Meter Interface

The present invention relates to interfaces for meters such as water, heat or electricity meters but particularly gas meters.

As well as measuring a quantity of a commodity supplied to a user, meters are increasingly used in a number of different applications, for example to provide a more convenient meter reading display remote from the meter or as a prepayment meter arranged to accept money, tokens or 'smart cards' in order to dispense a commodity.

To perform each of these applications a different type of meter is required. Alternatively a reading may be taken from a meter which may be arranged to provide an electrical or optical output signifying the quantity of a commodity dispensed and this reading used by a suitable module attached to the meter to perform a desired application.

However, such meters are only able to support a single application at a time which is inconvenient if more than one application is desired or expensive if more than one meter is installed. Furthermore it is often burdensome to add a module to an inconveniently positioned meter.

According to a first aspect of the present invention there is provided an interface for providing a meter reading to a

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plurality of remote units each arranged to perform a different function;

the interface comprising means to receive a first signal from a meter corresponding to a quantity of a commodity measured by the meter;

radio transmission means and

means arranged to control the radio transmission means to transmit a second signal derived from the first signal using radio waves to at least one of a plurality of remote units, each remote unit being arranged to perform a different function.

This interface allows different metering services to be added to a basic meter in a modular manner. RF technology enables different add-ons to be conveniently situated remote from the meter and to utilise the meter wherever it is installed. As the market need for different services emerge, the existing meter with the interface of the present invention will be able to accommodate them. This invention provides a robust method of future proofing the evolution of metering services in the competitive world of gas supply by enabling further remote units to be added without the need to make any adjustments to the interface thus supporting the wide range of new metering services that will become part of the competitive market place of energy supply. This invention aims to meet the technical requirements to facilitate the introduction of these services and allows competitive products to be matched to an open access system. The interface allows the meter owner to focus on the issues of the

meter installation, while giving a standard mechanism for providing access to any meter services provider.

The radio transmission control means may be able to arrange transmission to the plurality of remote units simultaneously. Such an interface is able to support more than one application at a time significantly increasing its usefulness. Alternatively or additionally a plurality of interfaces may be arranged to transmit simultaneously to a single remote unit.

Radio communication is particularly advantageous because any number of remote units can receive signals from a single transmitting means without the need for any adjustment as further remote units are added. Furthermore the provision of such transmitting means permits the provision of remote units some distance from the meter unit for greater convenience without the need for unsightly and untidy connecting wires between the meter unit and remote units. The interface may be incorporated within a meter. The meter may be a fluid meter such as a gas meter. The meter or interface may be arranged to control a means for cutting off the supply of the commodity. If the meter is a flow meter the cut-off means may be a shut-off valve to prevent the flow of fluid through the meter. The interface may include means to receive a signal from a remote unit to cause the cut-off means to close.

Such a meter or interface incorporating a shut-off valve is particularly useful when the remote unit is a gas detector or a

prepayment unit. When the remote unit is a gas detector it may be positioned in a room supplied with gas from the meter and can be used to send a signal to the meter or interface to shut off the gas supply via the valve when gas is detected. When the remote unit is a prepayment unit it can be positioned at a convenient position remote from the valve for a user to insert payment and can be used to send a signal to close the valve when credit has expired and more money/tokens/smart card credits need to be supplied.

Examples of remote units according to further aspects of the present invention to be used in conjunction with the interface of the first aspect of the present invention include:

Prepayment interface for coins, tokens, smartcards etc;

Home automation interface providing communication with consumer energy management products;

Multi-tariff meter to provide meter data to allow manipulation based on date/time and tariffs obtained from the supplier;

Customer display relaying the meter index to a more convenient location in the consumer's premises;

Automatic meter reading using an interface to any suitable media option such as telephone, radio, power line etc.

Off-site meter reading eg using a hand held computer to read meter index and diagnostic data from a more convenient remote location such as a consumer's doorstep.

Each of the remote units may have a receiver which is preferably an aerial which may be enclosed within the reception unit housing to receive transmissions from the interface. The remote units may alternatively or additionally have a transmitter to transmit a signal to the interface such as indicating that gas is detected or credit has expired. The same aerial may act as the receiver and transmitter. The remote unit may initiate communication with an interface by transmitting a signal to the interface and then waiting to receive a reply.

The invention is described further by way of example with reference to the accompanying drawings in which:

Figure 1 diagrammatically shows an interface connected to a meter, the interface being arranged to communicate with a number of remote units;

Figures 2a and 2b show an interface applied to a conventional fluid meter to enable it to communicate with remote units;

Figure 3 shows a system for controlling the interface shown in Figures 2a and 2b and

Figure 4 is a flow diagram showing the operation of an interface upon receipt of an incoming signal from a remote unit.

As shown in Figure 1, an interface 1 is arranged to receive a signal from a meter 2 indicative of a quantity of a commodity read by the meter 2 via communication link 3. The interface 1 is arranged to send a signal indicative of a reading from the

meter 2 via radio transmissions 4 to a plurality of remote units 5-10 each having different functions. Some of the remote units such as remote unit 5 which may be a gas detector for example may be able to send a signal to the interface 1 for it to perform a particular function such as in this case to close a valve preventing the flow of gas through the meter.

Examples of other remote units 6 - 10 may be as follows:

6 - Prepayment interface/card reader
7 - Home automation interface
8 - Hand held doorstep reading and billing unit
9 - Multi-tariff (off-peak) meter
10 - One or more other remote systems such as a customer display at some convenient position remote from the meter itself or an automatic meter reader.

The present invention also enables access to the meter for any future metering service developments as the market for innovative products in this area evolves.

The remote units 5 - 10 may have a receiver for the reception of transmissions from the interface 1 and/or a transmitter for sending transmissions to the interface 1. An aerial may be used as the receiver and/or transmitter.

Figure 2a shows an interface 1 which can be applied to a conventional fluid meter, in this case a gas meter 21 to enable

it to operate in accordance with the present invention. The interface 1 is physically supported in this example by an inlet pipe 22 which is arranged to deliver fluid, in this case fuel gas, to an inlet port 23 and by an outlet pipe 24 through which gas passes from an outlet port 25 of the gas meter 21.

The interface 1 could be temporarily supported by inlet pipe 22 and/or outlet pipe 24 and/or the existing meter 21 using resilient clips or brackets with bolts for example. Alternatively or additionally the interface 1 could have holes through its outer casing for the inlet 22 and outlet 24 pipes to pass through to support the interface 1 which may also rest on top of the gas meter 21. Alternatively the interface 1 could be supported on only one pipe, such as the outlet pipe 24 shown in Figure 2b. The example shown has also a standard meter bracket 38 and a standard pressure regulator 39. Alternatively or additionally the interface 1 could be provided with one or two gas pipes mounted to the interface 1 to be installed in addition to or as a replacement for existing meter inlet 22 and outlet 24 pipes. The provision of at least one of the inlet and outlet pipes with the interface 1 is particularly useful if the interface has a cut-off means in this example in the form of a valve to stop the flow of gas since the cut-off means can be provided in the inlet or outlet pipes provided with the interface 1.

The interface 1 has a connector 26 which may be connected to the gas meter 21 and which can supply the volume reading from the gas

meter 21 to a control means 27 which may comprise a microprocessor and/or electronics mounted in a housing inside the interface. Some gas meters are able to supply an electrical or optical signal indicative of the volume of gas it has measured in which case the connector 26 has a suitable male or female plug or socket to connect to the corresponding male or female plug or socket on the meter 21. Some meters 21 have dials or decimal digit wheels in which case a suitable optical detector as is well known in the art is employed to convert these readings into a suitable electrical signal to be received by the control means 27 of the interface 1.

The control means housing also supports a battery 28 which as well as supplying electrical power to the control means 27 also supplies electrical power for other systems such as an aerial 29 and valve 30 to be described later.

The control means 27 modulates the signal representing the meter reading read from the meter 21 via connector 26 and sends the modulated signal to aerial 29 from which it is transmitted to be received by the remote unit that requested the meter reading or possibly simultaneously to all remote units 5-10.

The control means 27 is also able to demodulate signals received from remote units 5-10 via the aerial 29. These signals may instruct the interface or meter to perform any appropriate function but in the present example are used to request the transmission of a meter reading to a remote unit or instruct the

closure of valve 30 to prevent the further flow of gas through the meter 21. The valve 30 need not necessarily be provided internally within the interface 1 but could be provided externally and at the inlet or outlet connection to the meter. All four variants offer advantages:

1. External Inlet: allows for a combined regulator and shut-off valve.
2. External Outlet: allows costs to be apportioned to gas supplier directly.
3. Internal Inlet: allows for a combined fire safety and shut-off valve.
4. Internal Outlet: conventional prepayment valve position.

To comply with current safety requirements the interface 1 is provided with a manual valve reset 31 for opening the valve after it has been closed. However, the valve 30 could just as easily be arranged to open under instruction from a remote unit via the radio link.

Radio frequency (RF) communication eliminates the need for any electrical wiring between the remote units and the gas meter. The illustrated example uses a low power short range radio link to provide communication between the interface 1 and remote units 5-10 reducing the risk of the remote units picking up communications from meters in other premises and giving erroneous readings. For use in the UK the aerial 29 preferably transmits and receives signals at 184 MHz. All remote units 5-10 are tuned

to receive and if necessary send signals at the same frequency. If other countries require transmission at other frequencies this can easily be achieved by replacement of a frequency modulating unit within the control means 27. Signals will have a standard protocol enabling remote units from any manufacturer to work with any interface.

Figure 3 diagrammatically shows the structure of the control means 27.

Meter 2 is connected to microcontroller 40 via a suitable connector 26 selected dependent upon the type of meter used as described earlier. The microcontroller 40 is arranged to take a volume measurement from the meter 2 via connector 26 whenever required. Microcontroller 40 is also connected to an RF module 41 via connector 42 to modulate a signal to be sent to any remote units from the interface 1 and to demodulate any signals received form the remote units. The RF module 41 is connected to an aerial 43 via connection 44. The aerial transmits to and receives signals from the remote units 5 - 10.

The micro-controller 40 controls a valve drive circuit 45 via connection 46. The valve drive circuit 45 can be activated to close valve 30 by applying an appropriate signal on line 47 when desired, for example when a remote unit gas detector detects a gas leak or when a prepayment meter runs out of credit. The microcontroller 40 can also open the valve 30 if desired, for example when a prepayment meter indicates to the interface that

sufficient credit is now available. Alternatively the valve 30 could be opened only using manual valve reset 31 to ensure that no gas releases occur upon restarting the gas supply.

To prevent tampering of the meter unit to prevent theft of gas and reduce the risk of leakage, a tamper unit 48 may be provided to send an appropriate signal to the microcontroller 40 on line 49 if for example the connection 26 to the meter 2 is broken or radio communication is blocked. Upon receipt of a tamper signal the microcontroller 40 closes valve 30 to prevent the further flow of gas.

The control means 27 is powered by a battery 50, preferably a 3.7 V lithium battery. When the battery power is nearly exhausted the microcontroller 40 preferably closes the valve 30 to prevent the further flow of gas which may not be charged for. To save battery power the interface 1 is only powered at regular intervals, for example every two seconds, and remains active for a fraction of this time unless it is addressed by a remote unit.

The interface 1 could transmit the meter reading to each of the remote units at regular intervals, eg every two seconds which would be received by each remote unit and acted on accordingly.

Alternatively or additionally a remote unit could initiate radio contact with the interface. For example a remote customer meter reading display or multi-tariff meter could request the current meter reading at regular intervals such as every few seconds or

minutes or an off site meter reader eg a hand held computer could request the meter reading to be used for billing purposes. An off-site meter reader could request the meter reading from a plurality of interfaces simultaneously. A remote unit could also send instructions to the interface 1 such as a gas detector or prepayment meter instructing the closure of the valve 30.

Figure 4 is a flow diagram showing the sequence of operations performed by the microcontroller upon receipt of an incoming signal from a remote unit.

Step 100 the microcontroller is asleep;

Step 101 the microcontroller detects an incoming signal;

Step 102 the microcontroller wakes up and waits for data;

Step 103 the microcontroller decodes any required addressing data and decides whether it is addressed;

Step 104 if it is not addressed it goes to step 100
if it is addressed it goes to step 105;

Step 105 the microcontroller decodes the rest of the message and interprets it;

Step 106 if the message is instructing the microcontroller to perform an action, eg close valve 30, the microcontroller performs this action;

Step 107 the microcontroller switches to transmit;

Step 108 the microcontroller takes or retrieves any required measurement;

Step 109 the microcontroller codes a response message such as providing the current meter reading or acknowledging that an instructed action has been performed;

Step 110 the microcontroller sends the response message and goes to step 100.

Of course some steps may be omitted if unnecessary in the circumstances. For example a remote unit that does not require use of the shut-off valve may not use step 106 or a remote unit that does not require a meter reading such as the gas detector may omit step 108 or steps 107 to 109.

Some remote units that may be used in conjunction with the interface will now be described.

A gas detecting means as is well known in the art is provided with an RF transmitting means arranged to send a signal to the interface indicating when the gas detecting means detects gas. The signal may be addressed to the particular interface connected to the meter supplying gas to the area in which the gas detector operates. A valve must be associated with the interface to be closed when the interface receives an appropriate signal from the gas detector.

A prepayment meter comprises means to receive payment such as a coin meter or a card reader to accept credit from a so-called 'smartcard', means to monitor the amount of gas consumed by communicating with the interface via an RF receiving means, control means to determine when credit has expired and RF

transmitting means to instruct the interface accordingly. When used with a prepayment meter the interface is associated with a valve to be closed when the prepayment meter advises that credit has expired.

A home automation system requires means to receive a meter reading from the interface and control means to operate various home systems in response to the meter reading to manage the temperature of the home whilst reducing gas consumption.

A multi-tariff remote unit comprises a time and/or date supplying means, means to receive meter readings from the interface including RF receiving means and control means to correlate the volume of gas consumed at different times and/or dates which have different charging rates. A multi-tariff remote unit can thus be applied to an existing gas meter fitted with a suitable interface without having to supply a number of different gas meters to operate during different parts of the day or different dates according to the charging rate in force at that time or date.

A customer display comprises a display means such as an LCD which can be positioned at any convenient location remote from the meter and RF receiving means to receive meter readings from the interface to be displayed on the display means. The customer display could also include an RF transmitting means to request the current meter reading from the interface, as could any of the remote units.

An automatic meter reader has means to interact with a suitable media access device such as a telephone and means to receive meter readings from the interface. The means to interact with a telephone for example is arranged to initiate contact with a central meter reading receiver such as the billing department of a gas supplier via the telephone and supply the meter reading.

An off-site meter reader has a receiving means to receive a meter reading from one or more interfaces as shown in Figure 4 for example. An off-site meter reader is particularly useful as the person having to collect meter readings for a particular area such as a street of houses does not have to gain access to each residence or meter installation, significantly reducing time and costs.

Whilst the invention has been described above in relation to a particular example, it is to be noted that the invention should not be restricted to the details described above. For example the interface 1 could be incorporated within and form a part of a meter. If desired, two or more remote units could be provided together in an integral unit.

CLAIMS

1. An interface for providing a meter reading to a plurality of remote units each arranged to perform a different function;

the interface comprising means to read a value from a meter corresponding to a quantity of a commodity measured by the meter;

radio transmission means and

means arranged to control the radio transmission means to transmit a signal corresponding to the value read by the reading means to at least one of a plurality of remote units, each remote unit being arranged to perform a different function.

2. An interface according to claim 1, wherein the transmitting means is arranged to transmit to a plurality of remote units simultaneously.

3. An interface according to claim 1 or claim 2, including means to receive a signal from a remote unit.

4. An interface according to any preceding claim, including means to control a cut-off means to permit or prevent the flow of a commodity measured by a meter.

5 An interface according to claim 3 and claim 4, wherein the means to receive a signal from a remote unit is arranged to

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instruct the cut-off means controlling means to open or close a cut-off means to permit or prevent the passage of a commodity upon receipt of an appropriate signal.

6. An interface according to claim 3, wherein the means to receive a signal from a remote unit is arranged to instruct the reading means to read a value from a meter and the control means to transmit a signal corresponding to the value read by the reading means to at least one of a plurality of the remote units upon receipt of an appropriate signal.

7. An interface according to any of the preceding claims, wherein the control means is arranged to transmit a signal at regular intervals.

8. An interface for providing a meter reading to a plurality of remote units each arranged to perform a different function;

the interface comprising means to read a value form a meter corresponding to a quantity of a commodity measured by the meter;

radio transmission means;

means arranged to control the radio transmission means to transmit a signal corresponding to the value read by the reading means to at least one of a plurality of remote units, each remote unit being arranged to perform a different function;

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means to receive a signal from a remote unit;

means to control a cut-off means to permit or prevent the passage of a commodity wherein the means to receive a signal from a remote unit is arranged to instruct the cut-off means controlling means to open or close a cut-off means to permit or prevent the passage of a commodity upon receipt of an appropriate signal.

9. A gas meter including an interface according to any of the preceding claims and wherein the cut-off means is a shut-off valve.

10. A detecting device for use with an interface according to claim 8 or a meter according to claim 9 when dependent upon claim 8, the device having means to detect gas and radio transmitting means to send a gas detected signal to an interface according to claim 8 or a meter according to claim 9 when dependent upon claim 8 when the detecting means detects gas, the interface receiving means being arranged to instruct the cut-off means controlling means to close a cut-off means when a gas detected signal is received.

11. A prepayment device for use with the interface of claim 8 or the meter of claim 9 when dependent upon claim 8, the device having means to receive payment, receiving means to receive a signal corresponding to the value read by the reading means from the radio transmission means of the

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interface according to claim 8 or a fluid meter according to claim 9 when dependent upon claims 8, control means to determine when credit has expired by comparing an output from the payment receiving means with the output from the receiving means and transmitting means to transmit a signal to instruct the cut-off means control means to shut-off a cut-off means when credit has expired.

12. A home automaton device for use with the interface of any of claims 1 to 8 or the meter of claim 9, the device comprising receiving means to receive signals corresponding to the value read by the reading means of the interface according to any of claims 1 to 8 or the meter according to claim 9 and control means to operate one or more home systems dependent upon the signals received by the receiving means.

13. A multi-tariff device for use with the interface of any of claims 1 to 8 or the meter of claim 9, the device comprising a time and/or date supplying means, receiving means to receive signals corresponding to the value read by the reading means of the interface of any of claims 1 to 8 or the meter according to claim 9 and control means to correlate meter readings with the times and/or dates of the readings supplied by the time and/or date supplying means.

14. A display device for use with the interface according to any of claims 1 to 8 or the meter according to claim 9, the

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device comprising a receiving means to receive a signal corresponding to the value read by the reading means of the interface according to any of claims 1 or 8 or the meter according to claim 9 and display means to display the meter reading received by the receiving means.

15. An automatic meter reading device to send meter readings over a suitable medium, the device being for use with the interface according to any of claims 1 to 8 or the meter according to claim 9, the device having a receiving means to receive a signal corresponding to the value read by the reading means of the interface according to any of claims 1 to 8 or the meter according to claim 9 and means to access a desired medium to send signals corresponding to the received meter reading over the medium.

16. An off-site meter reading device for use with the interface according to any of claims 1 to 8 or the meter of claim 9, the meter reading device having receiving means to receive a signal corresponding to the value read by the reading means of the interface according to any of claims 1 to 8 or the meter according to claim 9.

17. A device according to any of claims 12 to 16 including transmitting means to transmit a signal to the interface of any of claims 1 to 8 or the meter of claim 9 to prompt the interface control means to transmit a signal corresponding to the value read by the reading means.

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18. An interface substantially as hereinbefore described with reference to the accompanying drawings.

19. A gas meter substantially as hereinbefore described with reference to the accompanying drawings.

20. A detecting device substantially as hereinbefore described with reference to the accompanying drawings.

21. A prepayment device substantially as hereinbefore described with reference to the accompanying drawings.

22. A home automation device substantially as hereinbefore described with reference to the accompanying drawings.

23. A multi-tariff device substantially as hereinbefore described with reference to the accompanying drawings.

24. A display device substantially as hereinbefore described with reference to the accompanying drawings.

25. An automatic meter reading device substantially as hereinbefore described with reference to the accompanying drawings.

26. An off-site meter reading device substantially as hereinbefore described with reference to the accompanying drawings.

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