A	B	C	D	E	F
ACDC_TOPSwitchJX_011911; Rev.1.4; Copyright Power Integrations 2010	**INPUT**	**INFO**	**OUTPUT**	**UNIT**	**TOP_JX_011911: TOPSwitch-JX Continuous/Discontinuous Flyback Transformer Design Spreadsheet**
ENTER APPLICATION VARIABLES					**Design title**
VACMIN	195			Volts	Minimum AC Input Voltage
VACMAX	265			Volts	Maximum AC Input Voltage
fL	50			Hertz	AC Mains Frequency
VO	24.00			Volts	Output Voltage (main)
PO_AVG	26.00			Watts	Average Output Power
PO_PEAK	26.00		26.00	Watts	Peak Output Power
Heatsink Type	**PCB**		PCB		Heatsink Type
Enclosure	**Adapter**				Open Frame enclosure assume sufficienct airflow while adapter means a sealed enclosure.
n	0.85			%/100	Efficiency Estimate
Z	0.50				Loss allocation factor
VB	15			Volts	Bias Voltage - Verify that VB is > 8 V at no load and VMAX
tC	3.00			ms	Bridge Rectifier Conduction Time Estimate
CIN	33.0		33	uFarads	Input Filter Capacitor
ENTER TOPSWITCH-JX VARIABLES					
TOPSwitch-JX	**TOP266K**			Universal / Peak	115 Doubled/230V
Chosen Device		*TOP266K*	Power Out	36 W / 58 W	36W
KI	0.29				External Ilimit reduction factor (KI=1.0 for default ILIMIT, KI <1.0 for lower ILIMIT)
ILIMITMIN_EXT			0.688	Amps	Use 1% resistor in setting external ILIMIT
ILIMITMAX_EXT			0.791	Amps	Use 1% resistor in setting external ILIMIT
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	100.00			Volts	Reflected Output Voltage
VDS			10	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			218	Volts	Minimum DC Bus Voltage at which the power supply will start-up
VOV_SHUTDOWN			1050	Volts	Typical DC Bus Voltage at which power supply will shut-down (Max)
RLS			9.4	M-ohms	Use two standard, 4.7 M-Ohm, 5% resistors in series for line sense functionality.
OUTPUT OVERVOLTAGE					
VZ			27	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			1.2		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			1.17		Margin to current limit at low line.
ILIMIT_EXT_VMIN			0.59	A	Peak primary Current at VMIN
ILIMIT_EXT_VMAX			0.57	A	Peak Primary Current at VMAX
RIL			18.30	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	**Auto**		EF25		Core Type
Core		*EF25*		*P/N:*	PC40EF25-Z
Bobbin		*EF25_BOBBIN*		*P/N:*	*
AE			0.518	cm^2	Core Effective Cross Sectional Area
LE			5.78	cm	Core Effective Path Length
AL			2000	nH/T^2	Ungapped Core Effective Inductance
BW			15.6	mm	Bobbin Physical Winding Width
M	0.00			mm	Safety Margin Width (Half the Primary to Secondary Creepage Distance)
L	3.00				Number of Primary Layers
NS			36		Number of Secondary Turns
DC INPUT VOLTAGE PARAMETERS					
VMIN			251	Volts	Minimum DC Input Voltage
VMAX			375	Volts	Maximum DC Input Voltage
CURRENT WAVEFORM SHAPE PARAMETERS					
DMAX			0.29		Maximum Duty Cycle (calculated at PO_PEAK)
IAVG			0.12	Amps	Average Primary Current (calculated at average output power)
IP			0.59	Amps	Peak Primary Current (calculated at Peak output power)
IR			0.36	Amps	Primary Ripple Current (calculated at average output power)
IRMS			0.23	Amps	Primary RMS Current (calculated at average output power)
TRANSFORMER PRIMARY DESIGN PARAMETERS					
LP			3577	uHenries	Primary Inductance
LP Tolerance			10		Tolerance of Primary Inductance
NP			147		Primary Winding Number of Turns
NB			23		Bias Winding Number of Turns
ALG			166	nH/T^2	Gapped Core Effective Inductance
BM			2789	Gauss	Maximum Flux Density at PO, VMIN (BM<3000)
BP			4089	Gauss	Peak Flux Density (BP<4200) at ILIMITMAX and LP_MAX. Note: Recommended values for adapters and external power supplies <=3600 Gauss
BAC			837	Gauss	AC Flux Density for Core Loss Curves (0.5 X Peak to Peak)

A	B	C	D	E	F
ur			1776		Relative Permeability of Ungapped Core
LG			0.36	mm	Gap Length (Lg > 0.1 mm)
BWE			46.8	mm	Effective Bobbin Width
OD			0.32	mm	Maximum Primary Wire Diameter including insulation
INS			0.05	mm	Estimated Total Insulation Thickness (= 2 * film thickness)
DIA			0.26	mm	Bare conductor diameter
AWG			30	AWG	Primary Wire Gauge (Rounded to next smaller standard AWG value)
CM			102	Cmils	Bare conductor effective area in circular mils
CMA			438	Cmils/Amp	Primary Winding Current Capacity (200 < CMA < 500)
Primary Current Density (J)			4.57	Amps/mm^2	Primary Winding Current density (3.8 < J < 9.75)
TRANSFORMER SECONDARY DESIGN PARAMETERS (SINGLE OUTPUT EQUIVALENT)					
Lumped parameters					
ISP			2.42	Amps	Peak Secondary Current
ISRMS			1.47	Amps	Secondary RMS Current
IO_PEAK			1.08	Amps	Secondary Peak Output Current
IO			1.08	Amps	Average Power Supply Output Current
IRIPPLE			0.99	Amps	Output Capacitor RMS Ripple Current
CMS			294	Cmils	Secondary Bare Conductor minimum circular mils
AWGS			25	AWG	Secondary Wire Gauge (Rounded up to next larger standard AWG value)
DIAS			0.46	mm	Secondary Minimum Bare Conductor Diameter
ODS			0.43	mm	Secondary Maximum Outside Diameter for Triple Insulated Wire
INSS			-0.01	mm	Maximum Secondary Insulation Wall Thickness
VOLTAGE STRESS PARAMETERS					
VDRAIN			575	Volts	Maximum Drain Voltage Estimate (Includes Effect of Leakage Inductance)
PIVS			116	Volts	Output Rectifier Maximum Peak Inverse Voltage
PIVB			74	Volts	Bias Rectifier Maximum Peak Inverse Voltage
TRANSFORMER SECONDARY DESIGN PARAMETERS (MULTIPLE OUTPUTS)					
1st output					
VO1	24.00		24	Volts	Output Voltage
IO1_AVG	1.10		1.10	Amps	Average DC Output Current
PO1_AVG			26.40	Watts	Average Output Power
VD1			0.5	Volts	Output Diode Forward Voltage Drop
NS1			36.00		Output Winding Number of Turns
ISRMS1			1.491	Amps	Output Winding RMS Current
IRIPPLE1			1.01	Amps	Output Capacitor RMS Ripple Current
PIVS1			116	Volts	Output Rectifier Maximum Peak Inverse Voltage
CMS1			298	Cmils	Output Winding Bare Conductor minimum circular mils
AWGS1			25	AWG	Wire Gauge (Rounded up to next larger standard AWG value)
DIAS1			0.46	mm	Minimum Bare Conductor Diameter
ODS1			0.43	mm	Maximum Outside Diameter for Triple Insulated Wire
2nd output					
VO2				Volts	Output Voltage
IO2_AVG				Amps	Average DC Output Current
PO2_AVG			0.00	Watts	Average Output Power
VD2			0.7	Volts	Output Diode Forward Voltage Drop
NS2			1.03		Output Winding Number of Turns
ISRMS2			0.000	Amps	Output Winding RMS Current
IRIPPLE2			0.00	Amps	Output Capacitor RMS Ripple Current
PIVS2			3	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			0.00	Watts	Average Output Power
VD3			0.7	Volts	Output Diode Forward Voltage Drop
NS3			1.03		Output Winding Number of Turns
ISRMS3			0.000	Amps	Output Winding RMS Current
IRIPPLE3			0.00	Amps	Output Capacitor RMS Ripple Current
PIVS3			3	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			26.4	Watts	Total Continuous Output Power
Negative Output			N/A		If negative output exists enter Output number; eg: If VO2 is negative output, enter 2

Transformer Construction Parameters

Var	Value	Units	Description
Core Type	EF25		Core Type
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
LP	3219	µH	Primary Inductance
ML	0.00	mm	Safety Margin on Left Width
MR	0.00	mm	Safety Margin on Right Width
LG	0.360	mm	Estimated Gap Length

Bias Variables

Var	Value	Units	Description
NB	24		Bias Winding Number of Turns
Wire Size	30	AWG	Wire size of Bias windings
Winding Type	Bifilar (x2)		Wire type of Bias windings
Layers	0.91		Bias Winding Layers
Start Pin(s)	1		Starting pin(s) for Bias winding (Manual Input)
Termination Pin(s)	2		Termination pin(s) for Bias winding (Manual Input)

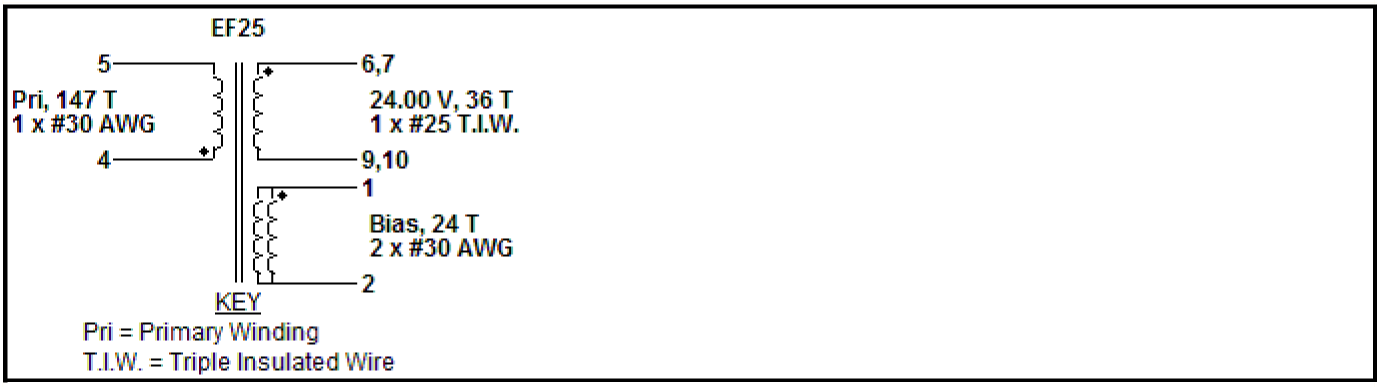
Primary Winding Section 1

Var	Value	Units	Description
NP1	147		Rounded (Integer) Number of Primary winding turns in the first section of primary
Wire Size	30	AWG	Wire size of primary winding
Winding Type	Single (x1)		Primary winding number of parallel wire strands
L	2.78		Primary Number of Layers
Start Pin(s)	4		Starting pin(s) for first section of primary winding (Manual Input)
Termination Pin(s)	5		Termination pin(s) for first section of primary winding (Manual Input)

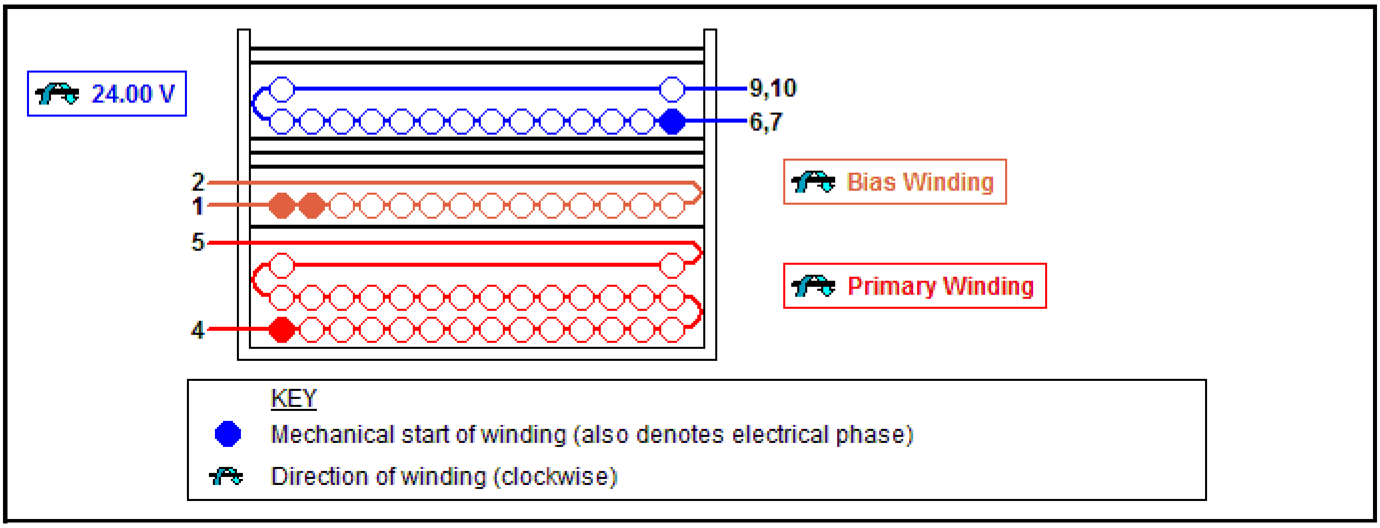
Output 1

Var	Value	Units	Description
VO	24.00	V	Output Voltage
IO	1.10	A	Output Current
VOUT_ACTUAL	24.00	V	Actual Output Voltage
NS	36		Secondary Number of Turns
Wire Size	25	AWG	Wire size of secondary winding
Winding Type	Single (x1)		Output winding number of parallel strands
L_S_OUT	1.50		Secondary Output Winding Layers
Start Pin(s)	6,7		Starting pin(s) for Output winding (Manual Input)
Termination Pin(s)	9,10		Termination pin(s) for Output winding (Manual Input)

Electrical Diagram



Mechanical Diagram



Winding Instruction

Primary Winding

Start on pin(s) 4 and wind 147 turns (x 1 filar) of item [5] in 3 layer(s) from left to right. At the end of 1st layer, continue to wind the next layer from right to left. At the end of 2nd layer, continue to wind the next layer from left to right. On the final layer, spread the winding evenly across entire bobbin. Finish this winding on pin(s) 5.

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

Bias Winding

Start on pin(s) 1 and wind 24 turns (x 2 filar) of item [5]. Wind in same rotational direction as primary winding. 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) 6,7 and wind 36 turns (x 1 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) 9,10.

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

2. Pins 9 and 10 are electrically shorted to each other on the PCB via a copper trace.

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

Materials

Item	*Description*
[1]	Core: EF25, NC-2H (Nicera) or Equivalent, gapped for ALG of 166 nH/t²
[2]	Bobbin: Generic, 5 pri. + 5 sec.
[3]	Barrier Tape: Polyester film [1 mil (25 µm) base thickness], 15.60 mm wide
[4]	Varnish
[5]	Magnet Wire: 30 AWG, Solderable Double Coated
[6]	Triple Insulated Wire: 25 AWG

Electrical Test Specifications

Parameter	*Condition*	*Spec*
Electrical Strength, VAC	**60 Hz 1 second, from pins 1,2,4,5 to pins 6,7,9,10.**	**3000**
Nominal Primary Inductance, μH	**Measured at 1 V pk-pk, typical switching frequency, between pin 4 to pin 5, with all other Windings open.**	**3577**
Tolerance, ±%	**Tolerance of Primary Inductance**	**10.0**
Maximum Primary Leakage, μH	**Measured between Pin 4 to Pin 5, with all other Windings shorted.**	**107.3**

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.

The products and applications illustrated herein (including circuits external to the products and transformer construction) may be covered by one or more U.S. and foreign patents or potentially by pending U.S. and foreign patent applications assigned to Power Integrations. A complete list of Power Integrations' patents may be found at www.powerint.com.