Design Example Report

Title	**36 W, 36 V Isolated Flyback Non-Dimmable Flicker-Free LED Driver with Switched Valley-Fill PFC Using TinySwitch™-5 (TNY5075K-H501)**
Specification	100 – 277 VAC Input; 36 V / 1 A Output
Application	LED Driver
Author	Applications Engineering Department
Document Number	DER-1094
Date	December 18, 2025
Revision	A

Summary and Features

- > 87% full load efficiency at 230 VAC
- < 10% full load THD at 230 VAC
- > 0.92 power factor from 115 V – 277 VAC
- < 5% flicker
- < 10 ms start-up time
- 36 V – 25 V constant current region
- Slim form factor: 123 mm (L) × 38 mm (W) × 15 mm (H)
- TinySwitch-5 protection features:
    - Output short circuit, overload and overvoltage protection
    - Over temperature protection (OTP)
    - Line undervoltage and overvoltage protection
- Meets 2 kV combination wave differential mode surge

Power Integrations

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Important Note:
Although this board is designed to satisfy safety isolation requirements, the engineering prototype has not been agency approved. Therefore, all testing should be performed using an isolation transformer to provide the AC input to the prototype board.

1 Introduction

This engineering report describes a 36 W non-dimmable isolated flyback LED driver that uses the TinySwitch™-5 integrated switcher IC in conjunction with a low-cost switched valley-fill PFC circuit to achieve high power factor and flicker-free operation.

The combination of the switched valley-fill PFC circuit and the TinySwitch-5 variable-frequency, variable-current control algorithm provides a low-cost solution that achieves near-unity power factor performance without requiring an active PFC stage.

The power supply provides constant output current across 25 V – 36 V LED applications and operates across an input voltage range of 100 VAC to 277 VAC. The design is optimized for high efficiency, high power factor, low THD and low flicker at 230 VAC input line.

This document includes the power supply specification, schematic, bill of materials, transformer documentation, printed circuit board layout, and performance data for evaluation and reference.

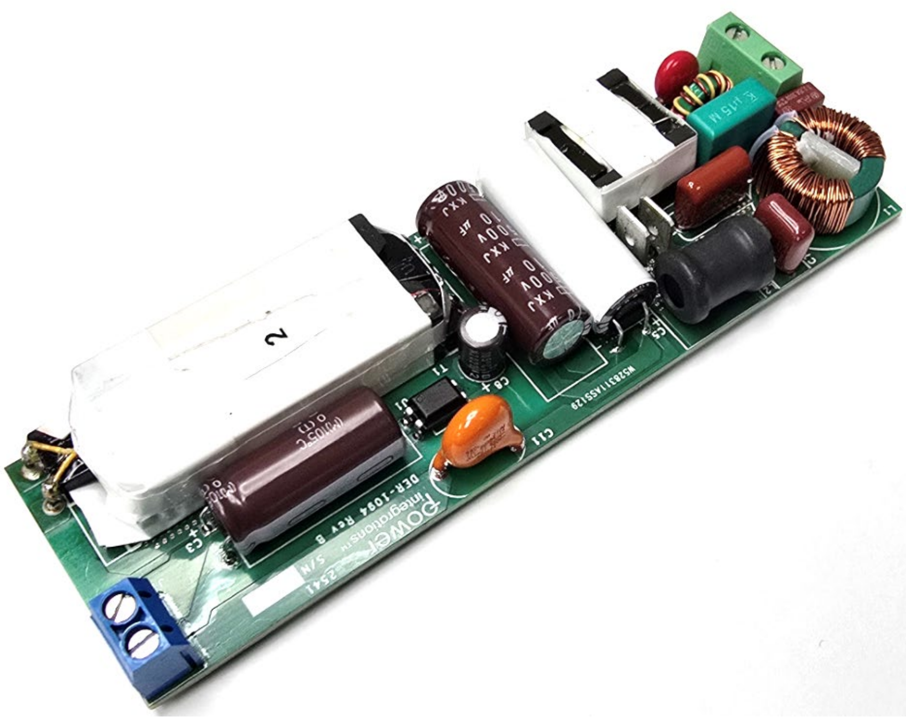


Figure 1 – Populated Circuit Board.

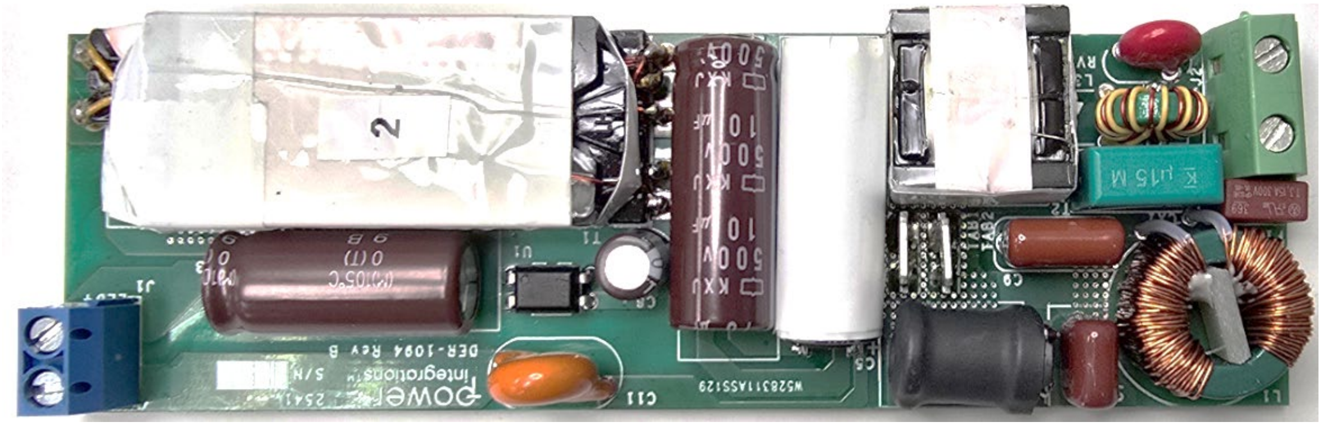


Figure 2 – Populated Circuit Board, Top Side.

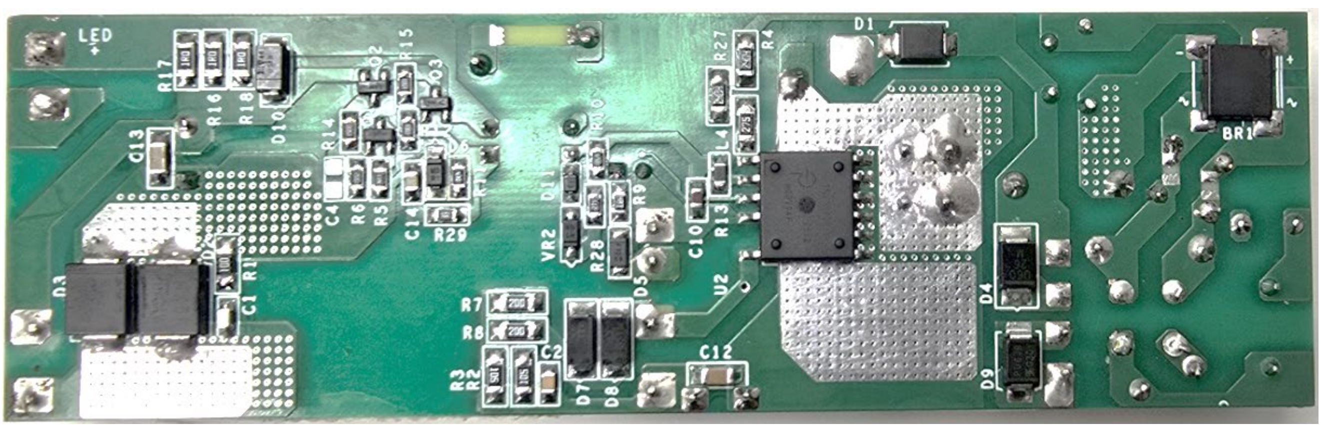


Figure 3 – Populated Circuit Board, Bottom Side.

2 Power Supply Specification

The table below represents the minimum acceptable performance for the design. Actual performance is listed in the results section.

Description	Symbol	Min	Typ	Max	Units	Comment
Input						
Voltage	V_{IN}	100		277	VAC	2 wire – no P.E.
Frequency	f_{LINE}	47	50/60	63	Hz	
Power Factor	PF	0.92				115 - 277 VAC, > 70% load
Total Harmonic Distortion	THD			10	%	@ 230 VAC full load, 36 V LED
Output						
Constant Voltage Region			36.5		V	±5%
Constant Current Region		25		36	V	
Output Current	I_{OUT}		1		A	±5%
Output Power	P_{OUT}		36		W	
Output Ripple Current				100	mA	peak to peak
Output Current Flicker				5	%	@ 25 – 35 V LED string
Efficiency						
Full Load	$\eta_{230\ VAC}$	87			%	Measured at output terminal, 36 V LED
Environmental						
Conducted EMI		CISPR22B / EN55022B				36 V LED load, floating
Combination Wave Surge (L/N)				±2	kV	Source impedance: 2 Ω
Ring Wave (L/N & L,N/PE)				±2.5	kV	Source impedance: 12 Ω
Ambient Temperature	T_{AMB}	0		55	°C	Free convection, sea level

Table 1 – Power Supply Specification.

3 Schematic

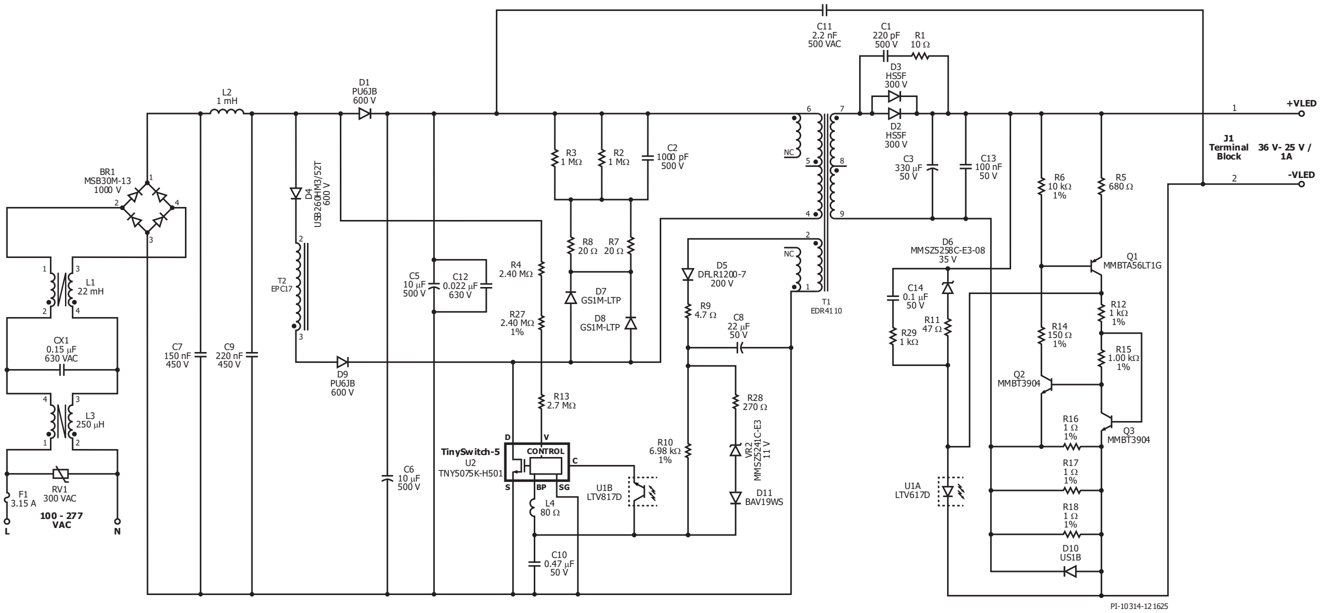


Figure 4 – Schematic Diagram.

4 Circuit Description

4.1 Input Rectification and EMI Filtering

Fuse F1 isolates the PSU circuitry and provides protection against component failures. RV1 protects the circuit from high-voltage surge events. The common-mode choke (CMC) L1, together with X-capacitor CX1, attenuates both common-mode and differential-mode noise in the <1 MHz conducted EMI frequency band. L1 also provides input current filtering to improve power factor and reduce THD. The common-mode choke L3 provides additional common-mode noise attenuation in the >1 MHz conducted EMI frequency band.

Bridge diode BR1 provides full-wave AC rectification. C7, L2, and C9 form a pi-filter that attenuates differential-mode noise caused by the flyback switching action. The capacitance and inductance values of these components are optimized to achieve high power factor and low THD while maintaining compliance with conducted EMI limits. Additionally, the TinySwitch-5 frequency jitter feature reduces conducted EMI.

4.2 Switched Valley-Fill PFC Circuit

The switched valley-fill (SVF) PFC circuit is a low-cost, passive-assisted power factor correction topology designed to improve input power factor and reduce THD. The input stage consists of low-capacitance film capacitors C7 and C9 together with differential choke L2 to form a pi-filter. One end of the SVF inductor is connected to the primary drain of the flyback MOSFET in series with boost diodes D4 and D9, while the other end is connected to film capacitor C9, across which the rectified AC input voltage is stored. Both the flyback transformer and the SVF inductor are designed to operate in discontinuous conduction mode (DCM), enabling improved input current shaping and enhanced power factor performance.

At start-up, the rectified input voltage across capacitors C7 and C9 initially charges the bulk capacitors C5 and C6 through diode D1, providing the start-up supply for the TinySwitch-5 flyback controller. Once switching begins, the SVF inductor (T2) and the flyback transformer (T1) magnetizing inductance are energized during each MOSFET turn-on interval. The SVF inductor is charged directly from the rectified AC input through the film capacitors C7 and C9, while the flyback magnetizing inductance is energized from the bulk capacitors C5 and C6. During this interval, the total MOSFET drain current is the sum of the currents flowing through the SVF inductor and the flyback transformer.

When the MOSFET turns off, the energy stored in the SVF inductor is released by driving current in the reverse direction through the primary winding, transferring energy from the bridge rectifier BR1 toward the bulk capacitor C5 and C6. At the same time, the energy stored in the flyback transformer magnetizing inductance is delivered to the load through the secondary winding by flyback action. Because not all the SVF inductor energy is transferred directly to the load, any excess energy charges the bulk capacitor C5 and C6, raising its voltage above the rectified voltage across C9. Diode D1 prevents this elevated bulk voltage from feeding back into C7 and C9, maintaining proper current shaping and power factor performance.

As a result, the input current supplying the power supply flows through T2, with its peak current proportional to the rectified AC input voltage across C9 and the inductor value. This interaction produces an input current that closely follows the input voltage waveform, resulting in near-sinusoidal current, high power factor, and low THD.

4.3 Flyback Converter Circuit Using TinySwitch-5

The line undervoltage and overvoltage thresholds are established by the current injected into the V pin through the line-sense resistors R4, R13, and R27. These resistors are connected to film capacitor C9 to accurately sense the peak rectified AC input voltage. The primary RCD snubber, formed by D7, D8, R2, R3, R7, R8, and C2, minimizes the primary drain voltage spike caused by the transformer's leakage inductance.

The TinySwitch-5 IC is self-powered at start-up through an internal high-voltage current source connected to the Drain, which supplies current to the internal primary bypass regulator to charge the BYPASS pin capacitor (C10) when AC input is first applied. A ferrite bead (L4) is added in series with the drain to improve noise immunity such as ring wave and EFT. During normal operation, the controller is powered from the bias winding of transformer T1. The bias winding output is rectified by diode D5 and filtered by R9 and C8. Resistor R10 limits the current supplied to the BYPASS pin of the TinySwitch-5 IC (U2), disabling the internal high-voltage current source once sufficient bias voltage is established.

Primary-side sensed overvoltage protection (OVP) is implemented using Zener diode VR2, current-limiting resistor R28, and blocking diode D11 connected from the bias supply to the BYPASS pin. If an output overvoltage occurs, the increased bias winding voltage causes VR2 to conduct, injecting additional current into the BYPASS pin. When this current exceeds the shutdown threshold (ISD), the TinySwitch-5 stops switching and enters auto-restart mode until the output voltage returns to within regulation.

The optocoupler U1 provides safety-isolated feedback loop control between the primary and secondary sides. During the primary switch turn-off interval, rectifier diodes D2 and D3 conduct the transformer flyback current from the secondary winding. Output capacitor C3 filters the DC output voltage, while C13 helps minimize high-frequency noise. The RC snubber network consisting of C1 and R1 reduces voltage stress across D2 and D3, suppresses high-frequency ringing, and improves both conducted and radiated EMI performance.

Zener diode D6 regulates the output voltage during constant-voltage (CV) operation from no load to full load. Resistor R11 limits the current through D6 and U1. The CV regulation voltage is set to more than 2.5% above the maximum LED string voltage (36 V) to allow full-current operation under rated load.

During start-up in constant-current (CC) operation with an LED load, the feed-forward network (R29 and C14) supplies an initial current to U1 to help prevent output-current overshoot, particularly when the LED load voltage is low. As the converter transitions into steady-state CC regulation, the current-sense resistors (R16, R17, and R18) develop a voltage proportional to the output current, which drives transistors Q2 and Q1 to regulate the output current. Transistor Q3 provides additional base-emitter drive to Q2, reducing power dissipation across the current-sense resistors.

5 PCB Layout

The PCB uses FR4 material with a thickness of 1.6 mm and a double-sided copper layer with a thickness of 2.0 oz.

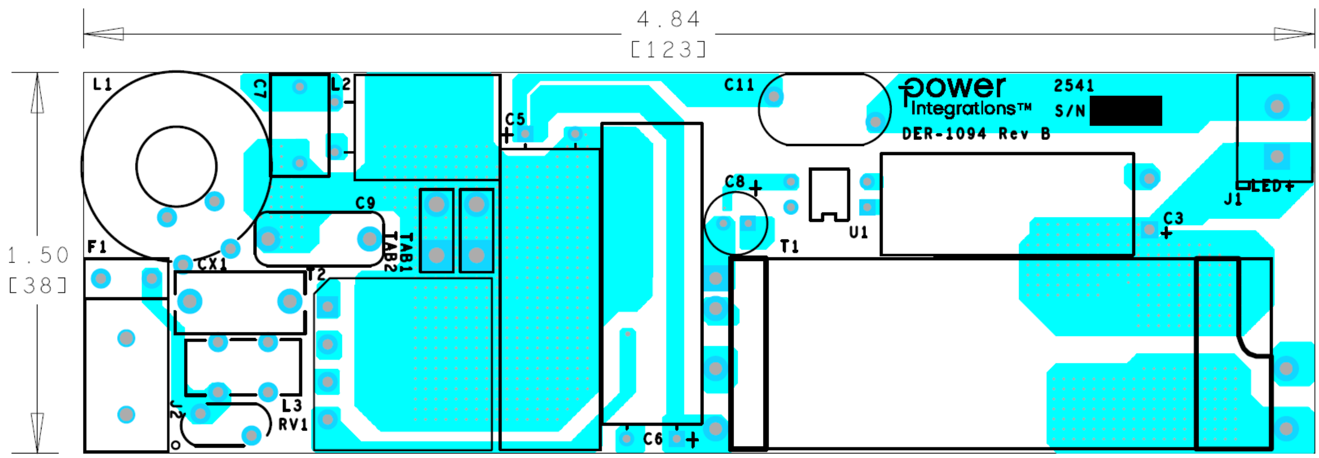


Figure 5 – Printed Circuit Layout, Top.

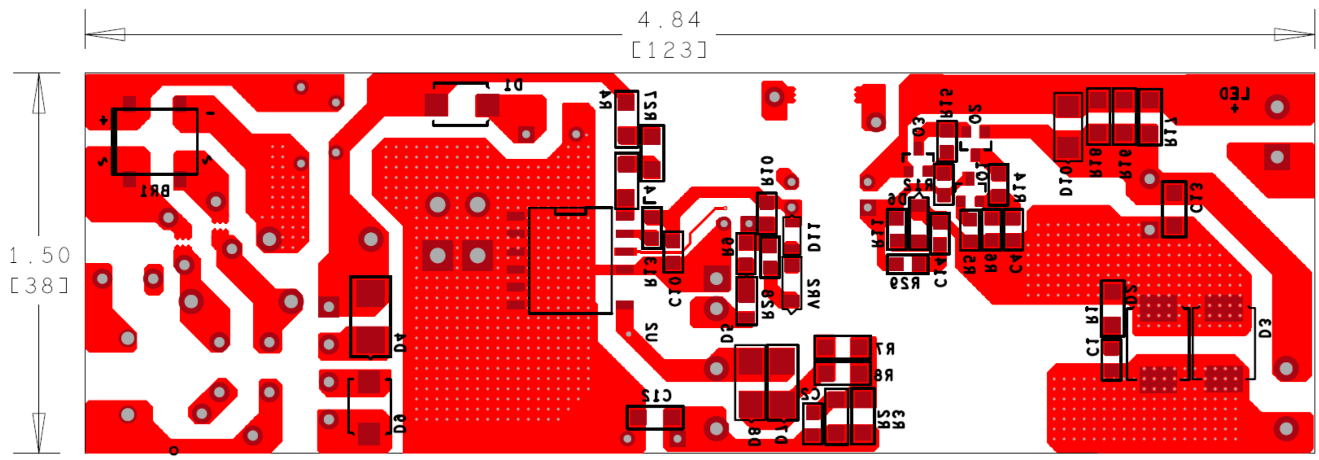


Figure 6 – Printed Circuit Layout, Bottom.

6 Bill of Materials

Item No.	Part Reference	Qty.	Description	Manufacturer	Mfr. Part Number
1	BR1	1	Bridge Rectifier, Single Phase, Standard, 1 kV, 3 A, Surface Mount, 4-MSBL, 4-SMD, Flat Leads	Diodes Incorporated	MSB30M-13
2	C1	1	220 pF, ±5%, 500 V, Ceramic Capacitor, X7R, 0805 (2012 Metric)	Kemet	C0805C221JCRAC7800
3	C2	1	1000 pF, ±10%, 500 V, Ceramic Capacitor X7R, 0805 (2012 Metric)	KEMET	C0805X102KCRACAUTO
4	C3	1	330 μF, 50 V, Electrolytic, Very Low ESR, 28 mOhm, (10 x 25)	Nippon Chemi-Con	EKZE500ELL331MJ25S
5	C5 C6	2	10 μF, ±20%, 500 V, Aluminum Electrolytic Capacitors Radial, Can 8000 Hrs @ 105 °C, (10 x 30)	Chemi-Con	EKXJ501ELL100MJ30S
6	C7	1	150 nF, 450 V, 10%, Polypropylene Metalized	Faratronic	C222S154K30
7	C8	1	22 μF, 50 V, Electrolytic, Gen. Purpose, (6.3 x 9)	Nichicon	UTT1H220MDD
8	C9	1	220 nF, 450 V, Film	Duratech	MEXXF32204JJ
9	C10	1	0.47 μF, ±10%, 50 V, Ceramic, X7R, 0805 (2012 Metric), -55 °C ~ 125 °C	TDK Corp	CGA4J3X7R1H474K125AB
10	C11	1	2200 PF, ±20%, 500 VAC (Y1), 760 VAC (X1), Ceramic, Y5U (E), RADIAL	Vishay	440LD22-R
11	C12	1	0.022 μF, ±10%, 630 V, Ceramic, X7R, -55 °C ~ 125 °C, 1206 (3216 Metric)	Samsung Electro-Mechanics America, Inc.	CL31B223KHHNNNE
12	C13	1	100 nF, 50 V, Ceramic, X7R, 1206	Yageo	CC1206KRX7R9BB104
13	C14	1	0.1 μF, ±10%, 50 V Ceramic Capacitor X7R 0805 (2012 Metric)	Samsung	CL21B104KBC5PNL
14	CX1	1	CAP, 0.15 μF, ±20%, 630 VDC, 310 VAC, FILM, POLYPROP, RAD, X2, 13 mm (L), 6 mm (W), 12 mm (H), 10 mm (LS)	KEMET	F861AP154M310L
15	D1 D9	2	Diode, 600 V, 6 A, Surface Mount DO-214AA (SMB)	Taiwan Semiconductor Corporation	PU6JB
16	D2 D3	2	Diode, 300 V, 5 A, Surface Mount DO-214AB (SMC)	Taiwan Semiconductor Corporation	HS5F
17	D4	1	Diode, Ultrafast Recovery, 600 V, 2 A, Surface Mount, DO-214AA (SMB), DO214AA (SMB)(SMBJ)	Vishay General Semiconductor - Diodes Division	USB260HM3/52T
18	D5	1	200 V, 1 A, Rectifier, Glass Passivated, POWERDI123	Diodes Inc	DFLR1200-7
19	D6	1	Zener Diode, 36 V, 500 mW, ±2%, Surface Mount SOD-123	Vishay Semiconductor Diodes Division	MMSZ5258C-E3-08
20	D7 D8	2	1000 V, 1 A, DO-214AC	Micro Commercial Co	GS1M-LTP
21	D10	1	DIODE ULTRA FAST, 1 A, 100 V, SMA	Diodes, Inc	US1B-13-F
22	D11	1	100 V, 0.2 A, Fast Switching, 50 ns, SOD-323	Diode Inc.	BAV19WS-7-F
23	F1	1	3.15 A, 300V, Slow, Long Time Lag, RST	Littelfuse Inc	36913150000
24	L1	1	22 mH +/- 40% @ 10KHz 0.4 V, 35 mH (typ) @ 100 KHz 0.4 V, 1 A, 0.3 ohm max DCR, Toroidal Common Mode Choke, Vert	Sumida	04291-T247
25	L2	1	1 mH, Unshielded Drum Core, Wirewound Inductor, 800 mA, 1.15 Ohm Max, Radial, Vertical Cylinder (Open) 10.5 mm x 14.5 mm height	Wurth	7447480102
26	L3	1	250 μH, Toroidal Common Mode Choke, custom, DER-1094, wound on 32-00330-00 core	Power Integrations	32-00485-00

27	L4	1	FERRITE Bead, 80 Ohms @ 100 MHz, 1 Signal Line, Ferrite Bead 0805 (2012 Metric), 300 mA, 300 mOhm	Max Echo	EBMS201209K800
28	Q1	1	PNP, Small Signal BJT, 80 V, 0.5 A, SOT-23	On Semiconductor	MMBTA56LT1G
29	Q2 Q3	2	NPN, Small Signal BJT, 40 V, 0.2 A, SOT-23	On Semiconductor	MMBT3904LT1G
30	R1	1	RES, 10 R, 5%, 2/3 W, Thick Film, 1206	Panasonic	ERJ-P08J100V
31	R2 R3	2	RES, 1.0 M, 5%, 2/3 W, Thick Film, 1206	Panasonic	ERJ-P08J105V
32	R4 R27	2	RES, 2.4 M, 1%, 1/4 W, Thick Film, 1206	Yageo	RC1206FR-072M4L
33	R5	1	RES, 680 R, 5%, 1/8 W, Thick Film, 0805	Panasonic	ERJ-6GEYJ681V
34	R6	1	RES, 10.0 k, 1%, 1/8 W, Thick Film, 0805	Panasonic	ERJ-6ENF1002V
35	R7 R8	2	RES, 20 R, 5%, 2/3 W, Thick Film, 1206	Panasonic	ERJ-P08J200V
36	R9	1	RES, 4.7 R, 5%, 1/8 W, Thick Film, 0805	Panasonic	ERJ-6GEYJ4R7V
37	R10	1	RES, 6.98 k, 1%, 1/8 W, Thick Film, 0805	Panasonic	ERJ-6ENF6981V
38	R11	1	RES, 47 R, 5%, 1/8 W, Thick Film, 0805	Panasonic	ERJ-6GEYJ470V
39	R12	1	RES, 1 k, 0.1%, 1/4 W, Thick Film, 0805	Stackpole Elect Inc	RNCS0805BKE1K00
40	R13	1	RES, 2.7 M, 5%, 1/4 W, Thick Film, 1206	YAGEO	RC1206FR-072M7L
41	R14	1	RES, 150 R, 1%, 1/8 W, Thick Film, 0805	Panasonic	ERJ-6ENF1500V
42	R15	1	RES, 1.00 k, 1%, 1/8 W, Thick Film, 0805	Panasonic	ERJ-6ENF1001V
43	R16 R17 R18	3	RES, 1 R, 1%, 1/4 W, Thick Film, 1206	Panasonic	ERJ-8RQF1R0V
44	R28	1	RES, 270 R, 5%, 1/8 W, Thick Film, 0805	Panasonic	ERJ-6GEYJ271V
45	R29	1	RES, 1 k, 5%, 1/8 W, Thick Film, 0805	Panasonic	ERJ-6GEYJ102V
46	RV1	1	275 VAC, 23 J, 7 mm, RADIAL	Littelfuse	V275LA4P
47	T1	1	Bobbin, Vertical, EDR4110, 9 pins, 6 pri, 3 sec	Changshu Xinli Magnetic Industrial CO LTD	FP9-EDR41/11
48	T2	1	Bobbin, EPC17, Horizontal, 10 pins	Pinshine	BEPC-17-1110CPH-P
49	U1	1	Optocoupler, 35 V, CTR 300-600%, 4-DIP	Liteon	LTV-817D
50	U2	1	TinySwitch-5, TNY5075K – H501, eSOP-12P	Power Integrations	TNY5075K
51	VR2	1	Zener Diode, 11 V, ±2%, 500 mW, Surface Mount, SOD-123	Vishay General Semiconductor - Diodes Division	MMSZ5241C-E3-08

Table 2 – Electrical Parts.

Item No.	Part Reference	Qty.	Description	Manufacturer	Mfr. Part Number
1	J1	1	CONN TERM BLOCK, 2 POS, 5 mm, PCB	On Shore Technology Inc	ED500/2DS
2	J2	1	2 Position Wire to Board Terminal Block Horizontal with Board 0.300" (7.62 mm) Through Hole	Phoenix Contact	1707027
3	TAB1 TAB2	2	0.250" (6.35 mm) Quick Connect Male - Solder Connector Non-Insulated	KeyStone Electronics	1287-ST

Table 3 – Miscellaneous Parts.

7 SVF Inductor and Flyback Transformer Design Spreadsheet

1	**ACDC_Flyback_PF_TinySwitch-5_022225; Rev.0.1; Copyright Power Integrations 2025**	**INPUT**	**INFO**	**OUTPUT**	**UNITS**	**Switched Valley-Fill Single Stage PFC (SVF S^2PFC)**
2	**Application Variables**					
3	VACMIN	100		100	V	Minimum Input AC Voltage
4	VACNOM			230	V	Nominal Input AC Voltage
5	VACMAX	277		277	V	Maximum Input AC Voltage
6	VACRANGE			CUSTOM		Input Voltage Range
7	FL			50	Hz	Line Frequency
8	CIN	20.00		20.00	μF	Minimum Input Capacitance
9	V_CIN			450	V	Input Capacitance Recommended Voltage Rating
10	VO	36.00		36.00	V	Output Voltage
11	IO	1.00		1.00	A	Output Current
12	PO			36.00	W	Total Output Power
13	N	88.00		88.00	%	Estimated Efficiency
14	Z			0.50		Loss Allocation Factor
15	**Calculations Basis**					
16	PARcalcBASIS	VACNOM		VACNOM		Calculated Results Based on Selected VAC - VACNOM, VACMAX, VACMIN or Worst Case only
17	Flyback_Ind_Basis	Nom		Nom		Calculated Results Based on Selected LP - Min = LP_MIN, Nom = LP_NOM, Max = LP_MAX
18	Boost_Ind_Basis	Nom		Nom		Calculated Results Based on Selected LBOOST - Min = LBOOSTMIN,Nom = LBOOSTNOM,Max = LBOOSTMAX
19	**Primary Controller Section**					
20	PACKAGE	K		K		Device Package. Available options are eSOP(K), eDIP(V), eSIP(E)
21	DEVICE_MODE	Standard		Standard		Device Current Limit Mode
22	DEVNAME	TNY5075K		TNY5075K		PI Device Name
23	RDSON			3.10	Ohm	Device RDSON at 100 °C
24	ILIMITMIN			1.748	A	Minimum Current Limit
25	ILIMITTYP			1.900	A	Typical Current Limit
26	ILIMITMAX			2.052	A	Maximum Current Limit
27	POUT_MAX			70.000	W	Power Capability of the Device based on Thermal Performance
28	BVDSS	Auto		725	V	Peak Drain to Source Breakdown Voltage
29	VDS			0.02	V	On state Drain to Source Voltage
30	VDRAIN			561.74	V	Peak Drain to Source Voltage during Fet turn off
31	**Calculated Electrical Parameters Based on Specified Basis**					
32	Boost Converter					
33	IBOOSTRMS			293.22	mA	Boost RMS current
34	IBOOSTMAX			1035.13	mA	Boost PEAK current
35	IBOOSTAVG			140.48	mA	Boost AVG current

36	IINRMS			162.21	mA	Input RMS current
37	PF_est			0.9953		Estimated Power Factor
38	**Flyback Converter**					
39	FSMIN	39000		39000	Hz	Minimum Switching Frequency in a Line Period
40	FSMAX			85632.82	Hz	Maximum Switching Frequency in a Line Period
41	KPmin			1.3170		Minimum KP in a Line Period for VAC specified by PARcalcBASIS
42	IFETRMS			417.29	mA	Fet RMS current
43	IFETMAX			1870.13	mA	Fet PEAK current
44	IPRIRMS			0.3356	A	Primary Winding RMS current
45	IPRIMAX			1.6132	A	Primary Winding PEAK current
46	IPRIAVG			0.0077	A	Primary Winding AVG current
47	IPRIMIN			822.66	mA	Primary Winding Minimum current
48	ISECRMS			1.65	A	Secondary RMS current
49	ISECMAX			4.90	A	Secondary PEAK current
50	ISECRIPPLE			1.31	A	Secondary RIPPLE current
51	**Boost Choke Construction Parameters**					
52	RATIO_LBST_LFB	0.7200		0.7200		Boost Inductance and Flyback Primary Inductance Ratio
53	LBOOSTMIN			505.45	µH	Minimum Boost Inductance
54	LBOOSTNOM			543.49	µH	Nominal Boost Inductance
55	LBOOSTMAX			581.54	µH	Maximum Boost Inductance
56	LBOOSTTOL	7.00		7.00	%	Boost Inductance Tolerance
57	**Boost Core and Bobbin Selection**					
58	CR_TYPE_BOOST	EPC17		EPC17		Boost Core
59	CR_PN_BOOST			PC44EPC17-Z		Boost Core Code
60	AE_BOOST			22.80	mm^2	Boost Core Cross Sectional Area
61	LE_BOOST			40.20	mm	Boost Core Magnetic Path Length
62	AL_BOOST			1150.00	nH/turns^2	Boost Core Ungapped Core Effective Inductance
63	VE_BOOST			917.00	mm^3	Boost Core Volume
64	BOBBINID_BOOST			P-1705		Bobbin
65	AW_BOOST			20.10	mm^2	Window Area of Bobbin
66	BW_BOOST			9.60	mm	Bobbin Width
67	MARGIN_BOOST			0.00	mm	Safety Margin Width
68	BOBFILLFACTOR_Boost			52.47	%	Boost Bobbin Fill Factor
69	**Boost Winding Details**					
70	NBOOST	75.00		75.00		Boost Choke Turns
71	BP_BOOST			3641.43	Gauss	Boost Peak Flux Density
72	ALG_BOOST			96.62	nH/turns^2	Boost Core Ungapped Core Effective Inductance
73	LG_BOOST			0.27	mm	Boost Core Gap Length
74	L_BOOST			2.93		Number of Boost Layers
75	AWG_BOOST	28		28		Boost Winding Wire AWG
76	OD_BOOST_INSULATED			0.375	mm	Boost Winding Wire Output Diameter with Insulation

77	OD_BOOST_BARE			0.321	mm	Boost Winding Wire Output Diameter without Insulation
78	CMA_BOOST			379.82	Circular Mils/A	Boost Winding Wire CMA
79	**Flyback Transformer Construction Parameters**					
80	VOR	100.00		100.00	V	Secondary Voltage Reflected in the Primary Winding
81	LP_MIN			702.01	µH	Minimum Flyback Inductance
82	LP_NOM			754.85	µH	Nominal Flyback Inductance
83	LP_MAX			807.69	µH	Maximum Flyback Inductance
84	LP_TOL	7.00		7.00	%	Flyback Inductance Tolerance
85	**Flyback Core and Bobbin Selection**					
86	CR_TYPE	Custom		Custom		Flyback Core
87	CR_PN	EDR4110		EDR4110		Flyback Core Code
88	AE	170.00		170.00	mm^2	Flyback Core Cross Sectional Area
89	LE	28.42		28.42	mm	Flyback Core Magnetic Path Length
90	AL	8850.00		8850.00	nH/turns^2	Flyback Core Ungapped Core Effective Inductance
91	VE	4832.00		4832.00	mm^3	Flyback Core Volume
92	BOBBINID	EDR4110		EDR4110		Flyback Bobbin
93	AW	31.80		31.80	mm^2	Flyback Window Area of Bobbin
94	BW	3.80		3.80	mm	Flyback Bobbin Width
95	MARGIN			0.00	mm	Safety Margin Width
96	**Flyback Winding Details**					
97	NP			28.00		Primary Turns
98	BP			3594.08	Gauss	Flyback Peak Flux Density
99	BM			3390.97	Gauss	Flyback Maximum Flux Density
100	BAC			1279.10	Gauss	Flyback AC Flux Density
101	ALG			962.82	nH/turns^2	Flyback Core Ungapped Core Effective Inductance
102	LG			0.20	mm	Flyback Core Gap Length
103	L			2.00		Number of Flyback Layers
104	NB			4.00		Bias Turns
105	NS	10.00		10.00		Secondary Turns

Table 4 – Flyback Transformer and SVF Boost Inductor Design Spreadsheet.

8 Flyback Transformer Specification

8.1 Electrical Diagram

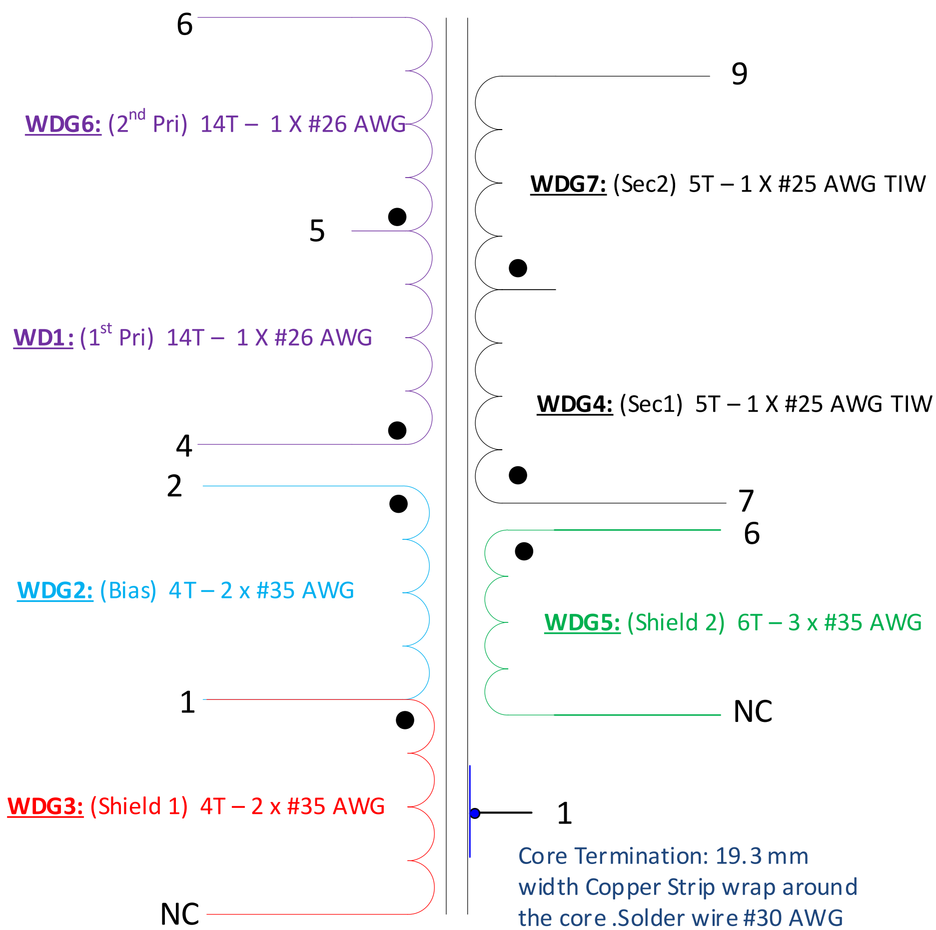


Figure 7 – Transformer Schematic.

8.2 Electrical Specifications

Parameter	Condition	Spec.
Nominal Primary Inductance	Measured at 1 V_{PK-PK}, 100 kHz switching frequency, between pin 4 and 6, with all other windings open.	750 µH ±5%
Primary Leakage Inductance	Measure inductance across Pin 4 and Pin 6 with all other windings shorted.	10 µH ±5%

Table 5 – Transformer Electrical Specification.

8.3 Materials

Item	Description
[1]	Core: EDR4110
[2]	Bobbin: Vertical, EDR4110, 9 pins, 6 pri, 3 sec, PI#: 25-01139-00
[3]	Magnet wire: #26 AWG, double coated
[4]	Magnet wire: #35 AWG, double coated
[5]	Magnet wire: #31 AWG, double coated
[6]	Magnet wire: #30 AWG, double coated
[7]	TIW: #25 AWG Tripple Insulated Wire
[8]	Tape: 36 mm, 3M 13450-F, Polyester Film
[9]	Tape: 18.6 mm, 3M 13450-F, Polyester Film
[10]	Tape: 4 mm, 3M 13450-F, Polyester Film
[11]	25 mm, 3M 1194 Copper Foil Tape
[12]	Varnish: Dolph BC-359.

Table 6 – Transformer Materials.

8.4 Transformer Build Diagram

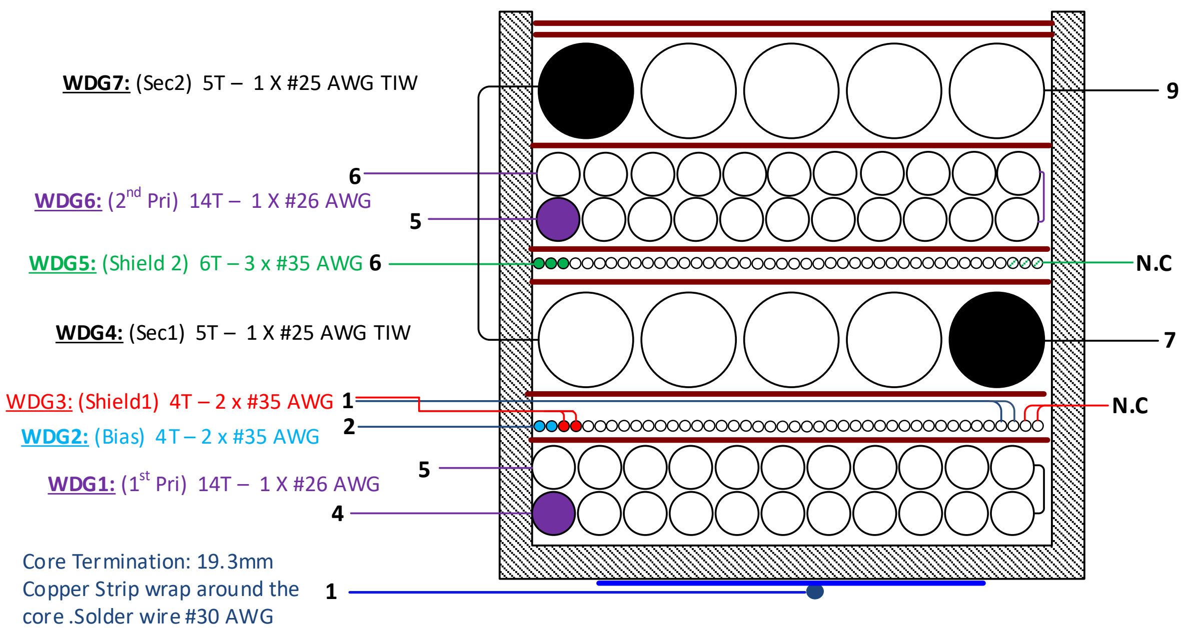
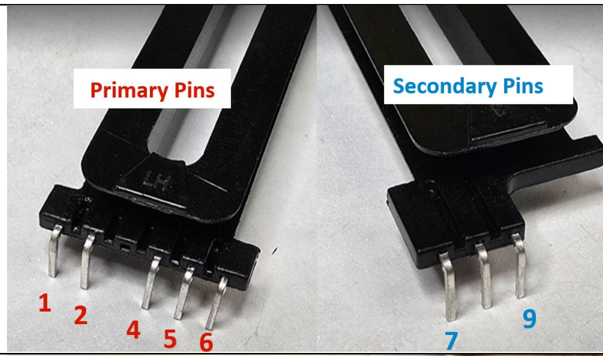
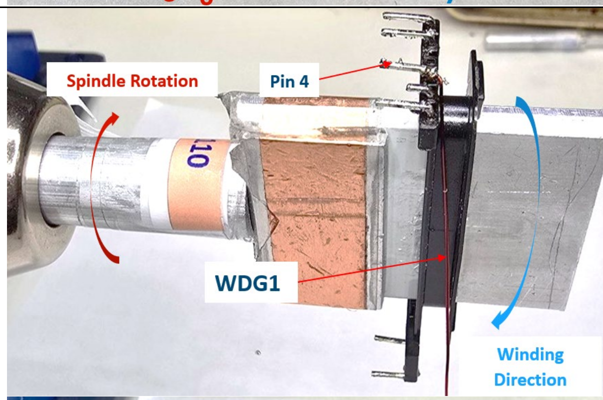
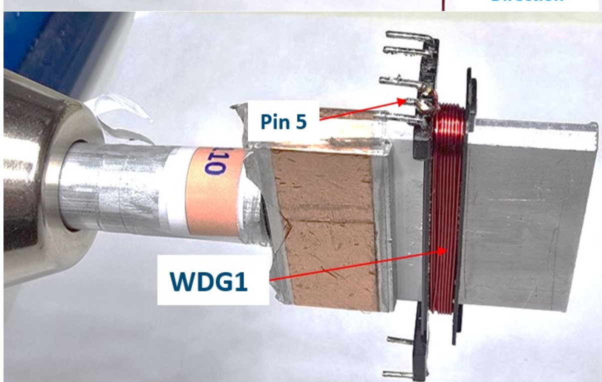
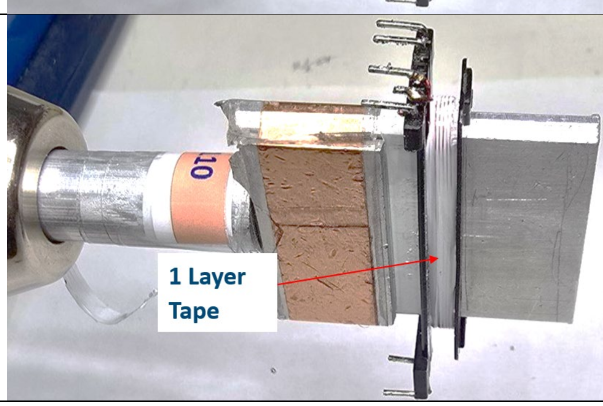
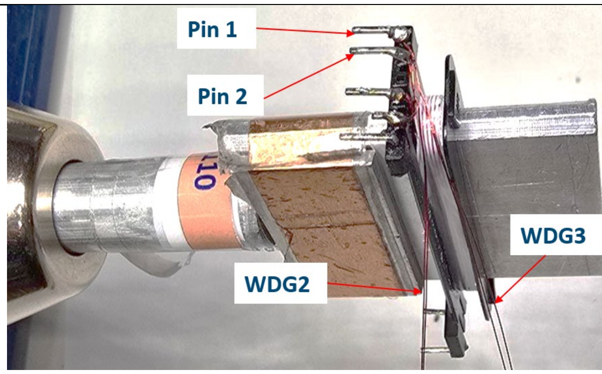
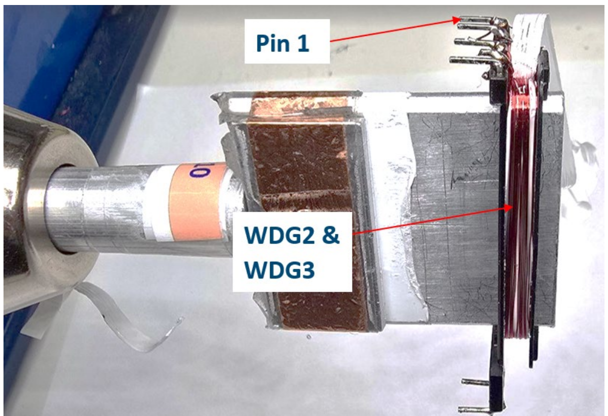
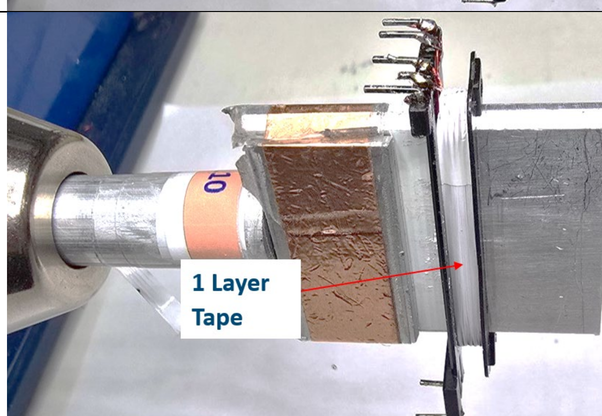
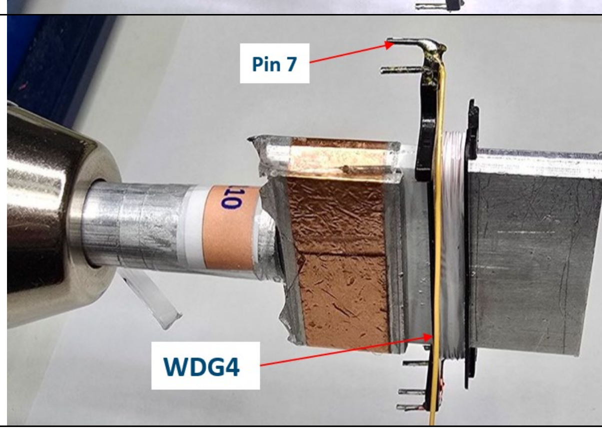
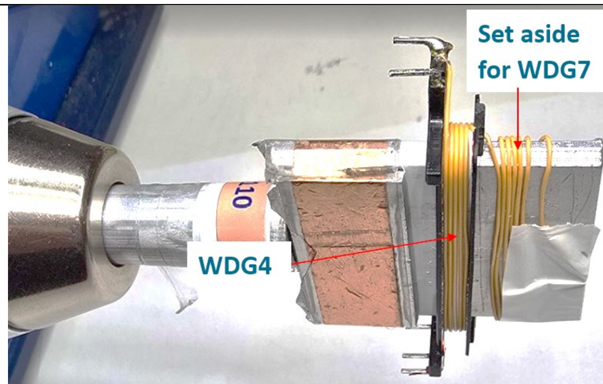
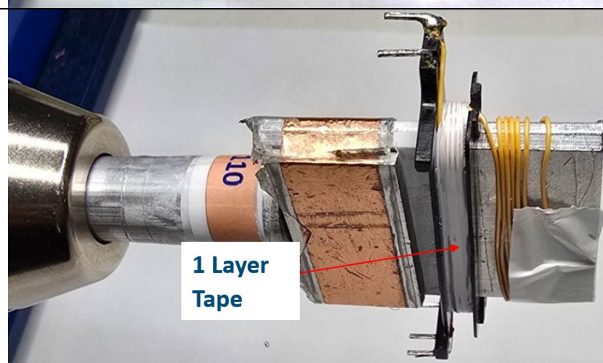
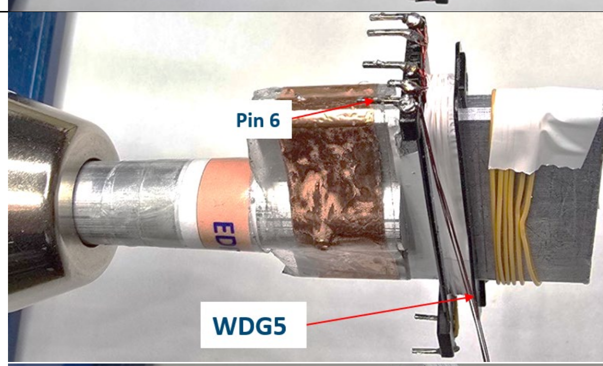
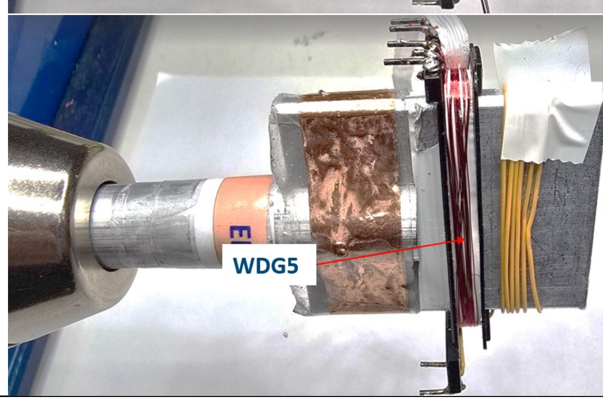


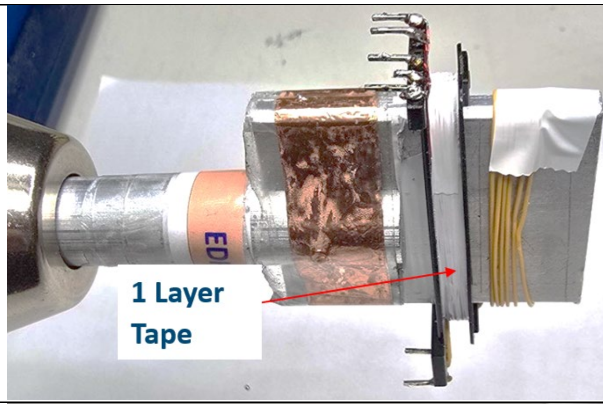
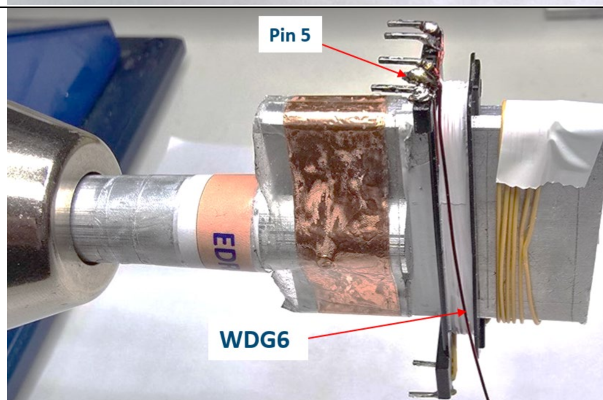
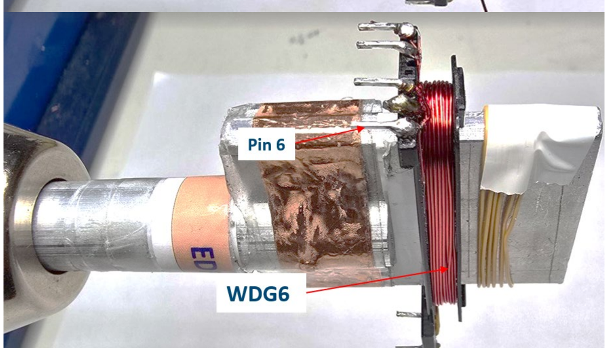
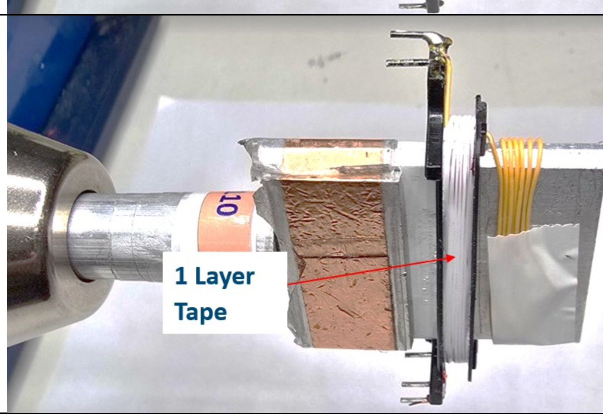
Figure 8 – Transformer Build Diagram.

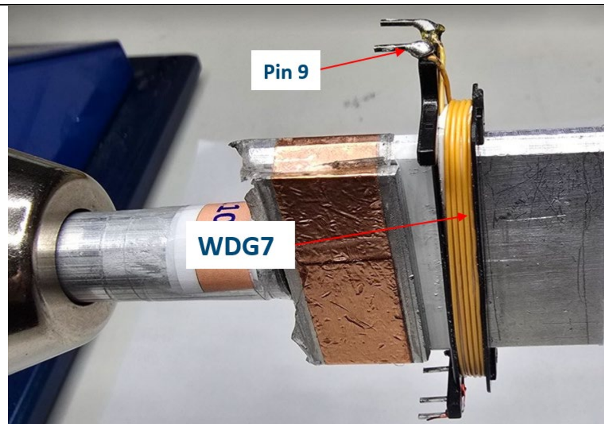
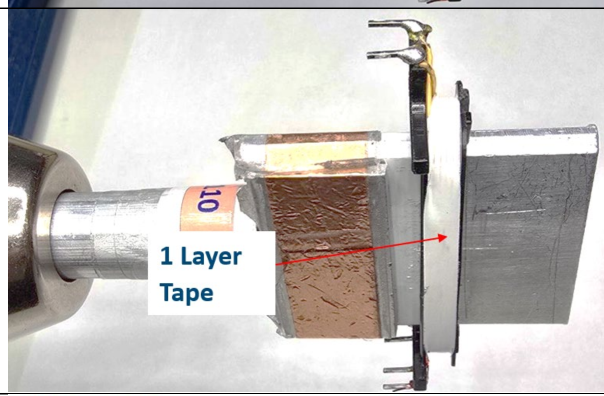
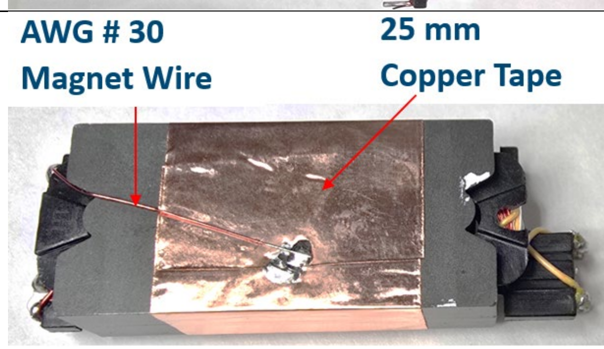
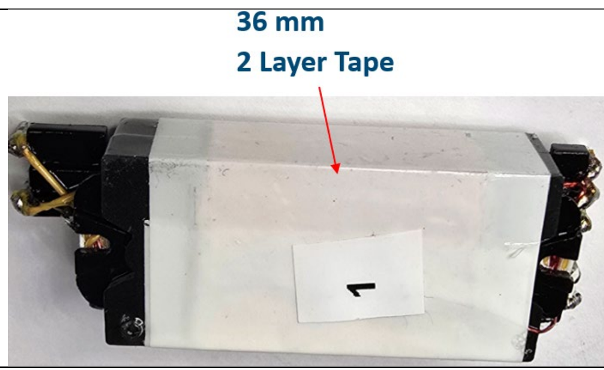
8.5 Winding Illustrations

EDR4110 Vertical Bobbin		Bobbin terminal pin assignments
WDG1 1st Primary		The winding direction and spindle rotation are indicated in the figure on the left. **WDG1:** Using bifilar AWG #26 magnet wire (Item [3]), start at pin 2 and wind 14 turns from left to right, evenly distributed in two layers. Terminate the finish leads at pin 5.
Insulation Tape		Apply one layer of tape insulation (Item [10]) over the winding.

WDG2 (Pri. Bias) **&** **WDG3** (Shield 1)	 	**WDG2 & WDG3:** Using bifilar AWG #35 magnet wire (Item [4]), start Winding 2 (WDG2) at pin 2 and Winding 3 (WDG3) at pin 1. Wind 4 turns of both wires together from left to right, distributed evenly. Terminate the WDG2 finish lead at pin 1 and leave the WDG3 finish lead cut and floating.
Insulation Tape		Apply one layer of tape insulation (Item [10]) over the winding.
WDG4 1st Secondary		**WDG4:** Position the bobbin with secondary pins (7–9) oriented at the top. Using AWG #25 triple-insulated wire (Item [7]), start WDG4 at pin 7 and wind 5 turns from left to right, distributed evenly.

		Place the finish lead of WDG4 into the secondary-side bobbin slot, leaving sufficient wire length reserved for WDG7 (5 turns) on the right.
Insulation Tape		Apply one layer of tape insulation (Item [10]) over the winding.
WDG5 Shield 2	 	**WDG5:** Position the bobbin back with primary pins (1–6) oriented at the top. Using trifilar AWG #35 magnet wire (Item [4]), start at pin 6 and wind 6 turns from left to right, distributed evenly. Cut and leave the finish leads floating.

Insulation Tape		Apply one layer of tape insulation (Item [10]) over the winding.
WDG6 2^{nd} Primary	 	**WDG6:** Using bifilar AWG #26 magnet wire (Item [3]), start at pin 5 and wind 14 turns from left to right, evenly distributed in two layers. Terminate the finish leads at pin 6.
Insulation Tape		Apply one layer of tape insulation (Item [10]) over the winding.

WDG7 2nd Secondary		**WDG7:** Position the bobbin one last time with secondary pins (7–9) oriented at the top. Using the AWG #25 triple-insulated wire (Item [7]) previously set aside for WDG7, wind 5 turns from right to left, distributed evenly. Terminate the finish lead at pin 9.
Insulation Tape		Apply one layer of tape insulation (Item [10]) over the winding
Core Copper Shielding		Use one pair of EDR4110 ferrite cores (Item [1]) and introduce a center-leg gap on one core to achieve the required inductance, measured between pins 4 and 6. Apply 3M copper tape (Item [11]) around the core and connect it to pin 1 using AWG #30 magnet wire (Item [6]), as shown in the figure.
Core Fixing		Wrap two layers of 36 mm polyester tape (Item [8]) to secure the cores to the bobbin. Ensure there is no excessive core overlap so that the gapped inductance value is maintained.

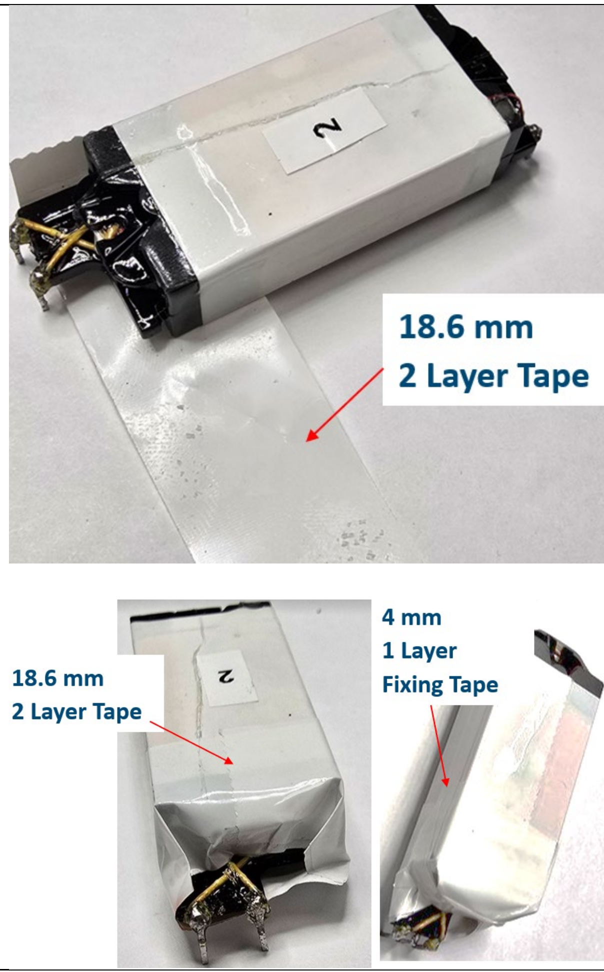
Secondary Safety Insulation Tape		Starting near the secondary terminals, wrap two layers of 18.6 mm-wide 3M polyester tape (Item [9]) to cover the exposed transformer core on the secondary side. Apply an additional 4 mm fixing tape (Item [10]) around the transformer, as shown in the figure, to secure the secondary safety-isolation tape. **Finish:** Dip-varnish the completed transformer in Dolph BC-359 (Item [12]) for 1 hour.

Table 7 – Transformer Winding Illustrations.

9 SVF Inductor Specification

9.1 Electrical Diagram

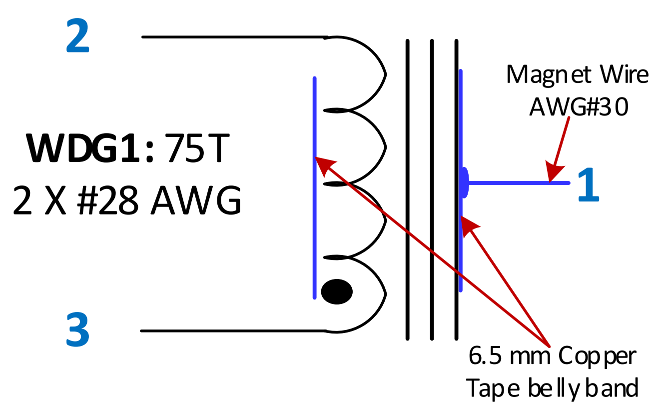


Figure 9 – SVF Inductor Electrical Diagram.

9.2 Electrical Specification

Parameter	Condition	Spec.
Nominal Primary Inductance	Measured at 1 V_{PK-PK}, 100 kHz switching frequency, between pin 2 and 3.	540 µH ±5%

Table 8 – SVF Inductor Electrical Specification.

9.3 Materials

Item	Description
[1]	Core: EPC17
[2]	Bobbin: EPC17, Horizontal, 10 pins: 25-00976-00
[3]	Magnet Wire: #28 AWG
[4]	Magnet Wire: #30 AWG
[5]	Tape: 6 mm, 3M 13450-F, Polyester Film
[6]	Tape: 9 mm, 3M 13450-F, Polyester Film
[7]	Tape: 9.5 mm, 3M 13450-F, Polyester Film
[8]	6.5 mm, 3M 1194 Copper Foil Tape
[9]	Varnish: Dolph BC-359

Table 9 – SVF Inductor Materials.

9.4 Build Diagram

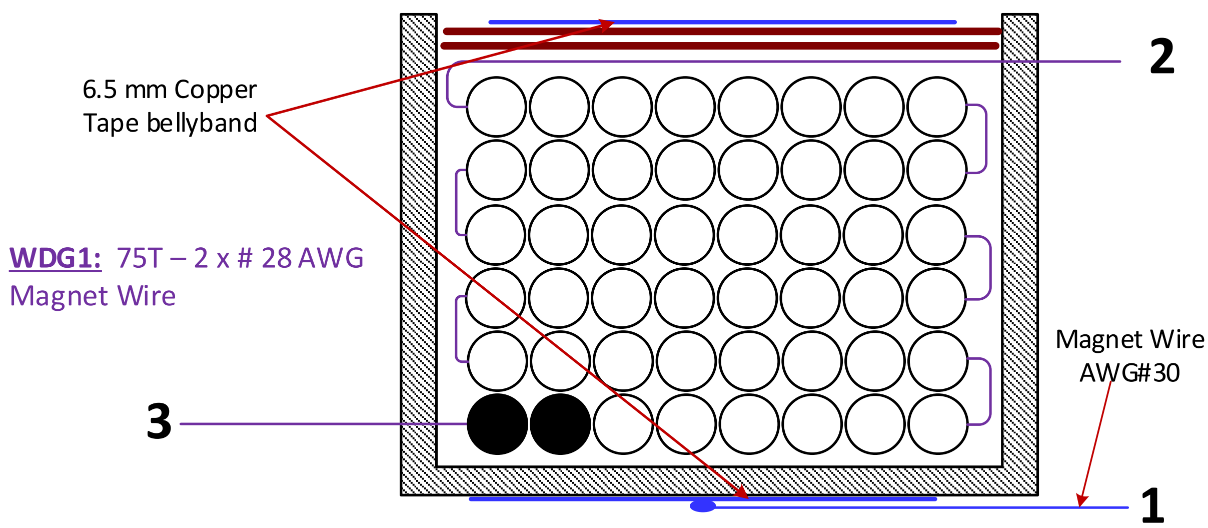
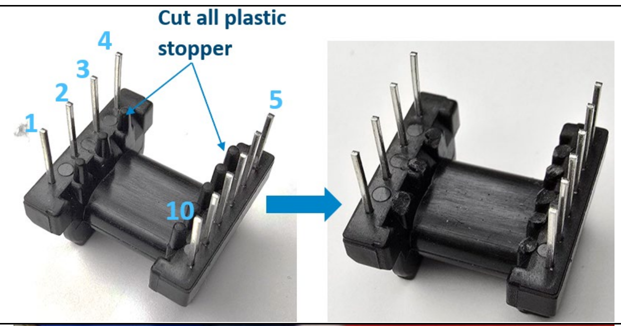
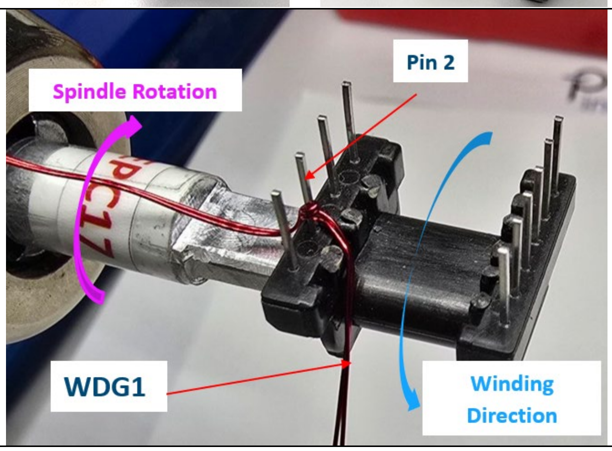


Figure 10 – SVF Inductor Build Diagram.

9.5 Winding Illustrations

Core Fixing		Cut all plastic wire stopper to reduce the height of the inductor.
WDG1 and Insulation Tape		**WDG1:** Using bifilar AWG #28 magnet wire (Item [3]), start at pin 2 and wind 75 turns evenly distributed across the bobbin, then terminate the finish lead at pin 3. Apply one layer of 9.5 mm insulation tape insulation (Item [7]) over the winding

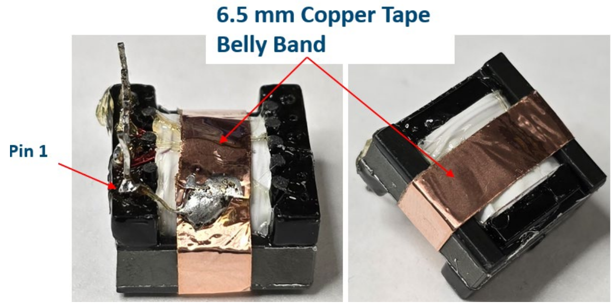
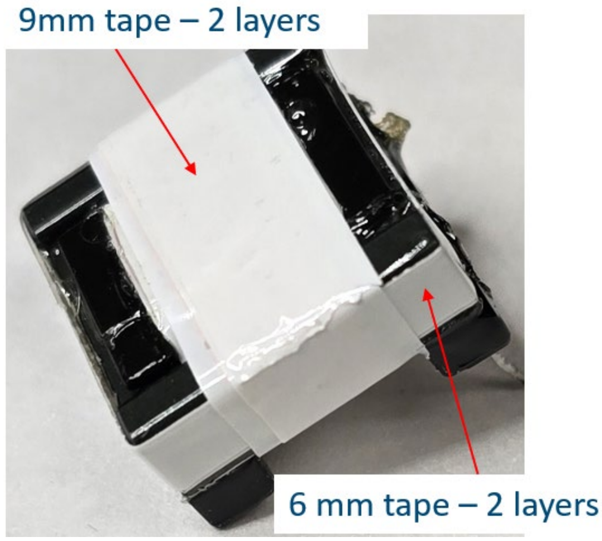
Copper Belly Band		Use one pair of EPC17 ferrite cores (Item [1]) and introduce a center-leg gap on one core to achieve the required inductance, measured between pins 2 and 3. Before applying the core-fixing tape, wrap the 6.5 mm copper tape belly band around the inductor as shown in the figure. Connect the belly band to pin 1 using AWG #30 magnet wire (Item [4]).
Core Fixing Tape and Insulation Tape		Apply two layers of 6 mm fixing tape (Item [5]) tightly around the core, ensuring no overlap or misalignment between the core halves so that the designed gap spacing — and thus the gapped inductance — is maintained. Apply 2 layer of 9 mm insulation tape (Item [6]) as shown in the figure. **Finish:** Dip-varnish the completed transformer in Dolph BC-359 (Item [9]) for 1 hour.

Table 10 – SVF Inductor Winding Illustrations.

10 Performance Data

Performance data collected at room temperature, with voltages taken on the input and output terminals of the PCB unless noted otherwise.

10.1 Efficiency vs Input Voltage

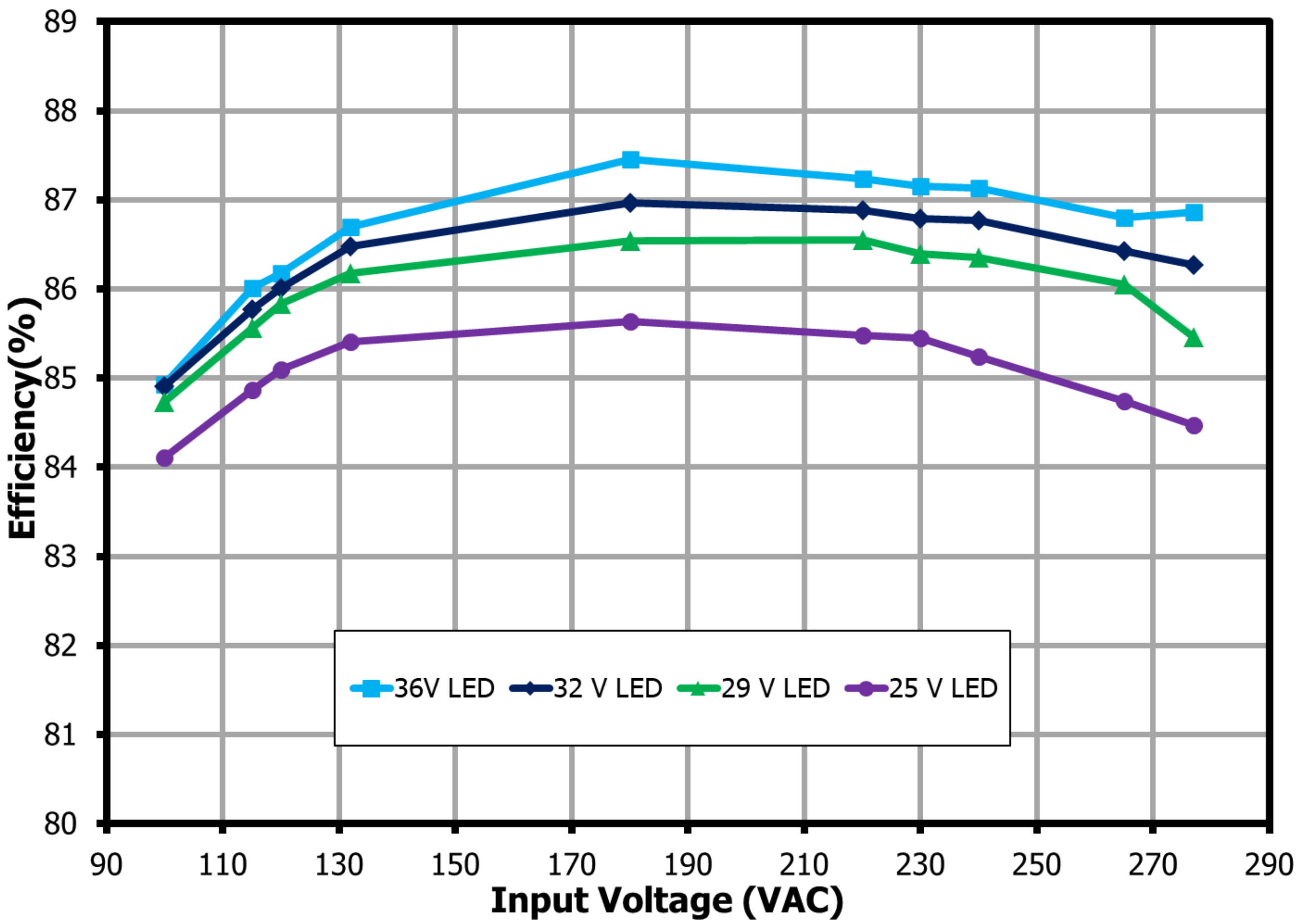


Figure 11 – Efficiency vs. Input Line Voltage at Different LED Voltage Load.

10.2 Power Factor vs Input Line Voltage

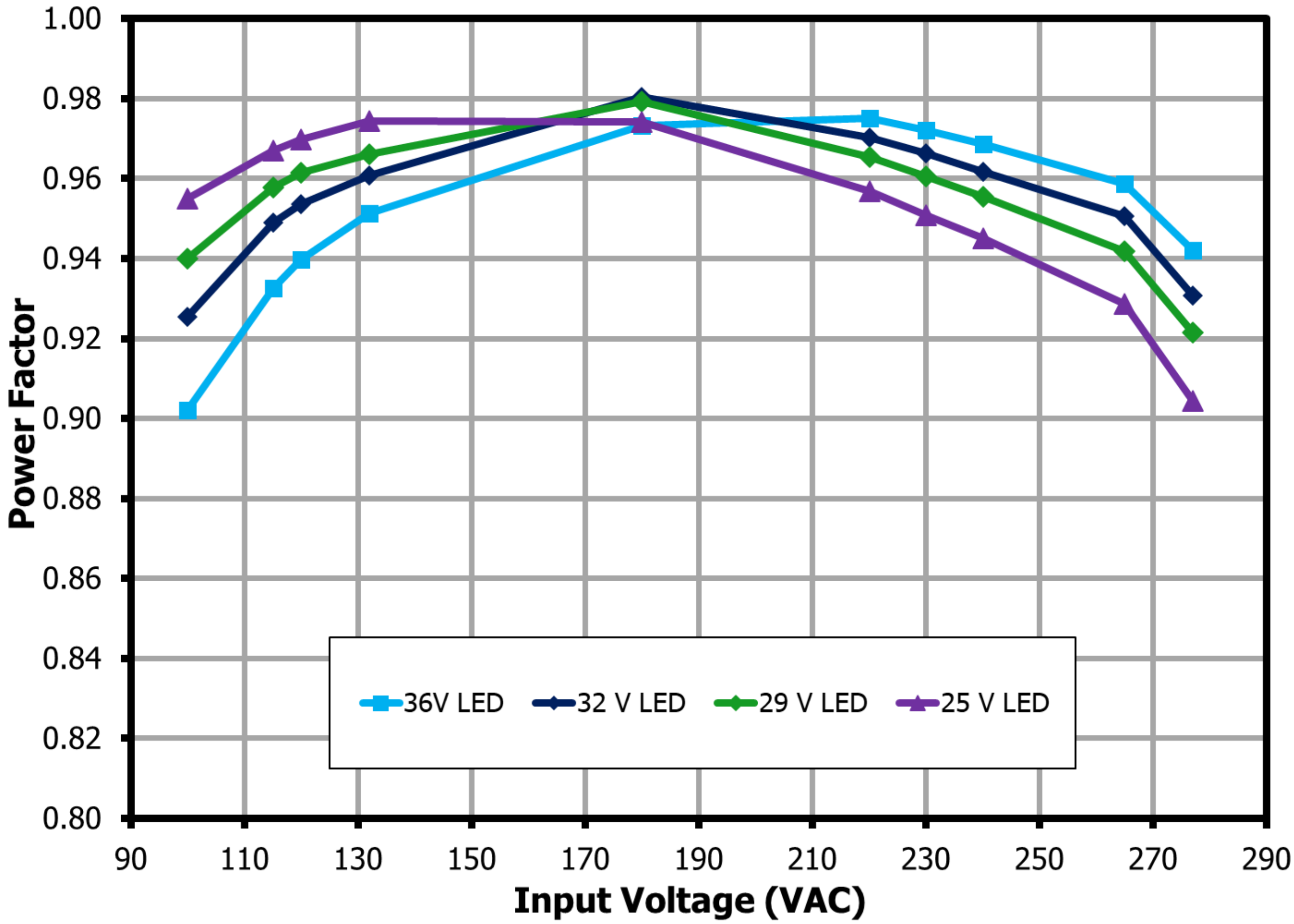


Figure 12 – Power Factor vs Input Line at Different LED Voltage Load.

10.3 Total Harmonic Distortion (THD) vs Input Line Voltage

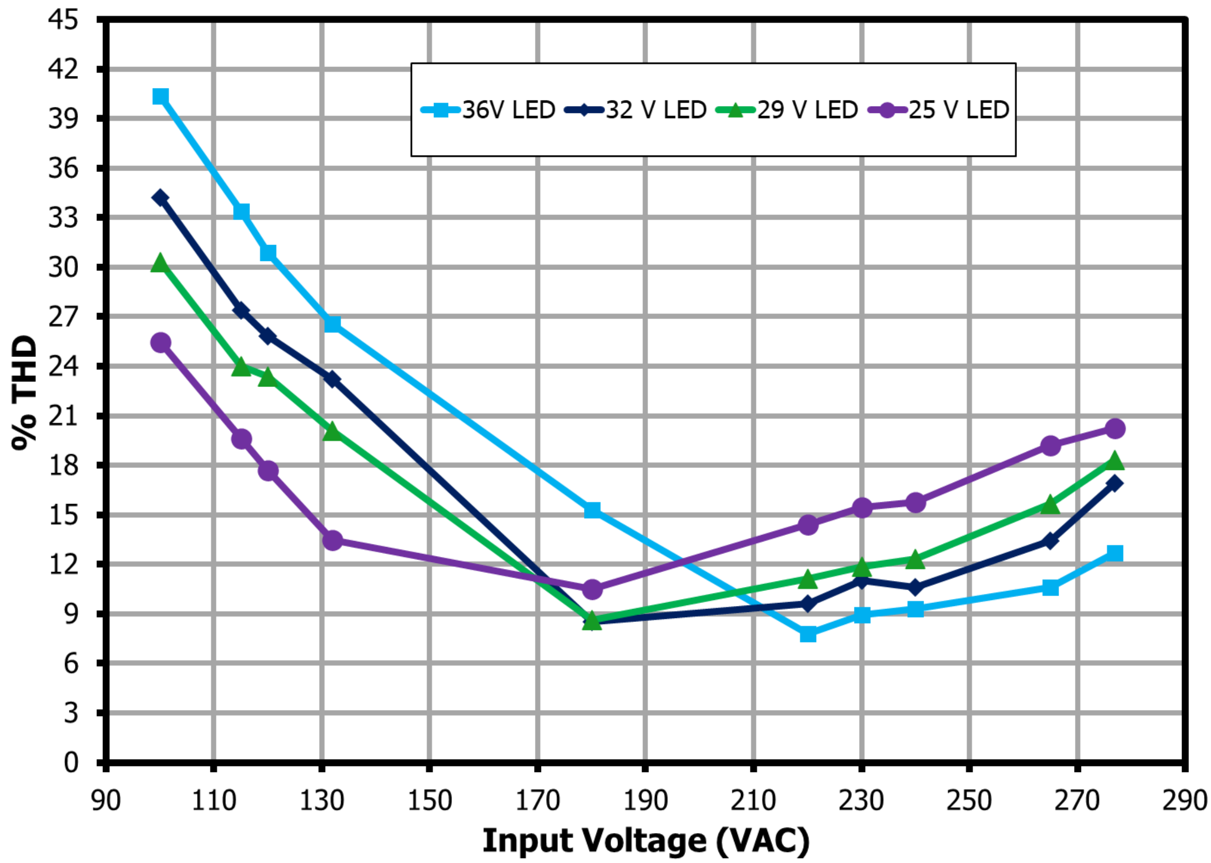


Figure 13 – THD vs Input Line at Different LED Voltage Load.

10.4 Output Current Regulation vs Input Line

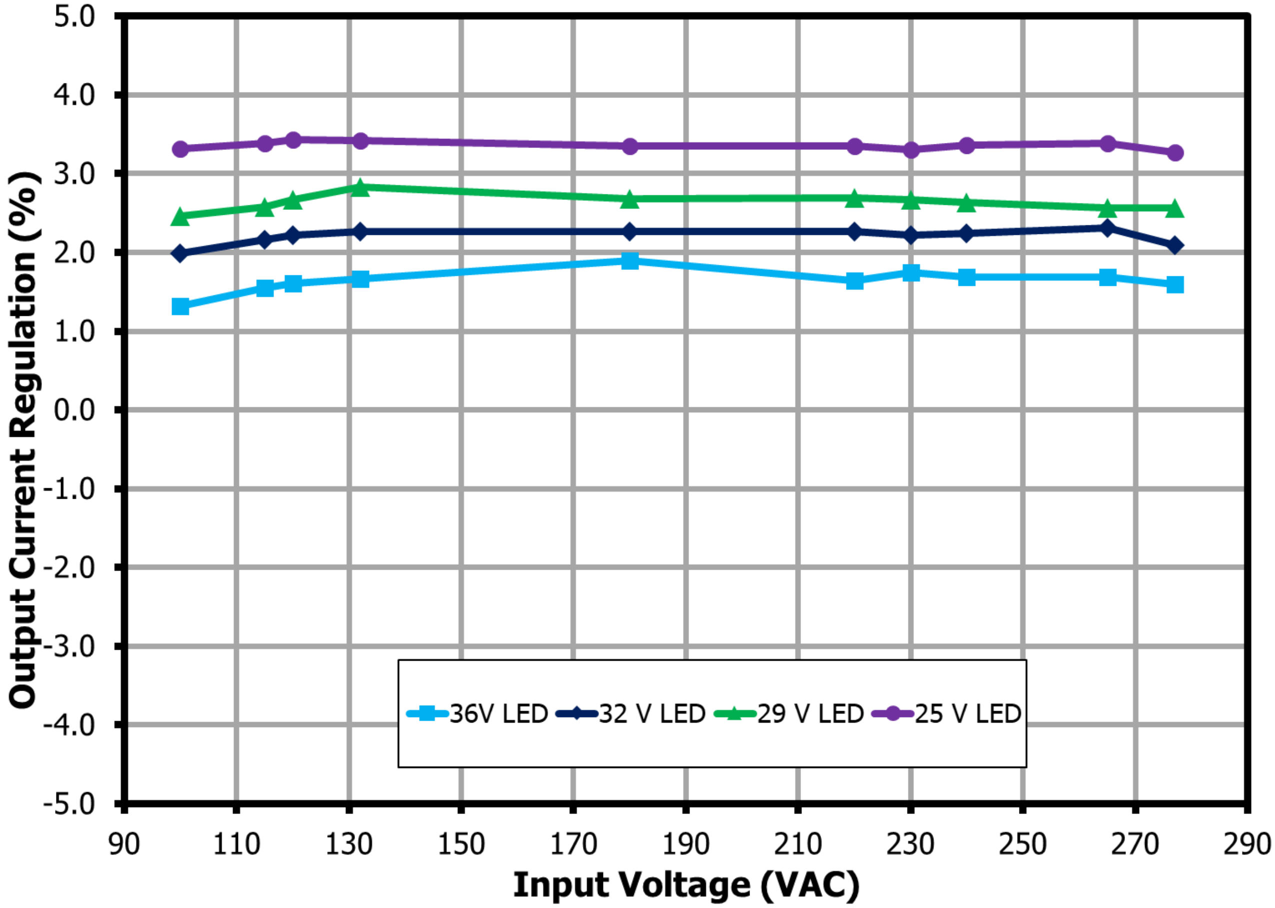


Figure 14 – Output Current Regulation vs Input Line at Different LED Voltage Load.

10.5 Electrical Test Data

	Input		**Input Measurement**					**Output Measurement**				
	VAC (RMS)	**Freq (Hz)**	**V_{IN} (RMS)**	**I_{IN} (mA)**	**P_{IN} (W)**	**PF**	**% THD**	**VO (V)**	**IO (A)**	**PO (W)**	**% I Reg**	**Eff**
36 V LED	100	60	100	476	42.9	0.90	40.4	36.0	1.01	36.5	1.32	84.9
	115	60	115	396	42.5	0.93	33.4	36.0	1.02	36.5	1.55	86.0
	120	60	120	376	42.4	0.94	30.9	36.0	1.02	36.6	1.61	86.2
	132	60	132	336	42.2	0.95	26.6	36.0	1.02	36.6	1.67	86.7
	180	50	180	239	41.9	0.97	15.3	36.0	1.02	36.7	1.89	87.5
	220	50	220	195	41.9	0.98	7.81	36.0	1.02	36.6	1.64	87.2
	230	50	230	188	42.0	0.97	8.94	36.0	1.02	36.6	1.75	87.2
	240	50	240	181	42.0	0.97	9.29	36.0	1.02	36.6	1.69	87.1
	265	50	265	166	42.1	0.96	10.6	36.0	1.02	36.6	1.69	86.8
	277	60	277	162	42.1	0.94	12.7	36.0	1.02	36.6	1.60	86.9
	Input		**Input Measurement**					**Output Measurement**				
	VAC (RMS)	**Freq (Hz)**	**V_{IN} (RMS)**	**I_{IN} (mA)**	**P_{IN} (W)**	**PF**	**% THD**	**VO (V)**	**IO (A)**	**PO (W)**	**% I Reg**	**Eff**
32 V LED	100	60	100	413	38.2	0.93	34.2	31.8	1.02	32.4	1.99	84.9
	115	60	115	347	37.9	0.95	27.4	31.8	1.02	32.5	2.16	85.8
	120	60	120	331	37.8	0.95	25.8	31.8	1.02	32.5	2.22	86.0
	132	60	132	297	37.6	0.96	23.2	31.8	1.02	32.5	2.27	86.5
	180	50	180	212	37.4	0.98	8.5	31.8	1.02	32.5	2.26	87.0
	220	50	220	175	37.5	0.97	9.63	31.8	1.02	32.5	2.27	86.9
	230	50	230	169	37.5	0.97	11.0	31.8	1.02	32.5	2.22	86.8
	240	50	240	162	37.5	0.96	10.6	31.8	1.02	32.5	2.24	86.8
	265	50	265	150	37.7	0.95	13.4	31.8	1.02	32.6	2.31	86.4
	277	60	277	146	37.7	0.93	16.9	31.8	1.02	32.5	2.09	86.3
	Input		**Input Measurement**					**Output Measurement**				
	VAC (RMS)	**Freq (Hz)**	**V_{IN} (RMS)**	**I_{IN} (mA)**	**P_{IN} (W)**	**PF**	**% THD**	**VO (V)**	**IO (A)**	**PO (W)**	**% I Reg**	**Eff**
29 V LED	100	60	100	373	35.0	0.94	30.3	29.0	1.02	29.7	2.46	84.7
	115	60	115	315	34.7	0.96	24.0	29.0	1.03	29.7	2.58	85.6
	120	60	120	301	34.7	0.96	23.4	29.0	1.03	29.7	2.67	85.8
	132	60	132	271	34.6	0.97	20.1	29.0	1.03	29.8	2.83	86.2
	180	50	180	195	34.4	0.98	8.6	29.0	1.03	29.8	2.68	86.5
	220	50	220	162	34.4	0.97	11.1	29.0	1.03	29.8	2.69	86.6
	230	50	230	156	34.4	0.96	11.8	29.0	1.03	29.7	2.67	86.4
	240	50	240	150	34.4	0.96	12.3	29.0	1.03	29.7	2.63	86.4
	265	50	265	138	34.5	0.94	15.7	29.0	1.03	29.7	2.57	86.1
	277	60	277	136	34.8	0.92	18.3	29.0	1.03	29.7	2.56	85.5
	Input		**Input Measurement**					**Output Measurement**				
	VAC (RMS)	**Freq (Hz)**	**V_{IN} (RMS)**	**I_{IN} (mA)**	**P_{IN} (W)**	**PF**	**% THD**	**VO (V)**	**IO (A)**	**PO (W)**	**% I Reg**	**Eff**
25 V LED	100	60	100	320	30.5	0.95	25.5	24.9	1.03	25.7	3.32	84.1
	115	60	115	272	30.3	0.97	19.6	24.9	1.03	25.7	3.39	84.9
	120	60	120	260	30.2	0.97	17.7	24.9	1.03	25.7	3.43	85.1
	132	60	132	234	30.1	0.97	13.5	24.9	1.03	25.7	3.42	85.4
	180	50	180	171	30.0	0.97	10.5	24.9	1.03	25.7	3.35	85.6
	220	50	220	143	30.1	0.96	14.4	24.9	1.03	25.7	3.35	85.5
	230	50	230	138	30.1	0.95	15.4	24.9	1.03	25.7	3.31	85.4
	240	50	240	133	30.1	0.95	15.8	24.9	1.03	25.7	3.36	85.2
	265	50	265	123	30.3	0.93	19.2	24.9	1.03	25.7	3.39	84.7
	277	60	277	121	30.4	0.90	20.3	24.9	1.03	25.7	3.27	84.5

Table 11 – Electrical Test Data.

10.6 Individual Harmonics Content

Individual current harmonics are below the Class C limit.

Set-up: Open frame unit.
Load: LED Load
V_{IN}: 230 V 60 Hz.
Ambient Temperature: 25 °C.
Soak Time: 5 minutes.

10.6.1 Individual Harmonics Content at 36 V LED

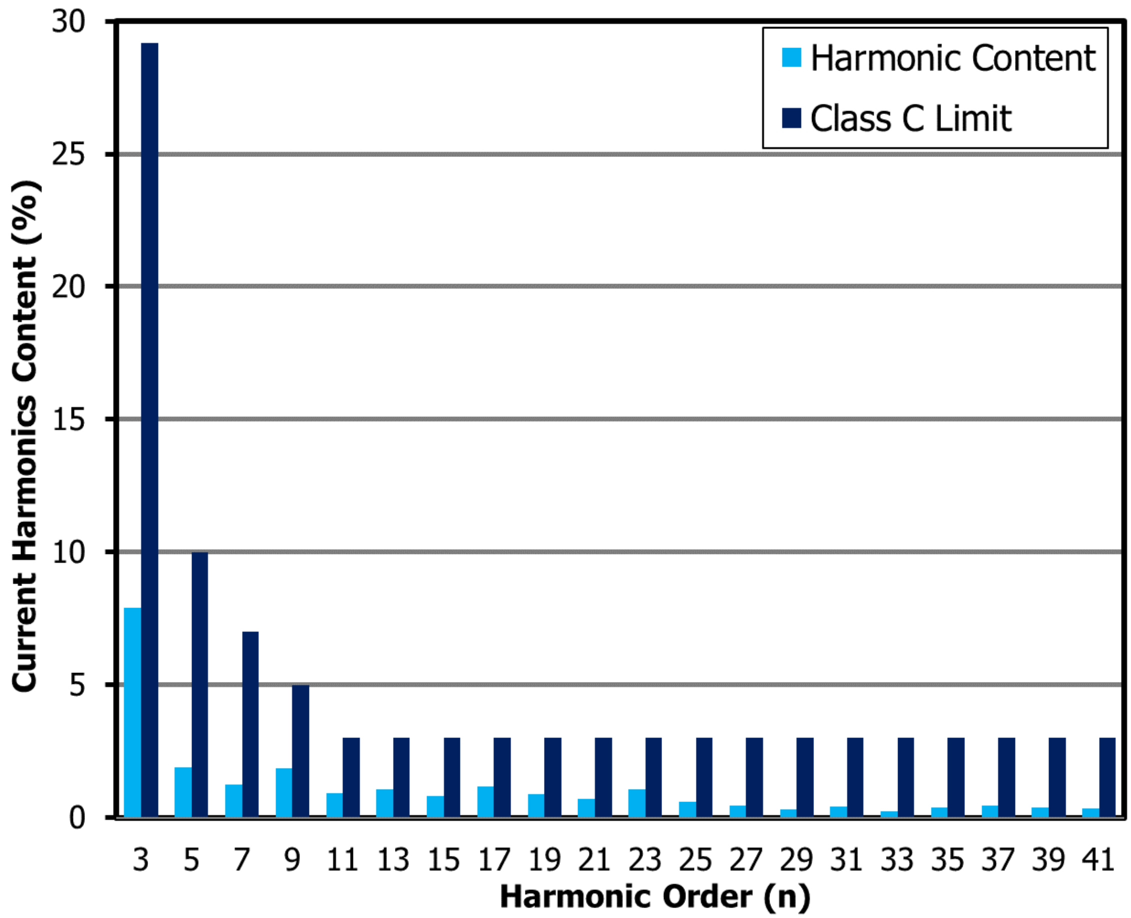


Figure 15 – Odd Harmonics Content at 36 V LED Load, 230 VAC 60 Hz.

10.6.2 Individual Harmonics Content at 32 V LED

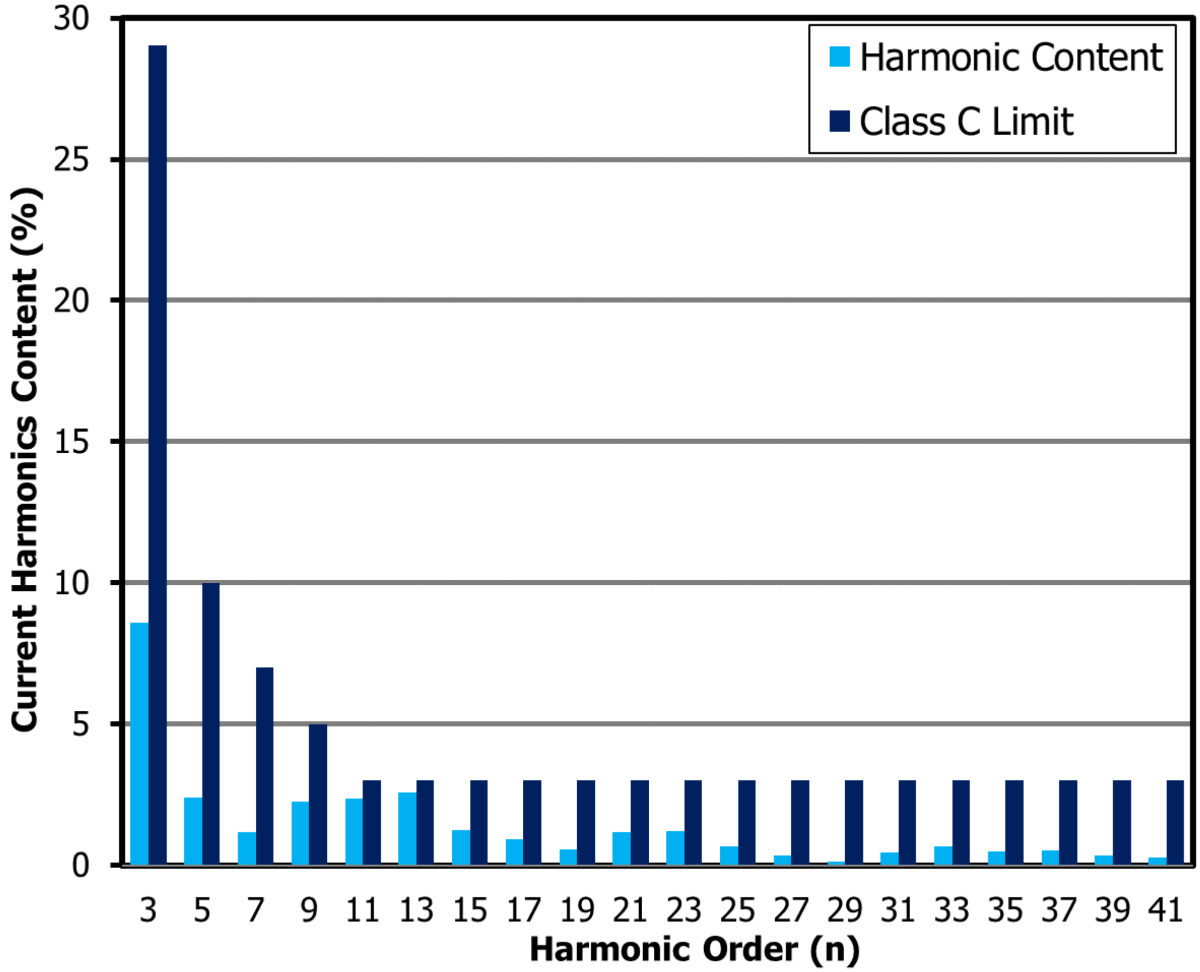


Figure 16 – Odd Harmonics Content at 32 V LED Load, 230 VAC 60 Hz.

10.6.3 Individual Harmonics Content at 29 V LED

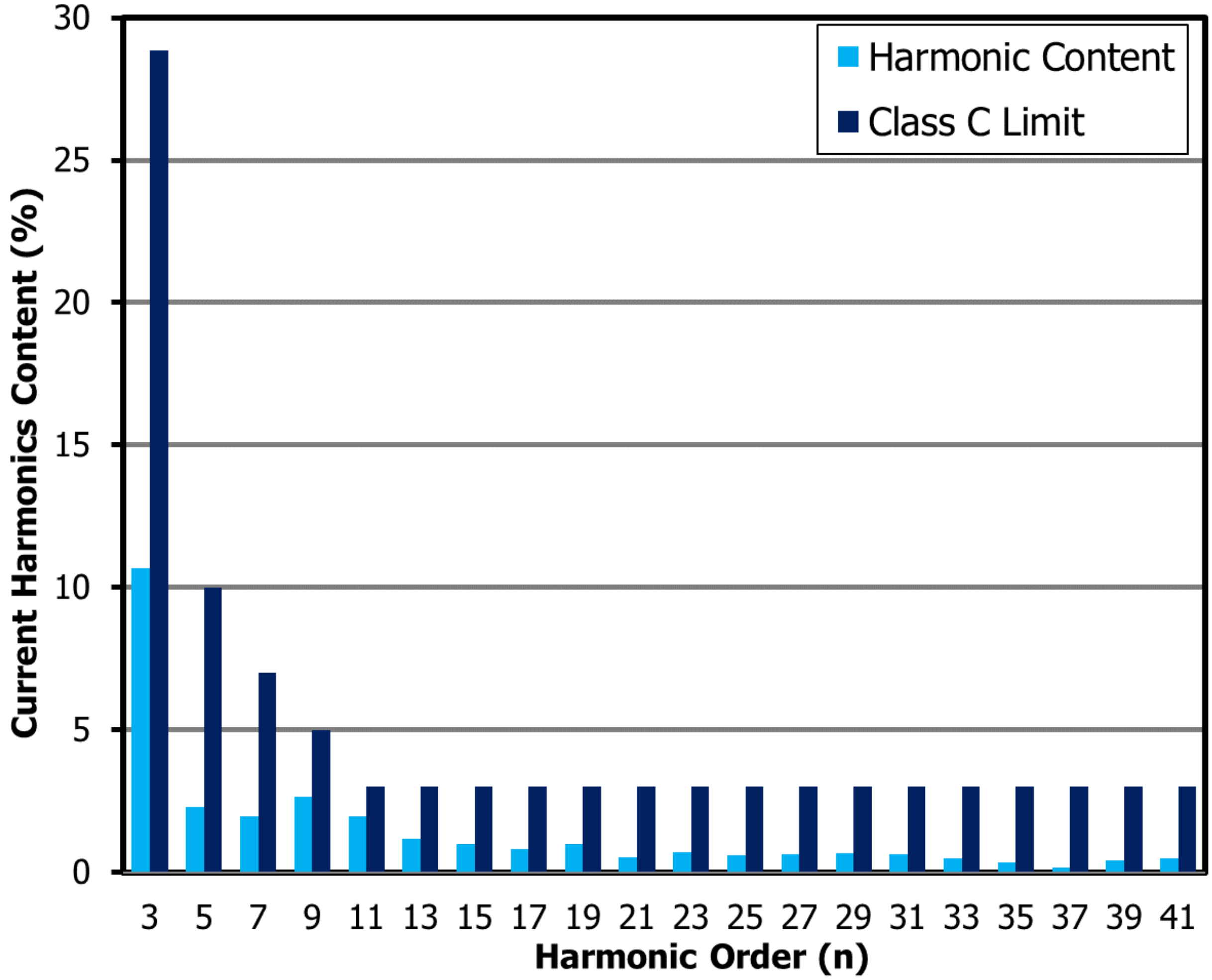


Figure 17 – Odd Harmonics Content at 29 V LED Load, 230 VAC 60 Hz.

10.6.4 Individual Harmonics Content at 25 V LED

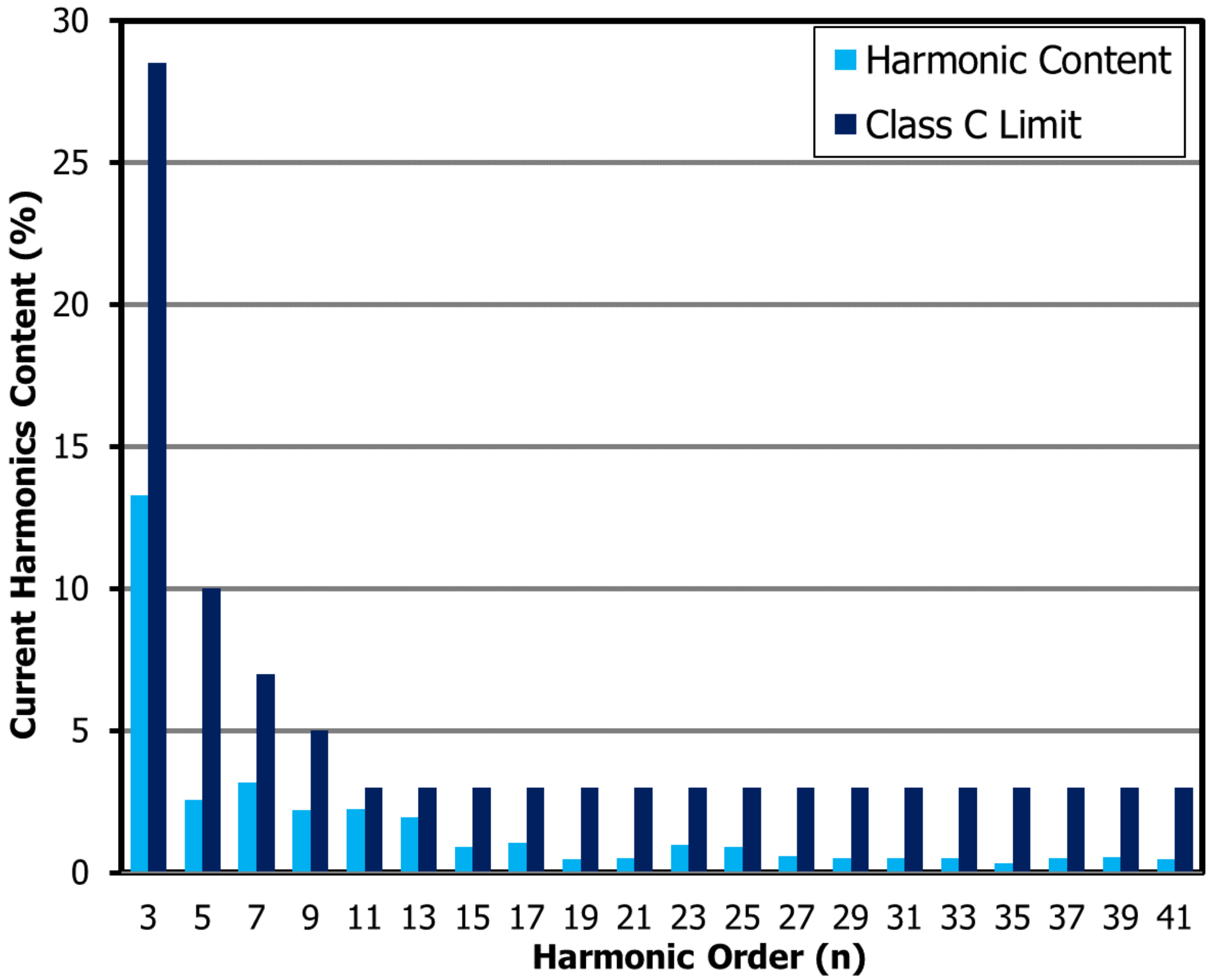


Figure 18 – Odd Harmonics Content at 25 V LED Load, 230 VAC 60 Hz.

10.7 Output CVCC Characteristic Curve

Note: This power supply unit (PSU) can operate in constant-current mode down to 5 V; however, flicker-free operation is specified only within the 36 V to 25 V output voltage range.

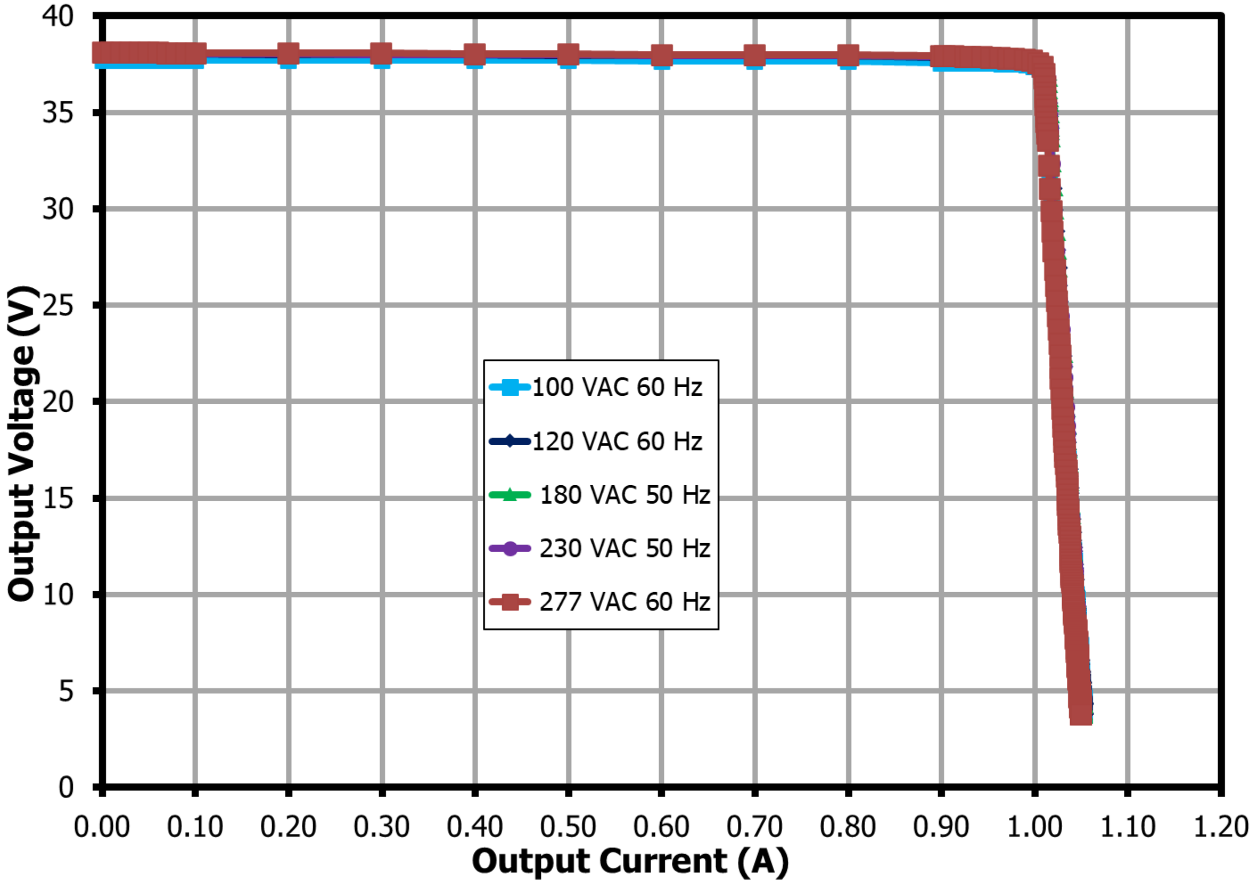


Figure 19 – CVCC Curve at Different Input Line.

10.8 Flicker Performance

% Flicker data was measured through output ripple current using the following formula.

$$\% \, Flicker = \frac{I_{max} - I_{min}}{I_{max} + I_{min}} \, x \, 100 \, \%$$

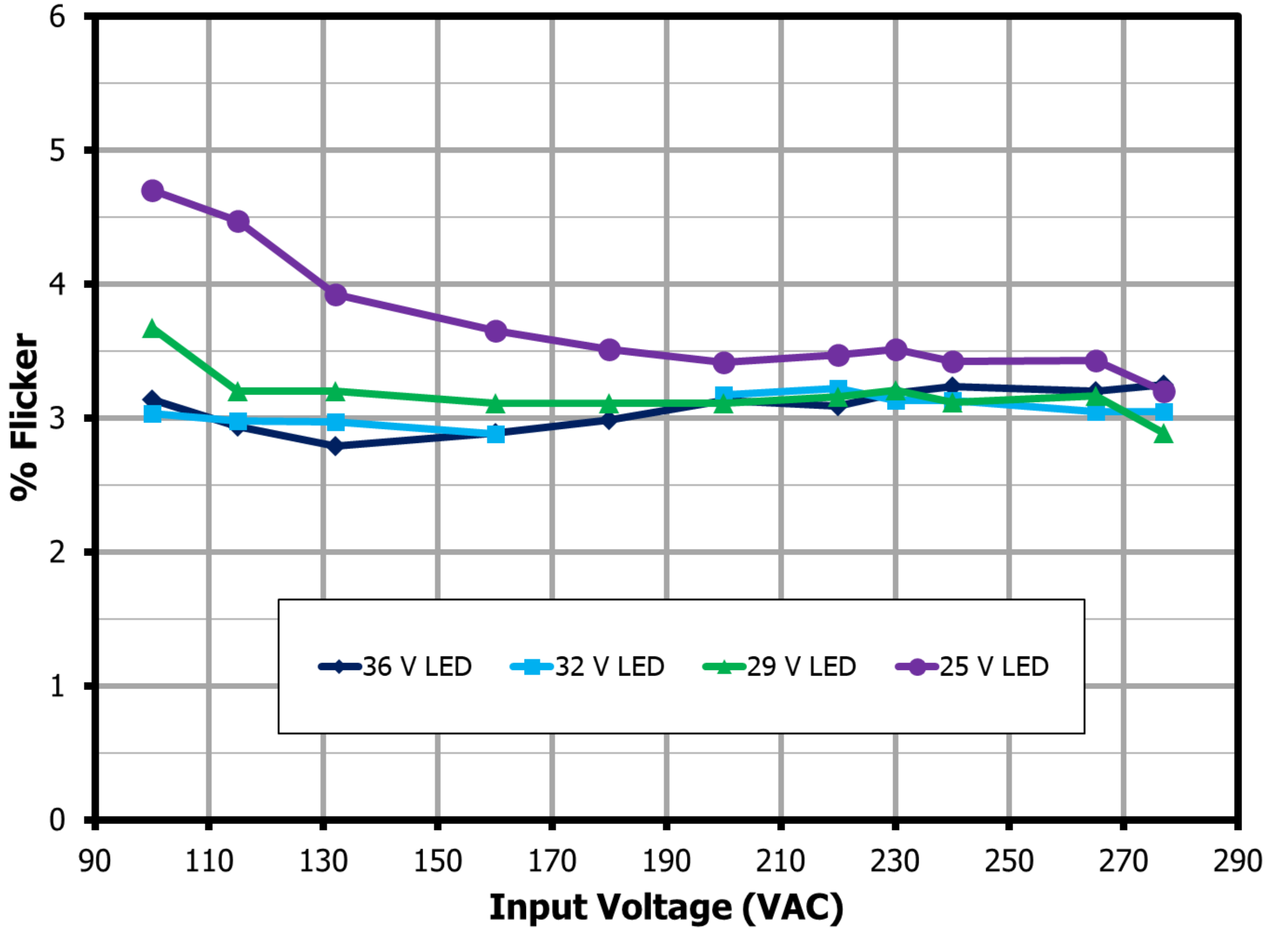


Figure 20 – % Flicker vs Input line at Different LED Voltage Load.

10.9 Ripple Current

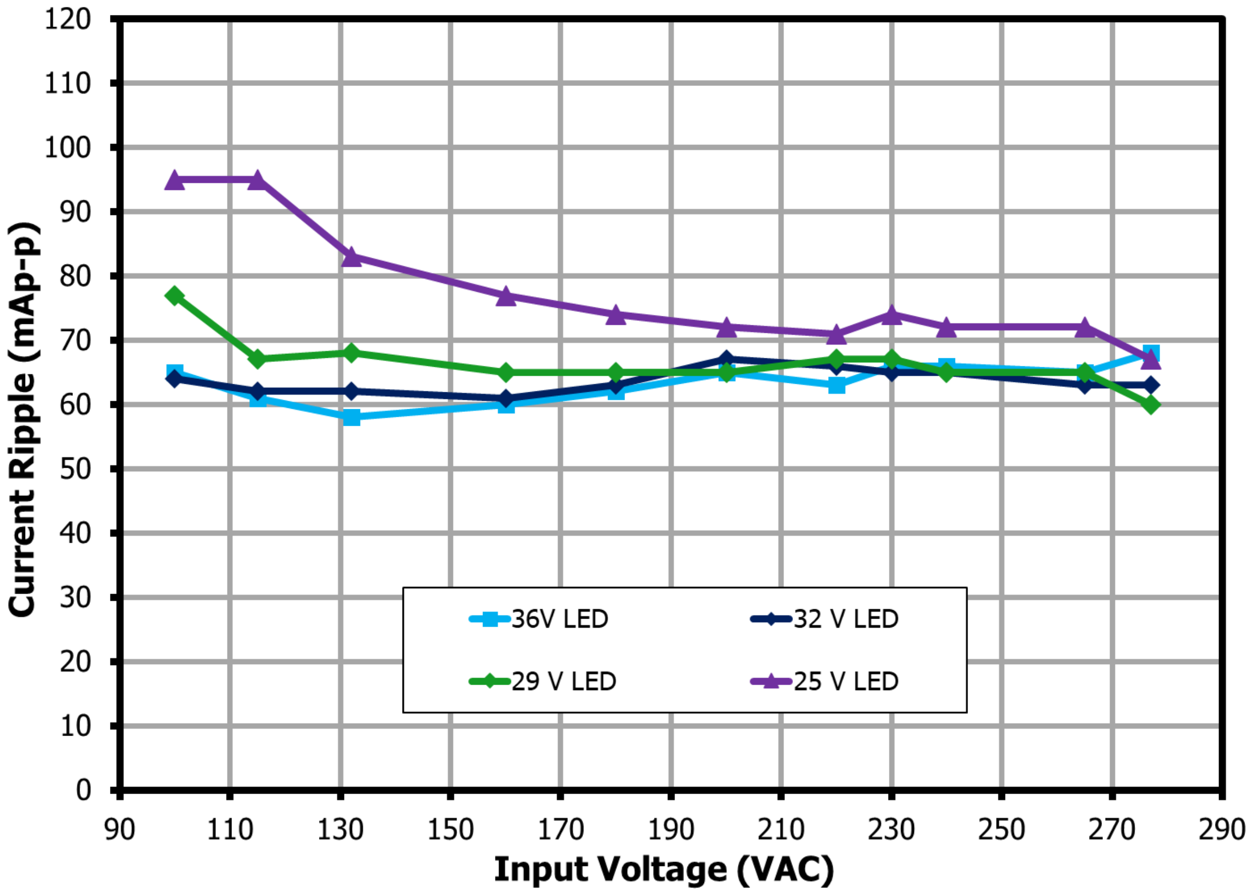


Figure 21 – Ripple Current at Different LED Voltage Load.

10.10 Thermal Test

10.10.1 Thermal Test at Room Ambient Temperature

The open-frame PSU was burned in for over one hour at room ambient temperature (25 °C) before capturing the thermal scan using a FLIR camera.

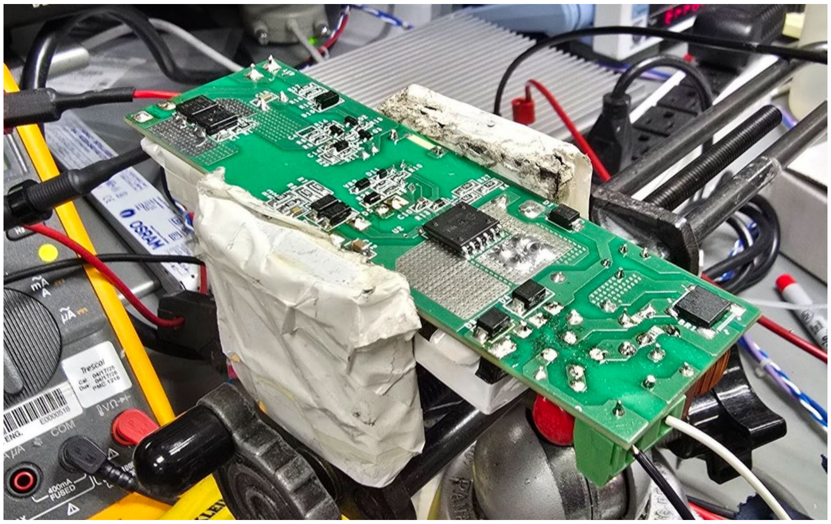


Figure 22 – Room Temperature Thermal Scan Test Set-up.

10.10.1.1 Thermal Scan Test Data (Summary)

The following thermal scan data shows that the heating components remain well below their maximum temperature ratings across the entire input voltage range.

Reference Designation	Part Description	Thermal Data °C			
		100 VAC	120 VAC	230 VAC	277 VAC
D3	Output Diode1	69.3	69	69.1	70.5
D5	Output Diode2	69.1	68.7	69	70.4
U2	TNY5075K	81	73.3	66.4	69.5
D8	Snubber Diode 1	67.7	64.6	61.5	62.8
D7	Snubber Diode 2	68	65.2	62.1	62.8
D9	SVF Boost Diode 1	81.7	76	67	68.4
D4	SVF Boost Diode 2	78.6	72.5	63.3	64.5
BR1	Bridge Rectifier	76.9	68.2	52	50
T1- Wire	TRF Wire	67.4	66.4	67.2	69.4
T1-Core	TRF Core	61.8	61.2	62.8	64.2
L2	Diff Choke	74.5	63	52.9	53.9
T2	SVF Inductor	68.8	64	64.1	67.2

Table 12 – Room Temperature Thermal Scan Test Data.

10.10.1.2Thermal Scan at 100 VAC 36 V LED String

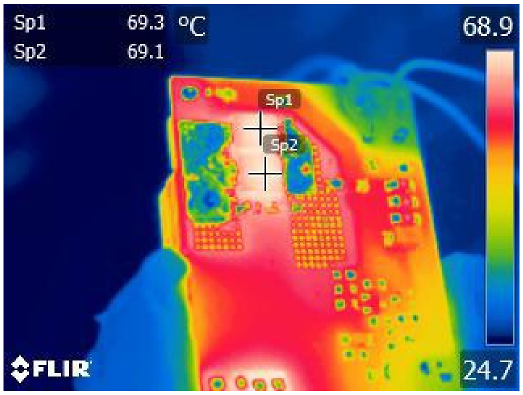


Figure 23 – Thermal Scan 100 V 36 V / 1 A
Sp1: D3-(Output Diode): 69.3 °C
Sp2: D5-(Output Diode): 69.1 °C

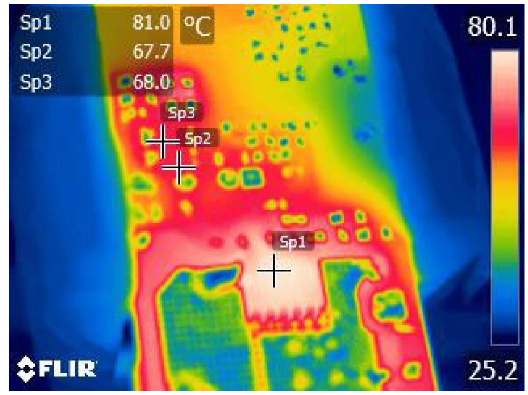


Figure 24 – Thermal Scan 100 V 36 V / 1 A
Sp1: U2-(TNY5075K): 81.0 °C
Sp2: D8-(Snubber Diode): 67.7 °C
Sp3: D7-(Snubber Diode): 68.0 °C

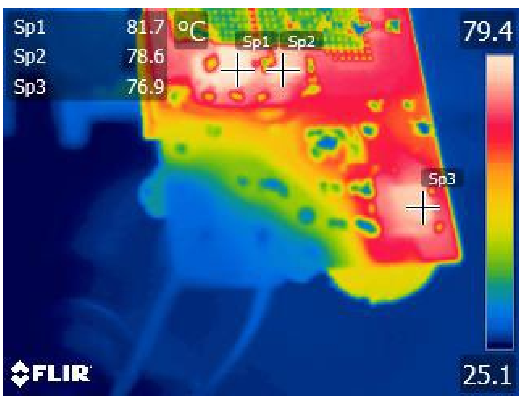


Figure 25 – Thermal Scan 100 V 36 V / 1 A
Sp1: D9-(SVF Boost Diode): 81.7 °C
Sp2: D4-(SVF Boost Diode): 78.6 °C
Sp3: BR1-(Bridge Diode): 76.9 °C

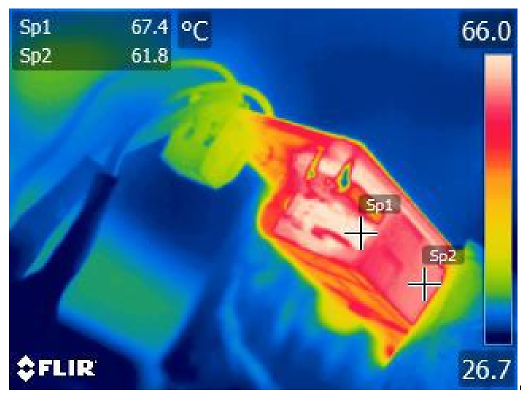


Figure 26 – Thermal Scan 100 V 36 V / 1 A
Sp1: T1-(Flyback TRF Wire): 67.4 °C
Sp2: T1-(Flyback TRF Core): 61.8 °C

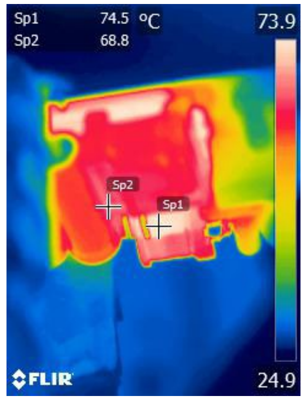


Figure 27 – Thermal Scan 100 V 36 V / 1 A
Sp1: L2-(Input Diff. Choke): 74.5 °C
Sp2: T2-(SVF Boost Inductor): 68.8 °C

10.10.1.3Thermal Scan at 120 VAC 36 V LED String

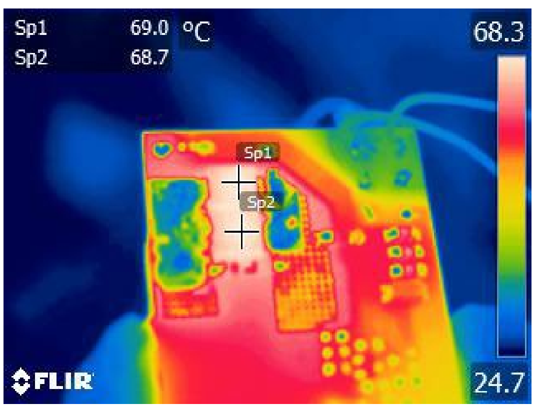


Figure 28 – Thermal Scan 120 V 36 V / 1 A
Sp1: D3-(Output Diode): 69.0 °C
Sp2: D5-(Output Diode): 68.7 °C

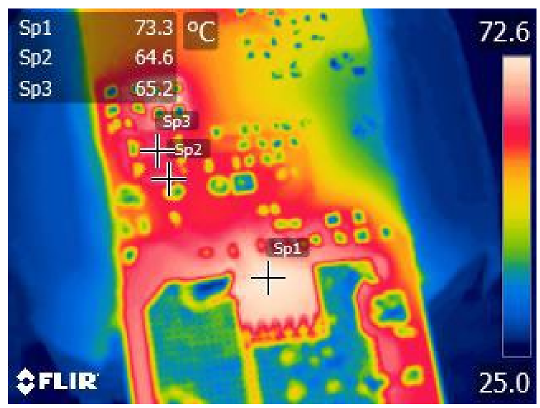


Figure 29 – Thermal Scan 120 V 36 V / 1 A
Sp1: U2-(TNY5075K): 73.3 °C
Sp2: D8-(Snubber Diode): 64.6 °C
Sp3: D7-(Snubber Diode): 65.2 °C

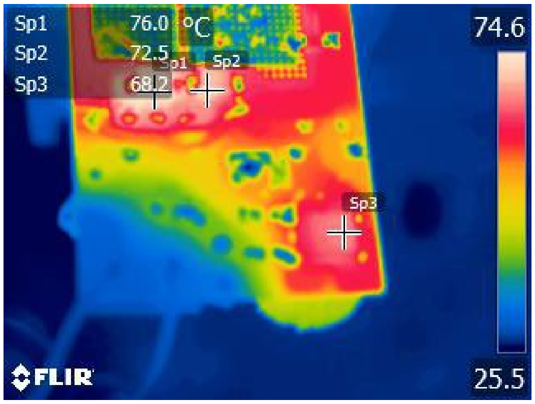


Figure 30 – Thermal Scan 120 V 36 V / 1 A
Sp1: D9-(SVF Boost Diode): 76.0 °C
Sp2: D4-(SVF Boost Diode): 72.5 °C
Sp3: BR1-(Bridge Diode): 68.2 °C

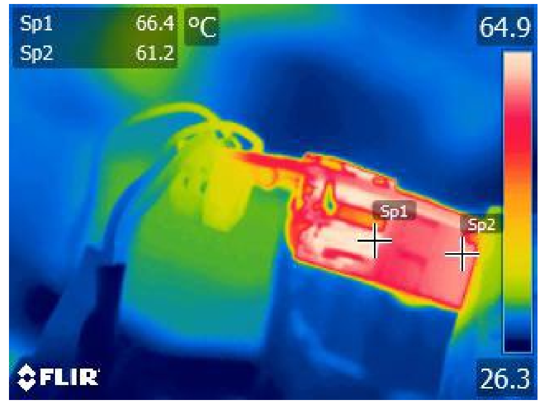


Figure 31 – Thermal Scan 120 V 36 V / 1 A
Sp1: T1-(Flyback TRF Wire): 66.4 °C
Sp2: T1-(Flyback TRF Core): 61.2 °C

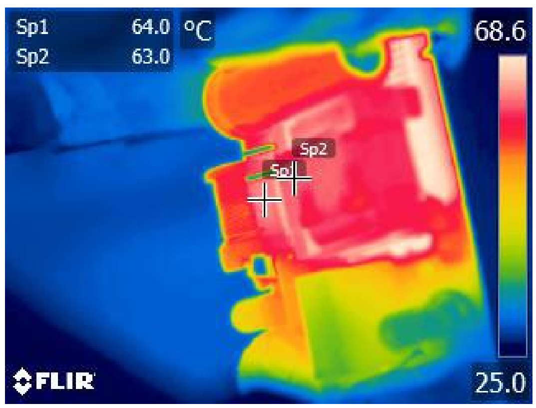


Figure 32 – Thermal Scan 120 V 36 V / 1 A
Sp1: L2-(Input Diff. Choke): 64 °C
Sp2: T2-(SVF Boost Inductor): 63 °C

10.10.1.4 Thermal Scan at 230 VAC 36 V LED String

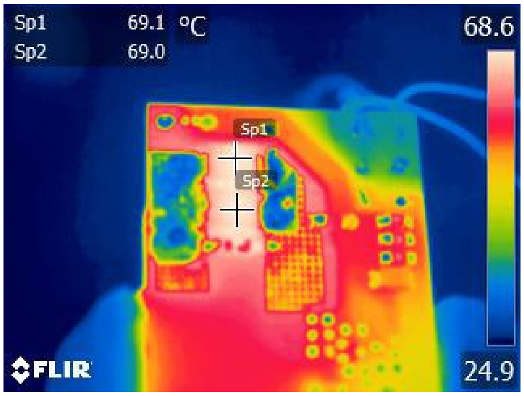


Figure 33 – Thermal Scan 230 V 36 V / 1 A
Sp1: D3-(Output Diode): 69.1 °C
Sp2: D5-(Output Diode): 69.0 °C

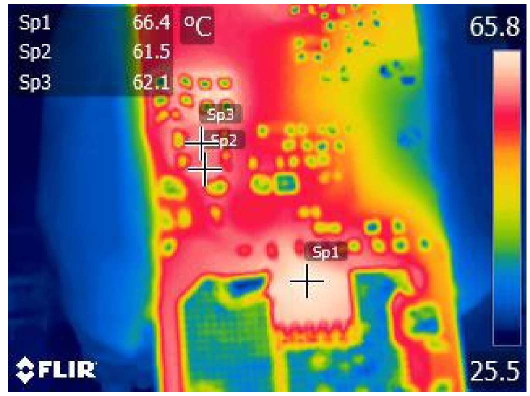


Figure 34 – Thermal Scan 230 V 36 V / 1 A
Sp1: U2-(TNY5075K): 66.4 °C
Sp2: D8-(Snubber Diode): 61.5 °C
Sp3: D7-(Snubber Diode): 62.1 °C

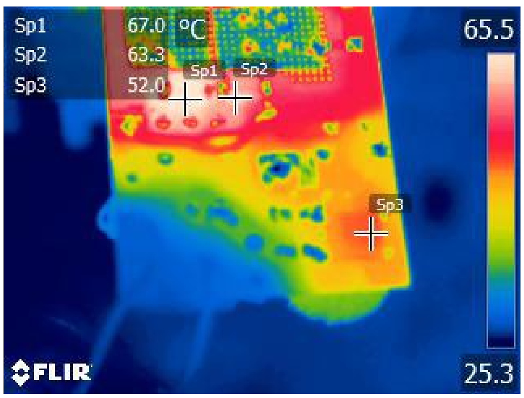


Figure 35 – Thermal Scan 230 V 36 V / 1 A
Sp1: D9-(SVF Boost Diode): 67.0 °C
Sp2: D4-(SVF Boost Diode): 63.3 °C
Sp3: BR1-(Bridge Diode): 52.0 °C

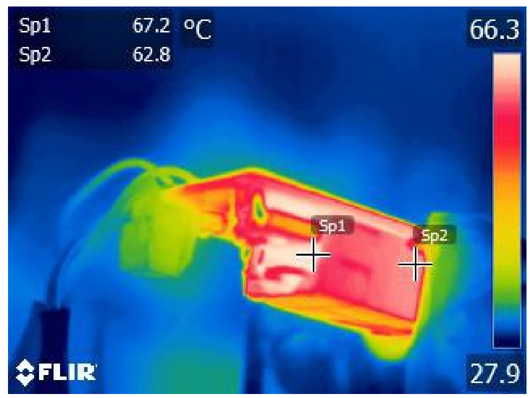


Figure 36 – Thermal Scan 230 V 36 V / 1 A
Sp1: T1-(Flyback TRF Wire): 67.2 °C
Sp2: T1-(Flyback TRF Core): 62.8 °C

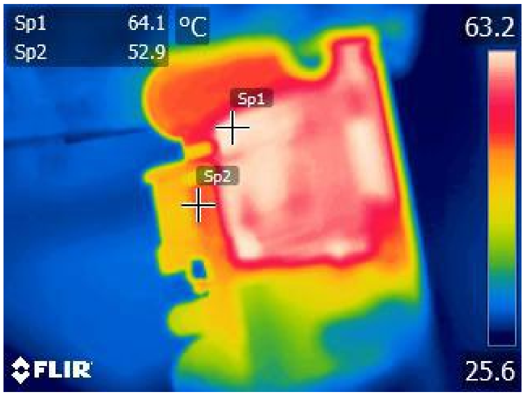


Figure 37 – Thermal Scan 230 V 36 V / 1 A
Sp1: T2-(SVF Boost Inductor): 64.1 °C
Sp2: L2-(Input Diff. Choke): 52.9 °C

10.10.1.5 Thermal Scan at 277 VAC 36 V LED String

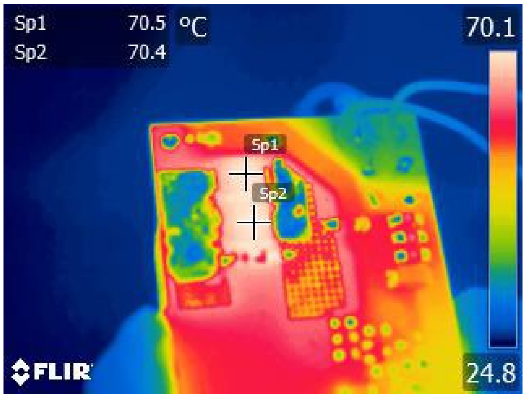


Figure 38 – Thermal Scan 100 V 36 V / 1 A
Sp1: D3-(Output Diode): 70.5 °C
Sp2: D5-(Output Diode): 70.4 °C

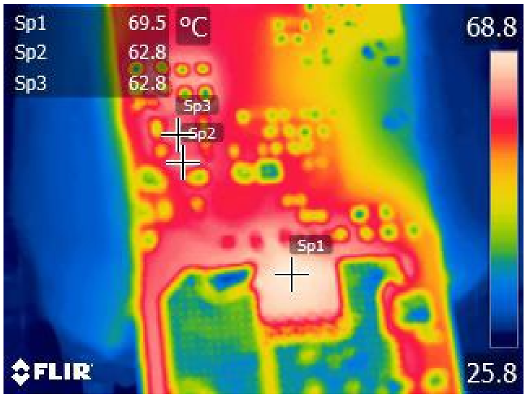


Figure 39 – Thermal Scan 277 V 36 V / 1 A
Sp1: U2-(TNY5075K): 69.5 °C
Sp2: D8-(Snubber Diode): 62.8 °C
Sp3: D7-(Snubber Diode): 62.8 °C

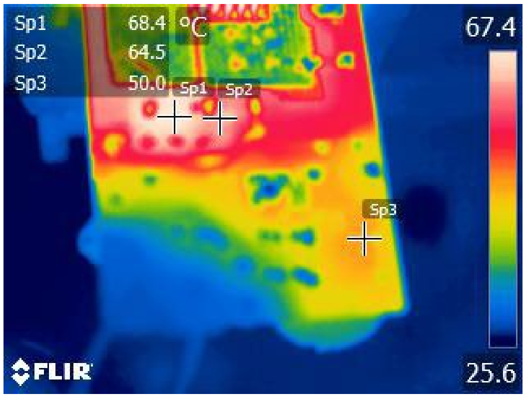


Figure 40 – Thermal Scan 277 V 36 V / 1 A
Sp1: D9-(SVF Boost Diode): 68.4 °C
Sp2: D4-(SVF Boost Diode): 64.5 °C
Sp3: BR1-(Bridge Diode): 50 °C

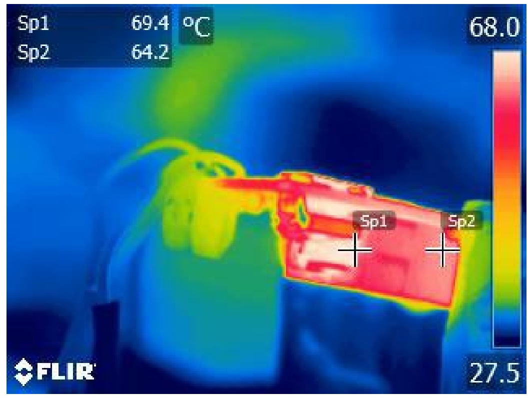


Figure 41 – Thermal Scan 277 V 36 V / 1 A
Sp1: T1-(Flyback TRF Wire): 69.4 °C
Sp2: T1-(Flyback TRF Core): 64.2 °C

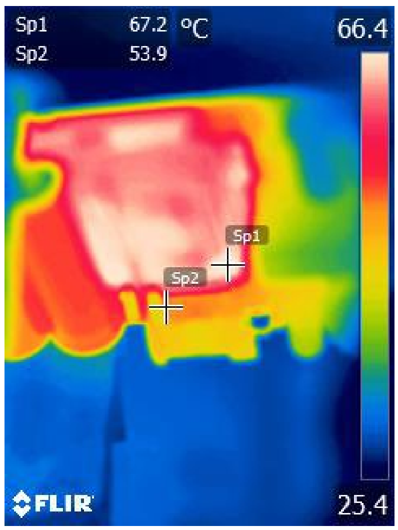


Figure 42 – Thermal Scan 277 V 36 V / 1 A
Sp1: T2-(SVF Boost Inductor): 67.2 °C
Sp2: L2-(Input Diff. Choke): 53.9 °C

10.10.2 Thermal Test at 55 °C Ambient Temperature

Type K thermocouples were used to measure the component temperatures. The open-frame power supply unit (PSU) was placed inside an enclosed housing and then positioned in an environmental chamber set to a static temperature of 55 °C. The unit was powered using a 36 V LED string delivering 36 W output power. The component thermal profile was recorded after more than 2 hours of burn-in under the 55 °C chamber condition.

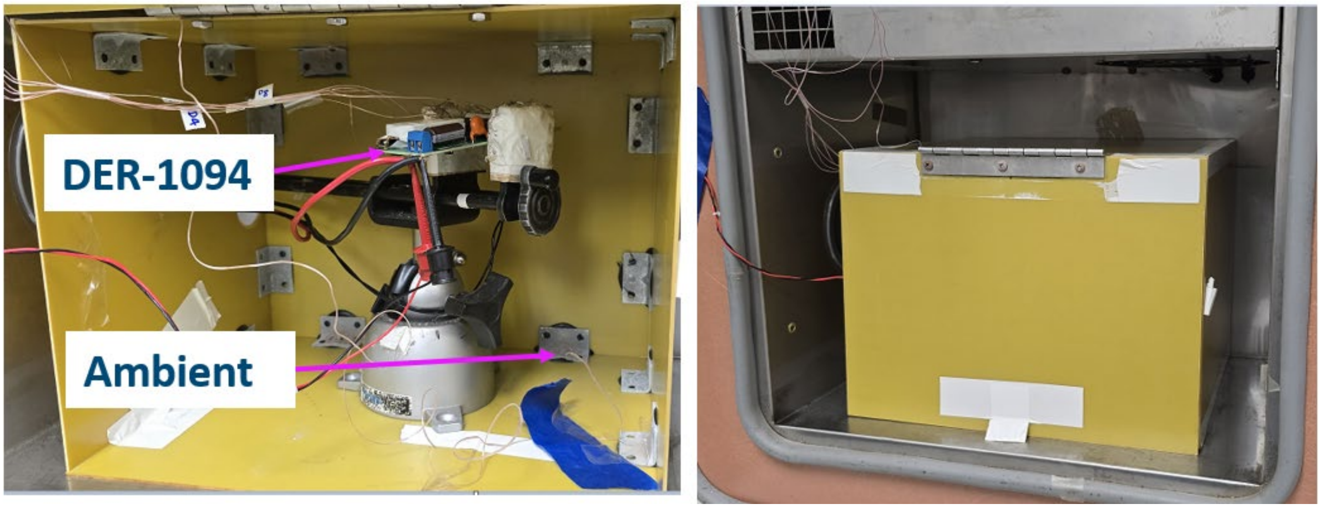


Figure 43 – Thermal Scan Test Set-up at 55 °C Ambient.

10.10.2.1 Thermal Test Data Summary at 55 °C Ambient Temperature

The following thermal scan data shows that the heating components remain well below their maximum temperature ratings across the entire input voltage range.

Item	CKT Code	Description	Temperature (°C)			
			100 VAC	120 VAC	230 VAC	277 VAC
1	D9	SVF Boost Diode1	109	102	94.9	96.9
2	D4	SVF Boost Diode2	109	101	92.7	94.6
3	T1	Flyback TRF	96.5	94.1	94.1	95.4
4	T2	SVF Boost Inductor	101	95.6	93.9	97.2
5	U2	TNY5075K	118	107	97.3	101
6	D8	Primary Snubber Diode	98.9	94.3	90.8	92.3
7	D2	Output Diode1	95.3	94.0	94.0	94.8
8	Amb	Ambient Temperature	55.7	55.2	55.3	55.3

Table 13 – Thermal Test Data at 55 °C Ambient Temperature.

10.10.2.2 Component Thermal Profile at 55 °C Ambient Temperature

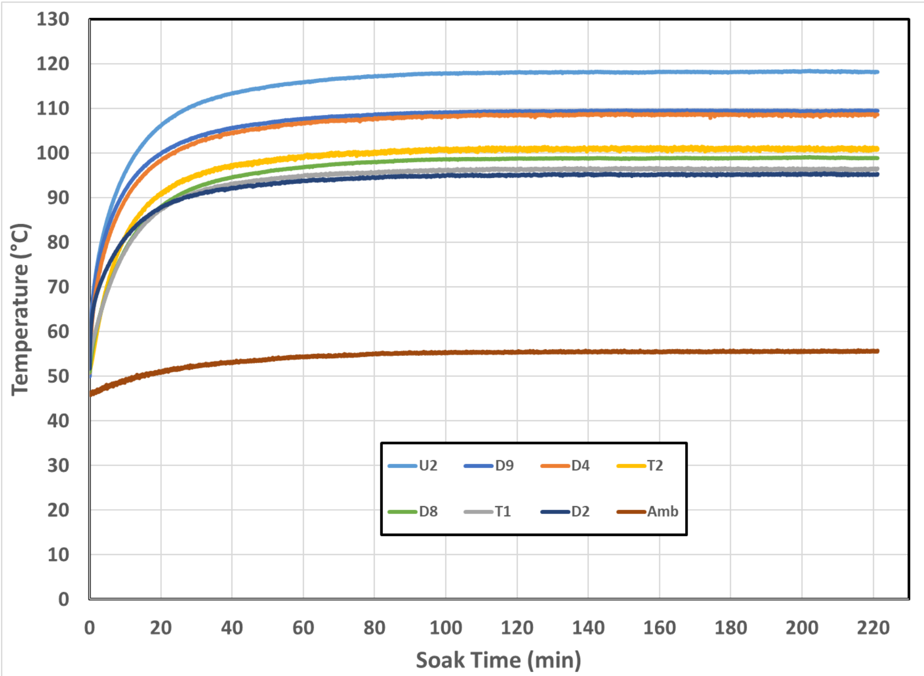


Figure 44 – Thermal Profile at 100 VAC, 36 V Full Load.

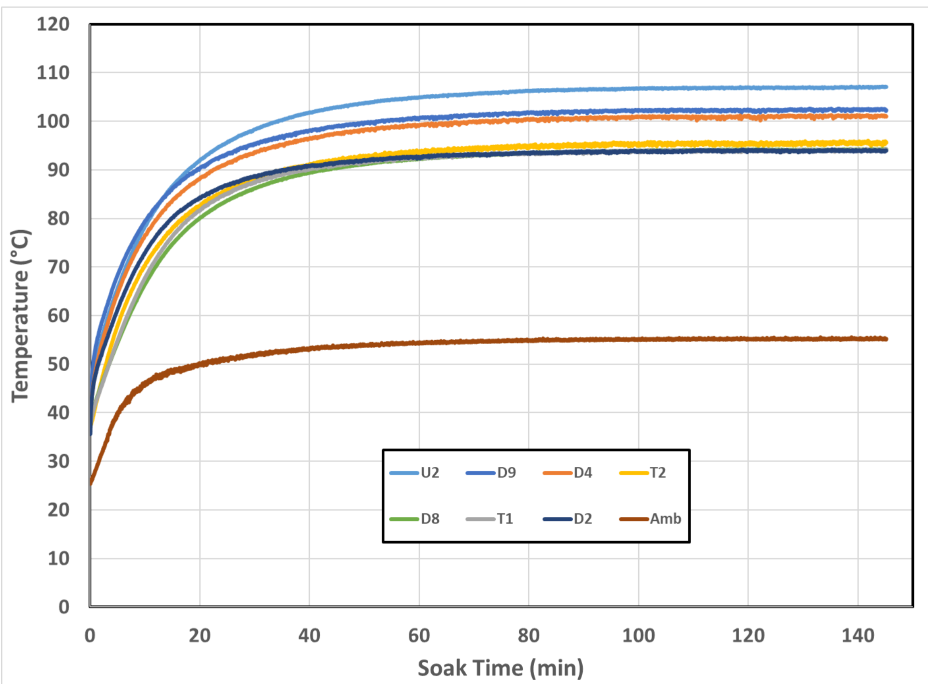


Figure 45 – Thermal Profile at 120 VAC, 36 V Full Load.

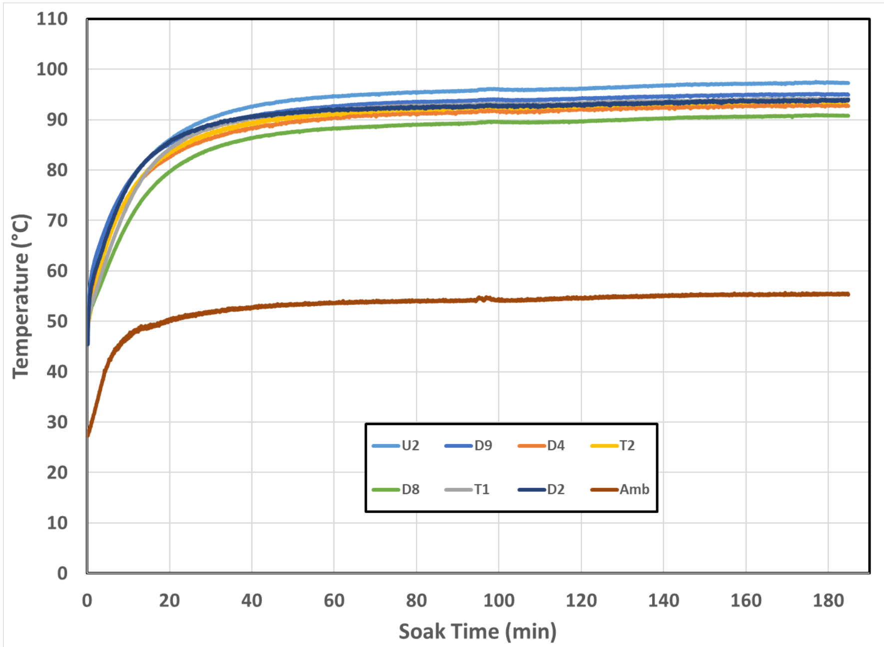


Figure 46 – Thermal Profile at 230 VAC, 36 V Full Load.

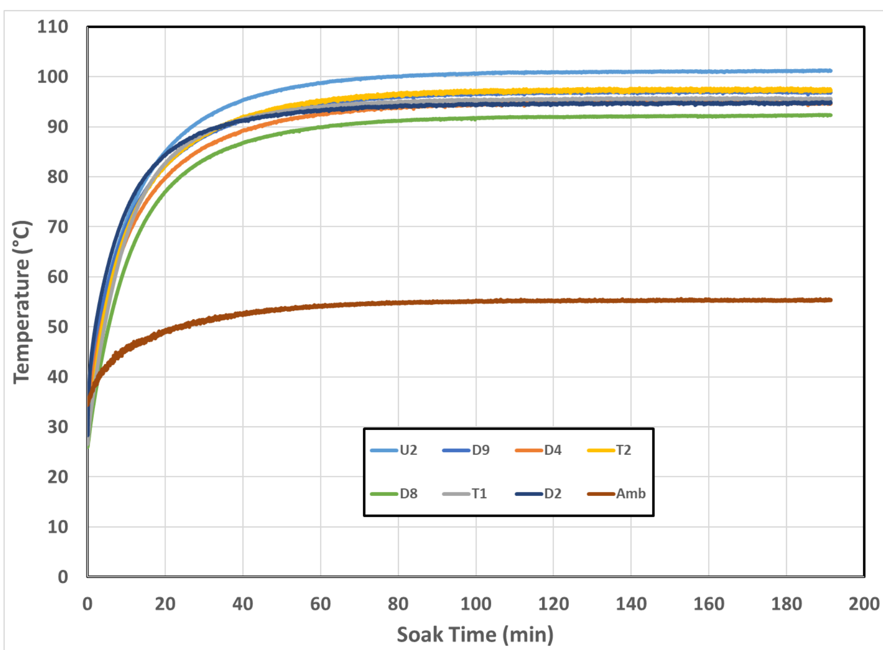


Figure 47 – Thermal Profile at 277 VAC, 36 V Full Load.

11 Waveforms

11.1 Start-up Profile

11.1.1 Start-up Profile at 36 V LED String

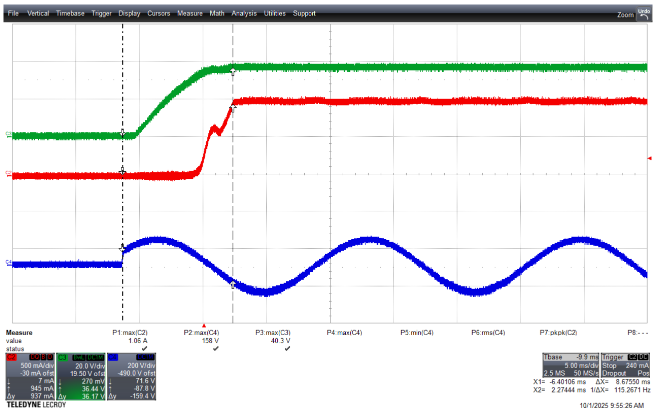


Figure 48 – 100 VAC, 60 Hz. 36 V LED String.
CH2: I_{OUT}, 500 mA / div., 5 ms / div.
CH3: V_{OUT}, 20 V / div., 5 ms / div.
CH4: V_{IN}, 200 V / div., 5 ms / div.
$t_{ON\ Delay}$ = 8.7 ms
$I_{OUT\ Max}$ = 1.06 A

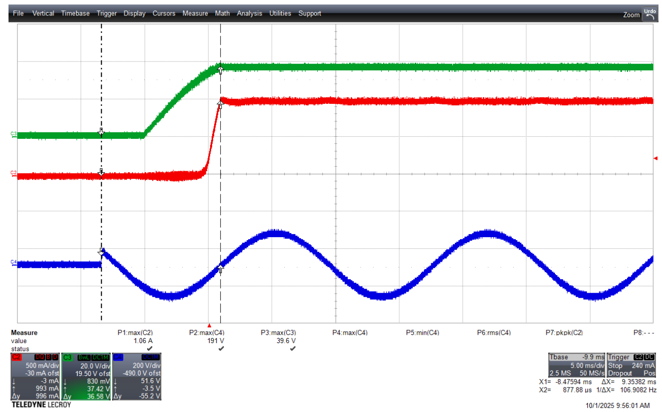


Figure 49 – 120 VAC, 60 Hz. 36 V LED String.
CH2: I_{OUT}, 500 mA / div., 5 ms / div.
CH3: V_{OUT}, 20 V / div., 5 ms / div.
CH4: V_{IN}, 200 V / div., 5 ms / div.
$t_{ON\ Delay}$ = 9.35 ms
$I_{OUT\ Max}$ = 1.06 A

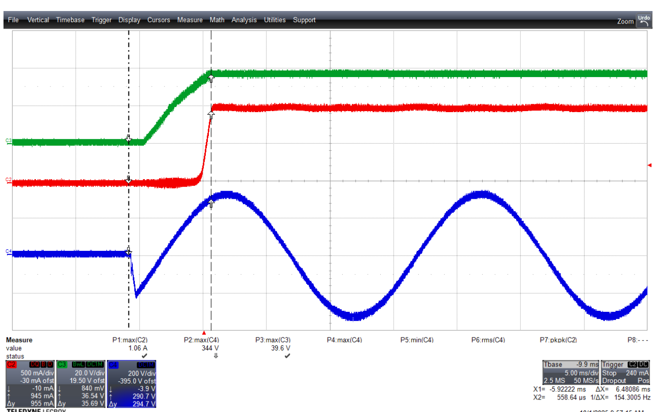


Figure 50 – 230 VAC, 50 Hz. 36 V LED String.
CH2: I_{OUT}, 500 mA / div., 5 ms / div.
CH3: V_{OUT}, 20 V / div., 5 ms / div.
CH4: V_{IN}, 200 V / div., 5 ms / div.
$t_{ON\ Delay}$ = 6.5 ms
$I_{OUT\ Max}$ = 1.06 A

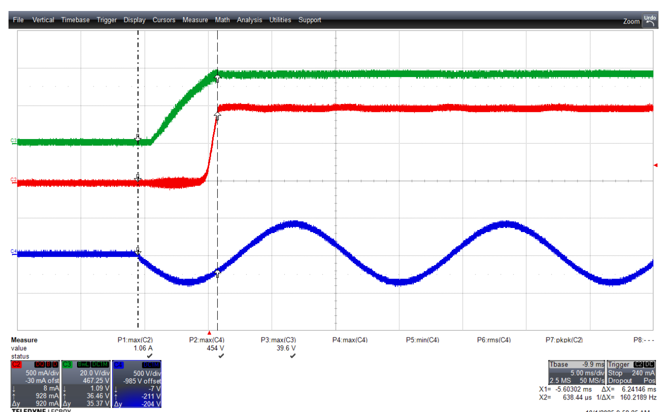


Figure 51 – 277 VAC, 50 Hz. 36 V LED String.
CH2: I_{OUT}, 500 mA / div., 5 ms / div.
CH3: V_{OUT}, 20 V / div., 5 ms / div.
CH4: V_{IN}, 500 V / div., 5 ms / div.
$t_{ON\ Delay}$ = 6.2 ms
$I_{OUT\ Max}$ = 1.06 A

11.1.2 Start-up Profile at 25 V LED String

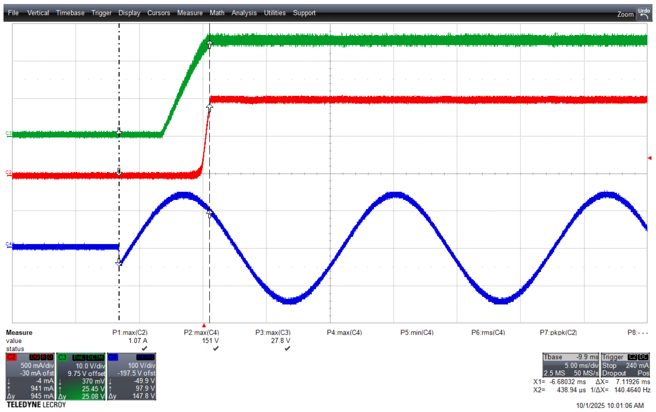


Figure 52 – 100 VAC, 60 Hz. 25 V LED String.
CH2: I_{OUT}, 500 mA / div., 5 ms / div.
CH3: V_{OUT}, 10 V / div., 5 ms / div.
CH4: V_{IN}, 100 V / div., 5 ms / div.
$t_{ON\ Delay}$ = 7.1 ms
$I_{OUT\ Max}$ = 1.07 A

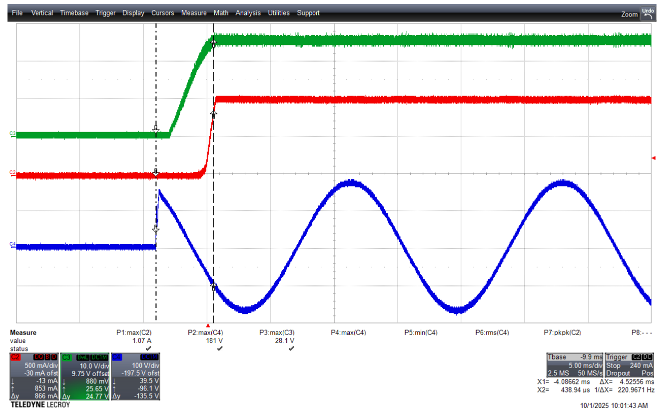


Figure 53 – 120 VAC, 60 Hz. 25 V LED String.
CH2: I_{OUT}, 500 mA / div., 5 ms / div.
CH3: V_{OUT}, 10 V / div., 5 ms / div.
CH4: V_{IN}, 100 V / div., 5 ms / div.
$t_{ON\ Delay}$ = 4.5 ms
$I_{OUT\ Max}$ = 1.07 A

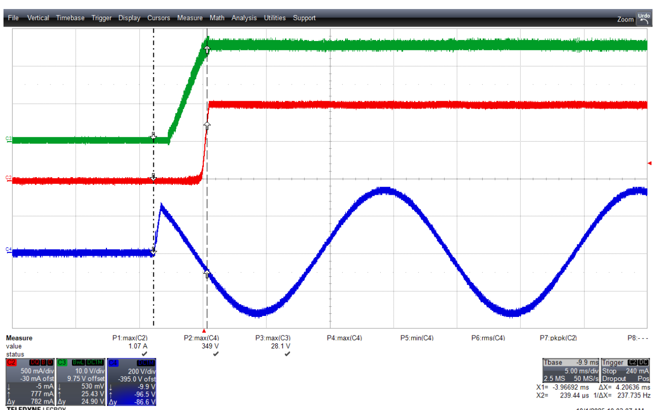


Figure 54 – 230 VAC, 50 Hz. 25 V LED String.
CH2: I_{OUT}, 500 mA / div., 5 ms / div.
CH3: V_{OUT}, 10 V / div., 5 ms / div.
CH4: V_{IN}, 200 V / div., 5 ms / div.
$t_{ON\ Delay}$ = 4.2 ms
$I_{OUT\ Max}$ = 1.07 A

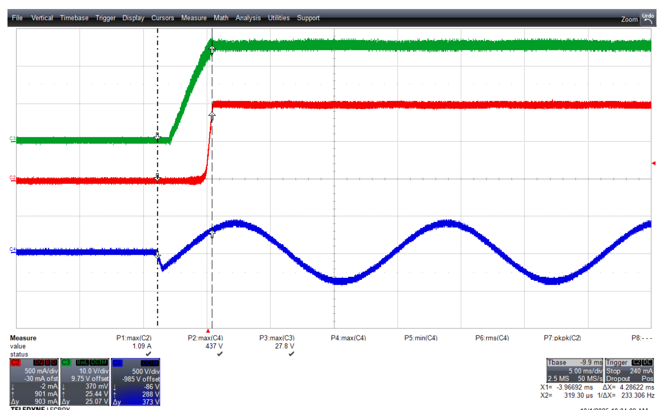


Figure 55 – 277 VAC, 50 Hz. 25 V LED String.
CH2: I_{OUT}, 500 mA / div., 5 ms / div.
CH3: V_{OUT}, 10 V / div., 5 ms / div.
CH4: V_{IN}, 500 V / div., 5 ms / div.
$t_{ON\ Delay}$ = 6.2 ms
$I_{OUT\ Max}$ = 1.09 A

11.2 Primary Drain Voltage and Current

11.2.1 Steady State Operation at 36 V LED String

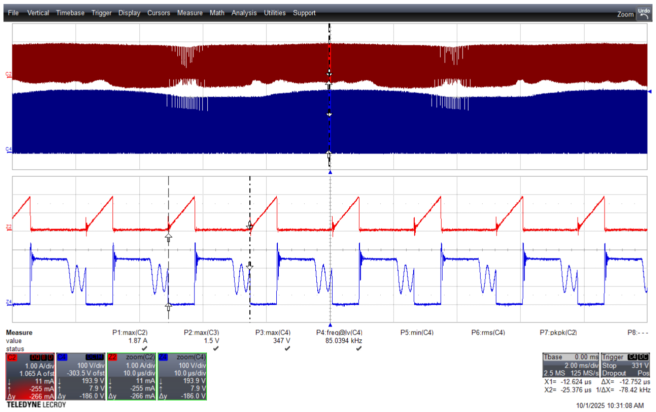


Figure 56 – 100 VAC, 60 Hz. 36 V LED String.
CH2: I_{DS}, 1 A / div., 2 ms / div.
CH4: V_{DS}, 100 V / div., 2 ms / div.
Zoom in: 10 μs / div.
$V_{DS\ Max}$ = 347 V
$I_{DS\ Max}$ = 1.87 A

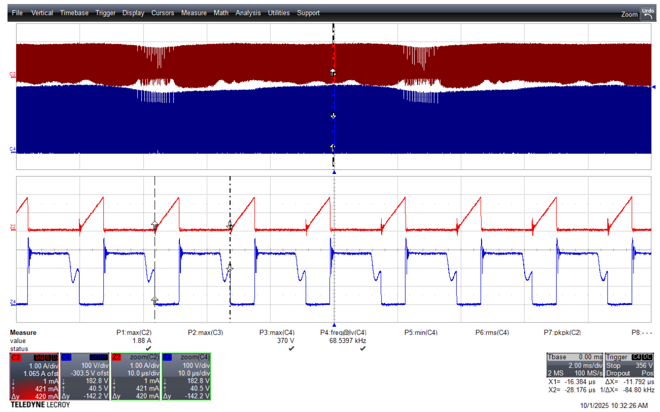


Figure 57 – 120 VAC, 60 Hz. 36 V LED String.
CH2: I_{DS}, 1 A / div., 2 ms / div.
CH4: V_{DS}, 100 V / div., 2 ms / div.
Zoom in: 10 μs / div.
$V_{DS\ Max}$ = 370 V
$I_{DS\ Max}$ = 1.88 A

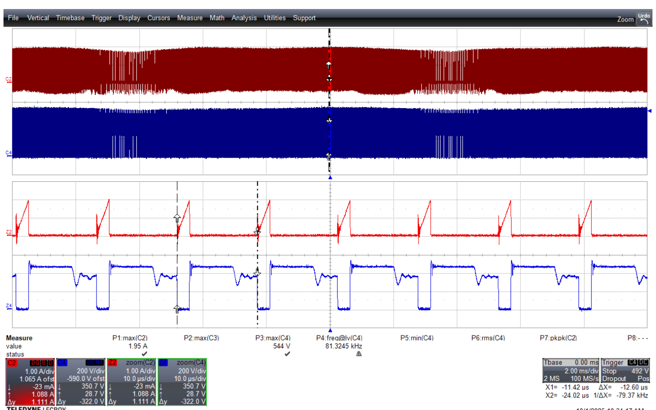


Figure 58 – 230 VAC, 50 Hz. 36 V LED String.
CH2: I_{DS}, 1 A / div., 2 ms / div.
CH4: V_{DS}, 200 V / div., 2 ms / div.
Zoom in: 10 μs / div.
$V_{DS\ Max}$ = 544 V
$I_{DS\ Max}$ = 1.95 A

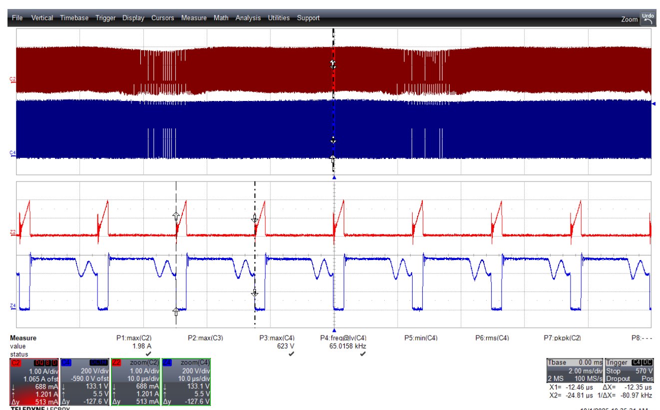


Figure 59 – 277 VAC, 60 Hz. 36 V LED String.
CH2: I_{DS}, 1 A / div., 2 ms / div.
CH4: V_{DS}, 200 V / div., 2 ms / div.
Zoom in: 10 μs / div.
$V_{DS\ Max}$ = 623 V
$I_{DS\ Max}$ = 1.98 A

11.2.2 Steady State Operation at 25 V LED String

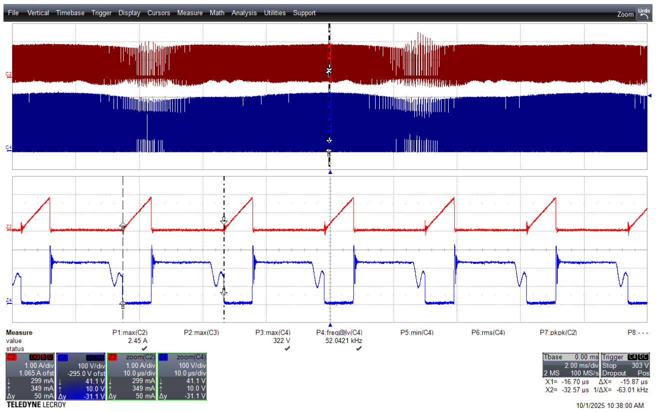


Figure 60 – 100 VAC, 60 Hz. 25 V LED String.
CH2: I_{DS}, 1 A / div., 2 ms / div.
CH4: V_{DS}, 100 V / div., 2 ms / div.
Zoom in: 10 µs / div.
$V_{DS\ Max}$ = 322 V
$I_{DS\ Max}$ = 2.45 A

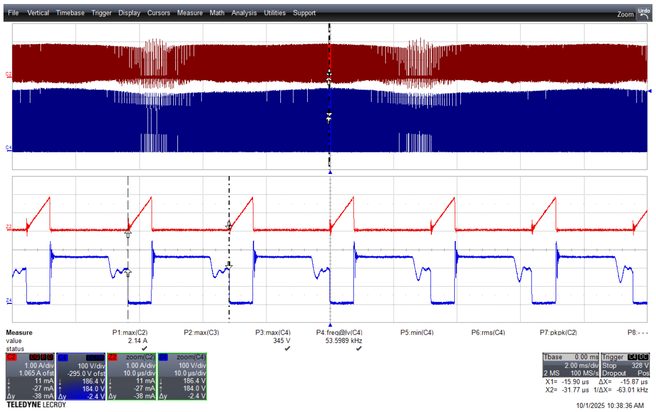


Figure 61 – 120 VAC, 60 Hz. 25 V LED String.
CH2: I_{DS}, 1 A / div., 2 ms / div.
CH4: V_{DS}, 100 V / div., 2 ms / div.
Zoom in: 10 µs / div.
$V_{DS\ Max}$ = 345 V
$I_{DS\ Max}$ = 2.14 A

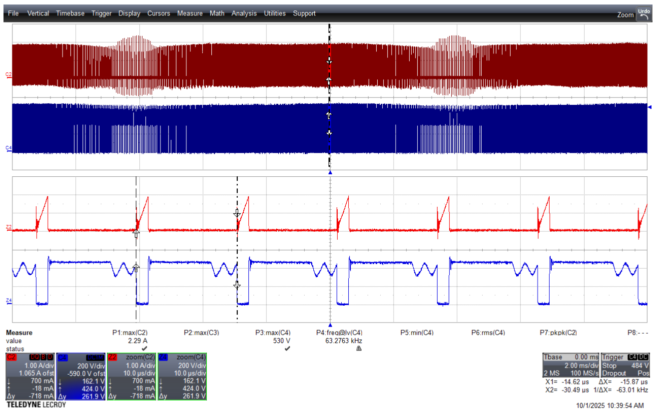


Figure 62 – 230 VAC, 50 Hz. 25 V LED String.
CH2: I_{DS}, 1 A / div., 2 ms / div.
CH4: V_{DS}, 200 V / div., 2 ms / div.
Zoom in: 10 µs / div.
$V_{DS\ Max}$ = 530 V
$I_{DS\ Max}$ = 2.29 A

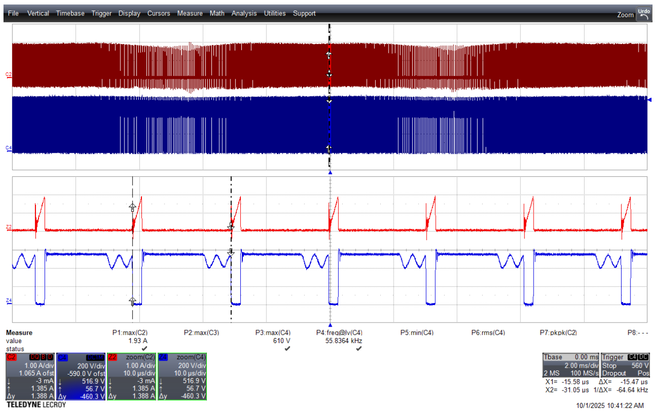


Figure 63 – 277 VAC, 60 Hz. 25 V LED String.
CH2: I_{DS}, 1 A / div., 2 ms / div.
CH4: V_{DS}, 200 V / div., 2 ms / div.
Zoom in: 10 µs / div.
$V_{DS\ Max}$ = 610 V
$I_{DS\ Max}$ = 1.93 A

11.2.3 Start-up Operation at 36 V LED String

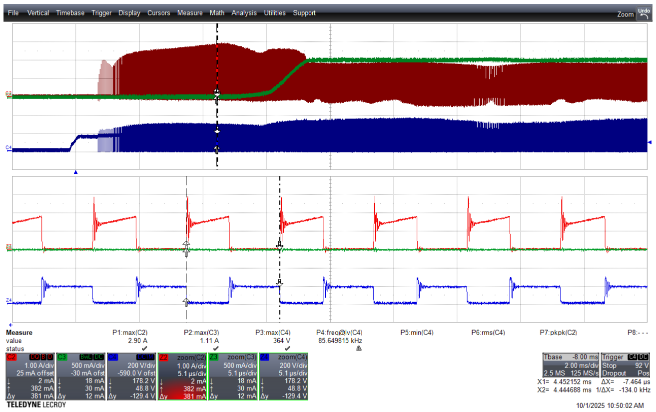


Figure 64 – 100 VAC, 60 Hz. 36 V LED String.
CH2: I_{DS}, 1 A / div., 2 ms / div.
CH3: I_{OUT}, 500 mA / div., 2 ms / div.
CH4: V_{DS}, 100 V / div., 2 ms / div.
Zoom in: 5.1 μs / div.
$V_{DS\ Max}$ = 364 V
$I_{DS\ Max}$ = 2.9 A

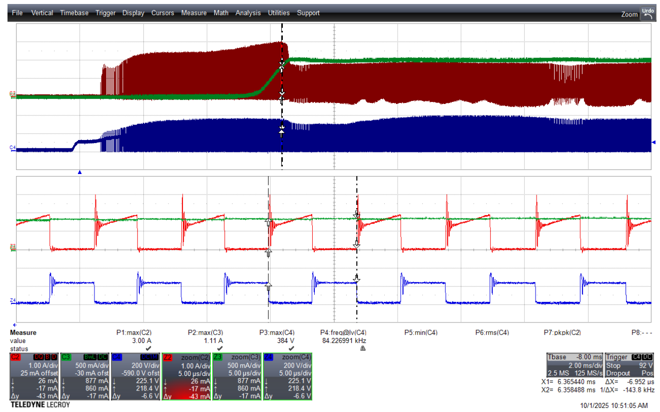


Figure 65 – 120 VAC, 60 Hz. 36 V LED String.
CH2: I_{DS}, 1 A / div., 2 ms / div.
CH3: I_{OUT}, 500 mA / div., 2 ms / div.
CH4: V_{DS}, 200 V / div., 2 ms / div.
Zoom in: 5 μs / div.
$V_{DS\ Max}$ = 384 V
$I_{DS\ Max}$ = 3 A

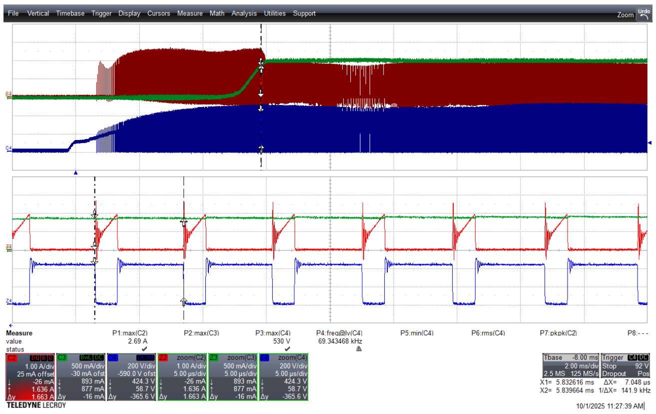


Figure 66 – 230 VAC, 50 Hz. 36 V LED String.
CH2: I_{DS}, 1 A / div., 2 ms / div.
CH3: I_{OUT}, 500 mA / div., 2 ms / div.
CH4: V_{DS}, 200 V / div., 2 ms / div.
Zoom in: 5 μs / div.
$V_{DS\ Max}$ = 530 V
$I_{DS\ Max}$ = 2.69 A

Figure 67 – 277 VAC, 60 Hz. 36 V LED String.
CH2: I_{DS}, 1 A / div., 2 ms / div.
CH3: I_{OUT}, 500 mA / div., 2 ms / div.
CH4: V_{DS}, 200 V / div., 2 ms / div.
Zoom in: 5 μs / div.
$V_{DS\ Max}$ = 590 V
$I_{DS\ Max}$ = 3.43 A

11.2.4 Start-up Operation at 25 V LED String

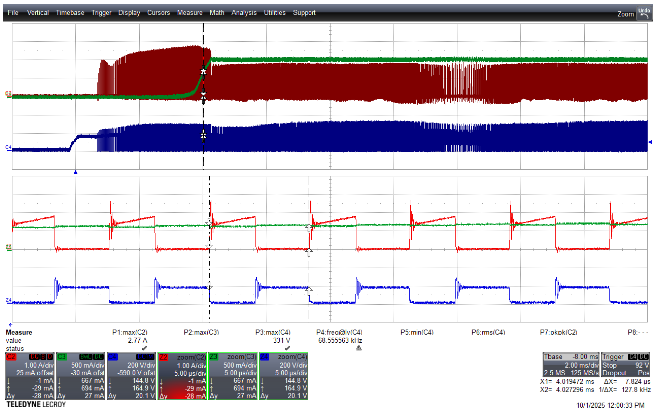


Figure 68 – 100 VAC, 60 Hz. 25 V LED String.
CH2: I_{DS}, 1 A / div., 2 ms / div.
CH3: I_{OUT}, 500 mA / div., 2 ms / div.
CH4: V_{DS}, 200 V / div., 2 ms / div.
Zoom in: 5 µs / div.
$V_{DS\ Max}$ = 331 V
$I_{DS\ Max}$ = 2.77 A

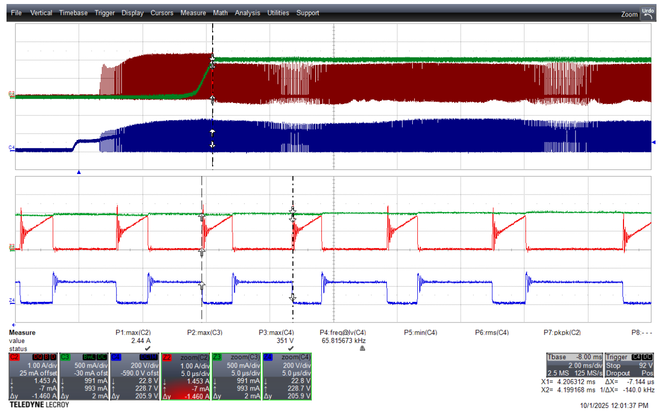


Figure 69 – 120 VAC, 60 Hz. 25 V LED String.
CH2: I_{DS}, 1 A / div., 2 ms / div.
CH3: I_{OUT}, 500 mA / div., 2 ms / div.
CH4: V_{DS}, 200 V / div., 2 ms / div.
Zoom in: 5 µs / div.
$V_{DS\ Max}$ = 351 V
$I_{DS\ Max}$ = 2.44 A

Figure 70 – 230 VAC, 50 Hz. 25 V LED String.
CH2: I_{DS}, 1 A / div., 2 ms / div.
CH3: I_{OUT}, 500 mA / div., 2 ms / div.
CH4: V_{DS}, 200 V / div., 2 ms / div.
Zoom in: 5 µs / div.
$V_{DS\ Max}$ = 490 V
$I_{DS\ Max}$ = 3.34 A

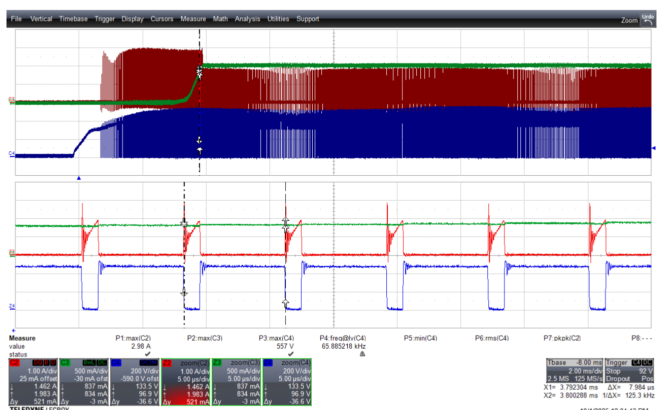


Figure 71 – 277 VAC, 60 Hz. 25 V LED String.
CH2: I_{DS}, 1 A / div., 2 ms / div.
CH3: I_{OUT}, 500 mA / div., 2 ms / div.
CH4: V_{DS}, 200 V / div., 2 ms / div.
Zoom in: 5 µs / div.
$V_{DS\ Max}$ = 557 V
$I_{DS\ Max}$ = 2.98 A

11.2.5 Start-Up Under Short-Circuit Condition

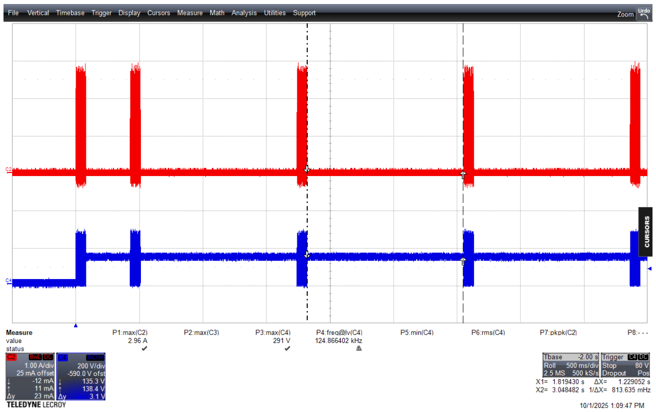


Figure 72 – 100 VAC, 60 Hz. Output Shorted.
CH2: I_{DS}, 1 A / div., 200 ms / div.
CH4: V_{DS}, 200 V / div., 200 ms / div.
$V_{DS\ Max}$ = 291 V
$I_{DS\ Max}$ = 2.96 A

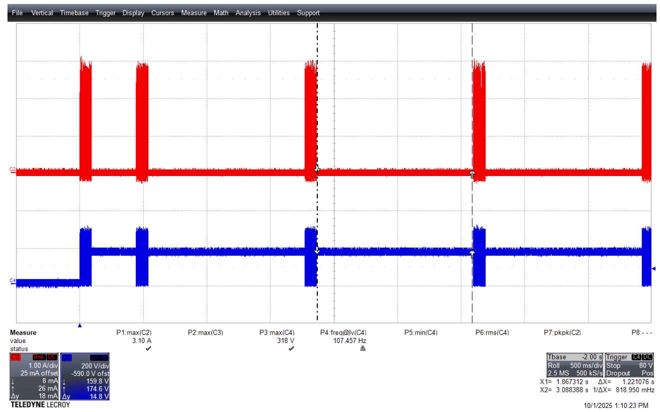


Figure 73 – 120 VAC, 60 Hz. Output Shorted.
CH2: I_{DS}, 1 A / div., 200 ms / div.
CH4: V_{DS}, 200 V / div., 200 ms / div.
$V_{DS\ Max}$ = 318 V
$I_{DS\ Max}$ = 3.10 A

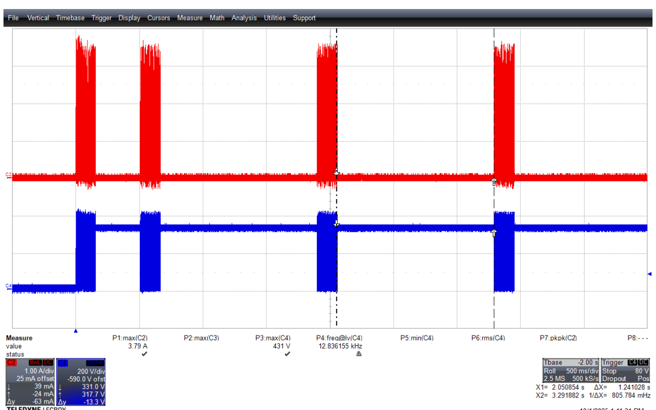


Figure 74 – 230 VAC, 50 Hz. Output Shorted.
CH2: I_{DS}, 1 A / div., 200 ms / div.
CH4: V_{DS}, 200 V / div., 200 ms / div.
$V_{DS\ Max}$ = 431 V
$I_{DS\ Max}$ = 3.79 A

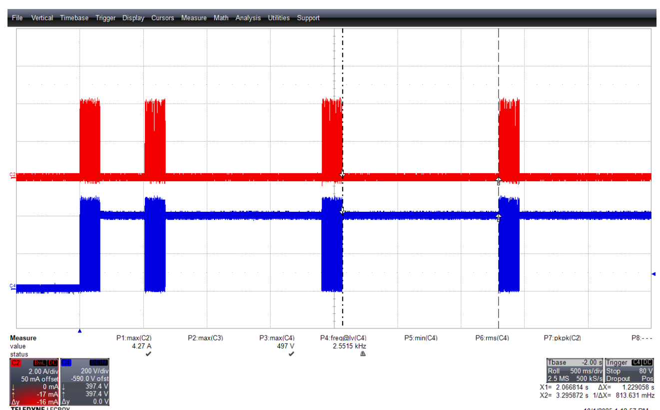


Figure 75 – 277 VAC, 60 Hz. Output Shorted.
CH2: I_{DS}, 2 A / div., 200 ms / div.
CH4: V_{DS}, 200 V / div., 200 ms / div.
$V_{DS\ Max}$ = 497 V
$I_{DS\ Max}$ = 4.27 A

11.2.6 Full-Load Operation with Output Shorted

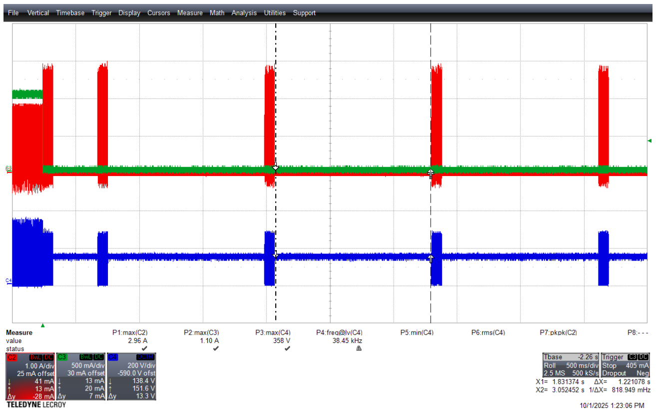


Figure 76 – 100 VAC, 60 Hz. 36 V LED - Shorted.
CH2: I_{DS}, 1 A / div., 500 ms / div.
CH3: I_{OUT}, 500 mA / div., 500 ms / div.
CH4: V_{DS}, 200 V / div., 500 ms / div.
$V_{DS\ Max}$ = 358 V
$I_{DS\ Max}$ = 2.96 A

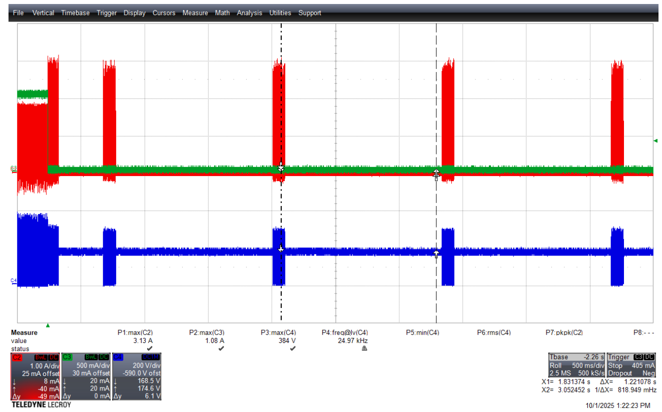


Figure 77 – 120 VAC, 60 Hz. 36 V LED - Shorted.
CH2: I_{DS}, 1 A / div., 500 ms / div.
CH3: I_{OUT}, 500 mA / div., 500 ms / div.
CH4: V_{DS}, 200 V / div., 500 ms / div.
$V_{DS\ Max}$ = 348 V
$I_{DS\ Max}$ = 3.13 A

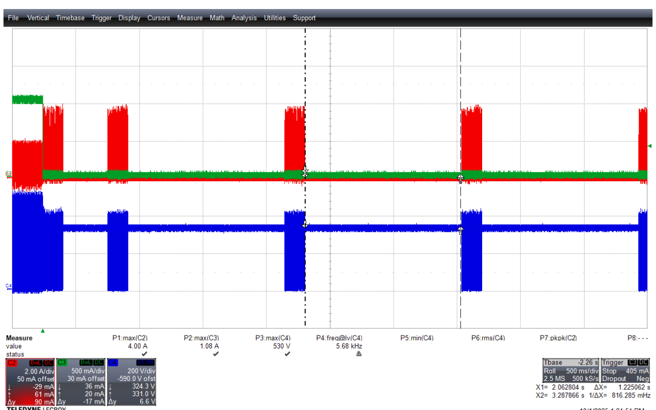


Figure 78 – 230 VAC, 50 Hz. 36 V LED - Shorted.
CH2: I_{DS}, 2 A / div., 500 ms / div.
CH3: I_{OUT}, 500 mA / div., 500 ms / div.
CH4: V_{DS}, 200 V / div., 500 ms / div.
$V_{DS\ Max}$ = 530 V
$I_{DS\ Max}$ = 4.00 A

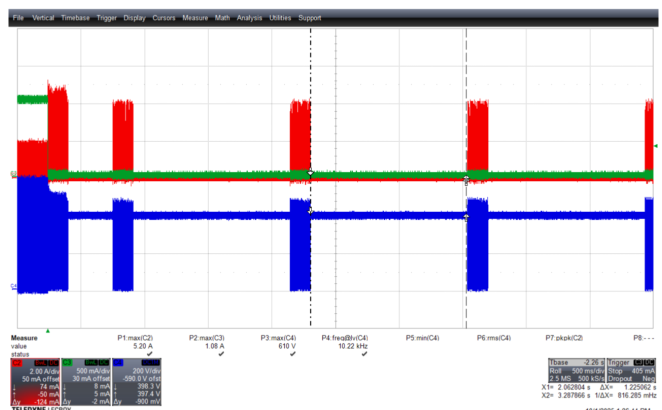


Figure 79 – 277 VAC, 60 Hz. 36 V LED - Shorted.
CH2: I_{DS}, 2 A / div., 500 ms / div.
CH3: I_{OUT}, 500 mA / div., 500 ms / div.
CH4: V_{DS}, 200 V / div., 500 ms / div.
$V_{DS\ Max}$ = 610 V
$I_{DS\ Max}$ = 5.20 A

11.3 Output Diode Voltage Stress

11.3.1 Output Diode Voltage Stress at Steady State

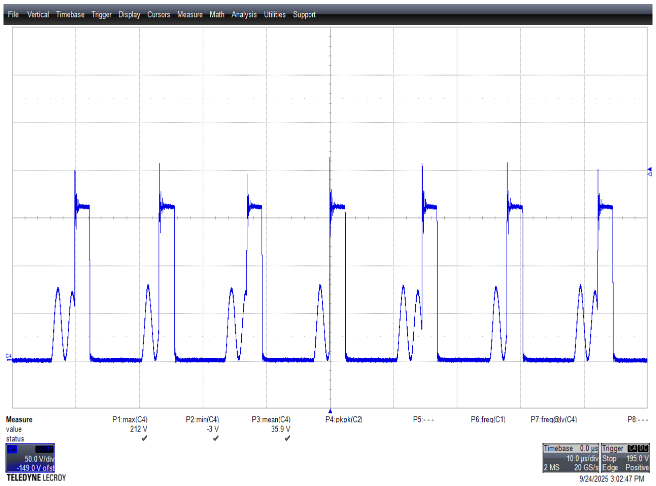


Figure 80 – 230 VAC, 50 Hz. 36 V LED.
CH4: V_{DIODE}, 50 V / div., 10 µs / div.
$V_{DIODE\ Max}$ = 212 V
Voltage Stress: 70.7%

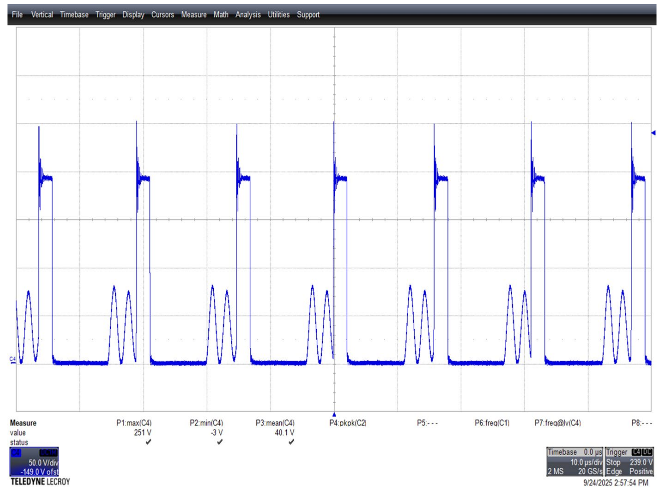


Figure 81 – 277 VAC, 60 Hz. 36 V LED.
CH4: V_{DIODE}, 50 V / div., 10 µs / div.
$V_{DIODE\ Max}$ = 251 V
Voltage Stress: 83.7%

11.3.2 Output Diode Voltage Stress During Start-up Full Load

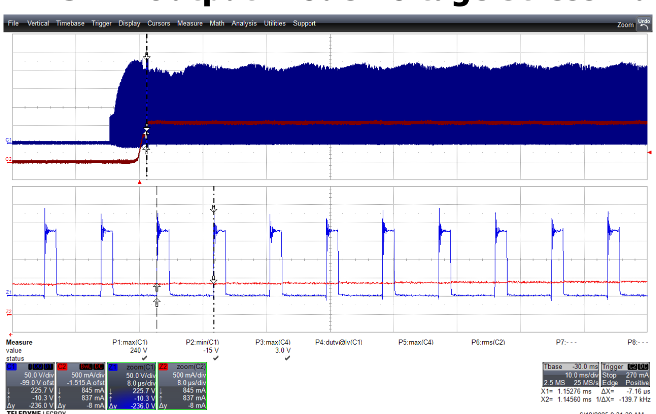


Figure 82 – 230 VAC, 50 Hz. 36 V LED.
CH2: I_{OUT}, 500 mA / div., 10 ms / div.
CH4: V_{DIODE}, 50 V / div., 10 ms / div.
Zoom In: 8 µs / div
$V_{DIODE\ Max}$ = 240 V
Voltage Stress: 80%

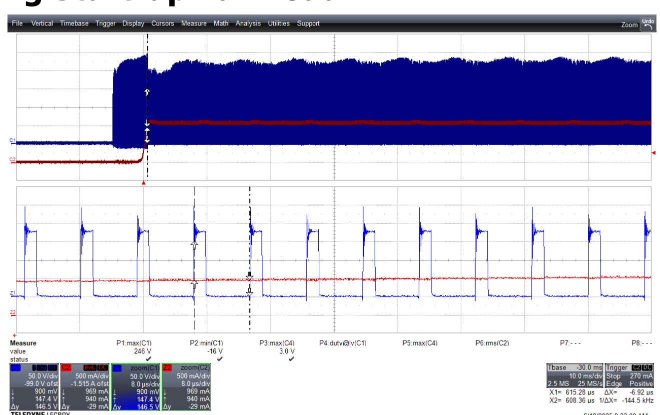


Figure 83 – 277 VAC, 50 Hz. 36 V LED.
CH2: I_{OUT}, 500 mA / div., 10 ms / div.
CH4: V_{DIODE}, 50 V / div., 10 ms / div.
Zoom In: 8 µs / div
$V_{DIODE\ Max}$ = 246 V
Voltage Stress: 82%

11.4 AC On / Off Cycling at 36 V LED String

11.4.1 On / Off Cycling at 36 V LED String

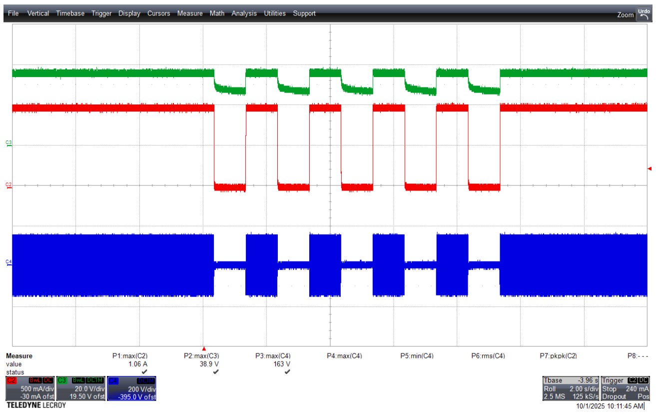


Figure 84 – 100 VAC, 60 Hz 1 s On/Off, 36 V LED.
CH2: I_{DS}, 500 mA / div., 2 s / div.
CH3: V_{OUT}, 20 V / div., 2 s / div.
CH4: V_{IN}, 200 V / div., 2 s / div.
$V_{OUT\ Max}$ = 38.9 V
$I_{OUT\ Max}$ = 1.06 A

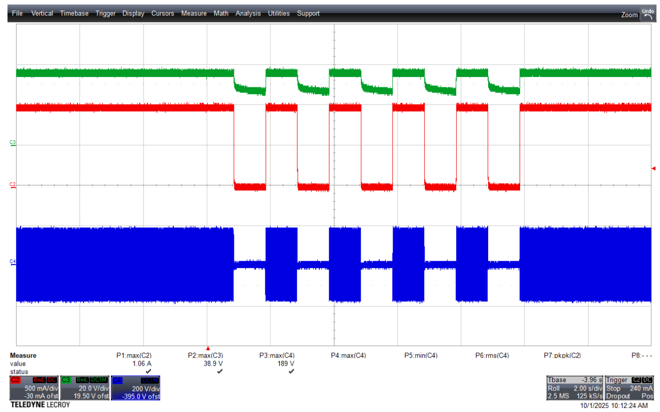


Figure 85 – 120 VAC, 60 Hz 1 s On/Off, 36 V LED.
CH2: I_{DS}, 500 mA / div., 2 s / div.
CH3: V_{OUT}, 20 V / div., 2 s / div.
CH4: V_{IN}, 200 V / div., 2 s / div.
$V_{OUT\ Max}$ = 38.9 V
$I_{OUT\ Max}$ = 1.06 A

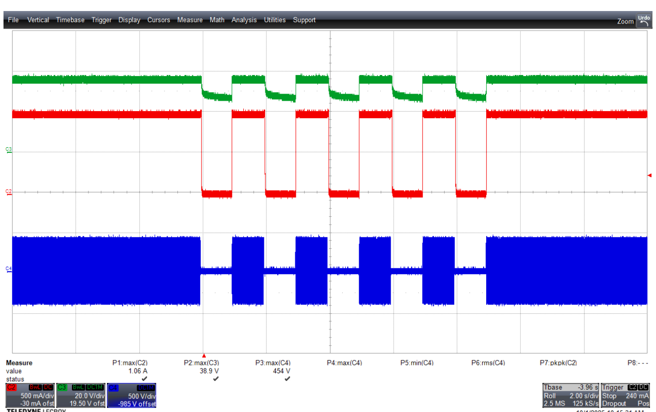


Figure 86 – 230 VAC, 50 Hz 1 s On/Off, 36 V LED.
CH2: I_{DS}, 500 mA / div., 2 s / div.
CH3: V_{OUT}, 20 V / div., 2 s / div.
CH4: V_{IN}, 500 V / div., 2 s / div.
$V_{OUT\ Max}$ = 38.9 V
$I_{OUT\ Max}$ = 1.06 A

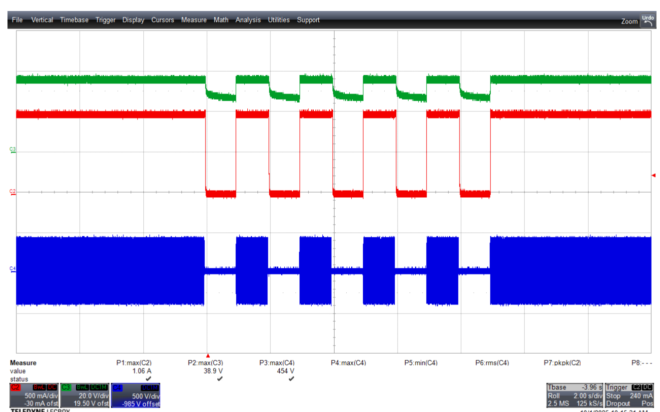


Figure 87 – 277 VAC, 60 Hz 1 s On/Off, 36 V LED.
CH2: I_{DS}, 500 mA / div., 2 s / div.
CH3: V_{OUT}, 20 V / div., 2 s / div.
CH4: V_{IN}, 500 V / div., 2 s / div.
$V_{OUT\ Max}$ = 38.9 V
$I_{OUT\ Max}$ = 1.06 A

11.4.2 AC On / Off Cycling at 25 V LED String

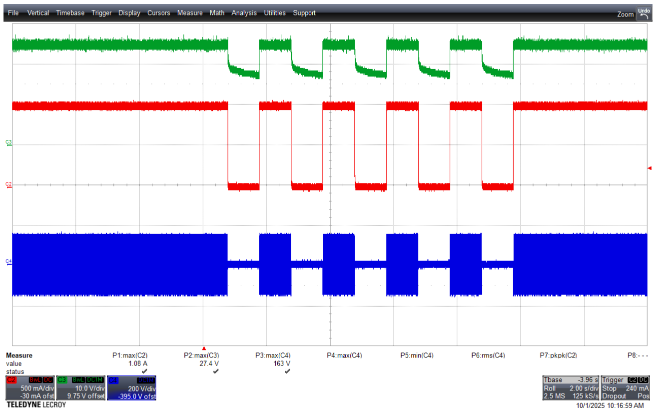


Figure 88 – 100 VAC, 60 Hz 1 s On/Off, 25 V LED.
CH2: I_{DS}, 500 mA / div., 2 s / div.
CH3: V_{OUT}, 10 V / div., 2 s / div.
CH4: V_{IN}, 200 V / div., 2 s / div.
$V_{OUT\ Max}$ = 27.4 V
$I_{OUT\ Max}$ = 1.08 A

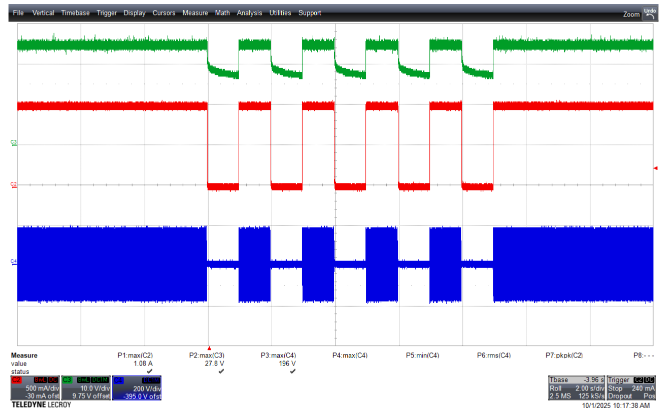


Figure 89 – 120 VAC, 60 Hz 1 s On/Off, 25 V LED.
CH2: I_{DS}, 500 mA / div., 2 s / div.
CH3: V_{OUT}, 10 V / div., 2 s / div.
CH4: V_{IN}, 200 V / div., 2 s / div.
$V_{OUT\ Max}$ = 27.8 V
$I_{OUT\ Max}$ = 1.08 A

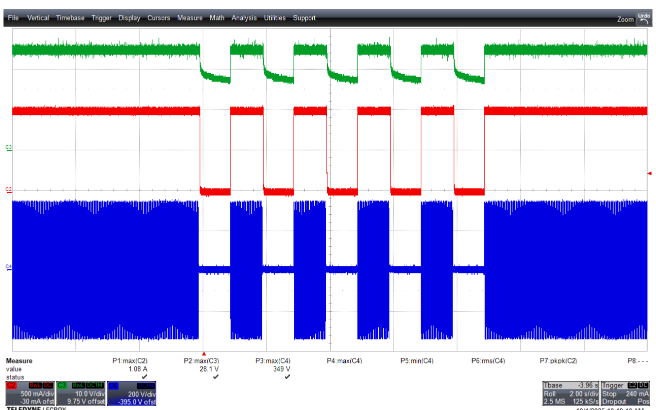


Figure 90 – 230 VAC, 50 Hz 1 s On/Off, 25 V LED.
CH2: I_{DS}, 500 mA / div., 2 s / div.
CH3: V_{OUT}, 10 V / div., 2 s / div.
CH4: V_{IN}, 200 V / div., 2 s / div.
$V_{OUT\ Max}$ = 28.1 V
$I_{OUT\ Max}$ = 1.08 A

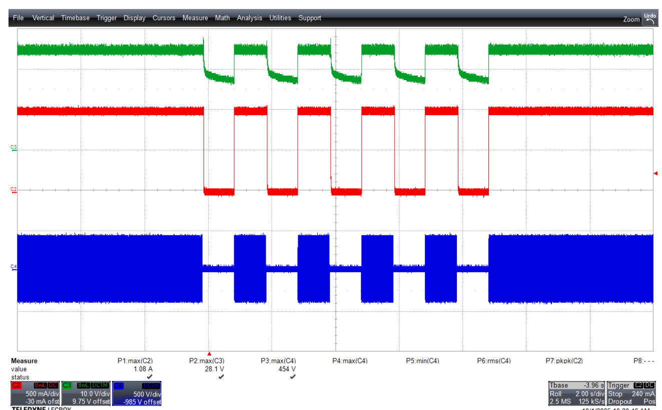


Figure 91 – 277 VAC, 60 Hz 1 s On/Off, 25 V LED.
CH2: I_{DS}, 500 mA / div., 2 s / div.
CH3: V_{OUT}, 10 V / div., 2 s / div.
CH4: V_{IN}, 500 V / div., 2 s / div.
$V_{OUT\ Max}$ = 28.1 V
$I_{OUT\ Max}$ = 1.08 A

11.5 Input Voltage and Current

11.5.1 Input Voltage and Current at 36 V LED Steady-State Condition

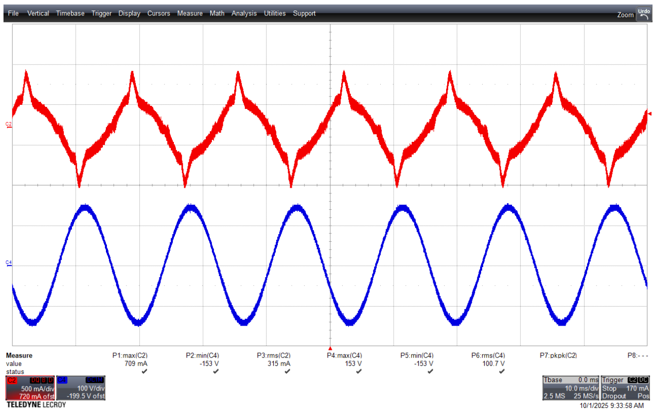


Figure 92 – 100 VAC, 60 Hz. 36 V LED String.
CH2: I_{IN}, 500 mA / div., 10 ms / div.
CH4: V_{IN}, 100 V / div., 10 ms / div.
$I_{IN\ RMS}$ = 315 mA
$I_{IN\ Max}$ = 709 mA

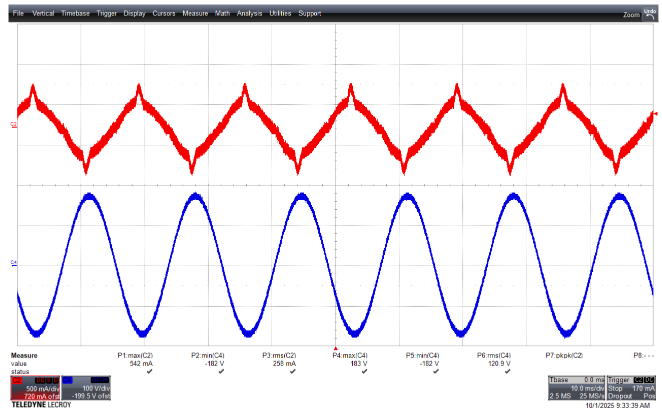


Figure 93 – 120 VAC, 60 Hz. 36 V LED String.
CH2: I_{IN}, 500 mA / div., 10 ms / div.
CH4: V_{IN}, 100 V / div., 10 ms / div.
$I_{IN\ RMS}$ = 258 mA
$I_{IN\ Max}$ = 542 mA

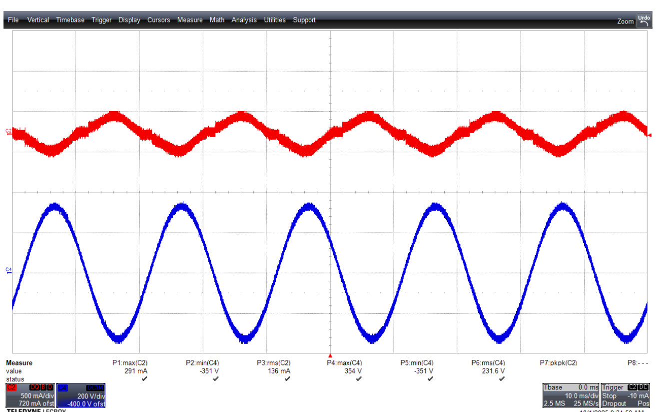


Figure 94 – 230 VAC, 50 Hz. 36 V LED String.
CH2: I_{IN}, 500 mA / div., 10 ms / div.
CH4: V_{IN}, 200 V / div., 10 ms / div.
$I_{IN\ RMS}$ = 136 mA
$I_{IN\ Max}$ = 291 mA

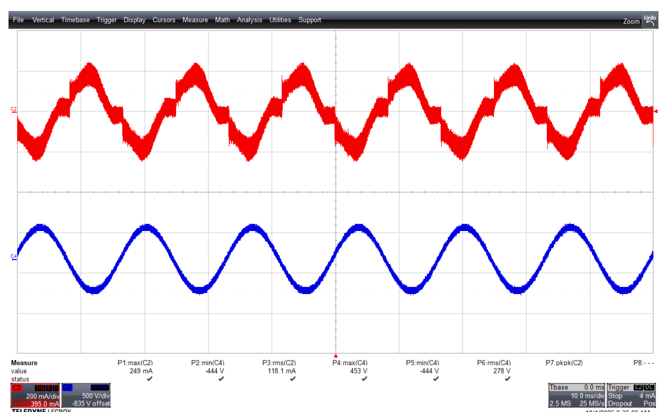


Figure 95 – 277 VAC, 60 Hz. 36 V LED String.
CH2: I_{IN}, 200 mA / div., 10 ms / div.
CH4: V_{IN}, 500 V / div., 10 ms / div.
$I_{IN\ RMS}$ = 118 mA
$I_{IN\ Max}$ = 249 mA

11.5.2 Input Voltage and Current at 25 V LED Steady-State Condition

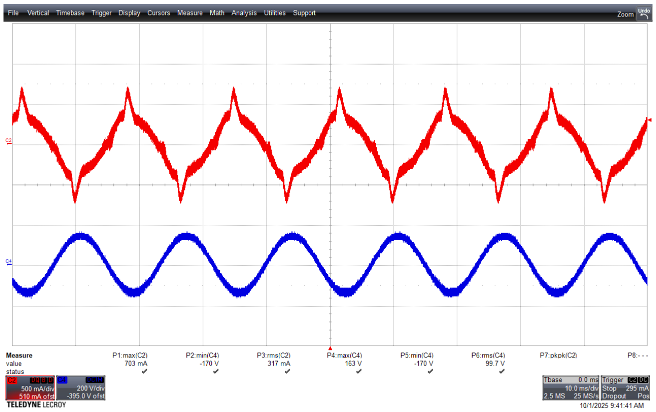


Figure 96 – 100 VAC, 60 Hz. 25 V LED String.
CH2: I_{IN}, 500 mA / div., 10 ms / div.
CH4: V_{IN}, 200 V / div., 10 ms / div.
$I_{IN\ RMS}$ = 317 mA
$I_{IN\ Max}$ = 703 mA

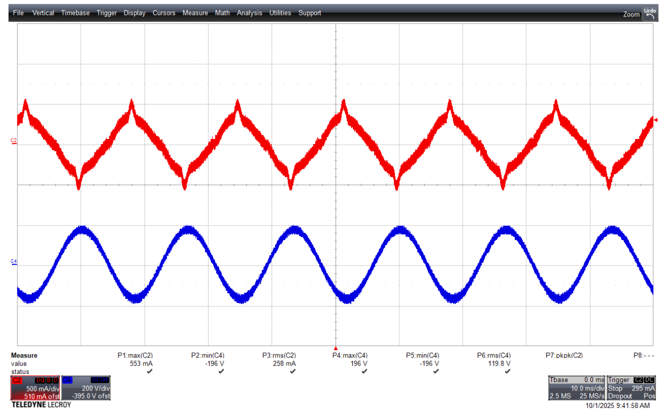


Figure 97 – 120 VAC, 60 Hz. 25 V LED String.
CH2: I_{IN}, 500 mA / div., 10 ms / div.
CH4: V_{IN}, 200 V / div., 10 ms / div.
$I_{IN\ RMS}$ = 258 mA
$I_{IN\ Max}$ = 553 mA

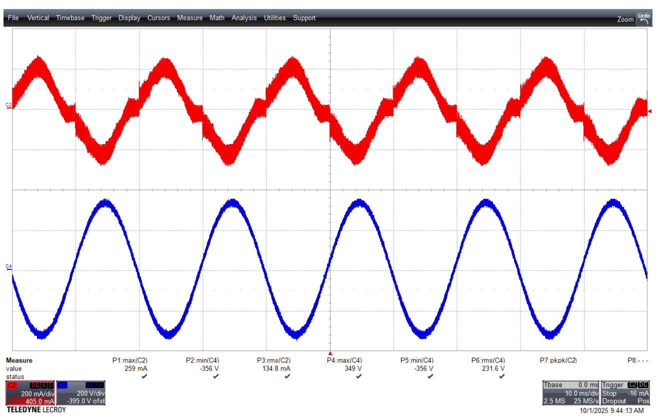


Figure 98 – 230 VAC, 50 Hz. 25 V LED String.
CH2: I_{IN}, 200 mA / div., 10 ms / div.
CH4: V_{IN}, 200 V / div., 10 ms / div.
$I_{IN\ RMS}$ = 135 mA
$I_{IN\ Max}$ = 259 mA

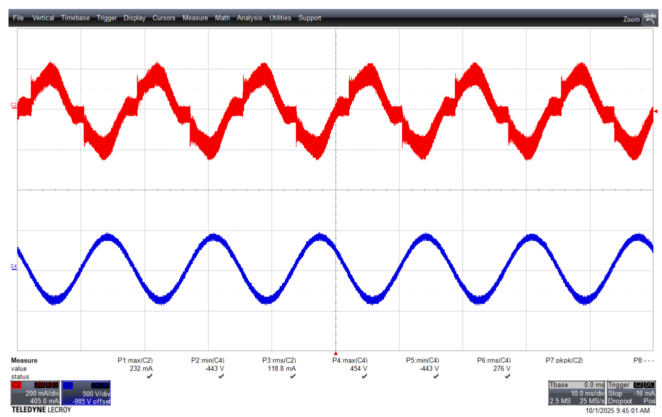


Figure 99 – 277 VAC, 60 Hz. 25 V LED String.
CH2: I_{IN}, 200 mA / div., 10 ms / div.
CH4: V_{IN}, 500 V / div., 10 ms / div.
$I_{IN\ RMS}$ = 119 mA
$I_{IN\ Max}$ = 232 mA

11.6 Output Ripple Current at 36 V LED String

11.6.1 Output Ripple Current at 36 V LED String

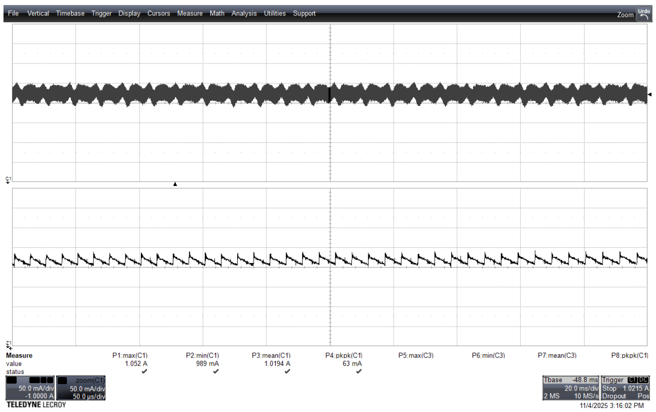


Figure 100 – 100 VAC, 60 Hz. 36 V LED String.
CH1: I_{OUT}, 50 mA / div., 20 ms / div.
Zoom In: 50 μs / div.
I_{RIPPLE} = 63 mA pk-pk

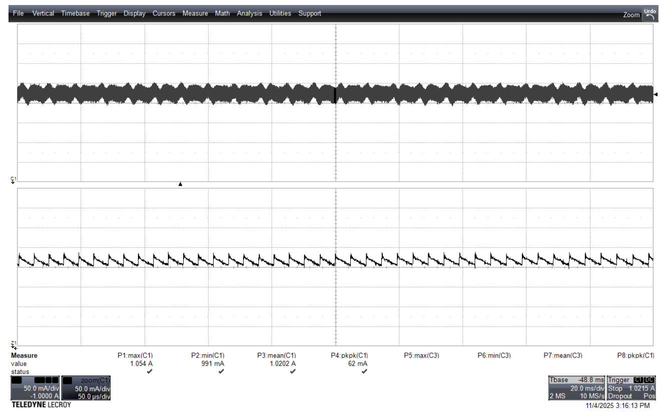


Figure 101 – 115 VAC, 60 Hz. 36 V LED String.
CH2: I_{OUT}, 50 mA / div., 20 ms / div.
Zoom In: 50 μs / div.
I_{RIPPLE} = 62 mA pk-pk

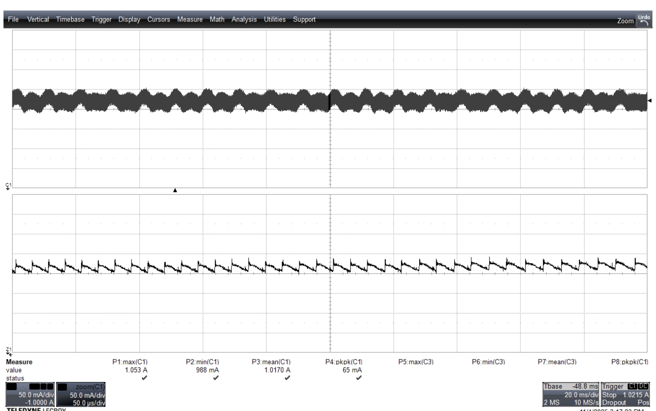


Figure 102 – 230 VAC, 50 Hz. 36 V LED String.
CH2: I_{OUT}, 50 mA / div., 20 ms / div.
Zoom In: 50 μs / div.
I_{RIPPLE} = 65 mA pk-pk

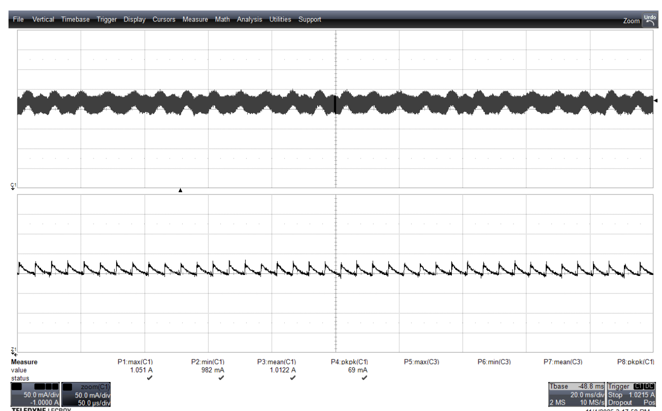


Figure 103 – 277 VAC, 60 Hz. 36 V LED String.
CH2: I_{OUT}, 50 mA / div., 20 ms / div.
Zoom In: 50 μs / div.
I_{RIPPLE} = 69 mA pk-pk

11.7 Input Line Overvoltage and Overvoltage Recovery Test

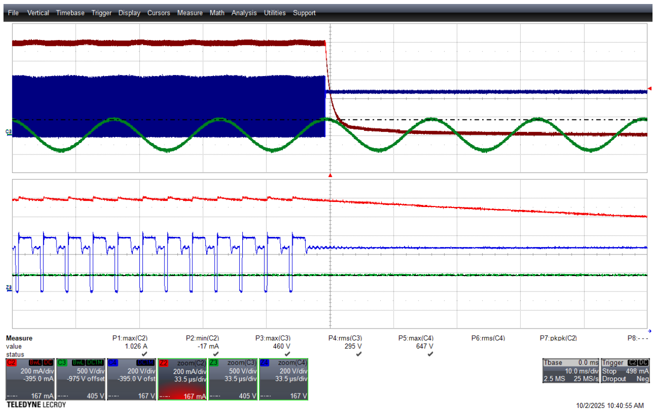


Figure 104 – Line Overvoltage at 36 V LED
CH2: I_{OUT}, 200 mA / div., 10 ms / div.
CH3: V_{IN}, 500 V / div., 10 ms / div.
CH4: V_{DS}, 200 V / div., 10 ms / div.
Zoom In: 33.5 µs / div.
$V_{IN\text{-}OVP\ RMS}$ = 295 V
V_{DS} = 460 V

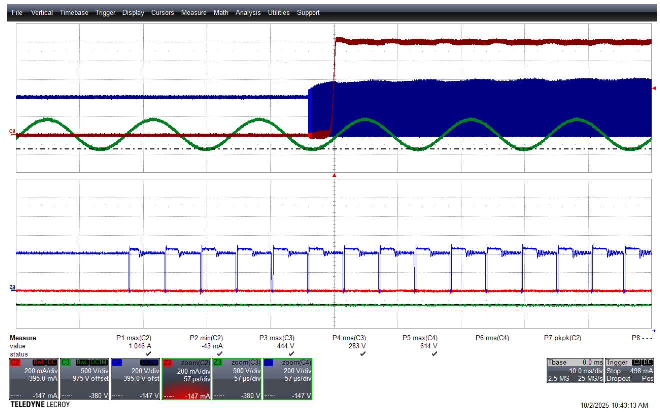


Figure 105 – Line Overvoltage Recovery at 36 V LED
CH2: I_{OUT}, 200 mA / div., 10 ms / div.
CH3: V_{IN}, 500 V / div., 10 ms / div.
CH4: V_{DS}, 200 V / div., 10 ms / div.
Zoom In: 57 µs / div.
$V_{IN\text{-}OVP\text{-}Recovery\ RMS}$ = 283 V
V_{DS} = 444 V

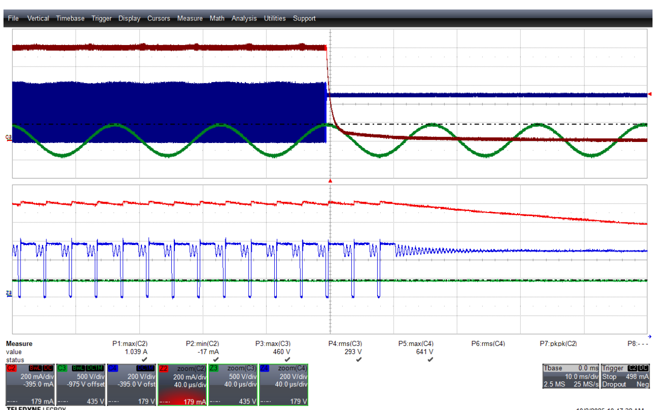


Figure 106 – Line Overvoltage at 25 V LED
CH2: I_{OUT}, 200 mA / div., 10 ms / div.
CH3: V_{IN}, 500 V / div., 10 ms / div.
CH4: V_{DS}, 200 V / div., 10 ms / div.
Zoom In: 40 µs / div.
$V_{IN\text{-}OVP\ RMS}$ = 293 V
V_{DS} = 460 V

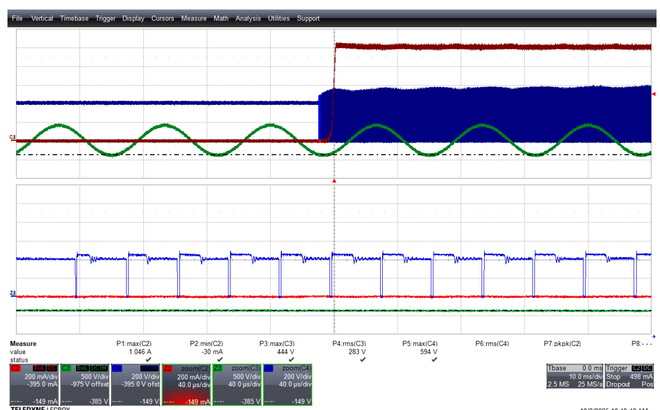


Figure 107 – Line Overvoltage Recovery at 25 V LED
CH2: I_{OUT}, 200 mA / div., 10 ms / div.
CH3: V_{IN}, 500 V / div., 10 ms / div.
CH4: V_{DS}, 200 V / div., 10 ms / div.
Zoom In: 40 µs / div.
$V_{IN\text{-}OVP\text{-}Recovery\ RMS}$ = 283 V
V_{DS} = 444 V

11.8 Input Step Line Transient

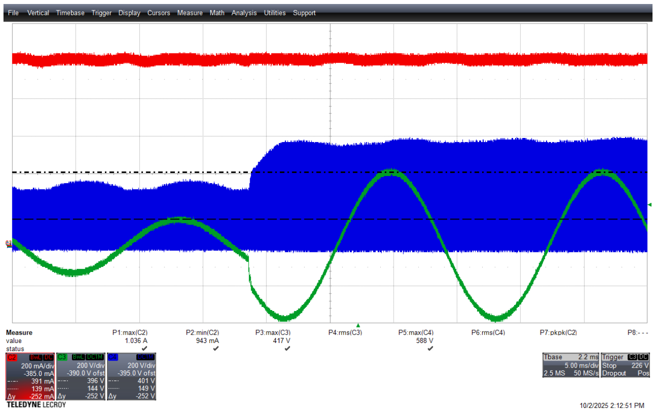


Figure 108 – Step Line 100 V -277 V at 36 V LED
CH2: I_{OUT}, 200 mA / div., 5 ms / div.
CH3: V_{IN}, 200 V / div., 5 ms / div.
CH4: V_{DS}, 200 V / div., 5 ms / div.
$I_{OUT\ Max}$ = 1.04 A
$I_{OUT\ Min}$ = 0.94 A

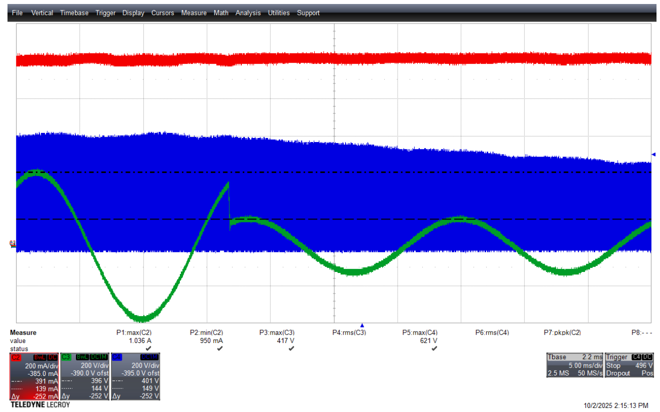


Figure 109 – Step Line 277 V -100 V at 36 V LED
CH2: I_{OUT}, 200 mA / div., 5 ms / div.
CH3: V_{IN}, 200 V / div., 5 ms / div.
CH4: V_{DS}, 200 V / div., 5 ms / div.
$I_{OUT\ Max}$ = 1.04 A
$I_{OUT\ Min}$ = 0.95 A

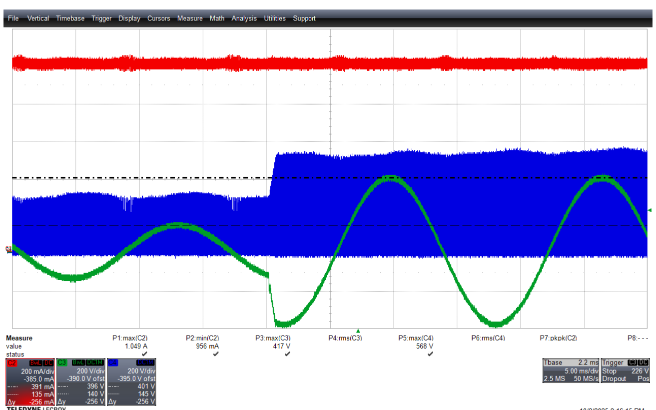


Figure 110 – Step Line 100 V -277 V at 25 VLED
CH2: I_{OUT}, 200 mA / div., 5 ms / div.
CH3: V_{IN}, 200 V / div., 5 ms / div.
CH4: V_{DS}, 200 V / div., 5 ms / div.
$I_{OUT\ Max}$ = 1.05 A
$I_{OUT\ Min}$ = 0.96 A

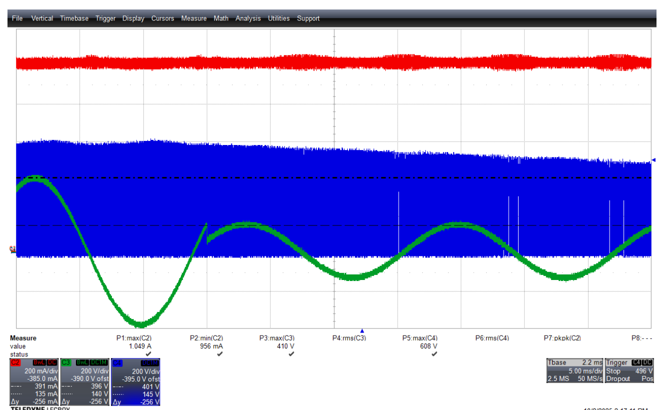


Figure 111 – Step Line 277 V -100 V at 25 VLED
CH2: I_{OUT}, 200 mA / div., 5 ms / div.
CH3: V_{IN}, 200 V / div., 5 ms / div.
CH4: V_{DS}, 200 V / div., 5 ms / div.
$I_{OUT\ Max}$ = 1.05 A
$I_{OUT\ Min}$ = 0.96 A

11.9 Brown-in / Brown-out Test at 36 V LED

11.9.1 Brown-in / Brown-out Test at 36 V LED

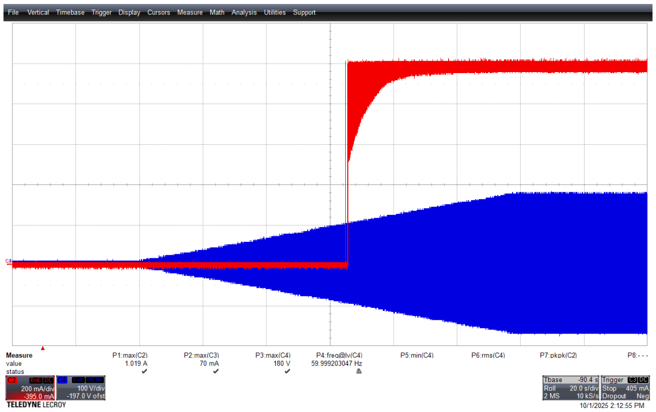


Figure 112 – Brown in, 0 - 100 V, 1 V / s, at 36 VLED
CH2: I_{OUT}, 200 mA / div., 20 s / div.
CH4: V_{IN}, 100 V / div., 20 s / div.

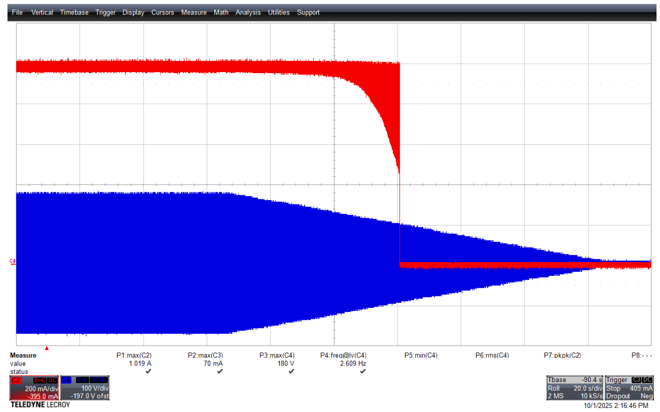


Figure 113 – Brown in, 100 - 0 V, 1 V / s, at 36 VLED
CH2: I_{OUT}, 200 mA / div., 20 s / div.
CH4: V_{IN}, 100 V / div., 20 s / div.

11.9.2 Brown-in / Brown-out Test at 25 V LED

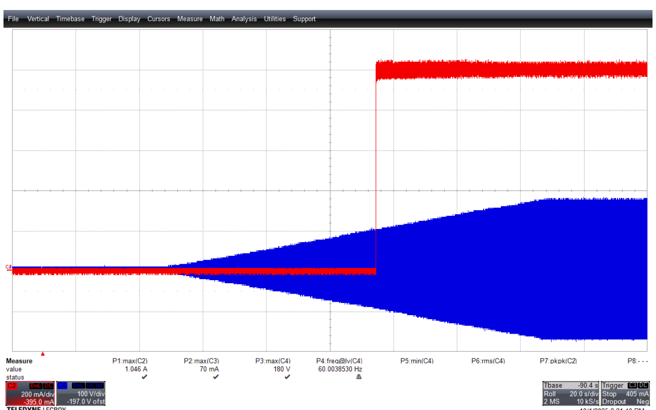


Figure 114 – Brown in, 0 - 100 V, 1 V / s, at 25 VLED
CH2: I_{OUT}, 200 mA / div., 20 s / div.
CH4: V_{IN}, 100 V / div., 20 s / div.

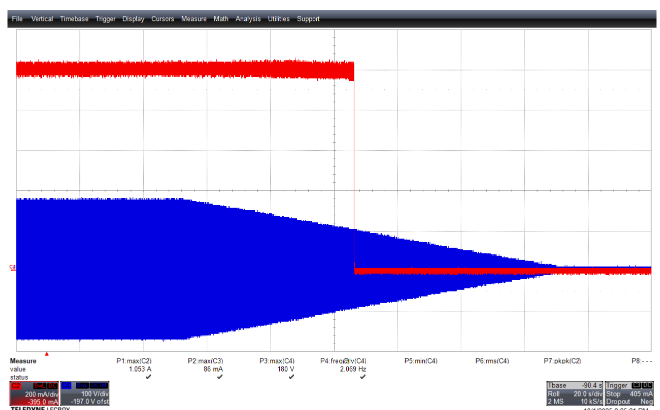


Figure 115 – Brown in, 100 - 0 V, 1 V / s, at 25 VLED
CH2: I_{OUT}, 200 mA / div., 20 s / div.
CH4: V_{IN}, 100 V / div., 20 s / div.

12 Conducted EMI

EMI scans were performed using a 36 V LED Load

12.1 Test Set-up

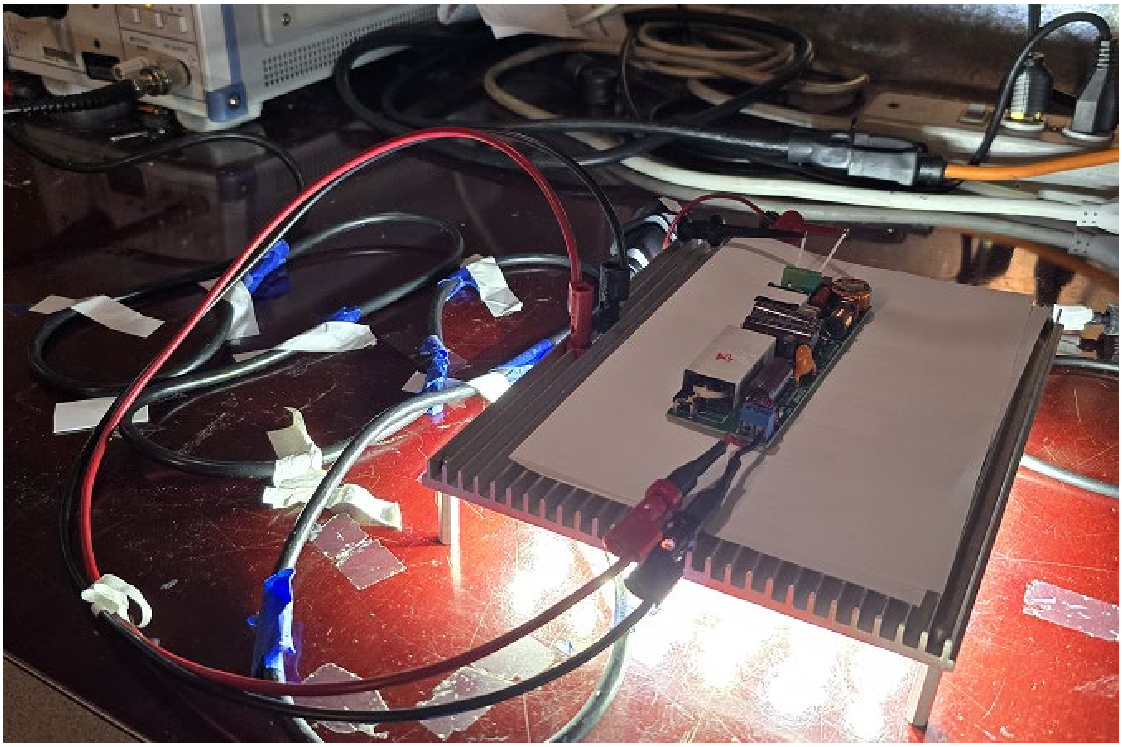


Figure 116 – Conducted EMI Test Set-up.

12.2 Conducted EMI Scan

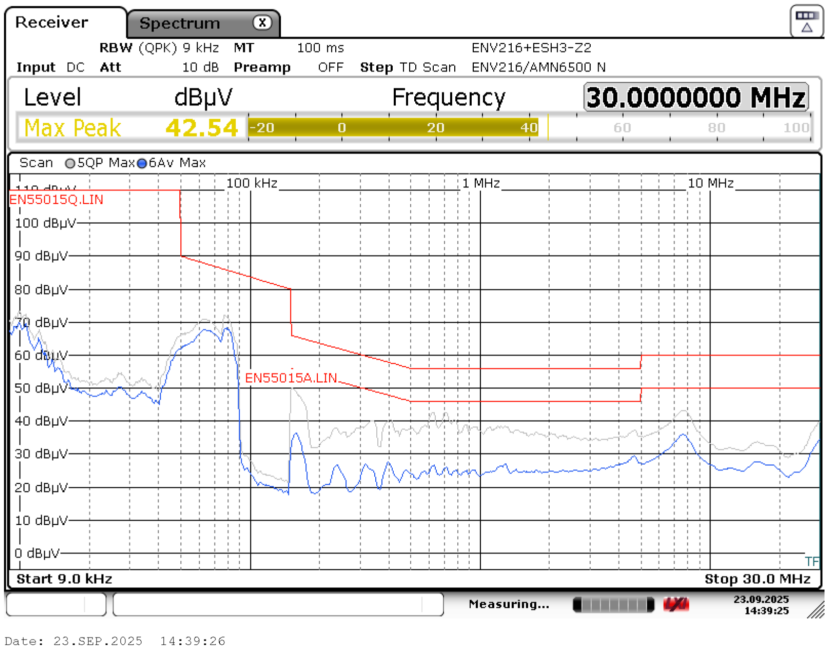


Figure 117 – Conducted EMI at 36 V LED (Floating), 115 VAC.

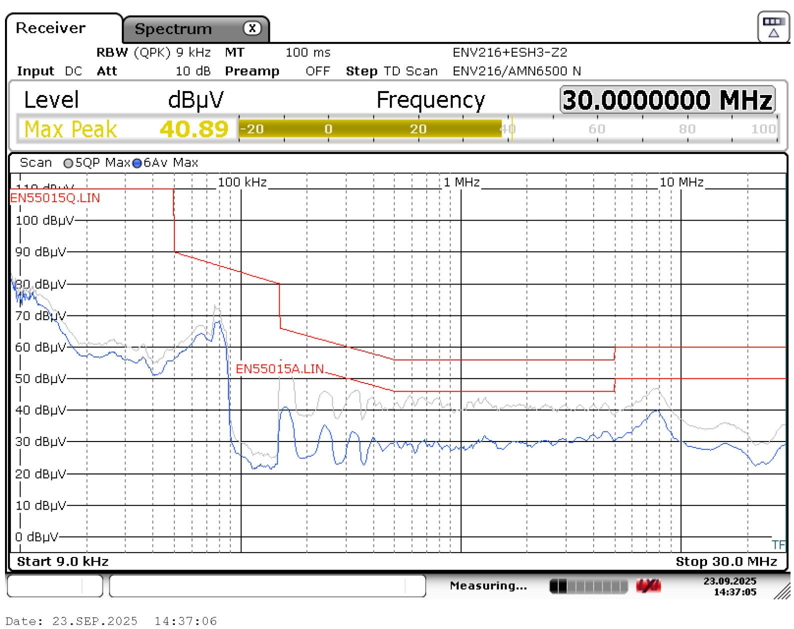


Figure 118 – Conducted EMI at 36 V LED (Floating), 230 VAC.

13 Line Surge

The unit was subjected to ±2500 V ring wave and ±2000 V combination wave surge with 10 strikes for each condition. The unit is considered to have failed if the result of the test is non-recoverable interruption of output that requires either repair or AC cycling.

13.1 Combination Wave Differential Mode Surge

AC Input Voltage (VAC)	Surge Voltage (kV)	Injection Location	Phase Angle (º)	Generator Impedance (Ω)	Number of Strikes	Test Result
230	+2000	L to N	0	2	10	PASS
230	-2000	L to N	0	2	10	PASS
230	+2000	L to N	90	2	10	PASS
230	-2000	L to N	90	2	10	PASS
230	+2000	L to N	180	2	10	PASS
230	-2000	L to N	180	2	10	PASS
230	+2000	L to N	270	2	10	PASS
230	-2000	L to N	270	2	10	PASS

Note: output recovered after AR

Table 14 – Combination Wave Differential Mode Surge.

13.2 Ring Wave Surge

13.2.1 Ring Wave Differential Mode Surge

AC Input Voltage (VAC)	Surge Voltage (kV)	Injection Location	Phase Angle (º)	Generator Impedance (Ω)	Number of Strikes	Test Result
230	+2500	L to N	0	12	10	PASS
230	-2500	L to N	0	12	10	PASS
230	+2500	L to N	90	12	10	PASS
230	-2500	L to N	90	12	10	PASS
230	+2500	L to N	180	12	10	PASS
230	-2500	L to N	180	12	10	PASS
230	+2500	L to N	270	12	10	PASS
230	-2500	L to N	270	12	10	PASS

Table 15 – Ring Wave Differential Mode Surge.

14 Revision History

Date	Author	Revision	Description & Changes	Reviewed
18-Dec-25	MGM	A	Initial Release.	Apps & Mktg

For the latest updates, visit our website: www.power.com

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