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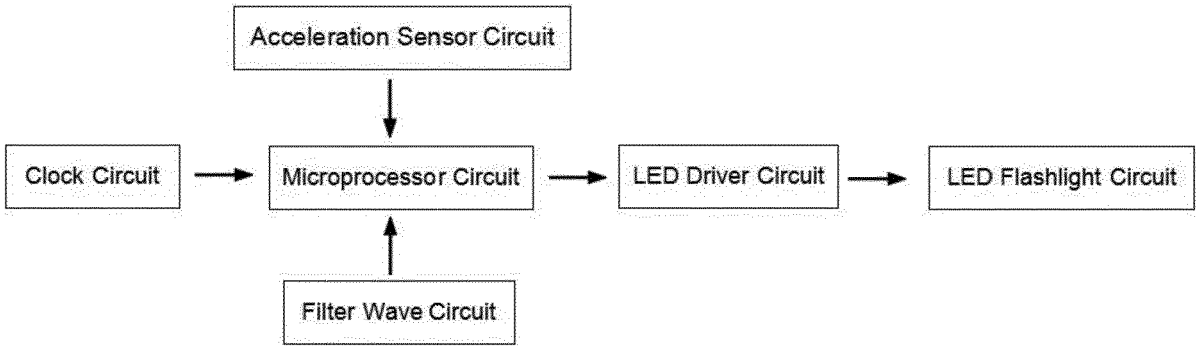
(54) **EARPHONE WHICH ILLUMINATES WITH MOTION**

(57) This invention involves smart wearable products, earphone which illuminates with motion in particular. The earphone adopts acceleration sensor to collect the acceleration value of the user in motion, which in turn, be transformed into data signal and then transmitted into ARM microprocessor for analysis and evaluation while the ARM microprocessor controls the illuminating and dimming of LED light through the driver circuit. Therefore, the earphone may illuminate automatically with motion, free the user from manual labor. The earphone specified in this invention includes filter circuit which ensures reliable function by filtering ripple waves from the power. Besides, this earphone has reasonable circuit design which helps reduce cost.



Drawing 1

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Description

Technical Scope

[0001] This invention involves smart wearable products, earphone which illuminates with motion in particular.

Technical Background

[0002] Thanks to the advancement of mobile communication technologies, the mobile internet has experienced rapid development. The smart wearable products which have gained popularity rapidly, in particular, have become a highlight. Smart wearable products involve sectors ranging from eye wears, entertainments, child care, health, smart home appliances, smart apparels to communications and offer functions including photo shooting, audio identification, lens navigation and body weight monitor. Smart wearable products may be regarded as cyber-based smart terminals featuring high performance-consumption ratio. They are represented by daily wearable products rather than cell phones. Making information exchanges with human body through sensors, these smart products have wide applications and can be upgraded to meet the specific demand of users. They also play an important role in improving the life quality and advocating smart lifestyle. It is expected that smart wearable products will embrace huge market in the years to come.

[0003] The smart earphones currently available in the market offer only few and limited functions and fail to make effective interaction with the users, which is a problem needs to be solved.

Details of the Invention

[0004] This invention overcomes technical restricts and aims to produce a kind of earphone which illuminates with motion of the user. It includes a LED light which illuminates with the user's motion, free him/her from manual labor. Besides, the earphone is reasonable in design and stable in performance which ensures its stability and reliability.

[0005] To solve the foresaid technical problem, this invention proposes the following technical plan:

1. The said microprocessor is type EFM32TG210 ARM microprocessor and has 33 pins.
2. the said LED driver circuit comprises three resistors and one NPN-type transistor. The first pin of ARM microprocessor connects to the first resistor on one end and the second resistor on the other end. The other end of the first resistor is earthed while the other end of the second resistor connects to the base of NPN-type transistor and one end of the third resistor. The collector connects to the LED flashlight circuit while the emitter is earthed together with the other end of the third resistor.
3. the said earphone adopts three LED driver circuits which respectively connects to the first pin, second pin and third pin of the ARM microprocessor.
4. the said LED flashlight circuit comprises a luminous diode, a fourth resistor and a first capacitor. The negative electrode of the luminous diode connects to the collector of the NPN-type transistor while the positive electrode connects to one end of the fourth resistor with its other end connects to the fourteenth pin of the ARM microprocessor and one end of the first capacitor. The other end of the first capacitor is earthed.
5. the described earphone adopts three LED flashlight circuits with Line. 1 LED flashlight circuit connects to the connector of NPN-type transistor in Line. 1 LED driver circuit, Line. 2 LED flashlight circuit connects to the connector of NPN-type transistor in Line. 2 LED driver circuit and Line. 3 LED flashlight circuit connects to the connector of NPN-type transistor in Line. 3 LED driver circuit.
6. the said acceleration sensor circuit comprises an acceleration sensor, a fifth resistor, a sixth resistor, a second capacitor and a third capacitor. It adopts type BMA250E acceleration sensor which has 12 pins. The first pin and fourth pin are earthed while the second pin connects to the thirty first pin of ARM microprocessor and one end of the fifth resistor. The other end of the fifth resistor connects to the fourth pin of ARM microprocessor. The third pin of the acceleration sensor connects respectively to one end of the second capacitor, the third capacitor and the fourth pin of the ARM microprocessor while the other ends of the second capacitor and the third capacitor are earthed. The fifth pin and sixth pin of the acceleration sensor are suspended while its seventh pin connects respectively to one end of the third capacitor and the fourth pin of the ARM microprocessor. The eighth pin and ninth pin of the acceleration sensor are earthed and its tenth pin suspended. The eleventh pin of the acceleration sensor connects respectively to one end of the third capacitor and the fourth pin of ARM microprocessor while its twelfth pin connects respectively to the thirty second pin of the ARM microprocessor and one end of the sixth resistor. The other end of the sixth resistor connects to the fourth pin of ARM microprocessor.
7. the said microprocessor comprises eight capacitors, namely, the fourth capacity to the eleventh capacitor. The fifth, sixth, tenth, twelfth, thirteenth, sixteenth to nineteenth and twenty second to twenty seventh and twenty ninth and thirtieth pins of the said ARM microprocessor are suspended. Its fourth pin is earthed through the fourth capacity, ninth pin earthed through the fifth capacitor, eleventh pin earthed through the sixth capacity, fourteenth pin earthed through the seventh capacitor, fifteenth pin earthed through the eighth capacitor, twentieth pin

earthed through the ninth capacitor, twenty first in earthed through the tenth capacitor and the twenty eighth pin earthed through the eleventh capacitor.

[0006] The benefits of this invention is that the acceleration sensor to collect the acceleration value of the user in motion, which in turn, be transformed into data signal and then transmitted into ARM microprocessor for analysis and evaluation while the ARM microprocessor controls the illuminating and dimming of LED light through the driver circuit. Therefore, the earphone may illuminate automatically with motion, free the user from manual labor. The earphone specified in this invention includes filter circuit which ensures reliable function by filtering ripple waves from the power. Besides, this earphone has reasonable circuit design which helps reduce cost.

Diagram Descriptions

[0007]

Drawing 1 structural diagram of earphone embodiment
Drawing 2 structural diagram of microprocessor embodiment
Drawing 3 structural embodiment of LED driver circuit embodiment
Drawing 4 structural diagram of 3-line LED driver circuit embodiment
Drawing 5 structural diagram of LED flashlight circuit embodiment
Drawing 6 structural diagram of 3-line LED flashlight circuit embodiment
Drawing 7 structural diagram of acceleration sensor circuit embodiment
Drawing 8 structural diagram of clock circuit embodiment
Drawing 9 structural diagram of filter wave embodiment
Drawing 10 flow diagram of earphone illuminating with motion

Detailed Description of Embodiment

[0008] Detailed descriptions are made with reference to drawings from Drawing 1 to Drawing 10, without limitation on the protection scope of this invention. For better understanding of the technical plan under this invention, the description shall be subject to those indicated in the drawings.

[0009] As indicated in Drawing 1, the earphone described in this embodiment includes acceleration sense circuit, microprocessor, LED driver circuits, LED flashlight circuits, clock circuit and filter wave circuit. The microprocessor connects to acceleration sense circuit, LED driver circuits, LED flashlight circuits, clock circuit and filter wave circuit respectively while LED driver circuits connects to LED flashlight circuits.

[0010] As further indicated in Drawing 1, acceleration sensor circuit collects the acceleration value of user in motion and transforms it into first signal; microprocessor then receives the first signal and generates second signal after analysis and evaluation; LED driver circuit then receives the second signal and generates the third signal; LED flashlight circuit receives the third signal transmitted by the LED driver circuit and illuminates. Of it, the first signal is acceleration signal, the second signal is PWM signal to drive LED light while the third signal is the driver signal which drives LED light to illuminate by magnifying the PWM signal.

[0011] As indicated in Drawing 2, The microprocessor is type EFM32TG210 ARM microprocessor and has 33 pins.

[0012] As indicated in Drawing 3, the said LED driver circuit comprises three resistors and one NPN-type transistor Q1. The first pin of ARM microprocessor connects to the first resistor R1 on one end and the second resistor R2 on the other end. The other end of the first resistor R1 is earthed while the other end of the second resistor R2 connects to the base of NPN-type transistor Q1 and one end of the third resistor R3. The collector connects to the LED flashlight circuit while the emitter is earthed together with the other end of the third resistor R3. Of it, the resistance of R1 is 100K while R2 and R3 are current-limiting resistor and pull-down resistor respectively.

[0013] As indicated in Drawing 4, the earphone adopts three LED driver circuits which respectively connects to the first pin, second pin and third pin of the ARM microprocessor. The extension of the first pin of the ARM microprocessor is identified as TIMERO_CCO in Drawing 2 and Drawing 4 while the extensions of the second pin and third pin of the ARM microprocessor are identified as TIMERO_CC1 and TIMERO-CC1 respectively in the same drawings. Besides, the collectors of NPN type transistor in each of the LED driver circuits are identified as LED_R, LED_G and LED_B respectively.

[0014] As indicated in Drawing 5, the LED flashlight circuit comprises a luminous diode D1, a fourth resistor R4 and a first capacitor C1. The negative electrode of the luminous diode D1 connects to the collector of the NPN-type transistor Q1 while the positive electrode connects to one end of the fourth resistor R4 with its other end connects to the fourteenth pin of the ARM microprocessor and one end of the first capacitor C1. The other end of the first capacitor C1 is earthed.

[0015] As indicated in Drawing 6, the described earphone adopts three LED flashlight circuits with Line. 1 LED flashlight circuit connects to the connector of NPN-type transistor in Line. 1 LED driver circuit, Line. 2 LED flashlight circuit connects to the connector of NPN-type transistor in Line. 2 LED driver circuit and Line. 3 LED flashlight circuit connects to the connector of NPN-type transistor in Line. 3 LED driver circuit. The extensions of negative electrode of luminous diode D1 in each of the LED flashlight circuits are identified as LED_R, LED_G

and LED_B respectively.

[0016] As indicated in Drawing 7, the acceleration sensor circuit comprises an acceleration sensor U1, a fifth resistor R5, a sixth resistor R6, a second capacitor C2 and a third capacitor C3. The type of acceleration sensor U1 is BMA250E and has 12 pins. The first pin and fourth pin are earthed while the second pin connects to the thirty first pin of ARM microprocessor and one end of the fifth resistor R4. The other end of the fifth resistor R5 connects to the fourth pin of ARM microprocessor U2. The third pin of the acceleration sensor U1 connects respectively to one end of the second capacitor C2, the third capacitor C3 and the fourth pin of the ARM microprocessor U2 while the other ends of the second capacitor C2 and the third capacitor C3 are earthed. The fifth pin and sixth pin of the acceleration sensor U1 are suspended while its seventh pin connects respectively to one end of the third capacitor C3 and the fourth pin of the ARM microprocessor U2. The eighth pin and ninth pin of the acceleration sensor U1 are earthed and its tenth pin suspended. The eleventh pin of the acceleration sensor U1 connects respectively to one end of the third capacitor C3 and the fourth pin of ARM microprocessor U2 while its twelfth pin connects respectively to the thirty second pin of the ARM microprocessor U2 and one end of the sixth resistor R6. The other end of the sixth resistor R6 connects to the fourth pin of ARM microprocessor U2.

[0017] As indicated in Drawing 2, the microprocessor circuit comprises eight capacitors, namely, the fourth capacity C4 to the eleventh capacitor C11. The fifth, sixth, tenth, twelfth, thirteenth, sixteenth to nineteenth and twenty second to twenty seventh and twenty ninth and thirtieth pins of the said ARM microprocessor are suspended. Its fourth pin is earthed through the fourth capacity C4, ninth pin earthed through the fifth capacitor C5, eleventh pin earthed through the sixth capacity C6, fourteenth pin earthed through the seventh capacitor C7, fifteenth pin earthed through the eighth capacitor C8, twentieth pin earthed through the ninth capacitor C9, twenty first earthed through the tenth capacitor C10 and the twenty eighth pin earthed through the eleventh capacitor C11.

[0018] Notably, as indicated in Drawing 2, the extension of the fourth pin of ARM microprocessor U2 is identified as VDD_MCU while that of the seventh pin, eighth pin, ninth pin, eleventh pin, thirty first pin and thirty second pin is identified as LFXTAL_P, LFXTAL_N, RESET_MCU, AVDD_MCU, SDA_MCU, SCL_MCU respectively.

[0019] As indicated in Drawing 8, the clock circuit comprises a twelfth capacitor C12, a thirteenth capacitor C13 and a crystal oscillator Y1. The seventh pin of ARM microprocessor U2 connects to one end of the crystal oscillator Y1 and the thirteenth capacitor C13 while the other end of the thirteenth capacitor C13 is earthed. The eighth pin connects respectively to one end of the crystal oscillator Y1 and the twelfth capacitor C12 while the other end of the twelfth capacitor C12 is earthed. As indicated in Drawing 9, The filter wave circuit comprises a filter inductor L1, a fourteenth capacitor C14 and a fifteenth capacitor C15. The fourth pin of the ARM microprocessor U2 connects respectively to one end of the filter wave inductor L1 and the fourteenth capacitor C14 while the other end of the fourteenth capacitor C14 is earthed. The other end of the filter wave inductor L1 connects respectively to the eleventh pin of the ARM microprocessor U2 and the fifteenth capacitor C15 while the other end of the fifteenth capacitor C15 is earthed.

[0020] The principle of earphone illuminates with motion is as following: as indicated in Drawing 10, the acceleration sensor circuit captures the motion of the user, namely, the acceleration value. ARM microprocessor transmits signal to the acceleration sensor circuit at an interval of 40 milliseconds to collect acceleration value of the user. The microprocessor presets threshold value for illuminating and dimming, and generates the second signal after analysis and evaluation of the acceleration value. When the acceleration value exceeds threshold value for illuminating, the microprocessor generates the second signal to illuminate the LED light through the LED light driver circuit. When the acceleration values is below threshold value for dimming, the LED light dims automatically. When the acceleration value falls between the threshold values for illuminating and dimming, the LED light remains in original state of illumination. When one is in motion, acceleration value is in constant change with it on the high side when the foot steps back on or bounces off the ground and on the low side when the foot moves in the air. Thus, the light illuminates when the foot steps back on the ground and dims when it bounces off the ground. Therefore, the LED light equipped on the earphone illuminates and dims on real time with the motion of the user.

[0021] Subject to the foresaid descriptions, the technical personnel in the field involving this invention may make amendments and changes to this embodiment. Therefore, this invention is not confined to the embodiment described above. Amendments and changes shall also be regarded as within the protection scope of this patent claims. Nevertheless the specific words used in this patent specification, these words are for the convenience of reference only without any limitation on this invention.

Claims

1. A kind of earphone which illuminates with motion, with features including:

   Acceleration sensor circuit; the said acceleration sensor circuit collects the acceleration value of user in motion and transforms it into acceleration data signal;

   Microprocessor which receives the acceleration data signal and generates PWM signal after

analysis and evaluation;
LED driver circuit which receives the PWM signal; the said LED driver circuit receives the PWM signal transmitted by the microprocessor and generates the corresponding drive signal;
LED flashlight circuit which receives the corresponding drive signal; the said LED flashlight circuit receives the corresponding drive signal transmitted by the LED driver circuit and illuminates.

2. The earphone which illuminates with motion described in patent Claims 1 has features including: it adopts ARM microprocessor with type EFM32TG210 and which has 33 pins.

3. The earphone which illuminates with motion described in patent Claim 2 has features including: the said LED driver circuit comprises three resistors and one NPN-type transistor. The first pin of ARM microprocessor connects to the first resistor on one end and the second resistor on the other end. The other end of the first resistor is earthed while the other end of the second resistor connects to the base of NPN-type transistor and one end of the third resistor. The collector connects to the LED flashlight circuit while the emitter is earthed together with the other end of the third resistor.

4. The earphone which illuminates with motion described in patent Claims 1 has features including: the said earphone adopts three LED driver circuits which respectively connects to the first pin, second pin and third pin of the ARM microprocessor.

5. The earphone which illuminates with motion described in patent Claims 1 has features including: the said LED flashlight circuit comprises a luminous diode, a fourth resistor and a first capacitor. The negative electrode of the luminous diode connects to the collector of the NPN-type transistor while the positive electrode connects to one end of the fourth resistor with its other end connects to the fourteenth pin of the ARM microprocessor and one end of the first capacitor. The other end of the first capacitor is earthed.

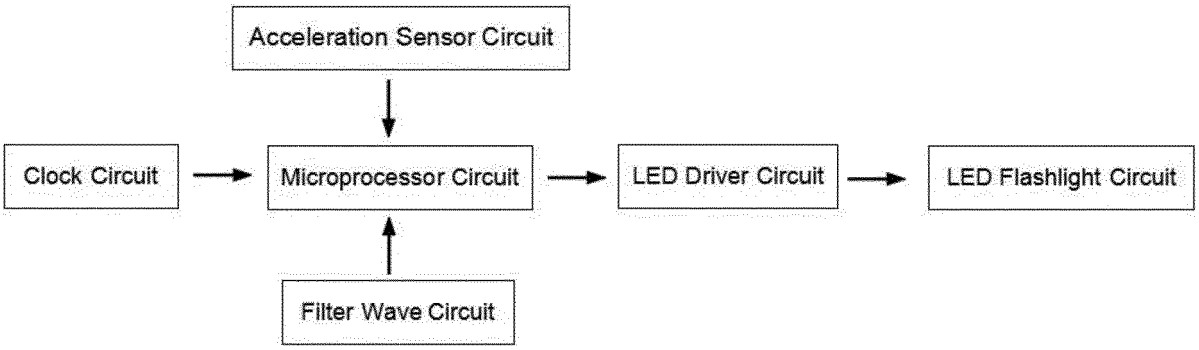
6. The earphone which illuminates with motion described in patent Claims 1 has features including: the described earphone adopts three LED flashlight circuits with Line. 1 LED flashlight circuit connects to the connector of NPN-type transistor in Line. 1 LED driver circuit, Line. 2 LED flashlight circuit connects to the connector of NPN-type transistor in Line. 2 LED driver circuit and Line. 3 LED flashlight circuit connects to the connector of NPN-type transistor in Line. 3 LED driver circuit

7. The earphone which illuminates with motion described in patent Claims 1 has features including: the said acceleration sensor circuit comprises an acceleration sensor, a fifth resistor, a sixth resistor, a second capacitor and a third capacitor. It adopts type BMA250E acceleration sensor which has 12 pins. The first pin and fourth pin are earthed while the second pin connects to the thirty first pin of ARM microprocessor and one end of the fifth resistor. The other end of the fifth resistor connects to the fourth pin of ARM microprocessor. The third pin of the acceleration sensor connects respectively to one end of the second capacitor, the third capacitor and the fourth pin of the ARM microprocessor while the other ends of the second capacitor and the third capacitor are earthed. The fifth pin and sixth pin of the acceleration sensor are suspended while its seventh pin connects respectively to one end of the third capacitor and the fourth pin of the ARM microprocessor. The eighth pin and ninth pin of the acceleration sensor are earthed and its tenth pin suspended. The eleventh pin of the acceleration sensor connects respectively to one end of the third capacitor and the fourth pin of ARM microprocessor while its twelfth pin connects respectively to the thirty second pin of the ARM microprocessor and one end of the sixth resistor. The other end of the sixth resistor connects to the fourth pin of ARM microprocessor.

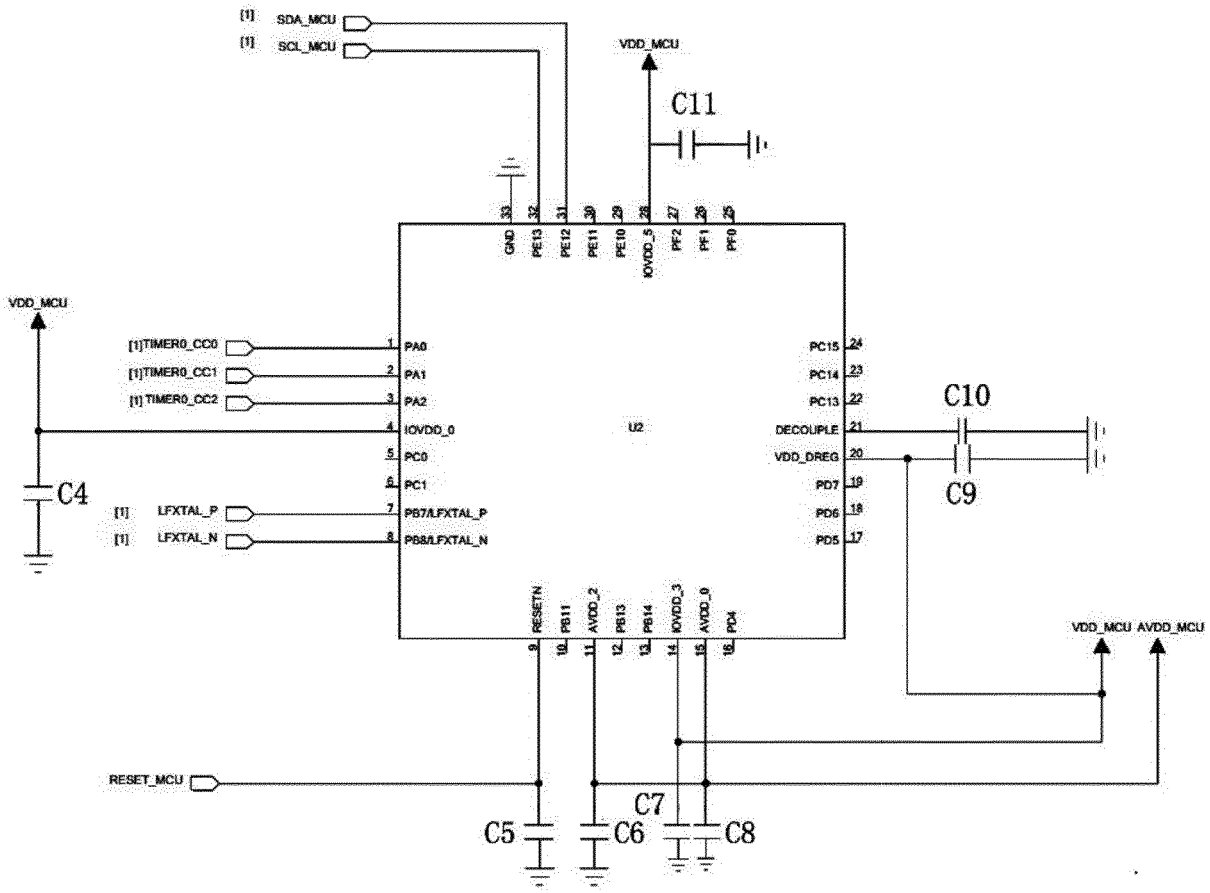
8. The earphone which illuminates with motion described in patent Claims 2 has features including: the said microprocessor comprises eight capacitors, namely, the fourth capacity to the eleventh capacitor. The fifth, sixth, tenth, twelfth, thirteenth, sixteenth to nineteenth and twenty second to twenty seventh and twenty ninth and thirtieth pins of the said ARM microprocessor are suspended. Its fourth pin is earthed through the fourth capacity, ninth pin earthed through the fifth capacitor, eleventh pin earthed through the sixth capacity, fourteenth pin earthed through the seventh capacitor, fifteenth pin earthed through the eighth capacitor, twentieth pin earthed through the ninth capacitor, twenty first in earthed through the tenth capacitor and the twenty eighth pin earthed through the eleventh capacitor.

9. The earphone which illuminates with motion described in patent Claims 1 has features including: the said earphone also comprises clock circuit. The clock circuit comprises a twelfth capacitor, a thirteenth capacitor and a crystal oscillator. The seventh pin of ARM microprocessor connects to one end of the crystal oscillator and the thirteenth capacitor while the other end of the thirteenth capacitor is earthed. The eighth pin connects respectively to one end of the crystal oscillator and the twelfth capacitor while the other end of the twelfth capacitor is earthed.

10. The earphone which illuminates with motion described in patent Claims 1 has features including: The filter wave circuit comprises a filter inductor, a fourteenth capacitor and a fifteenth capacitor. The fourth pin of the ARM microprocessor connects respectively to one end of the filter wave inductor and the fourteenth capacitor while the other end of the fourteenth capacitor is earthed. The other end of the filter wave inductor connects respectively to the eleventh pin of the ARM microprocessor and the fifteenth capacitor while the other end of the fifteenth capacitor is earthed.


Acceleration Sensor Circuit
Clock Circuit
Microprocessor Circuit
LED Driver Circuit
LED Flashlight Circuit
Filter Wave Circuit

Drawing 1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[1] SCL_MCU
VDD_MCU
C11
GND
PE13
PE12
PE11
PE10
IOVDD_5
PF2
PF1
PF0
VDD_MCU
[1]TIMER0_CC0
[1]TIMER0_CC1
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PA2
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PC1
U2
C4
[1] LFXTAL_P
[1] LFXTAL_N
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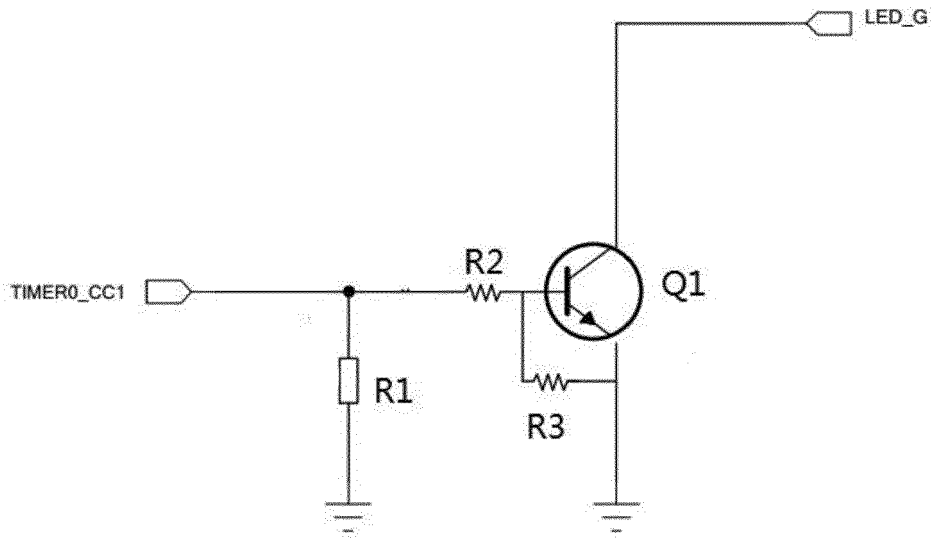
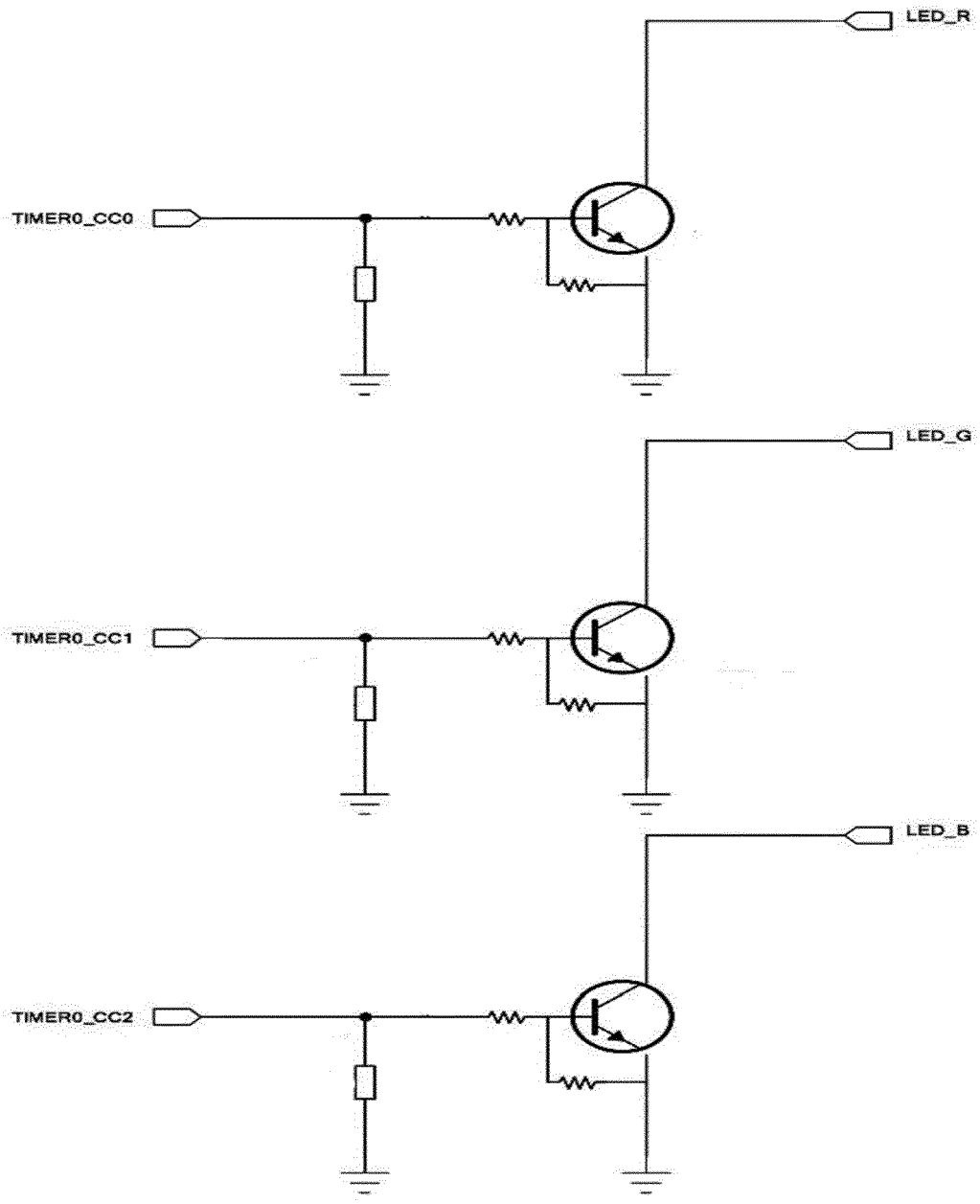
PB8/LFXTAL_N
PC15
PC14
PC13
DECOUPLE
VDD_DREG
PD7
PD6
PD5
C10
C9
RESETN
PB11
AVDD_2
PB13
PB14
IOVDD_3
AVDD_0
PD4
VDD_MCU AVDD_MCU
RESET_MCU
C5
C6
C7
C8

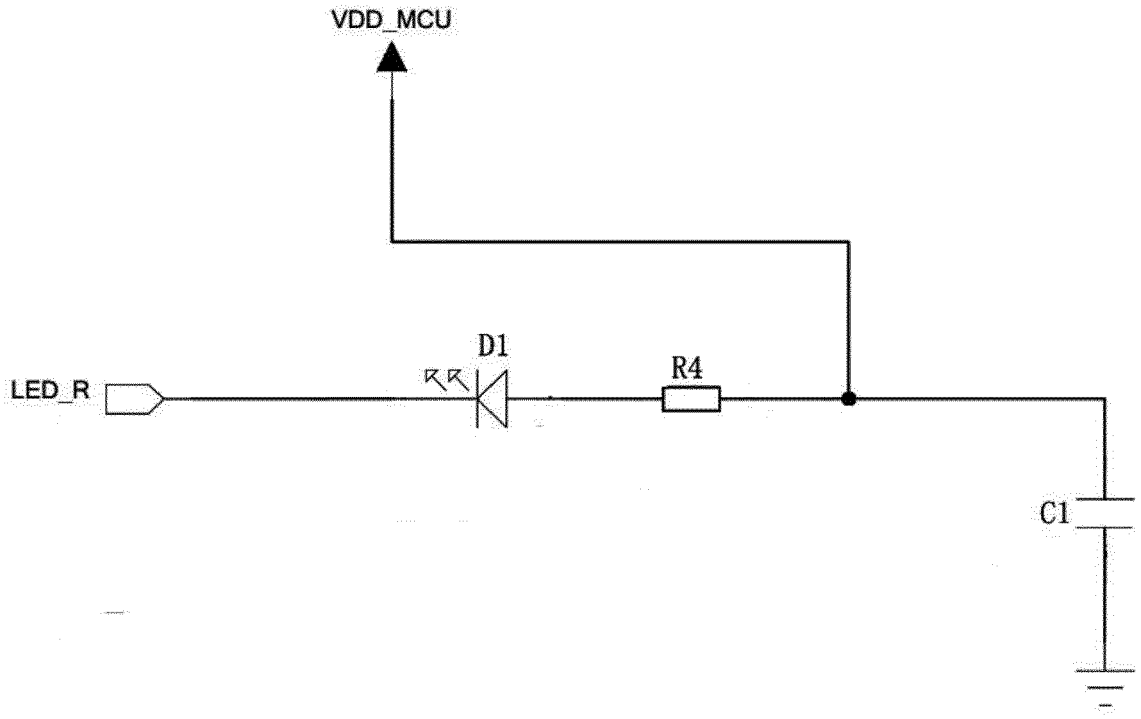
Drawing 2



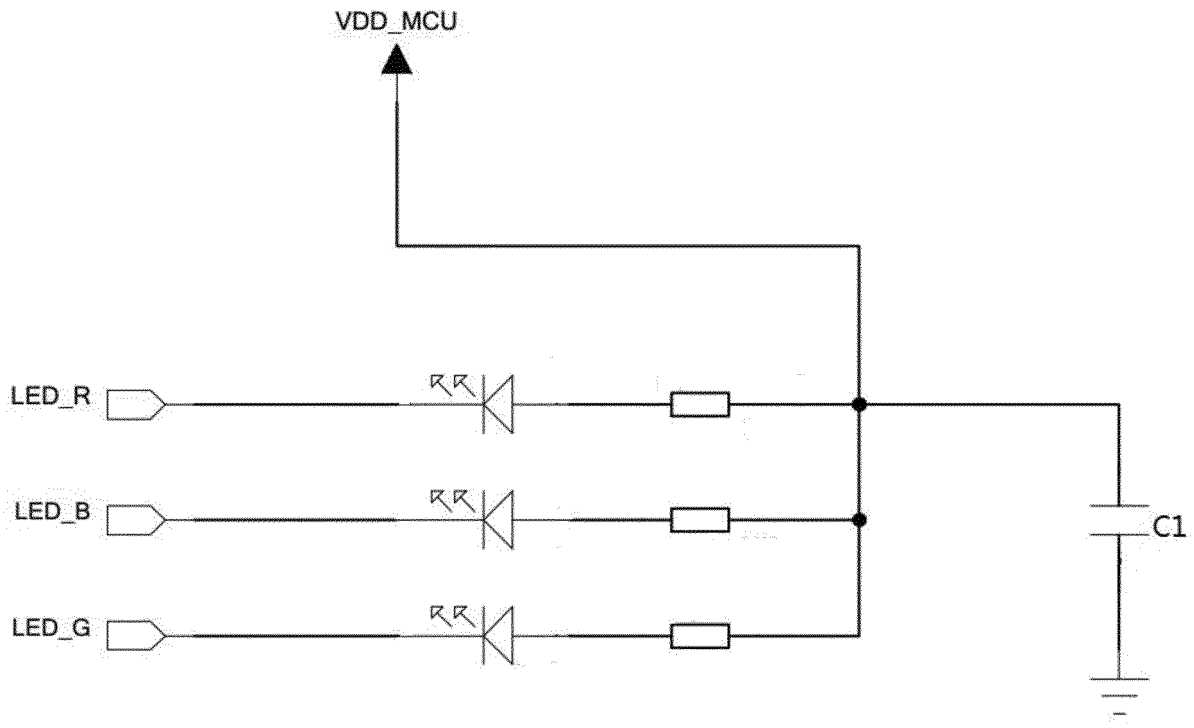
Drawing 3



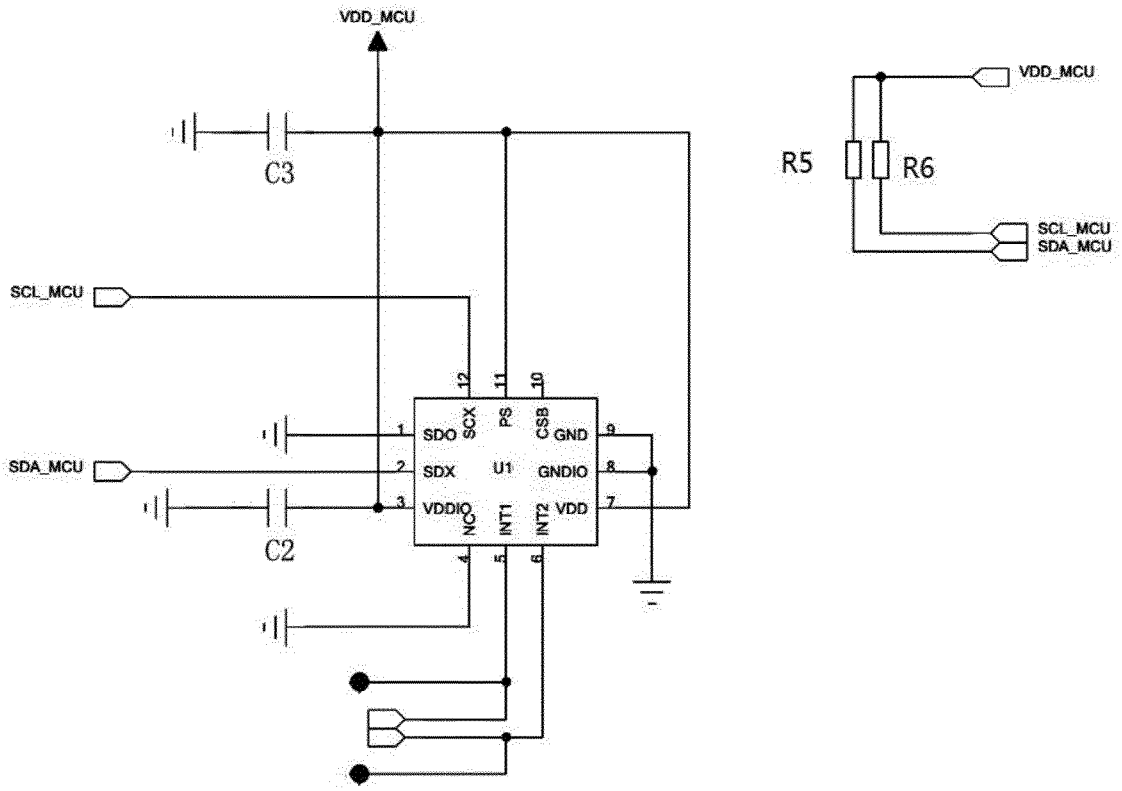
Drawing 4



Drawing 5



Drawing 6


VDD_MCU
C3
SCL_MCU
SDA_MCU
C2
SDO
SDX
VDDIO
SCX
PS
CSB
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NC
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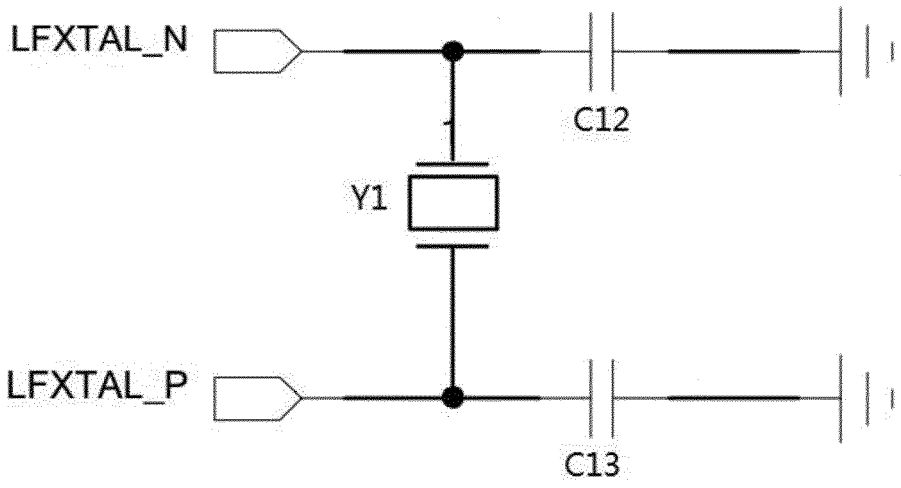
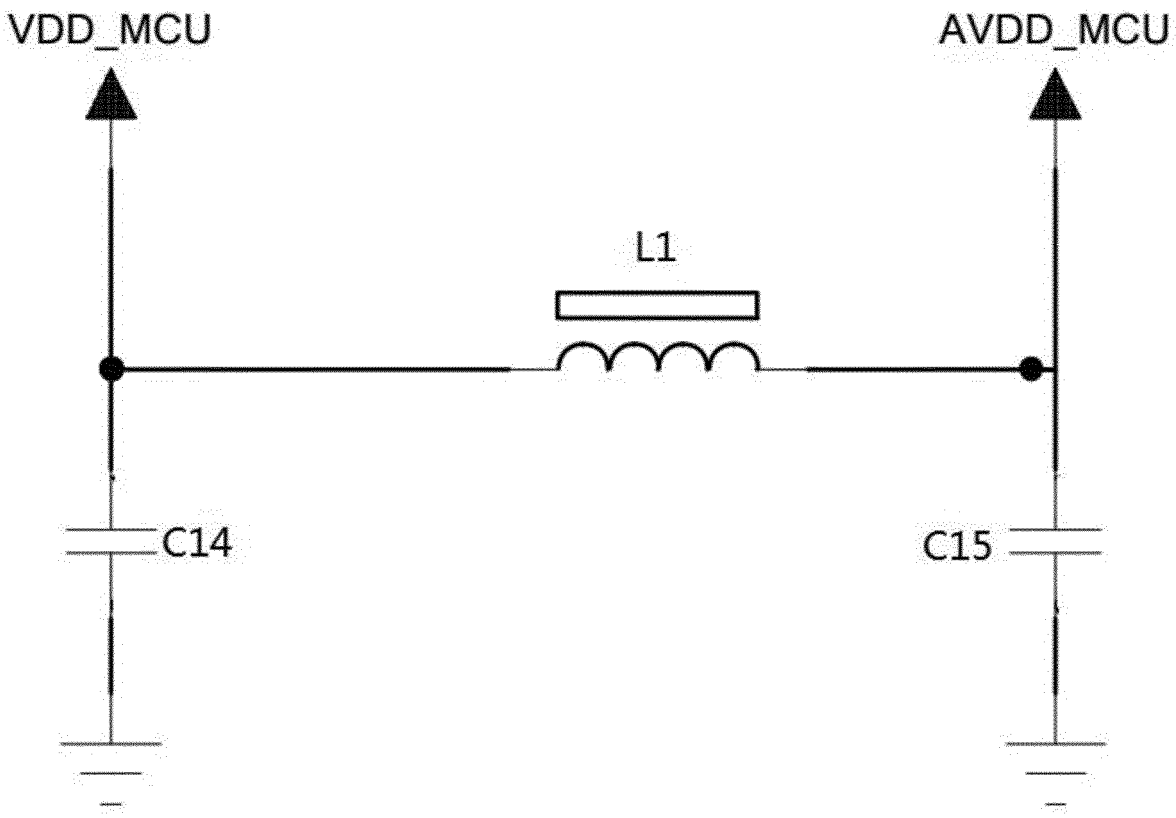
INT2
U1
R5
R6
VDD_MCU
SCL_MCU
SDA_MCU

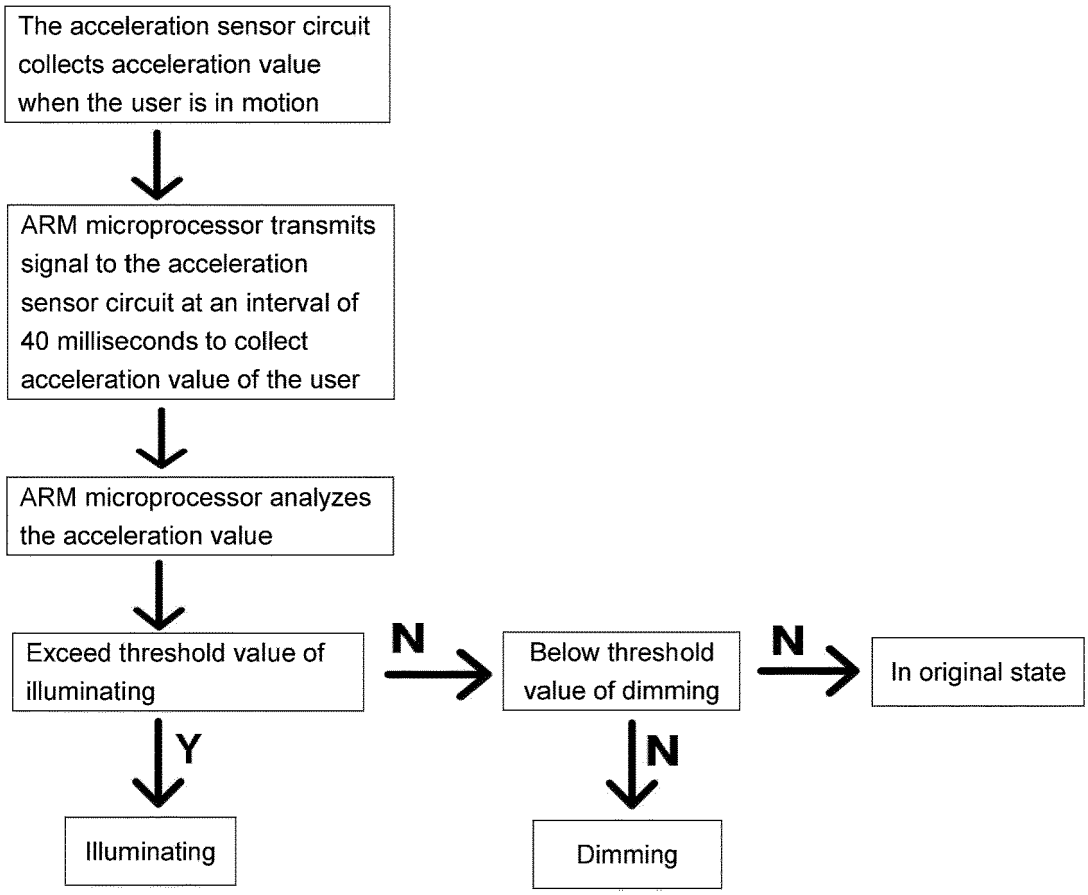
Drawing 7



Drawing 8



Drawing 9


The acceleration sensor circuit collects acceleration value when the user is in motion
ARM microprocessor transmits signal to the acceleration sensor circuit at an interval of 40 milliseconds to collect acceleration value of the user
ARM microprocessor analyzes the acceleration value
Exceed threshold value of illuminating
N
Below threshold value of dimming
N
In original state
Y
Illuminating
N
Dimming

Drawing 10

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 16 15 2448

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 105 100 998 A (SHENZHEN GEEKERY TECHNOLOGY CO LTD) 25 November 2015 (2015-11-25) * the whole document * -----	1-10	INV. H04R1/02 H04R1/10

TECHNICAL FIELDS SEARCHED (IPC)

H04R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	1 April 2016	Gerken, Stephan

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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01-04-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 105100998 A	25-11-2015	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82