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(54) **PHASE ADJUSTOR FOR SEMICONDUCTOR INTEGRATED CIRCUIT**

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(57) **ABSTRACT**

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In semiconductor integrated circuit devices containing a macro, a skew occurs between the clock pulse supplied to the latch in that mother circuit and the clock pulse supplied to the latch inside the macro. These clock skews obstruct the high frequency operation of the semiconductor integrated circuit device clock frequency so the semiconductor integrated circuit device cannot be operated at high speed. In a semiconductor integrated circuit device having a first clock processor means to generate a third clock pulse so that a first clock pulse and a second clock pulse are input at an identical phase and identical frequency, a second clock processor means to generate a fifth clock pulse so that a third and a fourth clock pulse are input at an identical phase and identical frequency, and a first latch group and a second latch group comprised of a plurality of latches, and in this semiconductor integrated circuit device the second clock pulse is generated by way of a buffer or a divider from a third clock pulse, a fourth clock pulse is generated by way of a buffer or a divider from a fifth clock pulse, and the third clock pulse is supplied to the first latch group by way of a buffer and the fifth clock pulse is supplied to the second latch group by way of a buffer.

(\* ) **Notice:** This is a publication of a continued prosecution application (CPA) filed under 37 CFR 1.53(d).

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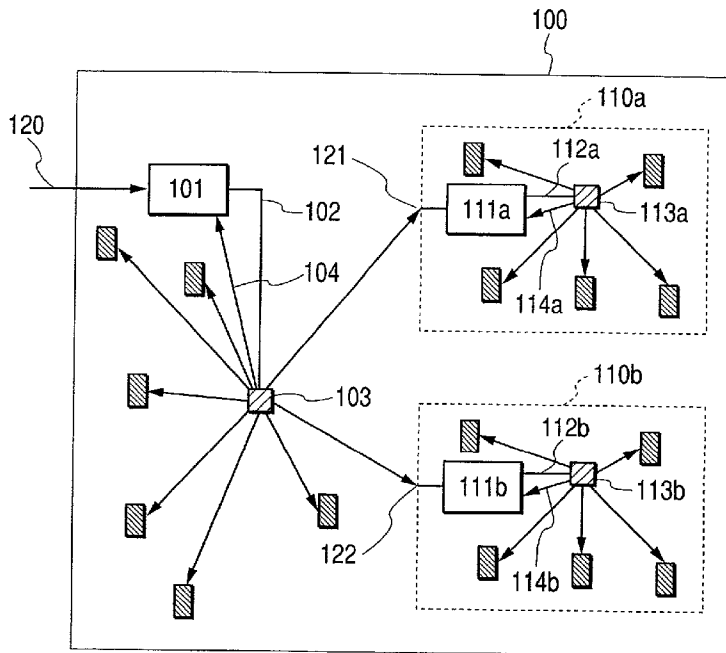
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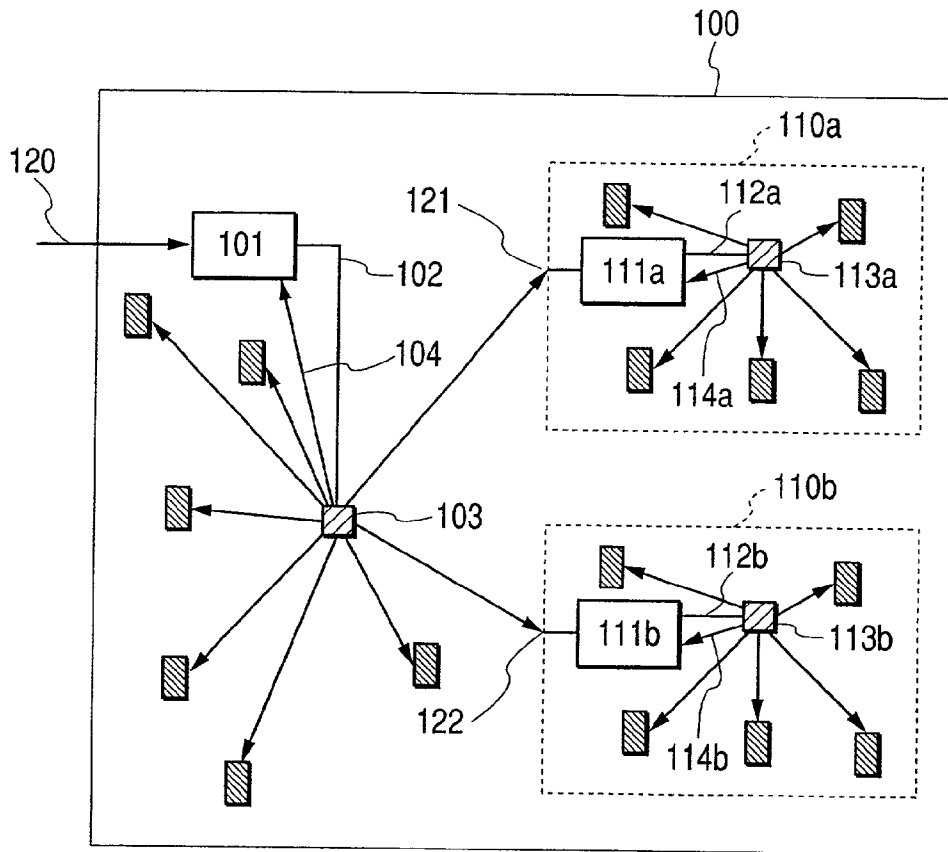
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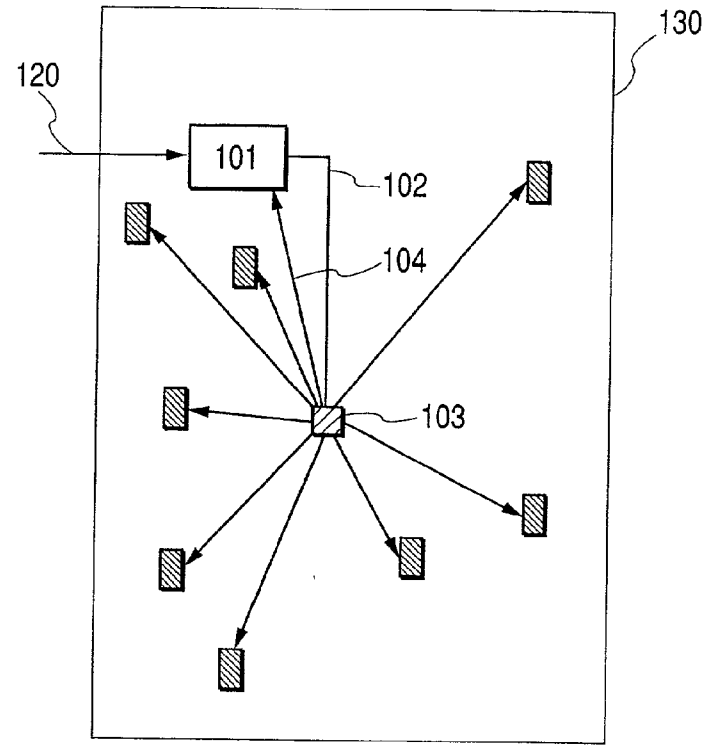
=CLOCKED CIRCUIT (E.G. LATCH, FLIP-FLOP OR REGISTER)

FIG. 1



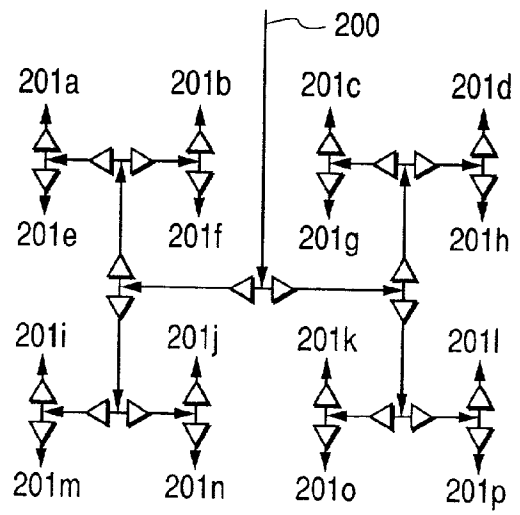
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FIG. 2 PRIOR ART



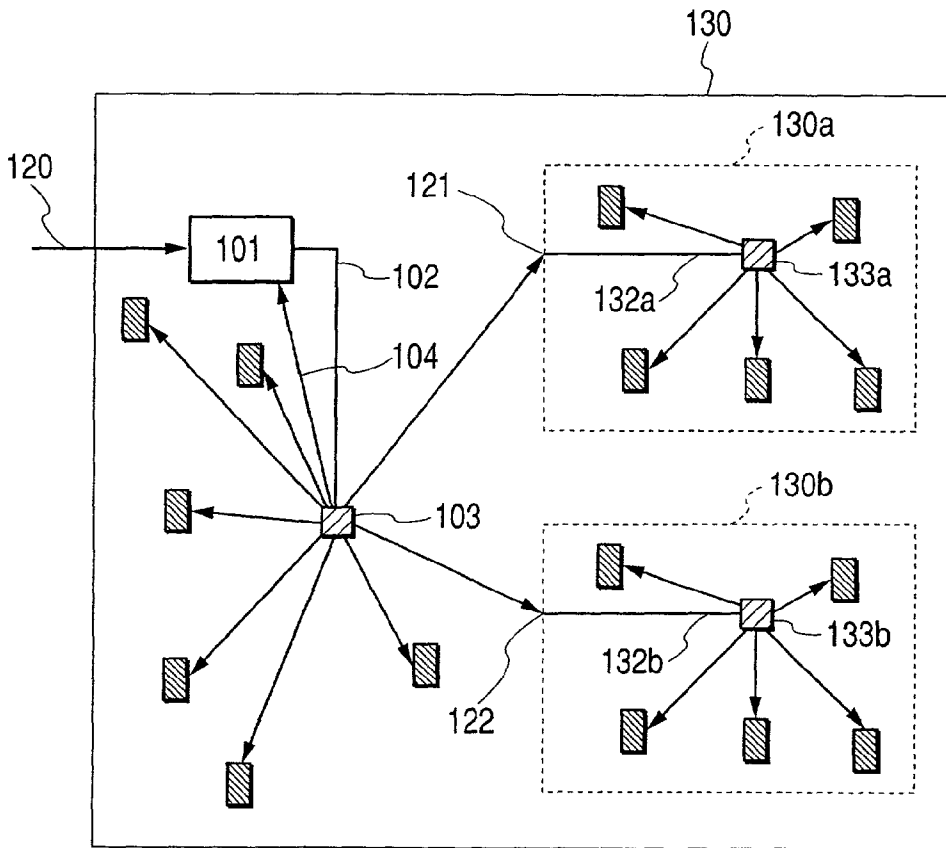
▨ =CLOCKED CIRCUIT (E.G. LATCH, FLIP-FLOP OR REGISTER)

FIG. 4



◁ =CLOCK BUFFER

FIG. 3



▨ = CLOCKED CIRCUIT (E.G. LATCH, FLIP-FLOP OR REGISTER)

FIG. 5A

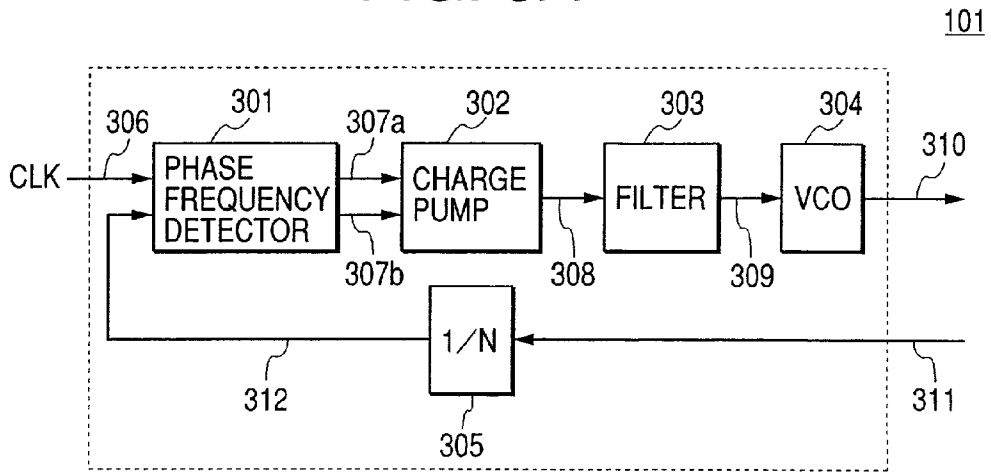


FIG. 5B

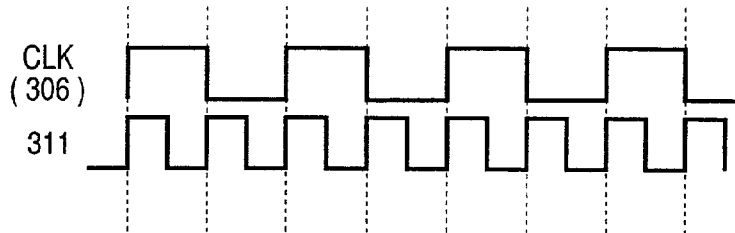


FIG. 6A

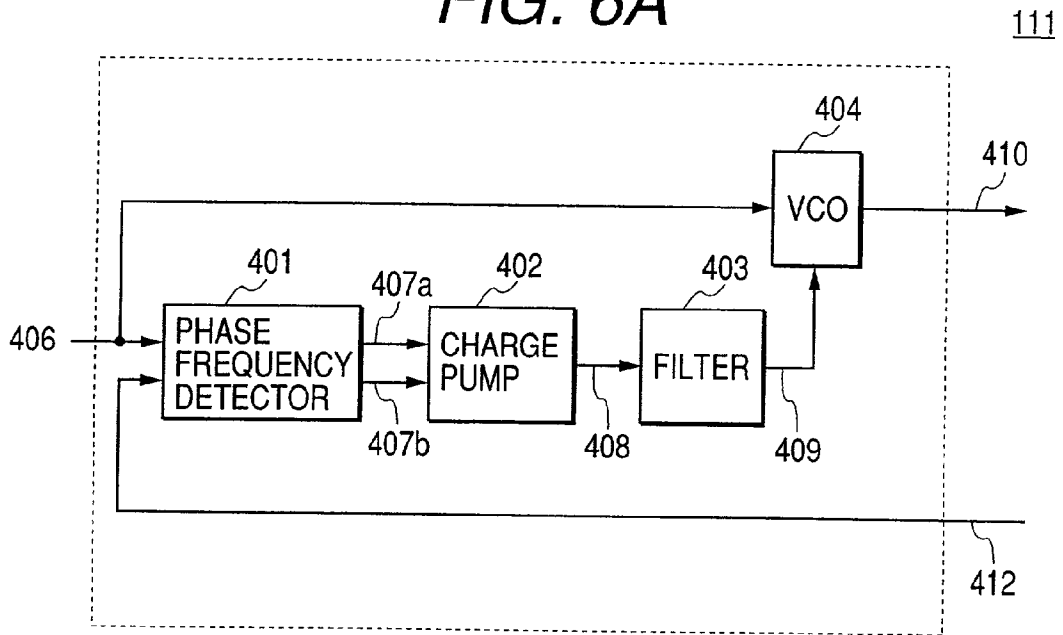


FIG. 6B

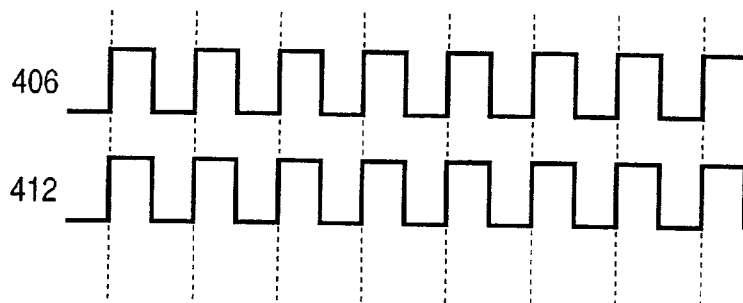


FIG. 7

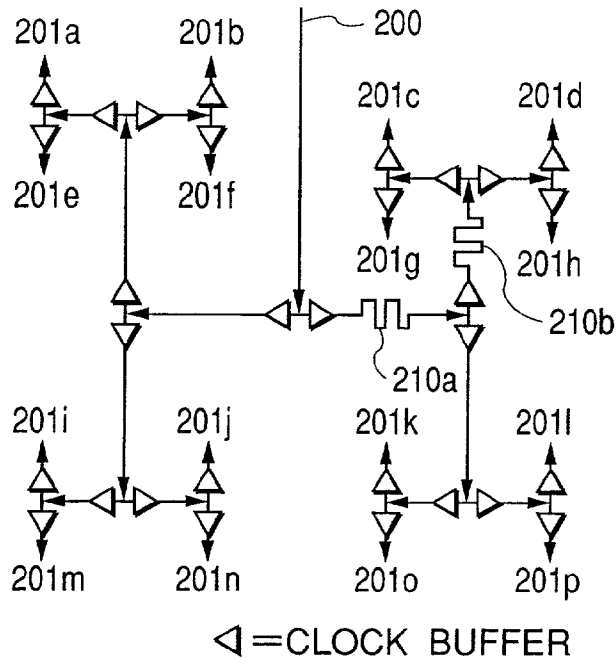


FIG. 8

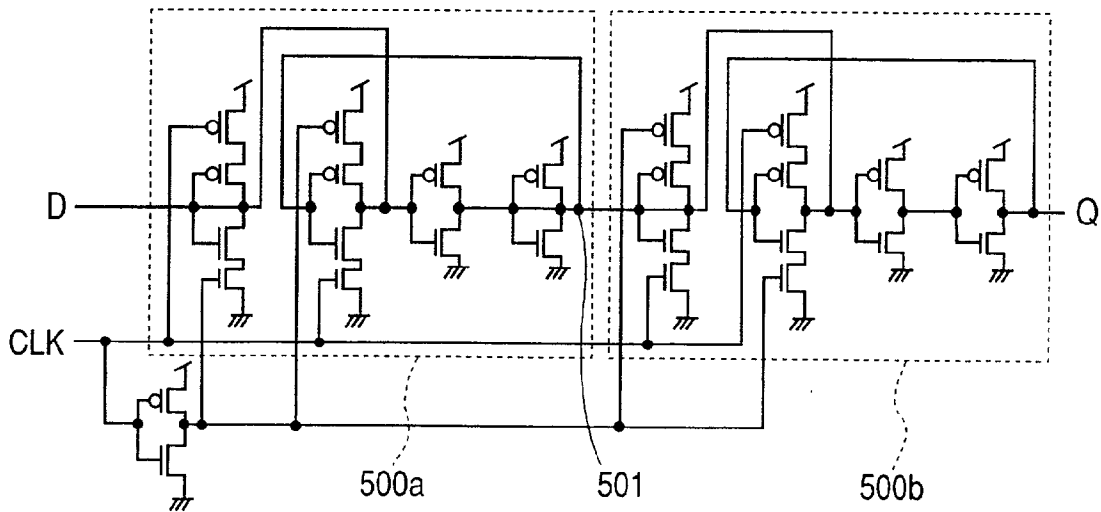
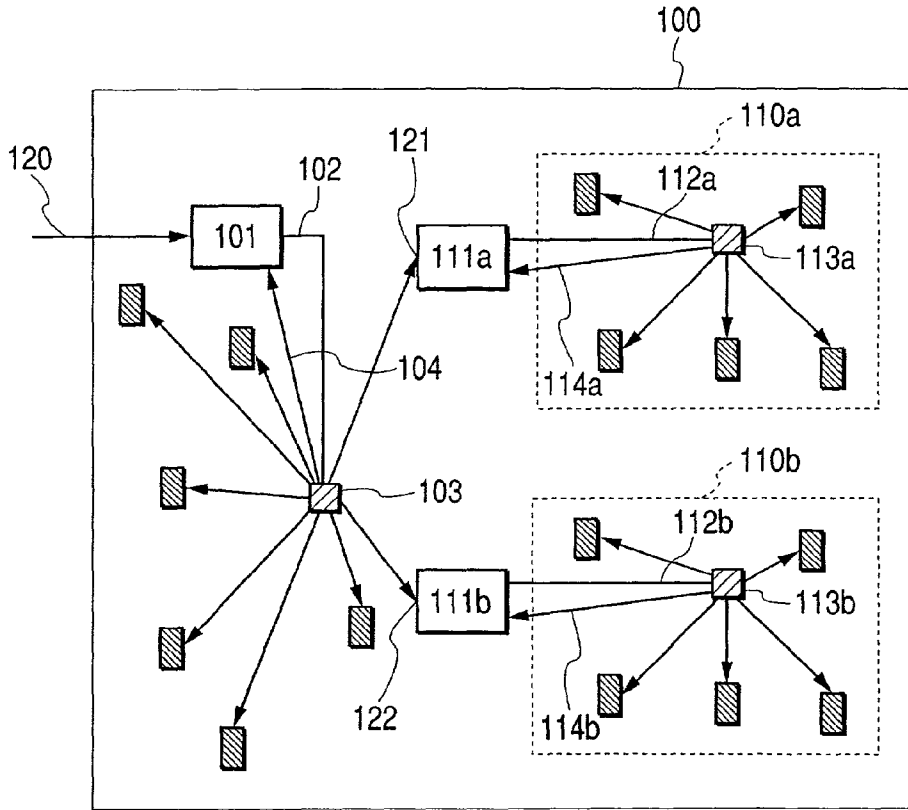


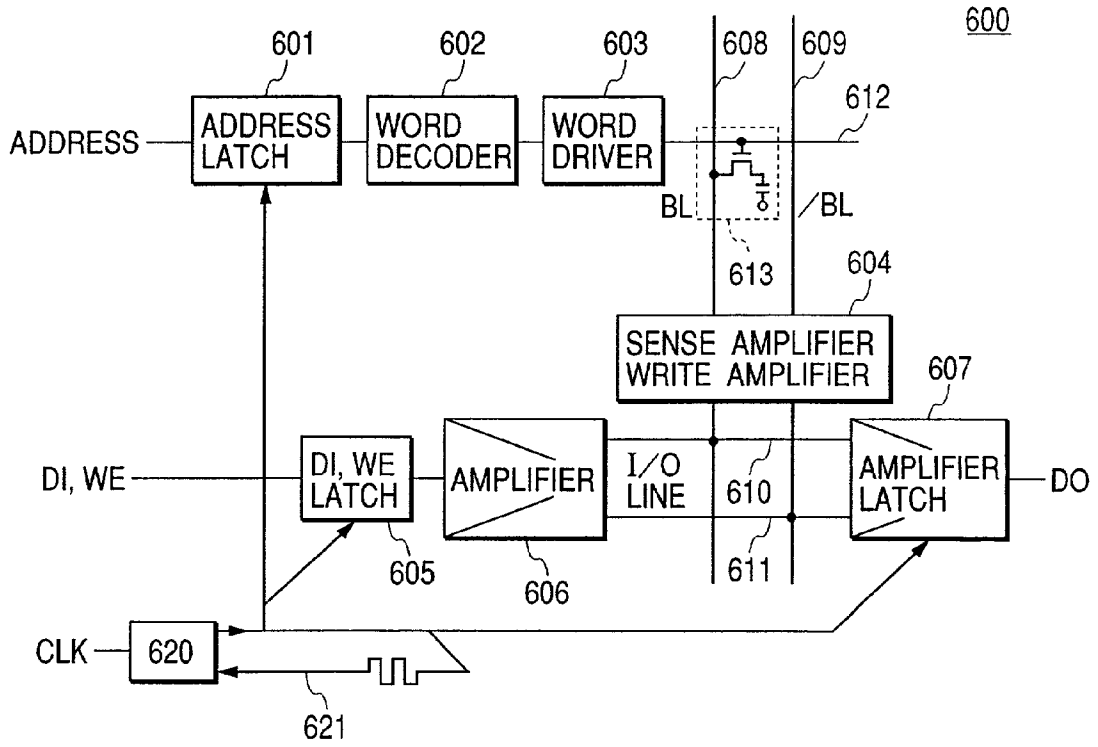
FIG. 9



▨ = CLOCKED CIRCUIT (E.G. LATCH, FLIP-FLOP OR REGISTER)



FIG. 10



## PHASE ADJUSTOR FOR SEMICONDUCTOR INTEGRATED CIRCUIT

### BACKGROUND OF THE INVENTION

#### [0001] 1. Field of the Invention

[0002] This invention relates to a semiconductor integrated circuit device and relates in particular to a semiconductor integrated circuit device having a high speed clock distribution network. This invention further relates to a technology capable of a high speed clock distribution network that efficiently utilizes design resources of independently designed semiconductor circuits.

#### [0003] 2. Description of Related Art

[0004] FIG. 2 shows an example of a semiconductor integrated circuit device utilizing a high speed clock distribution network of the prior art. In the figure, the reference numeral 101 denotes a phase locked loop (PLL), 102 is a clock distribution line and 103 is a clock buffer. Reference numeral 120 denotes an input clock which is multiplied (increased) N times by the PLL 101 and output frequency to 102 as a multiplied (increased) by N times. The clock pulse multiplied by PLL 101 is amplified in 103 and distributed to each latch (latch and flip-flops are different from each other in the strict sense of the word, however here both latch and flip-flops are represented by the word "latch") with an equivalent delay. Technical features assuring an equal-length wiring are utilized in order to achieve an equivalent distributed delay.

[0005] Once of the distributed clocks 104 is input to the PLL 101 and the PLL 101 functions to obtain an identical phase for the clocks 104 and 120.

[0006] FIG. 3 shows the clock distribution network for the semiconductor integrated circuit device of FIG. 2 when added with a macro 130a and 130b. A macro is a separately designed circuit that satisfies specifications for circuits other than the macro (hereafter referred to as mother circuits) as well as interface specifications between macro and mother circuit. As long as these interface specifications are satisfied, the macro can change the mother circuit in various ways.

[0007] As one example, the DRAM macro has a memory function to store information by means of capacitance in a circuit described in the 1998 IEEE International Solid-State Circuit Conference Digest of Technical Papers, pp. 72-73.

[0008] These macro circuits are sometimes designed as separate items by different designers. One designer may specialize in DRAM macro design while another may specialize in coprocessor macro design. A circuit can then be systematically assembled by combining the macros obtained from these different sources. This method allows utilizing existing macros to design system-level integration devices with high additional value.

[0009] In the macro, software IP is used to show design data at the circuit level, and hardware IP is data listing the physical structure of the semiconductor integrated circuit device such as the layout. Hardware IP is more appropriate when high speed operation is required, because performance cannot otherwise be guaranteed when redrafting the physical layout of the circuit.

[0010] The clocks distributed to the mother circuit latches are also supplied at an identical phase to the latches in the

circuits 121 and 122. The respective macros 130a and 130b distribute the clock pulses input from 121 and 122 to the latches within each macro at an equivalent delay by utilizing the clock buffers 133a and 133b within each macro.

[0011] The clock distribution in the semiconductor integrated circuit device of FIG. 3 containing the macros is at a phase identical to the clock phase of 121 and 122 and the latch phase within each mother circuit. However, a delay time  $T_m$  is required from 121 and 122 to the input of the clocks to the latches within each macro so that a phase difference (skew) equivalent to the  $T_m$ , occurs between the latches within the mother circuit and the latches within the macros.

[0012] Further, the  $T_m$  within each macro is different so that skew also occurs between macros. This  $T_m$  tends to become large when using large scale macros (also called megacells) and the clock skew increases in the semiconductor integrated circuit device using these macros.

[0013] In the semiconductor integrated circuit devices of the prior art containing these macros, skew occurs between the clock pulses supplied to the latches within the mother circuit and the clock pulses supplied to the latches within the macro. These clock skews interfere with the high frequency function of the semiconductor integrated circuit device clock frequency so that the semiconductor integrated circuit device cannot be operated at high speed.

[0014] A proper delay time for the clock distribution network, from the clock buffer 103 to 121 or 122 calculated during the macro design stage, that takes the  $T_m$  into account will resolve this problem but has the drawback that macrocell design cannot be performed independently of mother circuit design.

### SUMMARY OF THE INVENTION

[0015] In order to resolve the above mentioned problems, this invention has a clock generator to supply clock signals, a plurality of first controlled circuits supplied by the clock pulses from the clock generator and a phase adjuster for these clock signals, a second controlled circuit supplied by the clock signal that passed through the clock signal phase adjuster, and configured so that the clock phase input to this clock signal phase adjuster and first controlled circuit are an identical phase.

[0016] The number of first controlled circuits supplied at this time by clock pulses from the clock generator is typically larger than the number of clock signal phase adjuster (circuits).

[0017] This invention in this case, is characterized in having a clock generator to supply clock signals, a plurality of first controlled circuits supplied by the clock pulses from the clock generator and a phase adjuster for these clock signals, a second controlled circuit supplied by the clock signal that passed through the clock signal phase adjuster, and further characterized in that the number of the plurality of first controlled circuits supplied by clocks from the clock generator is larger than the number of clock signal phase control circuits.

[0018] To restate, this invention is characterized in that the percentage shared by first control circuits from among the

fan-out of the clock generator is larger than the percentage of clock signal phase control circuits.

[0019] A phase adjusting means contains a phase frequency detector to compare the frequencies input with the first clock and the second clock, and is configured to output the three clock signals controlled by the output of the phase frequency detector.

[0020] In a more detailed description, the semiconductor integrated circuit device of this invention has a first clock processing means to input a first clock and a second clock and generate a third clock, a second clock processing means to input a third clock and a fourth clock and generate a fifth clock, and a first latch group and a second latch group comprised of at least one latch, wherein the second clock is generated from the third clock by way of a buffer, the frequency of the second and third clocks are identical, the first clock processing means generates the third clock so that the first and second clocks will have an identical phase and frequency, a fourth clock is generated by way of a buffer from the fifth clock, the frequency of the fourth and fifth clocks are identical, the second clock processing means generates a fifth clock so that the third and fourth clocks will have an identical phase and identical frequency, the third clock is supplied by way of a buffer to the first latch group, the fifth clock is supplied by way of a buffer to the second latch group, and the first latch group and the second latch group operate at an identical phase.

[0021] Phrases such as "identical phase, identical frequency" as related in these specifications, allow for an error of an extent that can be ignored without hindrance to actual operation and can be tolerated in terms of performance demanded of the circuit.

[0022] The first clock processing means of this invention as described in a more detailed example, consists of a phase frequency detector to input a first clock and a second clock and output a first error signal, a charge pump circuit to input a first error signal and output a second error signal, a low-pass filter to input a second error signal and output a third error signal, and a voltage-controlled oscillator to change the oscillator frequency according to the third error signal. The third clock is capable of being generated by the voltage-controlled oscillator.

[0023] This invention is especially effective when making a single circuit such as semiconductor integrated circuits (chips) by combining a plurality of circuits from different sources (different designers and design companies).

[0024] In other words, a circuit design method for reading out a first circuit block of design data from a recording medium in which is stored the first circuit block of design data, and integrating this with a second circuit block of design data as design data for a signal semiconductor integrated circuit device and characterized in that a phase adjuster means inserts a clock signal between the first circuit block and the second circuit block. Utilizing this circuit design method eliminates the problem of clock phase deviations throughout the entire circuit.

[0025] A circuit design method to prepare design data for a first circuit block having a clock output terminal to output a clock signal, and having a circuit to adjust the phase of the clock signal sent from the clock output terminal, and combined with design data for a second circuit block, wherein

the clock output terminal of the first circuit block is connected to the clock input terminal of the second circuit block. Utilizing this method, a clock phase correction means is prepared beforehand for the circuit forming the mother circuit so that the load imposed is reduced when circuits are combined.

[0026] In a separate configuration, a clock phase adjuster means can be internally incorporated onto the circuit block that is to be added. By distributing design data for this kind of circuit, the purchaser can join and integrate circuits to achieve a circuit system of high additional value without having to worry about clock deviations between circuits.

[0027] This kind of design data is characterized in that it can be stored on a record medium such as a CD-ROM that stores circuit design data such as for circuits having a clock input terminal for receiving clock signals, circuits to adjust the clock signal phase sent from the clock input terminal, and internal circuits controlled by the adjusted clock signals. This circuit design data can then be distributed while stored on the CD-ROM.

[0028] For design data, a variety of items (so-called software IP) are available to show circuit electrical connections (so-called circuit schematics) or items (so-called hardware IP) such as to show physical scales, layouts, and material specifiers are available when the actual semiconductor integrated circuit device has been achieved. The data may be shown numerically or in a graphical form.

[0029] The circuits described with this kind of design data often describe only a portion of a single circuit device (such as a chip) however the signal exchange with external circuits is mostly performed by the metal level formed on the board substrate. The data for these portions of the circuit can be confirmed using hardware IP.

[0030] Instead of distributing this kind of data by CD-ROM as previously mentioned, the Internet can be used. In such cases, a recording medium to store circuit design data such as for circuits having a clock input terminal for receiving clock signals, circuits to adjust the clock signal phase sent from the clock input terminal, and internal circuits controlled by the adjusted clock signals, can be prepared beforehand and when data transfer is requested by a user, the circuit data stored on the recording medium can be sent to the user. If progress is made on setting up a proper infrastructure, then the Internet distribution method may prove more convenient than distribution by CD-ROM.

[0031] The main means utilized in this invention for resolving the above mentioned problems in the semiconductor integrated circuit device are a first clock processing means to input a first clock and a second clock and generate a third clock so that the first and second clocks will have identical phases and identical frequencies, a second clock processing means inputs a third clock and a fourth clock and generates a fifth clock so that the third and fourth clocks will have identical phases and identical frequencies, and a first latch group and a second latch group comprised of a plurality of latches wherein a second clock is generated from a third clock by way of a buffer or divider, a fourth clock is generated from a fifth clock by way of a buffer or divider, the third clock is supplied by way of a buffer to the first latch group and the fifth clock is supplied by way of a buffer to the second latch group.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0032] FIG. 1 is block diagram showing the embodiment of this invention.

[0033] FIG. 2 is a concept view showing the clock distribution network of the prior art.

[0034] FIG. 3 is a block diagram showing the clock distribution network for describing the issues of this invention.

[0035] FIG. 4 is a block diagram showing the H-tree type clock distribution network.

[0036] FIG. 5 is a block diagram showing the embodiment of the PLL.

[0037] FIG. 6 is a block diagram showing the embodiment of the DLL.

[0038] FIG. 7 is a block diagram showing the wire length adjusting section in the H-tree type clock distribution network.

[0039] FIG. 8 is a circuit schematic showing an embodiment of the latch.

[0040] FIG. 9 is a block diagram showing another embodiment.

[0041] FIG. 10 is a block diagram showing an embodiment of the DRAM macro.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0042] The embodiment of this invention is shown in FIG. 1. A comparison with FIG. 3 shows that phase adjusters 111a and 111b have been added to the macro 110a and 110b.

[0043] This example assumes the customer is purchasing block (macro) design data 110a, 110b by means of an IP provider for addition to circuits at the customer's company. The design data can be procured from a CD-ROM or on-line data. In this example, the phase adjusters 111a and 111b have been added to the design data from the IP provider.

[0044] The phase adjusters 111a issues a clock 112a from the clock input from 121. The clock 112a is amplified in the clock buffer 113a and distributed at the same phase to each latch within the macro. The clock is distributed to the phase adjusters 111a in the same way by the clock 114a. The phase adjuster 111a issues a clock 112a so that the clock 114a and the clock 121 have an identical phase.

[0045] An identical phase can therefore be achieved for the clock 121 and the input clock to each latch within the macro. The clock within the macro 100b can be made to operate the phase adjuster 111b in the same way as the phase adjuster 111a and the input clocks for each latch inside the macro 110b and the clock 122 given an identical phase. In this way, the latch within each macro and the mother circuit latches can be operated at the same phase in the semiconductor integrated circuit device 100 containing the macro 110a and 110b. Even if the macros of a mother circuit are changed, the phase adjusters 111a and 111b will keep the latches within each macro and the latches of each mother circuit operating at the same phase.

[0046] FIG. 8 shows an embodiment of a latch. The latch consists of 26 transistors and in the figure, D is the data

input, Q is the data output, CLK is the clock pulse. This latch is comprised of a master section shown by 500a and a slave section shown by 500b. When the clock is low or "L" the data input by D in the master section 500a is output unchanged to the node 501. The slave section 500b continually outputs the data held, to the Q regardless of the level of the node 501. Next, when the clock sets to "H" or high, the master section 500a holds the previous data in the node 501 regardless of the D level. The slave section 500b outputs the data of the node 501 to Q. In this way, the latch of FIG. 8 latches the D data at Q and outputs it the instant that the clock "L" transits from "L" to "H". (Strictly speaking, the circuit of FIG. 8 is not a latch but is actually a flip-flop, no distinction between those two names is made here.)

[0047] There are no particular restrictions on the method for distributing clock pulses at an identical phase to each latch from the clock buffers 103, 113a and 113b. The H-tree method may be used and the mesh method may be used.

[0048] FIG. 4 is an example showing use of the H-tree method. The clocks input from 200 can be distributed as clock pulses at an identical phase to nodes 201a through 201p.

[0049] Adjusting the lines to the same length is the generally used method for identical phase clock distribution. As low a resistance as possible is needed when selecting a (wire) line material for the clock. In recent years, copper has come to be used as the material for metallic wiring lines so copper wiring line is preferred for the clock signal line.

[0050] FIG. 7 shows an example when a wire-length adjuster for zero-skew clock routing 210a and 210b are added in the H-tree method of FIG. 4. Generally, adjusting the wire lengths to an equivalent length is difficult regardless of whether the H-tree method is used. In such cases, adding a wire-length adjuster for zero-skew clock routing 210a and 210b as shown in FIG. 7 will enable the proper adjustment.

[0051] In the embodiment in FIG. 1, the phase adjuster circuits 111a and 111b have been added to the macro 110a and 110b. This kind of method is utilized by the provider (designer) of the macro to eliminate clock skew.

[0052] Another configuration is shown in FIG. 9. This configuration is designed to counteract clock skew on the system side composed of macros. In FIG. 9, the phase adjuster circuits 111a and 111b have been added externally to the macros 110a and 110b.

[0053] Providing each macro with a phase adjuster as in the case of FIG. 1 has the advantage of making design of the mother circuit simple. On the other hand, if the configuration of FIG. 9 is used, providing a terminal for output to the mother circuit from the feedback clock 114a or 114b in each macro is required however since a phase adjuster in no longer needed for each macro, this configuration has the advantage that macro design is simple.

[0054] Generally, clock skew is not much of a problem in most cases when using macros at clock frequencies with low speeds. In such cases, the phase adjuster is not required inside the macro as was shown in FIG. 1. In contrast, in FIG. 9, a phase adjuster can be installed as needed in the mother circuit so that utilization of space is improved.

[0055] There are no particular restrictions on the structure of the PLL 101. The so called DLL structure may be used,

and an SMD (synchronous mirror delay) such as shown in the IEEE 1998 Custom Integrated Circuits Conference, pp. 511-514 may also be used. When the SMD is used for **101** shown in **FIG. 1**, a portion of the SMD does not have a feedback function and appears not to be applicable to the structure of **FIG. 1**. However, even in this case, a dummy clock buffer is usually contained internally and if the output from this dummy clock buffer is considered as the clock feedback, then the structure can be considered equivalent to the structure of the drawing of this invention in **FIG. 1**.

[**0056**] An embodiment of the PLL **101** (phase locked loop) is shown in **FIG. 5**. Clock CLK **306** is a clock that is input externally. In the figure, **301** is a phase frequency detector, **302** is a charge pump, **303** is a low-pass filter, **304** is a voltage-controlled oscillator and **305** is a divider. Details of the respective circuits are omitted here.

[**0057**] The difference in the phase and frequency between the clock **306** and the internal clock **312** are compared in the phase frequency detector **301** and output as the error signals **307a** and **307b**. These error signals are converted to analog signals in the charge pump **302** and after removing the high frequency component of these error signals with the low-pass filter **303** are input as an oscillator frequency control signal **309** to the voltage-control oscillator **304**. The oscillator output from the voltage-control oscillator **304** is supplied as a clock **310** to the clock distribution network of the mother circuit. The clock **311** from the clock distribution network is frequency divided in a divider **305**, and then input to the phase frequency detector **301**.

[**0058**] The phase of the clock **306** and an internal clock **306** are synchronized by means of the phase synchronous loop **101**, and the frequency of the clock **310** is divided several times according to the frequency division rate per the clock **306** of the divider **305**. **FIG. 5B** shows the operation waveforms when the frequency division rate of the divider **305** is two.

[**0059**] There are no particular restrictions on the structure of the phase adjuster **111**. The structure may be the so-called PLL or DLL (delay locked loop) or an SMD (synchronous mirror delay) structure may be used. Using an SMD structure allows a digital circuit configuration so that the phase adjuster can be comprised of a combination of logic circuits, having the beneficial effect that implementing the desired circuit is easy.

[**0060**] When SMD (synchronous mirror delay) is used for the phase adjuster **111** of **FIG. 1**, a portion of the SMD does not have a feedback function and does not appear to be applicable to the structure of **FIG. 1**. However, even in this case, a dummy clock buffer is usually contained internally and if the output from this dummy clock buffer is considered as the clock feedback, then the structure can be considered equivalent to the structure of the drawing of this invention in **FIG. 1**.

[**0061**] **FIG. 6** shows an example of the phase adjuster **111a** or **111b** configured with a DLL (delay locked loop) structure.

[**0062**] The reference numeral **406** in **FIG. 6** is an externally input clock. The reference numeral **401** is a phase frequency detector, **402** is a charge pump, **403** is a low-pass filter and **404** is a voltage-controlled delay line. Details of the respective circuits are omitted here.

[**0063**] The difference in the phase and frequency between the clock **406** and the internal clock **412** are compared in the phase frequency detector **401** and output as the error signals **407a** and **407b**. These error signals are converted to analog signals in the charge pump **402** and after removing the high frequency component of these error signals with the low-pass filter **403** are input as a delay control signal **409** to the voltage-control oscillator **404**. The oscillator output of the voltage-control oscillator **404** is supplied as a clock **410** to the clock distribution network inside the macro. The clock **412** from the clock distribution network is input to the phase frequency detector **401**.

[**0064**] A clock **410** is issued by the phase adjuster **111** to synchronize the phase of the clock **406** and the internal clock **412**. The operation waveforms are shown in **FIG. 6B**.

[**0065**] **FIG. 10** shows an example of the macro. The example in **FIG. 10** is a dynamic memory in a pipeline configuration. In this figure, **601** is an address latch, **602** is an address decoder, **603** is an address driver, **604** is a sensing amplifier and write amplifier, **605** is an input data DI latch, **606** is a write buffer, **607** is an I/O line amplifier to amplify the signals of I/O lines **610** and **611**, **608** and **609** are bit lines for BL and /BL, **610** and **611** are I/O lines, **612** is a word line, and **613** is a memory cell. After the clock CLK passes the phase adjuster **620**, it is input at an identical phase to the address latch **601**, the input data DI latch **605** and the I/O line amplifier **607**. The reference numeral **621** denotes a clock feedback line equivalent to the clock **114a** of **FIG. 1**, a clock at an identical phase for **601**, **605** and **607** is input to the phase adjuster **620**.

[**0066**] During read, after the address latched in the address latch **601** has been decoded, one address is selected and asserted in the word line **612**. The information output from the bit line BL, /BL is amplified in the sensing amplifier **604**. The amplified memory cell data is latched in **607** at the next clock and the amplifier latch **607** outputs as the output data DO.

[**0067**] During write, after the address latched in the address latch **601** has been decoded, one address is selected and asserted in the word line **612**. The write data is simultaneously latched in the input data DI latch **605** and the write buffer **606** drives the bit line BL, /BL. Writing is then performed onto the memory cell by this operation.

[**0068**] In the above two operations, the precharge operation such as for the bit lines BL, /BL and I/O lines, is omitted.

[**0069**] The clock phase supplied to each latch in the address switch **601**, the input data DI latch **605**, and the I/O line amplifier **607** is made to match the clock phase of the mother circuits using the dynamic memory of **FIG. 10**, by means of the clock distribution method of this invention.

[**0070**] This invention therefore renders the effect in a semiconductor integrated circuit device containing macros that the clock supplied to the latches inside the mother circuits and the clock supplied to the latches in the macro both have an identical phase.

What is claimed is:

1. An electrical circuit containing a clock generator to supply clock signals, a phase adjuster for said clock signals and plurality of first controlled circuits supplied with clock

pulses from said clock generator, a second controlled circuit supplied with clock signals passed by the phase adjuster for said clock signals wherein the clock phases input to said first controlled circuit and said phase adjuster for said clock signals are identical phases.

2. An electrical circuit of claim 1 wherein the number of first controlled circuits supplied at this time by clock pulses from the clock generator is typically larger than the number of clock signal phase adjusters.

3. An electrical circuit of claim 1 or claim 2 wherein said electrical circuit has a phase frequency detector to input a first clock and the second clock and compare the frequencies, and outputs three clock signals controlled by the output of the phase frequency detector.

4. A semiconductor integrated circuit device has a first clock processing means to input a first clock and a second clock and generate a third clock, a second clock processing means to input a third clock and a fourth clock and generate a fifth clock, and a first latch group and a second latch group comprised of at least one latch, wherein the second clock is generated from the third clock by way of a buffer, the frequency of the second and third clocks are identical, the first clock processing means generates the third clock so that the first and second clocks will have an identical phase and frequency, a fourth clock is generated by way of a buffer from the fifth clock, the frequency of the fourth and fifth clocks are identical, the second clock processing means generates a fifth clock so that the third and fourth clocks will have an identical phase and identical frequency, the third clock is supplied by way of a buffer to the first latch group, the fifth clock is supplied by way of a buffer to the second latch group, and the first latch group and the second latch group operate at an identical phase.

5. A semiconductor integrated circuit device has a first clock processing means to input a first clock and a second clock and generate a third clock, a second clock processing means to input a third clock and a fourth clock and generate a fifth clock, and a first latch group and a second latch group comprised of at least one latch wherein a second clock is generated from a third clock by way of a buffer or divider, the frequency of the second clock is lower than the frequency of the third clock, the first clock processing means generates a third clock so that the first and second clocks will have an identical phase and an identical frequency, a fourth clock is generated from a fifth clock by way of a buffer, the fourth clock and the fifth clock are identical frequencies, the second clock processing means generates a fifth clock so that the third and fourth clocks will have an identical phase and an identical frequency, a third clock is supplied by way of a buffer to the first latch group, a fifth clock is supplied by way of a buffer to the second latch group, and the first latch group and the second latch group operate at an identical phase.

6. A semiconductor integrated circuit device has a first clock processing means to input a first clock and a second clock and generate a third clock, a second clock processing means to input a third clock and a fourth clock and generate a fifth clock, and a first latch group and a second latch group comprised of at least one latch wherein a second clock is generated from a third clock by way of a buffer or divider, the frequency of the second clock is lower than the frequency of the third clock, the first clock processing means generates a third clock so that the first and second clocks will have an identical phase and an identical frequency, a fourth

clock is generated from a fifth clock by way of a buffer and divider, the fourth clock frequency is lower than the fifth clock frequency, the second clock processing means generates a fifth clock so that the third and fourth clocks will have an identical phase and an identical frequency, a third clock is supplied by way of a buffer to the first latch group, a fifth clock is supplied by way of a buffer to the second latch group, and the first latch group and the second latch group operate at an identical phase.

7. A semiconductor integrated circuit device of any or any one of claim 4 through claim 6 having a first clock processing means comprised of a phase frequency comparator to input a first clock and a second clock and output a first error signal, a charge pump circuit to input said first error signal and output a second error signal, a low-pass filter to input said second error signal and output a third error signal, and a voltage-controlled oscillator to change the oscillation frequency by means of said third error signal wherein said third clock is generated by said voltage-controlled oscillator.

8. A semiconductor integrated circuit device of any one of claim 4 through claim 7 wherein said first clock processing means and said second clock processing means are integrated onto the same chip.

9. A circuit design method to read out design data for a first circuit block from a record medium stored with design data for a first circuit block and combine with a second circuit block design data to comprise design data for a single semiconductor integrated circuit device wherein a clock signal phase adjuster means is inserted between said first circuit block and said second circuit block.

10. A circuit design method provided with a first circuit block design data having a clock output terminal to output a clock signal, and a circuit to adjust the phase of the clock signal sent from said clock output terminal, and combine with a second circuit block design data wherein the clock output terminal of said first circuit block is connected to the clock input terminal of said second circuit block.

11. A record medium for storing circuit design data wherein said record medium has a clock input terminal to receive a clock signal, a circuit to adjust the phase of the clock signal sent from said clock input terminal, and an internal circuit controlled by said adjusted clock signal.

12. A record medium of claim 11 wherein the circuit described by said design data performs signal exchange with external circuits by means of the metal level formed on said circuit board.

13. A record medium of claim 11 or claim 12 wherein said design data contains a physical layout and scale when fabricating a circuit as said semiconductor integrated circuit device.

14. A data distribution method provided with a recording medium for storing circuit design data and said record medium has a clock input terminal to receive a clock signal, a circuit to adjust the phase of the clock signal sent from said clock input terminal, and an internal circuit controlled by said adjusted clock signal wherein said circuit data from said record medium is sent to a user in response to a request from said user for transfer of data.

15. An electrical circuit having a clock generator to supply clock signals, a plurality of first controlled circuits supplied with clock signals from said clock generator and clock signal phase adjuster circuits, a second controlled circuit supplied with clock signals passed through said clock signal phase adjuster circuits wherein the number of first controlled

circuits supplied by clock pulses from said clock generator is larger than the number of clock signal phase adjuster circuits.

**16.** An electrical circuit having a clock generator to supply clock signals, a plurality of first controlled circuits supplied with clock signals from said clock generator and clock signal phase adjuster circuits, a second controlled circuit supplied with clock signals passed through said clock signal phase adjuster circuits wherein the percentage occupied by said first control circuits from among the fan-out from the clock generator is larger than the percentage of clock signal phase adjuster circuits.

**17.** An electrical circuit of claims **15** or claim **16** wherein said clock signal phase adjuster circuit is a phase locked loop or a delay locked loop.

**18.** An electrical circuit of any one of claims **15** through **17** wherein said electrical circuit has a first clock line and a second clock line distributed in two directions from said clock generator, a third clock line and a fourth clock line

distributed in two directions from said first clock line, and a fifth clock line and a sixth clock line distributed in two directions from said second clock line.

**19.** An electrical circuit of claim **18** where directions are opposite said two directions.

**20.** An electrical circuit of any one of claims **15** through **19** wherein said first and said second controlled circuits contain latch circuits.

**21.** An electrical circuit having a signal clock generator for supplying signals of a specified frequency, a plurality of first latch circuits and said phase adjuster circuits supplied with signals from said signal clock generator, and a plurality of second latch circuits supplied with signals passed through said signal phase adjuster circuits wherein the percentage occupied by said first latch circuits from among the fan-out from the signal clock generator is larger than the percentage of clock signal phase adjuster circuits.

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