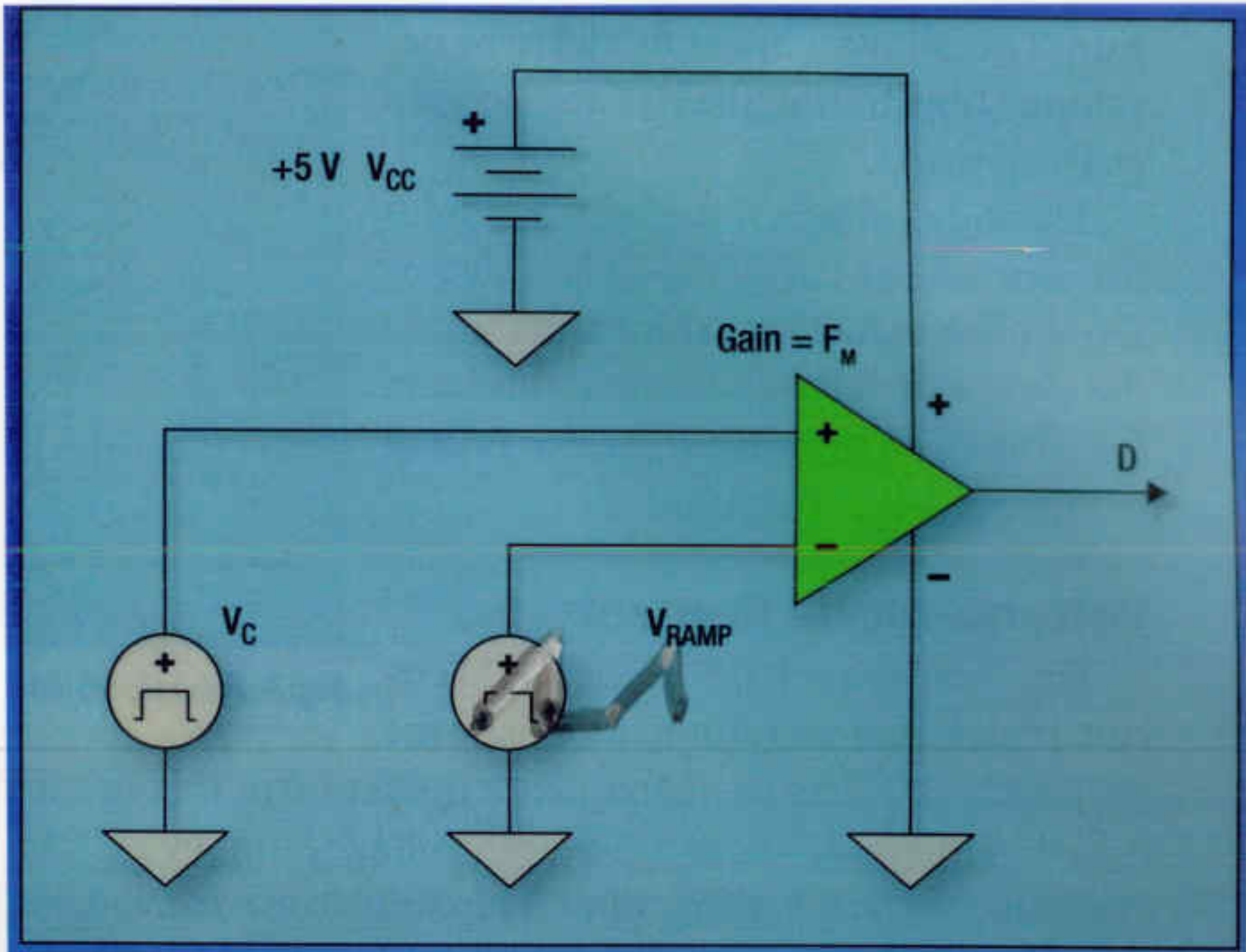
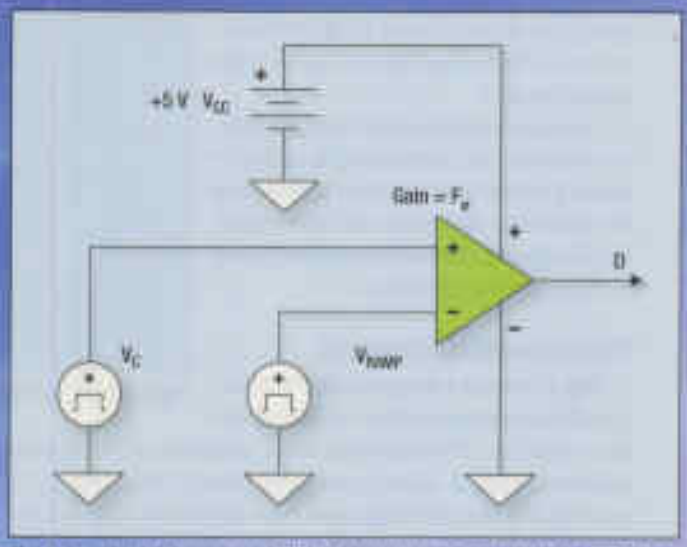


Fig. 1. *A typical voltage-mode PWM circuit uses a control voltage fed to a comparator to modulate the duty cycle of the regulator output stage.*



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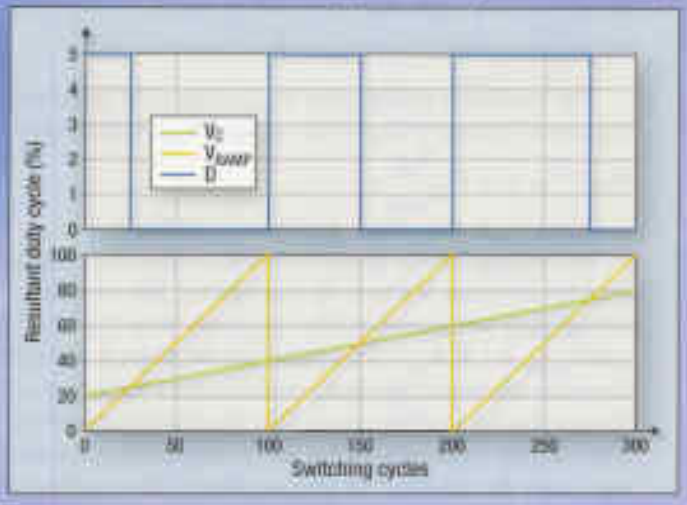

Fig. 2. *For fixed-frequency operation, an increase in the control voltage causes an increase in the duty cycle of the output of the Fig. 1 circuit.*

tronics industry. Papers on the topic that have been written at the graduate or Ph.D. level are hard to understand, and many of the concepts introduced are difficult to put into practical use. This article aims to demystify current-mode control, and cut through the myths and misconceptions of its operation.

For current-mode control, there are three factors to consider. First, an ideal current-mode converter is only dependent on the dc or average inductor current. The inner current loop turns the inductor into a voltage-controlled current source, effectively removing the inductor from the outer voltage control loop at dc and low frequency.

The second factor to consider is modulator gain, which is dependent on the effective slope of the ramp presented to the modulating comparator input. Each operating mode will have a unique characteristic equation for the modulator gain.

The third consideration is slope compensation. The requirement for slope compensation is dependent on the relationship of the average current to the value of current at the time the sample is taken. For fixed-frequency operation, if the sampled current were equal to the average current, there would be no requirement for slope compensation.

Current-Mode Operation

Whether the current-mode converter uses the peak, valley, average or sample-and-hold method is of secondary importance to the operation of the current loop. As long as the dc current is sampled, current-mode operation is maintained. The current-loop gain splits the complex-conjugate pole of the output filter into two real poles, so that the characteristics of the output filter are set by the capacitor and load resistor. Only when the impedance of the output inductor equals the current-loop gain does the inductor pole reappear at higher frequencies.

To understand how this works, voltage-mode operation is first examined. The basic concept of pulse-width modulation (PWM) is used to establish the criteria for the modulator

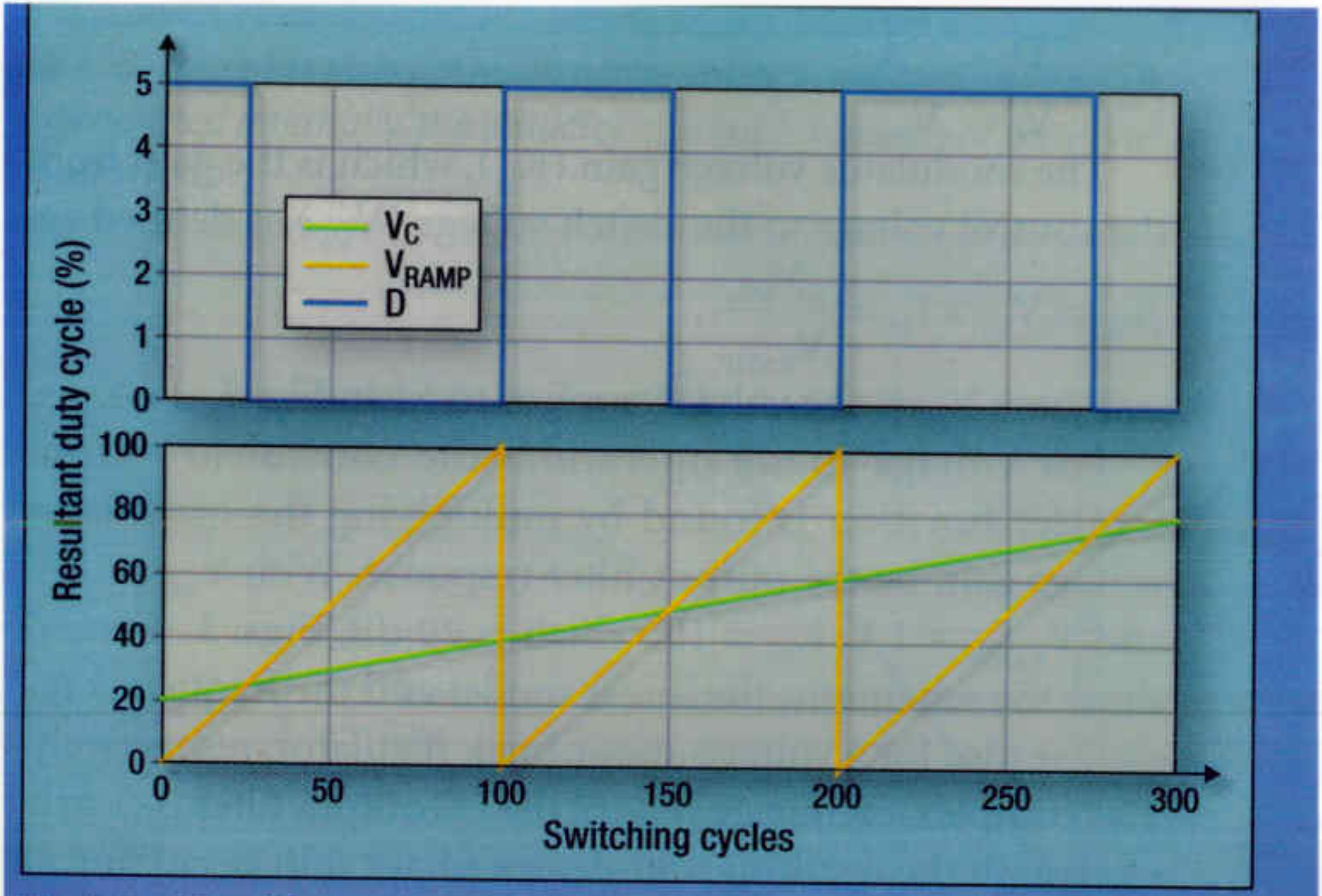

Fig. 2. *For fixed-frequency operation, an increase in the control voltage causes an increase in the duty cycle of the output of the Fig. 1 circuit.*

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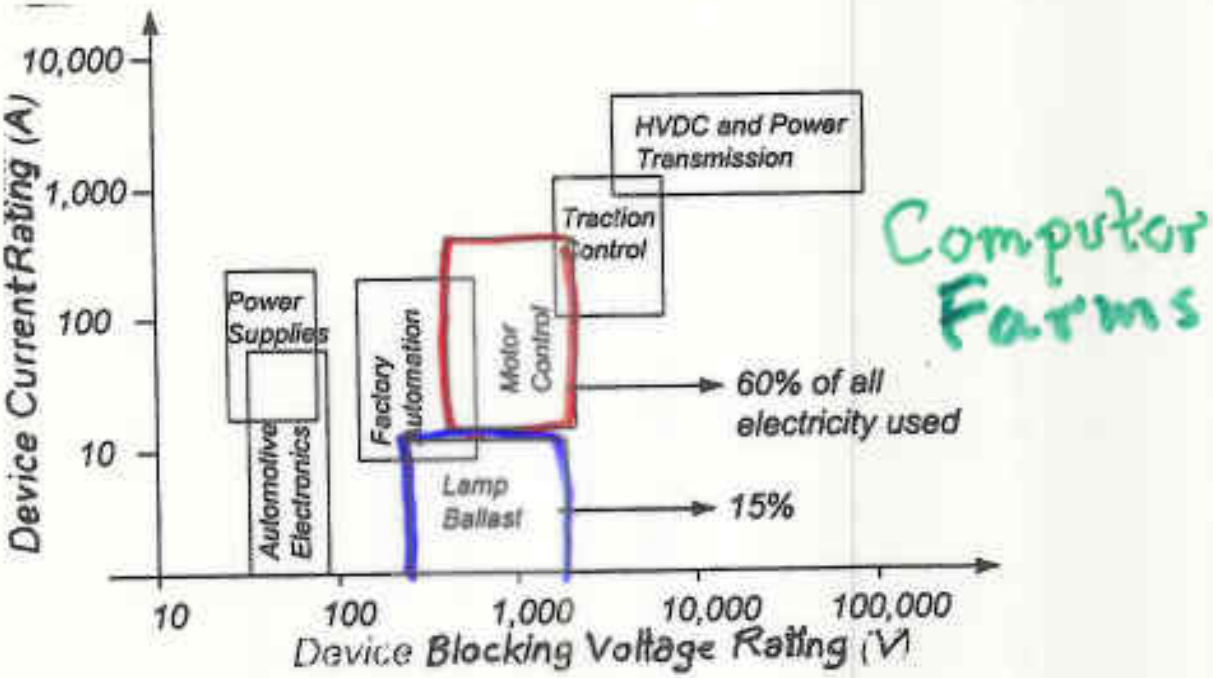
TWO MAJOR APPLICATIONS OF POWER ELECTRONICS: INDUSTRIAL ELECTRONICS

A. Overview

POWER ELECTRONICS USES NEW SWITCHING CIRCUIT TOPOLOGIES TO MAKE SMALLER, LOWER WEIGHT AND HIGHER EFFICIENCY POWER SUPPLIES. These supplies for the first time are available at variable frequencies need for applications in motor drive and in lighting which together constitute over 75% of electricity use.

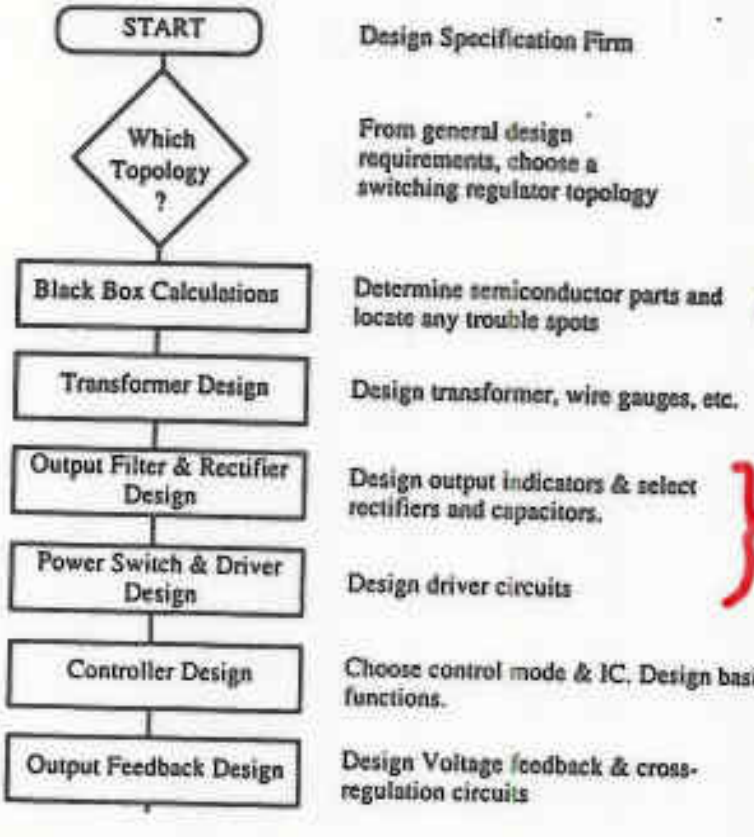


Clearly, we have different applications that place specific requirements on the solid state ~witches. Only as advances in solid state switches occurred could these new applications become cost effective. Switch technology is an enabling one for new applications. Two issues are enabling: electrical peformance and cost.

B. Improved Motor Control

Web notes L4

Building-block Approach to Switching Power Supply Design



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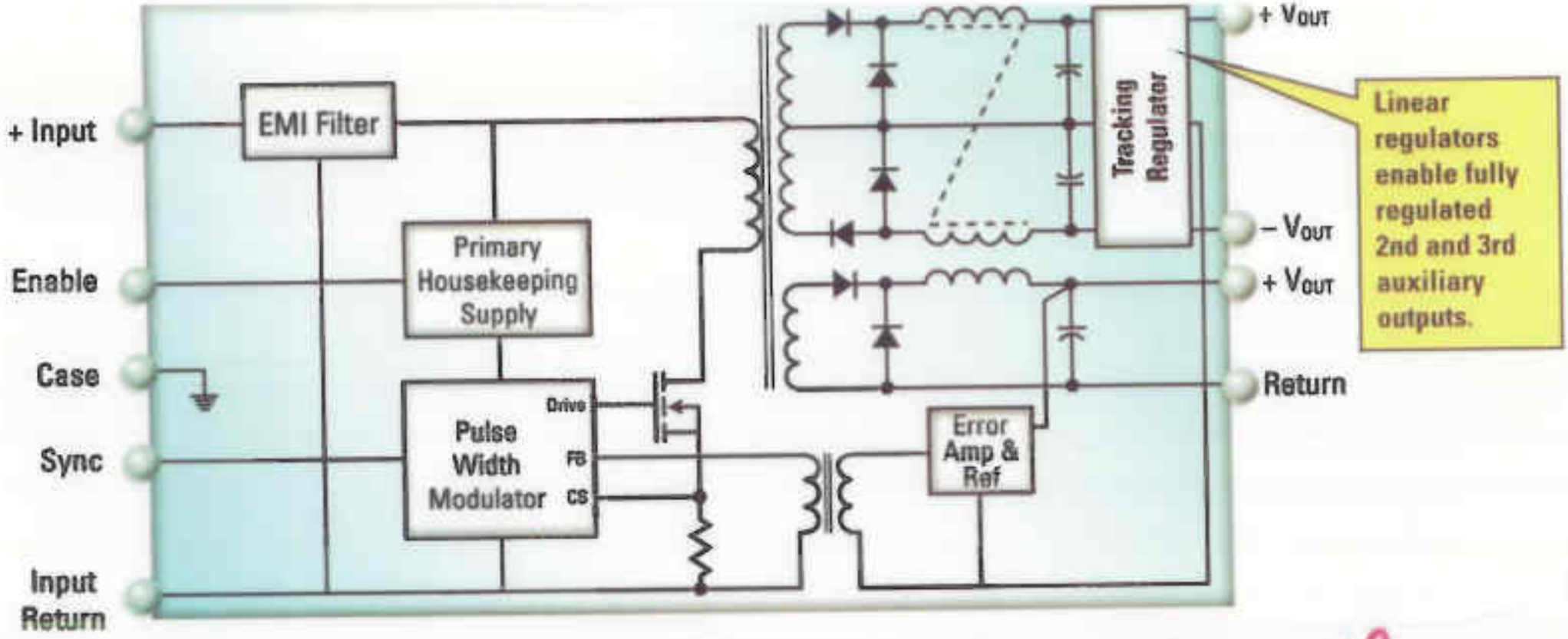
From the above approach we need to pick a starting point. We will focus next of the output filter design in the remainder of this lecture and in lectures 5 and 6.

E. BASIC TOPOLOGIES OF PASSIVE L-C FILTERS

We will use L-C filters both to remove v_{ac} signals lost to conversion and to avoid kvl and kil law violations from the switching.

1. DC OUTPUT REACTIVE FILTER (L-C). This places a series L between two voltages sources v_{in} and v_{out}. It also removes or reduces the switch signal at f_s and passes only dc if designed properly. lets look at the two



Talk #1 Chip Choices

Talk #2 Details