(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 615 188 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
11.01.2006 Bulletin 2006/02

(51) Int Cl.:
G08C 19/00 *(2006.01)*

(21) Application number: **04300435.7**

(22) Date of filing: **09.07.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL HR LT LV MK

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(54) Circuit and interface for remote control with hold key

(57) A remote control with a two-wire interface has a number of control keys with associated resistors. The resistance value that can be measured between the terminals of the two-wire interface is translated into a command by the interface circuit of the device to be controlled. A hold switch is arranged such that a DC path is always present independent of the position of the hold switch. The interface circuit of the device to be controlled is designed such that even when the device is in a low-power or off-mode and the hold switch is activated the operation of a control key can be detected and a message or indication can be issued. The user is thus informed about the status of the hold key.

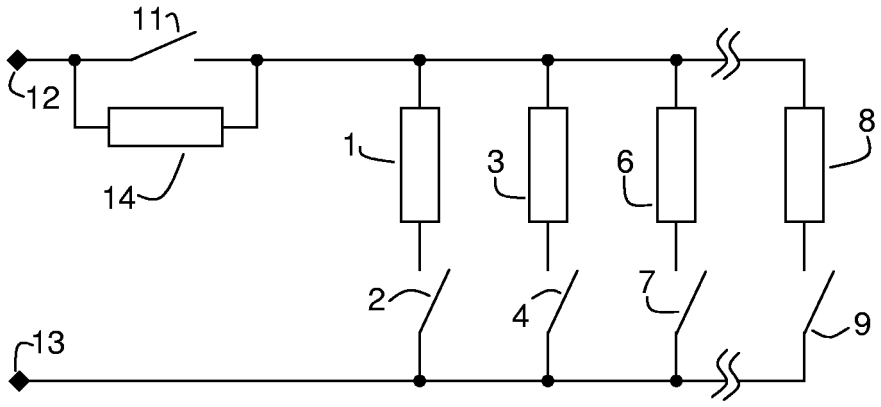

Fig. 2

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Description

[0001] The invention relates to remote controls for electrical apparatus, particularly to wired remote controls used in portable equipment.

[0002] A remote control unit for an apparatus such as a portable audio system is required to have several buttons, the depression of any of which can be sensed by the apparatus and used to control the operation of the system. For example, the remote control unit for an audio system may have buttons for increasing and decreasing the volume, for changing the tone, the left to right balance etc.

[0003] One known way for establishing communication between the remote control unit and the controlled apparatus involves the use of micro-controllers and a common data bus, but this is complex and costly to implement.

[0004] A less costly known alternative is to use a wired connection between the remote control unit and the controlled apparatus in which the resistance value between control wires varies as buttons in the remote control unit are depressed. The remote control unit in this case comprises a network of resistors that are connected to the control wires via switches operated by the buttons.

[0005] One known switched resistor circuit is the R-2R resistor ladder network. In this network, resistors of value R are connected in series with one another, the last resistor being connected to one control line of the remote control unit. A respective parallel resistor of value 2R is connected at one end to an end of each of the series resistors. The other end of each parallel resistor is connected by a single pole double throw switch either to ground or to a supply voltage. The voltage on the output line will in this circuit vary with the combination of switches that are activated by the buttons of the remote control unit. The disadvantage of this circuit is that it requires the use of expensive double throw switches.

[0006] Another known resistor network is a so-called binary network in which resistors are connected in parallel with one another across the two control lines, each resistor being connected in series with a respective single pole single throw switch. As implied by the name of this network, the resistors have values that are in the ratios of 1:2:4:8:16 etc. An advantage of this circuit for some applications is that one can detect any combination of switches depressed at the same time. However, the maximum number of switches that one can unambiguously detect is limited by the resistor values tolerances and changes, voltage drift, electrical noise etc.

[0007] In certain applications, such as given above as an example, the user should not operate more than one switch at a time to control the subject apparatus. Multiple simultaneous button presses must be recognised as such by the apparatus and disregarded. In this case, it is not necessary for the apparatus to able to identify which buttons have been pressed at the same time. However, there is still the need to maximise the number of switches for a given tolerance in resistor values and drift in the supply voltage.

[0008] All of the above-mentioned remote controls may be equipped with a hold-switch or -key that inhibits unwanted operation of the device. Typically the hold switch is a serial-connected single pole switch that interrupts one of the control lines when activated. If any control key is depressed while the hold-key is activated, the resistance will remain infinitely high, since the DC current path is interrupted. Thus unwanted operation is inhibited.

[0009] However, a user might not remember having activated the hold-key, or had activated the hold-key unintendedly. If the user then intends to operate the device he or she might be mislead into thinking the device is not working properly or defective.

[0010] In figure 1 a remote control according to the prior art is shown. During normal operation a hold switch 11 is closed. Control switches 2, 4, 7 and 9 are open. The control switches 2, 4, 7 and 9 are each arranged in a series connection with control resistors 1, 3, 6 and 8, respectively. When a user operates one of the control switches 2, 4, 7 or 9 the respective resistance value is present between the terminals 12 and 13. An associated interface circuit of the device to be controlled detects and evaluates the resistance value and performs a command which is corresponding to the respective resistance value. When the hold switch 11 is opened the DC path is interrupted. If the user now operates any one of the control switches 2, 4, 7 or 9 no DC current flows. The resistance value which can be measured between terminals 12 and 13 remains infinitely high, and detection that a control key was operated is impossible.

[0011] Often, the remote control or the controlled device or both are equipped with a display that is able to display alphanumeric messages. In this case it would be desirable to inform the user that the hold-key is activated when a control key is depressed while the hold-key is active.

[0012] However, portable electronic devices often call for lowest power consumption possible to extend the useful battery life as much as possible. Therefore, when a portable electronic device is switched off, the display is switched off as well. When the device is switched off and the hold-key is activated it is impossible to start-up the device for issuing a message on the display informing the user about the currently activated hold key.

[0013] It is, therefore, desirable to provide a remote control that allows for changing the operating condition or the power mode of a connected electronic device, particularly from a low power stand-by to a higher operating level, in order to inform a user about the current status of the hold-key. In the following the term power mode is used to describe the operating conditions "off" or "on". However, it is also conceivable that a device according to the invention exhibits more than two power modes, e.g. an additional power mode which only allows for turning on a display for issuing a message. It is further desirable to provide a remote control interface for the in-

ventive remote control. Finally, it is desirable to provide a method for operating the remote control interface of a device using the inventive remote control and interface.

[0014] The aforementioned objects are achieved by the remote control unit as presented in claim 1. The second object of the invention is achieved by the interface circuit for a remote control as presented in claim 5. The third object of the invention is achieved by the method for operating a device with a remote control as presented in claim 9. Developments and alternative embodiments of the invention are presented in the respective sub claims.

[0015] The inventive remote control has a two-wire interface to communicate with a device to be controlled. The remote control further exhibits one or more buttons or switches with respective associated resistors. When a button or switch is operated the respective resistor value may be measured at the two-wire interface, i.e. between the two wires. The resistors may also work in conjunction with a resistor built into the controlled device, forming a voltage divider. All these methods for determining a value corresponding to a resistance value shall be included in the inventive concept. Different resistor values are unambiguously associated to different switches of the remote control and accordingly to different functions of the controlled device. A hold key or switch is arranged in the circuit in such a way that a DC current path is always present if any of the control keys is depressed or operated, independent of the position of the hold switch. The inventive remote control is characterized by a low power consumption when the hold key is activated, while allowing for convenient user interfacing even in low-power or off-mode.

[0016] In a first embodiment a series-connected single pole switch is used as a hold switch that bypasses a hold-resistor connected in parallel to the hold switch. When the hold key is activated the switch is opened. The resistance that may be measured if any of the control keys is depressed is increased by the series connection of the respective control resistor and the hold resistor. By appropriately choosing the values of the hold resistor it is possible to unambiguously identify an activated hold key. Since a DC current path is present when any control key is operated the current flow may be used to change the power mode of the device from standby to a higher operating level, which e.g. allows displaying a message on a display. In case the device is already operating, changing the power mode is not necessary.

[0017] In a second embodiment of the invention the hold key is activated when the hold resistor is bypassed. The resistance values associated with respective control buttons or keys are chosen accordingly.

[0018] In a third embodiment of the invention the hold key effects a current flow when activated. The hold key is for example a single pole hold switch that is series-connected with a hold resistor and connected in between the two wires of the remote control interface. The hold resistor and thus the current flow in hold mode is chosen to be too small for changing the power mode, i.e. starting up the controlled device, when the device is not operating. If any of the control keys is operated during hold mode the total resistance is made up from the parallel-connected hold resistor and the resistor associated to the control key. The current flow that results from the parallel connection of the two resistors is high enough to change the power mode, i.e. to start up the connected device. In a power mode that is equivalent to an operating mode the connected device detects the resistance and compares the resistance with all values associated to control keys. If no match between the measured resistance value and the list of allowed resistance values is detected it is assumed that the hold key is operated. A message is issued accordingly.

[0019] The resistance values of the control resistors and the hold resistor are chosen such that the combination of the hold resistor and any control resistor may always be distinguished. By using appropriate resistance values it is unimportant if the hold resistor is connected in series or in parallel to the control resistors.

[0020] An interface for detecting operation of a control key while the hold key is activated detects a current flow through the remote control and sends a signal to a control circuit in the controlled device. When in a power mode that is equivalent to "off" the control circuit changes the power mode of the controlled device and issues a message informing the user about the current condition of the hold key. If the device is already operating a sensing circuit senses the resistance at the remote control interface and compares the measured resistance with stored resistances associated with control functions. If no match between the measured resistance and a stored resistance for a control function is detected, it is assumed that the hold key is activated. A message informing the user about the current status of the hold key is issued.

[0021] A method for operating a device via a remote control, wherein the remote control has a hold switch that inhibits operation of the device upon activation comprises the steps of decoding measured resistances into an operation to be performed by the device. The method further comprises detecting a DC current path between the terminals of the remote control, changing the power mode of the device and issuing a signal upon failure to decode the measured resistance into an operation to be performed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The invention will now be described further, by way of example, with reference to the accompanying drawings, in which

Figure 1 shows a remote control known from the prior art;

Figure 2 shows a first embodiment of an inventive remote control;

Figure 3 shows a second embodiment of an inventive

remote control;

Figure 4 depicts a third embodiment of a remote control according to the invention;

Figure 5 shows a fourth embodiment of a remote control according to the invention; and

Figure 6 presents a schematic of an interface circuit for a remote control according to the invention.

[0023] Figure 1 has already been referred to in the description of the prior art and is, therefore, not explained in detail again.

[0024] In figure 2 a first embodiment of an inventive remote control is shown. During normal operation a hold switch 11 is closed and bypasses a resistor 14. Control switches 2, 4, 7 and 9 are open. The control switches 2, 4, 7 and 9 are each arranged in a series connection with control resistors 1, 3, 6 and 8, respectively. When a user operates one of the control switches 2, 4, 7 or 9 the respective resistance value is present between the terminals 12 and 13. An associated interface circuit of the device to be controlled detects and evaluates the resistance value and performs a command which is corresponding to the respective resistance value. The resistance values may be chosen so as to enable the interface circuit to detect simultaneous closing of multiple control switches. When the hold switch 11 is opened a hold resistor 14 is series-connected with the control resistors 1, 3, 6 and 8. However, as long as none of the control switches 2, 4, 7 or 9 is closed, no DC current is flowing. If the user now operates any one of the control switches 2, 4, 7 or 9 a DC current flows. The resistance value which can be measured between terminals 12 and 13 corresponds to the resistance of the control resistor associated with the operated switch plus the resistance of the hold resistor. The DC current allows the device to detect that a control key is operated although the hold switch is active. The interface circuit which detects and evaluates the resistance which is present between the terminals 12 and 13 is now enabled to detect the depression or operation of any of the control switches and at the same time to determine that the hold switch is operated. The control circuitry of the device that is controlled via the remote control may now issue a message or any other indication to the user that the hold switch is activated, but discard the command associated with the control key. If the device was in a low power or stand-by mode prior to the operation of any of the control switches, the DC current flowing through the control resistor and the hold resistor may be used to start up the device. Starting up the device may be accomplished by first starting up only the control logic which controls a display or other means for informing the user. It is to be noted that throughout all drawings the number of resistors shown in the figure is not limited to four. Any other suitable number of resistors that is required for controlling a connected device is conceivable.

[0025] In Figure 3 a second embodiment of an inventive remote control is shown. In the figure a number of control resistors 1, 3 and 6 is each series-connected with a control switch 2, 4 and 7, respectively. The arrangements of control resistors and control switches are coupled in parallel between two lines, which are connected to terminals 12 and 13. Upon operation of any of the control switches the associated resistance can be measured between the terminals 12 and 13. A hold resistor 14 and a hold switch 11 are arranged in a series connection. The arrangement of hold resistor and hold switch is coupled in parallel to the control resistors and control switches. When the hold switch 11 is operated the resistance of the hold resistor is measurable between the terminals 12 and 13. The hold resistance does not correspond to any of the control resistors and thus is not decoded into a command for the device. If any of the control switches is operated the hold resistor and the control resistor associated to the respective switch are coupled in parallel. The resistance values of the control resistors and the hold resistor are chosen such that any parallel connection of a control resistor and the hold resistor will not be decoded into a command.

[0026] Figure 4 depicts a third embodiment of a remote control according to the invention. In the figure control resistors 1, 3 and 6 are arranged in a series connection. Control switches 2, 4 and 7 are coupled behind each control resistor when viewed from the terminal 12. Depending on the control switch that is operated the resistance which can be measured between terminals 12 and 13 is corresponding to the sum of the individual resistances which are arranged in the then closed circuit. A hold resistor 14 and a hold switch 11 are arranged in a series connection and are coupled across the last control switch 7 in the line of control switches. When the hold switch 11 is operated a total resistance that can be measured across the terminals 12 and 13 includes all control resistors 1, 3 and 6 and the hold resistor 14. Hence, when the hold switch is operated a DC current path is always present between the terminals 12 and 14. An interface circuit which decodes the resistance values that can be measured upon operation of any of the control switches may now determine that the hold switch of the remote control is operated. Any change in the resistance between the terminals 12 and 13 caused by operation of a control switch is detected. The control circuit coupled to the interface may now discard the command associated with the measured resistance value and inform the user that the hold switch is operated. Informing the user about the status of the hold switch may, as in the examples before, be effected by displaying a message on a display or issuing an audible or visible indication.

[0027] In Figure 5 another embodiment of an inventive remote control is shown. The circuit essentially corresponds to the circuit depicted in Figure 4. Control resistors 1, 3, 6 and 8 are coupled in series and control switches 2, 4, 7 and 9 are arranged behind each control resistors when viewed from terminal 12. The last control switch in the line of control switches is connected to the last control

resistor such that the resistance value that can be measured upon operation of the last control switch 9 equals the sum of the resistance values of all control resistors. As was explained in Figure 4 operating a control switch results in the value of the associated control resistor to be measurable between the terminals 12 and 13. During normal operation the hold switch 11 is closed, bypassing a hold resistor 14. If the hold switch 11 is opened the hold resistor 14 is series-coupled to the control resistors. The total resistance that can be measured between the terminals 12 and 13 upon operation of a control switch is thus increased by the value of the hold resistor. A control logic for measuring the resistance between the terminals 12 and 13 is capable to detect the presence of a resistance between the terminals and decodes the resistance into a command for the device to be controlled. The resistance values of the control resistors and hold resistor are chosen such that the series connection of the hold resistor and any of the control resistors will result in determining that the hold switch is operated. The control circuitry will thus issue an indication to the user that the hold switch is operated and discard the command which might otherwise be decoded.

[0028] Figure 6 shows an exemplary interface circuit according to the invention. The interface circuit shown in the figure is adapted for use with a remote control according to Figure 4. The terminal 12 of the remote control from Figure 4 is connected to the terminal RKEY. Terminal 13 of the remote control from Figure 4 is connected to ground and is not shown in the figure. It is assumed that the hold switch is operated and the hold resistor 14 may be measured between the terminal RKEY and ground. The resistance is chosen such that the resistance to ground that is present through the closed hold switch and the hold resistor will not suffice to bring transistor Q701 into a conducting state. If any of the control switches is operated the associated control resistor and the hold resistor are coupled in parallel. The total resistance is lower than the resistance of the hold resistor taken alone. The resistance value is now low enough so as to bring transistor Q701 into a conducting state. This, however, switches transistor Q700 into a conducting state. Transistor Q700 issues a signal EN which may be used to start up a power supply. Once the power supply is active voltages VG and DDVCC are present. A transistor Q703 is now in a conducting state. The resistance of the transistor Q703 is small compared to the resistance of the control resistors and the hold resistor. The resistance value that can be measured between the terminals 12 and 13 of the remote control via the input to the interface circuit RKEY can now be measured substantially unchanged at the terminal REMOCON of the interface circuit. The inventive interface circuit thus allows starting up a power supply of a device even when a hold key is operated and the device is in stand-by of off mode.

Claims

1. A remote control unit having two conductors with respective terminals (12, 13) and one or more control resistors (1, 3, 6, 8) associated with respective control switches (2, 4, 7, 9) connected between the conductors, wherein the resistance between the two terminals (12, 13) of the remote control is translated into a respective function or command of a connected device, wherein operation of a control switch (2, 4, 7, 9) effects the presence of a respective resistance between the terminals (12, 13) and wherein the remote control further has a hold switch (11) for inhibiting operation of the device, **characterised in that** upon activation of a control switch (2, 4, 7, 9) associated with a control resistor (1, 3, 6, 8) a DC current path is present independent of the position of the hold switch (11).

2. Remote control according to claim 1, **characterised in that** a hold resistor (14) is associated with the hold switch (11).

3. Remote control according to claim 2, **characterised in that** the hold resistor (14) associated with the hold switch (11) is bypassed in one position of the hold switch (11).

4. Remote control according to claim 3, **characterised in that** no DC current path is present when no control switch (2, 4, 7, 9) is operated.

5. Interface circuit for a remote control according to any one of the preceding claims, wherein the interface circuit includes means for evaluating the resistance present between two input terminals, **characterised in that** means are provided for detecting establishment of a DC current path between the two input terminals.

6. Interface circuit according to claim 5, **characterised in that** the circuit further comprises means for effecting a connected device to issue a message about the position of the hold switch.

7. Interface circuit according to claim 6, **characterised in that** the means for effecting a connected device to issue a message include means for activating a power supply.

8. Portable device including an interface according to any one of the preceding claims 5 to 7.

9. Method for operating a device with a remote control, wherein the remote control is connected to a device to be controlled via a two-terminal connection, wherein the device has at least a first and a second power mode, the method comprising the steps of:

- measuring the resistance between the two terminals (12, 13) during the second power mode, wherein the resistance is dependent of a control switch (2, 4, 7, 9) operated;
- decoding the measured resistance into an operation to be performed by the device;

wherein the remote control has a hold switch (11) for inhibiting operation of the device, the method further comprising the steps of:

- detecting a DC current path between the two terminals (12, 13) during the first power mode;
- activating the device, thereby entering the second power mode;
- issuing a signal upon failure to decode the measured resistance into an operation to be performed by the device.

10. The method of claim 9, **characterized in that** the first power mode is a stand-by or off-mode and the second power mode is an operating mode.

11. The method of claim 9, **characterized in that** the signal is an optically or acoustically discernible signal.

12. The method of claim 9, **characterized in that** the optically discernible signal is a text message displayed on a display.

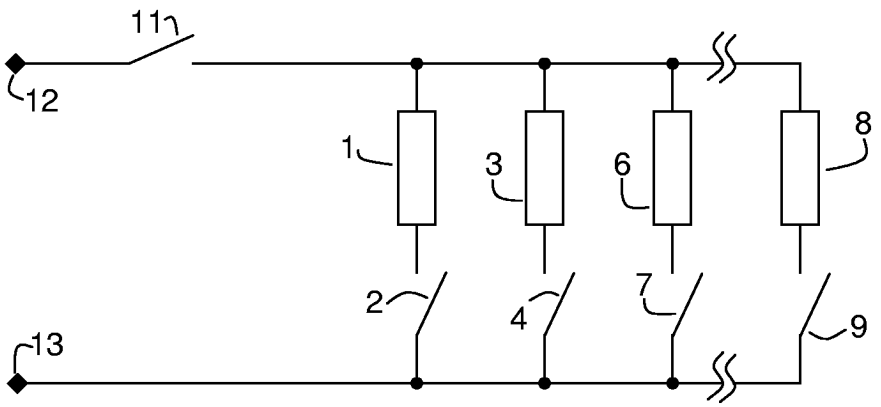

Fig. 1 Prior Art

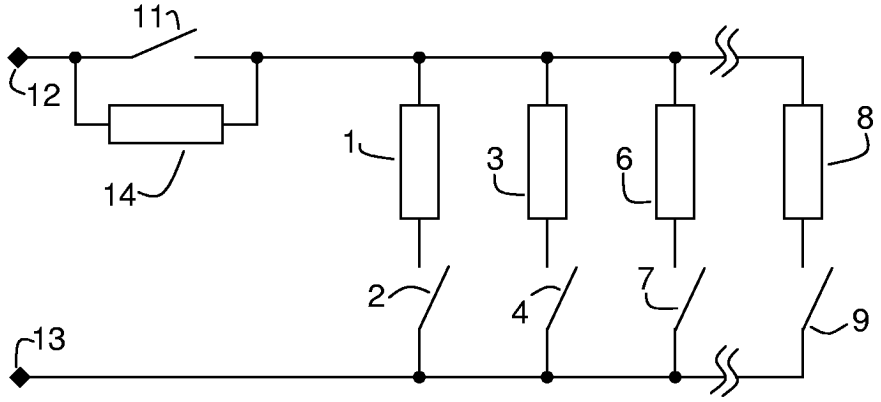

Fig. 2

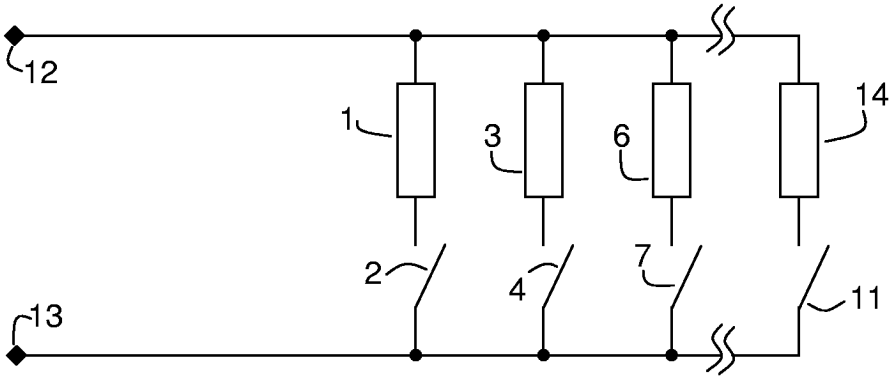

Fig. 3

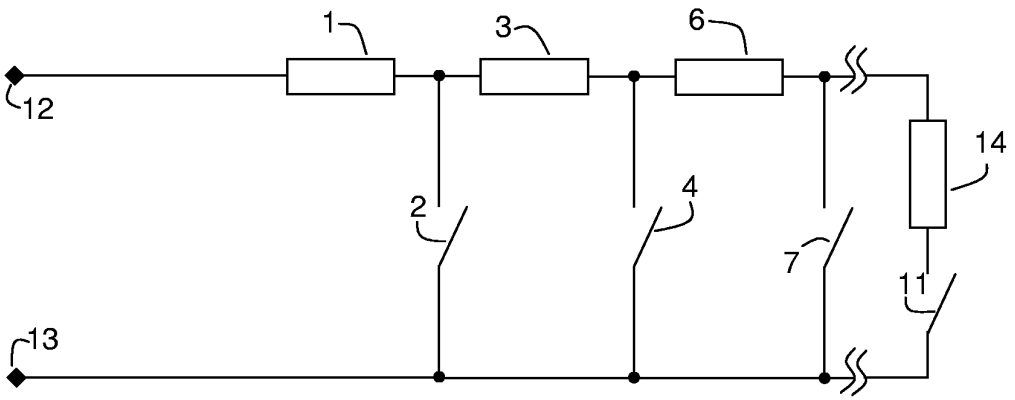

Fig. 4

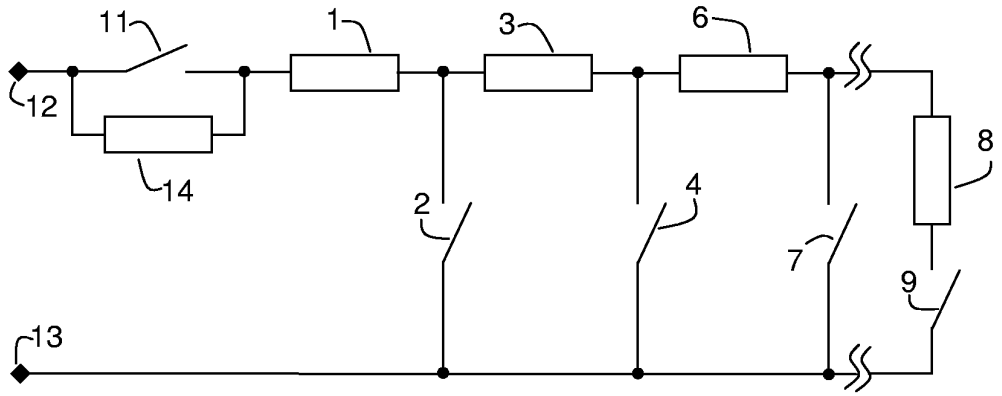

Fig. 5

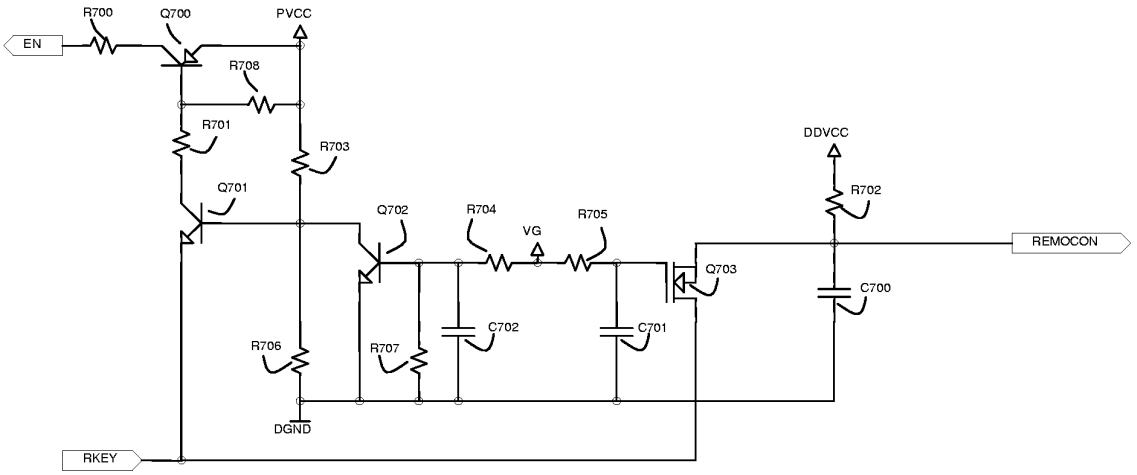

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 04 30 0435

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	PATENT ABSTRACTS OF JAPAN vol. 0091, no. 93 (E-334), 9 August 1985 (1985-08-09) & JP 60 058795 A (TOSHIBA KK), 4 April 1985 (1985-04-04)	5	G08C19/00
A	* abstract; figure 1 *	1,9	
A	"SIMPLE MULTIPLEXING HAND-HELD CONTROL UNIT" NTIS TECH NOTES, US DEPARTMENT OF COMMERCE. SPRINGFIELD, VA, US, 1 March 1990 (1990-03-01), page 231, XP000127247 ISSN: 0889-8464 * the whole document *	1,9	
A	GB 1 172 232 A (COAL INDUSTRY LTD) 26 November 1969 (1969-11-26) * page 2, line 6 - page 3, line 17 *	1,9	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			G08C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	21 December 2004	Kokkoraki, A

CATEGORY OF CITED DOCUMENTS

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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