WATER METERS
with smart card, PLC, or phone modem

A SMART WAY TO COLLECT PAYMENTS

Class B Residential Type Pre-Paid Water Meter G 3/4"
Total Built-In Length= 155mm    Width =136mm    Height= 142mm
SMART

ADVANTAGES FOR UTILITIES:

It frees utilities from:
- reading meters,
- distributing bills,
- checking and processing unpaid bills,
- fining consumers for unpaid bills,
- disconnecting and reconnecting meters,
- problems with consumers.

It provides for utilities:
- savings of personnel expenses,
- savings of stationery expenses,
- savings of time,
- 2-3 months advance revenue,
- reimbursement in short time,
- good relations with consumers,
- a modern, reliable, flexible and economical way to collect bills.

Options:
- usage data is uploaded from meter to smart card and, during recharge, from card to payment terminal and central computer,
- "friendly leakage": upon expiration of credit, don’t fully disconnect the consumer but allow him a very small consumption,
- credit operation: customers don’t have to prepay but are assigned one-month credit. At the end of each month, they should recharge the cards to pay for the previous month consumption,
- bank-grade security of smart card transactions.
ADVANTAGES FOR CONSUMERS:

- Wasting time for paying bills
- Variable prices
- Correctly measured consumption billing,
- Problems between house owners and tenants.

PRE-PAYMENT METERING SYSTEM
WITH SMART CARD

OPERATION PRINCIPLES

The main units of the pre-payment metering system are:

1. Electronic (Pre-Payment) Meter
2. Smart Card
3. Utility Center

A smart card is issued specific to each electronic meter at the utility center. Subscriber's individual smart card is credited at the utility sales points. Validity of the card is verified and receipt given to the customer.

When smart card is inserted in the meter, credit is transferred to the meter while data from the meter is uploaded for transfer to the Utility Center. Smart card is not kept in the slot during consumption.

As long as there is credit, consumption is enabled and when credit is below a certain limit, called critical credit, the consumer is warned on LCD to buy energy.

Smart card balance is charged according to real-time consumption. If new credit is not loaded, relay is automatically closed at the expiration of credit.

Emergency credit is also available. This credit can be loaded when the relay is closed and there is no remaining credit at the electronic meter.
The relay is closed and all the consumer's data is stored at the end of emergency credit except during night time and holidays. In this case, the subscriber is allowed to continue consumption till daytime of the next working day.

Whenever electronic meter detects attempts of fraud or misuse, relay is closed and all the data is stored. Afterwards, relay cannot be opened by the consumer card but only by inspector’s card.

**ELECTRONIC WATER METER**

Electronic (pre-payment) water meter consists of electronic and mechanical modules.

**Electronic Module:**
- Electronic Control Unit (ECU)
- Smart Card Reader/Writer
- Display (mechanical or LCD)
- LED low credit indicator
- Display-On button

**Mechanical Module**
- Mechanical Water Meter
- Latching Solenoid Valve

A lithium battery with minimum 16 years lifetime supplies the energy for ECU and valve operations. Since electronic meter has real time clock running inside, time based operations are easily performed.

**Electronic Control Unit (ECU)**
This unit controls the operations performed by the pre-payment meter. These operations are; metering the water consumed by counting electronic pulses, detecting fraud, controlling the automatic valve, communicating with the smart card, storing the data, performing time based functions, displaying the messages and checking the meter status continuously.

**Credit operation**
Usually meters are used in credit mode. Customer is assigned one-month credit. Until 20\textsuperscript{th} of the next month, he needs to recharge his card and pay the previous month usage.

For example, the meter is installed on January 1. Customer doesn’t have to pre-pay. On January 31, the balance is, say, $45. Customer has to recharge his card for $45 and insert it back in the meter before February 20. If not paid until February 21, he’s disconnected or only the minimum usage is allowed, say, 200W.
Prepaid operation
As long as there is credit, consumption is enabled and when credit is below a certain limit, called critical credit, ECU warns the subscriber about insufficient credit; relay would be closed at expiration of this credit.

The amount of critical credit is adjusted by the utility, so that different critical credit values can be used depending on the type of application and rate of consumption. If new credit is not loaded, ECU closes the automatic relay at the end of credit and disables consumption until new credit is loaded. Another type of credit, called emergency credit is also available. This credit can be loaded when the relay is closed and credit inside the meter is zero. The amount of emergency credit is adjusted at the utility sales point and as it is loaded to the meter, ECU opens the automatic relay.

The battery is regularly measured by the microprocessor and when it is below a critical level the subscriber is informed by the message. This information is transferred to smart card when it’s inserted in the meter. When customer recharges his card, the utility is informed to replace battery.

ECU has a real time clock. It provides tariff applications, storing the critical data along with the related time information, opening or closing the relay at specific time, time stamping of events in data log, such as fraud attempt, credit, etc.

Liquid Crystal Display (LCD)
ECU displays all messages on an eight digit alphanumeric LCD. Messages are easy to understand, they tell subscriber and service personnel about card operations and meter status. If desired, messages can be displayed in different languages or modified.

SMART CARD

Smart cards used in this system provide bi-directional data transfer between the utility center and electronic meter. Whenever the subscriber buys credit at the utility sales point, not only new credit is loaded in the card, but also tariff updates, new emergency credit limits, etc.

When card is inserted in the meter to update credit balance, consumption data is uploaded from the meter to the card. This data is transferred to utility computer during the card’ recharge at sales point. A customer may be requested to insert card in the meter just before going to recharge it, so that the utility may receive current information. It is possible to prevent card recharge if the card does not contain current consumption data (i.e., not more than 5-day old).

Security of the card transactions is assured by using highly reliable DES protocol, the same one as used for electronic commerce. Utility personnel, interested in obtaining more details, should contact technical support.
Customer card is used for recharge and data transfer. Meter will only accept its own card, not any other card. The card should be inserted in chip-down-left position. For lost or damaged card, a replacement can be issued by the utility. Last consumption data is still stored in the meter (until card is inserted after recharge) and no data loss occurs if a card is lost.

Inspector card can be used for data transfer and relay control purposes. It can also access technical data, such as ID block and constant.

**UTILITY CENTER**

The configuration of the operating system at the utility center depends on the application type for municipalities. The basic configuration consists of a PC, a smart card reader/writer installed on PC and operation software. The software running on this PC controls all the system. It stores the information about the subscribers, and system settings. A smart card reader/writer installed to the PC makes it possible to read/write subscribers' cards and prepare authority cards through the software. Also, the access rights of the utility person are set by this software. As a result, only authorized personnel could perform some critical operations and access databases. The software also has the capacity to prepare reports for statistical or financial purposes and print out these reports.

As the smart cards provide bi-directional data transfer between the utility center and the electronic meter, utility has chance to control the meters regularly without any personnel.

A more complex configuration consists of server and remote terminals. Server stores all the data of the system and remote terminals function as point of sale terminals. These terminals can be installed in different points of the city and the subscriber can buy credit at these points. An on line or off line communication is established between these remote terminals and the server depending on the type of application. Moreover, Internet or Intranet can also be used for this communication.

**HAND HELD TERMINAL**

When small amount of subscribers are considered a hand held (POS) terminal designed to sell credits and to read/write smart cards. It can be also used for test and service purposes to perform all the necessary functions. These hand held terminals include a LCD, keypad, smart card reader/writer, and microprocessor circuitry inside. At the test stage, service personnel could use this hand terminal to test all the functions of the meter. Also, the utility can use these hand terminals to prepare authority cards.
SYSTEM CONFIGURATIONS

The minimum configuration of pre-payment system includes:

1) pre-paid meter and a smart card for each consumer,
2) hand held (POS) terminal to sell credits and to read/write smart cards.

This application is very common when small amounts of consumers are considered and statistical/financial reports are not needed such as for landlords of hired apartments, managers of camping grounds, harbors and irrigation sites.

For municipalities and when large number of subscribers the considered configuration consists of:

1) pre-paid meter and a smart card for each consumer,
2) the software and a smart card reader/writer installed to PC for utility center/point of sale.

Optional is full-scale installation with meter management and reading software, remote offices and POS’s, smart card initialization center, customer service and fraud control.

Other devices available:
One- or two-way PLC modules for data collection and/ or remote disconnection
Phone modems
Concentrators for connection of several water meters to one PLC unit or modem
Electric power meters with inputs for reading water and gas meters

Technical specification:

- Nominal diameter: DN mm 20
- Overload flow-rate: Qs m3/h 3
- Nominal flow-rate: Qp m3/h 1.5
- Transitional flow-rate: Qt m3/h 0.15
- Minimum flow-rate: Qmin m3/h 0.06
- Maximum pressure loss: MPa < 0.1
- Minimum reading: m3 0.0001
- Working Voltage: V DC 3.6
- Static electric current: uA < 10
- Working current: mA < 200
- Normal cell life-span: year > 6

Working Condition:
- Max. admissible working pressure: MPa < 1
- Max. admissible temperature: °C <= 40
- Accuracy between Qs and Qt : +/- 2%
- Accuracy between Qt and Qmin : +/- 5%.
**SMART**

**Dimension:**
- length: mm 165
- width: mm 88
- high: mm 105
- weight: kg 1.8
- connecting screw: inch G1

Model: Z-8 Z-15E Z-20E
nominal size: 8mm 15mm 20mm
class A A
Max.overflow(Qs) 0.6 m3/h 0.3 m3/h 0.5 m3/h
norminal flow(Qp) 0.3 m3/h 1.5 m3/h 2.5 m3/h
transitional
flow (Qp) 22.5 m3/h 150 m3/h 250 m3/h
Min.flow (Qmin) 12.5 L/h 60 L/h 100 L/h.
start-flow rate: <2
working current: <10 mA < 10 mA < 10 mA
static current: <10 mA < 10 mA < 10 mA
Power Voltage: 3.6v 3.6v 3.6v
power protection: 3v 3v 3v
norminal pressure: 1MPa 1MPa 1MPa
using life-span: >8years >8years >8years.
TM card: >100000times >100000times >100000times.
data protection: >10years >10years >10years.

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**Industrial Type Pre-Paid Water Meter**

G 2", 3", 4", 6"

Length= 210mm  Width =210mm  Height= 310mm