



- (51) **International Patent Classification:**  
*H03K 17/955* (2006.01) *H03K 17/96* (2006.01)
- (21) **International Application Number:**  
PCT/EP2012/074717
- (22) **International Filing Date:**  
6 December 2012 (06.12.2012)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**  
10 201 1 056 226.5  
9 December 2011 (09.12.2011) DE
- (71) **Applicant: MICROCHIP TECHNOLOGY GERMANY II GMBH & CO. KG** [DE/DE]; Friedrichshafener Str. 3, 82205 Gilching (DE).
- (72) **Inventors: IVANOV, Artem;** Clara- VieBig-Str. 7, 84032 Landshut (DE). **ZHANG, Ce;** Baeckerstrasse 32, 81241 Munich (DE).
- (74) **Agent: GRUBERT, Andreas;** 125 Old Broad Street, London Greater London EC2N 1AR (GB).
- (81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(54) **Title:** SENSOR SYSTEM AND METHOD FOR REDUCING A SETTling TIME OF A SENSOR SYSTEM

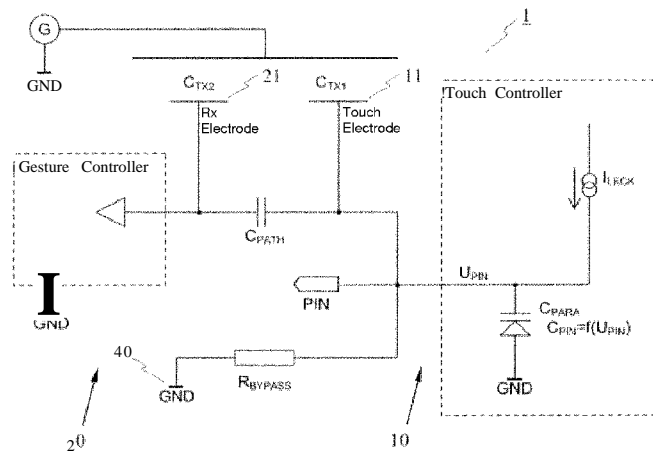


Fig. 1

(57) **Abstract:** Provided is a sensor system (1) comprising a first sensor device (10) and a second capacitive sensor device (20) for detecting a movement of the object relative to a detection surface, wherein the sensor system may be operated in a first mode of operation and in a second mode of operation, wherein the sensor system may be switched over from the first mode of operation into the second mode of operation, wherein the second capacitive sensor device (20) comprises a number of second sensor electrodes (21), and wherein in the sensor system at least in the second mode of operation at least one signal path (GND, R\_BYPASS, PIN) connectable with a predetermined fixed electric potential (GND) is provided, which is parallel to a parasitic capacitance (C\_PARA) of the first sensor device (10). Further provided is a method for reducing a settling time of the second capacitive sensor device (20) for detecting a movement of an object relative to the detection surface, wherein the second capacitive sensor device is part of the sensor system (1) according to the invention, wherein at least in the second mode of operation in the sensor system the at least one signal path (GND, R\_BYPASS, PIN) is connected with a predetermined fixed electric potential (GND), wherein the signal path is parallel to the parasitic capacitance (C\_PARA) of the first sensor device.



## Sensor system and method for reducing a settling time of a sensor system

### Field of the invention

5           The invention relates to a sensor system and a method for reducing a settling time of a sensor system according to the invention. The invention further relates to a capacitive sensor device for detecting a contact by an object with a detection surface, which is designed to reduce the settling time of a further capacitive sensor device in a sensor system according to the invention.

10

### Prior art and background of the invention

Known in prior art are capacitive sensor devices for detecting a contact by an object with a detection surface. Such sensor devices also are known as capacitive touch sensors.

15

Furthermore, known in prior art are capacitive sensor devices for detecting a movement of an object relative to a detection surface. These sensor devices also are known as capacitive movement sensors.

20

Contacts with a detection surface, for example by a finger, may be detected by means of the capacitive touch sensors, while movements of a finger relative to a detection surface and in a certain distance from the detection surface may be detected by means of capacitive movement sensors.

25

In this connection it is desired to detect contacts by a finger at a detection surface as well as movements of the finger in front of the detection surface relative to the detection surface. To do so, a sensor device may be provided, which comprises a capacitive touch sensor as well as a capacitive movement sensor. Both the capacitive touch sensor and the capacitive movement sensor each have a number of sensor electrodes by means of which a contact and a movement are detected, respectively. The sensor electrodes of the touch sensor and of the movement sensor are arranged relative to the detection surface such that in a certain area of the detection surface, preferably in the whole area of the detection surface, both a contact with the detection surface as well as a movement relative to the detection surface may be detected.

30

In order to detect both a contact as well as a movement by means of the respective capacitive sensor it may be required to operate the capacitive touch sensor and the capacitive movement sensor within different time intervals, so that in one instant of time always only one of the two capacitive sensors is active. In order to detect a contact as well as a movement ideally at the same time it may be advantageous to switch back and forth between the operation of the touch sensor and of the movement sensor within relatively short time intervals. This is to mean that when the touch sensor is active the movement sensor is inactive and vice versa.

However, switching over from the touch sensor to the movement sensor has the disadvantage that the output signal and the sensor signal, respectively, of the movement sensor has a relatively long settling phase immediately after the activation of the movement sensor, which may last several seconds, so that the sensor signal of the movement sensor in the worst case only may be evaluated correctly after several seconds. Settling times comprising durations that long are not acceptable for practical applications, in particular when a signal processing has to be carried out in real-time.

However, this problem also occurs when another sensor device is used instead of a touch sensor.

#### Goal of the invention

20

Therefore it is the goal of the invention to provide solutions which allow for a combination of a sensor, in particular a touch sensor, and of a movement sensor, in order to detect both a contact with a detection surface as well as a movement of an object relative to the detection surface and wherein at least during switching over from the touch sensor to the movement sensor the settling time of the movement sensor is reduced and minimized, respectively.

#### Solution according to the invention

30

According to the invention this goal is reached by means of a sensor system comprising a first sensor device and a second capacitive sensor device for detecting a movement of an object relative to a detection surface, by means of a method for reducing a

settling time of a capacitive movement sensor in a sensor system according to the invention, as well as by means of a capacitive sensor device for detecting a contact by an object with a detection surface according to the independent patent claims. Advantageous embodiments and advanced embodiments of the invention are given in the respective dependent claims.

5 According to that, provided is a sensor system comprising a first sensor device and a second capacitive sensor device for detecting a movement of the object relative to a detection surface, wherein the sensor system may be operated in a first mode of operation and in a second mode of operation, wherein the sensor system may be switched over from the first mode of operation into the second mode of operation, wherein the second capacitive sensor  
10 device comprises a number of second sensor electrodes, and wherein in the sensor system at least in the second mode of operation at least one signal path connectable with a predetermined fixed electric potential is provided, which is parallel to a parasitic capacitance of the first sensor device.

The predetermined fixed electric potential at least may comprise one of ground  
15 potential, supply voltage, half of the supply voltage ( $V_{cc}/2$ ), and an electric potential between ground potential and supply voltage.

The signal path may be connected with the predetermined electric potential via an electric resistance  $R_{BYPASS}$ .

By means of the signal path at least one terminal of the first sensor device may be  
20 coupled with the predetermined electric potential via the electric resistance  $R_{BYPASS}$ .

The first sensor device may comprise a capacitive sensor device for detecting a contact by an object with a detection surface, wherein the first capacitive sensor device comprises a number of first sensor electrodes, wherein in the first mode of operation a contact may be detected, and wherein in the second mode of operation the movement may be  
25 detected.

By means of the signal path

- at least one electrode of the first sensor electrodes may be coupled with the predetermined electric potential via the electric resistance  $R_{\text{BYPASS}}$ , or
- at least that first sensor electrodes may be coupled with the predetermined electric potential via a respective electric resistance  $R_{\text{BYPASS}}$ , whose distance from the second sensor electrodes is below a predetermined value.

Provided in the signal path may be a switching device, which is designed to connect the signal path with the predetermined fixed electric potential in the second mode of operation.

Furthermore, provided is a method for reducing a settling time of a second capacitive sensor device for detecting a movement of an object relative to a detection surface, wherein the second capacitive sensor device is part of a sensor system, which in addition comprises a first sensor device, wherein the sensor system is operated in a first mode of operation or in a second mode of operation, wherein at least in the second mode of operation in the sensor system at least one signal path is connected with a predetermined fixed electric potential, wherein the signal path is parallel to the parasitic capacitance of the first sensor device.

The signal path may be connected with the predetermined electric potential via an electric resistance  $R_{\text{BYPASS}}$ .

The first sensor device may comprise a capacitive sensor device for detecting a contact by an object with a detection surface, wherein the first capacitive sensor device comprises a number of first sensor electrodes, wherein in the first mode of operation a contact is detected, and wherein in the second mode of operation the movement is detected.

By means of the signal path

- at least one terminal of the first capacitive sensor device may be connected with the predetermined electric potential via the electric resistance  $R_{\text{BYPASS}}$ , or
- at least one electrode of the sensor electrodes of the first capacitive sensor device may be connected with the predetermined electric potential via the electric resistance  $R_{\text{BYPASS}}$ .

Further provided is a sensor device for detecting a contact by an object with a detection surface, wherein the sensor device comprises a number of sensor electrodes and wherein provided in the sensor device is at least one signal path connectable with a predetermined fixed electric potential, which is parallel to the parasitic capacitance of the sensor device.

By means of the signal path

- at least one terminal of the sensor device may be coupled with the predetermined electric potential via an electric resistance  $R_{\text{BYPASS}}$ , and/or
- at least one electrode of the sensor electrodes may be coupled with the predetermined electric potential via the electric resistance  $R_{\text{BYPASS}}$ .

The sensor device may comprise a capacitive sensor device.

#### Short description of the drawings

Details and characteristics of the invention as well as concrete embodiments of the invention result from the following description in connection with the drawing.

Fig. 1 shows a sensor system according to the invention comprising a capacitive touch sensor and a capacitive movement sensor and which is adapted to reduce the settling time of the capacitive movement sensor;

Fig. 2 shows an alternative embodiment of a sensor system according to the invention;

Fig. 3a shows the temporal course of a sensor signal of a capacitive movement sensor without a reduction of the settling time according to the invention; and

Fig. 3b shows the signal course of a sensor signal of a capacitive touch sensor comprising a reduction of the settling time according to the invention.

## Detailed description of the invention

Fig. 1 shows a sensor system 1 according to the invention, which comprises a  
5 capacitive sensor device 10 for detecting a contact by an object with a detection surface and a  
capacitive sensor device 20 for detecting a movement of an object relative to the detection  
surface. In the following, the capacitive sensor device 10 is designated as touch sensor, the  
capacitive sensor device 20 is designated as movement sensor. Instead of the touch sensor the  
sensor system 1 according to the invention also may comprise other sensor devices.

10 In the following, however, the invention is described on the basis of a sensor system  
1, which comprises a touch sensor and a movement sensor.

For convenience, only one sensor electrode 11 of the touch sensor 10 and only one  
sensor electrode 21 of the movement sensor 20 are shown in Fig. 1. In a concrete  
embodiment of the sensor system 1 the touch sensor 10 has a number of sensor electrodes 11  
15 and the movement sensor 20 has a number of sensor electrodes 21.

The touch sensor 10 and the movement sensor 20 are operated alternately, this is to  
mean that touch and movement are detected alternately by means of operating the sensor  
system 1 alternately in a first mode of operation and in a second mode of operation.

In the second mode of operation (detection of a movement of an object relative to the  
20 detection surface by means of the movement sensor 20) the sensor electrode 21 of the  
movement sensor 20 measures the overall capacitance to ground, which consists of the  
capacitance of the object to be detected and an unavoidable parasitic capacitance (basic  
capacitance). The basic capacitance substantially is composed of the capacitance of the  
sensor electrode 21 of the movement sensor 20, the pin capacitance  $C_{p_iN}$  of the touch sensor  
25 10 and the capacitance  $C_{p_{A_{TH}}}$ . During the interpretation of the measurement results of the  
movement sensor 20 the basic capacitance is assumed to be constant. In practice this  
assumption has been confirmed by means of measurements carried out over extended time  
intervals. However, due to internal effects of semiconductor technology this assumption does  
not apply directly after the switching actions.

30 After switching over from the first mode of operation into the second mode of  
operation the de-activated touch sensor 10 theoretically should not show any effect on the

above-mentioned basic capacitance. In practice, however, this basic capacitance is affected by the following effect:

A small leakage current  $I_{Leck}$  always present in the real components leads to the fact that the DC potential at the terminals PIN of the touch sensor 10 varies over time as a result of the charge / discharge of the capacitances present at the terminal. As a result of the internal construction of the integrated circuit the internal capacitance depends on the voltage at the terminal, for example because the structures integrated as a protection against electrostatic discharges have p-n junctions (diodes), which normally are operated in a reverse-biased manner.

10 The voltage dependency of the diode capacitance is well known. These effects result in that the overall basic capacitance varies over time. The practical time constants of this variation have magnitudes of several seconds.

However, it is exactly this capacitance variation, which results in settling processes at the measurement signals of the movement sensor 20.

15 In order to reduce the settling time of the movement sensor 20 in any case in the second mode of operation, i.e. in the mode in which the movement of an object relative to the detection surface is detected, a signal path is provided that is connected with a fixed electric potential 40 and that is parallel to the parasitic capacitance of the touch sensor 10. In Fig. 1 the fixed electric potential 40 is ground GND of the sensor system. However, the fixed  
20 electric potential 40 also may be a supply voltage  $V_{cc}$  or half of a supply voltage,  $V_{cc}/2$ . The fixed electric potential 40, however, also may be formed in another suitable manner and in particular may be between ground GND and supply voltage  $V_{cc}$ .

Here, provided in the signal path is an electric resistance  $R_{BYPASS}$  via which the signal path is connected with the fixed electric potential 40. A terminal PIN of the touch sensor 10  
25 may be coupled with the fixed electric potential 40 by means of the signal path. Likewise, the sensor electrode 11 of the touch sensor 10 may be coupled with the fixed electric potential 40. In both cases the coupling with the fixed electric potential 40 is carried out via the electric resistance  $R_{BYPASS}$ .

In an embodiment of the invention all the sensor electrodes 11 of the touch sensor 10  
30 may be coupled with the fixed electric potential 40 via the electric resistance  $R_{BYPASS}$ .

However, it also may be advantageous, in particular to reduce the manufacturing costs of the sensor system, only to connect those sensor electrodes 11 of the touch sensor 10 with the fixed electric potential 40 via the electric resistance  $R_{\text{BYPASS}}$  that are located in direct vicinity of the sensor electrodes 21 of the movement sensor 20. In this connection those  
5 sensor electrodes 11 may be selected whose distance from the next sensor electrode 21 falls below a certain value.

According to the invention the signal path for connecting the terminals PIN and for connecting the sensor electrodes 11 with the fixed electric potential 40 also may be formed without the electric resistance  $R_{\text{BYPASS}}$ -Providing the electric resistance  $R_{\text{BYPASS}}$  in the signal  
10 path, however, has the advantage that the variation of potential at the terminal PIN during switching over from the first mode of operation into the second mode of operation may be adapted and adjusted, respectively, for example by providing respective resistance values.

Tests have shown that with a respective selection of resistance values the electric resistances  $R_{\text{BYPASS}}$  do not affect the touch sensor 10 and do not affect the contact detection.  
15 The contact position and the contact, respectively, also are correctly detected when using the electric resistance  $R_{\text{BYPASS}}$  in the signal path.

By means of providing the signal path the settling time of the movement sensor 20 after the changeover from the first mode of operation into the second mode of operation is reduced because the variation of the potential at the terminals PIN, which is caused by the  
20 changeover from the first mode of operation into the second mode of operation, is adapted correspondingly.

Fig. 2 shows an alternative embodiment of a sensor system according to the invention. The sensor system shown in Fig. 2 substantially corresponds to the sensor system shown in Fig. 1.

25 In the sensor system 1 shown in Fig. 2 an electric switch 50 is provided in the signal path to separate the signal path from the fixed electric potential 40. For example, it may be advantageous to open the electric switch 50 when the sensor device 1 is in the first mode of operation, in which a contact of the detection surface is detected, because then the movement detection is inactive and therefore no reduction of a settling time of the movement sensor 20  
30 is required.

In a particular embodiment of the sensor system 1 the signal path also may be provided in the touch sensor 10 in order to connect the sensor electrodes 11 and the terminals PIN, respectively, with a fixed electric potential 40. Fig. 3a shows a signal course of a sensor signal of a movement sensor in a sensor system comprising a movement sensor and a touch sensor, wherein no measures for reducing the settling time of the movement sensor are provided. At first the sensor system is operated in the second mode of operation BM2. Thereafter a switchover from a second mode of operation BM2 into the first mode of operation BM1 is carried out, in which the contacting of a sensor surface by an object is detected. Subsequently a switchover from the first mode of operation BM1 into the second mode of operation BM2 is carried out.

As can be seen in Fig. 3a the signal requires a relatively long time until it has settled (about  $t = 2$  seconds). Only after the settlement of the signal it may be used for movement detection without further actions. Between the time of the switchover from the first mode of operation BM1 into the second mode of operation BM2 and the time at which the sensor signal has settled substantially, either no movement detection may be carried out or additional measures have to be provided in order to detect a movement from the signal not yet settled.

Fig. 3b shows the course of a signal of a sensor signal of a movement sensor in a sensor system comprising a touch sensor and a movement sensor, wherein the sensor system provides the measures for reducing the settling time of the movement sensor described with relation to Fig. 1.

In contrast to the signal course shown in Fig. 3a the settling time of the movement sensor after the switchover from the first mode of operation BM1 into the second mode of operation BM2 has been reduced significantly and almost has been eliminated, respectively, wherein an idealized signal course is shown in Fig. 3b.

The reduction according to the invention of the settling time of the capacitive movement sensor has the advantage that almost immediately after the switchover into the second mode of operation BM2 a settled sensor signal is present so that already immediately after the switchover of the mode of operation a movement detection may be carried out without additional measures having to be provided, as it would be the case with a signal course according to Fig. 3a, for example.

The sensor system according to the invention and the method according to the invention for reducing the settling time of the sensor signal of the movement sensor in addition have the advantage that noise in the sensor signal of the movement sensor is reduced significantly. A further advantage is that the signal processing is simplified considerably, because an extensive signal processing of the settling and not yet settled signal, respectively, may be forgone, so that more time and more calculating time, respectively, is available for other applications. In addition, the precision of detection of the movement detection may be improved significantly, because potential inaccuracies in the movement detection are eliminated to the greatest possible extent by means of the reduction of the settling time.

The sensor system according to the invention, for example, may be used in devices, in particular electric handheld devices, which comprise a touch sensitive and approach sensitive input surface, for example a touch panel. For example, the electric handheld device may be a mobile cell phone, a cordless telephone, a mobile mini-computer, a tablet PC or the like.

Furthermore it is possible according to the invention to combine commercially available and existing touch sensors, respectively, with a movement sensor in order to provide a sensor system according to the invention. In this connection it only has to be ensured that a corresponding signal path, if applicable comprising an electric resistance  $R_{\text{BYPASS}}$  is provided in the sensor system, which connects the sensor electrodes and/or the terminals of the touch sensor at least in the second mode of operation of the sensor system with a fixed electric potential.

Furthermore it is possible according to the invention to integrate the above described electric resistance  $R_{\text{BYPASS}}$  directly into the touch sensor. The touch sensor often only is an integrated circuit IC or a single chip system SoC, in which internal structures may be switched on and off. In addition also other measures may be provided to suppress the temporal variation of the pin capacitance, for example suitable transistor circuits and transistor devices, respectively.

## Claims

1. A sensor system (1) comprising a first sensor device (10) and a second capacitive sensor device (20) for detecting a movement of the object relative to a detection surface,  
5 wherein the sensor system (1) may be operated in a first mode of operation (BM1) and in a second mode of operation (BM2), wherein the sensor system (1) may be switched over from the first mode of operation into the second mode of operation, wherein the second capacitive sensor device (20) comprises a number of second sensor electrodes (21), and wherein in the sensor system (1) at least in the second mode of operation (BM2) at least one signal path  
10 connectable with a predetermined fixed electric potential (40) is provided, which is parallel to a parasitic capacitance of the first sensor device (10).
2. The sensor system of claim 1, wherein the predetermined fixed electric potential (40) comprises at least one of ground potential (GND), supply voltage ( $V_{cc}$ ), half of the supply voltage ( $V_{cc}/2$ ), and an electric potential between ground potential (GND) and supply voltage ( $V_{cc}$ ).
3. The sensor system of claim 1 or 2, wherein the signal path is connected with the predetermined electric potential (40) via an electric resistance  $R_{BYPASS}$ -  
20
4. The sensor system of claim 3, wherein by means of the signal path at least one terminal (PIN) of the first sensor device (10) is coupled with the predetermined electric potential (40) via the electric resistance ( $R_{BYPASS}$ )-
- 25 5. The sensor system of one of the preceding claims, wherein the first sensor device (10) comprises a capacitive sensor device for detecting a contact by an object with a detection surface, wherein the first capacitive sensor device (10) comprises a number of first sensor electrodes (11), wherein in the first mode of operation (BM1) a contact may be detected, and wherein in the second mode of operation (BM2) the movement may be detected.

6. The sensor system of claim 5, wherein by means of the signal path  
- at least one electrode of the first sensor electrodes (11) is coupled with the  
predetermined electric potential (40) via the electric resistance ( $R_{BYPASS}$ ), or  
- at least those first sensor electrodes (11) are each coupled via one electric resistance  
5 ( $R_{BYPASS}$ ) with the predetermined electric potential (40), whose distance from the second  
sensor electrodes (11) is below a predetermined value.
7. The sensor system of one of the preceding claims, wherein a switching device (50) is  
provided in the signal path that is designed to connect the signal path with the predetermined  
10 fixed electric potential (40) in the second mode of operation (BM2).
8. A method for reducing a settling time of a second capacitive sensor device (20) for  
detecting a movement of an object relative to a detection surface (30), wherein the second  
capacitive sensor device (20) is part of a sensor system (1) that in addition comprises a first  
15 sensor device (10), wherein the sensor system (1) is operated in a first mode of operation  
(BM1) or in a second mode of operation (BM2), wherein at least in the second mode of  
operation (BM2) at least one signal path is connected with a predetermined fixed electric  
potential (40) in the sensor system (1), wherein the signal path is parallel to the parasitic  
capacitance of the first sensor device (10).  
20
9. The method of claim 8, wherein the signal path is connected with the predetermined  
electric potential (40) via an electric resistance ( $R_{BYPASS}$ )-
10. The method of one of claims 8 or 9, wherein the first sensor device (10) comprises a  
25 capacitive sensor device for detecting a contact by an object with a detection surface, wherein  
the first capacitive sensor device (10) comprises a number of first sensor electrodes (11),  
wherein in the first mode of operation (BM1) a contact is detected, and wherein in the second  
mode of operation (BM2) the movement is detected.

11. The method of claim 10, wherein by means of the signal path  
- at least one terminal (PIN) of the first capacitive sensor device (10) is connected  
with the predetermined electric potential (40) via the electric resistance ( $R_{BYPASS}$ ), or  
- at least one electrode of the sensor electrodes (11) of the first capacitive sensor  
5 device (10) is connected with the predetermined electric potential (40) via the electric  
resistance ( $R_{BYPASS}$ ).
12. A sensor device (10) for detecting a contact by an object with a detection surface (30),  
wherein the sensor device (10) comprises a number of sensor electrodes (11), wherein at least  
10 one signal path connectable with a predetermined fixed electric potential (40) is provided in  
the sensor device (10), which is parallel to the parasitic capacitance of the sensor device (10).
13. The sensor device of claim 12, wherein by means of the signal path  
- at least one terminal (PIN) of the sensor device (10) is coupled with the  
15 predetermined electric potential (40) via an electric resistance ( $R_{BYPASS}$ ), and/or  
- at least one electrode of the sensor electrodes (11) is coupled with the predetermined  
electric potential (40) via the electric resistance ( $R_{BYPASS}$ ).
14. The sensor device of claim 12 or 13, wherein the sensor device comprises a capacitive  
20 sensor device.

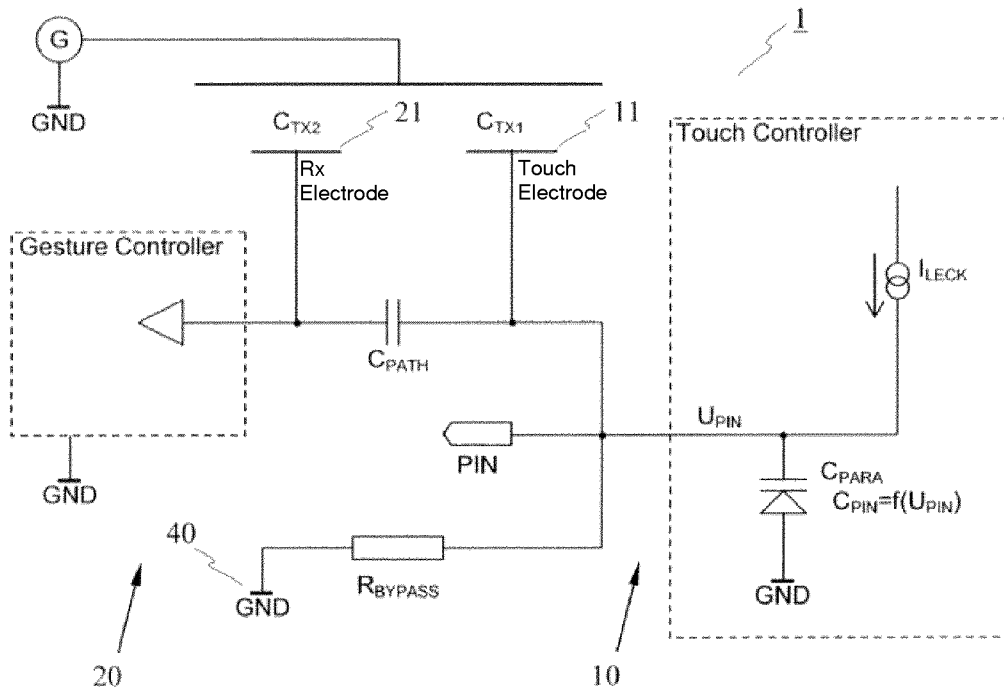


Fig. 1

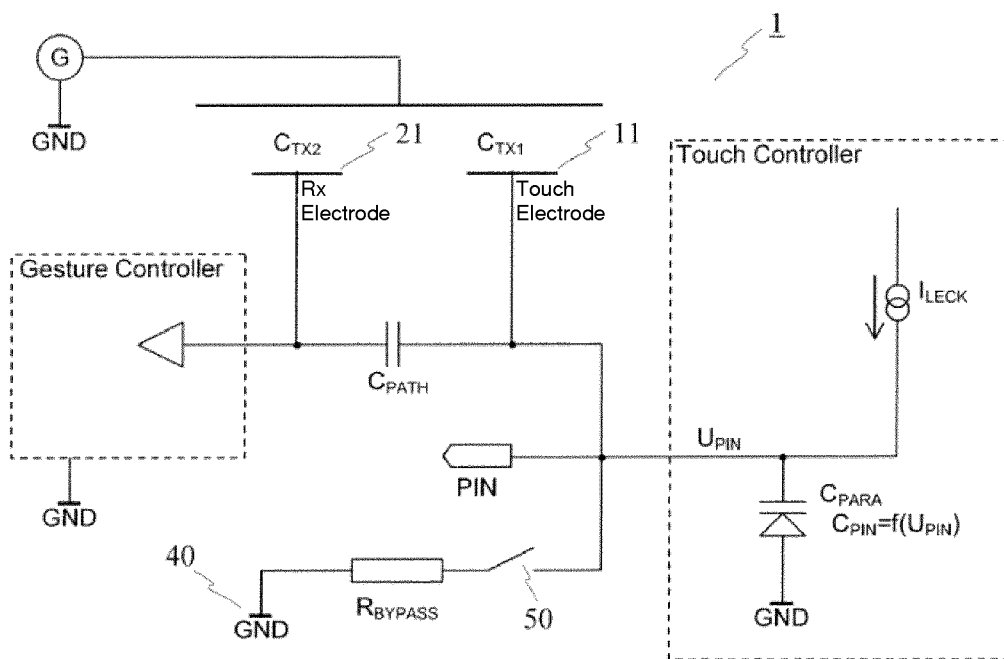


Fig. 2

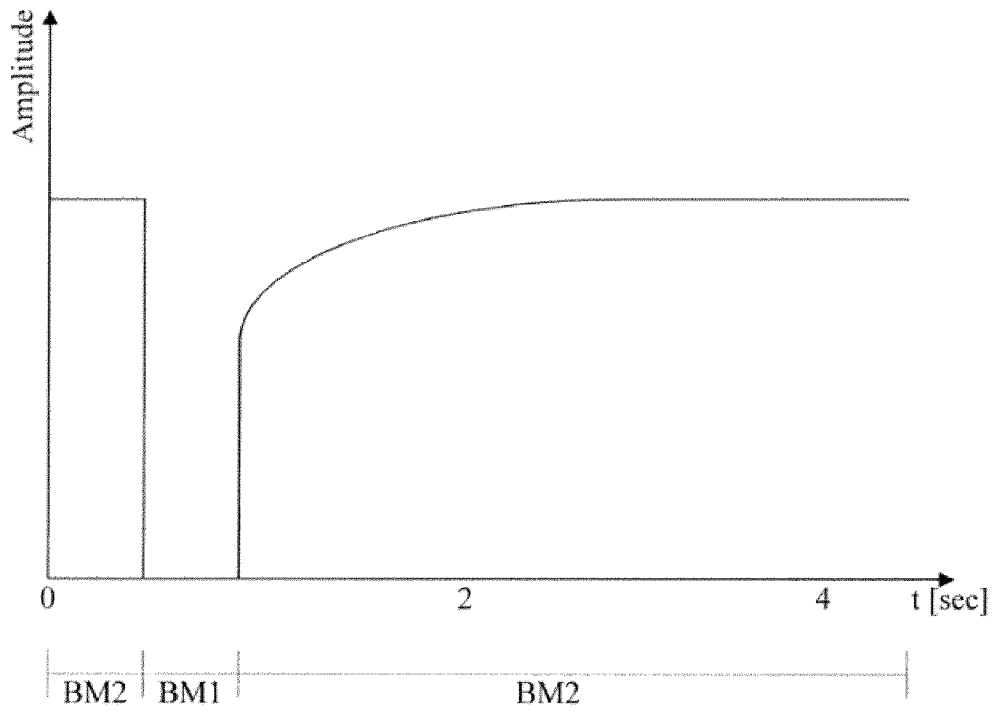


Fig. 3a

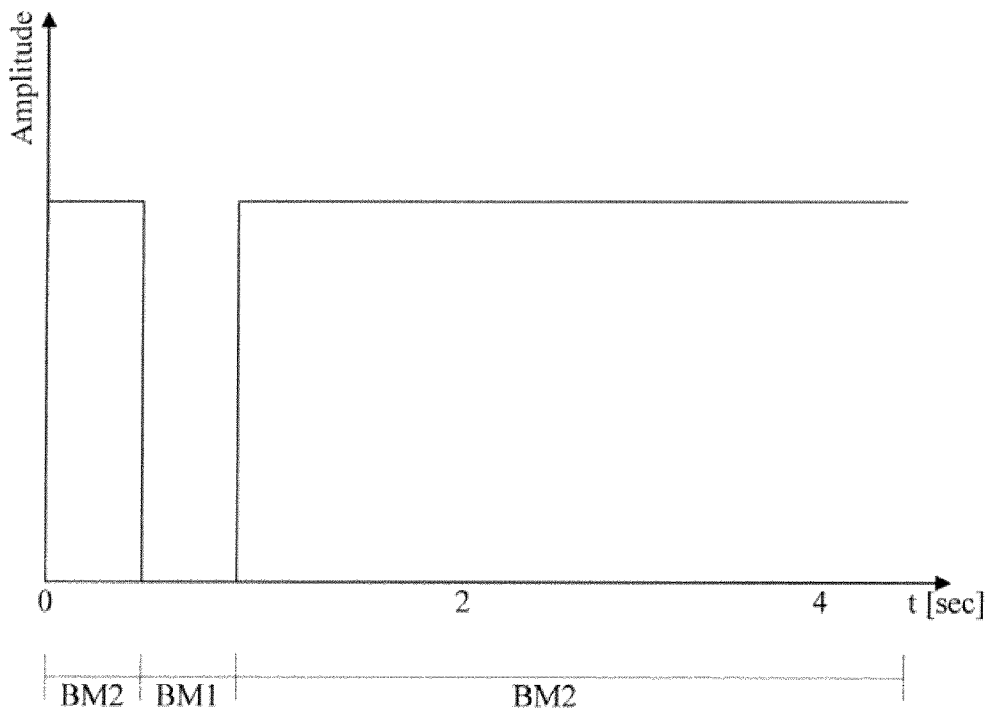


Fig. 3b

# INTERNATIONAL SEARCH REPORT

International application No PCT/EP2012/074717
---

A. CLASSIFICATION OF SUBJECT MATTER  
**INV. H03K17/955 H03K17/96**  
 ADD.

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)  
**H03K G06F**

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)  
**EPO-Internal , WPI Data**

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/295559 AI (OSOINACH BRYCE T [US] OSOINACH BRYCE T [US] ET AL) 25 November 2010 (2010-11-25) figures 1-5, 11-13 paragraph [0016] - paragraph [0020] paragraph [0030] - paragraph [0037] -----	1-14

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

\* Special categories of cited documents :

<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"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</p> <p>"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</p> <p>"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</p> <p>"&amp;" document member of the same patent family</p>
---	---

Date of the actual completion of the international search <b>12 April 2013</b>	Date of mailing of the international search report <b>24/04/2013</b>
---	---

Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  <p style="text-align: center; font-size: 1.2em;"><b>Simon , Vol ker</b></p>
--	---

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2012/074717

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010295559 AI	25-11-2010	CN 102439539 A	02-05-2012
		EP 2433202 A2	28-03-2012
		JP 2012527825 A	08-11-2012
		TW 201104261 A	01-02-2011
		US 2010295559 AI	25-11-2010
		WO 2010135072 A2	25-11-2010
-----			