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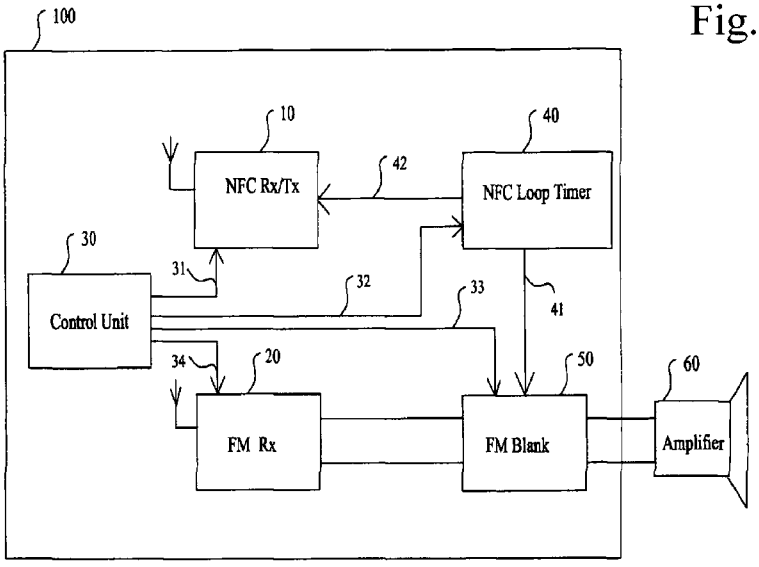
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[Continued on next page]

(54) Title: A PROCESS FOR PERFORMING NEAR FIELD COMMUNICATION (NFC) IN AN INTEGRATED CIRCUIT OR PACKAGE ALSO INCLUDING A FM RECEIVER

Fig. 1



(57) Abstract: A process for performing Near Field Communication (NFC) between a first NFC device (100) and a second NFC device. The first NFC device (100) includes a NFC transceiver (10) and a FM receiver (20) which are integrated in a same chip. The process involves the steps of: initializing (200) the NFC device (100) to perform a device detection polling loop for detecting any second NFC device, the device detection polling loop comprising activity detection periods which occur periodically; performing (250) within said NFC transceiver (10) a slicing of the activity detection periods in small time slots, each having a duration inferior to one predetermined value so as to reduce the noise generated by harmonics of the NFC operation frequency and which might be audible to the user.

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A process for performing Near Field Communication (NFC) in an integrated circuit or package also including a FM receiver

Technical field

The invention relates to the field of wireless communications and more particularly to a process for performing Near Field Communication (NFC) between a first NFC device and a second NFC device, the first device including a FM receiver.

Background Art

Near Field Communication (NFC) is a high-frequency wireless communication method applied in devices that are spaced from each other within about a distance of 10 cm. The NFC technology is an extension of the ISO/IEC 14443 proximity-card standard (Radio-Frequency Identification (RFID), contactless card) that combines the interface of an integrated circuit card (smartcard) and a reader into a single device.

Specifically, NFC communication occurs between two NFC compatible devices, and particularly between an initiator device and a target device. The initiator device chooses the bit rate of data transmission and initializes the communication with the target device.

Furthermore, NFC technology can operate in an active or a passive communication mode discussed below and all NFC devices are assumed to support both communication modes.

Analytically, in a so-called passive mode, an initiator device provides a carrier field and a target device answers by modulating this field. In the passive mode, the

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target draws operating power from the initiator's electromagnetic field and the target device's receiver is only required to acknowledge its presence when polled.

On the other hand, in an active mode, both the initiator device and the target device communicate by generating their own field. In this mode, both devices typically need a power supply.

In order to establish the above mentioned NFC communication between an initiator and a target device which are both NFC compatible, a device detection polling loop is applied. The device detection polling loop can be used by an initiator device to detect a target device or it can be used by a target device for being detected by an external initiator device.

More particularly, during the device detection polling loop, a periodic scanning detection process is performed. The periodic scanning detection, detects different data formats of an external device that can be either an initiator device or a target device.

Nowadays, the trend in wireless connectivity market is to integrate several connectivity cores in single chips. Specifically, in 3G generation, Global Positioning System (GPS), Bluetooth (BT) and FM cores are integrated in only one chip. Nevertheless, next generation chips are expected to additionally integrate the NFC connectivity core.

However, the above mentioned NFC core integration provokes significant impairments in the quality of NFC communication because of the close proximity of the NFC core and the FM core into the chip.

The close proximity of the two above mentioned cores results to interfering effects between the harmonics of the NFC core operation frequency (13.56 MHz) and the frequency of the FM broadcast band, when the FM core is tuned to a channel or frequency (hereinafter designed as the FM operation frequency) which is an harmonic of the NFC frequency. Specifically, the highest impact on the

interference comes from the permanent function of the device detection polling loop operating in the NFC frequency.

Thus there is a need to improve the NFC communication between NFC compatible devices and decrease the interference effect resulting from the integration of an FM core and an NFC core in a single chip, which interference particularly arises when a tuned FM core frequency matches a harmonic of the NFC core operation frequency.

Summary of the invention

It is an object of the present invention to provide a process for performing Near Field Communication (NFC) between a first NFC device and a second NFC device, the first NFC device including a FM receiver.

It is another object of the invention to provide a process for decreasing the interference effect resulting from the integration of a FM receiver and a NFC transceiver in a single chip included in a NFC device.

Those and other objects are achieved by means of a process for performing Near Field Communication (NFC) between a first NFC device and a second NFC device. The first NFC device includes a NFC transceiver and a FM receiver which are integrated in a same chip.

The process involves the steps of:

- initializing the NFC device for performing a device detection polling loop for detecting any second NFC device, the device detection polling loop comprising activity detection periods which occur periodically;
- performing within said NFC transceiver a slicing of the activity detection periods in small time slots, each having a duration inferior to one predetermined value so as to

reduce the noise generated by harmonics of the NFC operation frequency and which might be audible to the user.

In one embodiment, the time slots are randomly scheduled within the polling loop.

Preferably, the process further performs a blanking of the audio signal received by said FM receiver, said blanking occurring during said time slots.

In one embodiment there is determined the FM operation frequency of the FM receiver and the latter is compared with all possible harmonics of the NFC communication. Based on that comparison, the process enables the slicing operation in order to reduce the noise audible to the user when the FM operation frequency is too close to the NFC operation frequency.

Preferably, the predetermined value is set to 10 milliseconds.

The invention also provides a NFC device which includes NFC transceiver integrated together with a FM receiver.

The NFC device comprises:

- means for initializing a device detection polling loop for detecting a second NFC device on the basis of periodical activity detection periods;
- means for slicing said activity detection periods in time slots having a duration inferior to one predetermined value;

whereby the noise generated by harmonics of the NFC operation frequency is reduced in the FM receiver.

Preferably, the NFC device means for randomly scheduling said time slots within the polling loop.

In one embodiment the NFC device further includes a FM blanking circuit for switching off the FM audio signal received by said FM receiver during said time slots.

Preferably, the NFC device includes control unit, which can be for instance a Central Processing Unit (CPU) allowing easy software configuration, which compares the FM operation frequency used by said FM receiver with harmonics of the NFC operation frequency and, further to said comparison, for controlling the blanking of the FM audio signal.

Preferably, the time slots are set to have a duration inferior to 10 milliseconds so as to minimize the audible effects to the user of the FM receiver.

The invention is adapted to achieve integration of the NFC device together with the FM receiver either in a System on Chip (SOC) or System in Package (SIP) configuration.

Description of the drawings

Other features of one or more embodiments of the invention will best understood by reference to the following detailed description when read in conjunction with the accompanying drawings.

Figure 1 illustrates a Near Field Communication (NFC) device according to one embodiment.

Figure 2 illustrates one embodiment of the process.

Figure 3 illustrates the scanning process of the device detection polling loop.

Description of the preferred embodiment

The invention described below is implemented in NFC compatible devices. As known by the skilled man, a wide range of devices and machines are likely to become NFC compatible devices, including mobile phones, turnstiles, parking meters, check-out cash registers or "point-of-sale" equipment, ATMs, house and garage doors, personal computers, posters, street signs, bus stops, local points of interest (with NFC-readable tags only), product packaging, e.t.c.

A first NFC device can communicate with a wide range of NFC devices and particularly with a second device complying with the existing ISO/IEC 14443 standard (relating to integrated circuit cards also designated as smartcards) and readers. The technology is standardized in ISO/IEC18092, ECMA-340 (European association for standardizing information and communication systems), and ETSI 102.190 (European Telecommunications Standards Institute). It operates within the globally available and unregulated RF band of 13.56 MHz with data transfers of 106 kbps, 212 kbps and 424 kbps per second.

However, the process which will be described below can be adapted to a wide range of existing or future formats.

The general trend of NFC designers is to integrate those NFC functionalities with other circuits such as , for instance, a FM receiver which is widely used in the public.

In such a situation, the use of the frequencies mentioned above might clearly become a significant source of interference for the FM audio circuits.

FIG.1 illustrates an architecture of a NFC device 100 which comprises a NFC transceiver 10 which is integrated in a same chip than a FM receiver 20. One should understand that the integration into a same chip may encompasses both the situation of the integration within a single die (which is referred to a System On Chip

SOC designation) and the integration of two distinct dies in a same package, referred to as System in Package (SIP).

In one embodiment, the NFC transceiver 10 is able to transmit and receive a RF signal carrying data in its operation frequency (13.56 MHz) while the FM receiver 20 receives a FM signal carrying a modulated audio signal in its operation frequency varying between 87.5 to 108.0 MHz.

It can be seen that an interference effect may arise when the FM operation frequency is tuned to a frequency between the 6^{th} and the 8^{th} harmonics of the operation frequency of the NFC transceiver 10.

NFC device 100 also includes a control unit 30 which executes the hereinafter described process and also provides a set of control signals via control leads 31-34, required for controlling the different components of the NFC device 100.

Also, the NFC device 100 of the invention includes a NFC loop timer 40 which controls the NFC transceiver 10 through a control lead 42 and a FM blank circuit 50 connected with the FM receiver 20, also receiving a control signal through a lead 41 from NFC Loop timer 40. Furthermore, the NFC device 100 includes an amplifier 60.

It will be shown that the control unit 30, the NFC loop timer 40 and the FM blank circuit 50 cooperate together for the purpose of improving the reception of the FM audio signal.

This is achieved by means of the slicing of the NFC activity detection period in smaller slices or time slots TS1, TS2, TS3 or TS4 etc... as shown in figure 3, each corresponding to one particular data format which can be applicable by a second NFC device preferably less than 10 milliseconds and scheduling those time slots within the NFC scanning or polling loop by means of NFC loop timer 40, and also controlling the FM blank circuit so as to switch off the audio signal during those time slots. The slices or time slots can be built, for example, by starting the RF

carrier signal, waiting for the corresponding setup time, modulating the RF carrier signal according to one of the particular data formats, waiting for the corresponding response time, and stopping the RF carrier signal.

Preferably the slicing process is controlled by control unit 30 which determines, by means of a comparison of the active FM frequency being used by the FM receiver and the possible harmonics of the NFC operation frequency, whether the slicing of the NFC activity detection period is appropriate or not.

Also, in one embodiment, the NFC loop timer 40 performs a random scheduling of the time slots assigned to the different NFC activity detection.

With respect to FIG. 2, there will now be described a preferred embodiment of a process for performing Near Field Communication (NFC) between NFC device 100 and another NFC compatible device. The NFC device 100 comprises both a NFC transceiver 10 and a FM receiver 20. The FM transceiver 10 operates in a NFC frequency and the FM receiver 20 operates in a FM frequency.

Both the FM receiver and the NFC transceiver are integrated in a single chip and thus interference might occur if the FM operation frequency of the FM receiver is tuned to a frequency that matches the harmonics of the NFC operation frequency. This interference significantly impairs the above mentioned NFC communication that takes place when the first NFC device and the second NFC device are brought within close proximity (around 10 centimeters).

Referring to figure 2 again, one sees that, In a step 200, the process starts with an initialization of the NFC device 100. In particular, the FM audio circuits, including the FM blank circuit 50, are initialized so as to allow FM audio playing through amplifier 60.

In addition, the NFC device 100 is also initialized regarding the NFC functionalities which are performed in accordance with known procedures.

In particularly, the initialization includes the initialization of the NFC device detection polling loop. During that phase, the NFC device receives data signals from another NFC compatible device. These data signals correspond to different data formats according to different protocols of different standards, and well known to the skilled man.

In one embodiment, the NFC device can be in an initiator mode. In that case, the NFC device sends a signal to initiate communication with the NFC compatible device that is in a target mode.

Alternatively, in another embodiment, the NFC device can be in a target mode. In that case, the NFC device receives the signal send by a NFC compatible device being in initiator mode.

As illustrated in FIG. 3, the device detection polling loop is performed periodically over subsequent scanning periods or polling loops. Also, the different data formats (i.e. detection type A, detection type B, detection type F-212, detection type F-424, detection 15693 etc...) are received by the NFC device during an activity detection period or chunk at the beginning of each polling loop.

In one embodiment, the polling loop is designed to support all implemented protocols and is software configured.

In a step 210, the process proceeds with the determination of the active FM frequency being used by the FM receiver. This is achieved by Control Unit (CU) 30 which exchanges information with the FM receiver via (not represented) communication channel. Generally speaking, control unit 30 is embodied by means of a Central Processing Unit (CPU) which handles all high level control of the different components of the device and , therefore, is perfectly aware of the different parameters of such devices, including, in the case of FM Receiver 20, the operating frequency being used by the user.

In a step 220 , the process proceeds with performing a comparison between the FM operation frequency and the different harmonics of the NFC operation frequency.

This comparison is performed by the CU 30 in order to determine whether there could be a possible pollution of the FM audio signal. Specifically, the FM audio signal may be polluted if there is a match or close proximity between the channel or FM operation frequency and the different harmonics of the NFC operation frequency.

If the FM operation frequency does not correspond to one possible harmonics of the NFC communication, then the process proceeds to a step 230 , where the CU 30 disables the NFC loop timer 40 as well as the FM blank circuit 50, respectively by means of control leads 32 and 33.

This results in the fact that both circuits, NFC transceiver 10 and FM receiver 20, although located in the same chip package, operate independently since there is very limited risk of interference.

If there is a match in the comparison of the step 220, then the process proceeds to a step 240 where Control unit 30 enables the NFC loop timer 40 by means of control leads 32.

Consequently, NFC loop timer 40 initiates the slicing of the NFC activity detection period in small time slots, in a step 250.

Practically, the slicing is achieved by generating appropriate control signals on lead 42 which are forwarded to NFC transceiver 10, which results in the generation of short time slots as illustrated in figure 3. The time slots take the form of bursts.

In one embodiment, the time slots are scheduled randomly so as to reduce the audible effects for the user of the FM blanking process.

Similarly, NFC loop timer 40 generates a control signal on a lead 41 which is forwarded to FM blank circuit 50 , and which is active during the time slots which are scheduled on the NFC polling loop.

In one preferred embodiment, the slicing is performed in such a way that the time slots are less than 10ms.

Then the process proceeds to a step 260, where CU 30 activates control lead 33 so as to enable FM blanking.

Consequently, FM blanking circuit 50 starts performing blanking operation in accordance with control signal received on lead 41 and which results in the switch off of the audible FM signal being presented at the input of the audio amplifier.

Practically, one may take advantage of one special transistor, such as a MOS transistor, having its gate control lead driven by control lead 41.

Since, in the preferred embodiment, the slicing performed by NFC loop timer 40 generates activity time slots of less than 10ms, the corresponding audio blanks will not be audible to the user.

It should be noticed that the activation of FM blanking circuit 50 by control lead 33 is optional. However, when it is not activated, the improvement of the FM audio signal is only achieved by means of the random "slicing" introduced in the NFC activity detection scanning (performed by block 40).

Clearly, when the control unit activates control lead 33, the FM blanking circuit 50 significantly improves the quality of the audio signal.

CLAIMS

1. Process for performing Near Field Communication (NFC) between a first NFC device (100) and a second NFC device, said first NFC device (100) including a NFC transceiver (10) and a FM receiver (20) both integrated in a same chip, said NFC transceiver (10) operating at a NFC operation frequency and said FM receiver (20) operating at a FM operation frequency, said process comprising the steps of:

- initializing (200) said NFC device (100) to perform a device detection polling loop for detecting said second NFC device, said device detection polling loop comprising activity detection periods periodically occurring;
- performing (250) within said NFC transceiver (10) a slicing of said activity detection periods in time slots, each having a duration inferior to one predetermined value

for the purpose of reducing the noise generated by harmonics of the NFC operation frequency and audible to the user.

2. Process according to Claims 1 characterized in that the time slots are randomly scheduled within the polling loop.

3. Process according to claim 1 or 2 characterized in that it involves the step of:

- performing a blanking (260) of the audio signal received by said FM receiver, said blanking occurring during said time slots.

4. Process according to claim 1 or 2 or 3 characterized in that it involves the step of:

- determining (210) the FM operation frequency;
- comparing (220) the FM operation frequency with harmonics of the NFC operation frequency;
- enabling (240) the slicing operation of said activity detection periods when said FM operation frequency is close to one harmonics of said NFC operation frequency.

5. Process according to anyone of claims 1 to 4 characterized in that said predetermined value is set to 10 milliseconds.

6. Process according to anyone of claims 1 to 5 characterized in that said first NFC device is set in a initiator mode or in a target mode.

7. Process according to anyone of claims 1 to 6 characterized in that said device detection polling loop detects the following type of formats: detection type A, detection type B, detection type F-212, detection type F-424, detection 15693.

8. Near Field Communication (NFC) device including a NFC transceiver (10) and a FM receiver (20) both integrated in a same chip, said NFC transceiver (10) operating at a NFC operation frequency and said FM receiver (20) operating at a FM operation frequency,

said NFC device comprising:

- means for initializing a device detection polling loop for detecting a second NFC device on the basis of periodical activity detection periods;
- means for slicing (30, 40) said activity detection periods in time slots having a duration inferior to one predetermined value;

whereby the noise generated by harmonics of the NFC operation frequency is reduced in the FM receiver.

9. Near Field Communication (NFC) device according to claim 8 further including means for randomly scheduling said time slots within the polling loop.

10. Near Field Communication (NFC) device according to claim 8 or 9 further including means (50) for blanking the audio signal received by said FM receiver during said time slots.

11. Near Field Communication (NFC) device according to anyone of claims 8 to 10 further including a control unit (30) which compares the FM operation frequency

used by said FM receiver with harmonics of the NFC operation frequency and, further to said comparison, for enabling said blanking means (50).

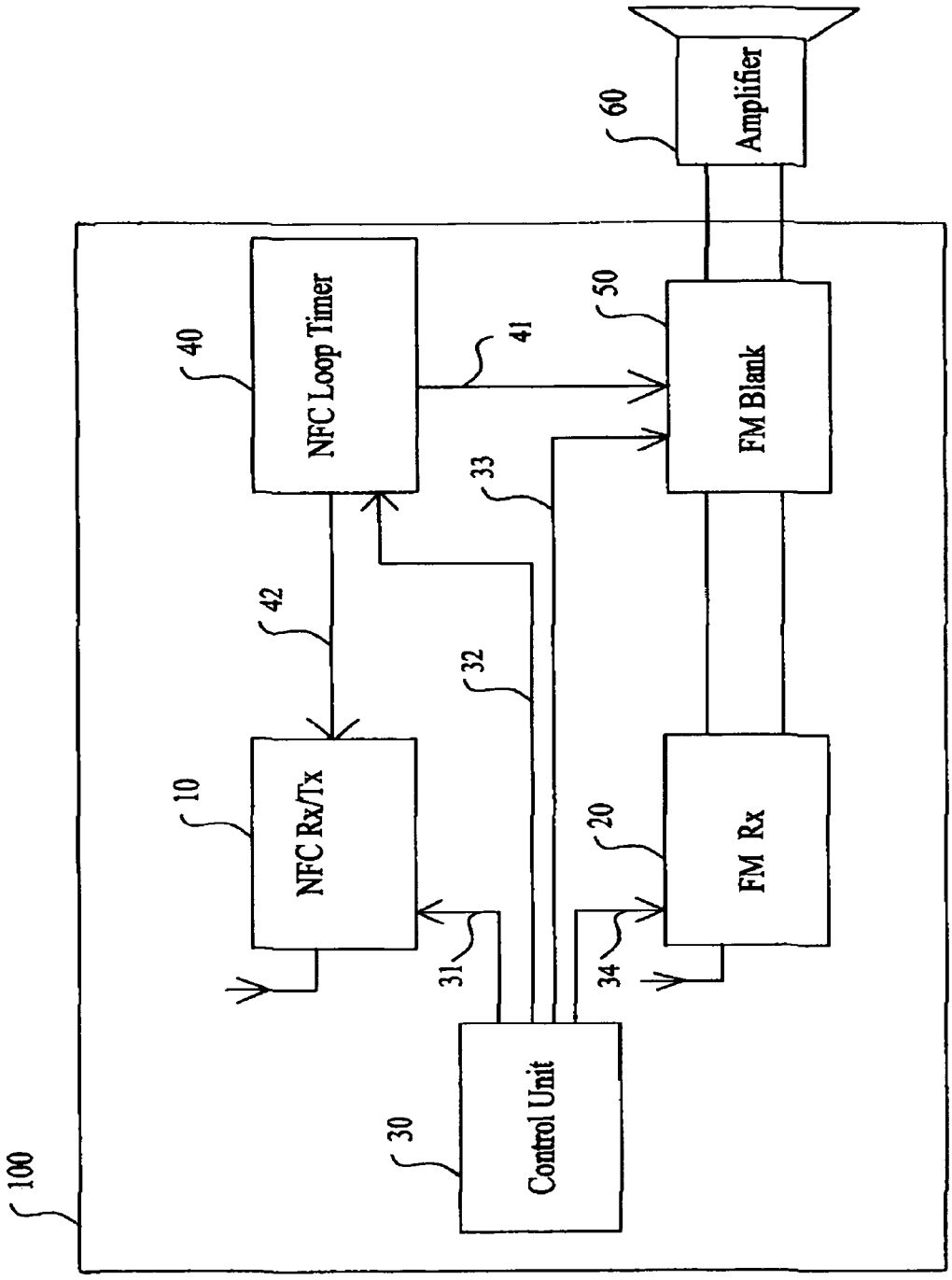
12. Near Field Communication (NFC) device according to anyone of claims 8 to 11 characterized in that said predetermined value is set to 10 milliseconds.

13. Near Field Communication (NFC) device according to anyone of claims 8 to 12 characterized in that it is adapted to detect the following type of formats: detection type A, detection type B, detection type F-212, detection type F-424, detection 15693.

14. Near Field Communication (NFC) device according to anyone of claims 8 to 12 characterized in that said integration of said FM receiver and said NFC transceiver is a System on Chip (SOC) or System in Package (SIP) integration.

15. Near Field Communication (NFC) device according to anyone of claims 8 to 14 characterized in that said polling loop is software configured.

Fig. 1


Amplifier
60
NFC Loop Timer
40
41
50
FM Blank
33
42
32
NFC Rx/Tx
10
20
FM Rx
31
34
Control Unit
30
100

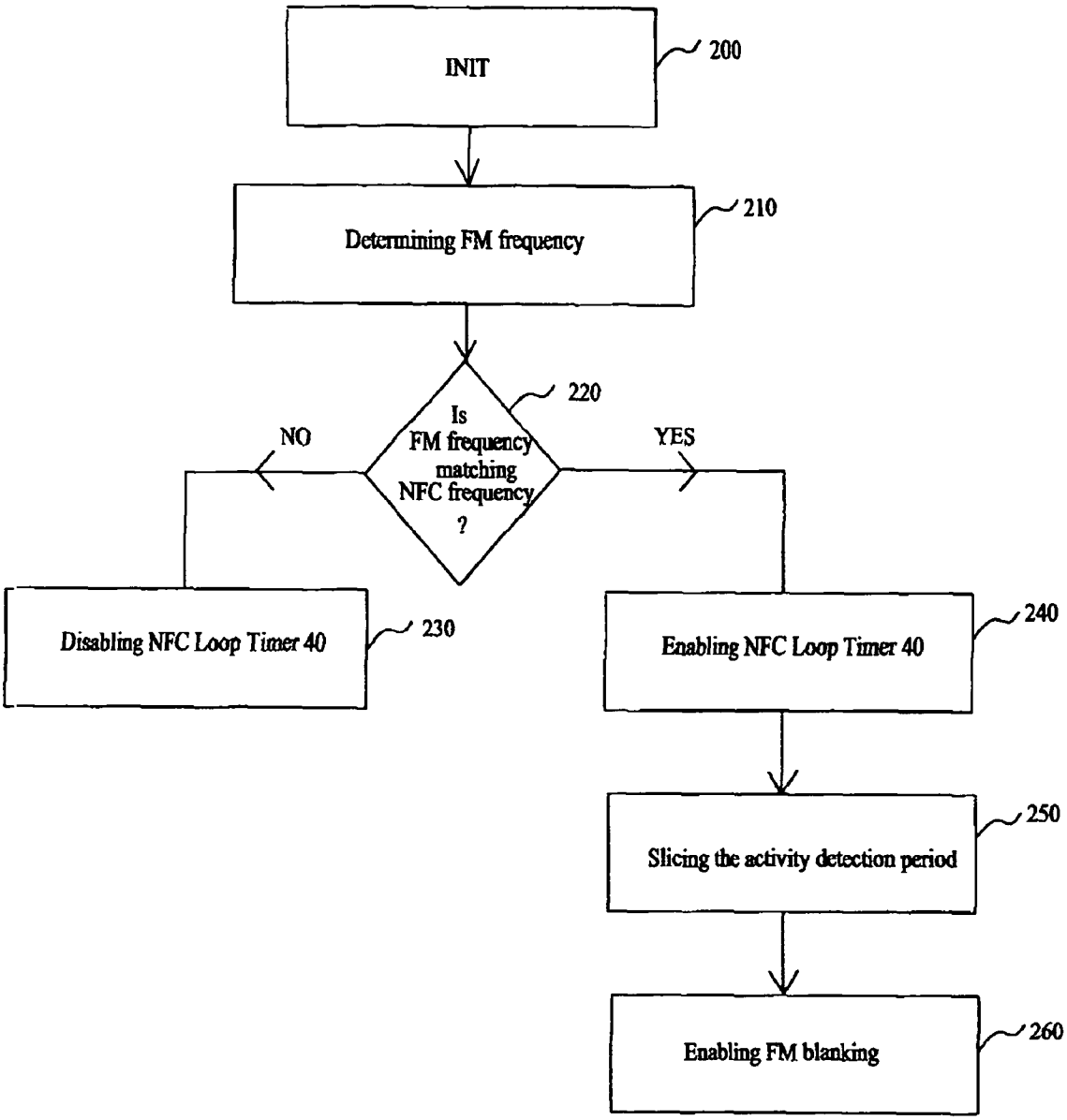

INIT
200
Determining FM frequency
210
Is FM frequency matching NFC frequency ?
220
NO
YES
Disabling NFC Loop Timer 40
230
Enabling NFC Loop Timer 40
240
Slicing the activity detection period
250
Enabling FM blanking
260

Fig. 2

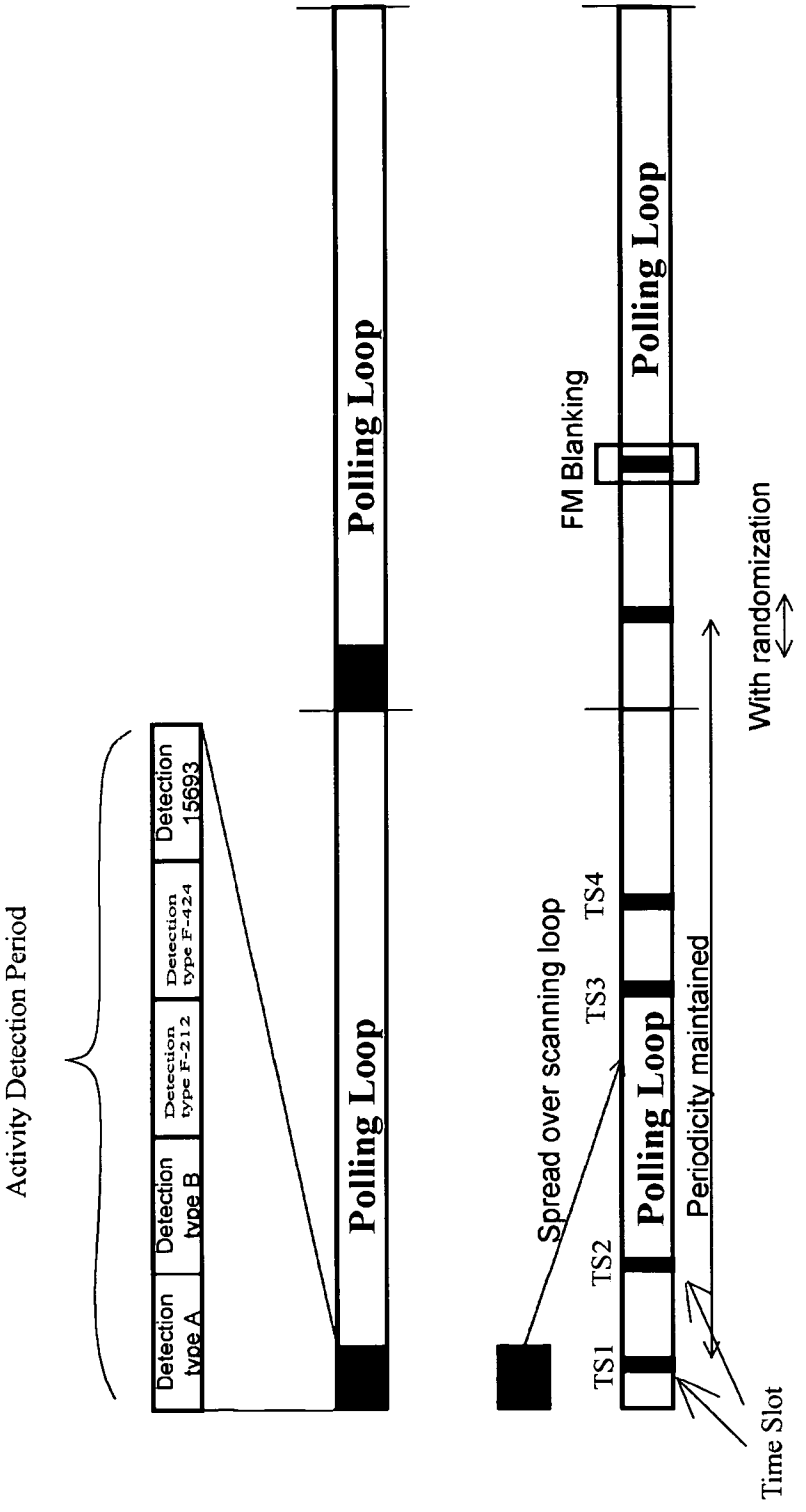

Activity Detection Period
Detection type A
Detection type B
Detection type F-212
Detection type F-424
Detection 15693
Polling Loop
Polling Loop
FM Blanking
Polling Loop
Spread over scanning loop
TS1
TS2
TS3
TS4
Polling Loop
Periodicity maintained
With randomization
Time Slot

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/007829

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04B5/02 H04B1/38 H04B15/00
ADD.

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)
H04B

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2008/081631 A1 (ROFOUGARAN AHMADREZA [US]) 3 April 2008 (2008-04-03) * abstract paragraph [0018] paragraph [0051] figure 1	1,8
A	US 2006/269021 A1 (IBRAHIM BRIMA [US] ET AL) 30 November 2006 (2006-11-30) * abstract paragraph [0036] - paragraph [0041] figure 1C	1,8

☐ 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	Date of mailing of the international search report
1 March 2011	07/03/2011

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Lustrini, Donato

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2010/007829

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2008081631 A1	03-04-2008	NONE	
US 2006269021 A1	30-11-2006	NONE	