ELECTRONIC COMPONENT AND CONTROL METHOD FOR CONTACTLESS COMMUNICATION

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to Chinese Patent Application No. 202510325295.8, filed with the China National Intellectual Property Administration on March 19, 2025 and entitled "ELECTRONIC COMPONENT AND CONTROL METHOD FOR CONTACTLESS COMMUNICATION", which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] This application relates to the field of contactless communication technologies, and in particular, to an electronic component and a control method for contactless communication.

BACKGROUND

[0003] Near field communication (NFC) is a short-range high-frequency wireless communication technology that allows electronic devices to exchange data when they approach each other. The NFC technology evolves from contactless radio frequency identification (RFID), and can implement fast and convenient data transmission within a range of several centimeters. Typical application scenarios of the NFC technology include mobile payment, access control, smart posters, product authentication, interconnection between internet of things (IoT) devices, etc.

[0004] In actual application, a mobile terminal device such as a smartphone can serve as an NFC card reader device to communicate with an NFC slave device such as an NFC card, an NFC tag, or an NFC device with a radio frequency circuit. To reduce power consumption, the NFC card reader device can be in a low power mode. In this way, the card reader device can be in a low power card detection (LPCD) mode to detect a nearby NFC card. However, the card reader device in the LPCD mode has reduced sensing sensitivity to the slave device, resulting in a significant decrease in a success rate of sensing the slave device by the card reader device, and affecting user

experience.

[0005] Therefore, how to increase a card detection success rate is an urgent technical problem to be resolved.

SUMMARY

[0006] Embodiments of this specification provide an electronic component and a control method for contactless communication, to resolve a problem of a low card detection success rate of an existing card reader device.

[0007] To resolve the above-mentioned technical problem, embodiments of this specification are implemented as follows:

[0008] An embodiment of this specification provides an electronic component for contactless communication. The electronic component includes an antenna, a communication chip, and a load adjustment circuit. The antenna is connected to the load adjustment circuit, and the load adjustment circuit is connected to the communication chip. The load adjustment circuit includes a first state and a second state. Load impedance of the electronic component in the first state is different from load impedance of the electronic component in the second state. If the electronic component obtains a low power card detection LPCD signal sent by a card reader device, the communication chip is configured to control the load adjustment circuit to switch from the first state to the second state, so that the card reader device switches to a normal card detection mode.

[0009] An embodiment of this specification provides an NFC tag. The NFC tag includes the above-mentioned electronic component.

[0010] An embodiment of this specification provides a control method for contactless communication, applied to the above-mentioned electronic component, and including:

obtaining a detection signal sent by a card reader device;

generating a first control signal if the detection signal is a low power card detection LPCD signal; and

switching the electronic component from a first state to a second state based on the first control signal, so that the card reader device switches to a normal card detection mode, where load impedance of the electronic component in the first state is different from load impedance of the electronic component in the second state.

[0011] Embodiments of this specification can achieve the following beneficial effects:

[0012] The electronic component provided in the embodiments of this specification can include the load adjustment circuit that can adjust load impedance. After a signal sent by the card reader device in the LPCD mode is detected, the load adjustment circuit can be adjusted to switch from the first state to the second state. The load impedance of the electronic component in the first state is different from the load impedance of the electronic component in the second state. The load impedance of the electronic component is changed, so that an amplitude or a phase of the signal sent by the card reader device can be greatly changed after the signal encounters the electronic component, to facilitate entry of the normal card detection mode by the card reader device from the LPCD mode. This can increase an identification probability in contactless communication, and increase a probability of successful card detection by the card reader device.

BRIEF DESCRIPTION OF DRAWINGS

[0013] To describe the technical solutions in embodiments of this specification or in the conventional technology more clearly, the following briefly describes the accompanying drawings needed for describing the embodiments or the conventional technology. Clearly, the accompanying drawings in the following descriptions merely show some embodiments of this application, and a person of ordinary skill in the art can still derive other drawings from these accompanying drawings without creative efforts.

[0014] FIG. 1 is a schematic structural diagram of an electronic component for contactless communication according to an embodiment of this specification;

[0015] FIG. 2 is a schematic diagram of an electronic component according to an embodiment of this specification;

[0016] FIG. 3 is a schematic diagram of an electronic component according to an embodiment of this specification;

[0017] FIG. 4 is a schematic diagram of an electronic component according to an embodiment of this specification;

[0018] FIG. 5 is a schematic diagram of an electronic component according to an embodiment of this specification;

[0019] FIG. 6 is a schematic diagram of an electronic component according to an embodiment

of this specification; and

[0020] FIG. 7 is a control method for contactless communication according to an embodiment of this specification.

DESCRIPTION OF EMBODIMENTS

[0021] To make the objectives, technical solutions, and advantages of one or more embodiments of this specification clearer, the following clearly and comprehensively describes the technical solutions in the one or more embodiments of this specification with reference to specific embodiments of this specification and corresponding accompanying drawings. Clearly, the described embodiments are merely some but not all of embodiments of this specification. All other embodiments obtained by a person of ordinary skill in the art based on the embodiments of this specification without creative efforts shall fall within the protection scope of the one or more embodiments of this specification.

[0022] Many specific details are described in the following descriptions to facilitate full understanding of this application. However, this application can be implemented in many different manners from those described herein. A person skilled in the art can make similar promotion without departing from the content of this application. Therefore, this application is not limited to the specific implementations disclosed below.

[0023] The terms used in the one or more embodiments of this application are merely used to describe specific embodiments, and are not intended to limit the one or more embodiments of this application. The terms "a" and "the" of singular forms used in the one or more embodiments and the appended claims of this application are also intended to include plural forms, unless otherwise specified in the context clearly. It should be further understood that the term "and/or" used in the one or more embodiments of this application indicates and includes any or all possible combinations of one or more associated listed items. It should be understood that although terms "first", "second", etc. may be used in the one or more embodiments of this application to describe various types of information, the information is not limited to these terms. These terms are merely used to distinguish between information of a same type. For example, "first" can also be referred to as "second" without departing from the scope of the one or more embodiments of this application. Similarly, "second" can also be referred to as "first". Depending on the context, the word "if" used

herein can be interpreted as "when", "while", or "in response to determining".

[0024] First, noun terms used in the one or more embodiments of this application are explained.

[0025] Contactless communication means a technology in which information transmission is performed without direct physical contact, and implements data transmission and communication by using an electromagnetic wave or another wireless signal, avoiding a potential security risk caused by physical contact. A core principle of contactless communication is to transmit information by using a radio wave or another electromagnetic wave. An electromagnetic signal generated by a transmitter is received and decoded by a receiver, to complete data transmission. Common contactless communication technologies mainly include near field communication (NFC), radio frequency identification (RFID), wireless charging, etc.

[0026] A principle of RFID is to perform contactless data communication between a reader and a tag, to identify a target. There are different types of frequencies, for example, a low frequency, a high frequency, and an ultra-high frequency.

[0027] NFC is a short-range wireless communication technology, can implement near field communication between two devices, data transmission, writing, and reading, etc., and is usually used at a high frequency of 13.56 MHz. NFC is developed based on the RFID technology, and NFC can be used as a subset of RFID, or NFC can be used as a special form of RFID.

[0028] The NFC technology mainly includes three communication modes: a reader/writer mode, a card emulation mode, and a peer-to-peer mode.

[0029] The reader/writer mode is a common working mode, similar to barcode or two-dimensional code scanning. In this mode, an NFC device can read information from or write information into an NFC tag or a device including an NFC tag. For example, in a payment scenario, in the reader/writer mode, a mobile phone can obtain payment information on a payment device side for payment. A device in this mode can be referred to as a card reader device.

[0030] In the card emulation mode, an NFC device can be emulated as a smart card, allowing the NFC device to be used as a payment card, an access card, or another type of card. The device can interact with an existing contactless infrastructure, for example, a POS machine or an access control system. For example, a mobile phone is used as a bank card for payment in a store; a mobile phone is used as an access card for use in a company or a residential area; or a mobile phone is used as a transportation card to take public transportation. A device in this mode can be referred to as a slave device.

[0031] In the peer-to-peer mode, two NFC devices can exchange data with each other. Both the two devices need to be active and can send and receive data. It is mainly applied to file transmission, a social network, game interaction, etc. For example, Bluetooth or Wi-Fi connections are quickly paired through NFC, and then a file or a photo is transmitted. For another example, business cards, contact information, or social media links are exchanged by tapping two mobile phones. For another example, role exchange or prop sharing is implemented in a multi-player game.

[0032] An NFC tag is a small electronic chip. An antenna is built into the NFC tag, and short-range communication with a device (for example, a smartphone) supporting an NFC function can be implemented by using a radio wave. The tag is usually very small and can be built into various items such as posters, business cards, product packages, and devices.

[0033] A low power card detection (LPCD) mode is a low power card polling mode. LPCD is a technology used to efficiently detect a neighboring contactless smart card or tag in a radio frequency technology, and is mainly used to reduce power consumption generated when a card reader device waits for the smart card or tag to approach. A card reader device in the LPCD mode can periodically send a low power pulse. When detecting that a signal amplitude on an antenna is changed and exceeds a preset threshold, the card reader device can determine that a card approaches, to start a further interaction process. Specifically, when a card enters a radio frequency field, presence of the card causes amplitude and phase changes of a signal. In the LPCD mode, a software-based card detection mechanism can be used to detect these changes by using an LPCD algorithm, to determine whether a card approaches, and further trigger further communication. In a portable device such as a mobile phone, the LPCD mode is particularly important, and a main advantage of the LPCD mode is a low power consumption characteristic. The mobile phone usually needs to be in standby for a long time, and frequent activation of a function such as NFC may significantly drain a battery. The LPCD mode allows the mobile phone to continuously detect a near field communication signal in background while maintaining a relatively low energy consumption level. Once a card is detected, the mobile phone can quickly switch from a low power state to a full-function state to execute a transaction or exchange data.

[0034] A standard card detection mode is alternatively referred to as a normal card detection mode or a normal card polling mode. To increase a rate and a success rate of contactless communication, a card reader device usually can be in a full-function state, namely, the standard card detection mode, when performing communication. In actual application, in both the LPCD

mode and the standard card detection mode, the card reader device (for example, a mobile terminal device such as a mobile phone) sends a signal at a preset frequency. For example, in an NFC scenario, the card reader device can send a sine wave at 13.56 MHz in both the LPCD mode and the standard card detection mode. A difference lies in that sending times and amplitudes of the sine wave in the LPCD mode and the standard card detection mode are different. For example, in the LPCD mode, a pulse width is usually in an order of μs, while in the standard card detection mode, a pulse width is usually in an order of tens of ms.

[0035] Currently, mobile devices such as mobile phones are increasingly widely applied as active devices in contactless communication such as NFC. However, the mobile device is usually powered by a battery. To control power consumption, many low power designs are made for transmit power of a card reader of the mobile device, etc. For example, an LPCD mode is set. For example, when a screen of the mobile phone is turned off, a card reading function is usually disabled, and most mobile phones automatically enter the LPCD mode after the screen is turned on for a period of time. When approaching a peer NFC target device, for example, an NFC tag or an NFC slave device, the mobile device in the LPCD mode can switch to a standard card detection mode. In actual application, only when the mobile device senses that a strength change that occurs when a radio frequency signal transmitted by the mobile device is sensed by the peer NFC target device approached by the mobile device is greater than or equal to a preset threshold, the mobile device is woken up from the LPCD mode, and enters the standard card detection mode. However, in the LPCD mode, signal strength sent by the mobile device is relatively weak, and an amplitude of a transmitted radio frequency signal is decreased compared with that in the standard card detection mode. Therefore, an amplitude change caused by impact of the peer NFC target device on the signal is correspondingly reduced. In this case, the mobile device cannot determine, by using the amplitude change of the signal, whether there is an NFC target device around. Consequently, the mobile device cannot switch to the standard card detection mode, and a success rate of sensing the NFC target device by the mobile device is significantly decreased. This affects a success rate of near field communication, and affects user experience.

[0036] The following describes, with reference to the accompanying drawings, in detail the technical solutions provided in the embodiments of this specification.

[0037] FIG. 1 is a schematic structural diagram of an electronic component for contactless communication according to an embodiment of this specification. As shown in FIG. 1, the

electronic component can include an antenna 102, a communication chip 104, and a load adjustment circuit 106. The antenna 102 is connected to the load adjustment circuit 106, and the load adjustment circuit 106 is connected to the communication chip 104. The electronic component can serve as a slave device or a passive device for contactless communication, or as a part of a slave device or a passive device to communicate with a card reader device. Specifically, the electronic component can be a contactless tag, for example, an NFC tag. Alternatively, the electronic component can serve as a component in a slave device or a passive device for contactless communication. For example, contactless communication can include near field communication NFC, and the electronic component serves as a part of an NFC device having an NFC tag function.

[0038] The antenna 102 can include a metal coil, can be specifically a conventional NFC antenna or another antenna configured to receive a radio frequency signal, and can be configured to receive a signal from the card reader device. A specific shape or size of the antenna can be consistent with or close to a shape or size of an antenna coil of the card reader device, to achieve a better coupling effect with the card reader device. The antenna 102 can be a pure coil, or can be an antenna including some electronic components. For example, the antenna can include a coil and a capacitor connected in parallel to the coil. This is not specifically limited herein.

[0039] The communication chip 104 can be a conventional NFC tag chip, and can complete related work such as communication by absorbing energy by using a radio frequency field provided by the card reader device. For example, the communication chip can be an NTAG series IC chip, for example, NTAG213, NTAG215, or NTAG216. Alternatively, the communication chip can be a MIFARE series IC chip, for example, MIFARE1 S50, MIFARE1 S70, and MIFARE Ultralight. Alternatively, the communication chip can be an I-CODE series IC chip, for example, I-CODE2. Alternatively, the communication chip can be an FM series IC chip, for example, FM11RF08. Alternatively, the communication chip can be an ST25 series IC chip, for example, ST25DV-I2C, ST25TV, ST25TN, ST25TA, and ST25TB. A specific model of the communication chip is not limited herein. The communication chip can include parts such as a control circuit and a memory.

[0040] The communication chip 104 can directly or indirectly control a state of the load adjustment circuit 106. Specifically, parameter information of a component in the load adjustment circuit can be controlled, or parameter information of load impedance in the load adjustment circuit can be controlled.

[0041] The load adjustment circuit can include a first state and a second state, and load impedance of the electronic component in the first state is different from load impedance of the electronic component in the second state. If the electronic component obtains a low power card detection LPCD signal sent by the card reader device, the communication chip is configured to control the load adjustment circuit to switch from the first state to the second state, so that the card reader device switches to a normal card detection mode.

[0042] In actual application, the electronic component performs contactless communication such as NFC with the card reader device, and the card reader device serves as an active device to provide energy required for communication. The electronic component can be equivalent to a load of the card reader device. When a load impedance characteristic of the electronic component is changed, a feedback signal obtained by the corresponding card reader device is changed. The electronic component in this embodiment of this specification can be used in an NFC tag in NFC communication, or can be used in another tag for contactless communication. Provided that a card reader device corresponding to the tag for contactless communication needs to switch from an LPCD mode to the normal card detection mode, the tag for contactless communication can include the electronic component provided in this specification.

[0043] The electronic component provided in this embodiment of this specification can include the load adjustment circuit that can adjust load impedance. After a signal sent by the card reader device in the LPCD mode is detected, the load adjustment circuit can be adjusted to switch from the first state to the second state. The load impedance of the electronic component in the first state is different from the load impedance of the electronic component in the second state. The load impedance of the electronic component is changed, so that an amplitude or a phase of the signal sent by the card reader device can be greatly changed after the signal encounters the electronic component, to facilitate entry of the normal card detection mode by the card reader device from the LPCD mode. This can increase an identification probability in contactless communication, and increase a probability of successful card detection by the card reader device.

[0044] In actual application, the card reader device sends a radio frequency signal. After sensing the radio frequency signal, the antenna in the electronic component affects the radio frequency signal sent by the card reader. The card reader device can detect a variation of the signal, for example, a variation of a parameter such as an amplitude or a phase. An existing NFC tag exerts fixed impact on each signal sent by the card reader device. For example, the card reader device

sends a plurality of signals in the LPCD mode. The card reader senses an unchanged difference for the plurality of signals, and the card reader device has an anti-fatigue action, and therefore cannot switch to the normal card detection mode. The electronic component provided in this embodiment of this specification can change a state of the load impedance in a card detection process of the card reader device, so that the card reader device can reflect different variations, to facilitate entry of the normal card detection mode by the card reader device.

[0045] In an implementation, load impedance of a circuit can be adjusted by adjusting a resonance point of the circuit. In this embodiment of this specification, the load adjustment circuit can be a tuning circuit, or can be referred to as a resonance circuit or an LC circuit, and is a circuit including an inductor (L) and/or a capacitor (C). In this specification, the load adjustment circuit 106 is connected to the antenna 102, and can constitute a circuit that can adjust a resonance frequency. The load adjustment circuit 106 can include the first state and the second state. The load adjustment circuit in the first state and the load adjustment circuit in the second state have different inductance values or capacitance values, so that the load adjustment circuit has different resonance points in the two states or can have different load impedance.

[0046] In an implementation, in the first state, a resonance point of the electronic component can conform to a preset resonance point. For example, in the first state, a resonance frequency of the electronic component can be equal to a preset resonance frequency or has a relatively small difference from a preset resonance frequency. In the second state, a resonance point of the electronic component can deviate from the preset resonance point. For example, in the second state, a resonance frequency of the electronic component can be greater than or less than the preset resonance frequency of the preset resonance point.

[0047] In another implementation, a resonance point of the electronic component in the first state can deviate from the preset resonance point, and a resonance point of the electronic component in the second state can conform to the preset resonance point.

[0048] The resonance point can represent a point at which the resonance circuit exhibits a maximum response or minimum impedance at a specific frequency. In this embodiment of this specification, the resonance point of the electronic component can represent a resonance point of a resonance circuit including the load adjustment circuit in the electronic component. The preset resonance point can be a resonance point corresponding to the card reader device on a working carrier frequency band, and the preset resonance point can also be represented by using a resonance

frequency. A working frequency of the card reader device can be a resonance frequency of the card reader device for identification by a slave device.

[0049] For example, a working carrier frequency band of a commonly used card reader device for NFC communication is approximately 13.56 MHz. For example, the card reader device can work in a range of 13.56±0.7 MHz. The preset resonance point can be a point at which a maximum response or minimum impedance is exhibited on the working carrier frequency band. The preset resonance frequency can be 13.56 MHz or a frequency in a range of 13.56±0.7 MHz.

[0050] In this embodiment of this specification, the communication chip 104 can be configured to control the load adjustment circuit 106 to be in the first state or the second state. Specifically, if the electronic component obtains the low power card detection LPCD signal sent by the card reader device, the communication chip can control the load adjustment circuit to switch from the first state to the second state. Through adjustment of the resonance point, exit of the low power card detection LPCD mode by the card reader device is facilitated, so that the card reader device switches to the normal card detection mode.

[0051] The low power card detection LPCD signal can be a signal sent by the card reader device in the low power card detection LPCD mode.

[0052] The card reader device can be an active device such as a mobile phone, a smartwatch, a computer, or a POS machine that can be used for contactless communication, for example, an NFC card reader device. The electronic component provided in this embodiment of this specification can be a slave device or a component for contactless communication. For example, the electronic component provided in this embodiment of this specification can be a part of an active or passive NFC tag or NFC card, or can be a part of an electronic device serving as an NFC slave device.

[0053] Near field communication NFC is used as an example. The card reader device can actively send an electromagnetic signal, for example, actively send a 13.56 MHz signal in the LPCD mode. The antenna included in the electronic component provided in this specification can sense the electromagnetic signal sent by the card reader device. In this specification, the electronic component can sense, through the antenna, whether there is a card reader device. If the electronic component detects a signal sent by a card reader device in the low power card detection LPCD mode, state switching can be performed on the load adjustment circuit, to facilitate switching of the card reader device from the LPCD mode to the normal card detection mode.

[0054] In an implementation, when the electronic component is in a non-working state, it can indicate an initial state of the electronic component. Alternatively, when there is no card reader device around the electronic component or when no radio frequency signal sent by the card reader device is detected, the electronic component can be in the first state, and the resonance point of the electronic component can conform to the preset resonance point. For example, the resonance frequency is 13.56 MHz. If a card reader device approaches, when the electronic component or the antenna in the electronic component senses a low power card detection LPCD signal sent by the card reader device, the communication chip can control the electronic component to switch from the first state to the second state, and the resonance point of the electronic component in the second state can deviate from the preset resonance point. For example, the resonance frequency is 11 MHz, 12 MHz, or 15 MHz, and the working frequency of the card reader device 13.56 MHz. Through adjustment of the resonance point, a variation of an amplitude or a phase of a feedback signal obtained by the card reader device under impact of the electronic component can be increased, to facilitate wakeup of the normal card detection mode by the card reader device. In actual application, if the card reader device switches from the LPCD mode to the normal card detection mode, and transmits a signal in the normal card detection mode, after the electronic component obtains the signal sent by the card reader device in the normal card detection mode, the resonance point of the electronic component can be further adjusted to conform to the working resonance point of the card reader. For example, restoration from the second state to the first state can be implemented, to ensure communication efficiency, or prepare for next wakeup of the card reader device in the LPCD mode.

[0055] In another implementation, the resonance point of the electronic component in the first state can deviate from the preset resonance point. If a card reader device approaches, when the electronic component or the antenna in the electronic component senses a low power card detection LPCD signal sent by the card reader device, the communication chip can control the electronic component to switch from the first state to the second state, and the resonance point of the electronic component in the second state can conform to the preset resonance point. Through adjustment of the resonance point, a variation of an amplitude or a phase of a feedback signal obtained by the card reader device under impact of the electronic component can be increased, to facilitate wakeup of the normal card detection mode by the card reader device. In actual application, if the card reader device switches from the LPCD mode to the normal card detection mode, and

transmits a signal in the normal card detection mode, after the electronic component obtains the signal sent by the card reader device in the normal card detection mode, or after communication with the card reader device ends, the resonance point of the electronic component can be further adjusted to deviate from the working resonance point of the card reader. For example, restoration from the second state to the first state can be implemented, to prepare for next wakeup of the card reader device in the LPCD mode.

[0056] According to the electronic component provided in this embodiment of this specification, after the signal sent by the card reader device in the LPCD mode is detected, the load adjustment circuit can be adjusted, so that an amplitude or a phase of the signal sent by the card reader device is greatly changed after the signal encounters the electronic component, to facilitate entry of the normal card detection mode by the card reader device from the LPCD mode. This can increase an identification probability in contactless communication, and increase a probability of successful card detection by the card reader device.

[0057] In some related technologies, a tag chip in an always listen mode (ALM) in which an additional power supply is used for power supply is used to provide a card detection success rate of a mobile terminal. In the ALM mode, the tag chip can continuously listen to a signal from a reader/writer in a case of very low power consumption, and respond quickly when a valid signal is received. In some other related technologies, an active signal wakeup circuit is separately set to enable the mobile terminal to exit the LPCD mode. It can be learned that the method used in the related technology has relatively high complexity and costs, which is not conducive to implementation in actual application.

[0058] The electronic component provided in this embodiment of this specification has a simple structure, neither requires an excessively complex circuit, nor requires an additional power supply, and has low costs, which is more conducive to implementation in actual application.

[0059] An NFC working frequency of 13.56 MHz is used as an example. A resonance frequency is $f = \frac{1}{2\Pi\sqrt{(LC)}}$, an impedance value is $Z = R + jwL + \frac{1}{(-jwc)}$, where wL is an inductive reactance value, and $\frac{1}{(wc)}$ is a capacitive reactance value, and a frequency angle is $w = \frac{1}{\sqrt{(LC)}}$.

[0060] Through the related theoretical calculation formula, it can be found that both the impedance and the phase (frequency angle) that cause an amplitude variation are related to

inductance and capacitance values.

[0061] The electronic component provided in this embodiment of this specification can affect, from a perspective of changing the capacitance value or the inductance value, the signal sent by the card reader device, so that the card reader device can smoothly switch from the LPCD mode to the normal card detection mode. From a perspective of the card reader device, the electronic component provided in this specification can serve as a load of the card reader device. In this specification, smooth switching of the card reader device from the LPCD mode to the normal card detection mode can be facilitated from a perspective of adjusting a load parameter.

[0062] In an implementation, the load adjustment circuit can include an LC resonance circuit that can change a circuit parameter. Optionally, the load adjustment circuit can include at least a first capacitor and a first adjustable inductor. The first capacitor is connected in parallel to the antenna, the first adjustable inductor is connected in series to the antenna, and an adjustable terminal of the first adjustable inductor is connected to the communication chip, so that the communication chip can adjust an inductance value of the inductor based on a signal status obtained by the antenna.

[0063] Specifically, an inductance value of the first adjustable inductor in the first state is a first inductance value, and an inductance value of the first adjustable inductor in the second state is a second inductance value. In this embodiment, the resonance frequency of the electronic component can be adjusted by adjusting an inductance value of the load adjustment circuit. If a resonance frequency of the electronic component in the second state is less than a resonance frequency of the electronic component in the first state, the first inductance value is less than the second inductance value. If a resonance frequency of the electronic component in the second state is greater than a resonance frequency of the electronic component in the first state, the first inductance value is greater than the second inductance value.

[0064] In an implementation, if the electronic component obtains the low power card detection LPCD signal sent by the card reader device, the load adjustment circuit needs to switch from the first state to the second state. If the resonance frequency of the electronic component in the first state is the working resonance frequency of the card reader device, and the resonance frequency of the electronic component in the second state is less than the working resonance frequency of the card reader device; or the resonance frequency of the electronic component in the first state is greater than the working resonance frequency of the card reader device, and the resonance

frequency of the electronic component in the second state is equal to the working resonance frequency of the card reader device, this can be indicated as that the resonance frequency of the electronic component in the second state is less than the resonance frequency of the electronic component in the first state. In this case, the resonance frequency of the electronic component can be decreased, and the load adjustment circuit switches from the first state to the second state. Specifically, this can be implemented by increasing the inductance value of the first adjustable inductor. In this case, the second inductance value can be greater than the first inductance value, that is, the first inductance value can be less than the second inductance value.

[0065] In another implementation, if the electronic component obtains the low power card detection LPCD signal sent by the card reader device, the load adjustment circuit needs to switch from the first state to the second state. If the resonance frequency of the electronic component in the first state is equal to the working resonance frequency of the card reader device, and the resonance frequency of the electronic component in the second state is greater than the working resonance frequency of the card reader device; or the resonance frequency of the electronic component in the first state is less than the working resonance frequency of the card reader device, and the resonance frequency of the electronic component in the second state is equal to the working resonance frequency of the card reader device, this can be indicated as that the resonance frequency of the electronic component in the second state is greater than the resonance frequency of the electronic component in the first state. This can be implemented by decreasing the inductance value of the first adjustable inductor. In this case, the second inductance value can be less than the first inductance value, that is, the first inductance value is greater than the second inductance value.

[0066] FIG. 2 is a schematic diagram of an electronic component according to an embodiment of this specification. As shown in FIG. 2, the load adjustment circuit 106 can include a first capacitor C1 and a first adjustable inductor L1. The first capacitor C1 is connected in parallel to the antenna 102, and the first adjustable inductor L1 is connected in series to the first capacitor C1, or the first adjustable inductor L1 can be connected in series to the antenna 102.

[0067] Specifically, one end A of the antenna 102 can be connected to one end b of the first adjustable inductor L1, and the other end a of the first adjustable inductor L1 can be connected to one input terminal IN1 of the communication chip 104. The other input terminal IN2 of the communication chip 104 can be connected to the other end B of the antenna 102. An adjustable terminal c of the first adjustable inductor L1 can be connected to a signal control terminal GPO of

the communication chip 104. The communication chip 104 can output an analog or digital control signal to control an inductance value of the first adjustable inductor L1. One end d of the first capacitor 204 can be connected to the other end a of the first adjustable inductor L1, and the other end e of the first capacitor C1 can be connected to the other end B of the antenna 102.

[0068] In this embodiment, the load adjustment circuit includes the adjustable inductor connected in series and the capacitor connected in parallel, which form a resonance circuit with an inductor L0 of a coil body of the antenna. The adjustable inductor can be an inductor that can adjust or change an inductance value, or can be referred to as a variable inductor.

[0069] In an implementation, when the adjustable inductor is in an idle state, for example, the antenna does not sense a signal sent by the card reader device, there is no card reader device that sends a near field communication signal nearby, or contactless data transmission with the card reader device is completed, the load adjustment circuit can be in the first state. In this case, a resonance point of the resonance circuit including the first capacitor and the first adjustable inductor in the electronic component can deviate from the preset resonance point, for example, deviate from 13.56 MHz, and impedance is relatively high. For the card reader device, a load is heavy, and a change in a signal sensed by the card reader device is great. When a field approaches, the antenna senses a radio frequency signal sent by the card reader device, and converts the radio frequency signal into electrical energy to be provided to the communication chip. The communication chip can determine that there is a card reader device that sends a low power card detection signal nearby, and can send a control signal to the first adjustable inductor, so that the inductance value of the first adjustable inductor is increased or decreased, and the load adjustment circuit can switch from the first state to the second state. In this case, a resonance point of the resonance circuit including the first capacitor 204 and the first adjustable inductor 206 in the electronic component conforms to the preset resonance point, for example, is exactly 13.56 MHz, and impedance is relatively low. For the card reader device, a load becomes smaller, and a change in a signal sensed by the card reader device is small, but becomes greater relative to a continuous signal change status. This can effectively resolve a problem that a normal card detection function is not triggered because the card reader device continuously obtains a same variation value. Further, the method in this embodiment can enable a signal change sensed by the card reader device to meet a requirement, and the card reader device can start the normal card detection mode.

[0070] Similarly, in another implementation, in an idle state, the load adjustment circuit is in

the first state, the resonance point of the electronic component in the first state can be the same as the preset resonance point, impedance is small, and a return loss is small. For the card reader device, a load is low, and a change in a signal sensed by the card reader device is small. When a field approaches, the antenna senses a radio frequency signal sent by the card reader device. After determining that the radio frequency signal is a low power card detection LPCD signal, the communication chip can adjust the load adjustment circuit from the first state to the second state. The load adjustment circuit in the second state can deviate from the preset resonance point, impedance is large, and a return loss is large. For the card reader device, a load is heavy, a change in a signal sensed by the card reader device becomes greater, and the normal card detection mode of the card reader device can be triggered.

[0071] In this embodiment of this specification, the resonance point of the electronic component can be adjusted by adjusting a capacitance value of the electronic component, to facilitate entry of the normal card detection mode by the card reader device. In an implementation, the load adjustment circuit can include an adjustable capacitor, which forms a parameter-adjustable LC resonance circuit with the antenna. Optionally, the load adjustment circuit can include at least a first adjustable capacitor. The first adjustable capacitor is connected in parallel to the antenna, and an adjustable terminal of the first adjustable capacitor is connected to the communication chip, so that the communication chip can adjust a capacitance value of the capacitor based on a signal status obtained by the antenna.

[0072] Specifically, the first adjustable capacitor has a first capacitance value in the first state, and the first adjustable capacitor has a second capacitance value in the second state. In this embodiment, the resonance frequency of the electronic component can be adjusted by adjusting an inductance value of the load adjustment circuit. If a resonance frequency of the electronic component in the second state is less than a resonance frequency of the electronic component in the first state, the first capacitance value is less than the second capacitance value. If a resonance frequency of the electronic component in the second state is greater than a resonance frequency of the electronic component in the first state, the first capacitance value is greater than the second capacitance value.

[0073] In an implementation, it is assumed that the resonance point of the electronic component in the first state is equal to the preset resonance point, and the resonance point of the electronic component in the second state is less than the preset resonance point, or the resonance

frequency of the electronic component can be less than the preset resonance frequency. Alternatively, the resonance point of the electronic component in the first state is greater than the preset resonance point, and the resonance of the electronic component in the second state is equal to the preset resonance point. If the electronic component obtains the low power card detection LPCD signal sent by the card reader device, the load adjustment circuit needs to switch from the first state to the second state. This can be implemented by increasing the capacitance value of the first adjustable inductor, that is, the first capacitance value can be less than the second capacitance value.

[0074] In another implementation, it is assumed that the resonance point of the electronic component in the first state is equal to the preset resonance point, and the resonance point of the electronic component in the second state is greater than the preset resonance point, or the resonance frequency of the electronic component can be greater than the preset resonance frequency. Alternatively, the resonance point of the electronic component in the first state is less than the preset resonance point, and the resonance point of the electronic component in the second state is equal to the preset resonance point. If the electronic component obtains the low power card detection LPCD signal sent by the card reader device, the load adjustment circuit needs to switch from the first state to the second state. This can be implemented by decreasing the capacitance value of the first adjustable capacitor, that is, the first inductance value can be greater than the second inductance value.

[0075] FIG. 3 is a schematic diagram of an electronic component according to an embodiment of this specification. As shown in FIG. 3, the load adjustment circuit 106 can include a first adjustable capacitor C2. The first adjustable capacitor C2 is connected in parallel to the antenna 102 to form a resonance circuit. Specifically, one end f of the first adjustable capacitor C2 can be connected to one end A of the antenna 102, and the other end g of the first adjustable capacitor C2 can be connected to the other end B of the antenna 102. An adjustable terminal h of the first adjustable capacitor C2 can be connected to a signal control terminal GPO of the communication chip, and the communication chip 104 can output an analog or digital control signal to control a capacitance value of the first adjustable capacitor C2. In actual application, one end f and the other end g of the first adjustable capacitor C2 can be fixed ends of the adjustable capacitor, for example, stator pins; and the adjustable terminal h of the first adjustable capacitor C2 can be a movable terminal of the adjustable capacitor, for example, a stator pin.

[0076] The antenna 102 can also be connected to the communication chip 104. Specifically, one end A of the antenna 102 can be connected to one input terminal IN1 of the communication chip 104, and the other end B of the antenna 102 can be connected to the other input terminal IN2 of the communication chip 104, so that the communication chip 104 can detect a signal sensed by the antenna 102.

[0077] In this embodiment, the load adjustment circuit includes the first adjustable capacitor C2 connected in parallel, and the first adjustable capacitor C2 and an inductor L0 of a coil body of the antenna can form a resonance circuit. The adjustable capacitor can be a capacitor that can adjust or change a capacitance value, or can be referred to as a variable capacitor.

[0078] In this embodiment, the resonance frequency of the electronic component can be adjusted by adjusting a capacitance value, to facilitate entry of the normal card detection mode by the card reader device. In an implementation, in an idle state, the load adjustment circuit can be in the first state in which the resonance point deviates from the preset resonance point, inductive capacitance of the first adjustable capacitor is C20, a resonance point of the resonance circuit including the first adjustable capacitor C2 and the coil of the antenna can deviate from the preset resonance point, for example, deviate from 13.56 MHz, and impedance is relatively high. For the card reader device, a load is heavy, and a change in a signal sensed by the card reader device is great. When a field approaches, the communication chip determines that there is a card reader device that sends a low power card detection signal nearby, and can send a control signal to the first adjustable capacitor C2, to adjust the inductance value to be increased or decreased through the adjustable terminal of the first adjustable capacitor C2. In this state, inductive capacitance of the first adjustable capacitor C21, which can form a resonance circuit with the coil body of the antenna. A resonance point of the resonance circuit conforms to the preset resonance point, for example, is exactly 13.56 MHz, and impedance is relatively low. For the card reader device, a load becomes smaller, and a change in a signal sensed by the card reader device is small, but becomes greater relative to a continuous signal change status. This can effectively resolve a problem that a normal card detection function is not triggered because the card reader device continuously obtains a same variation value. Further, the method in this embodiment can enable a signal change sensed by the card reader device to meet a requirement, and the card reader device can start the normal card detection mode.

[0079] Similarly, in another implementation, in an idle state, the load adjustment circuit can

be in the first state in which the resonance point conforms to the preset resonance point. After the LPCD signal is detected, the first adjustable capacitor can be adjusted to enable the load adjustment circuit to be in the second state in which the resonance point deviates from the preset resonance point, to change the resonance frequency of the electronic component, or to change a load parameter, so as to facilitate entry of the normal card detection mode by the card reader device. For a specific principle, references can be made to the above-mentioned embodiment. Details are not described herein again.

[0080] In this embodiment of this specification, the resonance point of the electronic component can be adjusted by using a controllable switch to enable a fixed capacitor to function as an adjustable capacitor, to facilitate start of the normal card detection mode by the card reader device. Optionally, in this embodiment of this specification, the load adjustment circuit can include a second capacitor, a third capacitor, and a first controllable switch. The second capacitor can be connected in parallel to the antenna, the third capacitor can be connected in series to the first controllable switch and then connected in parallel to the antenna, and the first controllable switch can be connected to the communication chip, so that the communication chip can control a state of the first controllable switch.

[0081] Specifically, if a resonance frequency of the electronic component in the second state is less than a resonance frequency of the electronic component in the first state, the first controllable switch can be in an open state in the first state, and the first controllable switch can be in a closed state in the second state, so that a capacitance value of the electronic component in the first state can be less than a capacitance value of the electronic component in the second state. If a resonance frequency of the electronic component in the second state is greater than a resonance frequency of the electronic component in the first state, the first controllable switch is in a closed state in the first state, and the first controllable switch is in an open state in the second state, so that a capacitance value of the electronic component in the first state can be greater than a capacitance value of the electronic component in the second state.

[0082] FIG. 4 is a schematic diagram of an electronic component according to an embodiment of this specification. As shown in FIG. 4, the load adjustment circuit 106 can include a second capacitor C4, a third capacitor C3, and a first controllable switch K1. One end p of the second capacitor C4 can be connected to one end A of the antenna 102, and the other end q of the second capacitor C4 can be connected to the other end B of the antenna 102. One end n of the third

capacitor C3 can be connected to one end A of the antenna 102, the other end m of the third capacitor C3 can be connected to one end s1 of the first controllable switch K1, and the other end t1 of the first controllable switch K1 can be connected to the other end B of the antenna 102. A control terminal r1 of the first controllable switch K1 can be connected to a signal control terminal GPO of the communication chip 104, so that the communication chip 104 can control an on/off state of the first controllable switch K1 to adjust the resonance point of the load adjustment circuit.

[0083] In actual application, the first controllable switch K1 can be a switch whose on/off state can be controlled by using an analog signal or a digital signal, for example, can be a switch that can be controlled by using a signal such as a pulse signal, a voltage signal, or a current signal. Specifically, the first controllable switch can be an electronic unit including a thyristor, or can be an integrated electronic element, for example, a TS5A3166 single-pole single-throw analog switch. A specific type and model of the first controllable switch K1 are not limited herein, provided that a function of adjusting a capacitance value can be implemented.

[0084] The antenna 102 can also be connected to the communication chip 104. Specifically, one end A of the antenna 102 can be connected to one input terminal IN1 of the communication chip 104, and the other end B of the antenna 102 can be connected to the other input terminal IN2 of the communication chip 104, so that the communication chip 104 can detect a signal sensed by the antenna 102, and perform a corresponding procedure.

[0085] In this embodiment, an available capacitance value of the load adjustment circuit is adjusted by using the first controllable switch. For a specific working principle, references can be made to the above-mentioned embodiments. Details are not described herein again.

[0086] In actual application, a load impedance status of the electronic component can be represented as a quality factor Q value of the electronic component. The Q value indicates a ratio of energy storage to energy loss in the resonance circuit. Similar to the principles of the above-mentioned embodiments, in this embodiment of this specification, the Q value can be adjusted by adjusting a resistance value of the electronic component, to adjust the load impedance, so as to facilitate switching of the card reader device from the low power LPCD mode to the normal card detection mode.

[0087] Optionally, in this embodiment of this specification, that load impedance of the electronic component in the first state is different from load impedance of the electronic component in the second state can specifically include: a resistance value of the electronic

component in the first state is different from a resistance value of the electronic component in the second state.

[0088] Through adjustment of the resistance value of the electronic component, the load impedance can be changed, to effectively avoid a case in which the normal card detection mode cannot be woken up by the card reader device due to a reason such as anti-fatigue.

[0089] In an implementation, the load adjustment circuit includes a fourth capacitor, a first resistor, and a second controllable switch. The fourth capacitor is connected in parallel to the antenna, the first resistor is connected in series to the second controllable switch and then connected in parallel to the antenna, and the second controllable switch is connected to the communication chip. The second controllable switch is in a closed state in the first state, and the second controllable switch is in an open state in the second state. Alternatively, the second controllable switch is in an open state in the first state, and the second controllable switch is in a closed state in the second state.

[0090] FIG. 5 is a schematic diagram of an electronic component according to an embodiment of this specification. As shown in FIG. 5, the load adjustment circuit 106 includes a fourth capacitor C5, a first resistor R1, and a second controllable switch K2. One end w1 of the fourth capacitor C5 can be connected to one end A of the antenna 102, the other end w2 of the fourth capacitor C5 can be connected to the other end B of the antenna, and the fourth capacitor C5 is connected in parallel to the antenna 102. One end v of the first resistor R1 can be connected to one end s2 of the second controllable switch K2, the other end u of the first resistor R1 can be connected to one end A of the antenna 102, the other end t2 of the second controllable switch K2 can be connected to the other end B of the antenna, and the first resistor R1 is connected in series to the second controllable switch K2 and then connected in parallel to the antenna 102. A controllable terminal r2 of the second controllable switch K2 can be connected to a signal control terminal GPO of the communication chip 102, so that the communication chip 102 adjusts the resistance value of the electronic component by controlling a state of the second controllable switch, to adjust the load impedance of the electronic component.

[0091] The antenna 102 can also be connected to the communication chip 104. Specifically, one end A of the antenna 102 can be connected to one input terminal IN1 of the communication chip 104, and the other end B of the antenna 102 can be connected to the other input terminal IN2 of the communication chip 104, so that the communication chip 104 can detect a signal sensed by

the antenna 102, and perform a corresponding procedure.

[0092] In actual application, the state of the second controllable switch can be set based on an actual requirement. For example, the second controllable switch can be in a closed state in the first state, and the second controllable switch can be in an open state in the second state. Alternatively, the second controllable switch can be in an open state in the first state, and the second controllable switch can be in a closed state in the second state.

[0093] It is assumed that when the electronic component is in an idle state, the electronic component is in the first state. It is assumed that the second controllable switch is in the closed state in the first state. After the LPCD signal sent by the card reader device is detected, the second controllable switch can be switched to the open state, the resistance value of the electronic component is changed, the Q value is changed, and the load impedance is changed, to facilitate entry of the normal card detection mode by the card reader device from the LPCD mode. Subsequently, to ensure information transmission efficiency, the electronic component can be restored to the first state after the card reader device enters the normal card detection mode, for example, the second controllable switch is closed again. Similarly, if the second controllable switch is in the open state in the first state, after the LPCD signal sent by the card reader device is detected, the second controllable switch can be switched to the closed state, to facilitate entry of the normal card detection mode by the card reader device.

[0094] In actual application, when the electronic component is in the idle state, the Q value of the electronic component can be within a preset range. The preset range can indicate a Q value of the electronic component existing after the card reader device starts the normal card detection mode or in a process of obtaining tag information through polling. Alternatively, when the electronic component is in the idle state, the Q value of the electronic component can deviate from a preset range. For example, the Q value is larger or smaller. A specific parameter can be set based on an actual requirement. This is not limited herein.

[0095] In another implementation, the load adjustment circuit includes a first adjustable resistor and a fifth capacitor. The fifth capacitor is connected in parallel to the antenna, the first adjustable resistor is connected in series to the antenna, and an adjustable terminal of the first adjustable resistor is connected to the communication chip. A resistance value of the first adjustable resistor in the first state is a first resistance value, and a resistance value of the first adjustable resistor in the second state is a second resistance value.

[0096] FIG. 6 is a schematic diagram of an electronic component according to an embodiment of this specification. As shown in FIG. 6, the load adjustment circuit 106 can include a first adjustable resistor R2 and a fifth capacitor C6. One end y1 of the fifth capacitor C6 is connected to one end A of the antenna 102, the other end y2 of the fifth capacitor C6 is connected to the other end B of the antenna 102, and the fifth capacitor C6 is connected in parallel to the antenna 102. One end x2 of the first adjustable resistor R2 is connected to one end A of the antenna 102, the other end x1 can be connected to one input terminal IN1 of the communication chip 104, and an adjustable terminal of the first adjustable resistor R2 can be connected to a signal control terminal GPO of the communication chip 102. The other end B of the antenna 102 can be connected to the other input terminal IN2 of the communication chip 104, so that the communication chip 104 can detect a signal sensed by the antenna 102, and perform a corresponding procedure.

[0097] A resistance value of the first adjustable resistor R2 in the first state is a first resistance value, a resistance value of the first adjustable resistor in the second state is a second resistance value, and the first resistance value is different from the second resistance value.

[0098] In actual application, the first resistance value and the second resistance value can be set based on an actual requirement. Similar to the circuit principle shown in FIG. 5, use of the electronic component shown in FIG. 6 can also facilitate start of the normal card detection mode by the card reader device. Details are not described herein again.

[0099] It can be understood that circuit parts that perform main functions are mainly described in the above-mentioned embodiments. In actual application, a required electronic element can be added to the circuit shown in the above-mentioned embodiments based on an actual requirement, or a connection sequence of elements can be adjusted, etc. For example, for the circuits shown in FIG. 2 to FIG. 6, an electronic element such as a resistor or an inductor can be further connected in series, or an electronic element such as a capacitor can be further connected in parallel. In addition, FIG. 2 to FIG. 6 are merely used to more clearly describe a schematic diagram provided by the electronic component provided in this specification. In actual application, another form of circuit can be used to adjust the load impedance. A specific circuit form is not limited herein.

[0100] To improve stability of the electronic component, optionally, the communication chip in this embodiment of this specification can be a chip that has an energy harvesting function and an energy output function. A power output terminal of the communication chip can be connected to a power input terminal of the load adjustment circuit, to supply power for state transition of the

load adjustment circuit.

[0101] For example, the first adjustable capacitor, the first adjustable inductor, the first adjustable resistor, the first controllable switch, or the second controllable switch can be an element having a power input terminal, and the communication chip can supply, to the first adjustable capacitor, the first adjustable inductor, the first adjustable resistor, the first controllable switch, or the second controllable switch, power required for adjustment, which can be specifically short-term power, for example, supply instantaneous power to a circuit for starting an element. In an implementation, the power output terminal of the communication chip can be connected to a power input terminal of the first controllable switch and/or a power input terminal of the second controllable switch, to supply power to the first controllable switch and/or the second controllable switch.

[0102] In actual application, the communication chip that has the energy harvesting function and the energy output function, the antenna, and the load adjustment circuit can form a passive NFC tag or a main circuit part of a passive NFC tag.

[0103] In actual application, an external power supply can alternatively be used to supply power to the electronic component or the load adjustment circuit in the electronic component. Optionally, the electronic component can include a power input terminal, configured to be connected to a power supply external to the electronic component, so that the power supply supplies power to the electronic component.

[0104] In an implementation, the power input terminal of the electronic component can represent a power input terminal of the load adjustment circuit and/or a power input terminal of the communication chip, and the external power supply can provide working power to the load adjustment circuit and/or the communication chip.

[0105] The power supply external to the electronic component can be a power supply located outside the electronic component, for example, a battery or a power supply module. A specific power supply form is not limited herein, and a specific parameter of the power supply can be set based on an actual circuit requirement.

[0106] In another implementation, a power supply component can alternatively include a power supply element, for example, a battery. The power supply element can be connected to the load adjustment circuit and/or the communication chip, to provide a power supply to the electronic component. The power supply element can be fastened to or integrated into a same circuit board

with the communication chip, the load adjustment circuit, etc., or can be separately placed. This is not limited herein.

[0107] In actual application, the load adjustment circuit can be a circuit controlled by using a digital signal level. To facilitate control of the load adjustment circuit, in this embodiment of this specification, the communication chip can have a function of outputting a digital signal level. That the load adjustment circuit is connected to the communication chip can specifically include: a digital signal level output pin of the communication chip is connected to a digital signal input terminal communication chip of the load adjustment circuit.

[0108] The digital signal level output pin of the communication chip can represent a signal control terminal of the communication chip, and the pin can be connected to an adjustable terminal that is in the load adjustment circuit and that is used to control capacitance or inductance, for example, can be connected to at least one of the adjustable terminal of the first adjustable inductor, the adjustable terminal of the first adjustable capacitor, and the control terminal of the controllable switch.

[0109] In actual application, the electronic component can alternatively include a power supply component or be connected to the communication chip through an external power supply component, so that the communication chip can generate, based on power supplied by the power supply component or the external power supply component, a digital signal level for controlling the load adjustment circuit.

[0110] In actual application, an external digital signal circuit can alternatively be used to provide a signal for controlling the load adjustment circuit. Optionally, the electronic component in this embodiment of this specification can further include a digital signal conversion unit. That the load adjustment circuit is connected to the communication chip specifically includes: an input terminal of the digital signal conversion unit is connected to the antenna, and is configured to obtain a radio frequency signal obtained by the antenna; and an output terminal of the digital signal conversion unit is connected to the resonance circuit, and is configured to provide a digital signal level to the load adjustment circuit, so that the load adjustment circuit switches from the first state to the second state.

[0111] The digital signal conversion unit can be a unit that can process a sine wave signal to generate a digital signal level that can be controlled, for example, can be an envelope detector circuit or a half-wave rectifier circuit. A specific circuit design of the digital signal conversion unit

is not limited herein.

[0112] In actual application, the digital signal conversion unit can also be connected to the communication chip. When the communication chip determines that the radio frequency signal obtained by the antenna is an LPCD signal, the digital signal conversion unit can generate a digital signal level. Alternatively, the digital signal level generated by the digital signal conversion unit can be provided to the load adjustment circuit through the communication chip, and the communication chip can provide the digital signal level to the load adjustment circuit based on an actual requirement. For example, when the communication chip determines that the radio frequency signal obtained by the antenna is an LPCD signal, the communication chip can provide the digital signal level generated by the digital signal conversion unit to the load adjustment circuit, or after communication with the card reader device is completed or the normal card detection function of the card reader device is successfully woken up, the communication chip can terminate providing the digital signal level to the load adjustment circuit, so that the load adjustment circuit can be restored to a previous state.

[0113] It can be understood that the circuits or the electronic elements provided in the above-mentioned embodiments can be used independently or in combination. For example, the load adjustment circuits shown in FIG. 2 to FIG. 6 can be used alone or a plurality of circuits in the load adjustment circuits can be simultaneously used. This is not specifically limited herein. If a plurality of load adjustment circuits are used, electronic elements in different load adjustment circuits can be shared. For example, the first capacitor and the second capacitor can be a same capacitor. Certainly, electronic elements in different load adjustment circuits can alternatively be used independently. This is not limited herein.

[0114] In actual application, degrees to which the resonance point of the electronic component deviates from the preset resonance point or the Q value deviates from the preset range when the above-mentioned several load adjustment circuits are in the first state or the second state can be the same or different. For an electronic component, if two or more of the above-mentioned load adjustment circuits are disposed in the electronic component, and the LPCD signal sent by the card reader device is obtained, the plurality of load adjustment circuits can be simultaneously triggered to work, one of the plurality of load adjustment circuits can be selected, or a plurality of load adjustment circuits can be used in a decrement manner. To implement the first state or the second state, one of the above-mentioned load adjustment circuits can be used for implementation, or a

plurality of load adjustment circuits can be used for implementation. This can be set based on an actual requirement, and is not limited herein.

[0115] In actual application, the load adjustment circuit can alternatively be set as a circuit that can be adjusted by a plurality of gears. For example, the above-mentioned state indicating deviation from the preset resonance point can include a plurality of sub-states, and a difference between different sub-states can be a difference between degrees of deviation from the preset resonance point. Alternatively, it can be understood that the load adjustment circuit can include not only the first state and the second state, but also a third state or even a fourth state, etc. A degree of deviation from the preset resonance point in the second state is different from that in the third state and/or that in the fourth state. For example, the degree of deviation of the electronic component from the preset resonance point in the third state can be greater than that in the second state. In actual application, it is assumed that the load adjustment circuit needs to be switched from the first state to the second state to facilitate start of the normal card detection mode by the card reader device. If the card reader device does not start the normal card detection mode within preset duration after switching to the second state is performed, the load adjustment circuit can be switched to the third state, to further facilitate start of the normal card detection mode by the card reader device. A specific setting of the load adjustment circuit is not limited herein.

[0116] Based on a same idea, an embodiment of this specification further provides an NFC tag. The NFC tag includes the electronic component provided above.

[0117] The NFC tag can be broadly understood as another party that can perform near field communication NFC with a card reader device, or can be referred to as a passive party of NFC communication, and tag information can be sent to a card reader device by using energy provided by the card reader device. For a communication process or principle between the NFC tag and the card reader device, references can be made to related technical descriptions. Details are not described herein again.

[0118] A specific form of the NFC tag can be a card, a sticker, a sticky tag, etc., or can be a key chain, an ornament, etc., or can be a wristband, a band, a badge, a name tag, a flexible tag, etc. Alternatively, the NFC tag can be built into an object, for example, integrated into a toy, a piece of furniture, or a device, for example, an electronic device with an NFC tag. The NFC tag can be a passive tag or an active tag. A specific form of the NFC tag is not limited.

[0119] It should be understood that in the electronic component in one or more embodiments

of this specification, connection sequences of some parts can be exchanged with each other based on an actual requirement, or some parts can be omitted or deleted.

[0120] Based on a same idea, an embodiment of this specification further provides a control method based on the above-mentioned electronic component. FIG. 7 shows a control method for contactless communication according to an embodiment of this specification. The method can be applied to the above-mentioned electronic component. For specific content of the electronic component, references can be made to the above-mentioned embodiments. Details are not described herein again. As shown in FIG. 7, the control method can include the following steps.

[0121] Step 702: Obtain a detection signal sent by a card reader device.

[0122] In actual application, the card reader device can actively send the detection signal, to detect a nearby passive communication device. The card reader device can be a terminal device such as a mobile phone, a computer, a smartwatch, or a POS machine.

[0123] The electronic component provided in this embodiment of this specification can be an NFC tag used in a near field communication NFC scenario, or can be an electronic component used in another radio frequency communication scenario, for example, a passive device applied to a radio frequency identification RFID scenario, for example, ETC identification. A specific actual scenario can include various scenarios such as payment, transportation, access control, information promotion, and management.

[0124] An antenna in the electronic component can obtain the detection signal sent by the card reader device, and send the detection signal to a communication chip or a signal analysis part for signal analysis.

[0125] Step 704: Generate a first control signal if the detection signal is a low power card detection LPCD signal.

[0126] The communication chip in the electronic component can be a chip that has an LPCD detection function, and can be configured to detect whether the signal obtained by the antenna is a low power card detection LPCD signal. Alternatively, whether the detection signal is a low power card detection LPCD signal can be determined through time characteristic analysis or instruction parsing, or in another manner. For example, the LPCD signal is represented as a short and periodic radio frequency field pulse. For example, a very short activation signal, for example, a 25 μs pulse signal, is sent every 500 ms. A radio frequency field of a normal signal persists until data exchange is completed. The communication chip can determine field strength duration by using an internal

timer, to determine whether the detection signal is a low power card detection LPCD signal. For another example, a signal type can be determined by detecting a voltage or a demodulation threshold sensed by the antenna. A specific determining manner is not limited herein, or references can be made to some existing determining manners.

[0127] Step 706: Switch the electronic component from a first state to a second state based on the first control signal, so that the card reader device switches to a normal card detection mode.

[0128] Load impedance of the electronic component in the first state is different from load impedance of the electronic component in the second state.

[0129] The first control signal can be a signal used to control a state of a load adjustment circuit, and can be specifically an analog signal or a digital signal. If the card reader device sends the LPCD signal, the electronic component can trigger, after obtaining the LPCD signal, adjustment of the load impedance of the electronic component, to facilitate switching of the card reader device to the normal card detection mode.

[0130] The load impedance of the electronic component in the first state can be greater than the load impedance of the electronic component in the second state, or the load impedance of the electronic component in the first state can be less than the load impedance of the electronic component in the second state.

[0131] The low power card detection LPCD signal can indicate a signal sent by the card reader device in a low power card detection LPCD mode, and can be specifically one or more pulse signals. In actual application, after determining that the card reader device is in the LPCD mode, the electronic component can immediately perform state switching, or can perform state switching after a short period of time.

[0132] An occasion of state switching can alternatively be set based on an actual requirement. For example, state switching can be performed at a start moment at which the card reader sends an LPCD pulse signal, so that the electronic component in the second state can affect an entire process or a front part of the LPCD pulse signal. It is assumed that the electronic component determines, based on an n^{th} LPCD pulse signal sent by the card reader device, that the card reader device is in the LPCD mode. The electronic component can be switched from the first state to the second state when the card reader sends an $(n+1)^{th}$ LPCD pulse signal. The electronic component in the second state can affect the $(n+1)^{th}$ LPCD pulse signal sent by the card reader, or can affect one or more pulse signals after the $(n+1)^{th}$ signal. Alternatively, after the $(n+1)^{th}$ LPCD pulse signal

ends, the electronic component can be restored to the first state.

[0133] For another example, the electronic component can alternatively perform state switching at a moment in the middle of an LPCD pulse signal sent by the card reader, so that the electronic component in the second state can affect a second half of the LPCD pulse signal or a subsequent signal. For example, it is assumed that an LPCD pulse signal is a 25 μs pulse signal. After the card reader device sends the signal, the electronic component can be in the first state in first 8 μs, and the electronic component can be in the second state in last 17 μs. Alternatively, the electronic component can be in the first state in first 8 μs, the electronic component can be in the second state in intermediate 10 μs, and the electronic component can be restored to the first state in last 7 μs.

[0134] In actual application, a state of the electronic component can be set based on an actual requirement. In a process of waking up the normal card detection mode of the card reader device one time, the electronic component can perform state transition one time, or can perform state transition a plurality of times. For example, after obtaining the LPCD signal, the electronic component can be switched from the first state to the second state, and then can maintain the second state until communication ends or the card reader device wakes up the normal card detection mode. For another example, after obtaining the LPCD signal, the electronic component can be switched from the first state to the second state. The second state can be maintained for a length of one or more LPCD pulse signals or maintained for a length less than one LPCD pulse signal, and then switching to the first state is performed. The first state can also be maintained for a length of one or more LPCD pulse signals or maintained for a length less than one LPCD pulse signal. In this way, state switching is repeatedly performed until communication ends or the card reader device wakes up the normal card detection mode.

[0135] It can be understood that the signal sent by the card reader device in the LPCD mode is a signal that conforms to a specific rule. For example, a sending period and a signal length can be fixed. After obtaining the LPCD signal sent by the card reader device, the electronic component can determine a parameter of the LPCD signal sent by the card reader device, and generate a corresponding control signal used to control state switching, to control or adjust the occasion of state switching.

[0136] In actual application, before obtaining the low power card detection LPCD signal, the electronic component can be in the first state. After obtaining the low power card detection LPCD

signal, the electronic component can be switched from the first state to the second state. In this embodiment of this specification, the load impedance of the electronic component can be adjusted to facilitate switching of the card reader device from the low power card detection LPCD mode to the normal card detection mode, and the card reader device can be affected from a perspective of adjusting load of the card reader device, without an excessively complex design. This is low in costs and easy to implement.

[0137] It should be understood that in the method in one or more embodiments of this specification, sequences of some steps can be exchanged with each other based on an actual requirement, or some steps can be omitted or deleted.

[0138] In actual application, the load impedance of the electronic component can be reflected in parameters such as a resonance frequency and circuit resistance.

[0139] In an implementation, to facilitate switching of the card reader device to the normal card detection mode, the electronic component can be switched from a state in which a resonance point conforms to a working resonance point of the card reader device to a state in which the resonance point deviates from the working resonance point, or the electronic component can be switched from a state in which a resonance point deviates from a working resonance point of the card reader device to a state in which the resonance point conforms to the working resonance point. Deviation from the resonance point can be represented as that a resonance frequency is greater than or less than a resonance frequency of the card reader device. Optionally, that load impedance of the electronic component in the first state is different from load impedance of the electronic component in the second state can specifically include: a resonance point of the electronic component in the first state conforms to a preset resonance point, and a resonance point of the electronic component in the second state deviates from the preset resonance point, where the preset resonance point is the working resonance point of the card reader device; or a resonance point of the electronic component in the first state deviates from the preset resonance point, and a resonance point of the electronic component in the second state conforms to the preset resonance point.

[0140] In this embodiment of this specification, the resonance point of the electronic component can be adjusted by adjusting an inductance value and/or a capacitance value of the electronic component, so that the resonance point can affect the card reader device.

[0141] In an implementation, in this embodiment of this specification, an inductance value of the load adjustment circuit in the electronic component in the first state is a first inductance value,

and an inductance value of the load adjustment circuit in the electronic component in the second state is a second inductance value. If a resonance frequency of the electronic component in the second state is less than a resonance frequency of the electronic component in the first state, the first inductance value is less than the second inductance value. Alternatively, if a resonance frequency of the electronic component in the second state is greater than a resonance frequency of the electronic component in the first state, the first inductance value is greater than the second inductance value.

[0142] In this embodiment of this specification, the resonance frequency of the electronic component in the second state can be greater than the resonance frequency of the card reader device, or can be less than the resonance frequency of the card reader device.

[0143] If before the electronic component obtains the LPCD signal sent by the card reader device, the electronic component is in the first state in which the resonance point conforms to the resonance point of the card reader device, after the LPCD signal sent by the card reader device is obtained, the electronic component can be adjusted to the second state, and the resonance point deviates from the resonance point of the card reader device. Specifically, the inductance value of the load adjustment circuit in the electronic component can be increased, so that the resonance frequency of the electronic component is less than the resonance frequency of the card reader device. Alternatively, the inductance value of the load adjustment circuit in the electronic component can be decreased, so that the resonance frequency of the electronic component is greater than the resonance frequency of the card reader device.

[0144] If before the electronic component obtains the LPCD signal sent by the card reader device, the electronic component is in the first state in which the resonance point deviates from the resonance point of the card reader device, after the LPCD signal sent by the card reader device is obtained, the electronic component can be adjusted to the second state, and the resonance point is retuned to the resonance point of the card reader device. Specifically, if the resonance frequency of the electronic component in the first state is greater than the resonance frequency of the card reader device, after the LPCD signal sent by the card reader device is obtained, the inductance value of the load adjustment circuit in the electronic component can be increased to decrease the resonance frequency, and the resonance point of the electronic component is retuned to the resonance point of the card reader device. If the resonance frequency of the electronic component in the first state is less than the resonance frequency of the card reader device, after the LPCD

signal sent by the card reader device is obtained, the inductance value of the load adjustment circuit in the electronic component can be decreased to increase the resonance frequency, and the resonance point of the electronic component is retuned to the resonance point of the card reader device.

[0145] As described in at least one of the above-mentioned embodiments, the load adjustment circuit in the electronic component can include a first adjustable inductor that can adjust an inductance value. The inductance value can be adjusted to adjust the resonance point of the electronic component. For a specific circuit structure and an adjustment manner, references can be made to at least one of the above-mentioned embodiments, or another circuit that can adjust a resonance point of a circuit by adjusting an inductance value. Details are not described herein again.

[0146] In another implementation, the resonance point of the electronic component can be adjusted by adjusting the capacitance value. Optionally, in this embodiment of this specification, a capacitance value of the load adjustment circuit in the electronic component in the first state is a first capacitance value, and a capacitance value of the load adjustment circuit in the electronic component in the second state is a second capacitance value. If a resonance frequency of the electronic component in the second state is less than a resonance frequency of the electronic component in the first state, the first capacitance value is less than the second capacitance value. Alternatively, if a resonance frequency of the electronic component in the second state is greater than a resonance frequency of the electronic component in the first state, the first capacitance value is greater than the second capacitance value.

[0147] In this embodiment of this specification, if the LPCD signal sent by the card reader device is detected, the electronic component can be switched from the first state to the second state, or can be switched from the first state to the second state. Specifically, if the electronic component is in the first state before the electronic component obtains the LPCD signal sent by the card reader device, the resonance point conforms to the resonance point of the card reader device. After the LPCD signal sent by the card reader device is obtained, the electronic component can be adjusted to the second state, and the resonance point deviates from the resonance point of the card reader device. Specifically, the capacitance value of the load adjustment circuit in the electronic component can be increased, so that the resonance frequency of the electronic component is less than the resonance frequency of the card reader device. Alternatively, the capacitance value of the

load adjustment circuit in the electronic component can be decreased, so that the resonance frequency of the electronic component is greater than the resonance frequency of the card reader device.

[0148] If the electronic component is in the second state before the electronic component obtains the LPCD signal sent by the card reader device, the resonance point deviates from the resonance point of the card reader device. After the LPCD signal sent by the card reader device is obtained, the electronic component can be adjusted to the first state, and the resonance point is retuned to the resonance point of the card reader device. Specifically, if the resonance frequency of the electronic component in the second state is greater than the resonance frequency of the card reader device, after the LPCD signal sent by the card reader device is obtained, the capacitance value of the load adjustment circuit in the electronic component can be increased to decrease the resonance frequency, and the resonance point of the electronic component is retuned to the resonance point of the card reader device. If the resonance frequency of the electronic component in the second state is less than the resonance frequency of the card reader device, after the LPCD signal sent by the card reader device is obtained, the capacitance value of the load adjustment circuit in the electronic component can be decreased to increase the resonance frequency, and the resonance point of the electronic component is retuned to the resonance point of the card reader device.

[0149] As described in at least one of the above-mentioned embodiments, the resonance point of the electronic component can be adjusted by adjusting the capacitance value of the load adjustment circuit. For example, a quantity of capacitors connected in parallel in the circuit can be controlled by using an adjustable capacitor or by using a first controllable switch. A specific manner of adjusting the capacitance value of the circuit is not limited herein.

[0150] In an implementation, a resistance value of the electronic component in the first state is a first resistance value, a resistance value of the electronic component in the second state is a second resistance value, and the first resistance value is not equal to the second resistance value.

[0151] In this embodiment of this specification, the load impedance can be adjusted by adjusting the resistance value of the electronic component, to facilitate entry of the normal card detection mode by the card reader device. For a specific working principle and implementation, references can be made to at least one of the above-mentioned embodiments. Details are not described again.

[0152] In this embodiment of this specification, if the LPCD signal sent by the card reader device is detected, the electronic component can be switched from the first state to the second state, for example, the resonance point is switched from 13.56 MHz to 11.5 MHz, that is, the resonance point is detuned to facilitate wakeup of the normal card detection mode by the card reader device. Alternatively, a Q value is switched from a preset range to deviate from the preset range, that is, the Q value is changed to facilitate wakeup of the normal card detection mode by the card reader device. The more the resonance point of the electronic component conforms to the resonance point of the card reader device or the more the Q value conforms to the preset range, the more advantageous it is for the electronic component to send tag information to the card reader device. To ensure communication quality, optionally, the method in this embodiment of this specification can further include: after the electronic component is switched from the first state to the second state, if it is detected that the card reader device is in the normal card detection mode, restoring the electronic component from the second state to the first state.

[0153] In actual application, the electronic component can determine, by using signal parameters such as an amplitude, a time interval, and signal content that are of a signal sent by the card reader device and that are detected by the antenna, whether the card reader device sends a normal card detection signal. If the card reader device sends a normal card detection signal, it can be determined that the card reader device has switched to the normal card detection mode. Subsequently, an information transmission process can be performed after card detection succeeds. In an implementation, if the electronic component is in the first state before detecting the LPCD signal sent by the card reader device, and is switched to the second state after detecting the LPCD signal, after it is subsequently detected that the card reader device sends the normal card detection signal, the communication chip can send a second control signal to the load adjustment circuit, so that the load adjustment circuit switches to the first state again, to help information transmission between the electronic component and the card reader device through contactless communication, or to prepare for next facilitation of switching of the card reader device from the LPCD mode to the normal card detection mode.

[0154] In this embodiment of this specification, the first state can indicate a state in which there is deviation from the preset resonance point or the Q value deviates from the preset range. After obtaining the LPCD signal sent by the card reader device, the electronic component can be switched from the first state to the second state, that is, the resonance point or the Q value is retuned

to facilitate wakeup of the normal card detection mode by the card reader device. To ensure that wakeup of the normal card detection mode by the card reader device can continue to be subsequently facilitated, the electronic component can be further switched to the first state again. Optionally, the method in this embodiment of this specification can further include: after the electronic component is switched from the first state to the second state, if communication between the electronic component and the card reader device ends, restoring the electronic component from the second state to the first state.

[0155] In an implementation, if before detecting the LPCD signal sent by the card reader device, the electronic component is in the first state in which there is deviation from the preset resonance point or the Q value deviates from the preset range, and after detecting the LPCD signal, is switched to the second state in which the resonance point conforms to the preset resonance point or the Q value conforms to the preset range, contactless communication can be continuously performed with the card reader device in the second state. For example, the electronic component can send stored tag information to the card reader device by using a circuit in the second state. After communication between the electronic component and the card reader device ends, for example, the electronic component completes sending of the tag information, or the electronic component is away from the card reader device and can no longer perform near field communication, the communication chip can send a third control signal to the load adjustment circuit, so that the load adjustment circuit switches to the first state again, to prepare for next facilitation of switching of the card reader device from the LPCD mode to the normal card detection mode.

[0156] In this embodiment of this specification, an analog signal or a digital signal can be used to control state transformation of the electronic component. Optionally, the first control signal can be a digital pulse signal.

[0157] As described in at least one of the above-mentioned embodiments, the communication chip can be a chip that can generate a digital pulse signal, or can generate a digital pulse signal through an external digital signal conversion circuit.

[0158] In an implementation, a length of the digital pulse signal can be equal to a length of the LPCD signal sent by the card reader device.

[0159] In actual application, the card reader device can send a plurality of short pulse signals in the LPCD mode. The length of the LPCD signal can represent a length of a single pulse signal,

and can be in an order of tens of microseconds, for example, 35 μs or 25 μs.

[0160] For example, after obtaining the LPCD signal sent by the card reader device, the electronic component can generate a digital pulse signal with a length equal to the length of the LPCD signal. In this way, a time period of an entire single pulse of the LPCD signal sent by the card reader device can be affected, to facilitate switching of the card reader device to the normal card detection mode.

[0161] In another implementation, a length of the digital pulse signal can alternatively be less than a length of the LPCD signal sent by the card reader device.

[0162] For example, the length of the digital pulse signal can be equal to one third, one half, two thirds, etc. of the length of the LPCD signal sent by the card reader device. In actual application, different card reader devices may have different signal analysis capabilities or signal sensitivity due to different hardware or software configurations. Alternatively, due to different parameters or quantities of electronic elements such as a capacitor, a resistor, and an inductor included in the electronic component, signal variations generated by electronic components with different configurations for the card reader device may be different. In actual application, for some card reader devices that have a relatively strong computing capability or electronic components that have relatively large impact on a signal change, the electronic component adjusts a state of the electronic component by using a digital pulse signal whose length is less than the length of the LPCD signal, to facilitate switching of the card reader device to the normal card detection mode. For example, if the length of the LPCD signal is 25 μs, a pulse signal with a length of 10 μs can be generated. For a single LPCD pulse signal sent by the card reader device, the electronic component can be in the second state in first 10μs of the signal, and the electronic component can be in the first state in last 15 μs, to facilitate switching of the card reader device to the normal card detection mode.

[0163] In this embodiment of this specification, duration in which the electronic component is in the first state or the second state can be controlled by using the length of the digital pulse signal. For example, if the electronic component is in the first state before detecting the LPCD signal sent by the card reader device, the digital pulse signal can be generated after the LPCD signal is obtained, and switching from the first state to the second state is performed. When the digital pulse signal disappears or ends, the electronic component can be restored from the second state to the first state.

[0164] It can be understood that in the above-mentioned embodiments, the solutions are described from a plurality of perspectives. In actual application, the content described in one or more embodiments can be used based on an actual requirement, and the plurality of embodiments can be combined or adjusted based on an actual requirement for implementation. Details are not described herein again.

[0165] The parts in the embodiments of this specification are merely described in terms of functions, and a specific parameter or quantity can be set based on an actual requirement. For example, the first adjustable inductor can be a single adjustable inductor, or can be a combined inductor including a plurality of single adjustable inductor. The first adjustable capacitor can be a single capacitor, or can be a combined capacitor including one or more single capacitors. The first capacitor, the second capacitor, the third capacitor, the fourth capacitor, the fifth capacitor, etc. can be capacitors with fixed capacitance values, can be single capacitors, or can be combined capacitors including a plurality of single capacitors. A specific composition form and a quantity of electronic elements are not limited herein, provided that a function of adjusting a resonance point is implemented.

[0166] The embodiments of this specification are described in a progressive manner. For same or similar parts of the embodiments, mutual references can be made to the embodiments. Each embodiment focuses on a difference from other embodiments.

[0167] It should be noted that the user information (including but not limited to user equipment information, user personal information, etc.) and the data (including but not limited to data used for analysis, stored data, displayed data, etc.) used in this application are information and data that are authorized by users or that are fully authorized by all parties, and the related data need to be collected, used, and processed in compliance with relevant laws, regulations, and standards of relevant regions, and corresponding operation entries are provided for users to choose to authorize or reject.

[0168] In the 1990s, whether a technical improvement is a hardware improvement (for example, an improvement to a circuit structure, such as a diode, a transistor, or a switch) or a software improvement (an improvement to a method procedure) can be clearly distinguished. However, as technologies develop, current improvements to many method procedures can be considered as direct improvements to hardware circuit structures. Almost all designers program an improved method procedure to a hardware circuit, to obtain a corresponding hardware circuit

structure. Therefore, a method procedure can be improved by using a hardware entity module. For example, a programmable logic device (PLD) (for example, a field programmable gate array (FPGA)) is such an integrated circuit, and a logical function of the PLD is determined by a user through device programming. The designer performs programming to "integrate" a digital system into a PLD without requesting a chip manufacturer to design and produce an application-specific integrated circuit chip. In addition, currently, instead of manually manufacturing an integrated circuit chip, such programming is mostly implemented by using "logic compiler" software. The "logic compiler" software is similar to a software compiler used to develop and write a program. Original code needs to be written in a particular programming language before being compiled. The language is referred to as a hardware description language (HDL). There are many HDLs such as the Advanced Boolean Expression Language (ABEL), the Altera Hardware Description Language (AHDL), Confluence, the Cornell University Programming Language (CUPL), HDCal, the Java Hardware Description Language (JHDL), Lava, Lola, MyHDL, PALASM, and the Ruby Hardware Description Language (RHDL). Currently, the Very-High-Speed Integrated Circuit Hardware Description Language (VHDL) and Verilog are most commonly used. It should also be clear to a person skilled in the art that a hardware circuit for implementing a logical method procedure can be easily obtained by performing slight logic programming on the method procedure by using the above-mentioned several hardware description languages and programming the method procedure into an integrated circuit.

[0169] A controller can be implemented by using any appropriate method. For example, the controller can be in a form of a microprocessor or a processor, a computer-readable medium that stores computer-readable program code (such as software or firmware) that can be executed by the microprocessor or the processor, a logic gate, a switch, an application-specific integrated circuit (ASIC), a programmable logic controller, or an embedded microcontroller. Examples of the controller include but are not limited to the following microcontrollers: ARC 625D, Atmel AT91SAM, Microchip PIC18F26K20, and Silicon Labs C8051F320. A storage controller can also be implemented as a part of control logic of a storage. A person skilled in the art also knows that in addition to implementing the controller by using only the computer-readable program code, logic programming can be performed on method steps to enable the controller to implement the same function in a form of a logic gate, a switch, an application-specific integrated circuit, a programmable logic controller, an embedded microcontroller, etc. Therefore, the controller can be

considered as a hardware component, and an apparatus that is configured to implement various functions and that is included in the controller can also be considered as a structure in the hardware component. Alternatively, the apparatus configured to implement various functions can even be considered as both a software module implementing a method and a structure in the hardware component.

[0170] The system, apparatus, module, or unit described in the above-mentioned embodiments can be specifically implemented by a computer chip or an entity, or can be implemented by a product having a certain function. A typical implementation device is a computer. Specifically, the computer can be, for example, a personal computer, a laptop computer, a cellular phone, a camera phone, a smartphone, a personal digital assistant, a media player, a navigation device, an email device, a game console, a tablet computer, a wearable device, or a combination of any of these devices.

[0171] For ease of description, the above-mentioned apparatus is separately described by dividing the apparatus into various units based on functions. Certainly, when this application is implemented, the functions of the units can be implemented in one or more pieces of software and/or hardware.

[0172] A person skilled in the art should understand that the embodiments of the present invention can be provided as methods, systems, or computer program products. Therefore, the present invention can use a form of hardware only embodiments, software only embodiments, or embodiments with a combination of software and hardware. In addition, the present invention can use a form of a computer program product implemented on one or more computer-usable storage media (including but not limited to a magnetic disk memory, a CD-ROM, an optical memory, etc.) including computer-usable program code.

[0173] The present invention is described with reference to the flowcharts and/or block diagrams of the method, the device (system), and the computer program product according to the embodiments of the present invention. It should be understood that computer program instructions can be used to implement each procedure and/or each block in the flowcharts and/or the block diagrams and a combination of a procedure and/or a block in the flowcharts and/or the block diagrams. These computer program instructions can be provided to a general-purpose computer, a special-purpose computer, an embedded processor, or a processor of another programmable data processing device to generate a machine, so that the instructions executed by the computer or the

processor of the another programmable data processing device generate an apparatus for implementing a specific function in one or more procedures in the flowcharts and/or in one or more blocks in the block diagrams.

[0174] Alternatively, these computer program instructions can be stored in a computer-readable storage that can instruct a computer or another programmable data processing device to work in a specific manner, so that the instructions stored in the computer-readable storage generate an artifact that includes an instruction apparatus. The instruction apparatus implements a specific function in one or more procedures in the flowcharts and/or in one or more blocks in the block diagrams.

[0175] Alternatively, these computer program instructions can be loaded onto a computer or another programmable data processing device, so that a series of operations and steps are performed on the computer or the another programmable device, thereby generating computer-implemented processing. Therefore, the instructions executed on the computer or the another programmable device provide steps for implementing a specific function in one or more procedures in the flowcharts and/or in one or more blocks in the block diagrams.

[0176] In a typical configuration, a computing device includes one or more processors (CPUs), one or more input/output interfaces, one or more network interfaces, and one or more memories.

[0177] The memory can include a non-persistent memory, a random access memory (RAM), a nonvolatile memory, and/or another form in a computer-readable medium, for example, a read-only memory (ROM) or a flash memory (flash RAM). The memory is an example of the computer-readable medium.

[0178] The computer-readable medium includes persistent, non-persistent, removable and non-removable media that can store information by using any method or technology. The information can be a computer-readable instruction, a data structure, a program module, or other data. Examples of the computer storage medium include but are not limited to a phase change random access memory (PRAM), a static random access memory (SRAM), a dynamic random access memory (DRAM), a random access memory (RAM) of another type, a read-only memory (ROM), an electrically erasable programmable read-only memory (EEPROM), a flash memory or another memory technology, a compact disc read-only memory (CD-ROM), a digital versatile disc (DVD), or another optical storage, a cassette, a cassette magnetic disk storage, or another magnetic storage device or any other non-transmission medium. The computer storage medium can be

configured to store information that can be accessed by the computing device. Based on the definition in this specification, the computer-readable medium does not include transitory media such as a modulated data signal and carrier.

[0179] It should be further noted that the terms "include", "comprise", or any other variants thereof are intended to cover a non-exclusive inclusion, so that a process, a method, a product, or a device that includes a list of elements not only includes those elements but also includes other elements which are not expressly listed, or further includes elements inherent to such a process, method, product, or device. Without more constraints, an element preceded by "includes a …" does not preclude the presence of additional identical elements in the process, method, product, or device that includes the element.

[0180] A person skilled in the art should understand that the embodiments of this application can be provided as methods, systems, or computer program products. Therefore, this application can use a form of hardware only embodiments, software only embodiments, or embodiments with a combination of software and hardware. In addition, this application can use a form of a computer program product implemented on one or more computer-usable storage media (including but not limited to a magnetic disk memory, a CD-ROM, an optical memory, etc.) including computer-usable program code.

[0181] This application can be described in the general context of computer-executable instructions, for example, a program module. Usually, the program module includes a routine, a program, an object, a component, a data structure, etc. for executing a specific task or implementing a specific abstract data type. This application can alternatively be practiced in distributed computing environments. In the distributed computing environments, tasks are executed by remote processing devices connected through a communication network. In the distributed computing environments, the program module can be located in both local and remote computer storage media including storage devices.

[0182] The above-mentioned descriptions are merely embodiments of this application, and are not intended to limit this application. A person skilled in the art can make various modifications and changes to this application. Any modification, equivalent replacement, improvement, etc. made without departing from the spirit and principle of this application shall fall within the scope of the claims of this application.

CLAIMS

What is claimed is:

1. An electronic component for contactless communication, wherein the electronic component comprises an antenna, a communication chip, and a load adjustment circuit, the antenna is connected to the load adjustment circuit, and the load adjustment circuit is connected to the communication chip;

the load adjustment circuit comprises a first state and a second state, and load impedance of the electronic component in the first state is different from load impedance of the electronic component in the second state; and

if the electronic component obtains a low power card detection LPCD signal sent by a card reader device, the communication chip is configured to control the load adjustment circuit to switch from the first state to the second state, so that the card reader device switches to a normal card detection mode.

2. The method according to claim 1, wherein that load impedance of the electronic component in the first state is different from load impedance of the electronic component in the second state specifically comprises: a resonance point of the electronic component in the first state conforms to a preset resonance point, and a resonance point of the electronic component in the second state deviates from the preset resonance point, wherein the preset resonance point is a working resonance point of the card reader device; or

a resonance point of the electronic component in the first state deviates from the preset resonance point, and a resonance point of the electronic component in the second state conforms to the preset resonance point.

3. The electronic component according to claim 2, wherein the load adjustment circuit comprises a first capacitor and a first adjustable inductor, the first capacitor is connected in parallel to the antenna, the first adjustable inductor is connected in series to the antenna, and an adjustable terminal of the first adjustable inductor is connected to the communication chip;

an inductance value of the first adjustable inductor in the first state is a first inductance value, and an inductance value of the first adjustable inductor in the second state is a second inductance value; and

if a resonance frequency of the electronic component in the second state is less than a

resonance frequency of the electronic component in the first state, the first inductance value is less than the second inductance value; or if a resonance frequency of the electronic component in the second state is greater than a resonance frequency of the electronic component in the first state, the first inductance value is greater than the second inductance value.

4. The electronic component according to claim 2, wherein the load adjustment circuit comprises a first adjustable capacitor, the first adjustable capacitor is connected in parallel to the antenna, and an adjustable terminal of the first adjustable capacitor is connected to the communication chip; and the first adjustable capacitor has a first capacitance value in the first state, and the first adjustable capacitor has a second capacitance value in the second state; and

if a resonance frequency of the electronic component in the second state is less than a resonance frequency of the electronic component in the first state, the first capacitance value is less than the second capacitance value; or if a resonance frequency of the electronic component in the second state is greater than a resonance frequency of the electronic component in the first state, the first capacitance value is greater than the second capacitance value.

5. The electronic component according to claim 2, wherein the load adjustment circuit comprises a second capacitor, a third capacitor, and a first controllable switch, the second capacitor is connected in parallel to the antenna, the third capacitor is connected in series to the first controllable switch and then connected in parallel to the antenna, and the first controllable switch is connected to the communication chip; and

if a resonance frequency of the electronic component in the second state is less than a resonance frequency of the electronic component in the first state, the first controllable switch is in an open state in the first state, and the first controllable switch is in a closed state in the second state; or if a resonance frequency of the electronic component in the second state is greater than a resonance frequency of the electronic component in the first state, the first controllable switch is in a closed state in the first state, and the first controllable switch is in an open state in the second state.

6. The electronic component according to claim 1, wherein that load impedance of the electronic component in the first state is different from load impedance of the electronic component in the second state specifically comprises: a resistance value of the electronic component in the first state is different from a resistance value of the electronic component in the second state.

7. The electronic component according to claim 6, wherein the load adjustment circuit comprises a fourth capacitor, a first resistor, and a second controllable switch, the fourth capacitor is connected in parallel to the antenna, the first resistor is connected in series to the second controllable switch and then connected in parallel to the antenna, and the second controllable switch is connected to the communication chip; and

the second controllable switch is in a closed state in the first state, and the second controllable switch is in an open state in the second state; or the second controllable switch is in an open state in the first state, and the second controllable switch is in a closed state in the second state.

8. The electronic component according to claim 7, wherein the load adjustment circuit comprises a first adjustable resistor and a fifth capacitor, the fifth capacitor is connected in parallel to the antenna, the first adjustable resistor is connected in series to the antenna, and an adjustable terminal of the first adjustable resistor is connected to the communication chip; and

a resistance value of the first adjustable resistor in the first state is a first resistance value, and a resistance value of the first adjustable resistor in the second state is a second resistance value.

9. The electronic component according to claim 1, wherein the communication chip has an energy harvesting function and an energy output function, and a power output terminal of the communication chip is connected to a power input terminal of the load adjustment circuit.

10. The electronic component according to claim 1, wherein the communication chip has a function of outputting a digital signal level; and

that the load adjustment circuit is connected to the communication chip specifically comprises: a digital signal level output pin of the communication chip is connected to a digital signal input terminal communication chip of the load adjustment circuit.

11. The electronic component according to claim 1, wherein the electronic component further comprises a power input terminal, configured to be connected to a power supply external to the electronic component, so that the power supply supplies power to the electronic component; or

the electronic component further comprises a power supply element, and the power supply element is connected to the communication chip, so that the communication chip generates, based on power supplied by the power supply element, a digital signal level for controlling the load adjustment circuit.

12. The electronic component according to claim 1, wherein the electronic component further comprises a digital signal conversion unit; and

that the load adjustment circuit is connected to the communication chip specifically comprises: an input terminal of the digital signal conversion unit is connected to the antenna, and is configured to obtain a radio frequency signal obtained by the antenna; and

an output terminal of the digital signal conversion unit is connected to the resonance circuit, and is configured to provide a digital signal level to the load adjustment circuit, so that the load adjustment circuit switches from the first state to the second state.

13. An NFC tag, wherein the NFC tag comprises the electronic component according to any one of claims 1 to 13.

14. A control method for contactless communication, applied to the electronic component according to claim 1, and comprising:

obtaining a detection signal sent by a card reader device;

generating a first control signal if the detection signal is a low power card detection LPCD signal; and

switching the electronic component from a first state to a second state based on the first control signal, so that the card reader device switches to a normal card detection mode, wherein load impedance of the electronic component in the first state is different from load impedance of the electronic component in the second state.

15. The method according to claim 14, wherein an inductance value of a load adjustment circuit in the electronic component in the first state is a first inductance value, and an inductance value of the load adjustment circuit in the electronic component in the second state is a second inductance value; and if a resonance frequency of the electronic component in the second state is less than a resonance frequency of the electronic component in the first state, the first inductance value is less than the second inductance value; or if a resonance frequency of the electronic component in the second state is greater than a resonance frequency of the electronic component in the first state, the first inductance value is greater than the second inductance value.

16. The method according to claim 14, wherein a capacitance value of a load adjustment circuit in the electronic component in the first state is a first capacitance value, and a capacitance value of the load adjustment circuit in the electronic component in the second state is a second capacitance value; and if a resonance frequency of the electronic component in the second state is less than a resonance frequency of the electronic component in the first state, the first capacitance value is less than the second capacitance value; or if a resonance frequency of the electronic

component in the second state is greater than a resonance frequency of the electronic component in the first state, the first capacitance value is greater than the second capacitance value.

17. The method according to claim 14, wherein a resistance value of the electronic component in the first state is a first resistance value, a resistance value of the electronic component in the second state is a second resistance value, and the first resistance value is not equal to the second resistance value.

18. The method according to claim 14, after switching the electronic component from the first state to the second state, further comprising:

if it is detected that the card reader device is in the normal card detection mode, restoring the electronic component from the second state to the first state; or

if communication between the electronic component and the card reader device ends, restoring the electronic component from the second state to the first state.

19. The method according to claim 14, wherein the first control signal is a digital pulse signal.

20. The method according to claim 19, wherein a length of the digital pulse signal is less than or equal to a length of the LPCD signal sent by the card reader device.