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(54) **An integrated real time clock circuit**

(57) An integrated circuit, IC, (1) comprising an integrated Real Time Clock, RTC, unit (2) adapted to provide a precise real time (PRT), said integrated circuit (1) comprising at least one embedded multizone receiver (4) adapted to receive external synchronization signals

transmitted on predetermined signal frequencies, wherein a current real time of said RTC unit (2) is corrected according to time information carried in said received external synchronization signal having the highest signal strength to provide said precise real time (PRT).

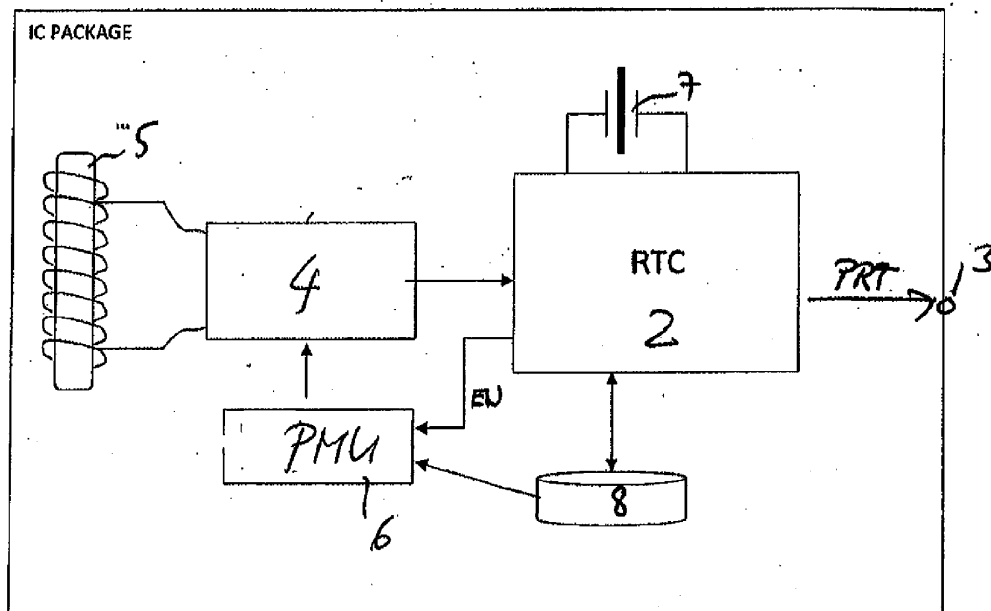


Fig 1

Description

[0001] The invention relates to an integrated circuit comprising an integrated real time clock unit adapted to provide a precise real time for an electronic device.

[0002] In many applications it is necessary to provide a precise real time PRT for a device, in particular for a mobile device which may be transported between different time zones.

[0003] A conventional real time clock circuit can be formed by a chip used in a computer or a mobile device to keep a current time and date.

[0004] Conventional devices having conventional integrated real time clock units can use precise quartz crystals which are normally embedded inside a chip package of the respective chip. However even for a precise quartz crystal which can be even temperature compensated during continuous use of the respective device normally a time drift is observed. In many cases the observed time drift can be substantial. In some cases the time drift may be more than 10 minutes during a time period of a few months of operation of the respective device. A further disadvantage is when the mobile device comprising the real time clock unit is transported between different time zones, the user of the mobile device has always to adjust the system time of the device corresponding to the current time of the momentary location or time zone. Moreover, if the change of summer to winter time and reverse is not supported by a software implemented in the respective device further adjustment has to be performed by a user of the mobile device.

[0005] Accordingly, it is an object of the present invention to provide an integrated circuit comprising an integrated real time clock unit adapted to provide a precise real time without any necessary adjustments by the user of a device within which the integrated circuit is provided when the device is moved between different time zones.

[0006] This object is achieved by an integrated circuit comprising the features of claim 1.

[0007] The invention accordingly provides an integrated circuit comprising an integrated real time clock unit adapted to provide a precise real time, said integrated circuit comprising at least one embedded multizone receiver adapted to receive external synchronization signals transmitted on predetermined signal frequencies, wherein a current real time of said real time clock unit is corrected according to a time information carried in said received external synchronization signal having the highest signal strength to provide the precise real time.

[0008] In a possible embodiment of the integrated circuit according to the present invention the at least one embedded multizone receiver of the integrated circuit comprises an embedded multizone radio receiver adapted to receive and demodulate received external radio synchronization signals transmitted on predetermined radio signal frequencies.

[0009] In a further possible embodiment of the integrat-

ed circuit according to the present invention the embedded multizone receiver of said integrated circuit is powered up by a power management unit of said integrated circuit from a power-down sleeping mode to a time correction mode for a predetermined time period in regular time intervals to correct the current real time according to the time information carried in said received external synchronization signals.

[0010] In a further possible embodiment of the integrated circuit according to the present invention the embedded multizone receiver of said integrated circuit is connected to at least one antenna of said integrated circuit to receive said external synchronization signals.

[0011] In a further possible embodiment of the integrated circuit according to the present invention the at least one antenna of said integrated circuit comprises a ferrite antenna.

[0012] In a still further embodiment of the integrated circuit according to the present invention said real time clock unit of the integrated circuit is connected to an embedded quartz crystal of said integrated circuit to provide a current real time stored in a real time memory of said real time clock unit.

[0013] In a possible embodiment of the integrated circuit according to the present invention the current real time stored in said real time memory of said real time clock unit is corrected according to time information carried in the received external synchronization signal having the highest signal strength when said embedded multizone receiver is powered up by said power management unit to operate in said time correction mode.

[0014] In a further possible embodiment of the integrated circuit according to the present invention the integrated power management unit switches said embedded multizone receiver from said power-down sleeping mode for a predetermined time period to said power-up time correction mode in response to an embedded signal received by said real time clock unit in regular time intervals determined on the basis of the current real time stored in said real time memory of said real time clock unit.

[0015] In a further possible embodiment of the integrated circuit according to the present invention the integrated circuit further comprises a battery which supplies said real time clock unit having a low power consumption permanently with electrical power and said embedded multizone receiver only when it has been switched by said power management unit in said power-up time correction mode.

[0016] In a further possible embodiment of the integrated circuit according to the present invention the battery is embedded in a package of said integrated circuit.

[0017] In a possible embodiment of the integrated circuit according to the present invention said integrated circuit comprises at least one embedded multizone receiver and/or an integrated embedded multizone GPS/GALILEO receiver adapted to extract in time information carried in a received GPS signal.

[0018] The invention further provides a user device

comprising an integrated circuit with an integrated real time clock unit adapted to provide a precise real time, said integrated circuit of said user device comprising at least one embedded multizone receiver adapted to receive external synchronization signals transmitted on predetermined signal frequencies, wherein a current real time of said real time clock unit is corrected according to time information carried in said received external synchronization signal having the highest signal strength to provide the precise real time.

[0019] In a possible embodiment of the user device according to the present invention the user device is a personal computer.

[0020] In a further possible embodiment of the present invention the user device is a mobile computer.

[0021] In a still further embodiment of the user device according to the present invention the user device is an automotive device of a vehicle.

[0022] The invention further provides a system comprising the features of claim 14.

[0023] Accordingly, the invention further provides a system comprising transmitters located in different time zones and adapted to transmit synchronization signals on predetermined signal frequencies and

user devices each having an integrated circuit with an integrated real time clock unit adapted to provide a precise real time, wherein the integrated circuit of said user device comprises at least one embedded multizone receiver adapted to receive external synchronization signals transmitted on the predetermined signal frequencies, wherein a current real time of said real time clock unit is corrected according to time information carried in said received external synchronization signal having the highest signal strength to provide said precise real time.

[0024] The invention further provides a method for providing a user device in different time zones with a precise real time comprising the features of claim 15.

[0025] Accordingly, the invention provides a method for providing a user device in different time zones with a precise real time comprising the steps of:

providing a precise real time for each time zone by a precise clock unit of the respective time zone, transmitting said precise real time in a synchronization signal of the respective time zone on a predetermined signal frequency and correcting a current real time of a user device according to the precise real time carried in a synchronization signal received by said user device and having the highest signal strength.

[0026] In the following possible embodiments of the integrated circuit having an integrated real time clock unit of a corresponding method for providing a user device in different time zones with a precise real time are explained in more detail with reference to the enclosed figures.

Fig. 1 shows a block diagram of a possible embodiment of the integrated circuit in an integrated real time clock unit according to the present invention;

Fig. 2 shows a block diagram of a possible implementation of a radio receiver provided in the integrated circuit of the present invention;

Fig. 3 shows a diagram for illustrating a possible implementation of a power management unit according to a possible embodiment of the integrated circuit according to the present invention;

Fig. 4 shows a flow chart of a possible implementation of a method for providing a user device in different time zones with a precise real time according to the present invention.

[0027] As can be seen in Fig. 1 the integrated circuit 1 according to the present invention comprises in the shown implementation different units embedded in an integrated circuit package as shown in Fig. 1. In the shown implementation the integrated circuit 1 comprises an integrated real time clock unit 2 adapted to provide a precise real time PRT which can output at a terminal 3 of the IC package to other components or units of the respective device such as a mobile device. The integrated circuit 1 further comprises at least one embedded multizone receiver 4 adapted to receive external synchronization signals transmitted on predetermined signal frequencies by means of an antenna 5 which can also be embedded in the integrated circuit 1. In the shown implementation of Fig. 1 the at least one antenna 5 of the integrated circuit 1 comprises a ferrite antenna. The ferrite antenna 5 is connected in the shown implementation to an embedded multizone radio receiver 4 of the integrated circuit 1 which is adapted to receive and demodulate received external radio synchronization signals transmitted on predetermined radio signal frequencies. The embedded multizone receiver 4 such as the embedded multizone radio receiver as shown in Fig. 1 is powered up by a power management unit 6 of said integrated circuit 1 from a power-up-down sleeping mode to a time correction mode for a predetermined time period in regular time intervals to correct the current real time CRT according to time information carried in the received external synchronization signals received by this embedded multizone receiver 4. In a possible embodiment such as in the implementation shown in Fig. 1 the real time clock unit 2 of the integrated circuit 1 can be connected to an embedded quartz crystal 7 of the integrated circuit 1 to provide a current real time CRT which may be stored in an internal real time memory or time register of the real time clock unit 2. The current real time CRT stored in the real time memory of the real time clock unit 2 is corrected according to the time information carried in the received

external synchronization signal having the highest signal strength when the embedded multizone receiver 4 is powered up by the power management unit 6 to operate in a time correction mode of the integrated circuit 1. In a possible embodiment the integrated power management unit 6 switches the embedded multizone receiver 4 from a power-down sleeping mode for a predetermined time period such as 60 seconds to said power-up time correction mode in response to an embedded signal received by the real time clock unit 2 in regular time intervals determined on the basis of the current real time CRT updated in the real time memory of the real time clock unit 2 on the basis of an oscillation signal generated by the quartz crystal 7.

[0028] In a possible embodiment such as in the implementation shown in Fig. 1 the integrated circuit 1 further comprises an embedded battery 8 which supplies said real time clock unit 2 having a low power consumption permanently with electrical power. In contrast, the embedded multizone receiver 4 is only supplied with electrical power by the embedded battery 8 when it has been switched by the power management unit 6 in the power-up time correction mode of the integrated circuit 1. The battery 8 can be embedded in the package of the integrated circuit 1.

[0029] The integrated circuit 1 as shown in Fig. 1 can be used within a user device, in particular in a mobile computer, laptop or in an automotive device of a vehicle such as a car. This mobile device can travel between different time zones. Moreover, the integrated circuit 1 according to the present invention can also be used in non mobile devices such as a personal computer to minimize a time drift of the internal reference time.

[0030] Fig. 2 shows a block diagram of a possible embodiment of an embedded multizone receiver 4 which is used by the real time clock unit 2 and embedded in an integrated circuit 1. The embedded multizone receiver 4 is in the shown implementation an embedded multizone radio receiver adapted to receive and demodulate received external radio synchronization signals transmitted on predetermined radio signal frequencies. The radio receiver can be connected to antenna 5 such as a ferrite antenna. An RF amplifying stage receives the radio signal and supplies it to an analog mixer connected to an analog local oscillator as shown in Fig. 2. An IF amplifier and filter can be provided receiving the mixed signal wherein the output of the IF amplifier and filter connected to a decoder. The output of the decoder is connected to a single bit analog-digital converter ADC as shown in Fig. 2.

[0031] In a possible embodiment the ferrite antenna 5 can also be embedded inside the IC package of the integrated circuit 1. To keep the power consumption of the integrated circuit 1 low the radio receiver 4 is in a possible embodiment kept in a power-down mode and is only powered up or started once a day or week for a few minutes to catch a synchronization signal in a time correction mode. The embedded multizone radio receiver 4 is then

powered down again in a power-off state after a predetermined time during after the synchronization signal has been received and extracted. A control of the power-up or power-down of the multizone radio receiver 4 can be performed by the power management unit 6 which can be also embedded in the IC package of the integrated circuit 1.

[0032] Since synchronization signals can be transmitted on different frequencies in different multi-time zones. Further different types of modulation can be used and corresponding demodulators can be arranged in the integrated multizone receiver 4 which is formed by a wide-band receiver adapted to decode different types of data coding. In a possible embodiment the embedded radio receiver comprises different input stages adjusted for the most used frequencies for different time zones and these stages can be supplied concurrently with power by the power management unit 6. In a possible implementation also a GPS receiver stage can be implemented.

[0033] To save battery power supplied by the embedded battery 8 such as a lithium battery, the power management unit 6 can enable the radio/GPS receiver 4 for some period, for example each day or week for a predetermined time which lasts long enough to allow that the time synchronization signal TSS transmitted in the respective time zone is caught and decoded. In a possible embodiment the power management unit 6 is enabled by the RTC unit 2 wherein an enable signal EN is applied by the RTC unit 2 to the power management unit 6 as shown in Fig. 1. When a multizone function is implemented the power management unit 6 can scan in a possible implementation the receivers and/or input stages supplying a supply voltage to the respective stages for a short time one by one to each stage until a synchronization signal is caught or all receivers have been scanned by the power management unit 6 as shown in principle in Fig. 3.

[0034] In the shown implementation the power management unit 6 comprises a power switch control which is adapted to control switches SW1, SW2, SW3, SW4 connected in parallel to a power supply unit, for instance the embedded battery 8 shown in Fig. 1. A switch is connected to a receiver/input stage connected to receive a synchronization signal in a different time zone or with a different modulation scheme. The different switches SW1 to SW4 are activated and closed consecutively by the power switch control of the power management unit 6 and scanned for different synchronization signals transmitted in the area where the device comprising the integrated circuit 1 is located. In the shown implementation the power management unit 6 receives an enable signal from the RTC unit 2 and is activated to perform a consecutive switching of the power supply to the different input stages of the multizone receiver 4. The switch SW1 is closed under the control of the power switch control and activates the receiver or input stage adapted to catch a synchronization signal in a first zone A. After a predetermined time the power switch control activates the next

input stage of the multizone receiver 4 to scan for another synchronization signal. Step by step each of the switches SW1 to SW4 are closed under the control of the power switch control of the power management unit 6. In a possible implementation one switch, for example switch 4, can be connected to a GPS/GALILEO receiver which receives a power supply if switch SW4 is closed. The GPS/GALILEO receiver is adapted to extract time information carried in a received GPS signal. The integrated circuit 1 shown in Fig. 1 has a multizone radio receiver 4 as shown in Fig. 2 and an embedded power management unit 6 as shown in Fig. 3. The integrated circuit IC can be provided within a user device such as a personal computer or a mobile computer. This user device can move between different locations and different time zones. Each time zone having one transmitter can be provided adapted to transmit synchronization signals on predetermined signal frequencies. Accordingly, the invention provides a system having transmitters located in different time zones adapted to transmit synchronization signals on predetermined signal frequencies as well as user devices each having an integrated circuit 1 with an integrated RTC unit 2 as shown in Fig. 1.

[0035] The invention further provides a method for providing a user device in different time zones with a precise real time, PRT, comprising the steps as shown in the flow chart of Fig. 4.

[0036] In a first step S1 a precise real time for each time zone can be generated by a precise clock unit of the respective time zone.

[0037] This precise real time, PRT, can be transmitted in a synchronization signal of the respective time zone on a predetermined signal frequency in step S2.

[0038] In step S3 a current real time, CRT, of a user device is corrected according to the received precise real time, PRT, carried in the synchronization signal received by said user device and having the highest signal strength.

[0039] The RTC unit 2 has the advantage that it frees the main system of the device from time-critical tasks. The quartz crystal 7 can be embedded inside the chip package as shown in Fig. 1. Also the antenna 5 can be embedded in the IC package.

Claims

1. An integrated circuit, IC, (1) comprising an integrated Real Time Clock, RTC, unit (2) adapted to provide a precise real time (PRT), said integrated circuit (1) comprising
at least one embedded multizone receiver (4) adapted to receive external synchronization signals transmitted on predetermined signal frequencies,
wherein a current real time (CRT) of said RTC unit (2) is corrected according to time information carried in said received external synchronization signal having the highest signal strength to provide said precise

real time (PRT).

2. The integrated circuit according to claim 1, wherein said at least one embedded multizone receiver (4) of said integrated circuit (1) comprises an embedded multizone radio receiver (4) adapted to receive and demodulate received external radio synchronization signals transmitted on predetermined radio signal frequencies.
3. The integrated circuit according to claim 1 or 2, wherein said embedded multizone receiver (4) of said integrated circuit (1) is powered up by a power management unit (6) of said integrated circuit (1) from a power-down sleeping mode to a time correction mode for a predetermined time period in regular time intervals to correct the current real time (CRT) according to the time information carried in said received external synchronization signals.
4. The integrated circuit according to one of the preceding claims 1 - 3, wherein said embedded multizone receiver (4) of said integrated circuit (1) is connected to at least one antenna (5) of said integrated circuit (1) to receive said external synchronization signals.
5. The integrated circuit according to claim 4, wherein said at least one antenna (5) of said integrated circuit (1) comprises a ferrite antenna (5).
6. The integrated circuit according to one of the preceding claims 1 - 5, wherein said RTC Unit (2) of said integrated circuit (1) is connected to an embedded quartz crystal (7) of said integrated circuit (1) to provide a current real time (CRT) stored in a real time memory of said RTC unit (2).
7. The integrated circuit according to claim 6, wherein the current real time (CRT) stored in said real time memory of said RTC unit (2) is updated according to time information carried in the received external synchronization signal having the highest signal strength when said embedded multizone receiver (4) is powered up by said power management unit (6) to operate in said time correction mode.
8. The integrated circuit according to claim 7, wherein said integrated power management unit (6) switches said embedded multizone receiver (4) from said power-down sleeping mode for a predetermined time period to said power-up time correction mode in response to an embedded signal received by said RTC unit (2) in regular time intervals determined on the basis of the current real time (CRT) provided in said real time memory of said RTC unit (2).

9. The integrated circuit according to one of the preceding claims 1 - 8,
wherein said integrated circuit (1) comprises a battery (8) which supplies said RTC unit (2) having a low power consumption permanently with electrical power and said embedded multizone receiver (4) when it has been switched by said power management unit (6) into said power-up time correction mode.
10. The integrated circuit according to claim 9, wherein said battery (8) is embedded in a package of said integrated circuit (1).
11. The integrated circuit according to claim 1, wherein said at least one embedded multizone receiver (4) of said integrated circuit (1) comprises an embedded GPS/GALILEO receiver adapted to extract time information carried in a received GPS signal.
12. A user device comprising an integrated circuit (1) with an integrated RTC unit (2) according to any of the preceding claims 1 - 11.
13. A user device according to claim 12, wherein said user device comprises
a personal computer or
a mobile computer or
an automotive device.
14. A system comprising

- transmitters located in different time zones and adapted to transmit synchronization signals on predetermined signal frequencies and
- user devices each having an integrated circuit with an integrated RTC unit according to one of the preceding claims 1 - 11.
15. A method for providing a user device in different time zones with a precise real time comprising the steps of:

- providing (S1) a precise real time (PRT) for each time zone by a precise clock unit of the respective time zone,
- transmitting (S2) said precise real time (PRT) in a synchronization signal of the respective time zone on a predetermined signal frequency and
- correcting (S3) a current real time (CRT) of a user device according to the precise real time (PRT) carried in a synchronization signal received by said user device and having the highest signal strength.

Amended claims in accordance with Rule 137(2) EPC.

1. An integrated circuit, IC, (1) comprising an integrated Real Time Clock, RTC, unit (2) adapted to provide a precise real time (PRT), said integrated circuit (1) comprising
at least one embedded multizone radio receiver (4) adapted to receive and demodulate received external radio synchronization signals transmitted on predetermined radio signal frequencies from transmitters located in different time zones,
wherein a current real time (CRT) of said RTC unit (2) is corrected according to time information carried in said received external synchronization signal having the highest signal strength to provide said precise real time (PRT),
wherein said embedded multizone radio receiver (4) of said integrated circuit (1) is powered up by a power management unit (6) of said integrated circuit (1) from a power-down sleeping mode to a time correction mode for a predetermined time period in regular time intervals to catch a synchronization signal and to correct the current real time (CRT) according to the time information carried in said received external radio synchronization signals.
2. The integrated circuit according to claim 1, wherein the embedded multizone radio receiver (4) of said integrated circuit (1) is powered down again in a power-off state, after a predetermined time after the synchronization signal has been received and extracted.
3. The integrated circuit according to one of the preceding claims 1 or 2, wherein said embedded multizone radio receiver (4) of said integrated circuit (1) is connected to at least one antenna (5) of said integrated circuit (1) to receive said external synchronization signals.
4. The integrated circuit according to claim 3, wherein said at least one antenna (5) of said integrated circuit (1) comprises a ferrite antenna (5).
5. The integrated circuit according to one of the preceding claims 1 - 4, wherein said RTC Unit (2) of said integrated circuit (1) is connected to an embedded quartz crystal (7) of said integrated circuit (1) to provide a current real time (CRT) stored in a real time memory of said RTC unit (2).
6. The integrated circuit according to claim 5, wherein the current real time (CRT) stored in said real time memory of said RTC unit (2) is updated according to time information carried in the received external synchronization signal having the highest

signal strength when said embedded multizone radio receiver (4) is powered up by said power management unit (6) to operate in said time correction mode.

7. The integrated circuit according to claim 6, wherein said integrated power management unit (6) switches said embedded multizone radio receiver (4) from said power-down sleeping mode for a predetermined time period to said power-up time correction mode in response to an embedded signal received by said RTC unit (2) in regular time intervals determined on the basis of the current real time (CRT) provided in said real time memory of said RTC unit (2).

8. The integrated circuit according to one of the preceding claims 1 - 7, wherein said integrated circuit (1) comprises a battery (8) which supplies said RTC unit (2) having a low power consumption permanently with electrical power and said embedded multizone radio receiver (4) when it has been switched by said power management unit (6) into said power-up time correction mode.

9. The integrated circuit according to claim 8, wherein said battery (8) is embedded in a package of said integrated circuit (1).

10. The integrated circuit according to claim 1, wherein said integrated circuit (1) further comprises an embedded GPS/GALILEO receiver adapted to extract time information carried in a received GPS signal.

11. A user device comprising an integrated circuit (1) with an integrated RTC unit (2) according to any of the preceding claims 1-10.

12. A user device according to claim 11, wherein said user device comprises a personal computer or a mobile computer or an automotive device.

13. A system comprising

- transmitters located in different time zones and adapted to transmit synchronization signals on predetermined signal frequencies and
- user devices each having an integrated circuit with an integrated RTC unit (2) according to one of the preceding claims 1 -12.

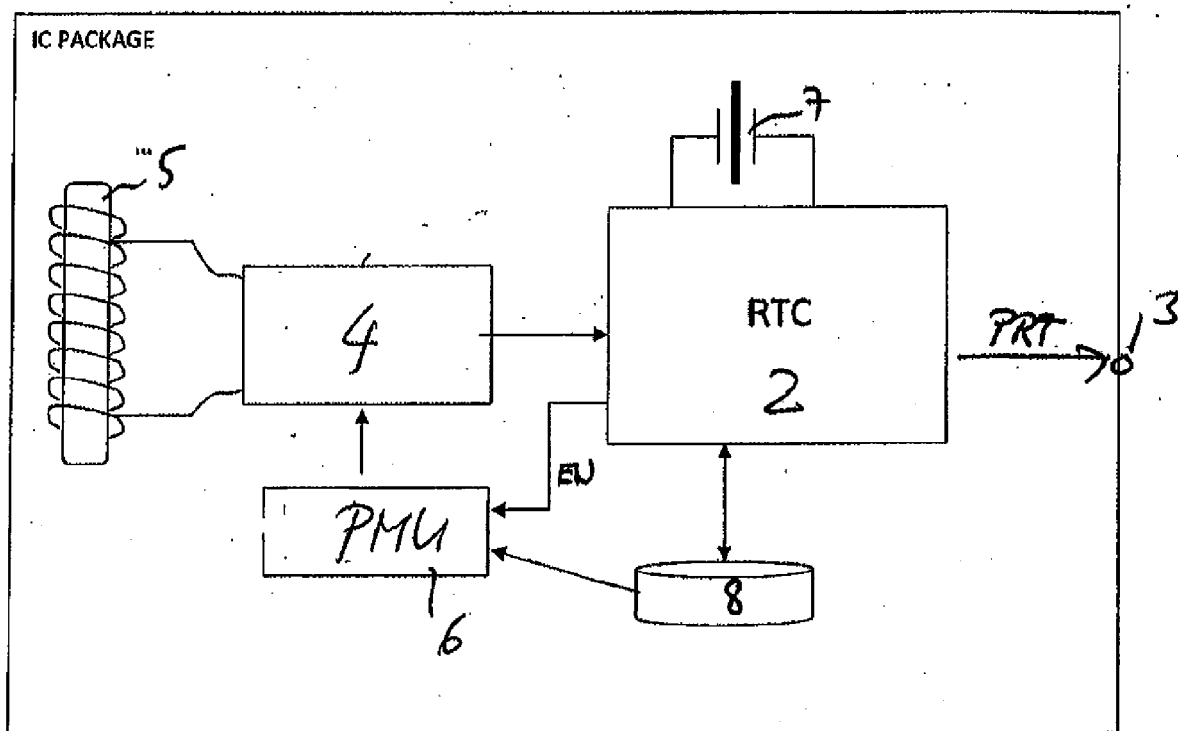


Fig 1

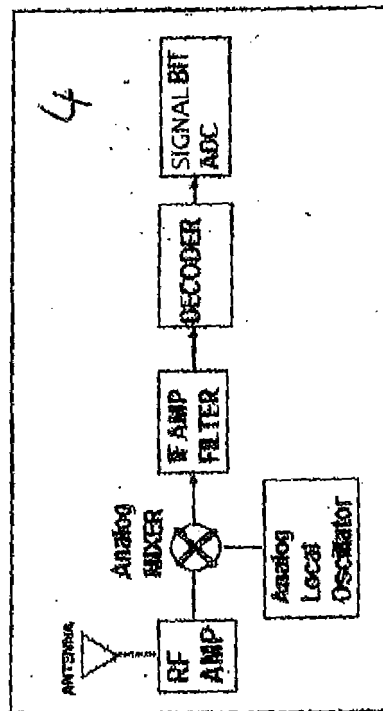


Fig. 2

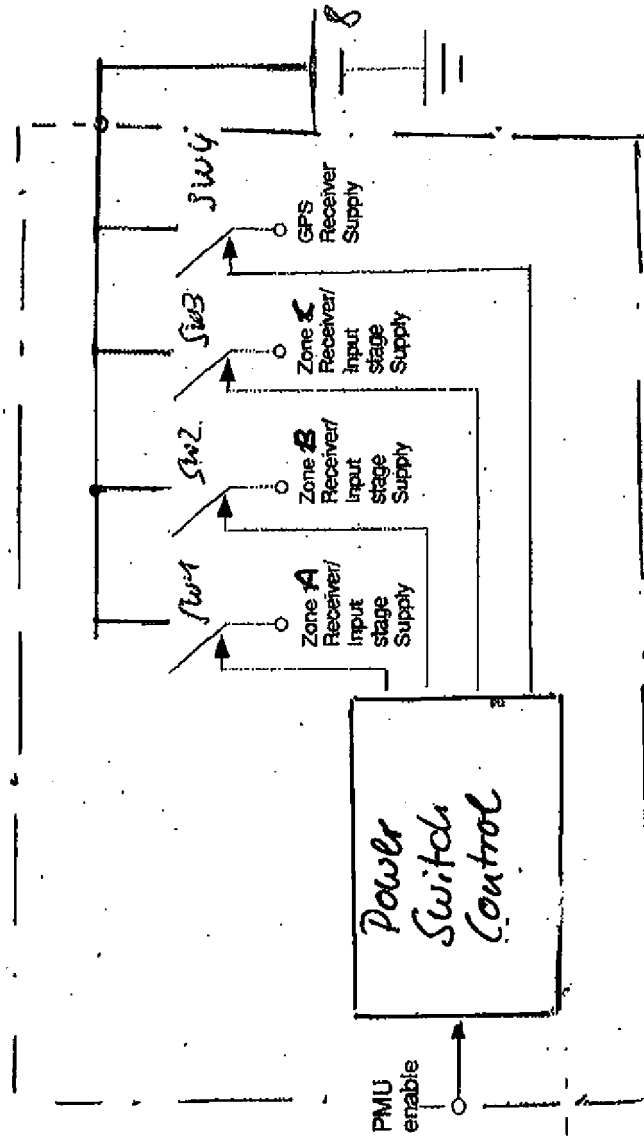


Fig 3

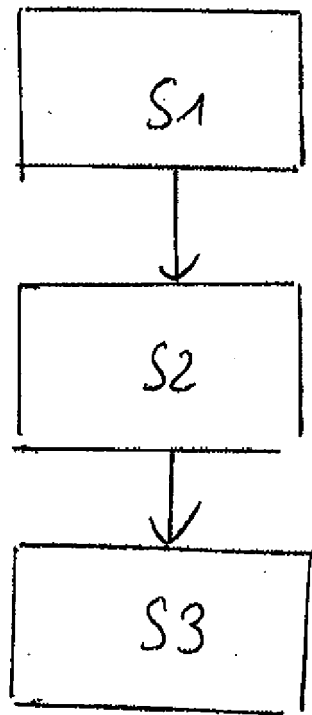


Fig 4



EUROPEAN SEARCH REPORT

Application Number
EP 12 18 4873

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Place of search The Hague		Date of completion of the search 18 February 2013	Examiner Pirozzi, Giuseppe
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 12 18 4873

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