

# C2000™ Piccolo™ TMS320F2805x Microcontroller Series



## Overview

The Piccolo™ TMS320F2805x microcontroller series is a member of the **C2000™ family of real-time microcontrollers**. This microcontroller series features improved analog integration to ease design and lower costs in closed-loop control systems like motor control.

### Get Started with TMS320F2805x MCUs

Learn more about  
Piccolo 'F2805x MCUs

View technical  
documents

Download software

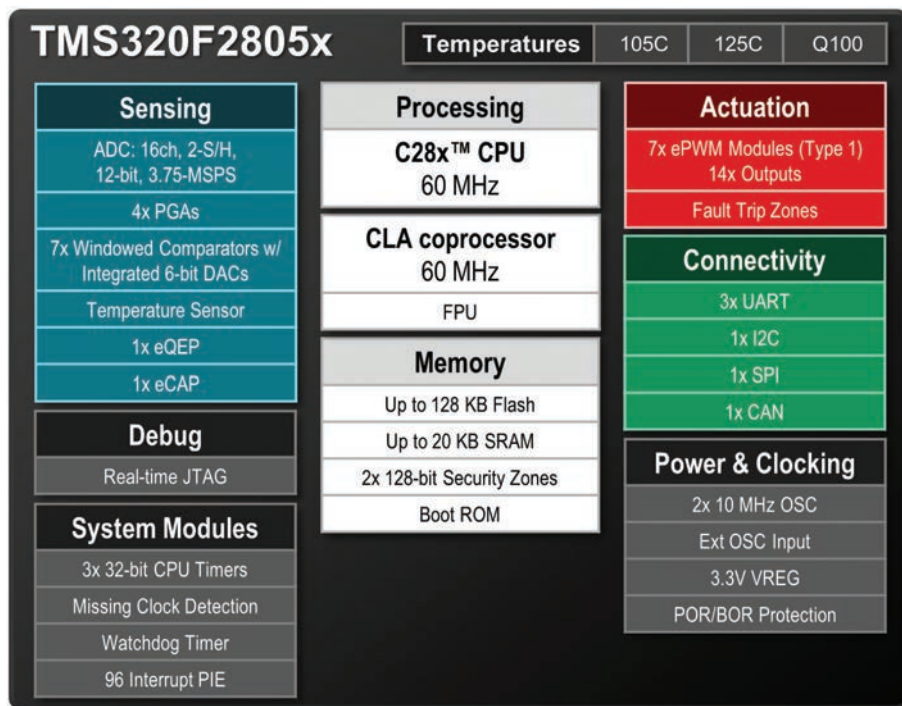
Purchase a  
development kit

Select a  
TMS320F2805x MCU

Compare 'F2805x to  
other Piccolo MCUs

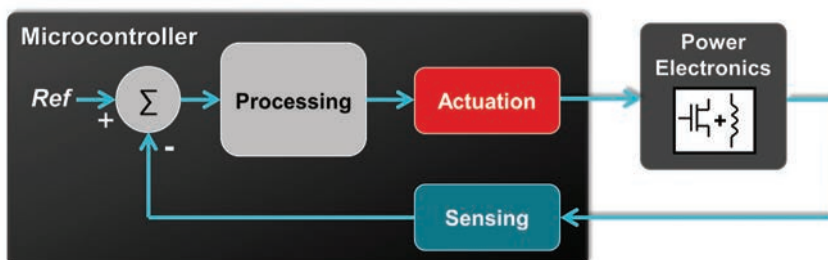
# C2000™ Piccolo™ TMS230F2805x Microcontroller Series

## Feature Guide



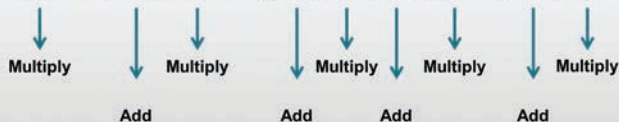
## Built for Closed-Loop Control

C2000™ microcontrollers are built with an optimized architecture for processing, sensing and actuation to increase closed-loop performance in real-time systems.



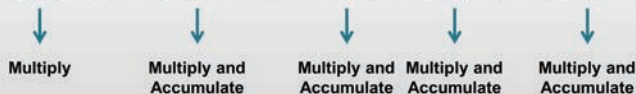
### Typical Processing Instructions

$$u(n) = a_1 u(n-1) + a_2 u(n-2) + b_0 e(n) + b_1 e(n-1) + b_2 e(n-2)$$



### C28x™ Processing Instructions

$$u(n) = a_1 u(n-1) + a_2 u(n-2) + b_0 e(n) + b_1 e(n-1) + b_2 e(n-2)$$



## Powerful C28x™ DSP Processing

Built around the 32-bit C28x DSP processing core and CLA co-processor, F2805x MCUs can process up to 120 MIPS with low interrupt response time, including single-cycle execution of common control law operations.

See the **TMS320C28x DSP CPU and Instruction Set User Guide** to learn more.

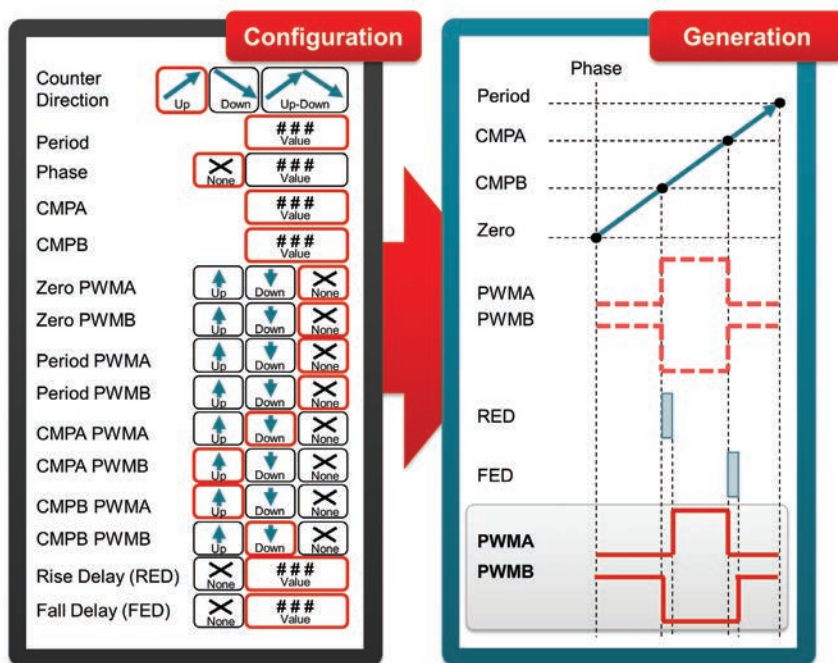
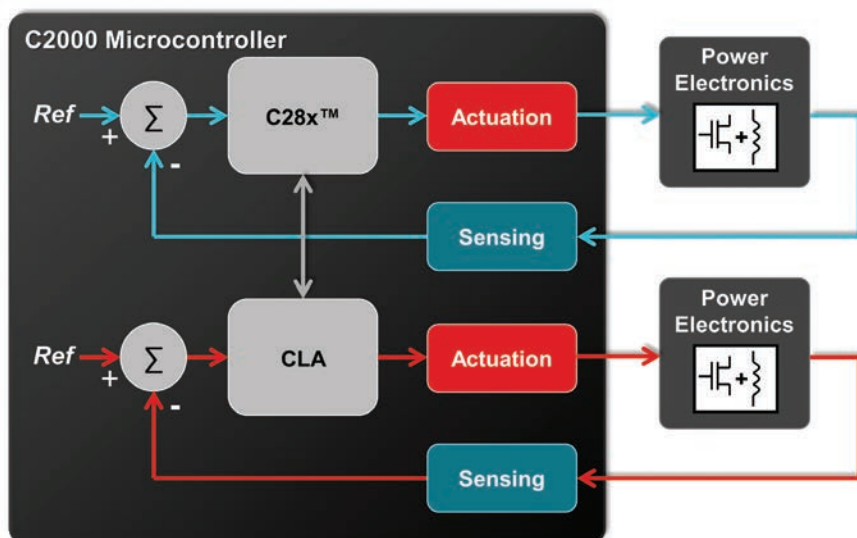
# C2000™ Piccolo™ TMS230F2805x Microcontroller Series

## Feature Guide

### Parallel Processing with the CLA

Run multiple control loops independently with the power of the 60-MIPS CLA Real-Time coprocessor. The CLA is an optimized floating-point math processor based on the C28x core. With the CLA and C28x processors, multiple control functions can be implemented with a single MCU.

See page 510 of the **TMS320F2805x Technical Reference Manual** to learn more.



### Ultra-Configurable PWM Waveforms

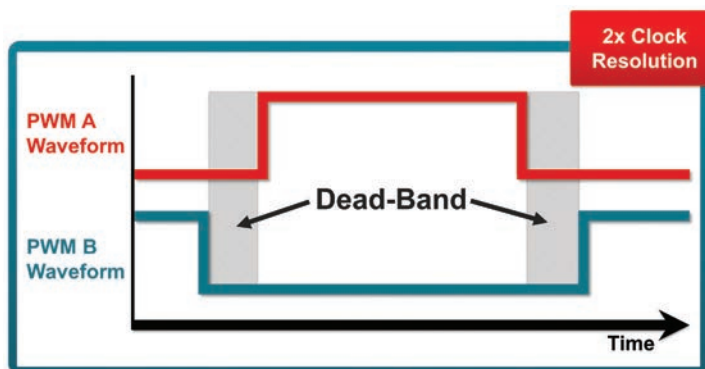
A multitude of configuration options enables generation of advanced PWM waveforms. PWM duty cycle can be configured according to zero, period, CMPA and CMPB timer events. Independent rising and falling edge dead-band prevents energy losses. Phase relationships between PWM waveforms are supported. From buck converter control to LLC resonant converter control, C2000 PWMs have what it takes.

See page 257 of the **TMS320F2805x Technical Reference Manual** to learn more.

### Deadband Protection

Minimize power losses from shoot through currents in FET switches with programmable dead band. TMS320F2805x MCU deadband has precision at double the clock rate of the MCU to further optimize efficiency.

See page 293 of the **TMS320F2805x Technical Reference Manual** to learn more.





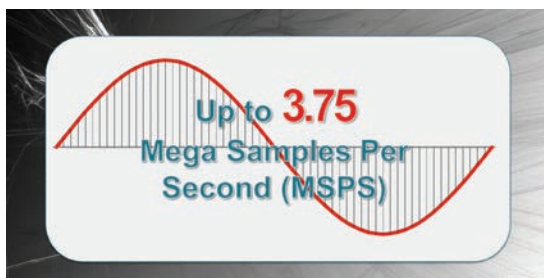
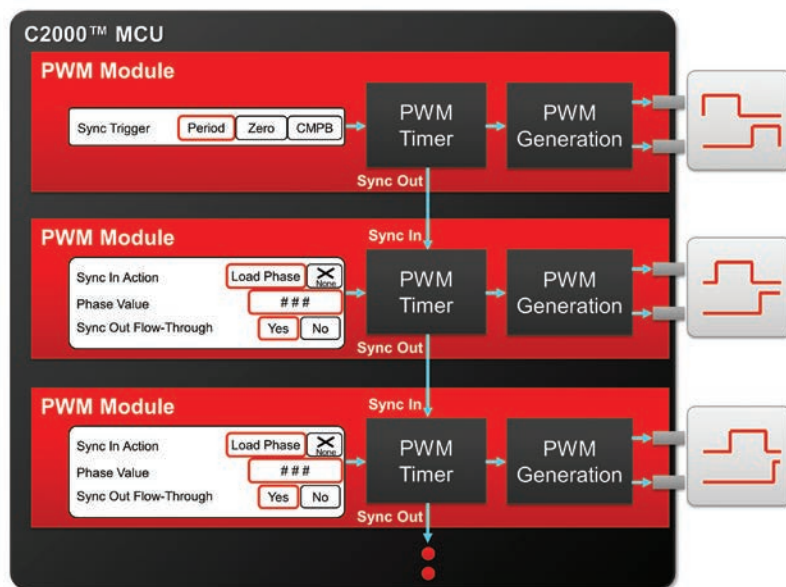
# C2000™ Piccolo™ TMS230F2805x Microcontroller Series

## Feature Guide

### PWM Phase Synchronization

C2000 PWM modules support configurable phase offset and time synchronization between PWMs. This enables control of advanced power stages where phase relationships between PWM waveforms are needed, such as multi-phase DC/DC converters. Likewise, phase-shifted full-bridge and zero-voltage switched full-bridge power converters can be implemented with cycle-by-cycle modification of the phase value.

See page 266 of the **TMS320F2805x Technical Reference Manual** to learn more.



### High-Performance ADC Sensing

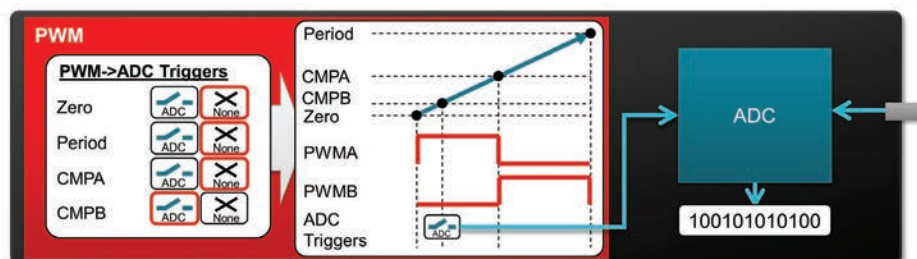
Get higher performance from your system. F2805x ADCs support conversion rates up to 3.75 mega samples per second with dual simultaneous sampling, perfect for motor control applications.

See page 442 of the **TMS320F2805x Technical Reference Manual** to learn more.

### On-Time ADC Triggering

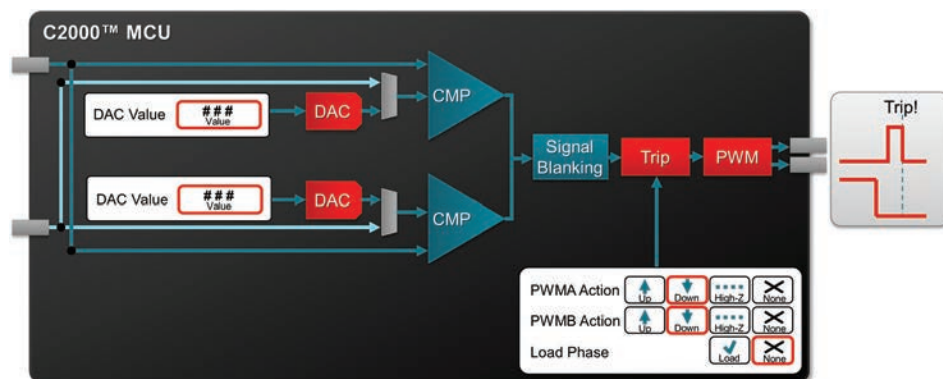
Sensing and actuation that work in harmony. C2000 MCUs support on-time feedback sampling through automated triggering from PWM modules.

See page 308 of the **TMS320F2805x Technical Reference Manual** to learn more.



# C2000™ Piccolo™ TMS230F2805x Microcontroller Series

## Feature Guide



### Protection Across All Conditions

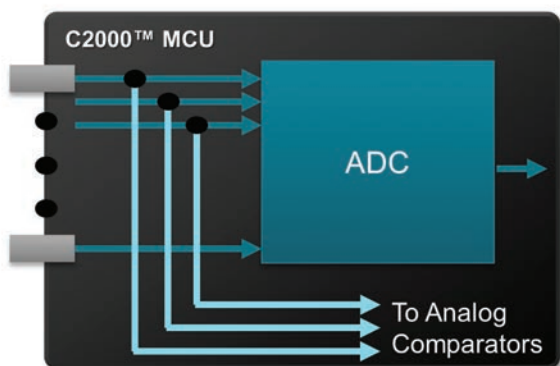
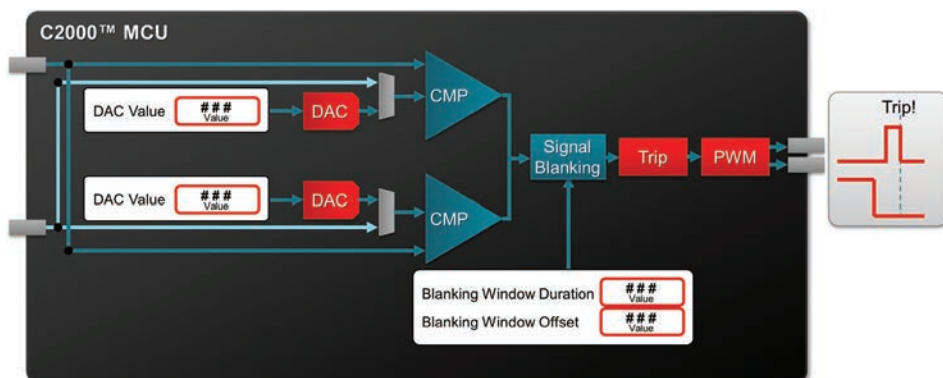
Featuring new windowed analog comparators, F2805x MCUs respond to both positive and negative over-current or over-voltage conditions in your system, and can shutdown (i.e., fault trip) PWM outputs in as little as 85ns from pin-to-pin. Plus, each windowed comparator block is tied to an ADC input to make it straightforward to add protection to your system with no extra routing or pin utilization.

See page 481 of the **TMS320F2805x Technical Reference Manual** to learn more.

### Tripping When You Want It

Analog comparators on C2000 MCUs also include blanking window and filtering features, allowing removal of noise and unwanted PWM trip triggering.

See page 313 of the **TMS320F2805x Technical Reference Manual** to learn more.



### Ready-to-Use Analog Comparators

Analog comparators on C2000 MCUs come ready-to-use. The analog comparators are tied internally to the ADC input pins, which means they require no external routing or additional pin utilization. This saves board routing space, frees up MCU pins for other functions, reduces latency and makes it easy for designers to implement system protection.

See page 484 of the **TMS320F2805x Technical Reference Manual** to learn more.

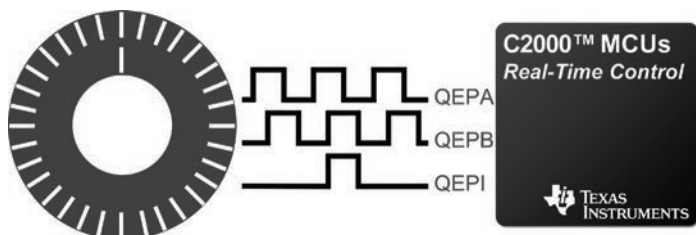
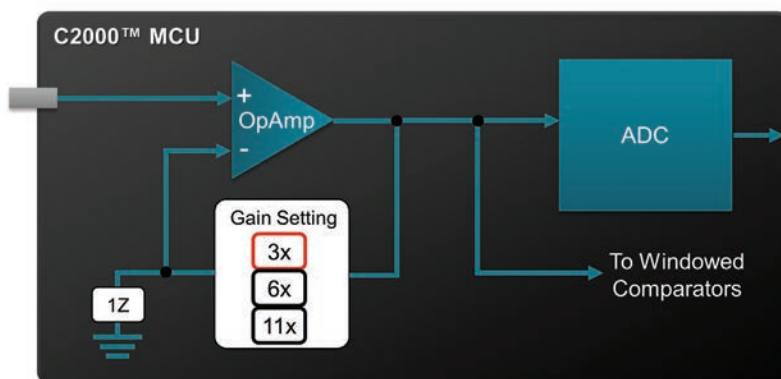
# C2000™ Piccolo™ TMS320F2805x Microcontroller Series

## Feature Guide

### Signal Conditioning Included

C2000 Piccolo TMS320F2805x MCUs even include integrated programmable gain amplifiers (PGAs) to eliminate both the costs of external opamps and the hassle of routing and signal conditioning necessary to interface your system with the MCU.

See page 477 of the  
**TMS320F2805x Technical  
Reference Manual** to learn more.



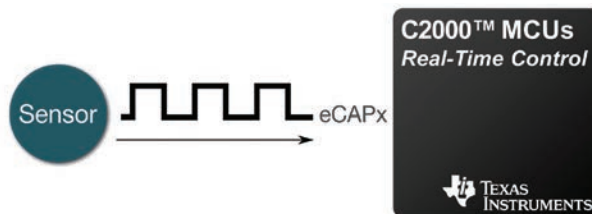
### Encoder Motor Feedback

With the Quadrature Encoder Pulse Module (QEP), you can interface with linear or rotary incremental encoders, providing position, direction and speed measurements in motion-control systems. Benefits include flexible interfacing to support a variety of encoders, support for low-speed measurements, and motor stall detection.

See page 407 of the  
**TMS320F2805x Technical  
Reference Manual** to learn more.

### Signal Input Capture Interface

C2000 enhanced capture modules (eCAP) provide signal capture capability to interface with external sensors and, more generally, measure period and/or duty cycle of pulse train signals. Example applications include speed measurements of rotating machines, elapsed time measurements between position sensor pulses, and decoding of current or voltage amplitude sensor measurements.



See page 377 of the  
**TMS320F2805x Technical  
Reference Manual** to learn more.

# C2000™ Piccolo™ TMS320F2805x Microcontroller Series

## Feature Guide



### CAN 2.0B Connectivity

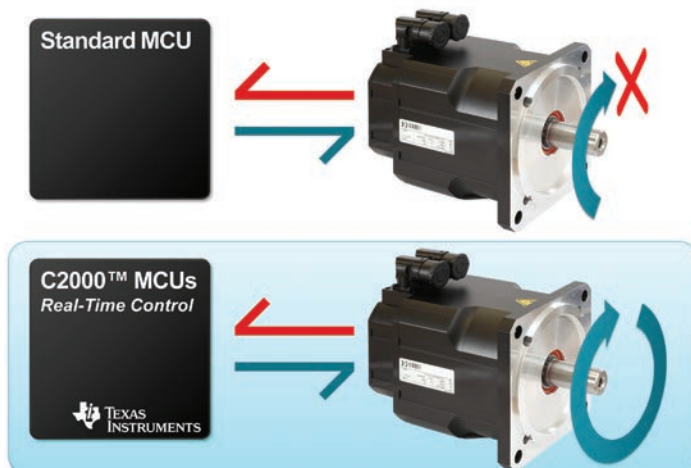
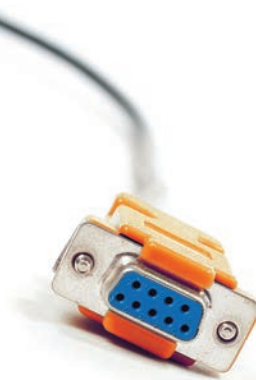
TMS320F2805x MCUs include a complete CAN controller compatible with the CAN 2.0B standard. This enables communication with other microcontrollers and logic in automotive applications.

See page 746 of the **TMS320F2805x Technical Reference Manual** to learn more.

### Serial Connectivity

Expand system functionality with robust serial connectivity. The TMS320F2805x series features various serial connectivity options, including SPI, UART and I<sup>2</sup>C.

See pages 659 of the **TMS320F2805x Technical Reference Manual** to learn more.



### Real-Time Debugging

C2000™ MCUs feature real-time debugging, enabling designers to debug their systems while keeping them in action. Where traditional MCUs stop all threads or prevent interrupts from being handled, C2000 MCUs allow time-critical interrupts to be serviced while background program execution is suspended. This functionality gives designers real-time, non-intrusive debugging of their system, making it easier to understand and adjust how the system performs.

See page 477 of the **C28x™ CPU and Instruction Set Reference Guide** to learn more.



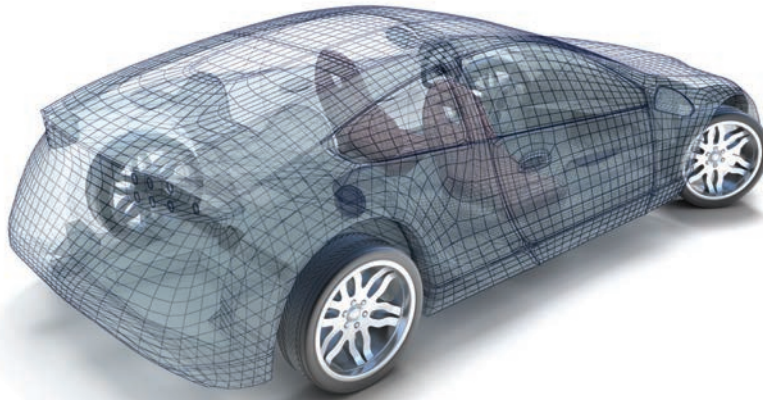
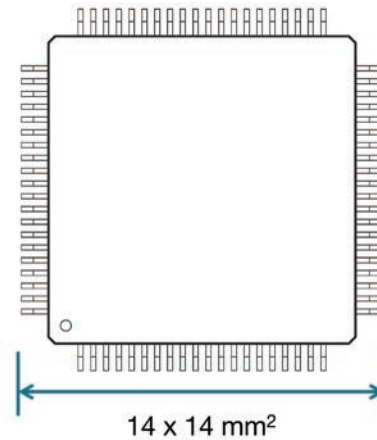
# C2000™ Piccolo™ TMS230F2805x Microcontroller Series

## Feature Guide

### 80-Pin QFP Package

TMS320F2805x MCUs come in a 14 × 14 mm<sup>2</sup> LQFP package.

See page 149 of the  
**TMS320F2805x Data Sheet** to  
view all package options.



### Extended Temperature Options and AEC-Q100 Automotive Qualification

Choose from three operating temperature options:

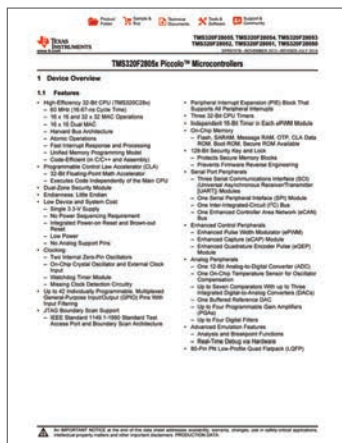
- -40 to 105°C
- -40 to 125°C
- -40 to 125°C AEC-Q100 qualified



# C2000™ Piccolo™ TMS320F2805x Microcontroller Series

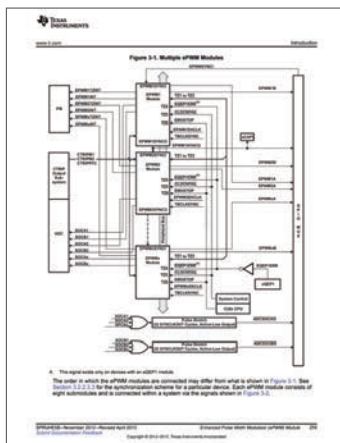
## Technical Documentation and Resources

### Product Data Sheet



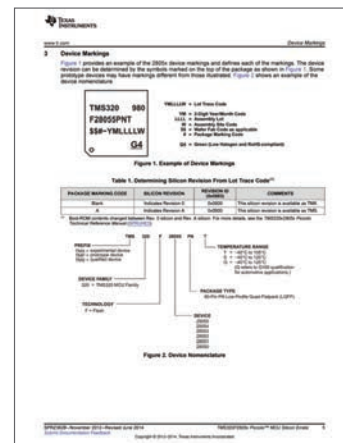
View

### Technical Reference Manual



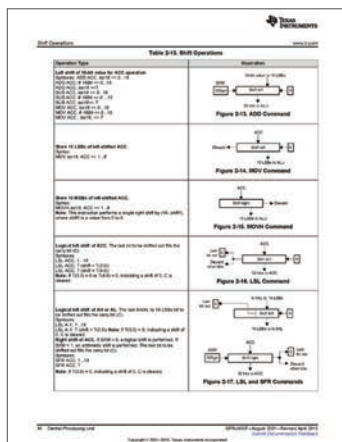
View

### Silicon Errata



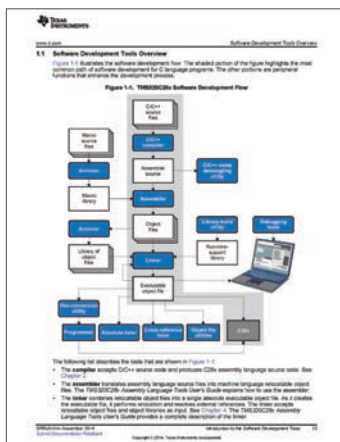
View

### TMS320C28x DSP CPU and Instruction Set



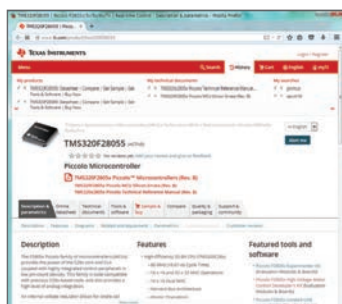
View

### TMS320C28x Optimizing C/C++ Compiler



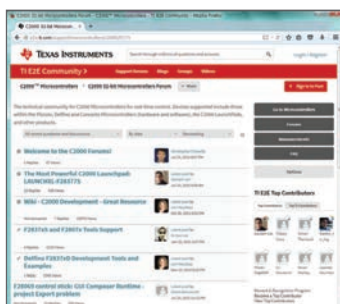
View

### Product Web Page



View

### E2E™ Support Forums



View

### Application Solutions



View

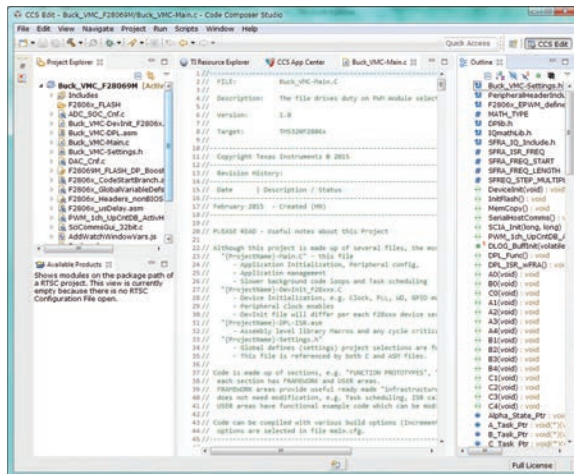
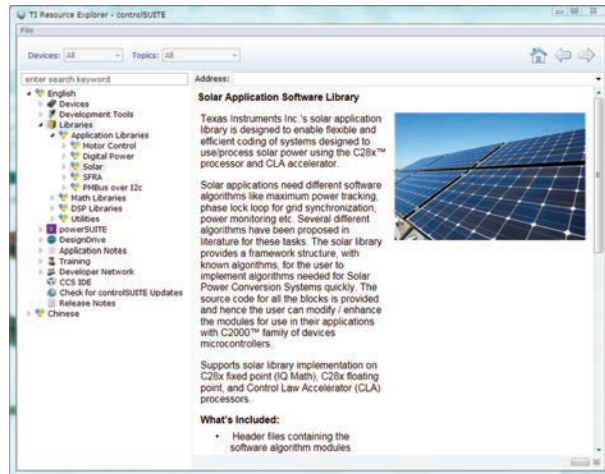
# C2000™ Piccolo™ TMS320F2805x Microcontroller Series

## Software and Tools

### controlSUITE™ Software

One place for all C2000 microcontroller software. controlSUITE includes: device support libraries, DSP and math libraries, application libraries, example projects, MCU documentation, development kit software and hardware source, technical application guides, training and more.

[Learn More](#)



### Code Composer Studio™ IDE

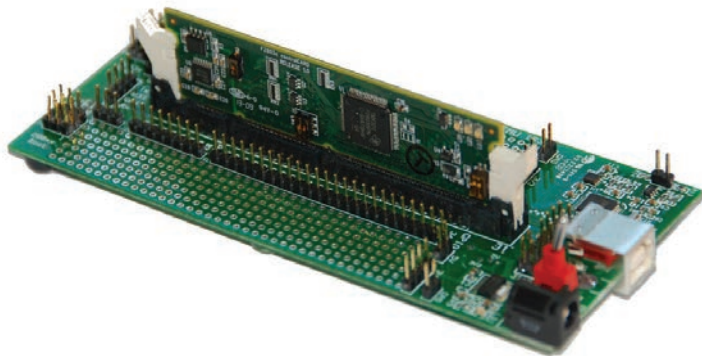
Code Composer Studio IDE is an integrated development environment (IDE) that supports TI's Microcontroller and Embedded Processors portfolio. Code Composer Studio IDE comprises a suite of tools used to develop and debug embedded applications. It includes an optimizing C/C++ compiler, source code editor, project build environment, debugger, profiler and many other features.

[Learn More](#)

### TMS320F2805x Development Kit

#### F2805x Experimenter's Kit

C2000™ MCU Experimenter Kits provide a robust hardware prototyping platform for real-time, closed-loop control development with C2000 microcontrollers. This platform is a great tool to customize and prove out solutions for many common power electronics applications, including motor control, power supplies, solar inverters, digital LED lighting, precision sensing and more.

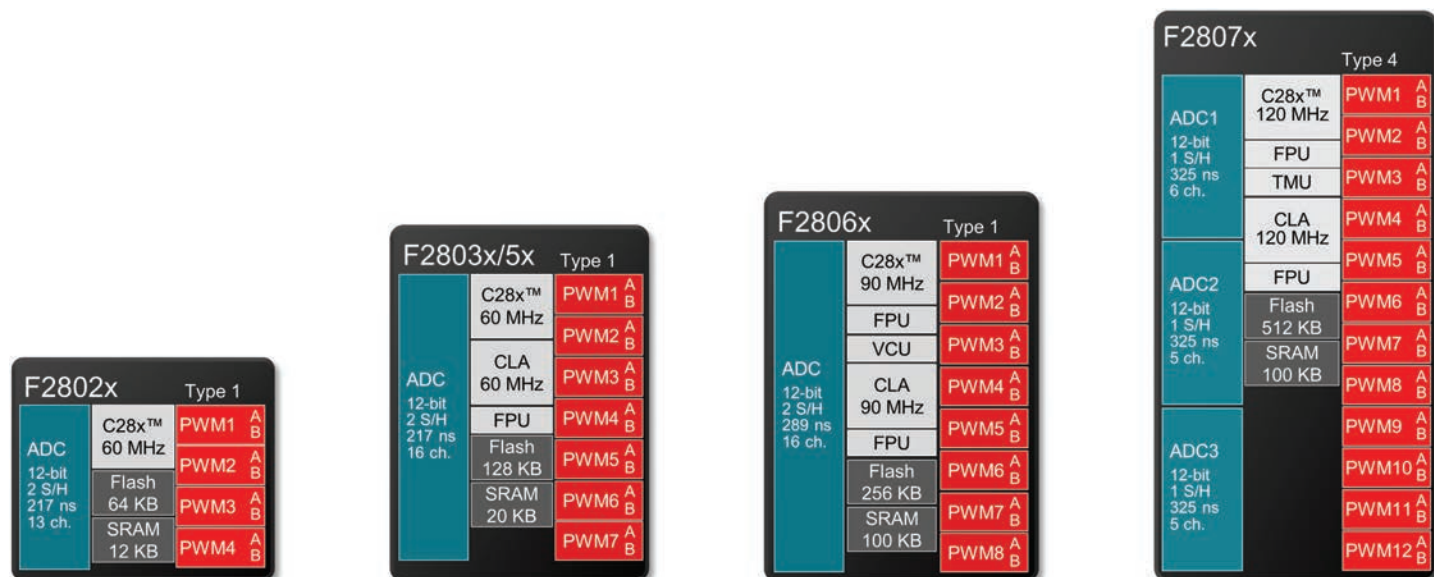


[Learn More](#)

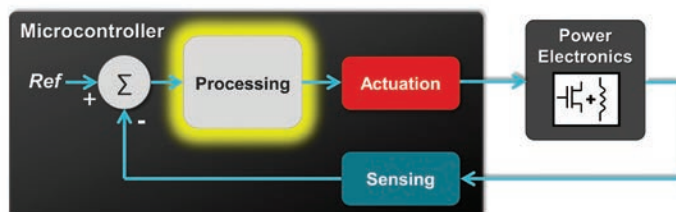
# C2000™ Piccolo™ TMS230F2805x Microcontroller Series



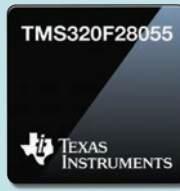
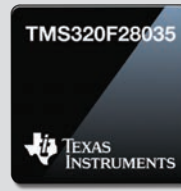
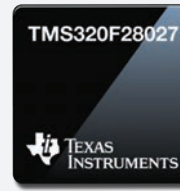
## Piccolo Family Comparison

Compare TMS320F2805x MCUs to the Rest of the Piccolo Family



## Piccolo Family Processing Feature Comparison

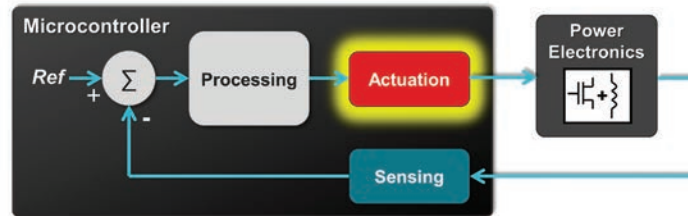




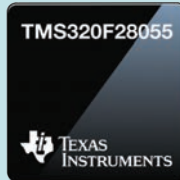
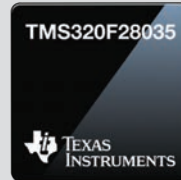
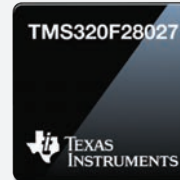
	 TMS320F28075	 TMS320F28069	 TMS320F28055	 TMS320F28035	 TMS320F28027
Total processing	240 MIPS	180 MIPS	120 MIPS	120 MIPS	60 MIPS
C28x processor	120 MHz	90 MHz	60 MHz	60 MHz	60 MHz
C28x accelerators	FPU TMU	FPU VCU	–	–	–
CLA processor	120 MHz	90 MHz	60 MHz	60 MHz	–
CLA accelerators	FPU	FPU	FPU	FPU	–
DMA	6 ch.	6 ch.	–	–	–
Flash	512 KB	256 KB	128 KB	128 KB	64 KB
SRAM	100 KB	100 KB	20 KB	20 KB	12 KB
Learn more	<a href="#">View Product Web Page</a>	<a href="#">View Product Web Page</a>	<a href="#">View Product Web Page</a>	<a href="#">View Product Web Page</a>	<a href="#">View Product Web Page</a>

# C2000™ Piccolo™ TMS230F2805x Microcontroller Series

## Piccolo Family Comparison

### Piccolo Family Actuation Feature Comparison



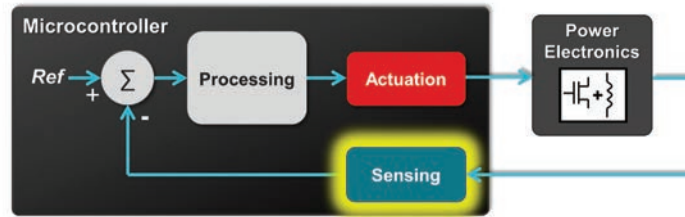
	 TMS320F28075	 TMS320F28069	 TMS320F28055	 TMS320F28035	 TMS320F28027
PWM ch.	24 ch.	16 ch.	14 ch.	14 ch.	8 ch.
HRPWM ch.	16 ch.	8 ch.	–	7 ch.	4 ch.
HRPWM resolution	150 ps	150 ps	–	150 ps	150 ps
PWM timer comparators	4	2	2	2	2
PWM trip	✓	✓	✓	✓	✓
PWM pin-to-pin trip response	50 ns	50 ns	85 ns	50 ns	50 ns
PWM trip delay	✓	–	–	–	–
PWM deadband	✓	✓	✓	✓	✓
PWM deadband resolution	150 ps	5555 ps	5555 ps	5555 ps	5555 ps
PWM phase synchronization	✓	✓	✓	✓	✓
DAC outputs	1	–	–	–	–
DAC resolution	12-bit	–	–	–	–
Learn more	<a href="#">View Product Web Page</a>	<a href="#">View Product Web Page</a>	<a href="#">View Product Web Page</a>	<a href="#">View Product Web Page</a>	<a href="#">View Product Web Page</a>


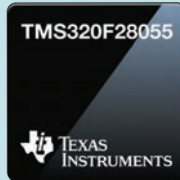
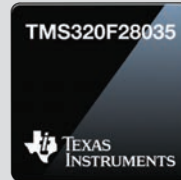
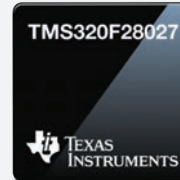


# C2000™ Piccolo™ TMS320F2805x Microcontroller Series

## Piccolo Family Comparison

### Piccolo Family Sensing Feature Comparison

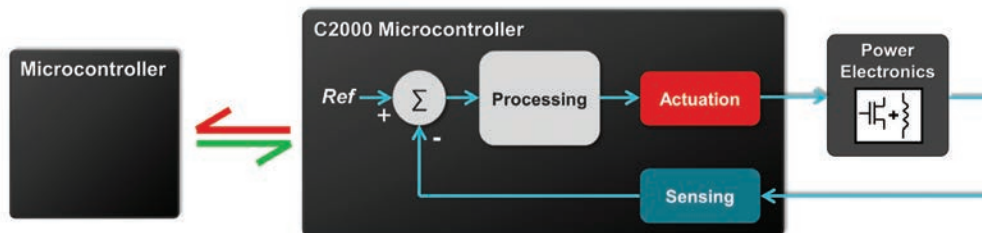







	 TMS320F28075	 TMS320F28069	 TMS320F28055	 TMS320F28035	 TMS320F28027
# of ADCs	3	1	1	1	1
ADC ch.	17 ch.	16 ch.	16 ch.	16 ch.	13 ch.
ADC resolution	12-bit	12-bit	12-bit	12-bit	12-bit
Simultaneous samples	3	2	2	2	2
Conversion rate per ADC	3.1 MSPS	3.46 MSPS	3.75 MSPS	4.6 MSPS	4.6 MSPS
Cumulative ADC MSPS	9.3 MSPS	3.46 MSPS	3.75 MSPS	4.6 MSPS	4.6 MSPS
Analog comparator modules	8	3	7	3	2
Analog comparator module type	Window	Standard	Window	Standard	Standard
Analog comparator DAC references	12-bit	10-bit	6-bit	10-bit	10-bit
Analog comparator DAC ramp generator	✓	✓	–	✓	✓
Analog comparator signal blanking	✓	✓	✓	✓	✓
Programmable gain amplifiers (PGAs)	–	–	4	–	–
Sigma-delta filter modules	8	–	–	–	–
Signal capture ch.	6	3	1	1	1
HRCAP ch.	–	4	–	2	–
HRCAP resolution	–	300 ps	–	300 ps	–
QEP ch.	3	2	1	1	–
Learn more	<a href="#">View Product Web Page</a>	<a href="#">View Product Web Page</a>	<a href="#">View Product Web Page</a>	<a href="#">View Product Web Page</a>	<a href="#">View Product Web Page</a>

# C2000™ Piccolo™ TMS320F2805x Microcontroller Series

## Piccolo Family Comparison

### Piccolo Family Connectivity Feature Comparison

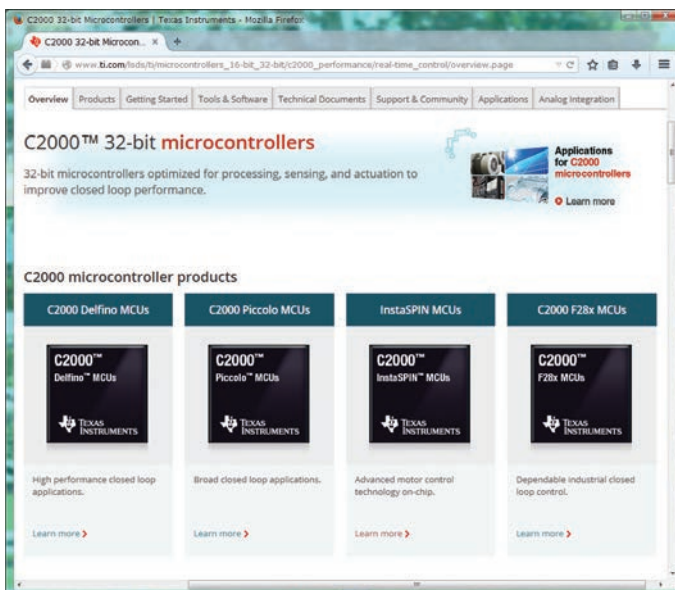


	 TMS320F28075	 TMS320F28069	 TMS320F28055	 TMS320F28035	 TMS320F28027
I <sup>2</sup> C	2	1	1	1	1
UART	3	2	3	1	1
SPI	4	2	1	2	1
USB	1	1	–	–	–
CAN	2	1	1	1	–
LIN	–	–	–	1	–
McBSP	2	1	–	1	–
External Memory interface (EMIF)	1	–	–	–	–
GPIO	97	54	42	45	22
Learn more	<a href="#">View Product Web Page</a>	<a href="#">View Product Web Page</a>	<a href="#">View Product Web Page</a>	<a href="#">View Product Web Page</a>	<a href="#">View Product Web Page</a>

### See All That the C2000 Family Has to Offer!

Learn more about Piccolo™, Delfino™ and InstaSPIN™ MCUs from Texas Instruments' C2000 family. Visit the C2000 home page to see all that C2000 has to offer!

[Learn More](#)



# TI Worldwide Technical Support

---

## Internet

### TI Semiconductor Product Information Center Home Page

[support.ti.com](http://support.ti.com)

### TI E2E™ Community Home Page

[e2e.ti.com](http://e2e.ti.com)

## Product Information Centers

**Americas** Phone +1(512) 434-1560

**Brazil** Phone 0800-891-2616

**Mexico** Phone 0800-670-7544

Fax +1(972) 927-6377  
Internet/Email [support.ti.com/sc/pic/americas.htm](http://support.ti.com/sc/pic/americas.htm)

### Europe, Middle East, and Africa

Phone

European Free Call 00800-ASK-TEXAS  
(00800 275 83927)  
International +49 (0) 8161 80 2121  
Russian Support +7 (4) 95 98 10 701

**Note:** The European Free Call (Toll Free) number is not active in all countries. If you have technical difficulty calling the free call number, please use the international number above.

Fax +(49) (0) 8161 80 2045  
Internet [www.ti.com/asktexas](http://www.ti.com/asktexas)  
Direct Email [asktexas@ti.com](mailto:asktexas@ti.com)

### Japan

Fax International +81-3-3344-5317  
Domestic 0120-81-0036  
Internet/Email International [support.ti.com/sc/pic/japan.htm](http://support.ti.com/sc/pic/japan.htm)  
Domestic [www.tij.co.jp/pic](http://www.tij.co.jp/pic)

### Asia

Phone Toll-Free Number

**Note:** Toll-free numbers may not support mobile and IP phones.

Australia 1-800-999-084  
China 800-820-8682  
Hong Kong 800-96-5941  
India 000-800-100-8888  
Indonesia 001-803-8861-1006  
Korea 080-551-2804  
Malaysia 1-800-80-3973  
New Zealand 0800-446-934  
Philippines 1-800-765-7404  
Singapore 800-886-1028  
Taiwan 0800-006800  
Thailand 001-800-886-0010

International +86-21-23073444  
Fax +86-21-23073686  
Email [tiasia@ti.com](mailto:tiasia@ti.com) or [ti-china@ti.com](mailto:ti-china@ti.com)  
Internet [support.ti.com/sc/pic/asia.htm](http://support.ti.com/sc/pic/asia.htm)

**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.

A021014

The platform bar, C2000, C28x, Code Composer Studio, controlSUITE, Delfino, E2E, InstaSPIN and Piccolo 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	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

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

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)