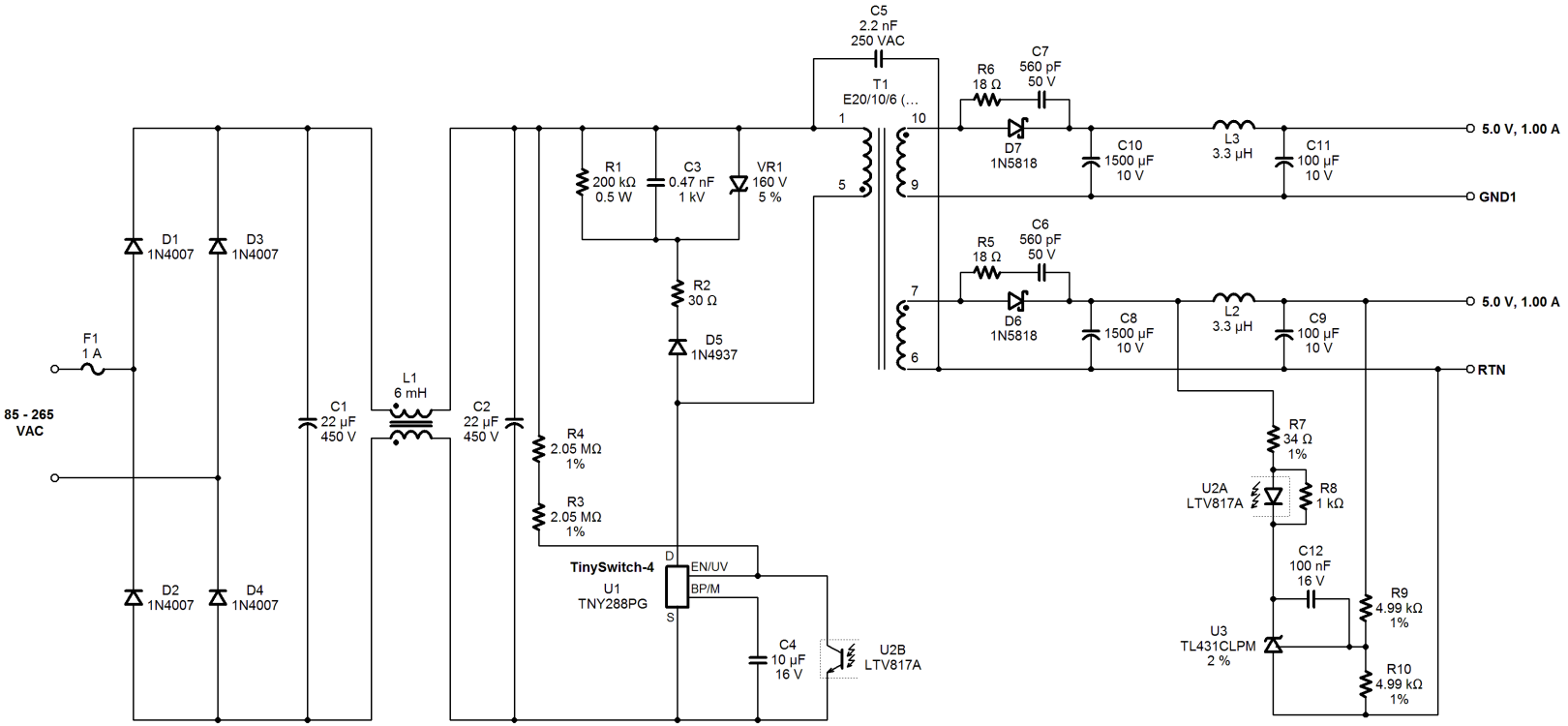

C5
2.2 nF
250 VAC
T1
E20/10/6 (…
1
10
5
9
7
6
R6
18 Ω
C7
560 pF
50 V
D7
1N5818
C10
1500 µF
10 V
L3
3.3 µH
C11
100 µF
10 V
5.0 V, 1.00 A
GND1
R5
18 Ω
C6
560 pF
50 V
D6
1N5818
C8
1500 µF
10 V
L2
3.3 µH
C9
100 µF
10 V
5.0 V, 1.00 A
RTN
R1
200 kΩ
0.5 W
C3
0.47 nF
1 kV
VR1
160 V
5 %
R2
30 Ω
D5
1N4937
F1
1 A
85 - 265
VAC
D1
1N4007
D3
1N4007
D2
1N4007
D4
1N4007
C1
22 µF
450 V
L1
6 mH
C2
22 µF
450 V
R4
2.05 MΩ
1%
R3
2.05 MΩ
1%
TinySwitch-4
U1
TNY288PG
D
EN/UV
BP/M
S
C4
10 µF
16 V
U2B
LTV817A
R7
34 Ω
1%
U2A
LTV817A
R8
1 kΩ
C12
100 nF
16 V
U3
TL431CLPM
2 %
R9
4.99 kΩ
1%
R10
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	Diode Conduction Time
Z	**0.70**		Loss Allocation Factor
η	**71.0**	%	Efficiency Estimate
VMIN	**96.5**	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
IAVG	**0.16**	A	Average Diode Bridge Current (DC Input Current)

Device Variables

Var	*Value*	*Units*	*Description*
Device	**TNY288PG**		PI Device Name
BVDSS	**700**		Drn-Src Bkdn Voltage
Device Mode	**Increased**		Current Limit mode for device
PO	**11.00**	W	Total Output Power
VDRAIN Estimated	**604.44**	V	Actual Estimated Drain Voltage
VDS	**4.45**	V	On state Drain to Source Voltage
I2F_MIN	**50.19**	A²kHz	Minimum I2F
I2F_MAX	**64.69**	A²kHz	Maximum I2F
FS_AT_ILIMMIN	**137129**	Hz	Switching Frequency at Current Limit Minimum
KP	**1.20**		Continuous/Discontinuous Operating Ratio
KP_TRANSIENT	**1.20**		Transient Ripple to Peak Current Ratio
ILIMITMIN	**0.60**	A	Minimum Current Limit
ILIMITMAX	**0.72**	A	Maximum Current Limit
IRMS	**0.27**	A	Primary RMS Current (at VMIN)
DMAX	**0.55**		Maximum Duty Cycle
RTH_DEVICE	**73.78**	°C/W	PI Device Maximum Thermal Resistance
DEV_HSINK_TYPE	**2 Oz (70 µ) Copper PCB**		PI Device Heatsink Type
DEV_HSINK_AREA	**52**	mm²	PI Device Heatsink Area

Clamp Circuit

Var	*Value*	*Units*	*Description*
Clamp Type	**RCD + Zener Clamp**		Clamp Circuit Type (Manual Overwrite)
VCLAMP	**95**	V	Estimated average clamping voltage
Estimated Clamp Loss	**0.27**	W	Clamp Dissipation

Transformer Construction Parameters

Var	*Value*	*Units*	*Description*
Core Type	**E20/10/6 (EF20)**		Core Type (Manual Overwrite)
Core Material	**NC-2H (Nicera) or Equivalent**		Core Material
Bobbin Reference	**Generic, 5 pri. + 5 sec.**		Bobbin Reference
Bobbin Orientation	**Horizontal**		Bobbin type

Primary Pins	**5**		Number of Primary pins used
Secondary Pins	**5**		Number of Secondary pins used
USE_SHIELDS	**NO**		Use shield Windings
LP_nom	**626**	µH	Nominal Primary Inductance
LP_Tol	**10.0**	%	Primary Inductance Tolerance
NP	**73.0**		Calculated Primary Winding Total Number of Turns
NSM	**3**		Secondary Main Number of Turns
CMA	**476**	Cmils/A	Primary Winding Current Capacity
VOR	**135.0**	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	**71**	%	Actual Transformer Fit Factor. 100% signifies fully utilized winding window
AE	**32.10**	mm²	Core Cross Sectional Area
ALG	**106**	nH/T²	Gapped Core Effective Inductance
BM	**1812**	Gauss	Maximum Flux Density
BAC	**815**	Gauss	AC Flux Density for Core Loss
LG	**0.350**	mm	Estimated Gap Length
L_LKG	**18.79**	µH	Estimated primary leakage inductance
LSEC	**15**	nH	Secondary Trace Inductance

Primary Winding Section 1

Var	*Value*	*Units*	*Description*
NP1	**73**		Rounded (Integer) Number of Primary winding turns in the first section of primary
Wire Size	**29**	AWG	Wire size of primary winding
Winding Type	**Single (x1)**		Primary winding number of parallel wire strands
L	**1.93**		Primary Number of Layers
DC Copper Loss	**0.05**	W	Primary 1 DC Losses

Output 1

Var	*Value*	*Units*	*Description*
VO	**5.00**	V	Output Voltage
IO	**1.00**	A	Output Current
VOUT_ACTUAL	**5.00**	V	Actual Output Voltage
NS	**3**		Secondary Number of Turns
Wire Size	**26**	AWG	Wire size of secondary winding
Winding Type	**Bifilar (x2)**		Output winding number of parallel strands
L_S_OUT	**0.29**		Secondary Output Winding Layers
DC Copper Loss	**0.06**	W	Secondary DC Losses
VD	**0.55**	V	Output Winding Diode Forward Voltage Drop
PIVS	**20**	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	**6.69**	A	Peak Secondary Current
ISRMS	**2.37**	A	Secondary RMS Current
RTH_DIODE	**96.55**	°C/W	Output Diode Maximum Thermal Resistance
OD_HSINK_TYPE	**2 Oz (70 µ) Copper PCB**		Output Diode Heatsink Type
OD_HSINK_AREA	**52**	mm²	Output Diode Heatsink Area

CO	**1500 x 1**	µF	Output Capacitor
IRIPPLE	**2.14**	A	Output Capacitor RMS Ripple Current
Expected Lifetime	**32118**	hr	Expected Lifetime of Output Capacitor

Output 2

Var	*Value*	*Units*	*Description*
VO	**5.00**	V	Output Voltage
IO	**1.00**	A	Output Current
VOUT_ACTUAL	**5.00**	V	Actual Output Voltage
NS	**3**		Secondary Number of Turns
Wire Size	**26**	AWG	Wire size of secondary winding
Winding Type	**Bifilar (x2)**		Output winding number of parallel strands
L_S_OUT	**0.29**		Secondary Output Winding Layers
DC Copper Loss	**0.07**	W	Secondary DC Losses
VD	**0.55**	V	Output Winding Diode Forward Voltage Drop
PIVS	**20**	V	Output Rectifier Maximum Peak Inverse Voltage
ISP	**6.69**	A	Peak Secondary Current
ISRMS	**2.37**	A	Secondary RMS Current
RTH_DIODE	**96.55**	°C/W	Output Diode Maximum Thermal Resistance
OD_HSINK_TYPE	**2 Oz (70 µ) Copper PCB**		Output Diode Heatsink Type
OD_HSINK_AREA	**52**	mm²	Output Diode Heatsink Area
CO	**1500 x 1**	µF	Output Capacitor
IRIPPLE	**2.14**	A	Output Capacitor RMS Ripple Current
Expected Lifetime	**32118**	hr	Expected Lifetime of Output Capacitor

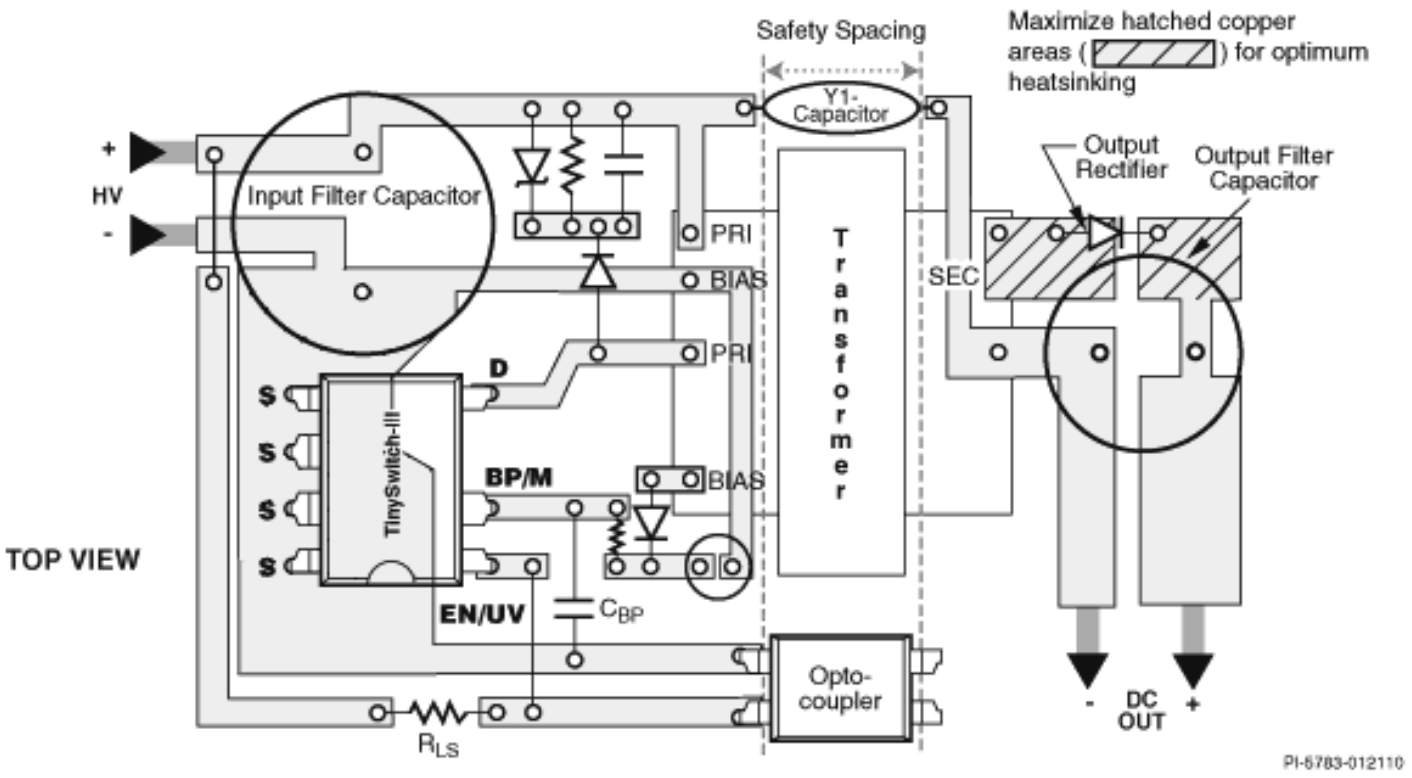
Feedback Circuit

Var	*Value*	*Units*	*Description*
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

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



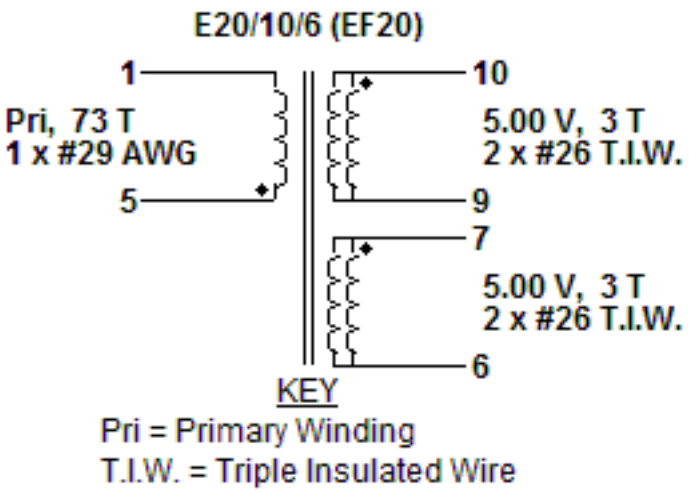
Click on the "Show me" icon to highlight relevant areas on the sample layout.

	Description	Show Me
1	Maximize source area for good heat-sinking	
2	Keep drain trace short	
3	The BYPASS pin capacitor should be located as close as possible to the BYPASS and SOURCE pins	
4	Keep noisy traces away from EN/UV pin	
5	Route bias winding currents back to the bulk cap	
6	Keep clamp loop short	
7	Connect Y capacitor to the B+ rail on the primary side for better surge immunity. Keep Y capacitor traces short	
8	The area of the loop connecting the secondary winding, the output diode and the output filter capacitor should be minimized	

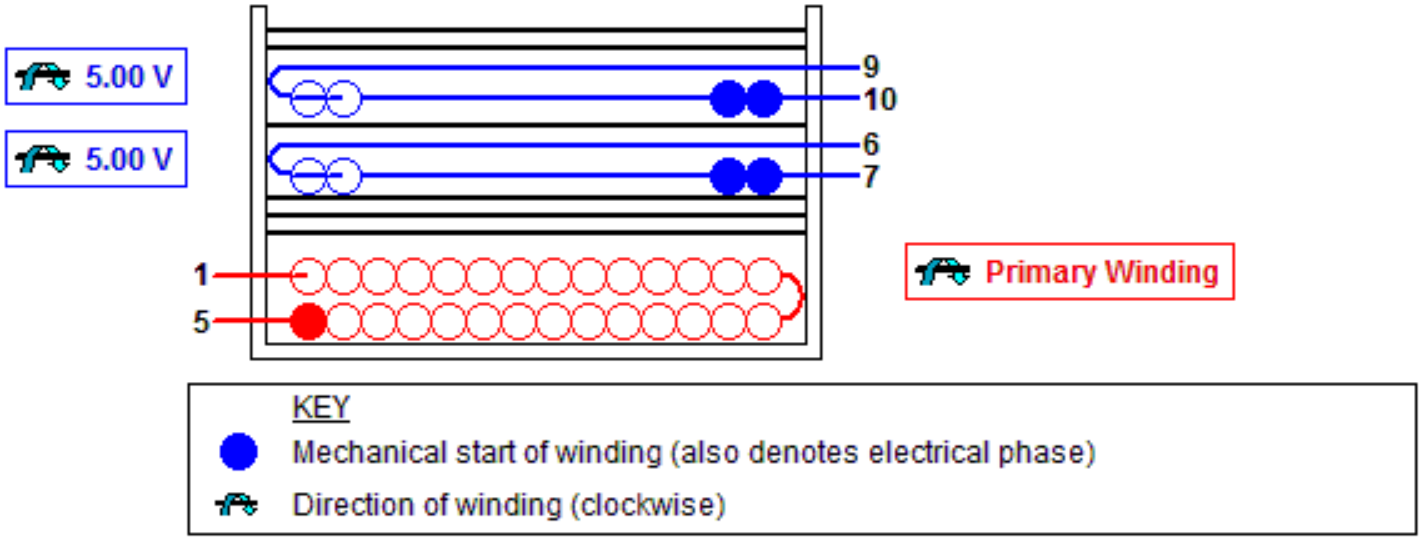
Bill Of Materials

Item #	Quantity	Part Ref	Value	Description	Mfg	Mfg Part Number
1	1	C1	22 µF	22 µF, 450 V, High Voltage Al Electrolytic, (35 mm x 10 mm)	United Chemi-Con	EPAG450VB22RM10X35LL
2	1	C2	22 µF	22 µF, 450 V, High Voltage Al Electrolytic, (25 mm x 16 mm)	United Chemi-Con	EKMX450VB22RM16X25LL
3	1	C3	0.47 nF	0.47 nF, 1 kV, High Voltage Ceramic	NIC Components Corp	NCD471K1KVY5F
4	1	C4	10 µF	10 µF, 16 V, Ceramic, X7R	TDK	C3216X7R1C106K
5	1	C5	2.2 nF	2.2 nF, 250 VAC, Ceramic, Y Class	TDK	CD12-E2GA222MYNS
6	2	C6, C7	560 pF	560 pF, 50 V, Ceramic, C0G	TDK	FK18C0G1H561J
7	2	C8, C10	1500 µF	1500 µF, 10 V, Electrolytic, Super Low ESR, 22 mΩ, (25 mm x 10 mm)	United Chemi-Con	EKZE100ELL152MJ25S
8	2	C9, C11	100 µF	100 µF, 10 V, Electrolytic, Low ESR, 500 mΩ, (11.5 mm x 5 mm)	United Chemi-Con	ELXZ100ELL101MEB5D
9	1	C12	100 nF	100 nF, 16 V, Ceramic, X7R	TDK	C1005X7R1C104K
10	4	D1, D2, D3, D4	1N4007	1000 V, 1 A, Standard Recovery, DO-41	Vishay	1N4007
11	1	D5	1N4937	600 V, 1 A, Fast Recovery, 200 ns, DO-41	Vishay	1N4937
12	2	D6, D7	1N5818	30 V, 1 A, Schottky, DO-41	Vishay	1N5818
13	1	F1	1 A	250 VAC, 1 A, Radial TR5, Time Lag Fuse	Littelfuse / Wickmann(R)	37411000410
14	1	L1	6 mH	6 mH, 1.6 A	Panasonic	ELF18N016
15	2	L2, L3	3.3 µH	3.3 µH, 2.66 A	Bourns Inc.	RL822-3R3K-RC
16	1	R1	200 kΩ	200 kΩ, 5 %, 0.5 W, Carbon Film	Generic	
17	1	R2	30 Ω	30 Ω, 5 %, 0.25 W, Carbon Film	Generic	
18	2	R3, R4	2.05 MΩ	2.05 MΩ, 1 %, 0.25 W, Metal Film	Generic	
19	2	R5, R6	18 Ω	18 Ω, 5 %, 0.25 W, Carbon Film	Generic	
20	1	R7	34 Ω	34 Ω, 1 %, 0.125 W, Metal Film	Generic	
21	1	R8	1 kΩ	1 kΩ, 5 %, 0.125 W, Carbon Film	Generic	
22	2	R9, R10	4.99 kΩ	4.99 kΩ, 1 %, 0.125 W, Metal Film	Generic	
23	1	T1	E20/10/6 (EF20)	NC-2H (Nicera) or Equivalent Core Material See Transformer Construction's Materials List for complete information	Epcos	B66311-G-X127
24	1	U1	TNY288PG	TinySwitch-4, TNY288PG, DIP-8	Power Integrations	TNY288PG
25	1	U2	LTV817A	Optocoupler LTV817A, 35 V, CTR 80 - 160 %, 4-DIP	Liteon	LTV817A
26	1	U3	TL431CLPM	2.495 V, Shunt Regulator IC, 2 %, TO-92	Texas Instruments	TL431CLPM
27	1	VR1	P6KE160A	160 V, 5 W, 5 %, DO-204AC, TVS	Vishay	P6KE160A
28	1			52 mm² area on Copper PCB. 2 oz (70 µm) thickness. Heatsink for use with Diode D6.	Custom	
29	1			52 mm² area on Copper PCB. 2 oz (70 µm) thickness. Heatsink for use with Device U1.	Custom	
30	1			52 mm² area on Copper PCB. 2 oz (70 µm) thickness. Heatsink for use with Diode D7.	Custom	

Electrical Diagram



Mechanical Diagram



Winding Instruction

Primary Winding

Start on pin(s) 5 and wind 73 turns (x 1 filar) of item [5]. in 2 layer(s) from left to right. 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 3 layers of tape, item [3], for insulation.

Secondary Winding

Start on pin(s) 7 and wind 3 turns (x 2 filar) of item [6]. Spread the winding evenly across entire bobbin. Wind in same rotational direction as primary winding. Finish this winding on pin(s) 6.

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

Start on pin(s) 10 and wind 3 turns (x 2 filar) of item [6]. Spread the winding evenly across entire bobbin. Wind in same rotational direction as primary winding. Finish this winding on pin(s) 9.

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), NC-2H (Nicera) or Equivalent, gapped for ALG of 106 nH/T²**
[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: 29 AWG, Solderable Double Coated**
[6]	**Triple Insulated Wire: 26 AWG**

Electrical Test Specifications

Parameter	*Condition*	*Spec*
Electrical Strength, VAC	**60 Hz 1 second, from pins 1,5 to pins 6,7,9,10.**	**3000**
Nominal Primary Inductance, µH	**Measured at 1 V pk-pk, typical switching frequency, between pin 1 to pin 5, with all other Windings open.**	**626**
Tolerance, ±%	**Tolerance of Primary Inductance**	**10.0**
Maximum Primary Leakage, µH	**Measured between Pin 1 to Pin 5, with all other Windings shorted.**	**18.79**

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.