APPLICATION NOTE

TURBOSWITCH™ IN AN ASYNCHRONOUS MOTOR DRIVE

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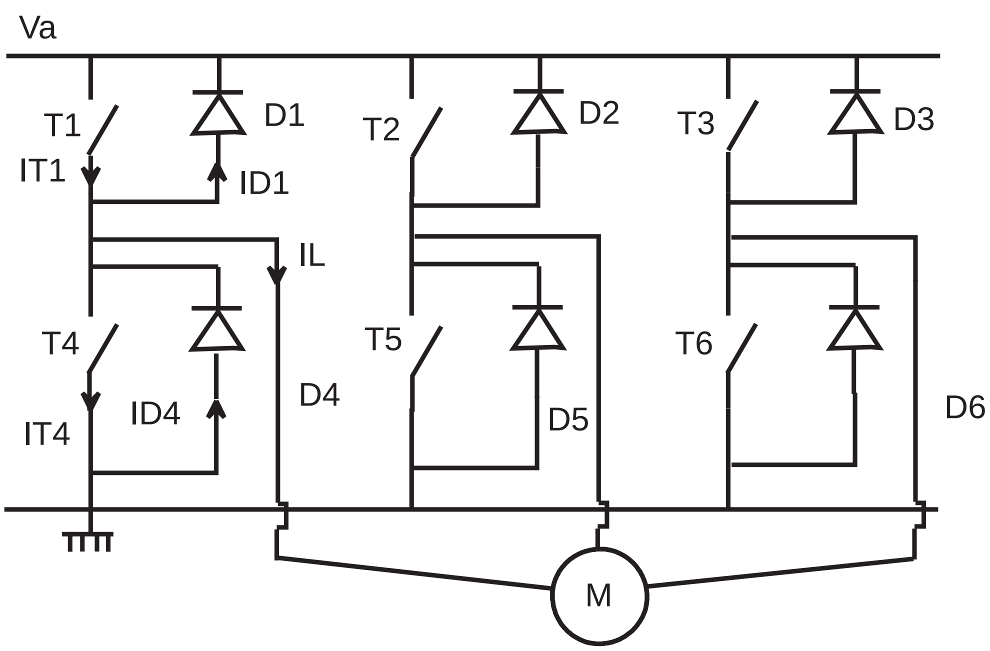
The basic schematic of an asynchronous motor drive is shown in fig.1

Fig.1 : Basic schematic of an asynchronous motor drive.



The positive sinusoidal current IL is built with the commutation of T1 and the complementary freewheel diode D4, whereas the negative sinusoidal part is built with T4 and D1 (Fig.2).

Switching losses (Turn-ON and Turn-OFF) in the diode are negligible with regard to conduction losses.

The average current in the diode can be estimated by making the hypothesis (with a big safety margine) that the current in the diode is a half sine wave (Fig.2). This hypothesis is valid when the motor works in braking mode.

With this hypothesis we find :

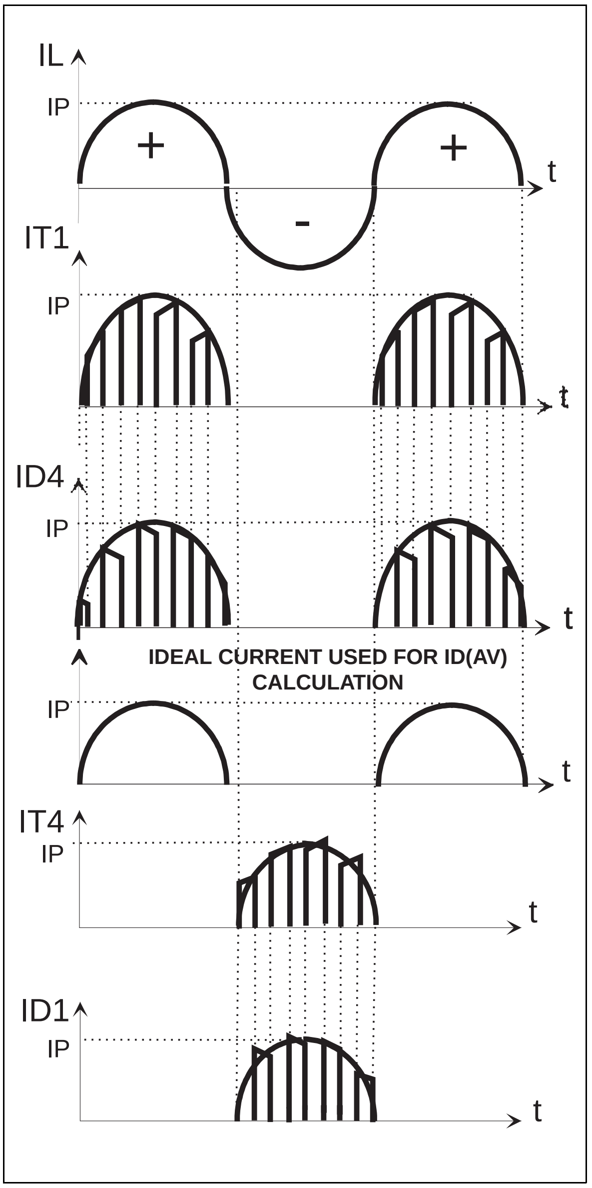
$$I_{F(AV)} = 0.43 \frac{P}{Va \cos \varphi} \qquad (1)$$

Example : P=1kVA Va=400V $\cos\varphi = 0.95$

$$\longrightarrow \quad I_{F(AV)} = 1.1A$$

Even with this pessimistic hypothesis, we find the average current in each diode is low (< 1.1A for a 1kVA motor).

Fig. 2 : Current waveform in T1, D1, T4 ,D4



When a transistor switches ON with a high dI/dt, (typically 250A/µs) the recovery current of the complementary diode flows in this transistor, inducing turn ON losses in the transistor : PON.

In the following bar graph we compare the losses due to six STTA506D with six STTB506D, in the following conditions :

P=1kVA Va=400V Fc=10kHZ di/dt=200A/µs

Notations :

POFF : turn OFF losses in the six diodes
POND : turn ON losses in the six diodes

PCOND :conduction losses of the six diodes (calculated with (1))

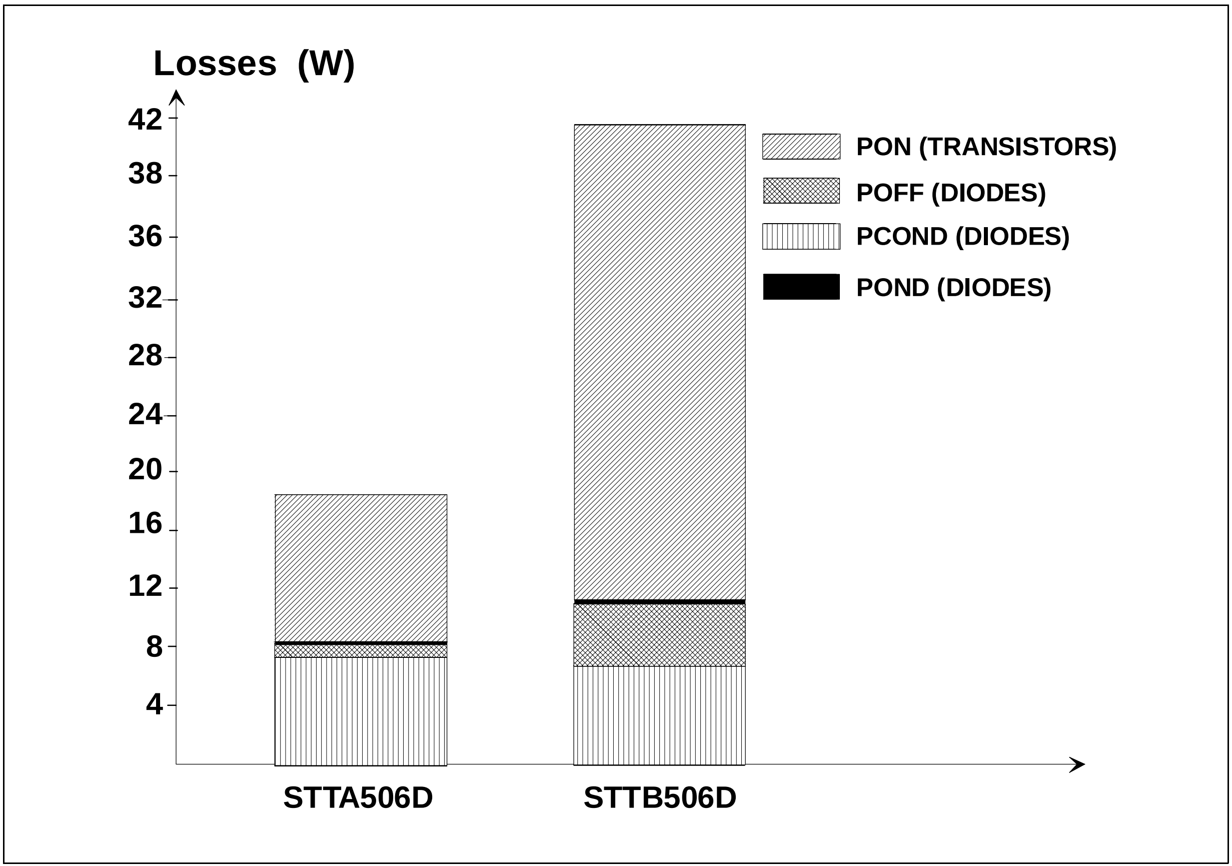
PON : turn ON losses in the six transistors due to the recovery current of the diodes

Fc : switching frequency

STTA506D :
TURBOSWITCH^{TM}600V diode Family A
VFmax (5A, 125°C)=1.5V
trr max (1A, 50A/µs, 30V)=50ns

STTA506D :
TURBOSWITCH^{TM}600V diode Family B
VFmax (5A, 125°C)=1.3V
trr max (1A, 50A/µs, 30V)=95ns

Fig. 3 : Comparison of losses between 6 STTA506D and 6 STTB506D



This bar graph shows that it is important to use the faster diode to reduce the total losses in the diodes and in the transistors.

CONCLUSIONS

The switching losses are negligible in comparison to conduction losses.

Average current in each diode is low (Ex.: < 1.1A for 1kVA). A very fast diode has to be used to reduce Turn ON losses in the transistor for switching frequency higher than 1kHZ. The TURBOSWITCH^{TM} family A 600V and 1200V is suited to Asynchronous Motor control working respectively on Single-phase (220V) and 3 - phase - (380V) mains.