FLY-BACK CONVERTER DESIGN AND CIRCUIT

Circuit diagram and design calculations are given to convert 12V DC to fixed 12.5V DC and 18V isolated DC. Fly-back converter works in self oscillating mode.

Ferrite core selected: E 25/10/6

Core Cross section Area Ae = 39.5mm^2

A_L = 1600 nH (from core datasheet)

Max flux density Bmax = 0.35 Wb/m^2

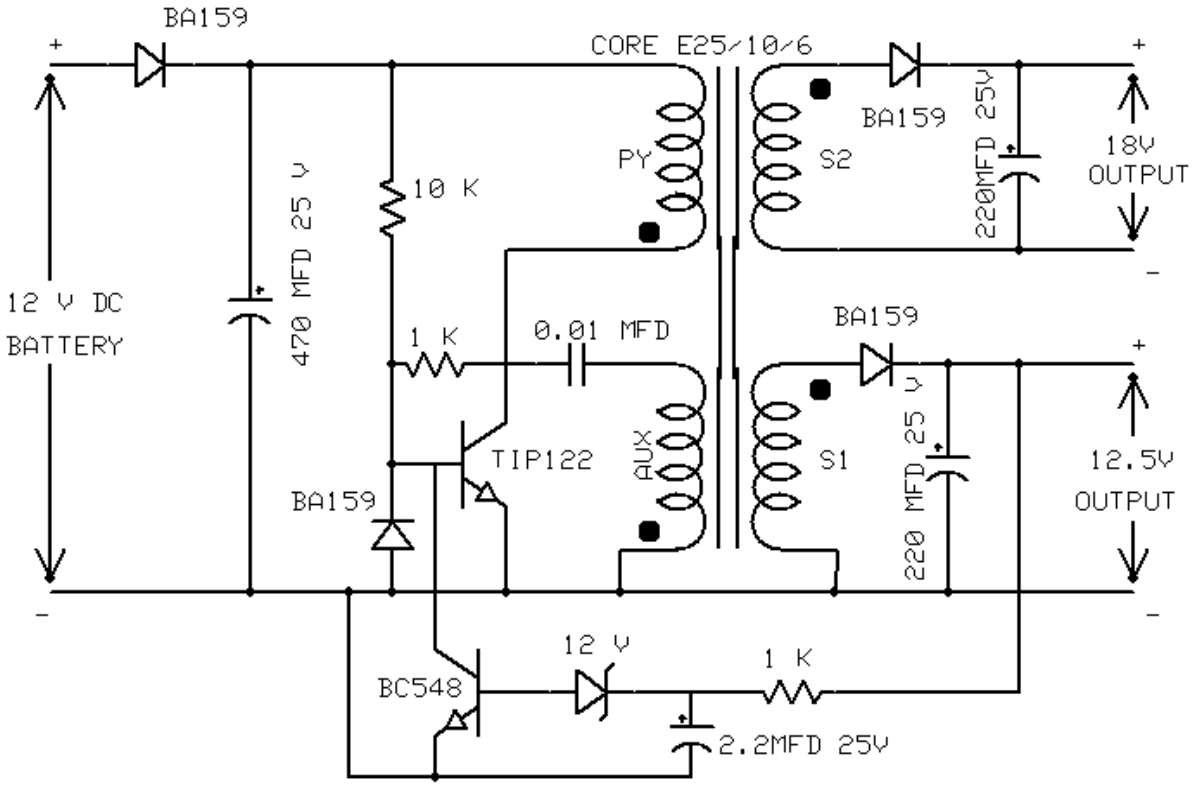
Minimum input voltage Vmin = (10.5V – 0.7V(Diode) – 0.7V(Transistor)) = 9.1 V

Minimum switching frequency Fs = 25 KHz

Maximum duty cycle Dmax = 0.5 (for self oscillating mode)

Total output power Po = 5 W

Efficiency η = 0.7



Peak Primary Current Ippk = (2 x Po) / (η x Dmax x Vmin)

= (2 x 5) / (0.7 x 0.5 x9.1)

= 3.1 A

Primary RMS Current Irms = Ippk x √(Dmax / 3)

= 3.1 x √(0.5 / 3)

= 1.26 A (Wire selected 24 SWG enameled copper wire)

Primary Inductance Lp = (Vmin x Dmax) / (Fs x Ippk)

= (9.1 x 0.5) / (25000 x 3.1)

= 58 µH

No. of Primary turns Np = (Vmin x Dmax) / (Fs x Bmax x Ae)

= (9.1 x 0.5) / (25000 x 0.35 x 39.5 x 10^{-6})

No. of Primary turns **Np = 13 Turns**

Auxiliary winding voltage = 6 V

No. of Aux Turns = (6/9.1) x 13 = **9 Turns (30 SWG enameled wire)**

(This 12.5 V may be used to supply KA3525 in push-pull converter to give constant gate drive to MOSFETs when input voltage decreases due to load)

S1 winding voltage = 12.5V + 1 V = 13.5 V

S1 winding Turns = (13.5/9.1) x 13 = **19 Turns (30 SWG enameled wire)**

(This isolated 18 V may be used to supply TLP250 drivers driving IGBTs)

S2 winding voltage = 18 V + 1 V = 19 V

S2 winding Turns = (19/9.1) x 13 = **27 Turns (30 SWG PVC insulated wire)**

(**Note: Winding directions are important in self oscillating Fly-back converter)**

Air gap required Lg = μ_o x Ae ((Np^2/Lp) – (1/A_L))

$= 4 \times \pi \times 10^{-7} \times 39.5 \times 10^{-6} \times ((13^2/58 \times 10^{-6}) - (1/1600 \times 10^{-9}))$

$= 0.1$ mm

Per limb air gap = 0.1 / 2 = 0.05 mm