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LOW POWER CONSUMPTION POWER-ON RESET SYSTEM

Abstract

A Power-on Reset (POR) system includes: an SR latch circuit, powered by a supply voltage, for generating a POR signal according to the supply voltage and an enable signal; and at least one operating circuit, powered by the supply voltage. At least one state circuit in the operating circuit is reset by the POR signal. When the supply voltage starts up, an output terminal of the SR latch circuit has a predetermined state, such that after the supply voltage starts up and before the enable signal is enabled for a first time, the POR signal is in a reset state to reset the at least one state circuit in the operating circuit. After the supply voltage starts up and the enable signal is enabled for the first time, the POR signal turns to a non-reset state, and the operating circuit is enabled to operate according to the enable signal.

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Background/Summary

CROSS REFERENCE

[0001] The present invention claims priority to TW patent application Ser. No. 11/310,6036, filed on Feb. 20, 2024.

BACKGROUND OF THE INVENTION

Field of Invention

[0002] The present invention relates to a power-on reset system. Particularly it relates to a low power consumption power-on reset system.

Description of Related Art

[0003] FIG. 1A shows a block diagram of a power-on reset system of prior art. As shown in FIG. 1A, in the power-on reset system **9000** of prior art, both the power-on reset circuit **910** and the operating circuit **920** are powered by the supply voltage VCC. The power-on reset circuit **910** generates a power-on reset signal POR' based on the supply voltage VCC. The operating circuit **920** resets plural SR latch circuits within the operating circuit **920** according to the power-on reset signal POR'.

[0004] FIGS. 1B and 1C show schematic diagrams of the power-on reset circuit of prior art. The power-on reset circuit **910** of FIG. 1A can be configured as the power-on reset circuit **911** of FIG. 1B or the power-on reset circuit **912** of FIG. 1C. As shown in FIG. 1B, the power-on reset circuit **911** includes a resistor Rs, a capacitor C and an inverter **9111**. The inverter **9111** generates the power-on reset signal POR' based on the signal Sig at the joint node between the resistor Rs and the capacitor C. As shown in FIG. 1C, the power-on reset circuit **912** includes a reference signal generation circuit **9121** and a comparator **9122**. The comparator **9122** generates the power-on reset signal POR' based on the reference signal Vref generated by the reference signal generation circuit **9121** and the supply voltage VCC.

[0005] FIG. 2 shows an operation waveform diagram corresponding to the power-on reset system of prior art in FIGS. 1A and 1B. One drawback of the prior art is that when the power-on reset circuit **910** of FIG. 1A is configured as the power-on reset circuit **911** of FIG. 1B, if the level of the supply voltage VCC ramps up slowly, the level of the power-on reset signal POR' will be too low to enter the reset state (e.g., high state), causing the plural SR latch circuits within the operating circuit **920** to also fail to enter the reset state. Another drawback of the prior art is that when the power-on reset circuit **910** of FIG. 1A is configured as the power-on reset circuit **912** of FIG. 1C, the power-on reset system is inefficient due to excessive power consumption.

[0006] In view of this, the present invention addresses the deficiencies of the prior art by proposing a low power consumption power-on reset system. The power-on reset system of the present invention, through the special design of the power-on reset circuit, not only reduces power consumption but also ensures that the level of the power-on reset signal can continue to keep ramping up, even when the level of the supply voltage ramps up slowly, to enter the reset state, thereby achieving the reset operation of the power-on reset circuit on the operating circuit.

SUMMARY OF THE INVENTION

[0007] From one perspective, the present invention provides a power-on reset system comprising: an SR latch circuit, powered by a supply voltage and configured to generate a power-on reset signal according to the supply voltage and an enable signal; and at least one operating circuit, powered by the supply voltage and configured to reset at least one state circuit within each of the at least one operating circuit according to the power-on reset signal; wherein when the supply voltage starts up, an output terminal of the SR latch circuit is configured to have and keep at a predetermined state, such that after a start-up of the supply voltage and before a first enablement of the enable signal, the power-on reset signal is in a reset state to reset the at least one state circuit within each

of the at least one operating circuit; wherein after the first enablement of the enable signal subsequent to the start-up of the supply voltage, the power-on reset signal turns to a non-reset state.

[0008] In one preferred embodiment, the SR latch circuit includes plural logic gates which include: a first logic gate and a second logic gate cross-coupled through feedback connections to each other, wherein the first logic gate receives a signal related to the enable signal, and the second logic gate receives a signal related to the supply voltage, wherein one of outputs of either the first logic gate or the second logic gate corresponds to the power-on reset signal.

[0009] In one preferred embodiment, each of the plural logic gates includes plural upper transistors and plural lower transistors complementarily coupled to each other, wherein the conduction impedances of the plural upper transistors and the plural lower transistors in at least one of the first logic gate and the second logic gate are asymmetrical to an extent that the output terminal of the SR latch circuit has the predetermined state upon the start-up of the supply voltage.

[0010] In one preferred embodiment, the output terminal includes a positive output terminal and a negative output terminal, the power-on reset system further comprising: a pulling circuit configured to pull at least one of the positive output terminal and the negative output terminal to a corresponding predetermined voltage upon the start-up of the supply voltage, such that the output terminal of the SR latch circuit has the predetermined state.

[0011] In one preferred embodiment, the pulling circuit is configured to pull the positive output terminal to a first predetermined voltage, and/or to pull the negative output terminal to a second predetermined voltage, wherein the first predetermined voltage and the second predetermined voltage are complementary.

[0012] In one preferred embodiment, the pulling circuit includes a pulling component coupled to either the positive output terminal or the negative output terminal for pulling the respective terminal to the corresponding predetermined voltage, wherein the pulling component includes: an enhancement-mode MOS transistor controlled to be non-conductive; a depletion-mode MOS transistor controlled to be non-conductive; or a resistor.

[0013] In one preferred embodiment, each of the first logic gate and the second logic gate is either a NOR gate or a NAND gate.

[0014] In one preferred embodiment, after the first enablement of the enable signal following the start-up of the supply voltage and after the power-on reset signal turns to the non-reset state, the operating circuit is configured to operate when the enable signal is enabled and to cease operation when the enable signal is disabled.

[0015] The objectives, technical details, features, and effects of the present invention will be better understood with regard to the detailed description of the embodiments below.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. 1A shows a block diagram of a power-on reset system of prior art.

[0017] FIGS. 1B and 1C show schematic diagrams of the power-on reset circuit of prior art.

[0018] FIG. 2 shows an operation waveform diagram corresponding to the power-on reset system of prior art in FIGS. 1A and 1B.

[0019] FIG. 3A shows a block diagram of an embodiment of the power-on reset system of the present invention.

[0020] FIG. 3B shows a block diagram of an embodiment of the power-on reset system of the present invention.

[0021] FIG. 4A shows an operation waveform diagram of an embodiment of the power-on reset system of the present invention.

[0022] FIG. 4B shows an operation waveform diagram corresponding to FIG. 3B of an

embodiment of the power-on reset system of the present invention.

[0023] FIGS. 5A and 5B show schematic diagrams of two specific embodiments of the SR latch circuit in the power-on reset system of the present invention.

[0024] FIG. 6 shows a schematic diagram of a specific embodiment

[0025] of the SR latch circuit in the power-on reset system of the present invention.

[0026] FIG. 7 shows an operation waveform diagram of an embodiment of the power-on reset system of the present invention compared to the prior art.

[0027] FIGS. 8A and 8B show schematic diagrams of two specific embodiments of the SR latch circuit in the power-on reset system of the present invention.

[0028] FIGS. 9A to 9C show schematic diagrams of various specific embodiments of the pulling circuit corresponding to FIG. 8A of the present invention.

[0029] FIGS. 10A to 10C show schematic diagrams of various specific embodiments of the pulling circuit corresponding to FIG. 8B of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0030] The drawings as referred to throughout the description of the present invention are for illustration only, to show the interrelations between the circuits and the signal waveforms, but not drawn according to actual scale.

[0031] FIG. 3A shows a block diagram of an embodiment of the power-on reset system of the present invention. In one embodiment, a power-on reset system **3001** comprises an SR latch circuit **100** and at least one operating circuit. In this embodiment, the at least one operating circuit includes an operating circuit **300**. In other embodiments, the at least one operating circuit may also include plural operating circuits, as those skilled in the art can infer from the description of the following embodiments. In one embodiment, the power-on reset circuit in the power-on reset system **3001** is configured as the SR latch circuit **100** to generate a power-on reset signal POR at the positive output terminal Q, thereby indicating to the operating circuit **300** to reset when required. In one embodiment, both the SR latch circuit **100** and the operating circuit **300** are powered by a supply voltage VCC. It should be noted that the SR latch circuit **100** includes a positive output terminal Q and a negative output terminal Q_N (the same applies to all SR latch circuits hereinafter), and either the positive output terminal Q or the negative output terminal Q_N can be used to generate the power-on reset signal POR according to the requirements (e. g., signal polarities) of the operating circuit.

[0032] As shown in FIG. 3A, in one embodiment, the SR latch circuit **100** generates the power-on reset signal POR based on the supply voltage VCC and the enable signal EN. The operating circuit **300** resets at least one state circuit within the operating circuit **300** according to the power-on reset signal POR, during start-up of the supply voltage. In this embodiment, the at least one state circuit includes a state circuit **200**. In other embodiments, the at least one state circuit may also include plural state circuits, as those skilled in the art can infer from the description of the following embodiments. In this embodiment, the state circuit **200** is an SR latch circuit, and the power-on reset signal POR is coupled to a reset terminal R of the state circuit **200**, thereby resetting the state circuit **200**.

[0033] Please refer to FIGS. 3A and 4A concurrently. FIG. 4A shows an operation waveform diagram of an embodiment of the power-on reset system of the present invention. In one embodiment, when the supply voltage VCC starts up (at time t₁, where VCC starts to ramp up from 0V), the output terminal of the SR latch circuit **100** is configured to have and keep at a predetermined state. Thus, after the start-up of the supply voltage VCC and before a first enablement of the enable signal EN (from time t₁ to t₂ in FIG. 4A), the power-on reset signal POR is in a reset state (e.g., high level following the level of VCC) to reset the state circuit **200** within the operating circuit **300**. In one embodiment, after the first enablement of the enable signal EN following the start-up of the supply voltage VCC (after time t₂ in FIG. 4A), the power-on reset signal POR turns to a non-reset state (e.g., low level).

[0034] In the embodiments of FIGS. 3A and 4A, after the rising edge of the enable signal EN triggers the power-on reset signal POR to turn to a non-reset state, the operating circuit **300** can operate in an operating state. For example, in the non-reset state, the state circuit **200** within the operating circuit **300** generates an output signal Lout according to the input signal

[0035] Din.

[0036] Please refer to FIGS. 3B and 4B concurrently. FIG. 3B shows a block diagram of an embodiment of the power-on reset system of the present invention. FIG. 4B shows an operation waveform diagram corresponding to FIG. 3B of an embodiment of the power-on reset system of the present invention. The power-on reset system **3001'** and the operating circuit **300'** in FIG. 3B are similar to the power-on reset system **3001** and the operating circuit **300** in FIG. 3A, respectively. In this embodiment, the operating circuit **300'** operates further according to the enablement of the enable signal EN. As specifically illustrated in FIG. 4B, after time t₂, the power-on reset signal POR turns to a low level, causing the operating circuit **300'** to enter a non-reset state. In the non-reset state, the operating circuit **300'** operates during the enablement period of the enable signal EN (e.g., the high level from t₂ to t₃ or t₄ to t₅) and is disabled during the disablement period of the enable signal EN (e.g., the low level between t₃ and t₄ or after t₅).

[0037] It should be noted that, as shown in FIGS. 4A and 4B, after the first enablement of the enable signal EN (after time t₂), the power-on reset signal POR remains in the non-reset state until the supply voltage VCC is turned off. Upon the next start-up of the supply voltage VCC following a power-down, the power-on reset signal POR re-enters the reset state according to the supply voltage VCC, thereby resetting the operating circuits **300** and **300'** again.

[0038] FIGS. 5A and 5B show schematic diagrams of two specific embodiments of the SR latch circuit in the power-on reset system of the present invention. In one embodiment, each of the SR latch circuits **100** in FIGS. 3A and 3B includes plural logic gates, which include a first logic gate and a second logic gate. In one embodiment, the first logic gate and the second logic gate are both NOR gates or both NAND gates. Specifically, each of the SR latch circuits **100** in FIGS. 3A and 3B can be configured as an SR latch circuit **110** in FIG. 5A or an SR latch circuit **120** in FIG. 5B. In one embodiment, the first logic gate and the second logic gate can be respectively configured as a NOR gate **41** and a NOR gate **42** in the SR latch circuit **110** in FIG. 5A. In another embodiment, the first logic gate and the second logic gate can be respectively configured as a NAND gate **51** and a NAND gate **52** in the SR latch circuit **120** in FIG. 5B.

[0039] In one embodiment, as shown in FIG. 5A, the first logic gate and the second logic gate are cross-coupled to each other. Specifically, an input terminal of the NOR gate **41** corresponds to a reset terminal R of the SR latch circuit **110**, and the other input terminal thereof is coupled to an output terminal of the NOR gate **42** (corresponding to a negative output terminal Q_Q of the SR latch circuit **110**). An input terminal of the NOR gate **42** corresponds to a set terminal S of the SR latch circuit **110**, and the other input terminal thereof is coupled to an output terminal of the NOR gate **41** (corresponding to a positive output terminal Q of the SR latch circuit **110**). In one embodiment, the first logic gate receives a signal related to the enable signal EN, and the second logic gate receives a signal related to the supply voltage VCC. The output of one of the first logic gate or the second logic gate corresponds to the power-on reset signal POR. In this embodiment, the NOR gate **41** receives the enable signal EN (via the reset terminal R), and the NOR gate **42** receives the signal related to the supply voltage VCC. In this embodiment, the set terminal S corresponding to the NOR gate **42** receives a ground potential, and the output terminal of the NOR gate **41** (i.e., the positive output terminal Q of the SR latch circuit **110**) corresponds to the power-on reset signal POR.

[0040] In one embodiment, as shown in FIG. 5B, the coupling structure of the NAND gate **51** and the NAND gate **52** is similar to that of FIG. 5A, which can be deduced by those skilled in the art from FIG. 5A and thus will not be redundantly described. The difference is that, in the embodiment of FIG. 5B, the NAND gate **51** receives an inverted enable signal EN (via an inverted reset

terminal R of the SR latch circuit **120**). In this embodiment, an inverted set terminal S corresponding to the NAND gate **52** receives the supply voltage VCC, and an output terminal of the NAND gate **52** (i.e., a positive output terminal Q of the SR latch circuit **120**) corresponds to the power-on reset signal POR. The following describes the operation of specific embodiments of FIG. 5A, and those skilled in the art can deduce the operation of specific embodiments of FIG. 5B from the following description.

[0041] FIG. 6 shows a schematic diagram of a specific embodiment of the SR latch circuit in the power-on reset system of the present invention. An SR latch circuit **111** of FIG. 6 is a specific embodiment of the SR latch circuit **110** of FIG. 5A. In one embodiment, each of the first logic gate (i.e., NOR gate **411**) and the second logic gate (i.e., NOR gate **421**) in the SR latch circuit **111** includes plural upper transistors and plural lower transistors complementarily coupled to each other. Specifically, the NOR gate **411** includes upper transistors UQ1 and UQ2, and lower transistors LQ1 and LQ2. The NOR gate **421** includes upper transistors UQ3 and UQ4, and lower transistors LQ3 and LQ4.

[0042] In one embodiment, the conduction impedances of the plural upper transistors and plural lower transistors in at least one of the first logic gate and the second logic gate are asymmetrical to an extent that the SR latch circuit **111** has the aforementioned predetermined state upon the start-up of the supply voltage VCC.

[0043] Specifically, the plural upper transistors and plural lower transistors in the NOR gate **411** and the NOR gate **421** in FIG. 6 are configured as one of the following: [0044] (1) The conduction impedances of the upper transistors UQ1 and UQ2 in the NOR gate **411** are smaller than those of the lower transistors LQ1 and LQ2, i.e., the width-to-length ratios of the upper transistors UQ1 and UQ2 are larger than those of the lower transistors LQ1 and LQ2; or [0045] (2) The conduction impedances of the upper transistors UQ3 and UQ4 in the NOR gate **421** are larger than those of the lower transistors LQ3 and LQ4, i.e., the width-to-length ratios of the upper transistors UQ3 and UQ4 are smaller than those of the lower transistors LQ3 and LQ4; or [0046] (3) The NOR gate **411** is configured as (1) above and the NOR gate **421** is configured as (2) above.

[0047] Please refer to FIGS. 6 and 7 concurrently. FIG. 7 shows an operation waveform diagram of an embodiment of the power-on reset system of the present invention compared to the prior art. In one embodiment, with the configuration in FIG. 6, the output terminal of the SR latch circuit **111** has a predetermined state, that is, the level of the power-on reset signal POR output from the positive output terminal Q is higher than that of the signal output from the negative output terminal Q. Thus, after the supply voltage VCC starts up at time t1 and before the first enablement of the enable signal EN at time t2, even if the level of the supply voltage VCC ramps up slowly during start-up (as shown in FIG. 7, the time from t1 to t2 is relatively long), the level of the power-on reset signal POR can still continuously ramp up with the ramping-up of the supply voltage VCC, thereby entering the reset state. This avoids the situation in the prior art where the level of the power-on reset signal POR cannot rise to the proper reset state during the start-up of the supply voltage VCC (as shown by the second waveform POR' in FIG. 7).

[0048] Please refer to FIGS. 3A, 6, and 7 concurrently. As shown in FIG. 7, in one embodiment, the level of the power-on reset signal POR ramps up according to the level of the supply voltage VCC, thereby entering the reset state. At the first enablement of the enable signal EN (at time t2), the power-on reset signal POR turns to a low level, entering the non-reset state. It keeps at the non-reset state until the supply voltage VCC is turned off (e.g., at time t5). When the supply voltage VCC starts up again (e.g., at time t6), the level of the power-on reset signal POR ramps up again according to the level of the supply voltage VCC. In one embodiment, during the non-reset state (from time t2 to t5), the set terminal S of the state circuit **200** begins to operate normally based on the input signal Din (e.g., at time t3). For example, the output signal Lout generated by the positive output terminal Q of the state circuit **200** is triggered to a high level by the input signal Din. In one embodiment, the output signal Lout turns to a high level at time t3 and maintains this level for a

period of time, and then gradually ramps down to a low level at time t₄ as the level of the supply voltage VCC ramps down.

[0049] FIGS. **8A** and **8B** show schematic diagrams of two specific embodiments of the SR latch circuit in the power-on reset system of the present invention. An SR latch circuit **112** of FIG. **8A** and an SR latch circuit **113** of FIG. **8B** are similar to the SR latch circuit **111** of FIG. **6**. The difference is that each of the SR latch circuit **112** and the SR latch circuit **113** further includes a pulling circuit. In one embodiment, as shown in FIG. **8A**, the pulling circuit **510** is coupled to the positive output terminal Q. In another embodiment, as shown in FIG. **8B**, the pulling circuit **520** is coupled to the negative output terminal Q Q Q. In yet another embodiment, the SR latch circuit of the present invention includes a pulling circuit coupled to the positive output terminal Q and a pulling circuit coupled to the negative output terminal Q Q Q. In one embodiment, the pulling circuit **510** is configured to pull the positive output terminal Q to a first predetermined voltage when the supply voltage VCC starts up. In another embodiment, the pulling circuit **520** is configured to pull the negative output terminal Q Q Q to a second predetermined voltage when the supply voltage VCC starts up.

[0050] In one embodiment, the first predetermined voltage has a high level, and the second predetermined voltage has a low level. The first predetermined voltage and the second predetermined voltage are complementary. In a specific embodiment, the first predetermined voltage is the supply voltage VCC, and the second predetermined voltage is ground potential. By pulling the positive output terminal Q to the supply voltage VCC and/or pulling the negative output terminal Q Q Q to the ground potential, the pulling circuit ensures that the output terminal of the SR latch circuit has the predetermined state when the supply voltage VCC starts up. For details on the predetermined state, refer to the descriptions of FIGS. **6** and **7**, which are not redundantly described here.

[0051] FIGS. **9A** to **9C** show schematic diagrams of various specific embodiments of the pulling circuit corresponding to FIG. **8A** of the present invention. FIGS. **10A** to **10C** show schematic diagrams of various specific embodiments of the pulling circuit corresponding to FIG. **8B** of the present invention. In one embodiment, as shown in FIGS. **9A** to **9C**, the pulling circuit **510** includes a pull-up component, which can be configured as a pull-up component **511**, a pull-up component **512**, or a pull-up component **513**. In another embodiment, as shown in FIGS. **10A** to **10C**, the pulling circuit **520** also includes a pull-up component, which can be configured as a pull-up component **521**, a pull-up component **522**, or a pull-up component **523**.

[0052] In one embodiment, the pulling component **511** and the pulling component **521** respectively include an enhancement-mode MOS transistor QE1 and QE2, with their gates and sources coupled to each other and controlled to be non-conductive. Specifically, the pulling components **511** and **521** pull the corresponding output terminals to the predetermined voltage through the leakage current of the enhancement-mode MOS transistors QE1 and QE2. In one embodiment, the pulling component **512** and the pulling component **522** respectively include a depletion-mode MOS transistor QD1 and QD2, with their gates and sources coupled to each other and controlled to be non-conductive. In one embodiment, the pulling component **513** and the pulling component **523** respectively include a resistor R1 and a resistor R2.

[0053] It should be noted that FIGS. **6**, **8A**, and **8B** correspond to FIG. **5A**, showing specific embodiments of the SR latch circuit including NOR gates. Corresponding to FIG. **5B**, the specific transistor-level implementations of the SR latch circuit including NAND gates can be deduced by those skilled in the art and are not redundantly described here.

[0054] The present invention has been described in considerable detail with reference to certain preferred embodiments thereof. It should be understood that the description is for illustrative purpose, not for limiting the scope of the present invention. It is not limited for each of the embodiments described hereinbefore to be used alone; under the spirit of the present invention, two or more of the embodiments described hereinbefore can be used in combination. For example, two

or more of the embodiments can be used together, or, a part of one embodiment can be used to replace a corresponding part of another embodiment. Furthermore, those skilled in this art can readily conceive variations and modifications within the spirit of the present invention. For example, to perform an action “according to” a certain signal as described in the context of the present invention is not limited to performing an action strictly according to the signal itself, but can be performing an action according to a converted form or a scaled-up or down form of the signal, i.e., the signal can be processed by a voltage-to-current conversion, a current-to-voltage conversion, and/or a ratio conversion, etc. before an action is performed. The spirit of the present invention should cover all such and other modifications and variations, which should be interpreted to fall within the scope of the following claims and their equivalents.

Claims

1. A power-on reset system comprising: an SR latch circuit, powered by a supply voltage and configured to generate a power-on reset signal according to the supply voltage and an enable signal; and at least one operating circuit, powered by the supply voltage and configured to reset at least one state circuit within each of the at least one operating circuit according to the power-on reset signal; wherein when the supply voltage starts up, an output terminal of the SR latch circuit is configured to have and keep at a predetermined state, such that after a start-up of the supply voltage and before a first enablement of the enable signal, the power-on reset signal is in a reset state to reset the at least one state circuit within each of the at least one operating circuit; wherein after the first enablement of the enable signal subsequent to the start-up of the supply voltage, the power-on reset signal turns to a non-reset state.
2. The power-on reset system of claim 1, wherein the SR latch circuit includes plural logic gates which include: a first logic gate and a second logic gate cross-coupled through feedback connections to each other, wherein the first logic gate receives a signal related to the enable signal, and the second logic gate receives a signal related to the supply voltage, wherein one of outputs of either the first logic gate or the second logic gate corresponds to the power-on reset signal.
3. The power-on reset system of claim 2, wherein each of the plural logic gates includes plural upper transistors and plural lower transistors complementarily coupled to each other, wherein the conduction impedances of the plural upper transistors and the plural lower transistors in at least one of the first logic gate and the second logic gate are asymmetrical to an extent that the output terminal of the SR latch circuit has the predetermined state upon the start-up of the supply voltage.
4. The power-on reset system of claim 2, wherein the output terminal includes a positive output terminal and a negative output terminal, the power-on reset system further comprising: a pulling circuit configured to pull at least one of the positive output terminal and the negative output terminal to a corresponding predetermined voltage upon the start-up of the supply voltage, such that the output terminal of the SR latch circuit has the predetermined state.
5. The power-on reset system of claim 4, wherein the pulling circuit is configured to pull the positive output terminal to a first predetermined voltage, and/or to pull the negative output terminal to a second predetermined voltage, wherein the first predetermined voltage and the second predetermined voltage are complementary.
6. The power-on reset system of claim 5, wherein the pulling circuit includes a pulling component coupled to either the positive output terminal or the negative output terminal for pulling the respective terminal to the corresponding predetermined voltage, wherein the pulling component includes: an enhancement-mode MOS transistor controlled to be non- conductive; a depletion-mode MOS transistor controlled to be non- conductive; or a resistor.
7. The power-on reset system of claim 2, wherein each of the first logic gate and the second logic gate is either a NOR gate or a NAND gate.
8. The power-on reset system of claim 1, wherein after the first enablement of the enable signal

following the start-up of the supply voltage and after the power-on reset signal turns to the non-reset state, the operating circuit is configured to operate when the enable signal is enabled and to cease operation when the enable signal is disabled.
