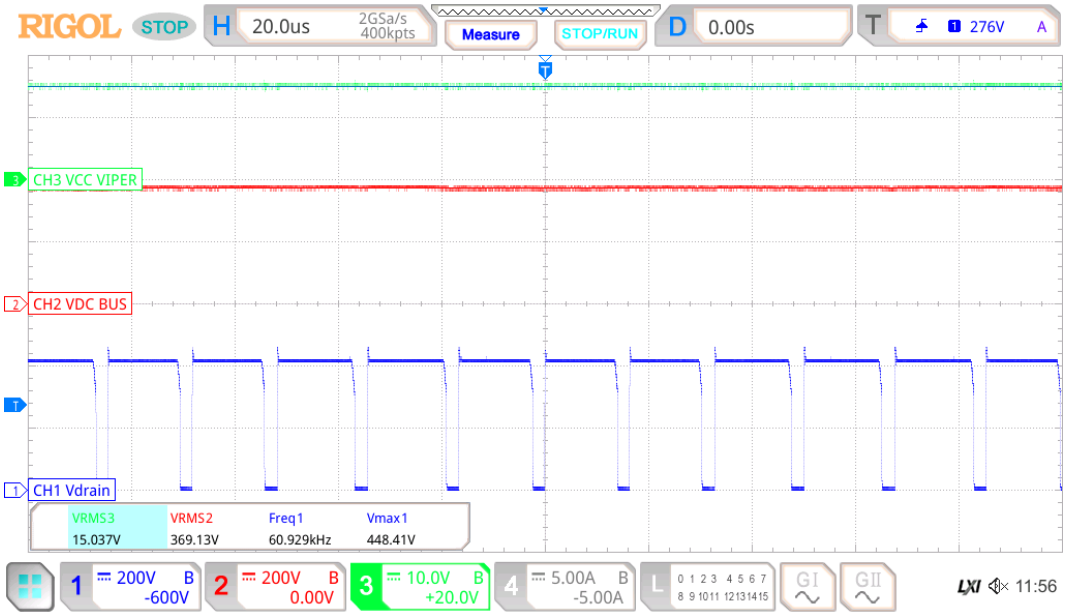


Figure 32. 135 Vac, 12 V/4 A



4.4 Steady state operation - 15 V

The following figures show the voltage on the Drain VIPERGAN100, Vdc_Bus and the Vcc of Vipergan at 1 A and full load (4 A). E-Load was set to 15 V (CV mode) and the duty cycle of the PWM was adjusted to get the respective output currents.

Figure 33. **90 Vac, 15 V/1 A**

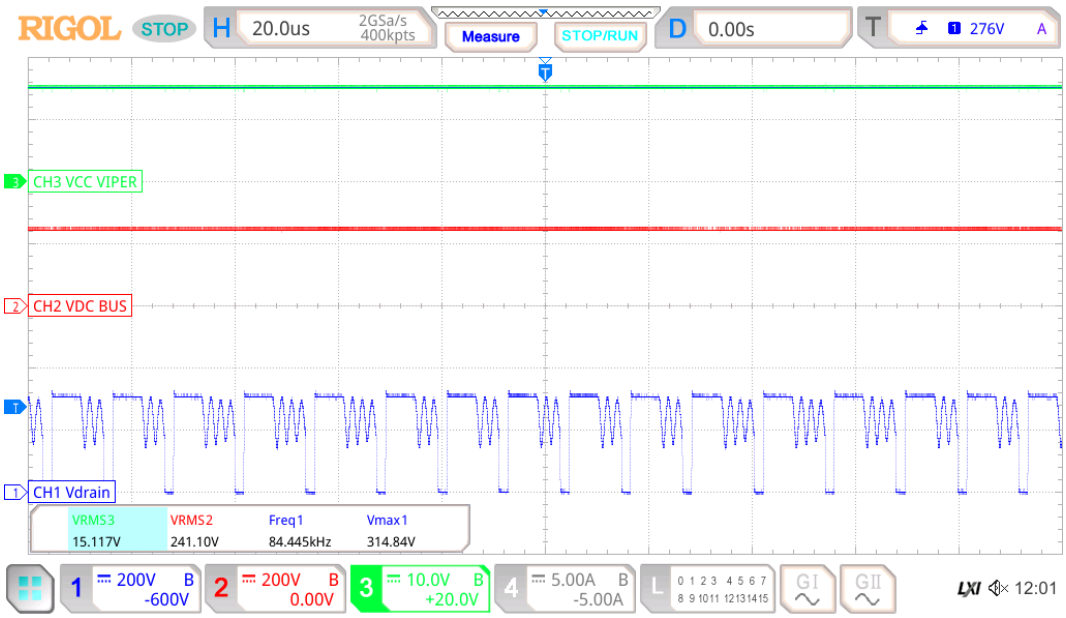


Figure 34. **90 Vac, 15 V/4 A**

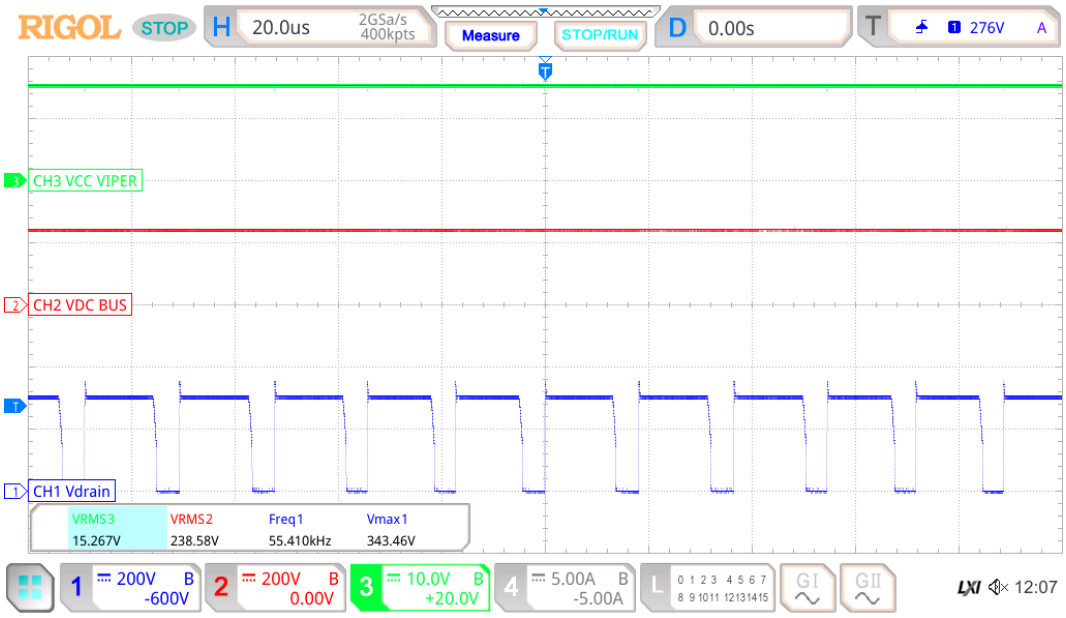


Figure 35. **115 Vac, 15 V/1 A**

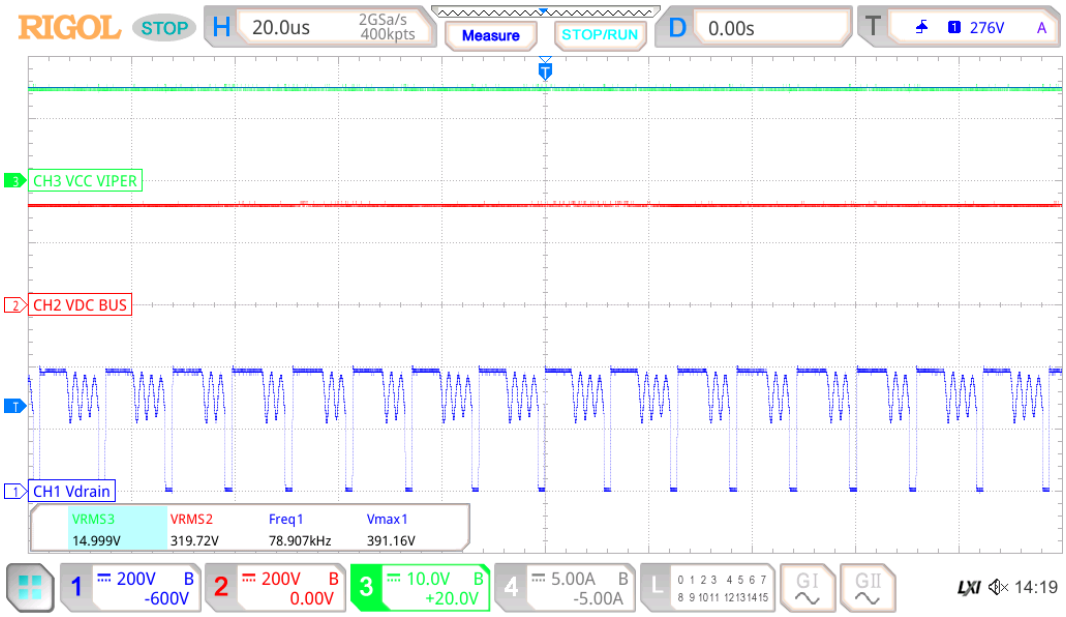


Figure 36. **115 Vac, 15 V/4 A**

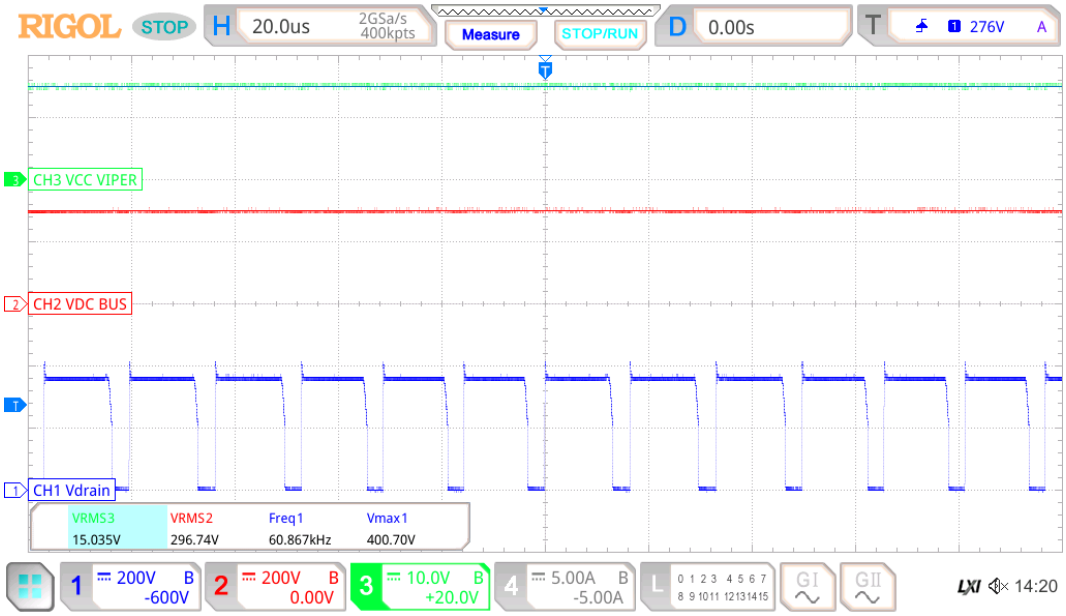


Figure 37. **135 Vac, 15 V/1 A**

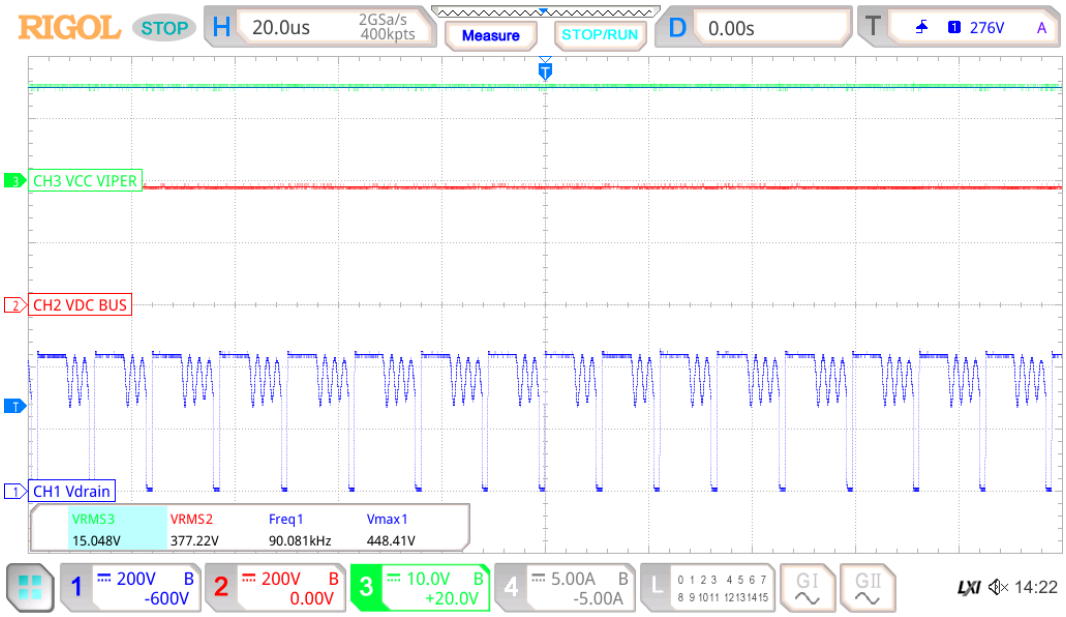
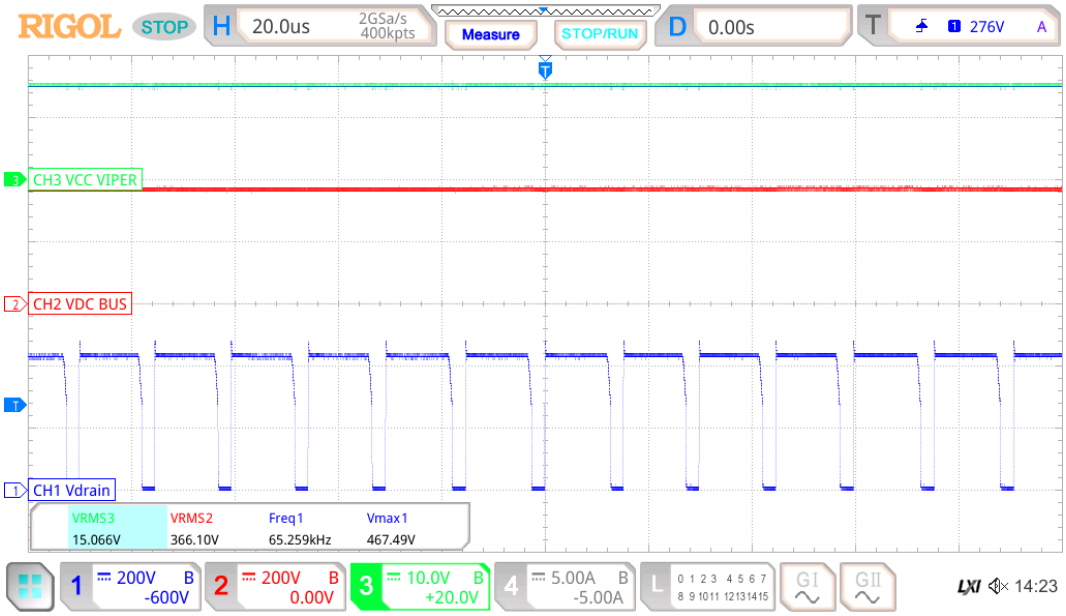


Figure 38. **135 Vac, 15 V/4 A**



4.5 Steady state operation - 20 V

The following figures show the voltage on the Drain VIPERGAN100, Vdc_Bus and the Vcc of Vipergan at no load and full load (4 A). E-Load was set to CC mode and the duty cycle of the PWM set to 80 % to allow maximum output current.

Figure 39. **90 Vac, 20 V/no load**

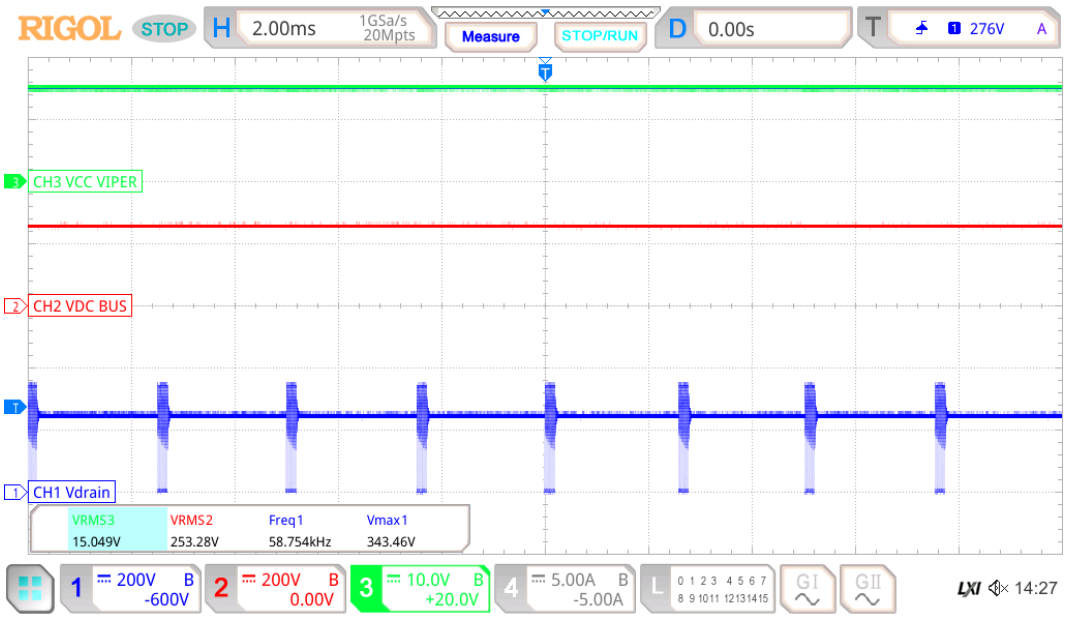


Figure 40. **90 Vac, 20 V/4 A**

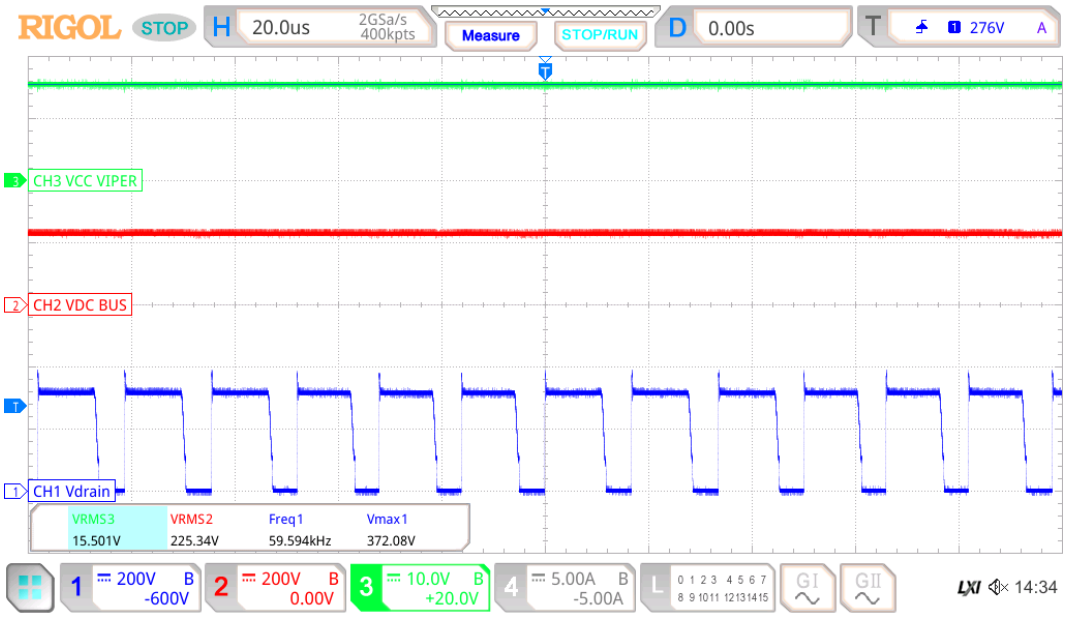


Figure 41. **115 Vac, 20 V/no load**

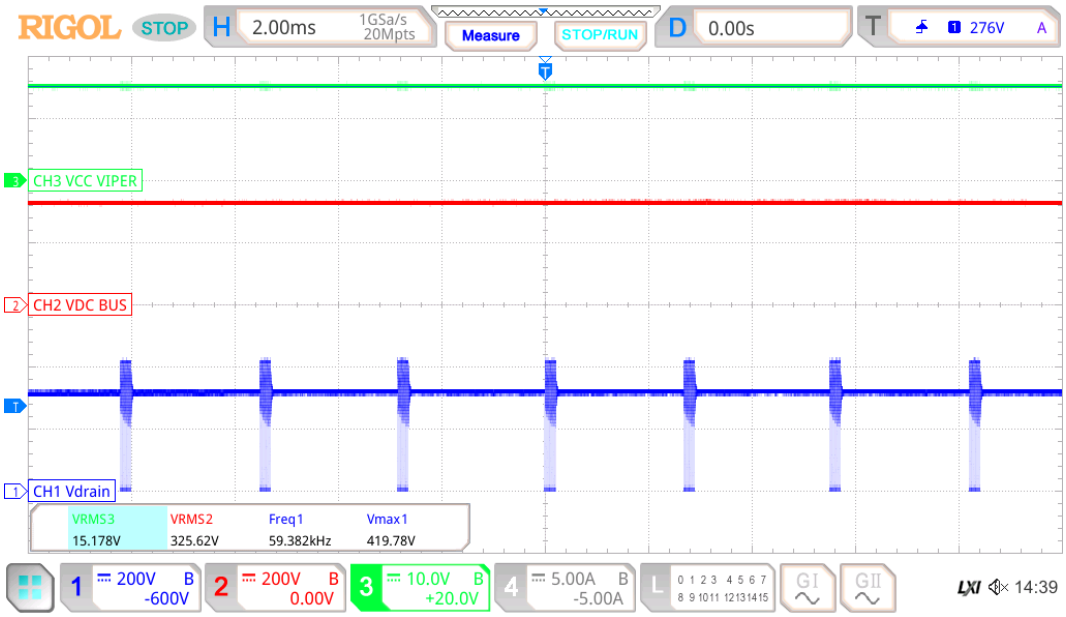


Figure 42. **115 Vac, 20 V/4 A**

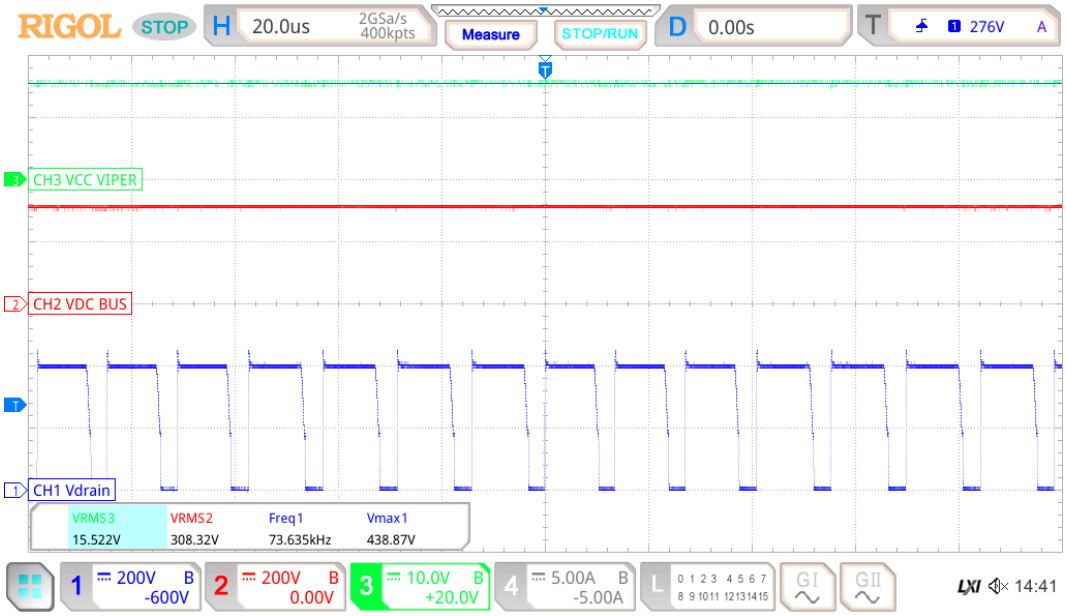


Figure 43. **135 Vac, 20 V/no load**

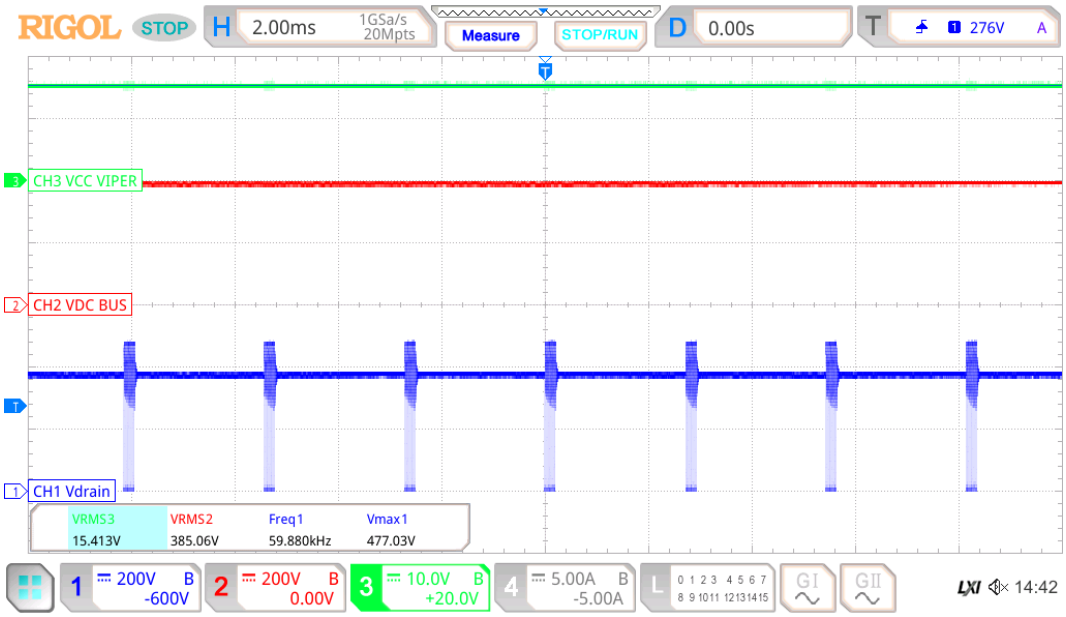
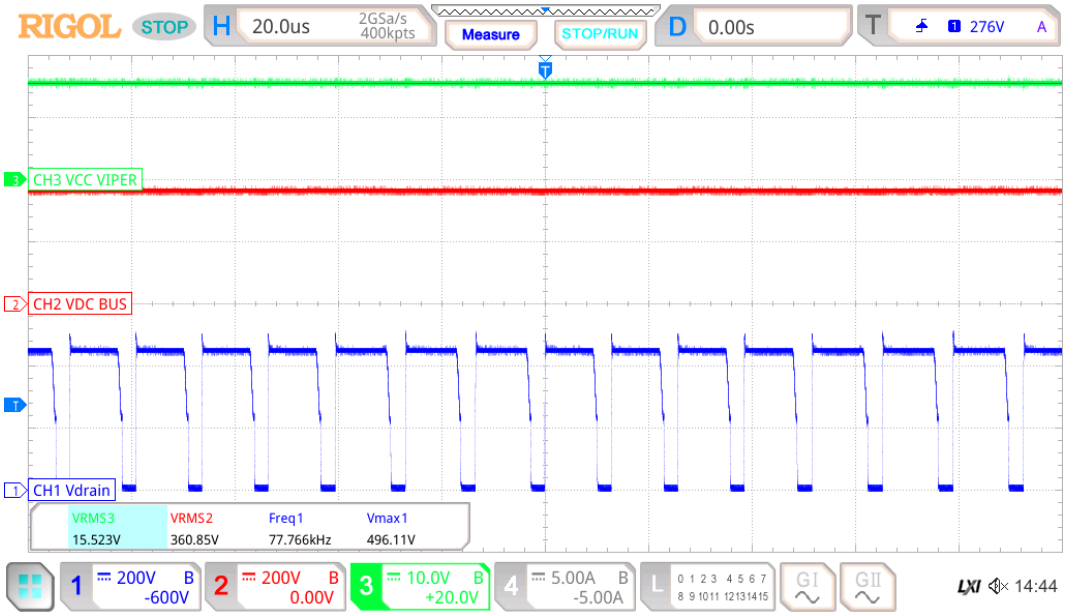


Figure 44. **135 Vac, 20 V/4 A**



4.6 Synchronous rectifier

The following figures show the voltage on the Drain of Vipergan and Drain of the Synchronous Rectifier Mosfet at full load in steady state. E-Load was set to CC mode and the duty cycle of the PWM set to 80 % to allow maximum output current.

Figure 45. 90 Vac, 20 V/4 A - synchronous rectifier Mosfet

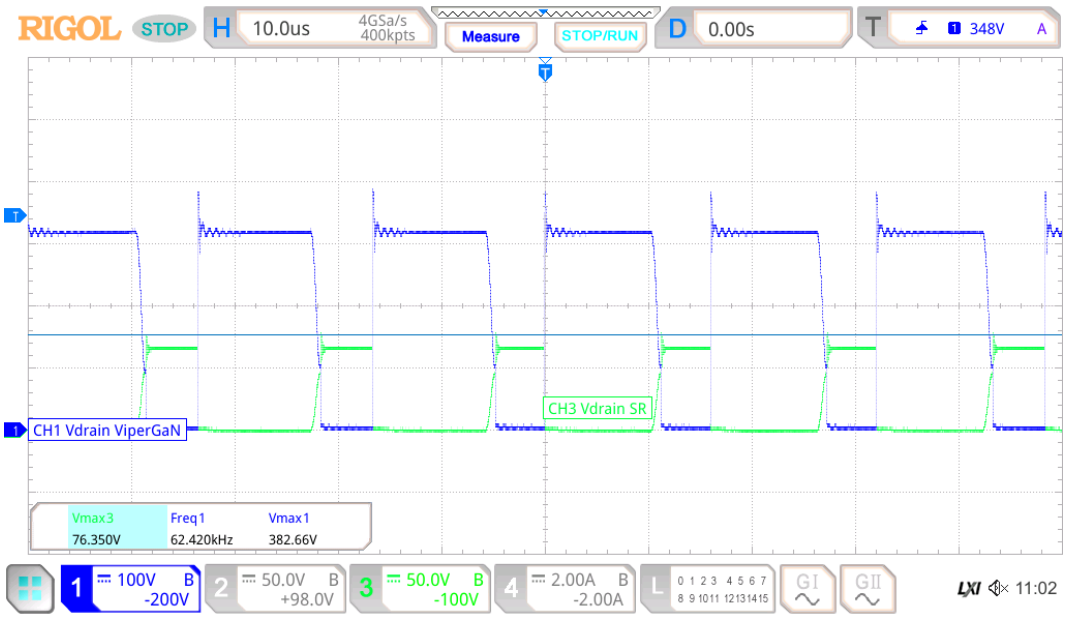


Figure 46. 115 Vac, 20 V/4 A - synchronous rectifier Mosfet

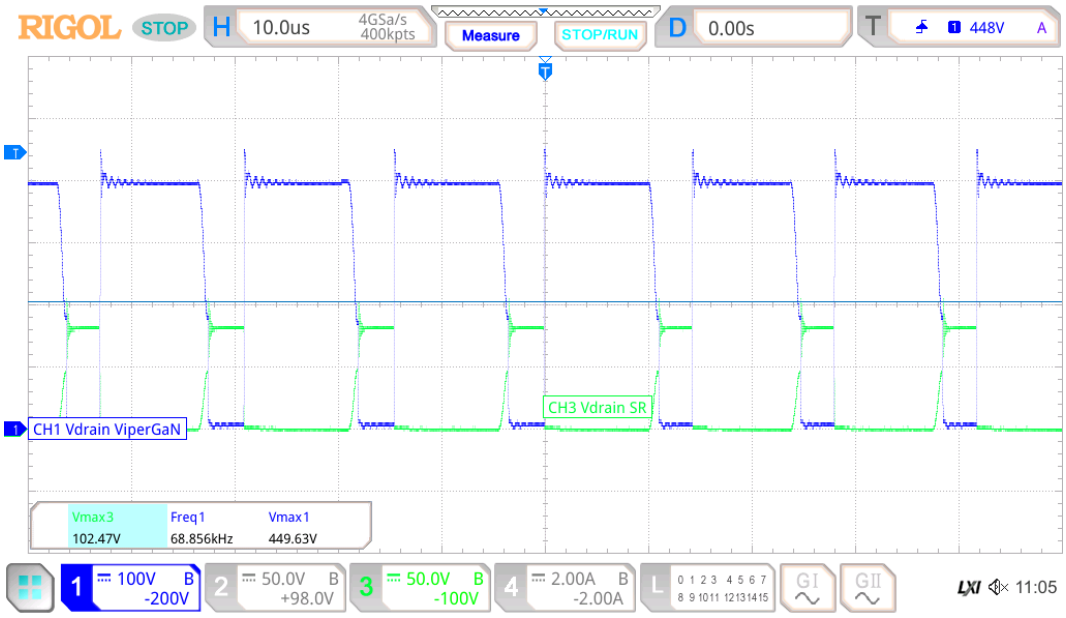
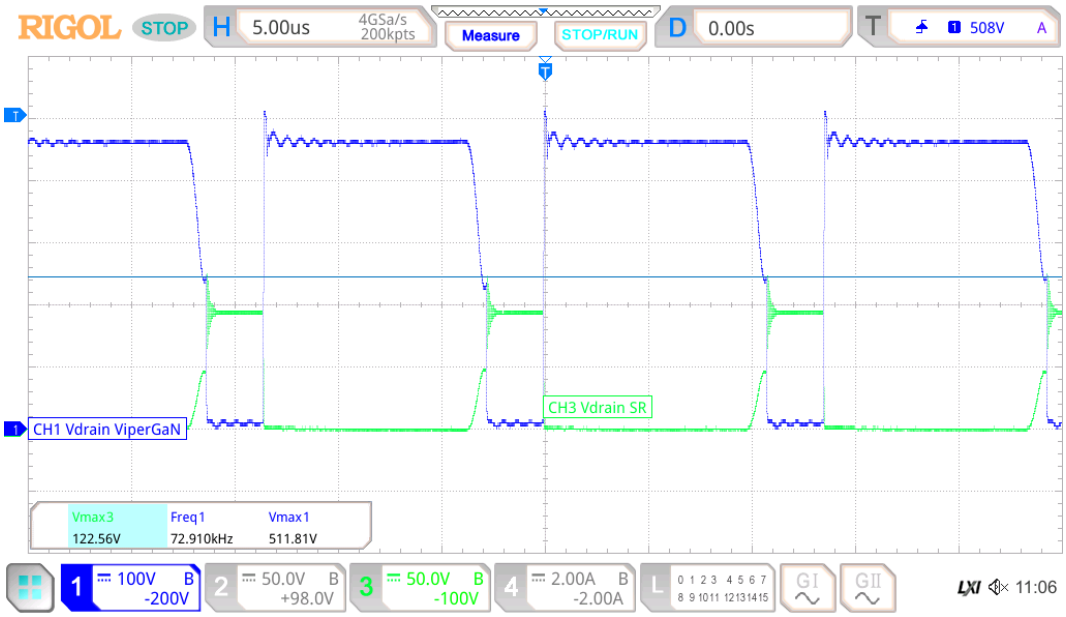
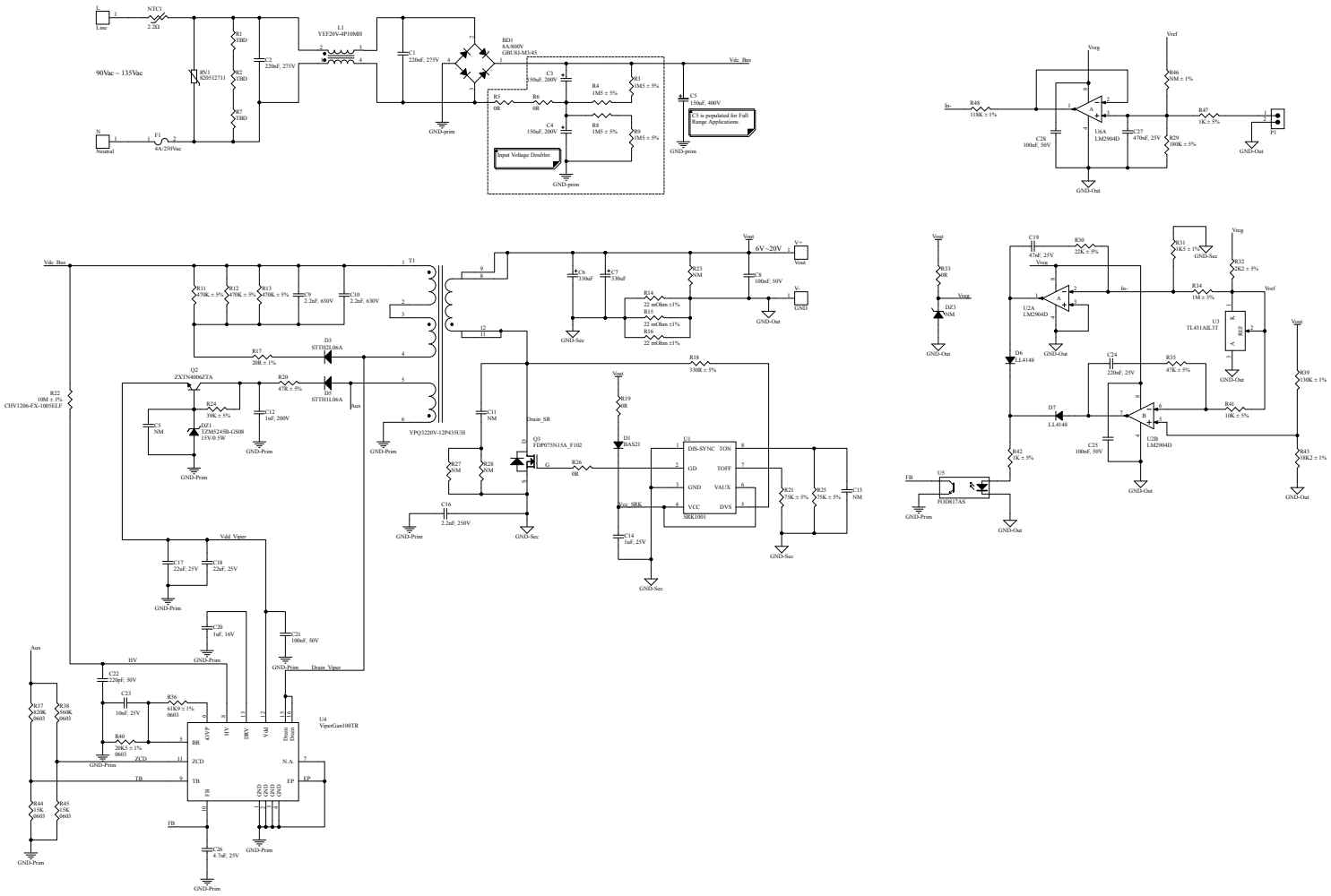


Figure 47. 135 Vac, 20 V/4 A - synchronous rectifier Mosfet



5 Schematic diagrams

Figure 48. **STDES-VGAN100F1 circuit schematic**



6 Bill of materials

Table 8. **STDES-VGAN100F1 bill of materials**

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
1	1	BD1	8A/800V	800V 8A Glass Passivated Single-Phase Bridge Rectifier	Vishay	GBU8J-M3/45
2	2	C1, C2	220nF, 275V	WCAP-FTX2 Film Capacitor, THT, L18W6H11.5, 220nF, 275V	Wurth Elektronik	890324025027
3	2	C3, C4	150uF, 200V	WCAP-AT1H Aluminum Electrolytic Capacitor, Radial, THT, D18xH25mm, 150uF, 200V	Wurth Elektronik	860241081008
4	2	C5, C13	N.A.			
5	2	C6, C7	330uF, 25V	WCAP-PTG5 Aluminum Polymer Capacitor, Radial THT, D10xH12.5mm, 330uF, 25V	Wurth Elektronik	870025575009
6	4	C8, C21, C25, C28	100nF, 50V	WCAP-CSGP Multilayer Ceramic Chip Capacitor, General Purpose, size 0603, X7R, 100nF, 50V	Wurth Elektronik	885012206095
7	2	C9, C10	2.2nF, 630V	WCAP-CSMH Multilayer Ceramic Chip Capacitor, size 1206, NP0 Class I, 2.2nF, 630V	Wurth Elektronik	885342008007
8	1	C11	N.A.			
9	1	C12	1nF, 200V	WCAP-CSMH Multilayer Ceramic Chip Capacitor, size 0805, NP0 Class I, 1nF, 200V	Wurth Elektronik	885342007003
10	1	C14	1uF, 25V	WCAP-CSGP Multilayer Ceramic Chip Capacitor, General Purpose, size 0805, X7R, 1uF, 25V	Wurth Elektronik	885012207078

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
11	1	C16	2.2nF, 250V	WCAP-CSSA Multilayer Ceramic Chip Safety Capacitor, size 2211, X1/Y2, 2.2nF, 250V	Wurth Elektronik	885352213015
12	2	C17, C18	22uF, 25V	WCAP-CSGP Multilayer Ceramic Chip Capacitor, General Purpose, size 1210, X7R, 22uF, 25V	Wurth Elektronik	885012209074
13	1	C19	47nF, 25V	WCAP-CSGP Multilayer Ceramic Chip Capacitor, General Purpose, size 0805, X7R, 47nF, 25V	Wurth Elektronik	885012207070
14	1	C20	1uF, 16V	WCAP-CSGP Multilayer Ceramic Chip Capacitor, General Purpose, size 0603, X7R, 1uF, 16V	Wurth Elektronik	885012206052
15	1	C22	220pF, 50V	WCAP-CSGP Multilayer Ceramic Chip Capacitor, General Purpose, size 0603, X7R, 220pF, 50V	Wurth Elektronik	885012206079
16	1	C23	10nF, 25V	WCAP-CSGP Multilayer Ceramic Chip Capacitor, General Purpose, size 0603, X7R, 10nF, 25V	Wurth Elektronik	885012206065
17	1	C24	220nF, 25V	WCAP-CSGP Multilayer Ceramic Chip Capacitor, General Purpose, size 0603, X7R, 470nF, 25V	Wurth Elektronik	885012206075
18	1	C26	4.7nF, 25V	WCAP-CSGP Multilayer Ceramic Chip Capacitor, General Purpose, size 0603, X7R, 4.7nF, 25V	Wurth Elektronik	885012206063

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
19	1	C27	470nF, 25V	WCAP-CSGP Multilayer Ceramic Chip Capacitor, General Purpose, size 0603, X7R, 470nF, 25V	Wurth Elektronik	885012206075
20	1	D1	BAS21	High Speed Switching Diode 250V 0.25A 3-Pin SOT-23 T/R.	Diodes	BAS21
21	1	D3	STTH2L06A 600 V, 2 A, SMA	600 V, 2 A Low Drop Ultrafast Diode.	ST	STTH2L06A
22	1	D5	STTH1L06A 600 V, 1 A, SMA	600 V, 1 A Low Drop Ultrafast Diode.	ST	STTH1L06A
23	2	D6, D7	LL4148	Small Signal Diode	Vishay	LL4148-M-18
24	1	DZ1	15V, 0.5W	Small Signal Zener Diodes, 5%, 500mW	Vishay	TZM5245B-GS08
25	1	DZ3	N.A.		Any	Any
26	1	F1	4A/250Vac	FUSE BOARD MOUNT 4A 250VAC RAD	Littelfuse Wickmann	37314000410
27	1	L1	YEF20V-4P10MH	CMC, 10mH - 2A	Trigon Components	YEF20V-4P10MH
28	1	NTC1	2.2Ω	Inrush Current Limiter, Diameter 11.5mm, Width 5.0mm, Height 16.0mm, Leads 5.0mm, 2.2Ω, 6 / 5A	TDK	B57236S0229M000
29	1	P1	61300211121	WR-PHD Pin Header, THT, Vertical, pitch 2.54mm, 1 Row, 2P	Wurth Elektronik	61300211121
30	1	Q2	200V, 1A	200V, 1A NPN LED DRIVING TRANSISTOR IN SOT89	Diodes	ZXTN4006ZTA
31	1	Q3	150V, 7.5m Ohms	N-Channel Mosfet, 150V, 130A, 7.5m Ohms.	ONSEMI	FDP075N15A_F102
32	3	R1, R2, R7	N.A.		Any	Any
33	4	R3, R4, R8, R9	1M5 ± 5%	SMD Chip Resistor, 200 mW, 0805 [2012 Metric], Thick Film, General Purpose	Any	Any

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
34	2	R5, R6	0R	SMD Chip Resistor, 250 mW, 1206 [3216 Metric], Thick Film, General Purpose	Any	Any
35	3	R11, R12, R13	470K ± 5%	SMD Chip Resistor, 1W, 2010, Thick Film, General Purpose	Yageo	RC2010JK-07470KL
36	3	R14, R15, R16	22 mOhm ±1%	SMD Chip Resistor, 2512, High Power Metal Strip Resistors for Current Sensing.	TE Connectivity	TLRP3A30DR022FTE
37	1	R17	20R ± 1%	SMD Chip Resistor, 250 mW, 1206 [3216 Metric], Thick Film, General Purpose	Any	Any
38	1	R18	330R ± 5%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any
39	1	R19	0R	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any
40	1	R20	47R ± 5%	SMD Chip Resistor, 200 mW, 0805 [2012 Metric], Thick Film, General Purpose	Any	Any
41	2	R21, R25	75K ± 5%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any
42	1	R22	10M ± 1%	SMD Chip Resistor, 250 mW, 1206 [3216 Metric], Thick Film, General Purpose	Bourns	CHV1206-FX-1005ELF
43	1	R23	N.A.		Any	Any
44	1	R24	39K ± 5%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
45	1	R26	0R	SMD Chip Resistor, 200 mW, 0805 [2012 Metric], Thick Film, General Purpose	Any	Any
46	2	R27, R28	N.A.		Any	Any
47	1	R29	180K ± 5%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any
48	1	R30	22K ± 5%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any
49	1	R31	1K5 ± 1%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any
50	1	R32	2K2 ± 5%	SMD Chip Resistor, 250 mW, 1206 [3216 Metric], Thick Film, General Purpose	Any	Any
51	1	R33	0R	SMD Chip Resistor, 250 mW, 1206 [3216 Metric], Thick Film, General Purpose	Any	Any
52	1	R34	1M ± 5%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any
53	1	R35	47K ± 5%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any
54	1	R36	61K9 ± 1%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any
55	1	R37	820K ± 2%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
56	1	R38	560K ± 2%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any
57	1	R39	130K ± 1%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any
58	1	R40	20K5 ± 1%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any
59	1	R41	10K ± 5%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any
60	2	R42, R47	1K ± 5%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any
61	1	R43	18K2 ± 1%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any
62	2	R44, R45	15K ± 2%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any
63	1	R46	N.A.		Any	Any
64	1	R48	118K ± 1%	SMD Chip Resistor, 125 mW, 0603 [1608 Metric], Thick Film, General Purpose	Any	Any
65	1	RV1	820512711	WE-VD Disk Varistor, D12.5mm, W6.5mm, H16mm, 275VAC, 350VDC	Wurth Elektronik	820512711
66	1	T1	YPQ3220V-12P 435UH	Transformer 12-Terminal , THT, Vertical, PQ Style Bobbins, PQ3220	Trigon Components	YPQ3220V-12P435UH

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
67	1	U1	SRK1001, SO8	Adaptive synchronous rectification controller for flyback converter	ST	SRK1001
68	2	U2, U6	LM2904D, SO8	Low-Power Dual Operational Amplifier	ST	LM2904D
69	1	U3	TL431AIL3T, SOT23-3	Voltage Reference, AEC-Q100, Shunt - Adjustable, 2.5V to 36V, 1 %	ST	TL431AIL3T
70	1	U4	VIPERGAN100 TR, QFN 5x6mm	Advanced quasi-resonant offline high voltage converter with E-mode GaN HEMT.	ST	VIPERGAN100TR
71	1	U5	FOD817AS	Optocoupler DC-IN 1-CH Transistor DC-OUT 4-Pin PDIP SMD Black T/R	ONSEMI	TPC817A C9G

7 Conclusions

The test results demonstrate the good performance achieved by this evaluation board. The reference design shows peak efficiency greater than 92 %. The VIPerGaN100 is an offline quasi-resonant flyback converter with a dynamic blanking time feature and valley synchronization function that turns on the power switch always at the valley of the drain resonance, reducing the switching losses and maximizing the overall efficiency at any input line and load conditions. The secondary losses are minimized by using the highly efficient and optimized synchronous rectification controller. Users no longer need to manage GaN driving complexity to enjoy the benefits of GaN technology thanks to the highly integrated VIPerGaN100 IC, enhancing the robustness of the application.

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Revision history

Table 9. **Document revision history**

Date	Revision	Changes
07-Mar-2025	1	Initial release.

Contents

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