

Energy Harvesting: Solar



TI's Broad Portfolio Provides the Total Solution for Solar Energy Harvesting



TI's comprehensive solar energy harvesting portfolio can deliver the entire solar system solution. A broad selection of analog, power management and microcontroller ICs are targeted at grid-tied central inverters, micro-converters and micro-inverters, as well as off-grid battery charging solutions, to maximize the power point and provide the highest possible system efficiency.

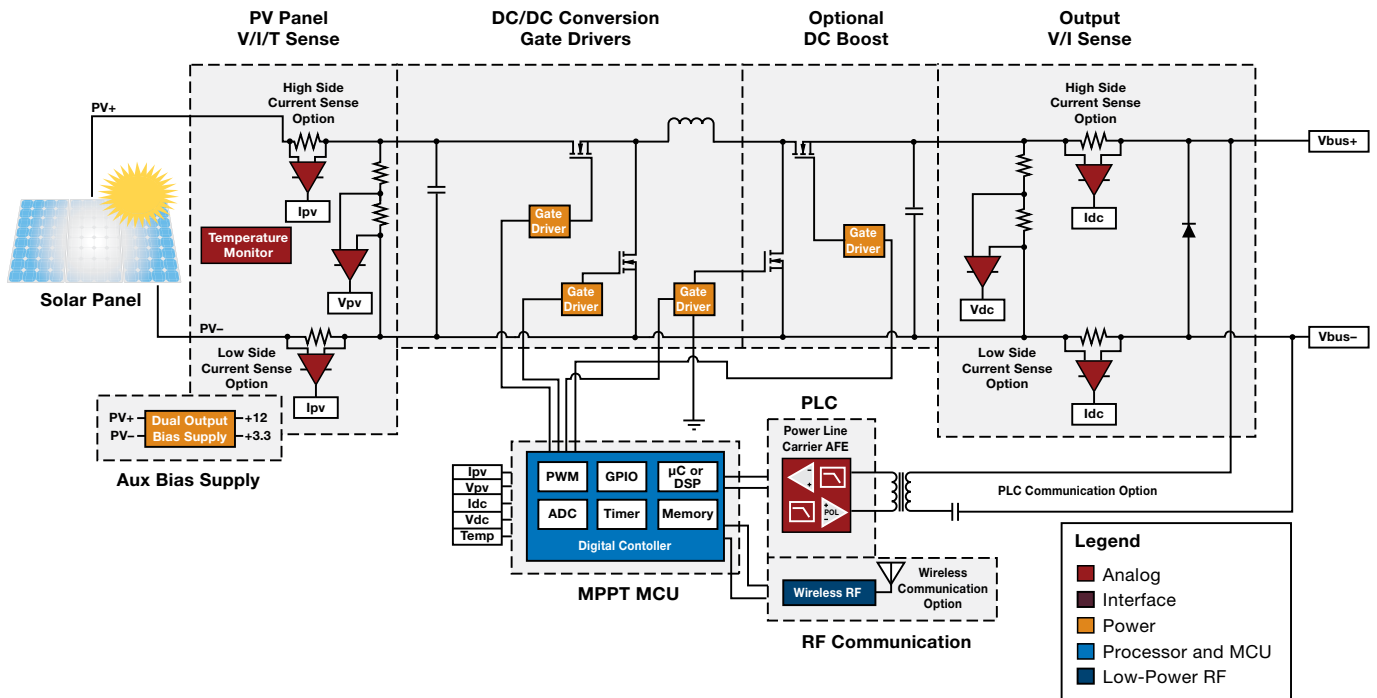
DSP- and ARM®-based MCUs also provide system control and support communication technologies

including power line communications (PLC), Ethernet, CAN bus, and low-power RF solutions such as ZigBee®. A variety of power management ICs can provide auxiliary bias supplies from either the DC or AC power rails.

TI's portfolio of high-performance analog ICs also provide ideal front ends for MPPT power sensing and power line communications; isolation to sensitive communications electronics; and relay drivers or power switches for islanding in systems requiring UL1741 compliance.

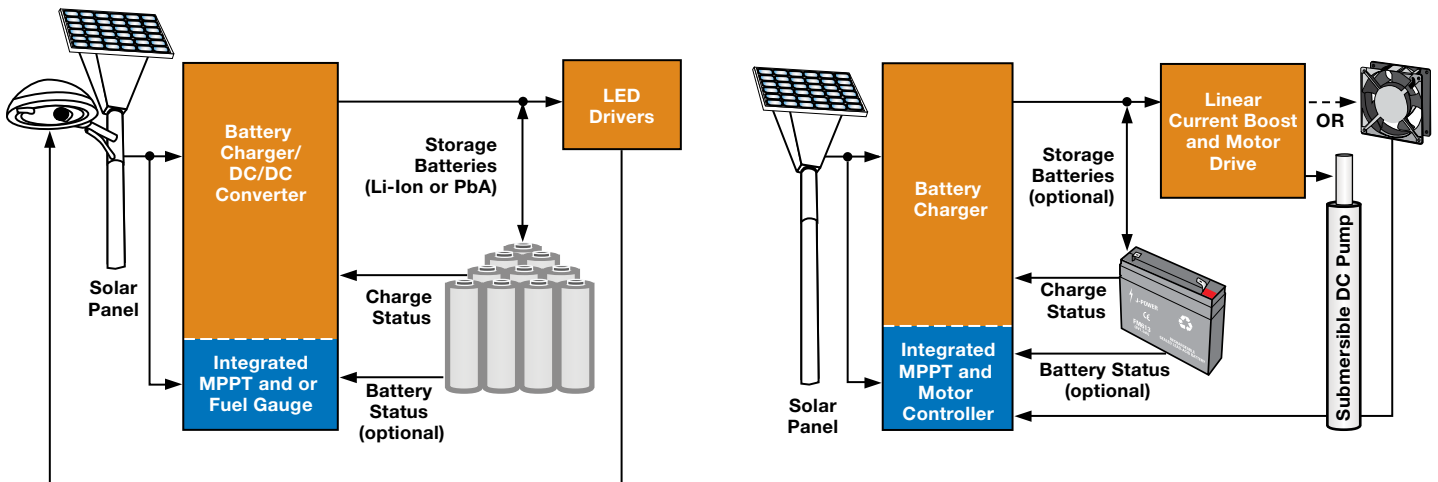
→ Micro-Converter Solutions

Micro-converters maximize the DC power point of a single solar panel and convert (down or up) the DC voltage to be transported downstream to a centralized AC (grid-tied) inverter. Being located on each panel, these systems are lower power (typ. 300 W) than centralized converters. These are sometimes called “optimizers” because they optimize the power of each panel, increasing the overall efficiency of the system.



→ Battery Charging Solutions

Off-grid solar power systems often need to charge a battery, or array of battery cells, that provide continuous power to the load when solar energy is no longer present. Often cost sensitive, in order to optimize the size, cost and usable power of the storage elements, off-grid systems also require that the power point be maximized. However, this can be done by employing, lower power and less complex MCUs than grid-tied systems or by employing a simple fixed power point – often set at 76% of VOC. Loads such as LED lighting and motors may require additional power boosting and/or control.



Solar street light/lantern block diagram.

Solar pump or fan block diagram.

→ Energy Harvesting: Solar Solutions from TI

Device	Description
Microcontrollers for MPPT, Communication and Control Panels	
TMS320F280xx/281xx	32-bit, 100-/150-MHz fixed-point digital signal controller with flash
TMS320F2803x	Piccolo™ series 32-bit, 60-MHz fixed-point microcontroller
TMS320F2833x	Delfino™ series 32-bit, 100-MHz floating-point microcontroller
MSP430F14x	Ultra-low-power 16-bit microcontroller with 12-bit ADC; up to 60-KB flash and 2-KB RAM
MSP430F21x1	Ultra-low-power 16-bit microcontroller; up to 8-KB flash and 256-B RAM
LM3S8xx, LM3S6911, LM3S8xxx	ARM® Cortex™-M3 application processors with multiple serial connectivity, security with encryption, ethernet MAC+PHY (LM3S6xxx and LM3S8xxx) and multiple CAN MACs (LM3S8xxx)
Gate and Relay Drivers	
UCD7100	Digital control compatible single low-side ± 4 -A MOSFET driver with current sense
UCC2732x, UCC3732x	Dual 4-A MOSFET drivers
UCC27200	120-V boot, 3-A peak, high-frequency, high-side/low-side MOSFET driver
TPS281x	Inverting high-speed MOSFET drivers with internal regulator
DRV101 (DRV103)	60-V (32-V) low-side power switch with PWM output drive up to 1.9 A (3 A)
DRV102 (DRV104)	60-V (32-V) high-side power switch with PWM output drive up to 2 A (1.2 A)
TPL9201, TLP9202	8-channel relay drivers with brown-out detection
PWM Controllers	
UC28xx	Current mode PWM controllers
UCC28xx	Current mode push-pull PWM controllers
Auxiliary Power	
TPS737xx	1-A LDO with reverse current protection
TPS734/5xx	250-mA/500-mA low quiescent current, low noise, high PSRR LDOs
TL783	3-pin 750-mA adjustable positive voltage regulator with 125 V _{IN}
TPS4005x	Wide input-voltage synchronous buck controllers
TPS54060	3.5-V to 60-V input, 0.5-A, 2.5-MHz step-down SWIFT™ converter with Eco-Mode™
Analog for Current/Voltage/Temperature Sensing	
TMP1xx	Digital temperature sensors
TLV246x	Low-power, rail-to-rail input/output operational amplifiers
OPA340, OPA350, OPA364, OPA365	Single-supply, high CMRR, low offset, rail-to-rail operational amplifiers
OPA2227, OPA2374	Rail-to-rail I/O CMOS precision amplifiers
INA159, INA198	High-speed, precision gain differential amplifiers
ADS1204, ADS1205, ADS1208, ADS1209	Four 1-bit, 10-MHz, 2nd-order delta-sigma modulators
ADS1202, ADS1203	16-bit, 10-MHz current-shunt delta-sigma modulators
DRV401	Sensor signal conditioning IC for V _{AC} or LEM magnetic current sensor
AMC1203	1-bit, 10-MHz, 2nd-order, isolated delta-sigma modulator
AMC1210	4-channel digital filter for ADS120x family of delta-sigma modulators

Visit www.ti.com/solar for more information.

TI's C2000™ high performance Piccolo™ fixed-point offer real time control with integrated ADC and PWM control for greater energy efficiency to cost sensitive solar converter/inverter applications. www.ti.com/piccolo

The Delfino™ floating-point MCUs offer the highest performance for MPPT and PWM control providing the highest possible solar panel efficiency. www.ti.com/delfino

TI's MSP430™ ultra-low power microcontroller is the perfect combination of low-power and high-performance analog integration. MSP430 offers devices for low-cost grid-tied or medium power off-grid solar MPPT applications. www.ti.com/msp430

Stellaris® real-time microcontrollers – based on the revolutionary Cortex™ - M3 technology from ARM® – combine sophisticated, flexible mixed-signal system on-chip integration with unparalleled real-time multi-tasking capabilities ideal for solar control panels and communication via ethernet or CAN bus. www.ti.com/stellaris

TI's power management solutions offer a range of low dropout linear regulators and DC/DC converters for auxiliary/bias power. A wide array of analog and digital PWM controllers and gate drivers provide flexibility in the efficient implementation of DC/DC conversion and DC/AC inversion. www.power.ti.com

TI also offers a large selection of high-performance digital temperature sensors, operational amplifiers, precision amplifiers, delta-sigma modulators and filters for current shunt and magnetic current sensing applications. For isolated solar energy harvesting applications, TI also offers digital isolators and isolated delta-sigma modulators. www.ti.com/analog

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Device	Description
Solar Battery Chargers	
bq24210	800mA, single-input, single-cell Li-Ion battery solar charger with power path
bq24650	High-efficiency synchronous switch-mode charger controller for solar power
TPS61200	0.3-V input voltage boost converter with 1.3-A switches
Capacitive Isolators and Galvanic Isolated Transceivers	
ISO72x, ISO722x, ISO723x, ISO724x	1-channel, 2-channel, 3-channel and 4-channel, 560-V _{pk} continuous, stand-alone signal isolators
ISO55xx	2.5-A isolated IGBT/MOSFET gate drivers
ISO1177, ISO37, ISO3088	Galvanic isolated RS-485 transceivers
ISO1050	Galvanic isolated CAN transceiver
Wired Communications	
TMS320F28235	Power line communications, PLC modem
PGA112	PLC AFE receive path: zero-drift, programmable gain amplifier with MUX
OPA564	PLC AFE transmit path: 1.5-A, 24-V, 17-MHz, power operational amplifier
SN65LBC179, SN65HVD12, SN65HVD308x	Differential (RS-485) bus transceivers
Low Power RF	
CC1101	Low-power, sub-1-GHz RF transceiver
CC1020	Single-chip FSK/OOK CMOS RF transceiver for narrowband applications in 402 to 470-MHz and 804 to 940-MHz range
CC259x, CC1190	RF front end antenna (CC1190 = 850 to 950-MHz)
LED and Motor Drivers	
TPS61165	High-brightness LED driver with integrated 1.2-A, 40-V power switch
TPS61500	High-brightness LED driver with integrated 3-A, 40-V power switch
DRV88xx	Full-bridge motor drivers
Other Analog	
TL05	Dual enhanced JFET precision operational amplifier
LP211	Single, low-power, strobed differential comparator with open collector and emitter outputs
Development Tools	
TMDSENERGYKIT	Renewable energy development kit with TPM320F2308 controlCARD™
TMDSPCLKIT-V2	Narrowband PLC kit (SFSK/PRIME/G3/FlexOFDM™)
CC2531EMK	ZigBee® USB dongle development kit

Visit www.ti.com/solar for more information.

For off-grid solar applications, cost-effective fully-integrated linear battery chargers provide the combined functionality of maximum power point control and battery charge management into single integrated solutions. Solar-optimized switching battery charge management ICs with external FET drive provide the ideal solution for higher-power, large-scale battery array charging applications. www.ti.com/battery

TI's low-power RF ICs include cost-effective low-power RF transmitters, transceivers, SoCs, RF front ends and processors for short-range applications in the sub-1GHz and 2.4-GHz frequency bands. TI's industry-leading RF ICs meet the stringent requirements for low system costs, high integration, low power, and flexibility — a total system-solution provider of hardware and software, as well as a leading provider of ZigBee/RF4CE/IEEE 802.15.4 technology. www.ti.com/lprf

Communication links from the solar panels to the inverter/converter control units or gateways are made possible with the use of TI's family of RS-485 transceivers.

Power line communications hardware and software solutions can be utilized for communication links to both the solar panel and onto the grid. www.ti.com/plc

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