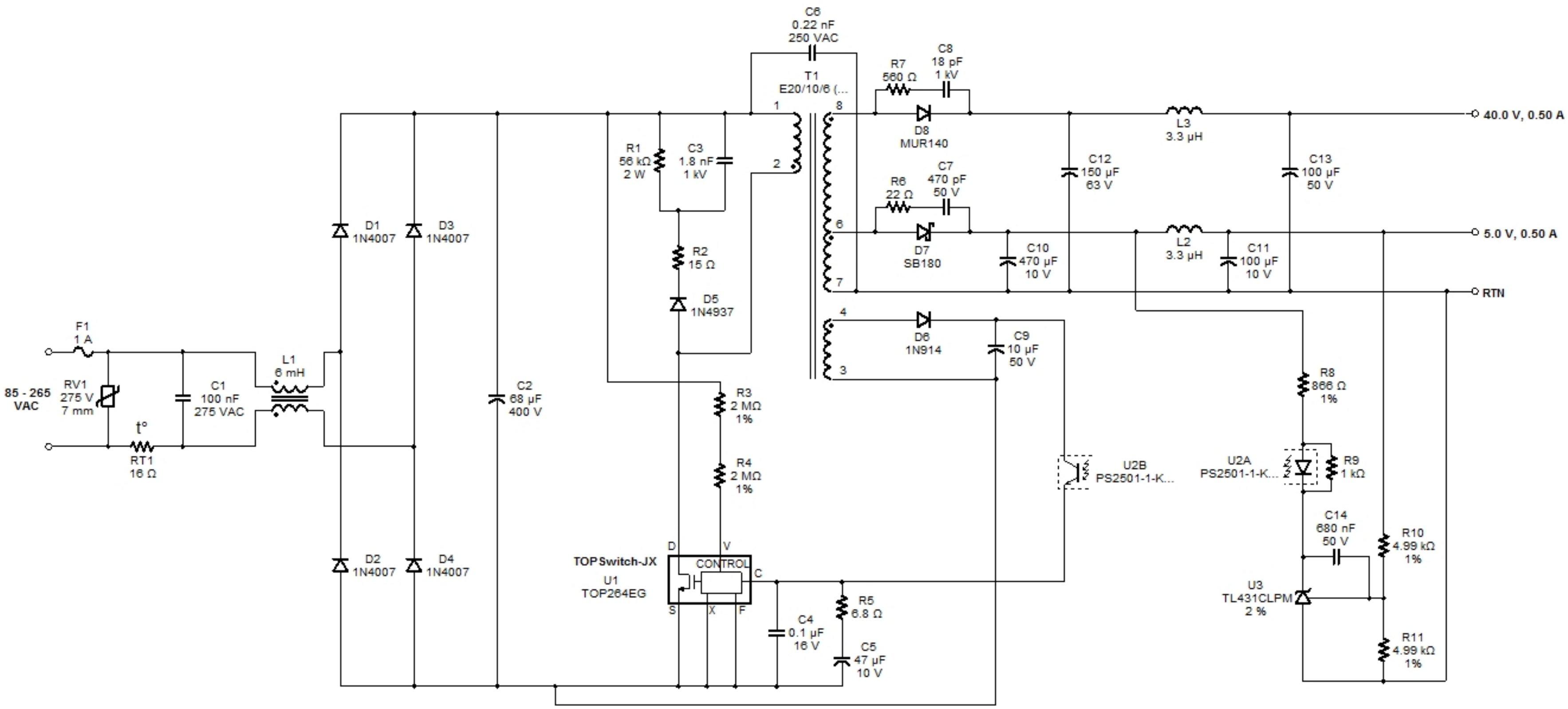


C6
0.22 nF
250 VAC
T1
E20/10/6 (...
R7
560 Ω
C8
18 pF
1 kV
D8
MUR140
L3
3.3 µH
40.0 V, 0.50 A
R1
56 kΩ
2 W
C3
1.8 nF
1 kV
C12
150 µF
63 V
C13
100 µF
50 V
R6
22 Ω
C7
470 pF
50 V
D7
SB180
C10
470 µF
10 V
L2
3.3 µH
C11
100 µF
10 V
5.0 V, 0.50 A
RTN
D1
1N4007
D3
1N4007
R2
15 Ω
D5
1N4937
D6
1N914
C9
10 µF
50 V
F1
1 A
85 - 265
VAC
RV1
275 V
7 mm
C1
100 nF
275 VAC
L1
6 mH
t°
RT1
16 Ω
C2
68 µF
400 V
R3
2 MΩ
1%
R4
2 MΩ
1%
R8
866 Ω
1%
U2B
PS2501-1-K...
U2A
PS2501-1-K...
R9
1 kΩ
C14
680 nF
50 V
R10
4.99 kΩ
1%
D2
1N4007
D4
1N4007
TOPSwitch-JX
U1
TOP264EG
CONTROL
R5
6.8 Ω
C4
0.1 µF
16 V
C5
47 µF
10 V
U3
TL431CLPM
2 %
R11
4.99 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	0.59		Loss Allocation Factor
η	72.0	%	Efficiency Estimate (Target)
VMIN	87.8	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	0.36	A	Average Diode Bridge Current (DC Input Current)
Thermistor	16.00	Ω	Input Thermistor
MOV_VRATED	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	22.57	W	Total Output Power
VDRAIN Estimated	570.58	V	Estimated Drain Voltage
VDS	11.67	V	On state Drain to Source Voltage
FS	132000	Hz	Switching Frequency (at VMIN and Full Load)
KP	0.88		Continuous/Discontinuous Operating Ratio (at VMIN and full load)
DMAX	0.55		Maximum Duty Cycle (at VMIN and full load)
KI	1.00		Current Limit Reduction Factor
ILIMITEXT	1.21	A	Programmed Current Limit
ILIMITMIN	1.209	A	Minimum Current Limit
ILIMITMAX	1.391	A	Maximum Current Limit
PLIM_FLAG	NO		Enable Overload Power Limiting
IP	1.15	A	Peak Primary Current (at VMIN and full load)
IRMS	0.53	A	Primary RMS Current (at VMIN and full load)
RTH_DEVICE	23.57	°C/W	PI Device Heatsink Maximum Thermal Resistance
DEV_HSINK_TYPE	Custom Aluminum		PI Device Heatsink Type
DEV_HSINK_AREA	2241	mm^2	PI Device Heatsink Area

Clamp Circuit

Var	Value	Units	Description
Clamp Type	RCD Clamp		Clamp Circuit Type
VCLAMP	101	V	Average Clamping Voltage
Estimated Clamp Loss	0.68	W	Clamp Dissipation
VC_MARGIN	155.91	V	Clamp Voltage Safety Margin

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	7		Bias Winding Number of Turns

Transformer Construction Parameters

Var	Value	Units	Description
Core Type	E20/10/6 (EF20)		Core Type
Core Material	PC95		Core Material
Bobbin Reference	Generic, 5 pri. + 5 sec.		Bobbin Reference
Bobbin Orientation	Horizontal		Bobbin type
Primary Pins	4		Number of Primary pins used
Secondary Pins	3		Number of Secondary pins used
USE_SHIELDS	NO		Use shield Windings
LP_nom	346	µH	Nominal Primary Inductance
LP_Tol	10.0	%	Primary Inductance Tolerance
NP	48.4		Calculated Primary Winding Total Number of Turns
NSM	3		Secondary Main Number of Turns
CMA	612	Cmils/A	Primary Winding Current Capacity

VOR	94.3	V	Reflected Output Voltage
BW	12.50	mm	Bobbin Winding Width
ML	0.00	mm	Safety Margin on Left Width
MR	0.00	mm	Safety Margin on Right Width
FF	98	%	Actual Transformer Fit Factor. 100% signifies fully utilized winding window
AE	32.10	mm²	Core Cross Sectional Area
ALG	133	nH/T²	Gapped Core Specific Inductance
BM	2307	Gauss	Maximum Flux Density
BP	3073	Gauss	Peak Flux Density
BAC	1013	Gauss	AC Flux Density for Core Loss
LG	0.272	mm	Estimated Gap Length
L_LKG	10.37	µH	Estimated primary leakage inductance
LSEC	15	nH	Secondary Trace Inductance

Primary Winding Section 1

Var	Value	Units	Description
NP1	49		Number of Primary Winding Turns in the First Section of Primary
Wire Size	25	AWG	Primary Winding - Wire Size
Winding Type	Single (x1)		Primary Winding - Number of Parallel Wire Strands
L	1.98		Primary Winding - Number of Layers
DC Copper Loss	0.06	W	Primary Section 1 DC Losses

Output 1

Var	Value	Units	Description
VO	40.00	V	Typical Output Voltage
IO	0.50	A	Output Current
VOUT_ACTUAL	40.00	V	Actual Output Voltage
NS	18		Secondary Number of Turns
Wire Size	27	AWG	Wire size of secondary winding
Winding Type	Single (x1)		Output winding number of parallel strands
L_S_OUT	0.79		Secondary Output Winding Layers
DC Copper Loss	0.14	W	Secondary DC Losses
OD_VD	0.95	V	Output Winding Diode Forward Voltage Drop
PIVS	201	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	2.06	A	Peak Secondary Current
ISRMS	0.85	A	Secondary RMS Current
RTH_RECTIFIER	92.82	°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	mm²	Output Rectifier Heatsink Area
CO	150 x 1	µF	Output Capacitor - Capacitance
IRIPPLE	0.68	A	Output Capacitor - RMS Ripple Current
Expected Lifetime	24414	hr	Output Capacitor - Expected Lifetime

Output 2

Var	Value	Units	Description
VO	5.00	V	Typical Output Voltage
IO	0.50	A	Output Current
VOUT_ACTUAL	5.00	V	Actual Output Voltage
NS	3		Secondary Number of Turns
Wire Size	27	AWG	Wire size of secondary winding
Winding Type	Bifilar (x2)		Output winding number of parallel strands
L_S_OUT	0.26		Secondary Output Winding Layers
DC Copper Loss	0.04	W	Secondary DC Losses
OD_VD	0.85	V	Output Winding Diode Forward Voltage Drop
PIVS	28	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	2.06	A	Peak Secondary Current
ISRMS	0.85	A	Secondary RMS Current
RTH_RECTIFIER	137.69	°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	mm²	Output Rectifier Heatsink Area
CO	470 x 1	µF	Output Capacitor - Capacitance
IRIPPLE	0.68	A	Output Capacitor - RMS Ripple Current
Expected Lifetime	27493	hr	Output Capacitor - Expected Lifetime

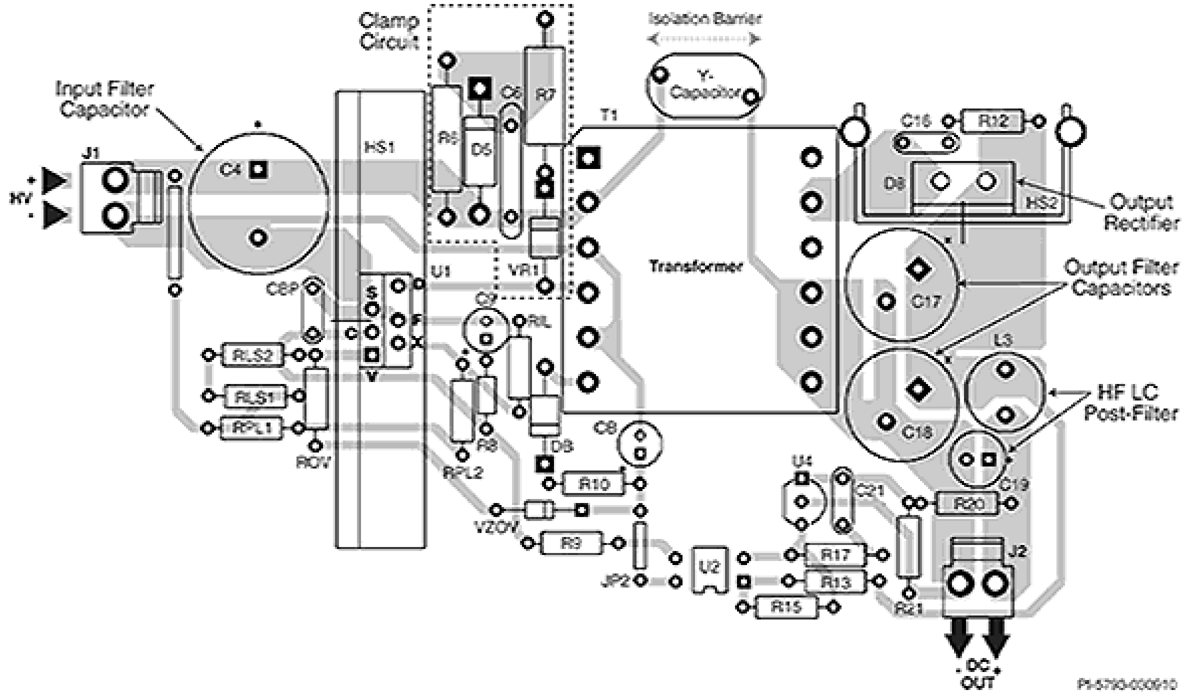
Feedback Circuit

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*

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.

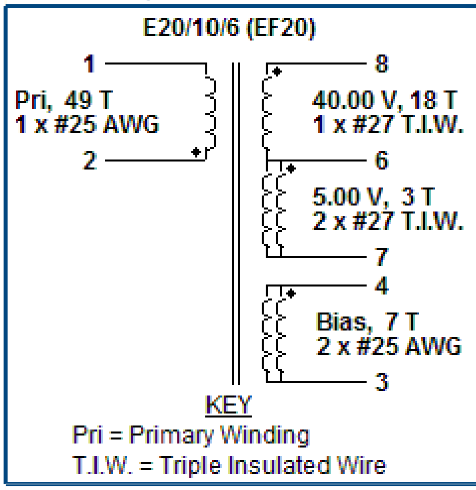


Click on the "Show me" icon to highlight relevant areas on the sample layout.

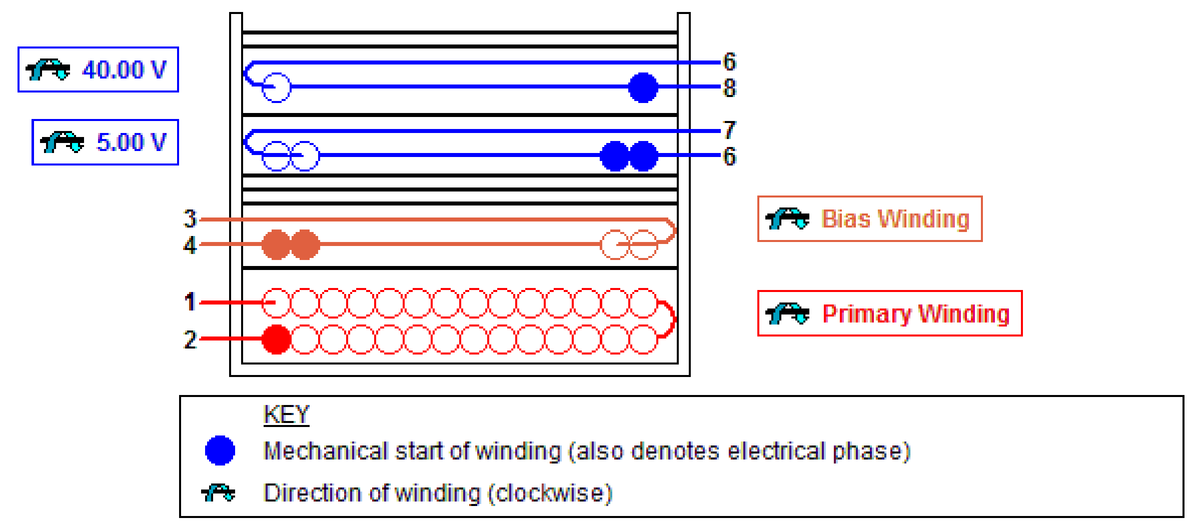
	Description	Show Me
1	Minimize loop area formed by drain, clamp and transformer	
2	Bias winding and bias capacitor are a power connection and therefore returned to Kelvin connection at SOURCE pin	
3	V and X pin node areas minimized, line sensing (R1 & R2) and power limiting (R3 & R4) close to device.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

Item #	Quantity	Part Ref	Value	Description	Mfg	Mfg Part Number
1	1	C1	100 nF	100 nF, 275 VAC, Film, X Class	Kemet	R46KI310000M1K
2	1	C2	68 µF	68 µF, 400 V, High Voltage Al Electrolytic, (40 mm x 12.5 mm)	United Chemi-Con	EPAG400VB68RM12X40LL
3	1	C3	1.8 nF	1.8 nF, 1 kV, High Voltage Ceramic	Panasonic	ECK-D3A182KBN
4	1	C4	0.1 µF	0.1 µF, 16 V, Ceramic, X7R	TDK	C1005X7R1C104K
5	1	C5	47 µF	47 µF, 10.0 V, Electrolytic, Gen Purpose, 1040 mΩ, (11 mm x 5 mm)	United Chemi-Con	KME10VB47RM5X11LL
6	1	C6	0.22 nF	0.22 nF, 250 VAC, Ceramic, Y Class	Vishay Cera-Mite	440LT22-R
7	1	C7	470 pF	470 pF, 50 V, Ceramic, C0G	TDK	FK18C0G1H471J
8	1	C8	18 pF	18 pF, 1 kV, High Voltage Ceramic	Panasonic	ECC-D3A180JGE
9	1	C9	10 µF	10 µF, 50 V, Electrolytic, Gen Purpose, 1050 mΩ, (11.5 mm x 5 mm)	Panasonic	ECA-1HHG100
10	1	C10	470 µF	470 µF, 10.0 V, Electrolytic, Super Low ESR, 72 mΩ, (11.5 mm x 8 mm)	United Chemi-Con	EKZE100ELL471MHB5D
11	1	C11	100 µF	100 µF, 10.0 V, Electrolytic, Low ESR, 500 mΩ, (11.5 mm x 5 mm)	United Chemi-Con	ELXZ100ELL101MEB5D
12	1	C12	150 µF	150 µF, 63 V, Electrolytic, Low ESR, 210 mΩ, (20 mm x 8 mm)	United Chemi-Con	ELXZ630ELL151MH20D
13	1	C13	100 µF	100 µF, 50 V, Electrolytic, Low ESR, 220 mΩ, (12 mm x 8 mm)	United Chemi-Con	ELXZ500ELL101MH12D
14	1	C14	680 nF	680 nF, 50 V, Ceramic, X7R	Murata	RPER71H684K3K1C03B
15	4	D1, D2, D3, D4	1N4007	1000 V, 1 A, Standard Recovery, DO-41	Vishay	1N4007
16	1	D5	1N4937	600 V, 1 A, Fast Recovery, 200 ns, DO-41	Vishay	1N4937
17	1	D6	1N914	100 V, 0.3 A, Fast Recovery, 4 ns, DO-35	Vishay	1N914
18	1	D7	SB180	80 V, 1 A, Schottky, DO-41	Vishay	SB180
19	1	D8	MUR140	400 V, 1 A, Ultrafast Recovery, 30 ns, DO-41	ON Semiconductor	MUR140
20	1	F1	1 A	250 VAC, 1 A, Radial TR5, Time Lag Fuse	Littelfuse / Wickmann(R)	37411000410
21	1	HS1		56 mm x 20 mm. Aluminum Alloy (3003 OR 5052), 1.6 mm thickness. Heatsink for use with Device U1.	Custom	
22	1	L1	6 mH	6 mH, 1.6 A	Panasonic	ELF18N016
23	2	L2, L3	3.3 µH	3.3 µH, 2.66 A	Bourns Inc.	RL822-3R3K-RC
24	1	R1	56 kΩ	56 kΩ, 5 %, 2 W, Metal Oxide Film	Generic	
25	1	R2	15 Ω	15 Ω, 5 %, 0.25 W, Carbon Film	Generic	
26	2	R3, R4	2 MΩ	2 MΩ, 1 %, 0.25 W, Metal Film	Generic	
27	1	R5	6.8 Ω	6.8 Ω, 5 %, 0.125 W, Carbon Film	Generic	
28	1	R6	22 Ω	22 Ω, 5 %, 0.25 W, Carbon Film	Generic	
29	1	R7	560 Ω	560 Ω, 5 %, 0.25 W, Carbon Film	Generic	
30	1	R8	866 Ω	866 Ω, 1 %, 0.125 W, Metal Film	Generic	
31	1	R9	1 kΩ	1 kΩ, 5 %, 0.125 W, Carbon Film	Generic	
32	2	R10, R11	4.99 kΩ	4.99 kΩ, 1 %, 0.125 W, Metal Film	Generic	
33	1	RT1	16 Ω	NTC Thermistor 16 Ω, 1.7 A	Thermometrics	CL180
34	1	RV1	V275LA4P	275 V, 23 J, 7 mm, RADIAL, MOV	Littelfuse	V275LA4P
35	1	T1	E20/10/6 (EF20)	PC95 Core Material See Transformer Construction's Materials List for complete information	Epcos	B66311-G-X127
36	1	U1	TOP264EG	TOPSwitch-JX, TOP264EG, eSIP-7C	Power Integrations	TOP264EG
37	1	U2	PS2501-1-K-A	Optocoupler PS2501-1-K-A, 80 V, CTR 300 - 600 %, 4-DIP	CEL	PS2501-1-K-A
38	1	U3	TL431CLPM	2.495 V, Shunt Regulator IC, 2 %, TO-92	Texas Instruments	TL431CLPM
39	1			52 mm² area on Copper PCB. 2 oz (70 µm) thickness. Heatsink for use with Rectifier D8.	Custom	
40	1			52 mm² area on Copper PCB. 2 oz (70 µm) thickness. Heatsink for use with Rectifier D7.	Custom	

Electrical Diagram



Mechanical Diagram



Winding Instruction

Primary Winding

Start on pin(s) 2 and wind 49 turns (x 1 filar) of item [5]. in 2 layer(s) from left to right. Winding direction is clockwise. 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 1 layer of tape, item [3], for insulation.

Bias Winding

Start on pin(s) 4 and wind 7 turns (x 2 filar) of item [5]. Winding direction is clockwise. Spread the winding evenly across entire bobbin. Finish this winding on pin(s) 3.

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

Secondary Winding

Start on pin(s) 6 and wind 3 turns (x 2 filar) of item [6]. Spread the winding evenly across entire bobbin. Winding direction is clockwise. Finish this winding on pin(s) 7.

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

Start on pin(s) 8 and wind 18 turns (x 1 filar) of item [6]. Spread the winding evenly across entire bobbin. Winding direction is clockwise. Finish this winding on pin(s) 6.

Add 2 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. For non margin wound transformers use triple insulated wire for all secondary windings.

Materials

Item	*Description*
[1]	**Core: E20/10/6 (EF20), PC95, gapped for ALG of 133 nH/T^2**
[2]	**Bobbin: Generic, 5 pri. + 5 sec.**
[3]	**Barrier Tape: Polyester film [1 mil (25 µm) base thickness], 12.50 mm wide**
[4]	**Varnish**
[5]	**Magnet Wire: 25 AWG, Solderable Double Coated**
[6]	**Triple Insulated Wire: 27 AWG**

Electrical Test Specifications

Parameter	*Condition*	*Spec*
Electrical Strength, VAC	**60 Hz 1 second, from pins 1,2,3,4 to pins 6,7,8.**	**3000**
Nominal Primary Inductance, μH	**Measured at 1 V pk-pk, typical switching frequency, between pin 1 to pin 2, with all other Windings open.**	**346**
Tolerance, ±%	**Tolerance of Primary Inductance**	**10.0**
Maximum Primary Leakage, μH	**Measured between Pin 1 to Pin 2, with all other Windings shorted.**	**10.37**

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.