ACDC_TOPSwitchJX_032514; Rev.1.6; Copyright Power Integrations 2014	***INPUT***	***INFO***	***OUTPUT***	***UNIT***	***TOP_JX_032514: TOPSwitch-JX Continuous/Discontinuous Flyback Transformer Design Spreadsheet***
ENTER APPLICATION VARIABLES					Design title
VACMIN	150			Volts	Minimum AC Input Voltage
VACMAX	265			Volts	Maximum AC Input Voltage
fL	50			Hertz	AC Mains Frequency
VO	5.00			Volts	Output Voltage (main)
PO_AVG	100.00			Watts	Average Output Power
PO_PEAK			100.00	Watts	Peak Output Power
Heatsink Type	External		External		Heatsink Type
Enclosure	Open Frame				Open Frame enclosure assumes sufficient airflow, while Adapter means a sealed enclosure.
n	0.80			%/100	Efficiency Estimate
Z	0.50				Loss allocation factor
VB	12			Volts	Bias Voltage - Verify that VB is > 8 V at no load and VMAX
tC	3.00			ms	Bridge Rectifier Conduction Time Estimate
CIN	180.0		180.0	uFarads	Input Filter Capacitor
ENTER TOPSWITCH-JX VARIABLES					
TOPSwitch-JX	TOP271E			Universal / Peak	115 Doubled/230V
Chosen Device		TOP271E	Power Out	177 W / 177 W	244W
KI	0.55				External Ilimit reduction factor (KI=1.0 for default ILIMIT, KI <1.0 for lower ILIMIT)
ILIMITMIN_EXT			2.644	Amps	Use 1% resistor in setting external ILIMIT
ILIMITMAX_EXT			3.906	Amps	Use 1% resistor in setting external ILIMIT. Includes tolerance over temperature. See Fig 37 of datasheet
Frequency (F)=132kHz, (H)=66kHz	H		H		Select 'H' for Half frequency - 66kHz, or 'F' for Full frequency - 132kHz
fS			66000	Hertz	TOPSwitch-JX Switching Frequency: Choose between 132 kHz and 66 kHz
fSmin			59400	Hertz	TOPSwitch-JX Minimum Switching Frequency
fSmax			72600	Hertz	TOPSwitch-JX Maximum Switching Frequency
High Line Operating Mode			FF		Full Frequency, Jitter enabled
VOR	120.00			Volts	Reflected Output Voltage
VDS			10.00	Volts	TOPSwitch on-state Drain to Source Voltage
VD	0.50			Volts	Output Winding Diode Forward Voltage Drop
VDB	0.70			Volts	Bias Winding Diode Forward Voltage Drop
KP	0.60				Ripple to Peak Current Ratio (0.3 < KRP < 1.0 : 1.0< KDP<6.0)
PROTECTION FEATURES					
LINE SENSING					V pin functionality
VUV_STARTUP			167.56	Volts	Minimum DC Bus Voltage at which the power supply will start-up
VOV_SHUTDOWN			804	Volts	Typical DC Bus Voltage at which power supply will shut-down (Max)

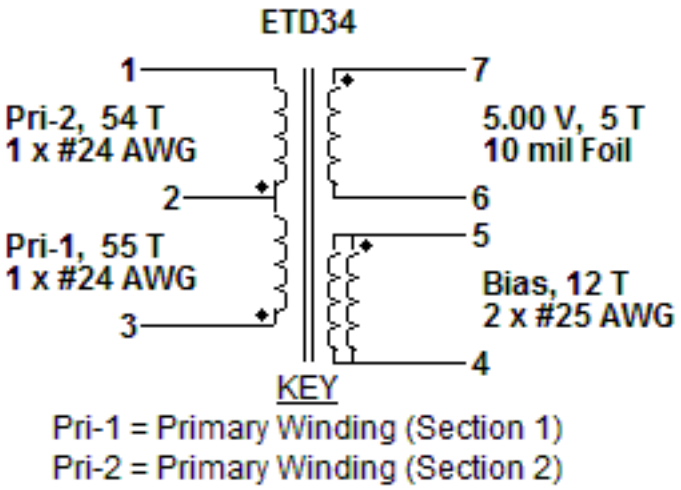
RLS			7.2	M-ohms	Use two standard, 3.6 M-Ohm, 5% resistors in series for line sense functionality.
OUTPUT OVERVOLTAGE					
VZ			22	Volts	Zener Diode rated voltage for Output Overvoltage shutdown protection
RZ			5.1	k-ohms	Output OVP resistor. For latching shutdown use 20 ohm resistor instead
OVERLOAD POWER LIMITING					X pin functionality
Overload Current Ratio at VMAX			1.20		Enter the desired margin to current limit at VMAX. A value of 1.2 indicates that the current limit should be 20% higher than peak primary current at VMAX
Overload Current Ratio at VMIN			1.12		Margin to current limit at low line.
ILIMIT_EXT_VMIN			2.36	A	Peak primary Current at VMIN
ILIMIT_EXT_VMAX			2.22	A	Peak Primary Current at VMAX
RIL			11.38	k-ohms	Current limit/Power Limiting resistor.
RPL			N/A	M-ohms	Resistor not required. Use RIL resistor only
ENTER TRANSFORMER CORE/CONSTRUCTION VARIABLES					
Core Type	ETD34		ETD34		Core Type
Custom Core (Optional)					If Custom core is used - Enter Part number here
Bobbin		ETD34_BOBBIN		P/N:	*
AE			0.9710	cm^2	Core Effective Cross Sectional Area
LE			7.8600	cm	Core Effective Path Length
AL			2780.0	nH/T^2	Ungapped Core Effective Inductance
BW			20.9	mm	Bobbin Physical Winding Width
M				mm	Safety Margin Width (Half the Primary to Secondary Creepage Distance)
L	3.00				Number of Primary Layers
NS			5		Number of Secondary Turns
DC INPUT VOLTAGE PARAMETERS					
VMIN			188	Volts	Minimum DC Input Voltage
VMAX			375	Volts	Maximum DC Input Voltage
CURRENT WAVEFORM SHAPE PARAMETERS					
DMAX			0.40		Maximum Duty Cycle (calculated at PO_PEAK)
IAVG			0.67	Amps	Average Primary Current (calculated at average output power)
IP			2.36	Amps	Peak Primary Current (calculated at Peak output power)
IR			1.42	Amps	Primary Ripple Current (calculated at average output power)
IRMS			1.08	Amps	Primary RMS Current (calculated at average output power)
TRANSFORMER PRIMARY DESIGN PARAMETERS					
LP			900	uHenries	Primary Inductance

LP Tolerance			10		Tolerance of Primary Inductance
NP			109		Primary Winding Number of Turns
NB			12		Bias Winding Number of Turns
ALG			76	nH/T^2	Gapped Core Effective Inductance
BM			2005	Gauss	Maximum Flux Density at PO, VMIN (BM<3000)
BP			3651	Gauss	Peak Flux Density (BP<4200) at ILIMITMAX and LP_MAX. Note: Recommended values for adapters and external power supplies <=3600 Gauss
BAC			601	Gauss	AC Flux Density for Core Loss Curves (0.5 X Peak to Peak)
ur			1791		Relative Permeability of Ungapped Core
LG			1.57	mm	Gap Length (Lg > 0.1 mm)
BWE			62.7	mm	Effective Bobbin Width
OD			0.57	mm	Maximum Primary Wire Diameter including insulation
INS			0.07	mm	Estimated Total Insulation Thickness (= 2 * film thickness)
DIA			0.51	mm	Bare conductor diameter
AWG			25	AWG	Primary Wire Gauge (Rounded to next smaller standard AWG value)
CM			323	Cmils	Bare conductor effective area in circular mils
CMA			299	Cmils/Amp	Primary Winding Current Capacity (200 < CMA < 500)
Primary Current Density (J)			6.65	Amps/mm^2	Primary Winding Current density (3.8 < J < 9.75)
TRANSFORMER SECONDARY DESIGN PARAMETERS (SINGLE OUTPUT EQUIVALENT)					
Lumped parameters					
ISP			51.48	Amps	Peak Secondary Current
ISRMS			28.69	Amps	Secondary RMS Current
IO_PEAK			20.00	Amps	Secondary Peak Output Current
IO			20.00	Amps	Average Power Supply Output Current
IRIPPLE			20.56	Amps	Output Capacitor RMS Ripple Current
CMS			5737	Cmils	Secondary Bare Conductor minimum circular mils
AWGS			12	AWG	Secondary Wire Gauge (Rounded up to next larger standard AWG value)
DIAS			2.05	mm	Secondary Minimum Bare Conductor Diameter
ODS			4.18	mm	Secondary Maximum Outside Diameter for Triple Insulated Wire
INSS			1.06	mm	Maximum Secondary Insulation Wall Thickness
VOLTAGE STRESS PARAMETERS					
VDRAIN			611	Volts	Maximum Drain Voltage Estimate (Includes Effect of Leakage Inductance)
PIVS			22	Volts	Output Rectifier Maximum Peak Inverse Voltage
PIVB			52	Volts	Bias Rectifier Maximum Peak Inverse Voltage

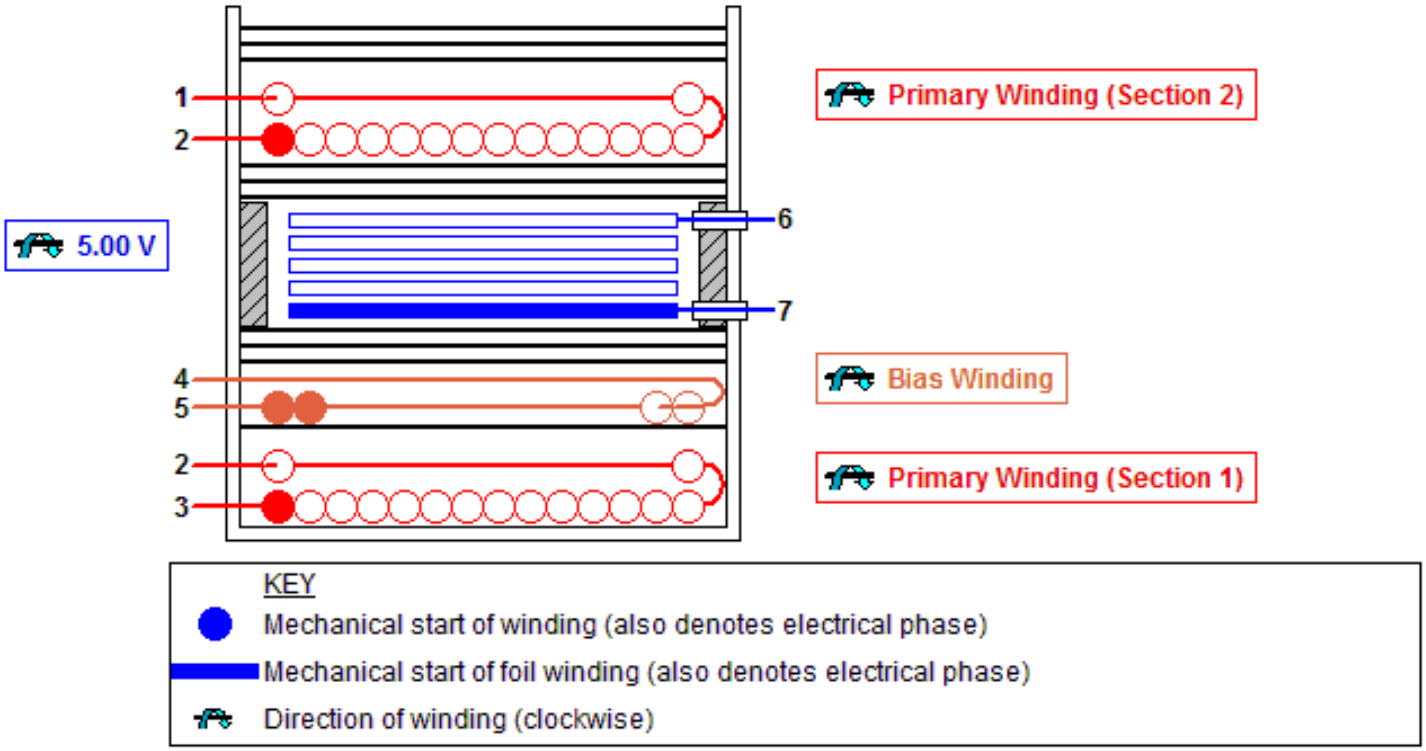
TRANSFORMER SECONDARY DESIGN PARAMETERS (MULTIPLE OUTPUTS)					
1st output					
VO1			5.00	Volts	Output Voltage
IO1_AVG			20.00	Amps	Average DC Output Current
PO1_AVG			100	Watts	Average Output Power
VD1			0.50	Volts	Output Diode Forward Voltage Drop
NS1			5.00		Output Winding Number of Turns
ISRMS1			28.686	Amps	Output Winding RMS Current
IRIPPLE1			20.56	Amps	Output Capacitor RMS Ripple Current
PIVS1			22	Volts	Output Rectifier Maximum Peak Inverse Voltage
CMS1			5737	Cmils	Output Winding Bare Conductor minimum circular mils
AWGS1			12	AWG	Wire Gauge (Rounded up to next larger standard AWG value)
DIAS1			2.05	mm	Minimum Bare Conductor Diameter
ODS1			4.18	mm	Maximum Outside Diameter for Triple Insulated Wire
2nd output					
VO2				Volts	Output Voltage
IO2_AVG				Amps	Average DC Output Current
PO2_AVG			0	Watts	Average Output Power
VD2			0.70	Volts	Output Diode Forward Voltage Drop
NS2			0.64		Output Winding Number of Turns
ISRMS2			0	Amps	Output Winding RMS Current
IRIPPLE2			0.00	Amps	Output Capacitor RMS Ripple Current
PIVS2			2	Volts	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				Volts	Output Voltage
IO3_AVG				Amps	Average DC Output Current
PO3_AVG			0	Watts	Average Output Power
VD3			0.70	Volts	Output Diode Forward Voltage Drop
NS3			0.64		Output Winding Number of Turns
ISRMS3			0	Amps	Output Winding RMS Current
IRIPPLE3			0.00	Amps	Output Capacitor RMS Ripple Current
PIVS3			2	Volts	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 Continuous Output Power			100	Watts	Total Continuous Output Power
Negative Output	N/A		N/A		If negative output exists enter Output number; e.g.: If VO2 is negative output, enter 2

Electrical Diagram



Mechanical Diagram



Winding Instruction

Primary Winding (Section 1)

Start on pin(s) 3 and wind 55 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) 2.

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

Bias Winding

Start on pin(s) 5 and wind 12 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 left side and 3 mm margin on the right side (to meet safety). Start on pin(s) 7 and wind 5 turns of item [7]. Wind in same rotational direction as primary winding. Finish this winding on pin(s) 6.

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

Primary Winding (Section 2)

Start on pin(s) 2 and wind 54 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.

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: ETD34, NC-2H (Nicera) or Equivalent, gapped for ALG of 76 nH/T²**
[2]	**Bobbin: Generic, 5 pri. + 2 sec.**
[3]	**Barrier Tape: Polyester film [1 mil (25 µm) base thickness], 20.90 mm wide**
[4]	**Varnish**
[5]	**Magnet Wire: 24 AWG, Solderable Double Coated**
[6]	**Magnet Wire: 25 AWG, Solderable Double Coated**
[7]	**Copper Foil: 10 mil thick, 14.90 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 6,7.**	**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.**	**900**
Tolerance, ±%	**Tolerance of Primary Inductance**	**10.0**
Maximum Primary Leakage, µH	**Measured between Pin 1 to Pin 3, with all other Windings shorted.**	**13.50**

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.

Transformer Construction Parameters

Var	*Value*	*Units*	*Description*
Core Type	**ETD34**		Core Type
Core Material	**NC-2H (Nicera) or Equivalent**		Core Material
Bobbin Reference	**Generic, 5 pri. + 2 sec.**		Bobbin Reference
Bobbin Orientation	**Horizontal**		Bobbin type
Primary Pins	**5**		Number of Primary pins used
Secondary Pins	**2**		Number of Secondary pins used
LP	**900**	µH	Nominal Primary Inductance
ML	**0.00**	mm	Safety Margin on Left Width
MR	**0.00**	mm	Safety Margin on Right Width
LG	**1.570**	mm	Estimated Gap Length

Bias Variables

Var	*Value*	*Units*	*Description*
NB	**12**		Bias Winding Number of Turns
Wire Size	**25**	AWG	Wire size of Bias windings
Winding Type	**Bifilar (x2)**		Wire type of Bias windings
Layers	**0.58**		Bias Winding Layers
Start Pin(s)	**5**		Starting pin(s) for Bias winding
Termination Pin(s)	**4**		Termination pin(s) for Bias winding

Primary Winding Section 1

Var	*Value*	*Units*	*Description*
NP1	**55**		Rounded (Integer) Number of Primary winding turns in the first section of primary
Wire Size	**24**	AWG	Wire size of primary winding
Winding Type	**Single (x1)**		Primary winding number of parallel wire strands
L	**1.49**		Primary Number of Layers
Start Pin(s)	**3**		Starting pin(s) for first section of primary winding
Termination Pin(s)	**2**		Termination pin(s) for first section of primary winding

Primary Winding Section 2

Var	*Value*	*Units*	*Description*
NP2	**54**		Rounded (Integer) Number of Primary winding turns in the second section of primary
Wire Size	**24**	AWG	Wire size of primary winding
Winding Type	**Single (x1)**		Primary winding number of parallel wire strands
L2	**1.46**		Primary Number of Layers in 2nd split winding
Start Pin(s)	**2**		Starting pin(s) for the second section of primary winding
Termination Pin(s)	**1**		Termination pin(s) for the second section of primary winding

Output 1

Var	*Value*	*Units*	*Description*
VO	**5.00**	V	Output Voltage
IO	**20.00**	A	Output Current
VOUT_ACTUAL	**5.00**	V	Actual Output Voltage
NS	**5**		Secondary Number of Turns
Foil Thickness	**10**	mil	Wire size of secondary winding

Winding Type	**Foil**		Output winding number of parallel strands
L_S_OUT	**5.00**		Secondary Output Winding Layers
Start Pin(s)	**7**		Starting pin(s) for Output winding
Termination Pin(s)	**6**		Termination pin(s) for Output winding