

A CIRCUIT FOR GENERATING A DISK CHANGE SIGNAL

The present invention relates to circuits which generate a disk change signal, and is concerned particularly although not exclusively with floppy disk driving apparatus, for detecting presence of a floppy disk inserted thereto.

Conventionally known is a floppy disk driving apparatus with an index sensor which detects the rotation of the floppy disk and a disk-in sensor which detects the insertion of the floppy disk. Figure 1A and 1B of the accompanying diagrammatic drawings are schematic diagrams of such a conventional floppy disk driving apparatus.

Referring to Figure 1A, when a floppy disk is inserted in a floppy disk driving apparatus, light emitted from a light emitting diode PD_1 of the disk-in sensor is cut off, thereby turning off light-receiving transistor PQ_1 . If light-receiving transistor is turned off, a logic signal of a line 1 becomes a high level signal and then the high level signal is applied to clear terminal CLR of a flip-flop FF_1 .

Applying a disk change reset signal from a controller to a clock terminal CLK of the flip-flop FF_1 , outputs a logic high level signal through an output terminal Q of the flip-flop FF_1 , and then the disk-in sensor S1 detects the insertion of the floppy disk. Upon changing the disk change signal logic "high level" output from the flip-flop FF_1 , a controller senses the disk change signal, and thereby regularly controls the floppy disk driving apparatus.

When the floppy disk is removed from the floppy disk driving apparatus, the disk-in sensor S1 is operated, and outputs a logic "low level" signal through the line 1, whereby the output signal of logic "low level" signal is applied to the clear terminal CLR of the flip-flop FF₁ and then the flip-flop is cleared. Thereby, a logic "low level" signal is output through the output terminal Q of the flip-flop FF₁. When the disk change signal output from the output terminal of the flip-flop FF₁ becomes the logic "low level" signal the controller detects an extraction of the floppy disk.

Referring to Figure 1B, which shows a circuit for detecting rotation of the floppy disk, an index sensor S2 is operated by a cycle of the rotation of the floppy disk, whereby an index sensing circuit 10 detects an index pulse. Conventional floppy disk driving apparatus as shown in Figures 1A and 1B comprises the disk-in sensor and the index sensor, whereby a respective circuit of the floppy disk driving apparatus tends to be complex and high capability of a printed circuit board is required.

Preferred embodiments of the present invention aim to provide a disk change signal generating circuit in which the disk change signal is generated by using the index sensor.

Another aim is to provide a floppy disk driving apparatus in which the disk-in sensor is omitted and integrated in an LSI (Large Scale Integrated Circuit) by using the index sensor.

Thus, in preferred embodiments of the present invention, a circuit may be constructed within LSI by generating a disk change signal which detects the

insertion of a floppy disk by using an index sensor, and such a design may simplify the structure of the respective apparatus.

According to a first aspect of the present invention, there is provided
5 a circuit for generating a disk change signal for use in a disk driver, the circuit comprising:

index sensing means for generating an index pulse signal to detect
rotation of a disk, said index sensing means comprising at least one pair of
10 light-emitting means and light-receiving means, said index pulse signal
having a first value when light is received by said light-receiving means and
a second value when light is not received by said light-receiving means;

counting means arranged to receive said index pulse signal into a clear
15 input terminal and a clock signal into a clock input terminal, and to generate
a counting signal after a predetermined time when said disk is not undergoing
normal rotation, wherein said predetermined time is longer than the pulse width of
said index pulse signal during said normal rotation of the disk; and

20 output means arranged to receive said index pulse signal and said
counting signal and comprising first flip-flop means arranged to provide an
output signal, and second flip-flop means arranged to receive said output
signal and to generate said disk change signal, wherein said disk change signal
has a first value when a disk is present in said disk driver and a second value
25 when no disk is present in said disk driver.

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Preferably, said first flip-flop means is arranged to receive said index pulse signal into a clear input terminal thereof and to produce therefrom a control signal to determine presence of a disk inserted into the drive; and

- 5 said second flip-flop means is arranged to receive said control signal into a clear input terminal thereof and to receive a disk change reset signal into a clock input terminal, to produce therefrom said disk change signal.

Preferably, said first and second flip-flop means comprise D-type flip-flops.

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A circuit according to the above aspects of the invention may further comprise an inverting means coupled between said index sensing means and said output means for providing an inverted signal of said index pulse signal to the clear input of said first flip-flop means.

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A circuit according to the above aspects of the invention may preferably be for use in a floppy disk driver.

20 The invention extends to a disk driver (e.g. a floppy disk driver) provided with a circuit according to any of the preceding aspects of the invention.

For a better understanding of the invention, and to show how the same may be carried into effect, reference will now be made, by way of example, to Figure 2 of the accompanying diagrammatic drawings, in which:

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Figure 2 shows one example of an embodiment of a disk change signal generating circuit embodying the present invention.

Referring to Figure 2, the circuit comprises an index sensor S_{11} , a timer 10, and two D-type flip-flops 20 and 30. The index sensor S_{11} generates an index pulse for detecting disk rotation. The timer 10 receives an output signal of the index sensor S_{11} into clear terminal CLR and outputs a counting value at a predetermined frequency, using a clock signal received on clock terminal CLK. D flip-flop 20 receives at a clear terminal CLR the output signal of the index sensor S_{11} after inversion, in an inverter I_1 and outputs at an inverse output terminal $\bar{Q}$ a control signal which indicates a floppy disk insertion by the output signal from the timer 10. The other D flip-flop 30 outputs a disk change signal, by receiving a disk change reset signal on a clock terminal CLK and the control signal which detects the disk insertion on a clear terminal CLR.

The index sensor S_{11} regularly generates ^{low level} index pulses, when the floppy disk is inserted in the floppy disk driving apparatus and then rotated. The timer 10 which receives an index pulse generated from the index sensor S_{11} on its clear terminal CLR starts counting on a falling edge of the index pulse and then outputs a logic "high level" signal from its output terminal Q after counting in a logic low level region. That is, a preset time of the timer 10 is established to be sufficiently greater than the index pulse width. The index pulse generated from the index sensor S_{11} is applied to the clear terminal CLR of the flip-flop 20 through the inverter I_1 .

The timer 10, which receives a clock signal from a clock generating circuit (not shown) into its clock terminal CLK, performs counting when the index pulse signal has a logic low level. The timer 10 ^{normally} outputs a logic "low level" signal from its output terminal Q to the clock terminal CLK of the D flip-flop 20, ^{but} when the preset time has elapsed the timer signal goes to logic "high level". As the index pulse having a logic "low level" signal output from the index sensor S_{11} is inverted by the inverter I_1 and is applied to the clear terminal CLR of the D flip-flop 20, the inverse output terminal $\bar{Q}$ of the D flip-flop 20 remains at a logic "high level", without changing state. The logic "high level" signal output from the inverse output terminal $\bar{Q}$ of the D flip-flop 20 is applied to the clear terminal CLR of the D flip-flop 30. When a disk change reset signal is input to the clock terminal CLK from a respective controller (not shown), the output terminal Q outputs a disk change signal of logic "high level". The index sensor S_{11} thus detects the presence of the floppy disk by the logic "high level" signal output from the D flip-flop 30.

The index sensor S_{11} outputs continuously a logic low level signal without output index pulses when the floppy disk inserted in floppy disk driving apparatus is extracted. The timer 10 which inputs into the clear terminal CLK of flip-flop 20 the logic low signal output from the index sensor S_{11} receives and counts the clock signal at clock terminal CLK, and when the preset elapsed time of the timer of the logic "low level" signal is passed, the timer 10 outputs the logic "high level" signal from its output terminal Q.

The logic low level signal output from the index sensor S_{11} is inverted by the inverter I_1 and is applied to the clear terminal CLR of the D flip-flop 20, whereby the D flip-flop 20 releases to its clear state. Therefore, the D

flip-flop 20 which inputs into its clock terminal CLK the logic high signal output from the timer 10, outputs the logic low level signal from its inverse output terminal $\bar{Q}$.

5 The logic low level signal output from the inverse output terminal $\bar{Q}$ of the D flip-flop 20 is applied to the clear terminal CLR of the D flip-flop 30 and clears the value of the D flip-flop, thereby outputting the disk change signal of the logic "low level" signal from its output terminal Q. In this case, although the disk change reset signal is input into the clock terminal CLK of
10 the D flip-flop 30, the output signal of the output terminal Q maintains the logic low level state. If the disk change signal output from the D flip-flop 30 is in logic "low level" state, the index sensor recognizes that no disk is inserted.

15 As above mentioned, when the floppy disk is inserted in the floppy disk driving apparatus and thereby interrupts the light transmission path of the index sensor S_{11} , the logic high level signal from the inverse output terminal $\bar{Q}$ of the D flip-flop 20 is applied to the clear terminal CLR of the D flip-flop 30, whereby the index sensor S_{11} recognizes the insertion of the floppy disk.
20 In this case, although the index pulse is generated by rotation of the floppy disk, the term of the logic "low level" signal of the index pulse is ignored until the time established by the timer 10 is passed, and the clear terminal CLR of the D flip-flop 30 maintains the logic "high level". Meanwhile, if the index sensor S_{11} is turned on for more than the time established by the timer 10 by
25 extracting the floppy disk from the floppy disk driving apparatus, such that the clear terminal CLR of the timer 10 maintains the logic "low level", the index sensor recognizes the extraction of the floppy disk by the clear terminal CLR

of the D flip-flop 30, and the disk change signal becomes a logic "low level" signal.

As described above, the circuit of Figure 2 may be accomplished in LSI
5 by generating the disk change signal which detects the insertion of the floppy disk by using the index sensor, and the design simplifies the structure of the apparatus.

The present invention is not limited to the above embodiments, and
10 various other changes and modifications may be made within the scope of the invention recited in the appended claims.

CLAIMS

1. A circuit for generating a disk change signal for use in a disk driver, the circuit comprising:

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index sensing means for generating an index pulse signal to detect rotation of a disk, said index sensing means comprising at least one pair of light-emitting means and light-receiving means, said index pulse signal having a first value when light is received by said light-receiving means and
10 a second value when light is not received by said light-receiving means;

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counting means arranged to receive said index pulse signal into a clear input terminal and a clock signal into a clock input terminal, and to generate a counting signal after a predetermined time when said disk is not undergoing
15 normal rotation, wherein said predetermined time is longer than the pulse width of said index pulse signal during said normal rotation of the disk; and

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output means arranged to receive said index pulse signal and said counting signal and comprising first flip-flop means arranged to provide an
20 output signal, and second flip-flop means arranged to receive said output signal and to generate said disk change signal, wherein said disk change signal has a first value when a disk is present in said disk driver and a second value when no disk is present in said disk driver.

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2. A circuit according to claim 1, wherein said

first flip-flop means is arranged to receive said index pulse signal into a clear input terminal thereof and to produce therefrom a control signal to
5 determine presence of a disk inserted into the drive; and

said second flip-flop means is arranged to receive said control signal into a clear input terminal thereof and to receive a disk change reset signal into a clock input terminal, to produce therefrom said disk change signal.
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3. A circuit according to claim 2, wherein said first and second flip-flop means comprise D-type flip-flops.

4. A circuit according to claim 3, further comprising an inverting means
15 coupled between said index sensing means and said output means for providing an inverted signal of said index pulse signal to the clear input of said first flip-flop means.

5. A circuit according to any of the preceding claims, for use in a floppy
20 disk driver.

6. A circuit substantially as hereinbefore described with reference to Figure 2 of the accompanying drawings.

25 7. A disk driver provided with a circuit according to any of the preceding claims.



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8. A disk driver according to claim 7, being a floppy disk driver.

