VP Bericht - Elektronik D

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Abstract—

CONTENTS

I. INTRODUCTION

In this experiment, some of the basic concepts of digital circuits are explored. Digital circuits contain logic gate. The gates transform a digital input signal into some digital output signal following a well defined functionality. The input and output signal are either "high/1" or "low/0". This is a main difference compared to the analogous circuits, which have a continuous range of input/output signals. In today's world gates play an important role in. Every digital circuit contains a few up to multiple billions of them.

Gates can be categorized by gate-family, that they belong to (e.g. TTL or CMOS) and some other specific properties. Gates perform different operations to "compute" the output signal based on some input signal. Also, gates differ in terms of propagation delay, which is the delay a change in one of the input signals takes to cause a change in the output signal. The propagation delay is very important when designing digital circuits.

In the following, the performed experiments are presented. The experiments describe how to determine the operation performed by a digital circuit and it's propagation delay, how a pulse generator is build and how to implement a very simple bit shifter logic.

4011			4001		
A	B	C	A	B	C
0	0	1	0	0	1
0	1	1	0	1	0
1	0	1	1	0	0
1	1	0	1	1	0

Fig. 1: Truth table measuring IC HCF40011BE and HCF4001BE

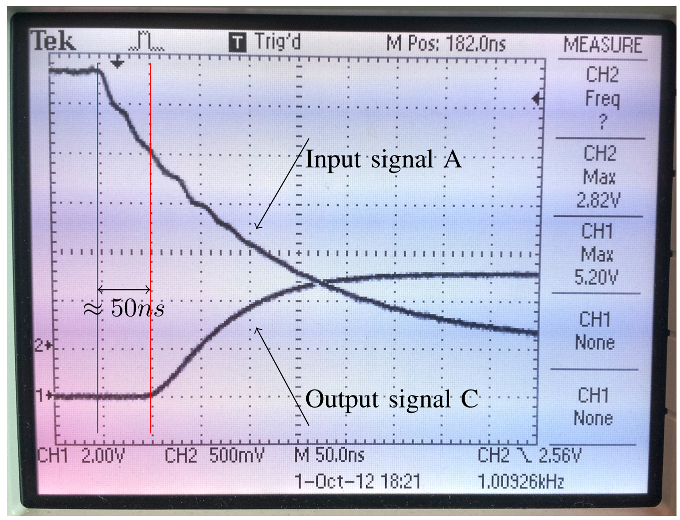

Fig. 2: Propagation delay measurement.

II. EXPERIMENT SIMPLE LOGIC GATE

A. Samples and measurement setup

The circuit was setup as shown in image ¡PLACEHOLDER¿. Based on the different input signals at A and B, different values for the output signal C were measured. As for the ICs, a HCF4001BE and HCF4011BE were used.

To measure the propagation delay, input signal A was connect to a square wave voltage generator. Input signal B was connected to ground. The IC HCF4001BE was used for this measurement. The voltage of the generator was set to 2.9V and the frequency to 1Hz. The input signal A and output signal C was visualized using a oscilloscope. The oscilloscope's trigger signal was connected to the voltage generator.

B. Results

For different input signals A and B, the truth-table was measured as shown in table 1.

The propagation delay was measured to be around 50ns as seen in figure 2.

C. Analysis and Discussion

Based on the measurements, the IC HCF4001BE seems to be a logic NOR gate, whereas the IC HCF4011BE seems to function as a NAND gate. This fits with the specified functionality of the gates.

Looking up the propagation delay from the data sheet, it is said to be typically around 40ns and up to 75ns. This fits with the here measured delay.

III. Pulse Generator

A pulse generators are used to create rectangular, periodic voltage signals. In this experiment, such a generator was build and the properties examined.

A. Samples and measurement setup

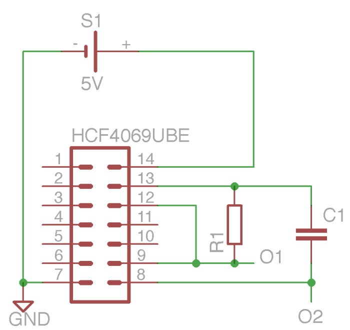

Fig. 3: Circuit diagram of astable multivibrator.

The circuit was assembled as shown in figure 3. Here, the IC HCF4069UBE was used, which contains six NOT gates. The voltage difference between the output signals $O1$, $O2$ and the ground was quantified using an oscilloscope. This also allowed to visualize and measure the period of the oscillations. Different values for the resistance $R1$ and the capacity $C1$ were chosen and the resulting period of the voltage signals determined.

B. Functionality explanation

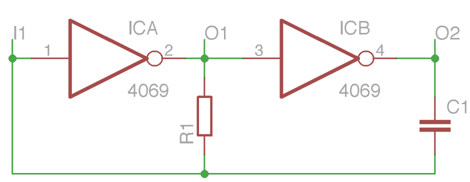

Fig. 4: schematic drawing of the astable multivibrator circuit.

A schematic drawing of the circuit is presented in figure 4. The explanation follows the one given in [BOOK]. Let's assume the voltage at $O1$ is set to be *high* and the capacitor is uncharged. Due to the *high* signal at $O1$, the signal at $O2$ is *low*. Over the resistance $R1$ the capacitor is charged. At some point, the voltage at $I1$ is high enough, such that the input signal of ICA is recognized as *high*. This causes the signal at $O1$ to become *low* and therefore the signal at $O2$ to be *high*. The charged capacitor discharges, which keeps the *high* signal at the $I1$ input for some time until the voltage on the capacitor is to low, such that the signal at $I1$ is recognized as a *low* signal, the signal at $O1$ becomes a *high* one and things start over again.

C. Results

The time diagram for the voltage at point A is shown in **??** and for the point B in **??**. In table **??** different period times due to different choices of resistor R and capacitor C are recorded.

D. Analysis and Discussion

The k-value is defined by

$$k = \frac{\Delta t}{R \cdot C} \tag{1}$$

where Δt is the period time, R is the resistance of the resistor R *and* C *is the capacity of the capacitor* C. Based on the measurements, the k-values are computed in **??**.

1) Die Analyse der Daten:

2) Genauigkeit der bestimmten Parameter:

3) Vergleich mit Literaturwerten:

E. Schlussfolgerung und Ausblick

IV. Die Messmethode und der experimentelle Aufbau

V. Die Messergebnisse

References

[BOOK] J. U. Bowie, R. Lüthy and D. Eisenberg. *A Method to Identify Protein Sequences That Fold into a Known Three-Dimensional Structure*. Science, 1991 (253), pp 164-170