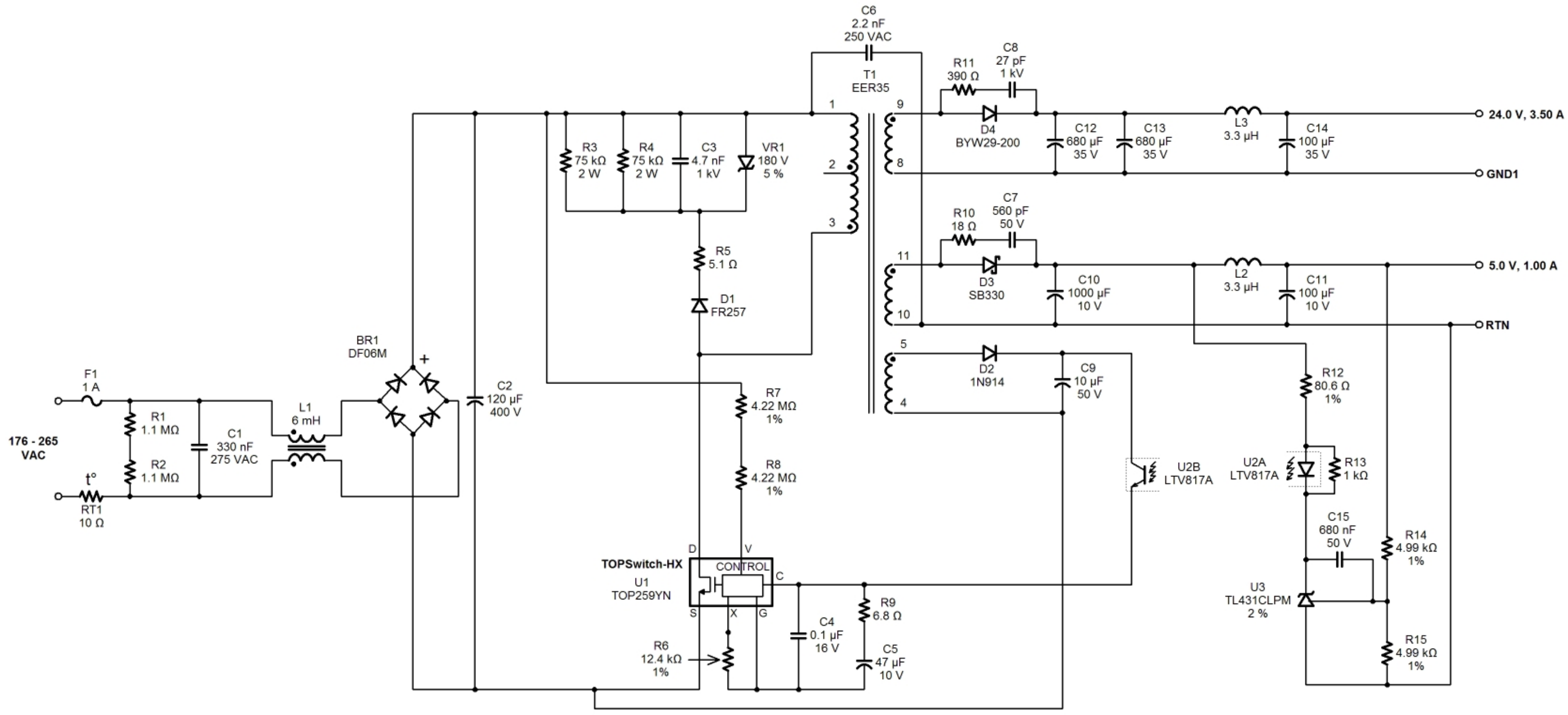

C6
2.2 nF
250 VAC
T1
EER35
R11
390 Ω
C8
27 pF
1 kV
D4
BYW29-200
C12
680 µF
35 V
C13
680 µF
35 V
L3
3.3 µH
C14
100 µF
35 V
24.0 V, 3.50 A
GND1
R3
75 kΩ
2 W
R4
75 kΩ
2 W
C3
4.7 nF
1 kV
VR1
180 V
5 %
R10
18 Ω
C7
560 pF
50 V
D3
SB330
C10
1000 µF
10 V
L2
3.3 µH
C11
100 µF
10 V
5.0 V, 1.00 A
RTN
R5
5.1 Ω
D1
FR257
BR1
DF06M
D2
1N914
C9
10 µF
50 V
R12
80.6 Ω
1%
F1
1 A
R1
1.1 MΩ
R2
1.1 MΩ
C1
330 nF
275 VAC
L1
6 mH
C2
120 µF
400 V
R7
4.22 MΩ
1%
R8
4.22 MΩ
1%
U2B
LTV817A
U2A
LTV817A
R13
1 kΩ
176 - 265
VAC
RT1
10 Ω
C15
680 nF
50 V
R14
4.99 kΩ
1%
TOPSwitch-HX
U1
TOP259YN
CONTROL
U3
TL431CLPM
2 %
R9
6.8 Ω
C4
0.1 µF
16 V
C5
47 µF
10 V
R6
12.4 kΩ
1%
R15
4.99 kΩ
1%

Power Supply Input

Var	*Value*	*Units*	*Description*
VACMIN	**176**	V	Minimum Input AC Voltage (Manual Overwrite)
VACMAX	**265**	V	Maximum Input AC Voltage (Manual Overwrite)
FL	**50**	Hz	Line Frequency (Manual Overwrite)
TC	**1.75**	ms	Diode Conduction Time
Z	**0.65**		Loss Allocation Factor
η	**74.0**	%	Efficiency Estimate
VMIN	**213.1**	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	**0.57**	A	Average Diode Bridge Current (DC Input Current)
Thermistor	**10.00**	Ω	Input Thermistor

Device Variables

Var	*Value*	*Units*	*Description*
Device	**TOP259YN**		PI Device Name (Manual Overwrite)
BVDSS	**700**		Drn-Src Bkdn Voltage
Device Mode	**Default**		Current Limit mode for device
OVP_FLAG	**NO**		Output Overvoltage Protection Enabled
PO	**89.09**	W	Total Output Power
VDRAIN Estimated	**618.49**	V	Actual Estimated Drain Voltage
VDS	**5.11**	V	On state Drain to Source Voltage
FS	**66000**	Hz	Switching Frequency
KP	**0.67**		Continuous/Discontinuous Operating Ratio
KI	**0.50**		Current Limit Reduction Factor (Manual Overwrite)
ILIMITEXT	**2.40**	A	Programmed Current Limit
ILIMITMIN	**4.79**	A	Minimum Current Limit
ILIMITMAX	**5.51**	A	Maximum Current Limit
PLIM_FLAG	**NO**		Enable Overload Power Limiting
IP	**2.02**	A	Peak Primary Current (at VMIN)
IRMS	**0.91**	A	Primary RMS Current (at VMIN)
DMAX	**0.42**		Maximum Duty Cycle
RTH_DEVICE	**24.68**	°C/W	PI Device Maximum Thermal Resistance
DEV_HSINK_TYPE	**Custom Aluminum**		PI Device Heatsink Type
DEV_HSINK_AREA	**2030**	mm²	PI Device Heatsink Area

Clamp Circuit

Var	*Value*	*Units*	*Description*
Clamp Type	**RCD + Zener Clamp**		Clamp Circuit Type
VCLAMP	**94**	V	Estimated average clamping voltage
Estimated Clamp Loss	**1.65**	W	Clamp Dissipation
VC_MARGIN	**75.23**	V	Clamp Voltage Safety Margin

Bias Variables

Var	*Value*	*Units*	*Description*

IB	**0.006**	A	Bias Current
PIVB	**56**	V	Bias Rectifier Max Peak Inverse Voltage

Transformer Construction Parameters

Var	*Value*	*Units*	*Description*
Core Type	**EER35**		Core Type (Manual Overwrite)
Core Material	**NC-2H (Nicera) или**		Core Material
Bobbin Reference	**Generic, 7 pri. + 7 sec.**		Bobbin Reference
Bobbin Orientation	**Vertical**		Bobbin type
Primary Pins	**5**		Number of Primary pins used
Secondary Pins	**4**		Number of Secondary pins used
USE_SHIELDS	**NO**		Use shield Windings
LP_nom	**977**	µH	Nominal Primary Inductance
LP_Tol	**10.0**	%	Primary Inductance Tolerance
NP	**82.0**		Calculated Primary Winding Total Number of Turns
NSM	**3**		Secondary Main Number of Turns (Manual Overwrite)
Primary Current Density	**2**	A/mm^2	Primary Winding Current Density
VOR	**150.0**	V	Reflected Output Voltage (Manual Overwrite)
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	**104**	%	Actual Transformer Fit Factor. 100% signifies fully utilized winding window
AE	**107.00**	mm^2	Core Cross Sectional Area
ALG	**131**	nH/T^2	Gapped Core Effective Inductance
BM	**203**	mT	Maximum Flux Density
BP	**276**	mT	Peak Flux Density
BAC	**67**	mT	AC Flux Density for Core Loss
LG	**0.979**	mm	Estimated Gap Length
L_LKG	**14.65**	µH	Estimated primary leakage inductance
LSEC	**10**	nH	Secondary Trace Inductance

Primary Winding Section 1

Var	*Value*	*Units*	*Description*
NP1	**41**		Rounded (Integer) Number of Primary winding turns in the first section of primary
Wire Size	**0.55**	mm	Primary Wire Inner Diameter Actual
Winding Type	**Bifilar (x2)**		Primary winding number of parallel wire strands
L	**1.78**		Primary Number of Layers
DC Copper Loss	**0.08**	W	Primary 1 DC Losses

Primary Winding Section 2

Var	*Value*	*Units*	*Description*
NP2	**41**		Rounded (Integer) Number of Primary winding turns in the second section of primary
Wire Size	**0.55**	mm	Primary Wire Inner Diameter Actual
Winding Type	**Bifilar (x2)**		Primary winding number of parallel wire strands
L2	**1.78**		Primary Number of Layers in 2nd split winding
DC Copper Loss	**0.14**	W	Primary 2 DC Losses

Output 1

Var	*Value*	*Units*	*Description*
VO	**24.00**	V	Output Voltage
IO	**3.50**	A	Output Current
VOUT_ACTUAL	**24.72**	V	Actual Output Voltage
NS	**14**		Secondary Number of Turns
Wire Size	**0.45**	mm	Secondary Wire Inner Diameter Actual
Winding Type	**Quadfilar (x4)**		Output winding number of parallel strands
L_S_OUT	**1.39**		Secondary Output Winding Layers
DC Copper Loss	**1.02**	W	Secondary DC Losses
VD	**0.90**	V	Output Winding Diode Forward Voltage Drop
PIVS	**89**	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	**10.85**	A	Peak Secondary Current
ISRMS	**5.74**	A	Secondary RMS Current
RTH_DIODE	**17.67**	°C/W	Output Diode Maximum Thermal Resistance
OD_HSINK_TYPE	**Custom Aluminum**		Output Diode Heatsink Type
OD_HSINK_AREA	**4165**	mm^2	Output Diode Heatsink Area
CO	**680 x 2**	µF	Output Capacitor
IRIPPLE	**4.55**	A	Output Capacitor RMS Ripple Current
Expected Lifetime	**42016**	hr	Expected Lifetime of Output Capacitor

Output 2

Var	*Value*	*Units*	*Description*
VO	**5.00**	V	Output Voltage
IO	**1.00**	A	Output Current
VOUT_ACTUAL	**5.00**	V	Actual Output Voltage
NS	**3**		Secondary Number of Turns
Wire Size	**0.35**	mm	Secondary Wire Inner Diameter Actual
Winding Type	**Bifilar (x2)**		Output winding number of parallel strands
L_S_OUT	**0.13**		Secondary Output Winding Layers
DC Copper Loss	**0.06**	W	Secondary DC Losses
VD	**0.49**	V	Output Winding Diode Forward Voltage Drop
PIVS	**19**	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	**3.10**	A	Peak Secondary Current
ISRMS	**1.64**	A	Secondary RMS Current
RTH_DIODE	**125.98**	°C/W	Output Diode Maximum Thermal Resistance
OD_HSINK_TYPE	**1 Oz (35 µ) Copper PCB**		Output Diode Heatsink Type
OD_HSINK_AREA	**52**	mm^2	Output Diode Heatsink Area
CO	**1000 x 1**	µF	Output Capacitor
IRIPPLE	**1.30**	A	Output Capacitor RMS Ripple Current
Expected Lifetime	**36096**	hr	Expected Lifetime of Output Capacitor

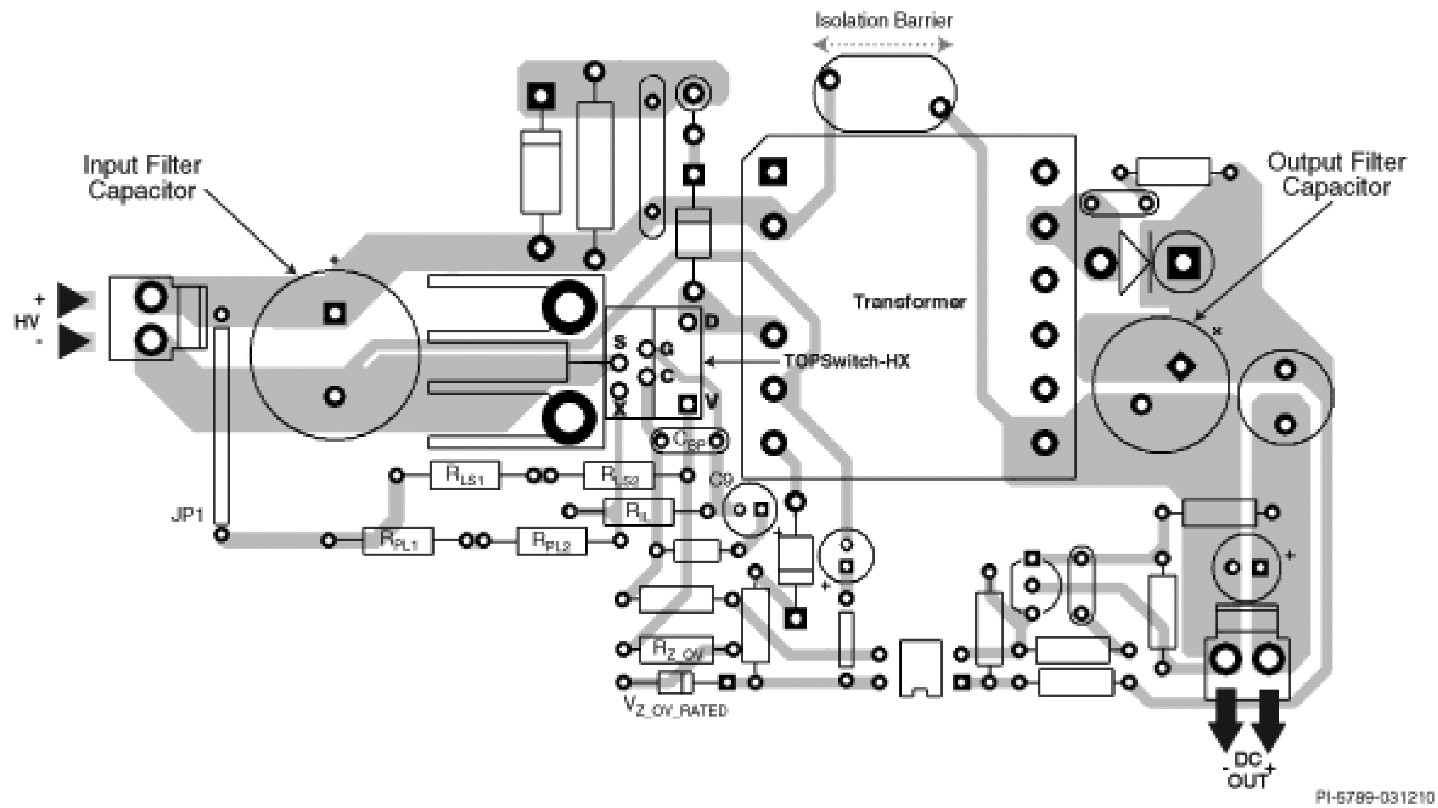
Feedback Circuit

Var	*Value*	*Units*	*Description*
DUAL_OUTPUT_FB_FLAG	**NO**		Dual Output Feedback regulations use flag
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.

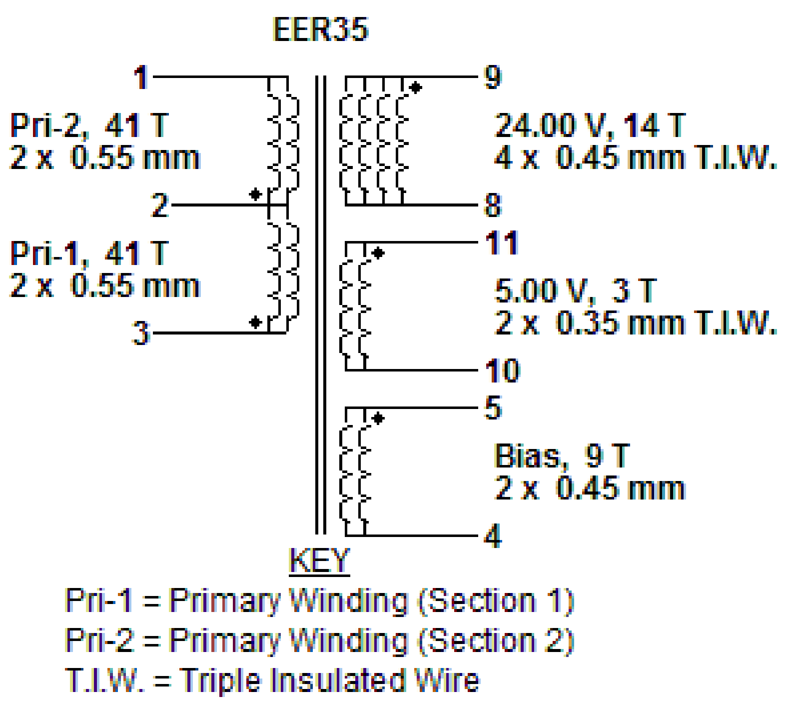
	Description	Show Me
1	Minimize loop area formed by drain, clamp and transformer	
2	Bias winding and bias capacitor are a power connection and therefore returned to Kelvin connection at SOURCE pin	
3	V and X pin node areas minimized, line sensing (R1 & R2) and power limiting (R3 & R4) close to device. 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 diode and the output filter capacitor	
7	Do not connect the SOURCE (S) and GND (G) pins on the PCB. The pins are internally connected. Use S pin to return power currents and the G pin as ground for control signals	
8	B+ connection of RLS or RPL resistor should be on input side of capacitor to prevent switching noise injection	

Bill Of Materials

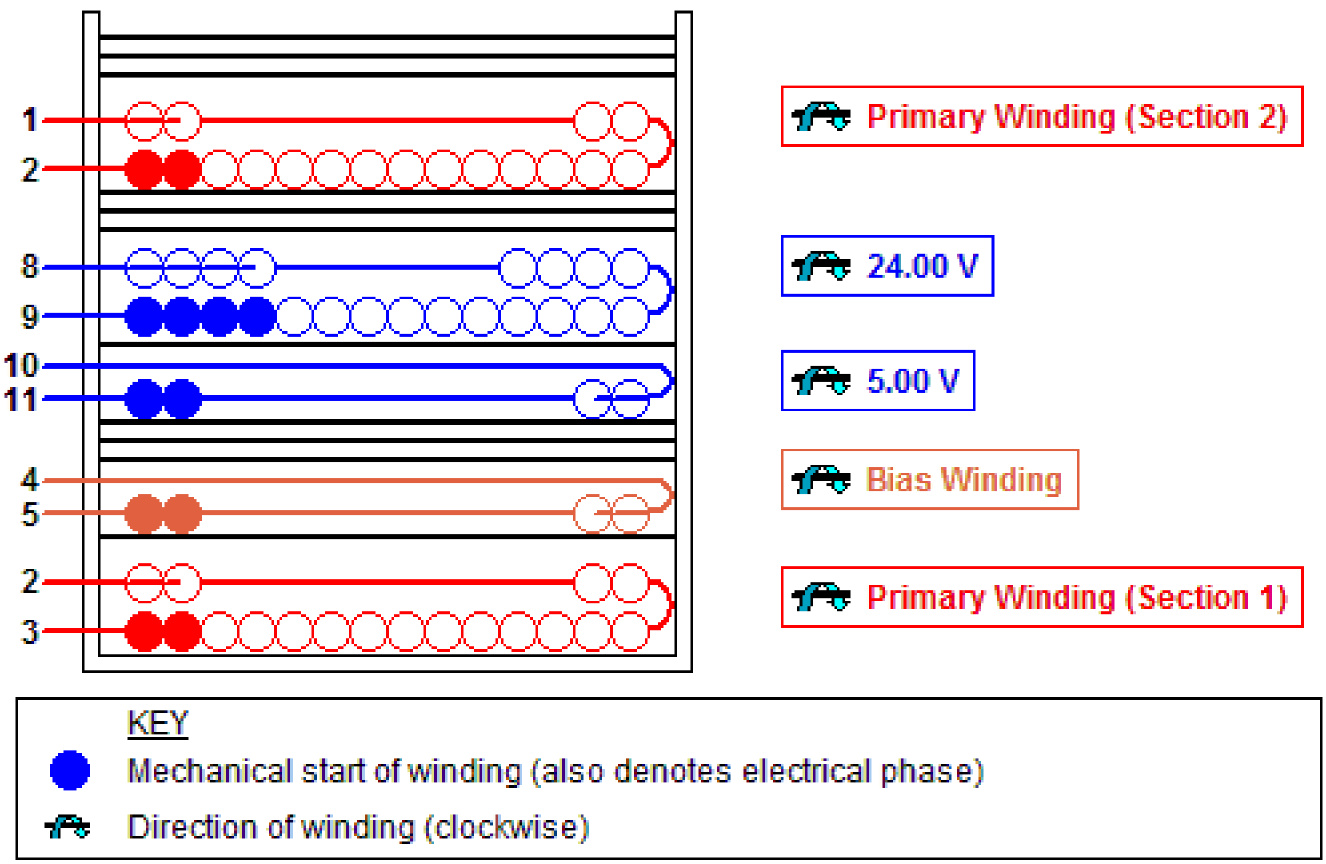
Item #	Quantity	Part Ref	Value	Description	Mfg	Mfg Part Number
1	1	BR1	DF06M	600 V, 1 A, Standard Recovery Bridge, DFM	International Rectifier	DF06M
2	1	C1	330 nF	330 nF, 275 VAC, Film, X Class	Panasonic	ECQ-UAAF334K
3	1	C2	120 μF	120 μF, 400 V, High Voltage Al Electrolytic, (30 mm x 18 mm)	United Chemi-Con	EPAG400VB121M18X30LL
4	1	C3	4.7 nF	4.7 nF, 1 kV, High Voltage Ceramic	Panasonic	ECK-D3A472KBN
5	1	C4	0.1 μF	0.1 μF, 16 V, Ceramic, X7R	TDK	C1005X7R1C104K
6	1	C5	47 μF	47 μF, 10 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	TDK	CD12-E2GA222MYNS
8	1	C7	560 pF	560 pF, 50 V, Ceramic, C0G	TDK	FK18C0G1H561J
9	1	C8	27 pF	27 pF, 1 kV, High Voltage Ceramic	Panasonic	ECC-D3A270JGE
10	1	C9	10 μF	10 μF, 50 V, Electrolytic, Gen Purpose, 1050 mΩ, (11.5 mm x 5 mm)	Panasonic	ECA-1HHG100
11	1	C10	1000 μF	1000 μF, 10 V, Electrolytic, Super Low ESR, 38 mΩ, (16 mm x 10 mm)	United Chemi-Con	EKZE100ELL102MJ16
12	1	C11	100 μF	100 μF, 10 V, Electrolytic, Low ESR, 500 mΩ, (11.5 mm x 5 mm)	United Chemi-Con	ELXZ100ELL101MEB5D
13	2	C12, C13	680 μF	680 μF, 35 V, Electrolytic, Super Low ESR, 21 mΩ, (20 mm x 12.5 mm)	United Chemi-Con	EKZE350ELL681MK20S
14	1	C14	100 μF	100 μF, 35 V, Electrolytic, Low ESR, 180 mΩ, (15 mm x 6.3 mm)	United Chemi-Con	ELXZ350ELL101MF15D
15	1	C15	680 nF	680 nF, 50 V, Ceramic, X7R	Murata	RPER71H684K3K1C03B
16	1	D1	FR257	1000 V, 2.5 A, Fast Recovery, 500 ns, R-3	Rectron	FR257
17	1	D2	1N914	100 V, 0.3 A, Fast Recovery, 4 ns, DO-35	Vishay	1N914
18	1	D3	SB330	30 V, 3 A, Schottky, DO-201AD	Vishay	SB330
19	1	D4	BYW29-200	200 V, 8 A, Ultrafast Recovery, 25 ns, TO-220AC	Philips	BYW29-200
20	1	F1	1 A	250 VAC, 1 A, Radial TR5, Time Lag Fuse	Littelfuse / Wickmann(R)	37411000410
21	1	HS1		50.8 mm x 20 mm. Aluminum Alloy (3003 OR 5052), 1.6 mm thickness. Heatsink for use with Device U1.	Custom	
22	1	HS2		104.1 mm x 20 mm. Aluminum Alloy (3003 OR 5052), 1.6 mm thickness. Heatsink for use with Diode D4.	Custom	
23	1	L1	6 mH	6 mH, 1.6 A	Panasonic	ELF18N016
24	1	L2	3.3 μH	3.3 μH, 2.66 A	Bourns Inc.	RL822-3R3K-RC
25	1	L3	3.3 μH	3.3 μH, 5.5 A	Bourns Inc.	RL622-3R3K-RC
26	2	R1, R2	1.1 MΩ	1.1 MΩ, 5 %, 0.25 W, Carbon Film	Generic	
27	2	R3, R4	75 kΩ	75 kΩ, 5 %, 2 W, Metal Oxide Film	Generic	
28	1	R5	5.1 Ω	5.1 Ω, 5 %, 0.25 W, Carbon Film	Generic	
29	1	R6	12.4 kΩ	12.4 kΩ, 1 %, 0.125 W, Metal Film	Generic	
30	2	R7, R8	4.22 MΩ	4.22 MΩ, 1 %, 0.25 W, Metal Film	Generic	
31	1	R9	6.8 Ω	6.8 Ω, 5 %, 0.125 W, Carbon Film	Generic	

32	1	R10	18 Ω	18 Ω, 5 %, 0.25 W, Carbon Film	Generic	
33	1	R11	390 Ω	390 Ω, 5 %, 0.25 W, Carbon Film	Generic	
34	1	R12	80.6 Ω	80.6 Ω, 1 %, 0.125 W, Metal Film	Generic	
35	1	R13	1 kΩ	1 kΩ, 5 %, 0.125 W, Carbon Film	Generic	
36	2	R14, R15	4.99 kΩ	4.99 kΩ, 1 %, 0.125 W, Metal Film	Generic	
37	1	RT1	10 Ω	NTC Thermistor 10 Ω, 1.7 A	Thermometrics	CL-120
38	1	T1	EER35	NC-2H (Nicera) или эквивалент Core Material See Transformer Construction’s Materials List for complete information	TDK	PC40EER35-Z
39	1	U1	TOP259YN	TOPSwitch-HX, TOP259YN, TO-220	Power Integrations	TOP259YN
40	1	U2	LTV817A	Optocoupler LTV817A, 35 V, CTR 80 - 160 %, 4-DIP	Liteon	LTV817A
41	1	U3	TL431CLPM	2.495 V, Shunt Regulator IC, 2 %, TO-92	Texas Instruments	TL431CLPM
42	1	VR1	P6KE180A	180 V, 5 W, 5 %, DO-204AC, TVS	ON Semiconductor	P6KE180A
43	1			52 mm² area on Copper PCB. 1 oz (35 μm) thickness. Heatsink for use with Diode D3.	Custom	

Electrical Diagram



Mechanical Diagram



Winding Instruction

Primary Winding (Section 1)

Start on pin(s) 3 and wind 41 turns (x 2 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) 2.

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

Bias Winding

Start on pin(s) 5 and wind 9 turns (x 2 filar) of item [6]. Wind in same rotational direction as primary winding. 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 3 turns (x 2 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) 9 and wind 14 turns (x 4 filar) of item [8]. Spread the winding evenly across entire bobbin. Wind in same rotational direction as primary winding. Finish this winding on pin(s) 8.

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

Primary Winding (Section 2)

Start on pin(s) 2 and wind 41 turns (x 2 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.

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: EER35, NC-2H (Nicera) или эквивалент, gapped for ALG of 131 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: 0.55 mm, Solderable Double Coated**
[6]	**Magnet Wire: 0.45 mm, Solderable Double Coated**
[7]	**Triple Insulated Wire: 0.35 mm**
[8]	**Triple Insulated Wire: 0.45 mm**

Electrical Test Specifications

Parameter	*Condition*	*Spec*
Electrical Strength, VAC	**60 Hz 1 second, from pins 1,2,3,4,5 to pins 8,9,10,11.**	**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.**	**977**
Tolerance, ±%	**Tolerance of Primary Inductance**	**10.0**
Maximum Primary Leakage, µH	**Measured between Pin 1 to Pin 3, with all other Windings shorted.**	**14.65**

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
	The Copper thickness is not recommended at this level of output power.	Change board thickness to 2 oz (70 µm).	179