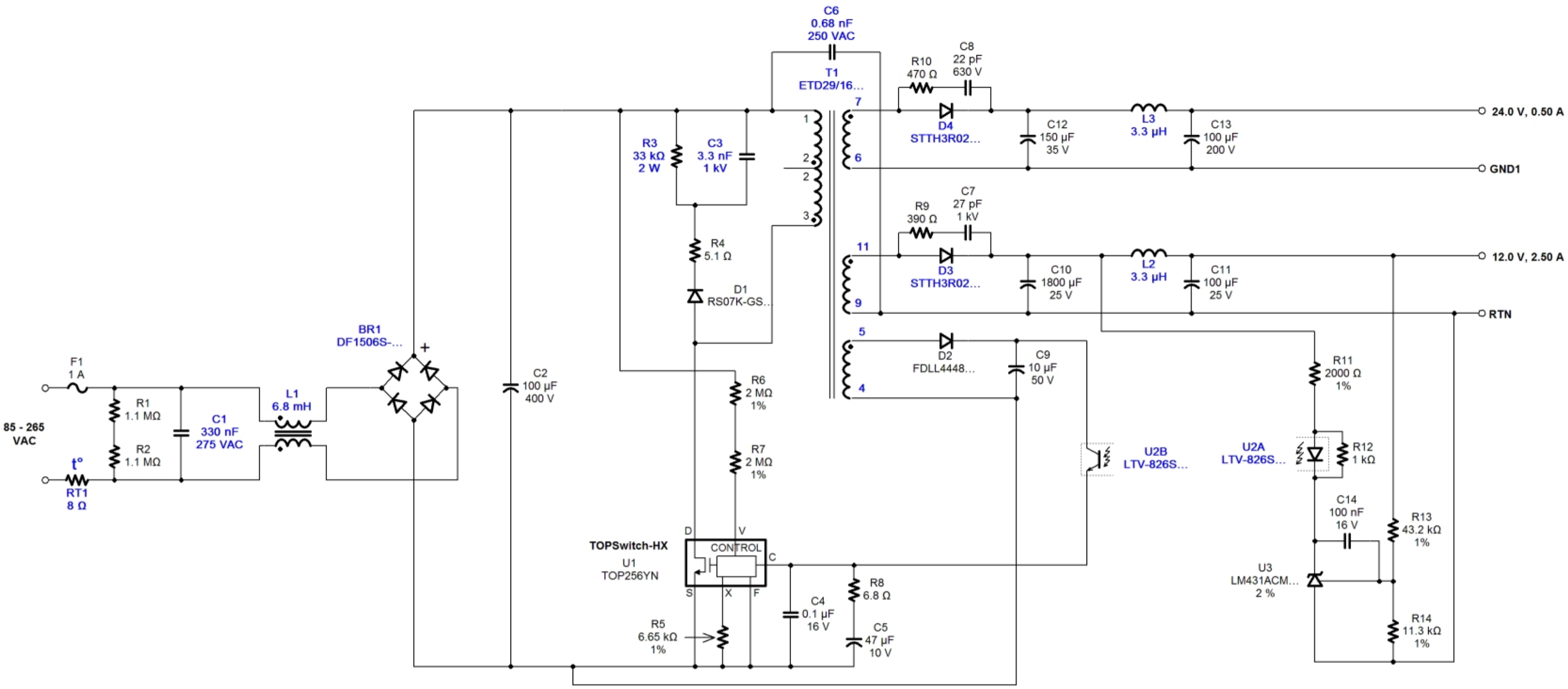


Schematic components that have been frozen by the user will appear with blue reference designators.

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	0.56		Loss Allocation Factor
η	80.0	%	Efficiency Estimate (Target)
VMIN	82.2	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	0.64	A	Average Diode Bridge Current (DC Input Current)
Thermistor	8.00	Ω	Input Thermistor (Manual Overwrite)

Device Variables

Var	Value	Units	Description
Device	TOP256YN		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	42.07	W	Total Output Power
VDRAIN Estimated	588.49	V	Estimated Drain Voltage
VDS	9.96	V	On state Drain to Source Voltage
FS	132000	Hz	Switching Frequency (at VMIN and Full Load)
KP	0.500		Continuous/Discontinuous Operating Ratio (at VMIN and Full Load)
DMAX	0.560		Maximum Duty Cycle (at VMIN and Full Load)
KI	0.94		Current Limit Reduction Factor (Manual Overwrite)
ILIMITEXT	2.23	A	Programmed Current Limit
ILIMITMIN	2.372	A	Minimum Current Limit
ILIMITMAX	2.729	A	Maximum Current Limit
PLIM_FLAG	NO		Enable Overload Power Limiting (Manual Overwrite)
IP	1.523	A	Peak Primary Current (at VMIN and Full Load)
IRMS	0.870	A	Primary RMS Current (at VMIN and Full Load)
RTH_DEVICE	17.27	°C/W	PI Device Heatsink Maximum Thermal Resistance
DEV_HSINK_TYPE	Custom Aluminum		PI Device Heatsink Type
DEV_HSINK_AREA	4376	mm²	PI Device Heatsink Area

Clamp Circuit

Var	Value	Units	Description
Clamp Type	RCD Clamp		Clamp Circuit Type (Manual Overwrite)
VCLAMP	121.72	V	Average Clamping Voltage
Estimated Clamp Loss	1.384	W	Clamp total power loss
VC_MARGIN	133.23	V	Clamp Voltage Safety Margin

Primary Bias Variables

Var	Value	Units	Description
VB	**15.0**	V	Bias Voltage
IB	**0.006**	A	Bias Current
PIVB	**82**	V	Bias Rectifier Maximum Peak Inverse Voltage
NB	**10**		Primary Bias Winding Number of Turns

Transformer Construction Parameters

Var	Value	Units	Description
Core Type	**ETD29/16/10**		Core Type (Manual Overwrite)
Core Material	**3C95**		Core Material
Bobbin Reference	**Generic, 7 pri. + 7 sec.**		Bobbin Reference
Bobbin Orientation	**Horizontal**		Bobbin type
Primary Pins	**5**		Number of Primary pins used
Secondary Pins	**6**		Number of Secondary pins used
USE_SHIELDS	**NO**		Use shield Windings
LP_nom	**447**	µH	Nominal Primary Inductance
LP_Tol	**10.0**	%	Primary Inductance Tolerance
NP	**55.8**		Calculated Primary Winding Total Number of Turns
NSM	**8**		Secondary Main Number of Turns
CMA	**464.12**	Cmils/A	Primary Winding Current Capacity
VOR	**92.00**	V	Reflected Output Voltage (Manual Overwrite)
BW	**19.40**	mm	Bobbin Winding Width
ML	**0.00**	mm	Safety Margin on Left Width
MR	**0.00**	mm	Safety Margin on Right Width
FF	**72.22**	%	Actual Transformer Fit Factor. 100% signifies fully utilized winding window
AE	**76.00**	mm^2	Core Cross Sectional Area
ALG	**129**	nH/T^2	Gapped Core Specific Inductance
BM	**1445**	Gauss	Maximum Flux Density
BP	**2434**	Gauss	Peak Flux Density
BAC	**361**	Gauss	AC Flux Density for Core Loss
LG	**0.693**	mm	Estimated Gap Length
L_LKG	**11.17**	µH	Estimated primary leakage inductance
LSEC	**10**	nH	Secondary Trace Inductance

Primary Winding Section 1

Var	Value	Units	Description
NP1	**28**		Number of Primary Winding Turns in the First Section of Primary
Wire Size	**24**	AWG	Primary Winding - Wire Size (Manual Overwrite)
Winding Type	**Single (x1)**		Primary Winding - Number of Parallel Wire Strands (Manual Overwrite)
L	**0.82**		Primary Winding - Number of Layers
DC Copper Loss	**0.09**	W	Primary Section 1 DC Losses

Primary Winding Section 2

Var	Value	Units	Description
NP2	**28**		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 (Manual Overwrite)
L2	**0.82**		Primary Number of Layers in 2nd split winding

Output 1

Var	Value	Units	Description
VO	**12.00**	V	Typical Output Voltage
IO	**2.50**	A	Output Current
VOUT_ACTUAL	**12.00**	V	Actual Output Voltage
NS	**8**		Secondary Number of Turns
Wire Size	**25**	AWG	Wire size of secondary winding
Winding Type	**Trifilar (x3)**		Output winding number of parallel strands
L_S_OUT	**0.80**		Secondary Output Winding Layers
DC Copper Loss	**0.28**	W	Secondary DC Losses
VD	**1.20**	V	Output Winding Diode Forward Voltage Drop (Manual Overwrite)
VD	**1.20**	V	Output Winding Diode Forward Voltage Drop (Manual Overwrite)
PIVS	**65.54**	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	**7.568**	A	Peak Secondary Current
ISRMS	**3.834**	A	Secondary RMS Current
ISRMS_WINDING	**3.834**	A	Secondary Winding RMS Current
CMAS	**251**	Cmils/A	Secondary Winding Current Capacity
RTH_RECTIFIER	**18.96**	°C/W	Output Rectifier Heatsink Maximum Thermal Resistance
OR_HSINK_TYPE	**1 Oz (35 µ) 2-Sided Copper PCB**		Output Rectifier Heatsink Type
OR_HSINK_AREA	**16112**	mm²	Output Rectifier Heatsink Area
CO	**1800 x 1**	µF	Output Capacitor - Capacitance
IRIPPLE	**2.907**	A	Output Capacitor - RMS Ripple Current
Expected Lifetime	**44174**	hr	Output Capacitor - Expected Lifetime

Output 2

Var	Value	Units	Description
VO	**24.00**	V	Typical Output Voltage
IO	**0.50**	A	Output Current
VOUT_ACTUAL	**23.55**	V	Actual Output Voltage
NS	**15**		Secondary Number of Turns
Wire Size	**28**	AWG	Wire size of secondary winding
Winding Type	**Single (x1)**		Output winding number of parallel strands (Manual Overwrite)
L_S_OUT	**0.40**		Secondary Output Winding Layers
DC Copper Loss	**0.14**	W	Secondary DC Losses
VD	**1.20**	V	Output Winding Diode Forward Voltage Drop (Manual Overwrite)
VD	**1.20**	V	Output Winding Diode Forward Voltage Drop (Manual Overwrite)
PIVS	**123.93**	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	**1.514**	A	Peak Secondary Current
ISRMS	**0.767**	A	Secondary RMS Current
ISRMS_WINDING	**0.767**	A	Secondary Winding RMS Current

CMAS	**207**	*Cmils/A*	*Secondary Winding Current Capacity*
RTH_RECTIFIER	**92.79**	*°C/W*	*Output Rectifier Heatsink Maximum Thermal Resistance*
OR_HSINK_TYPE	**1 Oz (35 µ) 2-Sided Copper PCB**		*Output Rectifier Heatsink Type*
OR_HSINK_AREA	**52**	*mm^2*	*Output Rectifier Heatsink Area*
CO	**150 x 1**	*µF*	*Output Capacitor - Capacitance*
IRIPPLE	**0.581**	*A*	*Output Capacitor - RMS Ripple Current*
Expected Lifetime	**31999**	*hr*	*Output Capacitor - Expected Lifetime*

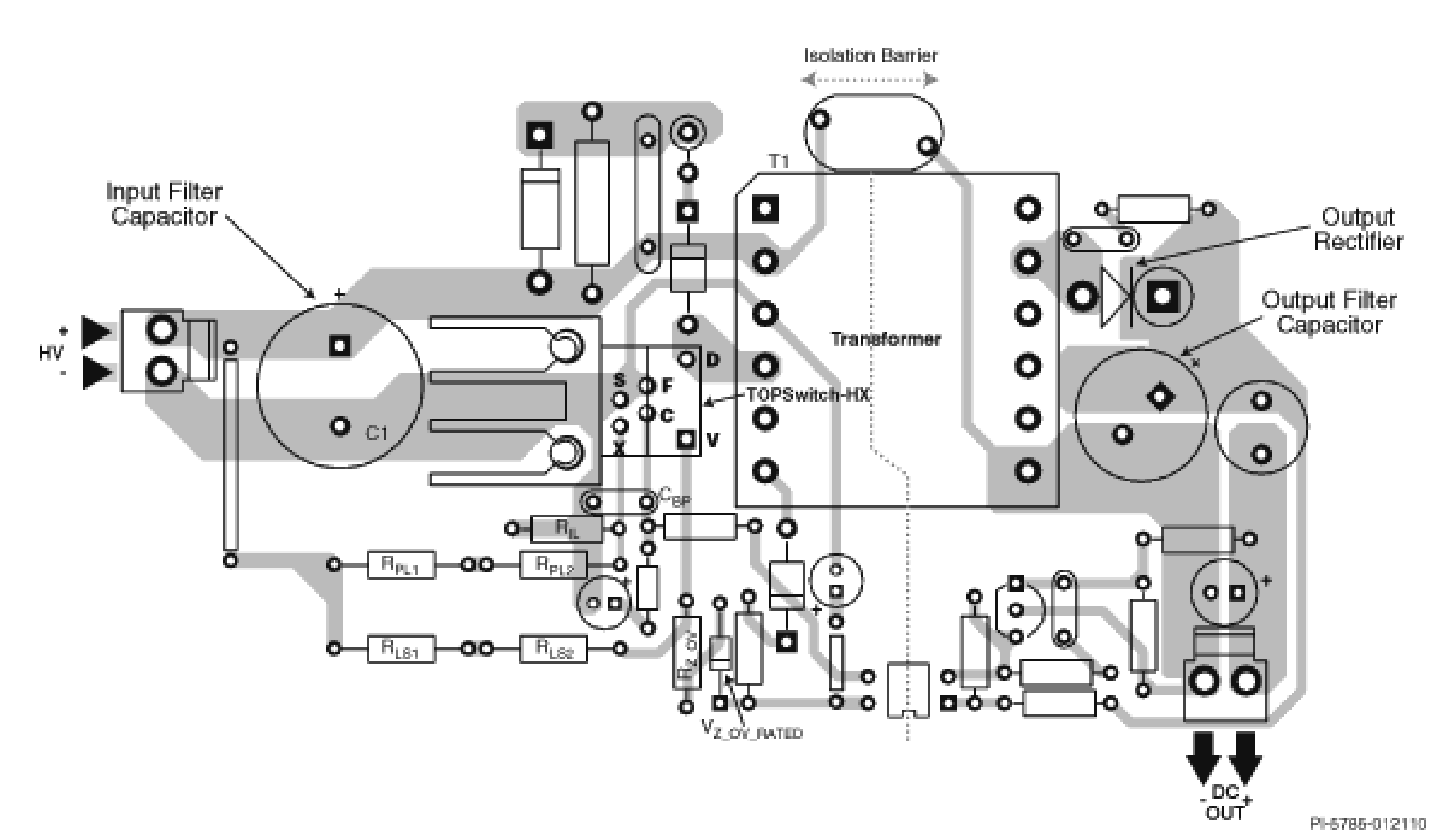
Feedback Circuit

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*

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



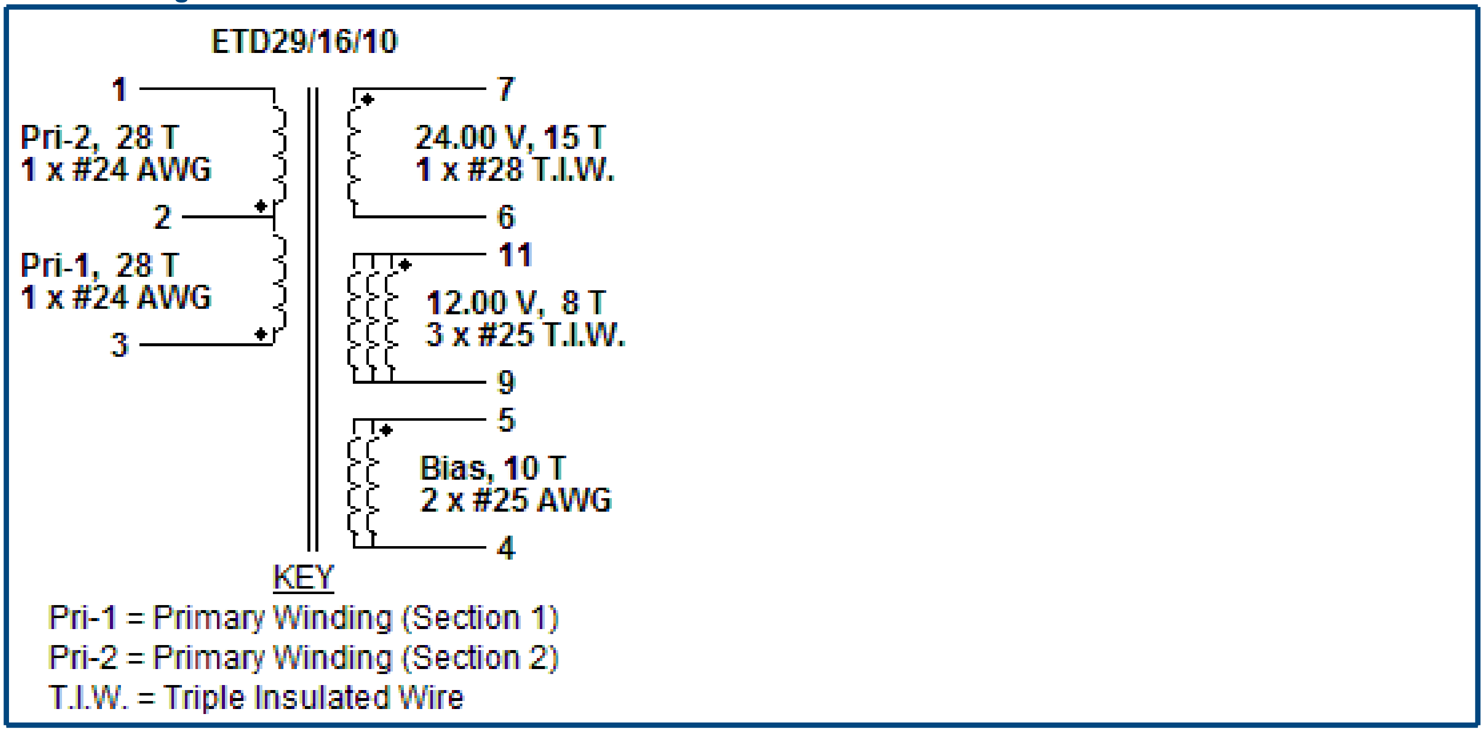
Click on the "Show me" icon to highlight relevant areas on the sample layout.		
	Description	*Show Me*
1	*Minimize loop area formed by drain, clamp and transformer*	
2	*Bias winding and bias capacitor are a power connection and therefore returned to Kelvin connection at SOURCE pin*	
3	*V and X pin node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

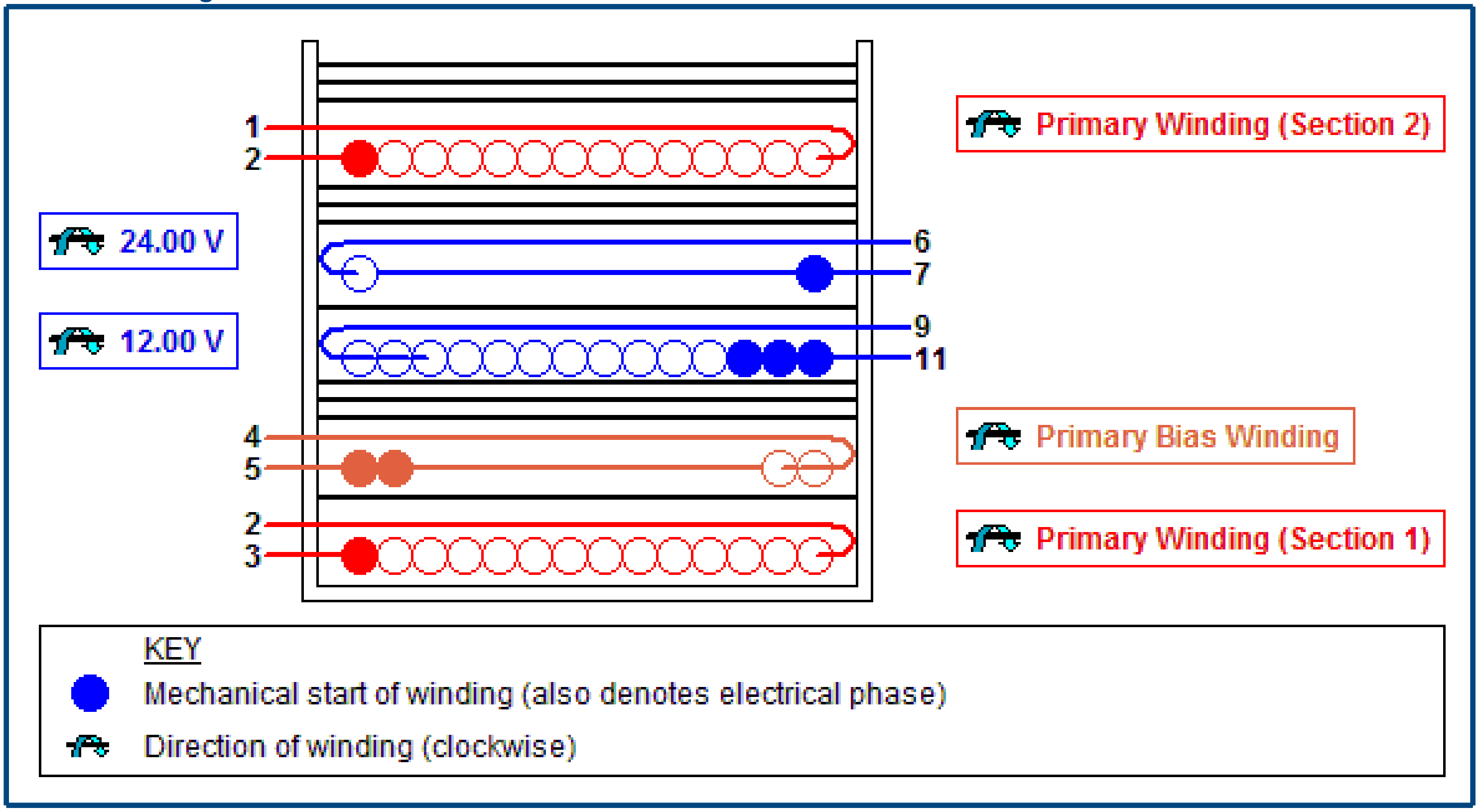
Item #	Quantity	Part Ref	Value	Description	Mfg	Mfg Part Number
1	1	BR1	DF1506S-T	600 V, 1.5 A, Standard Recovery Bridge, DFS	Diodes Inc.	DF1506S-T
2	1	C1	330 nF	330 nF, 275 VAC, Film, X Class	Panasonic	ECQ-UAAF334K
3	1	C2	100 µF	100 µF, 400 V, High Voltage Al Electrolytic, (30 mm x 16 mm)	United Chemi-Con	EPAG401ELL101ML30S
4	1	C3	3.3 nF	3.3 nF, 1 kV, High Voltage Ceramic	Kemet	C1206C332KDRACTU
5	2	C4, C14	0.1 µF	0.1 µF, 16 V, Ceramic, X7R	AVX Corp	0603YC104K4T4A
6	1	C5	47 µF	47 µF, 10.0 V, Electrolytic, Gen Purpose, 1000 mΩ, (5.2 mm x 6.3 mm)	United Chemi-Con	EMVY100ADA470MF55G
7	1	C6	0.68 nF	0.68 nF, 250 VAC, Ceramic, Y Class	Vishay Cera-Mite	440LT68-R
8	1	C7	27 pF	27 pF, 1 kV, High Voltage Ceramic	Murata	GRM31A5C3A270JW01D
9	1	C8	22 pF	22 pF, 630 V, High Voltage Ceramic	Murata	GRM31A5C2J220JW01D
10	1	C9	10 µF	10 µF, 50 V, Electrolytic, Gen Purpose, 1000 mΩ, (6.1 mm x 6.3 mm)	Rubycon	50TRV10M6.3X6.1
11	1	C10	1800 µF	1800 µF, 25 V, Electrolytic, Super Low ESR, 18 mΩ, (20 mm x 16 mm)	United Chemi-Con	EKZE250ELL182ML20S
12	1	C11	100 µF	100 µF, 25 V, Electrolytic, Low ESR, 260 mΩ, (8 mm x 6.2 mm)	Panasonic	EEEFK1E101AP
13	1	C12	150 µF	150 µF, 35 V, Electrolytic, Super Low ESR, 72 mΩ, (11.5 mm x 8 mm)	United Chemi-Con	EKZE350ELL151MHB5D
14	1	C13	100 µF	100 µF, 200 V, Electrolytic, Low ESR, 1900 mΩ, (21.5 mm x 18 mm)	Panasonic	EEVEB2D101M
15	1	D1	RS07K-GS08	800 V, 1.4 A, Fast Recovery, 300 ns, DO-219AB	Vishay	RS07K-GS08
16	1	D2	FDLL4448	100 V, 0.3 A, Fast Recovery, 4 ns, SOD-80	ON Semiconductor	FDLL4448
17	2	D3, D4	STTH3R02QRL	200 V, 3 A, Ultrafast Recovery, 20 ns, DO-15	STMicroelectronics	STTH3R02QRL
18	1	F1	1 A	250 VAC, 1 A, Radial TR5, Time Lag Fuse	Littelfuse / Wickmann(R)	37411000410
19	1	HS1		109.4 mm x 20 mm. Aluminum Alloy (3003 OR 5052), 1.6 mm thickness. Heatsink for use with Device U1.	Custom	
20	1	L1	6.8 mH	6.8 mH, 0.8 A	Panasonic	ELF15N008
21	2	L2, L3	3.3 µH	3.3 µH, 3.94 A	Eaton	DR74-3R3-R
22	2	R1, R2	1.1 MΩ	1.1 MΩ, 5 %, 0.25 W, Thick Film	Generic	
23	1	R3	33 kΩ	33 kΩ, 5 %, 2 W, Metal Oxide Film	Generic	
24	1	R4	5.1 Ω	5.1 Ω, 5 %, 0.25 W, Thick Film	Generic	
25	1	R5	6.65 kΩ	6.65 kΩ, 1 %, 0.125 W, Thick Film	Generic	
26	2	R6, R7	2 MΩ	2 MΩ, 1 %, 0.25 W, Thick Film	Generic	
27	1	R8	6.8 Ω	6.8 Ω, 5 %, 0.125 W, Thick Film	Generic	
28	1	R9	390 Ω	390 Ω, 5 %, 0.25 W, Thick Film	Generic	
29	1	R10	470 Ω	470 Ω, 5 %, 0.25 W, Thick Film	Generic	
30	1	R11	2000 Ω	2000 Ω, 1 %, 0.125 W, Thick Film	Generic	
31	1	R12	1 kΩ	1 kΩ, 5 %, 0.125 W, Thick Film	Generic	
32	1	R13	43.2 kΩ	43.2 kΩ, 1 %, 0.125 W, Thick Film	Generic	

33	1	R14	11.3 kΩ	11.3 kΩ, 1 %, 0.125 W, Thick Film	Generic	
34	1	RT1	8 Ω	NTC Thermistor 8 Ω, 3 A	Cornell Dubilier	SL12 8R003
35	1	T1	ETD29/16/10	3C95 Core Material See Transformer Construction's Materials List for complete information	Epcos	B66358-G-X127
36	1	U1	TOP256YN	TOPSwitch-HX, TOP256YN, TO-220	Power Integrations	TOP256YN
37	1	U2	LTV-826S	Optocoupler LTV-826S , 80 V, CTR 300 - 600 %, 4-SMD	Liteon	LTV-826S
38	1	U3	LM431ACM/NOPB	2.495 V, Shunt Regulator IC, 2 %, SOIC-8	Texas Instruments	LM431ACM/NOPB
39	1			16112 mm² area on Copper PCB. 1 oz (35 µm) thickness. Heatsink for use with Rectifier D3.	Custom	
40	1			52 mm² area on Copper PCB. 1 oz (35 µm) thickness. Heatsink for use with Rectifier D4.	Custom	

Electrical Diagram



Mechanical Diagram



Winding Instruction

Primary Winding (Section 1)

Start on pin(s) 3 and wind 28 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.

Primary Bias Winding

Start on pin(s) 5 and wind 10 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) 11 and wind 8 turns (x 3 filar) of item [7]. Spread the winding evenly across entire bobbin. Winding direction is clockwise. Finish this winding on pin(s) 9.

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

Start on pin(s) 7 and wind 15 turns (x 1 filar) of item [8]. 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 28 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), 3C95, gapped for ALG of 119 nH/T²**
[2]	**Bobbin: Generic, 7 pri. + 7sec.**
[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]	**Triple Insulated Wire: 25 AWG**
[7]	**Triple Insulated Wire: 28 AWG**
[8]	**Magnet Wire: 25 AWG, Solderable Double Coated**

Electrical Test Specifications

Parameter	*Condition*	*Spec*
Electrical Strength, VAC	**60 Hz 1 second, from pins 1,2,3,4,5 to pins 6,7,9,11.**	**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.**	**447**
Tolerance, ±%	**Tolerance of Primary Inductance**	**10.0**
Maximum Primary Leakage, µH	**Measured between Pin 1 to Pin 3, with all other Windings shorted.**	**11.17**

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. #**
	The Copper thickness is not recommended at this level of output power.	*Change board thickness to 2*	*179*