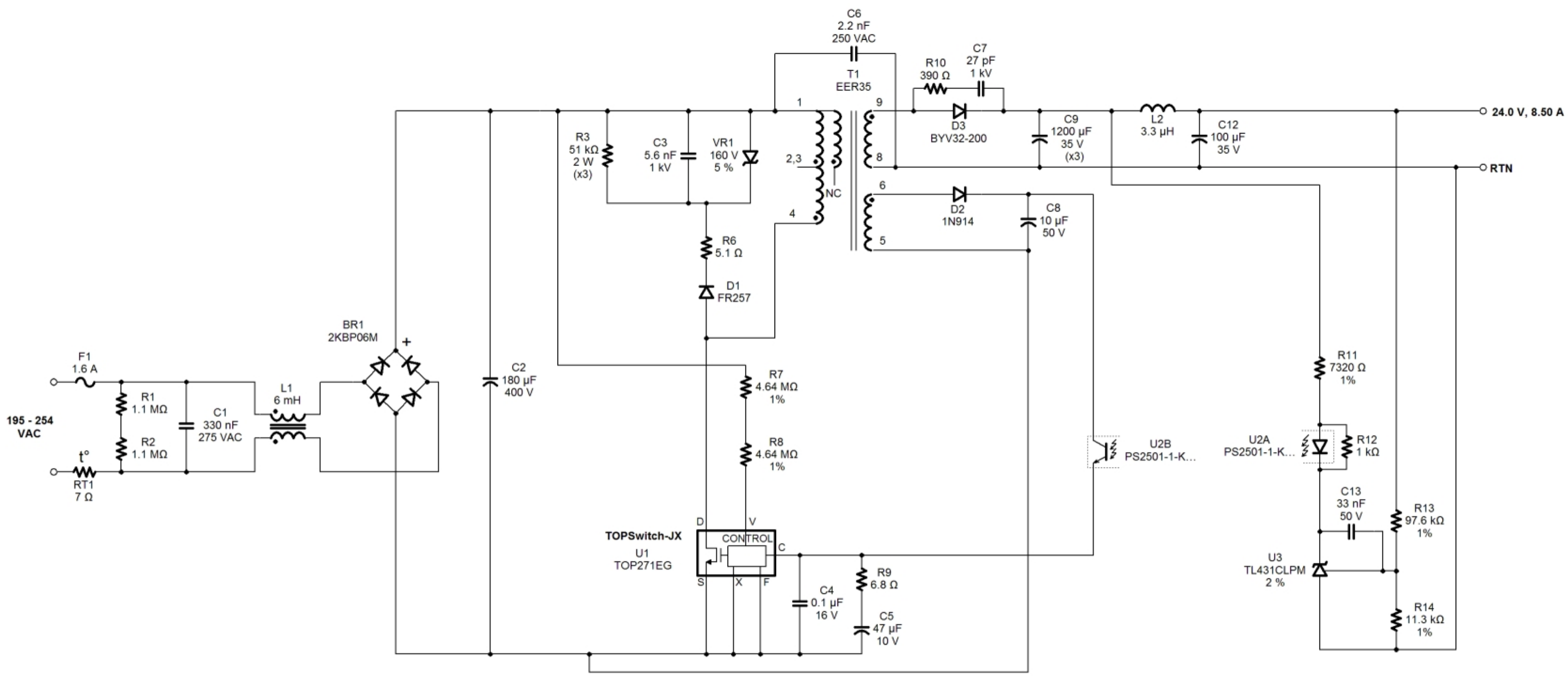


C6
2.2 nF
250 VAC
T1
EER35
R10
390 Ω
C7
27 pF
1 kV
D3
BYV32-200
C9
1200 µF
35 V
(x3)
L2
3.3 µH
C12
100 µF
35 V
24.0 V, 8.50 A
RTN
R3
51 kΩ
2 W
(x3)
C3
5.6 nF
1 kV
VR1
160 V
5 %
NC
D2
1N914
C8
10 µF
50 V
R6
5.1 Ω
D1
FR257
BR1
2KBP06M
F1
1.6 A
R1
1.1 MΩ
R2
1.1 MΩ
C1
330 nF
275 VAC
L1
6 mH
195 - 254
VAC
RT1
7 Ω
C2
180 µF
400 V
R7
4.64 MΩ
1%
R8
4.64 MΩ
1%
R11
7320 Ω
1%
U2B
PS2501-1-K...
U2A
PS2501-1-K...
R12
1 kΩ
C13
33 nF
50 V
R13
97.6 kΩ
1%
TOPSwitch-JX
U1
TOP271EG
CONTROL
U3
TL431CLPM
2 %
C4
0.1 µF
16 V
R9
6.8 Ω
C5
47 µF
10 V
R14
11.3 kΩ
1%

Power Supply Input

Var	Value	Units	Description
VACMIN	**195**	V	Minimum Input AC Voltage (Manual Overwrite)
VACMAX	**254**	V	Maximum Input AC Voltage (Manual Overwrite)
FL	**50**	Hz	Line Frequency (Manual Overwrite)
TC	**1.98**	ms	Input Rectifier Conduction Time
Z	**0.63**		Loss Allocation Factor
η	**83.0**	%	Efficiency Estimate (Target)
VMIN	**232.7**	V	Minimum DC Input Voltage
VMAX	**359.2**	V	Maximum DC Input Voltage

Input Section

Var	Value	Units	Description
Fuse	**1.60**	A	Input Fuse Rated Current
IAVG	**1.06**	A	Average Diode Bridge Current (DC Input Current)
Thermistor	**7.00**	Ω	Input Thermistor

Device Variables

Var	Value	Units	Description
Device	**TOP271EG**		PI Device Name (Manual Overwrite)
BVDSS	**725**	V	Drn-Src Bkdn Voltage
Current Limit Mode	**Default**		Device Current Limit Mode
OVP_FLAG	**NO**		Output Overvoltage Protection Enabled
PO	**204.07**	W	Total Output Power
VDRAIN Estimated	**598.51**	V	Estimated Drain Voltage
VDS	**11.10**	V	On state Drain to Source Voltage
FS	**132000**	Hz	Switching Frequency (at VMIN and Full Load)
KP	**0.70**		Continuous/Discontinuous Operating Ratio (at VMIN and full load)
DMAX	**0.38**		Maximum Duty Cycle (at VMIN and full load)
KI	**1.00**		Current Limit Reduction Factor
ILIMITEXT	**4.81**	A	Programmed Current Limit
ILIMITMIN	**4.808**	A	Minimum Current Limit
ILIMITMAX	**5.532**	A	Maximum Current Limit
PLIM_FLAG	**NO**		Enable Overload Power Limiting
IP	**4.29**	A	Peak Primary Current (at VMIN and full load)
IRMS	**1.80**	A	Primary RMS Current (at VMIN and full load)
RTH_DEVICE	**8.63**	°C/W	PI Device Heatsink Maximum Thermal Resistance
DEV_HSINK_TYPE	**Aluminum Extruded**		PI Device Heatsink Type
DEV_HSINK_PN	**7025BG**		PI Device (Extruded) Heatsink Part Number

Clamp Circuit

Var	Value	Units	Description
Clamp Type	**RCD + Zener Clamp**		Clamp Circuit Type
VCLAMP	**104**	V	Average Clamping Voltage
Estimated Clamp Loss	**3.37**	W	Clamp Dissipation
VC_MARGIN	**130.79**	V	Clamp Voltage Safety Margin

Bias Variables

Var	Value	Units	Description
VB	**12.0**	V	Bias Voltage
IB	**0.006**	A	Bias Current
PIVB	**57**	V	Bias Rectifier Maximum Peak Inverse Voltage
NB	**4**		Bias Winding Number of Turns

Transformer Construction Parameters

Var	Value	Units	Description
Core Type	**EER35**		Core Type
Core Material	**3F3**		Core Material (Manual Overwrite)
Bobbin Reference	**Generic, 7 pri. + 7 sec.**		Bobbin Reference
Bobbin Orientation	**Vertical**		Bobbin type
Primary Pins	**6**		Number of Primary pins used
Secondary Pins	**2**		Number of Secondary pins used
USE_SHIELDS	**YES**		Use shield Windings
LP_nom	**222**	µH	Nominal Primary Inductance
LP_Tol	**10.0**	%	Primary Inductance Tolerance
NP	**32.2**		Calculated Primary Winding Total Number of Turns
NSM	**6**		Secondary Main Number of Turns
CMA	**569**	Cmils/A	Primary Winding Current Capacity
VOR	**135.0**	V	Reflected Output Voltage
BW	**26.10**	mm	Bobbin Winding Width
ML	**0.00**	mm	Safety Margin on Left Width
MR	**0.00**	mm	Safety Margin on Right Width
FF	**80**	%	Actual Transformer Fit Factor. 100% signifies fully utilized winding window
AE	**107.00**	mm^2	Core Cross Sectional Area
ALG	**193**	nH/T^2	Gapped Core Specific Inductance
BM	**2492**	Gauss	Maximum Flux Density
BP	**3538**	Gauss	Peak Flux Density
BAC	**872**	Gauss	AC Flux Density for Core Loss
LG	**0.649**	mm	Estimated Gap Length
L_LKG	**3.33**	µH	Estimated primary leakage inductance
LSEC	**20**	nH	Secondary Trace Inductance

Primary Winding Section 1

Var	Value	Units	Description
NP1	**17**		Number of Primary Winding Turns in the First Section of Primary
Wire Size	**25**	AWG	Primary Winding - Wire Size
Winding Type	**Trifilar (x3)**		Primary Winding - Number of Parallel Wire Strands
L	**0.99**		Primary Winding - Number of Layers
DC Copper Loss	**0.12**	W	Primary Section 1 DC Losses

Primary Winding Section 2

Var	Value	Units	Description
NP2	**16**		Rounded (Integer) Number of Primary winding turns in the second section of primary
Wire Size	**25**	AWG	Primary Winding - Wire Size

Winding Type	**Trifilar (x3)**		*Primary Winding - Number of Parallel Wire Strands*
L2	**0.93**		*Primary Number of Layers in 2nd split winding*
DC Copper Loss	**0.17**	*W*	*Primary Section 2 DC Losses*

Output 1

Var	*Value*	*Units*	*Description*
VO	**24.00**	*V*	*Typical Output Voltage*
IO	**8.50**	*A*	*Output Current*
VOUT_ACTUAL	**24.00**	*V*	*Actual Output Voltage*
NS	**6**		*Secondary Number of Turns*
Foil Thickness	**5**	*mil*	*Wire size of secondary winding*
Winding Type	**Foil**		*Output winding number of parallel strands*
L_S_OUT	**6.00**		*Secondary Output Winding Layers*
DC Copper Loss	**0.20**	*W*	*Secondary DC Losses*
OD_VD	**1.15**	*V*	*Output Winding Diode Forward Voltage Drop*
PIVS	**89**	*V*	*Output Rectifier Maximum Peak Inverse Voltage*
ISP	**23.04**	*A*	*Peak Secondary Current*
ISRMS	**12.36**	*A*	*Secondary RMS Current*
RTH_RECTIFIER	**5.40**	*°C/W*	*Output Rectifier Heatsink Maximum Thermal Resistance*
OR_HSINK_TYPE	**Aluminum Extruded**		*Output Rectifier Heatsink Type*
OR_HSINK_PN	**532802B02500G**		*Output Rectifier (Extruded) Heatsink Part Number*
CO	**1200 x 3**	*µF*	*Output Capacitor - Capacitance*
IRIPPLE	**8.98**	*A*	*Output Capacitor - RMS Ripple Current*
Expected Lifetime	**42623**	*hr*	*Output Capacitor - Expected Lifetime*

Feedback Circuit

Var	*Value*	*Units*	*Description*
DUAL_OUTPUT_FB_FLAG	**NO**		*Get feedback from 2 outputs*
SF_FLAG	**NO**		*Soft Finish Circuits use flag*
TYPE_3CTRL_FLAG	**NO**		*Phase Boost Network flag*

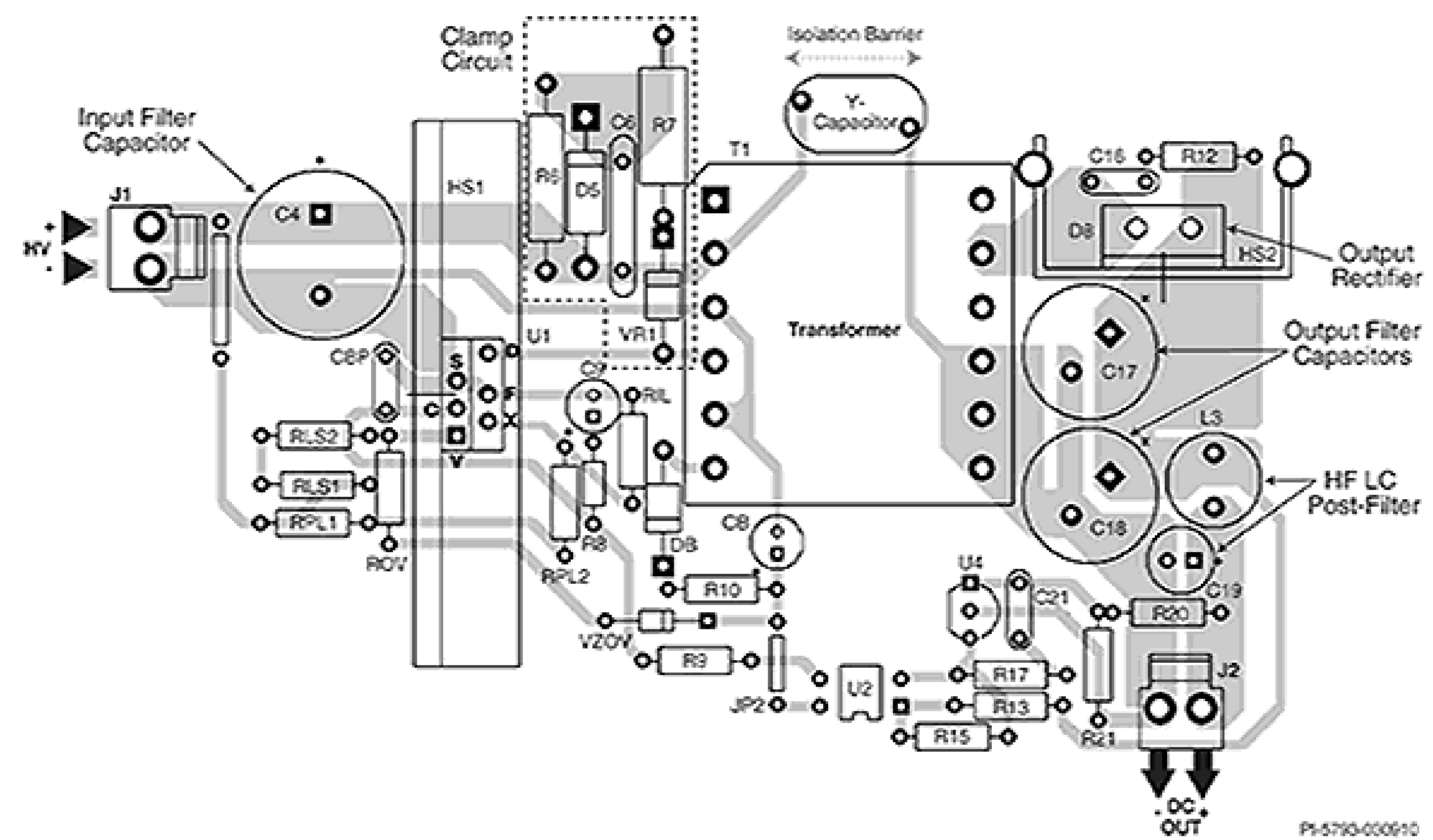
High output current Flyback design.

Use parallel low ESR output capacitors, reduce secondary ripple currents by reducing VOR and KP.

The regulation and tolerances do not account for thermal drifting and component tolerance of the output diode forward voltage drop and voltage drops across the LC post filter. The actual voltage values are estimated at full load only.

Please verify cross regulation performance on the bench.

Board Layout Recommendations



Click on the "Show me" icon to highlight relevant areas on the sample layout.		
	Description	Show Me
1	Minimize loop area formed by drain, clamp and transformer	
2	Bias winding and bias capacitor are a power connection and therefore returned to Kelvin connection at SOURCE pin	
3	V and X pin node areas minimized, line sensing (R1 & R2) and power limiting (R3 & R4) close to device. Connections to V and X pin nodes should be away from noisy switching nodes (drain, clamp and bias)	
4	Place CONTROL pin decoupling capacitor directly across CONTROL and SOURCE pins	
5	Y capacitor connected between output RTN and B+	
6	Minimize loop area formed by secondary winding, the output rectifier and the output filter capacitor	
7	Kelvin connection at SOURCE pins: power and signal currents kept separate	
8	B+ connection of RLS or RPL resistor should be on input side of capacitor to prevent switching noise injection	

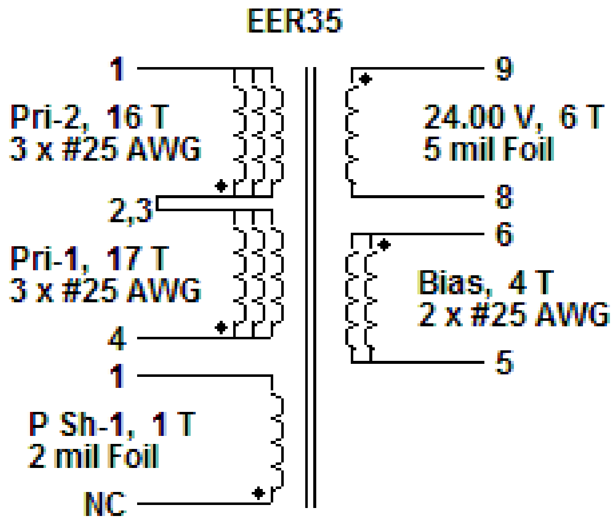
Bill Of Materials

Item #	Quantity	Part Ref	Value	Description	Mfg	Mfg Part Number
1	1	BR1	2KBP06M	600 V, 2 A, Standard Recovery Bridge, KBPM	Fairchild Semiconductor	2KBP06M
2	1	C1	330 nF	330 nF, 275 VAC, Film, X Class	Panasonic	ECQ-UAAF334K
3	1	C2	180 μF	180 μF, 400 V, High Voltage Al Electrolytic, (40 mm x 18 mm)	United Chemi-Con	EPAG400VB181M18X40LL
4	1	C3	5.6 nF	5.6 nF, 1 kV, High Voltage Ceramic	Panasonic	ECK-D3A562KBN
5	1	C4	0.1 μF	0.1 μF, 16 V, Ceramic, X7R	TDK	C1005X7R1C104K
6	1	C5	47 μF	47 μF, 10.0 V, Electrolytic, Gen Purpose, 1040 mΩ, (11 mm x 5 mm)	United Chemi-Con	KME10VB47RM5X11LL
7	1	C6	2.2 nF	2.2 nF, 250 VAC, Ceramic, Y Class	Vishay Cera-Mite	440LD22-R
8	1	C7	27 pF	27 pF, 1 kV, High Voltage Ceramic	Panasonic	ECC-D3A270JGE
9	1	C8	10 μF	10 μF, 50 V, Electrolytic, Gen Purpose, 1050 mΩ, (11.5 mm x 5 mm)	Panasonic	ECA-1HHG100
10	3	C9, C10, C11	1200 μF	1200 μF, 35 V, Electrolytic, Super Low ESR, 18 mΩ, (20 mm x 16 mm)	United Chemi-Con	EKZE350ELL122ML20S
11	1	C12	100 μF	100 μF, 35 V, Electrolytic, Low ESR, 180 mΩ, (15 mm x 6.3 mm)	United Chemi-Con	ELXZ350ELL101MF15D
12	1	C13	33 nF	33 nF, 50 V, Ceramic, X7R	Murata	RPER71H333K2P1A03B
13	1	D1	FR257	1000 V, 2.5 A, Fast Recovery, 500 ns, R-3	Rectron	FR257
14	1	D2	1N914	100 V, 0.3 A, Fast Recovery, 4 ns, DO-35	Vishay	1N914
15	1	D3	BYV32-200	200 V, 18 A, Ultrafast Recovery, 25 ns, TO-220AC	Vishay	BYV32-200
16	1	F1	1.6 A	250 VAC, 1.6 A, Radial TR5, Time Lag Fuse	Littelfuse / Wickmann(R)	37411600410
17	1	HS1	7025BG	6.8 °C/W TO-220. Heatsink for use with Device U1.	Aavid	7025BG
18	1	HS2	532802B02500G	4.2 °C/W TO-220. Heatsink for use with Rectifier D3.	Aavid	532802B02500G
19	1	L1	6 mH	6 mH, 1.6 A	Panasonic	ELF18N016
20	1	L2	3.3 μH	3.3 μH, 9.5 A	Wurth Elektronik	74437377033
21	2	R1, R2	1.1 MΩ	1.1 MΩ, 5 %, 0.25 W, Thick Film	Generic	
22	3	R3, R4, R5	51 kΩ	51 kΩ, 5 %, 2 W, Metal Oxide Film	Generic	
23	1	R6	5.1 Ω	5.1 Ω, 5 %, 0.25 W, Thick Film	Generic	
24	2	R7, R8	4.64 MΩ	4.64 MΩ, 1 %, 0.25 W, Thick Film	Generic	
25	1	R9	6.8 Ω	6.8 Ω, 5 %, 0.125 W, Thick Film	Generic	
26	1	R10	390 Ω	390 Ω, 5 %, 0.25 W, Thick Film	Generic	
27	1	R11	7320 Ω	7320 Ω, 1 %, 0.125 W, Thick Film	Generic	
28	1	R12	1 kΩ	1 kΩ, 5 %, 0.125 W, Thick Film	Generic	
29	1	R13	97.6 kΩ	97.6 kΩ, 1 %, 0.125 W, Thick Film	Generic	
30	1	R14	11.3 kΩ	11.3 kΩ, 1 %, 0.125 W, Thick Film	Generic	
31	1	RT1	7 Ω	NTC Thermistor 7 Ω, 5 A	Thermometrics	CL-50

32	1	T1	EER35	3F3 Core Material See Transformer Construction's Materials List for complete information	TDK	PC40EER35-Z
33	1	U1	TOP271EG	TOPSwitch-JX, TOP271EG, eSIP-7C	Power Integrations	TOP271EG
34	1	U2	PS2501-1-K-A	Optocoupler PS2501-1-K-A, 80 V, CTR 300 - 600 %, 4-DIP	CEL	PS2501-1-K-A
35	1	U3	TL431CLPM	2.495 V, Shunt Regulator IC, 2 %, TO-92	Texas Instruments	TL431CLPM
36	1	VR1	P6KE160A	160 V, 5 W, 5 %, DO-204AC, TVS	Vishay	P6KE160A

This design will use SMD components wherever available. Use Design Setting/Defaults dialog to change this selection

Electrical Diagram



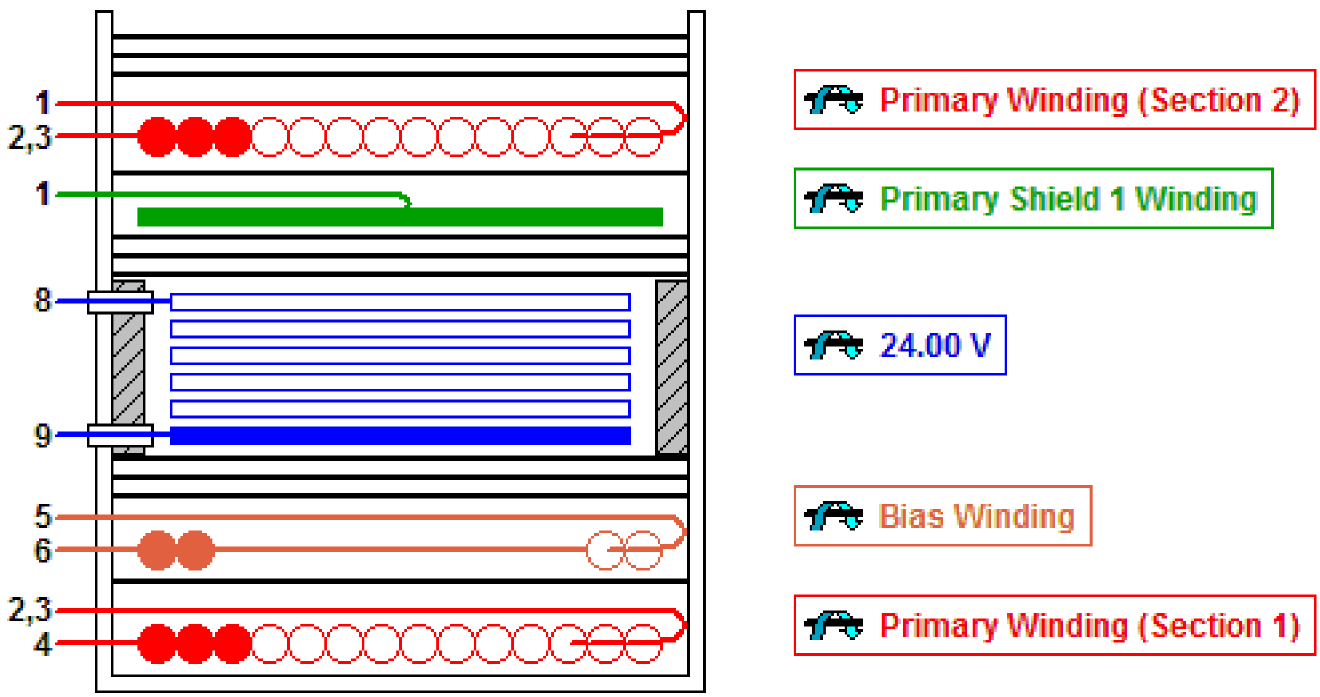
KEY

Pri-1 = Primary Winding (Section 1)

Pri-2 = Primary Winding (Section 2)

P Sh-1 = Primary Shield 1

Mechanical Diagram



KEY

Mechanical start of winding (also denotes electrical phase)

Mechanical start of foil winding (also denotes electrical phase)

Direction of winding (clockwise)

Winding Instruction

Primary Winding (Section 1)

Start on pin(s) 4 and wind 17 turns (x 3 filar) of item [5]. in 1 layer(s) from left to right. Winding direction is clockwise. On the final layer, spread the winding evenly across entire bobbin. Finish this winding on pin(s) 2,3.

Add 1 layer of tape, item [3], for insulation.

Bias Winding

Start on pin(s) 6 and wind 4 turns (x 2 filar) of item [5]. Winding direction is clockwise. Spread the winding evenly across entire bobbin. Finish this winding on pin(s) 5.

Add 3 layers of tape, item [3], for insulation.

Secondary Winding

Use 3 mm margin (item [7]) on the top and 3 mm margin on the bottom (to meet safety). Start on pin(s) 9 and wind 6 turns of item [6]. Winding direction is clockwise. Finish this winding on pin(s) 8.

Add 3 layers of tape, item [3], for insulation.

Primary Shield 1 Winding

Leaving the start of this winding unconnected, wind 1 turn of item [8]. Winding direction is clockwise. Finish this winding on pin(s) 1.

Add 1 layer of tape, item [3], to secure the winding in place.

Primary Winding (Section 2)

Start on pin(s) 2,3 and wind 16 turns (x 3 filar) of item [5]. in 1 layer(s) from left to right. Winding direction is clockwise. On the final layer, spread the winding evenly across entire bobbin. Finish this winding on pin(s) 1.

Add 3 layers of tape, item [3], for insulation.

Core Assembly

Assemble and secure core halves. Item [1].

Varnish

Dip varnish uniformly in item [4]. Do not vacuum impregnate.

Comments

1. Pins 2 and 3 are electrically shorted to each other on the PCB via a copper trace.
2. Use of a grounded flux-band around the core may improve the EMI performance.
3. For non margin wound transformers use triple insulated wire for all secondary windings.

Materials

Item	*Description*
[1]	**Core: EER35, 3F3, gapped for ALG of 193 nH/T²**
[2]	**Bobbin: Generic, 7 pri. + 7 sec.**
[3]	**Barrier Tape: Polyester film [1 mil (25 µm) base thickness], 26.10 mm wide**
[4]	**Varnish**
[5]	**Magnet Wire: 25 AWG, Solderable Double Coated**
[6]	**Copper Foil: 5 mil thick, 20.10 mm wide, covered with 1 layer of lapped tape. Terminations to foil: 2 x 23 AWG magnet wire with sleeving**
[7]	**Tape: Polyester web 3 mm wide**
[8]	**Copper Foil: 2 mil thick, 26.10 mm wide, covered with 1 layer of lapped tape. Terminations to foil: 1 x 25 AWG magnet wire**

Electrical Test Specifications

Parameter	*Condition*	*Spec*
Electrical Strength, VAC	**60 Hz 1 second, from pins 1,2,3,4,5,6 to pins 8,9.**	**3000**
Nominal Primary Inductance, µH	**Measured at 1 V pk-pk, typical switching frequency, between pin 1 to pin 4, with all other Windings open.**	**222**
Tolerance, ±%	**Tolerance of Primary Inductance**	**10.0**
Maximum Primary Leakage, µH	**Measured between Pin 1 to Pin 4, with all other Windings shorted.**	**3.33**

Although the design of the software considered safety guidelines, it is the user's responsibility to ensure that the user's power supply design meets all applicable safety requirements of user's product.

1 *Design Passed (No Optimization)*

	Description	***Fix***	***Ref. #***
	Drain voltage close to BVDSS at maximum OV threshold.	*Verify BVDSS during line surge, decrease VUVON_MAX or reduce VOR.*	*237*