

**ELECTRICITY METER AND METHOD OF CONTROLLING AN ELECTRICITY
METER USING AN APPLIED MAGNETIC FIELD**

FIELD

5 The present disclosure relates to an electricity meter for measuring one or more properties of a power supply and for a method of controlling an electricity meter using an applied magnetic field.

BACKGROUND

10 It is known to use an electricity meter for measuring one or more properties of a power supply. Known electricity meters may include a magnetic field sensor for detecting a magnetic field which is applied to the electricity meter using a hand-held permanent magnet device to enable control of the electricity meter according to the proximity of the hand-held permanent magnet device to the magnetic field sensor. Such known
15 electricity meters may incorporate a Tunnel Magnetoresistance (TMR) or a Hall Effect magnetic field sensor for detecting the proximity of a hand-held permanent magnet device. However, TMR magnetic field sensors can saturate or be damaged by a high magnetic field, such as a high magnetic field which may be used when a "bad actor" attempts to tamper with the electricity meter. Also, Hall Effect magnetic field sensors
20 may not be sensitive enough to detect a small magnetic field such as a small magnetic field generated by a hand-held permanent magnet device used to control the electricity meter.

SUMMARY

25 According to an aspect of the present disclosure there is provided an electricity meter for measuring one or more properties of a power supply, the electricity meter comprising:

a magnetic field sensor for sensing a magnetic field which is applied to the electricity meter, the magnetic field sensor including a coil;

30 a signal generator for generating an input electrical waveform such as a periodic input electrical waveform;

circuitry connected to the coil and to the signal generator; and

a processing resource,

 wherein the electricity meter is configured so that the circuitry receives the input
35 electrical waveform and the circuitry generates an output electrical signal which is

dependent on the input electrical waveform and a portion of the magnetic field to which the magnetic field sensor is exposed, and

wherein the processing resource is configured to receive the output electrical signal and to control the electricity meter based on the output electrical signal.

5 Optionally, the magnetic field is a DC magnetic field or is variable according to the manual movement or swipe of a hand-held permanent magnet device relative to the electricity meter.

Optionally, the signal generator comprises an oscillator, a microprocessor unit (MPU), or a 555 timer.

10 Optionally, the magnetic field sensor comprises a core, wherein the coil is arranged around the core.

Optionally, the circuitry is configured so that one or more properties of the output electrical signal are dependent on an inductance of the magnetic field sensor which is in turn dependent on the permeability of the core which is in turn dependent on the portion
15 of the magnetic field to which the core is exposed.

Optionally, the circuitry comprises a series coil-impedance arrangement comprising an impedance connected in series with the coil or wherein the circuitry comprises a parallel coil-impedance arrangement comprising an impedance connected in parallel with the coil.

20 The impedance may comprise a resistor, a capacitor or an inductor, or any combination of two or more of a resistor, a capacitor and an inductor.

Optionally, the circuitry comprises input circuitry for conditioning the input electrical waveform so as to generate a conditioned input electrical waveform, and wherein the input circuitry is configured to apply the conditioned input electrical waveform
25 to the series coil-impedance arrangement or to apply the conditioned input electrical waveform to the parallel coil-impedance arrangement.

Optionally, the input circuitry comprises low-pass filter circuitry.

Optionally, the circuitry is configured to generate a voltage waveform comprising a waveform of the voltage across the impedance of the series coil-impedance arrangement or a waveform of the voltage across the coil of the series coil-impedance
30 arrangement, or wherein the circuitry is configured to generate a current waveform comprising a waveform of the current through the impedance of the parallel coil-impedance arrangement or a waveform of the current through the coil of the parallel coil-impedance arrangement.

Optionally, the circuitry comprises output circuitry for conditioning the voltage waveform or the current waveform so as to generate a conditioned electrical signal.

Optionally, the output circuitry comprises comparator circuitry, wherein the comparator circuitry is configured to compare the voltage waveform to a reference voltage and generate a pulse train based on the results of the comparison or wherein the comparator circuitry is configured to compare the current waveform to a reference current and generate a pulse train based on the results of the comparison.

Optionally, the conditioned electrical signal comprises the pulse train.

Optionally, the output circuitry comprises amplifier circuitry, wherein the amplifier circuitry is configured to amplify any difference in voltage between the voltage waveform and a reference voltage to thereby generate an amplified electrical signal or wherein the amplifier circuitry is configured to amplify any difference in current between the current waveform and a reference current to thereby generate an amplified electrical signal.

Optionally, the conditioned electrical signal comprises the amplified electrical signal.

Optionally, the output circuitry comprises peak detector circuitry, wherein the peak detector circuitry is configured to receive the voltage waveform and generate a DC voltage or wherein the peak detector circuitry is configured to receive the current waveform and generate a DC current.

Optionally, the conditioned electrical signal comprises the DC voltage or the DC current.

Optionally, the output circuitry comprises comparator circuitry, wherein the comparator circuitry is configured to compare the DC voltage to a reference voltage and to generate a further DC voltage or a further DC current based on the results of the comparison, or wherein the comparator circuitry is configured to compare the DC current to a reference current and to generate a further DC voltage or a further DC current based on the results of the comparison.

Optionally, the conditioned electrical signal comprises the further DC voltage or the further DC current.

Optionally, the output circuitry comprises amplifier circuitry, wherein the amplifier circuitry is configured to amplify any difference in voltage between the DC voltage and a reference voltage to thereby generate a further DC voltage or a further DC current or wherein the amplifier circuitry is configured to amplify any difference in current between the DC current and a reference current to thereby generate a further DC voltage or a further DC current.

Optionally, the conditioned electrical signal comprises the further DC voltage or the further DC current.

Optionally, the circuitry comprises output circuitry, wherein the output circuitry comprises a voltage divider in parallel with the series coil-impedance arrangement, wherein the series coil-impedance arrangement defines a first node between the impedance and the coil, wherein the voltage divider defines a second node, and wherein the output circuitry is configured to generate a voltage waveform comprising a waveform of the voltage between the first and second nodes.

Optionally, the output electrical signal comprises the voltage waveform, the current waveform or the conditioned electrical signal.

Optionally, the processing resource comprises at least one of a microprocessor, a microcontroller, a digital signal processor (DSP), a field-programmable gate array (FPGA), an application-specific integrated circuit (ASIC), or an analogue-to-digital converter (ADC).

Optionally, controlling the electricity meter based on the output electrical signal comprises controlling the electricity meter based at least in part on the temporal characteristics of the output electrical signal.

Optionally, controlling the electricity meter based at least in part on the output electrical signal comprises controlling the electricity meter based on one or more properties of the output electrical signal.

Optionally, controlling the electricity meter based on the output electrical signal comprises controlling the electricity meter based at least in part on the temporal characteristics of one or more properties of the output electrical signal.

Optionally, controlling the electricity meter based on the output electrical signal comprises controlling the electricity meter based at least in part on one or more measured values of one or more properties of the output electrical signal.

Optionally, controlling the electricity meter based on the output electrical signal comprises controlling the electricity meter based at least in part on the temporal characteristics of one or more measured values of one or more properties of the output electrical signal.

Optionally, the electricity meter comprises a display for displaying one or more functions of the electricity meter.

Optionally, controlling the electricity meter based on the output electrical signal comprises navigating through the one or more functions displayed by the display based on the output electrical signal.

Optionally, controlling the electricity meter based on the output electrical signal comprises selecting one or more of the one or more functions displayed by the display based on the output electrical signal.

Optionally, controlling the electricity meter based on the output electrical signal
5 comprises causing the electricity meter to perform the one or more selected functions.

Optionally, controlling the electricity meter based on the output electrical signal comprises determining the strength of the magnetic field to which the magnetic field sensor is exposed based on the output electrical signal and controlling the electricity meter based on the determined strength of the magnetic field to which the magnetic field
10 sensor is exposed.

Optionally, controlling the electricity meter based on the output electrical signal comprises determining the temporal characteristics of the strength of the magnetic field to which the magnetic field sensor is exposed based on the temporal characteristics of the output electrical signal and controlling the electricity meter based on the determined
15 temporal characteristics of the strength of the magnetic field to which the magnetic field sensor is exposed.

Optionally, controlling the electricity meter based on the output electrical signal comprises determining whether a tamper event has occurred based on the results of a comparison between at least one of:

20 the determined strength of the magnetic field and a threshold magnetic field strength;

the determined strength of the magnetic field and a predetermined range of magnetic field strengths;

25 the determined temporal characteristics of the strength of the magnetic field and predetermined temporal characteristics of the magnetic field strength;
or

the determined temporal characteristics of the strength of the magnetic field and a predetermined range of temporal characteristics of the magnetic field strength.

30 Optionally, controlling the electricity meter based on the output electrical signal comprises registering the occurrence of the tamper event, for example by setting an appropriate flag in a memory of the electricity meter.

Optionally, controlling the electricity meter based on the output electrical signal comprises causing the electricity meter to provide an indication of the occurrence of the

tamper event for alerting a user of the electricity meter to the occurrence of the tamper event.

Optionally, the processing resource is configured to perform a plurality of different operations and wherein the processing resource is configured to select the operation
5 from the plurality of different operations based on the output electrical signal.

Optionally, the processing resource is configured to select the operation from the plurality of different operations based on one or more properties of the output electrical signal.

Optionally, the processing resource is configured to select the operation from the
10 plurality of different operations based on the temporal characteristics of the output electrical signal, for example based on the temporal characteristics of one or more properties of the output electrical signal.

Optionally, the processing resource is configured to compare the output electrical signal to a reference signal and to perform the operation based on the results of the
15 comparison.

Optionally, the processing resource is configured to compare one or more properties of the output electrical signal to one or more corresponding reference values and to perform the operation based on the results of the one or more comparisons.

Optionally, the processing resource is configured to perform a plurality of different
20 operations, wherein the processing resource is configured to compare the output electrical signal to a reference signal, and wherein the processing resource is configured to select the operation from the plurality of different operations based on the results of the comparison.

Optionally, the processing resource is configured to perform a plurality of different
25 operations, wherein the processing resource is configured to compare one or more properties of the output electrical signal to one or more corresponding reference values, and wherein the processing resource is configured to select the operation from the plurality of different operations based on the results of the one or more comparisons.

Optionally, the processing resource is configured to measure one or more
30 properties of the output electrical signal and to perform the operation based on the measured value of each measured property of the electrical signal.

Optionally, the processing resource is configured to measure one or more properties of the electrical signal as a function of time and to perform the operation based on the temporal characteristics of the measured values of each measured property of
35 the electrical signal.

Optionally, the processing resource is configured to perform a plurality of different operations and to measure one or more properties of the output electrical signal, and wherein the processing resource is configured to select the operation from the plurality of different operations based on the measured value of each measured property of the electrical signal.

Optionally, the processing resource is configured to perform a plurality of different operations and to measure one or more properties of the output electrical signal as a function of time, and wherein the processing resource is configured to select the operation from the plurality of different operations based on the temporal characteristics of the measured values of each measured property of the electrical signal.

Optionally, the one or more properties of the output electrical signal comprise one or more of a magnitude, a frequency and a phase of the output electrical signal.

Optionally, the electricity meter comprises a memory for storing calibration data, wherein the calibration data comprises a plurality of different known magnetic field strengths and the corresponding measured values of one or more properties of the output electrical signal, or the temporal characteristics of the corresponding measured values of one or more properties of the output electrical signal, as measured by the processing resource when the magnetic field sensor is exposed to the plurality of different known magnetic field strengths. Optionally, the processing resource is configured to determine an absolute value of the magnetic field strength from the output electrical signal in combination with the calibration data.

Optionally, the processing resource is configured to determine an absolute value of the magnetic field strength from the output electrical signal in combination with nominal or designed values or characteristics of the magnetic field sensor, the circuitry and the input electrical waveform.

Optionally, the magnetic field sensor serves a purpose in addition to sensing the magnetic field applied to the electricity meter, for example wherein the electricity meter comprises a switched-mode power supply and the magnetic field sensor also serves as an inductor of the switched-mode power supply.

Optionally, the electricity meter is configured for communication with an external device or system.

According to an aspect of the present disclosure there is provided a method for controlling an electricity meter, wherein the electricity meter is configured for measuring one or more properties of a power supply, wherein the electricity meter comprises a magnetic field sensor which includes a coil, wherein the electricity meter further

comprises a signal generator and circuitry, wherein the circuitry is connected to the coil and to the signal generator, and wherein the method comprises:

applying a magnetic field to the electricity meter so as to expose the magnetic field sensor to a portion of the magnetic field;

5 using the signal generator to generate an input electrical waveform such as a periodic input electrical waveform;

using the circuitry to generate an output electrical signal which is dependent on the input electrical waveform and the portion of the magnetic field to which the magnetic field sensor is exposed, and

10 controlling the electricity meter based on the output electrical signal.

Optionally, the magnetic field is a DC magnetic field or is variable according to the manual movement or swipe of a hand-held permanent magnet device relative to the electricity meter.

15 Optionally, the magnetic field sensor comprises a core, wherein the coil is arranged around the core.

Optionally, the method comprises exposing the core of the magnetic field sensor to a portion of the magnetic field so that one or more properties of the output electrical signal are dependent on an inductance of the magnetic field sensor which is in turn dependent on the permeability of the core which is in turn dependent on the portion of the magnetic field to which the core is exposed.

20 Optionally, controlling the electricity meter based on the output electrical signal comprises controlling the electricity meter based on at least one of:

the temporal characteristics of the output electrical signal;

one or more properties of the output electrical signal;

25 the temporal characteristics of one or more properties of the output electrical signal;

one or more measured values of one or more properties of the output electrical signal; or

30 the temporal characteristics of one or more measured values of one or more properties of the output electrical signal.

Optionally, controlling the electricity meter based on the output electrical signal comprises navigating through one or more functions of the electricity meter as displayed by a display of the electricity meter based on the output electrical signal.

Optionally, controlling the electricity meter based on the output electrical signal comprises selecting one or more of the one or more functions displayed by the display of the electricity meter based on the output electrical signal.

Optionally, controlling the electricity meter based on the output electrical signal
5 comprises causing the electricity meter to perform the one or more selected functions.

Optionally, controlling the electricity meter based on the output electrical signal comprises determining the strength of the magnetic field to which the magnetic field sensor is exposed based on the output electrical signal and controlling the electricity meter based on the determined strength of the magnetic field to which the magnetic field
10 sensor is exposed.

Optionally, controlling the electricity meter based on the output electrical signal comprises determining the temporal characteristics of the strength of the magnetic field to which the magnetic field sensor is exposed based on the temporal characteristics of the output electrical signal and controlling the electricity meter based on the determined
15 temporal characteristics of the strength of the magnetic field to which the magnetic field sensor is exposed.

Optionally, controlling the electricity meter based on the output electrical signal comprises determining whether a tamper event has occurred based on the results of a comparison between at least one of:

20 the determined strength of the magnetic field and a threshold magnetic field strength;

the determined strength of the magnetic field and a predetermined range of magnetic field strengths;

25 the determined temporal characteristics of the strength of the magnetic field and predetermined temporal characteristics of the magnetic field strength; or

the determined temporal characteristics of the strength of the magnetic field and a predetermined range of temporal characteristics of the magnetic field strength.

30 Optionally, controlling the electricity meter based on the output electrical signal comprises registering the occurrence of the tamper event, for example by setting an appropriate flag in a memory of the electricity meter.

Optionally, controlling the electricity meter based on the output electrical signal comprises causing the electricity meter to provide an indication of the occurrence of the

tamper event for alerting a user of the electricity meter to the occurrence of the tamper event.

It should be understood that any one or more of the optional features of any one of the foregoing aspects of the present disclosure may be combined with any one or more of the other foregoing aspects of the present disclosure or the optional features of any one or more of the other foregoing aspects of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

An electricity meter and associated methods will now be described by way of non-limiting example only with reference to the drawings of which:

FIG. 1 is a schematic of an electricity meter in use during interaction between the electricity meter and a hand-held permanent magnet device for controlling the electricity meter;

FIG. 2 is a schematic of a magnetic field sensor, a signal generator, circuitry and a processing resource of the electricity meter of FIG. 1;

FIG. 3 is a plot of voltage across a resistor of a series coil-impedance arrangement of the electricity meter of FIGS. 1 and 2 as a function of the magnetic field strength applied to a core of the magnetic field sensor;

FIG. 4 is a schematic of the magnetic field sensor, the signal generator, and the processing resource together with first alternative circuitry for use in place of the circuitry of FIGS. 1 and 2;

FIG. 5 is a schematic of the magnetic field sensor, the signal generator, and the processing resource together with second alternative circuitry for use in place of the circuitry of FIGS. 1 and 2;

FIG. 6 is a schematic of the magnetic field sensor, the signal generator, and the processing resource together with third alternative circuitry for use in place of the circuitry of FIGS. 1 and 2; and

FIG. 7 is a schematic of the magnetic field sensor, the signal generator, and the processing resource together with fourth alternative circuitry for use in place of the circuitry of FIGS. 1 and 2.

5 DETAILED DESCRIPTION OF THE DRAWINGS

Referring initially to FIG. 1 there is shown an electricity meter generally designated 2 for measuring one or more properties of a power supply 3. As will be described in more detail below, the electricity meter 2 is configured to be controlled using a hand-held permanent magnetic device 4.

10 The electricity meter 2 includes a transformer and/or burden resistors 8 for conditioning a voltage, current and/or power associated with the power supply 3. The electricity meter 2 further includes a magnetic field sensor 10, a signal generator 12 for generating an input electrical waveform, circuitry 14 connected to the magnetic field sensor 10 and to the signal generator 12, a processing resource 16, a memory 17, a
15 communication interface 18 and a display 19. As shown in FIG. 1, the processing resource 16 is configured for communication with the transformer and/or burden resistors 8, the circuitry 14, the memory 17, the communication interface 18, and the display 19.

The processing resource 16 is configured to measure one or more properties of the voltage, current and/or power associated with the power supply 3 and to store data
20 representative of the one or more measured properties of the voltage, current and/or power associated with the power supply 3 in the memory 17. The communication interface 18 enables communication of the data from the electricity meter 2 to the external device or system 6.

The electricity meter 2 is configured so that the circuitry 14 receives the input
25 electrical waveform generated by the signal generator 12, and the circuitry 14 generates an output electrical signal which is dependent on the input electrical waveform and a portion of the magnetic field to which the magnetic field sensor 10 is exposed. The processing resource 16 is configured to receive the output electrical signal from the circuitry 14 and to control the electricity meter 2 based on the output electrical signal.
30 For example, the processing resource 16 may be configured to enable navigation through one or more menus of the electricity meter 2 displayed via the display 19 based on the output electrical signal, wherein the one or more menus define one or more functions of the electricity meter 2. The processing resource 16 may also be configured to enable selection of one or more of the one or more functions of the electricity meter 2

displayed via the display 19 based on the output electrical signal and to cause the electricity meter 2 to perform the one or more selected functions.

Referring now to FIG. 2, there is shown the magnetic field sensor 10, the signal generator 12, the circuitry 14 and the processing resource 16 in more detail.

5 The magnetic field sensor 10 includes a core 10a and a coil 10b, wherein the coil 10b is arranged around the core 10a so as to define an inductance L1.

10 The circuitry 14 is connected to the coil 10b and is configured so that one or more properties of the output electrical signal are dependent on the inductance L1 of the magnetic field sensor 10 which is in turn dependent on a permeability of the core 10a which is in turn dependent on the portion of the magnetic field to which the core 10a is exposed. The circuitry 14 includes input circuitry in the form of a low-pass filter circuitry generally designated 20, a series coil-impedance arrangement 22, and output circuitry in the form of comparator circuitry generally designated 24. As will be understood by one of skill in the art, the low-pass filter circuitry 20 is defined by a resistor R1 and a capacitor C1. The series coil-impedance arrangement 22 comprises a resistance R2 connected in series with the coil 10b of the magnetic field sensor 10.

15 An input of the low-pass filter circuitry 20 is connected to the signal generator 12, an output of the low-pass filter circuitry 20 is connected across the series coil-impedance arrangement 22, an input of the comparator circuitry 24 is connected across the resistor R2 of the series coil-impedance arrangement 22, and an output of the comparator circuitry 24 is connected to the processing resource 16.

20 In use, the signal generator 12 generates an input electrical waveform in the form of a periodic input voltage waveform such a square-wave a sine-wave or a waveform which in intermediate a square-wave and a sine-wave. The low-pass filter circuitry 20 filters the input voltage waveform so as to generate a conditioned input voltage waveform which is sinusoidal or approximately sinusoidal. The sinusoidal or approximately sinusoidal, conditioned input voltage waveform is applied across the series coil-impedance arrangement 22 resulting in the generation of a voltage waveform across the resistor R2.

25 As the strength of the magnetic field to which the core 10a is exposed increases, the permeability of the material of the core 10a decreases. Moreover, the inductance L1 increases or decreases with the permeability of the core material. Hence, as the magnetic field strength increases, the inductance L1 decreases. For the sinusoidal or approximately sinusoidal conditioned input voltage waveform across the series coil-impedance arrangement 22, the impedance Z1 of the inductor L1 is given by $Z1=j\omega L1$.

Thus, as the magnetic field strength increases, the inductance L1 decreases and the impedance Z1 of the inductor L1 also decreases. Consequently, as the magnetic field strength increases, the magnitude of the voltage waveform across resistor R2 increases as shown in FIG. 3.

5 The voltage waveform across resistor R2 is applied to the input of the comparator circuitry 24. The comparator circuitry 24 compares the voltage waveform to a reference voltage defined at a node between resistors R3 and R4 and generates an output electrical signal in the form of a pulse train at the output of the comparator circuitry 24. It should be understood that the magnitude of the pulses of the pulse train may depend
10 on the bias voltages used to bias the comparator circuitry 24.

 The processing resource 16 detects the presence of pulses of the pulse train and, in response to detecting the presence of pulses of the pulse train, the processing resource 16 determines that the permanent magnet device 4 is located in proximity to the magnetic field sensor 10.

15 The processing resource 16 is configured to control the electricity meter 2 based on the output electrical signal, wherein controlling the electricity meter 2 based on the output electrical signal may comprise controlling the electricity meter 2 based on at least one of: the temporal characteristics of the output electrical signal; one or more properties of the output electrical signal; the temporal characteristics of one or more properties of
20 the output electrical signal; one or more measured values of one or more properties of the output electrical signal; or the temporal characteristics of one or more measured values of one or more properties of the output electrical signal. For example, the processing resource 16 may be configured to compare at least one of: the temporal characteristics of the output electrical signal; one or more properties of the output
25 electrical signal; the temporal characteristics of one or more properties of the output electrical signal; one or more measured values of one or more properties of the output electrical signal; or the temporal characteristics of one or more measured values of one or more properties of the output electrical signal, to a corresponding predetermined value or a corresponding predetermined range of values and to control the electricity meter 2
30 according to the results of the comparison.

 The processing resource 16 may be configured to enable navigation through one or more menus of the electricity meter 2 displayed via the display 19 based on the output electrical signal, wherein the one or more menus define one or more functions of the electricity meter 2. The processing resource 16 may also be configured to enable
35 selection of one or more of the one or more functions of the electricity meter 2 based on

the output electrical signal. The one or more functions of the electricity meter 2 may include initiating/interrupting or enabling/disabling communications between the electricity meter 2 and the external device or system 6 via the communication interface 18, for example to initiate/interrupt or enable/disable communication of the measured
5 one or more properties of the voltage, current and/or power associated with the power supply 3 to the external device or system 6. In view of the foregoing description, it should be understood that the permanent magnet device 4 and the magnetic field sensor 10 may together constitute a human machine interface (HMI) for controlling the electricity meter 2.

10 The processing resource 16 may be configured to determine the strength of the magnetic field to which the magnetic field sensor 10 is exposed from the duration or width of the pulses of the pulse train. This may be useful when determining whether the magnetic field sensor 10 has been exposed to a magnetic field which is commensurate with exposure to the permanent magnet device 4 of a "standard" or "regulation" magnetic
15 field strength located with a correct or predetermined orientation within a correct or predetermined range of the magnetic field sensor 10, thereby indicating an authentic request to control the electricity meter 2, or whether the magnetic field sensor 10 has been exposed to a magnetic field which is commensurate with exposure to a permanent magnet device which generates a magnet field of a strength which is less than or greater
20 than a "standard" or "regulation" magnetic field strength thereby indicating possible tampering. If the processing resource 16 fails to detect the presence of pulses of the pulse train, the processing resource 16 determines that no permanent magnet device is located in proximity to the magnetic field sensor 10 and/or that the strength of the magnetic field to which the magnetic field sensor 10 is exposed is zero.

25 The processing resource 16 may be configured to determine the temporal characteristics of the strength of the magnetic field to which the magnetic field sensor 10 is exposed. This may be useful when determining whether the magnetic field sensor 10 has been manually swiped by the permanent magnet device 4 in a predetermined manner thereby indicating an authentic request to control the electricity meter 2, or
30 whether the magnetic field sensor 10 has been exposed to a magnetic field which varies at a rate which is not commensurate with a manual swipe by the permanent magnet device 4 in a predetermined manner thereby indicating possible tampering.

Additionally or alternatively, the processing resource 16 may be configured to determine whether a tamper event has occurred based on the determined strength of
35 the magnetic field to which the magnetic field sensor 10 is exposed and/or based on the

temporal characteristics of the determined strength of the magnetic field to which the magnetic field sensor 10 is exposed. For example, the processing resource 16 may be configured to determine whether a tamper event has occurred based on the results of a comparison between at least one of the determined strength of the magnetic field and a threshold magnetic field strength; the determined strength of the magnetic field and a predetermined range of magnetic field strengths; the determined temporal characteristics of the strength of the magnetic field and predetermined temporal characteristics of the magnetic field strength; or the determined temporal characteristics of the strength of the magnetic field and a predetermined range of temporal characteristics of the magnetic field strength. The processing resource 16 may be configured to register the occurrence of the tamper event, for example by setting an appropriate flag in the memory 17 of the electricity meter 2 in response to determining that a tamper event has occurred. The processing resource 16 may be configured to cause the electricity meter to provide an indication of the occurrence of the tamper event for alerting a user of the electricity meter to the occurrence of the tamper event.

The magnetic field sensor 10 may enable the detection of smaller magnetic fields or more sensitive magnetic field measurements to be performed than known Hall Effect magnetic field sensors. This may be advantageous when detecting/measuring smaller magnetic fields generated by the hand-held permanent magnet device 4 used to control the electricity meter 2. This may also be advantageous where it is necessary to position the magnetic field sensor 10 within the electricity meter 2 at a position which is less than ideal due to the design constraints of the electricity meter 2, for example at a position which is less accessible within a housing of the electricity meter 2. This may also enable the magnetic field sensor 10 to detect weaker magnetic fields that may be present during a tamper attempt. These weaker magnetic fields may for example be due to the size of the tamper magnet and the orientation and position of the tamper magnet relative to the magnetic field sensor 10.

The magnetic field sensor 10 may be used to detect higher magnetic fields than known TMR magnetic field sensors. The magnetic field sensor 10 may be more robust than known TMR magnetic field sensors and/or may be less susceptible to damage in higher magnetic fields, such as those which may be used during a tamper attempt, than known TMR magnetic field sensors.

Referring now to FIG. 4, there is shown the magnetic field sensor 10, the signal generator 12, and the processing resource 16 together with first alternative circuitry 114 for use in place of the circuitry 14 of FIGS. 1 and 2. The first alternative circuitry 114

only differs from the circuitry 14 in that the output circuitry of the first alternative circuitry 114 which is connected across resistor R2 of the series coil-impedance arrangement 22 includes peak detector circuitry generally designated 126 followed by the comparator circuitry 24. As will be understood by one of skill in the art, the peak detector circuitry

5 126 is defined by a diode D1, a capacitor C2 and a resistor R6 as shown in FIG. 4.

In use, the peak detector circuitry 126 converts the voltage waveform generated across the resistor R2 of the series coil-impedance arrangement 22 into a DC voltage and the comparator circuitry 24 compares the DC voltage to a reference voltage defined at the node between resistors R3 and R4 resulting in the generation of an electrical

10 output signal in the form of a further DC voltage based on the results of the comparison. The processing resource 16 receives the further DC voltage and performs an operation based on the further DC voltage.

Although the foregoing description of the operation of the first alternative circuitry 114 of FIG. 4 describes the generation of the DC voltage at the output of the peak detector circuitry 126 and the generation of the further DC voltage at the output of the comparator circuitry 24, it should be understood that the magnetic field strength may vary over time according to a movement of a permanent magnet like permanent magnet device 4 relative to the magnetic field sensor 10, and that the DC voltage and the further DC voltage may therefore vary on a timescale which is commensurate with the speed of

15 movement of the permanent magnet relative to the magnetic field sensor 10.

The processing resource 16 may determine the strength of the magnetic field to which the magnetic field sensor 10 is exposed from the value of the further DC voltage and control the electricity meter 2 based on the value of the further DC voltage.

The processing resource 16 may determine the temporal characteristics of the further DC voltage or the temporal characteristics of the determined strength of the magnetic field and control the electricity meter 2 based on the temporal characteristics of the further DC voltage and/or based on the temporal characteristics of the determined strength of the magnetic field.

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From the foregoing description, it should be understood that the use of the peak detector circuitry 126 followed by the comparator circuitry 24 to generate an output electrical signal in the form of the further DC voltage may allow a logic state to be used for the output electrical signal instead of a pulse train.

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Referring now to FIG. 5, there is shown the magnetic field sensor 10, the signal generator 12, and the processing resource 16 together with second alternative circuitry 214 for use in place of the circuitry 14 of FIGS. 1 and 2. The second alternative circuitry

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214 only differs from the first alternative circuitry 114 of FIG. 4 in that the output circuitry of the second alternative circuitry 214 includes amplifier circuitry 224 in place of the comparator circuitry 24. The amplifier circuitry 224 includes a negative feedback resistor R7. As will be understood by one of skill in the art, the inclusion of the negative feedback resistor R7 means that the amplifier circuitry 224 amplifies any difference between the DC voltage generated by the peak detector circuitry 126 and the reference voltage defined at the node between resistors R3 and R4 to generate an output electrical signal in the form of an amplified further DC voltage. In other respects, the operation of the second alternative circuitry 214 of FIG. 5 is identical to the operation of the first alternative circuitry 114 of FIG. 4.

In a variant of the second alternative circuitry 214, the processing resource 16 may include an analogue-to-digital converter (ADC) for converting the amplified further DC voltage into a digital signal for processing by the processing resource 16.

Referring now to FIG. 6, there is shown the magnetic field sensor 10, the signal generator 12, and the processing resource 16 together with third alternative circuitry 314 for use in place of the circuitry 14 of FIGS. 1 and 2. The third alternative circuitry 314 only differs from the first alternative circuitry 114 of FIG. 4 in that the output circuitry of the third alternative circuitry 214 excludes the comparator circuitry 24. As will be understood by one of skill in the art, the absence of the comparator circuitry 24 means that the processing resource 16 receives the DC voltage and performs an operation based on the DC voltage. In all other respects, the operation of the third alternative circuitry 314 of FIG. 6 is identical to the operation of the first alternative circuitry 114 of FIG. 4. The processing resource 16 may also include an analogue-to-digital converter (ADC) for converting the DC voltage into a digital signal for processing by the processing resource 16.

Referring now to FIG. 7, there is shown the magnetic field sensor 10, the signal generator 12, and the processing resource 16 together with fourth alternative circuitry 414 for use in place of the circuitry 14 of FIGS. 1 and 2. The circuitry 414 includes input circuitry in the form of a low-pass filter circuitry generally designated 20, a series coil-impedance arrangement 22, and output circuitry in the form of a voltage divider generally designated 424. As will be understood by one of skill in the art, the low-pass filter circuitry 20 is defined by a resistor R1 and a capacitor C1. The series coil-impedance arrangement 22 comprises a resistance R2 connected in series with the coil 10b of the magnetic field sensor 10. The voltage divider 424 comprises a pair of resistors R3 and R4 connected in series.

An input of the low-pass filter circuitry 20 is connected to the signal generator 12, an output of the low-pass filter circuitry 20 is connected across the series coil-impedance arrangement 22 and the voltage divider 424. The series coil-impedance arrangement 22 defines a first node between the resistor R2 and the coil 10b of the magnetic field sensor 10. The voltage divider 424 defines a second node between the resistors R3 and R4 of the voltage divider 424. The processing resource 16 is connected between the first and second nodes. From the foregoing description, it should be understood that the fourth alternative circuitry 414 comprises a Wheatstone bridge configuration and that the circuitry 414 generates an output electrical signal in the form of the waveform of the voltage between the first and second nodes for processing by the processing resource 16. Moreover, the processing resource 16 includes an analogue-to-digital converter (ADC) for converting the voltage waveform between the first and second nodes into a digital signal for processing by the processing resource 16. Moreover, the processing resource 16 is configured to control the electricity meter 2 based on one or more properties of the output electrical signal. Additionally or alternatively, the processing resource 16 is configured to control the electricity meter 2 based on the temporal characteristics of the output electrical signal, for example based on the temporal characteristics of one or more properties of the output electrical signal. The one or more properties of the output electrical signal may comprise one or more of a magnitude, a frequency and a phase of the output electrical signal.

One of ordinary skill in the art will also understand that various modifications are possible to any of the electricity meters described above. For example, the signal generator may comprise an oscillator, a microprocessor unit (MPU), or a 555 timer. For example, the signal generator output may be generated at a toggling pin of a MPU.

Although the circuitry 14 and the alternative circuitry 114, 214, 314, 414, each comprises the low-pass filter circuitry 20, in a variant of any of the circuitry 14, 114, 214, 314, 414, the low-pass filter circuitry 20 may be omitted, especially where the signal generator 12 is configured to generate an input electrical waveform which comprises or approximates a sine-wave.

Although the circuitry 14 and the first alternative circuitry 114, each comprises comparator circuitry 24, in a variant of the circuitry 14, 114, the comparator circuitry 24 may be omitted.

Although the first, second and third alternative circuitry 114, 214 and 314 each comprises peak detector circuitry 126, in a variant of any of the first, second and third alternative circuitry 114, 214 and 314, the peak detector circuitry 126 may be omitted.

The fourth alternative circuitry 414 may comprise peak detector circuitry like peak detector circuitry 126 and/or amplifier circuitry like amplifier circuitry 224.

Although the electricity meter 2 comprises circuitry 14 or alternative circuitry 114, 214, 314, 414 which comprise a series coil-impedance arrangement 22 which includes
5 the resistor R2 connected in series with the coil 10b of the magnetic field sensor 10, in an alternative electricity meter embodiment, the electricity meter may comprise circuitry which comprise a series coil-impedance arrangement which includes an impedance of any kind connected in series with the coil 10b of the magnetic field sensor 10. For example, the circuitry may comprise a series coil-impedance arrangement which
10 includes a resistor, a capacitor or an inductor, or any combination of two or more of a resistor, a capacitor and an inductor, connected in series with the coil 10b of the magnetic field sensor 10.

Although the electricity meter 2 comprises circuitry 14 or alternative circuitry 114, 214, 314, 414 in which an output electrical signal is generated based on a voltage across
15 the resistor R2 which is connected in series with the coil 10b of the magnetic field sensor 10, the circuitry may be configured in any way so that one or more properties of the output electrical signal are dependent on an inductance of the magnetic field sensor which may in turn be dependent on the permeability of the core which may in turn be dependent on the portion of the magnetic field to which the core is exposed. For
20 example, the electricity meter 2 may comprise alternative circuitry in which an output electrical signal is based on a voltage across the coil 10b of the magnetic field sensor 10.

The electricity meter 2 may comprise alternative circuitry which includes a
25 transimpedance amplifier for amplifying current flowing through the coil 10b of the magnetic field sensor 10 to thereby generate an output electrical signal which is dependent on the current flowing through the coil 10b of the magnetic field sensor 10 and therefore also the magnetic field to which the magnetic field sensor 10 is exposed. The electricity meter 2 may comprise alternative circuitry comprising a parallel coil-impedance arrangement comprising an impedance connected in parallel with the coil
30 10b of the magnetic field sensor 10, wherein the alternative circuitry is configured to generate an output electrical signal which is based on a current which passes through the coil 10b or which is based on a current which passes through the impedance which is connected in parallel with the coil 10b. The impedance connected in parallel with the coil 10b of the magnetic field sensor 10 may include a resistor, a capacitor or an inductor,
35 or any combination of two or more of a resistor, a capacitor and an inductor.

Optionally, the processing resource comprises at least one of a microprocessor, a microcontroller, a digital signal processor (DSP), a field-programmable gate array (FPGA), an application-specific integrated circuit (ASIC), or an analog-to-digital converter (ADC).

5 Optionally, the processing resource is configured to compare the output electrical signal to a reference signal and to perform the operation based on the results of the comparison.

 Optionally, the processing resource is configured to compare one or more properties of the output electrical signal to one or more corresponding reference values and to perform the operation based on the results of the one or more comparisons.

10 Optionally, the processing resource is configured to perform a plurality of different operations, wherein the processing resource is configured to compare the output electrical signal to a reference signal, and wherein the processing resource is configured to select the operation from the plurality of different operations based on the results of the comparison.

15 Optionally, the processing resource is configured to perform a plurality of different operations, wherein the processing resource is configured to compare one or more properties of the output electrical signal to one or more corresponding reference values, and wherein the processing resource is configured to select the operation from the plurality of different operations based on the results of the one or more comparisons.

20 Optionally, the processing resource is configured to measure one or more properties of the output electrical signal and to perform the operation based on the measured value of each measured property of the electrical signal.

25 Optionally, the processing resource is configured to measure one or more properties of the electrical signal as a function of time and to perform the operation based on the temporal characteristics of the measured values of each measured property of the electrical signal.

30 Optionally, the processing resource is configured to perform a plurality of different operations and to measure one or more properties of the output electrical signal, and wherein the processing resource is configured to select the operation from the plurality of different operations based on the measured value of each measured property of the electrical signal.

35 Optionally, the processing resource is configured to perform a plurality of different operations and to measure one or more properties of the output electrical signal as a function of time, and wherein the processing resource is configured to select the

operation from the plurality of different operations based on the temporal characteristics of the measured values of each measured property of the electrical signal.

Optionally, the one or more properties of the output electrical signal comprise one or more of a magnitude, a frequency and a phase of the output electrical signal.

5 Optionally, the memory 17 of the electricity meter 2 stores calibration data, wherein the calibration data comprises a plurality of different known magnetic field strengths and the corresponding measured values of one or more properties of the output electrical signal, or the temporal characteristics of the corresponding measured values of one or more properties of the output electrical signal, as measured by the
10 processing resource 16 when the magnetic field sensor is exposed to the plurality of different known magnetic field strengths. Optionally, the processing resource is configured to determine an absolute value of the magnetic field strength from the output electrical signal in combination with the calibration data.

15 Optionally, the processing resource is configured to determine an absolute value of the magnetic field strength from the output electrical signal in combination with nominal or designed values or characteristics of the magnetic field sensor, the circuitry and/or the input electrical waveform.

20 Optionally, the magnetic field sensor serves a purpose in addition to sensing the magnetic field applied to the electricity meter, for example wherein the electricity meter comprises a switched-mode power supply and the magnetic field sensor also serves as an inductor of the switched-mode power supply.

25 Optionally, the core of the magnetic field sensor comprises a magnetic material with a high magnetic permeability. Optionally, the core of the magnetic field sensor comprises a ferromagnetic or a ferromagnetic material. Optionally, the core of the magnetic field sensor comprises at least one of mu-metal, permalloy or supermalloy material. Optionally, the core of the magnetic field sensor comprises a nanocrystalline alloy material.

30 Although the magnetic field sensor is described above as comprising a core and a coil arranged around the core, in other embodiments, the magnetic field sensor may comprise a coil without a core or the magnetic field sensor may comprise a coil having an air core.

35 Although the electricity meter has been described in terms of preferred embodiments as set forth above, it should be understood that these embodiments are illustrative only and that the claims are not limited to those embodiments. Those skilled in the art will be able to make modifications and alternatives to the described

embodiments in view of the disclosure which are contemplated as falling within the scope of the appended claims. Each feature disclosed or illustrated in the present specification may be incorporated in any embodiment, whether alone or in any appropriate combination with any other feature disclosed or illustrated herein. In particular, one of
5 ordinary skill in the art will understand that one or more of the features of the embodiments of the present disclosure described above with reference to the drawings may produce effects or provide advantages when used in isolation from one or more of the other features of the embodiments of the present disclosure and that different combinations of the features are possible other than the specific combinations of the
10 features of the embodiments of the present disclosure described above.

The skilled person will understand that in the preceding description and appended claims, positional terms such as 'above', 'along', 'side', etc. are made with reference to conceptual illustrations, such as those shown in the appended drawings. These terms are used for ease of reference but are not intended to be of limiting nature.
15 These terms are therefore to be understood as referring to an object when in an orientation as shown in the accompanying drawings.

Use of the term "comprising" when used in relation to a feature of an embodiment of the present disclosure does not exclude other features or steps. Use of the term "a" or "an" when used in relation to a feature of an embodiment of the present disclosure
20 does not exclude the possibility that the embodiment may include a plurality of such features.

The use of reference signs in the claims should not be construed as limiting the scope of the claims.

CLAIMS

1. An electricity meter for measuring one or more properties of a power supply, the electricity meter comprising:
 - 5 a magnetic field sensor for sensing a magnetic field which is applied to the electricity meter, the magnetic field sensor including a coil;
 - a signal generator for generating an input electrical waveform such as a periodic input electrical waveform;
 - circuitry connected to the coil and to the signal generator; and
 - 10 a processing resource,
 - wherein the electricity meter is configured so that the circuitry receives the input electrical waveform, and the circuitry generates an output electrical signal which is dependent on the input electrical waveform and a portion of the magnetic field to which the magnetic field sensor is exposed, and
 - 15 wherein the processing resource is configured to receive the output electrical signal and to control the electricity meter based on the output electrical signal.
2. The electricity meter as claimed in claim 1, wherein the magnetic field sensor comprises a core, wherein the coil is arranged around the core, and wherein the circuitry
 - 20 is configured so that one or more properties of the output electrical signal are dependent on an inductance of the magnetic field sensor which is in turn dependent on the permeability of the core which is in turn dependent on the portion of the magnetic field to which the core is exposed.
- 25 3. The electricity meter as claimed in claim 1 or 2, wherein the circuitry comprises a series coil-impedance arrangement comprising an impedance connected in series with the coil or wherein the circuitry comprises a parallel coil-impedance arrangement comprising an impedance connected in parallel with the coil.
- 30 4. The electricity meter as claimed in claim 3, wherein the circuitry comprises input circuitry for conditioning the input electrical waveform so as to generate a conditioned input electrical waveform, and wherein the input circuitry is configured to apply the conditioned input electrical waveform to the series coil-impedance arrangement or to apply the conditioned input electrical waveform to the parallel coil-impedance

arrangement and, optionally, wherein the input circuitry comprises low-pass filter circuitry.

5 5. The electricity meter as claimed in claim 3 or 4, wherein the circuitry is configured to generate a voltage waveform comprising a waveform of the voltage across the impedance of the series coil-impedance arrangement or a waveform of the voltage across the coil of the series coil-impedance arrangement, or wherein the circuitry is configured to generate a current waveform comprising a waveform of the current through the impedance of the parallel coil-impedance arrangement or a waveform of the current
10 through the coil of the parallel coil-impedance arrangement.

6. The electricity meter as claimed in claim 5, wherein the circuitry comprises output circuitry for conditioning the voltage waveform or the current waveform so as to generate a conditioned electrical signal.

15 7. The electricity meter as claimed in claim 6, wherein the output circuitry comprises comparator circuitry, wherein the comparator circuitry is configured to compare the voltage waveform to a reference voltage and generate a pulse train based on the results of the comparison or wherein the comparator circuitry is configured to compare the
20 current waveform to a reference current and generate a pulse train based on the results of the comparison, and wherein the conditioned electrical signal comprises the pulse train.

25 8. The electricity meter as claimed in claim 6, wherein the output circuitry comprises amplifier circuitry, wherein the amplifier circuitry is configured to amplify any difference in voltage between the voltage waveform and a reference voltage to thereby generate an amplified electrical signal or wherein the amplifier circuitry is configured to amplify any difference in current between the current waveform and a reference current to thereby generate an amplified electrical signal, and wherein the conditioned electrical signal
30 comprises the amplified electrical signal.

9. The electricity meter as claimed in claim 6, wherein the output circuitry comprises peak detector circuitry, wherein the peak detector circuitry is configured to receive the voltage waveform and generate a DC voltage or wherein the peak detector circuitry is
35 configured to receive the current waveform and generate a DC current.

10. The electricity meter as claimed in claim 9, wherein the conditioned electrical signal comprises the DC voltage or the DC current.

5 11. The electricity meter as claimed in claim 9, wherein the output circuitry comprises comparator circuitry, wherein the comparator circuitry is configured to compare the DC voltage to a reference voltage and to generate a further DC voltage or a further DC current based on the results of the comparison, or wherein the comparator circuitry is configured to compare the DC current to a reference current and to generate a further
10 DC voltage or a further DC current based on the results of the comparison, and wherein the conditioned electrical signal comprises the further DC voltage or the further DC current.

12. The electricity meter as claimed in claim 9, wherein the output circuitry comprises
15 amplifier circuitry, wherein the amplifier circuitry is configured to amplify any difference in voltage between the DC voltage and a reference voltage to thereby generate a further DC voltage or a further DC current or wherein the amplifier circuitry is configured to amplify any difference in current between the DC current and a reference current to thereby generate a further DC voltage or a further DC current, and wherein the
20 conditioned electrical signal comprises the further DC voltage or the further DC current.

13. The electricity meter as claimed in claim 5, wherein the circuitry comprises output circuitry, wherein the output circuitry comprises a voltage divider in parallel with the series coil-impedance arrangement, wherein the series coil-impedance arrangement
25 defines a first node between the impedance and the coil, wherein the voltage divider defines a second node, and wherein the output circuitry is configured to generate a voltage waveform comprising a waveform of the voltage between the first and second nodes.

30 14. The electricity meter as claimed in any one of claims 5 to 13, wherein the output electrical signal comprises the voltage waveform, the current waveform or the conditioned electrical signal.

15. The electricity meter as claimed in any preceding claim, wherein the processing
35 resource comprises at least one of a microprocessor, a microcontroller, a digital signal

processor, a field-programmable gate array, an application-specific integrated circuit, or an analog-to-digital converter.

16. The electricity meter as claimed in any preceding claim, wherein controlling the electricity meter based on the output electrical signal comprises controlling the electricity meter based on at least one of:

- the temporal characteristics of the output electrical signal;
- one or more properties of the output electrical signal;
- the temporal characteristics of one or more properties of the output electrical signal;
- one or more measured values of one or more properties of the output electrical signal; or
- the temporal characteristics of one or more measured values of one or more properties of the output electrical signal.

17. The electricity meter as claimed in any preceding claim, comprising a display for displaying one or more functions of the electricity meter, and wherein controlling the electricity meter based on the output electrical signal comprises at least one of:

- navigating through the one or more functions displayed by the display based on the output electrical signal;
- selecting one or more of the one or more functions displayed by the display based on the output electrical signal; or
- causing the electricity meter to perform the one or more selected functions.

18. The electricity meter as claimed in any preceding claim, wherein controlling the electricity meter based on the output electrical signal comprises:

- determining the strength of the magnetic field to which the magnetic field sensor is exposed based on the output electrical signal and controlling the electricity meter based on the determined strength of the magnetic field to which the magnetic field sensor is exposed, and/or
- determining the temporal characteristics of the strength of the magnetic field to which the magnetic field sensor is exposed based on the temporal characteristics of the output electrical signal and controlling the electricity meter based on the determined temporal characteristics of the strength of the magnetic field to which the magnetic field sensor is exposed.

19. The electricity meter as claimed in claim 18, wherein controlling the electricity meter based on the output electrical signal comprises:

5 determining whether a tamper event has occurred based on the results of a comparison between at least one of:

the determined strength of the magnetic field and a threshold magnetic field strength;

the determined strength of the magnetic field and a predetermined range of magnetic field strengths;

10 the determined temporal characteristics of the strength of the magnetic field and predetermined temporal characteristics of the magnetic field strength; or

the determined temporal characteristics of the strength of the magnetic field and a predetermined range of temporal characteristics of the magnetic field strength, and

15 registering the occurrence of the tamper event, for example by setting an appropriate flag in a memory of the electricity meter, and/or causing the electricity meter to provide an indication of the occurrence of the tamper event for alerting a user of the electricity meter to the occurrence of the tamper event.

20

20. A method for controlling an electricity meter, wherein the electricity meter is configured for measuring one or more properties of a power supply, wherein the electricity meter comprises a magnetic field sensor which includes a coil, wherein the electricity meter further comprises a signal generator and circuitry, wherein the circuitry is connected to the coil and to the signal generator, and wherein the method comprises:

25 applying a magnetic field to the electricity meter so as to expose the magnetic field sensor to a portion of the magnetic field;

using the signal generator to generate an input electrical waveform such as a periodic input electrical waveform;

30 using the circuitry to generate an output electrical signal which is dependent on the input electrical waveform and the portion of the magnetic field to which the magnetic field sensor is exposed, and

controlling the electricity meter based on the output electrical signal.

21. The method as claimed in claim 20, wherein the magnetic field sensor comprises a core, wherein the coil is arranged around the core, and wherein the method comprises exposing the core of the magnetic field sensor to a portion of the magnetic field so that one or more properties of the output electrical signal are dependent on an inductance of the magnetic field sensor which is in turn dependent on the permeability of the core which is in turn dependent on the portion of the magnetic field to which the core is exposed.

22. The method as claimed in claim 20 or 21, wherein controlling the electricity meter based on the output electrical signal comprises controlling the electricity meter based on at least one of:

the temporal characteristics of the output electrical signal;
one or more properties of the output electrical signal;
the temporal characteristics of one or more properties of the output electrical signal;
one or more measured values of one or more properties of the output electrical signal; or
the temporal characteristics of one or more measured values of one or more properties of the output electrical signal.

23. The method as claimed in any one of claims 20 to 22, wherein controlling the electricity meter based on the output electrical signal comprises at least one of:

navigating through one or more functions of the electricity meter as displayed by a display of the electricity meter based on the output electrical signal;
selecting one or more of the one or more functions displayed by the display of the electricity meter based on the output electrical signal; and
causing the electricity meter to perform the one or more selected functions.

24. The method as claimed in any one of claims 20 to 23, wherein controlling the electricity meter based on the output electrical signal comprises:

determining the strength of the magnetic field to which the magnetic field sensor is exposed based on the output electrical signal and controlling the electricity meter based on the determined strength of the magnetic field to which the magnetic field sensor is exposed, and/or

determining the temporal characteristics of the strength of the magnetic field to which the magnetic field sensor is exposed based on the temporal characteristics of the

output electrical signal and controlling the electricity meter based on the determined temporal characteristics of the strength of the magnetic field to which the magnetic field sensor is exposed.

- 5 25. The method as claimed in claim 24, wherein controlling the electricity meter based on the output electrical signal comprises:
- determining whether a tamper event has occurred based on the results of a comparison between at least one of:
- 10 the determined strength of the magnetic field and a threshold magnetic field strength;
- the determined strength of the magnetic field and a predetermined range of magnetic field strengths;
- the determined temporal characteristics of the strength of the magnetic field and predetermined temporal characteristics of the magnetic field strength;
- 15 or
- the determined temporal characteristics of the strength of the magnetic field and a predetermined range of temporal characteristics of the magnetic field strength, and
- 20 registering the occurrence of the tamper event, for example by setting an appropriate flag in a memory of the electricity meter, and/or causing the electricity meter to provide an indication of the occurrence of the tamper event for alerting a user of the electricity meter to the occurrence of the tamper event.