

The introduction of new, faster, CMOS techniques has given rise to a considerable increase in the number of available logic families. Understandably, this may cause confusion on the part of designers and users of logic circuits. Up until a few years, 3 families were commonly known: the CMOS 4xxx series; the TTL 74xx series; and the 74LSxx low-power Schottky series. TTL and LS chips are mutually interchangeable, but TTL consumes considerably more current at the same switching speed. The 4xxx series is about 10 times slower than the TTL family, but is more economic as regards current consumption. In many cases, TTL chips are no longer considered suitable for new design.

The new HC and HCT CMOS families are just as fast as TTL and LSTTL, and have a greatly reduced current consumption. HCT chips can work in LS based circuits, provided they are not driven from TTL or LS. This is because of the differently defined switching levels. It is, however, possible to use HCT for driving HC. With this in mind, it is possible to replace the LS family by the HC family. This is preferable since the HC family offers the highest noise immunity.

Figure 1 shows the current consumption of a HCMOS gate as a function of the input voltage. The shaded area represents the (logic high) output voltage of an LS chip. From this, two conclusions can be drawn. Firstly, the noise margin is very narrow: the HC gate sees 2.7 V as a logic high level already. Secondly, the current consumption of the gate is a few mA higher than necessary. Although usable in practice, driving HC with LS is, therefore, not recommended.

Another new logic family was recently introduced: FACT (Fairchild Advanced CMOS Technology), also referred to as ACL (Advanced CMOS Logic) by other chip manufacturers. There are 2 versions: AC and ACT. ACT, like HCT, is fully LS compatible, while AC gives the same drive problems as HC. Both series are typically 2 to 3 times as fast as LS or HC.

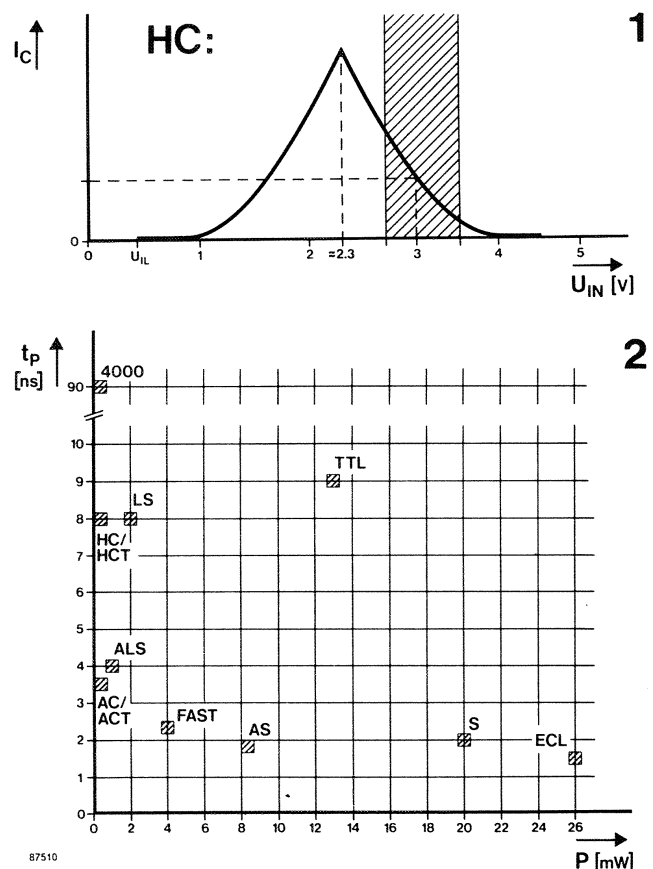
Figure 2 shows the correlation between the propagation delay,  $t_p$ , and the power consumption,  $P$ , of various logic families. It will be noted that the modern CMOS families are almost as fast as the ECL series, hitherto renowned for its unbeatable speed. It is expected, therefore, that a CMOS equivalent will soon be available for ECL, and that ECL will gradually become obsolete.

Replacing bipolar chips in existing circuits with CMOS types is not very useful if relatively high frequencies are involved. Finally, a rule of thumb for working with chips of different families in a single circuit: *HCT can replace LS, unless driven by LS.*

For further reading:

*RCA CMOS Databook*

*Fairchild FACT Logic Data Book*



The fast spreading incorporation of CMOS, HC and HCT chips has created a need for voltage regulators with a very low internal drop to enable

powering CMOS-based equipment from a set of batteries delivering 6 V. The recently introduced Types LP2951 and LP2950 from National Semiconductor