Hardware Block Diagram

EMIF Module
Energy Measurement Interface Module

It is a prefabricated electronics module based on ADE7755 Energy Measurement Chip (EMC). The chip contains both ‘Analog Signal Processing’ and ‘Digital Signal Processing’ circuits for precise and accurate noise free measurement of electrical power consumed by a load.

The chip is factory calibrated to generate 1600 cef pulses at the end of consumption of 1 kWh of electrical energy. This electrical energy meter that uses this chip is called ‘1600 Impulse Meter’. Thus the resolution of the EMC chip is 1 cef or 0.625 Wh.

The abbreviation cef stands for ‘Calibrated Energy Frequency’. The EMIF produces 16 cef pulses after the consumption of 0.01 kWh energy. The explanation is:

\[
0.01 \text{ KWh} = 0.01 \times 1000 \text{ Wh} = 10 \text{ Wh}
\]

If a 10 Watt lamp remains ON for 1 hour, the EMIF module will generate 16 cef pulses.
1. **Introduction**

The Load will get electricity if the switch K1 gets closed. The K1 will be closed under the following conditions:

1. The balance is not zero.
2. The balance has not arrived at lower cut-off value say Tk 2.00.

2. **Electrical Circuit:**

![Electrical Circuit Diagram]

3. **Control Structure to ON/OFF Relay:**

   L1: if (Balance >= Tk 2.00)
   
   \[\text{LH} \rightarrow \text{P3.3}\]

   L2: \[\text{LL} \rightarrow \text{P3.3}\]

4. **8051 Assembly Codes for Control Structures of Section-3**

   L1: \[\text{MOV A, } \#\text{Balance}\]
   
   \[\text{CJNE A, } \#\text{Tk2.00, L1B}\]
   
   L1A: \[\text{SETB P3.3} \quad ; \text{Balance = Tk 2.00}\]
   
   L1B: \[\text{JNC L1A} \quad ; \text{Balance > Tk 2.00}\]
   
   L2: \[\text{CLR P3.3} \quad ; \text{Balance < Tk 2.00}\]

5. **Working Principle of Electrical Circuit of Section – 4.**

   The relay ON/OFF control signal is supplied by the MCU over P3.3-pin. The signal is not directly applied to the base of transistor Q1. The P3.3 signal is synchronized with the zero-crossing 50Hz signal of the 220V line frequency. This arrangement allows the contact K1 to be open/close at minimum load current. The diode D1 works as a flywheel diode and provides a closed circuit for the relay-coil energy to dissipate. Without the presence of the diode, there would appear very high voltage across the CE-junction of Q1. As a result, the Q1 will break down.
MRIF
Microcontroller Reset Interface Circuit

The RST-pin of the 8051 is marked as active high, which means that the MCU will remain at Reset-state (inactive) state as long as the RST-pin remains at LH-state. The MCU will begin program execution from location 0000H whenever the RST-pin is brought to LL-state. The following circuits can do this job.

![MRIF Circuit Diagram]

BUIF
Buzzer Interface Circuit

1. Introduction
The Buzzer will produce a musical note whenever the balance falls below Tk 2.00. This is to draw the attention of the meter user to insert Prepaid Card into the meter. The meter will read the money from the Prepaid Card and will recharge the meter. The following is the electrical interface circuit for the meter.

2. Circuit Diagram

![BUIF Circuit Diagram]

The Music IC goes about 8 stages of musical notes. It is a free running chip. The music drives the Buzzer whenever the bit P3.3 assumes Logic-H state. +V refers to an unregulated DC voltage of about +15V.

3. Control Structure to activate P3.5
L1: if (Balance < Tk 2.00)
    LL → P3.5
L2: ..................
MCIF
Mechanical Coupling Interface Circuit

1. Introduction
When the meter balance falls below Tk 2.00, a musical alarm is initiated to tell the user to insert the Prepaid Card. The Prepaid Card has mechanical contacts (FPCP = Four Point Connector Port), which must be properly engaged to allow the Master MCU to read money from it. Because these are mechanical contacts, they will certainly make a ‘lot of bounces’ before making the final contacts. These bouncing may create ‘Electrical Noise’, which may be picked up by the master MCU as false money. Therefore, the possible solution to prevent the generation of the electrical noise due to mechanical bouncing is to allow the Prepaid Card get engaged first and then apply +5V (Vcc1) power to the Prepaid Card.

The Prepaid Card goes all the way inside the meter. The Prepaid Card activates a micro-switch K2. One end of K2 is connected to P1.3-pin and the other end is connected at 0V. As a result, the P1.3-pin gets shorted to 0V. When the Prepaid Card is removed, the K2 comes back to normally open condition and the P1.3-pin assumes LH-state through the internal pull-up resistor.

The Vcc1 for the Prepaid Card has been derived form the Vcc (+5V for the master MCU) through a control mechanism and is described later as PVIF (Prepaid Card Vcc1 Interface). The MCU continuously monitors the logic value of P1.3-bit and whenever it is found at Logic-L state, the MCU enables the Vcc1 supply by activating the P1.2-bit.

2. Control Structure
L1: if (P1.3 != LL)
   Goto L1
L2: Send LH to P1.2
   ………………………

3. Assembly Codes for Control Structure of Section - 2
L1: JNB P1.3, L1
L2: SETB P1.2
   …………………

PRIF
Prepaid Card Reset Interface Circuit

The Microcontroller used for the Prepaid Card id of the type AT90S2313 – a 20-pin RISC version. The MCU requires a LL-state at its RST/-pin to remain at reset state. The following circuit may well furnish the RST/ signal for the 2313 RMCU (RISC Microcontroller).
PVIF
Prepaid Card $V_{cc1}$ Supply Interface Circuit