



ELEKTROMED

EXCELLENCE IN METERING

PREPAID METERING
SYSTEM

EXCELLENCE IN METERING))



INTRODUCTION

Meter is defined as a kind of equipment which would measure the amount of water ,gas and electricity consumed in houses, workplaces, offices and social institutions in correct and reliable way. As it is understood from its definition above they were measuring only the amount of water , gas and electricity which is consumed and they had no other function.

There are continuous research and development studies about technological improvements, in order to make life much easier for human being.

Even though traditional meters have considerably long history, it is obvious that they could not resist any more against recent technological innovations.

As a result, classical mechanical meters are getting outdated and is being replaced by modern new electronic meters operated by pre-paid smart electronic credit card. By this new system, both the Distribution Authority and subscriber saves not only their time, but also their money.

Meter system that is operated by pre-paid smart chip card has been in use around in many countries for years and become a reality in the world. It replaces the old mechanical meter so fast within a plan.

Digital Meter Operated by (Pre-Paid) Smart chip card is manufactured specifically for the needs of the consumers within internationally norms. High quality materials are used in its production and it is programmed to serve up to 100 Million subscribers.

MAIN FUNCTIONS OF ELEKTROMED SMART METERING SYSTEM

1. The system works as "pre-paid credit system". So, it allows to subscribers to use only the quantity of the consumption which is equal to the credits that is bought.
2. It is 100 % reliable and sensitive.
3. It gives the user instruction on LCD display monitor; that is why it is so easy to use. (user friendly)
4. It does not let any malfunction, since it controls itself.
5. Each smart meter has its own special credit card (smart card)
6. Smart meter, identifies any illegal consumption by recording them into its memory. Then automatically locks its valve, cuts off flow and protects itself.
7. Smart meter warns the user before its credit finishes.
8. If the user does not purchase new credit, it allows the user to use an extra credit which exists in its reserve of the smart card or can be given extra reserve from the meter as utility demands.
9. If the user does not purchase new credit even after the reserve credit in its memory finished; it automatically locks its valve while giving the user "BUY CREDIT" message.
10. Smart meter warns the user before its batteries nearly out of charge.If the user does not consider the warnings, meter records its informations into its memory and protect itself.

11. Electronic credit card controls the meter with a special programme in its micro-chip.
12. Electronic credit card automatically cancels itself when it is put into another meter in fourth attempt.
13. When the user loses his credit card, a new card is issued and the old one is cancelled immediately.
14. If anyone finds the lost card, it will have no value since it is cancelled already.
15. The meter can provide information such as:
 How much consumption is done?
 How many credits left? Total consumption amount until current date
 Last valve failure date of the meter
 Last penalty date which is caused because of unauthorised access to the meter
 Last credit loading date
 Real hour and date etc
 Meter type and number
 Condition of the battery
 Type of the tariff which is currently on whenever requested. The Distribution Authority also might reach all statistical data when it is needed.
16. The Distribution Authority might apply separate tariffs to different locations as it decides. When it is decided by Distribution Authority, the new tariff reaches all credit sale units at the same time.
17. The users might buy as much credit as they request with fixed price guarantee. In other words, they may invest their money in their consumption goods.
18. Meter gives its messages on LCD display monitor in English: "buy credit, low credit, control, service, penalty, battery low, battery empty, penalty, cancelled, cancel, A. Shut, invalid, error"
19. Digital meter allows the Distribution Authority to save its expenditures by:
- Cancelling first and last reading,
 - Cancelling pull-up / re-install and locking/unlocking procedures of the meter,
 - Transferring the values that is counted to the computer. Thus, cancels the procedures in preparing and distributing bills.
 - Identifying paid and unpaid bills from the banks and charging interest to unpaid bills.
 - No more objections to the bills and payments,
 - In addition to the above, its main difference from similar meters around the world is its advanced system of security.

When the new credit is loaded, if there may occur any leakage in pipes or if any leakage has occurred, no matter how small this leakage is, ELEKTROMED smart meter locks the main valve and warns the user about the situation.

General Benefits:

- 1-It saves 85% of personnel and their expenses.
- 2-It saves 50 % of stationery.
- 3-It saves 90 % of transportation costs.
- 4-It saves 25 % as financial revenue from pre-payment.
- 5-It saves 100% of non collectable credits.

Adding up all these benefits,clearly, the system will amortize itself within a short period of time and it will be seen that, having a modern, economic and healthy solution won't be difficult.

UNITS OF DIGITAL METER OPERATED BY SMART CHIP CARD

- A - Digital Meter
- B - Smart Card
- C - Sales unit of credit and computer system

A- DIGITAL METER

Digital meter is defined as an equipment which measures the amount of consumption of water , gas and electricity in houses, offices and industry. In this system, users pay before they consume. Credits are recorded into smart cards and loaded to meters through these cards. When the loaded credit finishes, the smart electro-valve/relay in the meter cuts off the flow.

ELECTRONIC CONTROL UNIT

It evaluates the information which comes from other units, and controls the LCD DISPLAY, the smart electro-mechanic valve/relay and the card reader units.

LCD DISPLAY UNIT

Monitor is an LCD(Liquid Crystal Display) - Its messages, such consist of 8 digits, user friendly in functions such as learning remaining credit etc.

CARD READER

It provides the loading of user credit to the meter through the smart cards. When the card is inserted to the reader, transferring the credit is easily completed and the card is not needed to be left in meter

SMART VALVE/RELAY UNIT

-Smart valve/relay unit controls the flow by its microswitch. Electronic control unit may lock and unlock the valve/relay immediately according to the amount of credit left.

-The contactor provides the function to connect and disconnect the load. The contactor will be triggered on these conditions; zero credit reached, with the exception of friendly credit, tamper condition to be monitored when no power connected to meter.

BATTERY

-Energy for electronic control module and surrounding units are provided by battery unit placed into the meter. Batteries can be changed easily by opening battery nest cover.

-While the meter is in active operation, electronic control unit controls the battery and warns the user when its performance decreased.

-In case of batteries are empty, electronic control unit locks the valve/relay and prevents the consumption.

-Conditions of battery and meter covers are also controlled. Any intervention in bad intention is noticed by electronic control unit, then it is recorded into its memory and the flow is prevented.

SPECIFICATIONS OF DIGITAL METER

-When the user of digital meter inserts and withdraws the loaded smart card, it unlocks the smart valve/relay and water flow starts. The amount of consumption is compared by the loaded credit and it starts reducing the remaining credit.

-There is no need to keep the electronic smart card inside the card reader of the electronic meter. The user withdraws the card after remaining credit is recorded.

-When the amount of the credit decreases below the certain level of credit, a message "LOW CREDIT" related to this situation is seen on the LCD display. When the credit on the meter completely finishes the valve/relay will cut off the flow and "BUY CREDIT" message will appear on the LCD display. In this case, the user loads new credit to the meter by inserting the electronic smart card and withdrawing it.

-If the user does not load new credit after appearance of the message "LOW CREDIT", electro-mechanic smart valve/relay will be locked as the remaining credit is finished and flow will be cut and "BUY CREDIT" message will appear on the LCD display. The only way for restart of flow is by loading new credit into the meter. Otherwise it will not allow flow.

-When the user inserts his electronic smart card into the meter, as a protection of any leakage on the pipelines inside the house, electro-mechanic smart valve/relay will not let flow in the first instance and "CONTROL" message will appear on the LCD display. This message means that, the user must control everywhere. After a check, he re-inserts the card, then the smart valve/relay is unlocked and flow is allowed.

-If credit finishes outside of office hours of the Distribution Authority, the meter may start using reserve credit. The limit of reserve credit can be decided by local Distribution Authority or as an other option the the subscriber should have to use the reserve in his card. Choice of the options depends on the Distribution Authority, we can supply both options.

-Reserve credit is loaded to smart card automatically out of user's desire. At the same time there is main credit which is loaded continuously.

-The main credit must be finished in order to use the reserve credit. Meter puts reserve credit into use after "BUY CREDIT" message is appeared on the LCD display.

-If the reserve credit is finished, a certain amount of new loaded credit is registered as reserve credit. If it is not then new credit is registered automatically as a main credit and reserve credit is maintained.

-The process in the loading of reserve credit is same as main credit.

-User may purchase extra credit in addition to existing credit before finishes, and load the new credit into the meter.

-Each user has only one electronic smart card which is peculiar to himself. A user cannot use other users' card because the meter will not accept a card which belongs to other meter.

-Each card has an Identification number which is given by the Distribution Authority. Meter controls that number in every usage.

-When the user loses his card, he applies to Distribution Authority and receives a new card. The old one is cancelled in order to prevent to be used in another meter. Even if the user finds the lost card, he cannot use it since it is unidentified.

-If the user wishes to give back the remaining credit by any reason, the Distribution Authority deducts the credit used and expenses from the remaining credit, and get back the rest. That process is done only by "REFUND CARD". After that process remaining credit in the meter will be zero and the cost of given credit is paid back to the user.

-The Distribution Authority may put a bottom level for credit get back process and may only accept applications in the condition of above that level.

-All electronic circuit part of Electronic Meter is completely isolated from mechanical part where flow exists. It is operated by 3,6 Volt Lithium battery, which never lets contact and short circuit.

-Energy source of Electronic meter is a Lithium battery . The estimated life of these batteries is 10 years in active usage.

-Battery is placed into isolated nest in the front side of the meter, and the cover closed.

-User can not change the battery by himself, he should call the service team. When the battery nest cover is open, smart valve/relay will be locked and flow of is cut off. "CLOSED-B" message is appeared on LCD display, which shows that meter is closed due to the battery change operation.

-When the service team removes the batteries from its nest, remaining credit is automatically recorded in the meter's memory, and the amount of credit is kept.

-After changing the batteries, it continues from where it stopped.

-While changing the battery, the remaining credit and amount of consumed are maintained as they are.

- "CLOSED-B" message continues to appear on LCD display after the batteries placed in their nest. It disappear ü User can realize when the batteries have to be changed, by a message of 'LOW BATTERY' appears on LCD display.

-If the user does not change the batteries after the message of "EMPTY BATTERY", meter locks the smart valve/relay and cuts the flow. In this case, we must follow the process which is explained above.

-If the user opens the batteries' nest cover, "CLOSED-B" message appears on display and by locking smart valve/relay it cuts flow. In order to bring the meter to normal operating condition, the service team should come and check the meter.

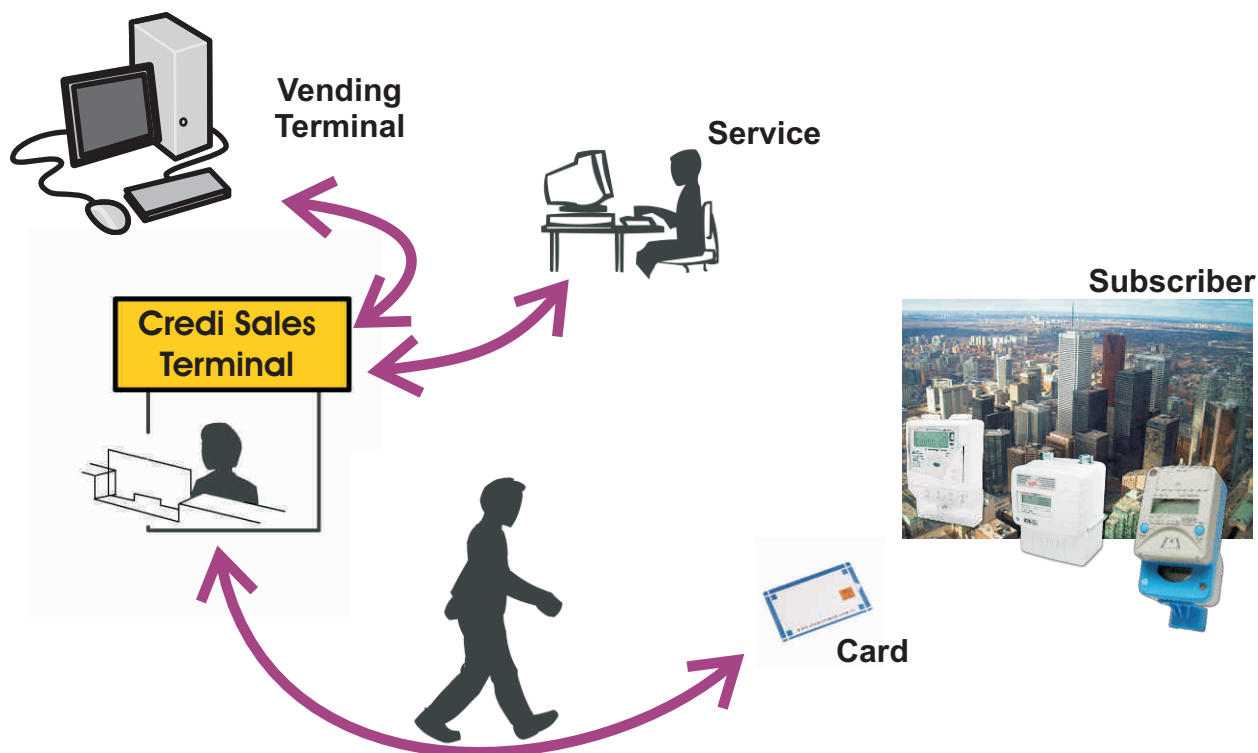
-If the user tries open the meter, electronic meter notice the situation and cuts the flow immediately by locking the electro-mechanic smart valve/relay. The meter stops and 'PENALTY' message appears LCD display.

-When the user punished, the meter stops and locks itself. In this case, electronic smart card of the user becomes invalid. The meter may only come to normal operating condition by the intervention of Distribution Authority. A technician from Distribution Authority use "UNLOCKING CARD" (AUTHORISATION CARD) and the meter starts working normally.

-The Distribution Authority may finish the subscription contract of user for any reason by recording the amount of consumption until that date and the remaining amount. In this case, "CANCEL" message appears on the display.

-A full capacity operational on-line network system allows the Distribution Authority to achieve credit sales, some reports, statistical datas and works, subscriber controls and functioning the meter in full condition.s after the smart card is inserted into the card reader and flow is provided. In other words, meter continues to work as usual.

How To Operate System

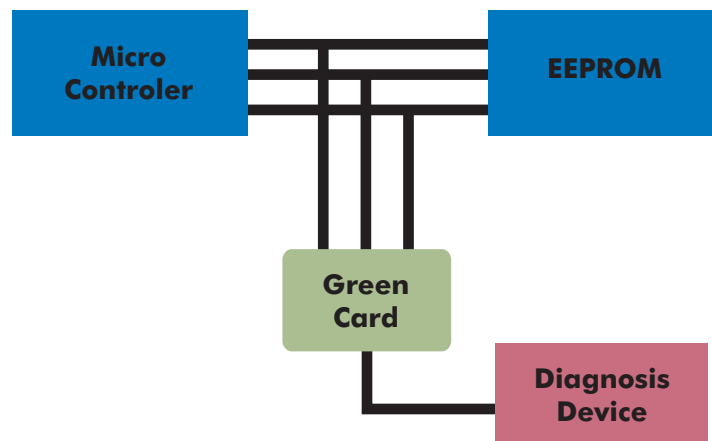


GREEN CARD

Green Card is a special card created by Elektromed especially for the benefit of authority and service utilities in prepaid system.

As it is well known, data communication between meter and central server of authority is realized with a smart card. Also, service teams of the authority use smart card for all their operations. For a service technician, it is an important points that he has to get all and correct data from the faulty meter. The function and benefit of the green card occurs exactly at that point. The matter can be explain as two topics:

- a) Green card acts as an interface between faulty meter and technician's diagnosis device. Instead of using a smart card to reach data, technician uses green card directly. Green card has same dimension and thickness with subscriber smart card. Green card has also physical connection service diagnosis device with cables. Green card gives flexible moving capability to the service team. The team can directly reach data in the faulty meter and evaluate the data with his device.
- b) The service technician can reach the physical connection between meter micro controller and memory unit; Eeprom. With using smart card, the technician can not get that connection point. Another important point is that the green card does not require any external power supply. It can get the required power for its proper operation directly from the meter. So technician with the green card has not any power supply restriction in the field.



DIGITAL METER DISPLAY MESSAGES

- CONTROL Credit available, Valve/Relay is in closed position; user card is waited to be inserted.
- SERVICE It means that there is a problem with the Valve/Relay .User should call the service.
- PENALTY Unauthorized tamper is made to the meter. The authorized card issued in the name of the user can unlock it.
- BATTERY LOW
Voltage of the back-up battery is low. User should call the service.
- BATTERY FINISHED
Battery is out of use. User should call the service.
- CANCELLATION
Meter is temporarily canceled by the administration. Credit and consumption information is kept. It may be unlocked by the "AUTHORISATION" card prepared by the administration in the name of the user.

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· LOW CREDIT

It warns when the credit amount is under the critical limit.

· PURCHASE CREDIT

Credit is consumed. The Cutting Unit is closed. User should purchase credit.

· ERROR

The read card belongs to the system but the card code is not coherent. The error coefficient of the card is decreased by one. If the card code is entered wrongly for 4 times, the card gets blocked and can not be used any more.



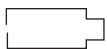
Battery is full



Battery level is medium



Battery level is low



Battery level is empty



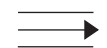
Displays the tariff type in which the meter is



Front-cover Opening Warning. Front-cover opening function saves the date information belonging to the first date of the function in to the memory and displays visual warning on the screen with key symbol. This warning is only removed after intervened to the seal of the Ministry of Industry and brought to the producer.



Connection terminal Cover Opening Warning: As it is saved to the memory penalty symbol becomes active when the first cover open. In READOUT reading, symbol warning is cleaned. The symbol re-activates when the cover opens.



Relay unit is closed: No credit available in the meter. For this reason, the meter stops the electricity use by opening the cutting unit. Meter allows the use of electricity by closing the cutting unit after the loading of the credit.



Valve/Relay unit is open: As long as credit is available in the meter, the symbol continuously appears on the screen.

The messages will appear on the LCD display with the icons on them.

B - SMART CARDS

A smart card, chip card, or integrated circuit card (ICC), is any pocket-sized card with embedded integrated circuits which can process data. This implies that it can receive input which is processed by way of the ICC applications and delivered as an output. In prepayment metering solutions smartcards are taking an important place. Because data transfer meter to vending station and vending station to meter is performing over smartcards.

Elektromed prepayment meters has two kind of smartcard type, one is contact card other contactless card.

A contactless smart card and a contact smartcard has same first-look but their working principles are different. Contact smartcards make contact with communication pins to performing data transfer. But contactless smartcards do not need a contact to transfer data. A convenient distance is enough to make a communication link. This implies that it can receive input which is processed and delivered as an output via radio frequencies. Elektromed contactless smartcards contain non-volatile memory storage components, and some specific security logic. Contrary to popular belief contactless smart cards do not contain an ordinary read-only RFID, but they do contain a re-writable smart card microchip that can be transcribed via radio frequencies.

In water meters contactless smartcards gain extra IP (Ingress Protection Rating) to the meter, cause meter do not has any aperture and therefore protection of electronic parts against water have increased.

1) Authorisation Cards (used by the distribution authority)

- a- Locking (Cancelling) Card
- b- Unlocking (Re-opening) Card
- c- Refund Card
- d- Control Card

2) User Cards

- a- Electronic Smart Credit Card

1) AUTHORISATION CARDS

a) LOCKING (CANCELLING) CARD : When the Distribution Authority decides to lock the digital meter of the user for any reason, this card will be used. In this case, it is impossible for the user to interfere or operate the meter, unless by using the pass number that had already recorded in the locking card. After recording the number of the locked meter to the card, only the meter belongs to that number become functionless.

b) UNLOCKING (RE-OPENING) CARD: When the meter is locked due to "PENALTY", "SERVICE", messages, the Distribution Authority unlocks the meter with this card. Only the Distribution Authority has this card and the meter is unlocked by an authorized technician. Unlocking card might be restricted to use for only one meter by recording number of that specific meter. This is done by the Distribution Authority and the card will be used only for that meter

c) REFUND CARD: When the user decides to refund back his remaining credit due to some reasons, this card is used by the Distribution Authority to identify the remaining credit. Refund credit card is used by the Distribution Authority following the user's application to the Distribution Authority. An officer from Distribution Authority inserts the card to the card reader and it records both the credit used and the remaining credit. After recording, it deletes the remaining credit in the meter and locks electro-mechanic smart valve/relay of the meter. A technician from Distribution Authority who carries the card takes it back. This card is read by computers in the centre and remaining credit is paid by the Distribution Authority accordingly. REFUND CARD, like other Distribution Authority cards, is for one specific use and it does not work in other machines. It works only in the machine which it has its number on.

d) CONTROL CARD: This card is used by the Distribution Authority for the purpose of regular technical controls in order to check all units of the electronic meter. It records problematic meters and users.

2) USER CARDS

a) SMART CREDIT CARD : This card is used by a subscriber in order to load credit to the meter. Identity number of meter, main and reserve credit informations are already recorded in the card. The user purchases credit from a credit sale unit or centre, and loads it to the meter.

THE INFORMATIONS TRANSFERED FROM THE METER TO THE ADMINISTRATION

- Subscriber's number
- Subscription type
- Meter's number
- Meter's model
- Credit information
- Spare credit information
- Remaining credit in the meter
- Total spent credit of the meter
- Battery voltage
- Last credit loading date
- Last using date

CHARACTERISTICS OF COMPUTER SYSTEM

The computer system of ELEKTROMED electronic meter system has two servers in the Distribution Authority Computer centre. Computer network system is operated on NT with Oracle Software .

Computer network operates "on-line", and it consists of Distribution Authority (Centre), Credit Sales Centres, and Credit Sales Units.

Computers within computer network are divided into three groups:

- 1 - Computers that are used in Distribution Authority Centre.
- 2 - Computers that are used in Credit Sale Centres.
- 3 - Computers that are used in Credit Sale Units.

MAIN COMPUTER called as FIRST SERVER is in the Centre. All informations are saved in the first server, and it also controls all Credit Sale Centres and Units. It is operated by NT with Oracle Software (i.e. credit sale units and centres) in a "on-line" system.

The second computer in the computer centre is the SECOND SERVER. It supports the first server. All informations from sale points are collected and saved in this computer. It transfers these informations to the FIRST SERVER. So, it is a bridge between 1st server and the sale points. In order to achieve that flow of information, there is a BOARD as port multiplier in second server and SOFTWARE is used to reach the computer terminals.

In order to set up on-line connection with each terminal which is outside the central system, a modem is used for each terminal which is connected to the second server.

There are terminals which contains card reader and card credit loading devices for the purpose of various subscriber operations, like returning credit, new subscription, follow up subscribers etc. and some other operations referring the Distribution Authority, like reporting, collecting statistical data etc.

C - CREDIT SALE CENTRES AND CREDIT SALE UNITS

There are two separate structures within communication network in which sale operations are made. For the places where the Distribution Authority expects higher sales, it sets up CREDIT SALE CENTRES which composed of four terminals. It sets up small CREDIT SALE UNITS with one terminal to a place where it is expected to achieve less amount of sales.

Moreover, when it is agreed, computer systems of the banks may be adapted to this system.

There are card reading and credit card loading machines in all credit sales units. These are connected to the computer and they are fully compatible with terminals.

When the subscriber gives his electronic smart card to the staff in Credit Sale Centres and Units, all information about the subscriber will appear on the computer, will load the card and give it back to user.

All terminals and computers in Credit Sale Centres and Units are attached to MAIN COMPUTER (FIRST SERVER) at the Distribution Authority Computer Centre. Any information recorded about operations between subscriber and sales, are directly transmitted to main computer through modem which is set to each terminal. So, this provides speed up in transactions, reliability in services and prevents abuse of power.

The latest computer technology is used in establishing this complete network. Any development in computer field is strictly followed and the system is updated accordingly. The system is eligible to be improved.

The system is completely reliable against any abus.

It is coded in 3 categories;

- a) Code of Operation System,
- b) Code of Terminal,
- c) Code of Computer program.

So, system protects itself against any internal and external interferences.

SPLIT METERING

Split metering is a method that aims preventing tampering attempts to meter and giving consumption rates and other necessary informations to subscriber as a subtitle of prepayment metering solution. Basic principle of this system is depending on detached metering unit and displaying unit. Several methods could be developed to perform a communication link between metering unit and displaying unit. Hard wire, radio frequency (RF), power line carrier communication (PLCC) could be examples of these methods.

Elektromed selected Power Line Carrier method to operate split metering solution, no need any extra hard wire or wi-fi or RF module to make communication between units. System is based on two-way communication working principle. In a two-way system (supporting both outbound and inbound), commands can be broadcast out from the metering unit to customer interface unit allowing for reconfiguration of the network, or to obtain readings, or to convey messages, etc.



A split meter come into existence with two main parts;

- 1) Measurement Unit (MU)
- 2) Customer Interface Unit (CIU).

As is evident from it's name Measuriment Unit (MU) is consisting of main measuring sensors, chips and relays. Difference than a classical meter is; it has no Liquid Crystal Display (LCD).

Customer Interface Unit (CIU) is main display and information agent of split meter system. It is powered by main electricity supply and could be easiliy plug to line anywhere in home.

Data listed below which could be traceable from CIU LCD.

Card Messages: Leads the customer what to do while using of card for loading credit or money to the CIU.

Consumption rates in kilowatthours (kWh)

Consumption rates in loacal currency

Tariff system

Date and time

The CIU has three LEDs for monitoring status of device. These are,

Power LED: Indicates the main supply situations as on/off

Link LED: Indicates communication status between CIU and MU.

Relay LED: Indicates relay status.

