TECHNICAL BRIEF

ABT16 Bus Hold

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ABT16 Bus Hold

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Floating CMOS inputs on ABT16 parts and on other similar devices without bus hold circuits or pullups can cause oscillation on the outputs or cause additional supply current draw when the driver holds the output at mid-rail. Hence, when the driving device goes into a 3-State condition, appropriate pullups or a bus hold circuit with or without pullups will control the input stage voltage level and prevent these oscillations and current draw problems. The special advantage of the bus hold circuit is that these problems are prevented without the necessity of adding resistive pullups.

All of Philips Semiconductors 74ABT16 products incorporate a bus hold circuit on each input except for the 74ABT16244/245 products. Products having the bus hold circuits allow designers the flexibility to eliminate external pullup resistors and thus simplify board design or to keep current designs in place which use pullups.

For board designs using pullup resistors, the Philips ABT16 devices will work provided certain design considerations are first understood and followed. Figure 1. is a simplified schematic diagram showing a bus hold circuit.

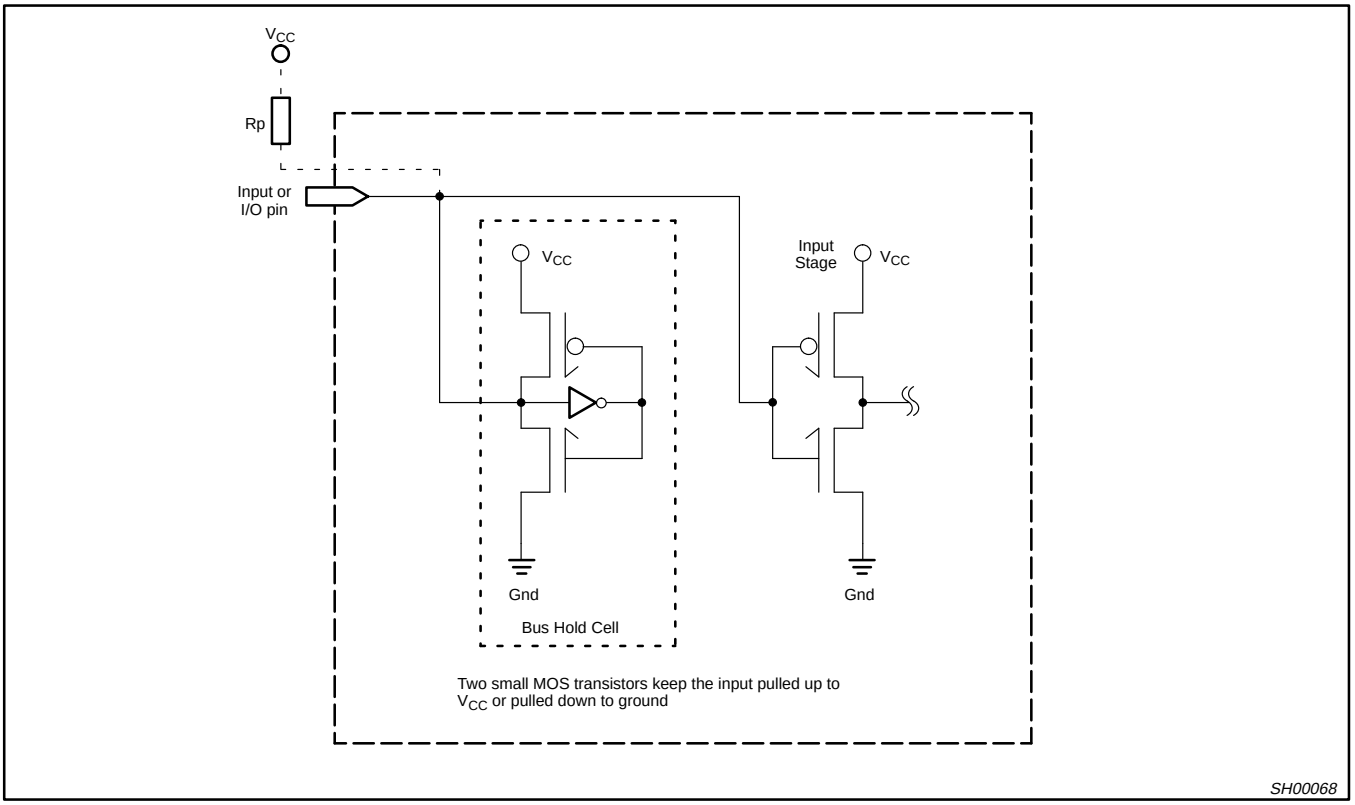

Figure 1. Simplified Input Structure and Bus Hold Cell

Let us examine several scenarios which can exist on the input:

Case 1: A driving device going from 3-State or a logic low to a logic high via the inverter will cause the bus hold lower NMOS device to turn off and the upper PMOS device to turn on to hold the input high level to the driving voltage level. If the input is not at V_{CC}, then the bus hold circuit may have some modest leakage depending on the voltage level.

Case 2: A driving device going from 3-State or a logic high to a logic low via the inverter will cause the bus hold upper PMOS device to turn off and the lower NMOS device to turn on to hold the input low level to the driving voltage level. If the input is not at ground, then the bus hold circuit will have a larger level current than in Case 1 due to the voltage drop across Rp.

Case 3: A driving device goes from a logic high to 3-State. The voltage on the device input will be pulled toward V_{CC} and will be assisted with an appropriately selected pullup resistor.

Case 4: Finally, when a driving device transitions from a logic low to 3-State, with V_{CC} as an input target level, there needs to be enough overdrive to control the bus hold state. The bus hold switching threshold is about 1.5V and about 175μA current is needed to cause the bus hold circuit to change state so that the device input will be close to V_{CC}. Therefore, for a single input:

$$Rp = \frac{\text{delta voltage}}{\text{overdrive current}}$$

$$Rp = \frac{(5–1.5V)}{175\mu A} = 20K \text{ ohms max.}$$

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To be conservative, allow for some margin and use a smaller resistor than this maximum. For multiple inputs tied to a common driver, the value of the pullup Rpn needs to be adjusted to provide more drive. This value should be:

$$Rpn = \frac{Rp}{n}, \text{ where } n = \text{the number of multiple bus hold inputs}$$

From experimental observations, the bus hold rise and fall times are nearly independent of n as just defined.

Even a low level input driver such as an HC device can provide enough current drive to override a large number of bus hold inputs. The fan-in drive capability of such a driver with a nominal drive of 6mA is:

$$\text{fan-in} = \frac{(I\ \text{drive})}{(I\ \text{bushold})}\ \text{current} = \frac{6mA}{200\mu A} = 30$$

Even so, the current required to charge or discharge a circuit board trace is an order of magnitude greater than the amount required to flip the state of a bus hold cell.

The ABT16 product family offers the functionality of two 8-bit ABT devices in a single package which reduces pc board real estate and also reduces the space used further with bus hold usage without the external resistor.

The ABT16 product family currently is offered with bus hold circuits on the inputs of each part except for the ABT16244/245 as mentioned earlier. In a new product line modification, this whole family of parts will be offered with/without the bus hold input circuit. The plan will use the conventional ABT16 numbering scheme for the non-bus hold parts to coordinate with competitive part numbering schemes. However, the parts utilizing the bus hold circuits will use ABTH16 as a numbering system, the H being used to denote the inclusion of the bus hold circuit. This new scheme will supercede the current practice and will be implemented in Q3 and Q4 of 1995.

Integrated bus hold cells have also been incorporated into the 3 volt LVT, LVT16, LVC16 and ALVC16 product families. The 3 volt LVC and 5 volt ABT families do not use bus hold cells.

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DEFINITIONS

Data Sheet Identification	Product Status	Definition
Objective Specification	**Formative or in Design**	This data sheet contains the design target or goal specifications for product development. Specifications may change in any manner without notice.
Preliminary Specification	**Preproduction Product**	This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.
Product Specification	**Full Production**	This data sheet contains Final Specifications. Philips Semiconductors reserves the right to make changes at any time without notice, in order to improve design and supply the best possible product.

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