

METER AND COMMUNICATIONS APPARATUS

Field of the Invention

5 The present invention relates to a meter and communications apparatus and, particularly, but not exclusively, to an electricity meter and an upgradeable communications apparatus for the electricity meter.

10 Background of the Invention

 Meters, both domestic and industrial, for monitoring data associated with the consumption of resources such as electricity and gas, are well known. It is usually a
15 regulatory requirement for most countries that meters be installed for monitoring resource consumption at all premises.

 Advanced metering devices, for example advanced domestic and industrial electricity meters, are provided
20 with communications apparatus to enable communication of data with a remote location. Communications functions may include reporting data to the remote location (e.g. automatic, central meter reading), providing data on resource tariff or other consumption data to a display
25 device (for example in the home), receiving control data from a remote location for control of the meter, or any other communications requirement. The Applicant's earlier Patent Application No. 2005227360, the disclosure of which is incorporated herein by reference, discloses an
30 electricity meter and an in-home display which receives data communicated from the electricity meter relating to

aspects of consumption and cost of electricity, for display to the domestic user.

A problem with communications apparatus is that there are many different communications formats, standards and types available for use. For example, different geographical locations may have different communications types serving them. A particular brand or type of electricity meter, therefore, may have to operate in different areas which have different communications types available. Further, the same type of electricity meter may be required to provide different functionality, depending upon its application, geographical position etc. Different types of communications may therefore be required of the same type of electricity meter.

Further, communications technology is changing rapidly, as are the requirements for the amount and type of data to be communicated. There is, therefore, often a requirement for communications apparatus associated with an electricity meter to be changed or upgraded.

Electricity meters are wired into the electricity supply, so that they can monitor electricity consumption. In order to access a meter to change, upgrade or otherwise service the communications apparatus, it is usually necessary to power-down the meter and have a qualified, registered engineer carry out the access. In many jurisdictions, including Australia, meters are "security sealed" to guard against unauthorised access. In order to access the communications apparatus in current electricity meters, the security seal must be broken.

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Summary of the Invention

In accordance with a first aspect, the present invention provides a meter apparatus, comprising a housing having first and second housing portions, the first housing portion mounting meter circuitry arranged to be
5 connected to a mains supply of electricity and arranged to monitor data associated with the mains supply, the meter apparatus being connectable to a communications apparatus mounted in the second housing portion and arranged for communicating data with the meter, the communications
10 apparatus being electrically isolated from the mains supply of electricity to enable access to the communications apparatus without affecting the mains supply to the meter, wherein the first and second housing portions comprise first and second access means
15 respectively, such that access can be had to the second housing portion, to access the communications apparatus via the second access means, without requiring access to the first housing portion.

It is an advantage of at least an embodiment of the
20 present invention, that the communications apparatus can be accessed for changing, upgrading or otherwise servicing, without it being necessary to affect the mains supply of electricity to the meter. In an embodiment, therefore, it is not necessary to power-down the meter,
25 and the meter can continue functioning while the communications apparatus is being accessed. Further, in embodiments, the communications apparatus may be accessed by a person who is not a qualified and registered engineer (as is required for accessing the meter circuitry). In
30 the embodiment where the housing comprises first and second housing portions, a person merely needs to access the second housing portion to access the communications

apparatus. In an embodiment, the second housing portion may be provided with a security seal to deter unauthorised access. In an embodiment, the first housing portion may also be provided with a security seal. In an embodiment,
5 a first access means is provided to enable access to at least the connection between the meter circuitry and the mains supply.

In an embodiment, the communications apparatus is mounted by a communications module. In an embodiment, the
10 communications module comprises a communications module housing mounting communications circuitry. In the embodiment where the communications apparatus is mounted in a second housing portion, the second housing portion comprises a communications compartment which is arranged
15 to receive the communications module housing. In an embodiment, the communications compartment comprises physical guides for positively locating the communications module housing. Advantageously, in an embodiment, the communications module housing is arranged to fit entirely
20 within the footprint of the meter housing, so that it may be accessed even where there is limited mounting space for the meter apparatus.

In an embodiment, the meter circuitry comprises an electrical connector for mating with a corresponding
25 electrical connector of the communications apparatus, whereby to provide one or both of power and data communications. In an embodiment, the electrical connector of the meter circuitry is located within the communications module compartment.

30 In the embodiment where the communications apparatus is mounted in a communications module housing, communication circuitry can be provided to deal with any

type of communications, including RF Mesh, WiMax, and any other communications system.

In accordance with a second aspect, the present invention provides a communications apparatus arranged for
5 connection to the meter apparatus of the first aspect of the invention, so as to be electrically isolated from the mains supply of electricity to enable access to the communications apparatus without affecting the mains supply to the meter.

10 In an embodiment, the communications apparatus comprises a communications module housing mounting communications circuitry, as discussed above in relation to the first aspect of the invention.

In accordance with a third aspect, the present
15 invention provides a meter system, comprising a meter apparatus in accordance with the first aspect of the invention and a communications apparatus in accordance with the second aspect of the invention.

In accordance with a fourth aspect, the present
20 invention provides a meter apparatus comprising a housing, the housing comprising a first housing portion mounting a meter arrangement, and a second housing portion arranged to mount a communications apparatus, the second housing portion comprising second access means, such that access
25 can be had to the second housing portion, to access the communications apparatus, via the second access means, without requiring access to the first housing portion.

In an embodiment, the meter arrangement comprises meter circuitry arranged to be connected to a mains supply
30 of electricity and arranged to monitor data associated with the mains supply.

In accordance with a fifth aspect, the present invention provides a method of enabling association of communications apparatus with metering apparatus in an electrical meter, the method comprising the steps of
5 electrically isolating the communications apparatus from the meter apparatus and also physically isolating the communications apparatus by providing a separate compartment from the meter apparatus, for receiving the communications apparatus.

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Brief Description of the Drawings

Features and advantages of the present invention will become apparent from the following description of
15 embodiments thereof, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a perspective view from above and one side of a meter apparatus in accordance with an embodiment of the invention, with a cover of the communications
20 compartment removed;

Figure 2 is a perspective view from above and one side of the embodiment of Figure 1, illustrating a communications module in place;

Figure 3 is a front view of the meter apparatus of
25 Figure 1;

Figure 4 is a perspective view from above and one side of the apparatus of Figure 1, illustrating a cover of the communications compartment in place;

Figure 5 is a top view of the apparatus of Figure 4;

30 Figure 6 is a side view from one side of the apparatus of Figure 4;

Figure 7 is a view from above and one side of the apparatus of Figure 1 showing a communications module in place;

Figure 8 is a perspective view from above and one
5 side of a communication module in accordance with an embodiment of the present invention;

Figure 9 is a front view of the apparatus of Figure 1, showing the cover of a meter terminal compartment removed;

10 Figure 10 is a view from the bottom of the apparatus of Figure 9;

Figure 11 is a top view of the apparatus of Figure 1, illustrating the communication compartment;

Figure 12 is a side view from one side of the
15 apparatus of Figure 1, showing the communication module separate from the meter apparatus;

Figure 13 is a perspective view from above and one side of the communication module;

Figure 14 is a perspective view from above and one
20 side of the communication module with a communication module cover removed;

Figure 15 is a front view of the communication module of Figure 13;

Figure 16 is a bottom view of the communication
25 module of Figure 13;

Figure 17 is a top view of the communication module of Figure 13;

Figure 18 is a side view from one side of the communication module of Figure 13;

30 Figure 19 is a functional block diagram showing components of the meter apparatus; and

Figure 20 is a block diagram of a meter apparatus illustrating isolation circuitry between the communications and meter circuitry.

5 Detailed Description of Embodiments

With reference to the Figures, a meter apparatus in accordance with an embodiment of the present invention is illustrated and generally designated by reference
10 numeral 1. The meter apparatus comprises meter circuitry 2 (Figure 19) and a communications apparatus, in this embodiment comprising a communications module 3 containing communications circuitry.

The meter circuitry is arranged to monitor data
15 associated with the mains supply and is arranged to be connected to the mains supply. In this embodiment, high voltage terminals 4 (Figure 9 and Figure 10) are provided for connecting the mains voltage to the meter circuitry.

The meter apparatus is arranged such that the
20 communications apparatus is electrically isolated from the mains supply of electricity to enable access to the communications apparatus without affecting the mains supply to the meter. This has the advantage that the communications circuitry may be changed, upgraded or
25 otherwise dealt with, without it being necessary to power-down the meter and, in this embodiment, without it being necessary that a qualified engineer be required to access the meter to access the communications apparatus. This has the further advantage that, because there is no
30 need to disconnect the power to the meter apparatus, the consumers' loads and electrical devices are unaffected.

Electrical isolation is such that the communications apparatus conforms with the requirements for Safe Extra Low Voltage (SELV).

In more detail, in this example embodiment, the meter apparatus comprises a housing 10 which has a first housing portion 11 which houses the meter circuitry and a second housing portion 12 which mounts the communications apparatus. In this embodiment, the first housing portion 11 is in the form of a first compartment 11 which houses all the meter circuitry. A dividing wall 13 divides the first compartment 11 from the second housing portion 12, in this embodiment being in the form of a communication compartment 12 for receiving a communication module 15 mounting the communications circuitry 3.

The meter circuitry may comprise any meter circuitry which is able to obtain and provide the appropriate data on the mains supply. In this embodiment, the meter circuitry is mounted on a PCB and comprises a power supply 100 (Figure 20), microprocessor for controlling the meter, memory and interface to a display 16. The meter apparatus also comprises a user interface (buttons 17, 18, and an optical port 19). A serial interface 21 is provided for communications between the communications apparatus 3 and the meter circuitry 2. Power is provided to the communications apparatus via a power supply 21. The communications apparatus 3 is isolated from the mains power supply.

A connector 22 is provided for connecting the communications apparatus 3 to the meter circuitry 2. The isolation barrier is provided for both the serial interface 20 and the supplied low voltage power 21. The

connector 22 also provides connection for the low voltage power supply 21 to the communications apparatus 3.

The RS 232 serial communication link 20 between the meter circuitry 2 and the communications apparatus 3
5 utilises a standard ANSI C12.18 protocol. In this embodiment, the communications apparatus 3 acts as the master in this protocol and initiates all communications with the meter circuitry 2. The communications apparatus 3 can read any of the metering data - energy
10 registers, interval data, event logs, etc from the meter circuitry 2, as well as sending commands to perform tasks such as activating relays, setting time, clearing registers etc.

Additional to the serial interface, direct signals
15 from the meter circuitry indicating loss of power or a critical meter event are provided.

The isolated power supply to the communications apparatus 3 is 12 Volts DC, 8W.

Electricity meters, such as the meter of this
20 embodiment, are connected directly to the mains supply (in this embodiment via terminals 4) to enable measurement of voltage and current and the calculation of energy. As a result, there is no isolation between the mains supply and the meter circuitry 2 and the meter is considered to be at
25 mains potential.

In this embodiment, as discussed above, there are two interfaces via the single connector 22, one of the interfaces 101 (Figure 20) providing power to the communications apparatus 3 and the other of the
30 interfaces 102 providing communications between the communications apparatus 3 and the meter circuitry 2.

In this embodiment, the communications signals are provided through opto-isolators 103 provided as the interface to the meter circuitry 2. They provide at least a 4 kV isolation barrier (in Australia this is a requirement for isolation for meter circuitry. The isolation test is 4 kV for a period of 1 minute).

The power is provided to the communications circuitry 3 via a switch mode power supply 100 that has a transformer 104 with two separate windings 105, 106 from which two separate low voltage DC supplies are derived. One 106 supplies the power to run the meter circuitry, and the other 105 is provided to the communications circuitry 3 via the connector 22. As can be seen from Figure 20, the communications apparatus comprises communications data processors 110 arranged to communicate with communications data processors 111 in the meter via the opto-couplers 103. The communications module also incorporates a DC communications power supply 112.

In this embodiment, the communications apparatus 3 comprises a communication module 15 (see Figures 13 to 18). This comprises a communications module housing mounting within it communications circuitry. Referring to Figure 14, the circuitry is mounted on a circuit board 26. The circuitry is not shown here. It will be appreciated that any communications circuitry able to provide required communication functions can be incorporated on the circuit board 26 or otherwise mounted within the communications module housing 25. An advantage of providing the communications apparatus 3 by way of a module 15, is that a module 15 can easily be replaced to change or upgrade the communications functions. A module 15 can also be easily accessed to service or change the communications

circuitry. Different modules having the same type of housing 25 may contain different communications circuitry with different capabilities, so that a particular meter apparatus may be upgraded or have its communications
5 functions varied merely by using a module with the particular capability. A simple upgrade, for example, may be implemented by removing one module 15 and replacing it with another with changed communications functionality. The communications module housing 25 may mount any number
10 of communications devices (e.g. for different communications types).

The communications module 15 includes a mating connector 27 for mating with the connector 22 to the meter circuitry 2 and power supply 21.

15 As discussed, the communications apparatus can include any communications functionality. For example, it may send or receive data and commands to/from anywhere that it is externally connected to via the technology it incorporates. In a typical advanced meter situation this
20 may be include a connection to a central location via a LAN/WAN e.g. RF Mesh, WiMax, and also domestically or within an industrial location via a home area network (e.g. Zigbee™) or other network.

Data may be communicated to a domestic display, for
25 example, such as described in Australian Patent Application No. 2005227360, so that information on electricity consumption can be provided to a user in the home. Data may be communicated with a control location, for example to facilitate remote meter reading. Data may
30 also be communicated from the remote location to control the meter (e.g. to automatically terminate electricity supply). Data may be communicated that is unrelated to

meter operation. For example, it is envisaged that in some embodiments a broadband link for networks such as the Internet to a domestic residence could be implemented via the communications apparatus 3. The communications apparatus 3 in this instance provides an internet gateway. It is envisaged that such a communications apparatus could provide a gateway for any communications to and/or from a dwelling or other establishment associated with the meter apparatus.

10 The communications module compartment 12 is provided in the upper part of the meter apparatus 1 in use. A mounting fixture 30 extends from a back wall 31 of the upper part of the meter apparatus housing 10. The fixture 30 has a hole 32 to receive a screw, bolt or the like for mounting the meter.

15 The communications module compartment 12 includes a back wall 33 and side walls 34 and 35 defining the communications compartment 12 together with the dividing wall 13 dividing the communications compartment 12 from the meter apparatus compartment 11. Locating guides 36, 37 38, 39 are provided in the walls for locating the communications module. The guides provide positive location guidance when connecting and disconnecting the communications module 15, to guide the connectors 22 and 27 together and maintain integrity. Further alignment is provided by a guide collar 70 (Figure 26) positioned about the mating connector 27 on the communications module 15. The collar 70 also provides protection to the mating connector 27 when the communications module 15 is uninstalled. The connector 22 protrudes from the surrounding housing so that it can be directly aligned with the mating connector 27.

A front wall 45 of the communications module compartment 12 is relatively lower than the back wall 33. The communications module housing 25 is designed so that it can be fitted solely within the meters footprint even
5 when other equipment is in close proximity to the meter apparatus 1. Referring to Figure 12, installation of the communications module 25 is via the installation path shown by arrows 46. In operation, the communications module is slid forward and down into the communications
10 compartment 12, being located by the guides. The communications module can be installed without it being necessary to have much or any room above the meter. It can also be removed this way. This ensures that the module can be accessed and changed in any installation,
15 even those with limited space around the meter apparatus.

Aerial connectors 50, 51 are provided for the optional connection of external antenna (up to two) for the communications apparatus 3. Locations 52, 53 are provided to locate the external antenna connectors 50, 51
20 within the communications module compartment 12.

A security cover 60 is provided for the first compartment 11 enabling access to the high voltage terminals 4. The security cover 60 may be provided with a security seal 61 to deter tampering. A separate
25 communications security cover 62 is provided for the communications compartment 12. The communication cover 62 also has a security seal 63 in this embodiment to deter tampering. The cover 62 has a pair of "knock-out" portions 64, 65, which are removable if antennas are
30 required for the communications apparatus 3.

The communications compartment 12, with cover 62, is environmentally sealed to protect against water getting into the compartment.

In the above embodiment, the meter apparatus includes
5 meter circuitry functioning as an electricity meter. In other embodiments, the two compartment approach implemented by this embodiment may be used for different types of meter apparatus. For example, a gas meter or a water meter may comprise a compartment which contains
10 communications apparatus, separate from the water and gas meter, in a similar manner to the electricity meter embodiment described above.

The term "comprising" (and its grammatical variations) as used herein are used in the inclusive sense
15 of "having" or "including" and not in the sense of "consisting only of".

In embodiments of this invention, any meter circuitry may be mounted within the housing 1 for providing any meter function. The invention is not limited to the meter
20 circuitry described above.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the
25 invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A meter apparatus, comprising a housing having first and second housing portions, the first housing portion mounting meter circuitry arranged to be connected to a mains supply of electricity and arranged to monitor data associated with the mains supply, the meter apparatus being connectable to a communications apparatus mounted in the second housing portion and arranged for communicating data with the meter, the communications apparatus being electrically isolated from the mains supply of electricity to enable access to the communications apparatus without affecting the mains supply to the meter, wherein the first and second housing portions comprise first and second access means respectively, such that access can be had to the second housing portion, to access the communications apparatus via the second access means, without requiring access to the first housing portion.

2. A meter apparatus in accordance with Claim 1, wherein the communications apparatus is mounted by a communications module comprising a communications module housing mounting communications circuitry, and wherein the second housing portion comprises a communications compartment which is arranged to receive the communications module housing, the communications compartment comprising physical guides for positively locating the communications module housing within the compartment.

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3. A meter apparatus in accordance with Claim 2, wherein the communications module housing is arranged to fit

entirely within the footprint of the meter housing,
whereby it may be accessed even where there is limited
mounting space for the meter apparatus.

5 4. A communications apparatus arranged for connection to
the meter apparatus of any one of Claims 1 to 3, and
comprising a communications module housing mounting
communications circuitry, and being arranged to be
connected to the meter apparatus in a manner such that it
10 is electrically isolated from the mains supply of
electricity to enable access to the communications
apparatus without affecting the mains supply to the meter.

5. A meter system, comprising a meter apparatus in
15 accordance with any one of claims 1 to 3 and a
communications apparatus in accordance with claim 4.

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