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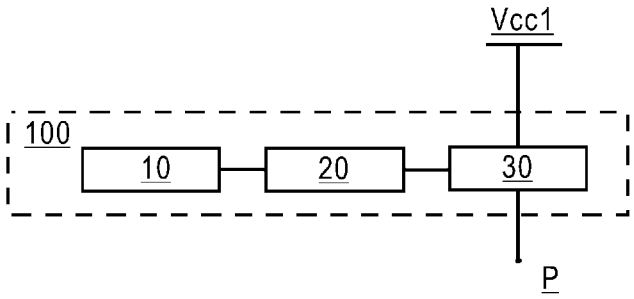

Fig. 1

(57) Abstract: In the embodiments of the present invention, a POE driving circuit is provided, comprising a constant current source module, a control module and a switch module which are connected in sequence, and the switch module is provided between a first voltage source and a first node used for connection of a load, wherein the constant current source module is used for outputting a constant current to the control module when the load is connected at the first node and has a resistance less than a preset maximum resistance; the control module is used for outputting a corresponding level signal to the switch module according to value comparison between the resistance of the load and a preset minimum resistance when the constant current is received; and the switch module is used for controlling the first voltage source on whether to supply power to the load, according to the received level signal. According to the present invention, it is possible to test whether a resistance of a load is within a normal range and enable power supply when the resistance of the load is within the normal range.

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POE Driving Circuit

TECHNICAL FIELD

[001] The present invention relates to the technical field of Power over Ethernet (POE), and especially to a POE driving circuit.

BACKGROUND OF THE INVENTION

[002] In a servo system, it is generally necessary to use a POE port which can provide Ethernet communication and can provide a power source to supply power to a load. In the power supply aspect, after a load is inserted into the POE port, it is necessary to test whether the inserted load is within a normal range, and the power supply to the load is enabled only when it is determined by testing that the above condition is met.

SUMMARY OF THE INVENTION

[003] In an embodiment of the present invention, a POE driving circuit is provided which can test whether a resistance of a load is within a normal range and enable power supply when the resistance of the load is within the normal range.

[004] In an embodiment of the present invention, a POE driving circuit is provided, comprising a constant current source module, a control module and a switch module which are connected in sequence, and the switch module is provided between a first voltage source and a first node used for connection of a load, wherein

the constant current source module is used for outputting a constant current to the control module when the load is connected at the first node and has a resistance less than a preset maximum resistance;

the control module is used for outputting a corresponding level signal to the switch module according to value comparison between the resistance of the load and a preset minimum resistance when the constant current is received; and

the switch module is used for controlling the first voltage source on whether to supply power to the load, according to the received level signal.

[005] The POE driving circuits as provided in the embodiments of the present invention, individually or in combination, can have at least the following technical effects:

(1) When the load is connected at the first node and has a resistance less than a preset maximum resistance, the constant current source module will output a constant current to the control module. Therefore, when the control module receives the constant current, it means that the resistance of the connected load is less than the preset maximum resistance. When the control module receives the constant current, it is only necessary for the control module to compare the resistance of the load with the preset minimum resistance. Further, a corresponding level signal is generated according to the value comparison result and is sent to the switch module. The switch module, after receiving the level signal, will control the first voltage source on whether to supply power to the load according to the level signal. As can be seen, the POE driving circuit(s) as provided in the embodiment(s) of the present invention can test whether the resistance of the load is within a normal range and enable power supply when the resistance of the load is within the normal range.

(2) In an embodiment, the control module comprises a comparison unit which comprises a first comparator. The negative input end of the first comparator has a voltage value equal to a product of the constant current multiplied by the preset minimum resistance, and the positive input end of the first comparator has a voltage value equal to a product of the constant current multiplied by the resistance of the load. Therefore, by comparison of the voltage values, a result of value comparison between the resistance of the load and the preset minimum resistance can be obtained. As can be seen, by comparison of the voltages, it is possible to determine whether the resistance of the load is higher than the preset minimum resistance. In an embodiment, the third voltage source has a voltage value equal to a product of the constant current multiplied by the preset maximum resistance. Therefore, according to whether there is a current in the loop, a result of value comparison between the resistance of the load

and the preset minimum resistance can be obtained. With the determination for the current, it is possible to determine whether the connected load is disconnected and whether the resistance of the load is higher than the preset maximum resistance. As can be seen, it is possible to determine whether the resistance of the load is within a normal range and the power supply to the load is enabled when the resistance of the load is within the normal range, and such logic can be achieved only by the hardware circuit(s), without the related software logic and without high-cost devices having software logic capability, such as a processor or a controller, thus reducing the cost.

(3) In an embodiment, the control module comprises a comparison unit and an optical coupling unit. It is to make judgment by both the output signal from the optical coupling unit and the level signal output from the comparison unit, thus preventing misjudgment and improving accuracy.

DESCRIPTION OF THE DRAWINGS

[006] In order to explain the technical solutions in the embodiments of the present invention or in the prior art more clearly, the figures necessary to be used for description in the embodiments or in the prior art will be briefly introduced as below. Apparently, the figures for the description below are for some embodiments in the present invention. Based on these figures, those skilled in the art can obtain other figures without any inventive work.

[007] Figure 1 is a structural block diagram of a POE driving circuit in an embodiment of the present invention; and

[008] Figure 2 is a circuit diagram of a POE driving circuit, with a load connected, in an embodiment of the present invention.

[009] Reference numerals:

100	POE driving circuit
10	constant current source module
20	control module
30	switch module
Vcc1	first voltage source

P	first node
21	comparison unit
22	optical coupling unit
Vin1	first input voltage
R1	first resistor
R2	second resistor
R3	third resistor
R4	fourth resistor
R5	fifth resistor
U2	second comparator
Vcc3	third voltage source
Iout	constant current
D1	first diode
U1	first comparator
Vd	voltage of positive input end of first comparator
Vin2	voltage of negative input end of first comparator
C1	capacitor
I1	first input end of photoelectric coupler
I2	second input end of photoelectric coupler
O1	first output end of photoelectric coupler
O2	second output end of photoelectric coupler
Rf	pull-up resistor
Vcc2	second voltage source
D2	second diode
Rx	load

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0010] In order to make the objective(s), technical solutions and advantages of embodiments of the present invention clearer, the technical solutions in the embodiments of the present invention will be described clearly and completely hereinafter in connection with the figures in the embodiments of the present invention. Apparently, the described embodiments are some embodiments in the present invention, rather than all embodiments. Any other embodiments obtained

based on the embodiments in the present invention by those skilled in the art without any inventive work will fall within the protection scope of the present invention.

[0011] In an embodiment of the present invention, a POE driving circuit is provided.

[0012] Referring to figure 1, the POE driving circuit 100 comprises a constant current source module 10, a control module 20 and a switch module 30 which are connected in sequence, and the switch module 30 is provided between a first voltage source Vcc1 and a first node P used for connection of a load, wherein

the constant current source module 10 is used for outputting a constant current to the control module when the load is connected at the first node and has a resistance less than a preset maximum resistance;

the control module 20 is used for outputting a corresponding level signal to the switch module according to value comparison between the resistance of the load and a preset minimum resistance when the constant current is received; and

the switch module 30 is used for controlling the first voltage source on whether to supply power to the load, according to the received level signal.

[0013] Herein, the POE is an abbreviation of Power over Ethernet.

[0014] Herein, the first node has a function of connection of the load, and the first node is the POE-P node. Specifically, the load is connected between the POE-P node and a grounded POE-M node. Therefore, it is possible to consider that the load is connected between the POE-P node and a ground end.

[0015] Herein, the preset maximum resistance is configured according to the user requirement, and the preset minimum resistance to be mentioned hereinafter is also configured according to the user requirement. When the resistance of the connected load is between the preset maximum resistance and the preset minimum resistance, the first voltage source will supply power to the load. When the resistance of the connected load is less than or equal to the preset minimum resistance, or higher than or equal to the preset maximum resistance, the first voltage source will not supply power to the load. This is the purpose to be achieved

by the POE driving circuits in the embodiments of the present invention. For this purpose, the POE driving circuit with the above structure is provided in the embodiment(s) of the present invention.

[0016] In the POE driving circuit with the above structure, when the load is connected at the first node and the resistance of the load is less than the preset maximum resistance, the constant current source module will output a constant current to the control module. Thus, when the control module receives the constant current, it means that the resistance of the connected load is less than the preset maximum resistance. When the control module receives the constant current, it is only necessary for the control module to compare the resistance of the load with the preset minimum resistance, and thus generate a corresponding level signal according to the value comparison result and send the level signal to the switch module. The switch module, after receiving the level signal, will control the first voltage source on whether to supply power to the load, according to the level signal.

[0017] For example, when the resistance of the load is higher than the preset minimum resistance, the control module generates the level signal with high level. When the resistance of the load is less than or equal to the preset minimum resistance, the control module generate the level signal with low level. With the high level, the switch module will control the first voltage source to supply power to the load, and with the low level, the switch module will control the first voltage source not to supply power to the load, thus achieving the above purpose.

[0018] In an embodiment, the constant current source module may be further used for: not outputting any current to the control module when the resistance of the load is higher than or equal to the preset maximum resistance; the control module may be further used for not outputting any level signal when the constant current is not received; and the switch module may be further used for controlling the first voltage source not to supply power to the load when the level signal is not received.

[0019] That is, when the resistance of the load is higher than or equal to the preset maximum resistance, the constant current source module will not output any

current to the control module; when the control module fails in receiving the constant current, it will not output the level signal; and when the switch module fails in receiving the level signal, it will not control the first voltage source to supply power to the load. Herein, a processing manner is clearly described for the case of the resistance of the load higher than or equal to the preset maximum resistance, thus further ensuring that the above purpose can be achieved.

[0020] In an embodiment, referring to figure 2, the control module comprises a comparison unit 21 which comprises a first comparator U1 wherein the first comparator U1 has a positive input end connected with the output end of the constant current source module and the first node P, with the load Rx connected between the first node P and a ground end; the first comparator U1 has a negative input end having a voltage value Vin2 equal to a product of the constant current Iout multiplied by the preset minimum resistance; the first comparator has an output end connected with the switch module; and when the control module receives the constant current, the positive input end of the first comparator has a voltage value Vd equal to a product of the constant current Iout multiplied by the resistance of the load Rx; and the first comparator U1 is specifically used for: outputting the level signal as a first level such that the switch module controls the first voltage source Vcc1 not to supply power to the load Rx when the constant current is received and the resistance of the load Rx is less than or equal to the preset minimum resistance and thus the voltage value Vd at the positive input end of the first comparator is less than or equal to the voltage value Vin2 at the negative input end of the first comparator; and outputting the level signal as a second level such that the switch module controls the first voltage source Vcc1 to supply power to the load Rx when the constant current is received and the resistance of the load Rx is higher than the preset minimum resistance and thus the voltage value Vd at the positive input end of the first comparator is higher than the voltage value Vin2 at the negative input end of the first comparator.

[0021] That is, when the load is connected between the first node and the ground end, the output end of the constant current source module, the positive input end of the first comparator, the first node, the load and the ground end are

connected in sequence, thus forming a loop. When a current flows in the loop, it equals to the constant current, and in turn the voltage value at the positive input end of the first comparator equals to a product of the constant current multiplied by the resistance of the load. As can be seen, the voltage value at the positive input end of the first comparator is related to the resistance of the load, and reflects the resistance of the load. The voltage value at the negative input end of the first comparator is a product of the constant current multiplied by the preset minimum resistance. That is, the voltage value at the negative input end of the first comparator is a constant voltage value which reflects the preset minimum resistance.

[0022] It is understandable that when the positive input end of the first comparator receives the constant current, if the resistance of the load is less than or equal to the preset minimum resistance, the voltage value at the positive input end of the first comparator is less than or equal to the voltage value at the negative input end of the first comparator. In this case, the first comparator will output the first level such that the switch module controls the first voltage source not to supply power to the load. When the positive input end of the first comparator receives the constant current, if the resistance of the load is higher than the preset minimum resistance, the voltage value at the positive input end of the first comparator is higher than the voltage value at the negative input end of the first comparator. The first comparator will output the second level such that the switch module controls the first voltage source to supply power to the load.

[0023] For example, when the resistance of the connected load is higher than the preset minimum resistance, the voltage value at the positive input end of the first comparator is higher than the voltage value at the negative input end of the first comparator. In this case, the first comparator will output the level signal with high level such that the switch module controls the first voltage source to supply power to the load. When the resistance of the connected load is less than or equal to the preset minimum resistance, the voltage value at the positive input end of the first comparator is less than or equal to the voltage value at the negative input end

of the first comparator. In this case, the first comparator will output the level signal with low level such that the switch module controls the first voltage source not to supply power to the load.

[0024] As can be seen, the above first comparator can output corresponding level signal to the switch module, according to the value comparison between the resistance of the connected load and the preset minimum resistance, such that the switch module controls the first voltage source on whether to supply power to the load.

[0025] In an embodiment, referring to figure 2, the comparison unit may further comprise a first diode D1 provided between the positive input end of the first comparator and the output end of the constant current source module, with a positive electrode of the first diode D1 connected with the output end the constant current source module and a negative electrode of the first diode D1 connected with the positive input end of the first comparator.

[0026] That is, a first diode is additionally provided between the positive input end of the first comparator and the output end of the constant current source module. With the first diode, in the loop formed by the output end of the constant current source module, the positive input end of the first comparator, the first node, the load and the ground end, the current can flow in only one direction. Therefore, when the voltage value at the positive input end of the first comparator is higher than that of a third voltage source in the constant current source module, the output end of the constant current source module does not output any current. That is, there is no current in the above loop in this case. In this case, the first comparator will not output the level signal, and the switch module will not drive the first voltage source to supply power to the load.

[0027] As can be seen, with the first diode and the third voltage source in the constant current source module, the constant current source module will output the constant current to the control module only when the load is connected at the first node and the resistance of the load is less than the preset maximum resistance.

[0028] Further, referring to figure 2, the control module may further comprise

an optical coupling unit 22 which is provided between the output end of the constant current source module and the positive electrode of the first diode D1 and is connected with the switch module; the optical coupling unit 22 is used for outputting the second level when the constant current output from the constant current source module is received, and not outputting any signal when the constant current output from the constant current source module is not received; wherein when the optical coupling unit 22 outputs the second level and the comparison unit 21 outputs the first level, the second level output from the optical coupling unit 22 is pulled to the first level such that the switch module controls the first voltage source Vcc1 not to supply power to the load Rx; when the optical coupling unit 22 outputs the second level and the comparison unit 21 outputs the second level, the switch module can control the first voltage source Vcc1 to supply power to the load Rx.

[0029] As can be seen, in the above loop, an optical coupling unit is provided between the output end of the constant current source module and the positive electrode of the first diode, and both the optical coupling unit and comparison unit are connected with the switch module. The optical coupling unit, when receiving the constant current output from the constant current source module, will output the second level, such as a high level. When the optical coupling unit outputs the second level, the comparison unit may output the second level or may output the first level, depending on the value comparison result between the resistance of the load and the preset minimum resistance.

[0030] For example, when the resistance of the load is less than or equal to the preset minimum resistance, the first comparator will output a low level. As the optical coupling unit outputs a high level, the high level output by the optical coupling unit will be pulled down to the low level. Thus, the switch module will receive the level signal with low level. When the resistance of the load is higher than the preset minimum resistance and is less than the preset maximum resistance, the first comparator will output a high level. As the optical coupling unit outputs a high level, the switch module will receive the level signal with high level.

[0031] That is, if the resistance of the load is between the preset maximum

resistance and the preset minimum resistance, the optical coupling unit will output a high level and the first comparator will output a high level. The switch module will control the first voltage source to supply power to the load only when both of the optical coupling unit and the first comparator output high levels. If either of the first comparator and the optical coupling unit outputs a low level, the switch module will receive the level signal with low level. Therefore, with judgment by both cases, it is possible to prevent misjudgment.

[0032] Further, referring to figure 2, the optical coupling unit 22 may comprise a photoelectric coupler; the photoelectric coupler has a first input end I1 connected with the output end of the constant current source, and a first output end O1 connected with the positive electrode of the first diode D1 and corresponding to the first input end I1; and the photoelectric coupler has a second input end I2 connected via a pull-up resistor Rf with a second voltage source Vcc2 and a second output end O2 connected with the switch module and corresponding to the second input end I2. The constant current is less than a driving current of the photoelectric coupler.

[0033] That is, the photoelectric coupler has four ends: a first input end, a first output end, a second input end and a second output end wherein the first input and output ends are a pair of ends, and the second input and output ends are a pair of ends. That is, the current flowing in the first input end will be output from the first output end, and the current flowing in the second input end will be output from the second output end. The first input end is connected with the output end of the constant current source. Therefore, when the first input end of the photoelectric coupler receives the constant current, the constant current will flow from the first output end and further to the positive electrode of the first diode. The second input end of the photoelectric coupler is connected with an end of the pull-up resistor and the other end of the pull-up resistor is connected with the second voltage source. Thus, when the constant current is received at the first input end, the second voltage source will generate a driving current by the pull-up resistor. The driving current then flows from the second input end into the photoelectric coupler such that a second level is output at the second output end. Herein, the constant

current is less than the driving current of the photoelectric coupler. Therefore, as long as the constant current flows into the first input end, the photoelectric coupler will output a second level at the second output end.

[0034] In an embodiment, the constant current source module may be further used for: not outputting any current to the control module when the load is disconnected from the ground end or from the first node such that the photoelectric coupler does not output any signal at its second output end and the first comparator does not output any signal at its output end; and the switch module is used for controlling the first voltage source not to supply power to the load when the photoelectric coupler does not output any signal and the first comparator does not output any signal.

[0035] That is, when the load is disconnected from the ground end or from the first node, the loop formed by the output end of the constant current source module, the optical coupling unit, the first diode, the positive input end of the first comparator, the first node and the ground end is disconnected. That is, the loop is in the open-circuit state. Therefore, the constant current does not exist in the loop. Further, the photoelectric coupler will not output any signal at its second output end and the first comparator will not output any signal at its output end. Thus, the switch module controls the first voltage source not to supply power to the load.

[0036] In an embodiment, referring to figure 2, the constant current source module may comprise a second comparator U2, a third voltage source Vcc3, a first resistor R1, a second resistor R2, a third resistor R3, a fourth resistor R4 and a fifth resistor R5 wherein

the first resistor R1 is connected between a positive input end of the second comparator U2 and a first input voltage Vin1; the second resistor R2 is connected between a negative input end of the second comparator U2 and the output end of the constant current source module; the third resistor R3 is connected between an output end of the second comparator and the output end of the constant current source module, wherein the third resistor has a resistance equal to that of the second resistor; the fourth resistor R4 is connected between the negative input end of the second

comparator and the ground end; the fifth resistor R5 is connected between the negative input end of the second comparator U2 and the output end of the second comparator U2, the fifth resistor R5 has a resistance equal to that of the fourth resistor R4; and the second comparator U2 is connected with the third voltage source Vcc3, and the third voltage source Vcc3 has a voltage value equal to a product of the constant current Iout multiplied by the preset maximum resistance.

[0037] Herein, the third resistor has a resistance equal to that of the second resistor and the fifth resistor has a resistance equal to that of the fourth resistor. These two conditions are provided to ensure that the constant current source module can output the constant current. The third voltage source has a voltage value equal to a product of the constant current multiplied by the preset maximum resistance. That is, the third voltage source has a constant voltage value which is equal to a product of the constant current multiplied by the preset maximum resistance. Therefore, when the resistance of the load is less than the preset maximum resistance, the voltage value at the positive input end of the first comparator is less than the voltage value of the third voltage source, and the constant current source module will output the constant current only in this case. When the resistance of the load is higher than or equal to the preset maximum resistance, the voltage value at the positive input end of the first comparator is higher than or equal to the voltage value of the third voltage source, and the constant current source module will not output the constant current in this case. The voltage of the third voltage source ensures that when the load is connected at the first node and the resistance of the load is less than the preset maximum resistance, the constant current source module will output the constant current to the control module.

[0038] Herein, the constant current depends on the first input voltage and the value comparison result between the resistors.

[0039] In an embodiment, referring to figure 2, the switch module may comprise a metal oxide semiconductor (MOS) tube which has a source electrode used as an input end of the switch module, a gate electrode connected with the first voltage source, and a drain electrode connected with the first node, wherein a second

diode D2 is connected in parallel between the gate electrode and the drain electrode of the MOS tube.

[0040] For example, the MOS tube is a NMOS tube. When the source electrode of the NMOS tube receives a high level, the gate electrode and the drain electrode are conducted to each other, and thus the first voltage source will supply power to the load. When the source electrode of the NMOS tube receives a low level, the gate electrode and the drain electrode are not conducted to each other, and thus the first voltage source will not supply power to the load. As can be seen, it is very simple and easy to use the MOS tube as the switch module to control the first voltage source on whether to supply power to the load.

[0041] In an embodiment, referring to figure 2, a capacitor C1 is connected between the output end of the first comparator U1 and the ground end.

[0042] It is understandable that with the capacitor provided between the output end of the first comparator U1 and the ground end, a filtering function can be achieved.

[0043] For example, when the resistance of the load is less than or equal to the preset minimum resistance, the voltage value at the positive input end of the first comparator is less than or equal to the voltage value at the negative input end of the first comparator, and thus the first comparator will output a low level. In this case, the photoelectric coupler is in the ON state and its second output end outputs a high level. However, the high level will be pulled down by the low level output by the first comparator. Therefore, the NMOS tube can not be opened, that is, the gate electrode and the drain electrode are in the cut-off state therebetween. When the resistance of the load is higher than or equal to the preset maximum resistance, the voltage value at the positive input end of the first comparator is higher than the power supply voltage of the second comparator in the constant current source module, i.e. the voltage of the third voltage source. Therefore, in the loop formed by the output end of the constant current source module, the first input end and the first output end of the photoelectric coupler, the first diode, the positive input end of the first comparator, the first node, the load and the ground

end, no current exists, that is, the loop is in the open-circuit state. Therefore, the photoelectric coupler will not output any signal at its second output end and the first comparator will not output any signal at its output end. Thus, the gate electrode and the drain electrode of the NMOS tube are in the cut-off state therebetween. Therefore, in the above two cases, the first voltage source will not supply power to the load. When the resistance of the load is less than the preset maximum resistance and is higher than the preset minimum resistance, the voltage value at the positive input end of the first comparator is less than that of the third voltage source. Therefore, the constant current exists in the loop, and the photoelectric coupler will output a high level. Moreover, the voltage value at the positive input end of the first comparator is higher than the voltage value at the negative input end of the first comparator, and thus the first comparator will output a high level. Therefore, the gate electrode and the drain electrode of the NMOS tube are in the conduction state therebetween, and the first voltage source will supply power to the load. After normal power supply for a period of time, the load is disconnected by the user. Then the loop where the load is connected is disconnected, that is, the loop is in the open-circuit state. In this case, there is no current in the above loop. Further, the photoelectric coupler will not output any signal and the first comparator will not output any signal. Thus, the gate electrode and the drain electrode of the NMOS tube are in the cut-off state therebetween and the first voltage source will stop supplying power to the load.

[0044] As can be seen, based on the above POE driving circuit(s), it is possible to test whether the resistance of the load is within a normal range, to supply power to the load when the resistance of the load is within the normal range, and not to supply power to the load when the resistance of the load is not within the normal range. After the load is disconnected from the POE port, the power supply to the load is stopped.

[0045] As can be seen, in the POE driving circuit(s) as provided in the embodiment(s) of the present invention, with the determination for the current, it is possible to determine whether the connected load is disconnected and whether the

resistance of the load is higher than the preset maximum resistance. By comparison of the voltages, it is possible to determine whether the resistance of the load is higher than the preset minimum resistance. In the embodiment(s) of the present invention, it is possible to determine whether the resistance of the load is within a normal range and the power supply to the load is enabled when the resistance of the load is within the normal range, and such logic can be achieved only by the hardware circuit(s), without the related software logic and without high-cost devices having software logic capability, such as a processor or a controller, thus reducing the cost.

[0046] The embodiments in the present description are described in a gradually progressive manner. The same or similar portions between different embodiments can be referred to each other. Each embodiment emphasizes in explaining the difference(s) with respect to other embodiment(s). In particular, as the apparatus/device embodiments are substantially similar to the method embodiments, the description thereof is relatively simple, and the description of the method embodiments may be referred to for the related portions.

[0047] With the above-described specific embodiments, the purposes, technical solutions and beneficial effects of the present invention are further explained in detail. It should be understood that the above description is only for specific embodiments in the present invention, not for defining the protection scope of the present invention. Any variation, equivalent substitution or improvement made based on the technical solutions of the present invention will fall within the protection scope of the present invention.

CLAIMS

1. A Power over Ethernet (POE) driving circuit, characterized in that it comprises a constant current source module, a control module and a switch module which are connected in sequence, and the switch module is provided between a first voltage source and a first node used for connection of a load, wherein

the constant current source module is used for outputting a constant current to the control module when the load is connected at the first node and has a resistance less than a preset maximum resistance;

the control module is used for outputting a corresponding level signal to the switch module according to value comparison between the resistance of the load and a preset minimum resistance when the constant current is received; and

the switch module is used for controlling the first voltage source on whether to supply power to the load, according to the received level signal.

2. The POE driving circuit according to claim 1, characterized in that

the constant current source module is further used for not outputting any current to the control module when the resistance of the load is higher than or equal to the preset maximum resistance;

the control module is further used for not outputting any level signal when the constant current is not received; and

the switch module is further used for controlling the first voltage source not to supply power to the load when the level signal is not received.

3. The POE driving circuit according to claim 1, characterized in that the control module comprises a comparison unit which comprises a first comparator wherein

the first comparator has a positive input end connected with an output end of the constant current source module and the first node, with the load connected between the first node and a ground end; the first comparator has a negative input end having a voltage value equal to a product of the constant current multiplied by the preset minimum resistance; the first comparator has an output end connected with the switch

module; and when the control module receives the constant current, the positive input end of the first comparator has a voltage value equal to a product of the constant current multiplied by the resistance of the load; and

the first comparator is specifically used for: outputting the level signal as a first level such that the switch module controls the first voltage source not to supply power to the load when the constant current is received and the resistance of the load is less than or equal to the preset minimum resistance and thus the voltage value at the positive input end of the first comparator is less than or equal to that at the negative input end of the first comparator; and outputting the level signal as a second level such that the switch module controls the first voltage source to supply power to the load when the constant current is received and the resistance of the load is higher than the preset minimum resistance and thus the voltage value at the positive input end of the first comparator is higher than that at the negative input end of the first comparator.

4. The POE driving circuit according to claim 3, characterized in that the comparison unit further comprises a first diode provided between the positive input end of the first comparator and the output end of the constant current source module, with a positive electrode of the first diode connected with the output end the constant current source module and a negative electrode of the first diode connected with the positive input end of the first comparator.

5. The POE driving circuit according to claim 4, characterized in that the control module further comprises an optical coupling unit which is provided between the output end of the constant current source module and the positive electrode of the first diode and is further connected with the switch module; the optical coupling unit is used for outputting the second level when the constant current output from the constant current source module is received, and not outputting any signal when the constant current output from the constant current source module is not received;

wherein when the optical coupling unit outputs the second level and the comparison unit outputs the first level, the second level output from the optical

coupling unit is pulled to the first level such that the switch module controls the first voltage source not to supply power to the load; when the optical coupling unit outputs the second level and the comparison unit outputs the second level, the switch module can control the first voltage source to supply power to the load.

6. The POE driving circuit according to claim 5, characterized in that the optical coupling unit comprises a photoelectric coupler; the photoelectric coupler has a first input end connected with the output end of the constant current source, and a first output end connected with the positive electrode of the first diode and corresponding to the first input end; and the photoelectric coupler has a second input end connected via a pull-up resistor with a second voltage source and a second output end connected with the switch module and corresponding to the second input end, wherein the constant current is less than a driving current of the photoelectric coupler.

7. The POE driving circuit according to claim 6, characterized in that

the constant current source module is further used for not outputting any current to the control module when the load is disconnected from the ground end or from the first node such that the photoelectric coupler does not output any signal at the second output end and the first comparator does not output any signal at the output end; and

the switch module is used for controlling the first voltage source not to supply power to the load when the photoelectric coupler does not output any signal and the first comparator does not output any signal.

8. The POE driving circuit according to claim 1, characterized in that the constant current source module comprises a second comparator, a third voltage source, a first resistor, a second resistor, a third resistor, a fourth resistor and a fifth resistor wherein

the first resistor is connected between a positive input end of the second comparator and a first input voltage;

the second resistor is connected between a negative input end of the second comparator and the output end of the constant current source module;

the third resistor is connected between an output end of the second comparator and the output end of the constant current source module, wherein the third resistor

has a resistance equal to that of the second resistor;

the fourth resistor is connected between the negative input end of the second comparator and the ground end;

the fifth resistor is connected between the negative input end of the second comparator and the output end of the second comparator, the fifth resistor has a resistance equal to that of the fourth resistor; and

the second comparator is connected with the third voltage source, and the third voltage source has a voltage value equal to a product of the constant current multiplied by the preset maximum resistance.

9. The POE driving circuit according to claim 1, characterized in that the switch module comprises a MOS tube which has a source electrode used as an input end of the switch module, a gate electrode connected with the first voltage source, and a drain electrode connected with the first node, wherein a second diode is connected in parallel between the gate electrode and the drain electrode of the MOS tube.

10. The POE driving circuit according to claim 3, characterized in that a capacitor is connected between the output end of the first comparator and the ground end.

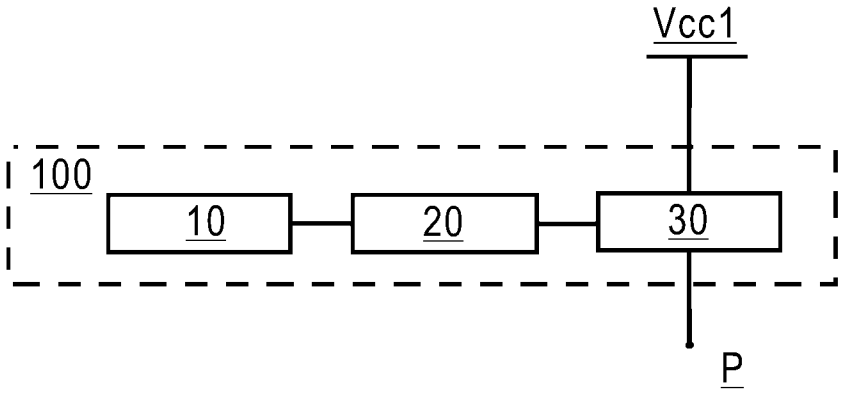

Fig. 1

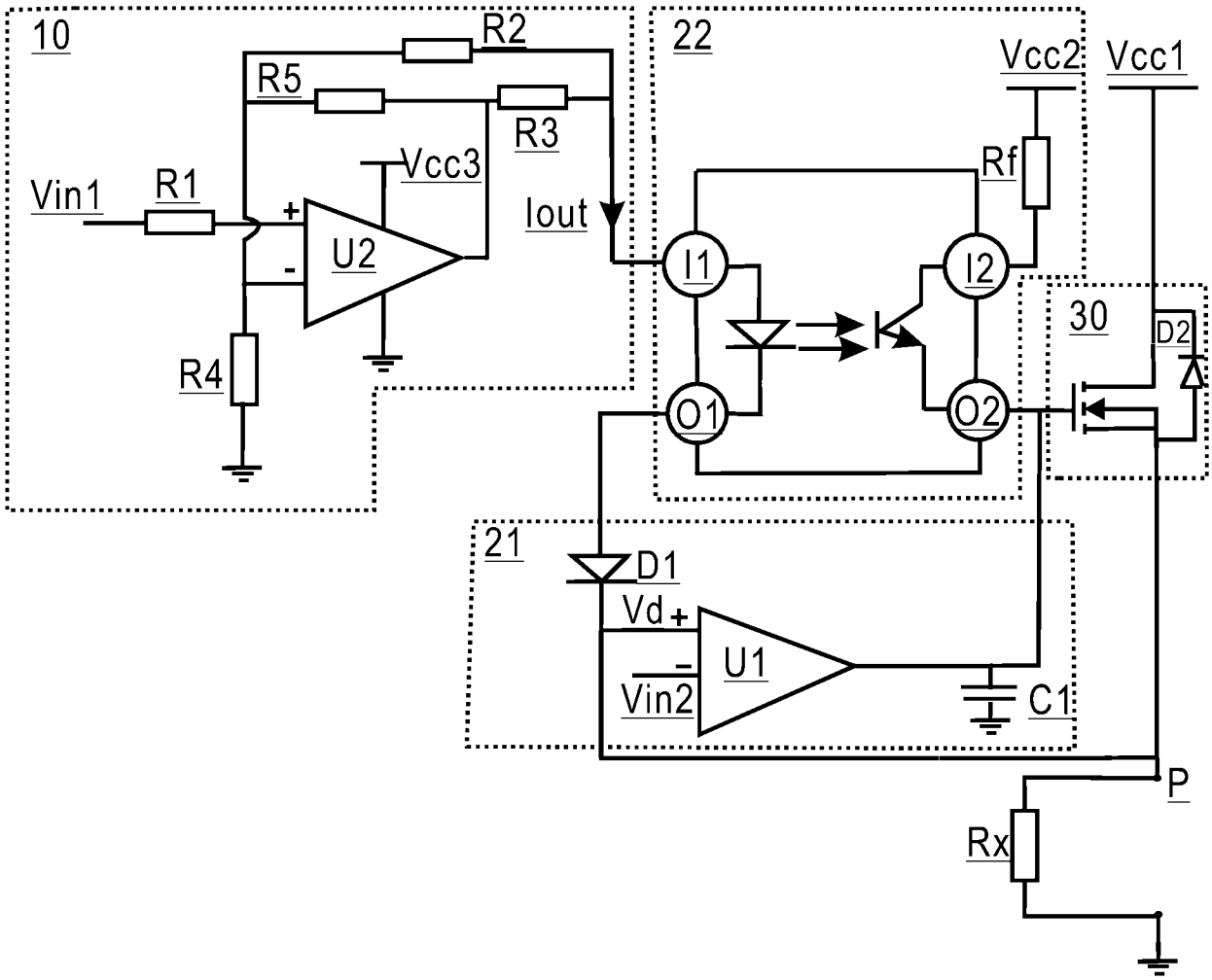
10
R2
R5
R3
Vin1
R1
Vcc3
U2
+
-
R4
Iout
22
Vcc2
Vcc1
Rf
I1
I2
O1
O2
30
D2
21
D1
Vd+
-
Vin2
U1
C1
P
Rx

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2023/085636

A. CLASSIFICATION OF SUBJECT MATTER

H04L12/10(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC:H04L,H02H,G01R

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNKI,CNTXT,DWPI,VEN:POE, driving, circuit, supply, power, enable, disable, start, turn on, off, cut, stop, compare, threshold, range, resistance, current, voltage, switch, load, level signal, input, output, MOS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 105048439 A (FUJIAN STAR NET RUIJIE NETWORK CO., LTD.) 11 November 2015 (2015-11-11) description, paragraphs 2-34, 49-87, figures 1, 3	1-10
A	CN 110431344 A (HUBBELL INCORPORATED) 08 November 2019 (2019-11-08) the whole document	1-10
A	US 2018139062 A1 (GENERAL ELECTRIC COMPANY) 17 May 2018 (2018-05-17) the whole document	1-10
A	US 2009085586 A1 (MICREL, INC.) 02 April 2009 (2009-04-02) the whole document	1-10
A	US 2021306750 A1 (SENNHEISER ELECTRONIC GMBH & CO. KG) 30 September 2021 (2021-09-30) the whole document	1-10

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 December 2023	**07 December 2023**

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2023/085636

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 105048439 A	11 November 2015	None	
CN 110431344 A	08 November 2019	US 2018235055 A1	16 August 2018
		EP 3583348 A1	25 December 2019
		WO 2018152057 A1	23 August 2018
		US 2022141941 A1	05 May 2022
US 2018139062 A1	17 May 2018	None	
US 2009085586 A1	02 April 2009	None	
US 2021306750 A1	30 September 2021	EP 3890155 A1	06 October 2021
		DE 102020108855 A1	30 September 2021