

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
22 May 2008 (22.05.2008)

PCT

(10) International Publication Number
WO 2008/060098 A1

(51) International Patent Classification:
H02J 9/06 (2006.01)

(74) Agent: BAE, KIM & LEE IP GROUP; Hankook Tire Bldg., 647-15 Yoksam-dong, Gangnam-gu, Seoul 135-723 (KR).

(21) International Application Number:
PCT/KR2007/005713

(22) International Filing Date:
14 November 2007 (14.11.2007)

(25) Filing Language: Korean

(26) Publication Language: English

(30) Priority Data:
10-2006-0112150
14 November 2006 (14.11.2006) KR

(71) Applicant (for all designated States except US): **KT CORPORATION** [KR/KR]; 206 Jeongja-dong, Bundang-gu, Sungnam-si, Gyeonggi-do 463-010 (KR).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **JUNG, Hyun Chul** [KR/KR]; #2-1703 Namsan Town Apt., Sindang, 3-dong, Jung-gu, Seoul 100-754 (KR). **PARK, Dong Sung** [KR/KR]; #805-1601 Jeongdeunmaeul Hanjin 8-danji, Apt., Jeongja-dong, Bundang-gu, Seongnam-si, Gyeonggi-do 463-758 (KR).

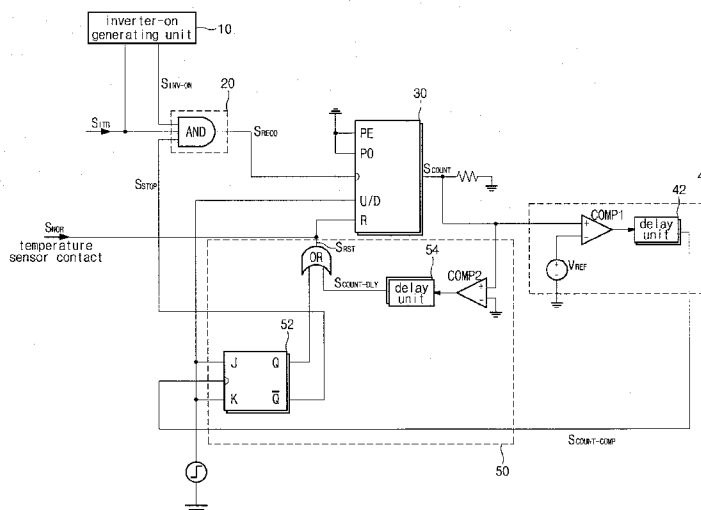
(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

(54) Title: UNINTERRUPTIBLE POWER SUPPLY WATCHDOG SYSTEM AND AUTO RECOVERY METHOD USING THE SYSTEM



(57) Abstract: According to the present invention, provided is a watchdog system for Uninterruptible Power Supply (UPS), and auto recovery method using the same. In case the power supply path of UPS is switched from the normal power line to the bypass line, the UPS watchdog system of the present invention is firstly compulsively recovers again the power supply path to the normal power line for given times and, nevertheless, in case it is not recovered, the power is supplied through the bypass line. Accordingly, in case the power supply path is switched to the bypass line due to the temporary disorder of UPS, it can be rapidly recovered to the normal power path, so that the power supply by the UPS apparatus can be more stably performed.

【DESCRIPTION】**【Invention Title】**

UNINTERRUPTIBLE POWER SUPPLY WATCHDOG SYSTEM AND
AUTO RECOVERY METHOD USING THE SAME

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【Technical Field】

The present invention relates to the Uninterruptible Power Supply (UPS), more particularly, to the UPS watchdog system and auto recovery method using the same, which determines whether a failure
10 is temporary or not in case a power supply path is switched to a bypass line due to an unusual condition of UPS, and rapidly recovers the disabled power supply path to the normal power line in case a corresponding failure is temporary.

15

【Background Art】

Typically, the UPS is designed with a view to steadily supplying the power having a constant voltage and frequency to a load even when a power failure is occurred in the common power source without notice or an input power is not constant.

20

Fig. 1 is a drawing that shows the configuration of an uninterruptible power supply (UPS) of the related art.

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In a normal mode, in case an alternating current (AC) power is inputted to UPS through a switch CB1, the inputted alternating current (AC) power is transformed from a rectifier 1 to a direct current (DC) power, and then, it is supplied to an inverter 2 and is charged in a

battery 3. The inverter 2 converts again the output power of the rectifier 1 into the alternating current to provide to a load. At this time, an output breaker CB3 is ON, while the switch STS, CB4 of a bypass module 4 is OFF. At this time, in case the input power is blocked due to the power failure, the DC power which is charged in the battery 3 is transformed into the AC power by the inverter 2 and the transformed AC power is supplied to a load. The path in which the input power or the DC power of the battery 3 is supplied through the inverter 2 is called as normal power line.

However, in case a malfunction of the inside of UPS or a momentary short circuit of the outside of UPS is generated while the input power is normally inputted, the electric power supply through the normal power line may be impossible. In this case, the control means (not shown) of the UPS blocks off the normal power line by making the output breaker CB3 to be OFF. The control means (not shown) changes the power supply path from the normal power line to the bypass line by making the switch STS, CB4 of the bypass module 4 to be ON. Accordingly, the input power is immediately supplied to a load through the bypass line. At this time, the switch CB4 of the bypass module 4 is applied with ON signal simultaneously with the static switch STS, and immediately being turned on after the static switch STS is turned on.

In case the power supply path is switched to the bypass line, a user checks out the unusual condition of UPS. When the check out is completed, the electric power supply is manually changed as 'inverter

first'. Therefore, the power is supplied again to a load through the normal power line.

In case of conventional UPS, an artificial operation of a user is required in order that the power supply path is switched again to the normal power line after switching to the bypass line.

Of course, the switching to the bypass line in the UPS can be generated when a really important failure is generated in the normal power line. However, it also can be generated by a temporary control failure of the inside of UPS or a temporary external load short circuit.

After the switching to the bypass line, the process of checking out by a user and manual switching to the normal power line should be completed. Therefore, there is a problem in that too much time is required for the recovery procedure even when a temporary control failure or a temporary external load short circuit is occurred.

Furthermore, if the failure of the bypass line is generated during such recovery procedure, there is a problem that the power supply for the load is completely blocked.

【Disclosure】

【Technical Problem】

Accordingly, an object of the present invention is to solve at least the problems and disadvantages of the related art. The object of the present invention is to provide a UPS apparatus capable of steadily supplying power by rapidly recovering to a normal power path in case a power supply path is switched to a bypass line due to a temporary

failure of UPS.

【Technical Solution】

In order to accomplish the object, according to an aspect of the present invention, provided is an UPS watchdog system that compulsively recovers a power supply path to a normal power line as much as a preset number, in case the power supply path of UPS is switched from the normal power line to a bypass line.

According to another aspect of the present invention, provided is an UPS watchdog system comprising an inverter-on generating unit that generates an inverter-on signal for turning on an inverter of an UPS in case a bypass signal is generated; a recovery signal generating unit that generates a recovery signal for changing the power supply path from the bypass line to the normal power line according to the bypass signal, the inverter-on signal and a recovery stop signal; a counter unit that outputs an accumulation count signal of the magnitude corresponding to the number of occurrence of the recovery signal; a counting comparison unit that generates a counting comparison signal in case the magnitude of the accumulation count signal is greater than a preset reference value; and a recovery stop unit that controls the generation of a reset signal for stopping the recovery stop signal and the counting of the counter unit according to the counting comparison signal and the accumulation count signal.

According to still another aspect of the present invention, provided is an UPS auto recovery method comprising a first step of

determining whether a power supply path of an UPS is switched from a normal power line to a bypass line; a second step of turning on an inverter of UPS and switching again the power supply path to the normal power line, in case the power supply path is switched to the bypass line; and a third step of repeatedly performing the first and the second step until the number of switching to the bypass line reaches a preset number.

【Advantageous Effects】

The present invention is to provide a UPS apparatus capable of steadily supplying power by rapidly recovering to a normal power path in case a power supply path is switched to a bypass line due to a temporary failure of UPS.

【Description of the Drawings】

Fig. 1 is a diagram showing the configuration of an uninterruptible power supply (UPS) of the related art.

Fig. 2 is a diagram showing the configuration of an UPS watchdog system according to the present invention.

Fig. 3 is a timing diagram showing the auto recovery operation according to the present invention, in case the failure of UPS is temporary.

Fig. 4 is a timing diagram showing the auto recovery operation process according to the present invention, in case the recovery signal SRECO is consecutively generated three times.

Fig. 5 is a timing diagram showing the auto recovery operation process according to the present invention, in case the recovery signal SRECO is consecutively generated five times.

5 **【Best Mode】**

The embodiment of the present invention will be illustrated in detail with reference to attached drawings.

Fig. 2 is a diagram showing the configuration of an UPS watchdog system according to the present invention.

10 The UPS watchdog system of Fig. 2 provides an inverter-on generating unit 10, a recovery signal generating unit 20, a counter unit 30, a counting comparison unit 40 and a recovery stop unit 50.

15 The inverter-on generating unit 10 outputs the inverter-on signal S_{INV-ON} for turning-on the inverter 2 when a preset given time elapses, in case a bypass signal S_{ITB} for switching the power supply path from a normal power line to a bypass line is generated when the UPS has a failure. That is, in case the power supply path is switched from the normal power line to the bypass line, the inverter-on generating unit 10 automatically generates an inverter-on signal S_{INV-ON} when the bypass signal S_{ITB} is generated in order to confirm whether such switching is caused by a temporary abnormal occurrence.

20 The recovery signal generating unit 20 outputs the recovery signal S_{RECO} for returning the power supply path from the bypass line to the normal power line according to the bypass signal S_{ITB} , the inverter-on S_{INV-ON} and the recovery stop signal S_{STOP} which will be

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mentioned later. Such recovery signal generating unit 20 includes a AND gate having the bypass signal S_{ITB} , the inverter-on signal S_{INV-ON} and a recovery stop signal S_{STOP} as input signal.

The counter unit 30 outputs the accumulation count signal S_{COUNT} that counts the output signal of the recovery signal generating unit 20, that is, the number of occurrence of the recovery signal S_{RECO} and has the magnitude corresponding to the number of generating the recovery signal S_{RECO} . In the present embodiment, the up-counter is used as counter unit 30. The counter unit 30 increases the magnitude of the accumulation count signal S_{COUNT} as much as a predetermined amount (for example, 1V) to output whenever the recovery signal S_{RECO} is generated. For example, the counter unit 30 outputs the accumulation count signal S_{COUNT} which has the magnitude of 1V when the recovery signal S_{RECO} is once generated, thereafter, when the recovery signal S_{RECO} is again generated, it outputs the accumulation count signal S_{COUNT} which has the magnitude of 2 V (1V + 1V). The counter unit 30 is to be reset when a normal operation signal S_{NOR} or a reset signal S_{RST} from the recovery stop unit 50 is applied, and discontinues a count.

The counting comparison unit 40 outputs the counting comparison signal $S_{COUNT-COMP}$ in case the magnitude of the accumulation count signal S_{COUNT} becomes larger than a reference value V_{REF} by comparing the magnitude of the accumulation count signal S_{COUNT} with a preset reference value V_{REF} . At this time, the magnitude of the reference value V_{REF} is settled depending on how

many times the watchdog system of the present invention implements repair operation in UPS in the abnormal occurrence. That is, since the magnitude of the accumulation count signal S_{COUNT} is increased in proportion to the number of occurrence of the recovery signal S_{RECO} , in case the reference value V_{REF} is set up between $2V \sim 3V$, the counting comparison signal $S_{\text{COUNT-COMP}}$ is generated when the recovery signal S_{RECO} is generated three times. This counting comparison unit 40 includes a comparator COMP1 that outputs the counting comparison signal $S_{\text{COUNT-COMP}}$ by comparing the magnitude of the accumulation count signal S_{COUNT} with the preset reference value V_{REF} , and a delay unit 42 that makes a time delay of the output signal $S_{\text{COUNT-COMP}}$ of the comparator COMP1 to output to the recovery stop unit 50.

The recovery stop unit 50 selectively stops the auto recovery operation of the present invention and the counting operation of the counter unit 30 according to the counting comparison signal $S_{\text{COUNT-COMP}}$. That is, when the counting comparison signal $S_{\text{COUNT-COMP}}$ is generated, the recovery stop unit 50 determines that the failure of UPS is not a temporary failure but a serious failure, and generates the recovery stop signal S_{STOP} . The recovery stop signal S_{STOP} is applied to the recovery signal generating unit 20 and stops the occurrence of the recovery signal S_{RECO} . Further, the recovery stop unit 50 outputs the signal of high level to one of input terminal of the OR-gate and generates the reset signal S_{RST} . Furthermore, in case the recovery signal S_{RECO} is not generated as much as the preset times for a predetermined time (for example, three minutes), the recovery stop

unit 50 determines this as a normal state and generates the reset signal S_{RST} to stop the counting operation of the counter unit 30. This recovery stop unit 50 provides a J/K flip flop 52 that outputs the differential signal($\mathcal{Q}$, $\overline{\mathcal{Q}}$) according to the counting comparison signal $S_{COUNT-COMP}$, a comparator COMP2 that senses the generation of the accumulation count signal S_{COUNT} and changes it into a rectangular wave to output, a delay unit 54 that delays the output signal of the comparator COMP2 for a given time, and an OR-gate that outputs the reset signal S_{RST} when at least one signal is generated among any one differential signal($\mathcal{Q}$) of J/K flip flop 52 and a delay count signal $S_{COUNT-DLY}$ from the delay unit 54.

Fig. 3 to Fig. 5 are a timing diagram showing the operation of watchdog system according to the present invention.

Fig. 3 is a timing diagram showing the auto recovery operation according to the present invention, in case the failure of UPS is temporary.

As mentioned in Fig. 1, in case the malfunction of the inside of UPS or the external momentary short circuit is generated, the power supply through the normal power line may be impossible. In this case, the control means of UPS (not shown) blocks off the normal power line by turning off the output breaker CB3. Additionally, the control means (not shown) generates the bypass signal S_{ITB} in order to change the power supply path from the normal power line to the bypass line by turning on the switch STS, CB4 of the bypass module 4.

In the meantime, the generated disorder is so serious that it

may require an additional check-out or step by a user. However, sometimes, it can be just a temporary problem (for example, the temporary disconnection of a temperature sensor, the temporary fan disorder, and so on), that it can be automatically restored sooner or later.

Therefore, in case the power supply path is switched to the bypass line, the watchdog system of the present invention firstly performs the automatic recovery operation of the present invention which will be explained in the below. Additionally, in case the auto recovery is not performed, the check-out and manual recovery by a user can be performed like a related art.

Hereinafter, the automatic recovery operation of the present invention will be described.

In case the bypass signal S_{ITB} is generated, the inverter-on generating unit 10 generates the inverter-on signal S_{INV-ON} immediately or after a predetermined time to turn on again the inverter 2. At this time, the bypass signal S_{ITB} and the inverter-on signal S_{INV-ON} are also inputted to the recovery signal generating unit 20.

In case the inverter-on signal S_{INV-ON} is generated, the inverter 2 performs the operation for the electric power supply, after being turned on again and passing through the initialization process. Such operation of the inverter 2 is identical with the operation when the inverter 2 is turned on again by the manual operation of the user of the related art.

At this time, since the counting comparison signal $S_{COUNT-COMP}$ is

not yet generated (low level), another input signal S_{STOP} of the recovery signal generating unit 20 maintains the high level state as shown in Fig. 3.

Therefore, the recovery signal generating unit 20 generates the
5 recovery signal S_{RECO} for changing again the power supply path from the bypass line to the normal power line with a high level since three input signals are all applied with a high level. UPS recovers the power supply path from the bypass line to the normal power line by the recovery signal S_{RECO} outputted in the recovery signal generating unit
10 20. And the recovery signal S_{RECO} is applied to the counter unit 30.

The counter unit 30 generates the accumulation count signal S_{COUNT} having the magnitude of 1V since the recovery signal S_{RECO} was generated for the first time. As the accumulation count signal S_{COUNT} having the magnitude of 1V is smaller than the reference value
15 S_{REF} (for example, 2.5V), the counting comparison signal $S_{COUNT-COMP}$ still maintains the low level state. Therefore, the recovery stop signal S_{STOP} still maintains the high level state. However, since the bypass signal S_{ITB} is switched to the low level due to the generation of the recovery signal S_{RECO} , the recovery signal S_{RECO} is switched again to the
20 low level. And the delay count signal $S_{COUNT-DLY}$ still maintains the low level state for the delay time by the delay unit 54, although the accumulation count signal S_{COUNT} is generated.

Like this, in case the disorder generated in the inverter 2 is still maintained although the inverter 2 is compulsively turned on again by
25 the inverter on signal S_{INV-ON} and the power supply path is restored

again to the normal power line by the recovery signal S_{RECO} , the UPS switches again the power supply path to the bypass line by generating again the bypass signal S_{ITB} .

And then, as described above, the inverter-on generating unit
5 10 generates again the inverter-on signal S_{INV-ON} , and, accordingly, as shown in Fig. 3, the recovery signal generating unit 20 generates again the recovery signal S_{RECO} . That is, the recovery signal S_{RECO} is generated twice.

As the recovery signal S_{RECO} is generated again, the counter unit
10 30 increases the magnitude of the accumulation count signal S_{COUNT} to 2V and outputs. However, being the accumulation count signal S_{COUNT} of 2V is also smaller than the reference value S_{REF} (for example, 2.5V), the counting comparison signal $S_{COUNT-COMP}$ still maintains the low level state. Accordingly, the recovery stop signal S_{STOP} still maintains the
15 high level state. However, since the bypass signal S_{ITB} is switched to the low level due to the generation of the recovery signal S_{RECO} , the recovery signal S_{RECO} is switched again to the low level.

At this time, in case the disorder generated in the UPS is temporary and is automatically restored, the UPS normally operates
20 again. For example, in Fig. 2, in case the contact signal S_{NOR} of the temperature sensor is normally generated again, the counter unit 30 is reset by the contact signal S_{NOR} and the counting operation is interrupted.

In Fig. 2, the counter unit 30 is reset in case the contact signal
25 S_{NOR} of the temperature sensor is generated. However, in case the

power supply through the normal power line is possible although the contact signal S_{NOR} of the temperature sensor is not continuously generated, the counting operation does not need to be continued. That is, by applying the accumulation count signal S_{COUNT} to the OR gate after making a time delay of the accumulation count signal S_{COUNT} ,
5 the delay unit 54 resets the counter unit 30 in case the bypass signal S_{ITB} is not generated again within a predetermined time. Accordingly, the accumulation count signal S_{COUNT} is transitted to a low level.

Thereafter, the watchdog system of the present invention
10 discontinues the automatic recovery operation until a disorder is generated again in UPS and the bypass signal S_{ITB} is generated.

In Fig. 2, the counter unit 30 made to be reset according to the contact signal S_{NOR} of the temperature sensor, however, it is just an embodiment of the present invention. By using the experience or the statistics, an application by the user is possible for the temperature
15 sensor and/or the instrument to which a temporary disorder is expected.

Fig. 4 is a timing diagram showing the auto recovery operation process according to the present invention, in case the recovery signal
20 S_{RECO} is consecutively generated three times. That is, the automatic recovery operation according to the present invention is shown in case that the disorder of the UPS is not temporary.

In Fig. 3, it is described that the recovery signal S_{RECO} is generated only two times and, thereafter, the bypass signal S_{ITB} is not
25 generated again, so that the recovery operation is not performed any

more. However, in spite of the recovery operation of two times, the bypass signal S_{ITB} can be generated again.

That is, in case the disorder generated in the inverter 2 is still maintained even when the inverter 2 is compulsively turned on twice since the inverter-on signal S_{INV-ON} and the recovery signal S_{RECO} has been generated twice, the UPS generates again the bypass signal S_{ITB} .

And then, the inverter-on generating unit 10 once again generates the inverter-on signal S_{INV-ON} , and accordingly, the recovery signal generating unit 20 once again generates the recovery signal S_{RECO} . That is, the recovery signal S_{RECO} is generated three times.

Like this, in case the recovery signal S_{RECO} is generated three times, the counter unit 30 generates the accumulation count signal $SCOUNT$ of 3V. Accordingly, the comparator COMP1 generates the counting comparison signal $S_{COUNT-COMP}$ with a high level to output. And the counting comparison signal $S_{COUNT-COMP}$ is time-delayed by the delay unit 42 and applied to the J/K flip flop 52.

Any one of differential signal ($\overline{Q}$) of the J/K flip flop 52, that is, the recovery stop signal S_{STOP} is switched to the low level as the counting comparison signal $S_{COUNT-COMP}$ is switched to the high level. Accordingly, the recovery signal generating unit 20 generates the recovery signal S_{RECO} with the low level. At the same time, since another differential signal ($\overline{Q}$) of the J/K flip flop 52 is outputted with the high level, the reset signal S_{RST} is generated and the counting operation of the counter unit 30 is interrupted.

That is, in the present embodiment, in case the power supply

path is switched to the bypass line, firstly the auto recovery operation is consecutively performed three times. Nevertheless, in case the recovery has not been performed, it is determined that the UPS has an important disorder, so that the recovery operation is not performed any more. In this case, the manual recovery by a user is performed like a related art.

Fig. 5 is a timing diagram showing the auto recovery operation process according to the present invention, in case the recovery signal S_{RECO} is consecutively generated five times.

Compared with Fig. 4, this embodiment shows that the automatic recovery operation is paused in case the recovery signal S_{RECO} is consecutively generated five times during a given time by enhancing the reference value V_{REF} of the counting comparison unit 40, for example, to 4.5V. That is, the number of the automatic recovery operation can be controlled by controlling the reference value V_{REF} .

The description of the auto recovery principles of this embodiment is omitted since it is identical with Fig. 4.

【Claims】**【Claim 1】**

An UPS watchdog system that compulsively recovers a power supply path to a normal power line as much as a preset number, in case the power supply path of UPS is switched from the normal power line to a bypass line.

【Claim 2】

The UPS watchdog system of claim 1, wherein the watchdog system comprises:

an inverter-on generating unit that generates an inverter-on signal for turning on an inverter of an UPS in case a bypass signal is generated;

a recovery signal generating unit that generates a recovery signal for changing the power supply path from the bypass line to the normal power line according to the bypass signal, the inverter-on signal and a recovery stop signal;

a counter unit that outputs an accumulation count signal of the magnitude corresponding to the number of occurrence of the recovery signal;

a counting comparison unit that generates a counting comparison signal in case the magnitude of the accumulation count signal is greater than a preset reference value; and

a recovery stop unit that controls the generation of a reset signal for stopping the counter unit from counting and the recovery

stop signal according to the counting comparison signal and the accumulation count signal.

【Claim 3】

5 The UPS watchdog system of claim 2, wherein the counter unit increases the magnitude of the accumulation count signal in proportion to the number of occurrence of the recovery signal with a given magnitude.

10 **【Claim 4】**

 The UPS watchdog system of claim 3, wherein the recovery stop unit generates both the recovery stop signal and the reset signal in case the counting comparison signal is generated.

15 **【Claim 5】**

 The UPS watchdog system of claim 4, wherein the recovery signal generating unit stops the generation of the recovery signal in case the recovery stop signal is generated when the bypass signal and the inverter-on signal are generated.

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【Claim 6】

 The UPS watchdog system of claim 2, wherein the recovery stop unit generates the reset signal in case a given time has elapsed after the accumulation count signal is generated, regardless of the
25 generation of the counting comparison signal.

【Claim 7】

The UPS watchdog system of claim 2, wherein the recovery stop unit includes:

5 a J/K flip flop that outputs a differential signal according to the counting comparison signal;

 a delay unit that makes a preset time delay of the accumulation count signal; and

10 a logical operation unit that outputs the reset signal to the counter unit in case at least one of a first differential signal having the same phase as the counting comparison signal among the differential signals and the output signal of the delay unit is generated.

【Claim 8】

15 The UPS watchdog system of claim 7, wherein the J/K flip flop outputs a second differential signal having the opposite phase to the counting comparison signal among the differential signals as recovery stop signal.

20 **【Claim 9】**

 An UPS auto recovery method that compulsively recovers a power supply path to a normal power line as much as a preset number, in case the power supply path of UPS is switched from the normal power line to a bypass line.

25

【Claim 10】

The UPS auto recovery method of claim 9, further comprising:

a first step of determining whether a power supply path of an UPS is switched from a normal power line to a bypass line;

5 a second step of turning on an inverter of UPS and switching again the power supply path to the normal power line, in case the power supply path is switched to the bypass line; and

a third step of repeatedly performing the first and the second step until the number of switching to the bypass line reaches a preset
10 number.

【Claim 11】

The UPS auto recovery method of claim 10, wherein, in the first step, the generation of the bypass signal for switching the power
15 supply path from the normal power line to the bypass line in the UPS is determined.

【Claim 12】

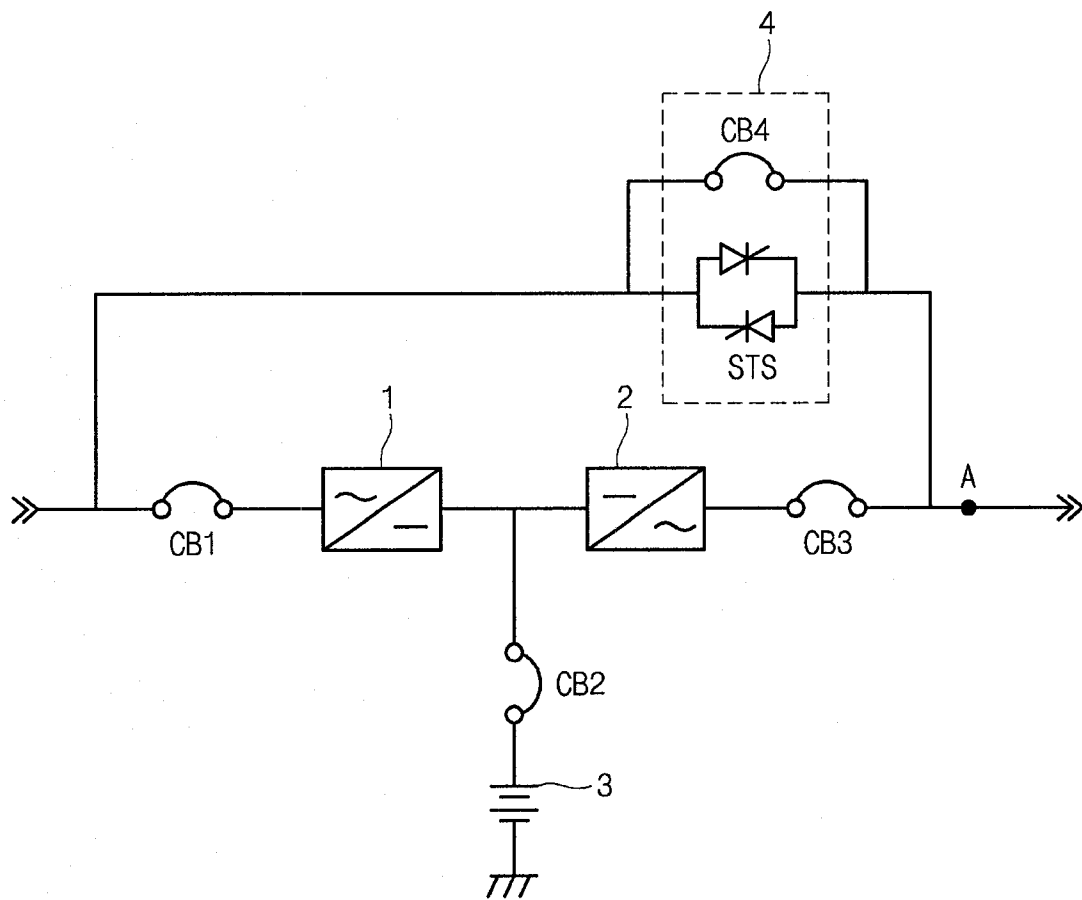
The UPS auto recovery method of claim 11, wherein, in the
20 third step, the number of occurrence of the recovery signal for switching the power supply path from the bypass line to the normal power line is counted, and the first and the second step is repeatedly performed until the number of occurrence reaches the preset number for a given time.

25

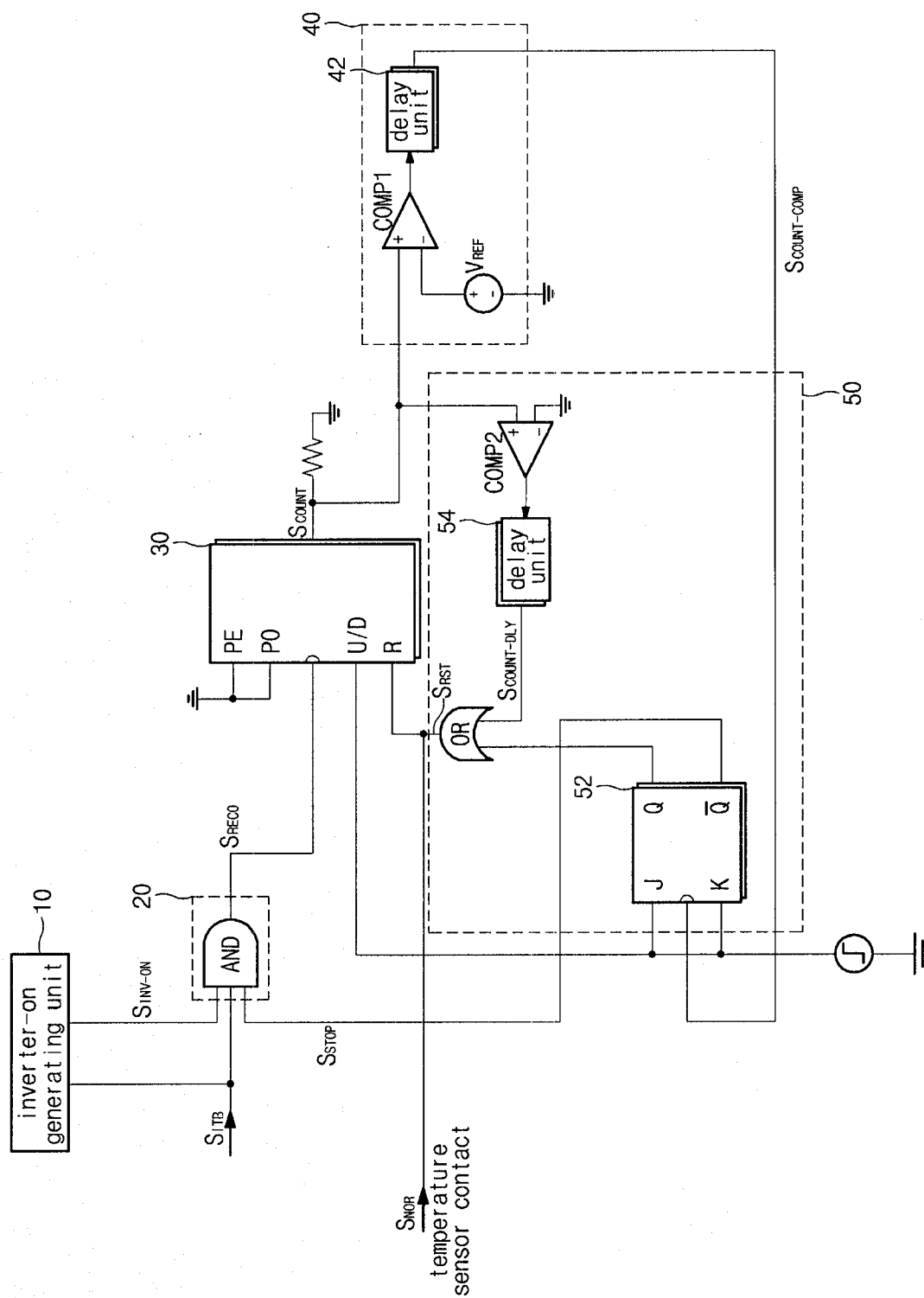
【Claim 13】

The UPS auto recovery method of claim 12, wherein, in the third step, the generation of the recovery signal is paused in case the number of occurrence of the recovery signal reaches the preset
5 number or the bypass signal is not generated after the recovery signal occurrence.

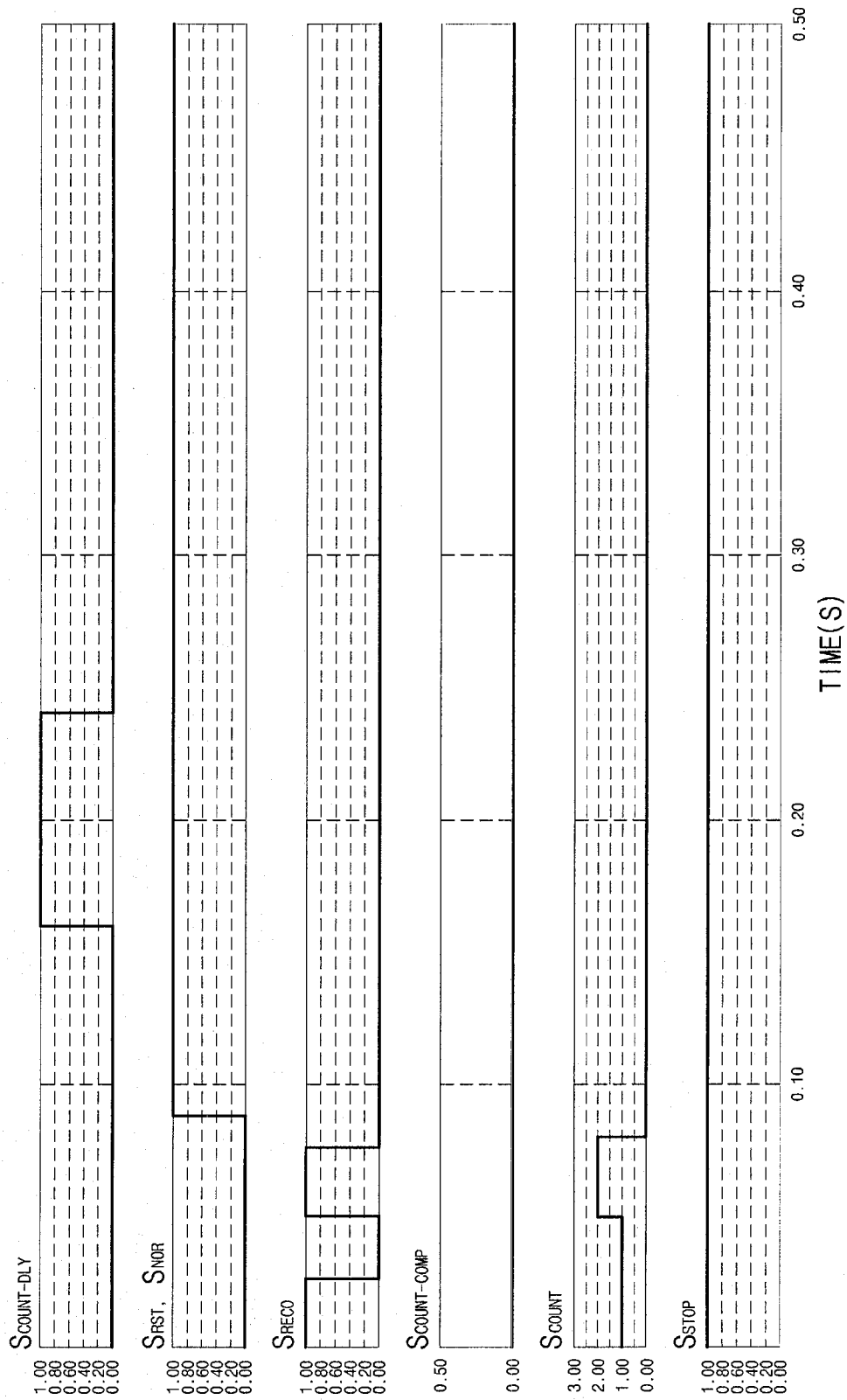
[Fig. 1]



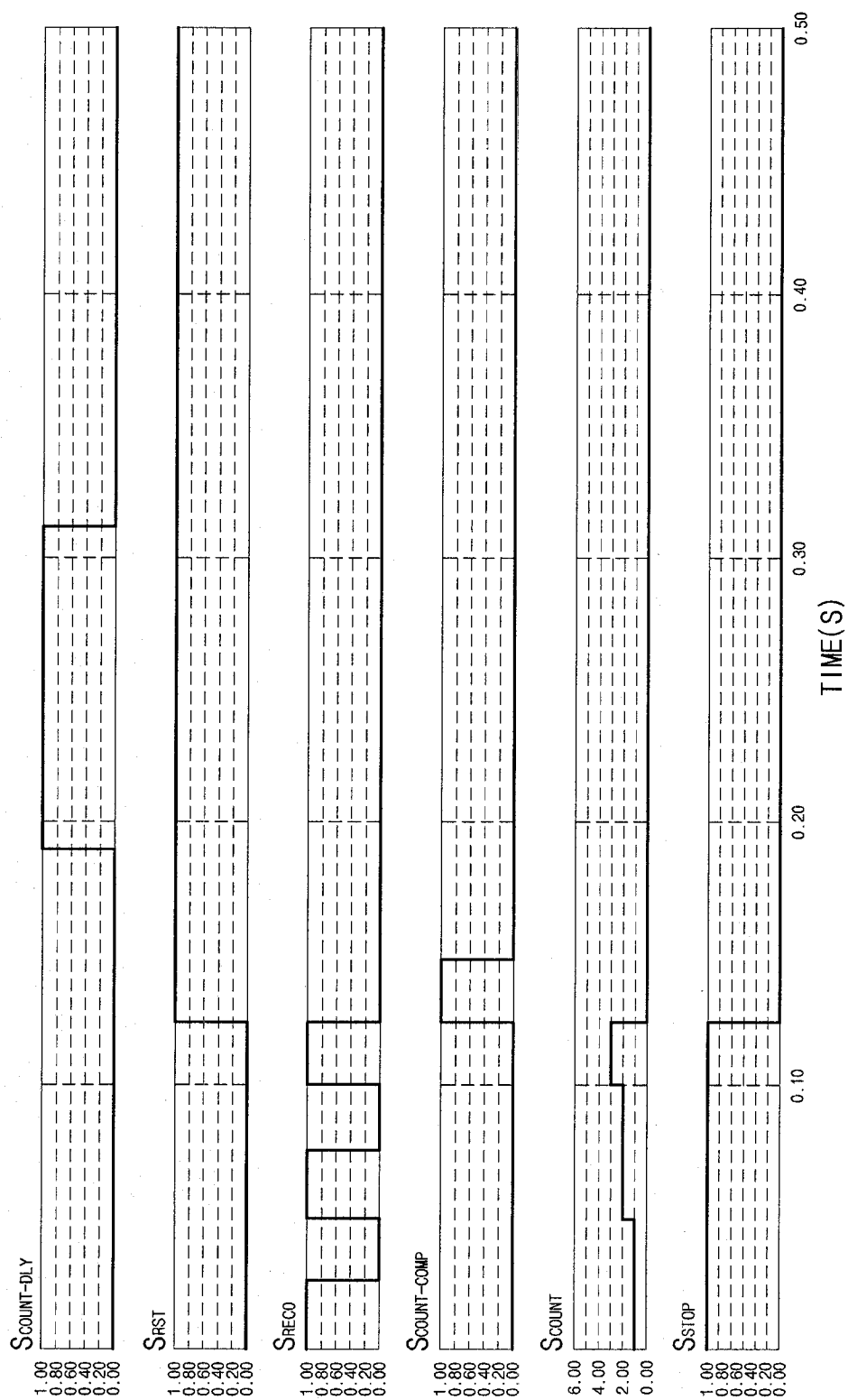
[Fig. 2]



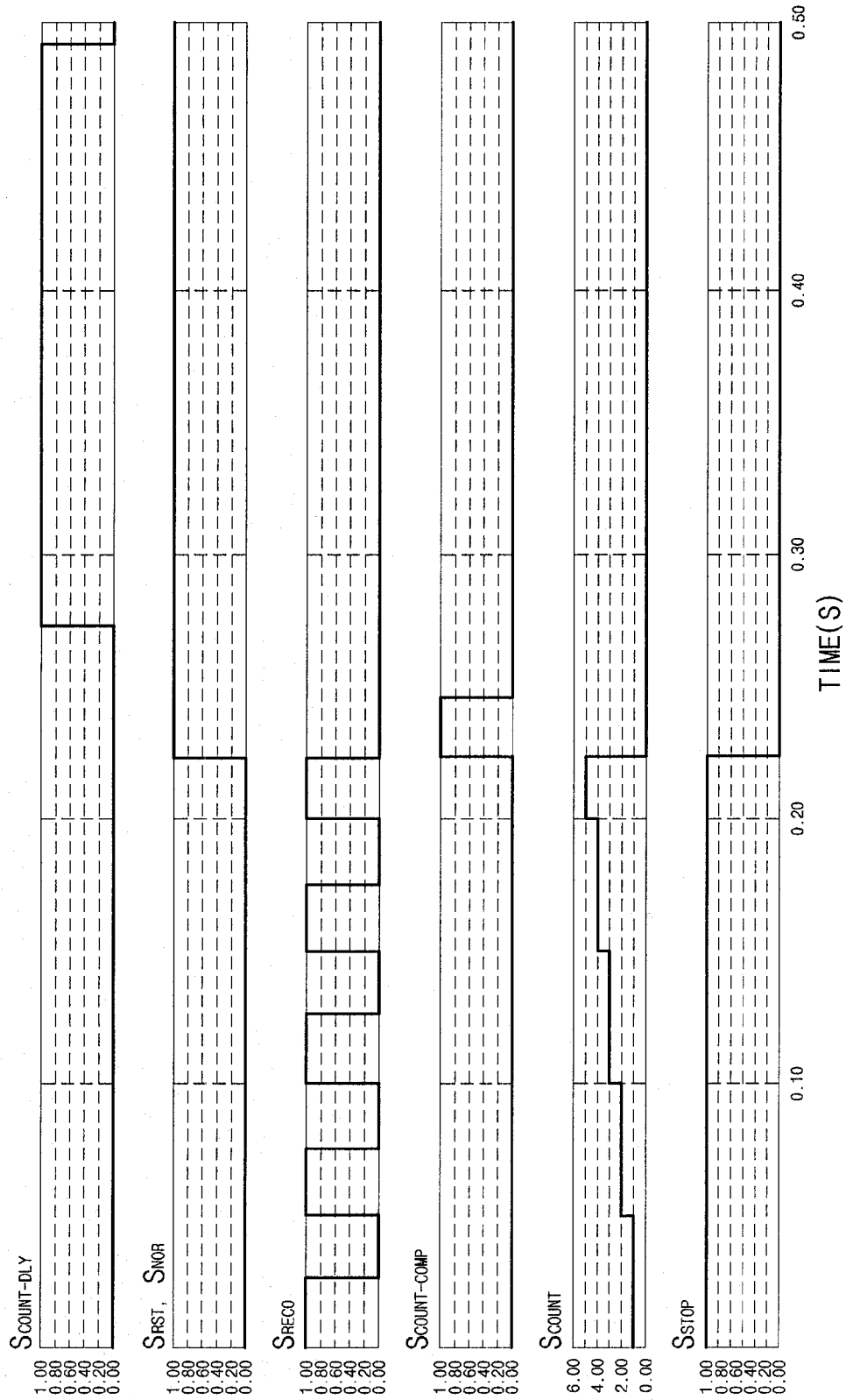
[Fig. 3]



[Fig. 4]



[Fig. 5]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2007/005713**A. CLASSIFICATION OF SUBJECT MATTER****H02J 9/06(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 8: H02J 9/00, 9/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility Models since 1975

Japanese Utility models and applications for Utility Models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS(KIPO internal) "UPS", "bypass", "recovery"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-2004-0042529 A (POSCO) 20 May 2004 See the abstract; figure 4	1-13
A	KR 10-2006-0065181 A (MAXCOM CO., LTD.) 14 June 2006 See the abstract; figure 1	1-13
A	KR 10-2006-0008007 A (ASEA ELECTRONIC & TECHNOLOGY CO., LTD.) 26 January 2006 See the abstract; figure 2	1-13
A	KR 10-2006-0107435 A (KT CORPORATION) 13 October 2006 See the abstract; figure 3	1-13

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search

26 FEBRUARY 2008 (26.02.2008)

Date of mailing of the international search report

26 FEBRUARY 2008 (26.02.2008)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon, 139 Seonsa-ro, Seo-
gu, Daejeon 302-701, Republic of Korea

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HAN, SANG IL

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2007/005713

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