SIEMENS

Microcontrollers

ApNote AP1610

☐ additional file
APXXXX01.EXE available

Input Signal Rise and Fall Times

All inputs of the C16x family have Schmitt-Trigger input characteristics.

K.H.Mattheis / Siemens HL MCB PD

AP1610 ApNote - Revision History		
Actual Revision : Rel.01	Previous Revison: Rel. none	
Page of actual Rel.	Page of prev. Rel.	Subjects changes since last release)

Input Signal Rise and Fall Times

All inputs of the C16x family have Schmitt-Trigger input characteristics. These Schmitt-Triggers are intended to always provide proper internal low and high levels, even if an undefined voltage level (between TTL-VIL and TTL-VIH) is externally applied to the pin. The hysteresis of these inputs, however, is very small, and can not be properly used in an application to suppress signal noise, and to shape slow rising/falling input transitions.

Thus, it must be taken care that rising/falling input signals pass the undefined area of the TTL-specification between VIL and VIH with a sufficient rise/fall time, as generally usual and specified for TTL components (e.g. 74LS series: gates 1V/us, clock inputs 20V/us). The effect of the implemented Schmitt-Trigger is that even if the input signal remains in the undefined area, well defined low/high levels are generated internally. Note that all input signals are evaluated at specific sample points (depending on the input and the peripheral function connected to it), at that signal transitions are detected if two consecutive samples show different levels. Thus, only the current level of an input signal at these sample points is relevant, that means, the necessary rise/fall times of the input signal is only dependant on the sample rate, that is the distance in time between two consecutive evaluation time points. If an input signal, for instance, is sampled through software every 10us, it is irrelevant, which input level would be seen between the samples. Thus, it would be allowable for the signal to take 10us to pass through the undefined area. Due to the sample rate of 10us, it is assured that only one sample can occur while the signal is within the undefined area, and no incorrect transition will be detected. For inputs which are connected to a peripheral function, e.g. capture inputs, the sample rate is determined by the clock cycle of the peripheral unit. In the case of the CAPCOM unit this means a sample rate of 400ns @ 20MHz CPU clock. This requires input signals to pass through the undefined area within these 400ns in order to avoid multiple capture events.

For input signals, which do not provide the required rise/fall times, external circuitry must be used to shape the signal transitions.

In the attached diagram, the effect of the sample rate is shown. The numbers 1 to 5 in the diagram represent possible sample points. Waveform a) shows the result if the input signal transition time through the undefined TTL-level area is less than the time distance between the sample points (sampling at 1, 2, 3, and 4). Waveform b) can be the result if the sampling is performed more than once within the undefined area (sampling at 1, 2, 5, 3, and 4).

Sample points:

1. Evaluation of the signal clearly results in a low level
2. Either a low or a high level can be sampled here. If low is sampled, no transition will be detected. If the sample results in a high level, a transition is detected, and an appropriate action (e.g. capture) might take place.
3. Evaluation here clearly results in a high level. If the previous sample 2) had already detected a high, there is no change. If the previous sample 2) showed a low, a transition from low to high is detected now.

4. As for sample point 2), a low or a high level can be detected here. A transition would be detected only if the sample shows a low level.
5. If multiple samples occur while the signal is in the undefined area, incorrect transitions might be detected. In this case, a high-to-low transition would be detected here if the previous sample at 2) already showed a high level, but now, due to disturbances on the input signal or on the ground line, a low level is detected. This would again lead to the detection of a further transition at sample point 3).

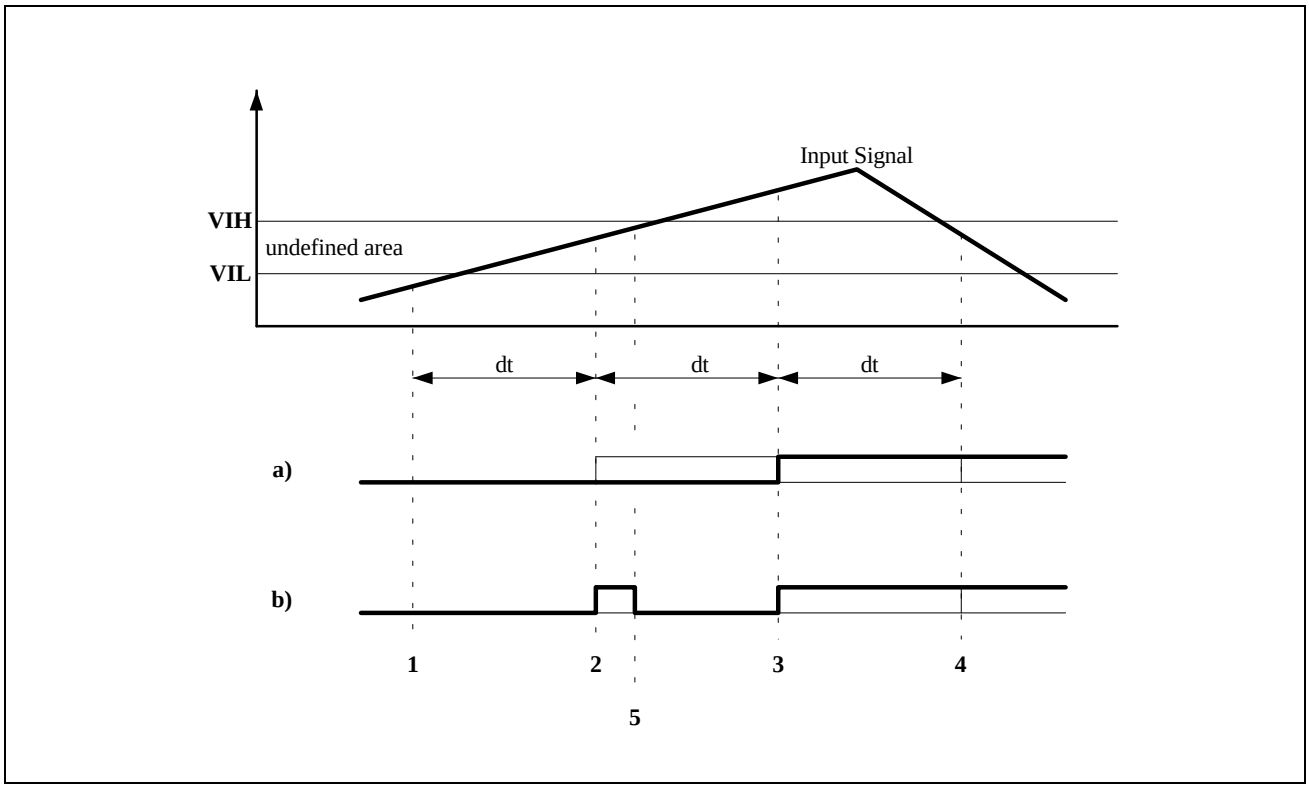

Figure 1: