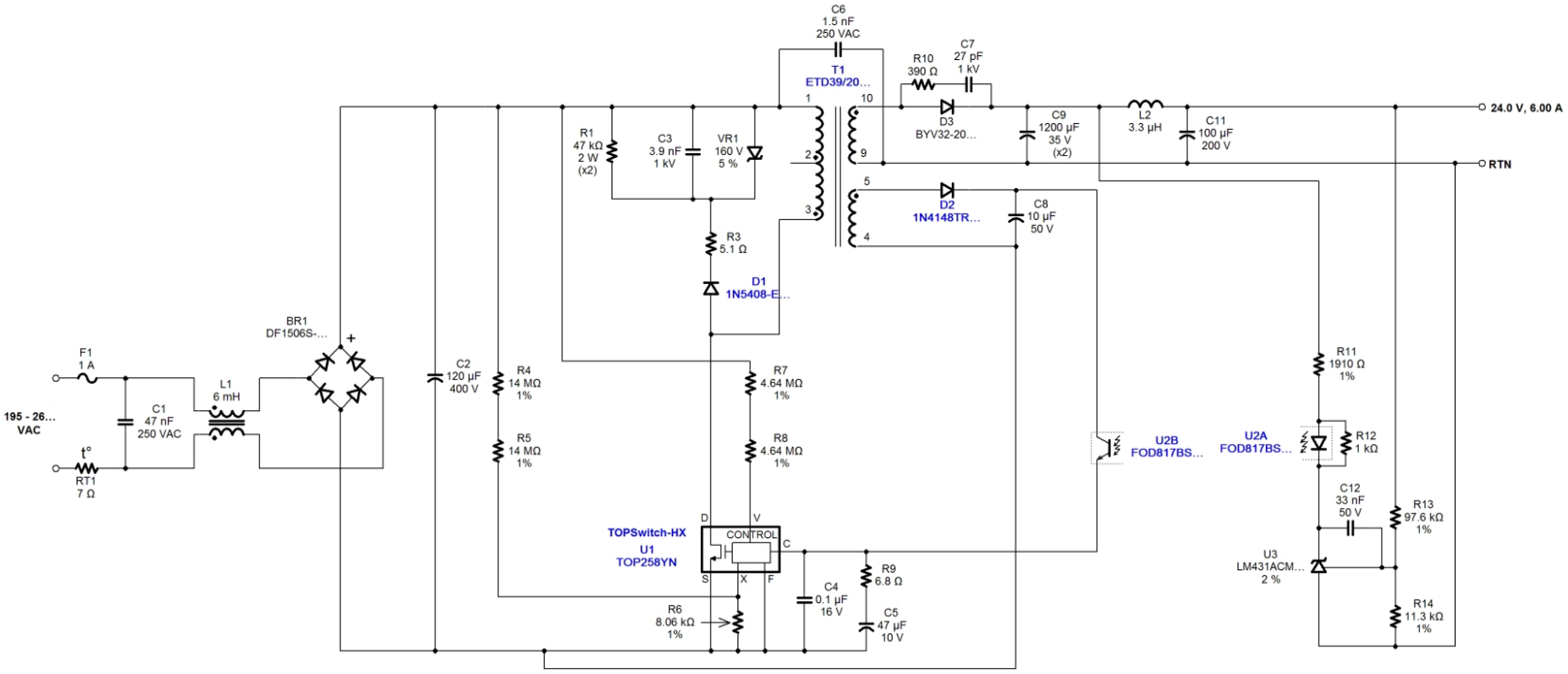


Schematic components that have been frozen by the user will appear with blue reference designators.

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	1.98	ms	Input Rectifier Conduction Time
Z	0.63		Loss Allocation Factor
η	83.0	%	Efficiency Estimate (Target)
VMIN	229.9	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	0.76	A	Average Diode Bridge Current (DC Input Current)
Thermistor	7.00	Ω	Input Thermistor

Device Variables

Var	Value	Units	Description
Device	TOP258YN		PI Device Name (Manual Overwrite)
BVDSS	700	V	Drn-Src Bkdn Voltage
Current Limit Mode	Default		Device Current Limit Mode
OVP_FLAG	NO		Output Overvoltage Protection Enabled
PO	144.07	W	Total Output Power
VDRAIN Estimated	609.10	V	Estimated Drain Voltage
VDS	12.83	V	On state Drain to Source Voltage
FS	132000	Hz	Switching Frequency (at VMIN and Full Load)
KP	0.700		Continuous/Discontinuous Operating Ratio (at VMIN and Full Load)
DMAX	0.383		Maximum Duty Cycle (at VMIN and Full Load)
KI	1.00		Current Limit Reduction Factor
ILIMITEXT	4.00	A	Programmed Current Limit
ILIMITMIN	3.999	A	Minimum Current Limit
ILIMITMAX	4.601	A	Maximum Current Limit
RPL	14.00	MΩ	Power Limit Resistor
RPL2	14.00	MΩ	2nd Power Limit Resistor
PLIM_FLAG	YES		Enable Overload Power Limiting
IP	3.029	A	Peak Primary Current (at VMIN and Full Load)
IRMS	1.277	A	Primary RMS Current (at VMIN and Full Load)
RTH_DEVICE	11.04	°C/W	PI Device Heatsink Maximum Thermal Resistance
DEV_HSINK_TYPE	Aluminum Extruded		PI Device Heatsink Type
DEV_HSINK_PN	7020B-TC12-MTG		PI Device (Extruded) Heatsink Part Number

Clamp Circuit

Var	Value	Units	Description
Clamp Type	RCD + Zener Clamp		Clamp Circuit Type
VCLAMP	99.33	V	Average Clamping Voltage
Estimated Clamp Loss	2.337	W	Clamp total power loss
VC_MARGIN	90.23	V	Clamp Voltage Safety Margin

Primary Bias Variables

Var	Value	Units	Description
VB	15.0	V	Bias Voltage
IB	0.006	A	Bias Current
PIVB	62	V	Bias Rectifier Maximum Peak Inverse Voltage
NB	4		Primary Bias Winding Number of Turns

Transformer Construction Parameters

Var	Value	Units	Description
Core Type	ETD39/20/13		Core Type (Manual Overwrite)
Core Material	3F3		Core Material
Bobbin Reference	Generic, 8 pri. + 8 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	315	µH	Nominal Primary Inductance
LP_Tol	10.0	%	Primary Inductance Tolerance
NP	32.2		Calculated Primary Winding Total Number of Turns
NSM	6		Secondary Main Number of Turns
CMA	632.76	Cmils/A	Primary Winding Current Capacity
VOR	135.00	V	Reflected Output Voltage
BW	25.70	mm	Bobbin Winding Width
ML	0.00	mm	Safety Margin on Left Width
MR	0.00	mm	Safety Margin on Right Width
FF	52.85	%	Actual Transformer Fit Factor. 100% signifies fully utilized winding window
AE	125.00	mm²	Core Cross Sectional Area
ALG	273	nH/T²	Gapped Core Specific Inductance
BM	2134	Gauss	Maximum Flux Density
BP	3241	Gauss	Peak Flux Density
BAC	747	Gauss	AC Flux Density for Core Loss
LG	0.513	mm	Estimated Gap Length
L_LKG	4.73	µH	Estimated primary leakage inductance
LSEC	20	nH	Secondary Trace Inductance

Primary Winding Section 1

Var	Value	Units	Description
NP1	17		Number of Primary Winding Turns in the First Section of Primary
Wire Size	24	AWG	Primary Winding - Wire Size
Winding Type	Bifilar (x2)		Primary Winding - Number of Parallel Wire Strands
L	0.75		Primary Winding - Number of Layers
DC Copper Loss	0.07	W	Primary Section 1 DC Losses

Primary Winding Section 2

Var	Value	Units	Description
NP2	16		Rounded (Integer) Number of Primary winding turns in the second section of primary

Wire Size	**24**	*AWG*	*Primary Winding - Wire Size*
Winding Type	**Bifilar (x2)**		*Primary Winding - Number of Parallel Wire Strands*
L2	**0.71**		*Primary Number of Layers in 2nd split winding*

Output 1

Var	*Value*	*Units*	*Description*
VO	**24.00**	*V*	*Typical Output Voltage*
IO	**6.00**	*A*	*Output Current*
VOUT_ACTUAL	**24.00**	*V*	*Actual Output Voltage*
NS	**6**		*Secondary Number of Turns*
Foil Thickness	**2**	*mil*	*Wire size of secondary winding*
Winding Type	**Foil**		*Output winding number of parallel strands*
L_S_OUT	**6.00**		*Secondary Output Winding Layers*
DC Copper Loss	**0.16**	*W*	*Secondary DC Losses*
VD	**1.15**	*V*	*Output Winding Diode Forward Voltage Drop*
VD	**1.15**	*V*	*Output Winding Diode Forward Voltage Drop*
PIVS	**92.14**	*V*	*Output Rectifier Maximum Peak Inverse Voltage*
ISP	**16.253**	*A*	*Peak Secondary Current*
ISRMS	**8.687**	*A*	*Secondary RMS Current*
ISRMS_WINDING	**8.687**	*A*	*Secondary Winding RMS Current*
CDS_FOIL	**6.65**	*A/mm²*	*Secondary Winding Current Density*
RTH_RECTIFIER	**7.72**	*°C/W*	*Output Rectifier Heatsink Maximum Thermal Resistance*
OR_HSINK_TYPE	**Aluminum Extruded**		*Output Rectifier Heatsink Type*
OR_HSINK_PN	**533702B02552G**		*Output Rectifier (Extruded) Heatsink Part Number*
CO	**1200 x 2**	*µF*	*Output Capacitor - Capacitance*
IRIPPLE	**6.282**	*A*	*Output Capacitor - RMS Ripple Current*
Expected Lifetime	**42534**	*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	**NO**		*Phase Boost Network flag*

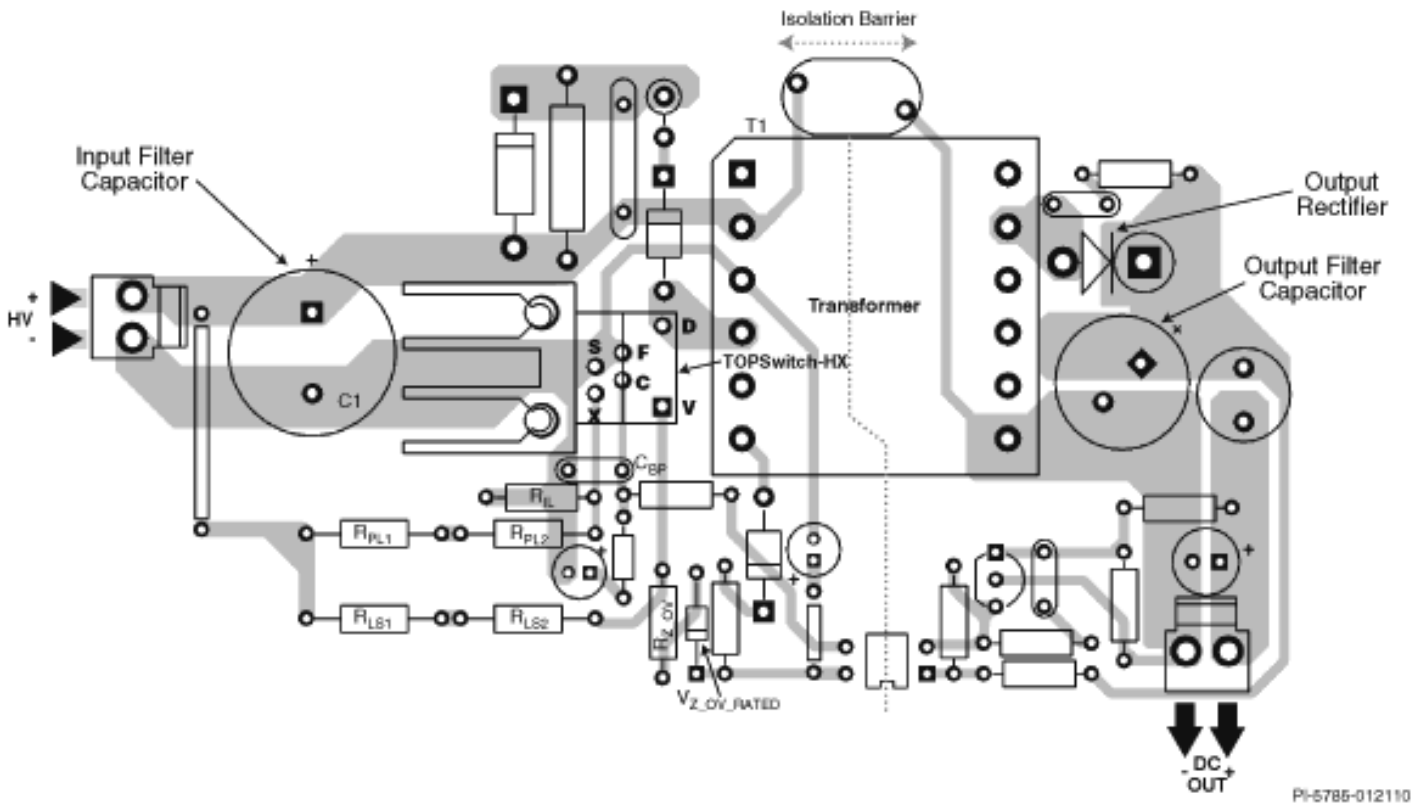
High output current Flyback design.

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.

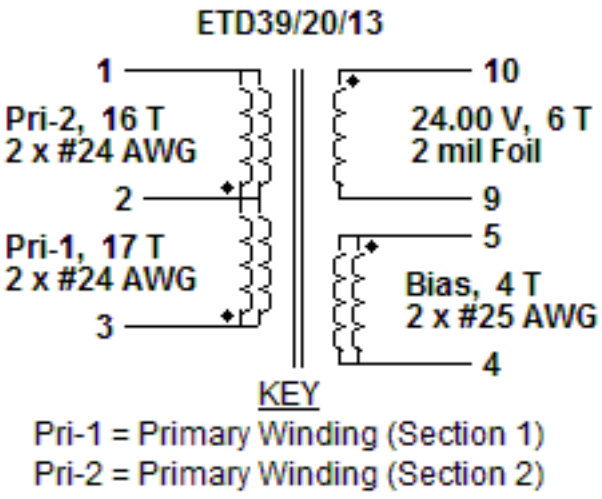
	Description	*Show Me*
1	*Minimize loop area formed by drain, clamp and transformer*	
2	*Bias winding and bias capacitor are a power connection and therefore returned to Kelvin connection at SOURCE pin*	
3	*V and X pin node areas minimized, line sensing (R1 & R2) and power limiting (R3 & R4) close to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

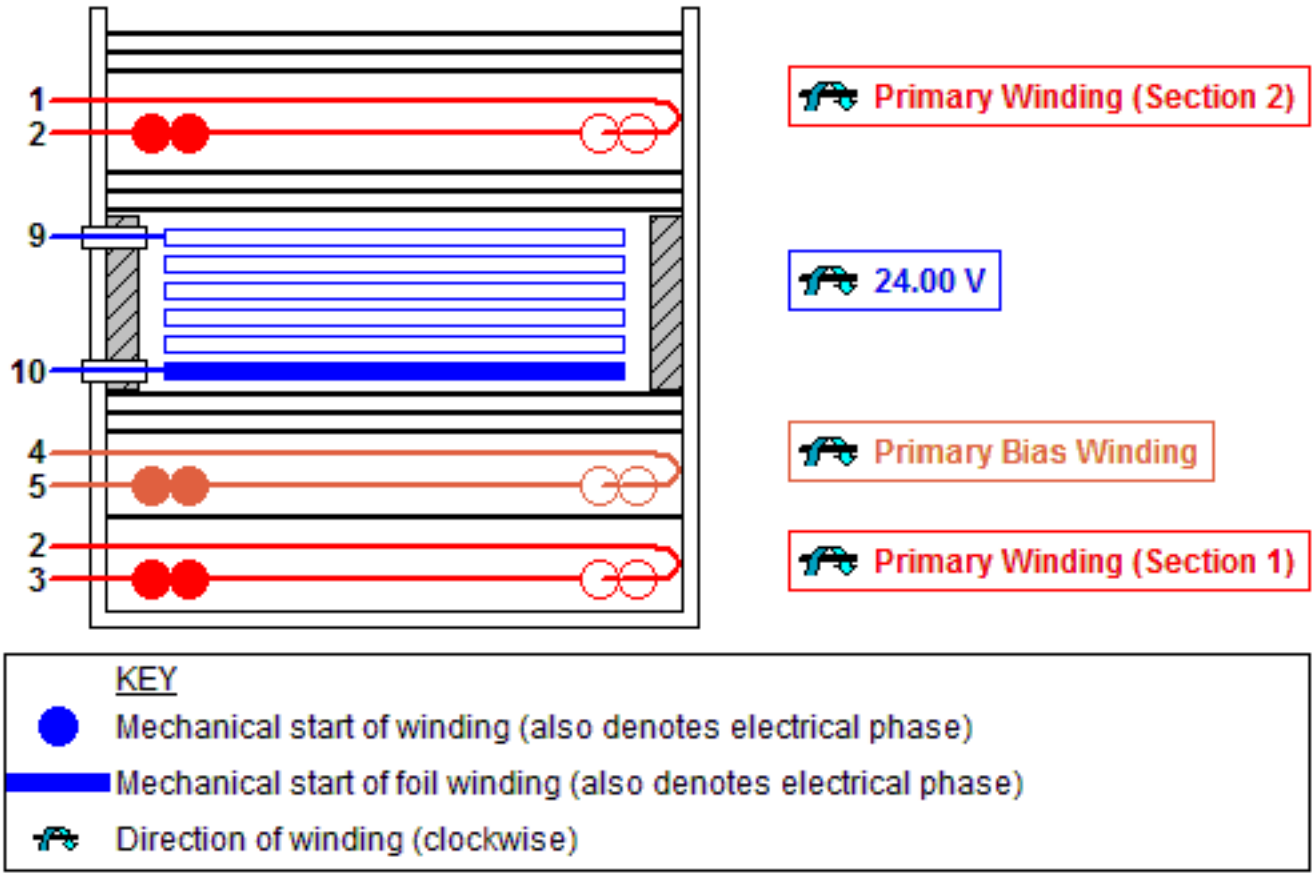
Item #	Quantity	Part Ref	Value	Description	Mfg	Mfg Part Number
1	1	BR1	DF1506S-T	600 V, 1.5 A, Standard Recovery Bridge, DFS	Diodes Inc.	DF1506S-T
2	1	C1	47 nF	47 nF, 250 VAC, Film, X Class	Murata	GA355ER7GB473KW01L
3	1	C2	120 µF	120 µF, 400 V, High Voltage Al Electrolytic, (35.5 mm x 18 mm)	Nichicon	UPT2G121MHD6
4	1	C3	3.9 nF	3.9 nF, 1 kV, High Voltage Ceramic	Kemet	C1206C392KDRAC7800
5	1	C4	0.1 µF	0.1 µF, 16 V, Ceramic, X7R	AVX Corp	0603YC104K4T4A
6	1	C5	47 µF	47 µF, 10.0 V, Electrolytic, Gen Purpose, 1000 mΩ, (5.2 mm x 6.3 mm)	United Chemi-Con	EMVY100ADA470MF55G
7	1	C6	1.5 nF	1.5 nF, 250 VAC, Ceramic, Y Class	Murata	GA352QR7GF152KW01L
8	1	C7	27 pF	27 pF, 1 kV, High Voltage Ceramic	Murata	GRM31A5C3A270JW01D
9	1	C8	10 µF	10 µF, 50 V, Electrolytic, Gen Purpose, 1000 mΩ, (6.1 mm x 6.3 mm)	Rubycon	50TRV10M6.3X6.1
10	2	C9, C10	1200 µF	1200 µF, 35 V, Electrolytic, Super Low ESR, 16 mΩ, (30 mm x 12.5 mm)	United Chemi-Con	EKZE350ELL122MK30S
11	1	C11	100 µF	100 µF, 200 V, Electrolytic, Low ESR, 1900 mΩ, (21.5 mm x 18 mm)	Panasonic	EEVEB2D101M
12	1	C12	33 nF	33 nF, 50 V, Ceramic, X7R	Kemet	C0805C333K5RACTU
13	1	D1	1N5408-E3/54	1000 V, 3 A, Standard Recovery, DO-201AD	Vishay	1N5408-E3/54
14	1	D2	1N4148TR	100 V, 0.3 A, Fast Recovery, 8 ns, DO-35	Vishay	1N4148TR
15	1	D3	BYV32-200G	200 V, 18 A, Ultrafast Recovery, 25 ns, TO-220AB	Vishay	BYV32-200G
16	1	F1	1 A	250 VAC, 1 A, Radial TR5, Time Lag Fuse	Littelfuse / Wickmann(R)	37411000410
17	1	HS1	7020B-TC12-MTG	8.7 °C/W TO-220. Heatsink for use with Device U1.	Aavid	7020B-TC12-MTG
18	1	HS2	533702B02552G	5.7 °C/W TO-220. Heatsink for use with Rectifier D3.	Aavid	533702B02552G
19	1	L1	6 mH	6 mH, 1.6 A	Panasonic	ELF18N016
20	1	L2	3.3 µH	3.3 µH, 7.6 A	Bourns Inc.	PM5022-3R3M-RC
21	2	R1, R2	47 kΩ	47 kΩ, 5 %, 2 W, Metal Oxide Film	Generic	
22	1	R3	5.1 Ω	5.1 Ω, 5 %, 0.25 W, Thick Film	Generic	
23	2	R4, R5	14 MΩ	14 MΩ, 1 %, 0.25 W, Thick Film	Generic	
24	1	R6	8.06 kΩ	8.06 kΩ, 1 %, 0.125 W, Thick Film	Generic	
25	2	R7, R8	4.64 MΩ	4.64 MΩ, 1 %, 0.25 W, Thick Film	Generic	
26	1	R9	6.8 Ω	6.8 Ω, 5 %, 0.125 W, Thick Film	Generic	
27	1	R10	390 Ω	390 Ω, 5 %, 0.25 W, Thick Film	Generic	
28	1	R11	1910 Ω	1910 Ω, 1 %, 0.125 W, Thick Film	Generic	
29	1	R12	1 kΩ	1 kΩ, 5 %, 0.125 W, Thick Film	Generic	
30	1	R13	97.6 kΩ	97.6 kΩ, 1 %, 0.125 W, Thick Film	Generic	
31	1	R14	11.3 kΩ	11.3 kΩ, 1 %, 0.125 W, Thick Film	Generic	

32	1	RT1	7 Ω	NTC Thermistor 7 Ω, 5 A	Thermometrics	CL-50
33	1	T1	ETD39/20/13	3F3 Core Material See Transformer Construction's Materials List for complete information	Epcos	B66363-G-X127
34	1	U1	TOP258YN	TOPSwitch-HX, TOP258YN, TO-220	Power Integrations	TOP258YN
35	1	U2	FOD817BSD	Optocoupler FOD817BSD, 70 V, CTR 130 - 260 %, 4-SMD	ON Semiconductor	FOD817BSD
36	1	U3	LM431ACM/NOPB	2.495 V, Shunt Regulator IC, 2 %, SOIC-8	Texas Instruments	LM431ACM/NOPB
37	1	VR1	P6SMB160A-E3/52	160 V, 5 W, 5 %, DO-214AA, TVS	Vishay	P6SMB160A-E3/52

Electrical Diagram



Mechanical Diagram



Winding Instruction

Primary Winding (Section 1)

Start on pin(s) 3 and wind 17 turns (x 2 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 4 turns (x 2 filar) of item [6]. 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

Use 3 mm margin (item [8]) on the top and 3 mm margin on the bottom. Use 3 layers of tape for the foil insulation both sides around the edges which together with the margins are providing a total of 6.40 mm minimum of creepage and clearance to any primary part.

Start on pin(s) 10 and wind 6 turns of item [7]. 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 16 turns (x 2 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.
3. The sleeving length must comply with 6.40 mm safety margins required.

Materials

Item	*Description*
[1]	**Core: ETD39/20/13, 3F3, gapped for ALG of 273 nH/T²**
[2]	**Bobbin: Generic, 8 pri. + 8 sec.**
[3]	**Barrier Tape: Polyester film [1 mil (25 µm) base thickness], 25.70 mm wide**
[4]	**Varnish**
[5]	**Magnet Wire: 24 AWG, Solderable Double Coated**
[6]	**Magnet Wire: 25 AWG, Solderable Double Coated**
[7]	**Copper Foil: 2 mil thick, mm wide, covered with 1 layer of lapped tape. Terminations to foil: 2 x 23 AWG 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 9,10.**	**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.**	**315**
Tolerance, ±%	**Tolerance of Primary Inductance**	**10.0**
Maximum Primary Leakage, µH	**Measured between Pin 1 to Pin 3, with all other Windings shorted.**	**4.73**

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