

# Smart Grid Solutions



TEXAS INSTRUMENTS

## For Power Infrastructure & Industrial Energy Systems

- Grid Infrastructure
- Smart Meters for Electricity, Gas, Water and Heat
- Smart Energy Management for Homes and Buildings
- Wired and Wireless Communication

distribution



transmission



management



communication



measurement

# Smart Grid Solutions Guide

## Introduction



## Engineering a Smarter Grid

### Today's solutions for tomorrow's power infrastructure and industrial energy systems

- Grid Infrastructure
- Smart Meters for Electricity, Gas, Water and Heat
- Smart Energy Management for Homes and Buildings
- Wired and Wireless Communication

With millions of energy-meter ICs shipped over the past decade, Texas Instruments is the global systems provider for innovative, secure, economical and future-proof semiconductor solutions for the worldwide smart grid. TI offers the industry's broadest smart grid portfolio of metrology expertise, application processors, communication systems and analog components in readily available silicon. Advanced software, tools and support are also available to meet the needs of the world's smart energy grid.

## Table of Contents

### Engineering a Smarter Grid

- 2-3 Dedicated Silicon + Optimized Software + Global Support = The Power of TI

### Smart Grid Infrastructure

- 4-5 Data Concentrator Solutions

### Power Line Communications (PLC)

- 5 System Block Diagram and Recommended Products

### Smart Electricity Meter

- 6 Recommended Products

- 7 System Block Diagram and Recommended Products

### Flow Meter

- 8-9 Smart Gas/Water/Heat/Heat Cost Allocator

- 9 Wireless M-Bus Solutions

### Smart Energy Management for Homes and Buildings

- 10 System Solutions

- 11 Recommended Products

### Wireless Connectivity

- 11 Sub-1 GHz, ZigBee®, 6LoWPAN, wM-Bus and Wi-Fi® Solutions

### Signal Chain and Power Management

- 12 Analog Products

- 13 Power Management Products

### Development Tools

- 14-17 Smart Grid Development Tools

# Engineering a Smarter Grid

Dedicated Silicon + Optimized Software + Global Support = The Power of TI

Across the smart grid application spectrum, TI supports every stage of the design process, from device selection and software development to tools and system solutions.

## Electric Meter Metrology

Solutions that meet ANSI C12.20 and IEC 62053 standards, Class 0.2 and 0.5:

- Single-phase System on Chip (SoC): MSP430F673x and MSP430AFE2xx
- Three-phase SoC: MSP430F677x
- Dedicated analog front ends: ADS13xx

## Flow Meter Metrology

Dedicated Automatic Meter Reading (AMR) solutions for increased accuracy and ultra-low-power performance:

- Water/heat meter MCU (with Scan IF): MSP430FW42x

## Applications Processors

Industry standard microcontrollers and microprocessors:

- Tiva™ C Series ARM® Cortex™-M4 microcontrollers: TM4C123x – 80 MHz, up to 256KB flash
- Sitara™ processors: AM335x with Cortex-A8 core, up to 1 GHz
- Powerful SoC DSP + ARM
- MSP430™ Microcontrollers: MSP430F5xx/6xx – ultra-low-power, up to 512KB

## Power Line Communications (PLC)

Complete, certified and field-tested PLC modems for all narrowband PLC standards:

- PRIME, G3, IEEE-P1901.2, ITU G.9903
- TI PLC reference designs for both meter end points and data concentrators

## Wireless Connectivity

TI produces the best performing RF solutions for wide-area and home-area networks:

- CC112x: Narrowband transceivers in the ISM band, down to 6.25-kHz channels
- CC12xx: Broadband transceivers in the ISM band, data rates up to 1 Mbps
- CC2538: SoC for ZigBee®, Smart Energy with ARM Cortex-M3

- CC3000: SimpleLink™ Wi-Fi® module solution is self-contained and integrates total Wi-Fi connectivity, including Wi-Fi access point
- WiLink™ 8 solutions are highly integrated and support Wi-Fi, Bluetooth® on a single chip.
- Bluetooth/Bluetooth low energy: CC256x dual-mode controller, CC254x Bluetooth low energy devices.

TI wireless semiconductors are complemented by protocol stacks and application profiles supported by TI, including ZigBee PRO and ZigBee/IP, Smart Energy Profile, Wireless M-BUS and 6LoWPAN.

## Prepayment Systems

RFID technology supporting ISO 14443A/B, ISO 15693, MIFARE™ and Near-Field Communications (NFC) provides complete silicon and software stack solutions:

- TRF7970A transceiver
- RF430CL NFC smart interface tag

## Power Management

TI provides optimized power-management solutions for all smart grid applications (including offline, isolated AC/DC to non-isolated DC/DC) with the widest range of integration and performance options available.

See Power tables for AC/DC, DC/DC, LDO, PMIC and more on page 13.

## Development Tools

Robust and fully tested solutions with one-to-many approach—Industry-leading smart-meter board for development, ZigBee and power line communication large-node network test—and more.

## Logistics

Expertise with large-scale production ramps—TI production, assembly and test sites are auditable.

## Quality

TI meets high-volume, high-quality requirements with expertise in manufacturing.

## People

TI provides dedicated application teams for hardware and software that support complete analog and digital system solutions in grid infrastructure, metrology, PLC and RF connectivity.

## External Representation

TI maintains an active presence in global regulatory bodies, including:

- Bluetooth SIG
- ETSI
- EcoNet Consortium
- Euridis
- EU-US Smart Grid Coordination Group
- G3-PLC Alliance
- IEEE 802.15.4/IEEE 802.15.4g Smart Utility Network (SUN) wireless standard
- Home Plug Alliance
- IEEE P1901.2 narrowband PLC standard
- IPSO Alliance (6LoWPAN)
- ISO/IEC JWG CI (PEV)
- ITU-T Focus Group on Smart Grid
- ITU-T G.9901, G.9902, G.9903, G.9904 narrowband PLC standard
- KNX Alliance
- PRIME Alliance
- SAE PHEV Committee
- Smart Grid Interoperability Panel (NIST)
- Wi-Fi Alliance
- ZigBee Alliance
- WiSUN



**TI E2E™  
Community**

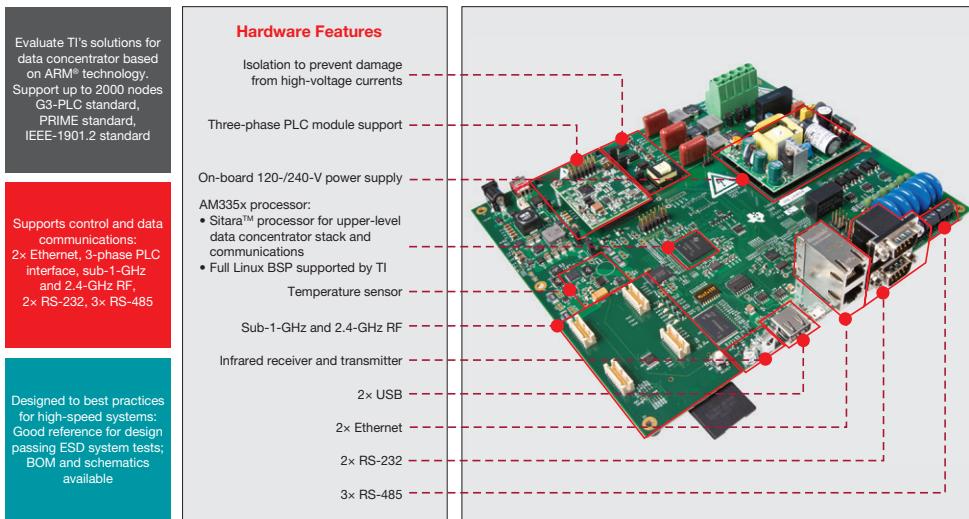
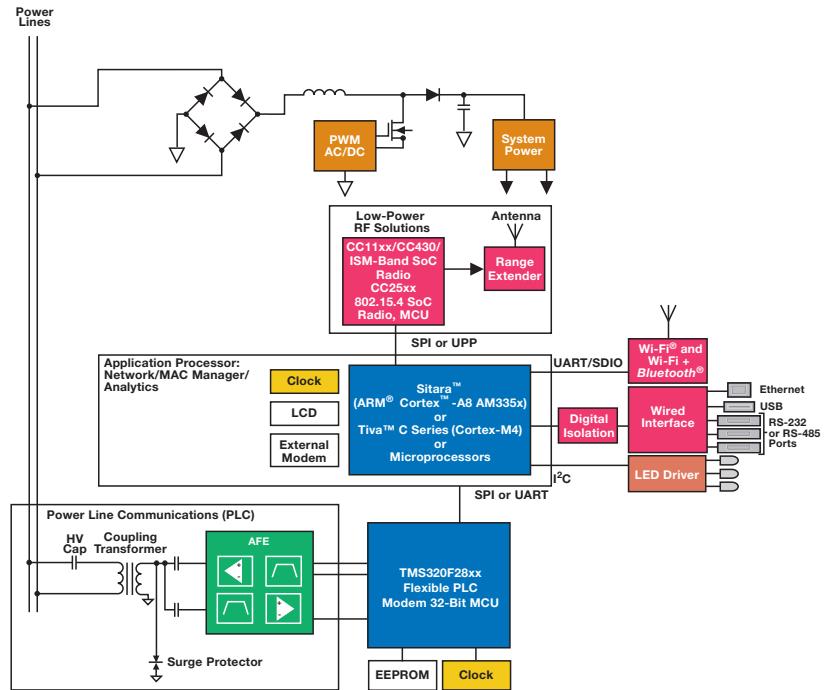
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solving problems

[www.ti.com/smartygrid-blog](http://www.ti.com/smartygrid-blog)

# Smart Grid Infrastructure

## Data Concentrator Solutions

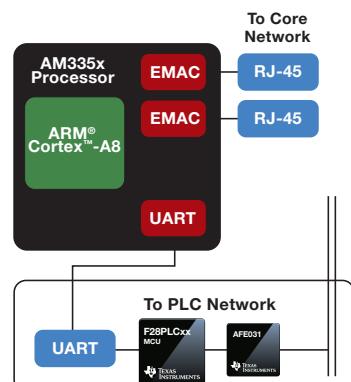
Automatic metering infrastructure (AMI) and automatic meter reading (AMR) provide the necessary means to measure, analyze, collect energy usage and communicate that data to a central database for billing, troubleshooting, and analyzing. It would not be practical, technically as well as economically, for all meters to directly communicate with utility servers. Data concentrator applications are important nodes in the AMI and are networked with several utility meters and central utility servers. These nodes enable communication of the data between the meters and the utility servers. Data-concentrator nodes at several points in the infrastructure securely aggregate data from a manageable number of meters and sends it to the utility servers.



The communication mode largely depends on the power infrastructure and can be either wired or wireless. Wired communication is comprised of Power Line Communication (PLC) and in some cases with serial or Ethernet-based communication where PLC is not suited for the infrastructure. The wireless mode is comprised of mainly low-power RF (IEEE 802.15.4g protocol) communication and in some cases the existing cellular network. The communication from the concentrator to the utility servers can be via Ethernet, GSM, GPRS, WiMAX or telecom networks.

## Products for Data Concentrators

Description/Device	Key Benefits
<b>Sitara™ processors (AM335x Series)</b>	<ul style="list-style-type: none"> <li>Up to 1-GHz Cortex-A8 32-bit RISC microprocessor</li> <li>Extensive peripheral set (2x Gbit-Ethernet, CAN, USB, 8x UARTs extended from PRU, ...)</li> <li>Flexible communication protocols</li> <li>Linux® community, Android®, Windows® Embedded CE, DSP/BIOS™ Real-Time Kernel and RTOS ecosystem of development partners</li> </ul>
<b>Tiva™ C Series ARM Cortex-M4-Based MCUs (TM4C123x Series)</b>	<ul style="list-style-type: none"> <li>Up to 80-MHz core</li> <li>256KB single-cycle flash, 32KB single-cycle SRAM</li> <li>Rich interface featuring 8x UARTs, USB, CAN, up to 43 GPIOs, etc.</li> <li>2x 12-bit ADC with 12 analog input channels</li> </ul>
<b>C2000™ 32-bit real-time MCUs Piccolo™ Floating-Point Series</b>	<ul style="list-style-type: none"> <li>PLC accelerators</li> <li>Integrated real-time control peripherals</li> <li>Support multiple PLC modulations</li> </ul>



Get more information: [www.ti.com/solution/data\\_concentrator](http://www.ti.com/solution/data_concentrator)

# Smart Grid Infrastructure

## Signal Chain and Power Products

Device	Description
SimpleLink™ CC1200	Low-power, high-performance RF transceiver
SimpleLink CC1120	High-performance RF transceiver for narrowband systems
UCC28710/700	PWM controller with/without integrated 700-V startup switch, constant-voltage, constant-current controller with primary-side regulation, QR green mode, optocoupler less feedback, very-low no-load power, high efficiency
LM3671	2.7-V to 5.5-V input, 600-mA output, 2-MHz step-down DC-DC converter optimized for powering low-voltage circuits
TLV62080	2.5-V to 5.5-V input, 1.2-A step-down converter in 2x2-mm package with high efficiency over wide output-current range
ADS8558/7/6	12/14/16-bit, 6-channel, simultaneous-sampling SAR ADC, supports up to 730 kSPS in parallel interface mode, up to 91-dB SNR
ADS131E04/06/08	4/6/8-channel, up to 24-bit ΔΣ, simultaneous sampling AFE for relay protection, power monitoring, power quality, up to 64 kSPS, 107-dB SNR

See more Signal Chain and Power recommendations on pages 12 and 13.

## Power Line Communications (PLC)

Power Line Communications (PLC) technology is being adopted by electric utilities around the world for their Advanced Metering Infrastructure (AMI) and Home Area Networks (HANs). PLC offers the advantage of reusing existing infrastructure to lower costs, retain reliable performance and maintain scalability to larger network sizes.

Modern PLC networks utilize OFDM modulation techniques to increase data throughput and improve reliability in inherently noisy environments such as electric grids. Texas Instruments has long been a pioneer in developing OFDM communications technology.

TI's PLC modems provide the best performing platform for today's Smart Grid networks due to this legacy of OFDM expertise and TI's modems are being deployed by utilities around the world.

For smart meter OEMs, TI's PLC solutions provide the flexibility of a single hardware and software design that can support multiple standards and therefore a single global platform. This will greatly reduce research and development costs and speed time to market.

### Integrated Analog Front End (AFE)

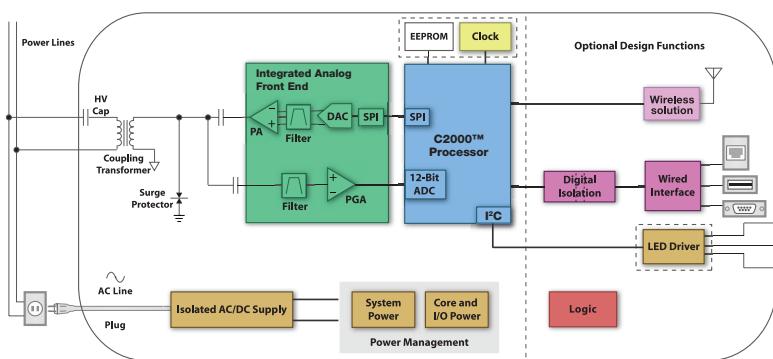
TI's new AFE032 is a low-cost, integrated AFE device capable of transformer-coupled connections in a PLC system and can be controlled by a digital signal processor (DSP) or microcontroller. This AFE is suited for driving high-current, low-impedance lines with up to 1.9 A into a reactive load.

### PLC Standards Support

PLC Standard	Frequency Band	TI Chipset
PRIME, G3 or IEEE-P1901.2	CENELEC	TMS320F28PLC83 + AFE03x
G3	FCC, ARIB	TMS320F28M35 + AFE032
IEEE-P1901.2	FCC	TMS320F28M35 + AFE032

### TMDSPLCKIT-V3 C2000™ Power Line Modem Developer's Kit

- Two PLC modems
- PRIME, G3 or IEEE P1901.2 PLC software
- Zero config GUI PLC diagnostic tool
- Built-in USB JTAG emulation
- Includes Code Composer Studio™ Integrated Development Environment
- Connect to TI Data Concentrator Development tool TMDSDC3359
- Plug-In System-On-Module (SOM) available  
(See page 15)



Power Line Communication Modem System



Learn more at [www.ti.com/plc](http://www.ti.com/plc)

# Smart Electricity Meter

Electric meter requirements around the world are rapidly evolving in response to market forces and governmental regulations that mandate Smart Grid deployments in most areas of the globe. Smart Grid applications such as dynamic pricing, demand response, remote connect and disconnect, outage management, network security and reduction of non-technical losses are driving the need for increasing technological sophistication in today's smart electric meters.

## Metrology

At the heart of any smart meter is the basic energy measurement function. It is critical that utilities and consumers can rely on the accuracy, security and reliability of this metering capability. Energy-measurement products from Texas Instruments are designed to meet all of the requirements of ANSI C12.20 and IEC 62053 accuracy for Class 0.2 and Class 0.5 meters across the entire temperature range and with a full 2000:1 dynamic input range.

Protecting meter integrity is a key to reducing non-technical losses in the field. TI's electric meter metrology solutions include sophisticated anti-tampering protection.

## Host Processors

Host processors for meters must be able to support the multiple applications and external interfaces required in smart meters today. Data management applications for meters such as DLMS/COSEM and communication stacks such as ZigBee® Smart Energy and wireless M-Bus are all evolving to require more memory and increased processor performance.

## Advanced Meter Infrastructure (AMI) Solutions

AMI networks require robust communications between the individual meters and the data concentrators which aggregate meter data in a neighborhood area before sending that information to the utility's central office through a backhaul link. AMI networks are either RF (mesh or star topology) or Power Line Communications (PLC). The choice between RF or PLC networks is usually driven by grid topology and geographical environment because these factors have enormous influence on network performance and infrastructure cost. TI's solutions for AMI networks span both RF and PLC. These solutions also support most industry standards, including IEEE-802.15.4g, PRIME, G3, IEEE-P1901.2 and ITU-G.990x.

## RFID and NFC

RFID systems using Near Field Communication (NFC) are an attractive way to deploy pre-payment. TI's solutions cover the entire NFC ecosystem that includes a complete line of ultra-low-power transceiver devices and a broad offering of dynamic and static tags. Low-cost, easy-to-use hardware and software solutions lower barriers to using NFC designs that can achieve added connectivity, more flexibility and faster time to market. Learn more at: [www.ti.com/rfid](http://www.ti.com/rfid) and [www.ti.com/nfc](http://www.ti.com/nfc)

## Metrology Products

Device	Key Benefits
<b>MSP430F673x SoC</b>	Single-phase SoCs with 128KB flash, 320-segment LCD controller, anti-tamper protection, standby power consumption less than 500 nA, TI's Energy Library firmware
<b>MSP430F677x SoC</b>	Three-phase SoCs with 512KB flash, 320-segment LCD controller, anti-tamper protection, standby power consumption less than 500 nA, TI's Energy Library firmware
<b>MSP430AFE2xx</b>	Analog front end with six 24-bit sigma-delta channels, 103-dB performance, integrated PGA and internal reference

## Host Processors

Device	Key Benefits
<b>Tiva™ C Series LM4Fx Cortex™-M4 MCUs</b>	80-MHz, 256KB flash, low-power RTC, TivaWare™ for C-Series driver library pre-loaded into every device
<b>Sitara™ AM335x Processors</b>	Up to 1 GHz, three-level cache memory, DDR2 and low-power DDR, complete Linux® board support package

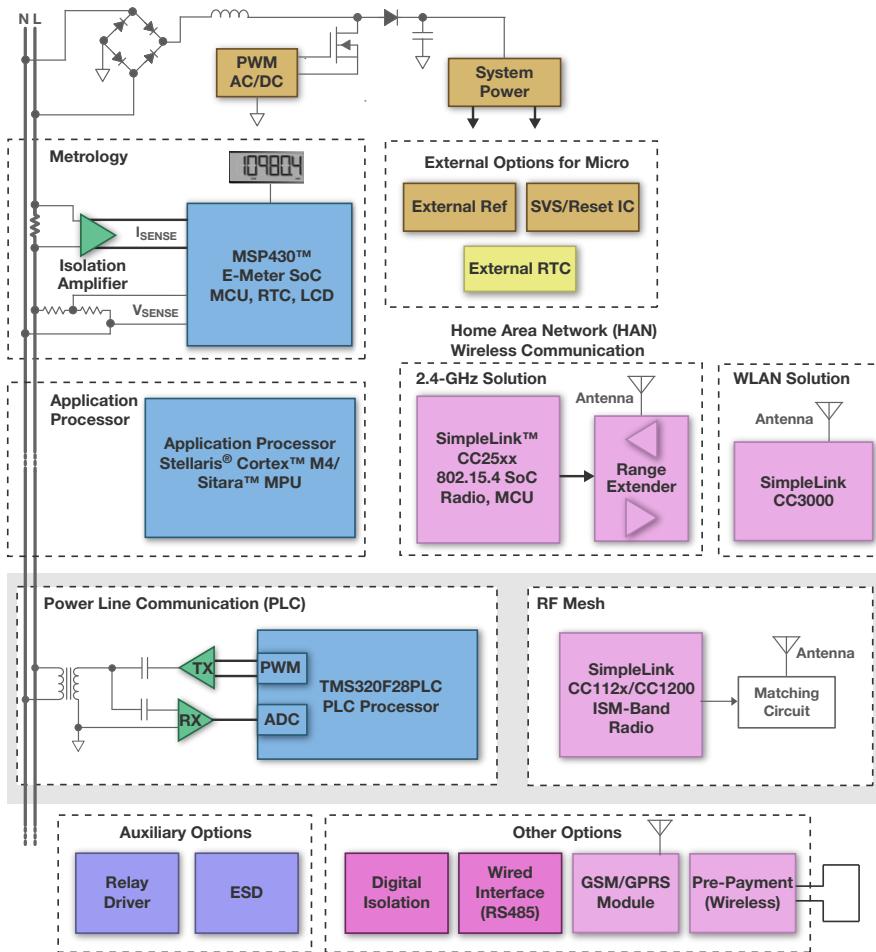
## Wireless Connectivity Products

Device	Key Benefits
<b>SimpleLink™ CC1120</b>	<ul style="list-style-type: none"><li>Ultra-low-power transceiver for narrowband systems</li><li>Channel spacing down to 12.5 kHz</li><li>170/315/433/868/915/950-MHz ISM/SDR bands</li><li>IEEE 802.15.4g, ETSI, FCC and ARIB regulatory compliance</li><li>Excellent receiver sensitivity: -123 dBm at 1.2 kbps, -110 dBm at 50 kbps</li><li>64-dB adjacent channel selectivity at 12.5-kHz offset</li><li>Only 2-mA consumption in RX Sniff Mode</li></ul>
<b>SimpleLink CC1200</b>	<ul style="list-style-type: none"><li>High-performance transceiver for broadband systems</li><li>Up to 1 Mbps in transmit and receive</li><li>169/433/868/915/920-MHz ISM/SDR bands</li><li>Dedicated package handling for 802.15.4g</li><li>ETSI, FCC and ARIB regulatory compliance</li><li>Excellent receiver sensitivity: -123 dBm at 1.2 kbps, -110 dBm at 50 kbps</li><li>60-dB adjacent channel selectivity at 12.5-kHz offset</li><li>Only 2-mA consumption in RX Sniff Mode</li></ul>
<b>SimpleLink CC2538 SoC and CC2520 2.4-GHz Transceiver</b>	<ul style="list-style-type: none"><li>Complete 2.4-GHz ISM SoC with ZigBee® PRO/SE application profile software</li><li>Robust link budget and best-in-class selectivity for noisy RF environments</li><li>Improve range with CC259X PA/LNA front end</li></ul>

## RFID and NFC

Device	Key Benefits
<b>RF430CL NFC Smart Interface Tag</b>	Dynamic NFC transponder for service interface <ul style="list-style-type: none"><li>ISO14443B RF compliant and NFC Tag Type-4 compliant</li><li>Up to 848-kbps transfer rate with serial interface to MCU</li></ul>
<b>TRF7970A Transceiver</b>	Multi-protocol fully integrated 13.56-MHz RFID/NFC transceiver IC for prepayment <ul style="list-style-type: none"><li>ISO 14443A/B, ISO 15963 support and NFCIP-1, NFCIP-2</li><li>Peer-to-peer, card emulation, reader/writer functionality</li><li>TI-supported firmware stack for MIFARE™, NFC</li></ul>

# Smart Electricity Meter



Smart E-Meter System

## Analog Products

Device	Description	Application	Optimized Solution
<b>UCC28910</b>	PWM HV switcher with 700-V integrated power FET and primary-side regulation. The UCC28910 is dedicated to flyback power supplies and provides isolated output voltage and current regulation without the use of an optical coupler	AC/DC supply	E-meter, data concentrator, grid infrastructure
<b>TPS5401</b>	Cost-optimized 42-V, 0.5-A step-down DC/DC converter; cap-drop off-line power supplies	Step-down regulator	Low-cost cap-drop solution
<b>TPS54227/327</b>	4.5-V to 18-V input, 2-A and 3-A output respectively; DC/DC step-down converter, adaptive on-time D-CAP2™ enables high efficiency over load range, fast transient response, allows use of low ESR caps, adjustable soft start	Step-down regulator	E-meter, data concentrator, grid infrastructure, general system supply
<b>SN65HVD3082/85/88</b>	200-kbps/1-Mbps/20-Mbps capable, half-duplex transceivers, operate with very-low supply current	RS485 interface	E-meter, data concentrator, grid infrastructure
<b>ISO7131</b>	3-channel, small-footprint, digital isolators provide galvanic isolation up to 2500 V <sub>RMS</sub> for 1 minute per UL and 4242 V <sub>PK</sub>	Digital isolation	E-meter, data concentrator, grid infrastructure

See more Power and Signal Chain recommendations on pages 12 and 13.



## Smart Meter Board (SMB)

The SMB is a modular development platform incorporating key TI Smart Grid devices to demonstrate the capabilities of a smart meter. SMB is a unique tool that performs energy or electricity metering and it also has the capability of transferring key metering data via wired PLC and wireless (Wi-Fi®, ZigBee®, Sub-1 GHz). It is designed to showcase a simple system for automatic meter reading (AMR) and automatic metering infrastructure (AMI). Watch video at [www.ti.com/smb3](http://www.ti.com/smb3)



**TIDesigns**

TI Designs Reference  
Design Library

[www.ti.com/tidesigns](http://www.ti.com/tidesigns)



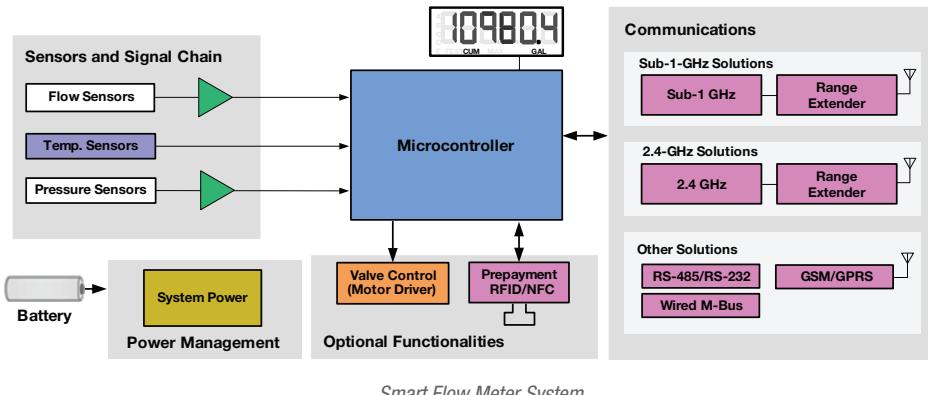
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Community**

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solving problems

[www.ti.com/smartygrid-blog](http://www.ti.com/smartygrid-blog)

# Flow Meter

## Smart Metering for Gas/Water/Heat/Heat Cost Allocator



### Smart Gas/Water/Heat Meter Products

Function	Part Number	Key Features	Category
<b>Ultra-Low-Power Microcontrollers</b>			
MSP430F448/F449 (48/60-KB Flash)	MSP430F417	32KB flash, 96-seg LCD	General Purpose
	MSP430F448	48/60KB flash, 160-seg LCD, 2 USARTs, hardware multiplier, temp sensor	Dedicated Flow-Meter Devices
	MSP430FW429	60KB flash, LCD, scan interface peripheral for rotation detection under low-power mode (supports multiple types of sensors)	Embedded FRAM
	MSP430FR5969	Next-generation MCU platform with embedded FRAM	
Apps Processor	MSP430F6736	128KB flash, 320-seg LCD, RTC with battery backup, power management	High Performance
	MSP430F6638	256KB flash, 160-seg LCD, RTC with battery backup	
	MSP430F6779	512KB flash, 320 segment LCD, RTC with battery back-up power management	
MCU + RF System-on-Chip (SoC)	CC430F6147	Sub-1-GHz SoC, LCD; CC1101 transceiver, MSP430™ MCU	MCU + RF SoC
<b>Connectivity</b>			
Sub-1 GHz	SimpleLink™ CC1101	Transceiver; low cost, low power; -116-dBm sensitivity	Proprietary RF w/M-Bus
	SimpleLink CC1120	Transceiver; high performance, narrowband, -123-dBm sensitivity	
	SimpleLink CC1175	Transmitter; high performance, narrowband, 16-dBm TX power	
	SimpleLink CC110L	Transceiver; cost-optimized, -116-dBm sensitivity	
	SimpleLink CC1190	RF front end; 27-dBm (0.5-W) TX power	Range Extender
2.4 GHz	SimpleLink CC2510	Low-cost SoC; 8051 MCU (up to 32KB flash), -103-dBm sensitivity	Proprietary RF
	SimpleLink CC2520	Transceiver; 8051 MCU (up to 256KB flash), -98-dBm sensitivity	ZigBee®/IEEE 802.15.4
	SimpleLink CC2530	SoC; 8051 MCU (up to 256KB flash), -97-dBm sensitivity	
	SimpleLink CC2538	SoC; Cortex™-M3 MCU (up to 512K flash, 32K RAM)	
	SimpleLink CC2590	RF front end; cost-effective, for low-power apps, 14-dBm TX power	Range Extender
	SimpleLink CC2591	RF front end; cost-effective, for low-power apps, 22-dBm TX power	
	WL18xx	Transceiver module, integrated Wi-Fi® + dual-mode Bluetooth®, MIMO, extended range, Wi-Fi direct concurrent operation	Wi-Fi
Wired M-Bus	TSS721A	Transceiver module, self-contained Wi-Fi network processor, one-step configuration for Internet	Wired M-Bus
<b>Power Management</b>			
PMIC	TPS65290	Power management IC for gas/water meters	Gas/Water Meter
	TPS65250	Power management IC with "last gasp" storage and release circuit	E-Meter
Step-Down Regulator	TPS62730	Step-down converter with Bypass Mode for ultra-low-power wireless applications	Flow (Gas/Water) Meters
	TPS62740	Ultra-low $I_{Q}$ , step-down converter for low-power wireless applications	Flow (Gas/Water) Meters

For other Analog and Power Management Solutions, see pp 12-13.

### Additional Smart Functionalities

Prepayment (RFID/NFC)	TRF7960A	RFID/NFC reader/writer IC; fully integrated protocol handling	RFID/NFC
	TRF7970A	RFID/NFC transceiver IC (supports reader/writer, peer-to-peer and card-emulation modes); fully integrated protocol handling; compliant to NFC standards NFCIP-1 and NFCIP-2	
Valve Control (Motor Driver)	DRV8830	Secure I <sup>2</sup> C control interface; up to 1-A continuous current with inrush protection	Brushed
	DRV8832	Speed regulation: Constant speed over lifetime of battery	
	DRV8833	Up to 3-A continuous current with inrush protection	Brushed/Stepper
	DRV8835	Up to 3-A continuous current in a 2 x 3-mm package; split $V_M/V_{CC}$ supplies	
	DRV8836	Tiny 2 x 3-mm package; dedicated sleep pin; 40-nA sleep current	
	DRV8837	Up to 1.8-A continuous current in a 2 x 2-mm package; split $V_M/V_{CC}$ supplies	Brushed

# Flow Meter

Smart Metering for Gas/Water/Heat/Heat Cost Allocator

**Complete system solution for battery lifetime optimization:**  
Sensing, MCU, Power, Communication and Software

## TI Flow Sensing Solutions

Sensing Techniques	Sensor Type	TI Solution	Benefits	Actions
Rotation Detection	<ul style="list-style-type: none"> <li>LC sensors</li> <li>Magnetic Sensors (Resistor ladder, GMR sensors)</li> <li>Optical sensors</li> </ul>	Flexible solution based on AFE + TDC + MCU + SW optimized combo	<ul style="list-style-type: none"> <li>Continuous flow measurement in low power mode</li> <li>5X less power consumption compared to equivalent software implementation</li> </ul>	
Ultrasonic Time of Flight (ToF)	Piezo ceramic PMUT, CMUT	Flexible solution based on AFE + TDC + MCU + SW optimized combo	<p>Ultra-low-noise signal chain:</p> <ul style="list-style-type: none"> <li>Offers customizable system to meet various system requirement</li> <li>Enables system differentiation for developers</li> <li>Provides optimized combination for accuracy and low power</li> </ul>	
Others	Magneto Inductive (MID)	ADC tuned for MID	<ul style="list-style-type: none"> <li>High input impedance</li> <li>24-bit dynamic range</li> <li>Fast wake-up</li> <li>Ultra-low standby current</li> </ul>	

## Wireless M-Bus Solutions

Hardware and Software Support for Both 169 MHz and 868 MHz

### Key Features

- Best blocking and selectivity performance for a robust and cost-optimized solution
- Packet loss reduction mechanism to improve battery lifetime
- “RX Sniff” mode maintains best RF performance in RX while reducing power consumption
- Optimized DC/DC energy management solution for extending battery lifetime
- Analog, digital, software evaluation kits immediately available
- See TI’s wM-Bus Guide  
[www.ti.com/wmbus](http://www.ti.com/wmbus)
- wM-Bus tool page  
[www.ti.com/tool/wmbus](http://www.ti.com/tool/wmbus)

### wM-Bus Hardware and Software Kits

Frequency Band	Microcontroller	Radio		Software
		Option 1: General	Option 2: High Transmit Power	
868 MHz	SimpleLink™ (CC1120): CC1120DK SimpleLink (CC1200): CC1200DK SimpleLink (CC11XL): CC11XL Includes TrxEB (MCU, USB I/F, LCD, accelerometer, light sensor)	(CC1101): CC1101EMK868-915 or (CC110L): CC110LEM-868-915-RD or (CC1120): CC1120EMK-868-915 or (CC1200): CC1200EMK-868-930	SimpleLink (CC1120 + CC1190): CC1120-CC1190EM868	wM-Bus Stack
	(CC430F6147): EM430F6137RF900	—	—	
169 MHz	SimpleLink (CC1120): CC1120DK	CC1120EMK-169	SimpleLink (CC1120 + PA): CC112XSKY65367EM-RD + 30 dBm	

### Power Management EVMs for wM-Bus

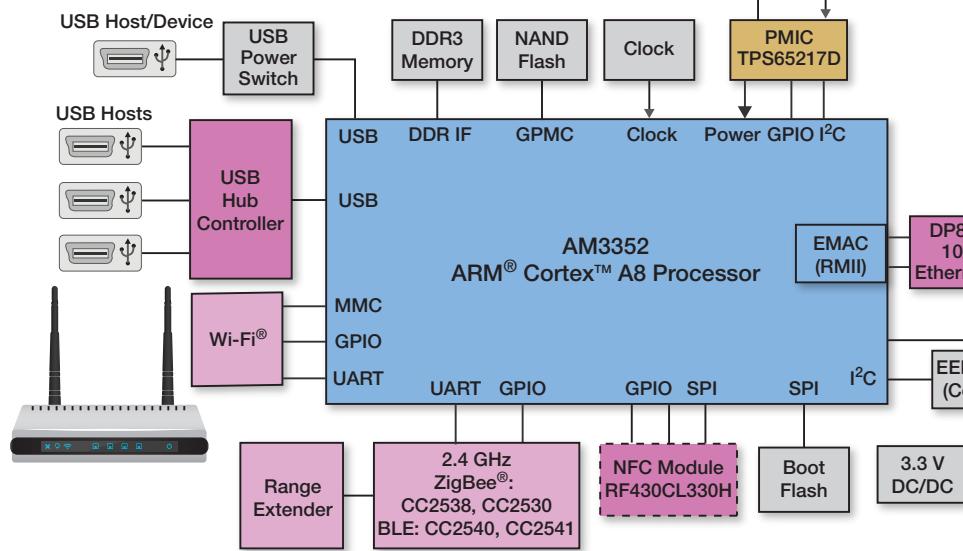
Issue to Address	Solution	Evaluation Tool
Efficient power supply from primary batteries (Supports all MCU+RF kits listed above)	TPS62730	TPS62730EVM
High-power supply (RFPA)	TPS62065/67	TPS62065-67EVM-347
Capacitor-based battery assistance	TPS61251	TPS61251EVM-517
Ultra-low-power step-down converter	TPS62740	TPS62740EVM-186

# Smart Energy Management for Homes and Buildings

TI offers complete system solutions for measurement, management and communication of energy systems for smart homes and buildings

## Smart Energy Gateway/Hub Solution

- Large software foundation for base-line validation
- Enable seamless profile integration for smart energy, lighting and building automation
- Easier coexistence validation



Reference Design

**TIDesigns**

TI Designs Reference Design Library

[www.ti.com/tidesigns](http://www.ti.com/tidesigns)

## Sensor Network

TI provides connectivity solutions for sensors:

**Longevity:** High idle-power consumption and frequent “listening” reduce lifetime of device battery

- TI implements 802.15.4e to increase battery life to >10 years

**Reliability:** Noise and instability in wireless channels and slow recovery

- TI implements TSCH and compensated RF with PLC >99.999% data reliability

**Coverage:** Many “hops” needed to cross large area or long distance inside building for “flat” network

- TI implements PLC/RF combo nodes for seamless hybrid communications

**Scalability:** Extend network size from 100s to 1000s with “plug and play”

- TI implements standard IPv6 with RPL for complete mesh formation in less than one second

## Sub-Meter Class 0.5 Single-Phase Metrology, Analog-Front-End Evaluation Module

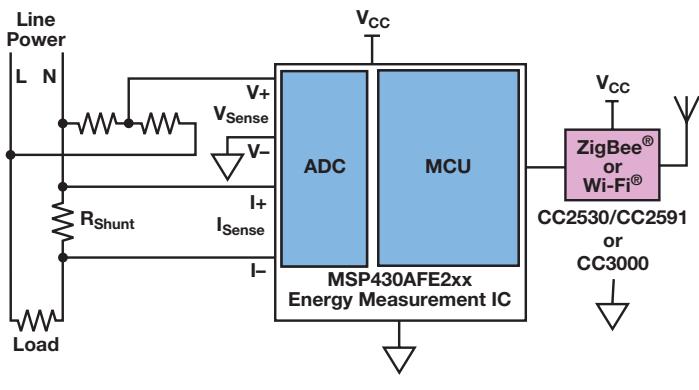
- Single-phase, Class 0.5 electricity meter/sub meter
- 24-bit sensor input with AMI capability and RF interface: ZigBee®, wM-Bus/<1 Ghz and Wi-Fi®/PLC via UART
- Software features: 1-phase 0.5% energy library and anti-tampering

(Read more on page 14)



## Sub-Metering/Smart Plug Solutions

- Sub-0.5% accuracy metrology solution
- Easy wireless connection
- Reference design



Smart Plug Solution

# Smart Energy Management for Homes and Buildings

## Smart Home and Building Products

Device	Description
<b>Host Processors</b>	
AM335x Cortex™-A8	Powerful and scalable host-processor for home gateways and high-end in-home displays
MSP430F543xA	Host processor with up to 256KB flash for applications such as a simple in-home display
<b>Energy Measurement ICs</b>	
MSP430AFE2xx	Single-phase energy measurement IC for sub-meters
MSP430F471xx	Poly-phase energy measurement IC that can also be used for multi-outlet smart power strips and PDUs
<b>Communication</b>	
SimpleLink™ CC2520/2538/2530	2.4-GHz transceivers and SoCs for ZigBee® and 802.15.4-based communications
SimpleLink CC11xx	Sub-1-GHz transceivers for backhaul and proprietary HAN communication
WiLink™ 8 WL18xx	High-performance, power-optimized 8.02.11 b/g/n and dual-mode Bluetooth® on a single chip; extended range, high throughput and multi-channel, multi-role features
SimpleLink CC3000	802.11 b/g solution for Wi-Fi® implementation without previous Wi-Fi or RF experience
SimpleLink CC1200	SimpleLink CC1200 low power, high performance RF transceiver
SimpleLink CC1120	High performance RF transceiver for narrowband systems
SimpleLink CC2591	Radio PA/LNA for extended range
TPS650250	Low-cost power-management IC for the AM335x processor
DP83848J	Ethernet PHY (10/100 Mbps) for home-gateway application

## Wireless Communication

TI's wireless solutions for Smart Grid communication include more options to create infrastructure, smart meters, and home automation systems.



Get more information:  
[www.ti.com/connectmore](http://www.ti.com/connectmore)

## Wireless Connectivity Solutions for Smart Grid

### Sub-1 GHz

[www.ti.com/rfperformanceline](http://www.ti.com/rfperformanceline)

- CC1200: Broadband transceivers, sub-1 GHz with data rates up to 1 Mbps
- CC1120: High-performance RF transceiver for Narrow-band systems
- CC110L: Low-cost RF transceiver for cost-sensitive systems
- CC430: Enables smarter RF solutions with MSP430™ MCU plus low-power RF IC
- Sub-1 GHz enables long-range communications that support communication distances of several kilometers

### ZigBee® (IEEE 802.15.4)

**ZigBee PRO** [www.ti.com/zigbee](http://www.ti.com/zigbee)

- Complete hardware and software for the ZigBee-Compliant Platform (ZCP), certified by a ZigBee alliance-approved test house
- Free IEEE 802.15.4 MAC software and golden unit status Z-Stack™ protocol stack
- High-performance CC253x radio offers excellent coexistence with WLAN, Bluetooth® and other 2.4-GHz solutions
- Smart-energy and home-automation application profiles and support
- Range extenders available for CC2590 and CC2591
- Development kits and tools

### 6LoWPAN

[www.ti.com/6lowpan](http://www.ti.com/6lowpan)

- Gateway for remote, low-cost wireless sensors to connect to the Internet and a wireless extension of wired IPv6 infrastructures
- Sub-1-GHz product family includes the CC1180 network processor, CC430 complete system-on-chip (SoC), CC1101/MSP430F5xxx platform and 6LoWPAN software stacks
- Supports large-scale mesh networks and applications such as smart grid, security, building automation, street lighting and other wireless sensor networks
- Available range extender for CC1190

which supports both analog and digital peripherals

- Other Bluetooth options: CC256x Bluetooth/Bluetooth low-energy dual mode for short-range, portable applications; WiLink™ Wi-Fi® plus Bluetooth/Bluetooth low-energy dual mode for high performance WLAN

### Wi-Fi

[www.ti.com/wifi](http://www.ti.com/wifi)

- SimpleLink™ CC3000: Self-contained 802.11 b/g solution enables easy-to-implement Internet connectivity with SmartConfig™ technology; embedded Wi-Fi and networking software including drivers, stack and supplicant; allows Wi-Fi implementation quickly without previous Wi-Fi or RF experience
- WiLink combo solutions: WL18xx modules integrate high-performance 802.11 b/g/n and dual-mode Bluetooth platform on a single chip with best-in-class coexistence technology and power optimization
- TI's WLAN technology allows secure, high-throughput, extended-range, multi-channel and multi-role performance and reliable Wi-Fi connectivity of electronic devices to each other, the Internet and wired networks

(See wireless development tools on page 16.)

# Signal Chain and Power Management Solutions

## Analog Products

Device	Description	Type	Application
<b>Digital Isolation</b>			
<b>ISO7131</b>	3-channel, small-footprint digital isolators provide galvanic isolation up to 2500 V <sub>RMS</sub> for 1 minute per UL and 4242 V <sub>PK</sub>	Digital Isolation	E-Meter, Data Concentrator, Grid Infrastructure
<b>ISO7140/41</b>	4-channel, small-footprint digital isolators provide galvanic isolation up to 2500 V <sub>RMS</sub> for 1 minute per UL and 4242 V <sub>PK</sub>	Digital Isolation	E-Meter, Data Concentrator, Grid Infrastructure
<b>RS485 (Isolated &amp; Non-Isolated)</b>			
<b>SN65HVD3082/85/88</b>	200-kbps/1-Mbps/20-Mbps capable, half-duplex transceivers, operate with very low supply current	RS485 Interface	E-Meter, Data Concentrator, Grid Infrastructure
<b>SN65HVD3080/83/86</b>	200-kbps to 20-Mbps capable, full-duplex transceivers, operate with very low supply current	RS485 Interface	E-Meter, Data Concentrator, Grid Infrastructure
<b>ISO3080/82/86/88</b>	Isolated 5-V full- and half-duplex RS485 transceivers, provide 2500 V <sub>RMS</sub> of isolation for 60 s	Isolated RS485 I/F	E-Meter, Data Concentrator, Grid Infrastructure
<b>External RTC</b>			
<b>BQ32000</b>	Real-time clock	RTC	E-Meter
<b>Relay/Actuator Drivers</b>			
<b>ULN2003</b>	Family of relay drivers	Relay	E-Meter, Flow Meter, Grid Infrastructure
<b>DRV777</b>	7 low-output-impedance drivers minimize power dissipation; 140 mA/channel, 1 A when tied together, 20-V-capable output pins	Relay	E-Meter, Flow Meter, Grid Infrastructure
<b>DRV8830/60</b>	Low-voltage motor/actuator driver with serial interface. The device has one H-bridge driver which can drive 1-A peak output current	Relay	E-Meter, Flow Meter, Grid Infrastructure
<b>Ethernet PHY</b>			
<b>TLK105L</b>	10/100 Ethernet PHY, error free to 150 meters, cable diagnostics, Auto-MIDX, supports MII and RMII	Interface	Data Concentrator, Home Area Network
<b>DP83848K</b>	10/100 Ethernet PHY, error free to 130 meters, Auto-MIDX, supports MII and RMII	Interface	Data Concentrator, Home Area Network
<b>DP83640</b>	IEEE 1588 precision-time-protocol transceiver for real-time industrial connectivity. Packet time stamps for clock synchronization	Interface	Data Concentrator, Home Area Network
<b>SAR ADC</b>			
<b>ADS8558/7/6</b>	12/14/16-bit, 6-channel simultaneous-sampling ADC, up to 730 kSPS in parallel interface mode, up to 91-dB SNR	Interface	E-Meter, Grid Infrastructure
<b>ADS8528/48/68</b>	12/14/16-bit, 8-channel simultaneous-sampling ADC, up to 650 kSPS in parallel interface mode, up to 91-dB SNR	Interface	E-Meter, Grid Infrastructure
<b>Delta-Sigma (<math>\Delta\Sigma</math>) ADC</b>			
<b>ADS131E04/06/08</b>	4/6/8-channel, up to 24-bit, simultaneous-sampling AFE for relay protection, power monitoring, power quality, up to 64 kSPS, 107-dB SNR	Interface	E-Meter, Data Concentrator
<b>ADS1271/4/8</b>	1/4/8-channel, up to 24-bit, simultaneous-sampling AFE for power monitoring, quality and protection, up to 144 kSPS, 111-dB SNR	Interface	E-Meter, Data Concentrator
<b>Analog Isolation</b>			
<b>AMC1100</b>	Fully-differential isolation amplifier for energy metering; SiO <sub>2</sub> barrier up to 4250 V <sub>PK</sub> and resistant to magnetic interference	Analog Isolation	E-Meter, Grid Infrastructure
<b>AMC1204/B</b>	20-MHz, second-order, isolated delta-sigma modulator for current-shunt measurement, SiO <sub>2</sub> barrier up to 4250 V <sub>PK</sub>	Analog Isolation	E-Meter, Grid Infrastructure
<b>Op Amps</b>			
<b>OPA4188/71/40</b>	Wide V <sub>S</sub> : +4.0 V to +36 V ( $\pm 2$ V to $\pm 18$ V), low offset voltage, near-zero drift, low I <sub>0</sub> , high input impedance and rail-to-rail output swing	Interface	Grid Infrastructure
<b>OPA4277</b>	V <sub>S</sub> operates from $\pm 2$ V to $\pm 18$ V, ultra-low offset and drift, low I <sub>0</sub>	Interface	Grid Infrastructure
<b>External Reference</b>			
<b>LM4050</b>	Precision micropower, shunt-voltage reference, external stabilizing capacitor	Voltage Reference	E-Meter, Grid Infrastructure
<b>LMV431</b>	1.24-V shunt regulators capable of adjustment to 30 V	Voltage Reference	E-Meter, Grid Infrastructure
<b>ESD</b>			
<b>TPD1E10B06/B09</b>	Single channel ESD protection in small 0402 package, $\pm 30$ -kV IEC air-gap, over $\pm 30$ -kV contact, bipolar or bidirectional signal support	ESD Protection	E-Meter, Grid Infrastructure
<b>TPD4E1U06</b>	Quad-channel, ultra-low-cap ESD device, offers $\pm 15$ -kV IEC air-gap and $\pm 15$ -kV, suitable for multiple applications like USB	ESD Protection	E-Meter, Grid Infrastructure
<b>TPD2E007</b>	2-channel ESD protection offers system-level ESD solutions for wide range of industrial applications like RS485, RS232	ESD Protection	E-Meter, Grid Infrastructure
<b>Temperature Sensors</b>			
<b>TMP275</b>	$\pm 0.5^\circ\text{C}$ accurate from $-20^\circ\text{C}$ to $+100^\circ\text{C}$ , serial output, SMBus and two-wire interface	Temperature Sensor	E-Meter, Grid Infrastructure
<b>TMP108</b>	$\pm 0.75^\circ\text{C}$ accurate from $-20^\circ\text{C}$ to $+85^\circ\text{C}$ , $\pm 1^\circ\text{C}$ from $-40^\circ\text{C}$ to $+125^\circ\text{C}$ , features SMBus and two-wire interface	Temperature Sensor	E-Meter, Grid Infrastructure
<b>TMP75/LM75A</b>	$\pm 1.5^\circ\text{C}$ to $\pm 3^\circ\text{C}$ accuracy depending on temperature range, features SMBus and two-wire interface	Temperature Sensor	E-Meter, Grid Infrastructure

# Signal Chain and Power Management Solutions

## Power Management Products

Device	Description	Type	Application
<b>Isolated AC/DC Power Solutions</b>			
<b>UCC28910</b>	PWM HV switcher with 700-V integrated power FET and primary-side regulation. The UCC28910 is dedicated to flyback power supplies and provides isolated output voltage and current regulation without the use of an optical coupler	AC/DC Supply	E-meter, Data Concentrator, Grid Infrastructure
<b>UCC28710/700</b>	PWM controller with/without integrated 700-V startup switch. Constant-voltage, constant-current controller with primary-side regulation, QR green mode, optocoupler-less feedback, very-low no-load power and high efficiency	AC/DC Supply	E-meter, Data Concentrator, Grid Infrastructure
<b>UCC28600/610</b>	QR/DCM PWM controller, excellent efficiency at full load, low power consumption at no load; small footprint	AC/DC Supply	E-meter, Data Concentrator, Grid Infrastructure
<b>Cap-Drop Power Solutions</b>			
<b>TPS5401</b>	Cost-optimized, 42-V, 0.5-A step-down DC/DC converter; cap-drop off-line power supplies	Step-Down Regulator	Low-Cost, Cap-Drop Solution
<b>TPS54060/160/260</b>	DC/DC switching power supply: 60-V, 0.5-A/1.5-A/2.5-A step-down DC/DC converters with Eco-mode™ for light load efficiency and very low $I_Q$	Step-Down Regulator	60-V, Cap-Drop Solution
<b>LM5017</b>	100-V, 600-mA, constant on-time, synchronous buck regulator. Can also be configured in flybuck mode	Step-Down Regulator	E-Meters (Low Cost)
<b>DC/DC Solutions</b>			
<b>TPS54478</b>	2.95- to 6-V input, 4-A output, DC/DC switching power supply, 2-MHz synchronous step-down converter	Step-Down Regulator	E-Meter, Grid Infrastructure, Processor Power
<b>TPS5432</b>	2.95- to 6-V input, 3-A output, value concious, 700-kHz synchronous step-down converter	Step-Down Regulator	E-Meter, Grid Infrastructure, Processor power
<b>TLV62065</b>	2.9- to 5.5-V with 2-A output, 2x2-mm footprint, synchronous DC/DC step-down converter, up to 97% efficient	Step-Down Regulator	E-Meter, Grid Infrastructure, Processor power
<b>LM3671</b>	2.7- to 5.5-V input, 600-mA output, 2-MHz step-down DC/DC converter, optimized for powering low-voltage circuits	Step-Down Regulator	E-Meter (1-Phase or 3-Phase)
<b>TLV62080</b>	2.5- to 5.5-V input, 1.2-A step-down converter in 2x2-mm package, high efficiency over wide output-current range	Step-Down Regulator	E-Meter, Grid Infrastructure
<b>TPS62560</b>	2.5- to 5.5-V input with up to 600-mA output, synchronous step-down converter, optimized for low power or battery applications	Step-Down Regulator	E-Meter, Grid Infrastructure, Processor power
<b>TPS62240</b>	2- to 6-V input with 300-mA output, 2.25-MHz buck in 2x2 SON/SOT23; offers high efficiency and power-save mode at light loads	Step-Down Regulator	E-Meter, Grid Infrastructure, Processor power
<b>TPS54227/327/427/627</b>	4.5- to 18-V input, 2-, 3-, 4- and 6-A output respectively; DC/DC step-down converter, adaptive on-time D-CAP2™ enables high efficiency over load range, fast transient response, allows use of low ESR caps; adjustable soft start	Step-Down Regulator	Data concentrator, Grid Infrastructure, General System Supply
<b>TPS62730</b>	For battery-powered applications. Companion power supply for low power RF devices; bypass mode saves 20-30% battery current without compromising on transmit power; DCS-Control™ topology provides low output-voltage ripple	Step-Down Regulator	Flow Meters (Gas/Water)
<b>LMR12010</b>	20-V <sub>IN</sub> , 1-A buck regulator, 30-nA low-shutdown $I_Q$ and switching up to 3 MHz. Offers internal soft start, current-mode PWM control	Step-Down Regulator	Data Concentrator
<b>TPS63030/1</b>	DC/DC buck-boost regulators, 0.8 A, low $I_Q$ with up to 96% efficiency	Buck-Boost, Regulator	General System Supply (Battery Operated), Home Area Network
<b>TPS63060/1</b>	DC/DC buck-boost regulators: 2.5- to 12-V input voltage with 93% efficiency and 2.25-A switch-current limit	Buck-Boost Regulator	General System Supply (Battery Operated), Home Area Network
<b>LM2733</b>	0.6/1.6-MHz boost converter with 40-V integrated FET switch and low $R_{DS(on)}$ . Offers cycle-by-cycle current limiting	Step-Up/Boost Regulator	Data Concentrator
<b>LM5001</b>	75-V integrated MOSFET with a 1-A peak current limit for boost and SEPIC implementation	Step-Up/Boost Regulator	Data Concentrator
<b>Linear Regulators</b>			
<b>TLV71310/11/12/15/18</b>	Capacitor-free, 150-mA, LDO with 1.5% regulation over temperature range. This next generation LDO was designed to be stable without an output cap	LDO	E-Meter, Data Concentrator, Grid Infrastructure, Flow Meter
<b>LP38691</b>	500-mA, low-dropout, CMOS linear regulator with tight output tolerance and excellent AC performance with ultra-low ESR ceramic caps	LDO	Data Concentrator
<b>TLV70710/11/12/15</b>	200-mA LDO with low $I_Q$ , tight output regulation (2% typ). Offers excellent line- and load-transient performance	LDO	Data Concentrator
<b>LP5907</b>	250-mA LDO for RF and analog circuits, provides low noise, high PSRR, low $I_Q$ and low transient response	LDO	Data Concentrator
<b>PMICs</b>			
<b>TPS65290</b>	Power-management IC for gas/water meters	PMU	Gas/Water Meter
<b>TPS650250</b>	Low-cost PMU for AM335x	PMU	Grid Infrastructure
<b>TPS65250</b>	Power-management IC for e-meters with "last gasp" storage and release circuit	PMU	E-Meter
<b>Voltage Supervisor and Reset ICs</b>			
<b>TPS3831/9</b>	Ultra-low power, 150-nA, ultra-small voltage supervisor	Voltage Supervisor	E-Meter, Grid Infrastructure
<b>TPS3700</b>	UV, OV voltage monitor; wide input voltage	Voltage Supervisor	E-Meter, Grid Infrastructure
<b>TLV803/809/810</b>	Low-cost voltage supervisor with 200-ms reset delay	Voltage Supervisor	E-Meter, Grid Infrastructure
<b>TPS3808</b>	Highly-accurate (0.5% typ) supervisor with low $I_Q$ and adjustable reset delay	Voltage Supervisor	E-Meter, Grid Infrastructure
<b>Chargers</b>			
<b>BQ24171</b>	Highly-integrated 1- to 3-cell Li-ion/Li-polymer charger with battery detection, pre-conditioning, charge monitoring and termination	Battery Charger	Home Area Network, Flow Meter
<b>BQ25504</b>	Ultra-low-power boost converter with battery management for energy-harvester applications	Boost Controller, Battery Charger, MPPT Controller	Home Area Network, Wireless Sensor Node

# Smart Grid Development Tools

## Metrology: Single-Phase

Tool Identification	Description	Resources
<b>Metrology Front End</b>		
	<b>Class 0.2 Single-Phase Metrology, Analog-Front-End Evaluation Module (EVM430-AFE253)</b>  Single-phase, Class 0.2 electricity-meter/sub-meter (3 sigma-delta 24-bit sensor inputs, 16KB flash, 0.5KB RAM) evaluation board. Comes with application note, energy library and schematics. Features MSP430AFE253, the industry's first programmable analog front end microcontroller.	<b>Get Started:</b> Watch video at <a href="http://www.ti.com/afe-video">www.ti.com/afe-video</a> <b>Contact TI representative</b> <b>Support:</b> MSP430™ Energy Library at <a href="http://www.ti.com/tool/msp430-energy-library">www.ti.com/tool/msp430-energy-library</a> Read application report at <a href="http://www.ti.com/lit/slaa494">www.ti.com/lit/slaa494</a>
	<b>NEW Class 0.5 Single-Phase Metrology, Analog-Front-End Evaluation Module (EVM430-i2040)</b>  Single-phase, Class 0.5 electricity-meter/sub-meter (4 sigma-delta 24-bit sensor inputs, 32KB flash, 2KB RAM), evaluation board with application notes, energy library and schematics. Features the next-generation MSP430i2040 ultra-low-power metrology analog front end. <b>AMI Capability:</b> RF interface: ZigBee®, wM-Bus/<1 GHz, Wi-Fi®/PLC via UART. <b>Software Features:</b> 1-phase 0.5% energy library, anti-tampering.	<b>Get Started:</b> <a href="#">Contact TI representative</a> <b>Support:</b> MSP430 Energy Library at <a href="http://www.ti.com/tool/msp430-energy-library">www.ti.com/tool/msp430-energy-library</a>
	<b>NEW EVM430-Sub-Metering Server Power, Single-Phase Metrology solution</b>  Hardware based on the next-generation MSP430i2040, metrology analog front end (4 SD24, 32KB flash, 2KB RAM), works across supply AC/DC input 90 – 220 VAC, 100 – 200 VDC. <b>Software:</b> Server power library, power library for $V_{RMS}$ , $I_{RMS}$ , active, reactive and apparent powers, THD for current/voltage, fundamental voltage/current, readings update every four AC cycles, capable of AC and DC supply measurement, automatic switching between AC and DC, EMI filter capacitor compensation capabilities, no separate DC calibration required, serial port command reading and calibration interface.	<b>Get Started:</b> <a href="#">Contact TI representative</a> <b>Support:</b> MSP430 Server Power Library Read white paper at <a href="http://www.ti.com/lit/slay020">www.ti.com/lit/slay020</a>
<b>Metrology SoC</b>		
	<b>Class 0.5, Low-End Single-Phase E-Meter SoC Evaluation Module (EVM430-FE4272)</b>  Low-end single-phase, Class 0.5 electricity meter (32KB flash, 2 sigma-delta sensor inputs + segment LCD) evaluation board. Comes with application notes, energy library and schematics; features ultra-low-power MSP430FE4272 metrology SoC.	<b>Get Started:</b> Orderable at <a href="http://www.ti.com/tool/evm430-fe4272">www.ti.com/tool/evm430-fe4272</a> <b>Support:</b> Read white paper at <a href="http://www.ti.com/lit/slaa203">www.ti.com/lit/slaa203</a>
	<b>Class 0.5, Low-End Single-Phase E-Meter SoC (+ Anti-Tamper) Evaluation Module (EVM430-FE427A)</b>  Low-end single-phase, Class 0.5 electricity-meter plus anti-tamper (32KB flash, 3 sigma-delta sensor inputs + segment LCD) evaluation board with application notes, energy library and schematics. Features MSP430FE427A ultra-low-power metrology SoC.	<b>Get Started:</b> Orderable at <a href="http://www.ti.com/tool/evm430-fe427a">www.ti.com/tool/evm430-fe427a</a> <b>Support:</b> Read white paper at <a href="http://www.ti.com/lit/slaa203">www.ti.com/lit/slaa203</a>
	<b>Class 0.1, Single-Phase Smart E-Meter SoC (+ Anti-Tamper + Communication) Evaluation Module (EVM430-MSP430F6736)</b>  Optimized smart meter SoC, Class 0.1 electricity meter (128KB flash, 8KB RAM, 3 sigma-delta 24-bit sensor inputs, anti-tamper, 320-segment LCD + communications ports). Support for CT/shunt. <b>AMI capability:</b> RF interface: ZigBee, wM-Bus/<1 GHz, Wi-Fi/PLC via UART. <b>Software features:</b> 1-phase 0.1% energy library, THD and fundamental, anti-tampering, temperature compensation and DLMS.	<b>Get Started:</b> Orderable at <a href="http://www.ti.com/tool/EVM430-F6736">www.ti.com/tool/EVM430-F6736</a> <b>Support:</b> Watch video at <a href="http://www.ti.com/f6736video">www.ti.com/f6736video</a>

## Metrology: Poly-Phase

Tool Identification	Description	Resources
<b>Metrology SoC</b>		
	<b>Class 0.5 Three-Phase SoC E-Metering Evaluation Module (EVM430-F67641)</b>  Three-phase, Class 0.5 electricity meter plus anti-tamper (128KB flash, 3 sigma-delta sensor inputs + 160-segment LCD) evaluation board with application notes, energy library and schematics. Features MSP430F67641. <b>AMI Capability:</b> RF interface: ZigBee, wM-Bus/<1 GHz, Wi-Fi®. <b>Software Features:</b> 3-phase 0.1% energy library, THD and fundamental, anti-tampering, temperature compensation and DLMS.	<b>Get Started:</b> <a href="#">Contact TI representative</a> <b>Support:</b> MSP430™ Energy Library at <a href="http://www.ti.com/tool/msp430-energy-library">www.ti.com/tool/msp430-energy-library</a>
	<b>Class 0.1 Three-Phase SoC E-Meter (Anti-Tamper) Evaluation Module (EVM430-F47197)</b>  Three-phase electricity-meter, Class 0.1 with anti-tamper (120KB flash, 4KB RAM, 7 sigma-delta 24-bit sensor inputs, 120-segment LCD controller) evaluation board with application notes, software and schematics. Features MSP430F47197 ultra-low-power metrology SoC.	<b>Get Started:</b> Orderable at <a href="http://www.ti.com/tool/evm430-f47197">www.ti.com/tool/evm430-f47197</a> Buy on TI e-store at <a href="http://www.ti.com/e-F47197">www.ti.com/e-F47197</a> <b>Support:</b> Read application report at <a href="http://www.ti.com/lit/slaa409">www.ti.com/lit/slaa409</a>
	<b>Class 0.1 Three-Phase SoC E-Meter (+ Anti-Tamper) evaluation module (EVM430-F6779)</b>  Three-phase electricity-meter, Class 0.1 with anti-tamper (512KB flash, 32KB RAM, 7 sigma-delta 24-bit sensor inputs, 360-segment LCD controller) evaluation board with application notes, software and schematics. Features MSP430F6779 ultra-low-power metrology SoC. <b>AMI Capability:</b> RF interface: ZigBee, wM-Bus/<1 GHz, Wi-Fi/PLC via UART. <b>Software Features:</b> 3-phase 0.1% energy library, anti-tampering, THD and fundamental, temperature compensation and DLMS.	<b>Get Started:</b> Orderable at <a href="http://www.ti.com/tool/EVM430-F6779">www.ti.com/tool/EVM430-F6779</a> <b>Contact TI representative</b> <b>Support:</b> Watch video at <a href="http://www.ti.com/F6779">www.ti.com/F6779</a>

# Smart Grid Development Tools

## Flow Meter Solutions

Tool Identification	Description	Resources
<b>SCAN IF Flow Meter</b>		
 <span style="color: red; border: 1px solid red; border-radius: 50%; padding: 2px 5px;">NEW</span> <b>Scan-Interface-Based Flow Meter</b>	<p>Features MSP430FW429, manual wheel spin to simulate flow rate, real-time update to LCD and legacy design improved to showcase our scan interface.</p>	<b>Get Started:</b> Sampling now <a href="#">Contact TI representative</a> <b>Support:</b> <a href="http://www.ti.com/scan_interface">www.ti.com/scan_interface</a>
<b>SCAN IF + FRAM Flow Meter</b>		
 <span style="color: red; border: 1px solid red; border-radius: 50%; padding: 2px 5px;">NEW</span> <b>Scan Interface + FRAM Flow Meter</b>	<p>Features MSP430FR689 based on FRAM device, uses enhanced scan interface to measure flow, motor control board to simulate flow rate, real-time update to LCD and RF modules.</p> <p><b>Software Features:</b> Extended scan-interface water measurement library for GMR, LC, optical sensor, integration to wireless M-Bus using CC1120 + Steinbeis stack.</p>	<b>Get Started:</b> Sampling now <a href="#">Contact TI representative</a> <b>Support:</b> <a href="http://www.ti.com/scan_interface">www.ti.com/scan_interface</a>
<b>Ultrasonic for Flow Meter</b>		
 <span style="color: red; border: 1px solid red; border-radius: 50%; padding: 2px 5px;">NEW</span> <b>Ultrasonic Time Of Flight</b>	<p><b>Hardware Features:</b> TPL7200 with discrete AFE + TDC + MCU and interface to RF modules.</p> <p><b>Software Features:</b> Time-of-Flight technique and &lt;100-ps resolution for ultrasonic flow library.</p>	<b>Get Started:</b> Sampling now <a href="#">Contact TI representative</a> <b>Support:</b> <a href="http://www.ti.com/scan_interface">www.ti.com/scan_interface</a>

## Power Line Communications (PLC)

Tool Identification	Description	Resources
 <span style="color: red; border: 1px solid red; border-radius: 50%; padding: 2px 5px;">NEW</span> <b>TMDSPLCKIT-V3 C2000™ Power Line Modem Developer's Kit</b>	<p>The PLC developer's kit enables easy development of software-based PLC modems. The kit includes two PLC modems based on the C2000 TMS320F28069 controlCARD™ and TI's advanced PLC analog front end (AFE031). The included plcSUITE™ software supports several communication techniques, including OFDM (PRIME/G3 and P1901.2) and is SFSK-capable. The kit includes onboard USB JTAG emulation and Code Composer Studio™.</p>	<b>Get Started:</b> Orderable at <a href="http://www.ti.com/tool/tmdsplckit-v3">www.ti.com/tool/tmdsplckit-v3</a> <b>Support:</b> <a href="http://www.ti.com/plc">www.ti.com/plc</a>
 <span style="color: red; border: 1px solid red; border-radius: 50%; padding: 2px 5px;">NEW</span> <b>SOMPLC-PLC83 System On Module (SOM) for CENELEC Power Line Communication (SFSK/PRIME/G3/P1901.2)</b>	<p>The SOMPLC-PLC83 is a self-contained hardware SOM for PLC that includes an analog front end (AFE031) and a digital modem (F28PLC83) on one single PCB. It is the ideal plug-in tool for developers to easily and quickly evaluate the most popular narrowband CENELEC PLC standards like SFSK/PRIME/G3/P1901.2 in their application environment. Plugs onto the TI PLC docking station.</p>	<b>Get Started:</b> Orderable at <a href="http://www.ti.com/SOMPLC">www.ti.com/SOMPLC</a> <b>Support:</b> <a href="http://www.ti.com/plc">www.ti.com/plc</a>
 <span style="color: red; border: 1px solid red; border-radius: 50%; padding: 2px 5px;">NEW</span> <b>SOMPLC-PLCM35 System On Module (SOM) for FCC Power Line Communication (G3-FCC, G3-ARIB, P1901.2 FCC)</b>	<p>The SOMPLC-PLCM35 is a self-contained hardware SOM for PLC that includes an analog front end (AFE032) and a digital modem (F28M35) on one single PCB. The plug-in tool is for developers to easily and quickly evaluate the most popular narrowband FCC PLC standards like G3-FCC, G3-ARIB, P1901.2 FCC in their application environment. It also plugs onto the TI PLC docking station.</p>	<b>Get Started:</b> Sampling now <a href="#">Contact TI representative</a> <b>Support:</b> <a href="http://www.ti.com/plc">www.ti.com/plc</a>
 <span style="color: red; border: 1px solid red; border-radius: 50%; padding: 2px 5px;">NEW</span> <b>Power Line Communication Docking Station (TMDSPLCKIT-V4)</b>	<p>The TI PLC docking station is the new TI PLC kit compatible with CENELEC and FCC PLC standards. Developers can plug TI PLC SOM modules to support the various narrowband standards.</p> <p><b>Hardware Features:</b> Single hardware can support multiple modulation and standards interface to RF modules to support ZigBee®, wM-Bus, Wi-Fi®, USB to PC, RJ45 Ethernet connector.</p> <p><b>Software Features:</b> plcSUITE library, zero-configuration GUI, service-node software for PRIME, G3, P1901.2. Up to FCC/ARIB bands, automated testing and firmware upgrade.</p>	<b>Get Started:</b> Sampling now <a href="#">Contact TI representative</a> <b>Support:</b> <a href="http://www.ti.com/plc">www.ti.com/plc</a>



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# Smart Grid Development Tools

## Wireless Connectivity

Tool Identification	Description	Resources
<b>Wide-Area Network</b>		
 <b>SimpleLink™ Sub-1-GHz Performance-Line Development Kit (CC1120DK)</b>	<p>Kit provides a complete hardware-performance-testing and software-development platform for TI's sub-1-GHz performance-line devices. It can test power consumption and RF range/robustness with different settings (supports 868/915 MHz). Additional kits can be purchased separately to support other frequencies.</p>	<b>Get Started:</b> Orderable at <a href="http://www.ti.com/tool/cc1120dk">www.ti.com/tool/cc1120dk</a> <b>Support:</b> <a href="http://www.ti.com/lit/swru290">www.ti.com/lit/swru290</a>
<b>ZigBee® Home-Area Network</b>		
 <b>SimpleLink™ NEW CC2538 Development Kit for ZigBee® and the Internet of Things (IoT) (CC2538DK)</b>	<p>The CC2538DK development kit is a 2.4-GHz IEEE 802.15.4-compliant SoC for ZigBee and the Internet of Things. The CC2538DK contains all hardware, software, and tools necessary to build a 802.15.4-compliant product. It includes CC2538-based evaluation modules, development boards, a USB interface dongle, cables, antennas and documentation. It features a 2.4-GHz transceiver and ARM® Cortex™-M3 MCU.</p>	<b>Get Started:</b> Orderable at <a href="http://www.ti.com/tool/cc2538dk">www.ti.com/tool/cc2538dk</a> <b>Support:</b> <a href="http://www.ti.com/lit/swrs096">www.ti.com/lit/swrs096</a>
 <b>SimpleLink™ CC2530 Development Kit (CC2530DK)</b>	<p>The CC2530DK development kit supports TI's second generation 2.4-GHz IEEE 802.15.4-compliant SoC (CC2530) and contains all hardware, software and tools necessary to build your 802.15.4-compliant product. It includes CC2530-based evaluation modules, development boards, a USB interface dongle, cables, antennas and documentation. The CC2530EM evaluation modules can be plugged into SmartRF05EB boards, which are included.</p>	<b>Get Started:</b> Orderable at <a href="http://www.ti.com/tool/cc2530dk">www.ti.com/tool/cc2530dk</a> <b>Support:</b> <a href="http://www.ti.com/lit/swrs081b">www.ti.com/lit/swrs081b</a>
<b>Secure Prepayment</b>		
 <b>RFID/NFC Transceiver Evaluation Module Kit (TRF7960AEVM/TRF7970AEVM)</b>	<p>Self contained development platform which can be used to independently evaluate/test the performance of the TRF7960A or TRF7970A RFID/near-field-communications transceiver IC, custom firmware, customer designed antennas and/or potential transponders for a customer defined RFID/NFC application. TRF7970AEVM NFC Modes: Reader/writer, peer to peer and card emulation. TRF7960AEVM NFC Modes: Reader/writer.</p>	<b>Get Started:</b> Orderable at <a href="http://www.ti.com/tool/trf7970aevm">www.ti.com/tool/trf7970aevm</a> <b>Support:</b> <a href="http://www.ti.com/lit/slos743">www.ti.com/lit/slos743</a>
<b>NFC Interface</b>		
 <b>RF430CL330HTB Target Board for NFC Development</b>	<p>The RF430CL330HTB target board enables simplified BT + Wi-Fi® paring and the evaluation of the dynamic NFC transponder with SPI/I<sup>2</sup>C interface for short-range wireless communication with the NFC-enabled smart phones. The target board also features an on-board PCB antenna and can be used with many different TI microcontroller platforms.</p>	<b>Get Started:</b> Orderable at <a href="http://www.ti.com/tool/rf430cl330htb">www.ti.com/tool/rf430cl330htb</a> <b>Support:</b> <a href="http://www.ti.com/lit/slas916a">www.ti.com/lit/slas916a</a>
<b>Internet of Things (IoT)</b>		
 <b>MSP-EXP430G2-CC3000BOOST – SimpleLink™ Wi-Fi CC3000 BoosterPack and MSP430™ LaunchPad™ Bundle</b>	<p>The SimpleLink Wi-Fi CC3000 Booster Pack (CC3000BOOST) is an add-on board designed to bring Wi-Fi to the MCU LaunchPad, based on TI's SimpleLink Wi-Fi CC3000 module. The CC3000 module enables simplified Wi-Fi connectivity for Internet-of-Things MCU-based applications and comes with a full suite of support tools. Additionally through its unique SmartConfig™ technology, the CC3000 delivers an easy one-click network set up for end-users. It is also compatible with the MSP430 LaunchPad as well as the Tiva™ C Series TM4C123G LaunchPad.</p>	<b>Get Started:</b> Orderable at <a href="http://www.ti.com/msplauchpad-cc3000boost">www.ti.com/msplauchpad-cc3000boost</a> <b>Contact TI representative</b> <b>Support:</b> <a href="http://www.ti.com/cc3000wiki">www.ti.com/cc3000wiki</a>

# Smart Grid Development Tools

## Grid Infrastructure

Tool Identification	Description	Resources
 <b>TMDSDC3359 Smart Data Concentrator Evaluation Module (EVM)</b>	<p>Smart data concentrator evaluation module (EVM) with accompanying power line communication (PLC) system-on-module and supporting software for smart grid developers. Featuring the AM3359, the highly integrated TMDSDC3359 EVM provides the ultimate level of flexibility and scalability with numerous performance, cost and connectivity options so developers can create data-concentrator designs that can adapt to many worldwide smart grid standards.</p> <p><b>Hardware Support:</b> Sitara™ AM335x processor with Cortex™ A8, interface to all PLC SOM modules, interface to all RF modules (CC1101, CC1120, CC25xx), Ethernet, USB and CAN.</p> <p><b>Software Support:</b> MAC layers and Library plcSUITE™, showcase a full network solution, single base board offers multiple RF technologies and PLC standards, usable for e-meter and flow meter networks, third party provides full DC solution.</p> <p>PLC: PRIME, G3, P1901.2, PLC lite, proprietary</p> <p>RF: ZigBee®, wM-Bus, Wi-Fi, 802.15.4g, proprietary</p>	<p><b>Get Started:</b> Orderable at <a href="http://www.ti.com/tool/TMDSDC3359">www.ti.com/tool/TMDSDC3359</a></p> <p><b>Support:</b> Watch demo videos at <a href="http://www.ti.com/dc_demo">www.ti.com/dc_demo</a></p> <p><b>Overview:</b> <a href="http://www.ti.com/dc_overview">www.ti.com/dc_overview</a></p>

## Smart Building/Internet of Things (IoT)

Tool Identification	Description	Resources
 <b>Linux Based Gateway/Smart Hub Reference Design</b>	<p>The IoT Gateway reference design creates a bridge between ZigBee® and Wi-Fi® or Ethernet and enables applications such as real-time energy monitoring or interaction with Wi-Fi-enabled smart appliances or smart plugs. It features the AM3359 and aggregates data from wireless sensor networks and can provide additional functions like security and monitoring. Additional communications interfaces like NFC for smart phone pairing or prepayment and Bluetooth® can also be used. The Linux®-based IoT Gateway manages communications, data processing and applications locally instead of relying on intelligence in the cloud.</p> <p><b>Hardware Support:</b> Sitara™ AM335x processor with Cortex™ A8, TI ZigBee CC2530 SoC, TI Combo Wi-Fi+ Bluetooth, TI NFC RF430 and interfaces available for PLC.</p> <p><b>Software Support:</b> TI Linux SDK, TI Wi-Fi Drivers, TI ZigBee library (HA and SE profile), TI NFC.</p>	<p><b>Get Started:</b> Sampling today; schematics available</p> <p><b>Contact TI representative</b></p> <p><b>Support:</b> Watch video at <a href="http://www.ti.com/solution/iot_gateway">www.ti.com/solution/iot_gateway</a></p>

## Full System Solution Demo

Tool Identification	Description	Resources
 <b>Smart Meter Board (SMB)</b>	<p>The SMB is a modular development platform incorporating key TI Smart Grid devices to demonstrate the capabilities of a smart meter. SMB is a unique tool with multiple features. It performs energy or electricity metering and has the capability of transferring key metering data via PLC and wireless (Wi-Fi®, ZigBee®, Sub-1 GHz) communication to showcase a simple automatic meter reading (AMR) and automatic metering infrastructure (AMI) system. The development platform takes advantage of TI Smart Grid software libraries to implement key communication standards and typical utility-meter functions. A feature of the platform is that the tool allows developers to choose the development tool matching their project needs.</p> <p><b>AMI:</b> CC3000 for Wi-Fi, CC2530 for ZigBee and SE 1.x, CC2538 for ZigBee IP and SE2.0, TRF7970 for NFC and C2000™ for PLC.</p>	<p><b>Get Started:</b> <a href="http://www.ti.com/smartgrid">www.ti.com/smartgrid</a></p> <p><b>Contact TI representative for demonstration</b></p> <p><b>Support:</b> Watch video at <a href="http://www.ti.com/smb3">www.ti.com/smb3</a></p>



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