Based on high-performance, 24-bit sigma-delta ADC

Kinetis KM3x MCU Single-Phase Metering Reference Design

OVERVIEW

With the growing consumption of energy worldwide, particularly in the residential market, utility providers need increasingly accurate and cost-effective energy metering solutions. The Kinetis M series single-phase electricity meter reference design addresses these accuracy and cost needs by providing a high-performance analog front end (24-bit AFE) combined with an embedded programmable gain amplifier (PGA) to increase the accuracy of energy measurement, along with a cost-effective shunt sensing circuit implementation and bill of materials (BOM).

The single-phase meter reference design is used for measurement and registration of active and reactive energy in single-phase two-wire networks for direct connection. It is pre-certified according to European EN50470-1, EN50470-3, class B and C, as well as to IEC 62053-21 and IEC 62052-11 international standards for electronic meters of active energy classes 2 and 1. The integrated switched mode power supply (buck converter) enables efficient operation of the meter electronics and provides enough power for optional modules of the meter such NVM memories, for data logging and firmware storage, a low-power, 3-axis Xtrinsic tilt sensor for an electronic tamper detection and an RF communication module for AMR and remote monitoring.

The backup battery is used to power the meter electronics in case of power loss. This battery will activate the meter in case the user button is pressed or a tamper event occurs. The permanent sources of tamper events include two tamper switches protecting the main and terminal covers. An additional optional tamper event is generated by a low-power, 3-axis Xtrinsic tilt sensor. With the tilt sensor populated, metering electronics are powered when coordinates of the installed meter unexpectedly change. The tilt sensor in the meter not only prevents physical tampering but can also power meter electronics to disconnect a house from the mains in case of an earthquake.

The 32-bit MKM34Z128 Kinetis MCU at the heart of the reference design is based on the ARM® Cortex™-M0+ core. This efficient processor core with support for 32-bit math enables fast execution of filter-based metering algorithms.

REFERENCE DESIGN FEATURES

▸ MKM34Z128 Kinetis MCU built on the ARM Cortex-M0+ core

▸ 5 to 80 A current range (nominal current is 5 A, peak current is 80 A)

▸ 85 to 264 V, 50/60 Hz voltage range

▸ Accuracy class: B or C (active energy EN50470-3) and 3 or 2 percent (reactive energy EN62053-23)

▸ Line frequency measurement (for precision zero-cross detection)

▸ Cost-effective shunt-resistor sensing circuit implementation

▸ Low-power modes including the use of built-in RTC (lithium battery backup)

▸ 4 x 22 segment LCD, including charge pump (values shown on LCD: V, A, W, Var, VA, kWh, kVarh, cos F, Hz, time, date)

▸ Single built-in mechanical button as control interface

▸ An upper and lower tamper meter cover monitoring with time stamp stored in meter logbook in external NVM (optional)

- Isolated (4 kV) RS232 port for monitoring, parameterization and firmware upgrade
- LED pulse outputs (kWh, kVarh)
- IEC1107 infrared hardware interface
- RF connector supporting sub-GHz or 2.4 GHz 802.15.4 communications for AMR and remote control (KW01 or KW20 wireless MCU module optional)
- Low-power, 3-axis Xtrinsic tilt sensor for electronic tamper detection (optional)
- EMC proven design (EN61000-4-2, EN610004-4)
- Cost-effective bill of materials (BOM)

## SOFTWARE PROVIDED

- Multiple advanced metering algorithms
  - Filter-based
  - FFT method
- MQX™ real-time operating system
- Comprehensive peripheral library drivers

KM34Z128 MCU FEATURES

- Up to 50 MHz ARM Cortex M0+ core with up to 128 KB flash and 16 KB RAM
- Highest resolution AFE with 4 x 24-bit SD ADC with 94 dB SNR
- Built-in VREF and PGA with low drift over temperature
- Four UART, two SPI and two I²C with IRDA and 7816 support
- Two analog comparators
- Single low-cost 32 kHz crystal for MCU and RTC
- Auto compensated RTC with high-speed calibration with high accuracy and 0.88 ppm resolution (1 Hz output pulse)
- Security with active tamper, memory protection unit
- Up to 4 x 40 and 8 x 36 segment LCD

Kinetis M Series One-Phase Power Meter Reference Design
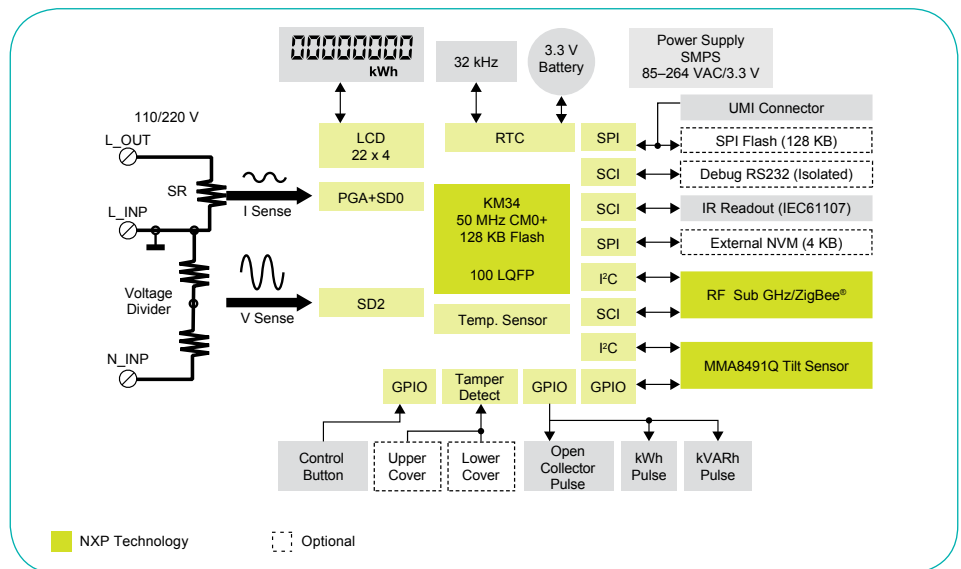
DOCUMENTATION

- Design reference manual
- Filter-based algorithm for metering application
- FFT-based algorithm for metering applications (AN4255)
- Low-level on-chip peripheral drivers
- Hardware schematic diagram
- Reference design quick start guide

RELATED PRODUCTS

KW20 Wireless 2.4 GHz MCUs (Optional)

- Efficient ARM Cortex™-M4 CPU with up to 512 KB flash
- Low RF power consumption TX (0 dBm) 15 mA and RX 15 mA
- Dual PAN and antenna diversity support with +10 dBm output power and –102 dBm sensitivity
- Support IEEE 802.15.4-compliant radio with ZigBee®, 6LowPAN, WirelessHART and ISA 100.11a stacks

KW01 Wireless Sub-GHz MCUs (Optional)

- Efficient ARM Cortex-M0+ CPU with up to 128 KB flash
- Ultra-low-power mode with 1.7 µA/4.3 µs wake-up time
- High RF budget link up to +137 dBm
- Support of WM bus, 802.15.4g/e

MMA8491Q Xtrinsic 3-Axis MEMS Tilt Sensor (Optional)

- Miniature 3 mm x 3 mm QFN
- Low current consumption: 400 nA at 1 Hz sample rate
- 14-bit accelerometer data

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