

PULSELESS KEYPAD SCANNING MECHANISM

FIELD OF THE INVENTION

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The present invention relates generally to telephone keypad scanning mechanism, and in particular, to a transistor-based telephone keypad scanning mechanism that uses a constant scanning voltage signal instead of a pulse signal to reduce pulse-related noise in the telephone receiver.

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BACKGROUND OF THE INVENTION

A keypad and a keypad scanning mechanisms are generally well known by those skilled in the art, and their description and function are described in many publications including US Patent No. 5,512,893, among others. For the convenience of the readers, however, some of the relevant portions shall be repeated herein.

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A keypad is a common device for communicating with a microcontroller or other electronic circuitry and devices. In a microcontroller application, the software controlling the microcontroller identifies pressed keys of the keypad as a signal to the microcontroller to perform certain functions. A keypad consisting of an array of keys is essentially a collection of switches, each key forming a switch. Each switch (i.e., key) may be connected independently to an input port of a device, for example, a microcontroller, to which the keypad serves as an input. The interfacing and programming necessary to allow input to the device via the keypad is similar

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to the interfacing and programming necessary for accomplishing similar results with any other collection of switches.

Generally, the microcontroller for interpreting signals from a keypad must perform the tasks listed below:

- 5 1. Determine if any keys have been pressed;
 2. If a key has been pressed, determine which one; and
 3. Decide on an action, for example, data entry, based on the key that was pressed.
- 10 The microcontroller must perform these tasks in response to a number of activities on the keypad.

 An integral element which detects the particular activities on a keypad and allows the activities to be acted upon by the device to which the keypad provides input is a keypad scanner circuit or mechanism. The

15 keypad scanner mechanism is the device and process by which the rows and columns of a matrix keypad are examined to determine whether keys have been pressed and, if so, which keys. Although there are now very sophisticated analytical means for detecting the depression of a key and distinguishing between a true depression versus an inadvertent contact,

20 fundamentally, the fundamental function of the keypad scanner circuit or mechanism is to transfer a signal from the keypad to the input port of the microcontroller or some other devices to alert the receiving device that a key has been depressed.

 Prior to the present invention, this signal has always been in a form of

25 a pulse. So for instance, in a cordless phone system, a microcontroller would continuously send out a frequency of pulses to a matrix keypad. Each keypad would have a unique set of dual lines, and each line would have a contact point which, when a particular keypad is depressed, would be electrically joined to the other contact point so as to disturb the pulse

signal. The disturbance would be detected by the microcontroller and, by recognizing the what lines the disturbance is detected, it would indicate that a key has been depressed, and appropriate actions would follow.

Although this type of keypad depression detection circuit has been
5 generally effective and is widely in use, for some cordless phones, the pulse signal is undesirable as it can create noise in the telephone's receiver. Given the obvious importance of a clear reception, it would be desirable to have a keypad scanning circuit which reduces or eliminates pulse-related noise in a telephone receiver.

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OBJECT OF THE INVENTION

It is therefore an object of the present invention to provide a keypad scanning circuit which does not utilize a pulse signal to detect a depression
15 of a key on the keypad.

It is another object of the present invention to provide a keypad scanning circuit which utilizes a signal which would eliminate or reduce the type of noise in receiver which is associated with pulse signals.

20 SUMMARY OF THE INVENTION

The preferred embodiment of the present invention is a transistor-based telephone keypad scanning mechanism that uses a constant scanning voltage signal instead of a pulse signal to reduce pulse-related
25 noise in the telephone receiver. It is particular useful for a cordless telephone keypads that have very small keys.

The mechanism circuit includes a plurality of C lines and R lines which are initially electrically unconnected to each other. Each line

terminates to a contact point. A unique pair of one C line and one R line corresponds to each key of the keypad and the contact point for each line is placed under each key. The key has a metal plate on its bottom side such that when the key is depressed, the two contact points are electrically
5 joined.

Each of the R lines is connected to the base of a transistor. The corresponding collector of the transistor and the corresponding C line are connected to a microcontroller and tied high to a DC voltage source. The emitter of the transistor is connected to a ground. When no key is
10 depressed, all of the C lines and the collector lines are at the voltage level that of the voltage source. When a key is depressed, both the collector and the C line corresponding to the key is pulled to ground. The microcontroller, by determining which lines experienced the drop in voltage, determines which of the keys has been depressed.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of the preferred embodiment of the circuit for the pulseless keypad scanning mechanism.

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FIG. 2 is a sample keypad matrix layout utilizing the mechanism of FIG. 1.

DETAILED DESCRIPTION OF THE INVENTION

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It was appreciated by the inventors that a noise in a cordless telephone receiver can be caused by the pulse signals used by a keypad scanning mechanism. It was also appreciated by the inventors that the

pulse-related noise in the telephone receiver may be eliminated by replacing the pulse signal with a low-level constant DC voltage signal of, e.g., 3.6 volts. One way to implement a DC signal in a keypad scanning circuit is by providing each of the keys in the keypad with a unique pair of DC lines with a contact point for each line and a third contact point connected to a ground for a total of three contact points for each key in the keypad. Each of the DC lines would be connected to a microcontroller. Each key would have a metal plate on the bottom side of the key such that when a key is depressed, all three contact points will be electrically connected. Hence the depression of a key would connect the two DC contact points to the ground contact point and thus bringing down the DC lines to ground. The drop in the voltage would be detected by the microcontroller and by determining which unique set of DC lines experienced the drop in voltage, the microcontroller would recognize that the key was depressed.

One shortcoming to this method was that it required the use of three contact points underneath each of the keys in the keypad. For the cordless telephones, and especially those with very small keypads, fitting three contact points under each key is difficult. Moreover, having three contact points means that all three points must be contacted in order to detect the depression of the key instead of making contact with just two contact points. This can be problematic because the keys are often flexible and can tilt when depressed. The tilting motion may prevent the key from contacting all three contact points making it difficult to ensure that all three contact points are electrically joined when a key is depressed.

It was appreciated by the inventors that having two contact points for each of the keys is more effective in ensuring that the contact points are electrically joined when a key is depressed. To eliminate the third line, the

preferred embodiment of the present invention is a transistor-based scanner mechanism as shown in FIG. 1.

FIG. 2 is a sample phone keypad matrix layout utilizing the keypad scanning circuit of FIG. 1. Each of the keys, 1 through 0, "*", "#", "PHONE", "OFF", "HOLD", "VOLUME", "REDIAL", "CHANNEL", "MEM/PROG", has two contact points under the key, one contact point corresponding to a C line, and a second contact point corresponding to an R line. So for instance, following the matrix layout of FIG. 2, the key having the number "1" would have the lines C1 and R1; the key having the number "0" would have the lines C5 and R3; the key having the word "CHANNEL" would have the lines C3 and R4, and so on.

Referring now to FIG. 1, lines C1 through C5 are all connected to a DC voltage source VBatt, preferably 3.6 volts via biasing resistors of 10K, and to the microcontroller 100. The lines R1 through R4 are connected to the base of transistors T1 through T4 and to a ground via resistors of 10K. The collectors, E1 through E4, of all the transistors are connected to a DC voltage source, VBatt, preferably 3.6 volts, via biasing resistors of 1K and also to the microcontroller 100. The emitters of the transistors are all tied to a ground.

Each of the keys is identical to each other in its structure, function and operation. Therefore, only one of the keys, the key having the number "1" shall be used to illustrate the operation of the circuit.

Before the key, "1", is depressed, the inputs to the microcontroller 100, C1 and E1, are both high. The microcontroller 100 recognizes this to mean that the key has not been depressed. When the key is depressed, the contact points corresponding to lines C1 and R1 are electrically joined. Hence, R1 is now high which turns on the transistor T1. Since the emitter of T1 is tied to the ground, this pulls both E1 and R1, and hence C1, to ground.

With C1 and E1 both at ground, the microcontroller 100 detects the drop in voltage in its inputs, C1 and E1. By recognizing that lines C1 and E1 correspond to the key having the number "1", it concludes that the key "1" has been depressed.

5 Although the present invention was described in reference to a telephone keypad, it is contemplated that the pulseless keypad scanning circuit may be used in other applications other than just for telephones where the elimination of the pulse is desirable in scanning a keypad. In addition, although a specific transistor-based circuit was shown here as a
10 way of disclosing the preferred embodiment of the present invention, it is contemplated that other circuits are possible which utilize the same principles and equivalent circuitry as the present invention.

 More generally, it is also contemplated that the present invention may be embodied in other specific forms without departing from the spirit or
15 essential characteristics thereof. The presently disclosed embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims and all changes which come within the meaning and range of equivalency of the claims are, therefore, to be embraced therein.

CLAIMS

I Claim:



- 1 1. A pulseless keypad scanning mechanism incorporated in an
 2 electronic instrument having a keypad arrangement and having a
 3 microcontroller, said mechanism for each key in the keypad comprising:
 4 a transistor with a collector, emitter, and base, the collector connected
 5 to a DC voltage source and to a first input to the microcontroller, and the
 6 emitter connected to a ground;
 7 a first contact point connected to a DC voltage source and to a
 8 second input to said microcontroller;
 9 a second contact point connected to the base of said transistor and to
 10 a ground;
 11 wherein said first and second inputs to the microcontroller are high
 12 when said key is not depressed, and a depression of said key electrically
 13 connects said first and second contact points, and said first and second
 14 inputs are pulled to ground.
- 1 2. A method of scanning a keypad in a telephone system without
 2 inducing keypad scanning pulse-related noise in a telephone receiver of the
 3 telephone system, said method comprising the following steps:
 4 providing each key of the keypad with a pair of unique contact points;
 5 coupling each contact point of the pair to an input of a microcontroller;
 6 supplying each input of the microcontroller with a DC voltage;
 7 providing a mechanism wherein if a key is depressed, the input to the
 8 microcontroller drops from the DC voltage level to a logical ground;



9 recognizing a non-depression of the key if the input to the
10 microcontroller is at the DC voltage level; and
11 recognizing a depression of the key if the input to the microcontroller
12 is at the logical ground.

1 3. The method as recited in claim 2 wherein said mechanism uses a
2 transistor.