

Introduction to Advanced BiCMOS Logic Products

INTRODUCTION

A true BiCMOS process, such as QUBiC, gives an integrated circuit designer a great deal of freedom in approaching the optimum requirement goals of the systems designer. The input and output structures can be designed in such a way that they are optimum from a system standpoint. Noise characteristics such as ground bounce and EMI can be minimized without performance degradation. Speed can be maximized towards that of the fastest bipolar devices and power dissipation can be greatly reduced below even pure CMOS approaches.

QUBiC PROCESS

The QUBiC BiCMOS process from Philips Semiconductors is truly a major achievement in semiconductor technology. With equal emphasis on optimization of the CMOS as well as the bipolar devices, the process offers 13 GHz bipolar NPN devices, one micron NMOS devices, and one micron NMOS devices, altogether with three layers of Al/Cu interconnect. The devices are completely free of latch-up, have high ESD protection, show no electromigration, and, due to low bipolar reverse leakage currents and lightly doped CMOS drains, show extremely long reliability lifetimes. From an electrical performance standpoint, the results of this process are clear.

AC CHARACTERISTICS

Speed is almost always the first characteristic considered when choosing an integrated circuit. With bus frequencies constantly on

the rise and the demand for greater data transfer rates continuously increasing, bus interface devices have become especially sensitive to speed. Figure 2 clearly shows the advantage of Philips Semiconductors Advanced BiCMOS interface devices.

Supply voltage and temperature stability is also an important feature of a product. Figure 1 shows the propagation delay versus change in the supply voltage and change in temperature. The temperature stability of devices is again a by-product of the process technology. A bipolar transistor generally becomes faster with increases in temperature and a CMOS transistor slows down with an increase in temperature. The effective addition of these two phenomena create the desirable feature in the figure. The flat slope of these curves essentially removes the variables of power supply and temperature from a designer's list of considerations. It also ensures that the device will be more resistant to unexpected system deviations from supply and temperature norms.

INPUT CHARACTERISTICS

The Advanced BiCMOS bus interface devices have TTL input electrical levels, guaranteeing switching between 0.8V and 2.0V (typically 1.6V) in order to be driven by TTL or CMOS level buses. They have the desired CMOS characteristic of very low input current loading and input capacitance in the 3-4pF range. This feature ensures that the devices lightly load the buses they are interfacing to, allowing the devices to be driven from lower output current devices on a local bus, thus allowing higher system integration.

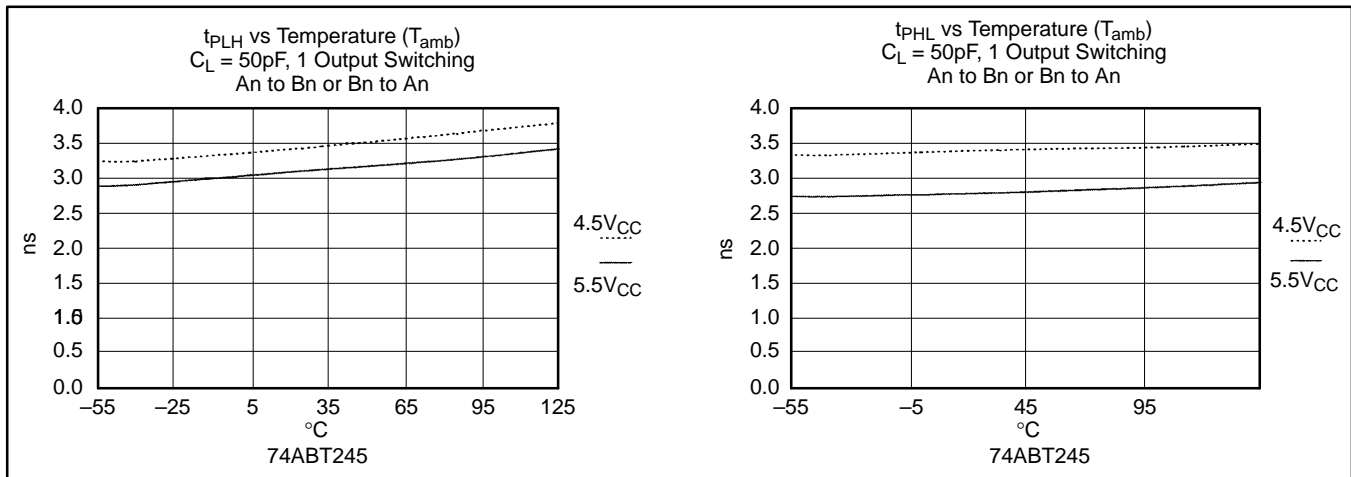


Figure 1. Propagation Delay

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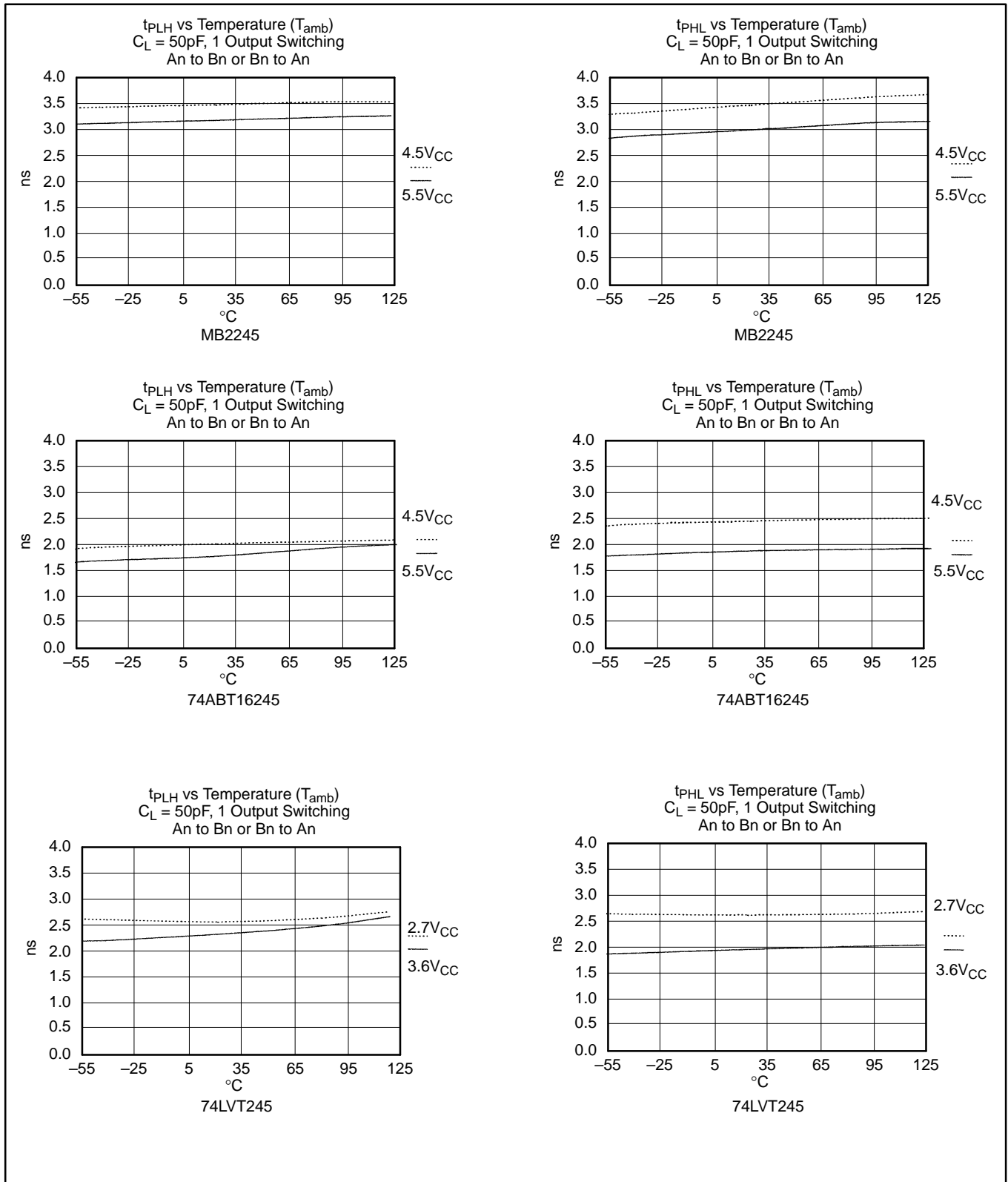


Figure 1. (Continued) Propagation Delay

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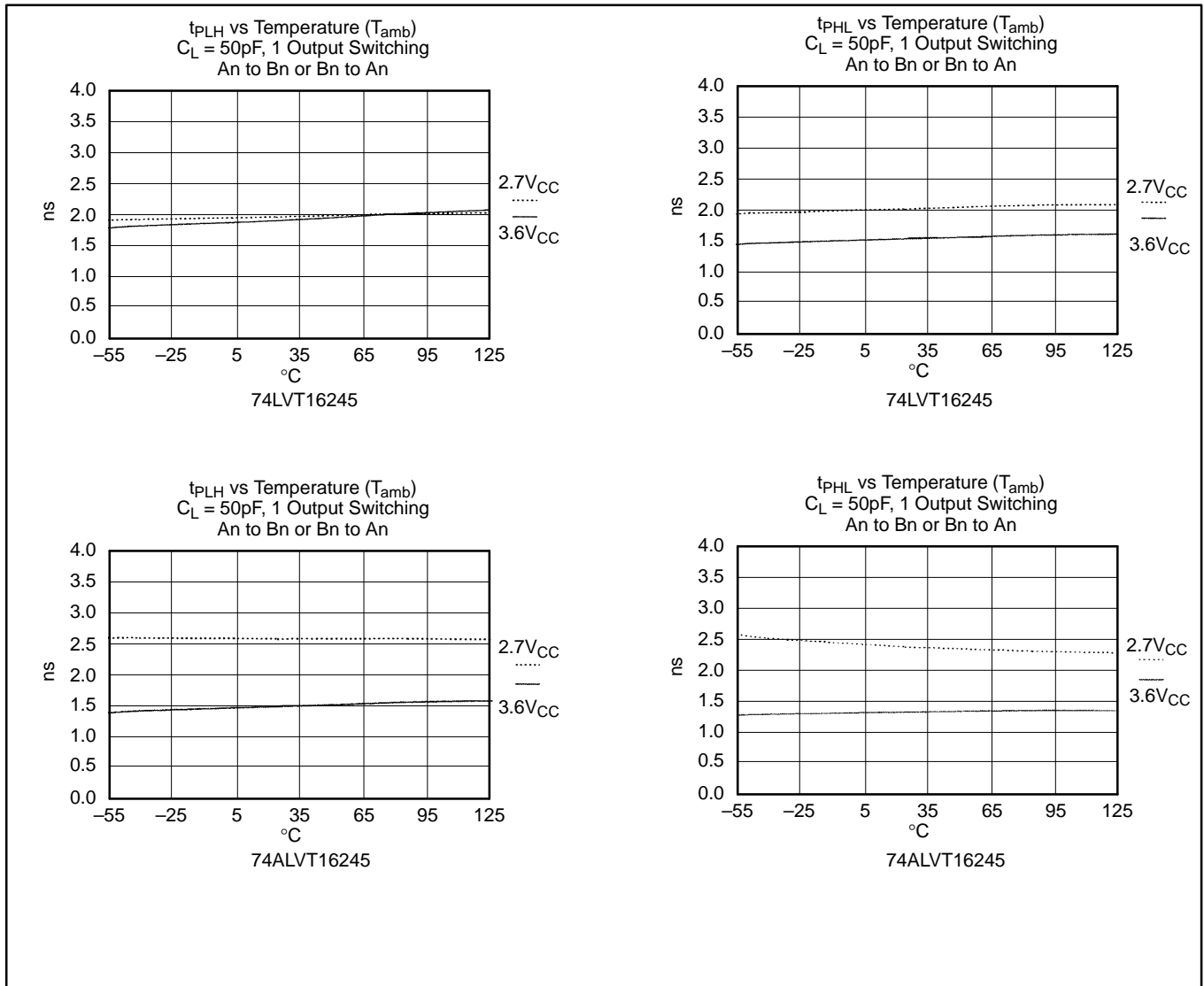


Figure 1. (Continued) Propagation Delay

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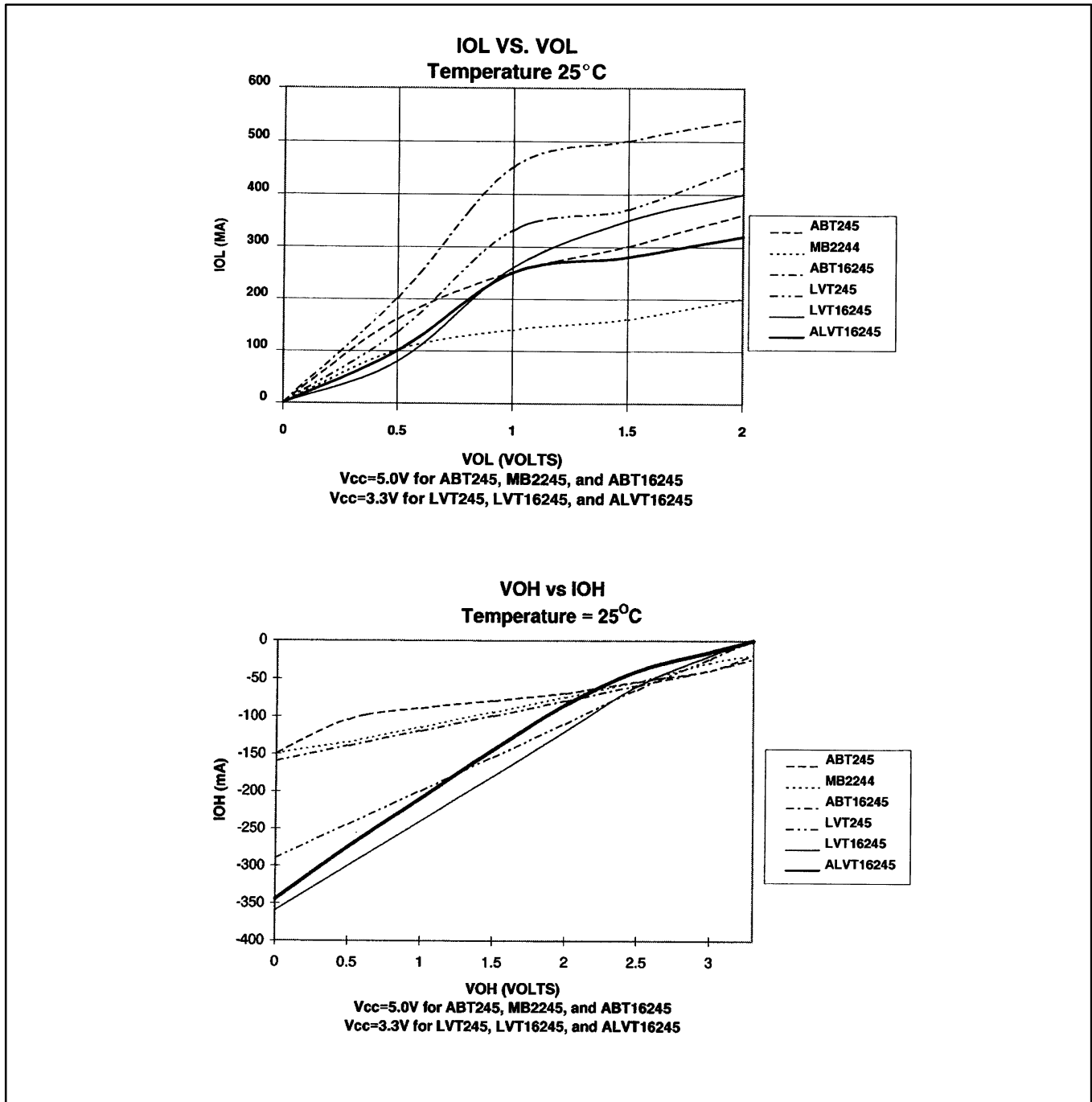


Figure 2. Voltage vs Current

OUTPUT CHARACTERISTICS

The BiCMOS interface devices have TTL output electrical levels, guaranteeing a V_{OL} of 0.55V while sinking 64mA and guaranteeing a V_{OH} level of 2.0V while sourcing 32mA. Unlike a pure bipolar output structure, these outputs will effectively “turn-off” when the output is in the High state or the disabled state and will not contribute to I_{CC} . This causes I_{CCH} and I_{CCZ} values to be very small (μ A). When the output is in the Low state, the device will show some I_{CCL} but this value is less than most equivalent bipolar devices by a factor of three to four.

In order to effectively drive heavily loaded local bus applications or almost all backplane or system bus applications, high output current drivers are required. The Philips Semiconductors Advanced BiCMOS devices provide as standard 64mA I_{OL} , enough current for nearly all bus driving applications. Figure 2 shows the output current versus voltage characteristics for Philips Semiconductors Advanced BiCMOS devices. This clearly shows the ability of the output to source and sink large amounts of current to and from the bus to which it is interfaced.