

## Automatic Meter Reading – Why Not Using PLC

In automatic meter reading system, mainly there are two different communication media, namely PLC and 485. Because PLC does not need to implement additional communication lines, so it suits the residence which has been completed already, and is preferred by some utilities. However RS485 begins to have increasing market sharing due to its advantages over the PLC system.

There are about 1-2 million PLC meters running in China, but basically no meter reading system can consistently read the data reliably. In one city, there is a PLC system with about 200 PLC meters, it takes about 13 HOURS to read all the data. This means wave carrier interference has been introduced into the electric network permanently by the meter reading device.

In China, some systems use PLC meter reading, which is not able to read the meters data simultaneously; nevertheless it can read all the meters data within more than 10 hours. As far as the billing policy concerns, the system can be used; but the electric network will suffer the long-term interference. The long-term high frequency interference imposes on the household appliances and causes the equipments over-heating, electric power losing and motor output decreasing etc. At present, it has not been confirmed whether the interference will affect the energy measurement.

During the last ten years, the two major factors causing PLC meter reading unstable have been found out, i.e. the electric network signal attenuation and random interference. The wave carrier signal is lost according to the exponential curves of different time constants. The heavier the corresponding branch load, the faster the signal attenuates. The network and branch load are all uncontrollable and absolutely random. On the geometric nodal point, the signal amplitude is the boundary condition of a set of differential equation; when the electric network load fluctuates, the load change in these points will cause the change of the signal amplitude in these points and also will change the reading condition in the whole electric network; and there are two electric network fluctuation, i.e. high frequency fluctuation and low frequency fluctuation. Therefore, the attenuation in electric network is very complicated.

The signal attenuation affects the electric network greatly. According to some research reports, the largest attenuation that has been measured in China reaches 130 db, which has exceeded the limit of the communication ability in the physical layer of the carrier modulation chip. So both experts of China and overseas have made the conclusion that PLC meter reading is technically unworkable for low voltage PLC system in China.

Because of attenuation, wave carrier reading system can not read meters stably and reliably if there is no relay or other anti-attenuation techniques. We should also pay attention to the network interference. The law on the electric network pollution is still left behind in China and with the development of the economy and the improvement of the people's living conditions, various household electric appliances enter common people's houses, so the pollution caused by many poor quality electric appliances becomes more and more severe. Those we used to call accident random interference now are not accidental but consistent. If the sensitivity of the meter reading device is constant, the existence of this

interference equals to increasing the attenuation of the electric network and decreasing the receiving sensitivity, and therefore it will affect the meter reading system severely. According to what we have tested, the largest attenuation can reach 120dB, i.e. 1V in frequency domain. Although the interference may not appear in the carrier frequency, or occupy the whole communication time domain, the value of such high attenuation is nevertheless very terrible.

In any communication system, interference has been a problem at all, so people can solve related problems skillfully. All kinds of anti-interference techniques are available nowadays, for example, frequency domain related technique includes spread spectrum, hopping frequency, multi-carrier modulation and quadrature modulation, and time domain related technique includes channel code adaptive modulation, system error detection and correction, and hopping time and crushing frame technology. All of the above can gain some effects. The interference problem can surely be solved, if we utilize various anti-interference methods comprehensively and reasonably.

But the problem of unstable meter reading still exists! It is suspected that the anti-interference methods are not enough. In fact the problem is not because of lack of methods. Interference appears on the receiving end, and the signal is attenuated severely through the network. No matter what anti-interference method you use, if on the receiving end, the signal-to-noise ratio is not enough, the signal will not be received reliably. So the main cause of the signal reading has focused on the attenuation of the carrier signal in electric network.

In a general communication system, anti-interference does not have any problem; however, when it comes to the PLC meter reading system, it does have some problems if applying the existing experience. First, raising signal amplitude is restricted by the harmonic coefficient. In a system of 220 VAC, the signal can not exceed 6.6V (3% of 220V). Even if we do not need to consider the other harmonic components, the gain is just several dB, which is far from enough to meet the anti-interference requirement. Raising receiving sensitivity is restricted by the white noise of the electric power network, so the gain is more limited.

The technology of raising audio-frequency in fixed-line communication and relay technology in wireless communication can not solve the problem in PLC AMR system. This is because the architecture of low voltage power distribution network is random, dynamic and free topology network. So no one can define precisely the structure of the low voltage electric power network topology. So we should first analyze the structure of the topology if we want to use the existing mature experience on anti-interference problem. This is an obstacle that we can not skip.

Because of this topology problem, the solution on the relay problem is very weak. None of exhaustivity, traversing, relay monitoring, or posteriori topology can effectively solve the electric power network attenuation problem. And therefore the market has not made any solid progress in this area during the last 10 years.