Window Comparator Along with MOD-16 Counter for Counting Based Data Line Selection Operation

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Abstract—A window comparator circuit, also called window detector circuit determines whether an unknown input is between two precise reference threshold voltages or not. This work presents a window comparator connected to a 4-bit binary counter. The output of counter goes to a multiplexer as selection lines to direct one of 16 data sources into a single destination. The window comparator circuit, analog part, and counter along with multiplexer, digital circuit, make a mixed signal circuit which is the goal of this project to meet.

Keywords—Mixed signal, Window comparator, Multiplexer, Binary counter.

I.   CIRCUIT DETAILS

A window comparator consists of two op-amp. Op-amps have two inputs, inverting input (+) and non-inverting input (-), and they operate as (1), where A_0 is voltage gain.

$$V_o = A_0(V_+ - V_-) \qquad (1)$$

If two op-amps connect to each other as is shown in fig.1 the result circuit can be a window comparator. In a window comparator circuit, if the input voltage (V_{IN}) rises above a certain level (V_{LOW}), the output voltage (V_O) reach VDD, and if V_{IN} rises more to above V_{HIGH}, V_O drops to GND. In sum, V_O is only ON for voltages in between V_{LOW} and V_{HIGH}. Fig. 2(a) shows how a window comparator works.

The output of window comparator is connected to 4-bit counter, also called MOD-16 counter, which can count from 0000 to 1111 (0 to 15). The timing diagram of counter is shown in Fig. 2(b).

Then, outputs of counter (Q_0 to Q_3) go to a 16×1 multiplexer. A $2^N \times 1$ multiplexer is consist of N selectors by which one input is directed to the output among 2^N incoming data. Therefore, multiplexer selects one data, D_i ($D_0 < D_i < D_{15}$), among 16 incoming inputs to the output of multiplexer. The circuit diagram of multiplexer and how it works is shown in Fig.1 and 2(c), respectively.
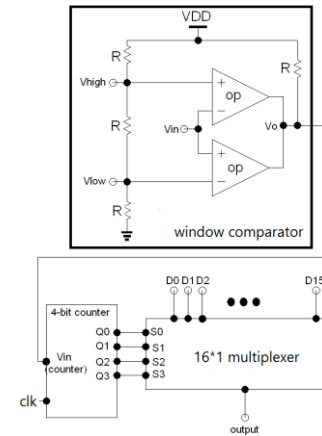
II.   REFERENCE CIRCUIT

Fig.1: Circuit Diagram

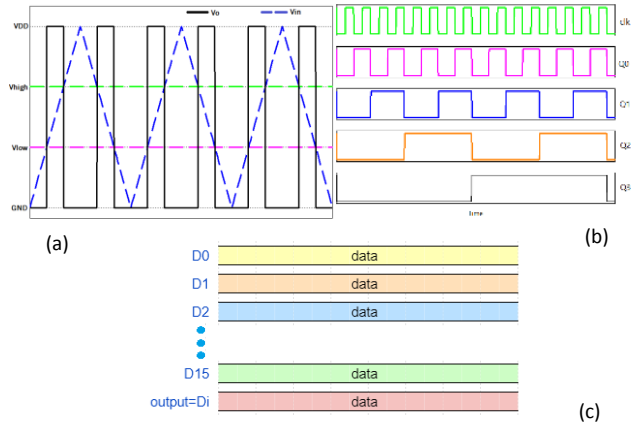## III.   REFERENCE WAVEFORMS

Fig.2. Reference waveforms: (a) Window comparator, (b) 4-bit counter, (c) Multiplexer.

REFERENCES

[1] Window comparator circuit, Analog Engineer's Circuit: Amplifiers, Texas Instruments, SBOA221A–January 2018–Revised February 2019

[2] M. Morris Mano; Michael D. Ciletti (2007*). Digital design. Pearson.* pp.272. ISBN: 978-0-13-277420-8.