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根据细则 4.17 的声明:

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(54) Title: BIDIRECTIONAL WIRELESS ELECTRICAL ENERGY MONITORING SYSTEM

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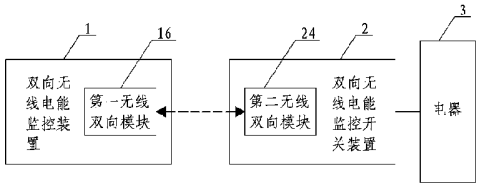

图1 / Fig. 1

1 BIDIRECTIONAL WIRELESS ELECTRICAL ENERGY MONITORING DEVICE
2 BIDIRECTIONAL WIRELESS ELECTRICAL ENERGY MONITORING SWITCH DEVICE
3 ELECTRICAL APPARATUS
16 FIRST WIRELESS BIDIRECTIONAL MODULE
24 SECOND WIRELESS BIDIRECTIONAL MODULE

(57) Abstract: A bidirectional wireless electrical energy monitoring system, the system comprises a bidirectional wireless electrical energy monitoring device (1) and a bidirectional wireless electrical energy monitoring switch device (2); the monitoring device (1) comprises a first wireless bidirectional module (16) for receiving a current signal from the switch device or sending a control signal to the switch device (2); the switch device (2) comprises a second wireless bidirectional module (24) for receiving the control signal from the monitoring device or sending the current signal of an electrical apparatus to the monitoring device (1); the monitoring device (1) is in bidirectional wireless connection with the switch device (2) through the first wireless bidirectional module (16) and the second wireless bidirectional module (24).

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(57) 摘要:

一种双向无线电能监控系统，该系统包括双向无线电能监控装置(1)和双向无线电能监控开关装置(2)；该监控装置(1)包括用于接收来自该开关装置(2)的电流信号或者发送控制信号给该开关装置(2)的第一无线双向模块(16)；该开关装置(2)包括用于接收来自该监控装置(1)的控制信号或者发送电器的电流信号给该监控装置(1)的第二无线双向模块(24)；该监控装置(1)和该开关装置(2)通过第一无线双向模块(16)与第二无线双向模块(24)进行双向无线连接。

BIDIRECTIONAL WIRELESS ELECTRICAL ENERGY MONITORING SYSTEM

Field of the Invention

[0001] The present invention relates to the technical field of energy monitoring system, and particularly to a bidirectional wireless electrical energy monitoring system. The present invention is based on the Chinese Invention Patent Application No. 200910037128.4, filed February 10, 2009, the content of which is incorporated herein by reference.

Background of the Invention

[0002] The electrical energy is one of the important energy sources, which is used widely in the industrial and agricultural production and daily life. Currently, as the energy sources are increasingly decreasing, energy saving becomes an important study task. Various methods have been taken to control the loss of electrical energy with respect to the transmission of power supply and the performance of energy saving of the electrical equipment and so on, and all of these energy saving measures have certain energy saving effect.

[0003] Unidirectional wireless electrical energy monitoring system is a new energy saving monitoring system, which is mainly composed of a unidirectional wireless electrical energy monitoring apparatus and a unidirectional wireless electrical energy monitoring switchgear. The unidirectional wireless electrical energy monitoring apparatus typically includes a first microprocessor, a display module, a key module and a wireless unidirectional receiving module. The unidirectional wireless electrical energy monitoring switchgear typically includes a second microprocessor, a current induction module, a switch control circuit and a wireless unidirectional transmitting module. The unidirectional wireless electrical energy monitoring switchgear is connected to a socket corresponding to the electrical equipment and senses a corresponding current signal through the current induction module. This current signal is processed by the second microprocessor and after that transmitted to the wireless unidirectional transmitting module which then sends it to the wireless unidirectional receiving module of the unidirectional electrical energy monitoring apparatus, and after the processing by the first microprocessor the signal is transmitted to the display module and output from the display module to an external display screen for displaying the electrical energy parameters, such as the

power of electrical equipment, the power consumption and real time, etc. Between such unidirectional wireless electrical energy monitoring apparatus of the unidirectional wireless electrical energy monitoring system and the unidirectional wireless electrical energy monitoring switchgear, only one-way signal transmission can be realized and bidirectional operation and control and remote control may not be implemented, which causes inconvenience for use and has considerable limitation.

Summary of the Invention

[0004] The object of the present invention is to provide a bidirectional wireless electrical energy monitoring system for overcoming the disadvantages in the prior art. Bidirectional signal transmission and bidirectional control and remote control may be realized by such bidirectional wireless electrical energy monitoring system.

[0005] In order to realize the above object, the present invention is implemented by the technical solution as follows. The present invention includes a bidirectional wireless electrical energy monitoring apparatus and a bidirectional wireless electrical energy monitoring switchgear. The bidirectional wireless electrical energy monitoring apparatus includes a first microprocessor, a display module and a first key module, an input of the display module being connected to a display driving output of the first microprocessor, and an output of the first key module being connected to a key detection input of the first microprocessor. The bidirectional wireless electrical energy monitoring switchgear includes a second microprocessor, a current induction module and a switch control circuit, an output of the current induction module being connected to a current detection input of the second microprocessor, and an input of the switch control circuit being connected to a control output of the second microprocessor. The bidirectional wireless electrical energy monitoring apparatus also includes a first wireless bidirectional module for receiving a current signal from the bidirectional wireless electrical energy monitoring switchgear and transmitting a control signal to the bidirectional wireless electrical energy monitoring switchgear, the first wireless bidirectional module being connected to the first microprocessor. The bidirectional wireless electrical energy monitoring switchgear also includes a second wireless bidirectional module for receiving the control signal from the bidirectional wireless electrical energy monitoring apparatus and transmitting the current signal

of electrical equipment to the second wireless bidirectional module of the bidirectional wireless electrical energy monitoring apparatus, the second wireless bidirectional module being connected to the second microprocessor. Bidirectional wireless connection is realized between the bidirectional wireless electrical energy monitoring apparatus and the bidirectional wireless electrical energy monitoring switchgear through the first wireless bidirectional module and the second wireless bidirectional module.

[0006] The first wireless bidirectional module is composed of a radio frequency transceiver chip U1_1, a crystal oscillator Y1_1, an antenna J1_1, capacitors C1_1, C1_2, C1_4, C1_5 and inductances L1_1、L1_2、L1_3. One end of the crystal oscillator Y1_1 is connected to the 9 pin of the radio frequency transceiver chip U1_1, and the other end is grounded; one end of the capacitor C1_5 is connected to the 15 pin of the radio frequency transceiver chip U1_1, and the other end is grounded; the inductance L1_1 is connected between the 12 pin and 13 pin of the radio frequency transceiver chip U1_1, and the inductance L1_2 is connected between the 12 pin and 14 pin of the radio frequency transceiver chip U1_1; one end of the capacitor C1_1 is connected to the 13 pin of the radio frequency transceiver chip U1_1, and the other end is grounded; one end of the capacitor C1_4 is connected to the 12 pin of the radio frequency transceiver chip U1_1, the other end is connected to one end of the inductance L1_3, and the other end of the inductance L1_3 is connected to the 13 pin of the radio frequency transceiver chip U1_1; one end of the capacitor C1_2 is connected to the intersection of the inductances L1_3 and C1_4, and the other end is connected to the antenna J1_1; the 11 pin of the radio frequency transceiver chip U1_1 is a grounding pin which is grounded, the 14 pin of the radio frequency transceiver chip U1_1 is a power pin for providing power, and the 1-8 pins, 10 pin and 16 pin of the radio frequency transceiver chip U1_1 are connected to the first microprocessor.

[0007] The first wireless bidirectional module uses IA4421 as the radio frequency transceiver chip U1_1.

[0008] The bidirectional wireless electrical energy monitoring apparatus further includes a clock and calendar module that is connected to the first microprocessor for configuration of the clock and calendar.

[0009] The bidirectional wireless electrical energy monitoring apparatus further includes a first power source module which is composed of a first power input circuit and a first voltage regulator circuit. The input of the first power input circuit is connected to an external power source, the output of the first power input circuit is connected to the input of the first voltage regulator circuit, and the output of the first voltage regulator circuit is connected to the power inputs of the first microprocessor, the display module, the first key module, the first wireless bidirectional module and the clock and calendar module, respectively.

[0010] The second wireless bidirectional module is composed of a radio frequency transceiver chip U2_1, a crystal oscillator Y2_1, an antenna J2_1, capacitors C2_1, C2_2, C2_4, C2_5 and inductances L2_1、L2_2、L2_3. One end of the crystal oscillator Y2_1 is connected to the 9 pin of the radio frequency transceiver chip U2_1, and the other end is grounded; one end of the capacitor C2_5 is connected to the 15 pin of the radio frequency transceiver chip U2_1, and the other end is grounded; the inductance L2_1 is connected between the 12 pin and 13 pin of the radio frequency transceiver chip U2_1, and the inductance L2_2 is connected between the 12 pin and 14 pin of the radio frequency transceiver chip U2_1; one end of the capacitor C2_1 is connected to the 13 pin of the radio frequency transceiver chip U2_1, and the other end is grounded; one end of the capacitor C2_4 is connected to the 12 pin of the radio frequency transceiver chip U2_1, the other end is connected to one end of the inductance L2_3, and the other end of the inductance L2_3 is connected to the 13 pin of the radio frequency transceiver chip U2_1; one end of the capacitor C2_2 is connected to the intersection of the inductances L2_3 and C2_4, and the other end is connected to the antenna J2_1; the 11 pin of the radio frequency transceiver chip U2_1 is a grounding pin which is grounded, the 14 pin of the radio frequency transceiver chip U2_1 is a power pin for providing power, and the 1-8 pins, 10 pin and 16 pin of the radio frequency transceiver chip U2_1 are connected to the second microprocessor.

[0011] The second wireless bidirectional module uses IA4421 as the radio frequency transceiver chip U2_1.

[0012] The bidirectional wireless electrical energy monitoring switchgear further includes a second key module, an indicator circuit. The output of the second key module is connected to the key detection input of the second microprocessor, and the input of the indicator circuit is

connected to the status output of the second microprocessor.

[0013] The bidirectional wireless electrical energy monitoring switchgear further includes a second power source module which includes a second power input circuit, a rectifying circuit and a second voltage regulator circuit. The input of the second power input circuit is connected to an external power source, the output of the second power input circuit is connected to the AC input of the switch control circuit and the input of the rectifying circuit, respectively, the output of the rectifying circuit is connected to the AC input of the switch control circuit and the input of the second voltage regulator circuit, respectively, the output of the second voltage regulator circuit is connected to the DC inputs of the second microprocessor, the current induction module, the second wireless bidirectional module, the second key module and the indicator circuit, respectively.

[0014] The second power source module further includes a voltage detection circuit. The input of the voltage detection circuit is connected to the output of the second power input circuit, and the output of the voltage detection circuit is connected to the voltage detection input of the second microprocessor for detecting the input voltage of the power source.

[0015] The present invention has beneficial effects as follows. The bidirectional wireless electrical energy monitoring system according to the present invention includes a bidirectional wireless electrical energy monitoring apparatus and a bidirectional wireless electrical energy monitoring switchgear. The first wireless bidirectional module of the bidirectional wireless electrical energy monitoring apparatus may receive a current signal from the bidirectional wireless electrical energy monitoring switchgear and transmitting a control signal to the bidirectional wireless electrical energy monitoring switchgear; the second wireless bidirectional module the bidirectional wireless electrical energy monitoring switchgear may receive the control signal from the bidirectional wireless electrical energy monitoring apparatus or transmit the current signal of electrical equipment to the bidirectional wireless electrical energy monitoring apparatus. As can be seen from the above technical solution, the first wireless bidirectional module of the present invention matches the second wireless bidirectional module, which may implement bidirectional signal transmission, therefore, the present invention may realize the bidirectional signal transmission, bidirectional control and remote control between the bidirectional wireless electrical energy monitoring apparatus and the bidirectional wireless

electrical energy monitoring switchgear, the power consumption of multiple electrical equipments may be monitored by the bidirectional wireless electrical energy monitoring switchgear, and the users may operate the keys in the first key module, according to the power consumption sent by the bidirectional wireless electrical energy monitoring switchgear, to control the switch control circuit of the bidirectional wireless electrical energy monitoring switchgear, thereby powering on/off the electrical equipment, which has the effects of prompting power saving and reasonable power consumption.

Brief Description of the Drawings

[0016] Figure 1 is a schematic diagram of connection between the bidirectional wireless electrical energy monitoring apparatus, the bidirectional wireless electrical energy monitoring switchgear and the electrical equipment according to the present invention;

[0017] Figure 2 is a block diagram showing the principle of the bidirectional wireless electrical energy monitoring apparatus according to the present invention;

[0018] Figure 3 is a block diagram showing the principle of the bidirectional wireless electrical energy monitoring switchgear according to the present invention;

[0019] Figure 4 is a schematic diagram showing the circuit of the first wireless bidirectional module according to the present invention;

[0020] Figure 5 is a schematic diagram showing the circuits of the clock and calendar module and the first power source module according to the present invention;

[0021] Figure 6 is a schematic diagram showing the circuit of the first microprocessor according to the present invention;

[0022] Figure 7 is a schematic diagram showing the circuits of the display module and the first key module according to the present invention;

[0023] Figure 8 is a schematic diagram showing the circuit of the second wireless bidirectional module according to the present invention;

[0024] Figure 9 is a schematic diagram showing the circuits of the second microprocessor, the current induction module, the second key module and the indicator circuit according to the present invention;

[0025] Figure 10 is a schematic diagram showing the circuits of the second power source module and the switch control circuit according to the present invention.

Detailed Description of the Embodiments

[0026] The present invention will be further described with reference to the figures. Referring to figures 1 to 3, the bidirectional wireless electrical energy monitoring system includes a bidirectional wireless electrical energy monitoring apparatus 1 and a bidirectional wireless electrical energy monitoring switchgear 2. The bidirectional wireless electrical energy monitoring switchgear 2 is connected to a socket corresponding to the electrical equipment 3; the bidirectional wireless electrical energy monitoring apparatus 1 includes a first wireless bidirectional module 16 which may receive a current signal from the bidirectional wireless electrical energy monitoring switchgear 2 or transmit a control signal to the bidirectional wireless electrical energy monitoring switchgear 2; the bidirectional wireless electrical energy monitoring switchgear 2 includes a second wireless bidirectional module 24 which may receive the control signal from the bidirectional wireless electrical energy monitoring apparatus 1 or transmit the current signal of electrical equipment 3 to the bidirectional wireless electrical energy monitoring apparatus 1; the first wireless bidirectional module 16 matches the second wireless bidirectional module 24, which may implement bidirectional signal transmission, therefore, the present invention may realize the bidirectional signal transmission, bidirectional control and remote control between the bidirectional wireless electrical energy monitoring apparatus 1 and the bidirectional wireless electrical energy monitoring switchgear 2, the power consumption of the electrical equipment 3 may be monitored by the bidirectional wireless electrical energy monitoring switchgear 2, and the bidirectional wireless electrical energy monitoring apparatus 1 may reversely control the bidirectional wireless electrical energy monitoring switchgear 2 according to the power consumption sent by the bidirectional wireless electrical energy monitoring switchgear 2, thereby powering on/off the electrical equipment 3, which has the effects of prompting power saving and reasonable power consumption.

[0027] The bidirectional wireless electrical energy monitoring apparatus 1 according to the present invention includes a first microprocessor 11, a display module 13 and a first key module 14. An input of the display module 14 is connected to a display driving output of the first microprocessor 11 such that the first microprocessor 11 may drive an external display screen through the display module 13 for displaying the electrical energy parameters, such as the power, the power consumption and real time of electrical equipment 3, etc. An output of the

first key module 14 is connected to a key detection input of the first microprocessor 11 such that the user may input a control signal through the first key module 14 to control the bidirectional wireless electrical energy monitoring switchgear 2. As shown in figure 7, when a key K of the first key module 14 is pressed, an instruction of the key K is transmitted to the execution end, and after reception of the instruction of the key K, the execution end feeds back the execution status of the instruction to the LED lamp. For example, if the execution end executes the instruction of the key K, the LED lamp is lightened after receiving the feedback instruction from the execution end; otherwise, if the execution end does not execute the instruction of the key K, the LED lamp is not lightened after receiving the feedback instruction from the execution end. Therefore, it can be determined whether the instruction has been executed according to whether the LED lamp is lightened after a key K is pressed,

[0028] The bidirectional wireless electrical energy monitoring apparatus 1 according to the present invention further includes a clock and calendar module 15 and a first power source module 12. The clock and calendar module 15 is connected to the first microprocessor 11 for setting the clock and calendar; the first power source module 12 is composed of a first power input circuit 121 and a first voltage regulator circuit 122. The input of the first power input circuit 121 is connected to an external power source, the output of the first power input circuit 121 is connected to the input of the first voltage regulator circuit 122, and the output of the first voltage regulator circuit 122 is connected to the power inputs of the first microprocessor 11, the display module 13, the first key module 14, the first wireless bidirectional module 16 and the clock and calendar module 15, respectively, for providing the first microprocessor 11, the display module 13, the first key module 14, the first wireless bidirectional module 16 and the clock and calendar module 15 with working power.

[0029] The bidirectional wireless electrical energy monitoring switchgear 2 according to the present invention includes a second microprocessor 21, a current induction module 25 and a switch control circuit 23. An output of the current induction module 25 is connected to a current detection input of the second microprocessor 21, such that the second microprocessor 21 may measure the current used by the electrical equipment 3 through the current induction module 25; an input of the switch control circuit 23 is connected to a control output of the second microprocessor 21, such that the second microprocessor 21 may control the power off/on of the

electrical equipment 3 through the switch control circuit 23.

[0030] The bidirectional wireless electrical energy monitoring switchgear 2 according to the present invention further includes a second key module 26 and an indicator circuit 27. The output of the second key module 26 is connected to the key detection input of the second microprocessor 21, and the input of the indicator circuit 27 is connected to the status output of the second microprocessor 21, such that the operator may input a control signal through the second key module 26 and the control signal is output from the second microprocessor 21 to the switch control circuit 23 and the indicator circuit 27, thereby controlling the working status of the switch control circuit 23 and the indicating status of the indicator circuit 27.

[0031] The bidirectional wireless electrical energy monitoring switchgear 2 according to the present invention further includes a second power source module 22 which includes a second power input circuit 221, a rectifying circuit 222 and a second voltage regulator circuit 223. The input of the second power input circuit 221 is connected to an external power source, the output of the second power input circuit 221 is connected to the AC input of the switch control circuit 23 and the input of the rectifying circuit 222, respectively, the output of the switch control circuit 23 is used to be connected to the power input of the electrical equipment 3, the output of the rectifying circuit 222 is connected to the AC input of the switch control circuit 23 and the input of the second voltage regulator circuit 223, respectively. When the switch control circuit 23 is switched on, the electrical equipment 3 is powered on, and when the switch control circuit 23 is switched off, the electrical equipment 3 is powered off. The output of the second voltage regulator circuit 223 is connected to the DC inputs of the second microprocessor 21, the current induction module 25, the second wireless bidirectional module 24, the second key module 26 and the indicator circuit 27, respectively, for providing the second microprocessor 21, the current induction module 25, the second wireless bidirectional module 24, the second key module 26 and the indicator circuit 27 with working power. The second power source module 22 further includes a voltage detection circuit 224. The input of the voltage detection circuit 224 is connected to the output of the second power input circuit, and the output of the voltage detection circuit 224 is connected to the voltage detection input of the second microprocessor 21 for detecting the input voltage of the power source, such that the second microprocessor 21 may detect whether the voltage of power source is normal through the voltage detection circuit 224,

therefore the functions of overvoltage protection, under-voltage protection and overload protection may be realized by the present invention.

[0032] Referring to figures 4 to 10, they show the particular circuit diagrams of the present invention. The first wireless bidirectional module 16 according to the present invention is composed of a radio frequency transceiver chip U1_1, a crystal oscillator Y1_1, an antenna J1_1, capacitors C1_1, C1_2, C1_4, C1_5 and inductances L1_1、L1_2、L1_3. One end of the crystal oscillator Y1_1 is connected to the 9 pin of the radio frequency transceiver chip U1_1, and the other end is grounded; one end of the capacitor C1_5 is connected to the 15 pin of the radio frequency transceiver chip U1_1, and the other end is grounded; the inductance L1_1 is connected between the 12 pin and 13 pin of the radio frequency transceiver chip U1_1, and the inductance L1_2 is connected between the 12 pin and 14 pin of the radio frequency transceiver chip U1_1; one end of the capacitor C1_1 is connected to the 13 pin of the radio frequency transceiver chip U1_1, and the other end is grounded; one end of the capacitor C1_4 is connected to the 12 pin of the radio frequency transceiver chip U1_1, the other end is connected to one end of the inductance L1_3, and the other end of the inductance L1_3 is connected to the 13 pin of the radio frequency transceiver chip U1_1; one end of the capacitor C1_2 is connected to the intersection of the inductances L1_3 and C1_4, and the other end is connected to the antenna J1_1; the 11 pin of the radio frequency transceiver chip U1_1 is a grounding pin which is grounded, the 14 pin of the radio frequency transceiver chip U1_1 is a power pin for providing power, and the 1-8 pins, 10 pin and 16 pin of the radio frequency transceiver chip U1_1 are connected to the first microprocessor 11. The antenna J1_1 may receive the signal from the second wireless bidirectional module 24 and output to the radio frequency transceiver chip U1_1 which then outputs the signal to the first microprocessor 11. When the first microprocessor 11 outputs the control signal to the radio frequency transceiver chip U1_1, the radio frequency transceiver chip U1_1 performs coding processing on the control signal and then output it to the antenna J1_1 which may transmit the control signal to the second wireless bidirectional module 24.

[0033] The clock and calendar module 15 is composed of a clock chip U1_5, a crystal oscillator Y1_2, a backup battery BT1_1, resistors R1_1, R1_2, R1_3, capacitors C1_17, C1_20 and diodes D1_1, D1_21. Y1_2 is connected between the 1 pin and 2 pin of the U1_5, C1_17 is

connected between the 1 pin and 4 pin of the U1_5, and the 4 pin of the U1_5 is grounded; one end of R1_2 is connected to the 6 pin (SCL pin) of the U1_5, and the other end is connected to the power source (VCC1), one end of R1_3 is connected to the 5 pin (SDA pin) of the U1_5, and the other end is connected to the power source; one end of C1_20 is connected to the 8 pin of the U1_5, and the other end is grounded, the cathode of the C1_21 is connected to the 8 pin of the U1_5, and the anode is connected to the power source; the cathode of the D1_21 is connected to the 8 pin of the U1_5, and the anode is connected to the anode of the BT1_1; one end of the R1_1 is connected to the 8 pin of the U1_5, the other end is connected to the anode of the BT1_1, and the cathode of the BT1_1 is grounded; the 3 pin (INT) of the U1_5 is connected to the first microprocessor 11. Since the backup battery BT1_1 is provided, when the power input of the clock and calendar module 15 has no input power, the backup battery BT1_1 may keep the clock and calendar module 15 working normally.

[0034] The first power source module 12 is composed of a first power input circuit 121 and a first voltage regulator circuit 122. The first power input circuit 121 is composed of a power socket J1_3 and capacitors C1_13, C1_18. The capacitors C1_13, C1_18 are both connected between the 1 pin and 2 pin of the power socket J1_3 in parallel, and the 2 pin of J1_3 is grounded; the first voltage regulator circuit 122 is composed of a power voltage regulator chip U1_2 and capacitors C1_14, C1_19. The 1 pin of U1_2 is connected to the 1 pin of the power socket J1_3, and the 2 pin of U1_2 is grounded. The capacitors C1_14, C1_19 are both connected between the 2 pin and 3 pin of the U1_2 in parallel, and the 3 pin of the U1_2 is an output of the first power source module 12, for providing the first microprocessor 11, the display module 13, the first key module 14, the first wireless bidirectional module 16 and the clock and calendar module 15 with working power.

[0035] The second wireless bidirectional module 24 according to the present invention is composed of a radio frequency transceiver chip U2_1, a crystal oscillator Y2_1, an antenna J2_1, capacitors C2_1, C2_2, C2_4, C2_5 and inductances L2_1、L2_2、L2_3. One end of the crystal oscillator Y2_1 is connected to the 9 pin of the radio frequency transceiver chip U2_1, and the other end is grounded; one end of the capacitor C2_5 is connected to the 15 pin of the radio frequency transceiver chip U2_1, and the other end is grounded; the inductance L2_1 is connected between the 12 pin and 13 pin of the radio frequency transceiver chip U2_1, and the

inductance L2_2 is connected between the 12 pin and 14 pin of the radio frequency transceiver chip U2_1; one end of the capacitor C2_1 is connected to the 13 pin of the radio frequency transceiver chip U2_1, and the other end is grounded; one end of the capacitor C2_4 is connected to the 12 pin of the radio frequency transceiver chip U2_1, the other end is connected to one end of the inductance L2_3, and the other end of the inductance L2_3 is connected to the 13 pin of the radio frequency transceiver chip U2_1; one end of the capacitor C2_2 is connected to the intersection of the inductances L2_3 and C2_4, and the other end is connected to the antenna J2_1; the 11 pin of the radio frequency transceiver chip U2_1 is a grounding pin which is grounded, the 14 pin of the radio frequency transceiver chip U2_1 is a power pin for providing power, and the 1-8 pins, 10 pin and 16 pin of the radio frequency transceiver chip U2_1 are connected to the second microprocessor. When the second microprocessor 21 output the current signal of the electrical equipment 3 to the radio frequency transceiver chip U2_1, the radio frequency transceiver chip U2_1 performs coding processing on this signal and then output to the antenna J2_1, the J2_1 may transmit the current signal of the electrical equipment 3 to the first wireless bidirectional module 16; the J2_1 may also receive the control signal from the first wireless bidirectional module 16 and input it to the radio frequency transceiver chip U2_1 which then output the control signal to the second microprocessor 21, the second microprocessor 21 controls the switch control circuit 23 according to this control signal, thereby powering off/on the electrical equipment 3.

[0036] The types of the radio frequency transceiver chip U1_1 used by the first wireless bidirectional module 16 and the radio frequency transceiver chip U2_1 used by the second wireless bidirectional module 24 according to the present invention are both IA4421. Such chip has the features including less peripheral devices, automatic frequency control, assurance for the transceiver to be automatically adjusted to the frequency of the input signal, and the chip works in the frequency band 433/868/915MHz which needs no registration.

[0037] The second microprocessor 21 according to the present invention is a singlechip, the type of witch is PIC16F687. The indicator circuit 27 is composed of a light-emitting diode (LED) D2_9 and a resistor R2_10. One end of the R2_10 is connected to the output of the second voltage regulator circuit 223, and the other end is connected to the anode of the D2_9, the cathode of the D2_9 is connected to the second microprocessor 21, and the second

microprocessor 21 may control the working status of the LED D2_9 display circuit by outputting the control signal to the indicator 27. Of course, the indicator circuit 27 may also use the display apparatus such as the LCD display screen, not limiting to the LED.

[0038] The switch control circuit 23 according to the present invention is composed of a relay J2_2, a transistor Q2_1, a diode D2_1 and resistors R2_1, R2_13. The 1 pin of J2_2 is connected to the output of the second power input circuit 221, the 2 pin of J2_2 is a common pin, the 3 pin of J2_2 is an output of the switch control circuit 23 for connecting with the power input of the electrical equipment 3. The 4 pin of J2_2 is connected to the output of the rectifying circuit 222, the 5 pin of J2_2 is connected to the collector of the Q2_1, and the emitter of the Q2_1 is grounded. The R2_13 is connected between the emitter and base of the Q2_1. The cathode of the D2_1 is connected to the 4 pin of J2_2, and the anode of the D2_1 is connected to the 5 pin of J2_2. The base of the Q2_1 is connected to one end of the R2_1, and the other end of the R2_1 is connected to the second microprocessor 21, such that the second microprocessor 21 may output the control signal for controlling the relay J2_2 to be closed or opened, thereby powering off/on the electrical equipment 3.

[0039] The embodiments described above are only the preferred embodiment of the present invention, therefore the equivalent changing or modification according to the constructions, features and principles within the scope of the present invention paten application will be included in the scope of the present invention paten application.

Industrial applicability

[0040] The present invention may realize the bidirectional signal transmission, bidirectional control and remote control between the bidirectional wireless electrical energy monitoring apparatus and the bidirectional wireless electrical energy monitoring switchgear, the power consumption of multiple electrical equipments may be monitored by the bidirectional wireless electrical energy monitoring switchgear, and the users may operate the keys in the first key module, according to the power consumption sent by the bidirectional wireless electrical energy monitoring switchgear, to control the switch control circuit of the bidirectional wireless electrical energy monitoring switchgear, thereby powering on/off the electrical equipment, which has the effects of prompting power saving and reasonable power consumption.

CLAIMS

1. A bidirectional wireless electrical energy monitoring system, comprising a bidirectional wireless electrical energy monitoring apparatus and a bidirectional wireless electrical energy monitoring switchgear; the bidirectional wireless electrical energy monitoring apparatus comprising a first microprocessor, a display module and a first key module, an input of the display module being connected to a display driving output of the first microprocessor, and an output of the first key module being connected to a key detection input of the first microprocessor; the bidirectional wireless electrical energy monitoring switchgear comprising a second microprocessor, a current induction module and a switch control circuit, an output of the current induction module being connected to a current detection input of the second microprocessor, and an input of the switch control circuit being connected to a control output of the second microprocessor, wherein the bidirectional wireless electrical energy monitoring apparatus also comprises a first wireless bidirectional module for receiving a current signal from the bidirectional wireless electrical energy monitoring switchgear and transmitting a control signal to the bidirectional wireless electrical energy monitoring switchgear, the first wireless bidirectional module being connected to the first microprocessor; the bidirectional wireless electrical energy monitoring switchgear also comprises a second wireless bidirectional module for receiving the control signal from the bidirectional wireless electrical energy monitoring apparatus and transmitting the current signal of electrical equipment to the second wireless bidirectional module of the bidirectional wireless electrical energy monitoring apparatus, the second wireless bidirectional module being connected to the second microprocessor; bidirectional wireless connection is realized between the bidirectional wireless electrical energy monitoring apparatus and the bidirectional wireless electrical energy monitoring switchgear through the first wireless bidirectional module and the second wireless bidirectional module.

2. The bidirectional wireless electrical energy monitoring system according to claim 1, wherein the first wireless bidirectional module is composed of a radio frequency transceiver chip U1_1, a crystal oscillator Y1_1, an antenna J1_1, capacitors C1_1, C1_2, C1_4, C1_5 and inductances L1_1、L1_2、L1_3, one end of the crystal oscillator Y1_1 is connected to the 9 pin of the radio frequency transceiver chip U1_1, and the other end is grounded; one end of the capacitor C1_5 is connected to the 15 pin of the radio frequency transceiver chip U1_1, and the other end is grounded; the inductance L1_1 is connected between the 12 pin and 13 pin of the radio frequency transceiver chip U1_1, and the inductance L1_2 is connected between the 12 pin and 14 pin of the radio frequency transceiver chip U1_1; one end of the capacitor C1_1 is connected to the 13 pin of the radio frequency transceiver chip U1_1, and the other end is grounded; one end of the capacitor C1_4 is connected to the 12 pin of the radio frequency transceiver chip U1_1, the other end is connected to one end of the inductance L1_3, and the

other end of the inductance L1_3 is connected to the 13 pin of the radio frequency transceiver chip U1_1; one end of the capacitor C1_2 is connected to the intersection of the inductances L1_3 and C1_4, and the other end is connected to the antenna J1_1; the 11 pin of the radio frequency transceiver chip U1_1 is a grounding pin which is grounded, the 14 pin of the radio frequency transceiver chip U1_1 is a power pin for providing power, and the 1-8 pins, 10 pin and 16 pin of the radio frequency transceiver chip U1_1 are connected to the first microprocessor.

3. The bidirectional wireless electrical energy monitoring system according to claim 1, wherein the first wireless bidirectional module uses IA4421 as the radio frequency transceiver chip U1_1.

4. The bidirectional wireless electrical energy monitoring system according to claim 1, wherein the bidirectional wireless electrical energy monitoring apparatus further comprises a clock and calendar module that is connected to the first microprocessor for configuration of the clock and calendar.

5. The bidirectional wireless electrical energy monitoring system according to claim 4, wherein the bidirectional wireless electrical energy monitoring apparatus further comprises a first power source module which is composed of a first power input circuit and a first voltage regulator circuit, the input of the first power input circuit is connected to an external power source, the output of the first power input circuit is connected to the input of the first voltage regulator circuit, and the output of the first voltage regulator circuit is connected to the power inputs of the first microprocessor, the display module, the first key module, the first wireless bidirectional module and the clock and calendar module, respectively.

6. The bidirectional wireless electrical energy monitoring system according to claim 1, wherein the second wireless bidirectional module is composed of a radio frequency transceiver chip U2_1, a crystal oscillator Y2_1, an antenna J2_1, capacitors C2_1, C2_2, C2_4, C2_5 and inductances L2_1、L2_2、L2_3, one end of the crystal oscillator Y2_1 is connected to the 9 pin of the radio frequency transceiver chip U2_1, and the other end is grounded; one end of the capacitor C2_5 is connected to the 15 pin of the radio frequency transceiver chip U2_1, and the other end is grounded; the inductance L2_1 is connected between the 12 pin and 13 pin of the radio frequency transceiver chip U2_1, and the inductance L2_2 is connected between the 12 pin and 14 pin of the radio frequency transceiver chip U2_1; one end of the capacitor C2_1 is connected to the 13 pin of the radio frequency transceiver chip U2_1, and the other end is grounded; one end of the capacitor C2_4 is connected to the 12 pin of the radio frequency transceiver chip U2_1, the other end is connected to one end of the inductance L2_3, and the other end of the inductance L2_3 is connected to the 13 pin of the radio frequency transceiver chip U2_1; one end of the capacitor C2_2 is connected to the intersection of the inductances L2_3 and C2_4, and the other end is connected to the antenna J2_1; the 11 pin of the radio

frequency transceiver chip U2_1 is a grounding pin which is grounded, the 14 pin of the radio frequency transceiver chip U2_1 is a power pin for providing power, and the 1-8 pins, 10 pin and 16 pin of the radio frequency transceiver chip U2_1 are connected to the second microprocessor.

7. The bidirectional wireless electrical energy monitoring system according to claim 6, wherein the second wireless bidirectional module uses IA4421 as the radio frequency transceiver chip U2_1.

8. The bidirectional wireless electrical energy monitoring system according to claim 1, wherein the bidirectional wireless electrical energy monitoring switchgear further comprises a second key module, an indicator circuit, the output of the second key module is connected to the key detection input of the second microprocessor, and the input of the indicator circuit is connected to the status output of the second microprocessor.

9. The bidirectional wireless electrical energy monitoring system according to claim 8, wherein the bidirectional wireless electrical energy monitoring switchgear further comprises a second power source module which includes a second power input circuit, a rectifying circuit and a second voltage regulator circuit, the input of the second power input circuit is connected to an external power source, the output of the second power input circuit is connected to the AC input of the switch control circuit and the input of the rectifying circuit, respectively, the output of the rectifying circuit is connected to the AC input of the switch control circuit and the input of the second voltage regulator circuit, respectively, the output of the second voltage regulator circuit is connected to the DC inputs of the second microprocessor, the current induction module, the second wireless bidirectional module, the second key module and the indicator circuit, respectively.

10. The bidirectional wireless electrical energy monitoring system according to claim 9, wherein the second power source module further comprises a voltage detection circuit, the input of the voltage detection circuit is connected to the output of the second power input circuit, and the output of the voltage detection circuit is connected to the voltage detection input of the second microprocessor for detecting the input voltage of the power source.

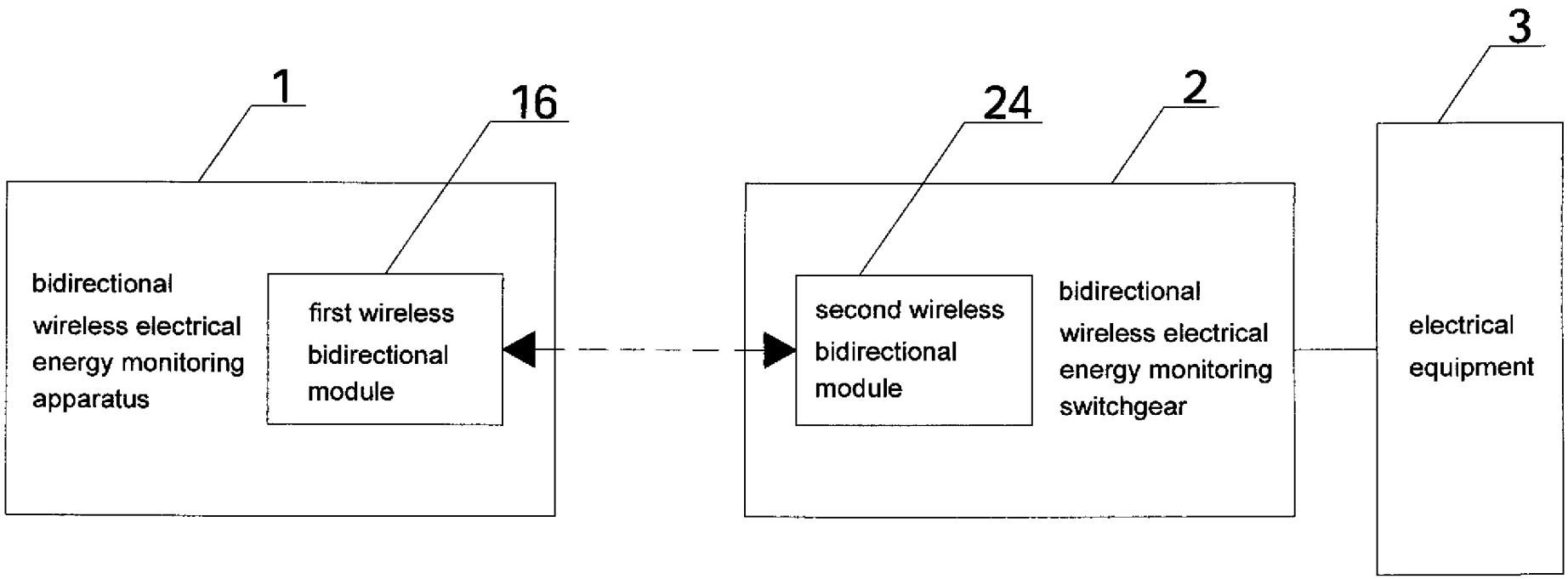
1
16
24
2
3
bidirectional wireless electrical energy monitoring apparatus
first wireless bidirectional module
second wireless bidirectional module
bidirectional wireless electrical energy monitoring switchgear
electrical equipment

FIG. 1

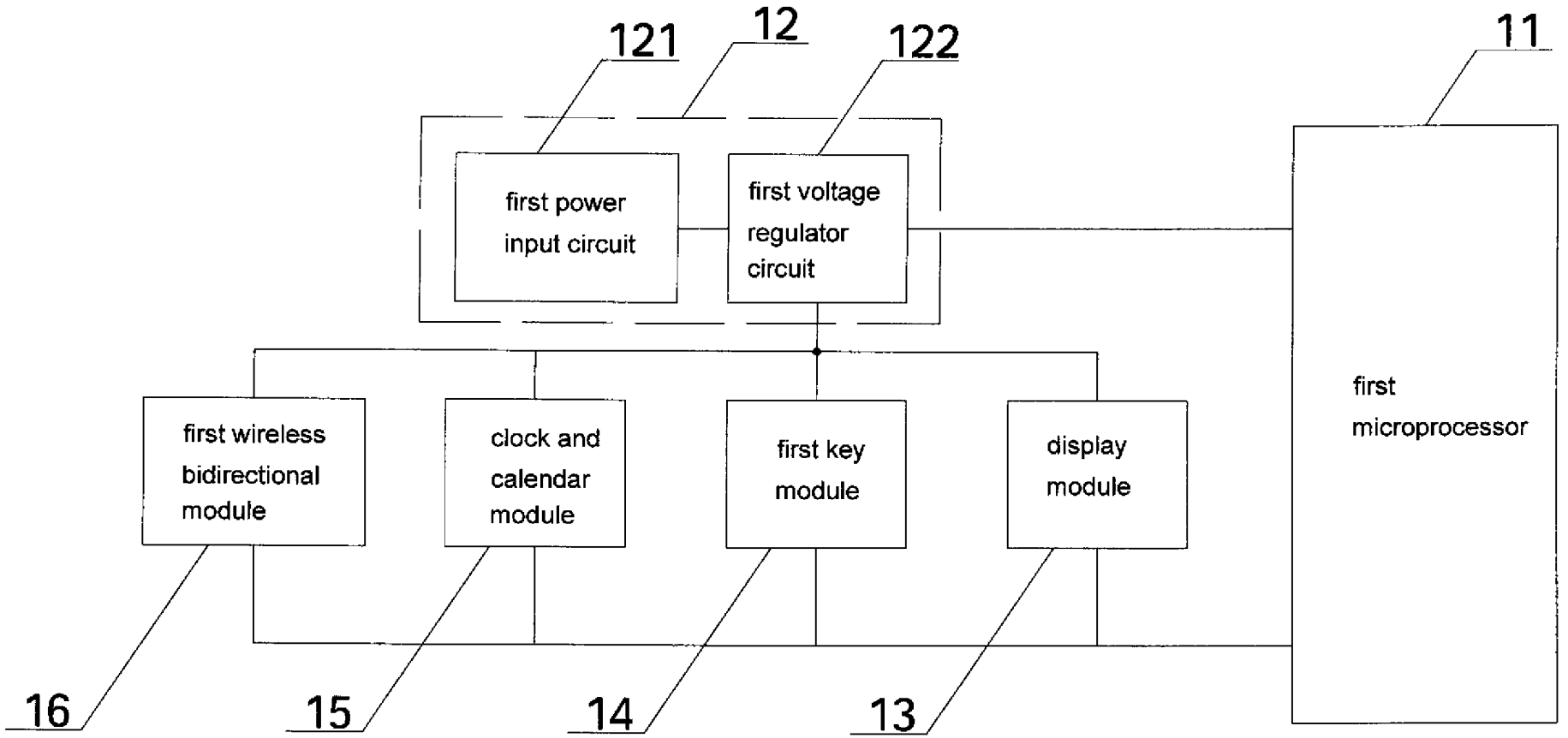
121
12
122
11
first power input circuit
first voltage regulator circuit
first microprocessor
first wireless bidirectional module
clock and calendar module
first key module
display module
16
15
14
13

FIG. 2

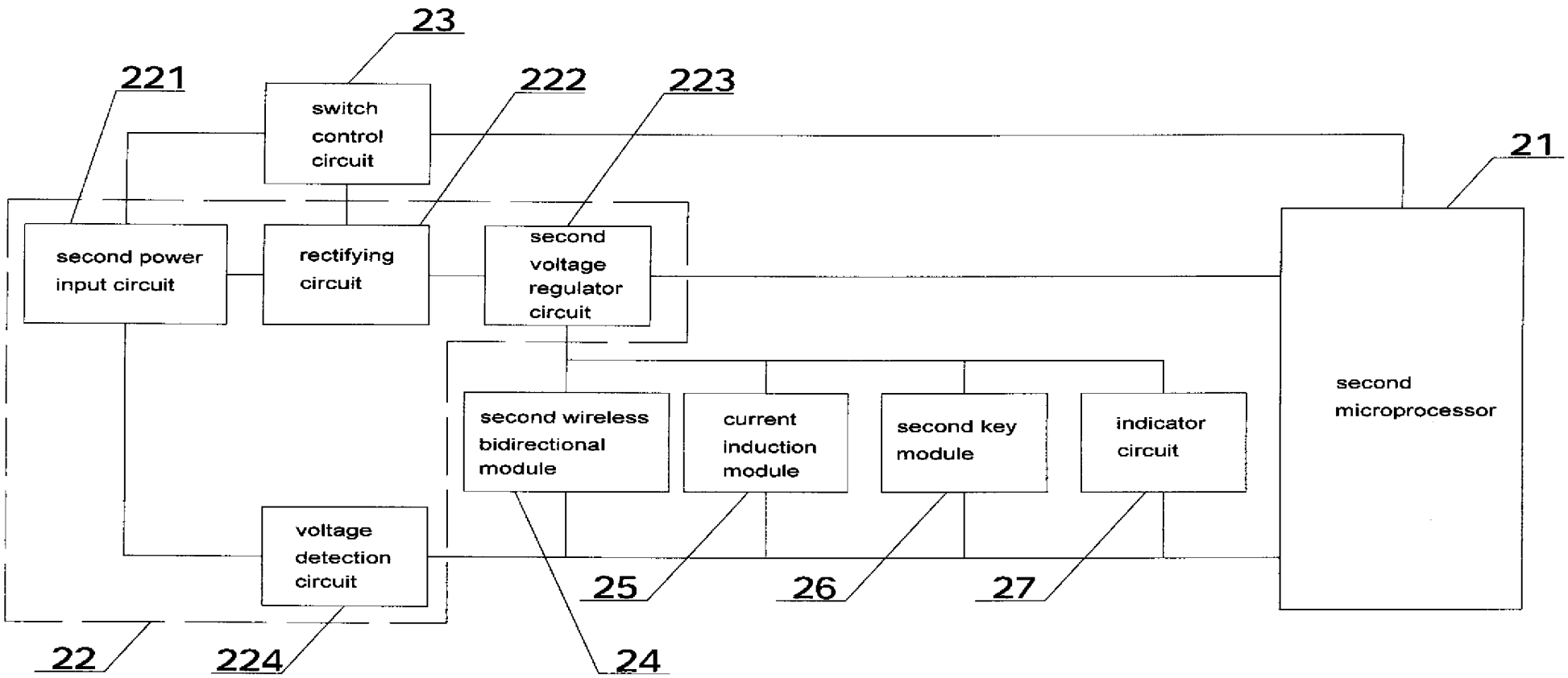
23
221
222
223
21
switch control circuit
second power input circuit
rectifying circuit
second voltage regulator circuit
second microprocessor
second wireless bidirectional module
current induction module
second key module
indicator circuit
voltage detection circuit
25
26
27
22
224
24

FIG. 3

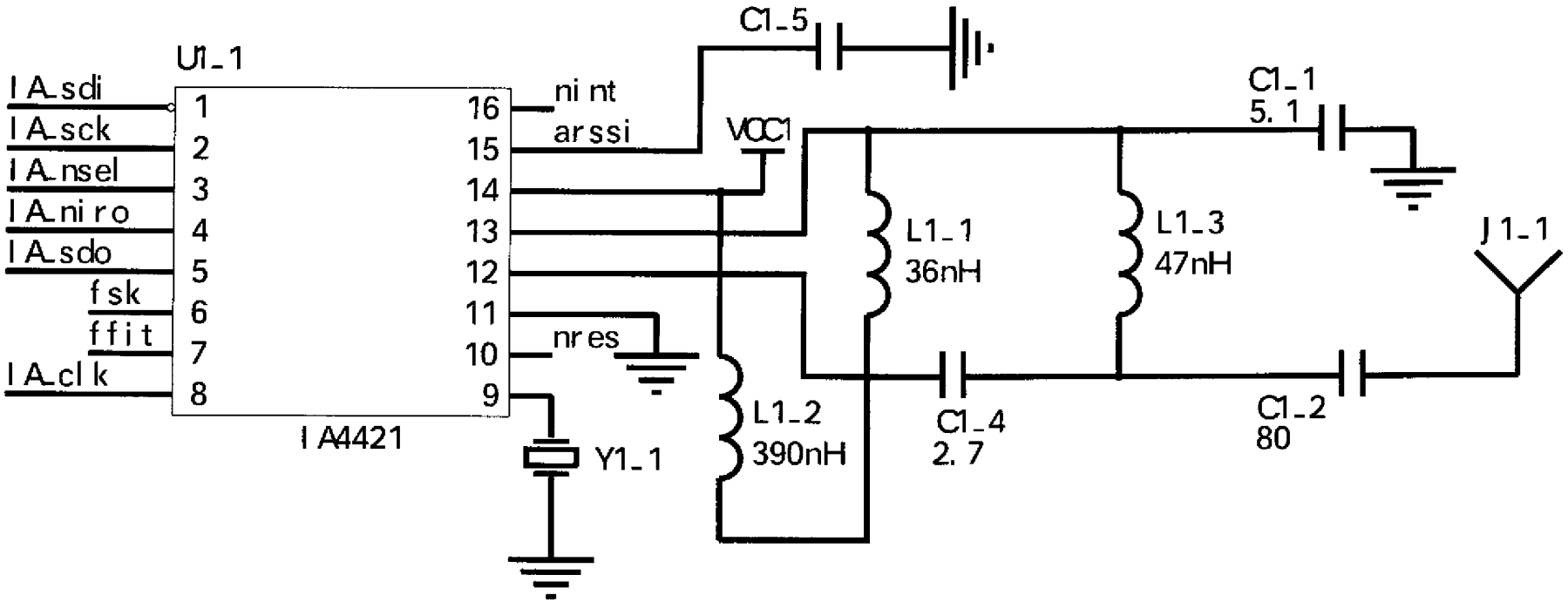
U1_1
IA_sdi
IA_sck
IA_nsel
IA_niro
IA_sdo
fsk
ffit
IA_clk
1
2
3
4
5
6
7
8
16
15
14
13
12
11
10
9
nint
arssi
nres
IA4421
Y1_1
C1_5
VCC1
L1_1
36nH
L1_2
390nH
L1_3
47nH
C1_4
2.7
C1_1
5.1
C1_2
80
J1_1

FIG. 4

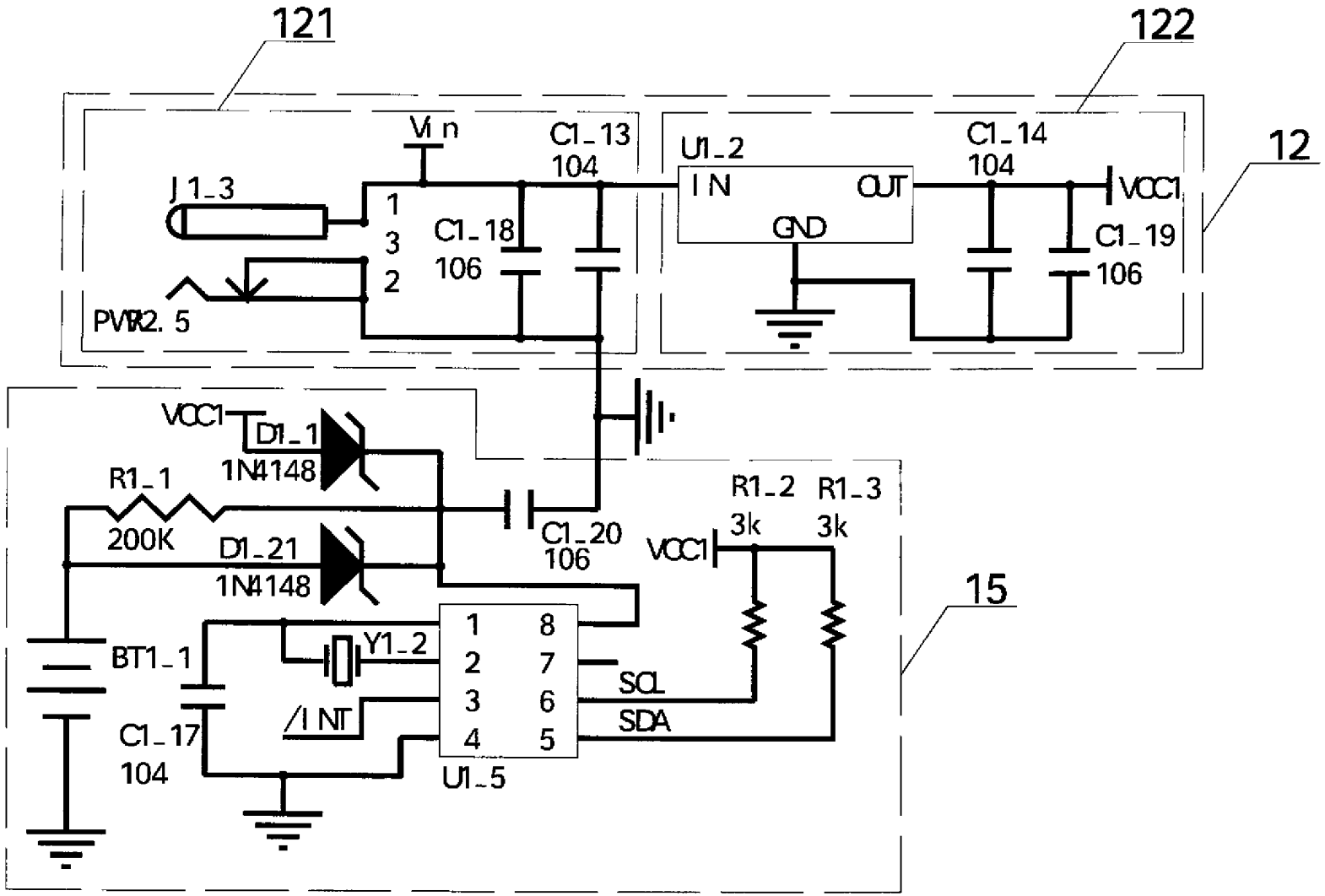
121
122
12
15
Vin
C1_13
104
U1_2
IN
OUT
GND
C1_14
104
VCC1
C1_19
106
J1_3
1
3
2
C1_18
106
PWR2.5
VCC1
D1_1
1N4148
R1_1
200K
D1_21
1N4148
C1_20
106
R1_2
3k
R1_3
3k
VCC1
BT1_1
Y1_2
C1_17
104
/INT
1
2
3
4
8
7
6
5
SCL
SDA
U1_5

FIG. 5

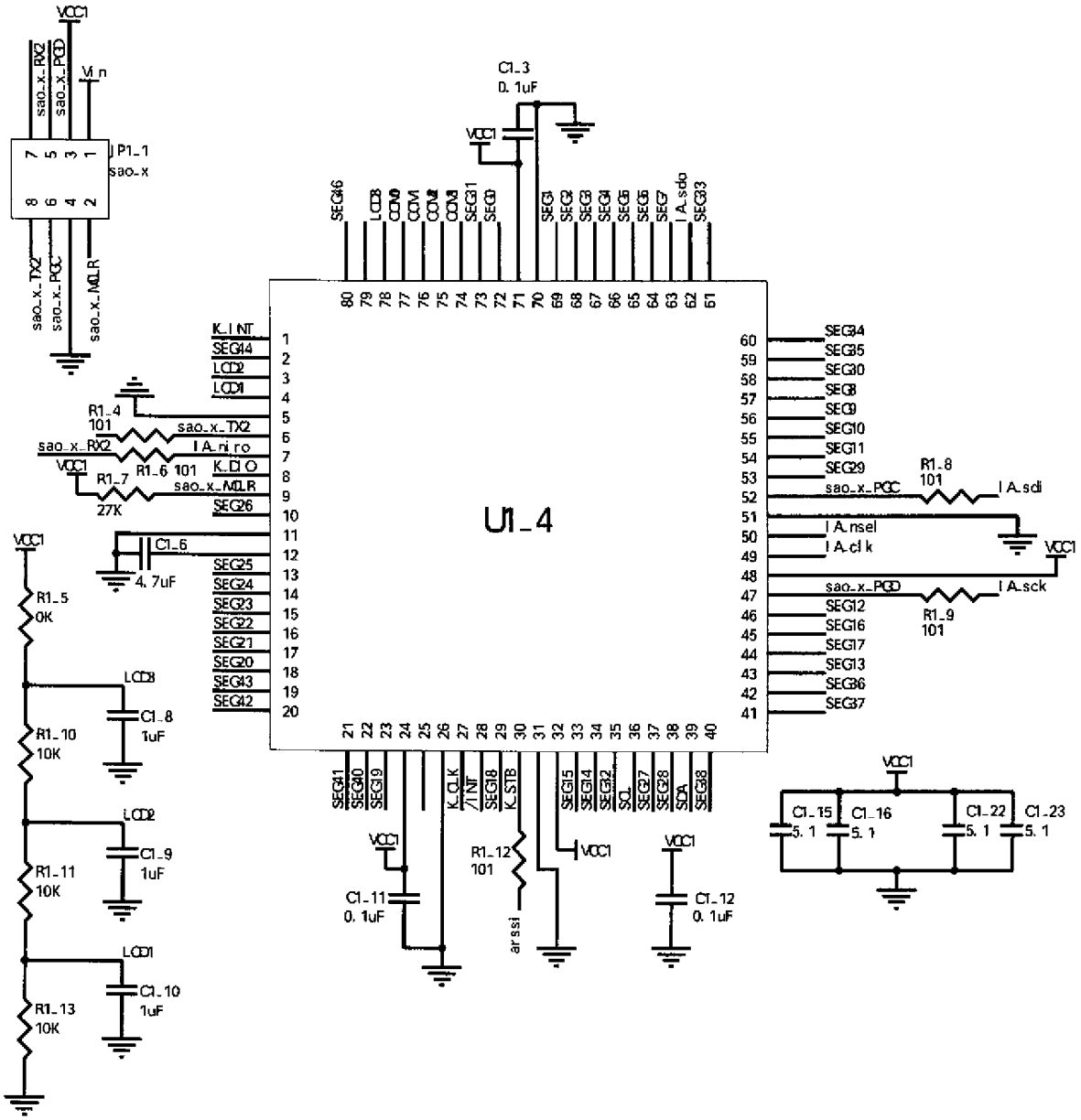
U1_4
VCC1
C1_3
0. 1uF
JP1_1
sao_x
sao_x_RX2
sao_x_PGD
sao_x_TX2
sao_x_PGC
sao_x_MCLR
K_INT
SEG44
LCD2
LCD1
R1_4
101
sao_x_TX2
sao_x_RX2
I A. n i r o
R1_6 101
K_DIO
R1_7
27K
sao_x_MCLR
SEG26
C1_6
4. 7uF
SEG25
SEG24
SEG23
SEG22
SEG21
SEG20
SEG43
SEG42
R1_5
0K
LCD3
C1_8
1uF
R1_10
10K
LCD2
C1_9
1uF
R1_11
10K
LCD1
C1_10
1uF
R1_13
10K
SEG46
LCD3
COM0
COM1
COM2
COM3
SEG31
SEG0
SEG1
SEG2
SEG3
SEG4
SEG5
SEG6
SEG7
I A. sdo
SEG33
SEG34
SEG35
SEG30
SEG8
SEG9
SEG10
SEG11
SEG29
R1_8
101
sao_x_PGC
I A. sdi
I A. nsel
I A. c l k
VCC1
sao_x_PGD
I A. sck
R1_9
101
SEG12
SEG16
SEG17
SEG13
SEG36
SEG37
SEG41
SEG40
SEG39
K_CLK
/INT
SEG18
K_STB
SEG15
SEG14
SEG32
SCL
SEG27
SEG28
SDA
SEG38
C1_11
0. 1uF
R1_12
101
arssi
C1_12
0. 1uF
C1_15
5. 1
C1_16
5. 1
C1_22
5. 1
C1_23
5. 1

FIG. 6

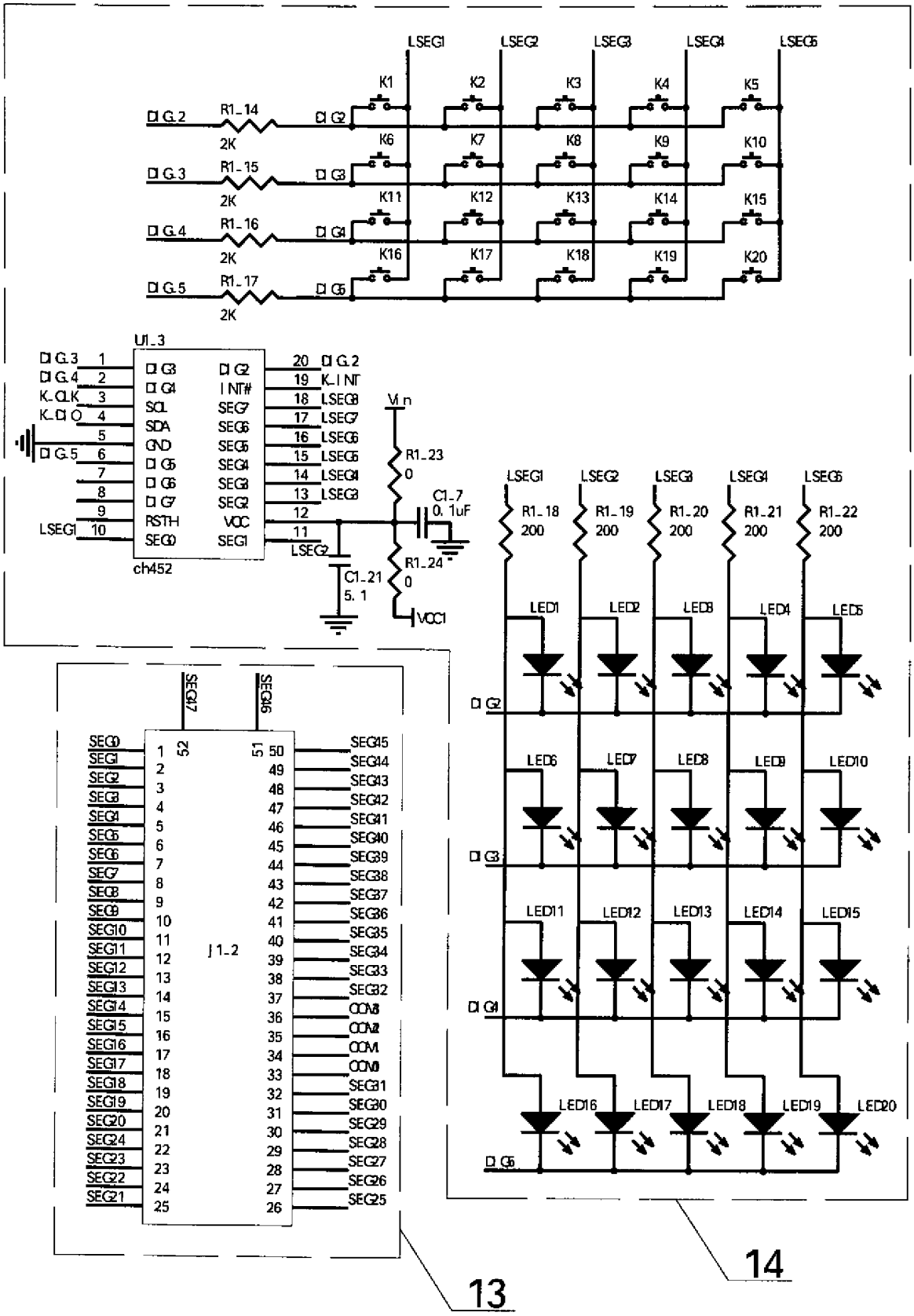
LSEG1
LSEG2
LSEG3
LSEG4
LSEG5
K1
K2
K3
K4
K5
K6
K7
K8
K9
K10
K11
K12
K13
K14
K15
K16
K17
K18
K19
K20
R1_14
2K
R1_15
2K
R1_16
2K
R1_17
2K
U1_3
ch452
INT#
SCL
SDA
GND
RSTH
VCC
R1_23
0
C1_7
0. 1uF
R1_24
0
C1_21
5. 1
VCC1
R1_18
200
R1_19
200
R1_20
200
R1_21
200
R1_22
200
LED1
LED2
LED3
LED4
LED5
LED6
LED7
LED8
LED9
LED10
LED11
LED12
LED13
LED14
LED15
LED16
LED17
LED18
LED19
LED20
J1_2
13
14

FIG. 7

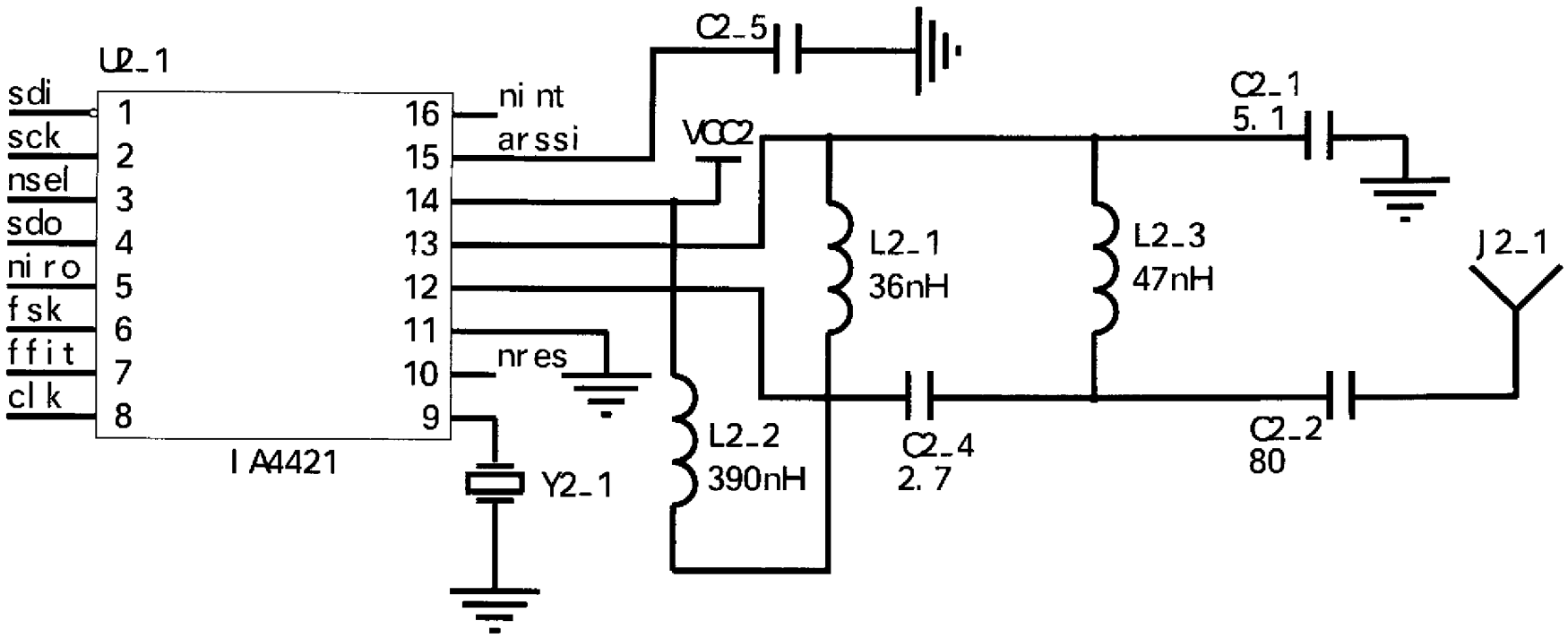
U2_1
sdi
sck
nsel
sdo
niro
fsk
ffit
clk
1
2
3
4
5
6
7
8
16
15
14
13
12
11
10
9
nint
arssi
nres
IA4421
Y2_1
C2_5
VCC2
L2_1
36nH
L2_2
390nH
L2_3
47nH
C2_4
2.7
C2_1
5.1
C2_2
80
J2_1

FIG. 8

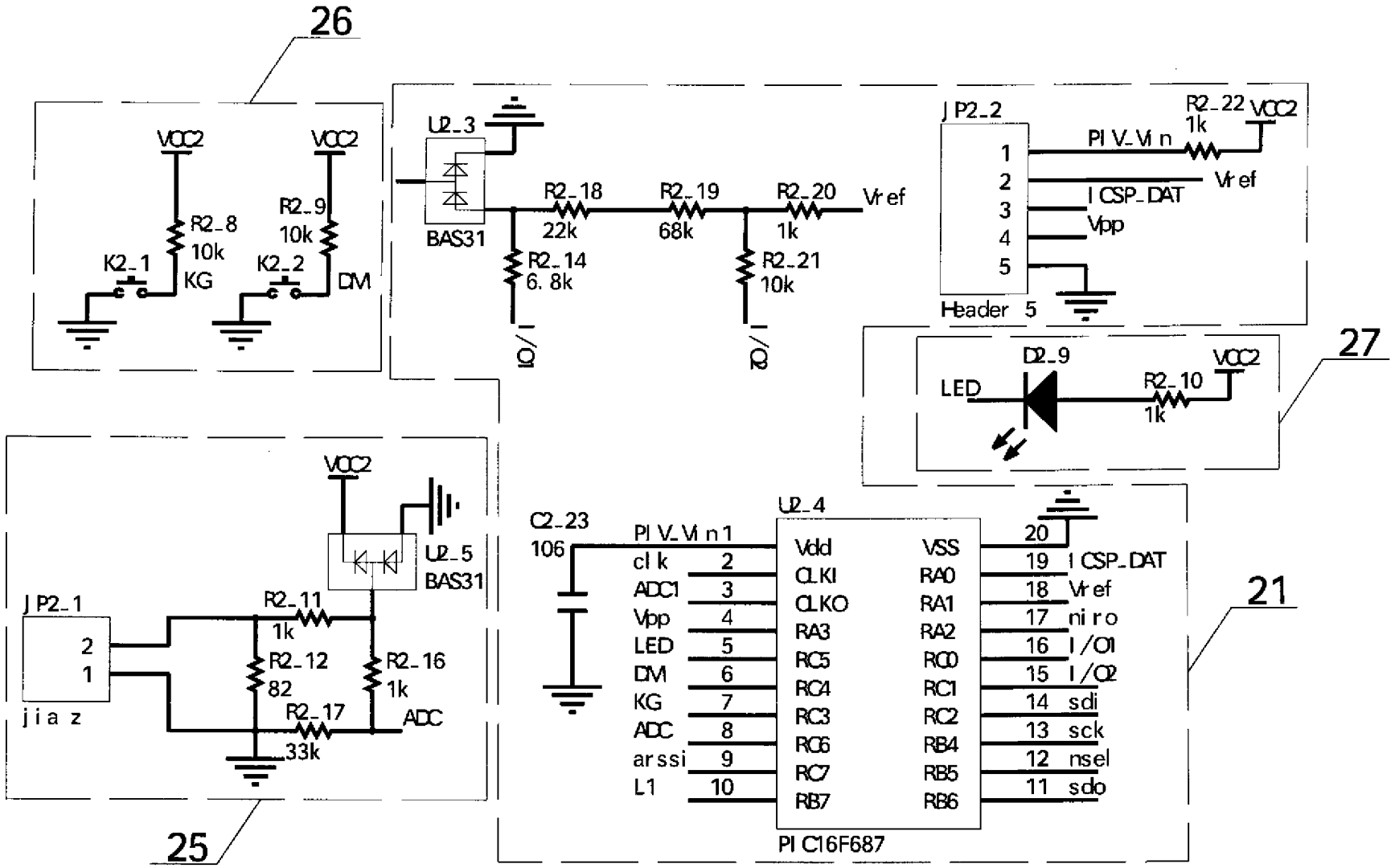
26
VCC2
VCC2
R2_8
10k
R2_9
10k
K2_1
KG
K2_2
DM
U2_3
BAS31
R2_18
22k
R2_19
68k
R2_20
1k
Vref
R2_14
6.8k
R2_21
10k
IO/
IO/
JP2_2
1
2
3
4
5
Header 5
PIV_Vin
R2_22
1k
VCC2
Vref
ICSP_DAT
Vpp
27
D2_9
LED
R2_10
1k
VCC2
U2_4
C2_23
106
PIV_Vin1
clk 2
ADC1 3
Vpp 4
LED 5
DM 6
KG 7
ADC 8
arssi 9
L1 10
Vdd
CLKI
CLKO
RA3
RC5
RC4
RC3
RC6
RC7
RB7
VSS
RA0
RA1
RA2
RC0
RC1
RC2
RB4
RB5
RB6
20
19 ICSP_DAT
18 Vref
17 niro
16 I/O1
15 I/O2
14 sdi
13 sck
12 nsel
11 sdo
PIC16F687
21
VCC2
U2_5
BAS31
JP2_1
2
1
jiaz
R2_11
1k
R2_12
82
R2_16
1k
R2_17
33k
ADC
25

FIG. 9

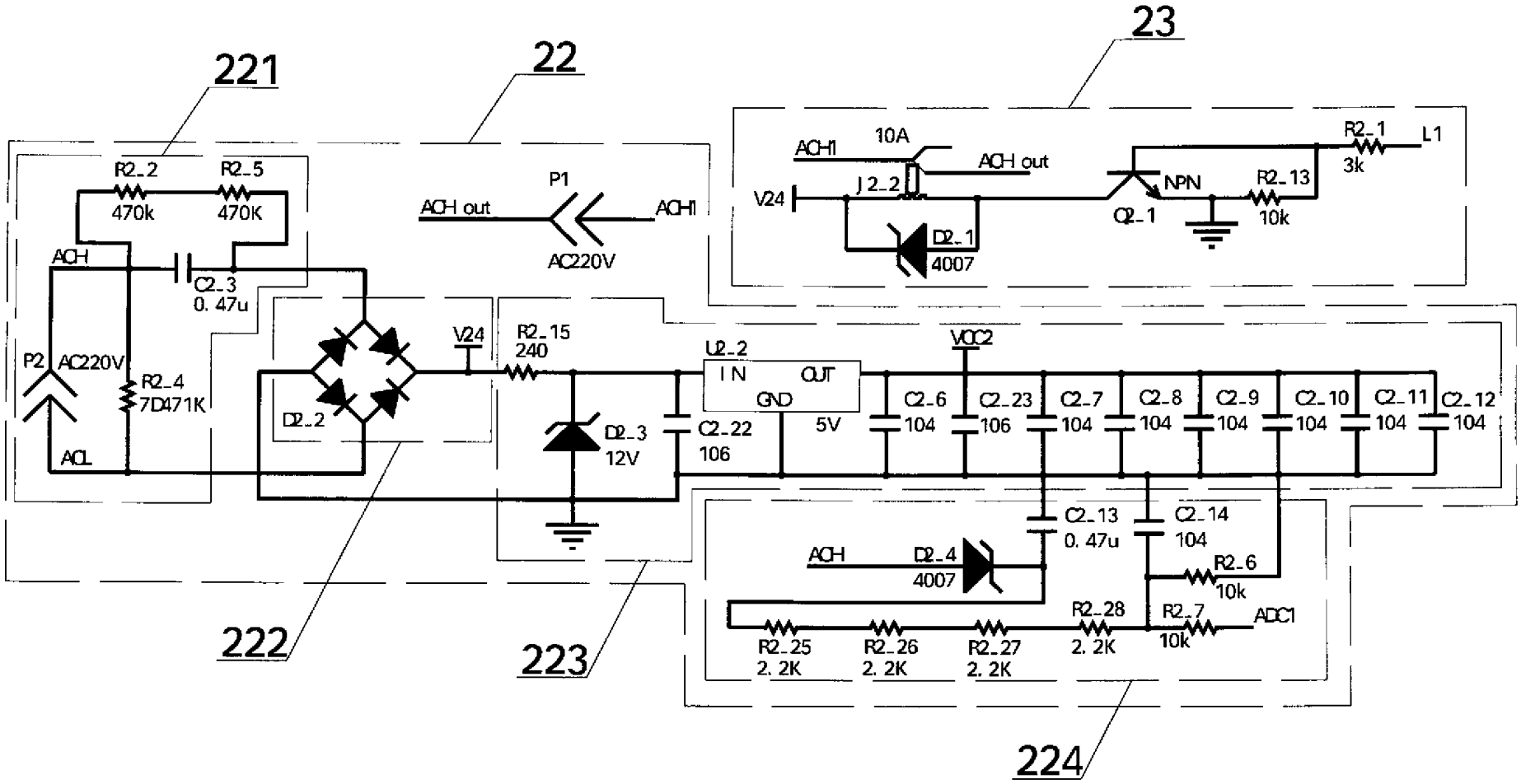
221
22
23
222
223
224
R2_2
470k
R2_5
470K
ACH
C2_3
0. 47u
P2
AC220V
R2_4
7D471K
ACL
D2_2
V24
R2_15
240
D2_3
12V
P1
ACH out
ACH1
AC220V
ACH1
10A
ACH out
J2_2
V24
D2_1
4007
Q2_1
NPN
R2_13
10k
R2_1
3k
L1
U2_2
IN
OUT
GND
5V
VCC2
C2_22
106
C2_6
104
C2_23
106
C2_7
104
C2_8
104
C2_9
104
C2_10
104
C2_11
104
C2_12
104
C2_13
0. 47u
C2_14
104
ACH
D2_4
4007
R2_6
10k
R2_25
2. 2K
R2_26
2. 2K
R2_27
2. 2K
R2_28
2. 2K
R2_7
10k
ADC1

FIG. 10