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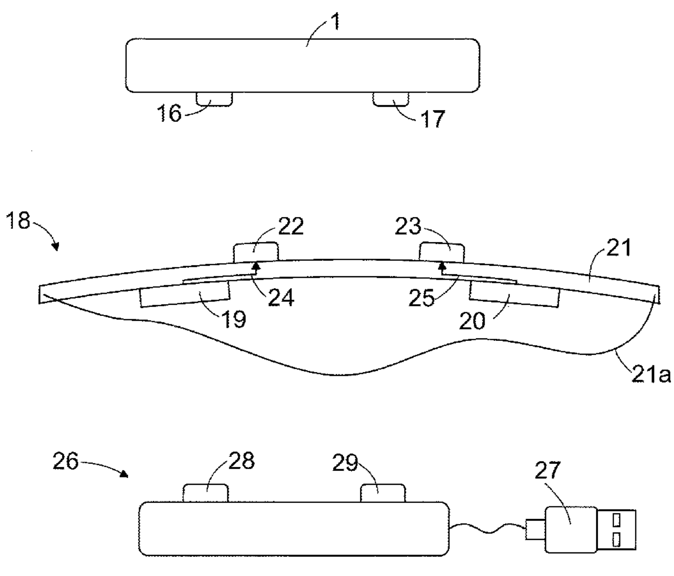

FIG. 1

(57) Abstract: A mobile device (1) for measuring at least one electrical biosignal. The device (1) comprises a first input (4) and a second input (5), a measuring circuit part (7) for providing an output signal indicating the electrical biosignal to be measured, the measuring circuit part (7) comprising a first input (8) and a second input (9), and a charging circuit part (13) for charging a rechargeable battery (3) inserted in the device (1), the charging circuit part (13) comprising a first input (14) and a second input (15). The first input (8) of the measuring circuit part (7) and the first input (14) of the charging circuit part (13) are connected to the first input (4) of the mobile device (1) and the second input (9) of the measuring circuit part (7) and the second input (15) of the charging circuit part (13) are connected to the second input (5) of the mobile device (1).

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MOBILE DEVICE FOR MEASURING ELECTRICAL BIOSIGNALS

FIELD OF THE INVENTION

The present invention relates to a mobile device for measuring at least one electrical biosignal.

BACKGROUND OF THE INVENTION

About 10 % of population suffers from various cardiac problems such as arrhythmias, ischemia, heart attacks or palpitations. Atrial fibrillation is one of the most severe arrhythmias since it may cause strokes that may in turn lead to permanent neurological damage or death. Heart attack is the most common cause of death. Electrocardiogram (ECG) is the most powerful tool to monitor and diagnose the cardiac illnesses. Often the ECG is taken with a 24 – 72 hour recording using a mobile electrocardiogram device that is to be attached to a body of a person to be monitored with galvanic contact between the device electrodes and the user skin.

Heart rate monitoring devices are commonly used during physical training to optimize training level and to follow up condition development. Optical heart rate monitors based on photoplethysmography give indicative heart rate signal, but the most accurate heart rate reading is obtained from the R-peak of the ECG signal by using electrical heart rate monitors.

The mobile heart rate monitoring device or the mobile electrocardiogram device often has a rechargeable battery that is recharged through pins or a connector such as micro USB connector. In many devices a battery charger may be connected to the device while using the device. However, a faulty battery charger may then expose the user of the device to line voltages through the ECG contacts unless costly line isolation circuitry is used. Usage of the device during charging can also be prevented with a circuitry that detects if the device is connected to a charger and resets the microcontroller or powers down the electronics while connected to the charger. However, this alone does not prevent charging of the device while connected to human body.

BRIEF DESCRIPTION OF THE INVENTION

An object of the present invention is to provide a novel mobile device for measuring at least one electrical biosignal.

The invention is characterized by the features of the independent claims.

A mobile device for measuring at least one electrical biosignal comprises a first input and a second input, a measuring circuit part for providing an output signal indicating the electrical biosignal to be measured and comprising a first input and a second input as well as a charging circuit part for charging a rechargeable battery inserted in the device, the charging circuit part comprising a first input and a second input. Further in the mobile device the first input of the measuring circuit part and the first input of the charging circuit part are connected to the first input of the mobile device and the second input of the measuring circuit part and the second input of the charging circuit part are connected to the second input of the mobile device.

In the mobile device disclosed there are common inputs both for measuring the electrical biosignal to be measured and for recharging the battery of the mobile device. This means that charging of the battery of the mobile device may be easily prevented at the same time when the mobile device is in active operation and measuring the electrical biosignal of the user of the device, because either a measurement operation or a charging operation may be in use at a time. Thereby a possibly faulty battery charger device may not expose the user of the mobile device to line voltages through the measurement electrode contacts. The number of physical ports or contacts of the mobile device is also minimized, whereby system costs are reduced and immunity of the mobile device to humid or wet conditions is increased, since ports or contacts penetrating a device cover increase a risk to short circuits and failure to water leakages.

Some embodiments of the invention are disclosed in dependent claims.

In an embodiment an additional circuitry is used that detects if the device is connected to a charger and resets or powers down a microcontroller or a microprocessor of the device during recharging. This gives additional safety by preventing running of a measurement algorithm while the device is connected to the battery charger device. An additional benefit is that a reset action without additional pins or switches is provided in case normal operation of the microprocessor is for some reason disturbed during usage. Such reasons can be, e.g., electrical shocks, processor malfunction or firmware bugs that cause the algorithm to halt.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following the invention will be described in greater detail by means of preferred embodiments with reference to the accompanying drawings, in which

Figure 1 shows schematically a side view of a mobile device for measuring at least one electrical biosignal, a wearable sensor module connectable to the mobile device and a battery charger device connectable to the mobile device;

Figure 2 shows schematically an internal circuit diagram of the mobile device of Figure;

Figure 3 shows schematically an embodiment of the internal circuit diagram of Figure 2,

Figure 4 shows schematically a second internal circuit diagram of the mobile device; and

Figure 5 shows schematically an embodiment of the internal circuit diagram of Figure 4.

For the sake of clarity, the figures show some embodiments of the invention in a simplified manner. Like reference numerals identify like elements in the figures.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows schematically a side view of a mobile device 1 for measuring at least one electrical biosignal. Figure 1 further shows a side view of a wearable sensor module 18 connectable to the mobile device 1 and collecting a signal that describes the electrical biosignal to be measured, as well as a side view of a battery charger device 26 connectable to the mobile device 1 for recharging a rechargeable battery inserted in the mobile device 1.

The mobile device 1 may for example be a heart rate monitor for measuring a heart rate of a user of the device 1, in which case the electrical biosignal to be measured describes the heart rate of the user of the device 1. Alternatively the mobile device 1 may be a mobile electrocardiogram device for measuring an electrocardiogram (EKG) of the user of the device 1, in which case the electrical biosignal to be measured describes the electrical activity of the heart of the user of the device 1. Alternatively the mobile device 1 may be a mobile electromyogram device for measuring an electromyogram (EMG) of the user of the device 1, in which case the electrical biosignal to be measured describes the electrical activity of muscles of the user of the device 1. Alternatively the mobile device 1 may be a mobile electroencephalogram device for measuring an electroencephalogram (EEG) of the user of the device 1, in which case the electrical biosignal to be measured describes the electrical activity of the brain of the user of the device

1. In addition, the mobile device may detect any electrical functions of the body, for example the electrical activity of organs such as eye, stomach, liver etc. The mobile device may also be used for measuring the electrical properties of the body,e.g. the bioimpedance of the body. The signals describing the electrical activities of the organs or the electrical properties of the body are also electrical biosignals that may be measured with the device 1.

It is also possible to use the device, instead of measuring a biosignal, to drive an electrical signal to the body to activate the neural or muscular system, through, e.g., transcutaneous electrical nerve stimulation – TENS, functional electrical stimulation – FES, or electrical muscle stimulation – EMS.

Alternatively to the devices and the electrical biosignals to be measured as listed above, the mobile device 1 may be intended to measure some other electrical biosignal or electrical properties of the user of the device 1. In the following description disclosing some embodiments of the mobile device 1, it is assumed that the mobile device 1 is intended to measure the electrocardiogram (EKG) of the user of the device 1.

Figure 2 shows schematically an embodiment of an internal circuit 2 of the mobile device 1. In Figure 2 the mobile device 1 is shown very schematically by a box drawn with a broken line. The mobile device 1 comprises a rechargeable battery 3 for providing an operating power of the mobile device 1. The rechargeable battery 3 may be replaceable because of a failure of the battery 3 or because of a reduced operating capability of the battery 3. The battery 3 may also be replaced after a certain predetermined lifetime of the battery 3 has passed. The battery 3 may for example be a lithium ion battery.

The internal circuit 2 comprises a first input 4 being a first input 4 of the mobile device 1. In the embodiments disclosed the first input 4 is a positive input 4. The voltage level in the first input 4 may be five volts when a battery charger device 26 is connected to the mobile device 1, for example. The internal circuit 2 comprises also a second input 5 being a second input 5 of the mobile device 1. In the embodiments disclosed the second input 5 is a negative input 5 or a lower voltage level input 5, i.e. an input connected to a lower voltage level in the mobile device 1. The second input 5 may thus be grounded, in which case the voltage level in the second input 5 is zero volt. Alternatively the second input 5 may be a virtual ground input having a voltage level less than the voltage level in the first input 4. According to an embodiment the voltage level in the second input 5 is 1 - 4 volts for example.

The internal circuit 2 further comprises a measurement signal output 6, through which a measurement signal indicating the electrical biosignal to be measured is supplied to an analog-to-digital converter and via a radio communication circuitry out of the mobile device 1 for further analysis and/or representation. The analog-to-digital conventer is shown schematically with a box denoted with a reference sign 38a and the radio communication circuitry is shown schematically with a box denoted with a reference sign 38b.

The internal circuit 2 comprises a measuring circuit part 7 for retrieving the signal indicating the electrical biosignal to be measured. The measurement signal describing the electrical biosignal to be measured is connected by the wearable sensor module 18 which is attached to the user of the device 1 to the mobile device 1 as described later in more detail. The measuring circuit part 7 comprises a first input 8 and a second input 9. The first input 8 of the measuring circuit part 7 is connected to the first input 4 of the mobile device 1, and the second input 9 of the measuring circuit part 7 is connected to the second input 5 of the mobile device 1. The measuring circuit part 7 thus receives through the inputs 4, 5 of the internal circuit 2 an electrical signal from the wearable sensor module 18 connected to the mobile device 1, which electrical signal contains, possibly together with many other unrelated signals and measurement noise, a signal portion that describes the electrical biosignal to be measured.

The measuring circuit part 7 of Figures 2 and 3 comprises a measurement filter 10 and an amplifier 11 connected in series with the measurement filter 10. The measurement filter 10 is a circuit that retrieves the signal portion, i.e. in a case of the electrocardiogram measurement the electrocardiogram signal, actually describing or indicating only the electrical biosignal from the measurement signal received from the wearable sensor module 18 through the inputs 4, 5 of the internal circuit 3, which measurement signal may also contain noise or other unrelated signal portions. The amplifier 11 amplifies the signal retrieved by the measurement filter 10 for an analog-to-digital conversion and to a transmission of the retrieved signal out of the mobile device 1. The digital signal may be transmitted out of the mobile device 1 via a wired transmission but preferably wirelessly using local area network or Bluetooth radio.

The configuration of the measuring circuit part 7 may vary from that disclosed in Figures 2 and 3 depending on the electrical biosignal to be measured, for example.

The internal circuit 2 of the mobile device 1 also comprises a charging circuit part 13 having parts 26a, 30 and 34 for recharging the rechargeable battery 3 of the mobile device 1. According to an embodiment, part 26a is a battery charging chip, e.g. MAX1555, part 30 is a switching element that may be a mechanical or solid-state switch but preferably a P-channel MOSFET transistor, part 34 is a diode.The charging circuit part 7 comprises a first input 14 and a second input 15.

The first input 14 of the charging circuit part 13 is connected to the first input 4 of the mobile device 1, and the second input 15 of the charging circuit part 13 is connected to the second input 5 of the mobile device 1. The charging circuit part 13 receives through the inputs 4, 5 of the internal circuit 2 charging current from the battery charger device 26 connectable to the mobile device 1.

In the mobile device 1 disclosed above the first input 8 of the measuring circuit part 7 and the first input 14 of the charging circuit part 13 are both connected to the first input 4 of the mobile device 1, and the second input 9 of the measuring circuit part 7 and the second input 15 of the charging circuit part 13 are connected to the same second input 5 of the mobile device 1. To be more precise, in the embodiments disclosed the first input 14 of the charging circuit part 13 is combined with the first input 8 of the measuring circuit part 7, that are connected together to the first input 4 of the mobile device 1, and the second input 15 of the charging circuit part 13 is combined with the second input 9 of the measuring circuit part 7, that are connected together to the first input 4 of the mobile device 1.

Alternatively, the first input 8 of the measuring circuit part 7 and the first input 14 of the charging circuit part 13 could be connected through separate lines to the first input 4 of the mobile device 1 and the second input 9 of the measuring circuit part 7 and the second input 15 of the charging circuit part 13 could also be connected through separate lines to the second input 5 of the mobile device 1.

In other words, the mobile device 1 disclosed above comprises common inputs both for measuring the electrical biosignal to be measured and for recharging the battery 3 of the mobile device 1.

For actually connecting the mobile device 1 to the wearable sensor module 18 and to the battery charger device 26 the mobile device 1 comprises a first connector element 16 connected to the first input 4 of the internal circuit 2 and a second connector element 17 connected to the second input 5 of the internal circuit 2 of the mobile device 1. The first 16 and the second 17 connector elements in the device 1 connect the device 1 both mechanically and electrically to the wearable sensor module 18 and the battery charger device 26 through counterpart connector elements in the wearable sensor module 18 and the battery charger device 26. The wearable sensor module 18 and the battery charger device 26 are described shortly next with reference to Figure 1.

The wearable sensor module 18 comprises a first measuring electrode 19 and a second measuring electrode 20 that are brought into contact with a skin of the user of the mobile device 1. The wearable sensor module 18 of Figure 1 comprises a strap 21 to which the measuring electrodes 19, 20 are attached to, and the strap 21 is to be put around a body of the user of the mobile device 1 by using a band 21a. Instead of the strap 21 a shirt, a cap or other piece of clothing could also provide a foundation for the measuring electrodes 19, 20. The wearable sensor module 18 further comprises a first connector element 22 to which the first measuring electrode 19 is connected through a first signal line 24 and a second connector element 23 to which the second measuring electrode 20 is connected through a second signal line 25.

When the mobile device 1 is taken in use, the first connector element 16 of the mobile device 1 is connected to the first connector element 22 in the wearable sensor module 18 and the second connector element 17 of the mobile device 1 is connected to the second connector element 23 in the wearable sensor module 18. The connection between the connector elements 16, 17 in the mobile device 1 and the connector elements 22, 23 in the wearable sensor module 18 provide both the mechanical and the electrical connection between the mobile device 1 and the wearable sensor module 18. After that the wearable sensor module 18 is put on the user of the mobile device 1 in such a way that the measuring electrodes 19, 20 of the wearable sensor module 18 are brought into contact with the skin of the user of the mobile device 1 and the mobile device 1 is turned on.

The battery charger device 26 comprises a plug 27 through which the battery charger device 26 may be connected to a power supply for recharging the battery 3 in the mobile device 1. In the embodiment of the battery charger device 26 of Figure 1 the plug 27 is a USB-port plug which may be connected to a USB-port in a portable computer, for example. Other kind of battery charger devices, like the ones comprising a voltage transformer, may also be applied. The battery charger device 26 further comprises a first connector element 28 and a second connector element 29 through which the battery charger device 26 may be connected to the mobile device 1.

When the battery 3 of the mobile device 1 is to be recharged, the mobile device 1 is unfastened from the wearable sensor module 18 and the first connector element 16 of the mobile device 1 is connected to the first connector element 28 of the battery charger device 26 and the second connector element 17 of the mobile device 1 is connected to the second connector element 29 of the battery charger device 26. The connection between the connector elements 16, 17 in the mobile device 1 and the connector elements 28, 29 in the battery charger device 26 provide both the mechanical and the electrical connection between the mobile device 1 and the battery charger device 26. After the battery 3 of the mobile device 1 is recharged, the mobile device 1 is unfastened from the battery charger device 26 and the mobile device 1 may be started to use again.

As stated above, the mobile device 1 disclosed comprises common inputs both for measuring the signal describing or containing a signal indicating the electrical biosignal to be measured and for recharging the battery of the mobile device.

This means firstly, that charging of the mobile device 1 may be easily prevented at the same time when the mobile device 1 is connected to the wearable sensor module 18, i.e. the charging of the mobile device 1 is prevented at the same time when the mobile device 1 is in operation and measuring the electrical biosignal of the user of the device 1, because either a measurement operation or a charging operation may be in use at a time. Thereby a possibly faulty battery charger device may not expose the user of the mobile device 1 to line voltages through the measurement electrode contacts.

Secondly, the number of physical ports or contacts of the mobile device 1 is also minimized, whereby system costs are reduced. Also the immunity of the mobile device 1 to humid or wet conditions, for example due to sweating, swimming or shower, is increased, since ports or contacts penetrating a device cover increase a risk to short circuits and failure to water leakages.

As stated above, the connector elements 16, 17 in the mobile device 1 and the connector elements 22, 23 in the wearable sensor module 18 or the connector elements 28, 29 in the battery charger device 26 provide both the mechanical and the electrical connection between the mobile device 1 and the wearable sensor module 18 or the battery charger device 26. That kind of connection may be implemented for example with snap fasteners. The connector elements 16 and

17 can also be part of a single electromechanical connector that snaps on a receptable connector in the wearable sensor module 18 and the battery charger device 26. The connectors in mobile device 1 and the wearable sensor module 18 can have a multitude of other connector elements for connecting to other sensor elements in the wearable sensor module 18, e.g. to other ECG electrodes or to a temperature sensor. The connector elements 28 and 29 may likewise be incorporated in a single connector to which the connector in mobile device 1 is attached.

Referring to Figure 2 again, the charging circuit part 13 of the mobile device 1 comprises a switching element 30 that is connected both to the first signal input 4 of the mobile device 1 and to the second signal input 5 of the mobile device 1. The switching element 30 detects a presence of the battery charger device 26 whereby the switching element 30 is configured to switch the charging circuit part 13 on a low-impedance on-state for charging the battery 3 of the mobile device 1. When the battery charger device 26 is removed from the mobile device 1, the switching element 30 is configured to switch the charging circuit part 13 back to a high-impedance off-state for the measurement of the at least one electrical biosignal.

The switching element 30 of Figure 2 comprises a first connection 31 that is connected to the first input 4 of the mobile device 1. The switching element 30 comprises a second connection 32 that is connected to the second input 5 of the mobile device 1. The switching element 30 of Figure 2 comprises also a third connection 33 that is to be connected to the battery charging chip 26a in the circuit 2 of the mobile device 1.

The charging circuit part 13 comprises also the diode 34. The diode 34 comprises a first connection 35, i.e. an anode connection that is to be connected to the battery charging chip 26a. The diode 34 comprises also a second connection 36, i.e. a cathode connection that is connected to the second input 5 of the mobile device 1. The diode 34 prevents any possible current flow from the direction of the second input 5 of the mobile device 1 towards the first input 4 of the mobile device 1 in a case that the second input 5 is not a completely grounded input but a virtual ground input having a voltage level above zero volts.

When the battery charger device 26 is connected to the mobile device 1, the battery charger device 26 will thus be connected between the switching element 30 and the diode 34 in the charging circuit part 13, whereby the switching element 34 activates and allows a charging current flow in the charging circuit part 13 and the battery 3 is started to be recharged. When the battery charger device 26 is disconnected from the mobile device 1, the switching element 30 deactivates and a current flow in the charging circuit part 13 is prevented. The switching element 30 thus provides a kind of a detection circuit which automatically detects whether a battery charger device 26 is connected to the mobile device 1 or not and correspondingly either allows or disallows a current flow in the charging circuit part 13.

According to an embodiment the switching element 30 is a transistor 37, such as a field effect transistor or a FET transistor. The switching element 30 could also be a transistor pair, such as a complementary CMOS transistor pair. Figure 3 shows schematically an embodiment of the internal circuit 2 of Figure 2 when the switching element 34 is a single transistor 37.

In the embodiment of Figure 3, a source S of the transistor 37 provides the first connection 31 of the switching element 30 that is connected to the first input 4 of the mobile device 1. A gate G of the transistor 37 provides the second connection 32 of the switching element 30 that is connected to the second input 5 of the mobile device 1. A drain D of the transistor 37 provides the third connection 33 of the switching element 30 that is to be connected to the battery charging chip 26a when the battery charger device 26 is connected to the mobile device 1.

When the battery charger device 26 is connected to the mobile device 1 the transistor 37 switches to the low-impedance on-state for allowing a current flow in the charging circuit part 13. When the battery charger device 26 is disconnected from the mobile device 1 the transistor 3 switches back to the high-impedance off-state for preventing the current flow in the charging circuit part 13.

When the switching element 30 is implemented by a transistor 37, the switching element 30 has a very simple and cost-efficient implementation. Other kinds of switching element embodiments different from those disclosed above are naturally possible.

Switching element may be a mechanical or solid-state relay controlled by a microprocessor of the mobile device 1. In this embodiment, the input of a voltage comparator is connected to the input 4 of the mobile device 1. The output of the voltage comparator is given to the microprocessor. When the battery charger device 26 is connected to the mobile device 1, the voltage comparator detects that the input 4 of the mobile device 1 is at a high charging voltage and supplies a signal to the processor that closes the switching element 30 and a charging current flows onto the battery charging chip 26a. When the mobile device 1 is measuring the electrical biosignal, the voltage comparator detects that the voltage level of the input 4 of the mobile device 1 is low and thereby the processor opens the switching element 30.

In the embodiment of Figure 4, the battery charging circuitry 13 and/or the battery charging chip 26a provides an additional reset signal 39 when device 1 is connected to the battery charger device 26. The signal 39 is used to stop normal operation of the device 1 by resetting a microcontroller 40 or a microprocessor 40 which runs or executes the firmware responsible for controlling operations in the mobile device 1. A simple realization of such resetting circuitry is shown in Figure 5. A MOSFET transistor 41 detects whether signal in the third connection 33 of the switching element 30 in the battery charging circuitry is ON and goes to LOW-state. A resistor 42 serves as a pull-up resistor. The reset signal output 39 of the transistor 41 is taken to the reset input 43 of the microcontroller 40. In this way operation of the device 1 is prevented while connected to battery charger device 26 providing charging current. An additional benefit is that the microcontroller 40 can be reset without additional switches or output pins penetrating the device 1 cover in case the normal operation of the device 1 is halted due to malfunction of the microcontroller.

It will be obvious to a person skilled in the art that, as the technology advances, the inventive concept can be implemented in various ways. The invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

CLAIMS

1. A mobile device (1) for measuring at least one electrical biosignal, the device (1) comprising

a measuring circuit part (7) for providing an output signal indicating the electrical biosignal to be measured, the measuring circuit part (7) comprising a first input (8) and a second input (9),

a charging circuit part (13) for charging a rechargeable battery (3) inserted in the device (1), the charging circuit part (13) comprising a first input (14) and a second input (15), **characterized** in that

the mobile device (1) comprises a first input (4) and a second input (5), and that

the first input (14) of the charging circuit part (13) is combined with the first input (8) of the measuring circuit part (7), the first input (8) of the measuring circuit part (7) and the first input (14) of the charging circuit part (13) being connected to the first input (4) of the mobile device (1), and the second input (15) of the charging circuit (13) part is combined with the second input (9) of the measuring circuit part (7), the second input (9) of the measuring circuit part (7) and the second input (15) of the charging circuit part (13) being connected to the second input (5) of the mobile device (1), and that

the charging circuit part (13) comprises a switching element (30) for switching the charging circuit part (13) to a low-impedance on-state for charging the rechargeable battery (3) inserted in the mobile device (1) and to a high-impedance off-state for the measurement of the at least one electrical biosignal.

2. A mobile device as claimed in claim 1, **characterized** in that

the measuring circuit part (7) comprises a measurement filter (10) for retrieving an output signal indicating the electrical biosignal to be measured and an amplifier (11) for amplifying the retrieved signal indicating the electrical biosignal to be measured.

3. A mobile device as claimed in claim 1, **characterized** in that

the switching element (30) is a transistor (37), whereby a source (S) of the transistor (37) is connected to a first input (4) of the mobile device (1), a gate (G) of the transistor (37) is connected to the second input (5) of the mobile device (1) and a drain (D)of the transistor (37) is connectable to a current supply for charging the rechargeable battery (3), the transistor (37) switching to the low-impedance on-state in response to the current supply being connected to the mobile device (1).

4. A mobile device as claimed in any one of the preceding claims, **characterized** in that

the mobile device (1) comprises a first connector element (16) connected to the first input (4) of the mobile device (1) and a second connector element (17) connected to the second input (5) of the mobile device (1), the first connector element (16) and the second connector element (17) configured to provide both a mechanical and an electrical connection between the mobile device (1) and a wearable sensor module (18) or a battery charger device (26) connectable to the mobile device (1).

5. A mobile device as claimed in any one of the preceding claims, **characterized** in that the mobile device (1) comprises a microcontroller (40) arranged to execute a firmware arranged to control operations in the mobile device (1), and that the charging circuit part (13) is arranged to provide a reset signal (39) the state of which is arranged to change when the mobile device (1) is connected to a battery charger device (26), the reset signal (39) being used to reset and/or stop the microcontroller (40).

6. A mobile device as claimed in claim 5, **characterized** in that the reset signal (39) is realized by using an element, such as a MOSFET transistor, arranged to sense a state of a signal that is arranged to activate in response to the battery charger device (26) being connected to the mobile device (1), thus activating the reset signal (39) to reset and/or stop the microcontroller (40).

7. A mobile device as claimed in any one of the preceding claims, **characterized** in that the mobile device (1) is at least one of the following: a heart rate monitor for measuring a heart rate, an electrocardiogram device for measuring an electrocardiogram (EKG), an electromyogram device for measuring an electromyogram (EMG), an electroencephalogram device for measuring an electroencephalogram (EEG).

8. A wearable sensor module (18) connectable to the mobile device (1) as claimed in any one of claims 1 to 7, the wearable sensor module (18) comprising

at least one pair of measurement electrodes (19, 20) for measuring a signal describing at least one electrical biosignal to be measured, and

a first connector element (22) and a second connector element (23) connectable to the first (16) and the second (17) connector elements of the mobile device (1) for connecting the wearable sensor module (18) both mechanically and electrically to the mobile device (1).

9. A battery charger device (26) connectable to the mobile device (1) as claimed in any one of claims 1 to 7, the battery charger device (26) comprising

a first connector element (28) and a second connector element (29) connectable to the first (16) and the second (17) connector elements of the mobile device (1) for connecting the battery charger device (26) both mechanically and electrically to the mobile device (1).

10. Use of a mobile device (1) as claimed in any one of claims 1 – 7 to drive an electrical signal to a body of a user of the device (1) to activate a neural or muscular system or to measure electrical properties.

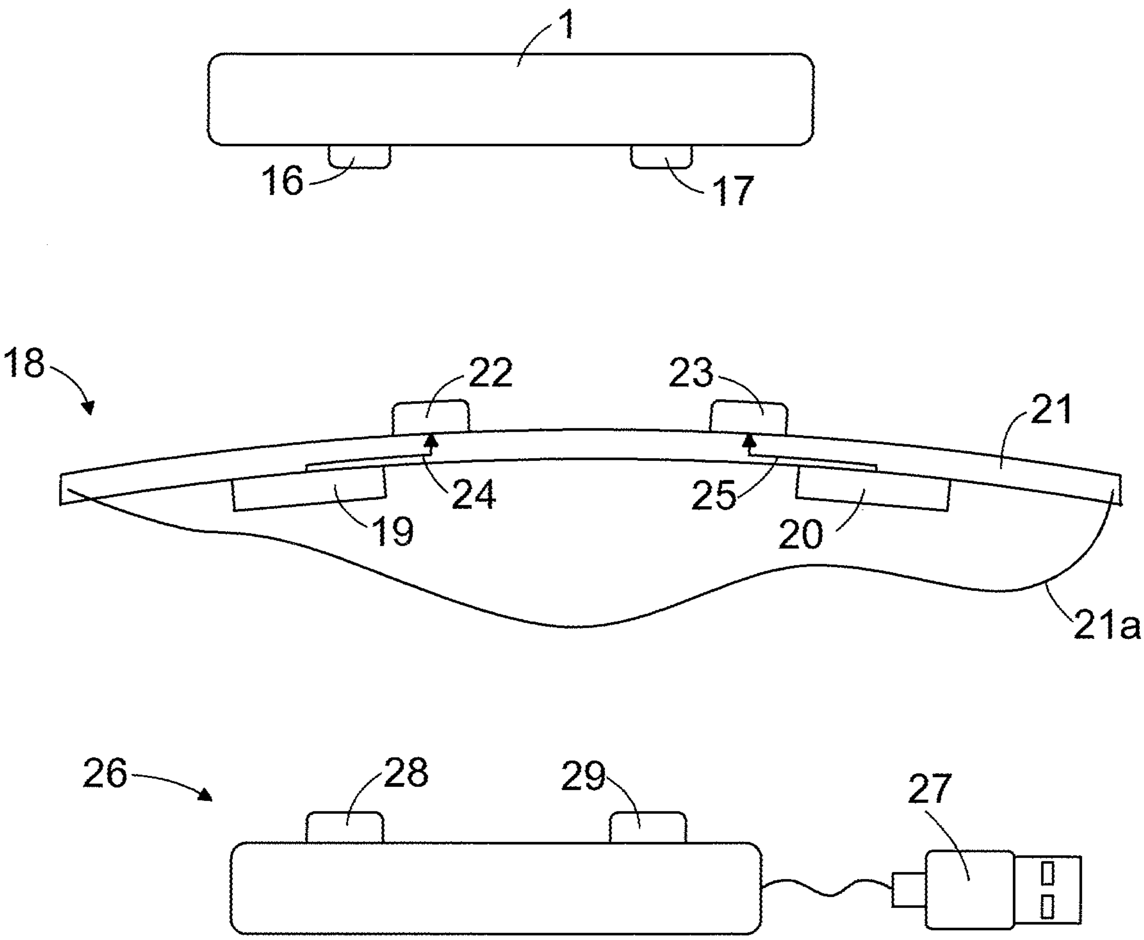

1
16
17
18
22
23
21
24
25
19
20
21a
26
28
29
27

FIG. 1

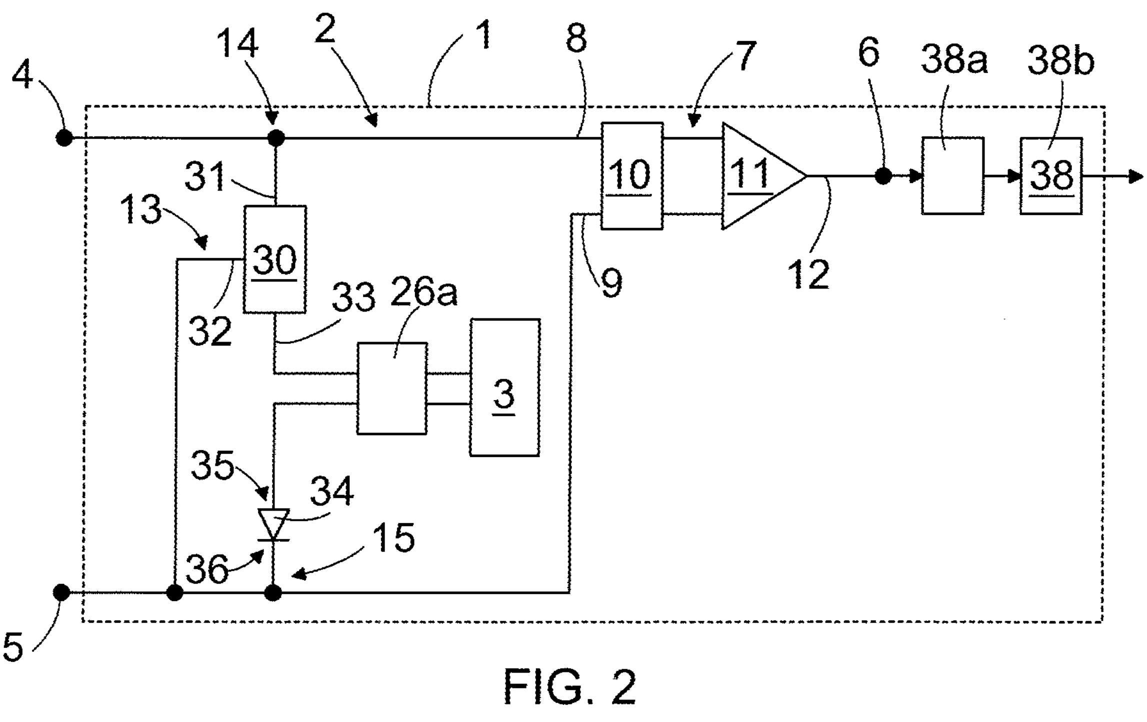
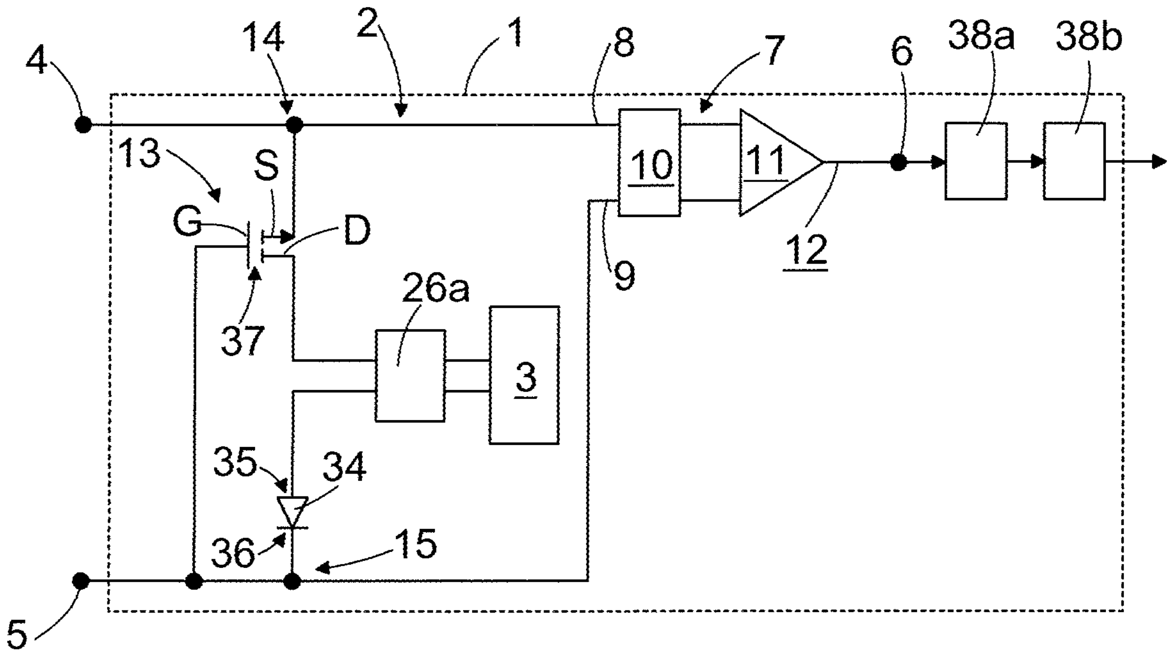

4
14
2
1
8
7
6
38a
38b
10
11
38
31
13
30
32
33
26a
9
12
3
35
34
15
36
5

FIG. 2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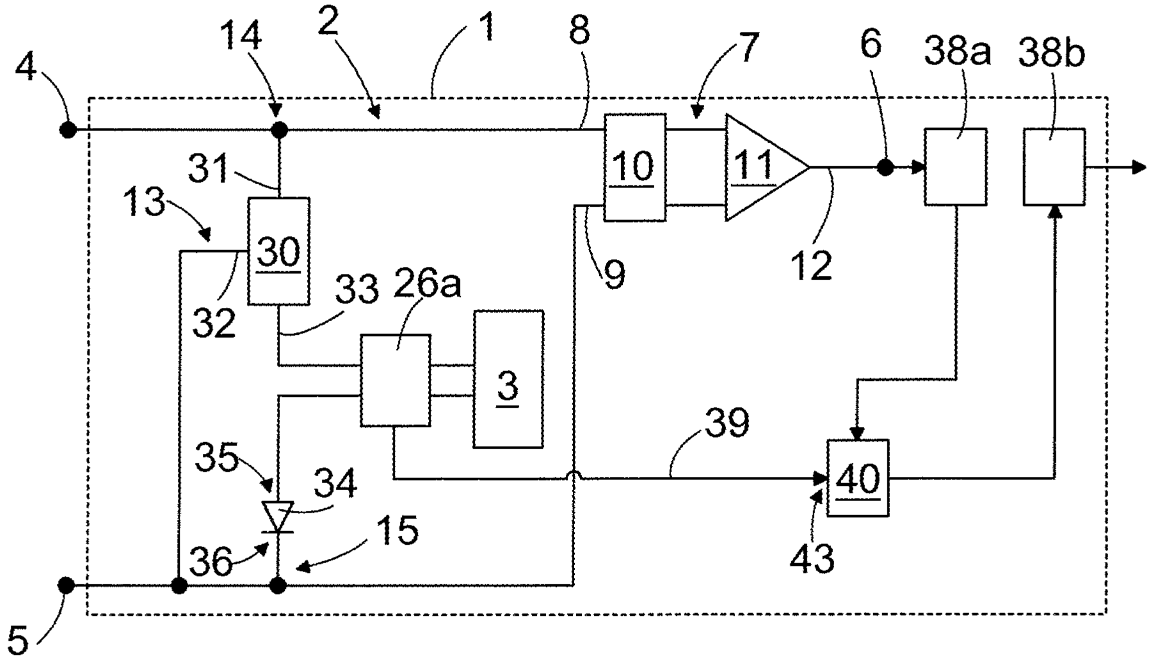
14
2
1
8
7
6
38a
38b
13
S
G
D
10
11
12
9
26a
37
3
35
34
36
15
5

FIG. 3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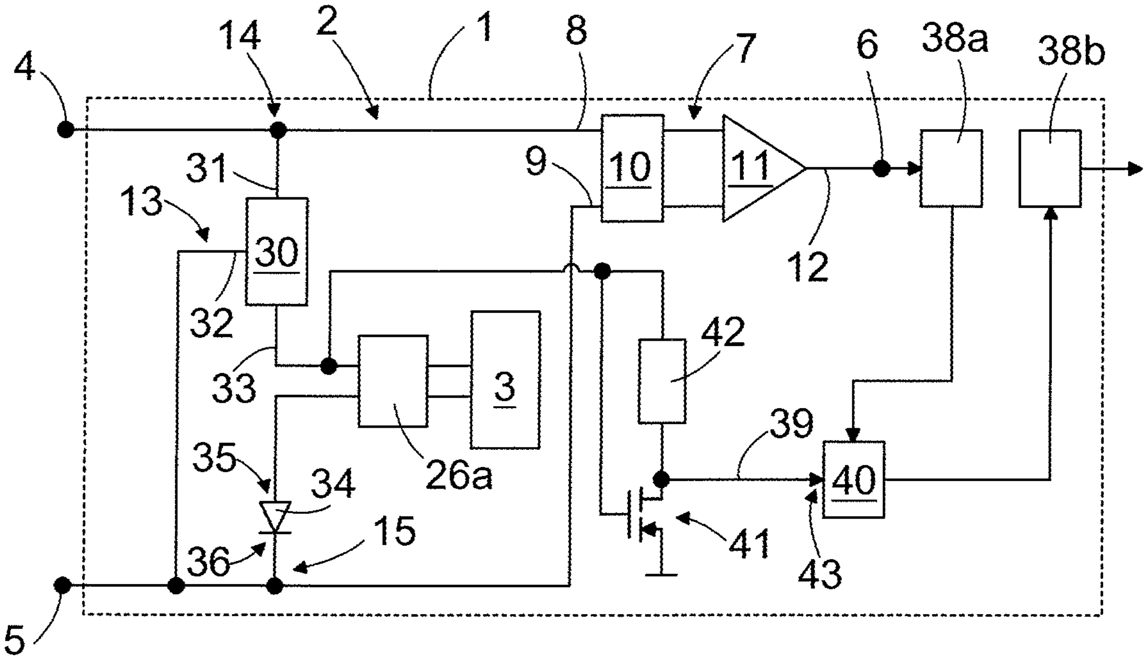
14
2
1
8
7
6
38a
38b
31
13
30
32
33
26a
10
11
9
12
3
39
35
34
15
36
40
43
5

FIG. 4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2
1
8
7
6
38a
38b
4
31
9
10
11
13
30
32
12
42
33
3
39
35
34
26a
40
15
36
41
43
5

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2017/050168

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B5/024 A61B5/04 A61B5/00 A61B5/0404
ADD. A61B5/0408

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)
A61B

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 2004/077954 A1 (OAKLEY NIGEL R [GB] ET AL) 22 April 2004 (2004-04-22) figures 1-7, 10 paragraphs [0001] - [0010], [0015] - [0016], [0032] - [0061], [0074] - [0083] -----	1-10
X	US 2015/366506 A1 (CHIEN JEN-CHIEN [TW] ET AL) 24 December 2015 (2015-12-24) abstract; figures 1-10 paragraphs [0007] - [0012], [0023] - [0036] -----	1-10
A	US 2015/364018 A1 (MIROV RUSSELL NORMAN [US] ET AL) 17 December 2015 (2015-12-17) figures 8-9 paragraphs [0061] - [0103] ----- -/--	1-10

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 June 2017	08/06/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Carta, Riccardo

1

International application No
PCT/FI2017/050168

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	WO 2016/053731 A1 (GOOGLE INC [US]) 7 April 2016 (2016-04-07) figure 6 paragraphs [0067], [0087], [0100] - [0101] -----	1,10

1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2017/050168

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [X] Claims Nos.: 10(partially)
because they relate to subject matter not required to be searched by this Authority, namely:
see FURTHER INFORMATION sheet PCT/ISA/210

2. [ ] Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. [ ] Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. [ ] As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/FI2017/050168

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004077954 A1	22-04-2004	AU 2003271968 A1	04-05-2004
		EP 1553869 A1	20-07-2005
		GB 2394294 A	21-04-2004
		US 2004077954 A1	22-04-2004
		US 2006235316 A1	19-10-2006
		WO 2004034896 A1	29-04-2004
US 2015366506 A1	24-12-2015	CN 105310683 A	10-02-2016
		JP 5807101 B1	10-11-2015
		JP 2016007525 A	18-01-2016
		TW 201600062 A	01-01-2016
		US 2015366506 A1	24-12-2015
US 2015364018 A1	17-12-2015	US 2015364018 A1	17-12-2015
		WO 2015191295 A1	17-12-2015
WO 2016053731 A1	07-04-2016	US 2016095527 A1	07-04-2016
		WO 2016053731 A1	07-04-2016

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.1

Claims Nos.: 10(partially)

Rule 39.1(iv) PCT - Method of treatment of the human body

Independent claim 10 (partially) discloses a method of treatment of the human body which is not patentable according to Rule 39.1(iv) PCT (see PCT-EPO Guidelines, B-VIII, 2.1-2.2). Claim 10 (partially) describes a therapy procedure for human patients which is based on "driving an electrical signal to a body of a user of the device (1) to activate a neural or muscular system" The disclosure of a single therapeutic feature is a sufficient condition to rise an objection for non patentable subject-matter under Rule 39.1(iv) PCT.

专利名称(译)	用于测量电子生物信号的移动设备		
公开(公告)号	[EP3429466A1](EP3429466A1)	公开(公告)日	2019-01-23
申请号	EP2017713992	申请日	2017-03-14
[标]申请(专利权)人(译)	芬兰国家技术研究中心股份公司		
申请(专利权)人(译)	TEKNOLOGIAN TUTKIMUSKESKUS VTT OY		
当前申请(专利权)人(译)	TEKNOLOGIAN TUTKIMUSKESKUS VTT OY		
[标]发明人	VARPULA TIMO HELISTO PANU		
发明人	VARPULA, TIMO HELISTÖ, PANU		
IPC分类号	A61B5/024 A61B5/04 A61B5/00 A61B5/0404 A61B5/0408		
CPC分类号	A61B5/0404 A61B5/0002 A61B5/0006 A61B5/0205 A61B5/02438 A61B5/04004 A61B5/04085 A61B5/0476 A61B5/0488 A61B5/6804 A61B5/6831 A61B5/6833 A61B5/6898 A61B5/7225 A61B2560/0209 A61B2560/0214 A61B2560/0443 A61B2560/0462 A61B2562/225 A61N1/0404		
代理机构(译)	KOLSTER OY AB		
优先权	2016005214 2016-03-15 FI		
外部链接	Espacenet		

摘要(译)

一种用于测量至少一个电生物信号的移动设备（1）。装置（1）包括第一输入（4）和第二输入（5），测量电路部分（7），用于提供指示待测量的电生物信号的输出信号，测量电路部分（7）包括第一输入信号输入（8）和第二输入（9），以及用于对插入装置（1）中的可充电电池（3）充电的充电电路部分（13），充电电路部分（13）包括第一输入（14）和第二个输入（15）。测量电路部分（7）的第一输入（8）和充电电路部分（13）的第一输入（14）连接到移动设备（1）的第一输入（4）和第二输入（ 9）测量电路部分（7）和充电电路部分（13）的第二输入（15）连接到移动设备（1）的第二输入（5）。