



Industrial, Connectivity

Secure Prepaid Electricity Meter Reference Design

Overview

This reference design provides a secure prepaid electricity meter with the ability to securely reload an energy balance. The secure element from INSIDE Secure allows for implementation of end-to-end security between the prepaid meter and the utility companies and distributors who sell energy credits. Integrated NFC connectivity allows users to upload energy credits using contactless smart card technology or an NFC phone. Firmware for this reference design is based on the MQX™ real-time operating system. All standard metering values are displayed on the built-in LCD and selectable via the built-in push button. A variety of communication interfaces are available for remote data collecting, making this an idea solution for residential metering.

Key Features

- End-to-end security between the meter, the utility company and energy credit distributors
- Physically secure: Hermetically sealed meter casing via NFC technology
- NFC energy balance reload
- 5–60 amp current range
- 85–264 volt range
- 47–63 Hz frequency range
- Four-quadrant measurement (lead/lag energy)
- Active and reactive energy accuracy: IEC50470-3 Class B, one percent
- Meter constants (imp/kWh, imp/kVAh): 500, 1000, 2000, 5000, 10000



Secure prepaid meter using MK30 MCU



- Line frequency measurement
- Cost-effective shunt resistor sensing circuit implementation
- Cost-effective bill of materials
- Effective implementation of low power modes, including use of the built-in real-time clock
- LCD display with charge pump
- Values displayed on the LCD: V, A, W, VAR, VA, kWh, kVAh, cos ϕ , Hz, time, date
- OBIS identifier on the LCD
- Tamper detection via two tamper buttons or magnetometer (event is stored in memory)
- Built-in push button
- LED pulse outputs (kWh, kVAh)
- Optically isolated open collector output
- IEC1107 infrared hardware interface
- Optically isolated RS232 interface
- MQX-based for advanced markets
- Advanced metering algorithm based on the Fast Fourier Transform (FFT)
- Optional ZigBee® communication

Related Documentation

- Readily available application firmware for balance reloading scheme and related security functions
- Design reference manual: DRM122
- Application note: AN4255
- Quick start guide for MK30 secure meter
- MQX reference manual and user guide
- Device development tools/demo kits
- Device documentation: MK30X256, VaultIC460, NFC (Microread® 3.4)

MK30X256 Microcontroller

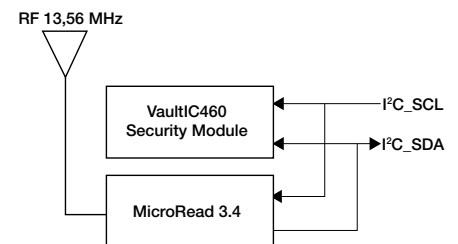
- Up to 100 MHz frequency with 1.25 DMIPS/MHz
- ARM® Cortex™-M4 Core
- 256 KB of program flash memory
- 256 KB of FlexNVM and 4 KB FlexRAM
- 64 KB of SRAM
- 16 independently selectable DMA channels
- Integrated 16-bit SAR ADCs with PGAs
- Two integrated 12-bit DACs
- Programmable 1.2-volt voltage reference
- High-speed analog comparator with 6-bit DAC
- WDOG + external watchdog monitor
- Hardware CRC generator circuit (16/32-bit)
- External bus interface (FlexBus) for external memory, gate-array logic or LCD
- Communications: CAN, I²C, I²S, SDHC, SPI, UART
- Timers: FlexTimers, programmable delay block programmable interrupt timer, low-power timer, carrier modulator timer, RTC
- Human-machine interface touch-sensing, segment LCD

- 10 low power operating modes
- 144-pin LQFP or MAPBGA packages
- -40°C to +105°C operating temperature range

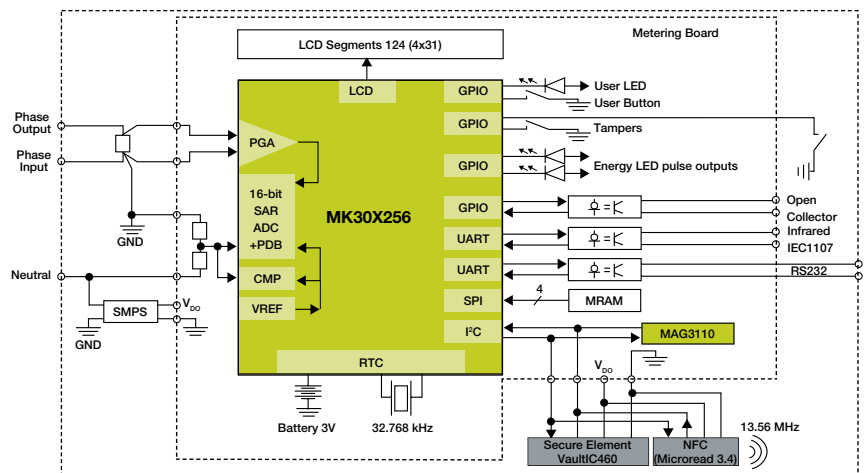
VaultIC™ Secure Element Features

- Tamper resistance
- Secure secret keys and certificates storage
- On-board key generation
- Secure implementation of standards algorithms (i.e. AES, ECC)
- Security functions: Mutual authentication, verify/generate certificate, encryption/decryption
- True random number generation
- Security level evaluation by third party
- FIPS 140-2 Level 3 certified, EAL4+ ready

VaultIC—NFC Connectivity



MK30X Single Phase Secure Meter Block Diagram



■ Freescale Technology ■ Freescale Partner Technology

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