

C2000™ Solar Inverter Development Kits



Jump start your solar design with development kits for micro, central and string inverters

C2000™ Solar Development Kits provide instructive development platforms for design of highly efficient and reliable solar inverters, including central, string and micro inverter topologies. These kits enable designers to jump-start solar inverter designs using leading technologies found in the solar industry today.

Solar development kits offered today include:

- **Solar Micro Inverter Development Kit**
- **Solar DC/DC MPPT Development Kit**
- **Solar AC/DC Single Phase Inverter Development Kit**
- **Solar Explorer Development Kit with F28M35H52C MCU**
- **Solar Explorer Development Kit with Piccolo TMS320F28035 MCU**

The **Solar Micro Inverter Development Kit** is based on the Piccolo™ **TMS320F28035** microcontroller and serves as a complete grid-tied solar micro inverter. The topology of the micro inverter consists of an active clamp fly-back DC/DC converter with secondary voltage multiplier, maximum power point tracking (MPPT), and a grid-tied DC/AC inverter. The single Piccolo MCU functions as the controller for the complete inverter, including control of both power stages, and MPPT execution.

The **Solar DC/DC MPPT Development Kit** is based on the Piccolo **TMS320F28035** MCU and serves as a DC/DC converter with maximum power point tracking (MPPT) for central or string inverters. Its companion kit, the **Solar AC/DC Single Phase Inverter Development Kit**, is based on the **F28M35H52C**

MCU (alternatively supports the Piccolo **TMS320F28035** MCU as well), and serves as a full-bridge, single-phase, grid-tied DC/AC inverter for central or string inverters. Together, the Solar DC/DC MPPT Development Kit and the Solar AC/DC Single Phase Inverter Development Kit operate as a complete central or string solar inverter.

The Solar Explorer Development Kit is designed as a low-voltage learning

Solar DC/DC MPPT Development Kit and Solar AC/DC Single Phase Inverter Development Kit

TMDSHVMPPTKIT, TMDSHV1PHINVKIT

Power stages:

- 2-phase interleaved boost DC/DC converter (for MPPT)
- Resonant LLC DC/DC converter with isolation
- Full-bridge single-phase, grid-tied, DC/AC inverter

Controller(s): Piccolo TMS320F28035 MCU and F28M35H52C MCU

MPPT support: Yes

Grid-tie support: Yes with anti-islanding protection

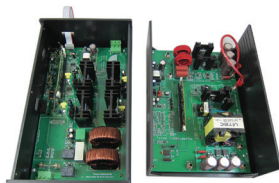
Input: 200–300 VDC

Output: 120–220 VAC universal, 500W

Other features: Ethernet communication

Test results:

- Greater than 94 percent peak efficiency through DC/DC converters
- Greater than 96 percent peak efficiency through DC/AC inverter



Solar Micro Inverter Development Kit

TMDSSOLARUINVKIT

Power stages:

- Active clamp fly-back DC/DC converter with isolation
- Grid-tied DC/AC inverter

Controller(s): Piccolo TMS320F28035 MCU

MPPT support: Yes

Grid-tie support: Yes

Input: 28–45 VDC

Output: 110–220 VAC universal (280W at 220 VAC, 140W at 110VAC)

Test results: 93 percent peak efficiency, 4 percent total harmonic distortion (THD)



Solar Explorer Development Kit

TMDSSOLARCEXPKIT,
TMDSSOLARPEXPKIT

Power stages:

- Boost DC/DC converter (for MPPT)
- SEPIC DC/DC converter (for battery charging)
- Full-bridge, single phase, grid-tie-capable DC/AC inverter

Controller(s): Piccolo TMS320F28035 MCU or F28M35H52C MCU

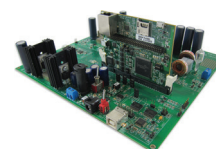
MPPT support: Yes

Grid-tie support: Capable

Input: 12 VDC

Output: 24 VAC, 50W

Other features: Ethernet communication, built-in PV emulator and ambient light sensor



platform for solar development. The kit features a built-in PV emulator, photo diode for light sensing, DC/DC boost converter for MPPT, DC/DC SEPIC converter for battery charging, and a full-bridge, grid-tie-capable, DC/AC inverter stage. Two versions of the kit are offered, allowing users to experiment with various controllers, a Piccolo **TMS320F28035** MCU or an **F28M35H52C** MCU. Ethernet connectivity for remote control and monitoring is available when using the F28M35H52C MCU version of the kit. Additionally, an online training workshop based around this kit is offered for free. Visit the C2000 Applications tab at www.ti.com/C2000 and see the Solar Power Training and Videos section.

Solar and Digital Power Application Library Contents

Solar and digital power software libraries provide code-optimized building blocks to implement a variety of power topologies and algorithms such as MPPT and Software Phase Locked Loops (PLL), perfect for designing customized solar inverter solutions.

Digital Power Math Algorithms

- Control 2P/2Z
- Control 3P/3Z
- Inverse square
- Exponential moving avg.
- Current command
- Soft /sequential start
- Ramp generators
- And more ...

Solar Library Functions

- MPPT (various methods)
- Anti-islanding
- Single-phase inverter
- Sine analyzer for RMS, frequency and ZCD
- ADC driver for sense signals
- PI controller for inverter control

- Software PLL for mains phase lock
- And more ...

Digital Power Hardware Drivers

- Single-channel buck
- High-resolution buck
- Multi-phase interleaved
- MP balanced interleaved
- Half-H bridge
- 2-phase interleaved PFC
- ZVS full bridge
- And more ...

For more information on solar and digital power libraries for C2000 MCUs and a complete listing of all supported functions, please download control-SUITE for *free* at www.ti.com/controlsuite.

To learn more about these kits before purchase, users are encouraged to download and explore **control-SUITE™** software. controlSUITE is a completely free, centralized portal of design resources for C2000 Real-Time Control Microcontrollers and development kits. Within control-SUITE, designers can quickly find all of the necessary tools and resources for the C2000 Solar Development Kits, including software source code, quick start GUIs, BOMs, gerber files, schematics, step-by-step documentation, and solar and digital power application libraries.

The screenshot displays the TI Resource Explorer - controlSUITE application. The left sidebar shows a tree view of resources, including 'Solar' and 'Solar Application Software Library'. The main content area displays the 'Solar Application Software Library' page, which includes a description of the library's purpose, a list of supported hardware, and a table of functions.

Solar Application Software Library

Texas Instruments Inc.'s solar application library is designed to enable flexible and efficient coding of systems designed to use process solar power using the C28x™ processor and CLA accelerator.

Solar applications need different software algorithms like maximum power tracking, phase lock loop for grid synchronization, power monitoring etc. Several different algorithms have been proposed in literature for these tasks. The solar library provides a framework structure, with known algorithms, for the user to implement algorithms needed for Solar Power Conversion Systems quickly. The source code for all the blocks is provided and hence the user can modify / enhance the modules for use in their applications with C2000™ family of devices microcontrollers.

Supports solar library implementation on C28x fixed point (IQ Math), C28x floating point, and Control Law Accelerator (CLA) processors.

What's Included:

- Header files containing the software algorithm modules
- Documentation including description, technical background, object definition, interface definition, and usage of each module.

Solar Library Function Summary:

#	Module	Module Type	Description
1	ABC_DQ0_POS	Transform	ABC to DQ0 Transform for positive sequence
2	ABC_DQ0_NEG	Transform	ABC to DQ0 Transform for negative sequence
3	DQ0_ABC	Transform	DQ0 to ABC Transform
4	SPLL_1ph	PLL	SPLL 1ph based on notch filter
5	SPLL_1ph_SOGI	PLL	SPLL 1ph based on second order generalized integrator
6	SPLL_3ph_SRF	PLL	SPLL 3ph stationary reference frame based
7	SPLL_3ph_DDSRF	PLL	SPLL 3ph decoupled double synchronous reference frame based
8	CLARKE	Transform	Clarke Transform
9	PARK	Transform	Park Transform
10	IPARK	Transform	Inverse Park Transform
11	ICLARKE	Transform	Inverse Clarke Transform
12	MPPT_PNO	MPPT	Perturb and Observe MPPT Algorithm Module
13	MPPT_INCC	MPPT	Incremental Conductance MPPT Algorithm Module
14	MPPT_INCC_I	MPPT	Incremental Conductance MPPT Algorithm Module
15	CNTL_2P2Z	CNTL	Control Law Two Pole Two Zero
16	CNTL_3P3Z	CNTL	Control Law Three Pole Three Zero
17	CNTL_PI	CNTL	Control Law PI
18	MATH_EMAVG	MATH	Moving Average/ Low Pass Filter Block

Important Notice: The products and services of Texas Instruments Incorporated and its subsidiaries described herein are sold subject to TI's standard terms and conditions of sale. Customers are advised to obtain the most current and complete information about TI products and services before placing orders. TI assumes no liability for applications assistance, customer's applications or product designs, software performance, or infringement of patents. The publication of information regarding any other company's products or services does not constitute TI's approval, warranty or endorsement thereof.

The platform bar, Piccolo, C2000 and controlSUITE are trademarks of Texas Instruments. All other trademarks are the property of their respective owners.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Texas Instruments:](#)

[TMDSSOLARCEXPKIT](#) [TMDSHVMPPTKIT](#)