

C2000™ Real-Time Microcontrollers



C2000™ Microcontrollers

Microcontrollers designed for power electronics and precision-sensing applications

The C2000 MCU Advantage

With a 32-bit architecture, DSP processing and advanced control peripherals, the C2000 MCU family enables uncompromising performance for a variety of real-time control applications such as motor control, digital power supplies, solar and renewable energy, LED lighting, smart grid, radar and more.

At the core, C2000 MCUs are based around the TMS320C28x 32-bit DSP core, featuring single-cycle 32×32-bit hardware multiplies and single-cycle atomic instruction execution. Unique, feature-filled peripherals complement the core performance with industry-leading PWM generation, unparalleled ADC conversion, enhanced capture units, and more. Plus, unique architectural designs are incorporated for faster, safer and more effective control systems.

At the heart of C2000 microcontrollers is an application-focused design. Many unique features are included to improve performance of power electronics applications. This application focus is further extended with development kits for C2000 MCUs, where extensive kit selections are offered for motor control, digital power, solar energy, LED lighting and power line communications to accelerate development.

Further easing and speeding development, C2000 MCUs include a vast collection of software libraries, both device-specific and application-specific, to make it easy to begin developing optimized software and hardware solutions.

C2000 MCUs are *the* control solution. Check out one of our Piccolo™, Delfino™, or F28M3x families to find the right MCU for your control application.

C2000 MCU Families:



Piccolo™ Microcontrollers

Real control. Real time. For real systems.

Highly-integrated microcontrollers for real-time control of cost-sensitive power electronics applications. With control-optimized performance, specialized peripherals, and a control-focused architecture, Piccolo MCUs bring innovative solutions to demanding control challenges.

Starting at U.S. \$1.89

Packages from
38 to 100 pins



Delfino™ Microcontrollers

High performance. For high-end control.

The leading microcontroller family for high-performance control needs. Featuring single-core devices with speeds up to 300 MHz and a dual-core device with a combined CPU performance of 400 MHz. This family also includes industry-leading PWM control resolution, and high-precision ADCs with ultra-fast response times. Delfino MCUs tackle the toughest control challenges.

Starting at U.S. \$8.95

Packages from
176 to 337 pins



F28M3x Microcontrollers

Connectivity. Control. No compromise.

Differentiated microcontroller family combining the ARM® Cortex®-M3 core with C2000's C28x core in a single MCU package. The F28M3x MCUs bring together leading host communications and leading real-time control without compromise of control performance or communications.

Starting at U.S. \$9.40

Packages from
144 pins

DSP performance, MCU ease

DSP core with control focused co-processor and accelerator options to provide unparalleled performance and flexibility for a variety of applications

- 32-bit C28x DSP architecture
- Modified Harvard architecture including six separate data/address buses for data and program memory
- Eight-stage pipeline with single-cycle operation across pipeline
- Native DSP math processing with single-cycle 32×32 -bit multiply accumulate (MAC) operations and dual 16×16 MACs
- 192 interrupt vectors with low-latency service routines down to nine cycles
- Floating-point unit options across portfolio and revolutionary IQMath™ floating-point software for fixed-point devices
- C28x CLA co-processor for dual-core architectures, doubled performance, and modular control systems
- Trigonometric Math Unit accelerator for fast execution of trig-based functions
- VCU accelerator for unparalleled execution of power line communication algorithms
- Best-in-class compiler efficiency
- Software compatibility across the portfolio

Take control with C2000 MCU peripherals

Most flexible, configurable, and highest performing in their class

PWM generation:

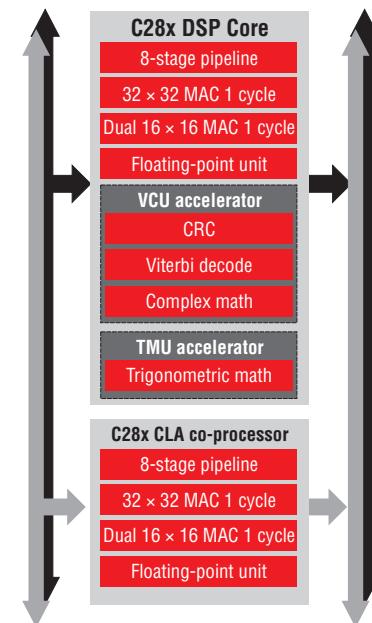
- Achieve unprecedented precision with unparalleled high-resolution duty-cycle control down to 55ps time steps
- Reduce power-switching losses with high-resolution and configurable deadband support
- Protect your system and add safety features with direct PWM tripping from comparator or trip zone pin inputs
- Flexible PWM outputs configurations, including dual-edge asymmetric and symmetric PWM generation
- Programmable or hardware-locked PWM time and phase synchronization

ADC feedback:

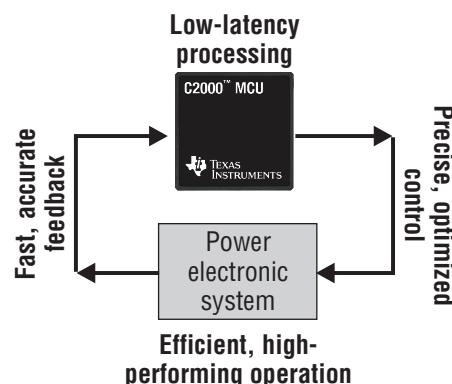
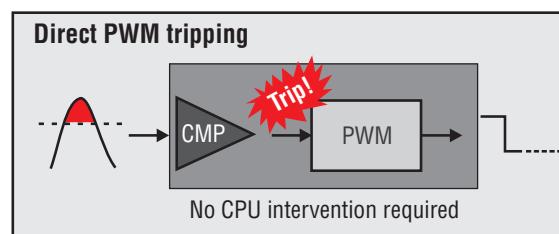
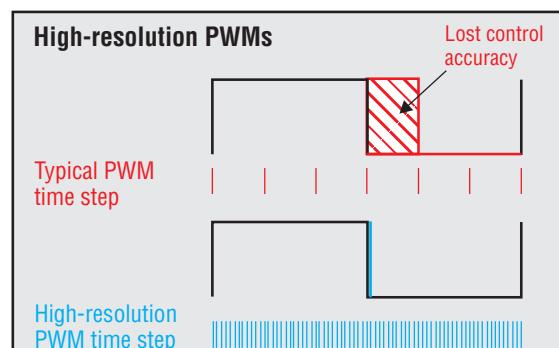
- 16-bit and 12-bit resolution for high accuracy
- Up to 4 ADCs
- Ultra-fast ADC sample and conversion rates up to 12.5 mega samples per second (MSPS)

Capture and Quadrature Encoder interfaces:

- Highly accurate capture interfaces based on 32-bit timers with additional capabilities for high-resolution measurements
- 32-bit quadrature encoder pulse module for interfacing with incremental encoders used in motor control systems



*C2000 MCU Processing Engine
Dual C28x, dual CLA co-processor, TMU accelerator and VCU accelerator*



C2000 MCUs complete the loop

C2000™ Microcontrollers

Piccolo™ Microcontrollers

Low-cost microcontrollers for real-time control applications such as white goods appliances, industrial drives, pumps, HVAC systems, solar inverters, digital power supplies, LED lighting, battery charging and power line communications.

See why Piccolo microcontrollers' combination of performance, control-oriented architecture, and low cost make them the ideal control solution for power electronics.

Powerful performance

C28x core, CLA co-processor, and VCU accelerator solve your toughest control challenges

- Up to 180 MIPS* of total performance with the 32-bit C28x DSP core combined with the CLA co-processor
- No need to hassle with fixed-point arithmetic, use an integrated floating-point unit or the IQMath™ engine
- Accelerate advanced communications-based algorithms by up to 7× with the VCU accelerator

Control-focused peripherals

Reduce power usage, enjoy more precise control, and just simply do more

- Experience a new level of control precision with the industry's leading PWM resolution on a low-cost device
- Run faster and more accurate control loops with a 4.6 MSPS, 12-bit ADC and high-resolution PWMs
- Reduce power-switching losses with high-resolution PWM dead-band
- Synchronize PWM generation by phase or time offset to create more advanced systems
- See why C2000 PWMs are the most powerful and flexible in the industry

CLA co-processor solutions

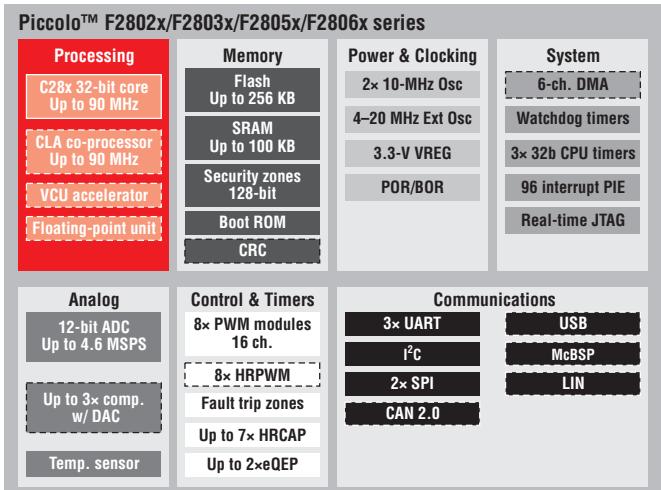
A new approach to system modularity, safety, and performance

- Run parallel control loops with independent operation of the CLA co-processor and C28x core, both have independent access to control peripherals
- Run multiple motors, motor plus power factor correction, LED lighting plus power line communications and more
- Implement safety standards with dual-core redundancy, cross-checking of computational results, and verification of peripheral functioning

InstaSPIN™ enabled

Unique motor control expertise on-chip

- Select Piccolo devices include motor control software on-chip
- FAST premium software sensor (observer) to replace mechanical sensors and software estimators
- InstaSPIN-FOC identifies motor parameters and tunes a sensorless field-oriented torque-control system
- InstaSPIN-MOTION adds premium position and speed control with full motion control suite
- See page 15 for details



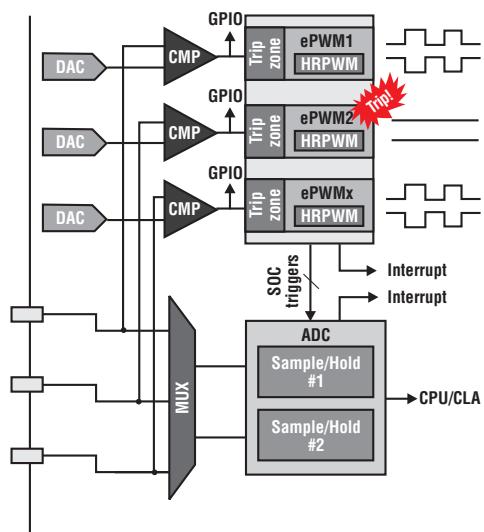
Starting at U.S. \$1.89

Q100 qualified and 125°C temperature support

On select devices

Control-tuned architecture

The integration you need with the features to differentiate your application from the competition.



- Simultaneously sample multiple motor phases or concurrent voltage and current values with a dual sample-and-hold ADC
- Add protection to your system with asynchronous PWM direct tripping through on-chip analog comparators
- Reduce Bill of Materials (BOM) costs through integrated analog comparators with DACs
- Simplify control with partitioned systems split between the C28x core and CLA co-processor, each has independent access to all control peripherals
- Forget about device life support hassles with on-chip power-on-reset (POR), brown-out-reset (BOR), clock fail detect and back-up oscillators

* On select devices

TMS320C2000™ Microcontrollers

| Device | Processor | | | | Memory | | | Control Interfaces | | | | | | Communication Ports | | | | | | External memory interface | Core supply (V) | GPIO pins | On-chip oscillator | Voltage regulator | Package pin counts | 1 kU pricing (U.S. \$) | | | | | | |
|--------------------------------|-------------|-----|------------------|-----------------|--------|------------|----------|--------------------|---------|-------------------------|--------------------|----------------|-------|---------------------|----------------|--------------------------|-------------|-----------|-----|---------------------------|-----------------|-----------|--------------------|-------------------|--------------------|------------------------|-----|-----|--------|------------|---------|-------|
| | Speed (MHz) | FPU | CLA co-processor | VCL accelerator | DMA | Flash (KB) | RAM (KB) | ROM (KB) | PWM ch. | High-resolution PWM ch. | Quadrature encoder | Event captures | HRCAP | Timers* | 12-bit ADC ch. | ADC conversion time (ns) | Comparators | OpAmp/PGA | USB | McBSP | I²C | UART/SCI | SPI | CAN | LIN | | | | | | | |
| Piccolo™ MCU generation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TMS320F2802x MCUs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TMS320F280220 | 40 | - | - | - | - | 16 | 6 | Boot | 7 | - | - | 1 | - | 8 | 13 | 1000 | - | - | - | 1 | 1 | 1 | - | - | 3.3 | 22 | 2 | Yes | 38, 48 | 1.89 | | |
| TMS320F280230 | 40 | - | - | - | - | 32 | 8 | Boot | 7 | - | - | 1 | - | 8 | 13 | 1000 | - | - | - | 1 | 1 | 1 | - | - | 3.3 | 22 | 2 | Yes | 38, 48 | 2.01 | | |
| TMS320F280260 | 50 | - | - | - | - | 16 | 6 | Boot | 7 | - | - | 1 | - | 8 | 13 | 800 | - | - | - | 1 | 1 | 1 | - | - | 3.3 | 22 | 2 | Yes | 38, 48 | 2.10 | | |
| TMS320F280270 | 50 | - | - | - | - | 32 | 8 | Boot | 7 | - | - | 1 | - | 8 | 13 | 800 | 2 | - | - | 1 | 1 | 1 | - | - | 3.3 | 22 | 2 | Yes | 38, 48 | 2.25 | | |
| TMS320F280200 | 40 | - | - | - | - | 16 | 6 | Boot | 9 | - | - | - | - | 8 | 13 | 500 | 2 | - | - | 1 | 1 | 1 | - | - | 3.3 | 22 | 2 | Yes | 38, 48 | 2.00 | | |
| TMS320F280202 | 40 | - | - | - | - | 32 | 6 | Boot | 9 | - | - | 1 | - | 9 | 13 | 500 | 2 | - | - | 1 | 1 | 1 | - | - | 3.3 | 22 | 2 | Yes | 38, 48 | 2.20 | | |
| TMS320F280201 | 40 | - | - | - | - | 64 | 10 | Boot | 9 | - | - | 1 | - | 9 | 13 | 500 | 2 | - | - | 1 | 1 | 1 | - | - | 3.3 | 22 | 2 | Yes | 38, 48 | 2.40 | | |
| TMS320F280202 | 50 | - | - | - | - | 32 | 12 | Boot | 9 | - | - | 1 | - | 9 | 13 | 260 | 2 | - | - | 1 | 1 | 1 | - | - | 3.3 | 22 | 2 | Yes | 38, 48 | 2.50 | | |
| TMS320F280203 | 50 | - | - | - | - | 64 | 12 | Boot | 9 | 4 | - | 1 | - | 9 | 13 | 260 | 2 | - | - | 1 | 1 | 1 | - | - | 3.3 | 22 | 2 | Yes | 38, 48 | 2.65 | | |
| TMS320F280206 | 60 | - | - | - | - | 32 | 12 | Boot | 9 | 4 | - | 1 | - | 9 | 13 | 217 | 2 | - | - | 1 | 1 | 1 | - | - | 3.3 | 22 | 2 | Yes | 38, 48 | 2.90 | | |
| TMS320F28026F [‡] | 60 | - | - | - | - | 32 | 12 | Boot | 9 | 4 | - | 1 | - | 9 | 13 | 217 | 2 | - | - | 1 | 1 | 1 | - | - | 3.3 | 22 | 2 | Yes | 48 | 4.45 | | |
| TMS320F28027 | 60 | - | - | - | - | 64 | 12 | Boot | 9 | 4 | - | 1 | - | 9 | 13 | 217 | 2 | - | - | 1 | 1 | 1 | - | - | 3.3 | 22 | 2 | Yes | 38, 48 | 3.05 | | |
| TMS320F28027F [‡] | 60 | - | - | - | - | 64 | 12 | Boot | 9 | 4 | - | 1 | - | 9 | 13 | 217 | 2 | - | - | 1 | 1 | 1 | - | - | 3.3 | 22 | 2 | Yes | 48 | 4.66 | | |
| TMS320F2803x MCUs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TMS320F28030 | 60 | - | - | - | - | 32 | 12 | Boot | 15 | - | 1 | 1 | 1 | 12 | 16 | 500 | 3 | - | - | 1 | 1 | 2 | 1 | 1 | - | 3.3 | 44 | 2 | Yes | 56, 64, 80 | 3.05 | |
| TMS320F28031 | 60 | - | - | - | - | 64 | 16 | Boot | 15 | - | 1 | 1 | 1 | 12 | 16 | 500 | 3 | - | - | 1 | 1 | 2 | 1 | 1 | - | 3.3 | 44 | 2 | Yes | 56, 64, 80 | 3.25 | |
| TMS320F28032 | 60 | - | - | - | - | 64 | 20 | Boot | 15 | 7 | 1 | 1 | 1 | 12 | 16 | 217 | 3 | - | - | 1 | 1 | 2 | 1 | 1 | - | 3.3 | 44 | 2 | Yes | 56, 64, 80 | 3.76 | |
| TMS320F28033 | 60 | - | Yes | - | - | 64 | 20 | Boot | 15 | 7 | 1 | 1 | 1 | 12 | 16 | 217 | 3 | - | - | 1 | 1 | 2 | 1 | 1 | - | 3.3 | 44 | 2 | Yes | 56, 64, 80 | 4.45 | |
| TMS320F28034 | 60 | - | - | - | - | 128 | 20 | Boot | 15 | 7 | 1 | 1 | 1 | 12 | 16 | 217 | 3 | - | - | 1 | 1 | 2 | 1 | 1 | - | 3.3 | 44 | 2 | Yes | 56, 64, 80 | 4.05 | |
| TMS320F28035 | 60 | - | Yes | - | - | 128 | 20 | Boot | 15 | 7 | 1 | 1 | 1 | 12 | 16 | 217 | 3 | - | - | 1 | 1 | 2 | 1 | 1 | - | 3.3 | 44 | 2 | Yes | 56, 64, 80 | 4.80 | |
| TMS320F2805x MCUs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TMS320F28050 | 60 | - | - | - | - | 32 | 12 | Boot | 15 | - | 1 | 1 | - | 12 | 16 | 500 | 6 | 3 | - | - | 1 | 3 | 1 | 1 | - | 3.3 | 42 | 2 | Yes | 80 | 3.25 | |
| TMS320F28051 | 60 | - | - | - | - | 64 | 16 | Boot | 15 | - | 1 | 1 | - | 12 | 16 | 500 | 7 | 4 | - | - | 1 | 3 | 1 | 1 | - | 3.3 | 42 | 2 | Yes | 80 | 3.55 | |
| TMS320F28052 | 60 | - | - | - | - | 64 | 20 | Boot | 15 | - | 1 | 1 | - | 12 | 16 | 267 | 7 | 4 | - | - | 1 | 3 | 1 | 1 | - | 3.3 | 42 | 2 | Yes | 80 | 4.05 | |
| TMS320F28053 | 60 | - | Yes | - | - | 64 | 20 | Boot | 15 | - | 1 | 1 | - | 12 | 16 | 267 | 7 | 4 | - | - | 1 | 3 | 1 | 1 | - | 3.3 | 42 | 2 | Yes | 80 | 4.80 | |
| TMS320F28054 | 60 | - | - | - | - | 128 | 20 | Boot | 15 | - | 1 | 1 | - | 12 | 16 | 267 | 7 | 4 | - | - | 1 | 3 | 1 | 1 | - | 3.3 | 42 | 2 | Yes | 80 | 4.55 | |
| TMS320F28055 | 60 | - | Yes | - | - | 128 | 20 | Boot | 15 | - | 1 | 1 | - | 12 | 16 | 267 | 7 | 4 | - | - | 1 | 3 | 1 | 1 | - | 3.3 | 42 | 2 | Yes | 80 | 5.30 | |
| TMS320F2806x MCUs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TMS320F28062 | 90 | Yes | - | - | Yes | 128 | 52 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | - | 1 | 1 | 1 | 2 | 2 | 1 | - | - | 3.3 | 54 | 2 | Yes | 80, 100 | 4.95 |
| TMS320F28062F [‡] | 90 | Yes | - | - | Yes | 128 | 52 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | - | 1 | 1 | 1 | 2 | 2 | 1 | - | - | 3.3 | 54 | 2 | Yes | 80, 100 | 6.70 |
| TMS320F28063 | 90 | Yes | - | - | Yes | 128 | 68 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | - | 1 | 1 | 1 | 2 | 2 | 1 | - | - | 3.3 | 54 | 2 | Yes | 80, 100 | 5.40 |
| TMS320F28064 | 90 | Yes | - | Yes | Yes | 128 | 100 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | - | 1 | 1 | 1 | 2 | 2 | 1 | - | - | 3.3 | 54 | 2 | Yes | 80, 100 | 6.20 |
| TMS320F28065 | 90 | Yes | Yes | Yes | Yes | 128 | 100 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | - | 1 | 1 | 1 | 2 | 2 | 1 | - | - | 3.3 | 54 | 2 | Yes | 80, 100 | 7.10 |
| TMS320F28066 | 90 | Yes | - | - | Yes | 256 | 68 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | - | 1 | 1 | 1 | 2 | 2 | 1 | - | - | 3.3 | 54 | 2 | Yes | 80, 100 | 6.20 |
| TMS320F28067 | 90 | Yes | - | - | Yes | 256 | 100 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | - | 1 | 1 | 1 | 2 | 2 | 1 | - | - | 3.3 | 54 | 2 | Yes | 80, 100 | 6.60 |
| TMS320F28068 | 90 | Yes | - | Yes | Yes | 256 | 100 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | - | 1 | 1 | 1 | 2 | 2 | 1 | - | - | 3.3 | 54 | 2 | Yes | 80, 100 | 7.00 |
| TMS320F28068F [‡] | 90 | Yes | - | Yes | Yes | 256 | 96 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | - | 1 | 1 | 1 | 2 | 2 | 1 | - | - | 3.3 | 54 | 2 | Yes | 80, 100 | 11.33 |
| TMS320F28068M [§] | 90 | Yes | - | Yes | Yes | 256 | 96 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | - | 1 | 1 | 1 | 2 | 2 | 1 | - | - | 3.3 | 54 | 2 | Yes | 80, 100 | 7.00 |
| TMS320F28069 | 90 | Yes | Yes | Yes | Yes | 256 | 100 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | - | 1 | 1 | 1 | 2 | 2 | 1 | - | - | 3.3 | 54 | 2 | Yes | 80, 100 | 7.90 |
| TMS320F28069F [‡] | 90 | Yes | Yes | Yes | Yes | 256 | 96 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | - | 1 | 1 | 1 | 2 | 2 | 1 | - | - | 3.3 | 54 | 2 | Yes | 80, 100 | 10.03 |
| TMS320F28069M [§] | 90 | Yes | Yes | Yes | Yes | 256 | 96 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | - | 1 | 1 | 1 | 2 | 2 | 1 | - | - | 3.3 | 54 | 2 | Yes | 80, 100 | 12.56 |

*Timers include CPU timers, PWM timers, eCAP timers and Watchdog timers

[†]Prices are quoted in U.S. dollars and represent 2014 suggested retail pricing for baseline packages and device configurations. All prices are subject to change.[‡]InstaSPIN-FOC capable devices[§]InstaSPIN-MOTION (and InstaSPIN-FOC) capable devices

C2000™ Microcontrollers

Delfino™ Microcontrollers

High-performance microcontrollers with high-integrity analog and unparalleled control peripherals to provide a real-time engine targeted at applications requiring heavy signal processing such as servo drives, mid-/high-end AC inverters, solar inverters, industrial UPS systems, power line communications, radar and much more.

Uncompromising performance

Up to 800 MIPS of total system performance with the 32-bit C28x DSP core combined with the performance of the CLA co-processor

- Get DSP performance in an MCU-class device with the C28x core and enjoy single-cycle 32×32 MAC or 16×16 dual-MAC operations
- Flash-based devices feature dual or single 32-bit floating-point C28x core options running at up to 200MHz each
- RAM-based device boasts 32-bit floating-point C28x CPUs at up to 300MHz
- Native floating-point support eliminates the hassle of fixed-point development – likewise, porting code between fixed- and floating-point native devices is a snap with the IQMath™ virtual floating-point engine
- Eliminate the need for a second processor with a single or dual core that is efficient at both the DSP math tasks and microcontroller system control tasks

Reducing system latency with new hardware accelerators

Boosting C28x execution speeds with the new Trigonometric Math Unit (TMU) and Viterbi Complex Unit (VCU II) accelerators

- TMU accelerator expedites trigonometric-based algorithms common in many control-loop calculations such as torque loops
- VCU II provides CPU acceleration for narrowband PLC standards widely used in smart grid advanced meter infrastructure networks such as PRIME, G3 and IEEE P1901.2
- Alternatively, VCU II can also be used for vibrational analysis (FFT) on motors to predict failures

Expanding CPU bandwidth with CLA co-processors

Doubling performance with a new approach to system partitioning

- Independent 32-bit floating point CLA co-processor with additional 400MIPS of system performance to alleviate signal processing burdens from C28x of complex tasks such as managing independent control loops, signal pre-processing, DSP filtering, etc.
- Cross-checking of computational results with C28x and CLA redundancy

Differentiating with high-performance analog

Powerful System on Chip (SoC) architected for speed and precision control systems

- Simultaneously sample multiple motor phases or concurrent voltage and current values with four integrated ADCs
- Develop precision feedback loops with 16-bit ADCs, 1MSPS
- Run fast control loops with a 12.5 MSPS, 12-bit ADC

Delfino™ F2837xD

| | | Temp options | 105°C | 125°C | Q100/155°C |
|----------------------------|----------------------------------|-------------------------------|--------------------|-----------------|------------|
| Memory | Power & Clocking | | | | |
| Up to 1MB Flash w/ ECC | Dual 10-MHz OSC | | | | |
| Up to 204KB SRAM w/ parity | 4–20-MHz Ext OSC | | | | |
| 2× 128-bit Secure Zones | POR/Brown-Out | | | | |
| Boot ROM | System Modules | | | | |
| | Dual 6Ch DMA | | | | |
| | 32-bit CPU Timers ×3 | | | | |
| | MMI Watchdog Timer | | | | |
| | Dual – 192 Interrupt PIE | | | | |
| Debug | | | | | |
| Real-Time JTAG | | | | | |
| Control Peripherals | Communication Peripherals | Analog Control Modules | | | |
| ePWM ×24 | I ² C/PMBus ×2 | uPP | 16-bit ADC ×4 | 1MSPS or | |
| 16 × eHRPWM | SPI ×3 | EMIF ×2 | 12-bit ADC ×4 | 3.5 MSPS | |
| Fault Trip Zones ×12 | McBSP ×2 | CAN 2.0 ×2 | Comparators ×8 | (Window or PCM) | |
| eCAP ×6 | UART ×4 | USB 2.0 OTG FS | 12-bit DAC ×3 | | |
| eQEP ×3 | Sigma Delta I/F ×8 | MAC & PHY | Temperature Sensor | | |

- Power stage protection with integrated analog windowed comparators with direct PWM trip in over/under current conditions
- Integrated Sigma-Delta demodulators enable direct interface to “hot side” isolated converters providing high-side current sense, with close coupling to trip logic for fast-acting protection
- Integrated 12-bit buffered DACs provide needed excitation for position resolver applications, reference and bias settings for external analog/op-amp interfaces, or simply for waveform reconstruction during tricky debug sessions.

Unprecedented control peripherals

Streamlined control to make your applications more responsive

- Enhanced PWM functions can precisely control complex switch timing for all drive inverters, solar inverters and every type of power-conversion application
- Sophisticated PWM shadowing, synchronization, asynchronous edge positioning, trip logic, etc., supports multi-level, matrix, and other demanding switching topologies
- High-resolution PWM duty cycle edge placement down to 55ps time unit increments for system efficiency and fast system response
- Create safer and quick systems with ultra-fast PWM tripping, allowing PWM shutdown or drive high/low conditions in 20ns
- Get more accuracy for speed and other time-sensitive sensing with responsive event capture units (5ns)

Expanding system communications

Providing on-/off-board communication

- A host of serial communications such as dual CAN, SPI, SCI for localized communication
- Dual EMIF with 32/1-bit-wide bus for extended memory additions
- USB interface for quick field updates
- Universal parallel port (uPP) provides high-speed 16-bit parallel data bus to other processors such as FPGAs or processors with the same interface

| TMS320C2000™ Microcontrollers | | Processor | | Memory | | Control Interfaces | | | | | | | | | | Communication Ports | | | | | | External Memory Interface (Mo.) | | Core supply (V) | | GPIO pins | | On-chip oscillator | | Voltage regulator | | Package pin counts | | 1 kU pricing (U.S. \$) | |
|-------------------------------|-------------|-------------|-----|------------------|-----------------|--------------------|------------|----------|----------|---------|-------------------------|--------------------|----------------|---------|----------------|---------------------------------|--------------------------------|-----------------------------|------------------------------------|--------------------------|-------------|---------------------------------|-------|-----------------|----------|-----------|-----|-------------------------------|------------|-------------------|-----------|--------------------|-------------------|------------------------|------------------------|
| Device | | Speed (MHz) | FPU | CLA co-processor | VCI accelerator | DMA | Flash (KB) | RAM (KB) | ROM (KB) | PWM ch. | High-resolution PWM ch. | Quadrature encoder | Event captures | Timers* | 12-bit ADC ch. | 12-bit ADC conversion time (ns) | 16-bit ADC or 12-bit ADC (Mo.) | 16-bit ADC / 12-bit ADC ch. | 16-bit/12-bit conversion time (ns) | Delta-sigma filter (ch.) | Comparators | USB | McBSP | I²C | UART/SCI | SPI | CAN | Universal Parallel Port (uPP) | EMIF (bit) | Core supply (V) | GPIO pins | On-chip oscillator | Voltage regulator | Package pin counts | 1 kU pricing (U.S. \$) |
| Delphi™ MCU generation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TMS320F2833x MCUs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TMS320F28335 | 150 | Yes | — | — | Yes | 512 | 68 | Boot | 18 | 6 | 2 | 6 | 16 | 16 | 80 | — | — | — | — | — | — | 2 | 1 | 3 | 1 | 2 | — | 1 | 16/32 | 1.9 | 88 | 1 | — | 176, 179 | 14.25 |
| TMS320F28334 | 150 | Yes | — | — | Yes | 256 | 68 | Boot | 16 | 6 | 2 | 4 | 14 | 16 | 80 | — | — | — | — | — | — | 2 | 1 | 3 | 1 | 2 | — | 1 | 16/32 | 1.9 | 88 | 1 | — | 176, 179 | 14.05 |
| TMS320F28332 | 100 | Yes | — | — | Yes | 128 | 52 | Boot | 16 | 4 | 2 | 4 | 14 | 16 | 80 | — | — | — | — | — | — | 1 | 1 | 2 | 1 | 2 | — | 1 | 16/32 | 1.9 | 88 | 1 | — | 176, 179 | 13.20 |
| TMS320C2834x MCUs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TMS320C28346 | 300 | Yes | — | — | Yes | — | 516 | Boot | 24 | 9 | 3 | 6 | 19 | — | — | — | — | — | — | — | — | 2 | 1 | 3 | 2 | 2 | — | 1 | 16/32 | 1.2 | 88 | 1 | — | 256 | 16.40 |
| TMS320C28345 | 200 | Yes | — | — | Yes | — | 516 | Boot | 24 | 9 | 3 | 6 | 19 | — | — | — | — | — | — | — | — | 2 | 1 | 3 | 2 | 2 | — | 1 | 16/32 | 1.1 | 88 | 1 | — | 179, 256 | 14.45 |
| TMS320C28344 | 300 | Yes | — | — | Yes | — | 260 | Boot | 24 | 9 | 3 | 6 | 19 | — | — | — | — | — | — | — | — | 2 | 1 | 3 | 2 | 2 | — | 1 | 16/32 | 1.2 | 88 | 1 | — | 256 | 12.80 |
| TMS320C28343 | 200 | Yes | — | — | Yes | — | 260 | Boot | 24 | 9 | 3 | 6 | 19 | — | — | — | — | — | — | — | — | 2 | 1 | 3 | 2 | 2 | — | 1 | 16/32 | 1.1 | 88 | 1 | — | 179, 256 | 11.25 |
| TMS320C28342 | 300 | Yes | — | — | Yes | — | 196 | Boot | 16 | 6 | 2 | 4 | 14 | — | — | — | — | — | — | — | — | 1 | 1 | 3 | 2 | 2 | — | 1 | 16/32 | 1.2 | 88 | 1 | — | 256 | 10.20 |
| TMS320C28341 | 200 | Yes | — | — | Yes | — | 196 | Boot | 16 | 6 | 2 | 4 | 14 | — | — | — | — | — | — | — | — | 1 | 1 | 3 | 2 | 2 | — | 1 | 16/32 | 1.1 | 88 | 1 | — | 179, 256 | 8.95 |
| TMS320F2837x MCUs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TMS320F28377D | 200 (x2) | Yes | 2 | 2 | Yes | 1024 | 204 | Boot | 24 | 16 | 3 | 6 | 24 | — | — | 4 | 12/24 | 910/ 286 | 8 | 8 | Yes | 2 | 2 | 4 | 3 | 2 | 1 | 2 | 16/32 | 3.3 | 169 | 1 | Yes | 176, 337 | 17.03 |
| TMS320F28376D | 200 (x2) | Yes | 2 | 2 | Yes | 512 | 164 | Boot | 24 | 16 | 3 | 6 | 24 | — | — | 4 | 12/24 | 910/ 286 | 8 | 8 | Yes | 2 | 2 | 4 | 3 | 2 | 1 | 2 | 16/32 | 3.3 | 169 | 1 | Yes | 176, 337 | 15.93 |
| TMS320F28375D | 200 (x2) | Yes | 2 | 2 | Yes | 1024 | 204 | Boot | 24 | 16 | 3 | 6 | 24 | — | — | 4 | —/24 | —/286 | 8 | 8 | Yes | 2 | 2 | 4 | 3 | 2 | 1 | 2 | 16/32 | 3.3 | 169 | 1 | Yes | 176, 337 | 15.43 |
| TMS320F28374D | 200 (x2) | Yes | 2 | 2 | Yes | 512 | 164 | Boot | 24 | 16 | 3 | 6 | 24 | — | — | 4 | —/24 | —/286 | 8 | 8 | Yes | 2 | 2 | 4 | 3 | 2 | 1 | 2 | 16/32 | 3.3 | 169 | 1 | Yes | 176, 337 | 14.33 |

*Timers include CPU timers, PWM timers, eCAP timers and Watchdog timers

†Prices are quoted in U.S. dollars and represent 2014 suggested retail pricing for baseline packages and device configurations. All prices are subject to change.

Fixed-point microcontrollers

C2000 also has an extensive line of fixed-point microcontrollers with various performance and feature set offerings to meet requirements for a variety of real-time control applications.

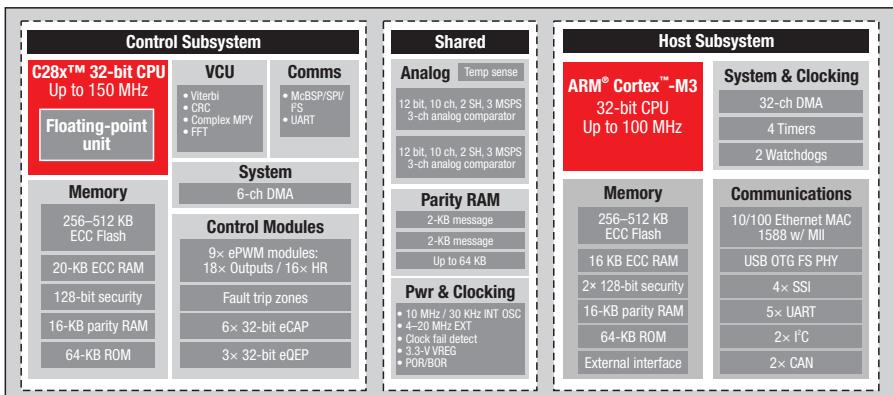
| TMS320C2000™ Microcontrollers | | Processor | | Memory | | Control Interfaces | | | | | | | | | | Communication Ports | | | | | | External memory interface (bit) | | Core supply (V) | | GPIO pins | | On-chip oscillator | | Voltage regulator | | Package pin counts | | 1 kU pricing (U.S. \$) |
|-----------------------------------|-----|-------------|-----|------------------|-----------------|--------------------|------------|----------|----------|---------|-------------------------|--------------------|----------------|-------|---------|---------------------|--------------------------|-------------|-----------|-----|-------|---------------------------------|----------|-----------------|-----|-----------|---------------------------------|--------------------|-----------|--------------------|-------------------|--------------------|------------------------|------------------------|
| Device | | Speed (MHz) | FPU | CLA co-processor | VCI accelerator | DMA | Flash (KB) | RAM (KB) | ROM (KB) | PWM ch. | High-resolution PWM ch. | Quadrature encoder | Event captures | HRCAP | Timers* | 12-bit ADC ch. | ADC conversion time (ns) | Comparators | OpAmp/PGA | USB | McBSP | I²C | UART/SCI | SPI | CAN | LIN | External memory interface (bit) | Core supply (V) | GPIO pins | On-chip oscillator | Voltage regulator | Package pin counts | 1 kU pricing (U.S. \$) | |
| Fixed-Point MCU generation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TMS320F2823x MCUs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TMS320F28235 | 150 | — | — | — | Yes | 512 | 68 | Boot | 18 | 6 | 2 | 6 | 16 | 16 | 80 | — | — | — | — | — | 2 | 1 | 3 | 1 | 2 | — | 16/32 | 1.9 | 88 | 1 | — | 176, 179 | 13.85 | |
| TMS320F28234 | 150 | — | — | — | Yes | 256 | 68 | Boot | 16 | 6 | 2 | 4 | — | 14 | 16 | 80 | — | — | — | — | 2 | 1 | 3 | 1 | 2 | — | 16/32 | 1.9 | 88 | 1 | — | 176, 179 | 13.05 | |
| TMS320F28232 | 100 | — | — | — | Yes | 128 | 52 | Boot | 16 | 4 | 2 | 4 | — | 14 | 16 | 80 | — | — | — | — | 1 | 1 | 2 | 1 | 2 | — | 16/32 | 1.9 | 88 | 1 | — | 176, 179 | 12.25 | |
| TMS320F281x MCUs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TMS320F2812 | 150 | — | — | — | — | 256 | 36 | Boot | 16 | — | 2 | 6 | — | 8 | 16 | 80 | — | — | — | — | 1 | — | 2 | 1 | — | — | 16 | 1.9 | 56 | 1 | — | 176, 179 | 14.25 | |
| TMS320F2811 | 150 | — | — | — | — | 256 | 36 | Boot | 16 | — | 2 | 6 | — | 8 | 16 | 80 | — | — | — | — | 1 | — | 2 | 1 | — | — | 1.9 | 56 | 1 | — | 128 | 14.05 | | |
| TMS320F2810 | 150 | — | — | — | — | 128 | 36 | Boot | 16 | — | 2 | 6 | — | 8 | 16 | 80 | — | — | — | — | 1 | — | 2 | 1 | — | — | 1.9 | 56 | 1 | — | 128 | 13.20 | | |
| TMS320F280x MCUs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TMS320F2809 | 100 | — | — | — | — | 256 | 36 | Boot | 16 | 6 | 2 | 4 | — | 14 | 16 | 80 | — | — | — | — | 1 | 2 | 4 | 2 | — | — | 1.8 | 35 | 1 | — | 100 | 12.30 | | |
| TMS320F28044 | 100 | — | — | — | — | 128 | 20 | Boot | 16 | 16 | — | 4 | — | 24 | 16 | 80 | — | — | — | — | 1 | 1 | 1 | — | — | — | 1.8 | 35 | 1 | — | 100 | 9.95 | | |
| TMS320F2808 | 100 | — | — | — | — | 128 | 36 | Boot | 16 | 4 | 2 | 4 | — | 14 | 16 | 160 | — | — | — | — | 1 | 2 | 4 | 2 | — | — | 1.8 | 35 | 1 | — | 100 | 11.05 | | |
| TMS320F2806 | 100 | — | — | — | — | 64 | 20 | Boot | 16 | 4 | 2 | 4 | — | 14 | 16 | 160 | — | — | — | — | 1 | 2 | 4 | 1 | — | — | 1.8 | 35 | 1 | — | 100 | 8.70 | | |
| TMS320F2802 | 100 | — | — | — | — | 64 | 12 | Boot | 8 | 3 | 1 | 2 | — | 9 | 16 | 160 | — | — | — | — | 1 | 1 | 2 | 1 | — | — | 1.8 | 35 | 1 | — | 100 | 7.10 | | |
| TMS320F2802-60 | 60 | — | — | — | — | 64 | 12 | Boot | 8 | 3 | 1 | 2 | — | 9 | 16 | 267 | — | — | — | — | 1 | 1 | 2 | 1 | — | — | 1.8 | 35 | 1 | — | 100 | 4.80 | | |
| TMS320F2801 | 100 | — | — | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

C2000™ Microcontrollers

F28M3x Microcontrollers

The F28M3x MCUs bring together connectivity and control by combining an ARM® Cortex®-M3 core with C2000's C28x core and control peripherals in a single device. With F28M3x MCUs, applications such as solar inverters and industrial control can retain the benefits of separate communications and control sub-systems while enjoying the benefits of a single-chip solution.

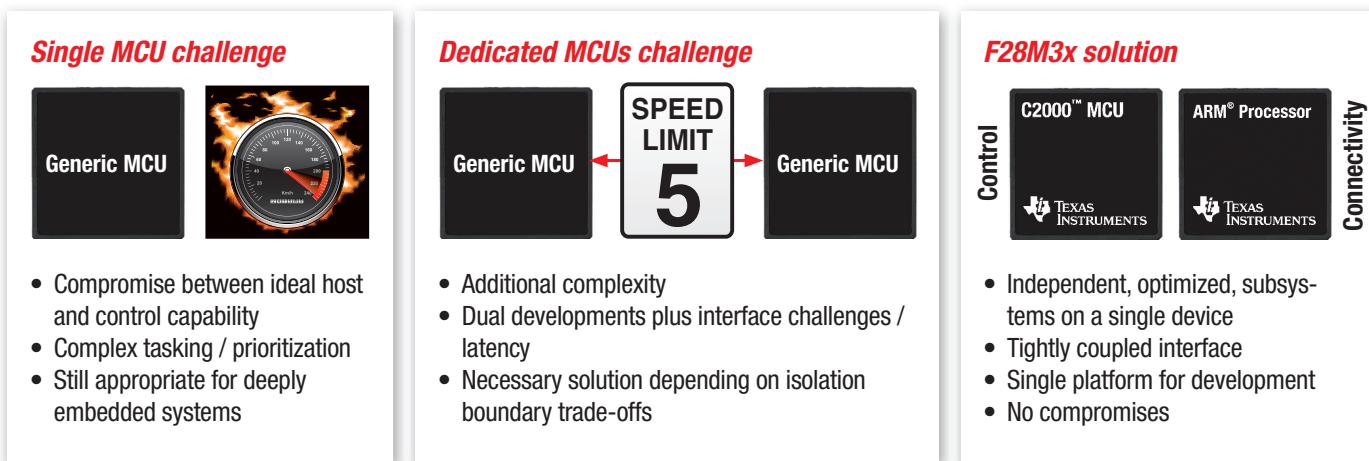
See why F28M3x MCUs have changed the game for intelligent power electronics applications.



*Starting at U.S. \$9.40
Q100 qualified and 125°C temperature support*

Control OR Communications: Why compromise? Get the best of both!

C2000 focused real-time control and ARM Cortex-M3 focused connectivity



C2000 + ARM® Cortex-M3

Using two strengths to your advantage

C2000 MCUs:

Precision control

- Industry-leading computational performance
- VCU communications accelerator hardware
- C2000 high-resolution PWMs
- Lowest latency control loops
- Robust control software support
- High-speed precision analog
- Fine-tuned control architecture

ARM:

Ecosystem of developers

- Operating systems
- Middleware
- Software infrastructure

Robust communication

- Ethernet
- USB
- CAN
- Serial
- Wireless
- Fieldbus support

Thinking safety?

Certification made easy with F28M3x MCU safety-enabling features

Error detection and correction

- Memory with error correction (ECC)
- Cyclic redundancy checking (CRC)
- Comparators for over-voltage and over-current protection
- Parity on CAN and interrupt registers



Security

- Lock protection on GPIO and registers
- Memory protection for IP safeguarding
- Permanent JTAG disable for anti-theft

Redundancy

- Two cores for cross checking computations and peripheral results
- Two ADCs for reliable measurements
- Two clocks for backup
- Multiple system watchdogs

TMS320C2000™ Microcontrollers

| Device | Processor | | | | Memory | | | | Control Interfaces | | | | | | | | | | Communication Ports | | | | | | External memory interface | Core supply (V) | GPIO pins | On-chip oscillator | Voltage regulator | Package pin counts | 10 KU pricing (U.S. \$)† | | | |
|------------------------------|------------------------|-----|------------------|-----------------|--------|------------|----------|----------|--------------------|----------------------------|--------------------|----------------|-------|---------|-----------|----------------|--------------------------|-------------|---------------------|-----|----------|-------|-----|----------|---------------------------|-----------------|-----------|--------------------|-------------------|--------------------|--------------------------|-----|-----|-------|
| | Speed (MHz) C28x/M3 | FPU | CIA co-processor | VCI accelerator | DMA | Flash (KB) | RAM (KB) | ROM (KB) | PWM ch. | High-resolution PWM ch. | Quadrature encoder | Event captures | HRGAP | Timers* | # of ADCs | 12-bit ADC ch. | ADC conversion time (ns) | Comparators | OpAmp/PGA | USB | Ethernet | McBSP | I²C | UART/SCI | SPI | CAN | LIN | | | | | | | |
| F28M3x MCU generation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F28M35Ex MCUs Entry | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F28M35E20B | 60/60 | Yes | – | Yes | Yes | 512 | 72 | Boot | 24 | 16 | 3 | 6 | – | 25 | 2 | 20 | 433/433 | 6 | – | – | – | 1 | 1 | 6 | 5 | 2 | – | Yes | 3.3 | 64 | 2 | Yes | 144 | 9.40 |
| F28M35Mx MCUs Mid-End | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F28M35M20B | 75/75 | Yes | – | Yes | Yes | 512 | 72 | Boot | 24 | 16 | 3 | 6 | – | 25 | 2 | 20 | 347/347 | 6 | – | – | – | 1 | 1 | 6 | 5 | 2 | – | Yes | 3.3 | 64 | 2 | Yes | 144 | 9.50 |
| F28M35M22C | 75/75 | Yes | – | Yes | Yes | 512 | 136 | Boot | 24 | 16 | 3 | 6 | – | 25 | 2 | 20 | 347/347 | 6 | – | 1 | Yes | 1 | 1 | 6 | 5 | 2 | – | Yes | 3.3 | 64 | 2 | Yes | 144 | 12.00 |
| F28M35M52C | 75/75 | Yes | – | Yes | Yes | 1024 | 136 | Boot | 24 | 16 | 3 | 6 | – | 25 | 2 | 20 | 347/347 | 6 | – | 1 | Yes | 1 | 1 | 6 | 5 | 2 | – | Yes | 3.3 | 64 | 2 | Yes | 144 | 13.25 |
| F28M35Hx High-End | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F28M35H22C | 150/75 or 100/100 | Yes | – | Yes | Yes | 512 | 136 | Boot | 24 | 16 | 3 | 6 | – | 25 | 2 | 20 | 347/520 | 6 | – | 1 | Yes | 1 | 1 | 6 | 5 | 2 | – | Yes | 3.3 | 64 | 2 | Yes | 144 | 14.75 |
| F28M35H52C | 150/75 or 100/100 | Yes | – | Yes | Yes | 1024 | 136 | Boot | 24 | 16 | 3 | 6 | – | 25 | 2 | 20 | 347/520 | 6 | – | 1 | Yes | 1 | 1 | 6 | 5 | 2 | – | Yes | 3.3 | 64 | 2 | Yes | 144 | 16.00 |
| F28M36Hx High-End | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F28M36H33B | 150/75 or 100/100 | Yes | – | Yes | Yes | 768 | 296 | Boot | 30 | 16 | 3 | 6 | – | 25 | 2 | 24 | 347/520 | 6 | – | – | – | 1 | 1 | 6 | 5 | 2 | – | Yes | 3.3 | 64 | 2 | Yes | 144 | 15.15 |
| F28M36H33C | 150/75 or 100/100 | Yes | – | Yes | Yes | 768 | 296 | Boot | 30 | 16 | 3 | 6 | – | 25 | 2 | 24 | 347/520 | 6 | – | 1 | Yes | 1 | 1 | 6 | 5 | 2 | – | Yes | 3.3 | 64 | 2 | Yes | 144 | 16.65 |
| F28M36H53B | 150/75 or 100/100 | Yes | – | Yes | Yes | 1024 | 296 | Boot | 30 | 16 | 3 | 6 | – | 25 | 2 | 24 | 347/520 | 6 | – | – | – | 1 | 1 | 6 | 5 | 2 | – | Yes | 3.3 | 64 | 2 | Yes | 144 | 15.75 |
| F28M36H53C | 150/75 or 100/100 | Yes | – | Yes | Yes | 1024 | 296 | Boot | 30 | 16 | 3 | 6 | – | 25 | 2 | 24 | 347/520 | 6 | – | 1 | Yes | 1 | 1 | 6 | 5 | 2 | – | Yes | 3.3 | 64 | 2 | Yes | 144 | 17.25 |
| F28M36Px Premium | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F28M36P53C | 150/75 or 125/125 | Yes | – | Yes | Yes | 1024 | 296 | Boot | 30 | 16 | 3 | 6 | – | 25 | 2 | 24 | 347/416 | 6 | – | 1 | Yes | 1 | 1 | 6 | 5 | 2 | – | Yes | 3.3 | 64 | 2 | Yes | 289 | 17.75 |
| F28M36P63C | 150/75 or 125/125 | Yes | – | Yes | Yes | 1536 | 296 | Boot | 30 | 16 | 3 | 6 | – | 25 | 2 | 24 | 347/416 | 6 | – | 1 | Yes | 1 | 1 | 6 | 5 | 2 | – | Yes | 3.3 | 64 | 2 | Yes | 289 | 19.25 |

*Timers include CPU timers, PWM timers, eCAP timers and Watchdog timers

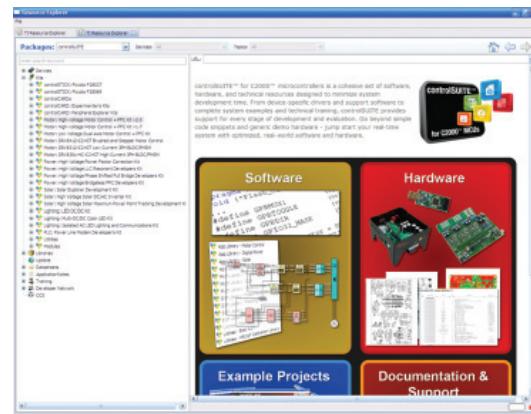
†Prices are quoted in U.S. dollars and represent 2014 suggested retail pricing for baseline packages and device configurations. All prices are subject to change.

C2000™ Microcontrollers

C2000 Software Solutions

controlSUITE™ Software Suite

controlSUITE software is a completely free suite of device software, development kit resources, software libraries, documentation, and design support. controlSUITE software comes with a graphical user interface (GUI) for easy visual navigation of all C2000 design resources. Users can learn through device-level example projects, begin application development with development kits, understand control methods through detailed application guides, and explore everything C2000 MCUs have to offer. With controlSUITE software, it is easy to access all the resources you need to for development. No more scouring the web searching for device headers, libraries, or documentation, controlSUITE software is a centralized resource for all C2000 microcontroller software, hardware and technical resource needs.

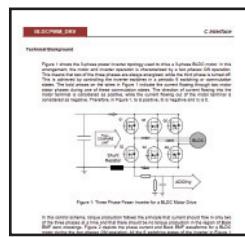


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All of your design resources in one place!



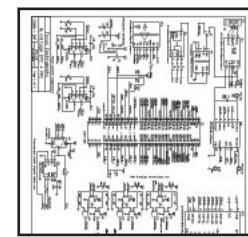
Example projects



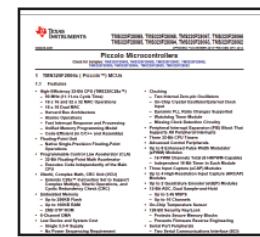
Device and application libraries



Kit software and GUIs



Hardware design files



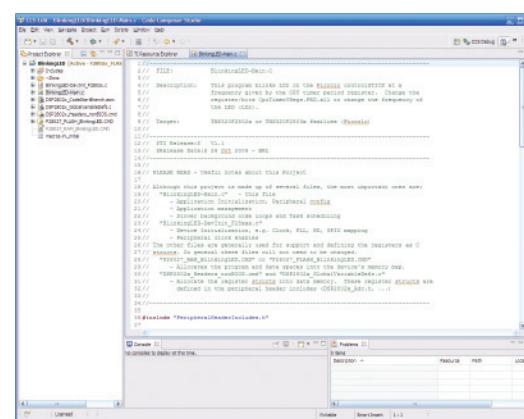
Datasheets, users guides, and more

Code Composer Studio™ IDE

Code Composer Studio (CCStudio) integrated development environment (IDE) comprises a single-user interface to a suite of tools used to develop and debug TI embedded applications.

Code Composer Studio IDE features

- C2000-optimized compilers
- Source code editor
- Project build environment
- Debugger (Full C/C++ and Assembly debugging)
- Profiler
- Simulators
- Real-time operating system
- Intuitive Eclipse-based interface



Learn more and download today at www.ti.com/ccs

C2000 MCUs real-time debugging

- Graph and modify variables/registers in real-time while running code
- Allows you to halt non-critical code for debugging while time-critical interrupts continue to be serviced
- Access memory and registers without stopping the processor
- Implemented in silicon, not by a debugging monitor: easy to use, no application resources required

controlSUITE™ Device Libraries

We have reinvented the wheel so you do not have to!



IQMath™ Library – A Virtual Floating-Point Engine

Texas Instruments IQMath Library is a virtual floating-point engine. This library is a collection of highly optimized mathematical functions enabling C/C++ programmers to develop with floating-point math on devices without native floating-point hardware support. IQMath enables code to be seamlessly ported between floating- and fixed-point devices for ultimate code scalability. The IQMath functions facilitate execution speeds considerably faster than equivalent code written in ANSI C on fixed-point MCUs, while eliminating the burden of dealing with fixed-point scaling. Just write C floating-point code and let the compiler take care of the rest.



DSP Fixed- and Floating-Point Libraries

Offers support for common DSP operations such as complex FFTs, real FFTs, inverse FFTs, FIR filters, IIR filters, vector and matrix routines, common math routines and utility functions.



DSP Signal Generation Library

Makes signal waveform generation easy with SIN generation, ramp generation and trapezoidal generation modules.



VCU DSP Library – Accelerated FFTs, Viterbi Decoding and CRC Memory Checking

VCU hardware accelerator library containing library functions for real, complex and inverse FFTs, Viterbi Add-Compare-Select and traceback operation, and CRC memory checking up to 32 bits. With the combination of the VCU hardware accelerator and library support, developers can achieve 2-cycle Viterbi butterfly operation, 3-cycle Viterbi traceback operation, 5-cycle 16-bit FFT butterfly operation, and overall, accelerate communications algorithms by up to 8× over the main C28x core of C2000™ devices.



Math Libraries

Common trigonometric and math function support. Includes libraries for fixed-point devices, floating-point devices and the CLA co-processor.

controlSUITE Software Application Libraries

Modular, application-tuned libraries essential for real-time control systems



Motor Control Library

Consists of C macros covering nearly all target-independent mathematical functions and target-specific peripheral configuration functions essential for motor control. This includes transformation and observer modules, signal generators and control modules, peripheral drivers and real-time debugging modules.



Digital Power Library

Consists of modules that enable digital control of various power topologies. This includes peripheral drivers, control modules, mathematical functions and utility functions.



Solar Power Library

Provides a framework of common solar algorithms to ease implementation of solar systems. This includes Maximum Power Point Tracking (MPPT) algorithms, Phase Locked Loop (PLL) modules, control modules and math modules.



Power Line Communications Libraries

Texas Instruments is a leader in Power Line Communications (PLC) technology, providing software for various modulations and standards. Included software libraries ease development of PLC applications for SFSK IEC61334, PRIME and G3 standards. FlexOFDM libraries are also available for custom OFDM implementations, enabling scalability for the emerging standards.

C2000™ Microcontrollers

Digital Power

C2000 microcontrollers bring a new range of possibilities in digital power management and power control. A digitally controlled system based on a C2000 MCU overcomes many of the analog power supply challenges and provides significant benefits to most power supplies, such as improved efficiency, added functions and features, and increased reliability. For example, C2000 microcontroller-driven power supplies are reaching unprecedented efficiency levels, especially at light loads. TI provides digital power algorithms and user-friendly software libraries that can be adapted to different topologies and voltage power levels, allowing for faster time to market. www.ti.com/digitalpower

controlSUITE™ software includes multiple control methods and multiple topologies through modular software for C2000 microcontrollers at no cost. www.ti.com/controlsuite

Why go for digital power?

Reduces costs

- Tunable platforms lead to new products quicker
- Calibration, better noise and temperature immunity
- Reduced board area and parts count

Higher reliability

- Built-in supervision
- Intelligent diagnostics, failure prediction, reporting capability

Higher quality

- Adaptive efficiency across load range
- Flexibility through programmability
- Calibration at final functional test
- Less sensitive to drift and better noise immunity
- Parameter monitoring for continual quality improvement
- Proven concept in mature digital motor control market

Key Applications

- *Switch-mode power supplies*
- *Uninterruptible power supplies*
- *AC/DC rectifiers*
- *Hybrid vehicles*
- *Digital TVs*
- *DC-DC modules or POLs:*
 - *Buck or boost*
 - *Half-bridge*
 - *Full-bridge*
 - *Multiphase interleaved*
- *Communication systems in:*
 - *Server farms*
 - *Base stations*
 - *Telecom/Consumer equipments*

Tools and software for digital power applications

High voltage development kits and digital power software libraries to jump start designs



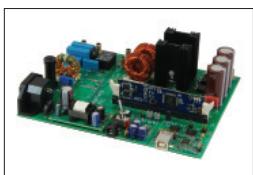
Power Factor Correction Kit – \$249

- 2-phase interleaved PFC
- 300W, up to 400V DC output
- Isolated JTAG for real-time debug
- Comes with Piccolo™ F28027 controller card



Phase Shifted Full Bridge – \$550

- Up to 400VDC input
- 600W 12VDC output
- Supports peak current mode with slope compensation on chip
- Comes with Piccolo F28027 controller card



Bridgeless PFC Kit – \$450

- 2-phase interleaved PFC
- 300W, up to 400V DC output
- Isolated JTAG for real-time debug
- Comes with Piccolo F28035 controller card



Resonant LLC Kit – \$400

- Up to 400VDC input
- 360W 12VDC output
- Experiment with OCP, OVP and UVP
- Comes with Piccolo F28027 controller card

Automotive

The automotive industry is constantly looking for new ways to make their cars safer, more reliable, and more efficient. The powerful PWM modules and analog ADC integrated in C2000 microcontroller devices can be used in applications such as collision avoidance, power steering, radar applications, heads-up display and electronically-controlled interfaces.

The industry is also looking at a shift toward hybrid and fully electric vehicles, and C2000 MCUs provide a low-cost solution to many aspects of HEV/EV operation. With a powerful DSP-based core, a variety of communication protocols including LIN and CAN, and automotive AEC-Q100 qualification (-40° to 125° C), C2000 microcontrollers work to complete your automotive designs. www.ti.com/hev

HEV benefits

- Reconfigurable constant voltage/current/power charging mode
- Optimized battery charging to extend battery life and performance
- Communication via PLC for smart charging
- Improved SOC/SOH estimation for optimal battery usage

Tools and Software

- Hardware reference designs
 - Start/Stop system – 4-phase interleaved boost
 - Motor control board for small-task-oriented vehicles (STOV)
 - Automotive headlamp
- controlSUITE™ software

Key Applications

- Automotive radar and collision avoidance
- Electric power steering
- Drive-by-wire
- Power conversion
- Heads-up displays
- Hybrid Electric Vehicle/Electric Vehicle (HEV/EV)
 - Off-line battery charger
 - DC/DC power conversion
 - Battery management system
 - Electric motor inverter



C2000™ Microcontrollers

Digital Motor Control

Texas Instruments understands the challenges facing motor-control developers, and provides software and tools that significantly accelerate development of motor-control systems. Thorough documentation, rich suites of digital motor control and math libraries, modular software strategies, and open-source motor-control development kits lead developers through the process of creating a complete motor-control system. Combining this complete motor ecosystem with motor-tuned microcontroller architectures, C2000 MCUs reduce the overall cost of motor-control systems and enable control techniques to create efficient, cutting-edge solutions. www.ti.com/c2000dmc and www.ti.com/instaspin

Key Applications

- Variable-speed drives
- Servo drives
- Appliance motors
- HVAC compressors and blowers
- Pumps and fans
- Electric power steering
- Soft starters
- Tools

C2000 motor control gives you MORE

- Variable speed control → MORE efficient motors
- Field-oriented control → MORE efficient control
- Space vector PWM → MORE efficient power stage
- Sensor-less control → MORE cost effective
- Multi-axis control → MORE motors per controller
- Integrated digital PFC → MORE system functions
- Meeting IEC standards → MORE reliable and robust
- Broadest MCU portfolio → MORE products, one platform

Motor Solution Kits

Brushed & Stepper Motor Kit with DRV8412 & Piccolo MCU – \$199

- 52V, 3.5A 3-phase motor driver stage
 - Quadrature encoder interface
 - Piccolo F28035 microcontroller control
 - Includes two brushed DC and one stepper motor
- 

High-Voltage PFC and MC Developer's Kit – \$699

- 1.5KW, 350V 3-phase motor driver stage
 - 750W 110–220 VAC PFC stage
 - Projects for ACI, BLDC, and PMSM motors sold by TI
 - Spin your own motor instantly with InstaSPIN versions
 - Isolated CAN and UART interfaces
- 

Three-Phase BLDC & PMSM Motor Kit with DRV8301/DRV8302 and Piccolo MCU – \$299

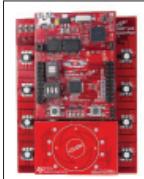
- 60V, 60A 3-phase motor driver stage
 - NO motor included
 - Spin your own motor instantly with InstaSPIN™ versions
 - Hall & Quadrature encoder interfaces
 - Isolated SPI and CAN interfaces
- 

Three Phase BLDC & PMSM Motor Kit with DRV8312 & Piccolo MCU – \$299

- 50V, 3.5A 3-phase motor driver stage
 - NEMA17 BLDC/ PMSM 55W motor
 - Spin your own motor instantly with InstaSPIN versions
 - Hall & Quadrature encoder interfaces
 - Isolated SPI and CAN interfaces
- 

LaunchPad + Booster Kit – \$66

- 6–24V, 10A continuous 14A peak inverter
- Self-protecting DRV8301 pre-driver with integrated buck and opamps
- Power dense NexFET™ power MOSFETs



| Kit Part Number | Controller Included | Voltage (V) | Current (Continuous, A) | Software | Control Techniques | Supported Motor Types | | Rotor Sensor | | | |
|-------------------|--------------------------------------|-------------|-------------------------|---------------|---------------------------------|-----------------------|-----|--------------|------|---------|-----------|
| | | | | | | Step/Brush | ACI | BLDC/PM | Hall | Encoder | SW Sensor |
| DRV8412-C2-KIT | TMDSNCND28035ISO | 12–50 | 3.5 | controlSUITE™ | Micro-stepping, Brushed torque | • | | | | | |
| DRV8312-C2-KIT | TMDSNCND28035ISO | 15–50 | 3.5 | controlSUITE | BLDC, InstaSPIN-BLDC, SMO FOC | | | • | • | | • |
| DRV8312-69M-KIT | TMDSNCND28069MISO | 15–50 | 3.5 | MotorWare | InstaSPIN-FOC, InstaSPIN-MOTION | | • | • | | • | • |
| BOOSTXL-DRV8301 | LAUNCHXL-F28027F* | 6–24 | 10 | MotorWare | InstaSPIN-FOC | | • | • | | | |
| DRV8302-HC-C2-KIT | TMDSNCND28035ISO | 18–60 | 60 | controlSUITE | InstaSPIN-BLDC, SMO FOC | | | • | | | • |
| DRV8301-HC-C2-KIT | TMDSNCND28035ISO | 18–60 | 60 | controlSUITE | InstaSPIN-BLDC, SMO FOC | | | • | | | • |
| DRV8301-69M-KIT | TMDSNCND28069MISO | 18–60 | 40 | MotorWare | InstaSPIN-FOC, InstaSPIN-MOTION | • | • | | • | • | • |
| TMDSHVMTRPFCKIT | TMDSNCND28035 and TMDSNCND28335 | 50–350 | 10 | controlSUITE | V/Hz, BLDC, SMO/FE FOC | | • | • | • | • | • |
| TMDXHVMTRKIT5X | TMDSNCND28055ISO | 50–350 | 10 | controlSUITE | SMO/FE FOC | | • | • | | | • |
| TMDSHVMTRINSPIN | TMDSNCND28069MISO and TMDSNCND28027F | 50–350 | 10 | MotorWare | InstaSPIN-FOC, InstaSPIN-MOTION | | • | • | • | • | • |

*If purchased as a bundle.

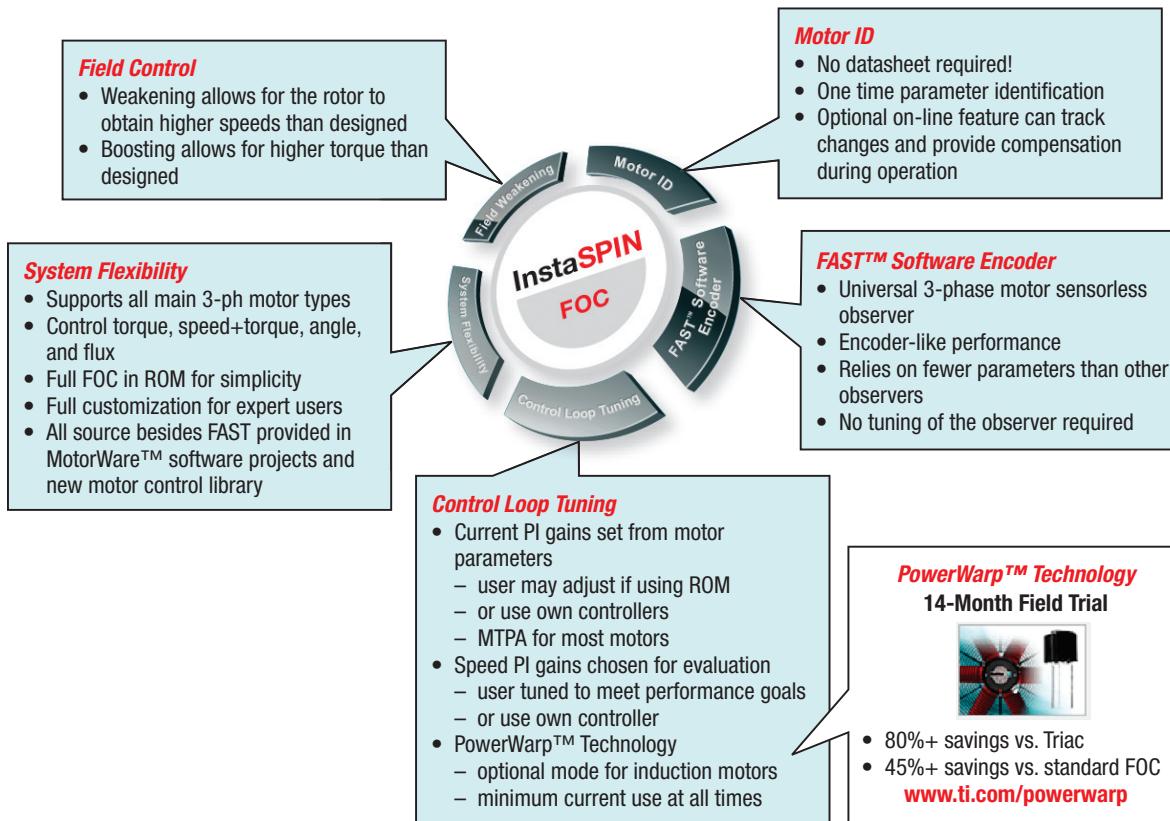
InstaSPIN™ motor and motion control technology

Making motor development easier, faster and more affordable

- Embedded in the read-only-memory (ROM) on select Piccolo devices
- Save months of design time with motor parameter identification, automatic software observer and torque control tuning, rapid speed-control tuning and a full suite of trajectory generation and state-based motion planning.
- Near encoder performance with embedded on-chip FAST™ observer algorithm, which through only analysis of currents and voltages, calculates a reliable and robust estimation of rotor flux, angle, speed and torque across use conditions. Accurate, sensorless estimator performance eliminates the need for a physical sensor in nearly all torque and velocity applications.
- Accommodate all three-phase motors, synchronous (BLDC, SPM and IPM) and asynchronous (ACI) with the same solution.
- Identify and tune with off-line motor commissioning that identifies the required parameters of the motor, tunes the FAST algorithm,

InstaSPIN-FOC

TI's InstaSPIN-FOC software solution takes advantage of the FAST™ premium software sensor for rotor flux measurement and provides motor identification, automatic current control tuning and sensorless feedback in a field-oriented control (FOC) torque controller and speeds deployment of efficient, sensorless, variable-load three-phase motor solutions.



- F** **Rotor Flux**
 - High integrity signal for stable field control
- A** **Rotor Angle**
 - Locks within one electrical cycle of rotation
 - Stable through zero
 - Robust under dynamics
 - Recovery after stall events
- S** **Rotor Speed**
 - Mechanical and electrical speed estimations
 - Near zero phase lag
- T** **Rotor Torque**
 - Accurate for load monitoring, flow rate, unbalanced load, motor diagnostics

FAST™ Software Encoder (Sensorless Observer)

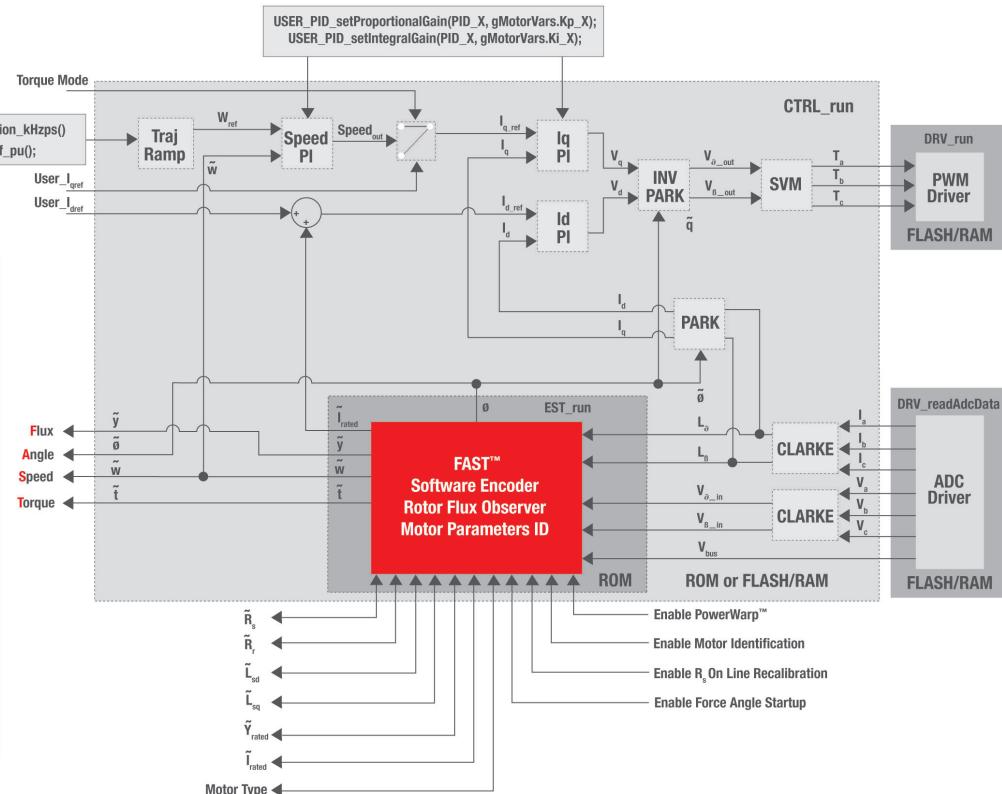
- Universal 3-phase motor software encoder supports
 - Synchronous (BLDC, SPM, IPM)
 - Asynchronous (ACI) motors
 - Unique, high-quality feedback signals for use in control systems
- Performance
 - Tracks below 1 Hz
 - Tracks through zero on speed reversals
 - Stable feedback to control system when rotor is at zero speed
- Motor parameters
 - Relies on fewer parameters than other observers
 - Off-line commissioning learns the needed electrical motor parameters
 - Optional on-line observer tracks parameter changes to ensure estimation accuracy over time and temperature
- Tuning
 - No tuning of the observer required



Included in ROM on select Piccolo™ MCUs, with software API

InstaSPIN FOC

- FAST is always called from ROM
- Full InstaSPIN-FOC system (torque or speed+torque) may be called from ROM
- Source also provided for FOC to call from user memory
- Any custom system may be developed using feedback from FAST



InstaSPIN™-MOTION

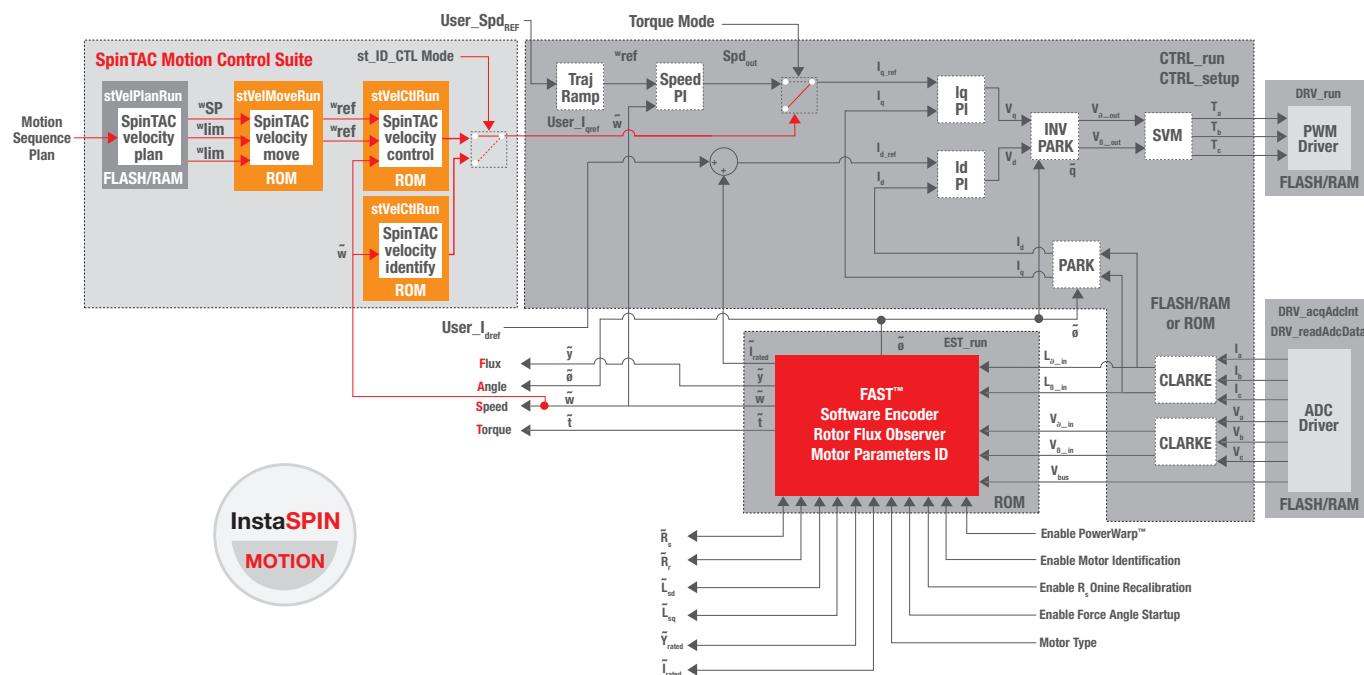
Built upon TI's InstaSPIN-FOC technology, InstaSPIN-MOTION software powered by SpinTAC™ technology provides accurate speed and position control with minimal disturbances.

IDENTIFY – Ensure optimum tracking and disturbance rejection, working with the real inertia of the system.

CONTROL – Minimize effort and reduce complexity with single coefficient tuning. Rapidly test and tune velocity control from soft to stiff response, defining a controller gain that typically works across the entire variable speed and load range of an application. Actively estimate and cancel system disturbances in real time, providing maximum performance.

MOVE – Produce an automatically optimized motion profile based on start velocity, target velocity and system limitations for acceleration, jerk and motion trajectory type.

PLAN – Quickly build various states of motion (speed A to speed B) and tie them together with state-based logic.

**InstaSPIN-FOC and -MOTION capable devices**

| Device | Processor | | | Memory | | | Control Interfaces | | | | | | Communication Ports | | | | | | External memory interface | Core supply (V) | GPIO pins | On-chip oscillator | Voltage regulator | Package pin counts | 1 kU pricing (U.S. \$) | | | | | | | |
|----------------------------|-------------|-----|------------------|-----------------|-----|------------|--------------------|---------|-------------------------|--------------------|----------------|-------|---------------------|----------------|--------------------------|-------------|-----------|-----|---------------------------|-----------------|-----------|--------------------|-------------------|--------------------|------------------------|-----|-----|-----|-----|------|---------|-------|
| | Speed (MHz) | FPU | CLA co-processor | VCI accelerator | DMA | Flash (KB) | RAM (KB) | PWM ch. | High-resolution PWM ch. | Quadrature encoder | Event captures | HRCAP | Timers* | 12-bit ADC ch. | ADC conversion time (ns) | Comparators | OpAmp/PGA | USB | McBSP | I²C | UART/SCI | SPI | CAN | LIN | | | | | | | | |
| TMS320F28026F [‡] | 60 | – | – | – | – | 32 | 12 | Boot | 9 | 4 | – | 1 | – | 9 | 13 | 217 | 2 | – | – | 1 | 1 | 1 | – | – | 3.3 | 22 | 2 | Yes | 48 | 4.45 | | |
| TMS320F28027F [‡] | 60 | – | – | – | – | 64 | 12 | Boot | 9 | 4 | – | 1 | – | 9 | 13 | 217 | 2 | – | – | – | 1 | 1 | 1 | – | – | 3.3 | 22 | 2 | Yes | 48 | 4.66 | |
| TMS320F28062F [‡] | 90 | Yes | – | – | Yes | 128 | 52 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | – | 1 | 1 | 1 | 2 | 2 | 1 | – | – | 3.3 | 54 | 2 | Yes | 80, 100 | 6.70 |
| TMS320F28068F [‡] | 90 | Yes | – | Yes | Yes | 256 | 96 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | – | 1 | 1 | 1 | 2 | 2 | 1 | – | – | 3.3 | 54 | 2 | Yes | 80, 100 | 11.33 |
| TMS320F28068M [§] | 90 | Yes | – | Yes | Yes | 256 | 96 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | – | 1 | 1 | 1 | 2 | 2 | 1 | – | – | 3.3 | 54 | 2 | Yes | 80, 100 | 7.00 |
| TMS320F28069F [‡] | 90 | Yes | Yes | Yes | Yes | 256 | 96 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | – | 1 | 1 | 1 | 2 | 2 | 1 | – | – | 3.3 | 54 | 2 | Yes | 80, 100 | 10.03 |
| TMS320F28069M [§] | 90 | Yes | Yes | Yes | Yes | 256 | 96 | Boot | 19 | 8 | 2 | 7 | 4 | 17 | 16 | 325 | 3 | – | 1 | 1 | 1 | 2 | 2 | 1 | – | – | 3.3 | 54 | 2 | Yes | 80, 100 | 12.56 |

[†]Prices are quoted in U.S. dollars and represent 2014 suggested retail pricing for baseline packages and device configurations. All prices are subject to change.

^{*}Timers include CPU timers, PWM timers, eCAP timers and Watchdog timers

[‡]InstaSPIN-FOC capable devices

[§]InstaSPIN-MOTION (and InstaSPIN-FOC) capable devices

C2000™ Microcontrollers

Power-Line Communications

Power-line communications (PLC) transmit data over an existing high-voltage power line instead of requiring dedicated cabling. Although the technology has been used for decades, recent concepts and ideas have opened the door to new innovations driven by power line communication. C2000 microcontrollers are an ideal platform for power-line networked applications because the performance, large on-chip memory, and integrated peripheral interfaces provide a single-chip solution for control and PLC functions. Additionally, with unique on-chip IP such as the Verterbi Complex Math Unit (VCU), C2000 MCUs are tuned for power-line communications, offering unparalleled performance in a cost-sensitive package. TI has developed freely available PLC software libraries and hardware reference designs which provide a flexible platform to quickly develop and test robust PLC implementations. With a flexible PLC development platform and PLC-optimized C2000 MCUs, TI provides industry-leading solutions for PLC development. www.ti.com/plc

Key Applications

- Lighting
- Solar
- Metering
- Industrial controls
- Ballast
- Security gates/cameras
- Motor control

C2000 Power-Line Modem

Developer's Kit – \$599

- Two PLC modems
- PLC software supporting OFDM (PRIME, G3, FlexOFDM) and SFSK communication
- Two F28069 controlCARDs included



Benefits

Single C2000 MCU has the performance and peripherals to control the entire system

PLC systems controlled with software allow multiple standard support and easy protocol updating

Software-based system allows modulation scheme to be changed in software

Integrated system communication interfaces: I²C, CAN, SPI, UART, LIN

Precision Sensing and Control

The growing requirements to add active intelligence and functionality to sensing and measurement applications make microcontrollers that enable a high-precision response very desirable. The benefits of a DSP-based core (filtering and high-performance calculations) combined with the best features of an MCU (easy development and low-cost integration) allow for innovative implementations and advancements of common systems. The C2000 platform is composed of components that can improve almost any application that requires precision sensing and control.

Key Applications

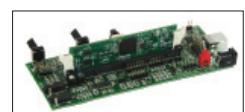
- RFID readers
- Bar-code scanners
- Musical effects
- Pressure/torque/inertial sensors
- Alarm systems
- Capacitive/piezoresistive sensors
- Robots
- Thermal and laser control for optical networks
- Motor systems
- Medical
- Radar sensing

Tools and Software

- C2000 LaunchPad
- Experimenter's Kit
- Peripheral Explorer Kit
- Software libraries

Peripheral Explorer Kit – \$179

- Easily learn how to use all of the advanced peripherals on a C2000 MCU
- Ready-to-run software and hardware
- Comes with an F28335 controlCARD
- Includes on-board USB JTAG emulation
- Includes C2000 teaching CD-ROM



Benefits

Accurate measurements

Enabling features

- Fastest on-chip ADC on the market – up to 12.5 MSPS with dual sample-and-hold to allow concurrent measurements

Precise outputs and control

- Multiple high-resolution PWM modules provide step resolution at 55ps
- Fully configurable PWM outputs allow the creation of almost any output waveform with any synchronization scheme
- 32-bit enhanced captures with four event time stamps

Minimize cost and improve reliability

- Dual integrated high-speed oscillators and analog comparators
- Power-on reset, brown-out protection, and programmable trip conditions

Solar Energy

Solar energy is a booming technology for energy harvesting. With C2000 microcontrollers, solar systems can extract more energy from the sun through advanced power conversion and maximum power point tracking (MPPT) performance. Whether the system feeds power back to the grid, charges a battery, or both, C2000 MCUs provide the power conversion control to most efficiently extract and deliver energy.

Solar Explorer Development Kit – \$349

- 20VDC / 50W non-isolated design
- Single-switch DC/DC boost for MPPT
- DC/DC sepic for MPPT and battery charging
- Output inverter stage 24VAC maximum
- Piccolo™ MCU



High-Voltage Solar DC/DC MPPT Kit – \$349

- 200–300VDC input up to 500W
- 400VDC output
- 2-phase DC/DC boost for MPPT
- 1:1 resonant LLC for isolation
- Piccolo MCU



Key Applications

- | | |
|---------------------------------------|---------------------------------|
| • Central and string inverters | • Battery charging applications |
| • Micro inverters | • Solar arc detection |
| • On- and off-grid solar applications | |

High Voltage Solar 1-Phase Inverter Kit – \$349

- >96% efficient
- Grid-tie with enable/disable
- Ethernet remote control and monitoring
- 110/220VAC selectable output
- Piccolo or F28M3x MCU control

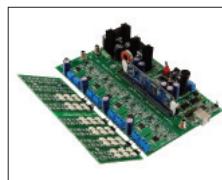


Lighting

LED lighting is increasingly becoming the dominant lighting technology due to its inherent efficiency, safety, configurability, and aesthetic benefits. Likewise, C2000 microcontrollers are an ideal solution for many LED lighting applications. With an optimized DSP core and powerful peripherals, C2000 microcontrollers provide the processing capability and integration to drive low-cost, dynamic, and energy-efficient lighting systems. With just a single, low-cost Piccolo™ MCU, high efficiency digital power conversion, dynamic multi-string LED lighting control, and advanced communications can be implemented in a lighting system. www.ti.com/led

Key Applications

- | | |
|------------------------------------|---------------------------------|
| • Industrial & commercial lighting | • Automotive lighting |
| • Building lighting | • Large infrastructure lighting |
| • Street lighting | • Intelligent lighting |
| • Stage lighting | |
- DC/DC LED Lighting Developer's Kit – \$399**
- Eight independent 10-watt LED driver stages
 - Buck or boost DC/DC power stage
 - Digital control of DC/DC power stage and LED driver stages with a single Piccolo MCU
 - Includes Piccolo F28035 controlCARD



Multi-DC/DC Color LED Kit – \$499

- Eight independent DC/DC boost/sepic power stages
- Implements color mixing
- Digital control of eight DC/DC power stages and eight LED driver stages with a single Piccolo MCU
- Includes Piccolo F28027 controlCARD



Benefits

Increase operating efficiency across lighting conditions

Single design for multiple lighting fixture implementations

Add intelligence with advanced communications protocols such as Power-Line Communications (PLC), DALI, DMX, KNX, etc.

Precise LED intensity, dimming, and color mixing through on-chip high-resolution PWM and ADC peripherals

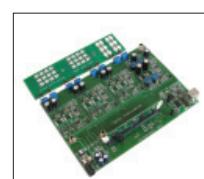
Reduce cost through integration of all major control systems into a single MCU

Easy field upgrades and dynamic on-the-fly adjustments

Easy implementation of advanced features such as temperature sensing and correction, dimming scheduler, aging compensation, etc.

Isolated AC LED Lighting & Communications Kit – \$699

- AC/DC LED lighting power supply
- 6 LED strings with dimming
- DALI, DMX512, & Power Line Communications (PLC)



C2000™ Microcontrollers

C2000 LaunchPad – A new robust platform to get started with C2000 MCUs

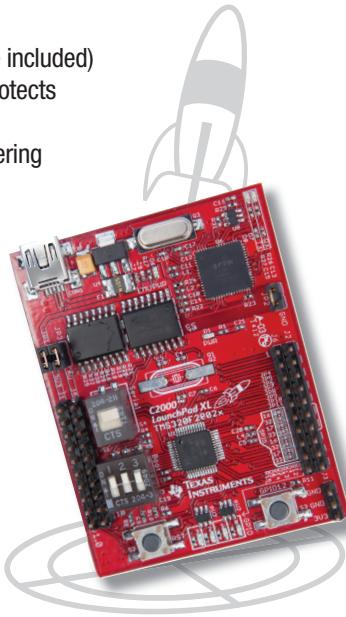
Get started in minutes

- Integrated USB-powered (cable included) isolated JTAG emulation tool protects host PC
- No additional hardware or soldering needed

Rapid prototyping

- Allows interface to external components or custom daughter boards
- Access to all C2000 pins with pin mappings*
- One programmable push button, one push button for CPU reset and four LEDs

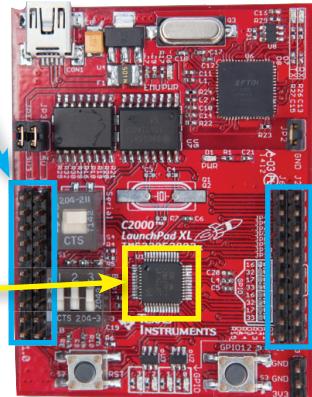
*Except JTAG



Just \$17

Easily evaluate and program

- 40 PCB pins (double-sided connectors), accessible from top and bottom
- C2000 Piccolo™ TMS320F28027 MCU includes a 12-bit ADC, temperature sensor, timers, UART, SPI, I²C, high-resolution PWMs and comes pre-programmed with a temperature measurement demo application



Orderable part numbers:

LAUNCHXL-F28027 for general use

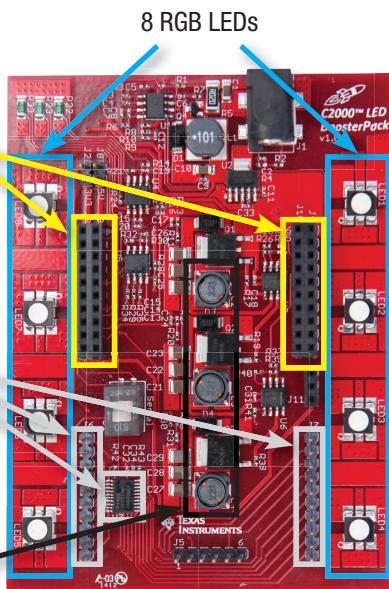
LAUNCHXL-F28027F InstaSPIN-FOC ready!

LED BoosterPack – 8 LEDs, 3 boost converters, digital dimming and control

Easily plug in C2000 LaunchPad to add lighting capability

Interface to the MSP430™ Capacitive Touch BoosterPack to enable touch-controlled LED lighting

3 boost converters to drive LEDs and allow control of dimming and color management

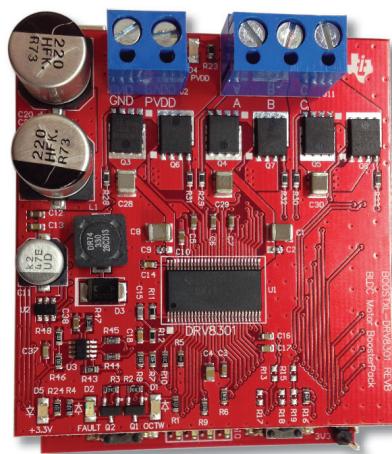


Just \$30

Motor Drive BoosterPack – 6–24V, 14A peak 3-ph inverter for sensorless InstaSPIN™-FOC

DRV8301 Pre-Driver

- 3 half bridges with 3 or 6 PWM control
- Bootstrap gate drivers with slew rate control
- Shoot through protection
- On-chip 3.3V/1.5A buck supplies power to the LaunchPad
- 2.3A sink / 1.7A source
- On-chip current-sense amps



Just \$49

NexFET™ MOSFETs

- 6× N-channel
- CSD18533Q58
- $R_{ds(on)} < 6.5\text{ m}\Omega$
- Power dense 5×6mm SON

Orderable part numbers:

BOOSTXL-C2KLED

BOOSTXL-DRV8301

controlCARD ecosystem

We understand picking the right processor can be tough, and purchasing device-specific EVM boards can become costly. That's why we created the controlCARD development platform.

C2000 controlCARDS detach the C2000 processor and all necessary support circuitry from development boards, and instead, assemble these onto modular adapter cards, called "controlCARDS". With the C2000 controlCARD platform, a designer can evaluate multiple C2000 MCUs using the same development board. Simply unplug the old controlCARD and plug-in a new controlCARD. By separating the MCU and support circuitry from the development board, controlCARDS simplify hardware prototyping and reduce replacement costs.

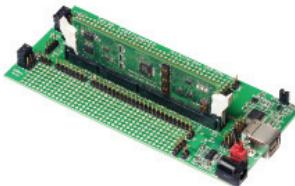
With over 20 device and end-equipment development kits available, C2000 MCUs make it easy to start developing today. All kits are complete with the Code Composer Studio™ IDE and on-board USB JTAG support. Provided through C2000 MCUs' controlSUITE™ Software Suite, each kit also includes fully documented software, example code and hardware development packages. Visit www.ti.com/c2000tools for a complete listing of C2000 development tools, and visit www.ti.com/controlSUITE to download controlSUITE software for C2000 development kits.



| controlCARDS | | | | |
|-------------------|---------------|--------------------|----------------|-----------------------|
| Part number | MCU | Socket | Incl. USB JTAG | Price (Each, U.S. \$) |
| TMDSCNCD28044 | TMS320F28044 | DIMM100 | – | 59 |
| TMDSCNCD2808 | TMS320F2808 | DIMM100 | – | 59 |
| Piccolo™ MCUs | | | | |
| TMDSCNCD28027 | TMS320F28027 | DIMM100 | – | 49 |
| TMDSCNCD28027F | TMS320F28027F | InstaSPIN™ DIMM100 | – | 69 |
| TMDSCNCD28035 | TMS320F28035 | DIMM100 | – | 59 |
| TMDSCNCD28035ISO | TMS320F28035 | DIMM100 | Yes | 69 |
| TMDSCNCD28069 | TMS320F28069 | DIMM100 | – | 59 |
| TMDSCNCD28069ISO | TMS320F28069 | DIMM100 | Yes | 85 |
| TMDSCNCD28069MISO | TMS320F28069M | InstaSPIN DIMM100 | Yes | 99 |
| Delfino™ MCUs | | | | |
| TMDSCNCD28335 | TMS320F28335 | DIMM100 | – | 69 |
| TMDSCNCD28346-168 | TMS320C28346 | DIMM168 | – | 125 |
| TMDSCNCD28377D | TMS320F28377D | HSEC180 | Yes | 159 |
| F28M3x MCUs | | | | |
| TMDSCNCDH52C1 | F27M35H52C1 | DIMM100 | Yes | 130 |

Experimenter's Kit

C2000 Experimenter's Kits are great tools for device exploration and initial prototyping. Each Experimenter's Kit includes a docking station and controlCARD with a C2000 MCU. The docking station provides access to all controlCARD signals and includes an on-board USB JTAG emulator. For prototyping, there are two breadboard areas and header pins, allowing for creation of custom solutions.

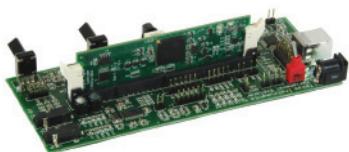


| Experimenter's Kits | | | | |
|---------------------|---------------|---------|----------------|-----------------------|
| Part number | MCU | Socket | Incl. USB JTAG | Price (Each, U.S. \$) |
| TMDSDOCK2808 | TMS320F2808 | DIMM100 | Yes | 89 |
| Piccolo MCUs | | | | |
| TMDSDOCK28027 | TMS320F28027 | DIMM100 | Yes | 79 |
| TMDSDOCK28035 | TMS320F28035 | DIMM100 | Yes | 130 |
| TMDSDOCK28069 | TMS320F28069 | DIMM100 | Yes | 99 |
| Delfino MCUs | | | | |
| TMDSDOCK28335 | TMS320F28335 | DIMM100 | Yes | 99 |
| TMDSDOCK28346-168 | TMS320C28346 | DIMM168 | Yes | 125 |
| TMDSDOCK28377D | TMS320F28377D | HSEC180 | Yes | 219 |
| F28M3x MCUs | | | | |
| TMDSDOCKH52C1 | F27M35H52C1 | DIMM100 | Yes | 185 |

C2000™ Microcontrollers

Peripheral Explorer Kit

The C2000 Peripheral Explorer Kit is a great learning tool for new C2000 developers and university students. The kit includes a peripheral explorer board and a controlCARD with the TMS320F28335 MCU. The board includes many hardware-based peripheral components for interacting with the various peripherals common to C2000 MCUs, such as the ADC, PWMs, eCAP, I²C, CAN, SPI and McBSP. Likewise, a teaching ROM is provided containing presentation slides, a learning textbook with over 750 pages, and over 15 laboratory exercises with solutions.



| Peripheral Explorer Kit | | | | |
|-------------------------|--------------|---------|----------------|-----------------------|
| Part number | MCU | Socket | Incl. USB JTAG | Price (Each, U.S. \$) |
| Delfino™ MCUs | | | | |
| TMDSPREX28335 | TMS320F28335 | DIMM100 | Yes | 179 |

controlSTICK

C2000 controlSTICKs provide a low-cost way to experiment with C2000 MCUs. Starting at only U.S. \$39, these tools provide convenient cableless USB JTAG access. controlSTICKs provide access to all control peripherals through on-board headers. A suite of example projects guide users through the advanced functionality of Piccolo MCUs from simple blinking LEDs to configuration examples for the high-resolution PWM peripherals. controlSTICKs are a great starting point for development with C2000 MCUs.



| controlSTICKs | | | |
|----------------------|--------------|----------------|-----------------------|
| Part number | MCU | Incl. USB JTAG | Price (Each, U.S. \$) |
| Piccolo™ MCUs | | | |
| TMDS28027USB | TMS320F28027 | Yes | 39 |
| TMDS28069USB | TMS320F28069 | Yes | 39 |

JTAG Emulators

Most C2000 development kits include on-board XDS100 emulation. However, for other JTAG needs, there are a wealth of third-party JTAG emulators available for C2000 MCUs:

| JTAG emulators | | | | |
|------------------|--------------------|-------------------------|-------------------------|-----------------------|
| Third party | Emulator | Website | Part number | Price (Each, U.S. \$) |
| Spectrum Digital | XDS100 | www.spectrumdigital.com | TMDSEMU100U-14T | 79 |
| Blackhawk | USB2000 | www.blackhawk-dsp.com | TMDSEMU2000U | 299 |
| Spectrum Digital | XDS510C | www.spectrumdigital.com | See third-party website | 249 |
| Spectrum Digital | XDS510USB | www.spectrumdigital.com | See third-party website | 1,299 |
| Signum Systems | JTAGjet-C2000 | www.signum.com | See third-party website | 595 |
| Signum Systems | JTAGjet-C2000-ISO | www.signum.com | JTAGjet-C2000-ISO | 795 |
| Signum Systems | JTAGjet-C2000F-ISO | www.signum.com | JTAGjet-C2000F-ISO | 995 |

Development Kit Software

All software and hardware packages for development kits are included in the controlSUITE software suite. Visit www.ti.com/controlsuite to download today.

Training

To better enable designers and engineers to make use of this performance, TI provides a multitude of training opportunities for C2000 microcontrollers. Between hands-on multi-day and one-day workshops and online training, it's easy to gain a working understanding of how to optimally use the C28x microcontroller and accelerate product development. Advanced technical seminars and deep-dive application training take these concepts still further. For a full list of training opportunities, visit www.ti.com/c2000training

Third-Party Tools and Software

The MathWorks® Embedded

Target for C2000 Microcontrollers

Embedded Target integrates MATLAB® and Simulink® with TI's Code Composer Studio™ IDE and C2000 microcontrollers. Together, these products let you perform automatic code generation, prototyping, and embedded system deployment. With Embedded Target, you can develop and validate control designs and DSP algorithms from concept through code.

www.mathworks.com/products/tic2000

Key Features

- Generates documented, readable, and editable C code in Code Composer Studio IDE project format
- Automates the testing and execution of Simulink models
- Enables the real-time evaluation of system designs on eZdsp™ boards
- Provides block-level access to on-chip peripherals
- Provides block-level access to the TI IQMath library for simulation and code generation

VisSim/Embedded Controls Developer™

VisSim/Embedded Controls Developer is a visual development environment for the rapid prototyping and development of motion-control systems. VisSim is unique in its ability to generate small memory footprint target files and can drastically reduce development time and lower prototyping costs. www.vissim.com/c2000

Key Features

- VisSim/Motion per vissim.com block set that includes pre-built motor, amplifier, sensor, encoder, dynamic load, and PID models
- C2000 MCU DMC block set includes all of the TI DMC library in block form
- Peripheral blocks generate code for C2000 MCU on-chip devices
- Automatic C code generation of production-quality fixed-point code
- Real-time visualization while code executes on DSPs
- Code Composer Studio IDE plug-in for automatic project creation

| Third Party | Website | Service |
|--|--|--|
| C2000 Microcontroller Third Parties | | |
| D3 Engineering | www.d3engineering.com | Design Services; Consulting; Algorithms |
| Drivetech | www.drivetechinc.com | Design Services; Consulting; DMC Expertise |
| The MathWorks | www.mathworks.com | Embedded Target; Auto Code Generation |
| Visual Solutions | www.vissim.com | Rapid Prototyper; Visual Application Development |
| Signum Systems | www.signum.com | Tools: Flash Programming; Emulation |
| Windmill | www.windmill-systems.com | TCP/IP |
| Pentad Design | www.pentaddesign.com | Design Services, DPS and CLA Expertise |
| Codeskin | www.codeskin.com | Flash Programming Tools and C2000 Code Development |
| Simma Software | www.simmasoftware.com | CAN and LIN Development |
| Wittenstein | www.safertos.com | Safety-Certified Operating Systems for F28M3x MCUs |

Visit the TI E2E™ Community

Join fellow engineers at the TI E2E Community web site, where you can find training videos, blogs, and an active forum to find the answers to your questions. With a rapidly growing user base, the E2E community will serve as a nexus for all things TI. www.ti.com/c2000community

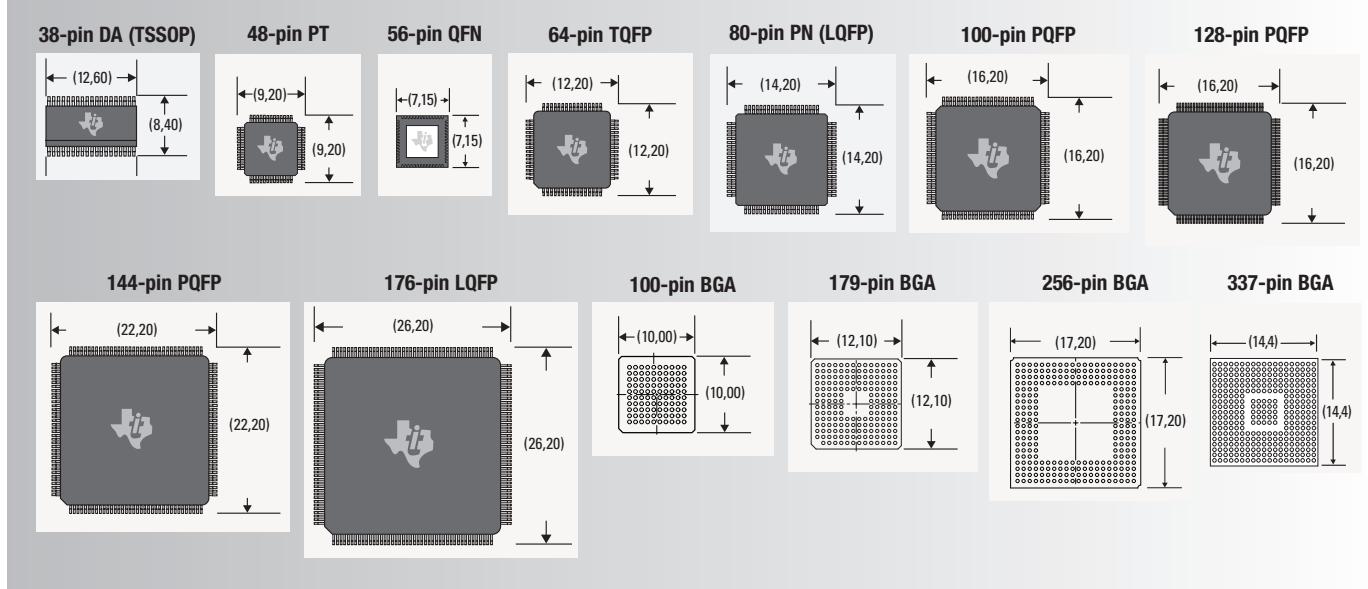
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Blogs – Read blog posts about everything from new discoveries to rising cases of “net lag.” Find blogs with the musings of some of the brightest minds at TI.

Forums – Get help at the TI E2E forums. Perused by engineers both inside and outside TI, there's someone out there who understands your problems. And if you're feeling smart, don't hesitate to return the favor.

For all C2000™ device configurations, please visit www.ti.com/c2000

Selected Package Options for TMS320C2000™ Devices



TI Worldwide Technical Support

Internet

TI Semiconductor Product Information Center Home Page

support.ti.com

TI E2E™ Community Home Page

e2e.ti.com

Product Information Centers

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Brazil Phone 0800-891-2616

Mexico Phone 0800-670-7544

Fax +1(972) 927-6377
Internet/E-mail support.ti.com/sc/pic/americas.htm

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