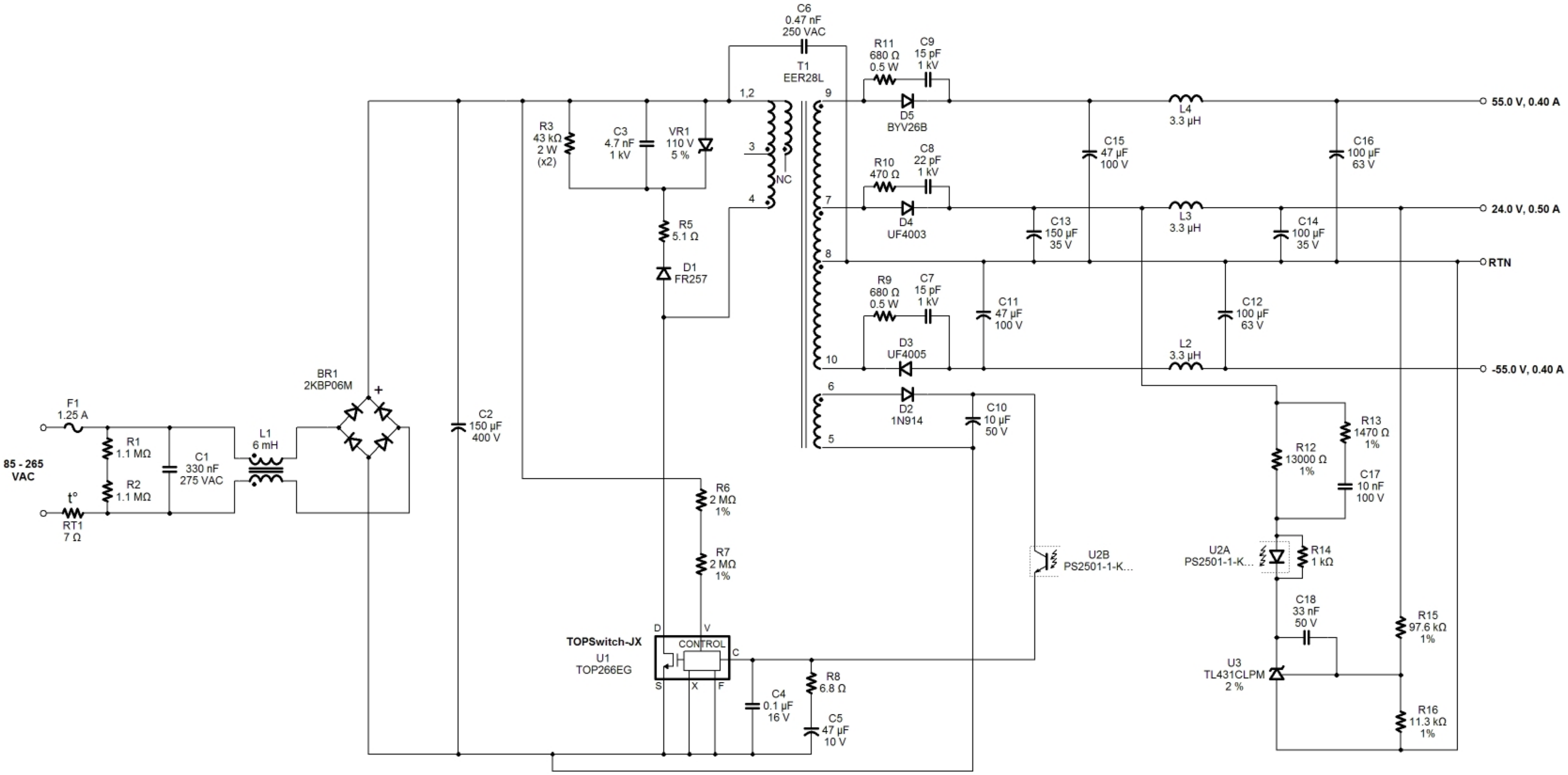


C6
0.47 nF
250 VAC
T1
EER28L
R11
680 Ω
0.5 W
C9
15 pF
1 kV
D5
BYV26B
55.0 V, 0.40 A
L4
3.3 µH
R3
43 kΩ
2 W
(x2)
C3
4.7 nF
1 kV
VR1
110 V
5 %
C15
47 µF
100 V
C16
100 µF
63 V
NC
R10
470 Ω
C8
22 pF
1 kV
D4
UF4003
24.0 V, 0.50 A
L3
3.3 µH
R5
5.1 Ω
C13
150 µF
35 V
C14
100 µF
35 V
D1
FR257
RTN
R9
680 Ω
0.5 W
C7
15 pF
1 kV
C11
47 µF
100 V
C12
100 µF
63 V
D3
UF4005
L2
3.3 µH
-55.0 V, 0.40 A
BR1
2KBP06M
D2
1N914
C10
10 µF
50 V
R13
1470 Ω
1%
F1
1.25 A
R1
1.1 MΩ
C1
330 nF
275 VAC
L1
6 mH
C2
150 µF
400 V
R12
13000 Ω
1%
85 - 265
VAC
R2
1.1 MΩ
C17
10 nF
100 V
t°
RT1
7 Ω
R6
2 MΩ
1%
R7
2 MΩ
1%
U2B
PS2501-1-K...
U2A
PS2501-1-K...
R14
1 kΩ
C18
33 nF
50 V
R15
97.6 kΩ
1%
TOPSwitch-JX
U1
TOP266EG
CONTROL
U3
TL431CLPM
2 %
R8
6.8 Ω
C4
0.1 µF
16 V
C5
47 µF
10 V
R16
11.3 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	**0.61**		*Loss Allocation Factor*
η	**79.0**	*%*	*Efficiency Estimate (Target)*
VMIN	**86.8**	*V*	*Minimum DC Input Voltage*
VMAX	**374.8**	*V*	*Maximum DC Input Voltage*

Input Section

Var	**Value**	*Units*	*Description*
Fuse	**1.25**	*A*	*Input Fuse Rated Current*
IAVG	**0.82**	*A*	*Average Diode Bridge Current (DC Input Current)*
Thermistor	**7.00**	*Ω*	*Input Thermistor*

Device Variables

Var	**Value**	*Units*	*Description*
Device	**TOP266EG**		*PI Device Name*
BVDSS	**725**	*V*	*Drn-Src Bkdn Voltage*
Current Limit Mode	**Default**		*Device Current Limit Mode*
OVP_FLAG	**NO**		*Output Overvoltage Protection Enabled*
PO	**56.07**	*W*	*Total Output Power*
VDRAIN Estimated	**560.62**	*V*	*Estimated Drain Voltage*
VDS	**13.57**	*V*	*On state Drain to Source Voltage*
FS	**132000**	*Hz*	*Switching Frequency (at VMIN and Full Load)*
KP	**0.66**		*Continuous/Discontinuous Operating Ratio (at VMIN and full load)*
DMAX	**0.54**		*Maximum Duty Cycle (at VMIN and full load)*
KI	**1.00**		*Current Limit Reduction Factor*
ILIMITEXT	**2.37**	*A*	*Programmed Current Limit*
ILIMITMIN	**2.37**	*A*	*Minimum Current Limit*
ILIMITMAX	**2.73**	*A*	*Maximum Current Limit*
PLIM_FLAG	**NO**		*Enable Overload Power Limiting*
IP	**2.27**	*A*	*Peak Primary Current (at VMIN and full load)*
IRMS	**1.16**	*A*	*Primary RMS Current (at VMIN and full load)*
RTH_DEVICE	**10.02**	*°C/W*	*PI Device Heatsink Maximum Thermal Resistance*
DEV_HSINK_TYPE	**Aluminum Extruded**		*PI Device Heatsink Type*
DEV_HSINK_PN	**513302B02500G**		*PI Device (Extruded) Heatsink Part Number*

Clamp Circuit

Var	**Value**	*Units*	*Description*
Clamp Type	**RCD + Zener Clamp**		*Clamp Circuit Type*
VCLAMP	**100**	*V*	*Average Clamping Voltage*
Estimated Clamp Loss	**1.61**	*W*	*Clamp Dissipation*
VC_MARGIN	**164.52**	*V*	*Clamp Voltage Safety Margin*

Bias Variables

Var	Value	Units	Description
VB	**12.0**	V	Bias Voltage
IB	**0.006**	A	Bias Current
PIVB	**80**	V	Bias Rectifier Maximum Peak Inverse Voltage
NB	**5**		Bias Winding Number of Turns

Transformer Construction Parameters

Var	Value	Units	Description
Core Type	**EER28L**		Core Type
Core Material	**NC-2H**		Core Material
Bobbin Reference	**Generic, 6 pri. + 6 sec.**		Bobbin Reference
Bobbin Orientation	**Horizontal**		Bobbin type
Primary Pins	**6**		Number of Primary pins used
Secondary Pins	**4**		Number of Secondary pins used
USE_SHIELDS	**YES**		Use shield Windings
LP_nom	**232**	µH	Nominal Primary Inductance
LP_Tol	**10.0**	%	Primary Inductance Tolerance
NP	**27.4**		Calculated Primary Winding Total Number of Turns
NSM	**8**		Secondary Main Number of Turns
Primary Current Density	**3**	A/mm^2	Primary Winding Current Density
VOR	**85.7**	V	Reflected Output Voltage
BW	**22.40**	mm	Bobbin Winding Width
ML	**3.20**	mm	Safety Margin on Left Width
MR	**3.20**	mm	Safety Margin on Right Width
FF	**94**	%	Actual Transformer Fit Factor. 100% signifies fully utilized winding window
AE	**81.40**	mm^2	Core Cross Sectional Area
ALG	**278**	nH/T^2	Gapped Core Specific Inductance
BM	**212**	mT	Maximum Flux Density
BP	**281**	mT	Peak Flux Density
BAC	**70**	mT	AC Flux Density for Core Loss
LG	**0.328**	mm	Estimated Gap Length
L_LKG	**5.80**	µH	Estimated primary leakage inductance
LSEC	**20**	nH	Secondary Trace Inductance

Primary Winding Section 1

Var	Value	Units	Description
NP1	**14**		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	**0.99**		Primary Winding - Number of Layers
DC Copper Loss	**0.04**	W	Primary Section 1 DC Losses

Primary Winding Section 2

Var	Value	Units	Description
NP2	**14**		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	**0.99**		Primary Number of Layers in 2nd split winding
DC Copper Loss	**0.07**	W	Primary Section 2 DC Losses

Output 1

Var	Value	Units	Description
VO	**55.00**	V	Typical Output Voltage
IO	**0.40**	A	Output Current
VOUT_ACTUAL	**54.95**	V	Actual Output Voltage
NS	**10**		Secondary Number of Turns
Wire Size	**0.28**	mm	Secondary Wire Inner Diameter Actual
Winding Type	**Single (x1)**		Output winding number of parallel strands
L_S_OUT	**0.21**		Secondary Output Winding Layers
DC Copper Loss	**0.08**	W	Secondary DC Losses
OD_VD	**1.30**	V	Output Winding Diode Forward Voltage Drop
PIVS	**296**	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	**1.33**	A	Peak Secondary Current
ISRMS	**0.63**	A	Secondary RMS Current
RTH_RECTIFIER	**91.01**	°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	**52**	mm²	Output Rectifier Heatsink Area
CO	**47 x 1**	µF	Output Capacitor - Capacitance
IRIPPLE	**0.48**	A	Output Capacitor - RMS Ripple Current
Expected Lifetime	**25035**	hr	Output Capacitor - Expected Lifetime

Output 2

Var	Value	Units	Description
VO	**-55.00**	V	Typical Output Voltage
IO	**0.40**	A	Output Current
VOUT_ACTUAL	**-54.55**	V	Actual Output Voltage
NS	**18**		Secondary Number of Turns
Wire Size	**0.28**	mm	Secondary Wire Inner Diameter Actual
Winding Type	**Single (x1)**		Output winding number of parallel strands
L_S_OUT	**0.37**		Secondary Output Winding Layers
DC Copper Loss	**0.15**	W	Secondary DC Losses
OD_VD	**1.70**	V	Output Winding Diode Forward Voltage Drop
PIVS	**295**	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	**1.33**	A	Peak Secondary Current
ISRMS	**0.63**	A	Secondary RMS Current
RTH_RECTIFIER	**73.23**	°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	**52**	mm²	Output Rectifier Heatsink Area
CO	**47 x 1**	µF	Output Capacitor - Capacitance
IRIPPLE	**0.48**	A	Output Capacitor - RMS Ripple Current
Expected Lifetime	**25035**	hr	Output Capacitor - Expected Lifetime

Output 3

Var	Value	Units	Description
VO	24.00	V	Typical Output Voltage
IO	0.50	A	Output Current
VOUT_ACTUAL	24.00	V	Actual Output Voltage
NS	8		Secondary Number of Turns
Wire Size	0.45	mm	Secondary Wire Inner Diameter Actual
Winding Type	Single (x1)		Output winding number of parallel strands
L_S_OUT	0.25		Secondary Output Winding Layers
DC Copper Loss	0.12	W	Secondary DC Losses
OD_VD	1.00	V	Output Winding Diode Forward Voltage Drop
PIVS	131	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	1.66	A	Peak Secondary Current
ISRMS	0.79	A	Secondary RMS Current
RTH_RECTIFIER	105.12	°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	52	mm²	Output Rectifier Heatsink Area
CO	150 x 1	μF	Output Capacitor - Capacitance
IRIPPLE	0.61	A	Output Capacitor - RMS Ripple Current
Expected Lifetime	30907	hr	Output Capacitor - Expected Lifetime

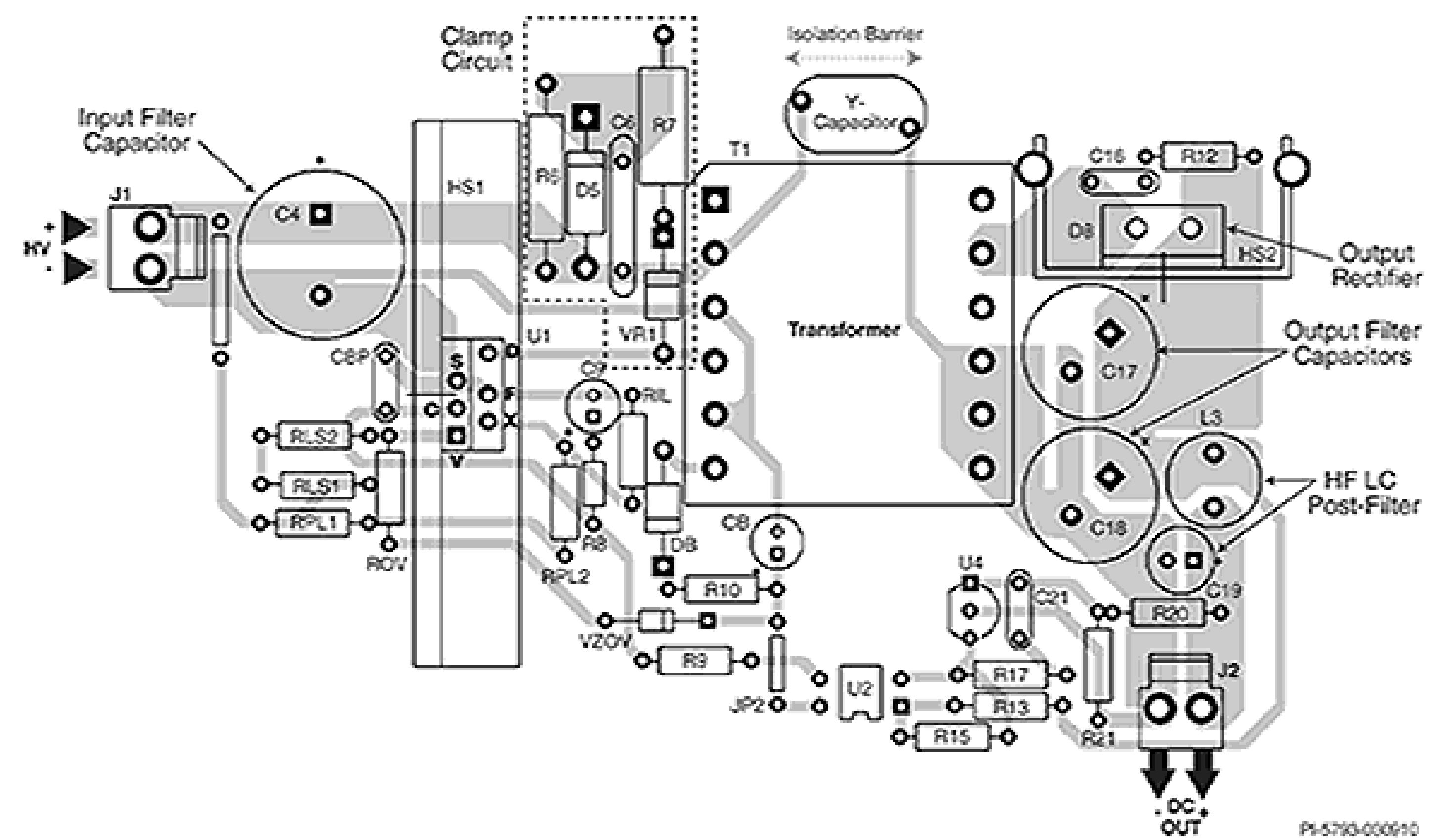
Feedback Circuit

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*	

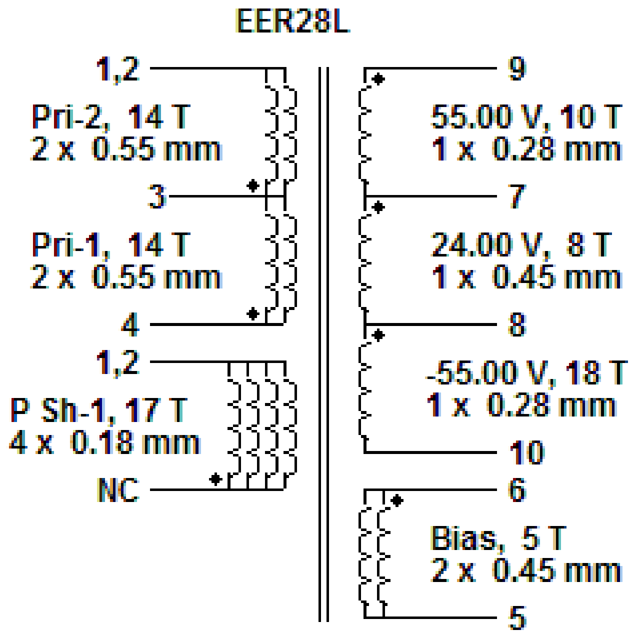
Bill Of Materials

Item #	Quantity	Part Ref	Value	Description	Mfg	Mfg Part Number
1	1	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	150 µF	150 µF, 400 V, High Voltage Al Electrolytic, (35 mm x 18 mm)	United Chemi-Con	EPAG400VB151M18X35LL
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, 10.0 V, Electrolytic, Gen Purpose, 1040 mΩ, (11 mm x 5 mm)	United Chemi-Con	KME10VB47RM5X11LL
7	1	C6	0.47 nF	0.47 nF, 250 VAC, Ceramic, Y Class	TDK	CD95-B2GA471KYNS
8	2	C7, C9	15 pF	15 pF, 1 kV, High Voltage Ceramic	Panasonic	ECC-D3A150JGE
9	1	C8	22 pF	22 pF, 1 kV, High Voltage Ceramic	Panasonic	ECC-D3A220JGE
10	1	C10	10 µF	10 µF, 50 V, Electrolytic, Gen Purpose, 1050 mΩ, (11.5 mm x 5 mm)	Panasonic	ECA-1HHG100
11	2	C11, C15	47 µF	47 µF, 100 V, Electrolytic, Low ESR, 320 mΩ, (16 mm x 10 mm)	United Chemi-Con	KMF100VB47RM10X16LL
12	2	C12, C16	100 µF	100 µF, 63 V, Electrolytic, Low ESR, 270 mΩ, (15 mm x 8 mm)	United Chemi-Con	ELXZ630ELL101MH15D
13	1	C13	150 µF	150 µF, 35 V, Electrolytic, Super Low ESR, 72 mΩ, (11.5 mm x 8 mm)	United Chemi-Con	EKZE350ELL151MHB5D
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	C17	10 nF	10 nF, 100 V, Ceramic, X7R	TDK	FK14X7R2A103K
16	1	C18	33 nF	33 nF, 50 V, Ceramic, X7R	Murata	RPER71H333K2P1A03B
17	1	D1	FR257	1000 V, 2.5 A, Fast Recovery, 500 ns, R-3	Rectron	FR257
18	1	D2	1N914	100 V, 0.3 A, Fast Recovery, 4 ns, DO-35	Vishay	1N914
19	1	D3	UF4005	600 V, 1 A, Ultrafast Recovery, 75 ns, DO-41	Vishay	UF4005
20	1	D4	UF4003	200 V, 1 A, Ultrafast Recovery, 50 ns, DO-41	Vishay	UF4003
21	1	D5	BYV26B	400 V, 1 A, Ultrafast Recovery, 30 ns, SOD57	Philips	BYV26B
22	1	F1	1.25 A	250 VAC, 1.25 A, Radial TR5, Time Lag Fuse	Littelfuse / Wickmann(R)	37411250410
23	1	HS1	513302B02500G	8 °C/W TO-220. Heatsink for use with Device U1.	Aavid	513302B02500G
24	1	L1	6 mH	6 mH, 1.6 A	Panasonic	ELF18N016
25	3	L2, L3, L4	3.3 µH	3.3 µH, 2.66 A	Bourns Inc.	RL822-3R3K-RC
26	2	R1, R2	1.1 MΩ	1.1 MΩ, 5 %, 0.25 W, Thick Film	Generic	
27	2	R3, R4	43 kΩ	43 kΩ, 5 %, 2 W, Metal Oxide Film	Generic	
28	1	R5	5.1 Ω	5.1 Ω, 5 %, 0.25 W, Thick Film	Generic	
29	2	R6, R7	2 MΩ	2 MΩ, 1 %, 0.25 W, Thick Film	Generic	
30	1	R8	6.8 Ω	6.8 Ω, 5 %, 0.125 W, Thick Film	Generic	
31	2	R9, R11	680 Ω	680 Ω, 5 %, 0.5 W, Thick Film	Generic	
32	1	R10	470 Ω	470 Ω, 5 %, 0.25 W, Thick Film	Generic	

33	*1*	*R12*	*13000 Ω*	*13000 Ω, 1 %, 0.125 W, Thick Film*	*Generic*	
34	*1*	*R13*	*1470 Ω*	*1470 Ω, 1 %, 0.125 W, Thick Film*	*Generic*	
35	*1*	*R14*	*1 kΩ*	*1 kΩ, 5 %, 0.125 W, Thick Film*	*Generic*	
36	*1*	*R15*	*97.6 kΩ*	*97.6 kΩ, 1 %, 0.125 W, Thick Film*	*Generic*	
37	*1*	*R16*	*11.3 kΩ*	*11.3 kΩ, 1 %, 0.125 W, Thick Film*	*Generic*	
38	*1*	*RT1*	*7 Ω*	*NTC Thermistor 7 Ω, 5 A*	*Thermometrics*	*CL-50*
39	*1*	*T1*	*EER28L*	*NC-2H Core Material* *See Transformer Construction's Materials List for complete information*	*TDK*	*PC40-EER28L-Z*
40	*1*	*U1*	*TOP266EG*	*TOPSwitch-JX, TOP266EG, eSIP-7C*	*Power Integrations*	*TOP266EG*
41	*1*	*U2*	*PS2501-1-K-A*	*Optocoupler PS2501-1-K-A, 80 V, CTR 300 - 600 %, 4-DIP*	*CEL*	*PS2501-1-K-A*
42	*1*	*U3*	*TL431CLPM*	*2.495 V, Shunt Regulator IC, 2 %, TO-92*	*Texas Instruments*	*TL431CLPM*
43	*1*	*VR1*	*P6KE110A*	*110 V, 5 W, 5 %, DO-204AC, TVS*	*Vishay*	*P6KE110A*
44	*1*			*52 mm² area on Copper PCB. 2 oz (70 µm) thickness. Heatsink for use with Rectifier D3.*	*Custom*	
45	*1*			*52 mm² area on Copper PCB. 2 oz (70 µm) thickness. Heatsink for use with Rectifier D4.*	*Custom*	
46	*1*			*52 mm² area on Copper PCB. 2 oz (70 µm) thickness. Heatsink for use with Rectifier D5.*	*Custom*	

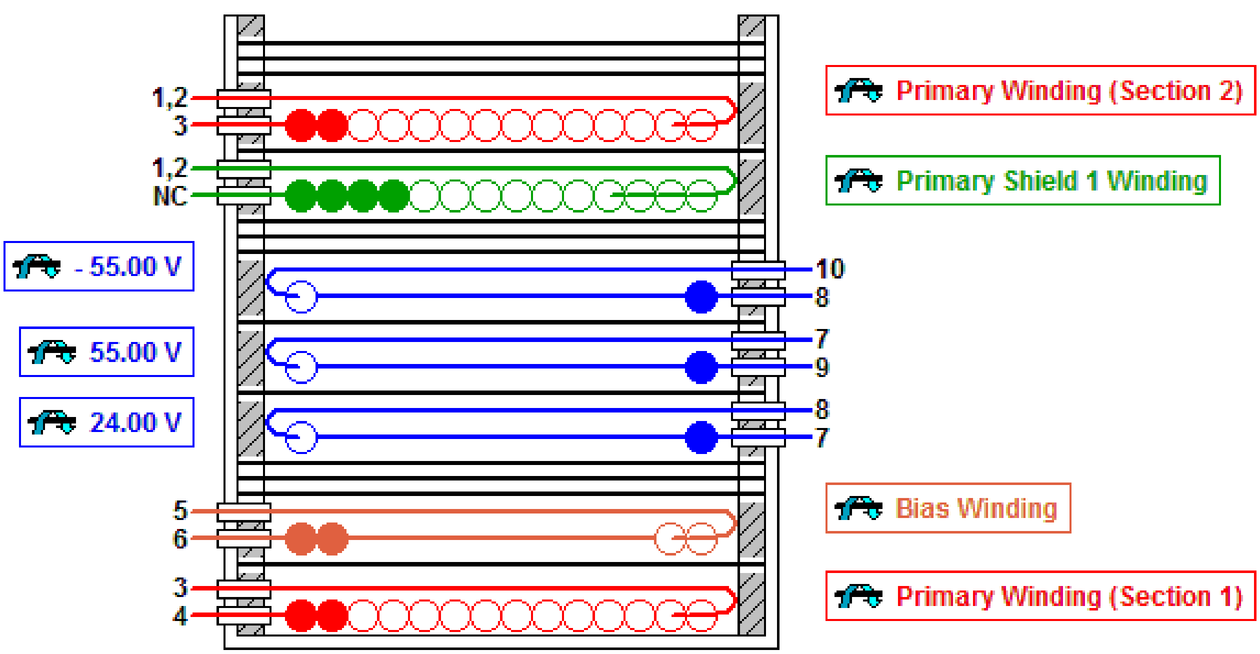
This design will use SMD components wherever available. Use Design Setting/Defaults dialog to change this selection

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)
Direction of winding (clockwise)

Winding Instruction

Use 3.20 mm margin (item [3]) on the left side. Use 3.20 mm margin (item [3]) on the right side.

Primary Winding (Section 1)

Start on pin(s) 4 using item [5] at the start leads and wind 14 turns (x 2 filar) of item [7]. 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) 3 using item [5] at the finish leads.

Add 1 layer of tape, item [4], for insulation.

Bias Winding

Start on pin(s) 6 using item [5] at the start leads and wind 5 turns (x 2 filar) of item [8]. Winding direction is clockwise. Spread the winding evenly across entire bobbin. Finish this winding on pin(s) 5 using item [5] at the finish leads.

Add 3 layers of tape, item [4], for insulation.

Secondary Winding

Start on pin(s) 7 using item [5] at the start leads and wind 8 turns (x 1 filar) of item [8]. Spread the winding evenly across entire bobbin. Winding direction is clockwise. Finish this winding on pin(s) 8 using item [5] at the finish leads.

Add 1 layer of tape, item [4], for insulation.

Start on pin(s) 9 using item [5] at the start leads and wind 10 turns (x 1 filar) of item [9]. Spread the winding evenly across entire bobbin. Winding direction is clockwise. Finish this winding on pin(s) 7 using item [5] at the finish leads.

Add 1 layer of tape, item [4], for insulation.

Start on pin(s) 8 using item [5] at the start leads and wind 18 turns (x 1 filar) of item [9]. Spread the winding evenly across entire bobbin. Finish this winding on pin(s) 10 using item [5] at the finish leads.

Add 3 layers of tape, item [4], for insulation.

Primary Shield 1 Winding

Start on any (temp) pin on the secondary side and wind 17 turns (x 4 filar) of item [10]. Winding direction is clockwise. Spread the winding evenly across entire bobbin. Finish this winding on pin(s) 1,2 using item [5] at the finish leads. Cut out wire connected to temp pin on secondary side. Leave this end of primary shield winding not connected. Bend the end 90 deg and cut the wire in the middle of the bobbin.

Add 1 layer of tape, item [4], for insulation.

Primary Winding (Section 2)

Start on pin(s) 3 using item [5] at the start leads and wind 14 turns (x 2 filar) of item [7]. 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) 1,2 using item [5] at the finish leads.

Add 3 layers of tape, item [4], for insulation.

Core Assembly

Assemble and secure core halves. Item [1].

Varnish

Dip varnish uniformly in item [6]. Do not vacuum impregnate.

Comments

1. Pins 1 and 2 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.

Materials

Item	***Description***
[1]	**Core: EER28L, NC-2H, gapped for ALG of 278 nH/T²**
[2]	**Bobbin: Generic, 6 pri. + 6 sec.**
[3]	**Tape: Polyester web 3.20 mm wide**
[4]	**Barrier Tape: Polyester film [1 mil (25 µm) base thickness], 22.40 mm wide**
[5]	**Teflon Tubing # 22**
[6]	**Varnish**
[7]	**Magnet Wire: 0.55 mm, Solderable Double Coated**
[8]	**Magnet Wire: 0.45 mm, Solderable Double Coated**
[9]	**Magnet Wire: 0.28 mm, Solderable Double Coated**
[10]	**Magnet Wire: 0.18 mm, Solderable Double Coated**

Electrical Test Specifications

Parameter	***Condition***	***Spec***

Electrical Strength, VAC	**60 Hz 1 second, from pins 1,2,3,4,5,6 to pins 7,8,9,10.**	**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.**	**232**
Tolerance, ±%	**Tolerance of Primary Inductance**	**10.0**
Maximum Primary Leakage, µH	**Measured between Pin 1 to Pin 4, with all other Windings shorted.**	**5.80**

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.