
# Balancing the energy equation

e-Metering solutions from NXP Semiconductors

NXP
founded by Philips

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As a manufacturer of energy-metering equipment, you'll understand only too well the potential market for electronic e-meters with comprehensive metering capabilities.

Your customers – the utility companies – are today faced with the increasing burden of reactive and non-linear loads that traditional electromechanical e-meters can't adequately handle. Leading in the worst cases to lost revenue for them. Power quality too, is now becoming a hot issue, and utility companies are looking more and more at metering solutions that maintain a clean electricity supply by continuously monitoring the power-quality pollution generated by individual users. What's more, with the world-wide pressure on reducing energy consumption, they are increasingly resorting to multiple-rate billing to encourage both their industrial and domestic customers to minimize peak usage by consuming off-peak electricity wherever possible.

## *"What if you could give your customers the smart e-metering solutions they need?"*

### Electronic metering is the key

For all these issues, electronic measurement is the only feasible option. Electronic e-meters offer exceptional metering accuracy even in the presence of non-linear loads. And even in economy electronic e-meters, it's comparatively easy to include at least some basic power-quality measurements such as total harmonic distortion and voltage sags and swells. What's more, the electronic e-meter's functionality can be expanded to include measurement of water and gas consumption, providing further added value for your customers by allowing them to combine measurement of all utilities within a single meter.

But the electronic e-meter is far more than just an improved replacement for the electromechanical meter. The real added value comes from combining the electronic metering functionality with the latest communications technology. Connecting customers to a network infrastructure via, for example, power-line communication (PLC), wired LAN or an 802.11b/g wireless LAN, or via proprietary wireless links based on the 900 MHz or 2.4GHz ISM bands, opens a host of new options for utility companies. Options such as remote meter reading, which cuts operational costs; bidirectional communications, which permits utility companies to actively manage their consumers' loading; and faster detection and correction of power outages.

### Solutions for the 21st century

Utility companies worldwide have not been slow to appreciate these benefits. Most are now moving over to electronic energy-metering, and are looking for e-meter manufacturers capable of providing the smart solutions they need for effective energy distribution and management for the 21st century.

### Committed to your success – today and in the future

When you choose NXP as your electronic e-metering partner, you choose a partner fully committed to your success. A partner offering one of the broadest portfolios of e-metering components in the industry and large-scale production capacity. Providing you with a true one-stop shop. A partner, moreover, with unrivalled communications know-how to give you the essential support you'll need to stay competitive – today and in the future. E-metering manufacturers throughout the world are designing our components into their products, and relying on our support to develop the innovative communication solutions they need for their markets. More than any words, this fact testifies to our commitment to the e-metering industry and to the added value we can provide.

NXP Semiconductors combines a leading position in system solutions and components for e-metering with unrivalled communications know-how to provide a strong competitive edge for modern electronic e-meter manufacturers.

# All solutions in one hand

**Integrated intelligence...**

Our microcontrollers for e-metering, for example, range from the 8 bit LPC 900 family for economy solutions up to our high performance 32 bit ARM7 LPC2000 family. Our new LPC23xx and LPC24xx, in particular, are ideal for high-end e-metering systems featuring advanced functions such as power quality analysis of mains flicker and transients. Embodying an internal ADC, they provide sufficient accuracy for virtually all standard electronic e-metering applications. They also feature an external memory controller and serial-parallel interface enabling them to connect to 12 or 16 bit ADCs of all major manufacturers if even higher accuracy is needed.

The LPC 23xx and 24xx families also feature a host of on-chip communication peripherals including up to 4 UART interfaces, other serial interfaces such as SPI, SSP, $I^2C$ and CAN, as well as modem and USB connectivity and an Ethernet controller with integrated MAC. Which means they also meet the broad range of communication needs of today's utility companies. They are, in fact, currently the only ARM7-based microcontrollers that can perform multiple high-speed communications operations simultaneously. With up to 72 MHz operation (64 Drystone MIPS performance), up to 512 kbytes of on-chip FLASH memory and up 98 kbytes SRAM, they offer plenty of bandwidth to add extra features and lots of memory for future upgrades. And they can accommodate downloadable firmware in the field, which can be critical for some utility companies.

**...plus a broad range of peripherals**

Recognizing the diverse requirements of utility companies throughout the world, we also offer a range of peripherals for wireless communications. This includes our SA636, SA58646 and SA58641 RF transceiver chips, WiMax transceivers, our BGW200 802.11b low-power WLAN and our Bluetooth "system-in-a-package" (SiP) solutions. We also have a range of RF MMIC and wideband transistor-based power amplifiers and PIN diodes for RF front ends, plus a range of USB, SD and MMC interfaces for logging metering data.

And that's not all. Drawing on the expertise of NXP Semiconductors in the cellular business, we can offer support in the development of GSM, GPRS, CDMA and EDGE cellular communication solutions. Based on our Nexperia System Solutions, these reference designs for use with cellular communication networks include possibilities for Direct Mode communication via RF. Direct Mode works without an operator supported network, thus combining the benefits from cellular with Power Line Carrier communication in any chosen topology. In addition, we can offer Wi-Fi options to cellular-based wireless communications systems to provide easy drive/walk-by meter reading in metropolitan and clustered residential areas.

Completing our broad portfolio of peripherals for electronic e-metering are our range of real-time clock (RTC) ICs and LCD display drivers, plus our high performance AC/DC converters known as the StarPlug and Greenchip SMPS IC families. With output powers up to 30 W, these SMPS ICs are the perfect choice for low power DC voltage requirements common in electronic e-metering application.

Finally, our e-metering solutions can also draw upon an extremely wide range of general purpose NXP commodity products, from ESD protection devices to complete families of discrete semiconductors such as diodes, transistors and logic.

### Contactless smart metering

Traditional meters allow no end-user control of when and how much of the supplied utility services are used. Smart metering gives the control back to customers but also benefits the service provider. Contactless smart metering makes use of NXP Semiconductor's contactless RFID technology for prepaid usage of utility services, such as energy, water or gas. End-customers can easily use the contactless RFID technology to control and manage quantity, timing and consumption of utility services. The technology is easy to use, maintenance free and very resistant to harsh environmental conditions. And the service providers benefit from a reliable, effective and maintenance-free hardware solution for their meter installations. What's more, prepaid metering promises low-cost "back office" systems and administration-free registration/deregistration processes to supply service to customers with poor payment history or who are frequent movers.

### How does this work?

Companies that provide their utilities with this type of meter typically use bank terminals where a customer can purchase credits. These bank terminals are, for example, based on NXP Semiconductors' contactless Mifare® Reader IC MFRC522. The credits are transferred from the contactless RFID-based terminal to a contactless RFID-based smart card.

NXP Semiconductors offers a wide range of different contactless RFID smart card ICs tailored to meet the requirements of low-cost applications but also for use in high-end high-security applications. Typical contactless RFID smart card ICs are Mifare® Ultralight, Mifare® Standard or Mifare® Desfire. At home, the customer can use the purchased credits to enable different utility services for a specific amount or a specific time.

## Typical NXP e-meter solutions

### Europe

E-metering solution providing the customer with extra information such as power consumption during the day and quality of energy.

### Benefits

- The LPC2000 microcontroller family has more than sufficient power to provide the extra functionality needed
- Plus sufficient performance for future needs
- The family can also be easily upgraded or downgraded for different e-meter solutions (single- and 3-phase, high precision etc.)

### China

Combined power meter, water meter and gas meter using:

- NXP LPC931/922/921/FDH plus external LCD/controller
- P89LPC9401FBD64 (with LCD driver)

### Benefits of LPC900 family

- Few external components
- Low power consumption
- Erasable FLASH (can be used as EEPROM)
- Lot of on-chip peripherals incl LCD driver

### India

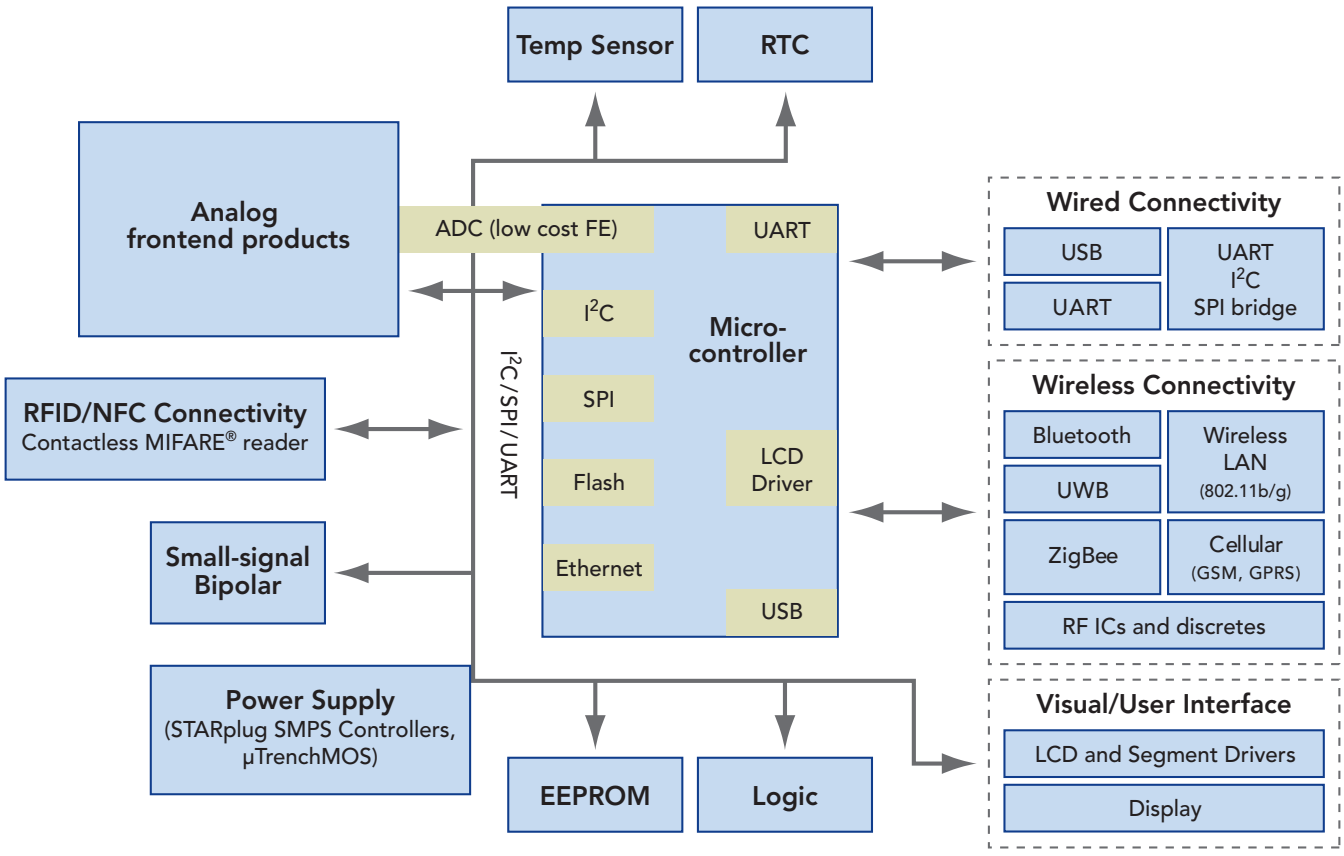
Single-phase energy meter solution using LPC9401 Micro with on-chip LCD Driver.

### Benefits

- Reduced system cost
- Low EMI/RFI
- Use of Internal FLASH & RC
- Innovative use of on-chip peripherals

Drawing on our experience in e-metering applications and our broad product portfolio, we can offer you a range of solutions for e-metering. Each takes into account your specific requirements with respect to measuring accuracy, additional functionality and cost.

# Tailored to your needs




Typical electronic e-meter architecture with communications

# Examples of NXP e-meter solutions

Microcontroller
ARM7 LPC2000 Family

## AMR (Automatic Meter Reading) advanced e-metering architecture – 3-phase professional application with advanced communications

**Microcontroller: ARM7 LPC2000 Family**
- From 8 kbyte up to 1 Mbyte on-chip FLASH memory
- Many S-RAM options, up to 98 kbyte
- Extensive range of on-chip peripherals and communication interfaces, e.g. Ethernet, USB, up to 4 UARTs, 3 SSI/SPI, 3 $I^2C$, with LCD controller etc.
- External Memory Interface optional

**RF connectivity**
- RF MMIC amplifiers
- Low-noise amplifier (LNA)
- Variable gain driver
- Power amp pre-drivers
- WiMax fully integrated transceivers and PAs: UXA234xx family

**Real-time clock: PCF2128**
- Temperature compensation
- Internal quartz crystal
- SPI/$I^2C$ bus interface

**Display driver: PCF8811**
- 80 x 128 graphics

**AC-DC conversion**
- STARplug™ TEA152x, TEA162x SMPS ICs
- High efficiency, low EMI
- For power ranges 2 - 40 W

## Standard solution – single-phase residential application

**Microcontroller: LPC9408**
- 8-bit µC
- On-chip LCD driver
- 10-bit ADC
- 512 B EEPROM
- 8 kB FLASH

**RF connectivity**
- Mixers
- VCO buffers
- RF transceivers
- IF Downconverters
- PLLs and RF switches
- Pin diodes for RF switches and attenuators

**Real-time clock: PCF8563**
- Low power consumption
- Operating temperature up to 85 °C
- 1 s resolution
- 400 kbit/s $I^2C$

**Display driver: PCF8562**
- Cost effective
- 128 segments

**Connectivity: SA58646 data transceiver IC**
- Wideband data output (600 kHz min.)
- Low power consumption: typically 7.5 mA at 5 V
- Low external component count
- ESD hardened

**RFID equipped**
- Mifare® Reader ICs, e.g. MFRC522
- Mifare® Smart Card ICs, e.g. Mifare® Ultralight


WiMax fully integrated transceiver UXA23466


PA UXF26000

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