

Utility Meter

The present invention relates to utility metering and more particularly to a utility meter providing external touch input detection.

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Utility meters such as electricity, gas and water meters can measure the amount of energy or utility (such as electricity, gas or water) supplied to a residence, business or consuming device. The meter will also normally have the capability to display parameters that are useful for a consumer or other user such as a meter inspector.

10 Meters will typically include a user interface such as a display screen for digitally displaying parameters and one or more buttons to enable interaction with the meter.

The buttons are normally mechanical push buttons or tactile feedback switches which result in a physical change in the state of the button when interacted with and the
15 interaction may activate a change in the display of the meter, such as display parameter scrolling. One such parameter may be an energy consumption meter reading.

A physical hole is needed in a cover or housing of the meter to accommodate the
20 button resulting in air gaps in the housing. These air gaps increase the possibility of ingress of dust or water into the meter. Further, the air gaps provide a possible access point into the meter thus increasing the vulnerability of the meter to external tampering. Under extreme circumstances, electrostatic discharges (such as those produced from automotive spark plugs) are used with the intent of tampering by stalling the proper
25 functioning of the meter through these vulnerable access points with lower dielectric strength. A push button will also require an associated pressing mechanism to allow for pressing of the button from outside the meter cover or housing thus increasing the number of mechanical parts to the meter.

30 A typical meter may have an enclosure arranged as separable front and back housings that can be attached resulting in an air gap joint all around the meter (i.e. top, sides and bottom) leaving it vulnerable to external electrostatic discharge tampering near vulnerable electronics within the meter.

The claimed invention aims to alleviate some or all of these drawbacks.

From a first aspect the present invention provides a utility meter according to the
5 appended independent claim 1. Further preferable aspects are provided in the
appended dependent claims.

Specifically, a utility meter comprises: means for measuring the consumption of a utility;
a housing for the measuring means, wherein the housing has a user input area that is
10 touch sensitive. The utility meter comprises a sensor means associated with the touch
sensitive area and furthers comprise a processing means in communication with the
sensor means and adapted to interpret an input in the touch sensitive area. The touch
sensitive area is preferably part of the housing.

15 The meter may further comprise a display screen and the user input area is operable to
control information displayed on the screen.

The touch sensitive area can be located at a different area on the housing to the
display screen.

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The sensor means can be provided in circuitry on a PCB located adjacent the touch
sensitive area. The PCB is within the housing.

The housing may comprise a base and cover and the touch sensitive area is preferably
25 a predefined area of the cover. The touch sensitive area may be a recessed or
indented portion of the housing and particularly the cover to enable close proximity of
the touch sensitive area to the sensor provided on the PCB.

The meter base may have a terminal block under the base and the cover is a
30 continuous structure that drops from the top and mates with the base at the bottom of
the cover. Any air gap joint is thus limited to the base of the meter near the terminals
away from the vulnerable electronics within the cover of the meter.

The processing means may include a filtering means to enable noise signals to be filtered out. An algorithm can be provided to filter out noise by applying a filter based on the minimum sensing time and minimum duration between consecutive sense occurrences. Filtering out multiple simultaneous key press signals can eliminate further
5 spurious external noise.

The touch input can be a tap on the surface of the touch sensitive area.

The sensor is preferably a capacitive touch sensor but could be a resistive touch
10 sensor instead or other type of sensor.

From another aspect, the present invention provides a utility meter comprising: means for measuring the consumption of a utility; a housing for the measuring means: two input terminals and two output terminals on the housing, at least one of the input and
15 output terminals being connected to the consumption measuring means, and the at least one of the input and output terminals are arranged on the housing in a non-linear configuration. The non-linear configuration contributes to enabling the size of the meter to be reduced resulting in a compact meter.

20 Embodiments of the invention are described below in more detail, by way of example, with reference to the accompanying drawings in which:

Figure 1 shows a perspective view of a utility meter according to an embodiment of the invention;
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Figure 2 shows a perspective view of the meter of fig. 1 with the bottom cover open;

Figure 3 shows another perspective view of the meter of fig. 1 with the bottom cover open with the input and output terminals shown;
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Figure 4 shows a bottom perspective view of the meter of fig. 1 with the bottom cover open;

Figure 5 shows a bottom view of the meter of fig. 1 partially showing at least one inlet and outlet when the bottom cover is closed;

Figure 6 shows a perspective view of the top part of the utility meter of fig. 1 with the top cover removed and the bottom cover not shown;

Figure 7a is a front view of the utility meter of fig. 1;

Figure 7b is a close up view of the touch sensitive area of the cover in fig. 1;

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Figure 7c is a cross sectional view taken along the line B-B of fig. 7b;

Figure 8 is a schematic view of various elements contained in the utility meter of fig. 1.

15 An embodiment will now be described with reference to figs. 1 to 8 which show an embodiment of an electricity meter which is a modern electronic meter utilising appropriate monitoring means such as a current shunt or transformer in order to detect consumption of electricity. Although the invention is particularly suited for an electricity meter and will be described with reference to an electricity meter, it may be embodied in different types of utility or energy meters that can measure the consumption of different flowing substances such as gas or water. Such meters may also be vulnerable to external tampering.

25 The electricity meter of this embodiment provides a touch sensitive area on the housing of the meter to enable a user to interact with the meter. The touch sensitive area is different to a push button and can be part of the surface of the housing meaning that there are no gaps around the touch sensitive area and thereby reducing the opportunity for tampering of the meter.

30 The electricity meter 10 comprises a housing including a base 11 and a top cover 12. The base 11 and cover 12 are formed of plastics material but may be formed of other material that is preferably electrically insulating.

In this embodiment, the meter is a single phase meter and includes a terminal block section under the base 11 with two input terminals 13a,13b and two output terminals 14a,14b. It will be appreciated that more or less terminals may be provided. In particular, single ports may be provided or more than two ports can be provided. A
5 bottom cover 150 is located at the bottom of the housing and can be attached to the top cover 12 such that the terminals are at least partially covered. The bottom cover 150 can be opened which enables access to the terminals and, in this embodiment, this is achieved with two hinged portions 150a that are located on the front of the bottom cover 150 and are received in cooperating elements 120 in the cover 12 (see fig. 6).
10 An exposed section 16 is provided in the bottom cover 150 to enable cables or other connections means (not shown) to pass from the outside of the meter housing to the terminals 13a,13b,14a,14b.

Thus the meter base 11 may have a terminal block under the base 11 and the top
15 cover 12 is a continuous structure that drops from the top and mates with the base 11 at the bottom of the top cover 12. Any air gap joint is thus limited to the base 11 of the meter 10 near the terminals 13, 14 away from the vulnerable electronics within the cover 12 of the meter 10.

20 The arrangement of the terminals 13a,13b,14a,14b is such that the utility meter can be relatively small compared to conventional meters. In particular, rather than all the terminals 13a,13b,14a,14b being placed adjacent each other linearly in a straight line such that, for example, they are parallel to one edge of the meter, they are in a non-linear arrangement where at least one or more of the terminals is offset from the
25 adjacent terminal which reduces the distance between end terminals of the four terminals. This compactness is achieved while still ensuring the minimum creepage distance between electrically conductive parts. In this embodiment, and as shown in more detail in Fig.4, first input terminal 13a is adjacent second input terminal 13b but second input terminal 13b is offset from first input terminal 13a. The first output terminal
30 14a is directly adjacent the second input terminal 13b and linearly arranged in a straight line parallel to the front edge of the meter base 11. The second output terminal 14b is offset compared to first output terminal 14a in a similar manner to the configuration of the first input terminal 13a and second the input terminal 13b. Therefore, the distance

between first input terminal 13a and second output terminal 14b can be less than if all the terminals were aligned in a straight line parallel to the parallel to the front edge of the meter base 11 allowing the terminals 13a and 14b to be relatively close together. The arrangement of the terminals 13a,13b,14a,14b in this embodiment is such that
5 each terminal is at a corner of a trapezium shape. In this manner, the terminals are positioned in a configuration that allows for a more compact electricity meter to conventional meters.

The input terminals 13a,13b receive a utility which in this embodiment is electricity from
10 a source of electricity and the output terminals 14a,14b output the electricity. As shown in fig. 8, at least one of the input terminals is connected to a utility consumption monitoring means 15 that is located within the meter housing i.e. within the enclosure formed by the base 11 and cover 12. The utility monitoring means is used to measure the consumption of electricity. Electricity consumption is metered, for example, by
15 detecting current utilizing a current detector (not shown) in the form of a current shunt or current transformer whose output is fed to a computation section, which is preferably constituted by a microcontroller 16 which is capable of processing data. The utility meter may use a conventional current detector (not shown) to determine the consumption or some other method as will be known to those in the art and will
20 therefore not be described in further detail. Utility meters will normally have at least one type of utility consumption monitoring means and the consumption monitoring means can be vulnerable to tampering.

Referring to figs. 1, 2, 3, 6, 7a, 7b, 7c, the cover 12 which is an outer casing for the
25 consumption means 15 is in the form of unitary trapezoidal body having a cavity with an opening at the bottom of the body to attach to the base 11. In this embodiment, the attachment is through a rim 17 of the lower portion of the cover 12 fitting into a U shaped channel 18 around the perimeter of the base 11. The base 11 and cover 12 are then semi permanently or permanently sealed such that access to the inside of the
30 housing is inhibited.

The cover 12 includes a front surface 12a with a display screen 19. A recessed portion 12b of the cover 12 is adjacent the screen 19 generally in a plane parallel to the line X

and is recessed from the front surface 12a. A touch sensitive area 20 is in a predefined position on the meter cover 12. In this embodiment, the touch sensitive area 20 is in the recessed portion and is therefore also adjacent the screen 19 when viewed from the front of the meter 10 but offset back from the front surface 12a when view from the side
5 of the meter 10. The touch sensitive area 20 is provided on a surface 20a that has been recessed back from the front surface 12a. The surface 20a is therefore not on the same plane as the front surface 12a but is parallel to the front surface 12a such that it is equivalent to the front surface 12a being pushed back in a direction Y of a perpendicular plane to the front surface 12a of the cover 12. It will be appreciated that
10 alternative configurations can be envisaged depending on the shape of the housing.

The touch sensitive area 20 of the surface 20a is in the form of a capacitive touch button. The area 20 is formed of the same material as the cover 12 and is a continuous surface with no air gaps which would be vulnerable to tamper. Therefore, no separate
15 button is provided but instead the area 20 is part of the cover 12 and may be indicated appropriately such as by printed circular button indicator (or any other shape).

In this embodiment, the area 20 is in a corner of the cover 12 which can prevent it from being inadvertently pressed given that it is recessed back from the main front surface
20 12a of the cover 12.

Behind the touch sensitive area 20 within the meter 10 is located a capacitive touch sensor 21. The sensor 21 may be of a type that is known in the field of touch input technology. The sensor 21 is arranged on a printed circuit board 22 which is in the
25 meter housing and attached to the base 12. The sensor 21 in this embodiment is implemented by means of one or more conductive tracks on the PCB 22. The conductive tracks or traces can act as one plate of a capacitor. The other plate will be a user's finger and the air gap and cover 12 will act as the dielectric of the capacitor. The PCB 22 is parallel to the front surface 12a and surface 20a when the cover 12 is
30 attached to the base 11. The touch sensitive area 20 is adjacent the sensor 21 on the PCB 22 in the perpendicular plane to the front surface 12a plane and can include a depression (see fig. 7c) in the surface 20a allowing the touch sensitive area 20 to be closer to the sensor 21. Thus, the surface 20a itself can have a depression or recess

by cutting away of a portion of the plastic surface 20a or recessing of the entire layer of the touch sensitive area being recessed back to be closer to the sensor 21. A user tapping the area 20 can be sensed by the sensor 21 that is located directly behind the area 20 in the housing of the meter 10. The recessing is advantageous to allow the touch sensitive area 20 to be close to the tracks of the PCB 22 thus providing an effective capacitive parallel plate for the sensor 21. The sensor 21 is in communication with the microcontroller 16 that can interpret the input accordingly. For example, a tap of the area 20 could result in the information such as parameters on the display screen 19 being changed.

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The microcontroller 16 is programmed to provide predefined action depending on the input in the touch area 20. For example, a tap may be interpreted differently to a touch for a predetermined time in the touch area or a double tap. Further, in other embodiments, the area may be enlarged and inputs in different areas of the enlarged area may be interpreted differently thus providing a similar effect to having multiple push buttons on conventional meters.

It will be known to those in the field of touch input technology that the user's fingertip can be sensed due to the change in capacitance that results when the fingertip or other material that affects the electric field is brought near the capacitive sensor 21.

Given that the sensor 21 is in very close proximity to the touch sensitive area 20 on the cover 12, it will be very sensitive and therefore vulnerable to external noise which can result in spurious inputs being detected. Filtering is provided which in this embodiment is programmed into the microcontroller 16 to remove noise signals. An algorithm removes the noise by applying a filter based on a predetermined minimum sensing time and a predetermined minimum duration between consecutive occurrences. Thus, for example, a touch input that is for less than a predetermined time may be interpreted by the filter as a spurious accidental touch and not result in a change in the display screen. Spurious noise filtering is achieved by simple analog filters (capacitive, inductive or a combination of both). Analog filtering is combined with digital filtering algorithms. In another embodiment where there may be more than one touch sensitive area or multiple touch sensitive keys, filtering from spurious external noises, such as

those from electro-magnetic interference is filtered by rejecting multiple simultaneous detections when more than one key is used.

If the meter 10 is powered off and a back-up battery (not shown) is providing power to the meter 10, a predefined sensing pattern can be programmed into the microcontroller which if applied to the touch sensitive area 20 can enable the meter 10 to communicate either through wired or wireless communication or for the display to be turned on briefly. The microcontroller can thus remain in a sleep mode and only made to wake up if a specific sensing pattern is detected to as to avoid unwarranted wake up and loss of battery power.

It is therefore apparent that the conventional push button for display parameters is not required thereby reducing the possibility of ingress of dust or water into the meter and removing a potential access point to the inside of the meter by those intending to tamper with the meter.

It will be appreciated that although a capacitive touch sensor is described, the sensor may be another type of touch sensitive sensor such as a resistive touch sensor and the appropriate modifications can be made. However, advantages are achieved in using a capacitive touch sensor as will be apparent.

A single meter is referred to above but it will be appreciated the invention is not limited to such and other types of electricity meters such as a polyphase meter may be provided. Similarly, although a meter with a single key capacitive sensor is described, a meter with multiple touch sensitive keys may also be provided. The keys may be such that user interaction with one touch sensitive key will produce a different result to an interaction with another touch sensitive key and this can be achieved by appropriate commands being programmed into the microcontroller. In such an embodiment (not shown), a single touch sensitive area with multiple keys may be provided and/or multiple touch sensitive areas each with one or more keys may be provided. Such multiple keys may be provided simply because more keys are required; or an additional touch sensitive area may simply be added for filtering.

In addition to the embodiments of the invention described in detail above, the skilled person will recognize that various features described herein can be modified and/or combined with additional features, and the resulting additional embodiments of the invention are also within the scope of the accompanying claims

CLAIMS

1. A utility meter comprising: means for measuring the consumption of a utility; a
5 housing for the measuring means, wherein the housing has a user input area that is touch sensitive the meter further comprising: a sensor means associated with the touch sensitive area; and a processing means in communication with the sensor means and adapted to interpret an input in the touch sensitive area..
- 10 2. The utility meter of claim 1, wherein the touch sensitive area is a surface of a predefined part of the housing.
3. The meter of claim 1 or 2, further comprising a display screen and interaction with the user input area enables information displayed on the screen to be controlled.
- 15 4. The utility meter of claim 3, wherein the touch sensitive area is located at a different area on the housing to the display screen.
5. The utility meter of any preceding claims where in the touch sensitive area is
20 located on a recessed portion of the housing.
6. The utility meter of claim 1, wherein the sensor means is on a PCB and located directly adjacent the touch sensitive area.
- 25 7. The utility meter of claim 6, wherein the sensor means comprises one or more conductive tracks on the PCB.
8. The utility meter of claim 6 or 7 wherein the PCB is contained entirely within the housing.
- 30 9. The utility meter of any preceding claim, wherein the housing comprises a base and cover.

10. The utility meter of claim 9, wherein the touch sensitive area is a predefined area of the cover.

11. The utility meter of any preceding claim wherein the housing is formed of plastics material.

12. The utility meter of claim 1 wherein the processing means includes a filtering means to enable noise signals detected by the sensor means to be filtered out.

13. The utility meter of claim 12 wherein the filtering means comprises an algorithm to filter out noise by applying a filter based on the minimum sensing time and minimum duration between consecutive sense occurrences by the sensor means.

14. The utility meter of any preceding claim, wherein the touch sensitive area comprises multiple touch sensitive keys.

15. The utility meter of claim 14 when dependent on claim 12, wherein the filtering means comprises an algorithm to filter out noise by rejecting multiple simultaneous key presses as spurious.

16. The utility meter of any preceding claim wherein the touch input is a tap on the surface of the touch sensitive area.

17. The utility meter of any preceding claim, wherein the sensor is a capacitive touch sensor.

18. The utility meter of any preceding claim further comprising an input terminal for receiving the utility and an output terminal to one or more loads, wherein the input and output terminal are connected to the consumption measuring means.

19. The utility meter of claim 18 wherein there are a two input terminals and two output terminals, at least one of the input and output terminal being connected to the

consumption measuring means, and the at least one of the input and output terminals are arranged on the housing in a non-linear configuration.

20. The utility meter of any preceding claim wherein the utility is electricity.

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21. A utility meter comprising: means for measuring the consumption of a utility; a housing for the measuring means: two input terminals and two output terminals on the housing, at least one of the input and output terminals being connected to the consumption measuring means, and the at least one of the input and output terminals
10 are arranged on the housing in a non-linear configuration.

22. The utility meter of claim 21, wherein a first input terminal is offset from an adjacent second input terminal, the first input terminal is directly adjacent a first output terminal, and the second output terminal which is adjacent the first output terminal is
15 offset from the first output terminal.

23. Utility meter substantially as hereinbefore described with reference to the drawings.