MSP430F471xx MCUs offer high accuracy, simultaneous sampling and anti-tamper for three-phase e-metering applications.

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MSP430 Product Marketing Engineer
The Energy Landscape

Energy Sources
- **Conventional Energy** (Coal, Oil, Natural Gas, Nuclear, etc...)
- **Renewable Energy** (Solar, Wind, Hydro, Tidal, Fuel Cell, Geo-Thermal, etc...)
- **Energy Harvesting** (Kinetic, Vibration, etc...)

Transmission & Distribution
- Metering & Smart Grid
- Automated Metering Infrastructure
  - Powerline Communications
  - Time of Use Billing
  - Broadband
- Monitoring & Management

Consumption & Usage
- Energy Efficiency Appliances
- HVAC
- Lighting
- Transportation
- Electronics
- Industrial
- Waste
- Water

Make It

Move It

Use It
TI's comprehensive utility metering portfolio drives smarter grid solutions

Processors
- Highly optimized application specific embedded processors, low power RF, power management and RFID

Applications
- Electricity, water and gas metering, power line communications (PLC) and radio frequency (RF) interfaces for Advanced Meter Infrastructure (AMI)

Software Support
- ZigBee
- 6LoWPAN
- WMBUS
- OFDM
- SFSK
MSP430 MCUs for single-phase, three-phase metering applications

- **Hi End 1-Phase**
  - ESP Engine
  - 16MHz
  - 4xSD16_A
  - 32x32 MPY
  - 160-seg LCD
  - 92/116/120kB

- **F47x3**
  - 16MHz
  - 2-Phase

- **Mid Range 1-Phase**
  - ESP Engine
  - 16MHz
  - 3xSD16_A

- **FE42xA**
  - Low End 1-Phase
  - ESP Engine
  - 8MHz
  - 2xSD16

- **F47x4**
  - 16MHz
  - 3xSD16_A
  - 32x32 MPY
  - 160-seg LCD

- **F5xx**
  - 3-Phase w/ Anti-Tamper
  - 16MHz
  - 7xSD16_A
  - 32x32 MPY
  - 160-seg LCD
  - 92/116/120kB

- **F471x6**
  - 3-Phase
  - 16MHz
  - 6xSD16_A
  - 32x32 MPY
  - 160-seg LCD
  - 92/116/120kB

- **F471x7**
  - 3-Phase w/ Anti-Tamper
  - 16MHz
  - 7xSD16_A
  - 32x32 MPY
  - 160-seg LCD
  - 92/116/120kB

- **F5xx**
  - 3-Phase w/ Anti-Tamper
  - 16MHz
  - 7xSD16_A
  - 32x32 MPY
  - 160-seg LCD
  - 92/116/120kB

**5xx Improvement**
- 25 MIPS+
- Up to 256 kB

**Performance**
- Production
- NEW
- Future

**Texas Instruments**
Secure, accurate energy monitoring achieved with F471xx MCU for e-metering applications

**Leading accuracy for precise energy measurements**
- Better than 0.1 percent accuracy rate
- Wide dynamic range of 2400:1 providing support for high and low currents

**Ultra-low power consumption for system reliability**
- Low power support of LCD and real-time clock when running on back-up battery during power outage
- Simpler, more cost effective power supply design due to reduced active power consumption

**Simultaneous sampling and support of tamper detection**
- More robust performance and software development with simultaneous sampling
- 7th sigma delta provides high precision measurements in parallel, such as temp and humidity, and support of tamper detection
F471xx system-on-chip metering solution

MSP430F471xx Microcontroller

- 16-bit RISC Orthogonal MCU
- 16 MHz

Memory
- 92/116/120 kB Flash
- 4/8 kB RAM

Debug
- Real-time JTAG
- Embedded Emulation
- Boot Strap Loader

Power & Clocking
- Clock System:
  - Digital Freq Lock Loop
  - Internal Trim'd LF Osc
  - Internal Digital Ctrl Osc
  - External 32kHz Clock
  - High Freq Crystal Osc
- Power on Reset
- Brownout Reset
- Supply Volt Supervisor

Ultra-low power consumption
- Low Supply Voltage Range 1.8 V to 3.6 V
- Active Mode: 350 μA @ 1MHz (2.2V)
- Standby Mode: 1.1 μA
- Off Mode (RAM Retention): 0.2 μA
- Ultrafast Wake-Up from Standby Mode in < 6 μs

Ultra-fast power consumption
- High performance MCU
  - Only integrated AFE solution with dedicated 16-bit sigma deltas for 3-phase e-metering
  - 62.5ns instruction cycle time

 intelligent integrated peripherals
- Integrated LCD Driver with Contrast Control for up to 160 Segments

7th sigma delta
- F471x7 supports tamper detection
- Can also be used for high-precision measurements like temperature and humidity

Peripherals
- 160 segment LCD
  - Comparator
  - 3 ch internal DMA
  - 32-bit Multiplier
  - 15/16 bit Watch Dog Timer
- Serial Interface
  - 4x USCI (UART, IrDA, SPI, I2C)
- Converters
  - 7x 16-bit Sigma-Delta

Timers
- 1x 16-bit Timer A with 3 cap-comp Regs
- 1x 16-bit Timer B with 3 cap-comp Regs
- Real Time Clock
- 16-bit Basic Timer

Connectivity
- 72 I/Os

F471xx starting at $5.75 @ 1K units
Three-phase e-meter application with F471xx

Diagram showing the connections and components of a three-phase e-meter application with F471xx, including CTs, sources, loads, and various sensor and communication interfaces.
Easy-to-use tools and support jump-start design

- **$75**
  - MSP-TS430PZ100A target board

- **$149**
  - MSP-FET430U100A target board + FET tool

- Application note (includes metrology software and calibration using GUI)

- **E-meter EVM**
  - Includes: sensors & support for RF and Infrared

[Image of Texas Instruments logo]
Backup
F471xx block diagram

Option for 6 or 7 SD16_A peripherals
## Device options

<table>
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<th>New Device</th>
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<th>RAM (KB)</th>
<th># of SD16</th>
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<td>MSP430F47197</td>
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</tbody>
</table>
**SD16_A block diagram**

- Multiple channels
- 30kHz to 1.1MHz modulation frequency
- Modulation frequency divider
- Up to 1024 OSR
- Temperature sensor
- AVCC measure