Title	***Reference Design Report for a 54 W (200 W Peak) Audio Amplifier Power Supply Using PKS607YN***
Specification	90 – 265 VAC Input; +28 V, 0.893 A ,-28 V, 0.893 A, and +12 V, 333 mA Outputs
Application	Audio Amplifier
Author	Applications Engineering Department
Document Number	RDR-203
Date	April 7, 2009
Revision	1.0

Summary and Features

- Greater than 74% efficiency at full load
- Capable of supplying peak load application with a 4:1 crest factor
  - Ideal for audio applications which demand high peak power with low quiescent current
- High switching frequencies allow for much smaller transformers, reducing cost, weight, copper area and audible noise
- Excellent load regulation provides constant output constant voltage under extreme loading
- Fast feedback loop provides excellent response to transient loading
- Less than 1 watt input power at no-load
- Protection features provide safe shutdown under fault conditions protecting audio loads
- Meets CISPR-22 / EN55022B limits for conducted EMI

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Table of Contents

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.

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1 Introduction

This document is an engineering report describing a 54 W continuous, 200 W peak power supply design utilizing two PKS607YN power conversion ICs. This power supply is intended as a replacement for linear power supplies for audio amplifiers.

The document contains the power supply specification, schematic, bill of materials, transformer documentation, printed circuit layout, and performance data.

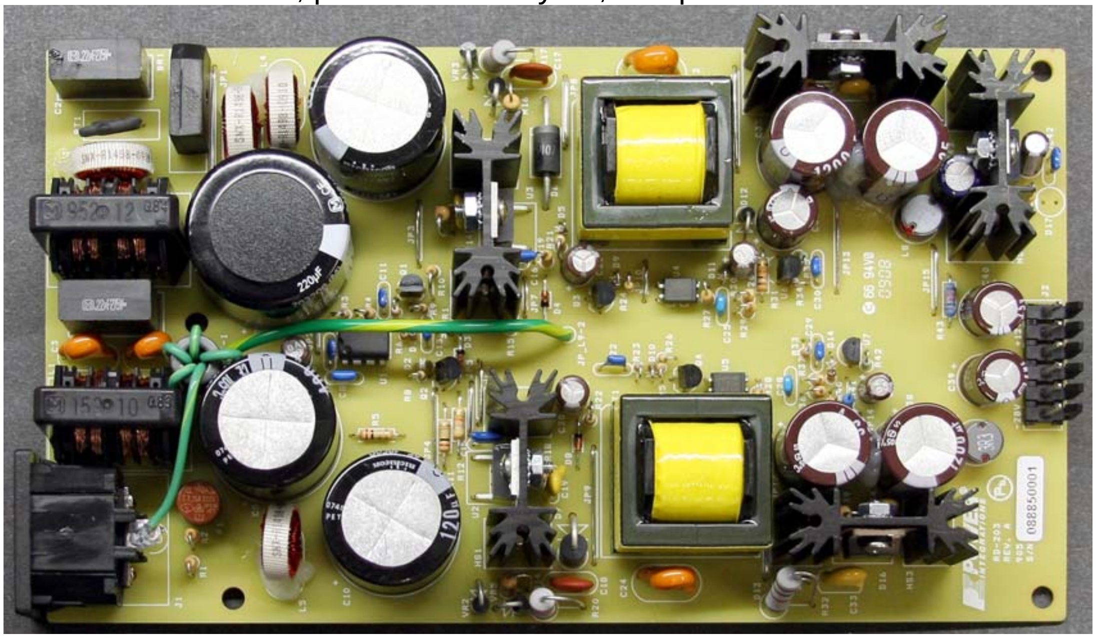

Figure 1 – Populated Circuit Board Photograph Top Side.

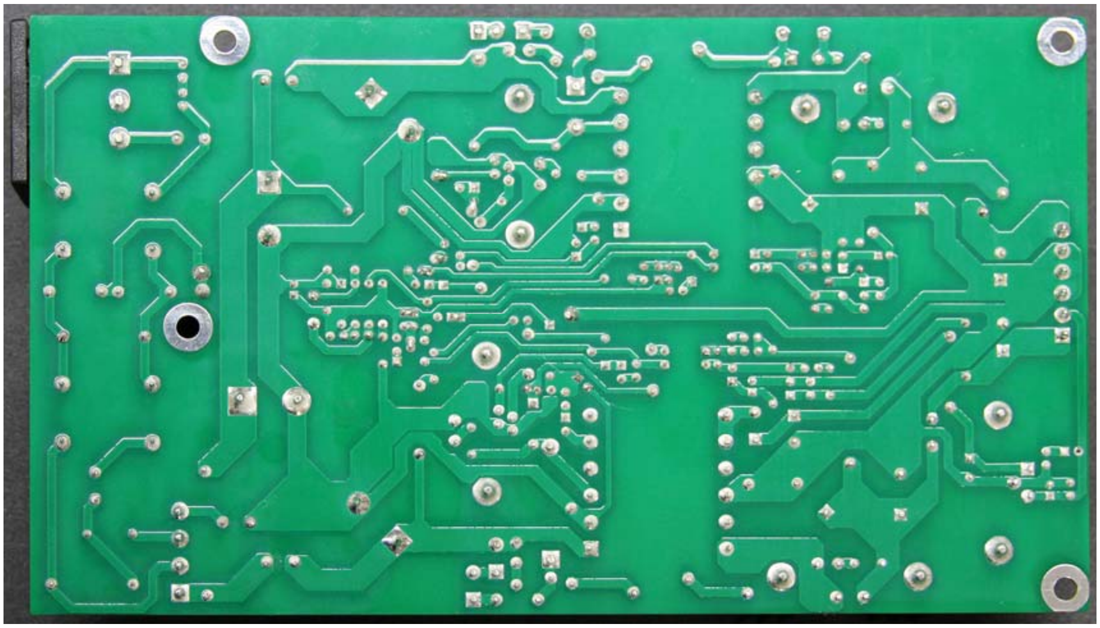

Figure 2 – Populated Circuit Board Photograph Bottom Side.

2 Power Supply Specification

Description	Symbol	Min	Typ	Max	Units	Comment
Input						
Voltage	V_{IN}	90		265	VAC	3 Wire – no P.E.
Frequency	f_{LINE}	47	50/60	64	Hz	
No-load Input Power (230 VAC)				1.0	W	
Output						
Output Voltage 1	V_{OUT1}	26.6	28	29.4	V	± 5%
Output Ripple Voltage 1	$V_{RIPPLE1}$			280	mV	20 MHz bandwidth
Output Current 1	I_{OUT1}		0.893	3.57	A	
Output Power 1	P_{OUT1}		25	100	W	
Output Voltage 2	V_{OUT2}	-26.6	-28	-29.4	V	± 5%
Output Ripple Voltage 2	$V_{RIPPLE2}$			280	mV	20 MHz bandwidth
Output Current 2	I_{OUT2}		0.893	3.57	A	
Output Power 2	P_{OUT2}		25	100	W	
Output Voltage 3	V_{OUT3}	11.4	12	12.6	V	± 5%
Output Ripple Voltage 3	$V_{RIPPLE3}$			120	mV	20 MHz bandwidth
Output Current 3	I_{OUT3}			333	mA	
Output Power 3	P_{OUT2}		4		W	
Total Output Power						
Continuous Output Power	P_{OUT}		54		W	
Peak Output Power	P_{OUT_PEAK}			200	W	
Efficiency						
Full Load	η	70			%	Measured at P_{OUT} 25 ^{o}C
Environmental						
Conducted EMI		Meets CISPR22B / EN55022B				
Safety		Designed to meet IEC950, UL1950 Class II				
Surge		2			kV	1.2/50 µs surge, IEC 1000-4-5, Series Impedance: Differential Mode: 2 Ω Common Mode: 12 Ω
Ambient Temperature	T_{AMB}	0		40	^{o}C	Free convection, sea level

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3 Schematic

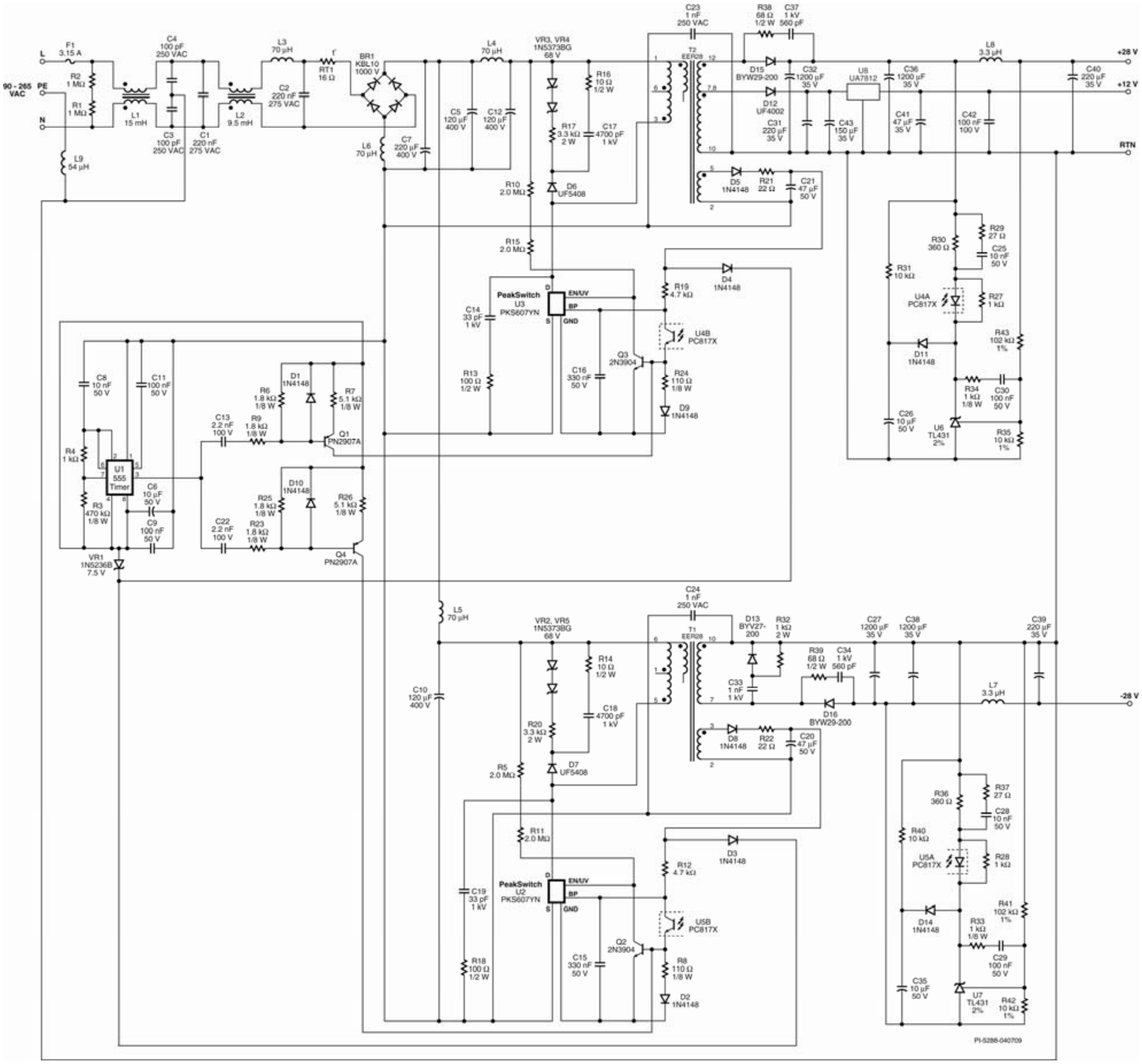

Figure 3 – Schematic.

4 Circuit Description

4.1 Input EMI Filtering

The three wire AC supply is connected to the circuit using connector J1. Fuse F1 provides protection against circuit faults. Thermistor RT1 limits the inrush current drawn by the circuit at start up.

Capacitors C3, C4, C23, C24 along with inductors L4, L5, L6 and L9 and common mode chokes L1 and L2 provide filtering to reduce common mode EMI.

X-caps C1 and C2 along with inductor L3 reduce differential mode EMI at the input while R1 and R2 provide a discharge path for C1. Capacitors C5, C10 and C12 and inductors L4 and L5 create a PI filter for each supply to further reduce differential mode EMI.

Diode bridge BR1 rectifies the AC input which is filtered by C5, C7, C10 and C12.

4.2 PeakSwitch Primary

PeakSwitch devices U3 and U2 drive two parallel, very similar, independent power supplies. The operation of both supplies will be described, with references to matching sets of components on each supply. The description will be referenced to the positive output supply driven by U3, with substitution components for the negative supply, driven by U2, noted in parentheses.

Resistors R10 and R15 (R5 and R11) provide AC line sense and under-voltage detection for U3 (U2).

One side of the power transformer T2 (T1) primary winding is connected to the positive leg of bulk capacitor C12 (C10), and the other side is connected to the DRAIN pin of U3 (U2). At the start of a switching cycle, the controller turns the MOSFET (inside U3 and U2) on and current ramps up in the primary winding, storing energy in the core of the transformer. When the primary current reaches the current limit threshold, the controller turns the MOSFET off. Due to the phasing of the transformer windings and the orientation of the output diode, the stored energy then induces a voltage across the secondary winding, which forward biases the output diode and delivers the stored energy to the output capacitors. When the MOSFET turns off, the leakage inductance of the transformer induces a voltage spike on the drain node. The amplitude of that spike is limited by an RCDZ clamp network that consists of D6, VR3, VR4, C17, R16, and R17 (D7, VR2, VR5, C18, R14 and R20). Zeners VR3 and VR4 (VR2 and VR5), and resistor R17 (R20) dissipate a part of the clamp energy stored in C17 (C18) before the start of the next switching cycle. Resistor R16 (R14) also limits the reverse current that flows through D6 (D7) when the MOSFET turns on. The output of the bias winding is rectified by diode D5 (D8) and filtered by capacitor C21 and R21 (C20 and R22). This rectified and filtered output is fed to the bypass pin capacitor C16 (C15) to power the PeakSwitch device U3,

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(U2). Diode D4 (D3) also feeds this output to the supply rail of the shut-down prevention circuit detailed below.

Unlike conventional pulse width modulation (PWM) controllers, PeakSwitch uses simple ON/OFF control to regulate the output voltage. At each sampling period of the EN/UV pin, if the current out of this pin exceeds 240 µA the device will skip the next cycle.

4.3 Output Rectification

Output rectification for the primary output is provided by diode D15 (D16). Low ESR capacitors C32 and C36 (C27 and C38) provide filtering. Inductor L8, (L7) and capacitor C40 (C39) form a second stage filter that significantly attenuates the switching ripple and ensures low ripple at the output.

The snubber network comprising R38 and C37, (R39 and C34) damp high frequency ringing across diode D15 (D16) which results from leakage inductance of the transformer windings and the secondary trace inductances.

Transformer T2 differs from T1 because its supply also provides a +12 V auxiliary output. Rectification for the +12 V output winding is provided by diode D12. Low ESR capacitor C31 provides filtering. Regulator U8 decreases and regulates the voltage to provide a +12 V auxiliary output, with capacitors C41, C42 and C43 providing the required input and output capacitance to ensure stable operation of U8.

The -28 V supply includes an additional snubber network comprising of D13, R32 and C33 to damp high frequency ringing across diode D16. This is necessary to counteract the increased trace inductance on the -28 V secondary layout.

4.4 Output Feedback

This supply incorporates a constant voltage feedback circuit. During normal operation, the TL431 U6 (U7) draws current through optocoupler U4 (U5) to provide feedback to the EN/UV pin of the PeakSwitch U3 (U2). This circuit operates by maintaining a constant output voltage for load variation from no load to peak load. Resistor R30 (R36) sets the loop gain while R34 and C30 (R33 and C29) set the frequency response of the feedback circuit. Capacitor C25 and R29 (C28 and R37) form the phase boost network that provides the correct phase margin to ensure proper operation over the entire load range (no-load to peak-load.)

Capacitor C26, D11 and R31 (C35, D14 and R40) form the soft-finish circuit. During startup, C26, (C35) begins to charge as the output voltage rises, causing current to flow through optocoupler U4 (U5) and diode D11 (D14). This provides a feedback signal to the device U3 (U2) as the output voltage rises, causing a smooth, monotonic charging of the output capacitors. After the loop is closed and TL431 comes into operation, C26 (C35) continues to charge through R31 (R40) and diode D11 (D14) isolates C26 (C35) from the feedback circuit. Resistor R31 (R40) discharges C26 (C35) when output voltage falls after the power supply has been switched off.

R27 (R28) is used to bias the TL431, and R43 and R35 (R41 and R42) set its reference voltage.

Transistor Q3, R24 and D9 (Q2, R8 and D2) form fast response feedback circuit that enables quick response from the PeakSwitch device U3 (U2) by operating the optocoupler under conditions that give the fastest response.

4.5 Shutdown Prevention Circuit

PeakSwitch incorporates an auto-restart feature which protects the power supply in case of overload or a broken feedback loop by safely shutting down the supply. Audio applications demand power supplies with drooping characteristics at high load that will limit power delivery to the load. This design incorporates a feedback circuit which prevents the device from going into auto-restart during overload conditions. The timing of U1 LMC555CN is controlled by R3, R4 and C8. In this example a 2 µs low pulse is generated every 10 ms. This ensures that, should the output voltage drop and feedback cease, the device will not go into auto-restart after 30 ms. C13 (C22) is a differentiator which biases Q1 (Q2) for a short period when the timer output pulses low. During this period Q1 (Q2) creates a current draw from the EN/UV pin to ensure the device continues to switch. Zener diode VR1 limits the supply voltage to U2 from the bias winding. Resistors R6 and R7 (R25 and R26) biases transistor Q1 (Q2), while diode D1 (D10) limits bias voltage.

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5 PCB Layout

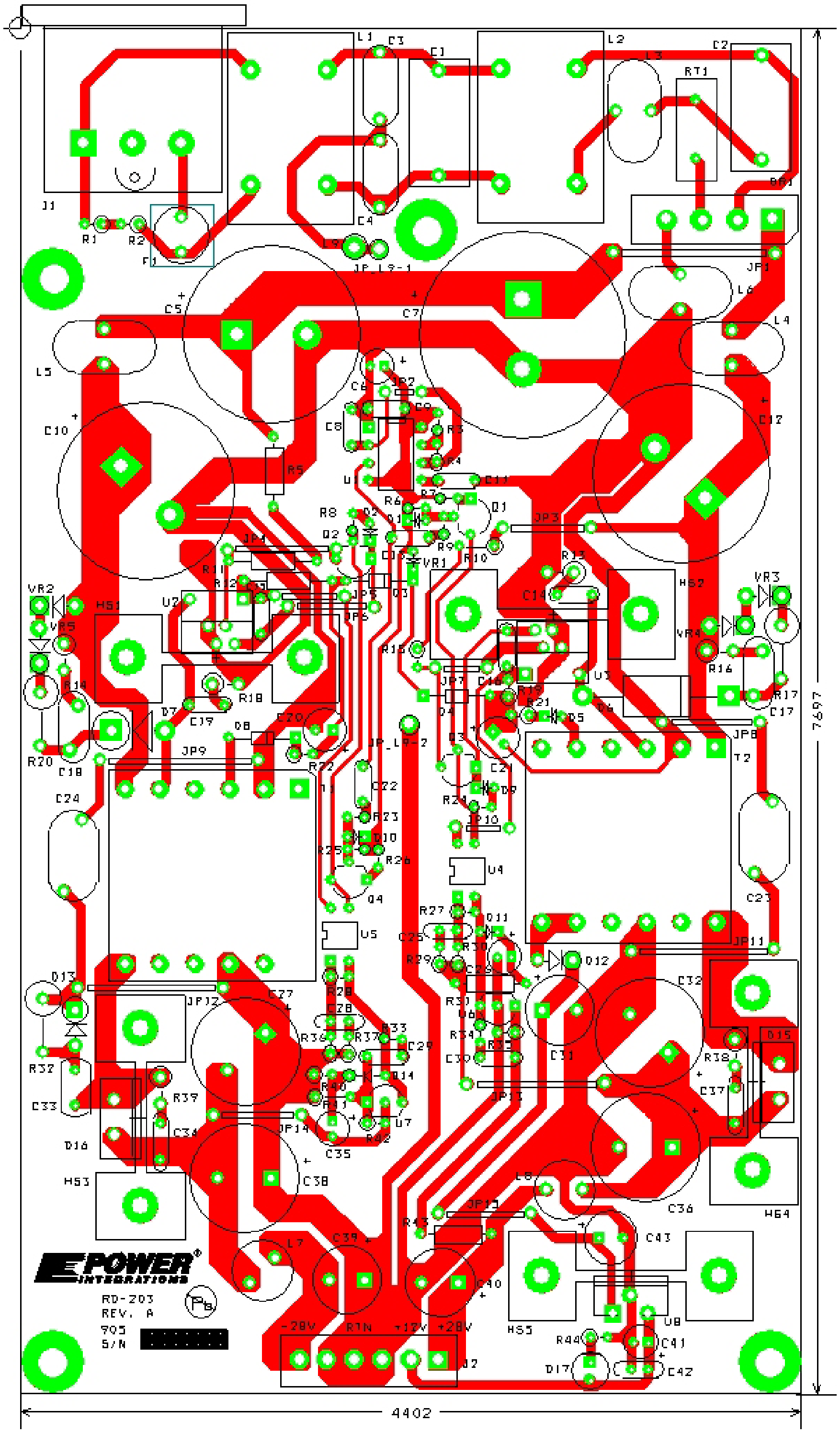

Figure 4 – Printed Circuit Layout.

6 Bill of Materials

Item	Qty	Ref Des	Description	Mfg	Mfg Part Number
1	1	BR1	1000 V, 4 A, Bridge Rectifier	Vishay	KBL10-E4/51
2	2	C1 C2	220 nF, 275 VAC, Film, X2	Panasonic	ECQ-U2A224ML
3	2	C3 C4	100 pF, Ceramic, Y1	Vishay	440LT10-R
4	3	C5 C10 C12	120 μF, 400 V, Electrolytic,GU Snap, (25 x 25)	Nichicon	LGU2G121MELA
5	3	C6 C26 C35	10 μF, 50 V, Electrolytic, Gen. Purpose, (5 x 11)	Nippon Chemi-Con	EKMG500ELL100ME11D
6	1	C7	220 μF, 400 V, Electrolytic, TS-UQ, (30 x 25)	Panasonic	EET-HC2G221DA
7	1	C8	10 nF, 50 V, Ceramic, COG	Epcos	B37986G5822J000
8	4	C9 C11 C29 C30	100 nF, 50 V, Ceramic, X7R	Epcos	B37987F5104K000
9	2	C13 C22	2.2 nF, 100 V, Ceramic, X7R	Epcos	B37981M1222K000
10	2	C14 C19	33 pF, 1 kV, Disc Ceramic	Panasonic	ECC-A3A330JGE
11	2	C15 C16	330 nF, 50 V, Ceramic, X7R	Epcos	B37984M5334K000
12	2	C17 C18	4700 pF, 1 kV, Thru Hole, Disc Ceramic	Vishay / Sprague	562R5GAD47
13	2	C20 C21	47 μF, 50 V, Electrolytic, Gen. Purpose, (6.3 x 11)	Nippon Chemi-Con	EKMG500ELL470MF11D
14	2	C23 C24	1 nF, Ceramic, Y1	Vishay	440LD10-R
15	2	C25 C28	10 nF, 50 V, Ceramic, X7R	Murata	RPER71H103K2P1A03B
16	4	C27 C32 C36 C38	1200 μF, 35 V, Electrolytic, Very Low ESR, 18 mΩ, (16 x 20)	Nippon Chemi-Con	EKZE350ELL122ML20S
17	1	C31	220 μF, 35 V, Electrolytic, Very Low ESR, 53 mΩ, (10 x 12.5)	Nippon Chemi-Con	EKZE350ELL221MJC5S
18	1	C33	1 nF, 1 kV, Disc Ceramic, Y5P	Panasonic	ECK-A3A102KBP
19	2	C34 C37	560 pF, 1 kV, Disc Ceramic	Panasonic	ECK-D3A561KBN
20	2	C39 C40	220 μF, 35 V, Electrolytic, Gen. Purpose, (10 x 12.5)	Nippon Chemi-Con	EKME350ELL221MJC5S
21	1	C41	47 μF, 35 V, Electrolytic, Gen. Purpose, (5 x 11)	Nippon Chemi-Con	EKMG350ELL470ME11D
22	1	C42	100 nF, 100 V, Ceramic, X7R	Epcos	B37987M1104K000
23	1	C43	150 μF, 35 V, Electrolytic, Low ESR, 120 mΩ, (8 x 12)	Nippon Chemi-Con	ELXZ350ELL151MH12D
24	10	D1 D2 D3 D4 D5 D8 D9 D10 D11 D14	75 V, 300 mA, Fast Switching, DO-35	Vishay	1N4148TR
25	2	D6 D7	1000 V, 3 A, Ultrafast Recovery, 50 ns, DO-201AD	Vishay	UF5407-E3/54
26	1	D12	100 V, 1 A, Ultrafast Recovery, 50 ns, DO-41	Vishay	UF4002-E3
27	1	D13	200 V, 2 A, Ultrafast Recovery, 25 ns, SOD57	Philips	BYV27-200
28	2	D15 D16	200 V, 8 A, Ultrafast Recovery, 25 ns, TO-220AC	ON Semiconductor	BYW29-200G
29	1	F1	3.15 A, 250V, Slow, TR5	Wickman	3721315041
30	5	HS1 HS2 HS3 HS4 HS5	HEATSINK, Alum, TO220_POWER W/PINS BK_ L 1.375" (34.92mm) W 0.50" (12.7 mm) H 1." (25.4 mm)	Aavid Thermaloy	513002B02500G
31	1	J1	AC Input Receptacle and Accessory Plug, PCBM	Kobiconn	161-R301SN13
32	1	J2	6 Position (1 x 6) header, 0.156 pitch, Vertical	Molex	26-48-1065

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33	5	JP1 JP3 JP6 JP14 JP15	Wire Jumper, Non insulated, 22 AWG, 0.5 in	Alpha	298
34	1	JP2	Wire Jumper, Non insulated, 22 AWG, 0.2 in	Alpha	298
35	2	JP4 JP8	Wire Jumper, Non insulated, 22 AWG, 0.6 in	Alpha	298
36	1	JP5	Wire Jumper, No insulated, 22 AWG, 0.4 in	Alpha	298
37	2	JP7 JP10	Wire Jumper, Non insulated, 22 AWG, 0.3 in	Alpha	298
38	1	JP9	Wire Jumper, Non insulated, 22 AWG, 0.9 in	Alpha	298
39	3	JP11 JP12 JP13	Wire Jumper, Non insulated, 22 AWG, 0.8 in	Alpha	298-
40	1	JP_L9	Wire, 20AWG,Grn/Yel, Length to be specified in Mech Drawing	Anixter	1180-20/19-54
41	1	L1	15 mH, 1 A, Common Mode Choke,	Panasonic-ECG	ELF-18N010A
42	1	L2	9.5 mH, 1.2 A, Common Mode Choke	Panasonic	ELF18N012A
43	4	L3 L4 L5 L6	70 μH, Common Mode Inductor, 2 Pins,	Santronics	SNX-R1498
44	2	L7 L8	3.3 uH, 5.0 A	Coilcraft	RFB0807-3R3L
45	1	L9	54 μH, Ground Choke, Flying Lead	Santronics	SNX-R1499
46	4	MTG_HOLE1 MTG_HOLE2 MTG_HOLE3 MTG_HOLE4	Mounting Hole No 6		
47	2	Q1 Q4	PNP, Small Signal BJT, 60 V, 0.6 A, TO-92	On Semiconductor	PN2907AG
48	2	Q2 Q3	NPN, Small Signal BJT, 40 V, 0.2 A, TO-92	On Semiconductor	2N3904RLRAG
49	2	R1 R2	1 MΩ, 5%, 1/4 W, Carbon Film	Yageo	CFR-25JB-1M0
50	1	R3	470 kΩ, 5%, 1/8 W, Carbon Film	Yageo	CFR-12JB-470K
51	3	R4 R27 R28	1 kΩ, 5%, 1/4 W, Carbon Film	Yageo	CFR-25JB-1K0
52	4	R5 R10 R11 R15	2.0 MΩ, 5%, 1/4 W, Carbon Film	Yageo	CFR-25JB-2M0
53	4	R6 R9 R23 R25	1.8 kΩ, 5%, 1/8 W, Carbon Film	Yageo	CFR-12JB-1K8
54	2	R7 R26	5.1 kΩ, 5%, 1/8 W, Carbon Film	Yageo	CFR-12JB-5K1
55	2	R8 R24	110 Ω, 5%, 1/8 W, Carbon Film	Yageo	CFR-12JB-110R
56	2	R12 R19	4.7 kΩ, 5%, 1/4 W, Carbon Film	Yageo	CFR-25JB-4K7
57	2	R13 R18	100 Ω, 5%, 1/2 W, Carbon Film	Yageo	CFR-50JB-100R
58	2	R14 R16	10 Ω, 5%, 1/2 W, Carbon Film	Yageo	CFR-50JB-10R
59	2	R17 R20	3.3 kΩ, 5%, 2 W, Metal Oxide	Yageo	RSF200JB-3K3
60	2	R21 R22	22 Ω, 5%, 1/4 W, Carbon Film	Yageo	CFR-25JB-22R
61	2	R29 R37	27 Ω, 5%, 1/4 W, Carbon Film	Yageo	CFR-25JB-27R
62	2	R30 R36	360 Ω, 5%, 1/4 W, Carbon Film	Yageo	CFR-25JB-360R
63	2	R31 R40	10 kΩ, 5%, 1/4 W, Carbon Film	Yageo	CFR-25JB-10K
64	1	R32	1 kΩ, 5%, 2 W, Metal Oxide	Yageo	RSF200JB-1K0
65	2	R33 R34	1 kΩ, 5%, 1/8 W, Carbon Film	Yageo	CFR-12JB-1K0
66	2	R35 R42	10 kΩ, 1%, 1/4 W, Metal Film	Panasonic	ERO-S2PHF1002
67	2	R38 R39	68 Ω, 5%, 1/2 W, Carbon Film	Yageo	CFR-50JB-68R
68	2	R41 R43	102 kΩ, 1%, 1/4 W, Metal Film	Yageo	MFR-25FBF-102K
69	1	R44	3.6 kΩ, 5%, 1/4 W, Carbon Film	Yageo	CFR-25JB-3K6
70	1	RT1	NTC Thermistor, 16 Ω, 2.7 A	Thermometrics	RL4504-10-73-S60
71	2	T1 T2	Bobbin, ER28, Horizontal, 12 pins	Pin-Shine Santronics (T1) Santronics (T2)	P-2816 SNX-R1496 SNX-R1497

72	1	U1	LMC555 CMOS TIMER 8-DIP	National Semiconductor	LMC555CN
73	2	U2 U3	PeakSwitch, PKS607Y, TO-220-7C	Power Integrations	PKS607YN
74	2	U4 U5	Opto coupler, 35 V, CTR 300-600%, 4-DIP	Sharp	PC817X4J000F
75	2	U6 U7	2.495 V Shunt Regulator IC, 2%, 0 to 70C, TO-92	On Semiconductor	TL431CLPG
76	1	U8	12 V, 1.5 A, Regulator, TO-220	Texas Instruments	UA7812CKC
77	1	VR1	7.5 V, 5%, 500 mW, DO-35	Micro Commercial Co.	1N5236B-TP
78	4	VR2 VR3 VR4 VR5	68 V, 5%, 5 W, DO-41	ON Semiconductor	1N5373BG

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7 Transformer Specification

7.1 28 V Positive Power Supply Transformer

7.1.1 Electrical Schematic and Build Diagram

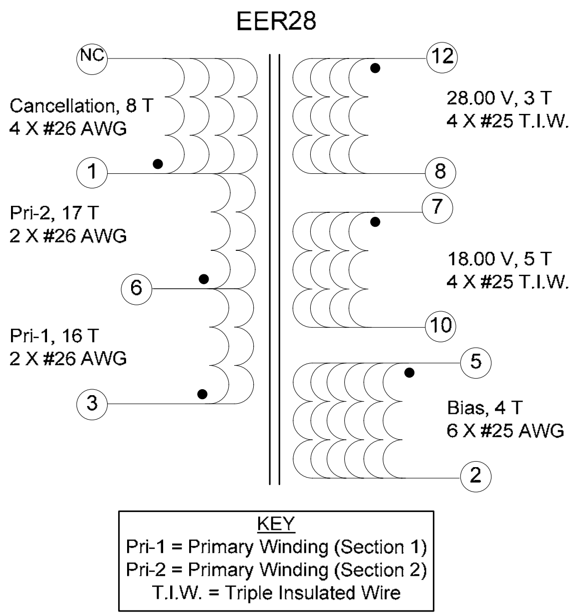

Figure 5 – Transformer Electrical Schematic.

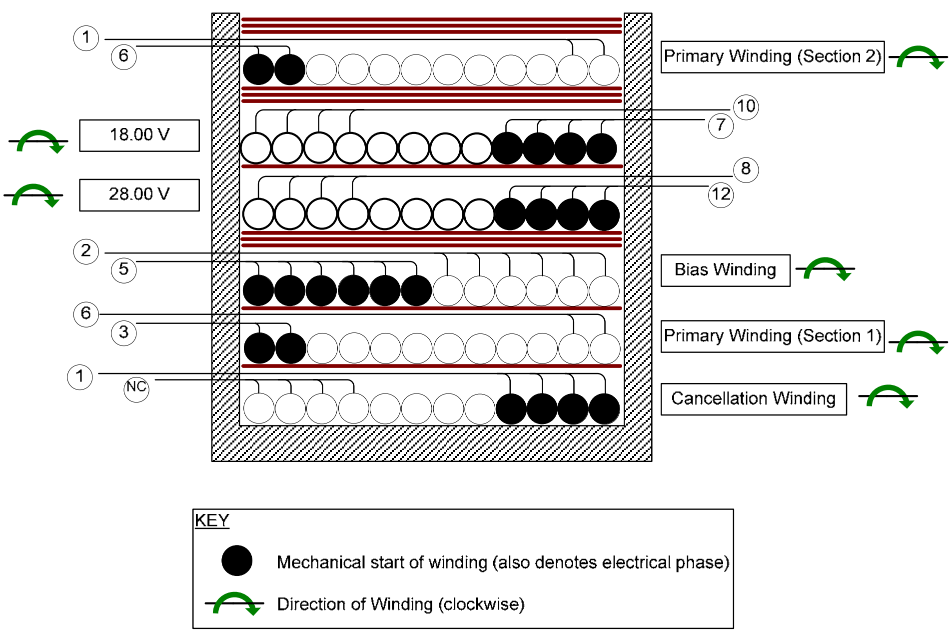

Figure 6 – Transformer Build Diagram.

7.1.2 Electrical Specifications

Electrical Strength	1 second, 60 Hz, from pins 3-6 to pins 7-12	3000 VAC
Primary Inductance	Pins 3-1, all other windings open, measured at 100 kHz, 0.4 VRMS	167 μH, ±5%
Resonant Frequency	Pins 3-1, all other windings open	1500 kHz (Min.)
Primary Leakage Inductance	Pins 3-1, with all other pins shorted, measured at 100 kHz, 0.4 VRMS	3.0 μH (Max.)

7.1.3 Materials

Item	Description
[1]	Core: EER28, NC-2H or Equivalent, gapped for ALG of 149 nH/t²
[2]	Bobbin: ER28 Pin-Shine P-2816, Horizontal, 12 pins (6/6)
[3]	Barrier Tape: Polyester film 16.40 mm wide
[4]	Magnet Wire: 26 AWG, Solderable Double Coated
[5]	Magnet Wire: 25 AWG, Solderable Double Coated
[6]	Triple Insulated Wire: 25 AWG
[7]	Varnish

7.1.4 Transformer Construction

Winding preparation	Orient bobbin item [2] on winding machine with primary side on the left side and secondary side on the right side. Direction for all windings is clockwise direction.
Cancellation	Temporarily hang quad-filar item [4] on pin 10, wind 8 turns from right to left with tight tension and place tape item [3] to hold these wires in place. Flip the start leads from pin 10 to the left side to terminate at pin 1. Cut the end leads to leave no-connect.
Basic Insulation	Add 1 layer of tape item [3] for insulation.
1st half of Primary	Start on pin 3, wind 16 bi-filar turns of item [4] in 1 layer from left to right and bring the wires back to the left side to terminate at pin 6.
Basic Insulation	Add 1 layer of tape item [3] for insulation.
Bias Winding	Start on pin 5, wind 4 turns (x 6 filar) of item [5]. Wind in same as primary winding with tight tension and finish this winding on pin2.
Basic Insulation	Add 3 layers of tape item [3] for insulation.
Secondary 1	Start on pin 12, wind 3 quad-filar turns of item [6] from right to left, spread wires evenly on the bobbin, at the last turn bring the wires back to the right and terminate at pin 8.
Basic Insulation	Add 1 layer of tape item [3] for insulation.
Secondary 2	Wind the same as secondary 1, but start at pin 7, terminate at pin 10, and wind 5 quad-filar turns of item [6].
Secondary Insulation	Add 3 layers of tape, item [3] for insulation.
2nd half of Primary	Wind the same as 1st half of Primary winding, but start on pin 6, terminate at pin 1, and wind 17 bi-filar turns of item [4].
Outer Wrap	Add 3 layers of tape item [3], for insulation.
Core Preparation	Assemble and secure core halves item [1].
Final Assembly	Dip varnish uniformly in item [7]. Do not vacuum impregnate.

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7.2 28 V Negative Power Supply Transformer

7.2.1 Electrical Schematic and Build Diagram

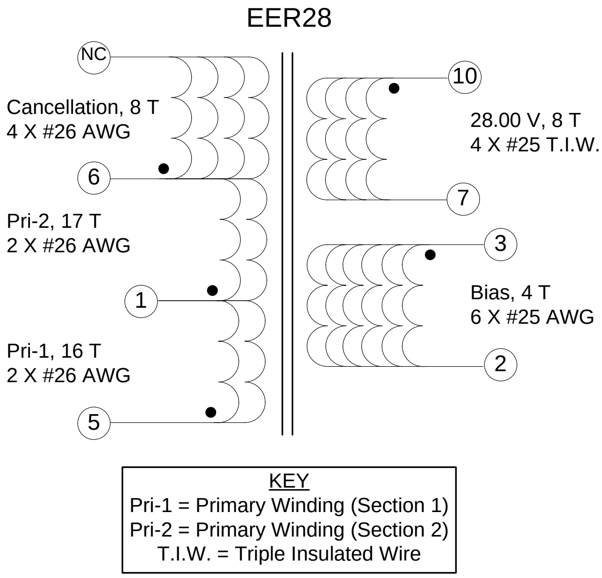

Figure 7 – Transformer Electrical Schematic.

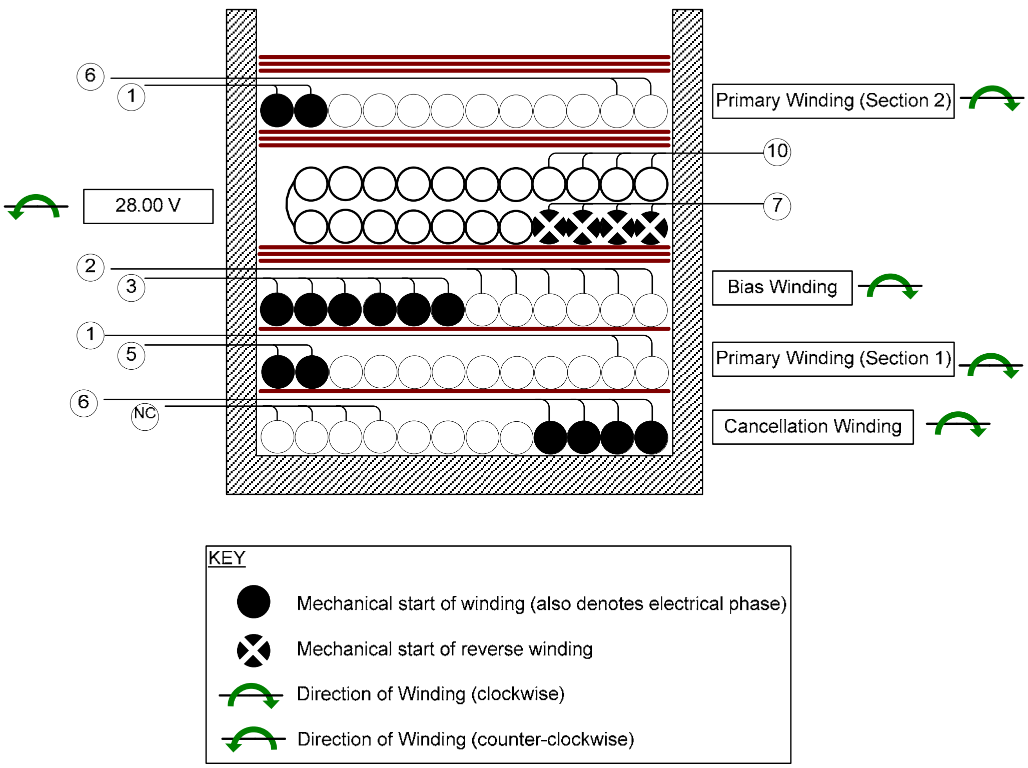

Figure 8 – Transformer Build Diagram.

7.2.2 Electrical Specifications

Electrical Strength	1 second, 60 Hz, from pins 1, 2, 3, 4, 5, 6 to pins 7,10	3000 VAC
Primary Inductance	Pins 5-6, all other windings open, measured at 100 kHz, 0.4 VRMS	167 μH, ±5%
Resonant Frequency	Pins 5-6, all other windings open	1500 kHz (Min.)
Primary Leakage Inductance	Pins 5-6, with all other pins shorted, measured at 100 kHz, 0.4 VRMS	2.5 μH (Max.)

7.2.3 Materials

Item	Description
[1]	Core: EER28, NC-2H or Equivalent, gapped for ALG of 149 nH/t²
[2]	Bobbin: ER28 Pin-Shine P-2816, Horizontal, 12 pins (6/6)
[3]	Barrier Tape: Polyester film 16.40 mm wide
[4]	Magnet Wire: 26 AWG, Solderable Double Coated
[5]	Magnet Wire: 25 AWG, Solderable Double Coated
[6]	Triple Insulated Wire: 25 AWG
[7]	Varnish

7.2.4 Transformer Construction

Winding preparation	Orient bobbin item [2] on winding machine with primary side on the left side and secondary side on the right side. Direction for all windings is clockwise direction.
Cancellation	Temporarily hang quad-filar item [4] on pin 7, wind 8 turns from right to left with tight tension and place tape item [3] to hold these wires in place. Flip the start leads from pin 7 to the left side to terminate at pin 6. Cut the end leads to leave no-connect.
Basic Insulation	Add 1 layer of tape item [3] for insulation.
1st half of Primary	Start on pin 5, wind 16 bi-filar turns of item [4] in 1 layer from left to right and bring the wires back to the left side to terminate at pin 1.
Basic Insulation	Add 1 layer of tape item [3] for insulation.
Bias Winding	Start on pin 3, wind 4 turns (x 6 filar) of item [5]. Wind in same as primary winding with tight tension and finish this winding on pin 2.
Basic Insulation	Add 3 layers of tape item [3] for insulation.
Secondary Winding	This winding direction is reverse direction; just rotate the bobbin so the secondary side is on the left side and keep the same winding direction (clockwise direction). Now start on pin 7, wind 8 quad-filar turns from left to right and then from right to left to terminate at pin 10.
Secondary Insulation	Add 3 layers of tape item [3] for insulation.
2nd half of Primary	Rotate the bobbin back to original position. Do the same as 1st half Primary winding, start on pin 1, wind 17 bi-filar turns of item [4] in 1 layer from left to right and bring the wires back to the left side to terminate at pin 6.
Outer Wrap	Add 3 layers of tape item [3] for insulation.
Core Preparation	Assemble and secure core halves item [1].
Bobbin Pin-out	Remove pin 12 from bobbin by clipping.
Final Assembly	Dip varnish uniformly in item [7]. Do not vacuum impregnate.

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8 Transformer Design Spreadsheets

8.1 28 V Positive Transformer Design

ACDC_PeakSwitch_032608; Rev.1.15; Copyright Power Integrations 2008	INPUT	INFO	OUTPUT	UNIT	ACDC_PeakSwitch_032608_Rev1-15.xls; PeakSwitch Continuous/Discontinuous Flyback Transformer Design Spreadsheet
ENTER APPLICATION VARIABLES					Customer
VACMIN	90			Volts	Minimum AC Input Voltage
VACMAX	265			Volts	Maximum AC Input Voltage
fL	50			Hertz	AC Mains Frequency
Nominal Output Voltage (VO)	28.00			Volts	Nominal Output Voltage (at continuous power)
Maximum Output Current (IO)	3.58			Amps	Power Supply Output Current (corresponding to peak power)
Minimum Output Voltage at Peak Load			28.00	Volts	Minimum Output Voltage at Peak Power (Assuming output droop during peak load)
Continuous Power	25.00		25.00	Watts	Continuous Output Power
Peak Power		*Warning (See Note 1 bleow)*	100.24	Watts	!!! Warning. Peak output power exceeds the power capability of chosen device. Use larger PeakSwitch or reduce peak output power
n	0.76				Efficiency Estimate at output terminals and at peak load. Enter 0.7 if no better data available
Z			0.60		Loss Allocation Factor (Z = Secondary side losses / Total losses)
tC Estimate	3.00			mSeconds	Bridge Rectifier Conduction Time Estimate
CIN	350.00		350	uFarads	Input Capacitance
ENTER PeakSwitch VARIABLES					
PeakSwitch	**PKS607Y**		**PKS607Y**		PeakSwitch device
Chosen Device		*PKS607Y*			
ILIMITMIN			2.790	Amps	Minimum Current Limit
ILIMITMAX			3.210	Amps	Maximum Current Limit
fSmin			250000	Hertz	Minimum Device Switching Frequency
I^2fmin			2242	A^2kHz	I^2f (product of current limit squared and frequency is trimmed for tighter tolerance)
VOR	120.00		120	Volts	Reflected Output Voltage (VOR <= 135 V Recommended)
VDS			10	Volts	PeakSwitch on-state Drain to Source Voltage
VD			0.7	Volts	Output Winding Diode Forward Voltage Drop
VDB			0.7	Volts	Bias Winding Diode Forward Voltage Drop
VCLO			200	Volts	Nominal Clamp Voltage
KP (STEADY STATE)			0.42		Ripple to Peak Current Ratio (KP < 6)
KP (TRANSIENT)			0.26		Ripple to Peak Current Ratio under worst case at peak load (0.25 < KP < 6)
ENTER UVLO VARIABLES					
V_UV_TARGET			121	Volts	Target DC under-voltage threshold, above which the power supply with start
V_UV_ACTUAL			120	Volts	Typical DC start-up voltage based

					on standard value of RUV_ACTUAL
RUV_IDEAL			4.75	Mohms	Calculated value for UV Lockout resistor
RUV_ACTUAL			4.70	Mohms	Closest standard value of resistor to RUV_IDEAL
BIAS WINDING VARIABLES					
VB			15.00	Volts	Bias winding Voltage
NB			4		Number of Bias Winding Turns
PIVB			60	Volts	Bias rectifier Maximum Peak Inverse Voltage
ENTER TRANSFORMER CORE/CONSTRUCTION VARIABLES					
Core Type	**EER28**		**EER28**		User Selected Core Size(Verify acceptable thermal rise under continuous load conditions)
Core		*EER28*		*P/N:*	PC40EER28-Z
Bobbin		*EER28_BOBBIN*		*P/N:*	EER28_BOBBIN
AE			0.821	cm^2	Core Effective Cross Sectional Area
LE			6.40	cm	Core Effective Path Length
AL			2870	nH/T^2	Ungapped Core Effective Inductance
BW			16.70	mm	Bobbin Physical Winding Width
M			0.00	mm	Safety Margin Width (Half the Primary to Secondary Creepage Distance)
L	1.00		1		Number of Primary Layers
NS	8		8		Number of Secondary Turns
DC INPUT VOLTAGE PARAMETERS					
VMIN	110.00		110	Volts	Minimum DC Input Voltage
VMAX			375	Volts	Maximum DC Input Voltage
CURRENT WAVEFORM SHAPE PARAMETERS					
DMAX			0.55		Duty Ratio at full load, minimum primary inductance and minimum input voltage
IAVG			1.32	Amps	Average Primary Current
IP			2.79	Amps	Minimum Peak Primary Current
IR			1.18	Amps	Primary Ripple Current
IRMS			1.89	Amps	Primary RMS Current
TRANSFORMER PRIMARY DESIGN PARAMETERS					
LP			167	uHenries	Typical Primary Inductance. +/- 5% to ensure a minimum primary inductance of 159 uH
LP_TOLERANCE	5.00		5	%	Primary inductance tolerance
NP			33		Primary Winding Number of Turns
ALG			149	nH/T^2	Gapped Core Effective Inductance
Target BM			3000	Gauss	Target Peak Flux Density at Maximum Current Limit
BM			1953	Gauss	Calculated Maximum Operating Flux Density, BM < 3000 is recommended
BAC			414	Gauss	AC Flux Density for Core Loss Curves (0.5 X Peak to Peak)
ur			1780		Relative Permeability of Ungapped Core
LG			0.65	mm	Gap Length (Lg > 0.1 mm)
BWE			16.7	mm	Effective Bobbin Width
OD			0.50	mm	Maximum Primary Wire Diameter including insulation
INS			0.07	mm	Estimated Total Insulation Thickness (= 2 * film thickness)
DIA			0.43	mm	Bare conductor diameter
AWG			26	AWG	Primary Wire Gauge (Rounded to

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					next smaller standard AWG value)
CM			256	Cmils	Bare conductor effective area in circular mils
CMA			135	Cmils/Amp	Primary Winding Current Capacity (100 < CMA < 500)
TRANSFORMER SECONDARY DESIGN PARAMETERS					
Lumped parameters					
ISP			11.67	Amps	Peak Secondary Current
ISRMS			7.22	Amps	Secondary RMS Current
IRIPPLE			6.26	Amps	Output Capacitor RMS Ripple Current
CMS			1443	Cmils	Secondary Bare Conductor minimum circular mils
AWGS			18	AWG	Secondary Wire Gauge (Rounded up to next larger standard AWG value)
VOLTAGE STRESS PARAMETERS					
VDRAIN			665	Volts	Maximum Drain Voltage Estimate (Assumes 20% zener clamp tolerance and an additional 10% temperature tolerance)
PIVS			118	Volts	Output Rectifier Maximum Peak Inverse Voltage
TRANSFORMER SECONDARY DESIGN PARAMETERS (MULTIPLE OUTPUTS)					
1st output					
VO1			28	Volts	Main Output Voltage (if unused, defaults to single output design)
IO1			3.580	Amps	Output DC Current
PO1			100.24	Watts	Output Power
VD1			0.7	Volts	Output Diode Forward Voltage Drop
NS1			8.00		Output Winding Number of Turns
ISRMS1			7.215	Amps	Output Winding RMS Current
IRIPPLE1			6.26	Amps	Output Capacitor RMS Ripple Current
PIVS1			118	Volts	Output Rectifier Maximum Peak Inverse Voltage
Recommended Diodes			**BYW29-200**		Recommended Diodes for this output
CMS1			1443	Cmils	Output Winding Bare Conductor minimum circular mils
AWGS1			18	AWG	Wire Gauge (Rounded up to next larger standard AWG value)
DIAS1			1.03	mm	Minimum Bare Conductor Diameter
ODS1			2.09	mm	Maximum Outside Diameter for Triple Insulated Wire
2nd output					
VO2	18.00			Volts	Output Voltage
IO2	0.33			Amps	Output DC Current
PO2			5.94	Watts	Output Power
VD2			0.7	Volts	Output Diode Forward Voltage Drop
NS2			5.21		Output Winding Number of Turns
ISRMS2			0.665	Amps	Output Winding RMS Current
IRIPPLE2			0.58	Amps	Output Capacitor RMS Ripple Current
PIVS2			76	Volts	Output Rectifier Maximum Peak Inverse Voltage
Recommended Diode			**MUR110, UF4002, SB1100**		Recommended Diodes for this output
CMS2			133	Cmils	Output Winding Bare Conductor minimum circular mils
AWGS2			28	AWG	Wire Gauge (Rounded up to next

					larger standard AWG value)
DIAS2			0.32	mm	Minimum Bare Conductor Diameter
ODS2			3.20	mm	Maximum Outside Diameter for Triple Insulated Wire
3rd output					
VO3				Volts	Output Voltage
IO3				Amps	Output DC Current
PO3			0.00	Watts	Output Power
VD3			0.7	Volts	Output Diode Forward Voltage Drop
NS3			0.20		Output Winding Number of Turns
ISRMS3			0.000	Amps	Output Winding RMS Current
IRIPPLE3			0.00	Amps	Output Capacitor RMS Ripple Current
PIVS3			2	Volts	Output Rectifier Maximum Peak Inverse Voltage
Recommended Diode					Recommended Diodes for this output
CMS3			0	Cmils	Output Winding Bare Conductor minimum circular mils
AWGS3			N/A	AWG	Wire Gauge (Rounded up to next larger standard AWG value)
DIAS3			N/A	mm	Minimum Bare Conductor Diameter
ODS3			N/A	mm	Maximum Outside Diameter for Triple Insulated Wire
Total power		***Warning (See Note 2 Below)***	106.18	Watts	Total power does not match calculated PO at top of sheet
Negative Output			N/A		If negative output exists enter Output number; eg: If VO2 is negative output, enter 2

Note 1: The power level recommended in the power table on the front page of the datasheet is based on several assumptions, as indicated in the applications section of the datasheet. The primary assumption is that the minimum DC Bus voltage be held to 100 V under all operating conditions. Peak power capability can be increased with an increase in the minimum DC Bus voltage.

Using increased bulk capacitance, this design is able to ensure that DC Bus voltage never falls below 110 V at peak load with 90 VAC input. The design does not violate any other design criteria (such as KP, flux density, etc.) at peak load and low line input and hence is able to deliver 100 W of power without encountering any limitations from device ratings.

PI Expert and PIXLs will typically generate a warning when the power level exceeds the rated power in the datasheet. This can be ignored if no other limits are exceeded. Careful attention to thermal design is necessary when operating parts close to rated power.

Note 2: It is assumed that the total load on either power supply will never exceed 100 W.

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8.2 28 V Negative Transformer Design

ACDC_PeakSwitch_032608; Rev.1.15; Copyright Power Integrations 2008	INPUT	INFO	OUTPUT	UNIT	ACDC_PeakSwitch_032608_Rev1-15.xls; PeakSwitch Continuous/Discontinuous Flyback Transformer Design Spreadsheet
ENTER APPLICATION VARIABLES					**Customer**
VACMIN	90			Volts	Minimum AC Input Voltage
VACMAX	265			Volts	Maximum AC Input Voltage
fL	50			Hertz	AC Mains Frequency
Nominal Output Voltage (VO)	28.00			Volts	Nominal Output Voltage (at continuous power)
Maximum Output Current (IO)	3.58			Amps	Power Supply Output Current (corresponding to peak power)
Minimum Output Voltage at Peak Load			28.00	Volts	Minimum Output Voltage at Peak Power (Assuming output droop during peak load)
Continuous Power	25.00		25.00	Watts	Continuous Output Power
Peak Power		*Warning (See Note 1 Below*	100.24	Watts	!!! Warning. Peak output power exceeds the power capability of chosen device. Use larger PeakSwitch or reduce peak output power
n	0.76				Efficiency Estimate at output terminals and at peak load. Enter 0.7 if no better data available
Z			0.60		Loss Allocation Factor (Z = Secondary side losses / Total losses)
tC Estimate	3.00			mSeconds	Bridge Rectifier Conduction Time Estimate
CIN	350.00		350	uFarads	Input Capacitance
ENTER PeakSwitch VARIABLES					
PeakSwitch	**PKS607Y**		**PKS607Y**		PeakSwitch device
Chosen Device		*PKS607Y*			
ILIMITMIN			2.790	Amps	Minimum Current Limit
ILIMITMAX			3.210	Amps	Maximum Current Limit
fSmin			250000	Hertz	Minimum Device Switching Frequency
I^2fmin			2242	A^2kHz	I^2f (product of current limit squared and frequency is trimmed for tighter tolerance)
VOR	120.00		120	Volts	Reflected Output Voltage (VOR <= 135 V Recommended)
VDS			10	Volts	PeakSwitch on-state Drain to Source Voltage
VD			0.7	Volts	Output Winding Diode Forward Voltage Drop
VDB			0.7	Volts	Bias Winding Diode Forward Voltage Drop
VCLO			200	Volts	Nominal Clamp Voltage
KP (STEADY STATE)			0.42		Ripple to Peak Current Ratio (KP < 6)
KP (TRANSIENT)			0.26		Ripple to Peak Current Ratio under worst case at peak load (0.25 < KP < 6)
ENTER UVLO VARIABLES					
V_UV_TARGET			121	Volts	Target DC under-voltage threshold, above which the power supply with start
V_UV_ACTUAL			120	Volts	Typical DC start-up voltage based on standard value of RUV_ACTUAL
RUV_IDEAL			4.75	Mohms	Calculated value for UV Lockout

					resistor
RUV_ACTUAL			4.70	Mohms	Closest standard value of resistor to RUV_IDEAL
BIAS WINDING VARIABLES					
VB			15.00	Volts	Bias winding Voltage
NB			4		Number of Bias Winding Turns
PIVB			60	Volts	Bias rectifier Maximum Peak Inverse Voltage
ENTER TRANSFORMER CORE/CONSTRUCTION VARIABLES					
Core Type	**EER28**		**EER28**		User Selected Core Size(Verify acceptable thermal rise under continuous load conditions)
Core		*EER28*		*P/N:*	PC40EER28-Z
Bobbin		*EER28_BOBBIN*		*P/N:*	EER28_BOBBIN
AE			0.821	cm^2	Core Effective Cross Sectional Area
LE			6.40	cm	Core Effective Path Length
AL			2870	nH/T^2	Ungapped Core Effective Inductance
BW			16.70	mm	Bobbin Physical Winding Width
M			0.00	mm	Safety Margin Width (Half the Primary to Secondary Creepage Distance)
L	1.00		1		Number of Primary Layers
NS	8		8		Number of Secondary Turns
DC INPUT VOLTAGE PARAMETERS					
VMIN	110.00		110	Volts	Minimum DC Input Voltage
VMAX			375	Volts	Maximum DC Input Voltage
CURRENT WAVEFORM SHAPE PARAMETERS					
DMAX			0.55		Duty Ratio at full load, minimum primary inductance and minimum input voltage
IAVG			1.32	Amps	Average Primary Current
IP			2.79	Amps	Minimum Peak Primary Current
IR			1.18	Amps	Primary Ripple Current
IRMS			1.89	Amps	Primary RMS Current
TRANSFORMER PRIMARY DESIGN PARAMETERS					
LP			167	uHenries	Typical Primary Inductance. +/- 5% to ensure a minimum primary inductance of 159 uH
LP_TOLERANCE	5.00		5	%	Primary inductance tolerance
NP			33		Primary Winding Number of Turns
ALG			149	nH/T^2	Gapped Core Effective Inductance
Target BM			3000	Gauss	Target Peak Flux Density at Maximum Current Limit
BM			1953	Gauss	Calculated Maximum Operating Flux Density, BM < 3000 is recommended
BAC			414	Gauss	AC Flux Density for Core Loss Curves (0.5 X Peak to Peak)
ur			1780		Relative Permeability of Ungapped Core
LG			0.65	mm	Gap Length (Lg > 0.1 mm)
BWE			16.7	mm	Effective Bobbin Width
OD			0.50	mm	Maximum Primary Wire Diameter including insulation
INS			0.07	mm	Estimated Total Insulation Thickness (= 2 * film thickness)
DIA			0.43	mm	Bare conductor diameter
AWG			26	AWG	Primary Wire Gauge (Rounded to next smaller standard AWG value)
CM			256	Cmils	Bare conductor effective area in

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					circular mils
CMA			135	Cmils/Amp	Primary Winding Current Capacity (100 < CMA < 500)
TRANSFORMER SECONDARY DESIGN PARAMETERS					
Lumped parameters					
ISP			11.67	Amps	Peak Secondary Current
ISRMS			7.22	Amps	Secondary RMS Current
IRIPPLE			6.26	Amps	Output Capacitor RMS Ripple Current
CMS			1443	Cmils	Secondary Bare Conductor minimum circular mils
AWGS			18	AWG	Secondary Wire Gauge (Rounded up to next larger standard AWG value)
VOLTAGE STRESS PARAMETERS					
VDRAIN			665	Volts	Maximum Drain Voltage Estimate (Assumes 20% zener clamp tolerance and an additional 10% temperature tolerance)
PIVS			118	Volts	Output Rectifier Maximum Peak Inverse Voltage
TRANSFORMER SECONDARY DESIGN PARAMETERS (MULTIPLE OUTPUTS)					
1st output					
VO1			28	Volts	Main Output Voltage (if unused, defaults to single output design)
IO1			3.580	Amps	Output DC Current
PO1			100.24	Watts	Output Power
VD1			0.7	Volts	Output Diode Forward Voltage Drop
NS1			8.00		Output Winding Number of Turns
ISRMS1			7.215	Amps	Output Winding RMS Current
IRIPPLE1			6.26	Amps	Output Capacitor RMS Ripple Current
PIVS1			118	Volts	Output Rectifier Maximum Peak Inverse Voltage
Recommended Diodes			**BYW29-200**		Recommended Diodes for this output
CMS1			1443	Cmils	Output Winding Bare Conductor minimum circular mils
AWGS1			18	AWG	Wire Gauge (Rounded up to next larger standard AWG value)
DIAS1			1.03	mm	Minimum Bare Conductor Diameter
ODS1			2.09	mm	Maximum Outside Diameter for Triple Insulated Wire
2nd output					
VO2				Volts	Output Voltage
IO2				Amps	Output DC Current
PO2			0.00	Watts	Output Power
VD2			0.7	Volts	Output Diode Forward Voltage Drop
NS2			0.20		Output Winding Number of Turns
ISRMS2			0.000	Amps	Output Winding RMS Current
IRIPPLE2			0.00	Amps	Output Capacitor RMS Ripple Current
PIVS2			2	Volts	Output Rectifier Maximum Peak Inverse Voltage
Recommended Diode					Recommended Diodes for this output
CMS2			0	Cmils	Output Winding Bare Conductor minimum circular mils
AWGS2			N/A	AWG	Wire Gauge (Rounded up to next larger standard AWG value)
DIAS2			N/A	mm	Minimum Bare Conductor Diameter
ODS2			N/A	mm	Maximum Outside Diameter for

					Triple Insulated Wire
3rd output					
VO3				Volts	Output Voltage
IO3				Amps	Output DC Current
PO3			0.00	Watts	Output Power
VD3			0.7	Volts	Output Diode Forward Voltage Drop
NS3			0.20		Output Winding Number of Turns
ISRMS3			0.000	Amps	Output Winding RMS Current
IRIPPLE3			0.00	Amps	Output Capacitor RMS Ripple Current
PIVS3			2	Volts	Output Rectifier Maximum Peak Inverse Voltage
Recommended Diode					Recommended Diodes for this output
CMS3			0	Cmils	Output Winding Bare Conductor minimum circular mils
AWGS3			N/A	AWG	Wire Gauge (Rounded up to next larger standard AWG value)
DIAS3			N/A	mm	Minimum Bare Conductor Diameter
ODS3			N/A	mm	Maximum Outside Diameter for Triple Insulated Wire
Total power			100.24	Watts	Total Output Power
Negative Output			N/A		If negative output exists enter Output number; eg: If VO2 is negative output, enter 2

Note 1: The power level recommended in the power table on the front page of the datasheet is based on several assumptions, as indicated in the applications section of the datasheet. The primary assumption is that the minimum DC Bus voltage be held to 100 V under all operating conditions. Peak power capability can be increased with an increase in the minimum DC Bus voltage.

Using increased bulk capacitance, this design is able to ensure that DC Bus voltage never falls below 110 V at peak load with 90 VAC input. The design does not violate any other design criteria (such as KP, flux density, etc.) at peak load and low line input and hence is able to deliver 100 W of power without encountering any limitations from device ratings.

PI Expert and PIXLs will typically generate a warning when the power level exceeds the rated power in the datasheet. This can be ignored if no other limits are exceeded. Careful attention to thermal design is necessary when operating parts close to rated power.

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9 Performance Data

All measurements performed at room temperature, 60 Hz input frequency.

9.1 Active Mode Efficiency

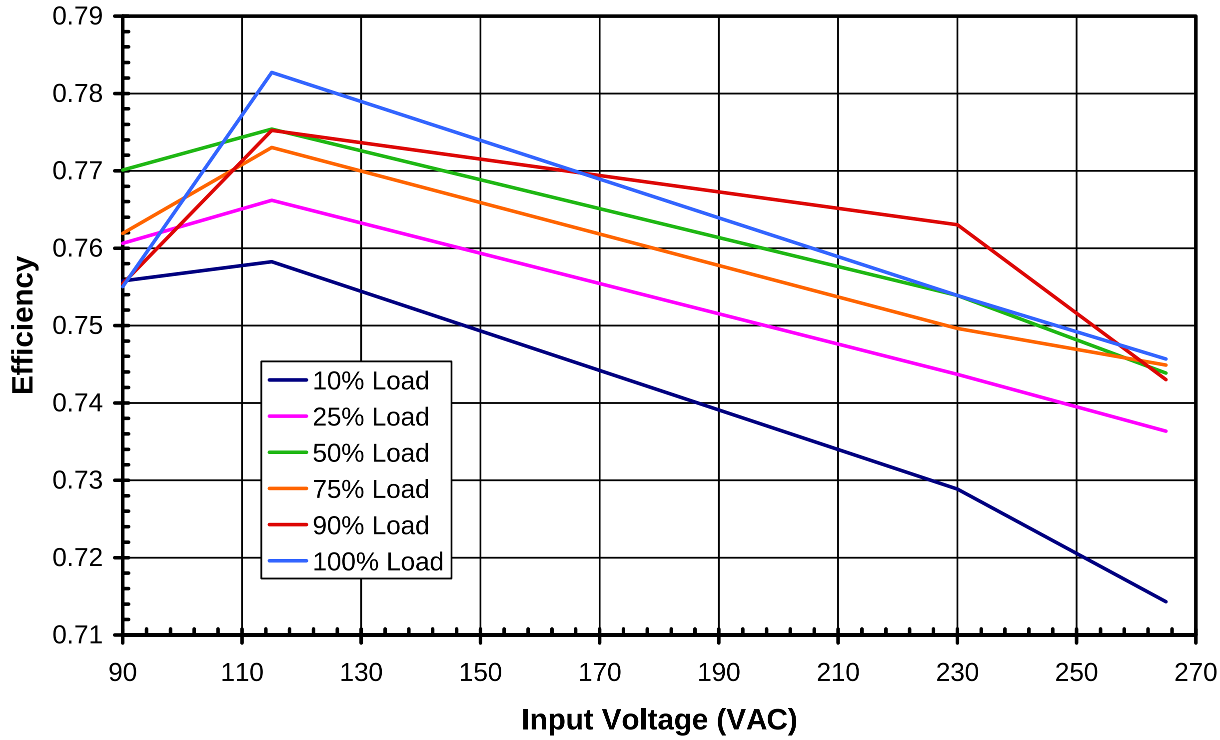

Figure 9 – Efficiency vs. Input Voltage, Room Temperature, 60 Hz.

Percent of Full Load	**Efficiency (%)**	
	115 VAC	**230 VAC**
25	76.6	74.4
50	77.5	75.4
75	77.3	75
100	78.3	75.4
Average	**77.4**	**75**

Note: This design utilizes a linear regulator to achieve a +12 V auxiliary output. Linear regulators have poor efficiency; hence the overall efficiency of this design can be increased by replacing the regulator with a dual weighted feedback scheme for both the +28 V and +12 V outputs, or by removing the auxiliary output completely.

9.2 No-load Input Power

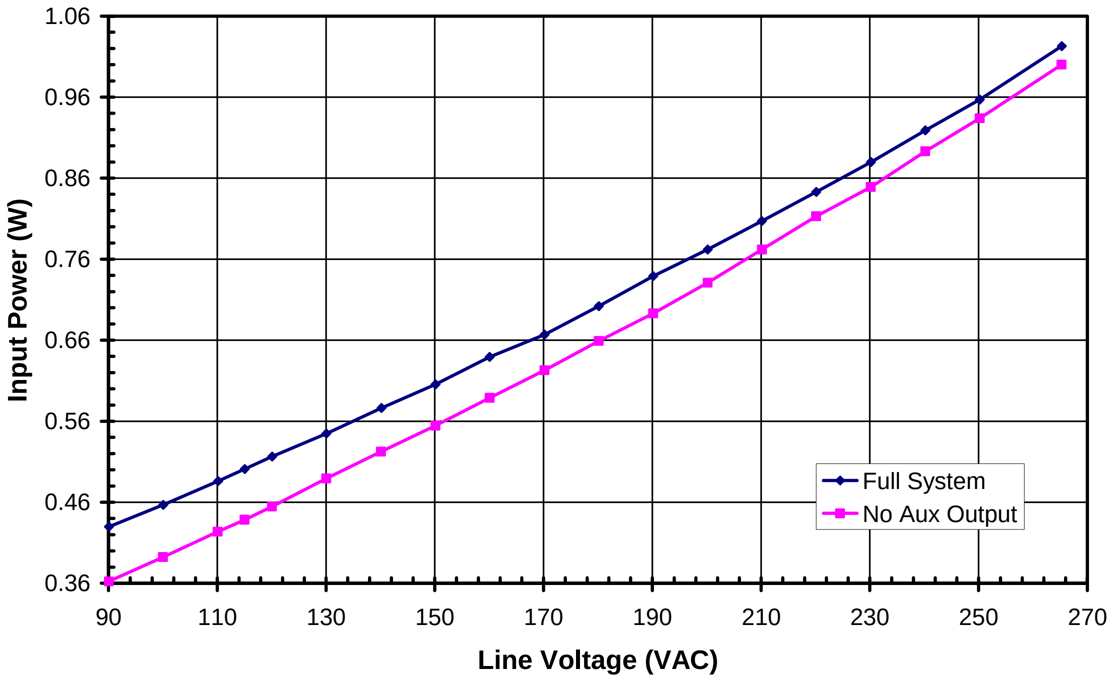

Figure 10 – Zero Load Input Power vs. Input Line Voltage, Room Temperature, 60 Hz.

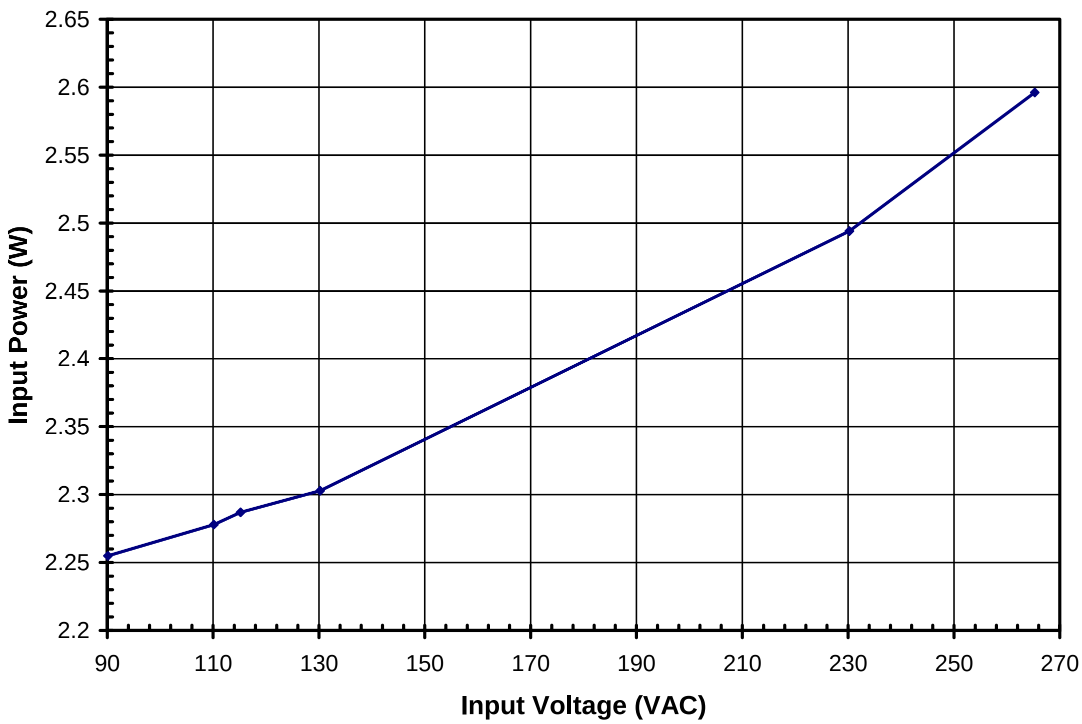

Figure 11 – 1.5 W Load (0.5 W per output) Input Power vs. Input Line Voltage, Room Temperature, 60 Hz.

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9.3 Available Standby Output Power

The chart below shows the input power vs line voltage for an output power of 1 W, 2 W and 3 W loading distributed across all outputs evenly.

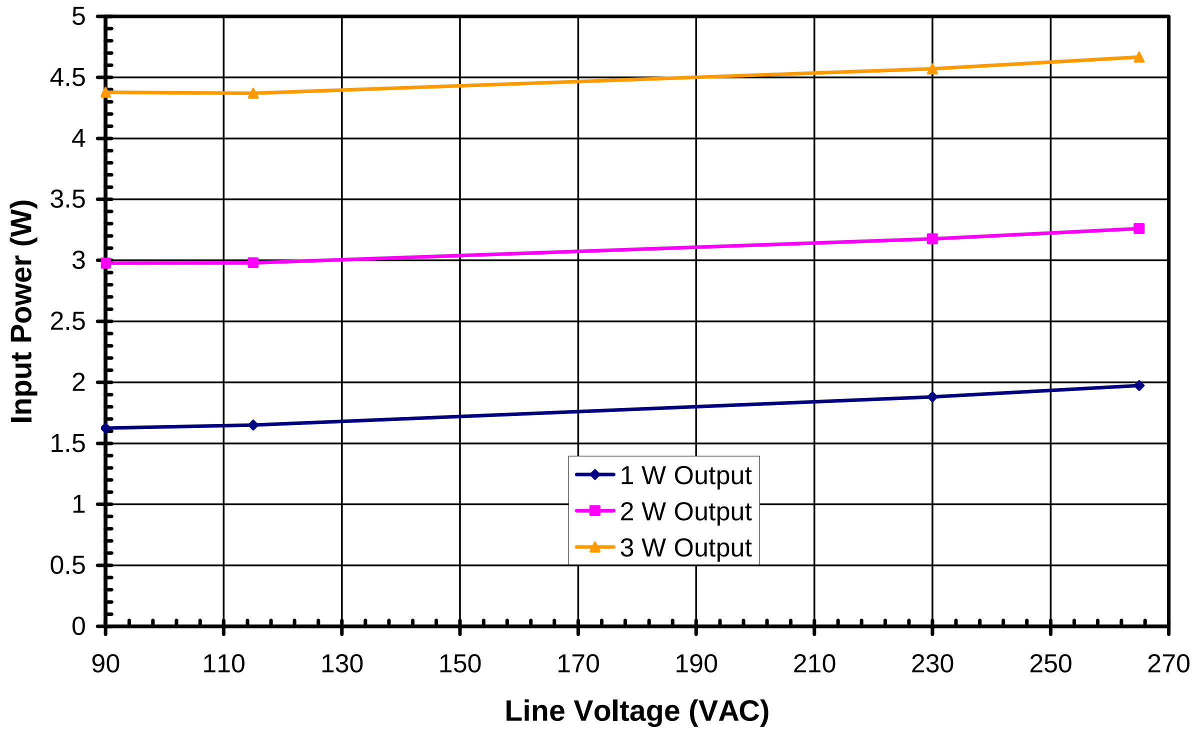

Figure 12 – Output Power Vs. Input Line Voltage, Various Standby Loading, Room Temperature, 60 Hz.

9.4 Regulation

9.4.1 Load

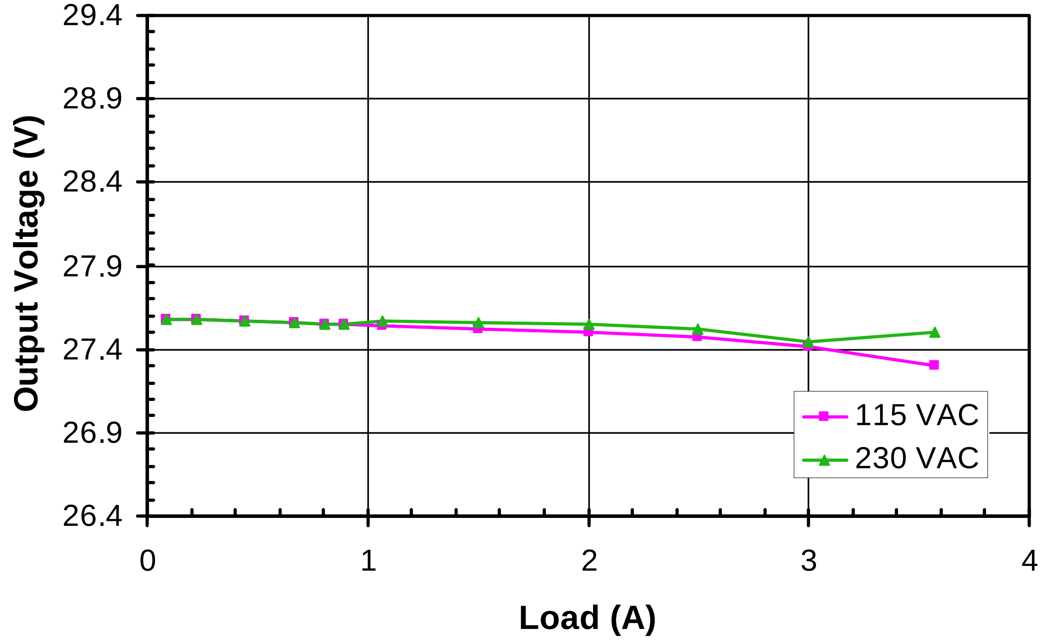

Figure 13 – Load Regulation +28 V Output, Room Temperature.

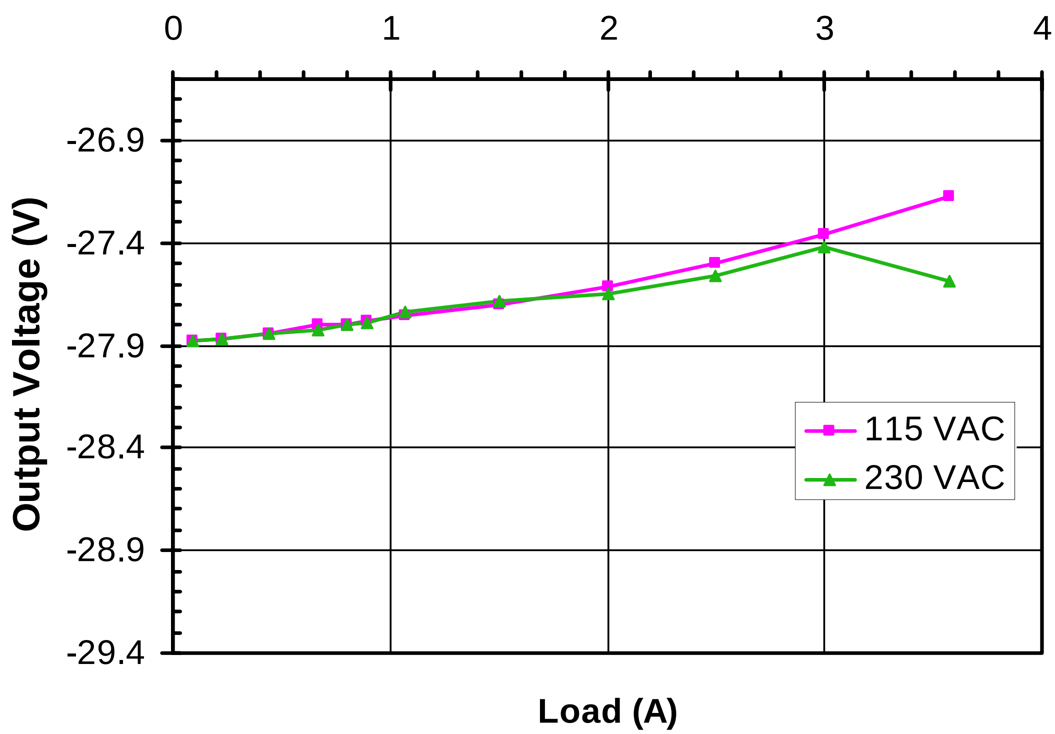

Figure 14 – Load Regulation -28 V Output, Room Temperature.

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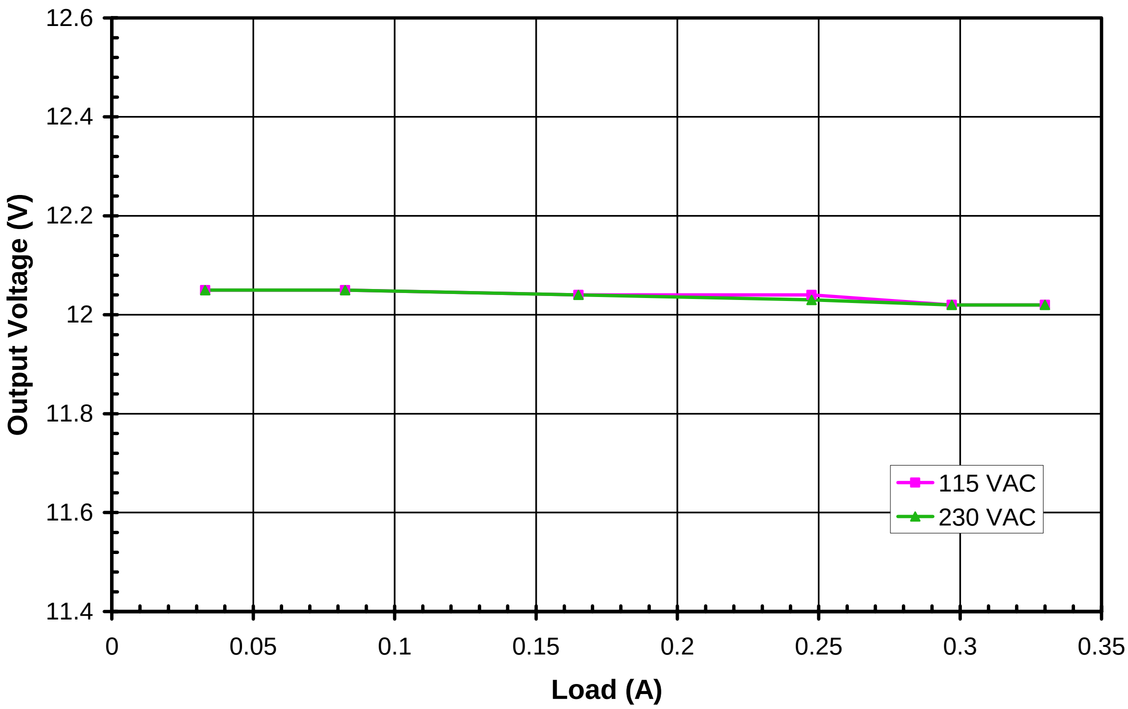

Figure 15 – Load Regulation +12 V Output, Room Temperature.

9.4.2 Line

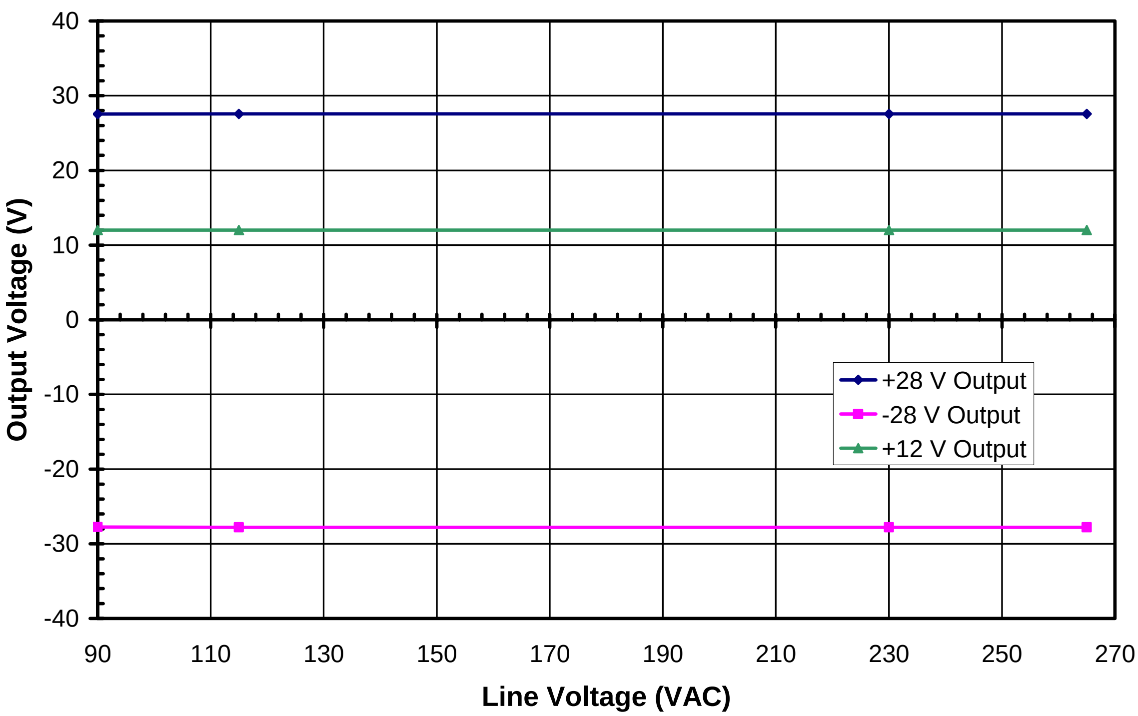

Figure 16 – Line Regulation, Room Temperature, Full Load.

9.4.3 Cross Regulation Matrix

The tables below show data for outputs under various loading conditions at 90, 115, 230 and 265 VAC. Regulation on all outputs is within $\pm$5% under all conditions.

90 VAC constant 33 mA Load on 12 V				115 VAC constant 33 mA Load on 12 V				230 VAC constant 33 mA Load on 12 V				265 VAC constant 33 mA Load on 12 V			
Io (+28 V	Io (12 V)	Vo (+28 V	Vo (12 V)	Io (+28 V)	Io (12 V)	Vo (+28 V)	Vo (12 V)	Io (+28 V)	Io (12 V)	Vo (+28 V)	Vo (12 V)	Io (+28 V)	Io (12 V)	Vo (+28 V)	Vo (12 V)
0.000	0.033	27.59	12.05	0.000	0.033	27.58	12.05	0.000	0.033	27.58	12.05	0.000	0.033	27.58	12.05
0.089	0.033	27.58	12.05	0.089	0.033	27.58	12.05	0.089	0.033	27.58	12.05	0.089	0.033	27.58	12.05
0.223	0.033	27.58	12.05	0.223	0.033	27.58	12.05	0.223	0.033	27.58	12.05	0.223	0.033	27.58	12.05
0.447	0.033	27.58	12.05	0.447	0.033	27.57	12.05	0.447	0.033	27.57	12.05	0.447	0.033	27.57	12.05
0.670	0.033	27.57	12.05	0.670	0.033	27.57	12.05	0.670	0.033	27.57	12.05	0.670	0.033	27.57	12.05
0.893	0.033	27.56	12.05	0.893	0.033	27.56	12.05	0.893	0.033	27.57	12.05	0.893	0.033	27.56	12.05

90 VAC - 12 V held constant at full load				115 VAC - 12 V held constant at full load				230 VAC - 12 V held constant at full load				265 VAC - 12 V held constant at full load			
Io (+28 V	Io (12 V)	Vo (+28 V	Vo (12 V)	Io (+28 V)	Io (12 V)	Vo (+28 V)	Vo (12 V)	Io (+28 V)	Io (12 V)	Vo (+28 V)	Vo (12 V)	Io (+28 V)	Io (12 V)	Vo (+28 V)	Vo (12 V)
0.000	0.330	27.58	12.04	0.000	0.330	27.57	12.02	0.000	0.330	27.57	12.02	0.000	0.330	27.57	12.02
0.089	0.330	27.57	12.04	0.089	0.330	27.57	12.03	0.089	0.330	27.57	12.03	0.089	0.330	27.57	12.02
0.223	0.330	27.57	12.04	0.223	0.330	27.57	12.03	0.223	0.330	27.57	12.03	0.223	0.330	27.57	12.02
0.447	0.330	27.56	12.04	0.447	0.330	27.56	12.02	0.447	0.330	27.56	12.03	0.447	0.330	27.56	12.02
0.670	0.330	27.56	12.04	0.670	0.330	27.56	12.02	0.670	0.330	27.56	12.02	0.670	0.330	27.56	12.02
0.893	0.330	27.55	12.04	0.893	0.330	27.55	12.02	0.893	0.330	27.55	12.02	0.893	0.330	27.55	12.02

90 VAC constant 89 mA Load on +28 V				115 VAC constant 89 mA Load on +28 V				230 VAC constant 89 mA Load on +28 V				265 VAC constant 89 mA Load on +28 V			
Io (+28 V	Io (12 V)	Vo (+28 V	Vo (12 V)	Io (+28 V)	Io (12 V)	Vo (+28 V)	Vo (12 V)	Io (+28 V)	Io (12 V)	Vo (+28 V)	Vo (12 V)	Io (+28 V)	Io (12 V)	Vo (+28 V)	Vo (12 V)
0.089	0.000	27.57	12.04	0.089	0.000	27.58	12.05	0.089	0.000	27.58	12.05	0.089	0.000	27.58	12.05
0.089	0.033	27.57	12.05	0.089	0.033	27.58	12.05	0.089	0.033	27.57	12.05	0.089	0.033	27.57	12.05
0.089	0.083	27.57	12.05	0.089	0.083	27.57	12.05	0.089	0.083	27.57	12.04	0.089	0.083	27.57	12.04
0.089	0.165	27.57	12.04	0.089	0.165	27.57	12.04	0.089	0.165	27.58	12.04	0.089	0.165	27.57	12.04
0.089	0.248	27.57	12.04	0.089	0.248	27.57	12.04	0.089	0.248	27.57	12.04	0.089	0.248	27.57	12.04
0.089	0.330	27.57	12.04	0.089	0.330	27.57	12.04	0.089	0.330	27.57	12.04	0.089	0.330	27.57	12.03

90 VAC +28 V held constant at full load				115 VAC +28 V held constant at full load				230 VAC +28 V held constant at full load				265 VAC +28 V held constant at full load			
Io (+28 V	Io (12 V)	Vo (+28 V	Vo (12 V)	Io (+28 V)	Io (12 V)	Vo (+28 V)	Vo (12 V)	Io (+28 V)	Io (12 V)	Vo (+28 V)	Vo (12 V)	Io (+28 V)	Io (12 V)	Vo (+28 V)	Vo (12 V)
0.893	0.000	27.55	12.04	0.893	0.000	27.55	12.03	0.893	0.000	27.55	12.03	0.893	0.000	27.55	12.03
0.893	0.033	27.56	12.04	0.893	0.033	27.56	12.03	0.893	0.033	27.56	12.04	0.893	0.033	27.56	12.03
0.893	0.083	27.56	12.04	0.893	0.083	27.56	12.03	0.893	0.083	27.56	12.04	0.893	0.083	27.56	12.03
0.893	0.165	27.55	12.04	0.893	0.165	27.56	12.03	0.893	0.165	27.56	12.04	0.893	0.165	27.56	12.03
0.893	0.248	27.55	12.03	0.893	0.248	27.55	12.03	0.893	0.248	27.56	12.03	0.893	0.248	27.56	12.03
0.893	0.330	27.55	12.03	0.893	0.330	27.55	12.03	0.893	0.330	27.55	12.03	0.893	0.330	27.55	12.03

Table 1 – Cross Regulation Matrix Between +28 V and +12 V Outputs.

90 VAC constant 89 mA Load on -28 V				115 VAC constant 89 mA Load on -28 V				230 VAC constant 89 mA Load on -28 V				265 VAC constant 89 mA Load on -28 V			
Io (+28 V	Io (-28 V)	Vo (+28 V	Vo (-28 V)	Io (+28 V)	Io (-28 V)	Vo (+28 V)	Vo (-28 V)	Io (+28 V)	Io (-28 V)	Vo (+28 V)	Vo (-28 V)	Io (+28 V)	Io (-28 V)	Vo (+28 V)	Vo (-28 V)
0.000	0.089	27.57	-27.88	0.000	0.089	27.58	-27.88	0.000	0.089	27.58	-27.88	0.000	0.089	27.58	-27.88
0.089	0.089	27.57	-27.88	0.089	0.089	27.57	-27.88	0.089	0.089	27.57	-27.88	0.089	0.089	27.57	-27.88
0.223	0.089	27.57	-27.88	0.223	0.089	27.57	-27.88	0.223	0.089	27.57	-27.88	0.223	0.089	27.57	-27.88
0.447	0.089	27.56	-27.88	0.447	0.089	27.56	-27.88	0.447	0.089	27.57	-27.88	0.447	0.089	27.57	-27.88
0.670	0.089	27.55	-27.88	0.670	0.089	27.56	-27.88	0.670	0.089	27.56	-27.88	0.670	0.089	27.56	-27.88
0.893	0.089	27.55	-27.88	0.893	0.089	27.54	-27.88	0.893	0.089	27.55	-27.88	0.893	0.089	27.55	-27.88

90 VAC -28 V held constant at full load				115 VAC -28 V held constant at full load				230 VAC -28 V held constant at full load				265 VAC -28 V held constant at full load			
Io (+28 V	Io (-28 V)	Vo (+28 V	Vo (-28 V)	Io (+28 V)	Io (-28 V)	Vo (+28 V)	Vo (-28 V)	Io (+28 V)	Io (-28 V)	Vo (+28 V)	Vo (-28 V)	Io (+28 V)	Io (-28 V)	Vo (+28 V)	Vo (-28 V)
0.000	0.893	27.58	-27.78	0.000	0.893	27.58	-27.78	0.000	0.893	27.58	-27.77	0.000	0.893	27.58	-27.79
0.089	0.893	27.58	-27.78	0.089	0.893	27.58	-27.78	0.089	0.893	27.58	-27.77	0.089	0.893	27.58	-27.79
0.223	0.893	27.57	-27.78	0.223	0.893	27.58	-27.78	0.223	0.893	27.58	-27.77	0.223	0.893	27.58	-27.79
0.447	0.893	27.56	-27.78	0.447	0.893	27.57	-27.78	0.447	0.893	27.57	-27.77	0.447	0.893	27.57	-27.79
0.670	0.893	27.55	-27.77	0.670	0.893	27.56	-27.78	0.670	0.893	27.56	-27.78	0.670	0.893	27.56	-27.79
0.893	0.893	27.54	-27.76	0.893	0.893	27.55	-27.78	0.893	0.893	27.55	-27.78	0.893	0.893	27.55	-27.79

90 VAC constant 89 mA Load on +28 V				115 VAC constant 89 mA Load on +28 V				230 VAC constant 89 mA Load on +28 V				265 VAC constant 89 mA Load on +28 V			
Io (+28 V	Io (-28 V)	Vo (+28 V	Vo (-28 V)	Io (+28 V)	Io (-28 V)	Vo (+28 V)	Vo (-28 V)	Io (+28 V)	Io (-28 V)	Vo (+28 V)	Vo (-28 V)	Io (+28 V)	Io (-28 V)	Vo (+28 V)	Vo (-28 V)
0.089	0.000	27.58	-27.89	0.089	0.000	27.58	-27.89	0.089	0.000	27.58	-27.89	0.089	0.000	27.58	-27.89
0.089	0.089	27.58	-27.88	0.089	0.089	27.58	-27.88	0.089	0.089	27.58	-27.88	0.089	0.089	27.58	-27.88
0.089	0.223	27.58	-27.87	0.089	0.223	27.58	-27.87	0.089	0.223	27.58	-27.87	0.089	0.223	27.58	-27.87
0.089	0.447	27.58	-27.84	0.089	0.447	27.58	-27.84	0.089	0.447	27.58	-27.85	0.089	0.447	27.58	-27.85
0.089	0.670	27.58	-27.79	0.089	0.670	27.58	-27.8	0.089	0.670	27.58	-27.82	0.089	0.670	27.58	-27.82
0.089	0.893	27.58	-27.76	0.089	0.893	27.58	-27.79	0.089	0.893	27.57	-27.78	0.089	0.893	27.58	-27.79

90 VAC +28 V held constant at full load				115 VAC +28 V held constant at full load				230 VAC +28 V held constant at full load				265 VAC +28 V held constant at full load			
Io (+28 V	Io (-28 V)	Vo (+28 V	Vo (-28 V)	Io (+28 V)	Io (-28 V)	Vo (+28 V)	Vo (-28 V)	Io (+28 V)	Io (-28 V)	Vo (+28 V)	Vo (-28 V)	Io (+28 V)	Io (-28 V)	Vo (+28 V)	Vo (-28 V)
0.893	0.000	27.55	-27.89	0.893	0.000	27.55	-27.89	0.893	0.000	27.55	-27.89	0.893	0.000	27.55	-27.89
0.893	0.089	27.55	-27.88	0.893	0.089	27.55	-27.88	0.893	0.089	27.55	-27.88	0.893	0.089	27.55	-27.88
0.893	0.223	27.55	-27.87	0.893	0.223	27.55	-27.87	0.893	0.223	27.55	-27.87	0.893	0.223	27.55	-27.87
0.893	0.447	27.54	-27.84	0.893	0.447	27.55	-27.84	0.893	0.447	27.55	-27.85	0.893	0.447	27.55	-27.85
0.893	0.670	27.54	-27.79	0.893	0.670	27.55	-27.8	0.893	0.670	27.55	-27.82	0.893	0.670	27.55	-27.82
0.893	0.893	27.54	-27.76	0.893	0.893	27.55	-27.79	0.893	0.893	27.55	-27.78	0.893	0.893	27.55	-27.8

Table 2 – Cross Regulation Matrix Between +28 V and -28 V Outputs.

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9.5 Power Delivery Capabilities

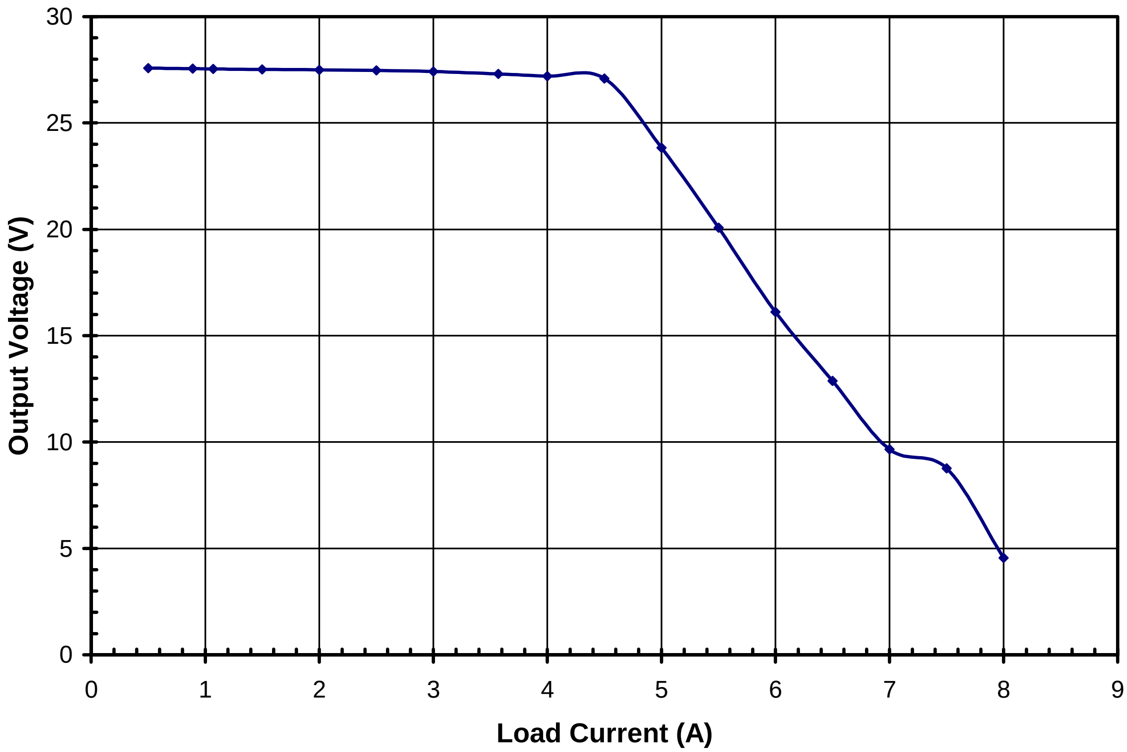

Figure 17 – Output V-I Curve +28 V Supply, Room Temperature, 115 VAC.

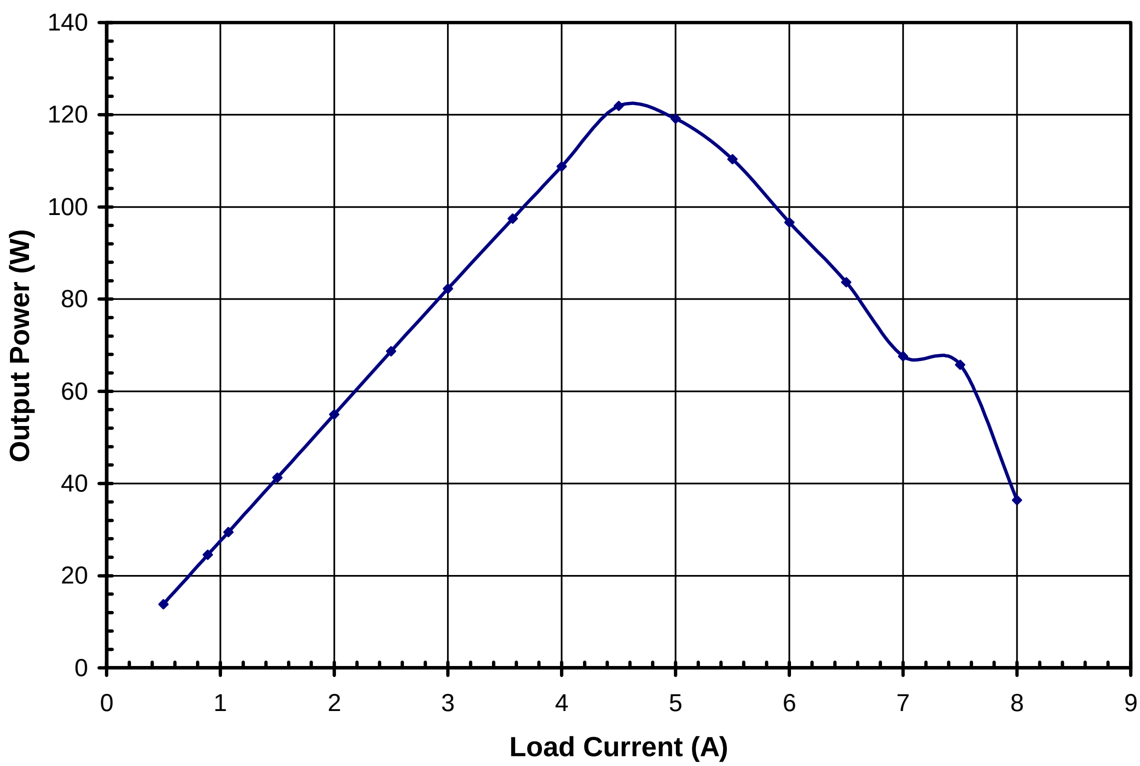

Figure 18 – Output Power Curve +28 V Supply, Room Temperature, 115 VAC.

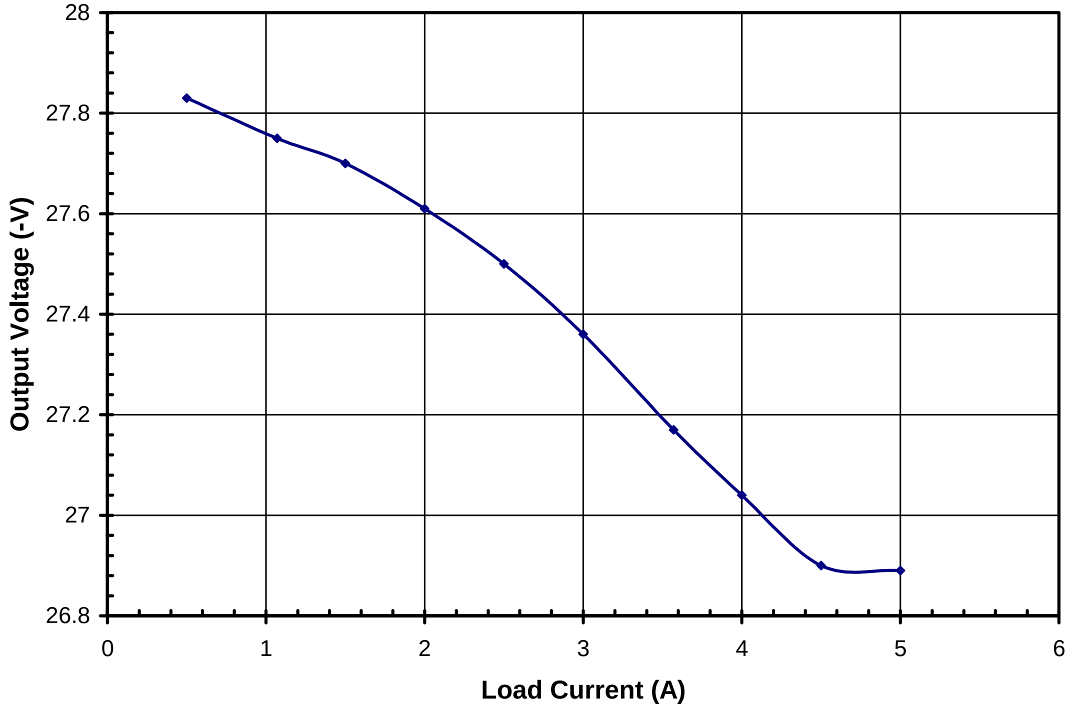

Figure 19 – Output V-I Curve -28 V Supply, Room Temperature, 115 VAC.

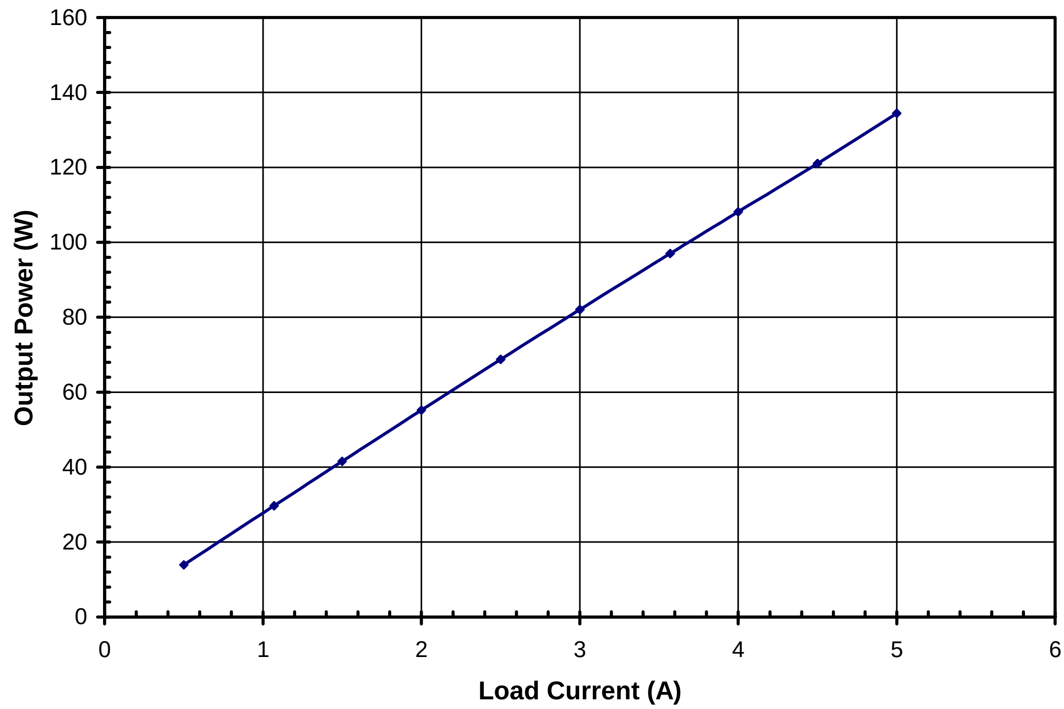

Figure 20 – Output Power Curve -28 V Supply, Room Temperature, 115 VAC.

Note: The overload response of the -28 V output will match that of the +28 V output provided that both outputs are loaded to the same levels simultaneously.

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10 Thermal Performance

Thermal performance is shown in thermal images taken below. Snapshots were taken at worst case steady-state conditions. Thermal markers are placed on the images to note the temperatures of several key components. In order to increase resolution, primary and secondary sides were photographed separately with an overlap centering on the device heatsink. Please refer to Figure 21 below for an illustration of component locations in the thermal images.

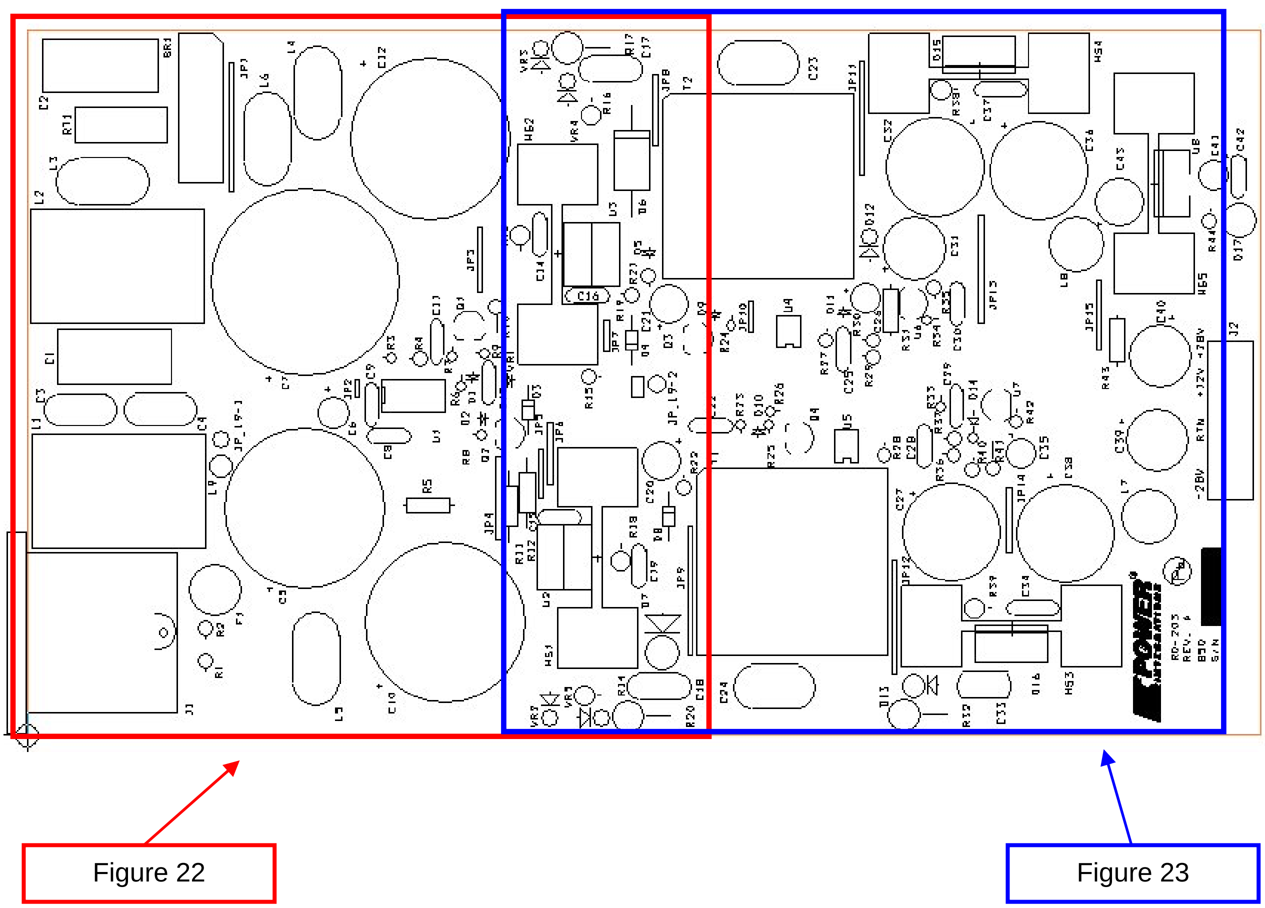

Figure 21 – Thermal Snapshot Outlines.

10.1 Full Load Measurements

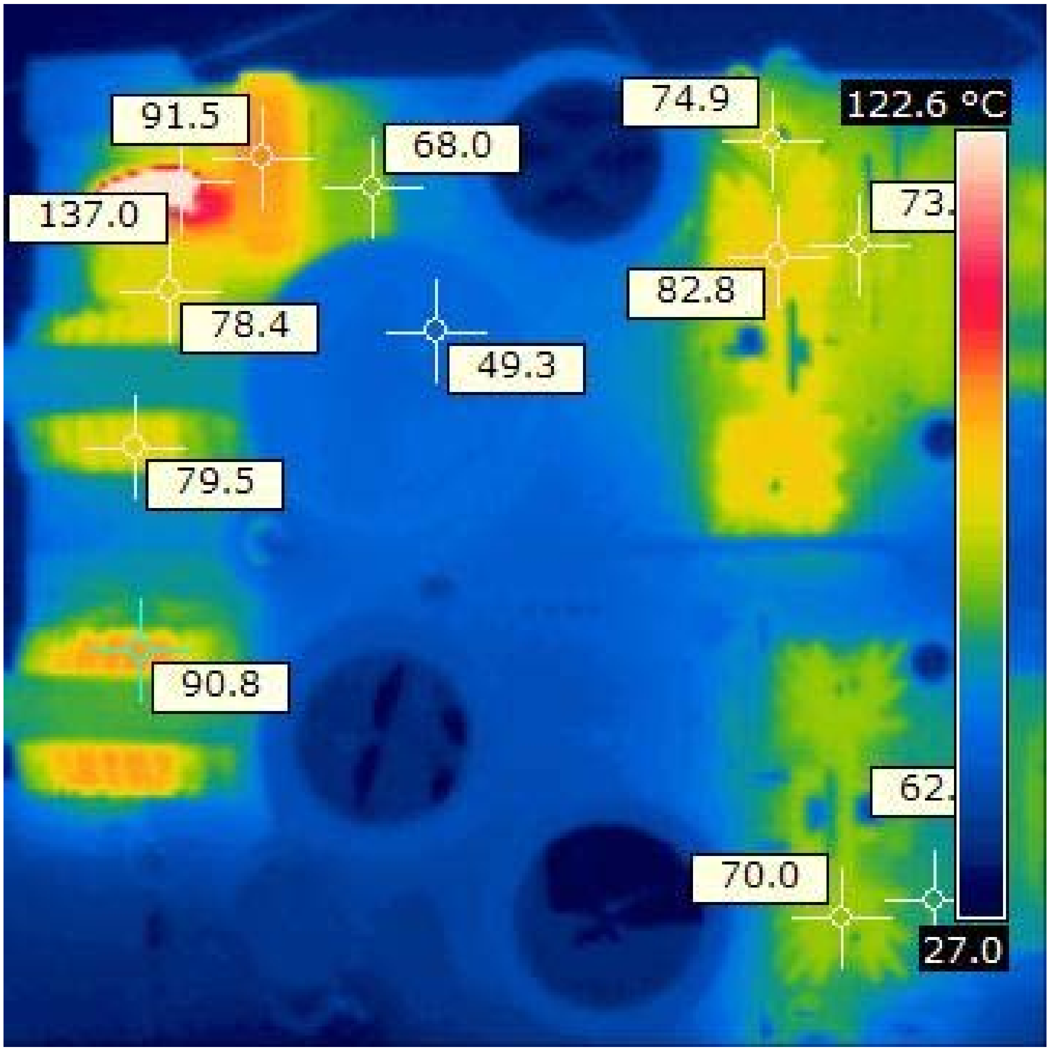

Figure 22 – Thermal Image of Primary Side, 40 °C Ambient Temperature, 90 VAC, Full Load, (Worst Steady State Conditions).

Note: The thermistor RT1 is measured at 137 °C in Figure 22 above. This is normal and does not violate the device specification. The maximum rated temperature for the device is 175 °C. The board has been designed to minimize heat coupling to nearby components.

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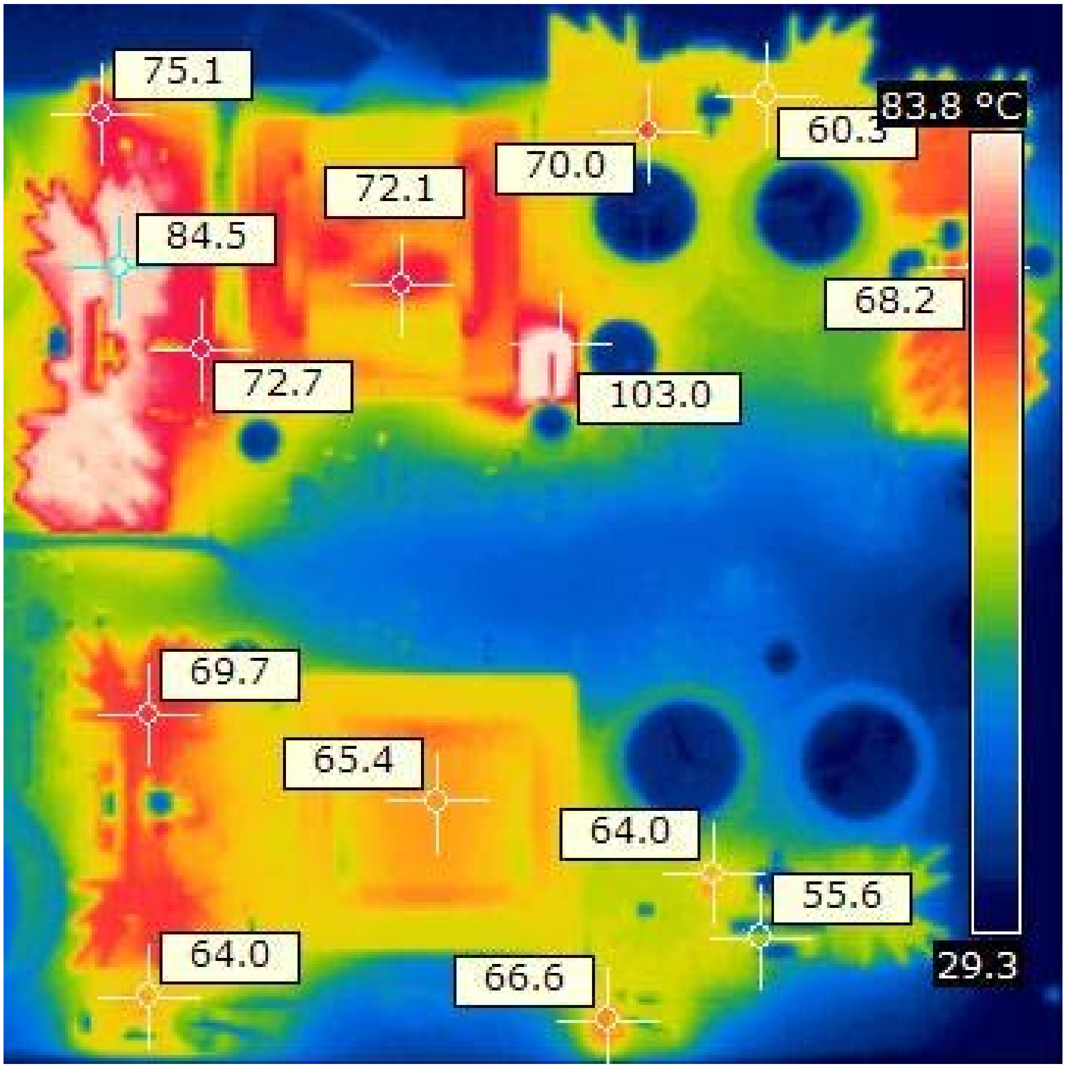

Figure 23 – Thermal Image of Secondary Side, 40 °C Ambient Temperature, 90 VAC, Full Load (Worst Steady State Conditions).

11 Waveforms

11.1 Drain Voltage and Current, Normal Operation

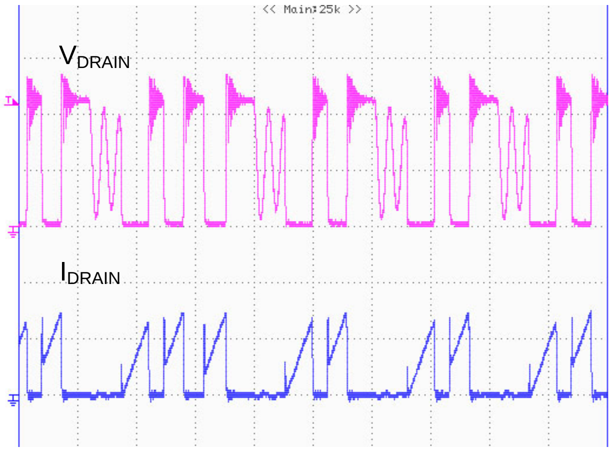

Figure 24 – 90 VAC, Full Load, +28 V Supply.
Lower: I_{DRAIN}, 1 A / div.
Upper: V_{DRAIN}, 100 V, 5 μs / div.

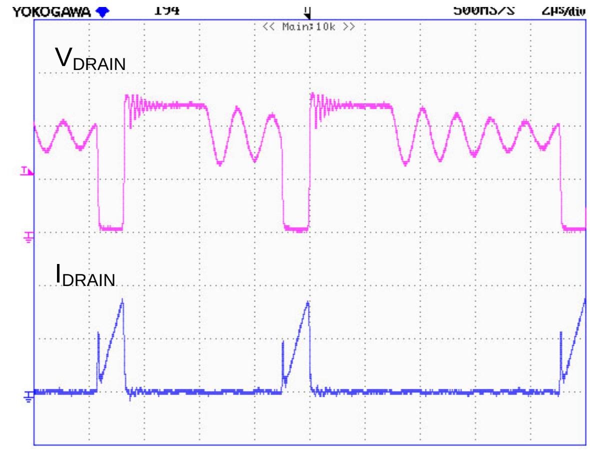

Figure 25 – 265 VAC, Full Load, +28 V Supply.
Lower: I_{DRAIN}, 1 A / div.
Upper: V_{DRAIN}, 200 V / div, 2 μs / div.

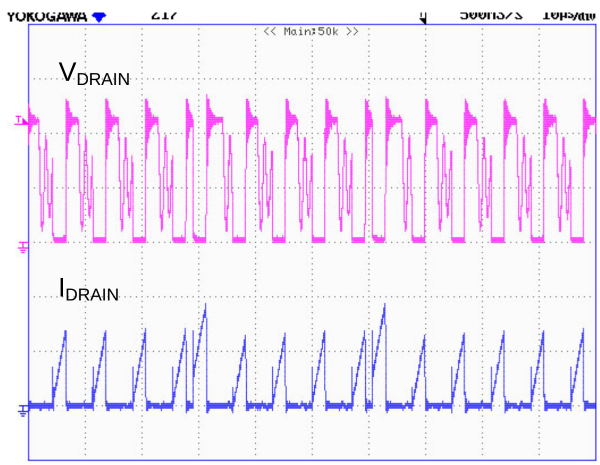

Figure 26 – 90 VAC, Full Load, -28 V Supply.
Lower: I_{DRAIN}, 1 A / div.
Upper: V_{DRAIN}, 100 V, 10 μs / div.

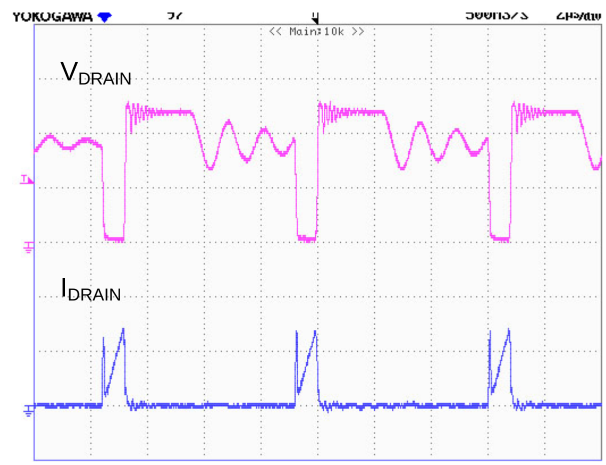

Figure 27 – 265 VAC, Full Load, -28 V Supply.
Lower: I_{DRAIN}, 1 A / div.
Upper: V_{DRAIN}, 200 V / div, 2 μs / div.

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11.2 Output Voltage Start-up Profile

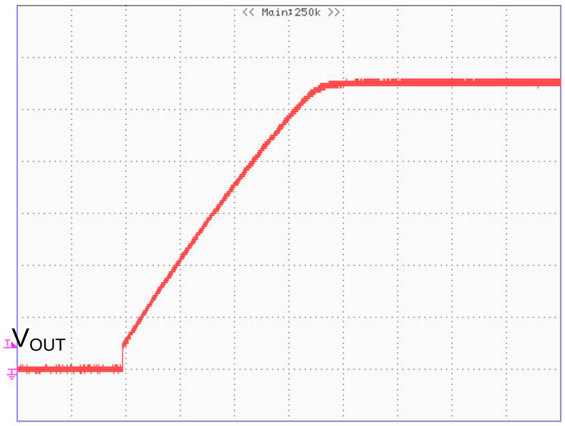

Figure 28 – Start-up Profile +28 V Output, 90VAC Full Load, 5 V, 50 ms / div.

Figure 29 – Start-up Profile +28 V Output, 265 VAC Full Load, 5 V, 50 ms / div.

Figure 30 – Start-up Profile -28 V Output, 90 VAC Full Load, 5 V, 50 ms / div.

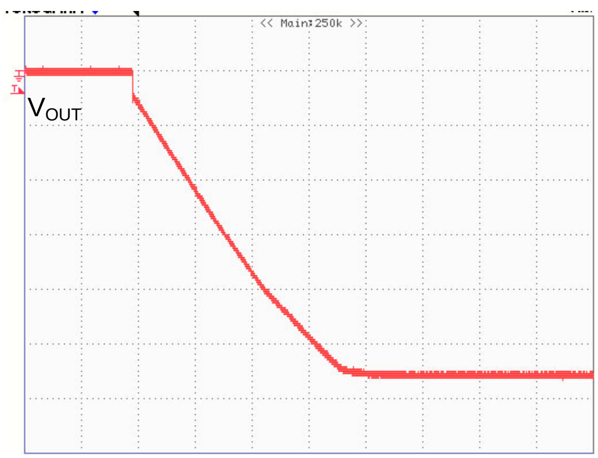

Figure 31 – Start-up Profile -28 V Output, 265 VAC Full Load, 5 V, 50 ms / div.

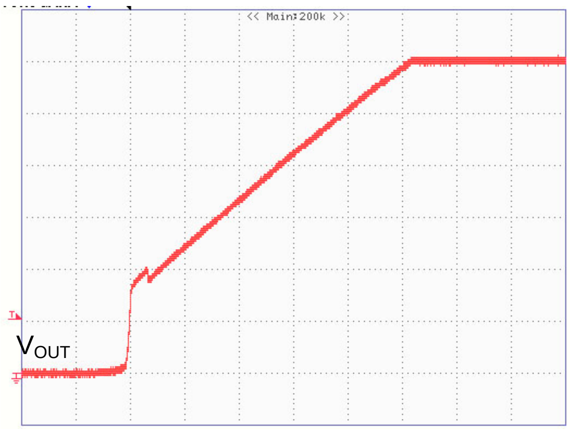

Figure 32 – Start-up Profile +12 V Output, 90VAC Full Load, 2 V, 20 ms / div.

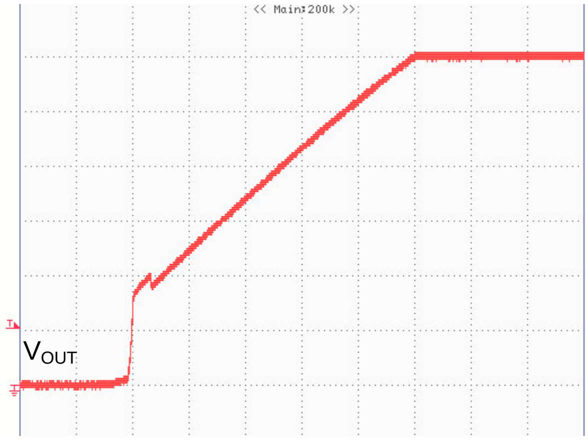

Figure 33 – Start-up Profile +12 V Output, 265 VAC Full Load, 2 V, 20 ms / div.

11.3 Drain Voltage and Current Start-up Profile

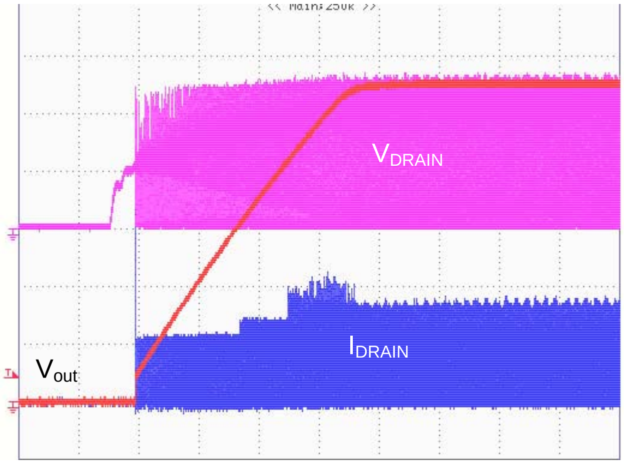

Figure 34 – 90 VAC Input, Full Load, +28 V Output.
Lower: I_{DRAIN}, 1 A / div.
Upper: V_{DRAIN}, 100 V.
Overlay: V_{OUT}, 5 V / div & 50 ms / div.

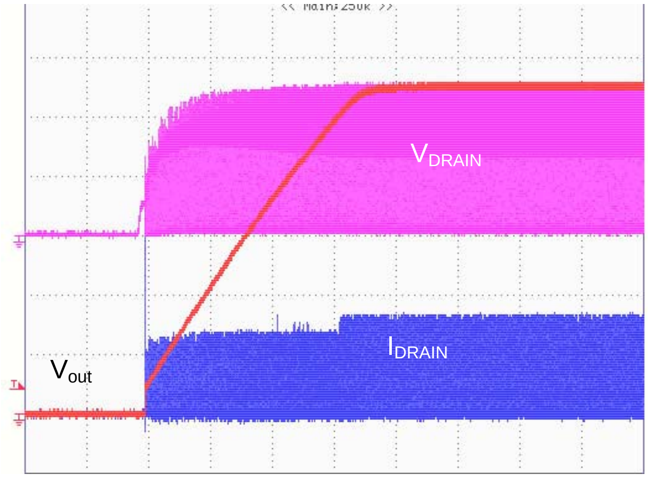

Figure 35 – 265 VAC Input, Full Load, +28 V Output.
Lower: I_{DRAIN}, 1 A / div.
Upper: V_{DRAIN}, 200 V.
Overlay: V_{OUT}, 5 V / div & 50 ms / div.

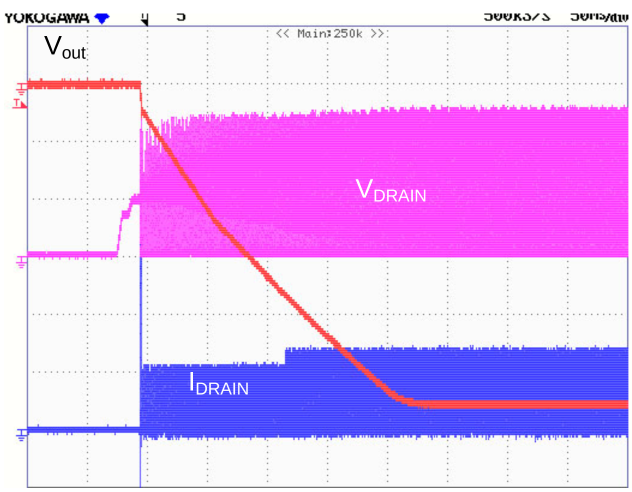

Figure 36 – 90 VAC Input, Full Load, -28 V Output.
Lower: I_{DRAIN}, 1 A / div.
Upper: V_{DRAIN}, 100 V.
Overlay: V_{OUT}, 5 V / div & 50 ms / div.

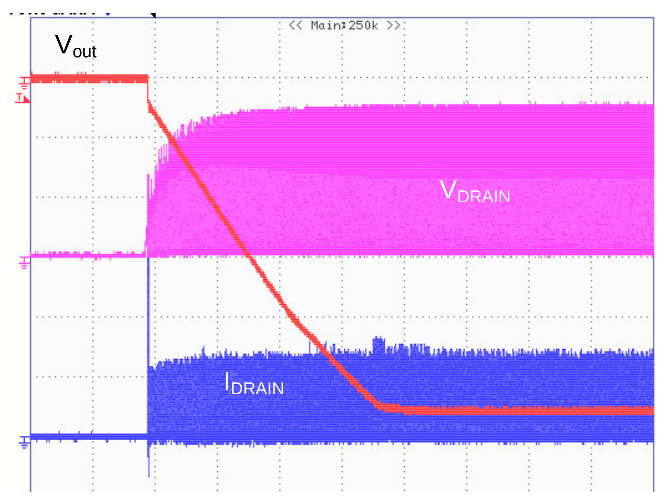

Figure 37 – 265 VAC Input, Full Load, -28 V Output.
Lower: I_{DRAIN}, 1 A / div.
Upper: V_{DRAIN}, 200 V.
Overlay: V_{OUT}, 5 V / div & 50 ms / div.

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11.4 Load Transient Response

In the figures shown below, signal averaging was used to better enable viewing the load transient response. The oscilloscope was triggered using the load current step as a trigger source. Since the switching and line frequency ripple on the DC Bus occur essentially at random with respect to the load transient, contributions to the output ripple from these sources will average out, leaving the contribution only from the load step response.

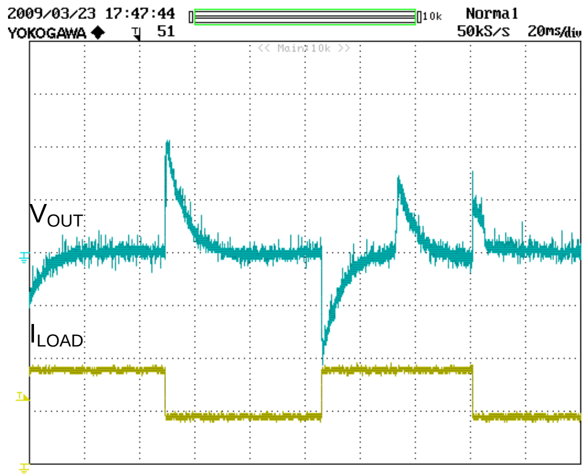

Figure 38 – Transient Response, 115 VAC, +28 V
50-100-50% Load Step.
Top: Output Voltage, 20 mV / div.
Bottom: Load Current, 500 mA / div,
20 ms / div. *(See note below)*

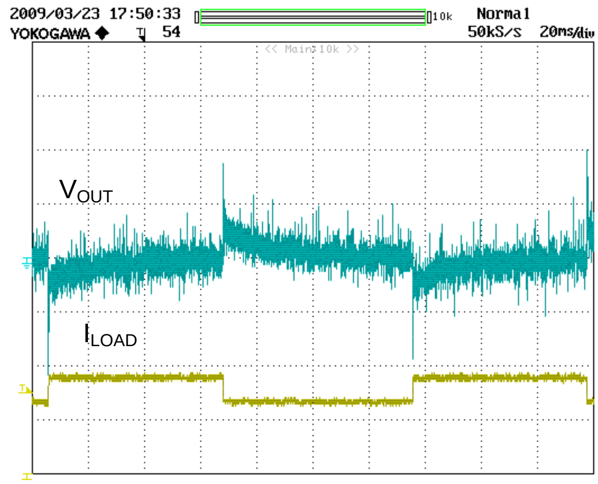

Figure 39 – Transient Response, 115 VAC, +28 V
75-100-75% Load Step
Top: Output Voltage, 10 mV / div.
Bottom: Load Current, 500 mA / div,
20 ms / div.

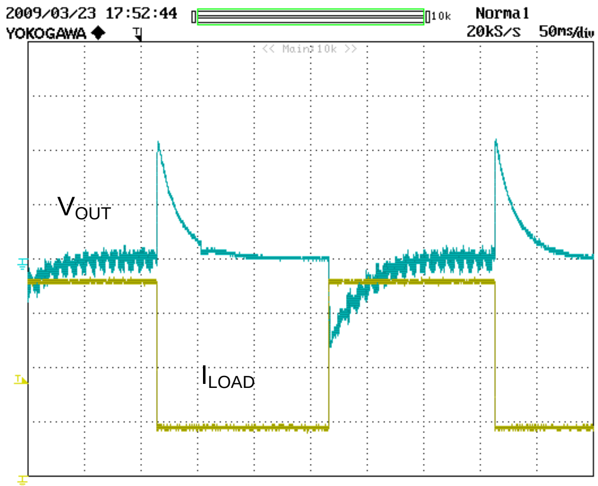

Figure 40 – Transient Response, 115 VAC, +28 V
100-Peak-100% Load Step.
Top: Output Voltage, 200 mV / div.
Bottom: Load Current, 1 A / div,
50 ms / div.

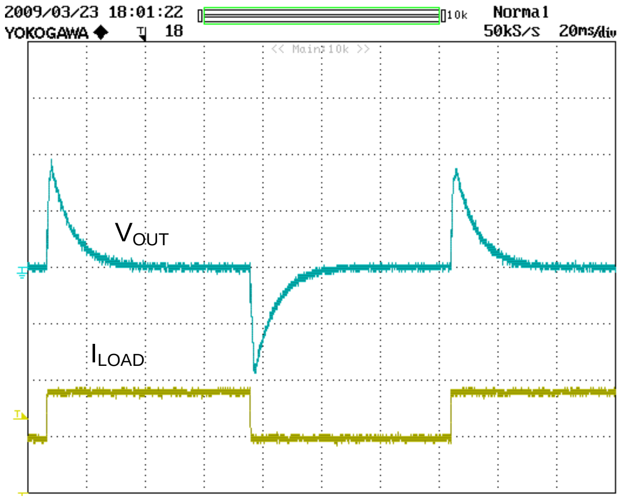

Figure 41 – Transient Response, 115 VAC, -28 V
50-100-50% Load Step.
Top: Output Voltage, 50 mV / div.
Bottom: Load Current, 500 mA / div,
20 ms / div.

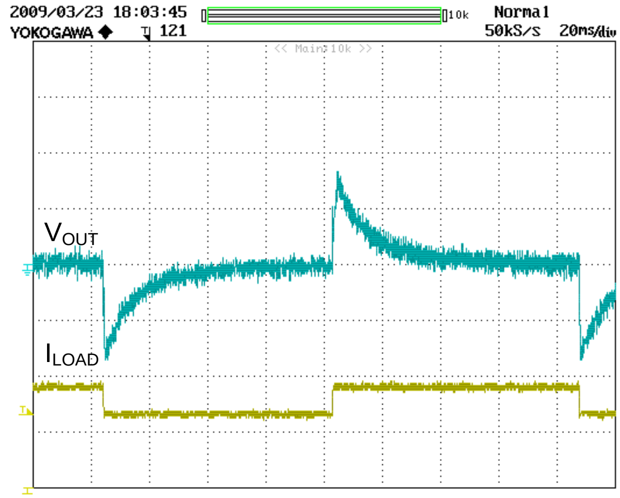

Figure 42 – Transient Response, 115 VAC, -28 V
75-100-75% Load Step
Top: Output Voltage, 20 mV / div.
Bottom: Load Current, 500 mA / div,
20 ms / div.

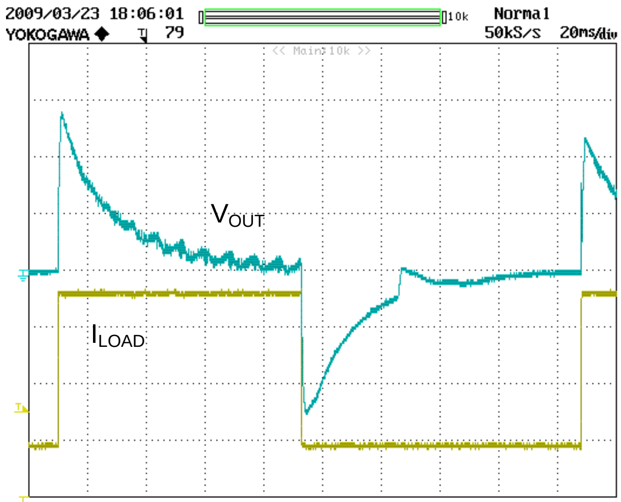

Figure 43 – Transient Response, 115 VAC, -28 V
100-Peak-100% Load Step.
Top: Output Voltage, 200 mV / div.
Bottom: Load Current, 1 A/div,
20 ms / div. *(See note below)*

Note: During transient load steps, the controller internal to the Peakswitch device U3, (U2) will adjust the primary current limit for optimum power delivery. This change in current limit will manifest as a fluctuation in output voltage as seen in Figures 38 and 43 above. This fluctuation occurs at random intervals as the controller adjusts the current limit to meet operating condition demands. The voltage variation does not violate acceptable regulation limits under any conditions.

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11.5 Output Ripple Measurements

11.5.1 Ripple Measurement Technique

For DC output ripple measurements, a modified oscilloscope test probe must be utilized in order to reduce spurious signals due to pickup. Details of the probe modification are provided in Figure 44 and Figure 45.

The 5125BA probe adapter is affixed with two capacitors tied in parallel across the probe tip. The capacitors include one (1) 0.1 μF/50 V ceramic type and one (1) 1.0 μF/50 V aluminum electrolytic. ***The aluminum electrolytic type capacitor is polarized, so proper polarity across DC outputs must be maintained (see below).***

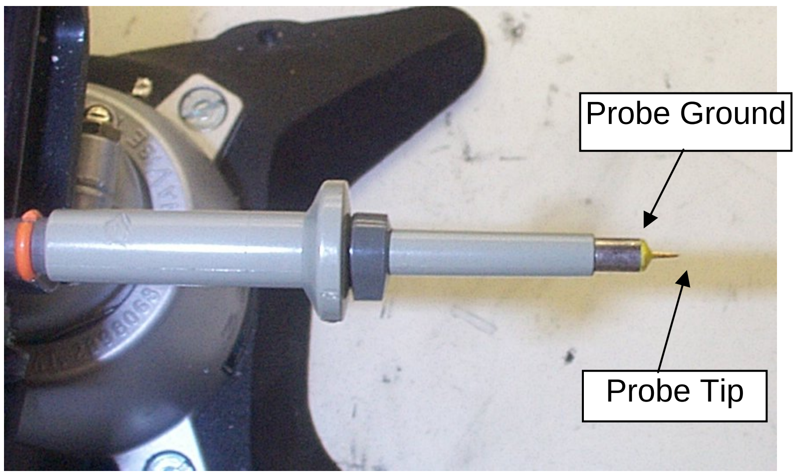

Figure 44 – Oscilloscope Probe Prepared for Ripple Measurement. (End Cap and Ground Lead Removed)

Figure 45 – Oscilloscope Probe with Probe Master 5125BA BNC Adapter. (Modified with wires for probe ground for ripple measurement, and two parallel decoupling capacitors added)

11.5.2 Measurement Results – 28 V Positive

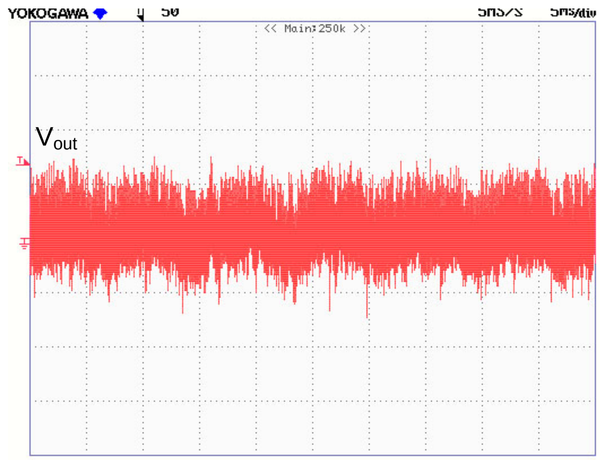

Figure 46 – +28 V Ripple, 90 VAC, 889 mA Load. 5 ms, 5 mV / div.

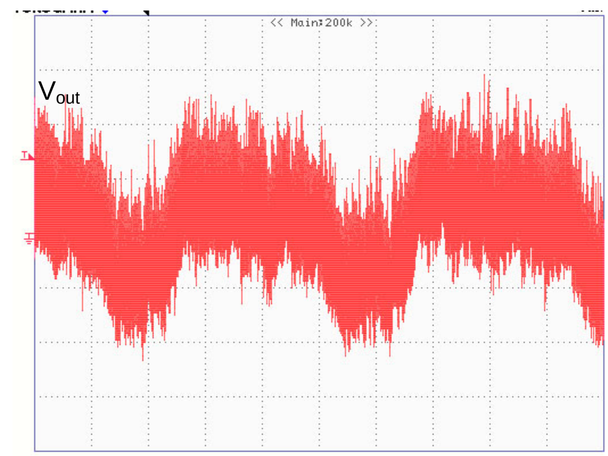

Figure 47 – +28 V Ripple, 90 VAC, 675 mA Load. 2 ms, 5 mV / div.

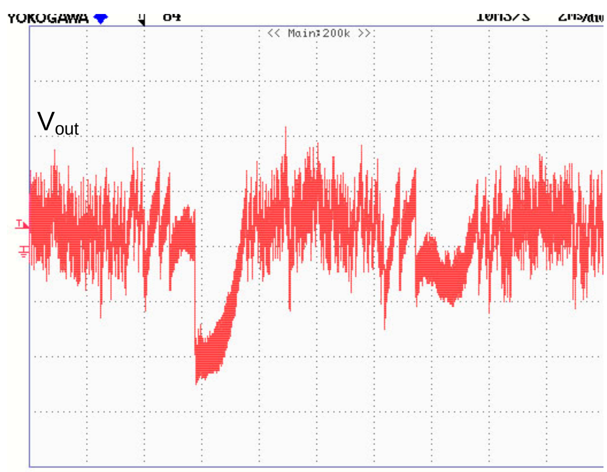

Figure 48 – +28 V Ripple, 90 VAC, 3.57 A Load on Both Outputs.
2 ms, 20 mV /div.

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11.5.3 Measurement Results – 28 V Negative

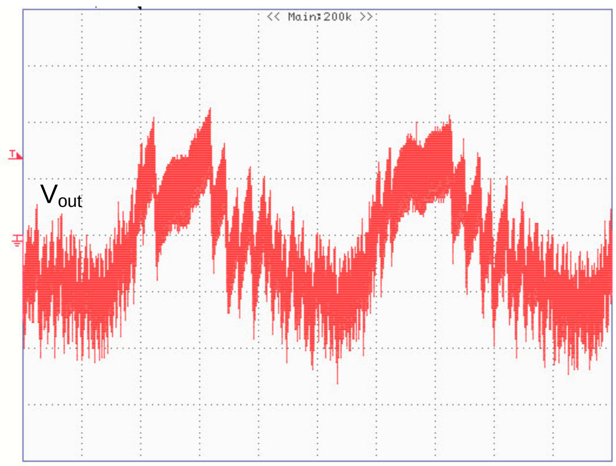

Figure 49 – -28 V Ripple, 90 VAC, 889 mA Load.
2 ms, 5 mV / div.

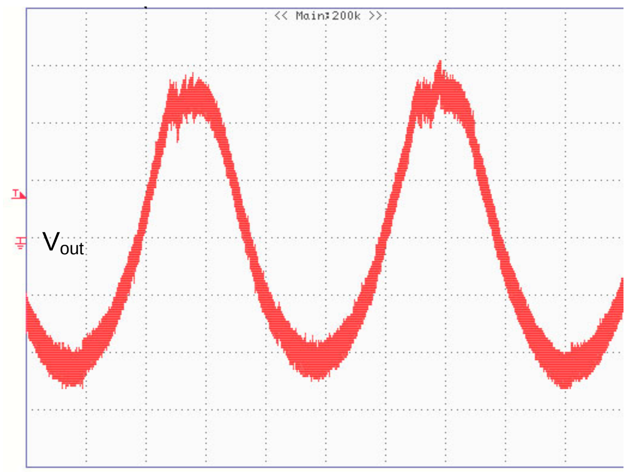

Figure 50 – -28 V Ripple, 90 VAC, 856 mA Load.
2 ms, 10 mV / div.

Figure 51 – -28 V Ripple, 90 VAC, 3.57 A Load.
5 ms, 50 mV /div.

11.5.4 Measurement Results – 12 V

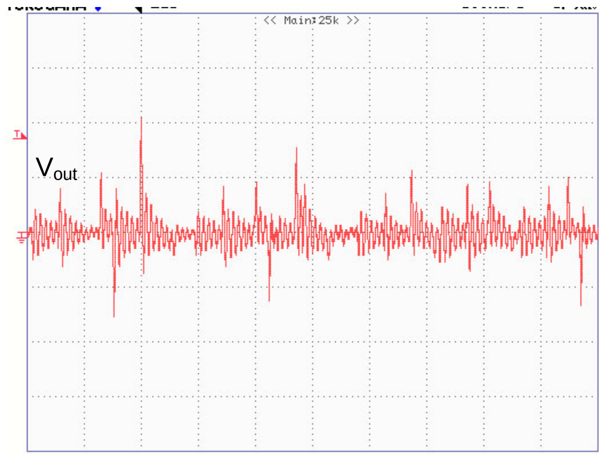

Figure 52 – +12 V Ripple, 90 VAC, 333 mA Load (889 mA on Main) 5 µs, 20 mV / div.

Figure 53 – +12 V Ripple, 90 VAC, 333 mA Load. (3.57 A load on Main) 2 µs, 20 mV / div.

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12 Non-Linear Loading

A sinusoidal pulse load was applied to the power supply output to simulate the loading of an audio amplifier. The loading was applied as a half-wave rectified sinusoid with a frequency of 10 Hz. Output voltage ripple was monitored during this test and it was confirmed that voltage did not droop below acceptable levels.

12.1 Measurement Results – 28 V Positive

Figure 54 – +28 V Sine Load, 115 VAC, 444 mA Load.
Upper: Output Voltage, 20 mV / div.
Lower: Load Current, 500 mA / div
& 50 ms / div.

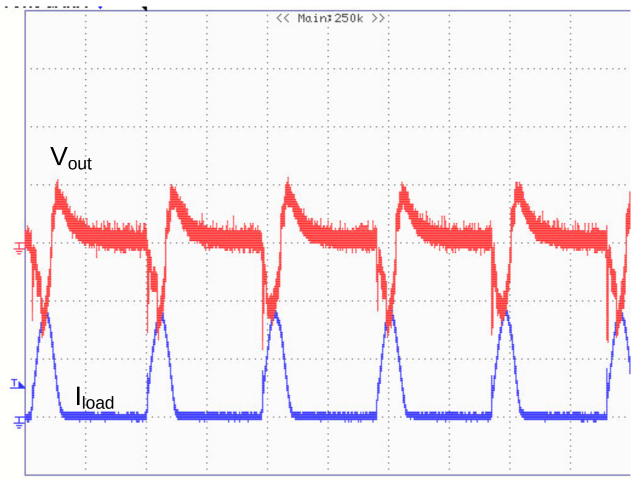

Figure 55 – +28 V Sine Load, 115 VAC, 889 mA Load.
Upper: Output Voltage, 20 mV / div.
Lower: Load Current, 500 mA / div
& 50 ms / div.

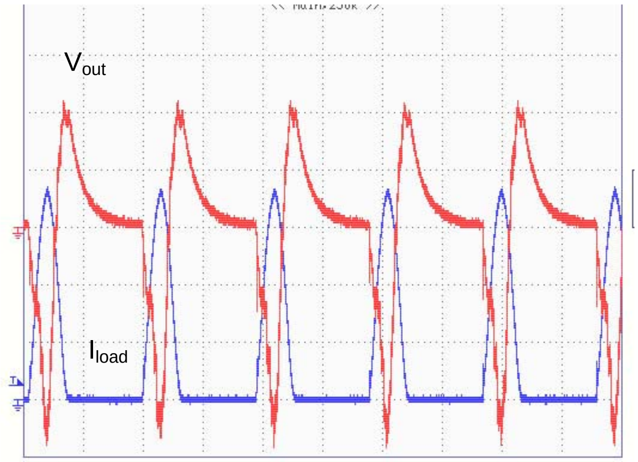

Figure 56 – +28 V Sine Load, 115 VAC, 3.57 A Load.
Upper: Output Voltage, 50 mV / div.
Lower: Load Current, 1 A / div
& 50 ms / div.

12.2 Measurement Results – 28 V Negative

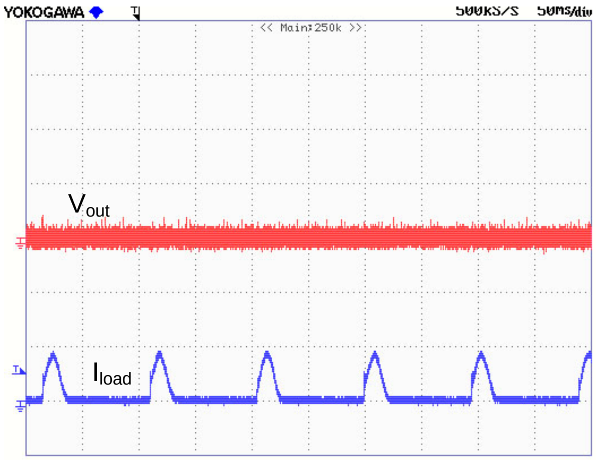

Figure 57 – -28 V Sine Load, 115 VAC,
444 mA Load.
Upper: Output Voltage, 20 mV / div.
Lower: Load Current, 500 mA / div
& 50 ms / div.

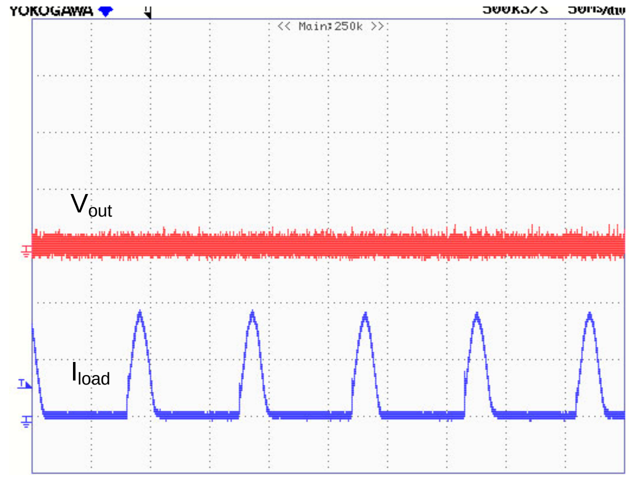

Figure 58 – -28 V Sine Load, 115 VAC,
889 mA Load.
Upper: Output Voltage, 20 mV / div.
Lower: Load Current, 500 mA / div
& 50 ms / div.

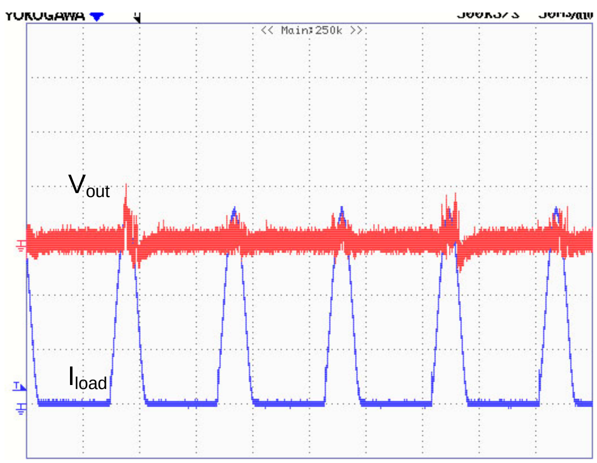

Figure 59 – -28 V Sine Load, 115 VAC,
3.57 A Load.
Upper: Output Voltage, 20 mV / div.
Lower: Load Current, 1 A / div
& 50 ms / div.

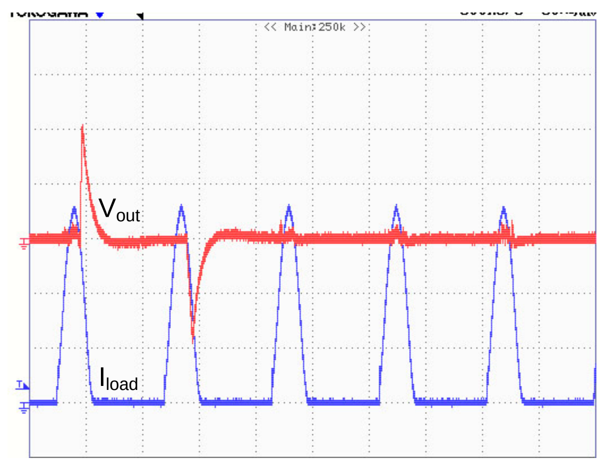

Figure 60 – -28 V Sine Load, 115 VAC,
3.57 A Load.
Upper: Output Voltage, 50 mV / div.
Lower: Load Current, 1 A / div
& 50 ms / div. *(See note below)*

Note: During transient loading, the controller internal to the PeakSwitch device U3 (U2) will adjust the primary current limit for optimum power delivery. This change in current limit will manifest as a fluctuation in output voltage as seen in Figure 60 above. This fluctuation occurs at random intervals as the controller adjusts the current limit to meet operating condition demands. The voltage variation does not violate acceptable regulation limits under any conditions.

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13 Line Surge

Differential input line 1.2/50 µs surge testing was completed on a single test unit to IEC61000-4-5. Input voltage was set at 230 VAC / 60 Hz. Output was loaded at full load and operation was verified following each surge event.

Surge Level (V)	Input Voltage (VAC)	Injection Location	Injection Phase (°)	Test Result (Pass/Fail)
+250	230	L to N	90	Pass
-250	230	L to N	90	Pass
+500	230	L to N	90	Pass
-500	230	L to N	90	Pass
+750	230	L to N	90	Pass
-750	230	L to N	90	Pass
+1000	230	L to N	90	Pass
-1000	230	L to N	90	Pass
+1000	230	L,N to GND	90	Pass
-1000	230	L,N to GND	90	Pass
+2000	230	L,N to GND	90	Pass
-2000	230	L,N to GND	90	Pass

Unit passes under all test conditions.

14 Conducted EMI

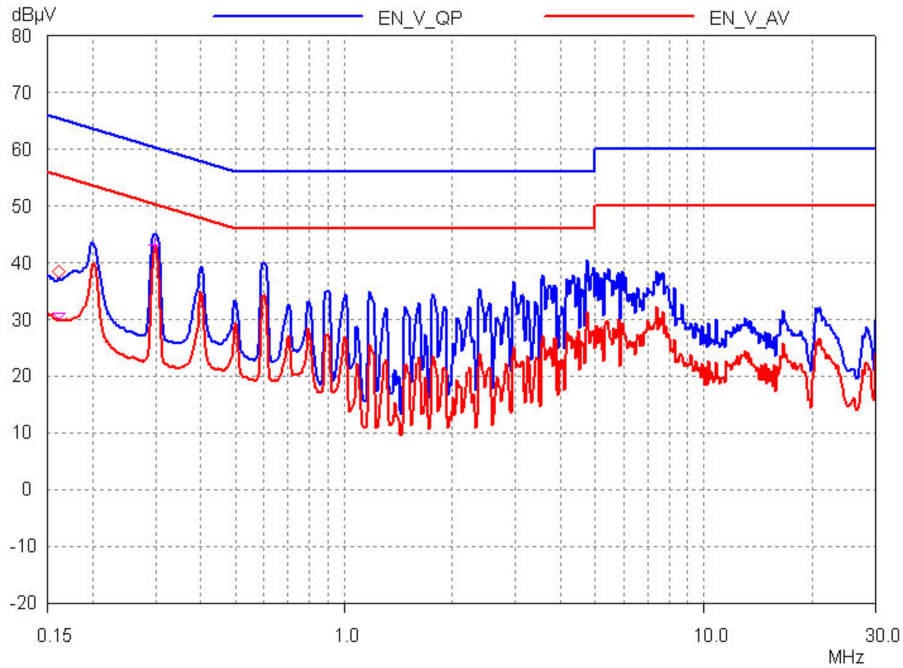

Figure 61 – Conducted EMI, Line Scan, Maximum Steady State Load, 115 VAC, 60 Hz, EN55022 B Limits, Output Return Floating.

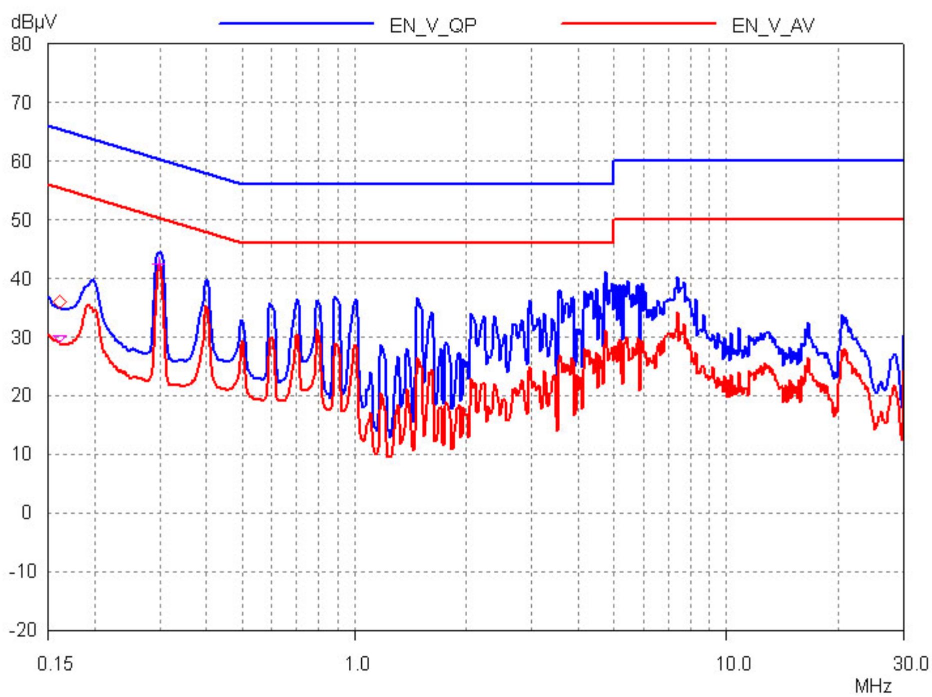

Figure 62 – Conducted EMI, Neutral Scan, Maximum Steady State Load, 115 VAC, 60 Hz, EN55022 B Limits, Output Return Floating.

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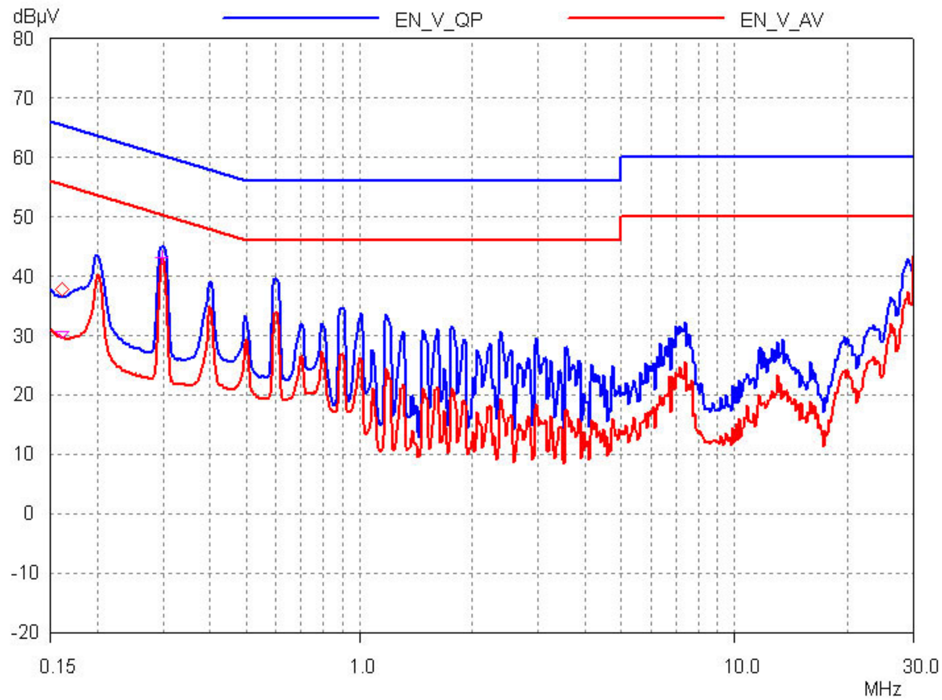

Figure 63 – Conducted EMI, Line Scan, Maximum Steady State Load, 115 VAC, 60 Hz, EN55022 B Limits, Output Return Earth Grounded.

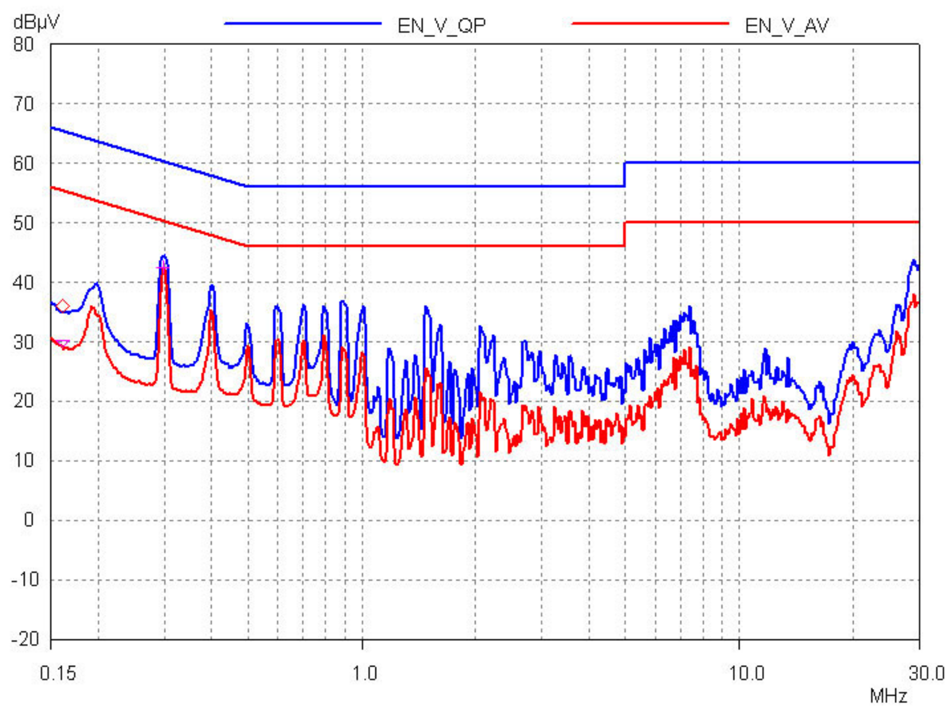

Figure 64 – Conducted EMI, Neutral Scan, Maximum Steady State Load, 115 VAC, 60 Hz, EN55022 B Limits, Output Return Earth Grounded.

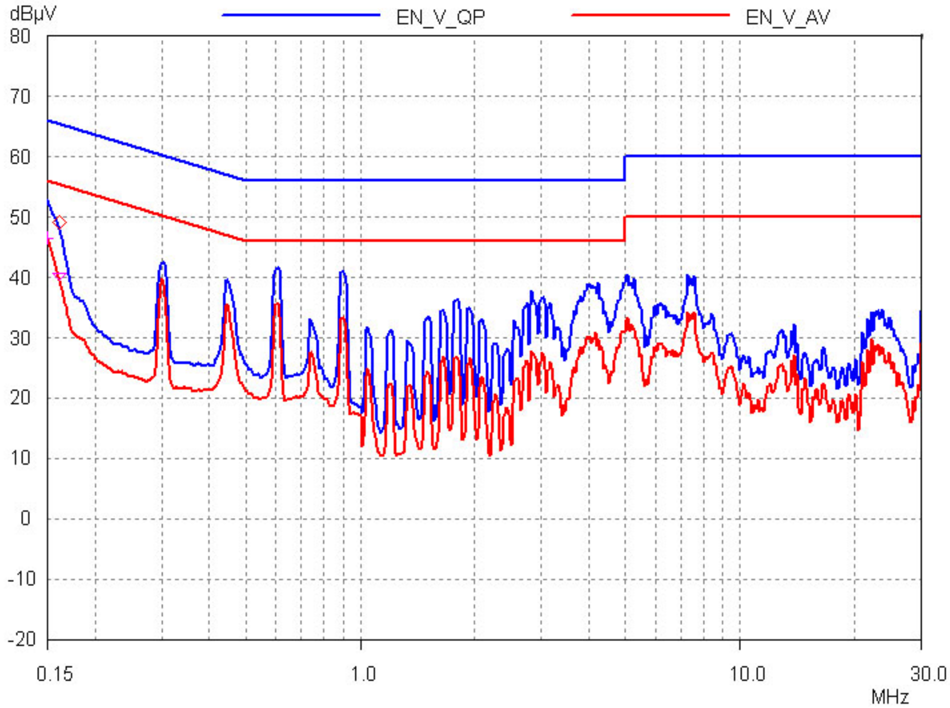

Figure 65 – Conducted EMI, Line Scan, Maximum Steady State Load, 230 VAC, 60 Hz, EN55022 B Limits, Output Return Floating.

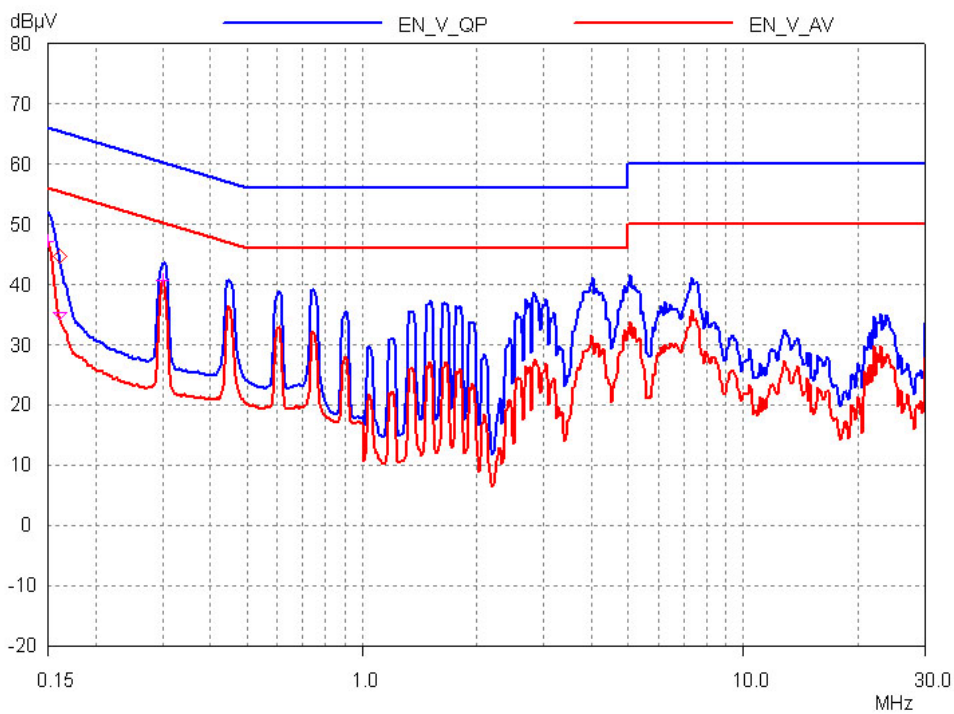

Figure 66 – Conducted EMI, Neutral Scan, Maximum Steady State Load, 230 VAC, 60 Hz, EN55022 B Limits, Output Return Floating.

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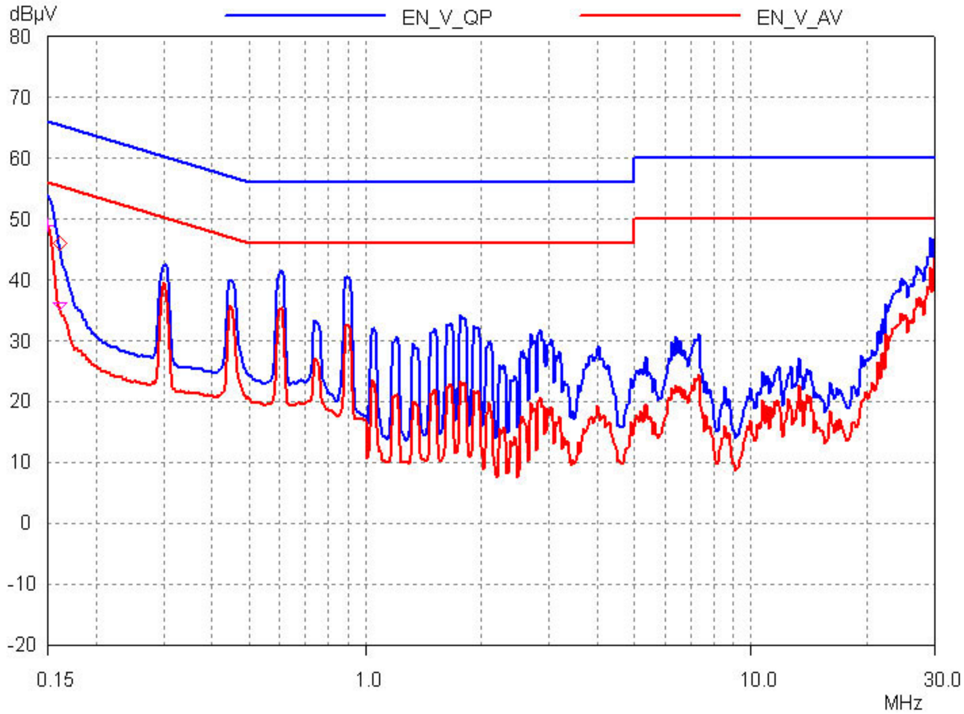


Figure 67 – Conducted EMI, Line Scan, Maximum Steady State Load, 230 VAC, 60 Hz, EN55022 B Limits, Output Return Earth Grounded.

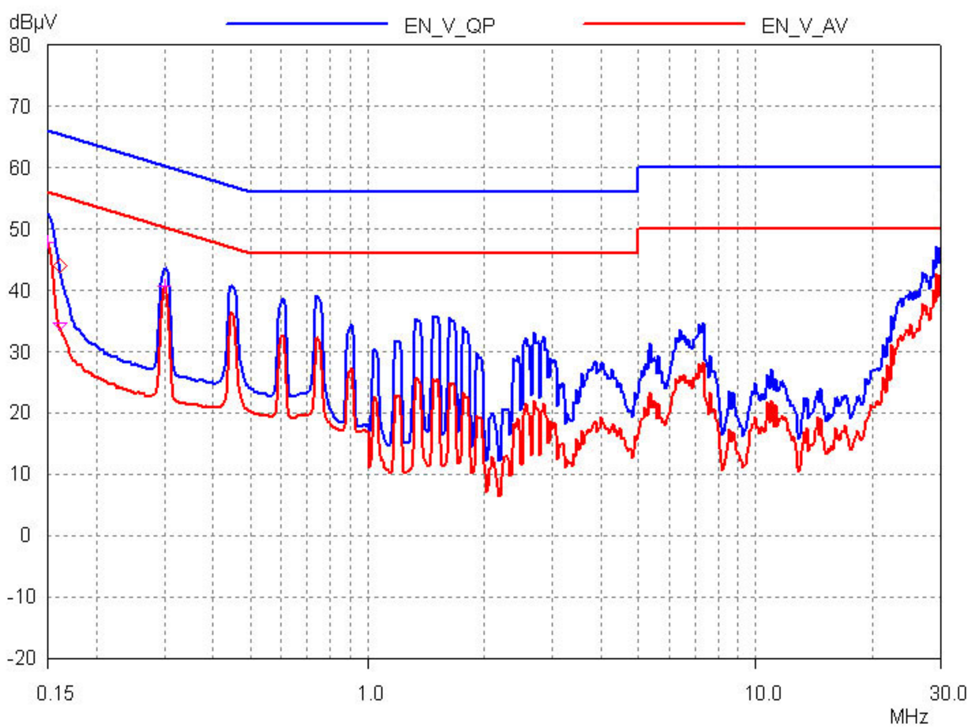


Figure 68 – Conducted EMI, Neutral Scan, Maximum Steady State Load, 230 VAC, 60 Hz, EN55022 B Limits, Output Return Earth Grounded.

15 Appendix A – Differential Mode Inductor

15.1 TOROIDAL FILTER INDUCTOR (L3, L4, L5 & L6)

ELECTRICAL SPECIFICATIONS:

Inductance	Measured at 100KHz with 0.4 Vrms signal	70.0 uH min.

MATERIALS:

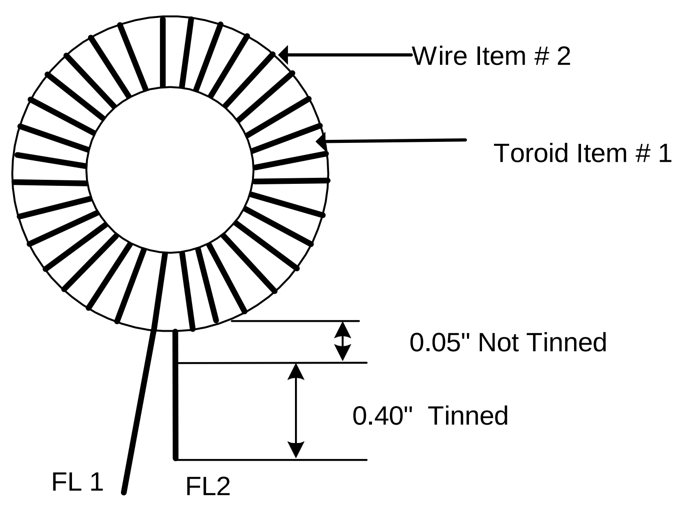
Item	Description
[1]	Core: Powder IronToroid Micrometals T50-26 or equivalent Epoxy coated (available from Lodestone Pacific)
[2]	Magnet Wire: #25 AWG Heavy Nyleze

COIL WINDING INSTRUCTION:

Use item [2]. Wind 48 turns; spread evenly around circumference of the core, as illustrated in Figure 1.

ILLUSTRATION:

Figure 1



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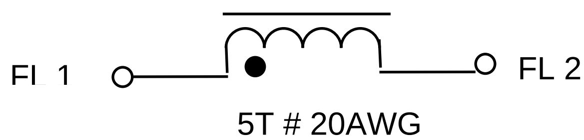
16 Appendix B – Common Mode Inductor

16.1 FERRITE BEAD CHOKE (L9)



ELECTRICAL SPECIFICATIONS:

Inductance	Measured at 100KHz with 0.4 Vrms signal	45 uH min.

MATERIALS:

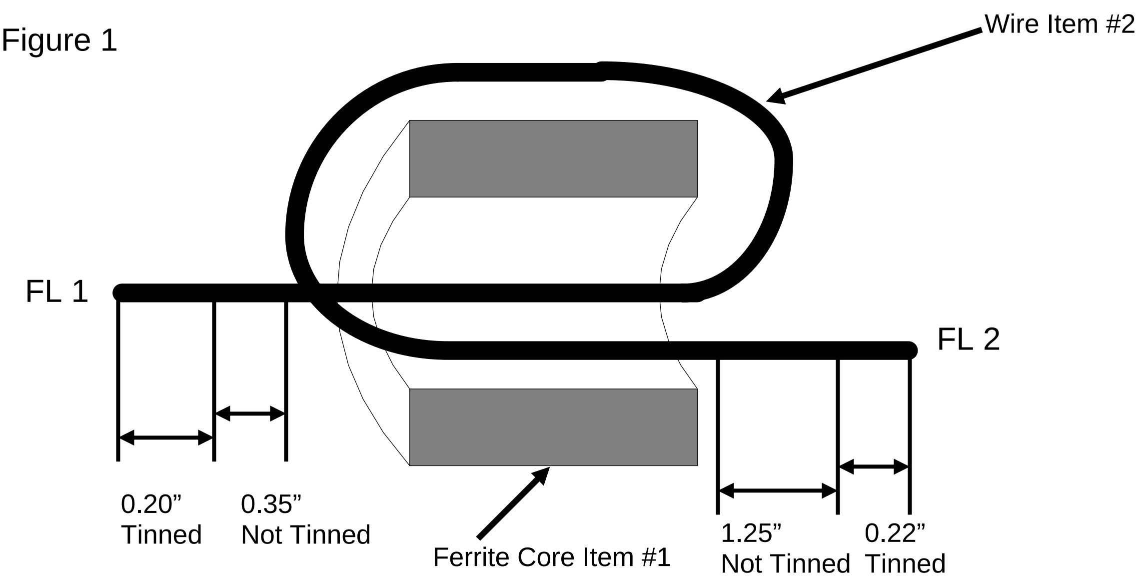
Item	Description
[1]	Core: Fair-Rite Part # 2643023002, 43 Shield Bead
[2]	Copper Strand Wire: #20 AWG TFE Teflon Insulated Hook-up Wire, Earth Return, UL 1180 rated earth return wire, Green/Yellow Striped

COIL WINDING INSTRUCTION:

Use item [2]. Wind 5 turns around ferrite bead, as illustrated in Figure 1.

ILLUSTRATION:

Figure 1



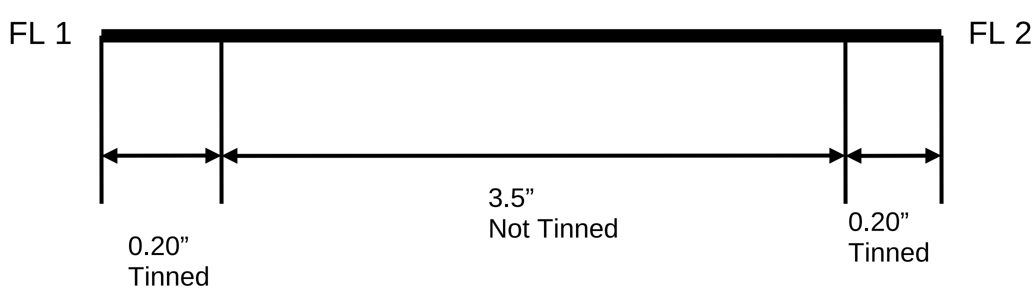
17 Appendix C – Earth Return Jumper (JP_L9)

MATERIALS:

Item	Description
[1]	Copper Strand Wire: #20 AWG TFE Teflon Insulated Hook-up Wire, Earth Return, UL 1180 rated earth return wire, Green/Yellow Striped

ILLUSTRATION:

Figure 1



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18 Revision History

Date	Author	Revision	Description & changes	Reviewed
07-Apr-09	Apps	1.0	Initial Release	

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