

Utility Meter

The present invention relates to utility metering and more particularly to a utility meter providing meter cover opening detection.

Utility meters such as electricity, gas and water meters can measure the amount of energy consumed by a residence, business or energy consuming device. The meter will also normally detect open detection of a cover of the meter as this can indicate an attempt of tampering with the meter. The meter may have a tamper detection circuit that has to operate even in the absence of mains power to the meter. This requires such circuits to be designed for very lower power operation so that they can be battery backed. Such circuits can be particularly vulnerable to malfunction over long periods of time.

Conventionally, a mechanical switch in the utility meter comprises a contact spring which will be actuated when the cover of the housing is removed and a time and / or date stamp may be taken by the meter at the time of the removal. Such a switch may have a limited lifetime and over time it can become less responsive particularly as such a switch is designed for low power operation. The switch may be made too sensitive to compensate for the reduction in responsiveness, which can result in false detections.

From a first aspect the present invention provides a utility meter according to the appended independent claim 1. From another aspect the present invention provides an optical detection apparatus for a utility meter, according to appended claim 27. Further preferable aspects are provided in the appended dependent claims.

In an embodiment, a utility meter comprises: means for measuring the consumption of a utility; a housing for the measuring means; the housing associated with an optical detection means that is arranged to detect movement of the housing.

The optical detection means is preferably arranged to detect movement of the housing relative to the optical detection means.

The optical detection means may be arranged to detect movement of the housing relative to the measurement means.

The optical detection means is connected to a surface within the utility meter separate to the housing.

The housing comprises a cover that can be opened and is movable relative to the surface and preferably the surface is part of a printed circuit board which is within the housing.

The optical detection means comprises a photo electric arrangement such as an optical transmitter for emitting an optical signal and a receiver for receiving optical signals. The transmitter and receiver are positioned to normally allow optical communication between the two. The optical detection means further comprises a mechanism for blocking or interrupting the signal emitted from the transmitter reaching the receiver thereby disabling optical communication between the transmitter and receiver. In one embodiment, the mechanism blocks the signal from the transmitter when the cover is closed. In an alternative embodiment, the mechanism allows the signal to reach the receiver from the transmitter when the cover is closed. The photo electric arrangement may be separable from the mechanism.

The mechanism comprises a plunger element to block the optical signal from the transmitter and the plunger element is movable dependent on interaction of the mechanism with an inner surface of the cover of the housing. The mechanism is normally in contact with the cover and causes the element to be pushed between the transmitter and receiver when the cover is closed. As the cover is opened and the surface of the cover moves away from the transmitter and receiver, the plunger is displaced axially and moves away from the transmitter and receiver enabling the signal from the transmitter to reach the receiver.

The transmitter and receiver form part of a device that is preferably U-shaped with the transmitter and receiver being positioned on an inner surface of the respective legs of the U-shape. The general arrangement of the receiver – transmitter pair is such as to avoid spurious light sources falling directly on the receiver. The device is fixedly attached to the surface of the PCB and is in electrical communication with a microcontroller that sends and receives signals from the device.

All or some of the mechanism may be formed of an elastomeric material such as silicon rubber.

The microcontroller may provide a non-continuous or pulsed light signal with a variable duty signal to the transmitter in order to save power compared to a continuous ON signal. That is, optical light source from transmitter is activated ON and deactivated OFF continuously.

The transmitter can operate with a variable digital bit sequence pattern including a predetermined signature that is recognisable by the receiver. As an alternative, a variable analogue light intensity pattern can be used. The variable pattern can assist in avoiding spurious detection of signals from other light sources that do not have the same signature. The signal received by the receiver is processed by the microcontroller which can distinguish between signals with the predetermined signature and other signals.

The optical detection means is attached to the top of the printed circuit board adjacent a surface of the cover. In one embodiment, the top of the optical detection means is arranged to contact the underside of the top of the cover when the cover is closed.

The housing preferably comprises a base and the cover is attached to the base. One side of the PCB is preferably attached to a base of the housing and this side is opposite to the side where the optical detection means is located.

The meter may further comprise a display screen and a capacitive touch user input area that 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.

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

The touch sensitive area is preferably 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 microcontroller may be in communication with the sensor means and adapted to interpret an input in the touch sensitive area. The microcontroller 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.

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 sensor instead or other type of sensor.

From another aspect, the present invention may provide 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 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.

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 with a closed hinged bottom cover that prevents access to a terminal section from the front;

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;

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 schematic view of various elements contained in the utility meter of fig. 1;

Figure 7 shows an embodiment of a photo electric device that forms part of an optical detection apparatus that is contained in the meter of fig. 1;

Figure 8a shows a back perspective view of a mechanism forming another part of the optical detection apparatus that is contained in the meter of fig. 1;

Figure 8b shows a front perspective view of the mechanism of fig. 8a;

Figure 8c shows a back view of the mechanism of fig. 8a;

Figure 8d shows a side view of the mechanism of fig. 8a;

Figure 8e shows a front view of the mechanism of fig. 8a;

Figure 9a shows another back perspective view of the mechanism shown in fig. 8a in a normal state;

Figure 9b shows the mechanism shown in fig. 9a in a compressed state with a load applied from above and in this embodiment this load is provided by the closed cover of the housing;

Figure 10 shows a perspective view of the optical detection apparatus that comprises the device and mechanism shown in figs. 7-9, and a close-up view of the optical detection apparatus positioned on a PCB of the meter such as the meter of Fig. 1;

Figure 11 shows a cutaway view of the meter cover of figure 1 in the closed condition and the mechanism of figure 8 in a compressed state in which the plunger member is interrupting light in the photo electric device of fig. 7;

Figure 12 shows a cutaway view of the meter cover of figure 1 in the open condition and the mechanism of figure 8 in a normal state in which the plunger member is not interrupting light in the photo electric device of fig. 7;

Figure 13 shows an example circuit diagram of the photo electric device of figure 7 when connected to a microcontroller;

Figure 14 show 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 15a is a front view of the utility meter of fig. 1;

Figure 15b is a close up view of the touch sensitive area of the cover in fig. 1; and

Figure 15c is a cross sectional view taken along the line B-B of fig. 7b.

An embodiment will now be described with reference to the figures which show an embodiment of an electricity meter which is a modern electronic meter utilising appropriate monitoring means such as a current transformer in order to detect consumption of electricity. Although, embodiments 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 tampering through removal of a cover of the meter.

The electricity meter of this embodiment provides an optical detection apparatus that can detect removal of a cover of a housing of the meter.

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.

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 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. 2). An exposed section 160 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.

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 adjacent terminal which reduces the distance between end terminals of the four terminals. 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 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 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 a source of electricity and the output terminals 14a,14b output the electricity. As shown in fig. 6, 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 detecting current utilizing a current detector (not shown) in the form of a current transformer whose output is fed to a computation section which is preferably constituted by a microcontroller 16. 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 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. As mentioned above, this is an example of the type of utility meter and the invention is not limited to such a meter. It will be appreciated that the arrangement of the terminal block section is an optional feature.

The cover 12 which is an outer casing for the 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 having a tongue section fitting into a U shaped channel or groove 18 around the perimeter of the base 11. Therefore, a tongue and groove connection can be provided. The base 11 and cover 12 are then semi permanently or permanently sealed such that access to the inside of the housing is inhibited. However, it is well known that persons may try and tamper with the meter 10 by removing the cover 12 of the meter 10.

Now referring to figures 1, 6 to 14 to assist in the explanation of an embodiment relating to detection of an open cover 12 that may be applied to meter 10. The cover 12 is associated with an optical detection apparatus 30 that is arranged to detect movement and particularly opening of the cover 12.

The optical detection apparatus 30 is preferably arranged to detect movement of the cover 12 relative to the optical detection apparatus 30. The optical detection apparatus 30 can be considered an optical switch that detects opening of the cover 12 relative to the measurement means 15 which is fixed in the housing.

The optical detection apparatus 30 comprises a photo electric device 31 including an optical transmitter 32 for emitting an optical signal and a receiver 33 for receiving optical signals. The transmitter 32 and receiver 33 are positioned to normally allow optical communication between the two. The transmitter 32 and receiver 33 are located within the housing. The photo electric device 31 is preferably U-shaped. The transmitter 32 and receiver 33 are positioned on an inner surface of the respective walls 31a, 31b of the U-shape and such that there is an optical path therebetween. The device 31 is fixedly attached to a surface of the printed circuit board 35 and is electrically connected to the microcontroller 16 that sends and receives signals from the device 31.

The optical detection apparatus 30 further comprises a mechanism 40 for blocking or interrupting the signal emitted from the transmitter 32 reaching the receiver 33 thereby disabling optical communication between the transmitter 32 and receiver 33. In one embodiment, the mechanism 40 blocks the signal from the transmitter 32 when the cover 12 is closed. The photo electric device 31 may be separable from the mechanism 40.

The mechanism 40 comprises a plunger element 41 to block the optical signal from the transmitter 32 and the plunger element 41 is movable dependent on interaction of the mechanism 40 with an inner surface 12c of the cover 12 of the housing. The mechanism 40 is normally in contact with the cover 12 and causes the element 41 to be located between the transmitter 32 and receiver 33 when the cover 12 is closed. As the cover 12 is opened and the surface of the cover 12 moves away from the transmitter 32 and receiver 33, the plunger 41 is displaced axially with the cover 12 and moves away from the transmitter 32 and receiver 33 thereby enabling the signal from the transmitter 32 to reach the receiver 33 and achieving optical communication.

The mechanism 40 is fixedly attached to the same surface which of the PCB 35 to which the device 31 is attached. Therefore it is contained within the housing of utility meter 10 and is separate to the cover 12. The mechanism has an attachment means such as one or more extension pieces 42 that are received in corresponding holes in the PCB 35. Any suitable

attachment means may be provided. The cover 12 is movable relative to the PCB 35 which is fixed to the base 11.

All or some of the mechanism 40 may be formed of an elastomeric material such as silicon rubber.

The microcontroller 16 may provide a non-continuous or pulsed light signal with a variable duty signal to the transmitter 32 in order to save power compared to a continuous ON signal. That is, optical light source from transmitter 32 is activated ON and deactivated OFF continuously. The sequence of activation and deactivation and the duration thereof may be made random.

The transmitter 32 can operate with a variable bit light pattern including a predetermined signature that is recognisable by the receiver 33. This can assist in avoiding spurious detection of signals from other light sources that do not have the same signature. The signal received by the receiver 33 is processed by the microcontroller 16 which can distinguish between signals with the predetermined signature and other signals. Hence, spurious signals such as external light not transmitted from the transmitter 32 or spurious electromagnetic noise can be filtered or ignored by the microcontroller 16 when interpreting signals received by the receiver 33.

The optical detection apparatus 30 is attached to the top side of the printed circuit board 35 adjacent a surface of the cover 12. In one embodiment, the top of the optical detection apparatus 30 is arranged to contact the underside of the top of the cover 12 when the cover 12 is closed. One side of the PCB 35 is attached to a base 11 of the housing and this side is opposite to the side where the optical detection means 30 is located. The optical detection means 30 may be mounted and positioned in one corner of the PCB 35 or another convenient location to allow for interaction with the cover 12 or another part of the housing which is moved and indicates tampering of the housing.

In one embodiment, the walls of the U-shaped device 31 are generally perpendicular to the surface of the PCB 35 on which the device 31 is attached such that the walls extend away from the surface. With the mechanism 40 cooperating with the device 31 to form the optical detection apparatus 30, the plunger element 41 is positioned between the walls on 31a, 31b on which the transmitter 32 and receiver 33 are positioned. The plunger element 41 is capable of moving in a direction generally parallel to a plane of the surface of the PCB 35 on

which the mechanism is mounted and thus obstruct the optical path between the transmitter 32 and receiver 33.

A top part of the mechanism 40 includes an extended portion 43 that interacts with the cover 12. The bottom part of the mechanism 40 is the plunger element 41 thus displacement of the extended portion 43 will cause similar displacement of the plunger element 41. The extended portion 40 is typically pressed from above and causes the plunger element 41 to move downwards towards the base of the mechanism 40 and further into the area between the transmitter 32 and receiver 33.

The plunger element 41 and extended portion 43 may be formed of a single integral member that is resilient with side arms 44 that push against a lower portion 45 of the mechanism 40. The extension pieces 42 that are received by respective holes in the PCB 35 are provided on the lower portion 45 and extend out in a generally perpendicular direction to the direction in which the extended portion 43 extends. One front face 45a of the lower portion 45 is solid and another opposite back side face 45b is removed to allow for the legs 31a, 31b of the relevant section of the photo electric device 31 to be received. Therefore, the one front face 45a of the lower portion 45 prevents external spurious light reaching the receiver 33 and the other back face 45b is covered by a surface of the PCB 35 to which the mechanism 40 is mounted.

The interruption of light or break of communication in the optical detection apparatus 30 is defined as the cover closed condition where the plunger element 41 is placed and held in the position by the cover 12. The cover 12 is arranged in its closed position so that the plunger element 41 is pressed between the transmitter 32 and the receiver 33 of the photo electric device 31. The plunger element 41 does not necessarily physically contact the transmitter 32 and receiver 33 and is shaped to be able to fit between the transmitter 32 and receiver 33. This creates a non-contact state indicator based on the signal between the transmitter 32 and receiver 33.

The passing of light or occurrence of optical communication in the optical detection apparatus is defined as the cover open condition. When the cover 12 is moved away from its closed position, the plunger element 41 moves out from the middle of photo electric device 31. Thus this allows the light from the transmitter 32 to pass to the receiver 33 and this is a meter cover open condition.

Information identifying the open condition such as date and time of open condition can be determined and stored in the memory of the microcontroller 16 or a separate memory means (not shown).

Figure 13 shows a schematic of one embodiment of electronics for the optical detection apparatus 30 and particularly the photo electric device 31. In this embodiment, the microcontroller 16 is connected to a diode anode through diode current limiting resistor (R40) and this diode forms part of the transmitter 32. Resistor R41 and R42 limit receiver 33 current. The microcontroller 16 is also connected via a transistor emitter to the receiver 33 that receives the transmitter 32 signal. Resistor R42 is connected between transistor emitter and ground. The microcontroller 16 in this embodiment has three points of connection including a control which connects to the resistor R41 which then connects to the transistor collector of the receiver 33. The control terminal ensures low power consumption when transmission is not taking place. It will be appreciated that the control terminal may not be needed.

Although the above refers to the mechanism 40 blocking the signal from the transmitter 32 when the cover 12 is closed, it will be appreciated by those skilled in the art that, alternatively, the mechanism can be adapted to allow the signal to reach the receiver 33 from the transmitter 32 when the cover 12 is closed so that when the cover is opened the signal is prevented from reaching the receiver 33 by the plunger element 41.

The meter may further comprise a display screen 19 and a touch sensitive user input area 50 that is operable to control information displayed on the screen as will now be described. It will be appreciated that this is an optional feature but may be combined with the cover opening detection feature. Indeed, the sensing means for the touch sensitive user input and the optical detection apparatus 30 may be provided on the same PCB 35 providing improved integration and compactness of the meter 10.

Referring to figs. 1, 2, 3, 14, 15a, 15b, 15c, the cover 12 which is an outer casing for the 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 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 50 is in a predefined position on the meter cover 12. In this embodiment, the touch sensitive area 50 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 of the meter 10. The touch sensitive area 50 is provided on a surface 50a that has been recessed back from the front surface 12a. The surface 50a 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 alternative configurations can be envisaged depending on the shape of the housing.

The touch sensitive area 50 of the surface 50a is in the form of a capacitive touch button. The area 50 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 button is provided but instead the area 50 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 50 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 12a of the cover 12.

Behind the touch sensitive area 50 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 the printed circuit board 35 which is in the 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 35 is parallel to the front surface 12a and surface 50a when the cover 12 is attached to the base 11. The touch sensitive area 50 is adjacent the sensor 21 on the PCB 35 in the perpendicular plane to the front surface 12a plane and can include a depression (see fig. 7c) in the surface 50a allowing the touch sensitive area 50 to be closer to the sensor 21. Thus, the surface 50a itself can have a depression or recess by cutting away of a portion of the plastic surface 50a 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 50 can be sensed by the sensor 21 that is located directly

behind the area 50 in the housing of the meter 10. The sensor 21 is in communication with the microcontroller 16 that can interpret the input accordingly. For example, a tap of the area 50 could result in the information such as parameters on the display screen 19 being changed.

The microcontroller 16 is programmed to provide predefined action depending on the input in the touch area 50. 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. The recessing is advantageous to allow the touch sensitive area 50 to be close to the tracks of the PCB 35 thus providing an effective capacitive parallel plate for the sensor 21.

Given that the sensor 21 is in very close proximity to the touch sensitive area 50 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 relevant circuits of the meter 10, a predefined sensing pattern can be programmed into the microcontroller which if applied to the touch sensitive area 50 can enable the meter 10 to communicate either through wired or wireless communication or for the display to be turned on briefly. Normally, specific parts of the meter circuit are powered to reduce power

consumption. Also, the controller 16 normally is in sleep mode and wakes up periodically to check any cover opening and then goes to sleep again (to save power). Typically, the sleeping periodicity is such that it is short enough to prevent any tamperer to quickly open and damage the battery before the test sequence is performed; and long enough to save 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 phase 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 poly phase meter may be provided.

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 comprises: means for measuring the consumption of a utility; a housing for the measuring means; the housing associated with an optical detection means that is arranged to detect movement of part of the housing, wherein optical detection means is connected to a surface within the utility meter, and comprises a photo electric arrangement including an optical transmitter for emitting an optical signal and a receiver for receiving optical signals.
2. The utility meter of claim 1 wherein the optical detection means is arranged to detect movement of the housing relative to the optical detection means.
3. The utility meter of claim 1 or 2 wherein the optical detection means is arranged to detect movement of the housing relative to the measurement means.
4. The utility meter of any preceding claim wherein the optical detection means is connected to a surface within the utility meter separate to the housing.
5. The utility meter of any preceding claim, wherein the housing comprises a cover for the measuring means, the cover being capable of being opened.
6. The utility meter of claim 5 when dependent on claim 4 wherein the cover is movable relative to the surface.
7. The utility meter of claim 6 wherein the surface is part of a printed circuit board which is within the housing.
8. The utility meter of any preceding claim wherein the transmitter and receiver are positioned to normally allow optical communication therebetween.
9. The utility meter of any preceding claim wherein the optical detection means further comprises a mechanism for blocking or interrupting the signal emitted from the transmitter from reaching the receiver.
10. The utility meter of claim 9 wherein the mechanism blocks the signal from the transmitter when the cover of the housing is closed.

11. The utility meter of claim 9 or 10, wherein the mechanism comprises a plunger element to block the optical signal from the transmitter and the plunger element is movable dependent on interaction of the mechanism with a surface of the cover of the housing.
12. The utility meter of claim 11 wherein the mechanism is normally pressed against the cover and the plunger element is between the transmitter and receiver when the cover is closed.
13. The utility meter of claim 12, wherein when the cover is opened, the surface of the cover is arranged to move away from the transmitter and receiver, and the plunger is displaced axially with the cover thereby moving away from the transmitter and receiver and enabling the signal from the transmitter to reach the receiver.
14. The utility meter of any preceding claim, wherein the transmitter and receiver form part of a device that is preferably U-shaped with the transmitter and receiver being positioned on an inner surface of the respective legs of the U-shape.
15. The utility meter of claim 14 wherein the device is fixedly attached to a surface of a PCB.
16. The utility meter of any preceding claim, wherein the photoelectric arrangement is in electrical communication with a microcontroller that sends and receives signals from the arrangement.
17. The utility meter of claim 16 wherein the microcontroller provides a pulsed light signal to the transmitter.
18. The utility meter of any preceding claim wherein the transmitter is operable to provide a variable bit light pattern including a predetermined signature that is recognisable by the receiver.
19. The utility meter of claim 18 wherein the variable light pattern is an analogue pattern or a digital bit stream sequence.
20. The utility meter of any of claims 9 to 19 wherein all or some of the mechanism is formed of an elastomeric material.

21. The utility meter of claim 7 wherein the optical detection means is attached to the top of the printed circuit board adjacent a surface of the cover.
22. The utility meter of any preceding claim wherein the housing comprises a base and the cover is attached to the base.
23. The utility meter of claim 22 when dependent on claim 7, wherein one side of the PCB is attached to a base of the housing and this side is opposite to the side where the optical detection means is located.
24. 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.
25. The utility meter of claim 24 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.
26. The utility meter of any preceding claim wherein the utility is electricity.
27. An optical detection apparatus for a utility meter, comprising: means for attaching to a surface within the utility meter; a photo electric arrangement including an optical transmitter for emitting an optical signal and a receiver for receiving optical signals; and a mechanism for blocking or interrupting the signal emitted from the transmitter from reaching the receiver, wherein part of the mechanism is adapted to be coupled to a housing of the utility meter, such that movement of the part of the housing causes movement of the part of the mechanism.
28. Utility meter substantially as hereinbefore described with reference to the drawings.