

## **A CONTROL MODULE FOR CONTROLLING ENERGIZATION OF A RELAY MODULE**

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### **TECHNICAL FIELD**

The present disclosure relates broadly to a control module for controlling energization of a relay module, a system for controlling a relay module and a method for controlling energization of a relay module.

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### **BACKGROUND**

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Relay modules are typically used to control external loads such as machinery. Typically, such relay modules are connected to a socket and the relay modules are controlled via the socket by energization of relay coils in the relay modules. The energization of the relay coils is typically instructed by programmable logic controllers (PLCs) that are in turn connected to the socket. The programmable logic controllers are placed in a centralized location in a centralized electrical cabinet. High costs are typically incurred for provision of such a centralized location. In addition, long and multiple wirings are also typically needed between the socket and the centralized location.

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Furthermore, programmable logic controllers are sensitive to power surges. Therefore, an additional protection module (which is typically an electronic module) for the socket is typically required to provide protection or buffer against electric or power surges in an electric system. A protection module typically needs to be attached to each socket to protect the components connected to the socket. Therefore, in a system having multiple relay modules, multiple protection modules are typically needed.

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Therefore, there exists a need to provide a control module for controlling energization of a relay module that seeks to address one or more of the problems above.

## SUMMARY

In accordance with an aspect, there is provided a control module for controlling energization of a relay module, the control module for coupling to a socket which comprises a socket terminal for energising the relay module, the socket terminal being capable of electrical connection with a power terminal of the socket, the control module comprising: a non-conductive lead for disposing between the socket terminal and the power terminal of the socket; a first conductive element disposed at a base of the control module; a second conductive element disposed at the base of the control module, the second conductive element being spaced apart from the first conductive element; an actuator switch disposed within the control module, the actuator switch being coupled to the first conductive element and the second conductive element, the first conductive element and the second conductive element being arranged to provide an electrical path between the socket terminal and the power terminal of the socket via the actuator switch; a wireless control module coupled to the actuator switch, the wireless control module comprising a wireless communication module to perform wireless communication with an external device; and wherein the actuator switch is controllable by the wireless control module.

The actuator switch may be capable of providing a non-connected state and a connected state between the first and the second conductive elements respectively.

The non-conductive lead may comprise a plastic material.

The non-conductive lead may be configured to be mechanically insertable into a receptacle of the socket to provide the electrical path via the actuator switch between the socket terminal and the power terminal of the socket.

The control module may further comprise a third conductive element for obtaining electrical power for the control module.

The first conductive element and the second conductive element may be capable of controlling the energization of the relay module based on the actuator switch.

The first conductive element may be disposed at a periphery of the non-conductive lead for electrical connection to the socket terminal.

The second conductive element may be disposed at the periphery of the non-conductive lead for electrical connection to the power terminal of the socket.

5 The first conductive element may comprise a first conductive receptacle arranged to receive the socket terminal of the socket.

The second conductive element may comprise a second conductive receptacle arranged to receive the power terminal of the socket.

10 In accordance with another aspect, there is provided a system for controlling a relay module, the system comprising: a socket which comprises a socket terminal for energizing a relay module, the socket terminal being capable of electrical connection with a power terminal of the socket; a control module as disclosed herein for coupling to the socket; and an external device configured to perform wireless communication with the  
15 control module.

The external device may be arranged to transmit a wireless signal to control an actuator switch disposed within the control module.

20 The electrical connection between the socket terminal and a power terminal of the socket may be controllable by the control module with a mechanical insertion of the non-conductive lead into a receptacle of the socket.

The power source may be connected to the socket for powering the control  
25 module.

The system may further comprise a relay module coupled to the socket and is caused to be in an energized state based on the actuator switch being in a closed state; and the relay module is caused to be in a de-energized state based on the actuator switch  
30 being in an open state.

The socket terminal may biased into electrical connection to the power terminal.

In accordance with another aspect, there is provided a method for controlling  
35 energization of a relay module comprising the steps of: providing a control module for coupling to a socket which comprises a socket terminal for energizing the relay module,

the socket terminal being capable of electrical connection with a power terminal of the socket; disposing a non-conductive lead of the control module between the socket terminal and the power terminal of the socket; electrically connecting a first conductive element of the control module to the socket terminal of the socket wherein the first  
5 conductive element is disposed at a base of the control module; electrically connecting a second conductive element of the control module to the power terminal of the socket wherein the second conductive element is disposed at the base of the control module; providing an actuator switch of the control module coupled to the first conductive element and the second conductive element, the first conductive element and the second  
10 conductive element providing an electrical path between the socket terminal and the power terminal of the socket via the actuator switch; providing a wireless control module of the control module coupled to the actuator switch, wherein the wireless control module comprises a wireless communication module to perform wireless communication with an external device; and controlling the actuator switch using the wireless control module.

15 The method may further comprise providing a non-connected state and a connected state between the first and second conductive elements respectively based on the actuator switch.

20 The method may further comprise inserting the non-conductive lead mechanically into a receptacle of the socket and providing the electrical path via the actuator switch between the socket terminal and the power terminal of the socket.

25 The method may further comprise controlling the energization state of the relay module based on the actuator switch.

The method may further comprise providing a third conductive element for coupling to another socket terminal of the socket for powering the control module.

30 The method may further comprise providing the first conductive element at a periphery of the non-conductive lead for electrical connection to the socket terminal.

35 The method may further comprise providing the second conductive element at the periphery of the non-conductive lead for electrical connection to the power terminal of the socket.

The method may further comprise providing the first conductive element comprising a first conductive receptacle arranged to receive the socket terminal of the socket.

5       The method may further comprise providing the second conductive element comprising a second conductive receptacle arranged to receive the power terminal of the socket.

## 10    **BRIEF DESCRIPTION OF THE DRAWINGS**

Exemplary embodiments of the present disclosure will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

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FIG. 1 is a schematic drawing of a system for controlling a relay module in an exemplary embodiment.

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FIG. 2 is a schematic drawing of a system when a control module is coupled to a socket in an exemplary embodiment.

FIG. 3 is a drawing of a system for controlling a relay module in an exemplary embodiment.

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FIG. 4A(i) is a schematic perspective view drawing of a control module (part of), a biased socket terminal of a socket and a power terminal of the socket in an exemplary embodiment.

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FIG. 4A(ii) is a schematic frontal view drawing of the exemplary embodiment of FIG. 4A(i) when viewed in the direction X.

FIG. 4A(iii) is a schematic side view drawing of the exemplary embodiment of FIG. 4A(i) when viewed in the direction Y.

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FIG. 4B(i) is a schematic perspective view drawing of the exemplary embodiment of FIGS. 4A(i) to 4(A)(iii), prior to the insertion of a first protruding lead of the socket into a first conductive element / receptacle and prior to the insertion of a second protruding lead of the socket into a second conductive receptacle.

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FIG. 4B(ii) is a schematic frontal view drawing of FIG. 4B(i) when viewed in the direction X.

FIG. 4B(iii) is a schematic side view drawing of FIG. 4B(i) when viewed in the direction Y.

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FIG. 4C(i) is a schematic perspective view drawing of the exemplary embodiment of FIGS. 4A(i) to 4(A)(iii), upon insertion of the first protruding lead of the socket into the first conductive receptacle and upon insertion of the second protruding lead of the socket into the second conductive receptacle.

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FIG. 4C(ii) is a schematic frontal view drawing of FIG. 4C(i) when viewed in the direction X.

FIG. 4C(iii) is a schematic side view drawing of FIG. 4C(i) when viewed in the direction Y.

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FIG. 5 is a schematic block diagram for illustrating an actuator switch in an exemplary embodiment.

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FIG. 6A is a schematic drawing for illustrating an interior (i.e. cross-sectional view) of a relay module in a first state.

FIG. 6B is a schematic drawing for illustrating the interior (i.e. cross-sectional view) of the relay module of FIG. 6A being in a second state.

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FIG. 7 is a schematic flow chart for illustrating a method for controlling energization of a relay module in an exemplary embodiment.

FIG. 8 is a schematic drawing of a wireless communication device suitable for implementing an example embodiment.

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## DETAILED DESCRIPTION

FIG. 1 shows a schematic drawing of a system 100 for controlling a relay module in an exemplary embodiment. In the exemplary embodiment, the system 100 comprises a socket 102 and a control module 104 for coupling to the socket 102. In the exemplary embodiment, the control module 104 is capable of detachably coupling to the socket 102. The socket 102 includes terminals for coupling to the control module 104 and the relay module (not shown). The socket 102 is coupled or connected to the relay module at connection points 110, 112. The socket 102 controls the energization of a relay coil of the relay module via at least two terminals 120, 122. In the description below, these terminals 120, 122 are termed socket terminals. The connection points 110, 112 couple the relay module to be in electrical connection with the socket terminals 120, 122. The socket 102 further comprises a power terminal 124 that is in electrical connection to a power source. In the exemplary embodiment, one of the socket terminals 120, 122 that is in electrical connection to the relay module is mechanically biased towards the power terminal 124 such that by default, the biased socket terminal 122 is electrically connected to the power terminal 124.

The biased socket terminal 122 is mechanically biased such that the biased socket terminal 122 is by default in mechanical contact with the power terminal 124 to establish electrical connection between the power terminal 124 and the biased socket terminal 122 for energization of the relay coil of the relay module. With the biased socket terminal 122 in mechanical contact with the power terminal 124, there is a contact joint 114 between the biased socket terminal 122 and the power terminal 124. Due to the contact joint 114, electric current may flow from the power terminal 124 to the biased socket terminal 122 and through the connection point 112. The relay coil of the relay module which is coupled or connected to the socket at connection points 110, 112 may thus be energized.

In the exemplary embodiment, the power source 106 may provide power to the relay module for energization of the relay coil. The control module 104 is configured to be powered by the power source 106 via the socket terminal 120 and the power terminal 124 of the socket 102.

In the exemplary embodiment, the control module 104 functions as a module for switching. The control module 104 comprises a non-conductive lead 130 disposed at a base

of the control module 104. The non-conductive lead 130 is configured to be disposed between the biased socket terminal 122 and the power terminal 124 such that the non-conductive lead 130 provides electrical insulation between the biased socket terminal 122 and the power terminal 124. That is, the non-conductive lead 130 functions to break/disrupt the contact or path between the biased socket terminal 122 and the power terminal 124. The non-conductive lead 130 may be, but is not limited to, a plastic material.

The control module 104 also comprises a first conductive element 132 disposed at the base of the control module 104 and around a periphery (or a first periphery part) of the non-conductive lead 130 to contact the biased socket terminal 122. The control module 104 further comprises a second conductive element 134 disposed at the base of the control module 104 and around the periphery (or a second periphery part) of the non-conductive lead 130 to contact the power terminal 124. Each of the first conductive element 132 and the second conductive element 134 may be in contact with the non-conductive lead 130. However, the first conductive element 132 and the second conductive element 134 are spaced apart from each other and are not in mechanical contact with each other.

The first conductive element 132 is configured to allow for electrical connection to the biased socket terminal 122. The second conductive element 134 is configured for electrical connection to the power terminal 124.

The first conductive element 132 and the second conductive element 134 are coupled to a switching circuit 140 disposed within the control module 104. The electrical conductivity or connection between the first conductive element 132 and the second conductive element 134 is controlled by the switching circuit 140. In the exemplary embodiment, the switching circuit 140 is in the form of a mechanical actuator switch 140. The control module 104 further comprises a wireless control module 142 coupled to the actuator switch 140. The wireless control module 142 comprises a wireless communication module (not shown) to perform wireless communication with an external device or device external to the control module 104. Wireless signals transmitted from the external device may be received by the wireless control module 142 via the wireless communication module. The actuator switch 140 is controllable via the wireless control module 142 to switch between an open state and a closed state by one or more wireless signals received at the wireless control module 142.

In some exemplary embodiments, the actuator switch 140 may alternatively be implemented using a variable resistor. In some exemplary embodiments, the actuator switch

140 may alternatively be implemented using electronic components such as a field-effect transistor (FET).

In the exemplary embodiment, the control module 104 also comprises a third  
 5 conductive element 136 disposed at the base of the control module 104. The third conductive element 136 is configured to be connected to the socket terminal 120 to provide electrical connection with the socket terminal 120. The third conductive element 136 is internally coupled to the second conductive element 134.

10 In the exemplary embodiment, the first conductive element 132, the second conductive element 134 and the third conductive element 136 are each in the form of a conductive lead or pad.

In an exemplary embodiment, the control module 104 may be configured to be  
 15 mechanically insertable into at least one receptacle of the socket 102. The receptacle can be, but is not limited to, an oblong opening. For example, one receptacle may be a first opening on the socket 102, which is capable of fittingly receiving the non-conductive lead 130 of the control module 104 for disposing between the biased socket terminal 122 and the power terminal 124 of the socket 102 such that the non-conductive lead 130 interrupts or breaks the  
 20 electrical connection between the biased socket terminal 122 and the power terminal 124 of the socket 102. Another receptacle may be a second opening of the socket 102, which is capable of fittingly receiving the third conductive element 136 for coupling the third conductive element 136 to the socket terminal 120 of the socket 102 to allow electrical connection between the socket terminal 120 and the wireless control module 142 in the control module  
 25 104.

FIG. 2 shows a schematic drawing of a system 200 with a control module 204 coupled to a socket 202 in an exemplary embodiment. The control module 204 and the socket 202 function substantially similarly to the control module 104 and the socket 102 described with  
 30 reference to FIG. 1 respectively. When the control module 204 is detachably/removably coupled to the socket 202, a non-conductive lead 230 disposed at a base of the control module 204 breaks or interrupts a contact joint (e.g. 114 in FIG. 1) between a biased socket terminal 222 and a power terminal 224 of the socket 202. Therefore, an interruption junction 217 is formed where there used to be a contact joint (e.g. 114 in FIG. 1).

When the control module 204 is detachably coupled to the socket 202, a first conductive element 232 disposed at the base of the control module 204 and around a periphery (or a first periphery part) of the non-conductive lead 230 comes into electrical contact with the biased socket terminal 222 of the socket 202. A second conductive element 234 disposed at the base of the control module 204 and around the periphery (or a second periphery part) of the non-conductive lead 230 comes into electrical contact with the power terminal 224 of the socket 202. A third conductive element 236 disposed at the base of the control module 204 comes into electrical contact with a socket terminal 220 of the socket 202. The control module 204 is therefore powered by a power source 206 connected to the socket 202, via the socket terminal 220 and the power terminal 224 of the socket 202.

In the exemplary embodiment, an actuator switch 240 is disposed in the control module 204 and is connected to the first conductive element 232 and to the second conductive element 234 via an electric circuit. Due to the interruption junction 217, an electric current flow path between the power terminal 224 and the biased socket terminal 222 is interrupted and therefore, energization of a relay coil of a relay module coupled to the socket 202 is controlled by the control module 204. The first conductive element 232 and the second conductive element 234 provide an electrical path that may be controlled by the actuator switch 240. Thus, the control module 204 is capable of disposing between the default joint between the biased socket terminal 222 and the power terminal 224 to provide an alternative path that incorporates and passes through a switch for controlling the energization of a relay coil of a relay module which is coupled to the socket 202.

In the exemplary embodiment, actuation of the actuator switch 240 between an open and a closed state is instructed by a wireless control module 242 that is in turn instructed by wireless signals received at a wireless communication module (not shown) of the wireless control module 242. When the actuator switch 240 is in an open state, there is a non-connected state between the first conductive element 232 and the second conductive element 234.

When there is a non-connected state between the first conductive element 232 and the second conductive element 234, electric current is prevented from flowing between the first conductive element 232 and the second conductive element 234 and thereby, causing the relay coil of the relay module to remain in, or switch to, a de-energized state.

On the other hand, when the actuator switch 240 is in a closed state, there is a connected state between the first conductive element 232 and the second conductive element 234. When there is a connected state between the first conductive element 232 and the second conductive element 234, electric current is allowed to flow through the power terminal 224, to the second conductive element 234, to the first conductive element 232 and to the biased socket terminal 222 and thereby, causing the relay coil of the relay module to be energized or switch to an energized state.

FIG. 3 shows a drawing of a system 300 for controlling a relay module in an exemplary embodiment. The system 300 comprises a socket 302 removably coupled to a control module 304 and coupled to a relay module 350. In the exemplary embodiment, the relay module 350 is in the form of a relay. The relay module 350 is coupled to an external load 360. The system 300 is in use with an external device 352 in the exemplary embodiment. In the exemplary embodiment, the socket 302 and the control module 304 function substantially similarly to the socket 102, 202 and the control module 104, 204 described with reference to FIG. 1 and FIG. 2 respectively. In the exemplary embodiment, a power source 306 is provided to provide power to the socket 302. The external device 352 is used to send one or more wireless signals to the control module 304 to control the energization/de-energization of a relay coil of the relay module 350.

In the exemplary embodiment, contacts or leads of the relay module 350 are electrically connected to a socket terminal 320, a biased socket terminal 322 and the external load 360. For example, a first contact 352 is in electrical contact with a socket terminal 320, a second contact 354 is in electrical contact with the biased socket terminal 322, and a third contact 356 and a fourth contact 358 are in electrical contact with the external load 360.

The relay coil of the relay module 350 is capable of switching between an energized state and a de-energized state. The energized state and the de-energized state of the relay coil is controlled via the control module 304.

When the control module 304 is detachably coupled to the socket 302, a non-conductive lead 330 disposed at the base of the control module 304 breaks or interrupts a default mechanical and electrical connection between the biased socket terminal 322 and the power terminal 324. An interruption junction 317 is therefore formed with the biased socket terminal 322, the non-conductive lead 330 and the power terminal 324. Due to the interruption junction 317, electric current is not allowed to directly flow from the power terminal 324 to the

biased socket terminal 322 and therefore, the relay coil of the relay module 350 is not able to switch between the energized state and the de-energized state independently of the control module 304. The energization state and the de-energization state of the relay coil of the relay module 350 is controlled by an actuator switch 340 disposed in the control module 304.

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When in use, a first conductive element 332 disposed at the base of the control module 304 and disposed at a periphery (or a first periphery part) of the non-conductive lead 330 is in electrical contact with the biased socket terminal 322 of the socket 302. A second conductive element 334 disposed at the base of the control module 304 and disposed at the periphery (or  
10 a second periphery part) of the non-conductive lead 330 is in electrical contact with the power terminal 324 of the socket 302. A third conductive element 336 disposed at the base of the control module 304 is in electrical contact with the socket terminal 320 of the socket 302. The control module 304 is powered by the power source 306 via the power terminal 324 and the socket terminal 320 of the socket 302.

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In the exemplary embodiment, an actuator switch 340 is disposed in the control module 304 and is connected to the first conductive element 332 and to the second conductive element 334 via an electric circuit. Due to the interruption junction 317, an electric current flow path between the power terminal 324 and the biased socket terminal 322 is interrupted and  
20 therefore, energization of the relay coil of the relay module 350 coupled to the socket 302 is controlled by the control module 304. The first conductive element 332 and the second conductive element 334 provide an electrical path that may be controlled by the actuator switch 340. Thus, the control module 304 is capable of disposing between the default joint between the biased socket terminal 322 and the power terminal 324 to provide an alternative  
25 path that incorporates and passes through a switch for controlling the energization of the relay coil of the relay module 350 which is coupled to the socket 302.

In the exemplary embodiment, actuation of the actuator switch 340 between an open and a closed state is instructed by a wireless control module 342 that is in turn instructed by  
30 wireless signals received at a wireless communication module (not shown) of the wireless control module 342. When the actuator switch 340 is in an open state, there is a non-connected state between the first conductive element 332 and the second conductive element 334.

35 When there is a non-connected state between the first conductive element 332 and the second conductive element 334, electric current is prevented from flowing between the

first conductive element 332 and the second conductive element 334 and thereby, causing the relay coil of the relay module 350 to remain in, or switch to, a de-energized state.

5 On the other hand, when the actuator switch 340 is in a closed state, there is a connected state between the first conductive element 332 and the second conductive element 334. When there is a connected state between the first conductive element 332 and the second conductive element 334, electric current is allowed to flow through the power terminal 324, to the second conductive element 334, to the first conductive element 332 and to the biased socket terminal 322 and thereby, causing the relay coil of the relay module 350 to be  
10 energized or switch to an energized state.

The external device 352 is configured to perform wireless communication with the control module 304. The external device 352 may be, but is not limited to, a mobile device with wireless communication capability. The external device 352 may also be a wireless  
15 communication module provided to a conventional programmable logic controller (PLC) for controlling the relay coil of the relay module 350.

The control module 304 is configured to detect whether a wireless signal is sent by the external device 352.  
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Wireless communication between the external device 352 and the control module 304 is via a wireless communication module of a wireless control module 342 disposed within the control module 304. The wireless communication may be, but is not limited to, Zigbee communication, Bluetooth communication, near-field communication (NFC) etc. In an  
25 example, the external device 352 and the wireless control module 342 may have a near field communication function to facilitate NFC communication between the external device 352 and the selected control module 304.

In the exemplary embodiment, when a signal is transmitted wirelessly by the external  
30 device 352 to a selected control module (for example 304), the signal is received by the wireless control module 342 disposed within the control module 304. The wireless control module 342 is configured to control the actuator switch 340 disposed in the control module 304 to switch between an open state and a closed state. For example, when a logic high signal is instructed via a wireless signal sent from the external device 352 and the wireless signal is  
35 received by the wireless control module 342, the actuator switch 340 is caused to switch to a closed state upon receipt of the logic high signal. Electric current is allowed to flow between

the power terminal 324, the second conductive element 334 and the first conductive element 332. The relay coil of the relay module 350 is thereby energized and power is then supplied to the external load 360. In the example, when a logic low signal is instructed via a wireless signal sent from the external device 352 and the wireless signal is received by the wireless control module 342, the actuator switch 340 is caused to switch to an open state upon receipt of the logic low signal. Electric current is not allowed or prevented to flow between the power terminal 324 and the first conductive element 332. The relay coil of the relay module 350 is de-energized and no power is supplied to the external load 360.

In the exemplary embodiments described with reference to FIGS. 1, 2 and 3, the first conductive element (for example 132 in FIG. 1, 232 in FIG. 2 and 332 in FIG. 3) and the second conductive element (for example 134 in FIG. 1, 234 in FIG. 2 and 334 in FIG. 3) are embodied as a pair of leads disposed at the base of the control module (for example 104 in FIG. 1, 204 in FIG. 2 and 304 in FIG. 3). However, the exemplary embodiments are not limited as such. For example, the first conductive element (for example 132 in FIG. 1, 232 in FIG. 2 and 332 in FIG. 3) and the second conductive element (for example 134 in FIG. 1, 234 in FIG. 2 and 334 in FIG. 3) may each alternatively be embodied as a conductive receptacle specifically arranged to each couple to a protruding lead of another form of socket (i.e. with protruding leads connected to the biased socket terminal (for example 122 in FIG. 1, 222 in FIG. 2 and 322 in FIG. 3) and the power terminal (for example 124 in FIG. 1, 224 in FIG. 2 and 324 in FIG. 3)). The first conductive element (for example 132 in FIG. 1, 232 in FIG. 2 and 332 in FIG. 3) and the second conductive element (for example 134 in FIG. 1, 234 in FIG. 2 and 334 in FIG. 3) are arranged to provide an alternative electric path between the biased socket terminal (for example 122 in FIG. 1, 222 in FIG. 2 and 322 in FIG. 3) and the power terminal (for example 124 in FIG. 1, 224 in FIG. 2 and 324 in FIG. 3) that incorporates and passes through the switching circuit (for example 140 in FIG. 1) for controlling the energization of a relay coil of a relay module which is coupled to the socket (for example 102 in FIG. 1, 202 in FIG. 2 and 302 in FIG. 3).

Similarly, in the exemplary embodiments described with reference to FIGS. 1, 2 and 3, the third conductive element (for example 136 in FIG. 1, 236 in FIG. 2 and 336 in FIG. 3) is embodied as a lead disposed at the base of the control module (for example 104 in FIG. 1, 204 in FIG. 2 and 304 in FIG. 3). However, the exemplary embodiments are not limited as such. For example, the third conductive element (for example 136 in FIG. 1, 236 in FIG. 2 and 336 in FIG. 3) may alternatively be embodied as a conductive receptacle specifically arranged to couple to a protruding lead of another form of socket (i.e. with a protruding lead connected

to the socket terminal (for example 120 in FIG. 1, 220 in FIG. 2 and 320 in FIG. 3)). The third conductive element (for example 136 in FIG. 1, 236 in FIG. 2 and 336 in FIG. 3) is arranged to be connected to the socket terminal (for example 120 in FIG. 1, 220 in FIG. 2 and 320 in FIG. 3) to provide electrical connection with the socket terminal (for example 120 in FIG. 1, 220 in FIG. 2 and 320 in FIG. 3) to allow electrical connection between the socket terminal (for example 120 in FIG. 1, 220 in FIG. 2 and 320 in FIG. 3) and the wireless control module (for example 142 in FIG. 1, 242 in FIG. 2 and 342 in FIG. 3) in the control module (for example 104 in FIG. 1, 204 in FIG. 2 and 304 in FIG. 3).

FIG. 4A(i) is a schematic perspective view drawing of a control module 404 (part of), a biased socket terminal 422 of a socket and a power terminal 424 of the socket in an exemplary embodiment. FIG. 4A(ii) is a schematic frontal view drawing of the exemplary embodiment of FIG. 4A(i) when viewed in the direction X. FIG. 4A(iii) is a schematic side view drawing of the exemplary embodiment of FIG. 4A(i) when viewed in the direction Y.

In the exemplary embodiment, the biased socket terminal 422 of the socket (for example 102 in FIG. 1, 202 in FIG. 2 and 302 in FIG. 3) is mechanically biased towards the power terminal 424 of the socket such that by default, the biased socket terminal 422 is electrically connected to the power terminal 424. See the connection Z.

The biased socket terminal 422 of the socket comprises a first protruding lead 426 connected to and disposed at a top surface of the biased socket terminal 422. The power terminal 424 of the socket comprises a second protruding lead 428 connected to and disposed at a top surface of the power terminal 424. The first protruding lead 426 and the second protruding lead 428 are configured for mechanical insertion into / detachably coupling with the control module 404. In the exemplary embodiment, the first protruding lead 426 and the second protruding lead 428 are disposed spaced apart from each other in both the X and Y directions.

In the exemplary embodiment, a non-conductive lead 430 is disposed at a base of the control module 404. The non-conductive lead 430 is configured to be disposed between the biased socket terminal 422 and the power terminal 424, such that the non-conductive lead 430 provides electrical insulation between the biased socket terminal 422 and the power terminal 424. That is, the non-conductive lead 430 functions to break/disrupt the contact Z or path between the biased socket terminal 422 and the power terminal 424 of the socket.

With reference to FIG. 4A(iii), a first conductive element 432 is disposed at a base of the control module 404. The first conductive element 432 is in the form of a first conductive receptacle to receive the first protruding lead 426. In the exemplary embodiment, the first conductive element 432 comprises a first conductive lead 450 coupled to a first fastening element 462. The first fastening element 462 is housed within a first aperture 460 provided in the control module 404. The first conductive lead 450 is provided extending out of the first aperture 460. The first fastening element 462 is a clip-like / clamp-like component substantially mechanically biased together in a normal state (i.e. before the control module 404 is detachably coupled to the socket). The first conductive element 432 is specifically arranged to receive and couple to the first protruding lead 426.

In the exemplary embodiment, a second conductive element is provided substantially identical to the first conductive element 432. That is, the second conductive element (not shown) is disposed at the base of the control module 404. The second conductive element is in the form of a second conductive receptacle (not shown) to receive the second protruding lead 428. The second conductive element comprises a second conductive lead 452 coupled to a second fastening element (not shown). The second fastening element (not shown) is housed within a second aperture (not shown with numeral) provided in the control module 404. The second conductive lead 452 is provided extending out of the second aperture. Similar to the first fastening element 462, the second fastening element is a clip-like / clamp-like component substantially mechanically biased together in a normal state (i.e. before the control module 404 is detachably coupled to the socket). The second conductive element (not shown) is specifically arranged to receive and couple to the second protruding lead 428.

The first conductive lead 450 and the second conductive lead 452 are each coupled to a switching circuit (for example 140 of FIG. 1) of the control module 404. The electrical conductivity or connection between the first conductive lead 450 and the second conductive lead 452 is controlled by the switching circuit (for example 140 of FIG. 1).

The first conductive element 432 and the second conductive element are spaced apart from each other and are not in mechanical contact with each other. The first aperture 460 and the second aperture (not shown with numeral) are distinct and separate. The first conductive lead 450 and the second conductive lead 452 may be arranged such that the first conductive lead 450 and the second conductive lead 452 are in staggered positions along an axis of the control module 404. For example, in the exemplary embodiment, the first conductive lead 450

and the second conductive lead 452 are disposed spaced apart from each other in both the X and Y directions.

In the exemplary embodiment, the first fastening element 462 and the second fastening element (not shown) are electrically conductive.

FIG. 4B(i) is a schematic perspective view drawing of the exemplary embodiment of FIGS. 4A(i) to 4(A)(iii), prior to the insertion of the first protruding lead 426 of the socket into the first conductive element / receptacle 432 and prior to the insertion of the second protruding lead 428 of the socket into the second conductive receptacle. FIG. 4B(ii) is a schematic frontal view drawing of FIG. 4B(i) when viewed in the direction X. FIG. 4B(iii) is a schematic side view drawing of FIG. 4B(i) when viewed in the direction Y.

When the non-conductive lead 430 is prior to breaking/disrupting the contact or path between the biased socket terminal 422 and the power terminal 424, the first fastening element 462 of the first conductive receptacle 432 remains substantially mechanically biased together. The arrangement is substantially identical for the second fastening element (not shown) in the second conductive receptacle (not shown with numeral).

FIG. 4C(i) is a schematic perspective view drawing of the exemplary embodiment of FIGS. 4A(i) to 4(A)(iii), upon insertion of the first protruding lead 426 of the socket into the first conductive receptacle 432 and upon insertion of the second protruding lead 428 of the socket into the second conductive receptacle. FIG. 4C(ii) is a schematic frontal view drawing of FIG. 4C(i) when viewed in the direction X. FIG. 4C(iii) is a schematic side view drawing of FIG. 4C(i) when viewed in the direction Y.

Referring to FIG. 4C(ii), the non-conductive lead 430 is disposed between the biased socket terminal 422 and the power terminal 424 such that the non-conductive lead 430 provides electrical insulation between the biased socket terminal 422 and the power terminal 424. That is, the non-conductive lead 430 functions to break/disrupt the contact or path between the biased socket terminal 422 and the power terminal 424.

Referring to FIG. 4C(iii), the first protruding lead 426 of the socket is inserted into the first conductive receptacle 432. The first fastening element 462 of the first conductive receptacle 432 receives the first protruding lead 426. The first fastening element 462 functions in a clip-like or clamp-like manner to hold onto the first protruding lead 426. Electrical

connection is provided between the biased socket terminal 422 and the first conductive lead 450 through the first protruding lead 426 and the first fastening element 462.

The arrangement for the second conductive receptacle is substantially identical to that of the first conductive receptacle 432. The second protruding lead 428 of the socket is inserted into the second conductive receptacle (not shown). The second fastening element (not shown) of the second conductive receptacle receives the second protruding lead 428. The second fastening element functions in a clip-like or clamp-like manner to hold onto the second protruding lead 428. Electrical connection is provided between the power terminal 424 and the second conductive lead 452 through the second protruding lead 428 and the second fastening element.

The first conductive element 432 and the second conductive element (not shown) are arranged to provide an alternative electric path between the biased socket terminal 422 and the power terminal 424 that incorporates and passes through a switching circuit (not shown) for controlling the energization of a relay coil of a relay module which is coupled to the socket.

It will be appreciated that a first conductive element and a second conductive element are not limited to be in the form of a receptacle and are not limited to be disposed at an outer periphery of a non-conductive lead.

FIG. 5 is a schematic block diagram for illustrating an actuator switch in an exemplary embodiment. In the exemplary embodiment, the actuator switch is implemented using a field-effect transistor (FET). In the exemplary embodiment, one or more wireless signals 502 transmitted by an external device (for example 352 in FIG. 3) is received by a wireless control module (for example 142 in FIG. 1, 242 in FIG. 2 and 342 in FIG. 3) in a control module (for example 104 in FIG. 1, 204 in FIG. 2 and 304 in FIG. 3). The one or more wireless signals 502 is converted into a digital output using an analog-to-digital converter 504 in the control module. The digital output is then input to an amplifier 506, for example a voltage follower, that may transmit a logic high signal or a logic low signal at an output gate of the amplifier 506. The amplifier 506 Vcc may be provided from a power source from a socket (see for example a power source 206 connected via a socket terminal 220 to a third conductive element 236 in FIG. 2). The output gate of the amplifier 506 is in turn connected to a field-effect transistor (FET) 508, for example a metal-oxide-semiconductor field-effect transistor (MOSFET). As an example, when a logic high signal is transmitted to the field-effect transistor 508, the field-effect transistor 508 switches on. Electric current is allowed to flow through a power terminal

(for example 124 in FIG. 1, 224 in FIG. 2 and 324 in FIG. 3), to the second conductive element (for example 134 in FIG. 1, 234 in FIG. 2 and 334 in FIG. 3), to the first conductive element (for example 132 in FIG. 1, 232 in FIG. 2 and 332 in FIG. 3) and to the biased socket terminal (for example 122 in FIG. 1, 222 in FIG. 2 and 322 in FIG. 3) and thereby, causing a relay coil of a relay module (for example 350 in FIG. 3) to be energized or switch to an energized state. In the example, when a logic low signal is transmitted to the field-effect transistor 508, the field-effect transistor 508 switches off or remains in an “off” state. Electric current is prevented from flowing between the first conductive element (for example 132 in FIG. 1, 232 in FIG. 2 and 332 in FIG. 3) and the second conductive element (for example 134 in FIG. 1, 234 in FIG. 2 and 334 in FIG. 3) and thereby, causing the relay coil of the relay module (for example 350 in FIG. 3) to remain in, or switch to, a de-energized state.

FIGs. 6A and 6B are schematic drawings for illustrating an interior (i.e. cross-sectional view) of a relay module.

FIG. 6A illustrates a relay module 600 in a first state. The relay module 600 comprises an energisable coil element (i.e. relay coil) such as an electromagnetic coil 602 that can affect a switch assembly. The electromagnetic coil 602 may be electrically powered or energized via leads e.g. 604 (for example 352, 354 in FIG. 3). The switch assembly of the relay module 600 comprises an armature 606 and a movable contact arm or contact 608 that is coupled to an end of the armature 606. The switch assembly is capable of sending a trigger signal via switching between leads e.g. 610. A Normally-Closed (NC) or “closed” contact 612 is provided on one of the leads e.g. 610 while a Normally-Open (NO) or “open” contact 614 is provided on another one of the leads e.g. 610. The movable contact 608 can switch between the contact 612, 614 positions. Further, the relay module 600 comprises a biasing means such as a spring 616 to bias or retain the movable contact 608 in e.g. the normally closed contact 612 position.

When no power is supplied to the electromagnetic coil 602 (for example when an actuator switch 140 in FIG. 1, 240 in FIG. 2 and 340 in FIG. 3 of a control module is in an open state), the electromagnetic coil 602 and the relay module 600 are not energized. Without energisation of the electromagnetic coil 602, the armature 606 is not attracted by magnetic force towards the electromagnetic coil 602. The movable contact 608, which is coupled at an end of the armature 606, remains biased in a first position. In the example, the first position is maintained by the spring 616 which retains/biases the armature 606 and movable contact 608, against a “closed” contact 612 of the relay module 600. In the example, the armature 606 and the movable contact 608 are collectively referred to as a switch assembly.

In an example, a settings command to effect energisation of the relay module 600 may be sent from an external device instructed by a programmable logic controller (such as 352 in FIG. 3) and sent via a wireless signal (such as a near field communication (NFC) signal) to a wireless communication module of a control module (for example 104 in FIG. 1, 204 in FIG. 2 and 304 in FIG. 3).

In the example, the relay module 600 is configured to remain in an initial de-energized state or to switch to a de-energized state if the actuator switch (for example 140 in FIG. 1, 240 in FIG. 2 and 340 in FIG. 3) of a control module is in an open state. The relay module 600 is further configured to switch to an energized state if a unique identification tag or unique address of the control module (for example 104 in FIG. 1, 204 in FIG. 2 and 304 in FIG. 3) which is capable of receiving instructions/commands from the external device (for example 352 in FIG. 3) is selected using the external device. When the control module (for example 104 in FIG. 1, 204 in FIG. 2 and 304 in FIG. 3) receives a wireless signal from the external device, the actuator switch of the control module switches to a closed state and the relay module 600 switches to an energized state.

FIG. 6B shows a second state of the relay module 600. When power is supplied to the electromagnetic coil 602, the electromagnetic coil 602 and the relay module 600 are energized. With sufficient power, the energized electromagnetic coil 602 generates a sufficient magnetic force to overcome the biasing force (generated by the spring 616) exerted on the armature 606. The magnetic force thus attracts armature 606 towards the electromagnetic coil 602. The movable contact 608 is moved to a second position, where it is switched and contacts an "open" (normally open) contact 614 of the relay module 600.

FIG. 7 is a schematic flow chart 700 for illustrating a method for controlling energization of a relay module in an exemplary embodiment. At step 702, a control module for coupling to a socket which comprises a socket terminal for energizing the relay module is provided. The socket terminal is capable of electrical connection with a power terminal of the socket. At step 704, a non-conductive lead of the control module is disposed between the socket terminal and the power terminal of the socket. At step 706, a first conductive element of the control module is electrically connected to the socket terminal of the socket wherein the first conductive element is disposed at a base of the control module. At step 708, a second conductive element of the control module is electrically connected to the power terminal of the socket wherein the second conductive element is disposed at the base of the control module. At step 710, an

actuator switch of the control module is provided to couple to the first conductive element and the second conductive element, the first conductive element and the second conductive element providing an electrical path between the socket terminal and the power terminal of the socket via the actuator switch. At step 712, a wireless control module of the control module  
5 is provided to couple to the actuator switch, wherein the wireless control module comprises a wireless communication module to perform wireless communication with an external device. At step 714, the actuator switch is controlled using the wireless control module.

10 In an exemplary embodiment, a non-connected state and a connected state between the first and second conductive elements is respectively provided based on the actuator switch.

The control module, for example the non-conductive lead of the control module, may be configured to be inserted mechanically into a receptacle of the socket to provide an  
15 electrical path via the actuator switch between the socket terminal and the power terminal of the socket. The energization of the relay module may be controlled based on the actuator switch. For example, when the actuator switch is in an open state, the relay module remains de-energized or switches to a de-energized state. When the actuator switch is in a closed state, the relay module remains energized or switches to an energized state.

20 In the exemplary embodiment, a third conductive element is provided in the control module for coupling to another socket terminal of the socket for powering the control module.

25 In the exemplary embodiment, the first conductive element is provided at a periphery of the non-conductive lead for electrical connection to the socket terminal. The second conductive element is provided at the periphery of the non-conductive lead for electrical connection to the power terminal of the socket.

30 In another exemplary embodiment, the first conductive element comprising a first conductive receptacle arranged to receive the socket terminal of the socket is provided. The second conductive element comprising a second conductive receptacle arranged to receive the power terminal of the socket is provided.

35 An exemplary wireless communication device e.g. as an external device communicating wirelessly with a control module is briefly disclosed herein. One or more

exemplary embodiments may be embodied with one or more communication devices e.g. 800, such as is schematically illustrated in FIG. 8.

The communication device 800 comprises a processor module 802, an input module  
5 such as a touchscreen interface or a keypad 804 and an output module such as a display 806 on a touchscreen.

The processor module 802 is coupled to a first communication unit 808 for  
communication with a cellular network 810. The first communication unit 808 can include, but  
10 is not limited to, a subscriber identity module (SIM) card loading bay. The cellular network 810 can, for example, be a 3G or 4G network.

The processor module 802 is further coupled to a second communication unit 812 for  
connection to a network 814. For example, the second communication unit 812 can enable  
15 access to e.g. the Internet or other network systems such as Local Area Network (LAN) or Wide Area Network (WAN) or a personal network. The network 814 can comprise a server, a router, a network personal computer, a peer device or other common network node, a wireless telephone or wireless personal digital assistant. Networking environments may be found in  
offices, enterprise-wide computer networks and home computer systems etc. The second  
20 communication unit 812 can include, but is not limited to, a wireless network card or an ethernet network cable port. The second communication unit 812 can also be a modem/router unit and may be any type of modem/router such as a cable-type modem or a satellite-type modem.

It will be appreciated that network connections shown are exemplary and other ways  
25 of establishing a communications link between computers can be used. The existence of any of various protocols, such as TCP/IP, Frame Relay, Ethernet, FTP, HTTP and the like, is presumed, and the communication device 800 can be operated in a client-server configuration to permit a user to retrieve web pages from a web-based server. Furthermore, any of various web browsers can be used to display and manipulate data on web pages.

The processor module 802 in the example includes a processor 816, a Random  
Access Memory (RAM) 818 and a Read Only Memory (ROM) 820. The ROM 820 can be a  
system memory storing basic input/ output system (BIOS) information. The RAM 818 can store  
one or more program modules such as operating systems, application programs and program  
35 data.

The processor module 802 also includes a number of Input/Output (I/O) interfaces, for example I/O interface 822 to the display 806, and I/O interface 824 to the keypad 804.

The components of the processor module 802 typically communicate and interface/couple connectedly via an interconnected bus 826 and in a manner known to the person skilled in the relevant art. The bus 826 can be any of several types of bus structures including a memory bus or memory controller, a peripheral bus, and a local bus using any of a variety of bus architectures.

It will be appreciated that other devices can also be connected to the system bus 826. For example, a universal serial bus (USB) interface can be used for coupling an accessory of the communication device, such as a card reader, to the system bus 826.

The application program is typically supplied to the user of the communication device 800 encoded on a data storage medium such as a flash memory module or memory card/stick and read utilising a corresponding memory reader-writer of a data storage device 828. The data storage medium is not limited to being portable and can include instances of being embedded in the communication device 800.

The application program is read and controlled in its execution by the processor 816. Intermediate storage of program data may be accomplished using RAM 818. The method(s) of the exemplary embodiments can be implemented with the assistance of computer readable instructions, computer executable components, or software modules. One or more software modules may alternatively be used. These can include an executable program, a data link library, a configuration file, a database, a graphical image, a binary data file, a text data file, an object file, a source code file, or the like. When one or more processor modules execute one or more of the software modules, the software modules interact to cause one or more processor modules to perform according to the teachings herein.

The operation of the communication device 800 can be controlled by a variety of different program modules. Examples of program modules are routines, programs, objects, components, data structures, libraries, etc. that perform particular tasks or implement particular abstract data types.

The exemplary embodiments may also be practiced with other computer system configurations, including handheld devices, multiprocessor systems/servers, microprocessor-

based or programmable consumer electronics, network PCs, minicomputers, mainframe computers, personal digital assistants, mobile telephones and the like. Furthermore, the exemplary embodiments may also be practiced in distributed computing environments where tasks are performed by remote processing devices that are linked through a wireless or wired communications network. In a distributed computing environment, program modules may be located in both local and remote memory storage devices.

The described exemplary embodiments may provide an insertable control module for use with sockets to introduce a module for switching and controlling energization of a relay module based on one or more wireless signals.

The inventors recognize that, presently, there does not exist an individual/separate device or module which is capable of controlling the energization of a relay coil of a relay module via wireless communication wherein the individual/separate device or module may be externally detachably attached or disposed with respect to the relay module.

In a conventional system, a protection module is typically disposed in the at least one receptacle of the socket. The described exemplary embodiments may provide a way for a programmable logic controller to control energization of a relay module using wireless communication with the control module. Thus, the described exemplary embodiments may eliminate usage of a protection module since the programmable logic controller is not wired to the socket. Further, the described exemplary embodiment may eliminate the multiple wiring typically used from one or more programmable logic controllers to one or more sockets.

The above described exemplary embodiments also provides an elegant solution for converting a system made up of typical relay modules to a system wherein the relay modules may be controlled via wireless communication. There is no need to re-design and/or modify the relay module or the socket. A control module as described in the various exemplary embodiments may be coupled to a socket which comprises at least one biased socket terminal for energizing a relay module, to control the energization of the relay module via wireless signals received by the control module.

The above described exemplary embodiments also remove the procedure of having to modify a relay module with components added into the relay module when a user desires to allow the relay module to be controlled via wireless communication. This advantageously removes the need for complicated re-wiring, re-design and/or modification of the relay module

when a user desires the energization of the relay module to be controlled wirelessly. Lead time and costs are thus reduced when setting up a relay module system which can advantageously be controlled wirelessly using the described exemplary embodiments.

5           Moreover, since a user needs to merely dispose a control module as described in the various exemplary embodiments in a socket to control a relay module via wireless communication, the user does not need to interpret wiring diagrams which is typically complex/complicated. Human errors are thus reduced and time savings may be achieved.

10           Further, since there is no need to replace existing relay modules in order to utilize wireless control and there is no need to modify the existing sockets, the described exemplary embodiments may achieve significant cost savings in this regard.

15           The terms "coupled" or "connected" as used in this description are intended to cover both directly connected or connected through one or more intermediate means, unless otherwise stated.

20           The description herein may be, in certain portions, explicitly or implicitly described as algorithms and/or functional operations that operate on data within a computer memory or an electronic circuit. These algorithmic descriptions and/or functional operations are usually used by those skilled in the information/data processing arts for efficient description. An algorithm is generally relating to a self-consistent sequence of steps leading to a desired result. The algorithmic steps can include physical manipulations of physical quantities, such as electrical, magnetic or optical signals capable of being stored, transmitted, transferred, combined, compared, and otherwise manipulated.

30           Further, unless specifically stated otherwise, and would ordinarily be apparent from the following, a person skilled in the art will appreciate that throughout the present specification, discussions utilizing terms such as "scanning", "calculating", "determining", "replacing", "generating", "initializing", "outputting", and the like, refer to action and processes of an instructing processor/computer system, or similar electronic circuit/device/component, that manipulates/processes and transforms data represented as physical quantities within the described system into other data similarly represented as physical quantities within the system or other information storage, transmission or display devices etc.

Additionally, when describing some embodiments, the disclosure may have disclosed a method and/or process as a particular sequence of steps. However, unless otherwise required, it will be appreciated the method or process should not be limited to the particular sequence of steps disclosed. Other sequences of steps may be possible. The particular order of the steps disclosed herein should not be construed as undue limitations. Unless otherwise required, a method and/or process disclosed herein should not be limited to the steps being carried out in the order written. The sequence of steps may be varied and still remain within the scope of the disclosure.

Further, in the description herein, the word "substantially" whenever used is understood to include, but not restricted to, "entirely" or "completely" and the like. In addition, terms such as "comprising", "comprise", and the like whenever used, are intended to be non-restricting descriptive language in that they broadly include elements/components recited after such terms, in addition to other components not explicitly recited. Further, terms such as "about", "approximately" and the like whenever used, typically means a reasonable variation, for example a variation of +/- 5% of the disclosed value, or a variance of 4% of the disclosed value, or a variance of 3% of the disclosed value, a variance of 2% of the disclosed value or a variance of 1% of the disclosed value.

Furthermore, in the description herein, certain values may be disclosed in a range. The values showing the end points of a range are intended to illustrate a preferred range. Whenever a range has been described, it is intended that the range covers and teaches all possible sub-ranges as well as individual numerical values within that range. That is, the end points of a range should not be interpreted as inflexible limitations. For example, a description of a range of 1% to 5% is intended to have specifically disclosed sub-ranges 1% to 2%, 1% to 3%, 1% to 4%, 2% to 3% etc., as well as individually, values within that range such as 1%, 2%, 3%, 4% and 5%. The intention of the above specific disclosure is applicable to any depth/breadth of a range.

It will be appreciated that although it has been described that the control module of exemplary embodiments can and is suitable for functioning with a socket having a biased terminal, the exemplary embodiments are not limited as such. The control module may function with other sockets and terminals to provide an electric path through the actuator switch.

In the description herein, it will be appreciated that a control module is not limited to being insertable or pluggable into a receptacle of the socket. Furthermore, in the description herein, a control module and a socket are not limited to be detachably coupled to each other. In some exemplary embodiments, a control module may be specifically arranged to mate to a socket. In some other exemplary embodiments, a control module may be integrally coupled to a socket.

Further, in the description herein, a control module is not limited to comprise a mechanical switch as the actuator switch. As described, an electronic switch such as, but not limited to, a field-effect transistor (FET) may be used. As another example, a variable resistor may be used in a control module to control the energization of a relay module.

Further, in the description herein, it will be appreciated that the described exemplary embodiments are not limited to an open and a closed state of a switching circuit. That is, the actuator switch of the described exemplary embodiments may be implemented in any suitable way to provide a turning on or off of a switch function.

Further, in the description herein, it will be appreciated that it is not necessary that a first conductive element be disposed at a base of the control module and that a second conductive element is disposed at the base of the control module. For example, a first conductive element and/or a second conductive element may be disposed at a suitable location to provide an electrical path from the terminals of the socket to the switching circuit.

It will be appreciated by a person skilled in the art that other variations and/or modifications may be made to the specific embodiments without departing from the scope of the present disclosure as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

**CLAIMS**

1. A control module for controlling energization of a relay module, the control module for coupling to a socket which comprises a socket terminal for energising the relay module, the socket terminal being capable of electrical connection with a power terminal of the socket, the control module comprising:

a non-conductive lead for disposing between the socket terminal and the power terminal of the socket;

a first conductive element disposed at a base of the control module;

a second conductive element disposed at the base of the control module, the second conductive element being spaced apart from the first conductive element;

an actuator switch disposed within the control module, the actuator switch being coupled to the first conductive element and the second conductive element, the first conductive element and the second conductive element being arranged to provide an electrical path between the socket terminal and the power terminal of the socket via the actuator switch;

a wireless control module coupled to the actuator switch, the wireless control module comprising a wireless communication module to perform wireless communication with an external device; and wherein

the actuator switch is controllable by the wireless control module.

2. The control module of claim 1, wherein the actuator switch is capable of providing a non-connected state and a connected state between the first and the second conductive elements respectively.

3. The control module of any one of the preceding claims, wherein the non-conductive lead comprises a plastic material.

4. The control module of any one of the preceding claims, wherein the non-conductive lead is configured to be mechanically insertable into a receptacle of the socket to provide the electrical path via the actuator switch between the socket terminal and the power terminal of the socket.

5. The control module of any one of the preceding claims, further comprising a third conductive element for obtaining electrical power for the control module.

6. The control module of any one of the preceding claims, wherein the first conductive element and the second conductive element are capable of controlling the energization of the relay module based on the actuator switch.

5 7. The control module of any one of the preceding claims, wherein the first conductive element is disposed at a periphery of the non-conductive lead for electrical connection to the socket terminal.

10 8. The control module of any one of the preceding claims, wherein the second conductive element is disposed at the periphery of the non-conductive lead for electrical connection to the power terminal of the socket.

15 9. The control module of any one of claims 1 to 6, wherein the first conductive element comprises a first conductive receptacle arranged to receive the socket terminal of the socket.

20 10. The control module of any one of claims 1 to 6 and 9, wherein the second conductive element comprises a second conductive receptacle arranged to receive the power terminal of the socket.

25 11. A system for controlling a relay module, the system comprising:  
a socket which comprises a socket terminal for energizing a relay module, the socket terminal being capable of electrical connection with a power terminal of the socket;  
a control module as claimed in any one of claims 1 to 10 for coupling to the socket; and  
an external device configured to perform wireless communication with the control module.

30 12. The system of claim 11, further comprising the external device arranged to transmit a wireless signal to control an actuator switch disposed within the control module.

35 13. The system of any one of claims 11 to 12, wherein an electrical connection between the socket terminal and a power terminal of the socket is controllable by the control module with a mechanical insertion of the non-conductive lead into a receptacle of the socket.

14. The system of any one of claims 11 to 13, further comprising a power source connected to the socket for powering the control module.

5 15. The system of any one of claims 11 to 14, further comprising a relay module coupled to the socket and is caused to be in an energized state based on the actuator switch being in a closed state; and

the relay module is caused to be in a de-energized state based on the actuator switch being in an open state.

10 16. The system of any one of claims 11 to 15, wherein the socket terminal is biased into electrical connection to the power terminal.

17. A method for controlling energization of a relay module comprising the steps of:

15 providing a control module for coupling to a socket which comprises a socket terminal for energizing the relay module, the socket terminal being capable of electrical connection with a power terminal of the socket;

20 disposing a non-conductive lead of the control module between the socket terminal and the power terminal of the socket;

electrically connecting a first conductive element of the control module to the socket terminal of the socket wherein the first conductive element is disposed at a base of the control module;

25 electrically connecting a second conductive element of the control module to the power terminal of the socket wherein the second conductive element is disposed at the base of the control module;

30 providing an actuator switch of the control module coupled to the first conductive element and the second conductive element, the first conductive element and the second conductive element providing an electrical path between the socket terminal and the power terminal of the socket via the actuator switch;

providing a wireless control module of the control module coupled to the actuator switch, wherein the wireless control module comprises a wireless communication module to perform wireless communication with an external device; and

35 controlling the actuator switch using the wireless control module.

18. The method of claim 17, further comprising providing a non-connected state and a connected state between the first and second conductive elements respectively based on the actuator switch.

5 19. The method of any one of claims 17 to 18, further comprising inserting the non-conductive lead mechanically into a receptacle of the socket and providing the electrical path via the actuator switch between the socket terminal and the power terminal of the socket.

10 20. The method of any one of claims 17 to 19, further comprising controlling the energization state of the relay module based on the actuator switch.

15 21. The method of any one of claims 17 to 20, further comprising providing a third conductive element for coupling to another socket terminal of the socket for powering the control module.

20 22. The method of any one of claims 17 to 21, further comprising providing the first conductive element at a periphery of the non-conductive lead for electrical connection to the socket terminal.

23. The method of any one of claims 17 to 22, further comprising providing the second conductive element at the periphery of the non-conductive lead for electrical connection to the power terminal of the socket.

25 24. The method of any one of claims 17 to 21, further comprising providing the first conductive element comprising a first conductive receptacle arranged to receive the socket terminal of the socket.

30 25. The method of any one of claims 17 to 21 and 24, further comprising providing the second conductive element comprising a second conductive receptacle arranged to receive the power terminal of the socket.