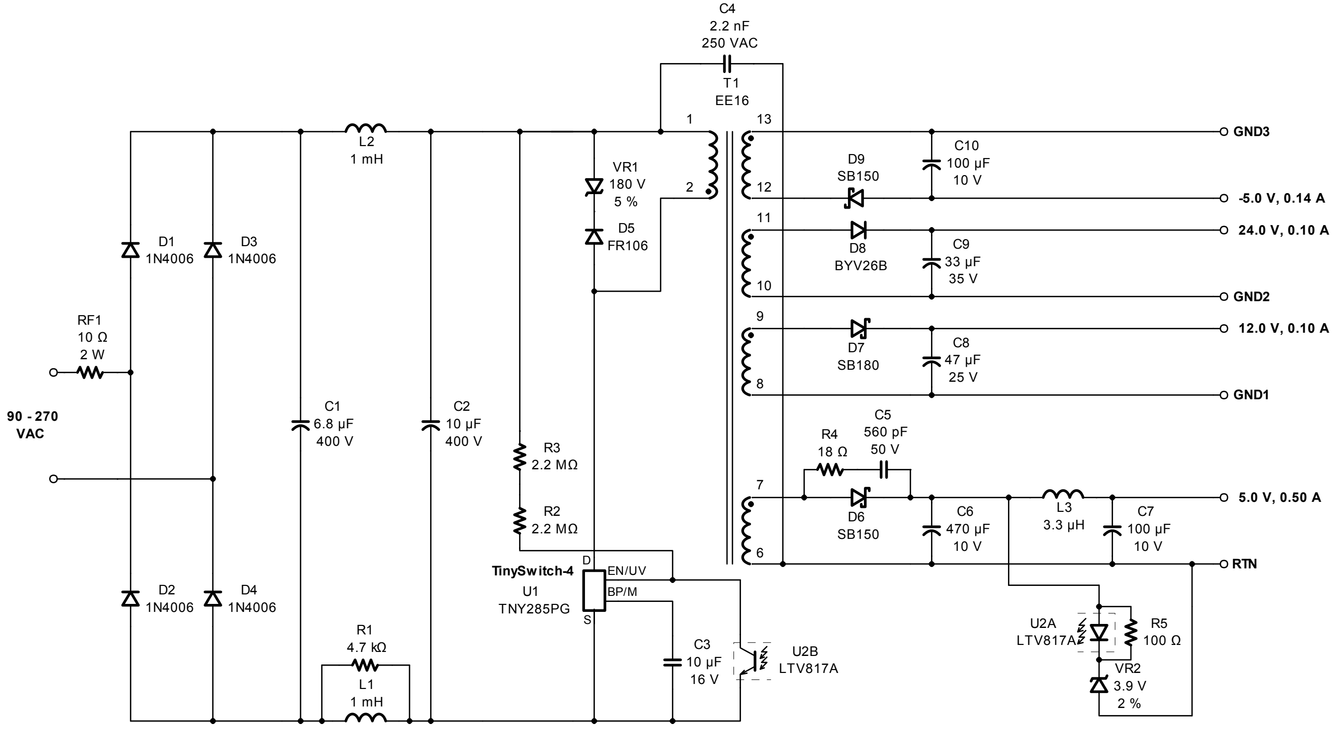

C4
2.2 nF
250 VAC
T1
EE16
RF1
10 Ω
2 W
90 - 270
VAC
D1
1N4006
D3
1N4006
D2
1N4006
D4
1N4006
L2
1 mH
C1
6.8 µF
400 V
C2
10 µF
400 V
R1
4.7 kΩ
L1
1 mH
VR1
180 V
5 %
D5
FR106
R3
2.2 MΩ
R2
2.2 MΩ
TinySwitch-4
U1
TNY285PG
D
EN/UV
BP/M
S
C3
10 µF
16 V
U2B
LTV817A
D9
SB150
C10
100 µF
10 V
GND3
-5.0 V, 0.14 A
D8
BYV26B
C9
33 µF
35 V
24.0 V, 0.10 A
GND2
D7
SB180
C8
47 µF
25 V
12.0 V, 0.10 A
GND1
R4
18 Ω
C5
560 pF
50 V
D6
SB150
C6
470 µF
10 V
L3
3.3 µH
C7
100 µF
10 V
5.0 V, 0.50 A
RTN
U2A
LTV817A
R5
100 Ω
VR2
3.9 V
2 %

Power Supply Input

Var	Value	Units	Description
VACMIN	90	V	Minimum Input AC Voltage (Manual Overwrite)
VACMAX	270	V	Maximum Input AC Voltage (Manual Overwrite)
FL	50	Hz	Line Frequency (Manual Overwrite)
TC	2.63	ms	Diode Conduction Time
Z	0.48		Loss Allocation Factor
η	75.0	%	Efficiency Estimate (Manual Overwrite)
VMIN	90.8	V	Minimum DC Input Voltage
VMAX	381.8	V	Maximum DC Input Voltage

Input Section

Var	Value	Units	Description
RFUSE	**10.00**	**Ω**	**Fusible Resistor. See Information section for detail**
IAVG	0.10	A	Average Diode Bridge Current (DC Input Current)

Device Variables

Var	Value	Units	Description
Device	TNY285PG		PI Device Name
Device Mode	Increased		Current Limit mode for device
PO	6.80	W	Total Output Power
VDRAIN Estimated	618.02	V	Actual Estimated Drain Voltage
VDS	11.88	V	On state Drain to Source Voltage
I2F_MIN	14.55	A²kHz	Minimum I2F
I2F_MAX	18.76	A²kHz	Maximum I2F
FS_AT_ILIMMIN	136935	Hz	Switching Frequency at Current Limit Minimum
KP	0.87		Continuous/Discontinuous Operating Ratio
KP_TRANSIENT	0.67		Transient Ripple to Peak Current Ratio
ILIMITMIN	0.33	A	Minimum Current Limit
ILIMITMAX	0.39	A	Maximum Current Limit
RLS	2.2	MΩ	Line sense resistor
RLS2	2.2	MΩ	Line sense resistor
IRMS	0.16	A	Primary RMS Current (at VMIN)
P_NO_LOAD	150	mW	Estimated No Load Input Power
DMAX	0.56		Maximum Duty Cycle
RTH_DEVICE	72.56	°C/W	PI Device Maximum Thermal Resistance
DEV_HSINK_TYPE	2 Oz (70 µ) Copper PCB		PI Device Heatsink Type
DEV_HSINK_AREA	52	mm²	PI Device Heatsink Area

Clamp Circuit

Var	Value	Units	Description
Clamp Type	Zener Clamp		Clamp Circuit Type
VCLAMP	180	V	Estimated average clamping voltage
Estimated Clamp Loss	0.39	W	Clamp Dissipation

Transformer Construction Parameters

Var	Value	Units	Description
Core Type	EE16		Core Type (Manual Overwrite)
Core Material	NC-2H (Nicera) or Equivalent		Core Material
Bobbin Reference	Generic, 5 pri. + 5 sec.		Bobbin Reference
Bobbin Orientation	Horizontal		Bobbin type
Primary Pins	4		Number of Primary pins used
Secondary Pins	**8**		**Number of Secondary pins used. See Warnings section for detail**
USE_SHIELDS	NO		Use shield Windings
LP_nom	1227	µH	Nominal Primary Inductance
LP_Tol	10.0	%	Primary Inductance Tolerance
NP	87.7		Calculated Primary Winding Total Number of Turns
NSM	5		Secondary Main Number of Turns (Manual Overwrite)
CMA	258	Cmils/A	Primary Winding Current Capacity
VOR	100.0	V	Reflected Output Voltage
BW	8.50	mm	Bobbin Winding Width
ML	0.00	mm	Safety Margin on Left Width
MR	0.00	mm	Safety Margin on Right Width
FF	114	%	Actual Transformer Fit Factor. 100% signifies fully utilized winding window
AE	19.20	mm²	Core Cross Sectional Area
ALG	144	nH/T²	Gapped Core Effective Inductance
BM	2647	Gauss	Maximum Flux Density
BAC	958	Gauss	AC Flux Density for Core Loss
LG	0.147	mm	Estimated Gap Length

L_LKG	49.10	µH	Estimated primary leakage inductance
LSEC	15	nH	Secondary Trace Inductance

Primary Winding Section 1

Var	*Value*	*Units*	*Description*
NP1	88		Rounded (Integer) Number of Primary winding turns in the first section of primary
Wire Size	34	AWG	Wire size of primary winding
Winding Type	Single (x1)		Primary winding number of parallel wire strands
L	1.97		Primary Number of Layers
DC Copper Loss	0.06	W	Primary 1 DC Losses

Output 1

Var	*Value*	*Units*	*Description*
VO	5.00	V	Output Voltage
IO	0.50	A	Output Current
VOUT_ACTUAL	5.00	V	Actual Output Voltage
NS	5		Secondary Number of Turns
Wire Size	27	AWG	Wire size of secondary winding
Winding Type	Single (x1)		Output winding number of parallel strands
L_S_OUT	0.32		Secondary Output Winding Layers
DC Copper Loss	0.03	W	Secondary DC Losses
VD	0.70	V	Output Winding Diode Forward Voltage Drop
PIVS	27	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	2.10	A	Peak Secondary Current
ISRMS	0.86	A	Secondary RMS Current
RTH_DIODE	164.42	°C/W	Output Diode Maximum Thermal Resistance
OD_HSINK_TYPE	2 Oz (70 µ) Copper PCB		Output Diode Heatsink Type
OD_HSINK_AREA	52	mm²	Output Diode Heatsink Area
CO	470 x 1	µF	Output Capacitor
IRIPPLE	0.71	A	Output Capacitor RMS Ripple Current
Expected Lifetime	26404	hr	Expected Lifetime of Output Capacitor

Output 2

Var	*Value*	*Units*	*Description*
VO	12.00	V	Output Voltage
IO	0.10	A	Output Current
VOUT_ACTUAL	11.69	V	Actual Output Voltage
NS	11		Secondary Number of Turns
Wire Size	32	AWG	Wire size of secondary winding
Winding Type	Single (x1)		Output winding number of parallel strands
L_S_OUT	0.52		Secondary Output Winding Layers
DC Copper Loss	0.01	W	Secondary DC Losses
VD	0.85	V	Output Winding Diode Forward Voltage Drop
PIVS	59	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	0.42	A	Peak Secondary Current
ISRMS	0.17	A	Secondary RMS Current
RTH_DIODE	661.02	°C/W	Output Diode Maximum Thermal Resistance
OD_HSINK_TYPE	2 Oz (70 µ) Copper PCB		Output Diode Heatsink Type
OD_HSINK_AREA	52	mm²	Output Diode Heatsink Area
CO	47 x 1	µF	Output Capacitor
IRIPPLE	0.14	A	Output Capacitor RMS Ripple Current
Expected Lifetime	25656	hr	Expected Lifetime of Output Capacitor

Output 3

Var	*Value*	*Units*	*Description*
VO	24.00	V	Output Voltage
IO	0.10	A	Output Current
VOUT_ACTUAL	23.78	V	Actual Output Voltage
NS	22		Secondary Number of Turns
Wire Size	32	AWG	Wire size of secondary winding
Winding Type	Single (x1)		Output winding number of parallel strands
L_S_OUT	1.04		Secondary Output Winding Layers
DC Copper Loss	0.02	W	Secondary DC Losses
VD	1.30	V	Output Winding Diode Forward Voltage Drop
PIVS	119	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	0.42	A	Peak Secondary Current
ISRMS	0.17	A	Secondary RMS Current
RTH_DIODE	403.94	°C/W	Output Diode Maximum Thermal Resistance
OD_HSINK_TYPE	2 Oz (70 µ) Copper PCB		Output Diode Heatsink Type
OD_HSINK_AREA	52	mm²	Output Diode Heatsink Area
CO	33 x 1	µF	Output Capacitor
IRIPPLE	0.14	A	Output Capacitor RMS Ripple Current
Expected Lifetime	25656	hr	Expected Lifetime of Output Capacitor

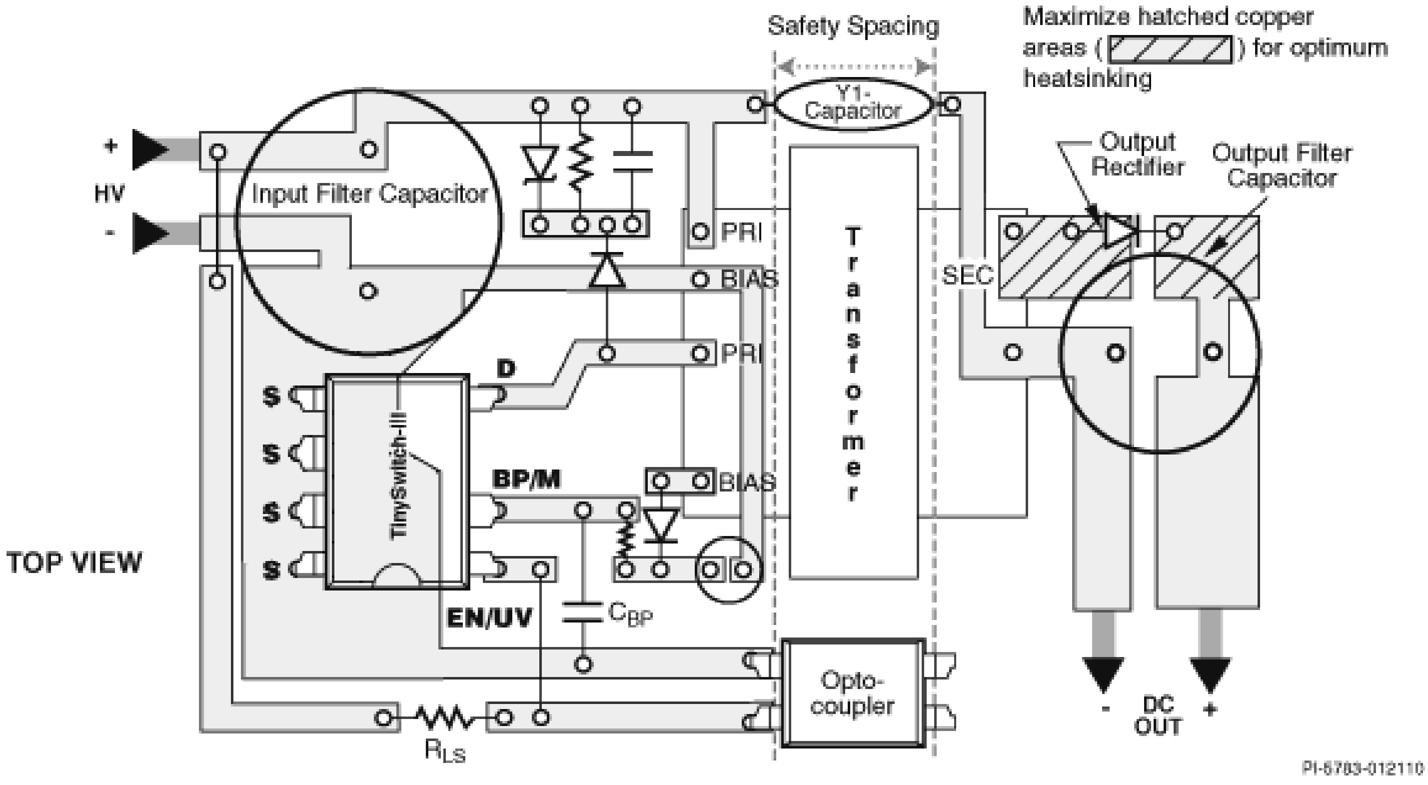
Output 4

Var	Value	Units	Description
VO	-5.00	V	Output Voltage
IO	0.14	A	Output Current
VOUT_ACTUAL	-5.00	V	Actual Output Voltage
NS	5		Secondary Number of Turns
Wire Size	32	AWG	Wire size of secondary winding
Winding Type	Single (x1)		Output winding number of parallel strands
L_S_OUT	0.24		Secondary Output Winding Layers
DC Copper Loss	0.01	W	Secondary DC Losses
VD	0.70	V	Output Winding Diode Forward Voltage Drop
PIVS	27	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	0.59	A	Peak Secondary Current
ISRMS	0.24	A	Secondary RMS Current
RTH_DIODE	620.08	°C/W	Output Diode Maximum Thermal Resistance
OD_HSINK_TYPE	2 Oz (70 µ) Copper PCB		Output Diode Heatsink Type
OD_HSINK_AREA	52	mm²	Output Diode Heatsink Area
CO	100 x 1	µF	Output Capacitor
IRIPPLE	0.20	A	Output Capacitor RMS Ripple Current
Expected Lifetime	20753	hr	Expected Lifetime of Output Capacitor

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



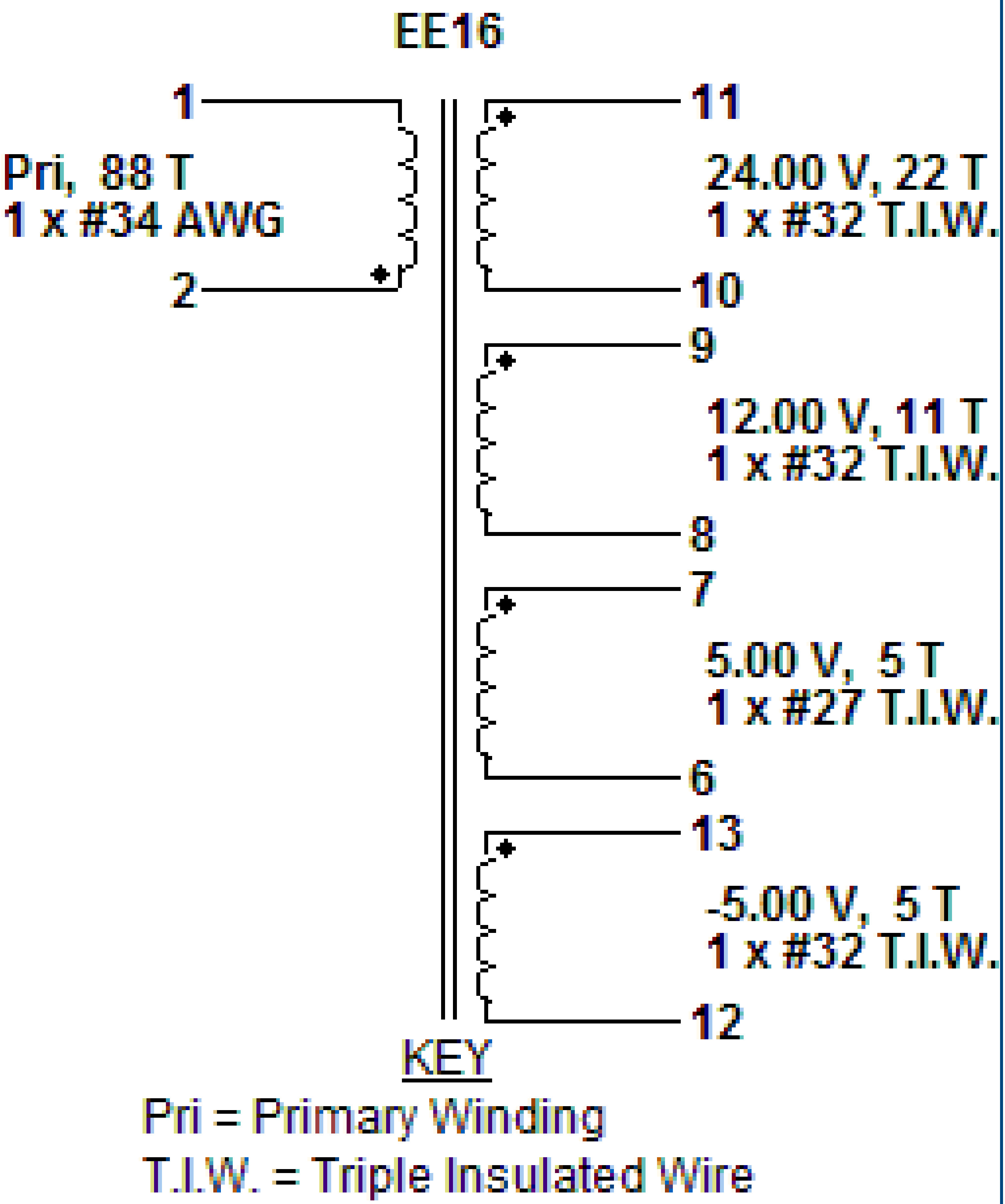
Click on the "Show me" icon to highlight relevant areas on the sample layout.

	Description	***Show Me***
1	Maximize source area for good heat-sinking	
2	Keep drain trace short	
3	The BYPASS pin capacitor should be located as close as possible to the BYPASS and SOURCE pins	
4	Keep noisy traces away from EN/UV pin	
5	Route bias winding currents back to the bulk cap	
6	Keep clamp loop short	
7	Connect Y capacitor to the B+ rail on the primary side for better surge immunity. Keep Y capacitor traces short	
8	The area of the loop connecting the secondary winding, the output diode and the output filter capacitor should be minimized	

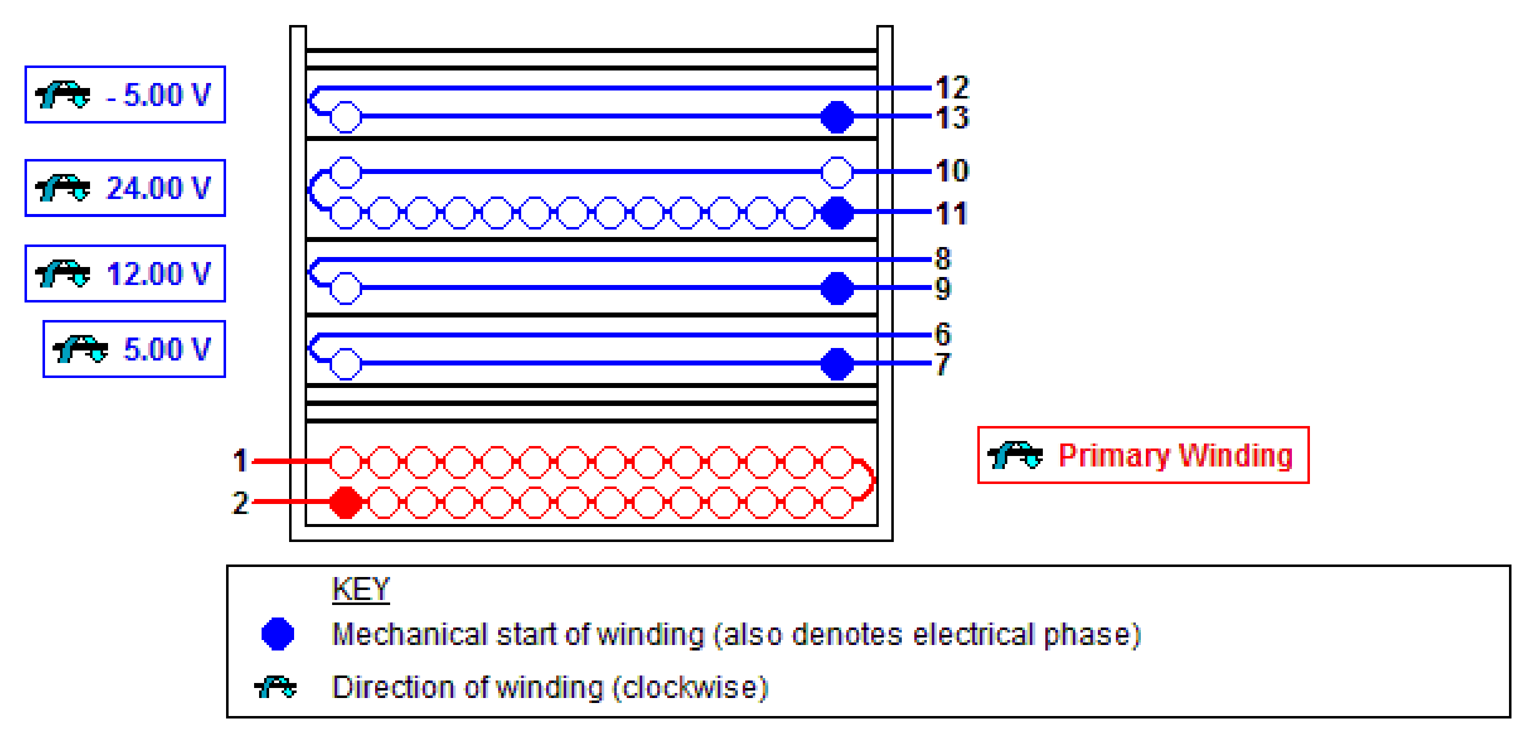
Bill Of Materials

Item #	*Quantity*	*Part Ref*	*Value*	*Description*	*Mfg*	*Mfg Part Number*
1	1	C1	6.8 µF	6.8 µF, 400 V, High Voltage Al Electrolytic, (16 mm x 10 mm)	Nippon Chemi-Con	EKXG401ELL6R8MJ1
2	1	C2	10 µF	10 µF, 400 V, High Voltage Al Electrolytic, (20 mm x 10 mm)	United Chemi-Con	EKMX400VB10RM10X20LL
3	1	C3	10 µF	10 µF, 16 V, Ceramic, X7R	TDK	C3216X7R1C106K
4	1	C4	2.2 nF	2.2 nF, 250 VAC, Ceramic, Y Class	TDK	CD12-E2GA222MYNS
5	1	C5	560 pF	560 pF, 50 V, Ceramic, C0G	TDK	FK18C0G1H561J
6	1	C6	470 µF	470 µF, 10 V, Electrolytic, Super Low ESR, 72 mΩ, (11.5 mm x 8 mm)	United Chemi-Con	EKZE100ELL471MHB5D
7	1	C7	100 µF	100 µF, 10 V, Electrolytic, Low ESR, 500 mΩ, (11.5 mm x 5 mm)	United Chemi-Con	ELXZ100ELL101MEB5D
8	1	C8	47 µF	47 µF, 25 V, Electrolytic, Super Low ESR, 300 mΩ, (11 mm x 5 mm)	United Chemi-Con	EKZE250ELL470ME11D
9	1	C9	33 µF	33 µF, 35 V, Electrolytic, Super Low ESR, 300 mΩ, (11 mm x 5 mm)	United Chemi-Con	EKZE350ELL330ME11D
10	1	C10	100 µF	100 µF, 10 V, Electrolytic, Super Low ESR, 300 mΩ, (11 mm x 5 mm)	United Chemi-Con	EKZE100ELL101ME11D
11	4	D1, D2, D3, D4	1N4006	800 V, 1 A, Standard Recovery, DO-41	Vishay	1N4006
12	1	D5	FR106	800 V, 1 A, Fast Recovery, 250 ns, DO-41	Diodes Inc.	FR106
13	2	D6, D9	SB150	50 V, 1 A, Schottky, DO-41	Vishay	SB150
14	1	D7	SB180	80 V, 1 A, Schottky, DO-41	Vishay	SB180
15	1	D8	BYV26B	400 V, 1 A, Ultrafast Recovery, 30 ns, SOD57	Philips	BYV26B
16	2	L1, L2	1 mH	1 mH, 0.19 A	TDK	TSL0709RA-102KR19-PF
17	1	L3	3.3 µH	3.3 µH, 2.66 A	Bourns Inc.	RL822-3R3K-RC
18	1	R1	4.7 kΩ	4.7 kΩ, 5 %, 0.25 W, Carbon Film	Generic	
19	2	R2, R3	2.2 MΩ	2.2 MΩ, 5 %, 0.25 W, Carbon Film	Generic	
20	1	R4	18 Ω	18 Ω, 5 %, 0.25 W, Carbon Film	Generic	
21	1	R5	100 Ω	100 Ω, 5 %, 0.125 W, Carbon Film	Generic	
22	1	RF1	10 Ω	10 Ω, 2 W, Flameproof Wire-Wound Resistor	Vitrohm	CRF253-4 10R
23	1	T1	EE16	NC-2H (Nicera) or Equivalent Core Material See Transformer Construction's Materials List for complete information	TDK	PC40EE16-Z
24	1	U1	TNY285PG	TinySwitch-4, TNY285PG, DIP-8	Power Integrations	TNY285PG
25	1	U2	LTV817A	Optocoupler LTV817A, 35 V, CTR 80 - 160 %, 4-DIP	Liteon	LTV817A
26	1	VR1	P6KE180A	180 V, 5 W, 5 %, DO-204AC, TVS	ON Semiconductor	P6KE180A
27	1	VR2	BZX79-B3V9	3.9 V, 500 mW, 2 %, DO-204AC, General Purpose	Vishay	BZX79-B3V9
28	1			52 mm² area on Copper PCB. 2 oz (70 µm) thickness. Heatsink for use with Diode D6.	Custom	
29	1			52 mm² area on Copper PCB. 2 oz (70 µm) thickness. Heatsink for use with Diode D9.	Custom	
30	1			52 mm² area on Copper PCB. 2 oz (70 µm) thickness. Heatsink for use with Device U1.	Custom	
31	1			52 mm² area on Copper PCB. 2 oz (70 µm) thickness. Heatsink for use with Diode D7.	Custom	
32	1			52 mm² area on Copper PCB. 2 oz (70 µm) thickness. Heatsink for use with Diode D8.	Custom	

Electrical Diagram



Mechanical Diagram



Winding Instruction

Primary Winding

Start on pin(s) 2 and wind 88 turns (x 1 filar) of item [5]. in 2 layer(s) from left to right. At the end of 1st layer, continue to wind the next layer from right to left. 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.

Secondary Winding

Start on pin(s) 7 and wind 5 turns (x 1 filar) of item [6]. Spread the winding evenly across entire bobbin. Wind in same rotational direction as primary winding. Finish this winding on pin(s) 6.

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

Start on pin(s) 9 and wind 11 turns (x 1 filar) of item [7]. Spread the winding evenly across entire bobbin. Wind in same rotational direction as primary winding. Finish this winding on pin(s) 8.

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

Start on pin(s) 11 and wind 22 turns (x 1 filar) of item [7]. Spread the winding evenly across entire bobbin. Wind in same rotational direction as primary winding. Finish this winding on pin(s) 10.

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

Start on pin(s) 13 and wind 5 turns (x 1 filar) of item [7]. Spread the winding evenly across entire bobbin. Finish this winding on pin(s) 12.

Add 2 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. For non margin wound transformers use triple insulated wire for all secondary windings.

Materials

Item	*Description*
[1]	**Core: EE16, NC-2H (Nicera) or Equivalent, gapped for ALG of 144 nH/T²**
[2]	**Bobbin: Generic, 5 pri. + 5 sec.**
[3]	**Barrier Tape: Polyester film [1 mil (25 µm) base thickness], 8.50 mm wide**
[4]	**Varnish**
[5]	**Magnet Wire: 34 AWG, Solderable Double Coated**
[6]	**Triple Insulated Wire: 27 AWG**
[7]	**Triple Insulated Wire: 32 AWG**

Electrical Test Specifications

Parameter	*Condition*	*Spec*
Electrical Strength, VAC	**60 Hz 1 second, from pins 1,2 to pins 6,7,8,9,10,11,12,13.**	**3000**
Nominal Primary Inductance, µH	**Measured at 1 V pk-pk, typical switching frequency, between pin 1 to pin 2, with all other Windings open.**	**1227**
Tolerance, ±%	**Tolerance of Primary Inductance**	**10.0**
Maximum Primary Leakage, µH	**Measured between Pin 1 to Pin 2, with all other Windings shorted.**	**49.10**