

(12) STANDARD PATENT APPLICATION (11) Application No. AU 2024219389 A1
(19) AUSTRALIAN PATENT OFFICE

(54) Title
CONTROL SYSTEM FOR DEVICE HAVING DC ELECTRIC MOTOR

(51) International Patent Classification(s)
H02P 6/06 (2006.01) **H02P 6/28** (2016.01)
H02P 6/08 (2016.01)

(21) Application No: **2024219389** (22) Date of Filing: **2024.09.04**

(43) Publication Date: **2026.03.19**

(43) Publication Journal Date: **2026.03.19**

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(56) Related Art
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US 2015/0349677 A1
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CN 211474491 U

Abstract

An electrical signal processing unit for facilitating the control of a Direct Current (DC) motor by an operator control input unit adapted to control an Alternating Current (AC) motor, wherein said signal processing unit is adapted to apply radio frequency (RF) modulation of the peaks of an AC electrical wave in a manner that modify said wave in a manner that allows a microcontroller associated with said DC motor to recognise an intended control signal characterised by said wave modulation; and wherein said unit is adapted to be interposed between said operator control input unit and said DC motor by direct connection in the electrical power circuit supplying the DC motor.

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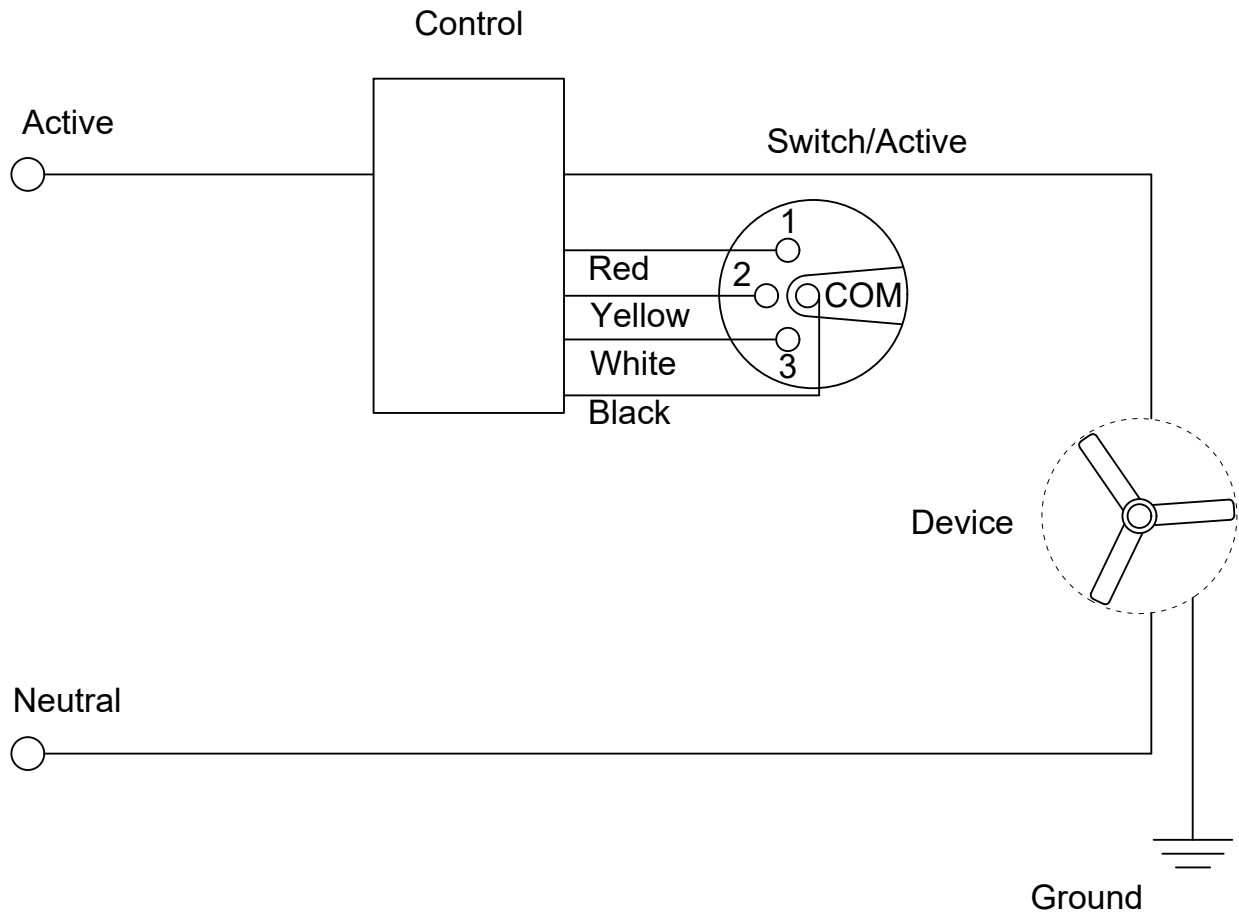


FIG. 3

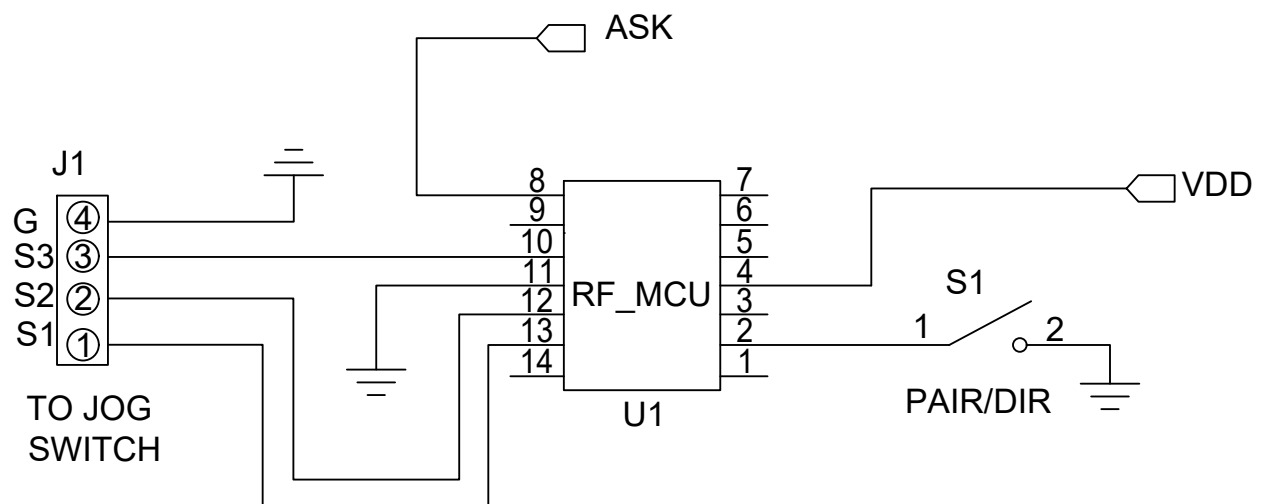


FIG. 4

CONTROL SYSTEM FOR DEVICE HAVING DC ELECTRIC MOTOR

Technical Field

[0001] The invention relates to the field of domestic electric device manufacture. In particular, the invention relates to an improved control system for an electric device that operates via a direct current (DC) electric motor.

Background of the Invention

[0002] Domestic electrical devices, particularly this that operate via mechanical rotation, typically use motors that run either on Alternating Current (AC) electrical input or Direct Current (DC) electrical input.

[0003] Most household electrical items run on AC input, as this is the most common form of electrical current supply. However, there is a growing demand for DC operable devices. DC operating devices tend to be more energy efficient, run cooler and tend to operate quieter. Also, DC motors can be more compact and lighter, allowing greater flexibility for more aesthetic designs to be achieved for given devices, where this is desirable.

[0004] However, a drawback with DC motors is that they are not typically able to be controlled (e.g. on/off, speed, reverse) via a wall-mounted controller. They are typically only controllable via a remote-control unit, that sends a signal to a receiver attached to the DC motor in the device.

[0005] Remote control units are not always popular or desirable. They require batteries for power and the units can often be lost or broken.

[0006] AC operable devices, on the other hand, can be controlled via a permanently wall-mounted control unit that is hard-wired directly into the electrical supply wiring for the device. This avoids the above described issued with remote controls. These typically use TRIAC controllers.

[0007] Therefore, for users desiring a DC powered device, there is a need to provide an improved electrical control system that is compatible with a DC motor, but which does not have the same drawbacks as those used for AC fans.

[0008] Accordingly, it is an object of the invention to provide a DC powered device control system and device that ameliorates at least some of the problems associated with the prior art.

Summary of the Invention

[0009] The invention relates to an electrical signal processing step, and a device adapted to carry out same, that can effectively interpret the output signal of the typical AC-type wall-mounted controller unit into a signal that can be received by a typical DC motor controller, allowing the DC motor to be controlled by inputs from the AC controller unit (such as a typical wall-mounted and hard-wired controller for an AC powered domestic electrical device).

[0010] Therefore, according to a first aspect of the invention, there is provided an electrical signal processing unit for facilitating the control of a Direct Current (DC) motor by an operator control input unit adapted to control an Alternating Current (AC) motor, wherein said signal processing unit is adapted to modulate the AC electrical wave in a manner that modify said wave in a manner that allows a microcontroller associated with said DC motor to recognise an intended control signal characterised by said wave modulation; and wherein said unit is adapted to be interposed between said operator control input unit and said DC motor by direct connection in the electrical power circuit supplying the DC motor.

[0011] Preferably, said signal processing unit is configured to modulate the wave peak of the AC power current wave in accordance with the desired control signal to the DC motor. It is further preferred that said signal processing unit applies radio frequency (RF) modulation to the AC current wave, and wherein said modulation is decodable by a DC motor microcontroller associated with said DC motor.

[0012] Specifically, the operation is to convert a capacitor-type signal to an RF signal by 'injecting' a signal overlay that acts to modulate the amplitude at the peaks of the AC sine wave, which is then read as an RF signal by the DC motor controller.

[0013] Said RF modulation is preferably done at approximately 433 MHz, but other frequencies may be used.

[0014] The above-described invention presents a significant advance in the control of some types of DC electric powered devices. The ability to control the speed and rotation direction of e.g. a ceiling fan by using a normal hard-wired wall controller (of the

type usually used only for AC powered devices) is new and substantially solves the problem outlined above with respect to remote controls being the only available method of controlling a DC device.

[0015] This further means that, by retrofitting the above-described device to existing wiring for an AC device, the installation of a replacement DC device can be achieved without substantial re-wiring.

[0016] It should also be understood that the present invention only requires connection to the active electrical supply wiring and does not need to be connected to a neutral or earth, which greatly simplifies the installation of the device and system according to the invention.

[0017] This invention changes the DC device market by enabling DC devices to be hardwired to a standard wall controller unit, as per AC Devices, by using standard AC wiring (active & switch wire only). The controller unit according to the invention converts a mechanical switch signal, inputted via a mechanical speed controller knob, to an RF signal, while not requiring any further wiring unlike other existing products known in the art. Therefore, the system according to the invention gives the user all of the benefits of a DC powered device without any modification to existing wiring.

[0018] According to another aspect of the invention, there is provided a control system for a direct current (DC) motor that modifies a signal from an operator control input unit adapted to control an alternating current (AC) motor to a signal capable of being recognised and processed by said DC motor; said system comprising: an electrically powered device having a DC motor that is controlled via a microcontroller; an operator control unit having a user interface and being adapted to control an AC motor; an electrical signal processing unit that is electrically connected between said control unit and said DC motor; wherein said control unit is connected to active AC wiring and sends an electrical control signal of a type normally send to an AC motor, and wherein said processing unit is configured to modify said signal sufficiently for it to be received by said DC motor and to control the operation of the DC motor.

[0019] Preferably, said signal processing unit is not connected to a neutral electrical wire, as it can operate by being connected to active electrical supply wires only. This is an advantage as there is no need to instal neutral wiring, which is typically not conveniently available in modern dwellings, so this greatly simplifies the installation process.

[0020] Preferably, said signal processing unit is configured to modulate the wave peak of the AC current wave in accordance with the desired control signal to the DC motor, and more preferably, said signal processing unit applies radio frequency (RF) modulation to the AC current wave, preferably at 433 MHz, which is read by the DC motor controller as a pulse arriving along the same wiring as the AC power supply.

[0021] According to another aspect of the invention, there is provided a method of controlling a DC electric motor using an AC wired control unit; said method including the step of placing an electrical signal processing unit in electrical connection between said control unit and said DC motor; wherein said signal processing unit is configured to modify said signal sufficiently for it to be received by said DC motor and to control the operation of the DC motor.

[0022] Now will be described, by way of a specific, non-limiting example, a preferred embodiment of the invention with reference to the drawings.

Brief Description of the Drawings

[0023] Figure 1 is a schematic circuit wiring diagram of a typical hard-wired control system for an AC powered electrical device (or similar device) according to the prior art.

[0024] Figure 2 is a schematic circuit wiring diagram of a typical remote-control system for a DC powered electrical device (or similar device) according to the prior art.

[0025] Figure 3 is a schematic circuit wiring diagram for a control system for a DC powered electrical device (or similar device) according to the invention.

[0026] Figure 4 is a schematic circuit diagram for a signal processing unit according to the invention.

[0027] Figure 5 is a schematic circuit diagram for an RF modulation unit according to the invention.

[0028] Figure 6 is a graphical representation of the wave modulation effected by the signal processing unit according to the invention.

[0029] Figure 7 is a schematic circuit diagram for an AC/DC power converter and motor control system for a DC powered device according to the invention.

Detailed Description of the Invention

[0030] The invention relates to an electrical signal processing step, and a TRIAC device adapted to carry out same, that can effectively interpret the output signal of the typical AC-type wall-mounted controller unit into a signal that can be received by a typical DC motor controller, allowing the DC motor to be controlled by inputs from the AC controller unit (such as a typical wall-mounted and hard-wired controller for an AC powered electrical device).

[0031] The following description relates particularly to electrical devices having a DC powered electric motor, however the inventive concept can also be applied to other types of DC electric motor-powered devices with minimal modification.

[0032] Figure 1 is a schematic circuit wiring diagram of a typical hard-wired control system for an AC powered electrical device (or similar device) according to the prior art. In this system, the live electrical supply wiring passes in parallel through the hard-wired wall-mounted device controller (and optionally through a light switch if a light is present on the device). The signal passes directly from the controller to the transformer in the electrical device and the device speed is modulated by direct changes in the AC current at the transformer.

[0033] Figure 2 is a schematic circuit wiring diagram of a typical remote-control system for a DC powered device according to the prior art. In this system, the DC remote control unit is attached to both active and neutral power supply wiring, independent of the active and neutral wiring to the device. The device speed control operates independently of the wiring via an RF signal send from the remote-control unit to the DC controller.

[0034] Figure 3 is a schematic circuit wiring diagram for a control system for a DC powered device according to the invention. In this embodiment of the inventive system, the active wiring passes through the wall control unit (as per the prior art AC system in figure 1, and the TRIAC signal processing unit injects an RF like signal overlay on the AC current e.g. as an increase in sine wave amplitude.

[0035] When the TRIAC is activated and triggered under the control of a bidirectional trigger diode, it has the characteristic of 'missing' conduction angle. The equivalent voltage corresponding to this missing conduction angle can be used to meet the use of electronic systems with low voltage and small current. The single live wire remote control uses this feature to rectify and filter the equivalent AC voltage

corresponding to the missing conduction angle, and then step down to 3.3V through DC/DC conversion, which is used as a power supply for MCU and RF transmission.

[0036] When the MCU detects that the user rotates a speed switch on the wall-mounted controller, or presses the "forward/reverse F/R button" on a remote handpiece, it transmits the corresponding RF command signal according to the requested operation. The RF signal is transmitted through wire conduction and space radiation. After the device electric control unit receives the RF command, it decodes and executes the corresponding action to realize the remote control function within an effective distance.

[0037] This is illustrated in figure 6, which is a graphical representation of the wave modulation effected by the TRIAC signal processing unit according to the invention. It can be seen how the AC sine wave is modulated by the input of the signal processing unit – this increase is then read at the DC motor controller as a signal to e.g. increase device speed by a pre-set amount.

[0038] Figure 4 is a schematic circuit diagram for a signal processing unit according to the invention. The signal processing unit (RF_MCU) receives active current input from the active wiring (VDD) and receives command input from the speed controller jog switch and converts that to an amplitude shift keying (ASK) output modulation that modifies the AC sinewave along the subsequent wiring to the motor controller, located in the device adjacent the DC motor.

[0039] Figure 5 is a schematic circuit diagram for an RF modulation unit according to the invention. The modulated AC signal (ASK) from the control signal processor (RF_MCU) is received by the motor control processor (PT4455) which can be programmed to convert that ASK signal to e.g. an 'increase speed' command to the DC motor output.

[0040] The ASK modulation does not need to be complex, for example the command interpreted by the signal could simply be to move to the next speed setting in a cyclical manner, such as:

[0041] OFF <signal> SPEED 1 <signal> SPEED 2 <signal> SPEED 3 <signal> OFF

[0042] Figure 7 is a schematic circuit diagram for an AC/DC power converter and motor control system for a DC powered electrical device or similar device according to the invention.

[0043] The major advantages of the system as described above include the lack of need to wire the controller to a neutral wire – it operates by operation on active wiring alone. It also allows the DC motor to be controlled via an AC type control input unit, which allows the DC device to be installed and controlled without changing to a remote-style controller, simply by retrofitting the signal processing unit to an existing controller and to the active AC wiring.

[0044] It will be appreciated by those skilled in the art that the above-described embodiment is merely one example of how the inventive concept can be implemented. It will be understood that other embodiments may be conceived that, while differing in their detail, nevertheless fall within the same inventive concept and represent the same invention.

Claims

1. An electrical signal processing unit for facilitating the control of a Direct Current (DC) motor by an operator control input unit adapted to control an Alternating Current (AC) motor, wherein said signal processing unit is adapted to apply radio frequency (RF) modulation of the peaks of an AC electrical wave in a manner that modify said wave in a manner that allows a microcontroller associated with said DC motor to recognise an intended control signal characterised by said wave modulation; and wherein said unit is adapted to be interposed between said operator control input unit and said DC motor by direct connection in the electrical power circuit supplying the DC motor.
2. The electrical signal processing unit of claim 1, wherein said signal processing unit is configured to modulate the wave peak of the AC power current wave in accordance with the desired control signal to the DC motor.
3. The control system of claim 2, wherein said signal processing unit applies radio frequency (RF) modulation to the AC current wave and wherein said modulation is decodable by the DC motor microcontroller.
4. The control system of claim 3, wherein said RF modulation is done at approximately 433 MHz.
5. A control system for a Direct Current (DC) motor that modifies a signal from an operator control input unit adapted to control an Alternating Current (AC) motor to a signal capable of being recognised and processed by said DC motor; said system comprising:

an electrically powered device having a DC motor that is controlled via a microcontroller;

a operator control unit having a user interface and being adapted to control an AC motor;

an electrical signal processing unit that is electrically connected between said control unit and said DC motor;

wherein said control unit is connected to active AC wiring and sends an electrical control signal of a type normally send to an AC motor, and wherein said processing unit

is configured to modify said signal sufficiently for it to be received by said DC motor and to control the operation of the DC motor.

6. The control system of claim 5, wherein said signal processing unit is not connected to a neutral wire.

7. The control system of claim 5, wherein said signal processing unit is configured to modulate the wave peak of the AC current wave in accordance with the desired control signal to the DC motor.

8. The control system of claim 7, wherein said signal processing unit applies radio frequency (RF) modulation to the AC current wave.

9. The control system of claim 8, wherein said RF modulation is done at 433 MHz.

10. A method of controlling a DC electric motor using an AC wired control unit; said method including the step of placing an electrical signal processing unit in electrical connection between said control unit and said DC motor; wherein said signal processing unit is configured to modify said signal sufficiently for it to be received by said DC motor and to control the operation of the DC motor.

11. A electrical device control unit incorporating the electrical signal processing unit according to any one of claims 1 to 4.

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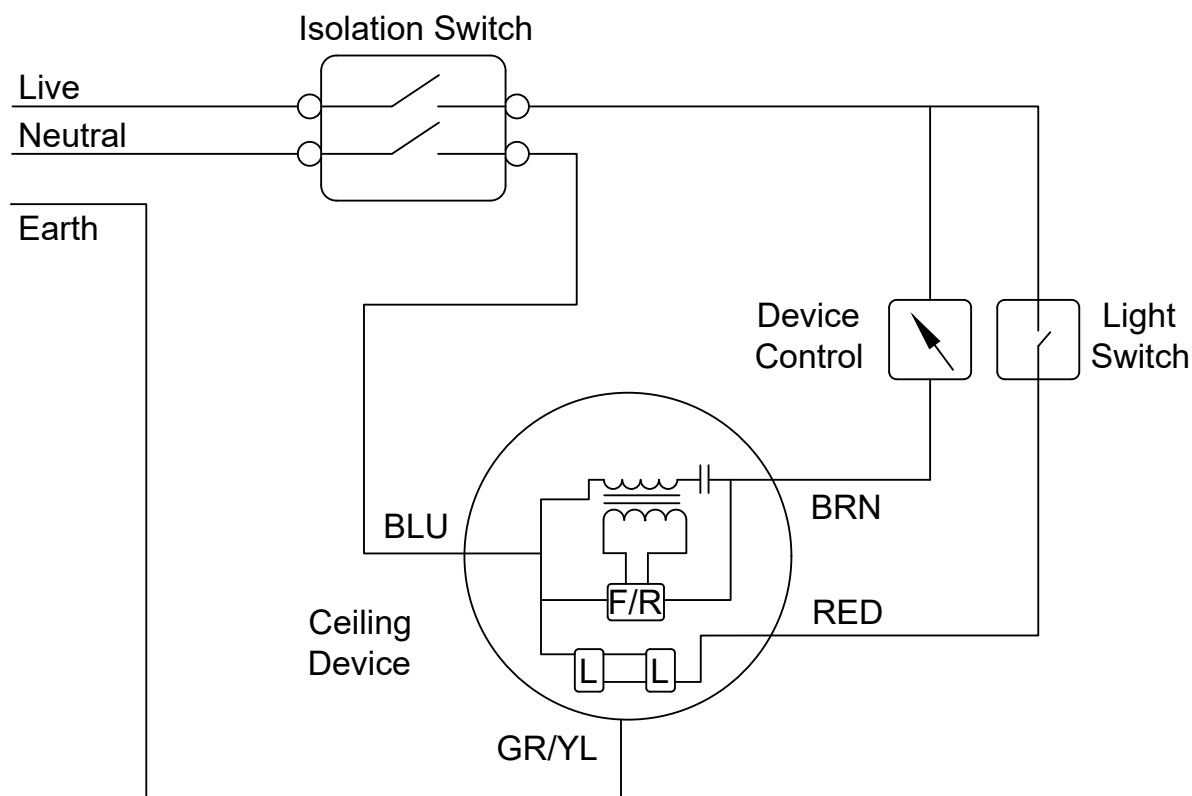


FIG. 1

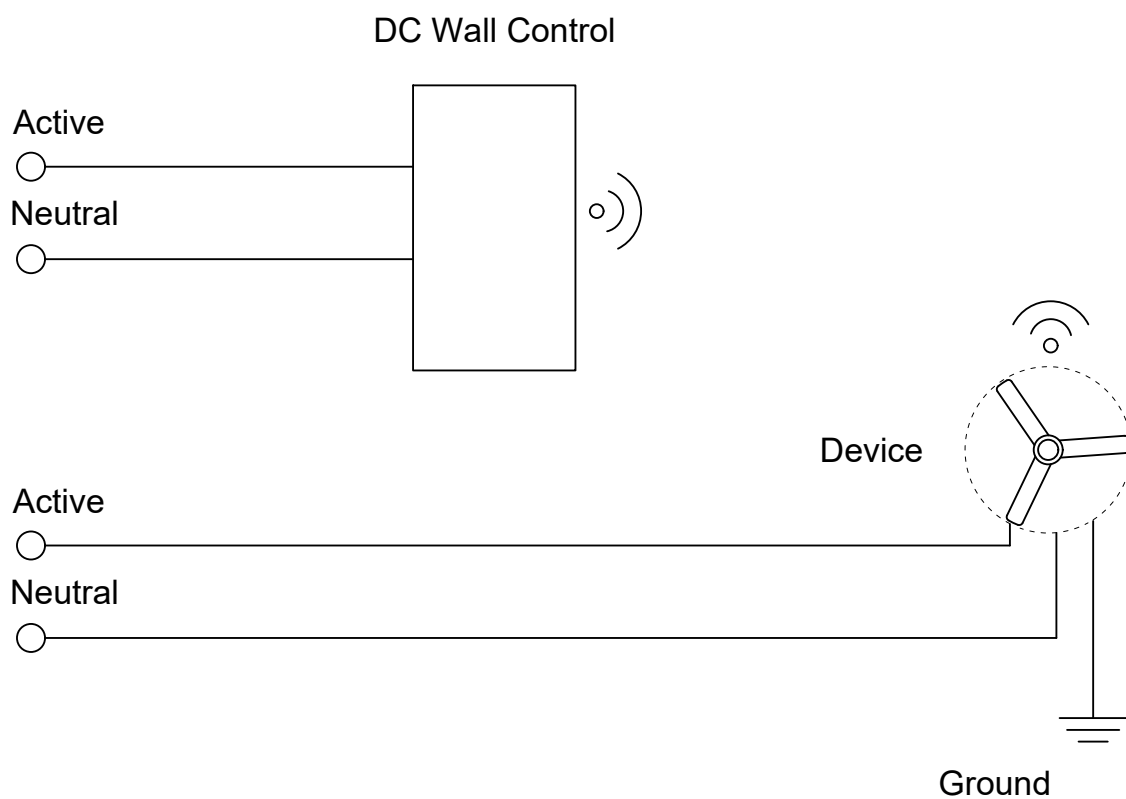


FIG. 2

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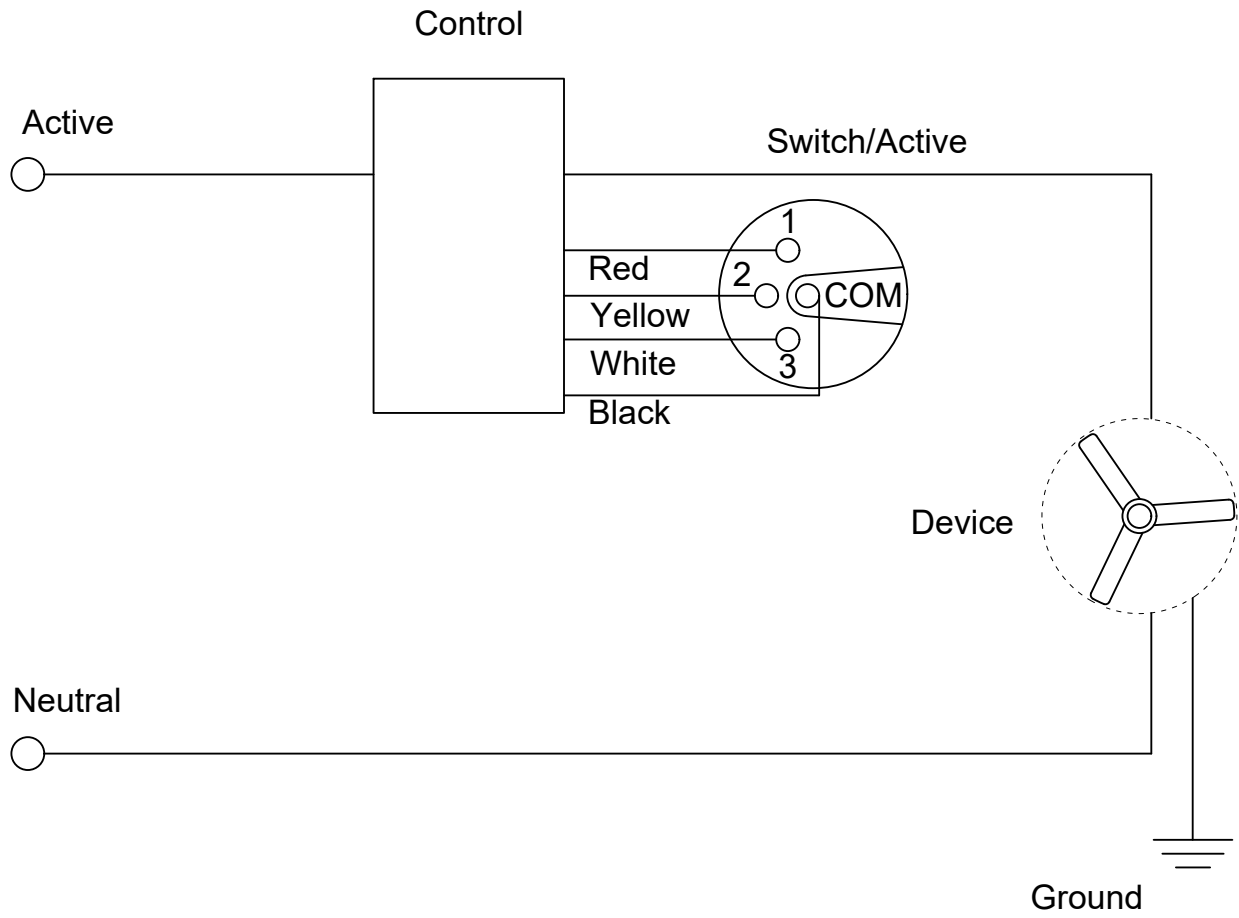


FIG. 3

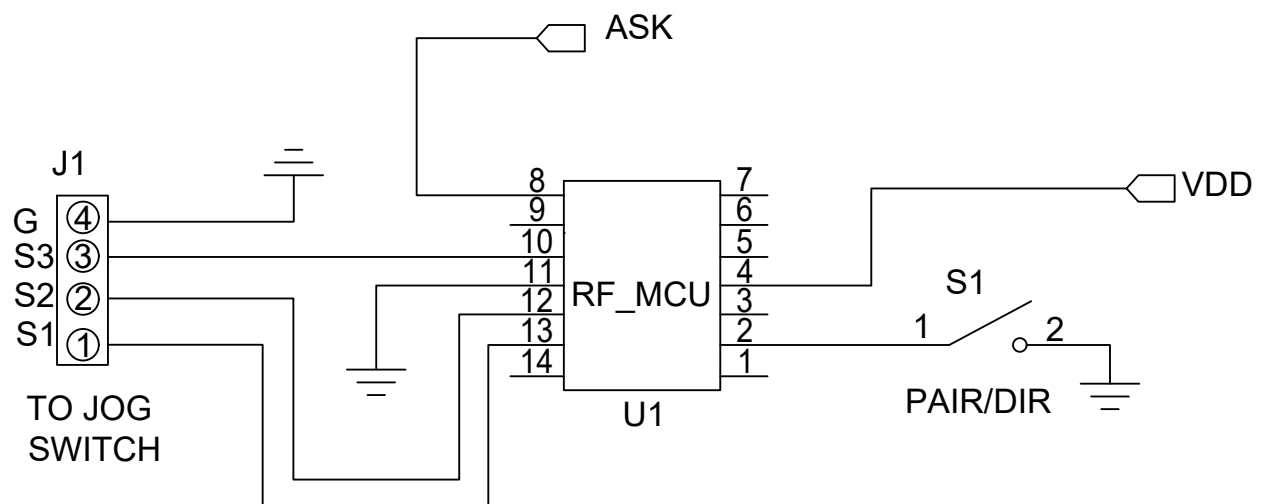


FIG. 4

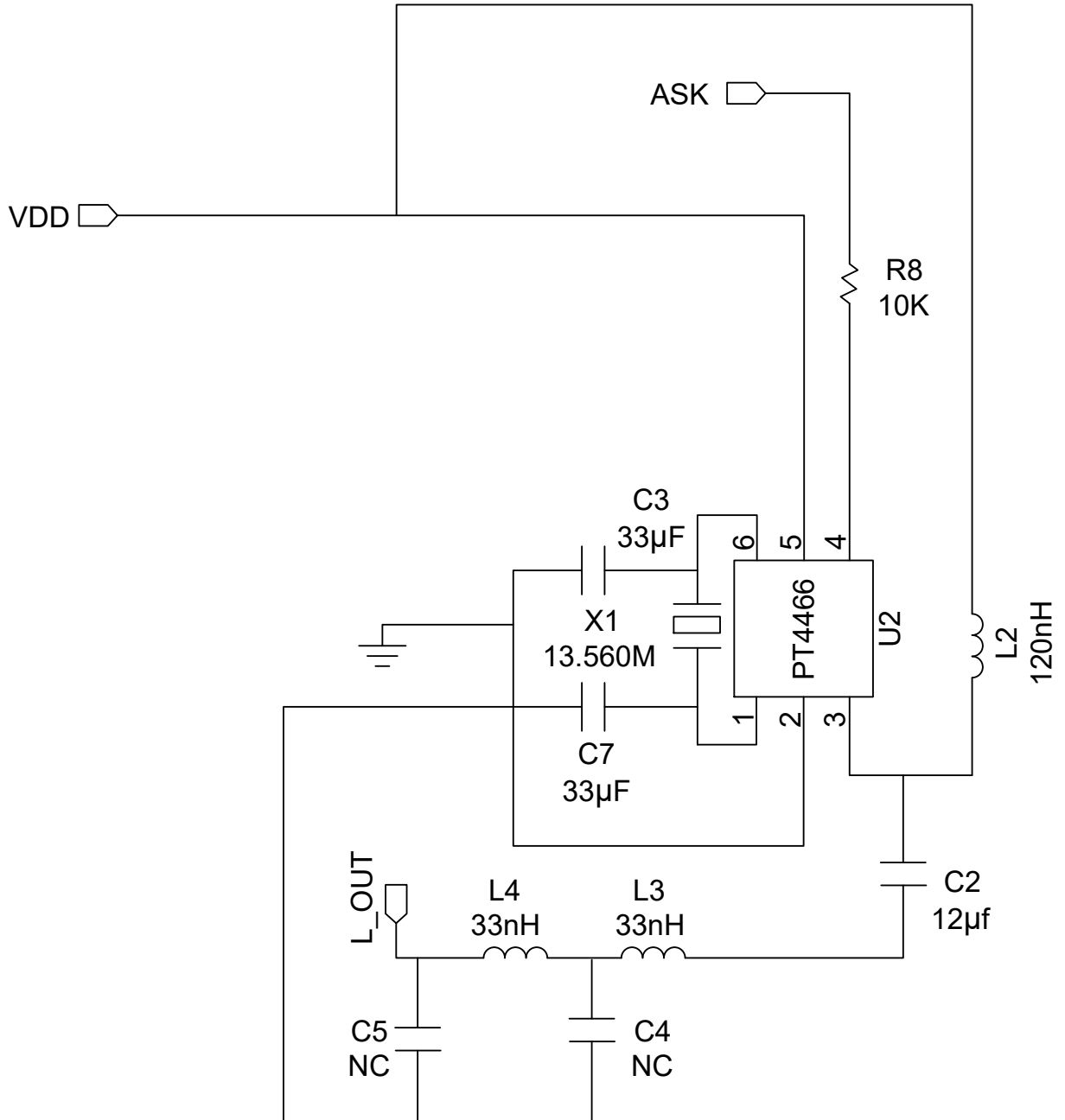


FIG. 5

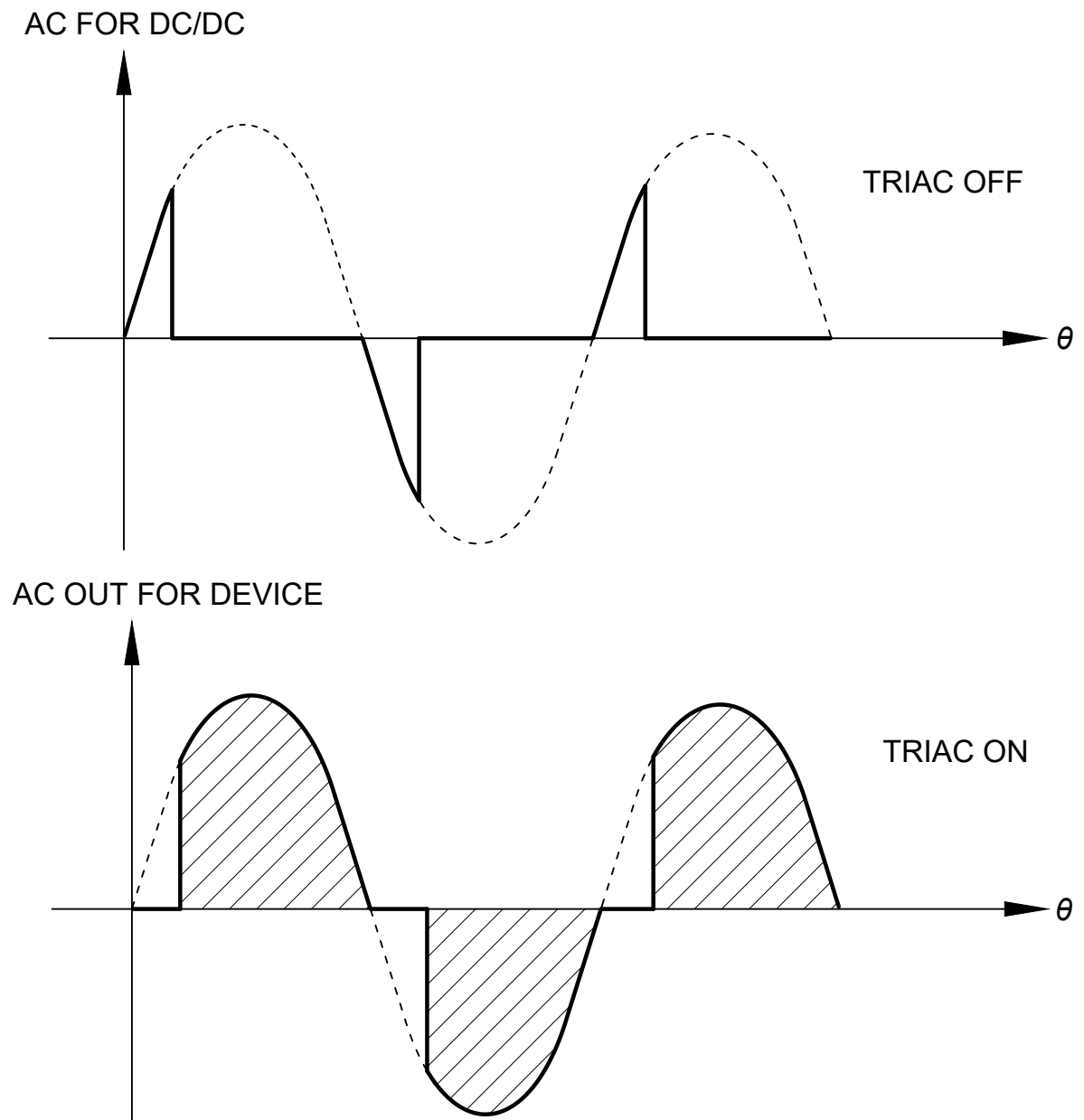
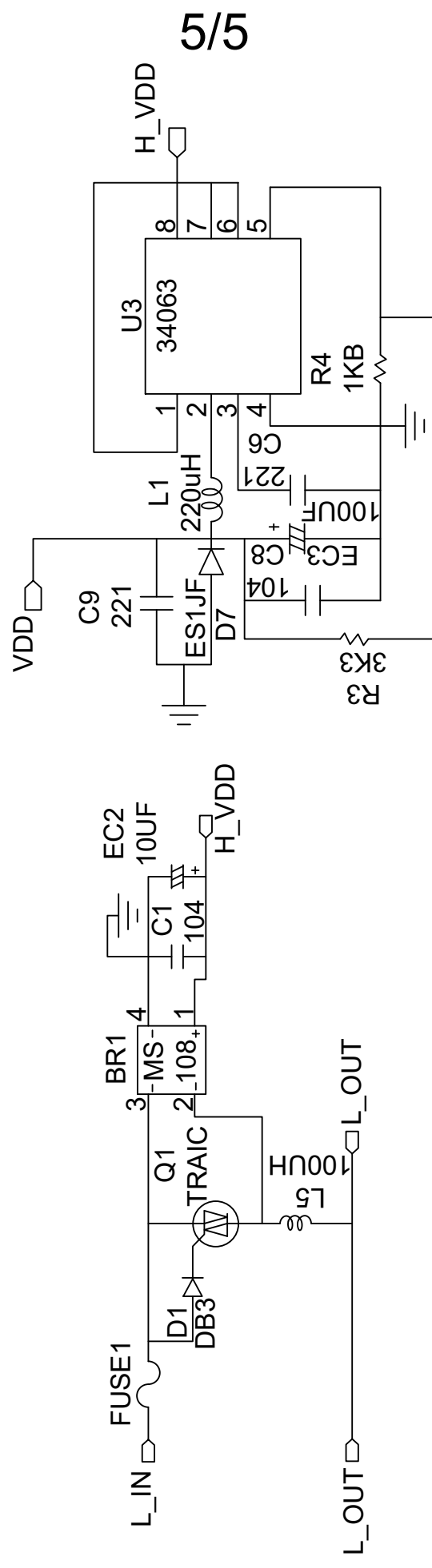


FIG. 6



AC/DC

FIG. 7