

Power Supply Input

<i>Var</i>	<i>Value</i>	<i>Units</i>	<i>Description</i>
VACMIN	195	V	Minimum Input AC Voltage
VACMAX	265	V	Maximum Input AC Voltage
FL	50	Hz	Line Frequency
TC	1.98	ms	Diode Conduction Time
Z	0.63		Loss Allocation Factor
η	82.0	%	Efficiency Estimate
VMIN	230.7	V	Minimum DC Input Voltage
VMAX	374.8	V	Maximum DC Input Voltage

Input Section

<i>Var</i>	<i>Value</i>	<i>Units</i>	<i>Description</i>
Fuse	1.25	A	Input Fuse Rated Current
Iavg	0.93	A	Average Diode Bridge Current (DC Input Current)
Thermistor	10.00	Ω	Input Thermistor

Device Variables

<i>Var</i>	<i>Value</i>	<i>Units</i>	<i>Description</i>
Device	TOP258EN		PI Device Name
BVDSS	700		Dm-Src Bkdn Voltage
Device Mode	Default		Current Limit mode for device
OVP_FLAG	NO		Output Overvoltage Protection Enabled
PO	175.09	W	Total Output Power
VDRAIN Estimated	604.10	V	Actual Estimated Drain Voltage
VDS	13.05	V	On state Drain to Source Voltage
FS	132000	Hz	Switching Frequency
KP	0.74		Continuous/Discontinuous Operating Ratio
KI	1.00		Current Limit Reduction Factor
ILIMITEXT	4.00	A	Programmed Current Limit
ILIMITMIN	4.00	A	Minimum Current Limit
ILIMITMAX	4.60	A	Maximum Current Limit
PLIM_FLAG	NO		Enable Overload Power Limiting
IP	3.83	A	Peak Primary Current (at VMIN)
IRMS	1.58	A	Primary RMS Current (at VMIN)
DMAX	0.38		Maximum Duty Cycle
RTH_DEVICE	7.19	$^{\circ}\text{C/W}$	PI Device Maximum Thermal Resistance
DEV_HSINK_TYPE	Aluminum Extruded		PI Device Heatsink Type
DEV_HSINK_PN	533702B02552G		PI Device (Extruded) Heatsink Part Number.

Clamp Circuit

<i>Var</i>	<i>Value</i>	<i>Units</i>	<i>Description</i>
Clamp Type	RCD + Zener Clamp		Clamp Circuit Type
VCLAMP	94	V	Estimated average clamping voltage
Estimated Clamp Loss	2.82	W	Clamp Dissipation
VC_MARGIN	90.23	V	Clamp Voltage Safety Margin

Bias Variables

Var	Value	Units	Description
IB	0.006	A	Bias Current
PIVB	63	V	Bias Rectifier Max Peak Inverse Voltage

Transformer Construction Parameters

Var	Value	Units	Description
Core Type	EER35		Core Type
Core Material	NC-2H (Nicera) or Equivalent		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	2		Number of Secondary pins used
USE_SHIELDS	NO		Use shield Windings
LP_nom	236	μH	Nominal Primary Inductance
LP_Tol	10.0	%	Primary Inductance Tolerance
NP	31.0		Calculated Primary Winding Total Number of Turns
NSM	6		Secondary Main Number of Turns
Primary Current Density	4	A/mm ²	Primary Winding Current Density
VOR	135.0	V	Reflected Output Voltage
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	66	%	Actual Transformer Fit Factor. 100% signifies fully utilized winding window
AE	107.00	mm ²	Core Cross Sectional Area
ALG	222	nH/T ²	Gapped Core Effective Inductance
BM	246	mT	Maximum Flux Density
BP	295	mT	Peak Flux Density
BAC	91	mT	AC Flux Density for Core Loss
LG	0.558	mm	Estimated Gap Length
L_LKG	3.54	μH	Estimated primary leakage inductance
LSEC	20	nH	Secondary Trace Inductance

Primary Winding Section 1

Var	Value	Units	Description
NP1	16		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	0.69		Primary Number of Layers
DC Copper Loss	0.10	W	Primary 1 DC Losses

Primary Winding Section 2

Var	Value	Units	Description
NP2	15		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	0.65		Primary Number of Layers in 2nd split winding

DC Copper Loss	0.14	W	Primary 2 DC Losses
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Output 1

<i>Var</i>	<i>Value</i>	<i>Units</i>	<i>Description</i>
VO	25.00	V	Output Voltage
IO	7.00	A	Output Current
VOUT_ACTUAL	25.00	V	Actual Output Voltage
NS	6		Secondary Number of Turns
Foil Thickness	50	µm	Secondary Wire Inner Diameter Actual
Winding Type	Foil		Output winding number of parallel strands
L_S_OUT	6.00		Secondary Output Winding Layers
DC Copper Loss	0.21	W	Secondary DC Losses
VD	1.15	V	Output Winding Diode Forward Voltage Drop
PIVS	98	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	19.76	A	Peak Secondary Current
ISRMS	10.34	A	Secondary RMS Current
RTH_DIODE	6.51	°C/W	Output Diode Maximum Thermal Resistance
OD_HSINK_TYPE	Aluminum Extruded		Output Diode Heatsink Type
OD_HSINK_PN	533402B02552G		Output Diode (Extruded) Heatsink Part Number
CO	1000 x 3	µF	Output Capacitor
IRIPPLE	7.61	A	Output Capacitor RMS Ripple Current
Expected Lifetime	44709	hr	Expected Lifetime of Output Capacitor

Feedback Circuit

<i>Var</i>	<i>Value</i>	<i>Units</i>	<i>Description</i>
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

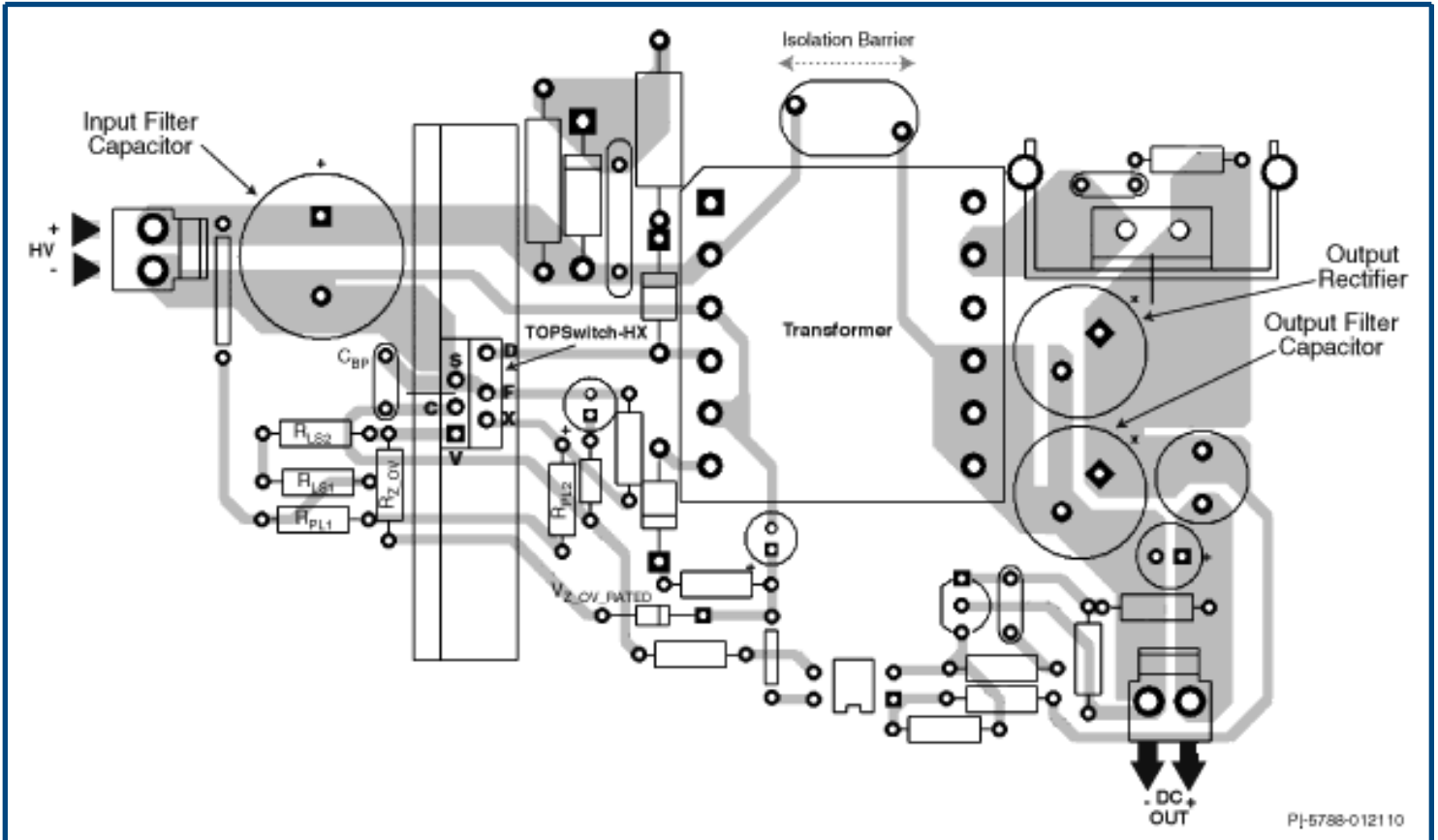
High output current flyback design.

Use parallel low ESR output capacitors, reduce secondary ripple currents by reducing VOR and KP.

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	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	

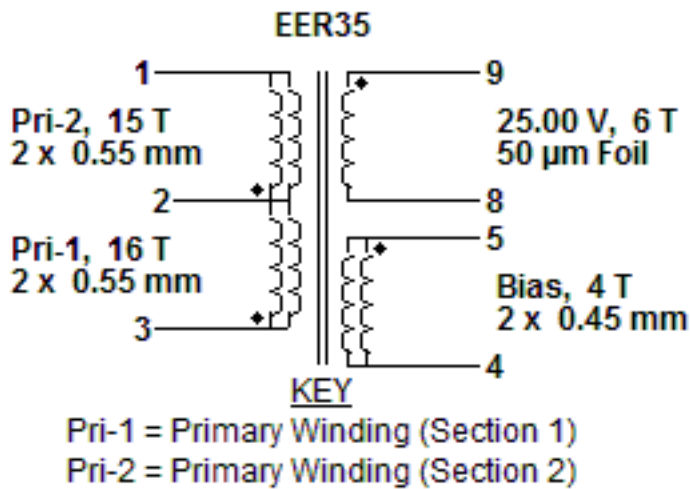
Bill Of Materials

<i>Ite m #</i>	<i>Quantity</i>	<i>Part Ref</i>	<i>Value</i>	<i>Description</i>	<i>Mfg</i>	<i>Mfg Part Number</i>
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 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	22 pF	22 pF, 1 kV, High Voltage Ceramic	Panasonic	ECC-D3A220JGE
9	1	C8	10 µF	10 µF, 50 V, Electrolytic, Gen Purpose, 1050 mΩ, (11.5 mm x 5 mm)	Panasonic	ECA-1HHG100
10	3	C9, C10, C11	1000 µF	1000 µF, 35 V, Electrolytic, Super Low ESR, 18 mΩ, (25 mm x 12.5 mm)	United Chemi-Con	EKZE350ELL102MK25S
11	1	C12	100 µF	100 µF, 35 V, Electrolytic, Low ESR, 180 mΩ, (15 mm x 6.3 mm)	United Chemi-Con	ELXZ350ELL101MF15D
12	1	C13	33 nF	33 nF, 50 V, Ceramic, X7R	Murata	RPER71H333K2P1A03B
13	1	D1	FR257	1000 V, 2.5 A, Fast Recovery, 500 ns, R-3	Rectron	FR257
14	1	D2	1N914	100 V, 0.3 A, Fast Recovery, 4 ns, DO-35	Vishay	1N914
15	1	D3	BYV32-200	200 V, 18 A, Ultrafast Recovery, 25 ns, TO-220AC	Vishay	BYV32-200
16	1	F1	1.25 A	250 VAC, 1.25 A, Radial TR5, Time Lag Fuse	Littelfuse / Wickmann(R)	37411250410
17	1	HS1	533702B02552 G	5.7 °C/W TO-220. Heatsink for use with Device U1.	Aavid	533702B02552G
18	1	HS2	533402B02552 G	5 °C/W TO-220. Heatsink for use with Diode D3.	Aavid	533402B02552G
19	1	L1	6 mH	6 mH, 1.6 A	Panasonic	ELF18N016
20	1	L2	3.3 µH	3.3 µH, 7.5 A	Würth Elektronik	7447471033
21	2	R1, R2	1.1 MΩ	1.1 MΩ, 5 %, 0.25 W, Thick Film	Generic	
22	3	R3, R4, R5	56 kΩ	56 kΩ, 5 %, 2 W, Metal Oxide Film	Generic	
23	1	R6	5.1 Ω	5.1 Ω, 5 %, 0.25 W, Thick Film	Generic	
24	2	R7, R8	4.64 MΩ	4.64 MΩ, 1 %, 0.25 W, Thick Film	Generic	
25	1	R9	6.8 Ω	6.8 Ω, 5 %, 0.125 W, Thick Film	Generic	
26	1	R10	470 Ω	470 Ω, 5 %, 0.25 W, Thick Film	Generic	
27	1	R11	1130 Ω	1130 Ω, 1 %, 0.125 W, Thick Film	Generic	
28	1	R12	1 kΩ	1 kΩ, 5 %, 0.125 W, Thick Film	Generic	
29	1	R13	102 kΩ	102 kΩ, 1 %, 0.125 W, Thick Film	Generic	
30	1	R14	11.3 kΩ	11.3 kΩ, 1 %, 0.125 W, Thick Film	Generic	
31	1	RT1	10 Ω	NTC Thermistor 10 Ω, 1.7 A	Thermometrics	CL-120

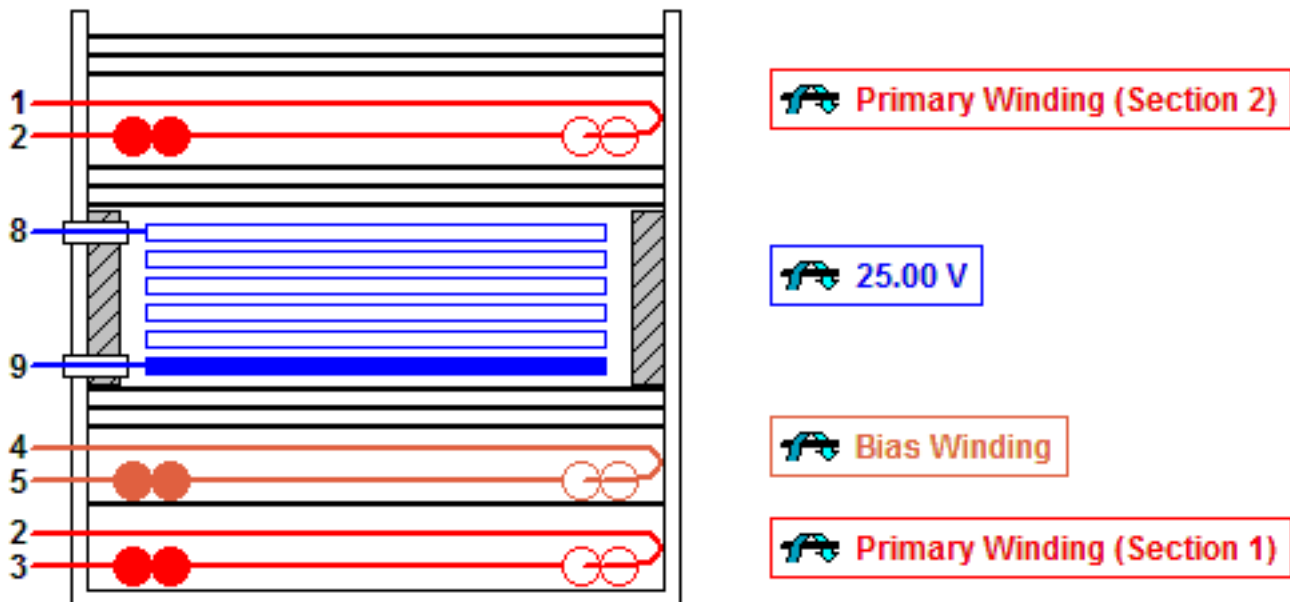
32	1	T1	EER35	NC-2H (Nicera) or Equivalent Core Material See Transformer Construction's Materials List for complete information	TDK	PC40EER35-Z
33	1	U1	TOP258EN	TOPSwitch-HX, TOP258EN, eSIP-7C	Power Integrations	TOP258EN
34	1	U2	LTV817A	Optocoupler LTV817A, 35 V, CTR 80 - 160 %, 4-DIP	Liteon	LTV817A
35	1	U3	TL431CLPM	2.495 V, Shunt Regulator IC, 2 %, TO-92	Texas Instruments	TL431CLPM
36	1	VR1	P6KE160A	160 V, 5 W, 5 %, DO-204AC, TVS	Vishay	P6KE160A

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

Electrical Diagram



Mechanical Diagram



KEY

- Mechanical start of winding (also denotes electrical phase)
- Mechanical start of foil winding (also denotes electrical phase)
- Direction of winding (clockwise)

Winding Instruction

Primary Winding (Section 1)

Start on pin(s) 3 and wind 16 turns (x 2 filar) of item [5]. in 1 layer(s) from left to right. 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 4 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

Use 3 mm margin (item [8]) on the top and 3 mm margin on the bottom (to meet safety). Start on pin(s) 9 and wind 6 turns of item [7]. 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 15 turns (x 2 filar) of item [5]. in 1 layer(s) from left to right. 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) or Equivalent, gapped for ALG of 222 nH/T ²
[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]	Copper Foil: 50 µm thick, 20.10 mm wide, covered with 1 layer of lapped tape. Terminations to foil: 2 x 0.6 mm magnet wire with sleeving
[8]	Tape: Polyester web 3 mm wide

Electrical Test Specifications

Parameter	Condition	Spec
Electrical Strength, VAC	60 Hz 1 second, from pins 1,2,3,4,5 to pins 8,9.	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.	236
Tolerance, ±%	Tolerance of Primary Inductance	10.0
Maximum Primary Leakage, µH	Measured between Pin 1 to Pin 3, with all other Windings shorted.	3.54

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