IEC 1107
Electricity Meter Interface

talk to your electricity meter

By C. Mester

Many electricity meters installed since the mid 1980's are equipped with an IEC1107 compliant optical interface. This gives a convenient method for the Electricity Company to access all manner of information held in the meter using a hand terminal. This simple project describes a neat IEC1107 to RS232 interface that together with some software allows a PC to talk to the meter and retrieve energy consumption information[1].

[1] *Editor's note:* Some IEC1107 compliant electricity meters used in the UK and other European countries may have password protection. The software referred to in this article does not make provision for passwords to be entered. (*Ed.*)

Among its prodigious output of documents describing international electrical standards the International Electrotechnical Commission (IEC) produced a specification IEC 1107 that defines a software communication protocol and the hardware necessary to pass information to and from electronic meters used to measure such things as electricity, gas and water consumption in the home and industry. Practically all the consumer meters manufactured these days have a microprocessor lurking somewhere inside and most are equipped with an IEC 1107 compliant interface or the equivalent European spec EN61107. The optical interface was originally introduced by the companies Ferranti and Landis & Gyr hence is alternative name, the FLAG port, derived from the company initials. This interface simplifies many functions of the meter operation and here in the UK it is possible for an operator from the electricity company to reset internal registers, alter the meter configuration and change tariffs via this interface. Before you get too excited I think we should point out that all
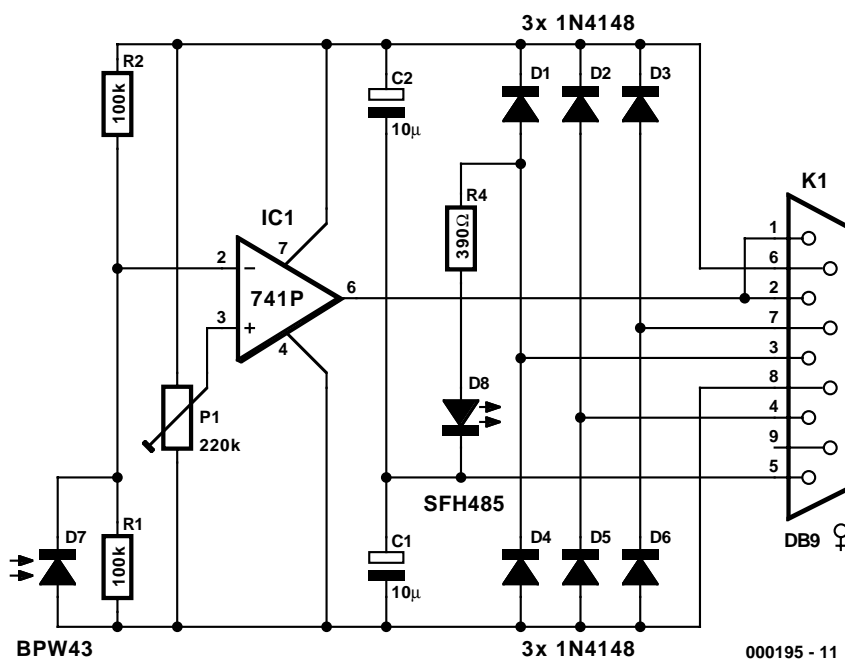

Figure 1. The ultra-simple interface circuit. Power for the transmitting diode is provided directly from the TXD signal. An Opamp comparator is used to amplify the received signal.

Figure 2. The 'Dialog' model electricity meter manufactured by Siemens featuring an IEC 1107 optical interface.

tial divider chain formed by R1 and R2 sets the voltage at the inverting input to IC1. Infrared receiving diode D7 is connected in parallel to R1 so that IR light falling on D7 will effectively reduce the resistance of the R1/D7 pair and so produce a waveform at the input to IC1 which corresponds to the received IR signal. The signal is converted to RS232 voltage levels by IC1 so that the output signal can be used to drive the received data line (RXD) directly. Signals to the meter are produced by the infrared emitting diode D8 while R4 limits the forward conduction current.

The data rate defined in the IEC 1107 protocol is so low that a standard 741 type op-amp is also suitable for use as a comparator in this application.

The layout of the circuit is so simple and uncritical that even without a purpose-made PCB construction should present few problems. The only points to look out for are firstly to ensure that you use a 9-way D-type **socket** for connector K1 and not a plug and also that the receiving diode D7 is fitted with a hood or tube so that it can only detect light coming from directly in front of it. If you choose to mount D7 any distance from the rest of the interface circuitry then the cabling to D7 should be screened.

Circuit alignment is necessary to set up the switching threshold of IC1. With the interface connected to a running PC, receiving diode D7 should first be disconnected from the circuit or covered up so that no IR light can reach it. Adjust P1 until the output of IC1 goes low now back-up the preset until just **before** the output of IC1 flips high and this will be the optimum setting of P1.

Assembling the bits

To ensure a good optical coupling between the transducers in the meter and D7 and D8 in the interface probe it is necessary for them to be in close physical contact. Commercial probes are usually fitted with a magnetic collar that attaches to the circular steel washer on the front of the meter. The meter transducers are mounted within the central area of this washer (see **Figure 2**). For our purposes it is simpler to mount D7 and D8 on a small strip of perforated board or plate and fix this to the front of the meter with tape. For the probe itself you will need a suitable piece of perforated strip or plate and using a drill, make two 5 mm holes at a spacing of 6.5 mm about the centre line. Diode D7 is fitted in the left hole and D8 in the right hole. This home-made probe can now be fitted over the reading zone on the meter and fixed with tape or better still Velcro to allow simpler re-attachment.

these features are of course protected by several layers of stringent security checks/passwords and are not available to the consumer.

The meter also stores power consumed and the average power consumption or 'load profile' can be output periodically by using a commercial meter reading hand terminal. These devices are expensive and it would not be possible to justify the purchase of one for home use where it may only be used occasionally or just to satisfy your natural curiosity by exploring the possibilities of this interface.

The simple interface design presented here offers a perfect low-cost alternative. This opto-electronic interface connects an IEC 1107 compliant meter directly to any PC or laptop via the RS232 serial interface port. From a hardware standpoint

the design could hardly be simpler even power for the interface is derived from the PC so that no external mains unit or battery is necessary. The accompanying software stores the load profile values in a file so that they can be used in other applications including spreadsheets.

This design offers a simple method for the consumer to monitor actual power consumption using the IEC 1107 interface.

Hardware

Figure 1 shows the complete interface circuit diagram. Power for the circuit is actually derived from the RS232 interface of the PC using signals TXD, DTR and CTS. Operational amplifier IC1 is configured as a comparator with its switching threshold voltage set by preset P1. The poten-

Software

The software accompanying this project allows the actual load profile to be sent out periodically from the meter. In some countries, the meters output this information every fifteen minutes but in the UK, it is every thirty minutes. The output values are positive and negative, active and reactive power components of the energy consumed. The corresponding documents detailing both the hardware and communication protocols can be found in references [1] and [2] respectively. The measured values should be available, provided the meter stores them. Unfortunately, the presence of a physical IEC 1107 interface on the meter does not guarantee that the load profile is stored in the meter! A call to the technical department of your utility supplier should make the picture clearer. Failing that, the complete interface circuitry is so simple that it can be constructed in an evening and together with the software (available freely from the *Elektor Electronics* website) it should be possible to ascertain relatively quickly if the meter wants to play ball. You will not have wasted much time or expense if the answer is negative and you will certainly gain a better understanding of the communication protocols involved.

Before attempting to run the project software, connect the interface board to the first serial port (COM1) of your PC, preferably before the PC has been switched on. If you intend to use the COM2 port then use executable program with '2' behind its name. The load profile can be stored to any file in ASCII format.

Table 1 shows a load profile taken from a meter made by EMH. The first line gives the date and time that the reading was taken (00-07-11,08:30:00) which you probably have already guessed was the 11th July 2000 at 08:30. The next line shows the measurement units together with the channel number. The

VA, Var and Kilovar

Few electrical loads are purely resistive even the humble light bulb has a degree of inductance. Non-resistive properties of loads have the effect of introducing a phase shift between the ac voltage applied and the current consumed by the load. The time difference between the voltage and current waveform is expressed as a fraction of the frequency of the ac voltage in degrees and is known as the phase shift. Every waveform with a phase shift between the voltage and current can be represented by two components the **active** current which is in phase with the voltage and the **reactive** current which is shifted by 90° with respect to the voltage. Capacitive loads cause the current to lead the voltage while inductive loads (motors, transformers etc) cause the current to lag the voltage. A simple ammeter will not be able to separate the two values of current; it will instead measure the total current and this will be the geometric sum of the two components. This is called the **apparent** current. Multiplying these values of current with the voltage will give three different values for power. (see the DIN 40110 standard):

– **Active Power** (Active current ? Voltage) expressed in Watts (**W**).

– **Reactive Power** (Reactive current ? Voltage) expressed in Voltampères reactive (**Var**).

– **Apparent Power** (Apparent current ? Voltage) expressed in Voltampères (**VA**).

VA and Var are nothing more than special names for Watts and are used so that we can distinguish between the active, reactive and apparent power. One Kilovar (kVar) is equal to 1000 Var – just as in Kilowatt (kW) and Kilovoltampère (kVA).

Table 1.

Load profile output information (example).

```
P.P(00-07-11,08:30:00)(C@@@@@@@)(15)(14563)

(1.5_kW,3.5_kvar,2.5_kW,4.5_kvar)

(02.24)(00.28)(00.00)(00.00)

(02.28)(00.36)(00.00)(00.00)

(02.28)(00.32)(00.00)(00.00)
```

third line shows the actual measurements at 08:30 and each successive line shows readings at 15-minute intervals. The positive value of the consumed active power of channel 1 is listed in the first column (02.24). The 5 after the channel number indicates that this is an average reading. The units are in Kilowatts (kW). The average value of the reactive component in channel 3 is shown in the second column (00.28). The average negative active power (power flowing from the consumer into the grid) is shown in the third column (00.00) and similarly the negative reactive component is shown in the fourth column (00.00). Reactive power is expressed in Kilovar (kVar).

The software comprising the executable programs along with its source file is freely available from the *Elektor Electronics* website at: http://www.elektor-electronics.co.uk Click on 'Download' and select number **000195-11** to receive the zipped files containing the executable (.exe) programs and the Pascal Unit (.tpu).

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Literature:

[1] German Industry standard DIN 43863-3

[2] International Standard IEC 1107/ Norme Internationale CEI 1107

Some useful Web addresses

Meter manufacturers:
www.siemet.com (select 'metering')
www.emh.de
www.enermet.de
www.dzg2.de
www.abb.de/messtechnik
www.iskraemeco.si

Useful IEC1107 info:
www.abacuselectrics.com/iec1107.htm