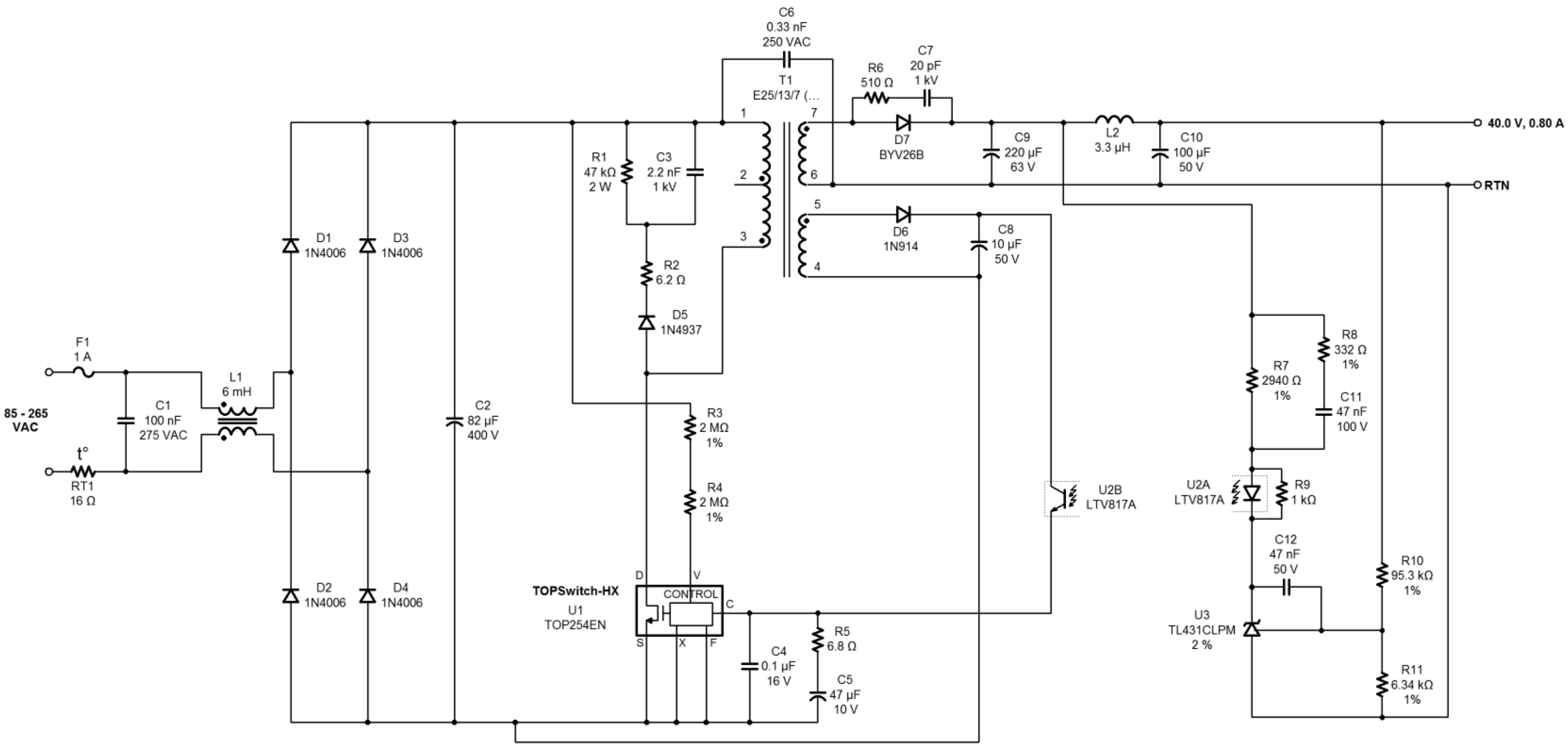


C6
0.33 nF
250 VAC
T1
E25/13/7 (...
R6
510 Ω
C7
20 pF
1 kV
40.0 V, 0.80 A
RTN
R1
47 kΩ
2 W
C3
2.2 nF
1 kV
D7
BYV26B
C9
220 µF
63 V
L2
3.3 µH
C10
100 µF
50 V
D6
1N914
C8
10 µF
50 V
R2
6.2 Ω
D5
1N4937
D1
1N4006
D3
1N4006
R8
332 Ω
1%
R7
2940 Ω
1%
C11
47 nF
100 V
F1
1 A
L1
6 mH
85 - 265
VAC
C1
100 nF
275 VAC
RT1
16 Ω
C2
82 µF
400 V
R3
2 MΩ
1%
R4
2 MΩ
1%
U2B
LTV817A
U2A
LTV817A
R9
1 kΩ
C12
47 nF
50 V
D2
1N4006
D4
1N4006
TOPSwitch-HX
U1
TOP254EN
CONTROL
R5
6.8 Ω
C4
0.1 µF
16 V
C5
47 µF
10 V
U3
TL431CLPM
2 %
R10
95.3 kΩ
1%
R11
6.34 kΩ
1%

Power Supply Input

Var	Value	Units	Description
VACMIN	85	V	Minimum Input AC Voltage
VACMAX	265	V	Maximum Input AC Voltage
FL	50	Hz	Line Frequency
TC	2.69	ms	Input Rectifier Conduction Time
Z	0.53		Loss Allocation Factor
η	80.0	%	Efficiency Estimate (Target)
VMIN	85.4	V	Minimum DC Input Voltage
VMAX	374.8	V	Maximum DC Input Voltage

Input Section

Var	Value	Units	Description
Fuse	1.00	A	Input Fuse Rated Current
IAVG	0.47	A	Average Diode Bridge Current (DC Input Current)
Thermistor	16.00	Ω	Input Thermistor

Device Variables

Var	Value	Units	Description
Device	TOP254EN		PI Device Name
BVDSS	700	V	Drn-Src Bkdn Voltage
Current Limit Mode	Default		Device Current Limit Mode
OVP_FLAG	NO		Output Overvoltage Protection Enabled
PO	32.09	W	Total Output Power
VDRAIN Estimated	576.77	V	Estimated Drain Voltage
VDS	14.08	V	On state Drain to Source Voltage
FS	132000	Hz	Switching Frequency (at VMIN and Full Load)
KP	0.63		Continuous/Discontinuous Operating Ratio (at VMIN and full load)
DMAX	0.59		Maximum Duty Cycle (at VMIN and full load)
KI	1.00		Current Limit Reduction Factor
ILIMITEXT	1.21	A	Programmed Current Limit
ILIMITMIN	1.21	A	Minimum Current Limit
ILIMITMAX	1.39	A	Maximum Current Limit
PLIM_FLAG	NO		Enable Overload Power Limiting
IP	1.15	A	Peak Primary Current (at VMIN and full load)
IRMS	0.63	A	Primary RMS Current (at VMIN and full load)
RTH_DEVICE	16.69	°C/W	PI Device Heatsink Maximum Thermal Resistance
DEV_HSINK_TYPE	Custom Aluminum		PI Device Heatsink Type
DEV_HSINK_AREA	4707	mm^2	PI Device Heatsink Area

Clamp Circuit

Var	Value	Units	Description
Clamp Type	RCD Clamp		Clamp Circuit Type
VCLAMP	98	V	Average Clamping Voltage
Estimated Clamp Loss	0.87	W	Clamp Dissipation
VC_MARGIN	120.82	V	Clamp Voltage Safety Margin

Bias Variables

Var	Value	Units	Description
VB	**15.0**	V	Bias Voltage
IB	**0.006**	A	Bias Current
PIVB	**74**	V	Bias Rectifier Maximum Peak Inverse Voltage
NB	**6**		Bias Winding Number of Turns

Transformer Construction Parameters

Var	Value	Units	Description
Core Type	**E25/13/7 (EF25)**		Core Type
Core Material	**PC95**		Core Material
Bobbin Reference	**Generic, 5 pri. + 5 sec.**		Bobbin Reference
Bobbin Orientation	**Vertical**		Bobbin type
Primary Pins	**5**		Number of Primary pins used
Secondary Pins	**2**		Number of Secondary pins used
USE_SHIELDS	**NO**		Use shield Windings
LP_nom	**515**	µH	Nominal Primary Inductance
LP_Tol	**10.0**	%	Primary Inductance Tolerance
NP	**37.9**		Calculated Primary Winding Total Number of Turns
NSM	**15**		Secondary Main Number of Turns
CMA	**645**	Cmils/A	Primary Winding Current Capacity
VOR	**104.4**	V	Reflected Output Voltage
BW	**15.30**	mm	Bobbin Winding Width
ML	**0.00**	mm	Safety Margin on Left Width
MR	**0.00**	mm	Safety Margin on Right Width
FF	**95**	%	Actual Transformer Fit Factor. 100% signifies fully utilized winding window
AE	**52.50**	mm^2	Core Cross Sectional Area
ALG	**322**	nH/T^2	Gapped Core Specific Inductance
BM	**2679**	Gauss	Maximum Flux Density
BP	**3236**	Gauss	Peak Flux Density
BAC	**841**	Gauss	AC Flux Density for Core Loss
LG	**0.167**	mm	Estimated Gap Length
L_LKG	**12.87**	µH	Estimated primary leakage inductance
LSEC	**20**	nH	Secondary Trace Inductance

Primary Winding Section 1

Var	Value	Units	Description
NP1	**19**		Number of Primary Winding Turns in the First Section of Primary
Wire Size	**24**	AWG	Primary Winding - Wire Size
Winding Type	**Single (x1)**		Primary Winding - Number of Parallel Wire Strands
L	**0.70**		Primary Winding - Number of Layers
DC Copper Loss	**0.03**	W	Primary Section 1 DC Losses

Primary Winding Section 2

Var	Value	Units	Description
NP2	**19**		Rounded (Integer) Number of Primary winding turns in the second section of primary
Wire Size	**24**	AWG	Primary Winding - Wire Size

Winding Type	**Single (x1)**		*Primary Winding - Number of Parallel Wire Strands*
L2	**0.70**		*Primary Number of Layers in 2nd split winding*
DC Copper Loss	**0.04**	*W*	*Primary Section 2 DC Losses*

Output 1

Var	*Value*	*Units*	*Description*
VO	**40.00**	*V*	*Typical Output Voltage*
IO	**0.80**	*A*	*Output Current*
VOUT_ACTUAL	**40.00**	*V*	*Actual Output Voltage*
NS	**15**		*Secondary Number of Turns*
Wire Size	**25**	*AWG*	*Wire size of secondary winding*
Winding Type	**Single (x1)**		*Output winding number of parallel strands*
L_S_OUT	**0.64**		*Secondary Output Winding Layers*
DC Copper Loss	**0.17**	*W*	*Secondary DC Losses*
OD_VD	**1.30**	*V*	*Output Winding Diode Forward Voltage Drop*
PIVS	**188**	*V*	*Output Rectifier Maximum Peak Inverse Voltage*
ISP	**2.90**	*A*	*Peak Secondary Current*
ISRMS	**1.31**	*A*	*Secondary RMS Current*
RTH_RECTIFIER	**48.11**	*°C/W*	*Output Rectifier Heatsink Maximum Thermal Resistance*
OR_HSINK_TYPE	**2 Oz (70 µ) 2-Sided Copper**		*Output Rectifier Heatsink Type*
OR_HSINK_AREA	**225**	*mm^2*	*Output Rectifier Heatsink Area*
CO	**220 x 1**	*µF*	*Output Capacitor - Capacitance*
IRIPPLE	**1.04**	*A*	*Output Capacitor - RMS Ripple Current*
Expected Lifetime	**40467**	*hr*	*Output Capacitor - Expected Lifetime*

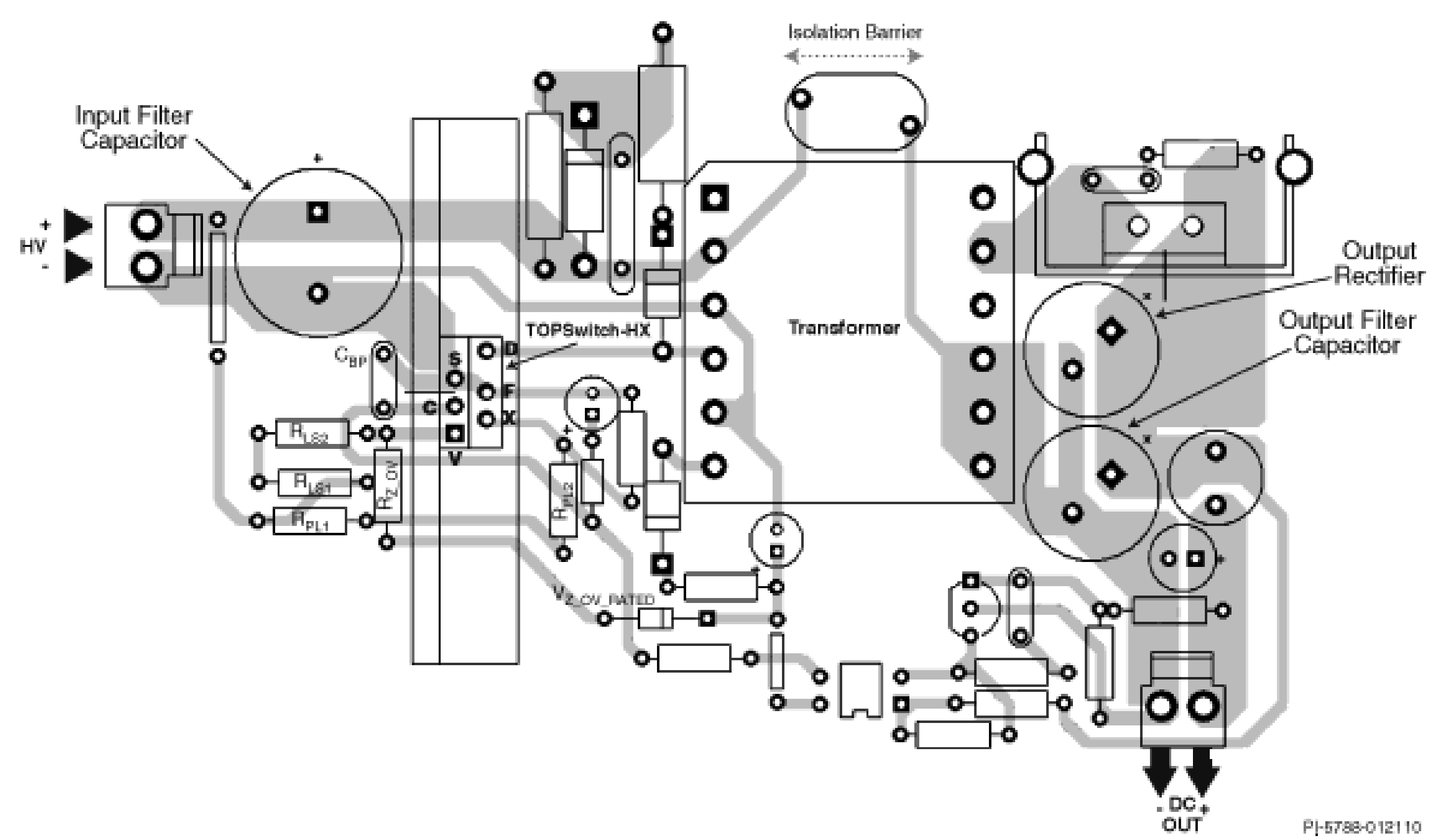
Feedback Circuit

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	**YES**		*Phase Boost Network flag*

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



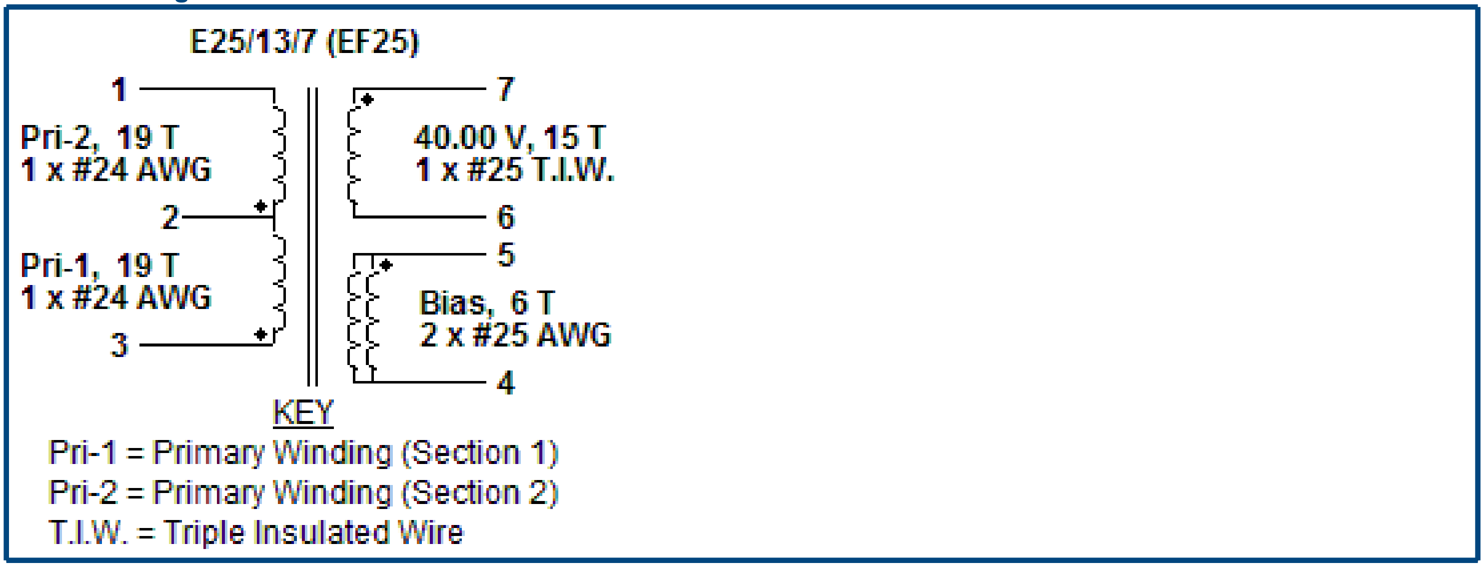
Click on the "Show me" icon to highlight relevant areas on the sample layout.		
	Description	*Show Me*
1	*Minimize loop area formed by drain, clamp and transformer*	
2	*Bias winding and bias capacitor are a power connection and therefore returned to Kelvin connection at SOURCE pin*	
3	*V and X pin node 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

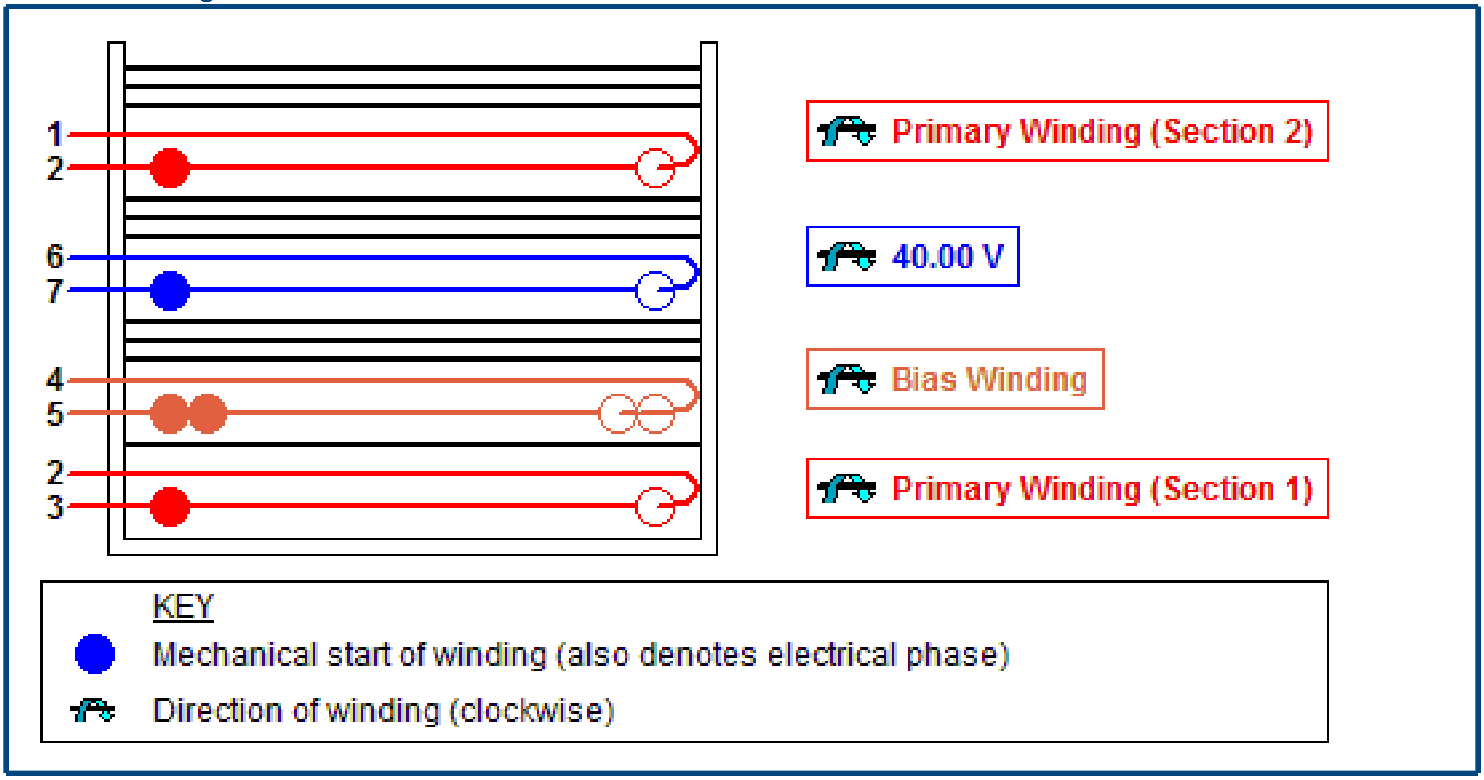
Item #	Quantity	Part Ref	Value	Description	Mfg	Mfg Part Number
1	1	C1	100 nF	100 nF, 275 VAC, Film, X Class	Kemet	R46KI310000M1K
2	1	C2	82 µF	82 µF, 400 V, High Voltage Al Electrolytic, (35 mm x 14.5 mm)	United Chemi-Con	EPAG400VB82RM14X35LL
3	1	C3	2.2 nF	2.2 nF, 1 kV, High Voltage Ceramic	NIC Components Corp	NCD222K1KVY5FF
4	1	C4	0.1 µF	0.1 µF, 16 V, Ceramic, X7R	TDK	C1005X7R1C104K
5	1	C5	47 µF	47 µF, 10.0 V, Electrolytic, Gen Purpose, 1040 mΩ, (11 mm x 5 mm)	United Chemi-Con	KME10VB47RM5X11LL
6	1	C6	0.33 nF	0.33 nF, 250 VAC, Ceramic, Y Class	Vishay Cera-Mite	440LT33-R
7	1	C7	20 pF	20 pF, 1 kV, High Voltage Ceramic	Vishay	5GAQ20
8	1	C8	10 µF	10 µF, 50 V, Electrolytic, Gen Purpose, 1050 mΩ, (11.5 mm x 5 mm)	Panasonic	ECA-1HHG100
9	1	C9	220 µF	220 µF, 63 V, Electrolytic, Low ESR, 130 mΩ, (25 mm x 10 mm)	United Chemi-Con	ELXZ630ELL221MJ25S
10	1	C10	100 µF	100 µF, 50 V, Electrolytic, Low ESR, 220 mΩ, (12 mm x 8 mm)	United Chemi-Con	ELXZ500ELL101MH12D
11	1	C11	47 nF	47 nF, 100 V, Ceramic, X7R	TDK	FK14X7R2A473K
12	1	C12	47 nF	47 nF, 50 V, Ceramic, X7R	Murata	RPER71H473K2P1A03B
13	4	D1, D2, D3, D4	1N4006	800 V, 1 A, Standard Recovery, DO-41	Vishay	1N4006
14	1	D5	1N4937	600 V, 1 A, Fast Recovery, 200 ns, DO-41	Vishay	1N4937
15	1	D6	1N914	100 V, 0.3 A, Fast Recovery, 4 ns, DO-35	Vishay	1N914
16	1	D7	BYV26B	400 V, 1 A, Ultrafast Recovery, 30 ns, SOD57	Philips	BYV26B
17	1	F1	1 A	250 VAC, 1 A, Radial TR5, Time Lag Fuse	Littelfuse / Wickmann(R)	37411000410
18	1	HS1		117.7 mm x 20 mm. Aluminum Alloy (3003 OR 5052), 1.6 mm thickness. Heatsink for use with Device U1.	Custom	
19	1	L1	6 mH	6 mH, 1.6 A	Panasonic	ELF18N016
20	1	L2	3.3 µH	3.3 µH, 2.66 A	Bourns Inc.	RL822-3R3K-RC
21	1	R1	47 kΩ	47 kΩ, 5 %, 2 W, Metal Oxide Film	Generic	
22	1	R2	6.2 Ω	6.2 Ω, 5 %, 0.25 W, Carbon Film	Generic	
23	2	R3, R4	2 MΩ	2 MΩ, 1 %, 0.25 W, Metal Film	Generic	
24	1	R5	6.8 Ω	6.8 Ω, 5 %, 0.125 W, Carbon Film	Generic	
25	1	R6	510 Ω	510 Ω, 5 %, 0.25 W, Carbon Film	Generic	
26	1	R7	2940 Ω	2940 Ω, 1 %, 0.125 W, Metal Film	Generic	
27	1	R8	332 Ω	332 Ω, 1 %, 0.125 W, Metal Film	Generic	
28	1	R9	1 kΩ	1 kΩ, 5 %, 0.125 W, Carbon Film	Generic	
29	1	R10	95.3 kΩ	95.3 kΩ, 1 %, 0.125 W, Metal Film	Generic	
30	1	R11	6.34 kΩ	6.34 kΩ, 1 %, 0.125 W, Metal Film	Generic	
31	1	RT1	16 Ω	NTC Thermistor 16 Ω, 1.7 A	Thermometrics	CL180

32	*1*	*T1*	*E25/13/7 (EF25)*	*PC95 Core Material* *See Transformer Construction's Materials List for complete information*	*Epcos*	*B66317-G-X127*
33	*1*	*U1*	*TOP254EN*	*TOPSwitch-HX, TOP254EN, eSIP-7C*	*Power Integrations*	*TOP254EN*
34	*1*	*U2*	*LTV817A*	*Optocoupler LTV817A, 35 V, CTR 80 - 160 %, 4-DIP*	*Liteon*	*LTV817A*
35	*1*	*U3*	*TL431CLPM*	*2.495 V, Shunt Regulator IC, 2 %, TO-92*	*Texas Instruments*	*TL431CLPM*
36	*1*			*225 mm² area on Copper PCB. 2 oz (70 µm) thickness. Heatsink for use with Rectifier D7.*	*Custom*	

Electrical Diagram



Mechanical Diagram



Winding Instruction

Primary Winding (Section 1)

Start on pin(s) 3 and wind 19 turns (x 1 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.

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

Bias Winding

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

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

Secondary Winding

Start on pin(s) 7 and wind 15 turns (x 1 filar) of item [7]. Spread the winding evenly across entire bobbin. Winding direction is clockwise. Finish this winding on pin(s) 6.

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

Primary Winding (Section 2)

Start on pin(s) 2 and wind 19 turns (x 1 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. Use of a grounded flux-band around the core may improve the EMI performance.
2. For non margin wound transformers use triple insulated wire for all secondary windings.

Materials

Item	*Description*
[1]	**Core: E25/13/7 (EF25), PC95, gapped for ALG of 322 nH/T²**
[2]	**Bobbin: Generic, 5 pri. + 5 sec.**
[3]	**Barrier Tape: Polyester film [1 mil (25 µm) base thickness], 15.30 mm wide**
[4]	**Varnish**
[5]	**Magnet Wire: 24 AWG, Solderable Double Coated**
[6]	**Magnet Wire: 25 AWG, Solderable Double Coated**
[7]	**Triple Insulated Wire: 25 AWG**

Electrical Test Specifications

Parameter	*Condition*	*Spec*
Electrical Strength, VAC	**60 Hz 1 second, from pins 1,2,3,4,5 to pins 6,7.**	**3000**
Nominal Primary Inductance, µH	**Measured at 1 V pk-pk, typical switching frequency, between pin 1 to pin 3, with all other Windings open.**	**515**
Tolerance, ±%	**Tolerance of Primary Inductance**	**10.0**
Maximum Primary Leakage, µH	**Measured between Pin 1 to Pin 3, with all other Windings shorted.**	**12.87**

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.

Design Passed (Optimization Done)