

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

Power Supply Input

Var	Value	Units	Description
VACMIN	195	V	Minimum Input AC Voltage
VACMAX	265	V	Maximum Input AC Voltage
FL	50	Hz	Line Frequency
TC	1.69	ms	Input Rectifier Conduction Time
Z	0.65		Loss Allocation Factor
η	76.0	%	Efficiency Estimate (Target)
VMIN	242.5	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
I _{AVG}	0.20	A	Average Diode Bridge Current (DC Input Current)
MOV_V _{RATED}	275	V	MOV Rated Voltage

Device Variables

Var	Value	Units	Description
Device	TOP264EG		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	37.07	W	Total Output Power
V _{DRAIN} Estimated	576.55	V	Estimated Drain Voltage
VDS	12.96	V	On state Drain to Source Voltage
FS	132000	Hz	Switching Frequency (at VMIN and Full Load)
KP	0.690		Continuous/Discontinuous Operating Ratio (at VMIN and Full Load)
D _{MAX}	0.303		Maximum Duty Cycle (at VMIN and Full Load)
KI	1.00		Current Limit Reduction Factor
I _{LIMITEXT}	1.21	A	Programmed Current Limit
I _{LIMITMIN}	1.209	A	Minimum Current Limit
I _{LIMITMAX}	1.391	A	Maximum Current Limit
R _{PL}	12.10	M Ω	Power Limit Resistor
R _{PL2}	12.10	M Ω	2nd Power Limit Resistor
PLIM_FLAG	YES		Enable Overload Power Limiting
I _P	1.012	A	Peak Primary Current (at VMIN and Full Load)
I _{RMS}	0.382	A	Primary RMS Current (at VMIN and Full Load)
R _{TH_DEVICE}	36.47	$^{\circ}\text{C}/\text{W}$	PI Device Heatsink Maximum Thermal Resistance
DEV_HSINK_TYPE	Custom Aluminum		PI Device Heatsink Type
DEV_HSINK_AREA	877	mm ²	PI Device Heatsink Area

Clamp Circuit

Var	Value	Units	Description
Clamp Type	RCD Clamp		Clamp Circuit Type
VCLAMP	101.78	V	Average Clamping Voltage
Estimated Clamp Loss	1.044	W	Clamp total power loss
VC_MARGIN	150.23	V	Clamp Voltage Safety Margin

Primary Bias Variables

Var	Value	Units	Description
VB	12.0	V	Bias Voltage
IB	0.006	A	Bias Current
PIVB	66	V	Bias Rectifier Maximum Peak Inverse Voltage
NB	10		Primary Bias Winding Number of Turns

Transformer Construction Parameters

Var	Value	Units	Description
Core Type	E30 (E30/15/7-3F3)		Core Type
Core Material	3F3		Core Material
Primary Pins	5		Number of Primary pins used
Secondary Pins	7		Number of Secondary pins used
USE_SHIELDS	NO		Use shield Windings
LP_nom	784	μH	Nominal Primary Inductance
LP_Tol	10.0	%	Primary Inductance Tolerance
NP	69.7		Calculated Primary Winding Total Number of Turns
NSM	4		Secondary Main Number of Turns
CMA	662.40	Cmils/A	Primary Winding Current Capacity
VOR	100.00	V	Reflected Output Voltage
BW	17.50	mm	Bobbin Winding Width
FF	89.59	%	Actual Transformer Fit Factor. 100% signifies fully utilized winding window
AE	60.00	mm ²	Core Cross Sectional Area
ALG	145	nH/T ²	Gapped Core Specific Inductance
BM	1708	Gauss	Maximum Flux Density
BP	2589	Gauss	Peak Flux Density
BAC	589	Gauss	AC Flux Density for Core Loss
LG	0.471	mm	Estimated Gap Length
L_LKG	19.61	μH	Estimated primary leakage inductance
LSEC	15	nH	Secondary Trace Inductance

Primary Winding Section 1

Var	Value	Units	Description
NP1	35		Number of Primary Winding Turns in the First Section of Primary
L	0.90		Primary Winding - Number of Layers
DC Copper Loss	0.03	W	Primary Section 1 DC Losses

Primary Winding Section 2

Var	Value	Units	Description
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NP2	35		Rounded (Integer) Number of Primary winding turns in the second section of primary
L2	0.90		Primary Number of Layers in 2nd split winding

Output 1

Var	Value	Units	Description
VO	5.00	V	Typical Output Voltage
IO	1.00	A	Output Current
VOUT_ACTUAL	5.00	V	Actual Output Voltage
NS	4		Secondary Number of Turns
L_S_OUT	0.34		Secondary Output Winding Layers
DC Copper Loss	0.11	W	Secondary DC Losses
VD	0.74	V	Output Winding Diode Forward Voltage Drop
VD	0.74	V	Output Winding Diode Forward Voltage Drop
PIVS	26.42	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	2.377	A	Peak Secondary Current
ISRMS	1.359	A	Secondary RMS Current
ISRMS_WINDING	2.717	A	Secondary Winding RMS Current
CMAS	595	Cmils/A	Secondary Winding Current Capacity
RTH_RECTIFIER	79.87	°C/W	Output Rectifier Heatsink Maximum Thermal Resistance
OR_HSINK_TYPE	2 Oz (70 μ) 2-Sided Copper PCB		Output Rectifier Heatsink Type
OR_HSINK_AREA	52	mm ²	Output Rectifier Heatsink Area
CO	680 x 1	μF	Output Capacitor - Capacitance
IRIPPLE	0.920	A	Output Capacitor - RMS Ripple Current
Expected Lifetime	26549	hr	Output Capacitor - Expected Lifetime

Output 2

Var	Value	Units	Description
VO	12.00	V	Typical Output Voltage
IO	1.00	A	Output Current
VOUT_ACTUAL	12.05	V	Actual Output Voltage
NS	9		Secondary Number of Turns
L_S_OUT	0.33		Secondary Output Winding Layers
DC Copper Loss	0.12	W	Secondary DC Losses
VD	0.87	V	Output Winding Diode Forward Voltage Drop
VD	0.87	V	Output Winding Diode Forward Voltage Drop
PIVS	60.23	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	2.377	A	Peak Secondary Current
ISRMS	1.359	A	Secondary RMS Current
ISRMS_WINDING	1.359	A	Secondary Winding RMS Current
CMAS	236	Cmils/A	Secondary Winding Current Capacity

RTH_RECTIFIER	64.52	°C/W	Output Rectifier Heatsink Maximum Thermal Resistance
OR_HSINK_TYPE	2 Oz (70 μ) 2-Sided Copper PCB		Output Rectifier Heatsink Type
OR_HSINK_AREA	72	mm ²	Output Rectifier Heatsink Area
CO	330 x 1	μF	Output Capacitor - Capacitance
IRIPPLE	0.920	A	Output Capacitor - RMS Ripple Current
Expected Lifetime	26549	hr	Output Capacitor - Expected Lifetime

Output 3

Var	Value	Units	Description
VO	15.00	V	Typical Output Voltage
IO	1.00	A	Output Current
VOUT_ACTUAL	14.92	V	Actual Output Voltage
NS	7		Secondary Number of Turns
L_S_OUT	0.26		Secondary Output Winding Layers
DC Copper Loss	0.10	W	Secondary DC Losses
VD	0.87	V	Output Winding Diode Forward Voltage Drop
VD	0.87	V	Output Winding Diode Forward Voltage Drop
PIVS	73.81	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	2.377	A	Peak Secondary Current
ISRMS	1.359	A	Secondary RMS Current
ISRMS_WINDING	1.359	A	Secondary Winding RMS Current
CMAS	236	Cmils/A	Secondary Winding Current Capacity
RTH_RECTIFIER	62.62	°C/W	Output Rectifier Heatsink Maximum Thermal Resistance
OR_HSINK_TYPE	2 Oz (70 μ) 2-Sided Copper PCB		Output Rectifier Heatsink Type
OR_HSINK_AREA	81	mm ²	Output Rectifier Heatsink Area
CO	330 x 1	μF	Output Capacitor - Capacitance
IRIPPLE	0.920	A	Output Capacitor - RMS Ripple Current
Expected Lifetime	26549	hr	Output Capacitor - Expected Lifetime

Output 4

Var	Value	Units	Description
VO	5.00	V	Typical Output Voltage
IO	1.00	A	Output Current
VOUT_ACTUAL	5.00	V	Actual Output Voltage
NS	4		Secondary Number of Turns
L_S_OUT	0.15		Secondary Output Winding Layers
DC Copper Loss	0.05	W	Secondary DC Losses
VD	0.74	V	Output Winding Diode Forward Voltage Drop
VD	0.74	V	Output Winding Diode Forward Voltage Drop
PIVS	26.42	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	2.377	A	Peak Secondary Current

<i>ISRMS</i>	1.359	<i>A</i>	<i>Secondary RMS Current</i>
<i>ISRMS_WINDING</i>	1.359	<i>A</i>	<i>Secondary Winding RMS Current</i>
<i>CMAS</i>	236	<i>Cmils/A</i>	<i>Secondary Winding Current Capacity</i>
<i>RTH_RECTIFIER</i>	79.87	<i>°C/W</i>	<i>Output Rectifier Heatsink Maximum Thermal Resistance</i>
<i>OR_HSINK_TYPE</i>	2 Oz (70 μ) 2-Sided Copper PCB		<i>Output Rectifier Heatsink Type</i>
<i>OR_HSINK_AREA</i>	52	<i>mm²</i>	<i>Output Rectifier Heatsink Area</i>
<i>CO</i>	680 x 1	<i>μF</i>	<i>Output Capacitor - Capacitance</i>
<i>IRIPPLE</i>	0.920	<i>A</i>	<i>Output Capacitor - RMS Ripple Current</i>
<i>Expected Lifetime</i>	26549	<i>hr</i>	<i>Output Capacitor - Expected Lifetime</i>

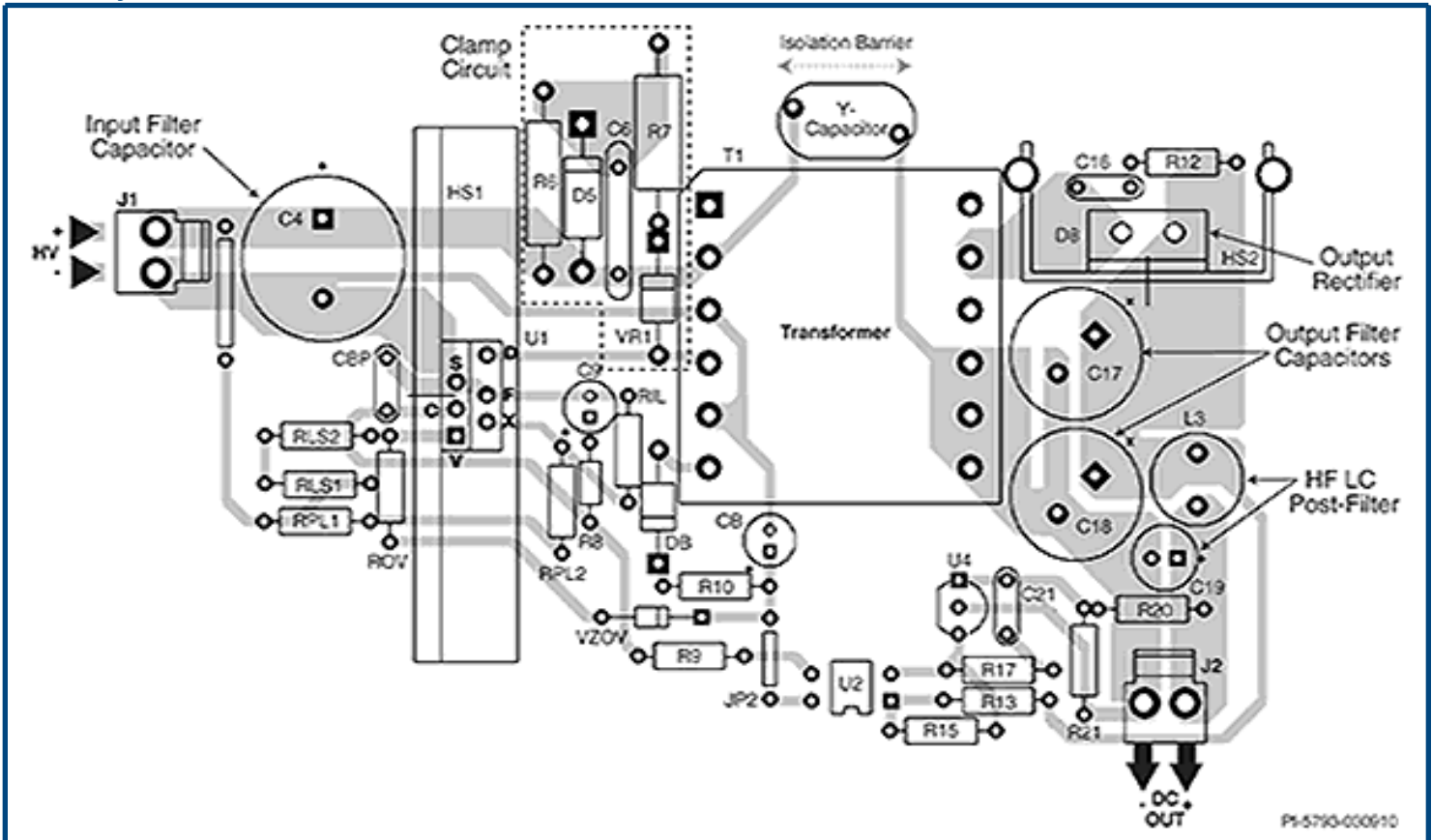
Feedback Circuit

Var	Value	Units	Description
<i>DUAL_OUTPUT_FB_FLAG</i>	NO		<i>Get feedback from 2 outputs</i>
<i>SF_FLAG</i>	NO		<i>Soft Finish Circuits use flag</i>
<i>TYPE_3CTRL_FLAG</i>	NO		<i>Phase Boost Network flag</i>

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.

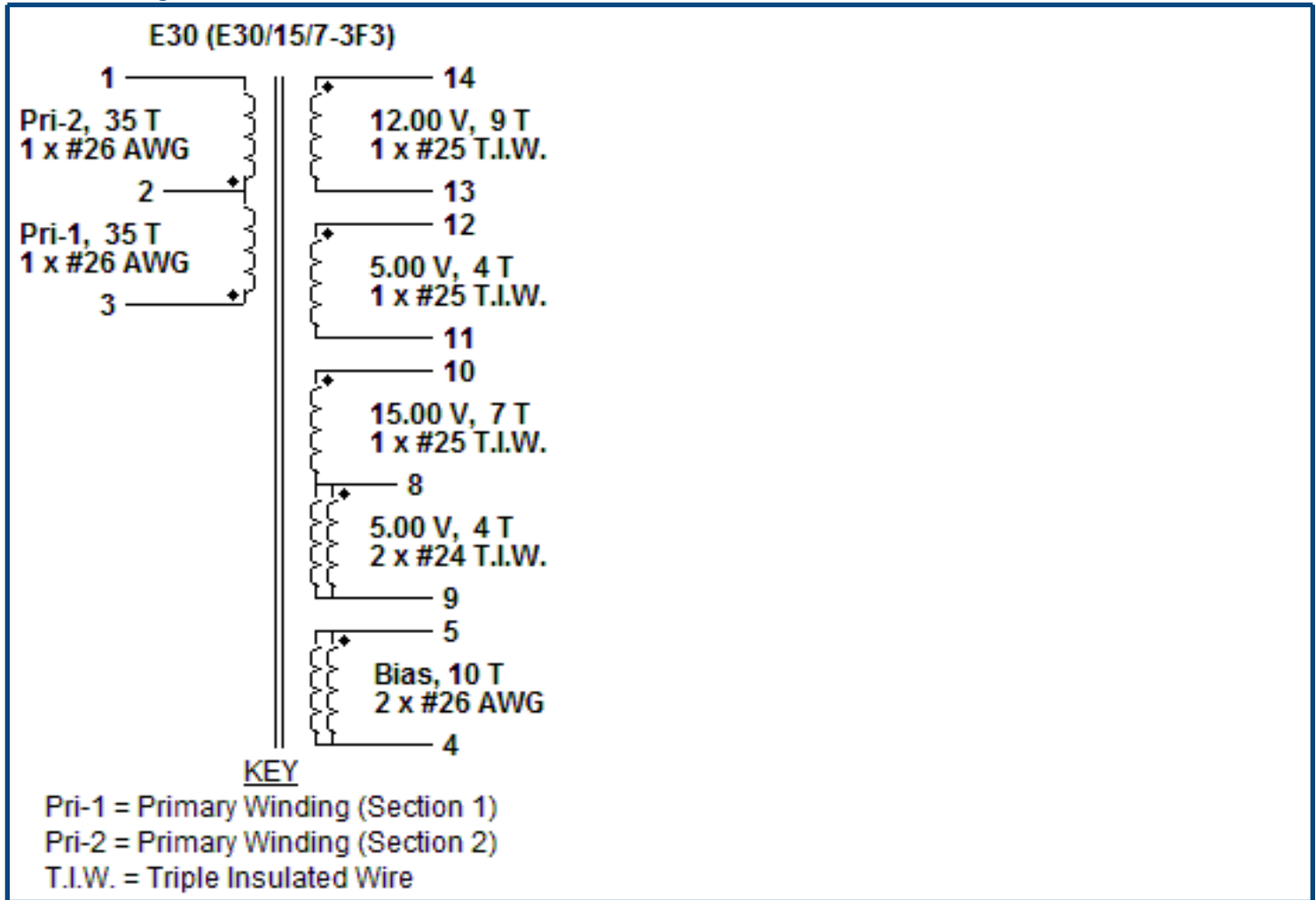
	Description	Show Me
1	Minimize loop area formed by drain, clamp and transformer	
2	Bias winding and bias capacitor are a power connection and therefore returned to Kelvin connection at SOURCE pin	
3	V and X pin node areas minimized, line sensing (R1 & R2) and power limiting (R3 & R4) close to device. 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

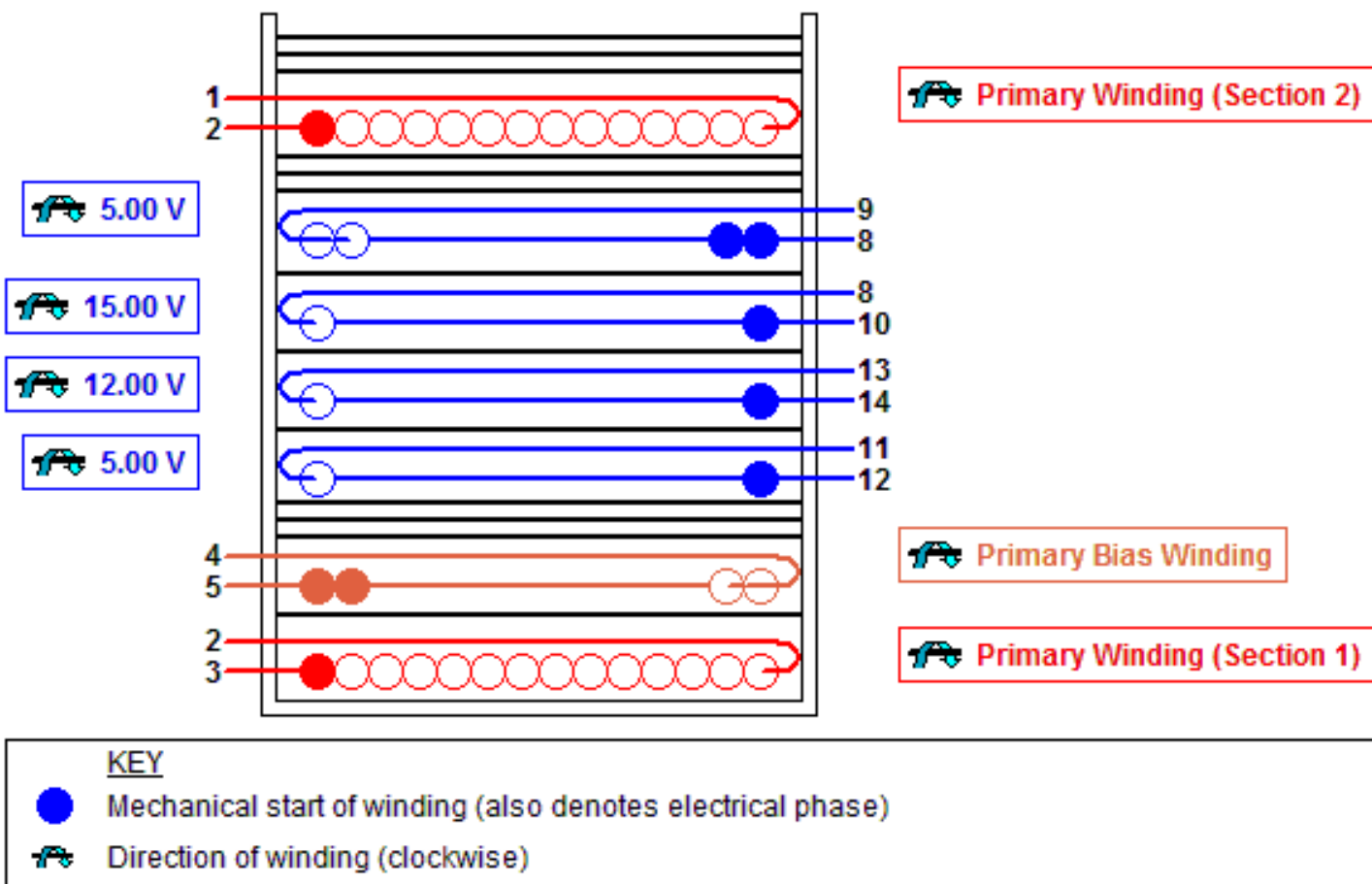
Ite m #	Quantity	Part Ref	Value	Description	Mfg	Mfg Part Number
1	1	C1	47 nF	47 nF, 250 V, Film, X Class	Murata	GA355ER7GB473KW01L
2	1	C2	47 μ F	47 μ F, 400 V, High Voltage Al Electrolytic, (25 mm x 22 mm)	Cornell Dubilier	381LX470M400H012
3	1	C3	2.7 nF	2.7 nF, 1 kV, High Voltage Ceramic	Kemet	C1210H272JDGACTU
4	1	C4	0.1 μ F	0.1 μ F, 16 V, Ceramic, X7R	AVX Corp	0603YC104K4T4A
5	1	C5	47 μ F	47 μ F, 10.0 V, Electrolytic, Gen Purpose, 1000 m Ω , (5.2 mm x 6.3 mm)	United Chemi-Con	EMVY100ADA470MF55G
6	1	C6	0.33 nF	0.33 nF, 250 VAC, Ceramic, Y Class	Murata	GA342DR7GF331KW02L
7	2	C7, C9	560 pF	560 pF, 100 V, Ceramic, C0G	AVX Corp	08051A561JAT2A
8	2	C8, C10	27 pF	27 pF, 1 kV, High Voltage Ceramic	Murata	GRM31A5C3A270JW01D
9	1	C11	10 μ F	10 μ F, 50 V, Electrolytic, Gen Purpose, 1000 m Ω , (6.1 mm x 6.3 mm)	Rubycon	50TRV10M6.3X6.1
10	2	C12, C16	680 μ F	680 μ F, 10.0 V, Electrolytic, Super Low ESR, 56 m Ω , (15 mm x 8 mm)	United Chemi-Con	EKZE100ELL681MH15D
11	2	C13, C17	100 μ F	100 μ F, 10.0 V, Electrolytic, Low ESR, 500 m Ω , (3.5 mm x 2.8 mm)	Kemet	T495B107M010ATE500
12	2	C14, C18	330 μ F	330 μ F, 25 V, Electrolytic, Super Low ESR, 56 m Ω , (15 mm x 8 mm)	United Chemi-Con	EKZE250ELL331MH15D
13	1	C15	100 μ F	100 μ F, 25 V, Electrolytic, Low ESR, 260 m Ω , (8 mm x 6.2 mm)	Panasonic	EEEFK1E101AP
14	1	C19	100 μ F	100 μ F, 16 V, Electrolytic, Low ESR, 260 m Ω , (6.3 mm x 5.8 mm)	Nichicon	UCL1C101MCL1GS
15	1	C20	680 nF	680 nF, 50 V, Ceramic, X7R	Kemet	C0805C684K5RACTU
16	4	D1, D2, D3, D4	DFLR1800-7	800 V, 1 A, Standard Recovery, POWERDI123	Diodes Inc.	DFLR1800-7
17	1	D5	RS07K-GS08	800 V, 1.4 A, Fast Recovery, 300 ns, DO-219AB	Vishay	RS07K-GS08
18	1	D6	LL4148-M-08	100 V, 0.15 A, Fast Recovery, 8 ns, SOD-80	Vishay	LL4148-M-08
19	2	D7, D9	SB350	50 V, 3 A, Schottky, DO-201AD	ON Semiconductor	SB350
20	2	D8, D10	CDBA5150-HF	150 V, 5 A, Schottky, DO-214AC	Comchip Technology	CDBA5150-HF
21	1	F1	1 A	250 VAC, 1 A, Radial TR5, Time Lag Fuse	Littelfuse / Wickmann(R)	37411000410
22	1	HS1		21.9 mm x 20 mm. Aluminum Alloy (3003 OR 5052), 1.6 mm thickness. Heatsink for use with Device U1.	Custom	
23	1	L1	6 mH	6 mH, 1.6 A	Panasonic	ELF18N016
24	4	L2, L3, L4, L5	3.3 μ H	3.3 μ H, 2.6 A	Murata	LQH66SN3R3M03L
25	1	R1	39 k Ω	39 k Ω , 5 %, 2 W, Metal Oxide Film	Generic	
26	1	R2	5.1 Ω	5.1 Ω , 5 %, 0.25 W, Thick Film	Generic	
27	2	R3, R4	12.1 M Ω	12.1 M Ω , 1 %, 0.25 W, Thick Film	Generic	
28	1	R5	7.32 k Ω	7.32 k Ω , 1 %, 0.125 W, Thick Film	Generic	
29	2	R6, R7	4.64 M Ω	4.64 M Ω , 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	18 Ω	18 Ω , 5 %, 0.25 W, Thick Film	Generic	
32	2	R10, R12	390 Ω	390 Ω , 5 %, 0.25 W, Thick Film	Generic	

33	1	R13	681 Ω	681 Ω , 1 %, 0.125 W, Thick Film	Generic	
34	1	R14	1 k Ω	1 k Ω , 5 %, 0.125 W, Thick Film	Generic	
35	2	R15, R16	4.99 k Ω	4.99 k Ω , 1 %, 0.125 W, Thick Film	Generic	
36	1	RV1	V275LA4P	275 V, 23 J, 7 mm, RADIAL, MOV	Littelfuse	V275LA4P
37	1	T1	E30 (E30/15/7-3F3)	3F3 Core Material See Transformer Construction's Materials List for complete information	Ferroxcube	E30/15/7-3F3
38	1	T1 Bobbin	E30/15/7 - 1 (P7-S7)	Bobbin Material : GFR polyterephthalate	EPCOS (TDK)	B66232
39	1	T1 Core Acc.1	B66232	Yoke . Stainless spring steel (0.4mm)	EPCOS (TDK)	B66232
40	1	T1 Core Acc.2	CLA-E30/15/7	Clasp . CuZn Alloy, Ni plated	Ferroxcube	CLA-E30/15/7
41	1	T1 Core Acc.3	SPR-E30/15/7	Spring . Stainless steel (CrNi)	Ferroxcube	SPR-E30/15/7
42	1	U1	TOP264EG	TOPSwitch-JX, TOP264EG, eSIP-7C	Power Integrations	TOP264EG
43	1	U2	LTV-826S	Optocoupler LTV-826S , 80 V, CTR 300 - 600 %, 4-SMD	Liteon	LTV-826S
44	1	U3	LM431ACM/NO PB	2.495 V, Shunt Regulator IC, 2 %, SOIC-8	Texas Instruments	LM431ACM/NOPB
45	1			52 mm ² area on Copper PCB. 2 oz (70 μ m) thickness. Heatsink for use with Rectifier D7.	Custom	
46	1			52 mm ² area on Copper PCB. 2 oz (70 μ m) thickness. Heatsink for use with Rectifier D9.	Custom	
47	1			72 mm ² area on Copper PCB. 2 oz (70 μ m) thickness. Heatsink for use with Rectifier D10.	Custom	
48	1			81 mm ² area on Copper PCB. 2 oz (70 μ m) thickness. Heatsink for use with Rectifier D8.	Custom	

Electrical Diagram



Mechanical Diagram



Winding Instruction

Primary Winding (Section 1)

Start on pin(s) 3 and wind 35 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 [5]. 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) 12 and wind 4 turns (x 1 filar) of item [6]. Spread the winding evenly across entire bobbin. Winding direction is clockwise. Finish this winding on pin(s) 11.

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

Start on pin(s) 14 and wind 9 turns (x 1 filar) of item [6]. Spread the winding evenly across entire bobbin. Winding direction is clockwise. Finish this winding on pin(s) 13.

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

Start on pin(s) 10 and wind 7 turns (x 1 filar) of item [6]. Spread the winding evenly across entire bobbin. Winding direction is clockwise. Finish this winding on pin(s) 8.

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

Start on pin(s) 8 and wind 4 turns (x 2 filar) of item [7]. Spread the winding evenly across entire bobbin. Winding direction is clockwise. Finish this winding on pin(s) 9.

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

Primary Winding (Section 2)

Start on pin(s) 2 and wind 35 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: E30 (E30/15/7-3F3), 3F3, gapped for ALG of 145 nH/T ²
[2]	Bobbin: Generic, 7 pri. + 7 sec.
[3]	Barrier Tape: Polyester film [1 mil (25 µm) base thickness], 17.50 mm wide
[4]	Varnish
[5]	Magnet Wire: 26 AWG (0.4 mm), Solderable Double Coated
[6]	Triple Insulated Wire: 25 AWG (0.45 mm)
[7]	Triple Insulated Wire: 24 AWG (0.55 mm)

Electrical Test Specifications

Parameter	Condition	Spec
Electrical Strength, VAC	60 Hz 1 second, from pins 1,2,3,4,5 to pins 8,9,10,11,12,13,14.	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.	784
Tolerance, ±%	Tolerance of Primary Inductance	10.0
Maximum Primary Leakage, µH	Measured between Pin 1 to Pin 3, with all other Windings shorted.	19.61

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.

	Description	Fix	Ref. #
	Drain voltage close to BVDSS at maximum OV threshold.	Verify BVDSS during line surge, decrease VUVON_MAX or reduce VOR.	237