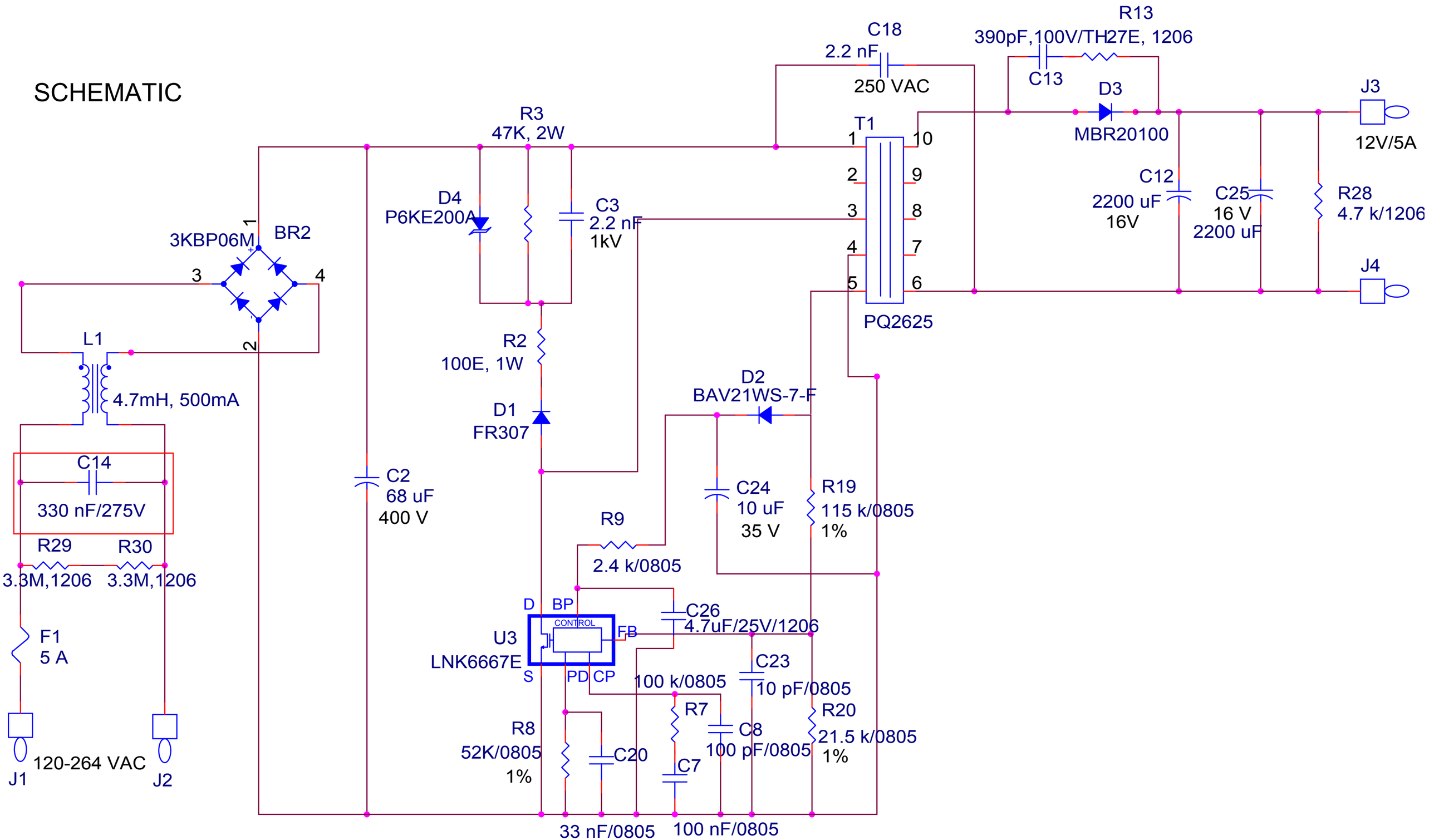
Title	***Engineering Design Proposal For 60 W Power Supply for Single Phase SMPS Using LNK6667E***
Specification	Input: 120 – 265VAC, 1 Phase, 2wire. Output: 12V/5A, ±5% CV
Application	
Author/Date/Rev	KU/11-9-2017/R1.0

SCHEMATIC


C18
2.2 nF
250 VAC
R13
390pF,100V/TH27E, 1206
C13
D3
MBR20100
J3
12V/5A
R3
47K, 2W
T1
1
2
3
4
5
10
9
8
7
6
PQ2625
C12
2200 uF
16V
C25
16 V
2200 uF
R28
4.7 k/1206
J4
D4
P6KE200A
C3
2.2 nF
1kV
BR2
3KBP06M
3
4
1
2
L1
4.7mH, 500mA
R2
100E, 1W
D1
FR307
D2
BAV21WS-7-F
C14
330 nF/275V
R29
R30
3.3M,1206
3.3M,1206
F1
5 A
J1
120-264 VAC
J2
C2
68 uF
400 V
C24
10 uF
35 V
R19
115 k/0805
1%
R9
2.4 k/0805
D
BP
CONTROL
FB
S
PD
CP
U3
LNK6667E
C26
4.7uF/25V/1206
C23
10 pF/0805
100 k/0805
R7
C8
100 pF/0805
R20
21.5 k/0805
1%
R8
52K/0805
1%
C20
C7
33 nF/0805
100 nF/0805

Bill Of Materials

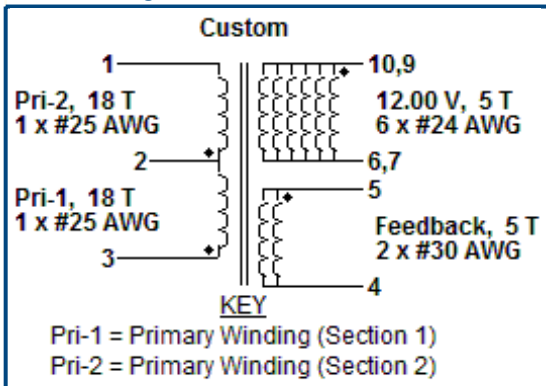
Item	Qty	Ref	Part
1	1	BR2	3KBP06M
2	1	C2	68 uF/400V
3	1	C18	2.2 nF,250V Y1 cap
4	1	C3	2.2 nF,1KV ceramic disc
5	1	C7	100 nF/0805
6	1	C8	100 pF/0805
7	2	C12,C25	2200 uF/16V
8	1	C13	390pF,100V/TH
9	1	C14	330 nF/275V, X cap
10	1	C20	33 nF/0805
11	1	C23	10 pF/0805
12	1	C24	10 uF/35V electrolytic TH cap
13	1	C26	4.7uF/25V/1206
14	1	D1	FR307
15	1	D2	BAV21WS-7-F
16	1	D3	MBR20100
17	1	D4	P6KE200A
18	1	F1	5A, 250V slow blow
19	1	L1	4.7mH, 500mA
20	1	R2	100E, 1W
21	1	R3	47K, 2W
22	1	R7	100 k/0805
23	1	R8	52K/0805
24	1	R9	2.4 k/0805
25	1	R13	27E, 1206
26	1	R19	115 k/0805
27	1	R20	21.5 k/0805
28	1	R28	4.7 k/1206
29	2	R29,R30	3.3M,1206
30	1	T1	PQ2625
31	1	U3	LNK6667E

ACDC_LinkSwitch-HP_050415; Rev.2.1; Copyright Power Integrations 2015	INPUT	INFO	OUTPUT	UNIT	ACDC_LinkSwitchHP_050415 Rev 2-1.xls: LinkSwitch-HP Flyback Continuous/Discontinuous Transformer Design Spreadsheet
ENTER APPLICATION VARIABLES					Customer
VACMIN	160		160	V	Minimum AC Input Voltage
VACMAX			265	V	Maximum AC Input Voltage
fL			50	Hz	AC Mains Frequency
VO			12	V	Output Voltage (main)
PO	60		60	W	Load Power
n			0.80		Efficiency Estimate
Z			0.50		Loss Allocation Factor
VB			10	V	Bias Voltage
tC			3	ms	Bridge Rectifier Conduction Time Estimate
CIN	68		68	uF	Input Filter Capacitor
Package	E/V		E/V		E and V Package Selected
Enclosure	Open Frame		Open Frame		Open Frame type enclosure
Heatsink	Metal		Metal		Metallic heatsink thermally connected to the exposed metal on the E-package
ENTER LinkSwitch-HP VARIABLES					
LinkSwitch-HP	**LNK6667E**		**LNK6667E**		Manual Device Selection
ILIMITMIN			2.418	A	Minimum Current limit
ILIMITMAX			2.782	A	Maximum current limit
ILIMITMIN_EXT			1.934	A	External Minimum Current limit
ILIMITMAX_EXT			2.226	A	External Maximum current limit
KI	Auto		0.800		Current limit reduction factor
Rpd			52.30	k-ohm	Program delay Resistor
Cpd			33.00	nF	Program delay Capacitor
Total programmed delay			0.38	sec	Total program delay
fS			132	kHz	LinkSwitch-HP Switching Frequency
fSmin			120	kHz	LinkSwitch-HP Minimum Switching Frequency
fSmax			136	kHz	LinkSwitch-HP Maximum Switching Frequency
KP			0.60		Ripple to Peak Current Ratio (0.4 < KP < 6.0)
VOR	90.00		90.00	V	Reflected Output Voltage
Voltage Sense					
VUVON			208.01	V	Undervoltage turn on
VUVOFF			85.00	V	Undervoltage turn off
VOV			954.40	V	Overvoltage threshold
FMAX_FULL_LOAD			136.00	kHz	Maximum switching frequency at full load
FMIN_FULL_LOAD			120.00	kHz	Minimum switching frequency at full load
TSAMPLE_FULL_LOAD			4.96	us	Minimum available Diode conduction time at full load. This should be greater than 2.5 us
TSAMPLE_LIGHT_LOAD			2.37	us	Minimum available Diode conduction time at light load. This should be greater than 1.4 us
VDS			2.20	V	LinkSwitch-HP on-state Drain to Source Voltage.
VD			0.50	V	Output Winding Diode Forward Voltage Drop
VDB			0.70	V	Bias Winding Diode Forward Voltage Drop
FEEDBACK SENSING SECTION					
RFB1			115.00	k-ohms	Feedback divider upper resistor
RFB2			21.50	k-ohms	Feedback divider lowerr resistor
ENTER TRANSFORMER CORE/CONSTRUCTION VARIABLES					
Select Core Size	**Custom**	Info	Custom		Manual Core Selected
Core			Custom		Selected Core
Custom Core	PQ2625				Enter name of custom core is applicable
AE	1.18		1.18	cm^2	Core Effective Cross Sectional Area
LE	5.55		5.55	cm	Core Effective Path Length
AL	6530		6530	nH/T^2	Ungapped Core Effective Inductance
BW	13.8		13.8	mm	Bobbin Physical Winding Width
M			0.00	mm	Safety Margin Width (Half the Primary to Secondary Creepage Distance)
L	1		1		Number of Primary Layers
NS			5		Number of Secondary Turns
DC INPUT VOLTAGE PARAMETERS					
VMIN			189	V	Minimum DC Input Voltage
VMAX			375	V	Maximum DC Input Voltage

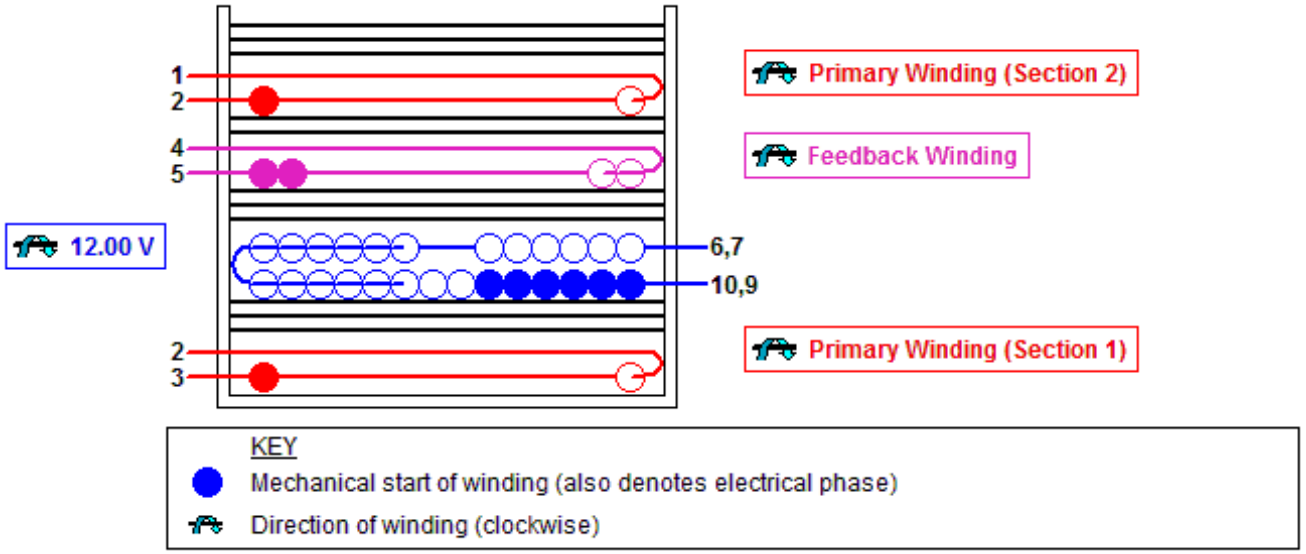
CURRENT WAVEFORM SHAPE PARAMETERS					
DMAX			0.33		Maximum Duty Cycle
IAVG			0.40	A	Average Primary Current
IP			1.74	A	Peak Primary Current
IR			1.05	A	Primary Ripple Current
IRMS			0.72	A	Primary RMS Current
TRANSFORMER PRIMARY DESIGN PARAMETERS					
LP_TYP			490	uH	Typical Primary Inductance
LP_TOL			10	%	Primary inductance Tolerance
NP			36		Primary Winding Number of Turns
NB			5		Bias Winding Number of Turns
ALG			378	nH/T^2	Gapped Core Effective Inductance
BM			2010	Gauss	Maximum Flux Density at PO, VMIN (BM<3100)
BP			2822	Gauss	Peak Flux Density (BP<3700)
BAC			603	Gauss	AC Flux Density for Core Loss Curves (0.5 X Peak to Peak)
ur			2444		Relative Permeability of Ungapped Core
LG			0.37	mm	Gap Length (Lg > 0.1 mm)
BWE			13.8	mm	Effective Bobbin Width
OD			0.38	mm	Maximum Primary Wire Diameter including insulation
INS			0.06	mm	Estimated Total Insulation Thickness (= 2 * film thickness)
DIA			0.32	mm	Bare conductor diameter
AWG			28	AWG	Primary Wire Gauge (Rounded to next smaller standard AWG value)
CM			161	Cmils	Bare conductor effective area in circular mils
CMA			225	Cmils/Amp	Primary Winding Current Capacity (200 < CMA < 500)
TRANSFORMER SECONDARY DESIGN PARAMETERS (SINGLE OUTPUT EQUIVALENT)					
Lumped parameters					
ISP			12.55	A	Peak Secondary Current
ISRMS			7.44	A	Secondary RMS Current
IO			5.00	A	Power Supply Output Current
IRIPPLE			5.50	A	Output Capacitor RMS Ripple Current
CMS			1487	Cmils	Secondary Bare Conductor minimum circular mils
AWGS			18	AWG	Secondary Wire Gauge (Rounded up to next larger standard AWG value)
DIAS			1.03	mm	Secondary Minimum Bare Conductor Diameter
ODS			2.76	mm	Secondary Maximum Outside Diameter for Triple Insulated Wire
INSS			0.87	mm	Maximum Secondary Insulation Wall Thickness
VOLTAGE STRESS PARAMETERS					
VDRAIN			584	V	Peak voltage across drain to source of Linkswitch-HP
PIVS			64	V	Output Rectifier Maximum Peak Inverse Voltage
PIVB			62	V	Bias Rectifier Maximum Peak Inverse Voltage
TRANSFORMER SECONDARY DESIGN PARAMETERS (MULTIPLE OUTPUTS)					
1st output					
VO1			12.00	V	Output Voltage
IO1			5.00	A	Output DC Current
PO1			60.00	W	Output Power
VD1			0.5	V	Output Diode Forward Voltage Drop
NS1			5.00		Output Winding Number of Turns
ISRMS1			7.436	A	Output Winding RMS Current
IRIPPLE1			5.50	A	Output Capacitor RMS Ripple Current
PIVS1			64	V	Output Rectifier Maximum Peak Inverse Voltage
CMS1			1487	Cmils	Output Winding Bare Conductor minimum circular mils
AWGS1			18	AWG	Wire Gauge (Rounded up to next larger standard AWG value)
DIAS1			1.03	mm	Minimum Bare Conductor Diameter
ODS1			2.76	mm	Maximum Outside Diameter for Triple Insulated Wire
2nd output					
VO2			0.00	V	Output Voltage
IO2			0.00	A	Output DC Current
PO2			0.00	W	Output Power
VD2			0.7	V	Output Diode Forward Voltage Drop
NS2			1.00		Output Winding Number of Turns
ISRMS2			0.000	A	Output Winding RMS Current
IRIPPLE2			0.00	A	Output Capacitor RMS Ripple Current
PIVS2			10	V	Output Rectifier Maximum Peak Inverse Voltage

CMS2			*0*	*Cmils*	*Output Winding Bare Conductor minimum circular mils*
AWGS2			*N/A*	*AWG*	*Wire Gauge (Rounded up to next larger standard AWG value)*
DIAS2			*N/A*	*mm*	*Minimum Bare Conductor Diameter*
ODS2			*N/A*	*mm*	*Maximum Outside Diameter for Triple Insulated Wire*
3rd output					
VO3			*0.00*	*V*	*Output Voltage*
IO3			*0.00*	*A*	*Output DC Current*
PO3			*0.00*	*W*	*Output Power*
VD3			*0.7*	*V*	*Output Diode Forward Voltage Drop*
NS3			*1.00*		*Output Winding Number of Turns*
ISRMS3			*0.000*	*A*	*Output Winding RMS Current*
IRIPPLE3			*0.00*	*A*	*Output Capacitor RMS Ripple Current*
PIVS3			*10*	*V*	*Output Rectifier Maximum Peak Inverse Voltage*
CMS3			*0*	*Cmils*	*Output Winding Bare Conductor minimum circular mils*
AWGS3			*N/A*	*AWG*	*Wire Gauge (Rounded up to next larger standard AWG value)*
DIAS3			*N/A*	*mm*	*Minimum Bare Conductor Diameter*
ODS3			*N/A*	*mm*	*Maximum Outside Diameter for Triple Insulated Wire*
Total power			*60*	*W*	*Total Power for Multi-output section*
Negative Output	*N/A*		*N/A*		*If negative output exists enter Output number; e.g. If VO2 is negative output, select 2*

Electrical Diagram



Mechanical Diagram



Winding Instruction

Primary Winding (Section 1)

Start on pin(s) 3 and wind 18 turns (x 1 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 3 layers of tape, item [3], for insulation.

Secondary Winding

Start on pin(s) 10,9 and wind 5 turns (x 6 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) 6,7.

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

Feedback Winding

Start on any (temp) pin on the secondary side and wind 5 turns (x 2 filar) of item [7]. Wind in same rotational direction as primary winding. Spread the winding evenly across entire bobbin. Finish this winding on pin(s) 4. Move end of wire from temp pin and terminate it on pin 5.

Add 2 layers of tape, item [3], for insulation.

Primary Winding (Section 2)

Start on pin(s) 2 and wind 18 turns (x 1 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. Pins 9 and 10 are electrically shorted to each other on the PCB via a copper trace.

2. Pins 6 and 7 are electrically shorted to each other on the PCB via a copper trace.

3. Use of a grounded flux-band around the core may improve the EMI performance.

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

Materials

Item	*Description*
[1]	Core: Custom, NC-2H (Nicera) or Equivalent, gapped for ALG of 378 nH/T²
[2]	Bobbin: Generic, 5 pri. + 5 sec.

[3]	Barrier Tape: Polyester film [1 mil (25 µm) base thickness], 13.80 mm wide
[4]	Varnish
[5]	Magnet Wire: 25 AWG, Solderable Double Coated
[6]	Magnet Wire: 24 AWG, Solderable Double Coated
[7]	Magnet Wire: 30 AWG, Solderable Double Coated

Electrical Test Specifications

Parameter	*Condition*	*Spec*
Electrical Strength, VAC	60 Hz 1 second, from pins 1,2,3,4,5 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 3, with all other Windings open.	490
Tolerance, ±%	Tolerance of Primary Inductance	10.0
Maximum Primary Leakage, µH	Measured between Pin 1 to Pin 3, with all other Windings shorted.	9.79

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.