Up to 20 MIP

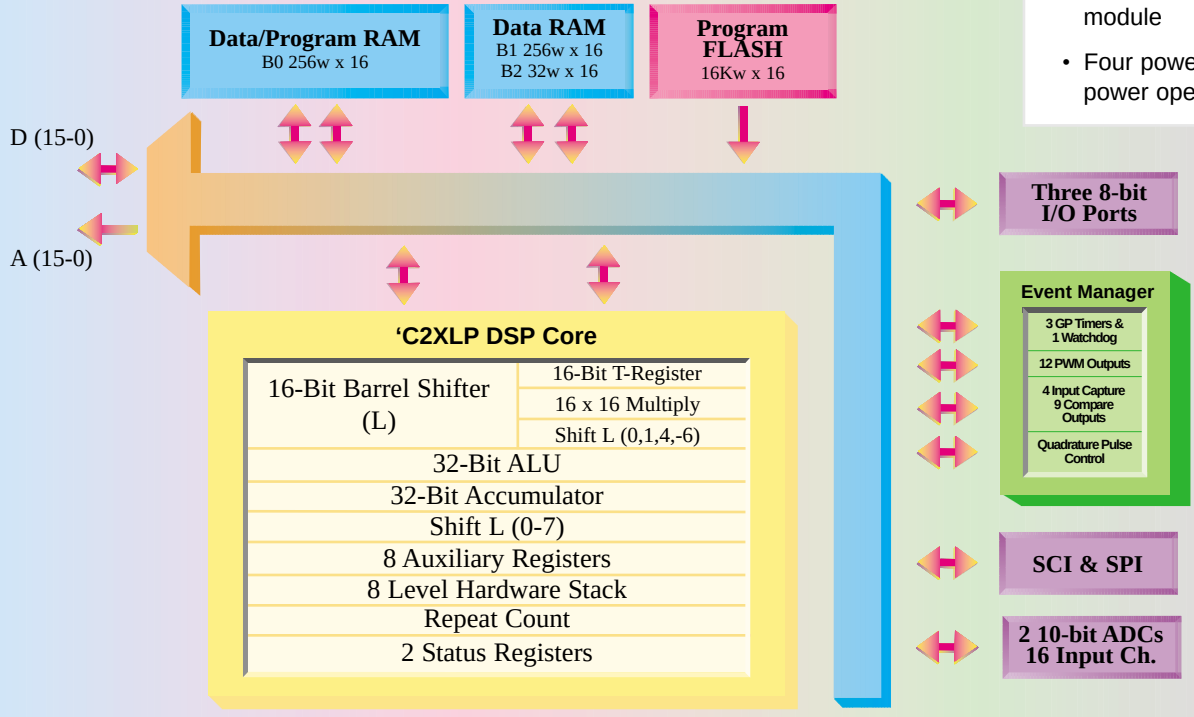
Product Bulletin

SM/SMJ320F240 Military Digital Signal Processors

Key Features:

- 132-pin ceramic quad flatpack
- 50-ns instruction cycle time
- Military temp range: -55ºC to 125ºC
- Watchdog timer and 3 general purpose timers
- PWM Module with asynchronous, synchronous and vector modes
- 28 individually programmable, multiplexed I/O pins
- Processed to MIL-PRF-38535 (SMJ) or Military Temperature Range (SM)
- Dual 10-bit analog-to-digital conversion module
- Four power-down modes for low power operation

'F240 Block Diagram



Texas Instruments Digital Signal Processor (DSP) controllers are revolutionizing today's motor control applications in appliances, HVAC, industrial drives, automotive and consumer electronics. The SMJ320F240 DSP has brought the performance and flexibility of the TI family of DSP motor controllers to the military and industrial markets.

The 'F24x platform provides the industry's highest level of on-chip integration and powerful computational ability which drives system costs down to unprecedented levels. This unique combination of processing power and control-specific peripherals allows designers to implement control systems with higher motor efficiency, quieter operation, lower energy consumption and greater reliability compared to traditional microcontroller solutions. Fewer external components are required which leads to reduced system cost. The SMJ320F240 features an on-chip Flash memory, a ceramic hermetic quad flatpack and a full military temperature range operation.

Optimized for Motor Control

Control-optimized 'F240 DSPs enable customers to design highly flexible and differentiated motor control systems. The 'F240 DSP is faster and more powerful than microcontrollers with the same level of peripheral integration. The 'F240 family provides up to 20 MIPS of DSP processing power with

SMJ320F240 Motor Control

Features:	Benefits:
Random PWM	• Reduces electrical and audible noise • Reduces mechanical resonance • Reduces size of EMI input filter
Sensorless Speed Control	• Replaces costly sensors with sophisticated rotor positioning and estimation routines
Variable Speed Control	• Eliminates mechanical gears/linkages • Improves system efficiency
PFC Control	• Eliminates external PFC controller • Reduces current spikes • Reduces board size
DC Link Ripple Compensation	• Reduces size and cost of dc link capacitors • Compensates for dc bus voltage ripple
Field-oriented Control	• Improves dynamic performance • Maximizes torque/amp operation • Reduces transient current spikes
Adaptive Control	• Compensates for changes in load and motor/system parameters

on-chip peripherals such as pulse-width modulation (PWM) channels, ultra-fast analog/digital converters, timers and Flash memory. Unlike classic 8- or 16-bit microcontrollers, TI's 'F240 DSP has the computational bandwidth to easily handle the sophisticated algorithms required for complex motor control functions, such as field oriented control (FOC) and random PWM generation. These control algorithms provide better dynamic performance while eliminating the need for expensive external components such as Hall-effect sensors and power factor correction (PFC) controllers. In addition, this processing power allows precise control of ac-induction, dc-brushless, switched-reluctance and stepper motors.

'F24x Flash Memory

The SMJF240 is the first DSP to offer the flexibility of single-cycle access to Flash memory on-chip at a price that is viable for military control systems. In a 16K-word configuration, the Flash module enables designers to store program code on-chip. This feature supports in-system reprogrammability and provides designers with a quick, easy way to adapt to changing standards and product upgrades with minimal development costs.

C2000™ DSP Core

The 16-bit 'C2000 core incorporates a static design and is manufactured in a sub-micron, triple-level-metal, full-complementary CMOS process for high performance, low power operation. The core was designed from the beginning to comprehend numerous complementary functions.

Performance at 20 MIPS allows the implementation of advanced algorithms and multi-tasking systems. A single-cycle instruction set enables complex mathematic functions to be calculated in real-time, and the Harvard architecture optimizes vector mathematics making it ideal for digital control system applications.

C2000 Memory Bus

The C2000 advanced Harvard architecture maximizes processing power by maintaining two separate memory bus structures, program and data, for full-speed execution. This multiple bus structure allows reading both data and instructions simultaneously. Instructions support data transfers between the two spaces. This architecture lets you store coefficients in program memory to be read in RAM thus eliminating the need for a separate coefficient ROM. This, coupled with a 4-deep pipeline, allows the SMJ320F240 to execute most instructions in a single cycle.

The C2000 dual-access RAM (DARAM) allows writes to and reads from the RAM in the same cycle without the address restrictions of SARAM. The dual-access RAM is configured in three blocks: block B0, block B1 and block B2. Block B0 is a 256-word block that can be configured as data or program memory. Block B1 is 256 words in data memory, and block B2 is 32 words in data memory. The ability of the DARAM to perform two accesses in one cycle, coupled with the parallel nature of the C2000 architecture, enables the C2000 devices to perform three concurrent memory accesses in any given machine cycle.

Event Manager

The 'F24x device's on-board event manager is key in giving designers a complete, high performance motor control solution. Functionally, it provides all PWM and I/O features to drive all motor types. Features include up to three up/down timers and up to nine comparators that, when coupled with flexible waveform generation logic, can create up to 12 PWM outputs. This design includes support for symmetrical (centered) and asymmetrical (non-centered) PWM generation capabilities and a space vector PWM state machine. The PWM's dead-band generation unit is included and helps protect associated power transistors.

In addition, the event manager integrates up to four capture inputs, two of which can serve as direct inputs for optical-encoder quadrature pulses. In all, these features represent a state-of-the-art solution for flexible PWM

generation and system control.

TI DSP Development Tools

TI and its third-party network have created a broad range of development tools that specifically support the requirements of motor-control designers that include:

• Code Generation Tools

• C Compiler—it accepts ANSI C source code and produces efficient C2000 assembly language code. It is able to perform a variety of optimizations to improve the density and efficiency of the compiled code.

• Assembly/Linker—it converts TMS320™ assembly language source files into executable code. The assembly language tools include an archiver, hex conversion utility, cross-reference utility and an absolute lister.

Evaluation/Development Tool Kits

The Evaluation Module (EVM) is the easiest way to fully evaluate and begin developing code for embedded, real-time motor control systems. The ‘F24x EVMs use industry leading development tools, including TI’s C Compiler and Code Composer Studio™, allowing designers to take their ideas from concept to production quickly and easily. Design flexibility is increased with on-board peripherals, such as 4-channel/12-bit DAC, additional external memory and multiple expansion ports.

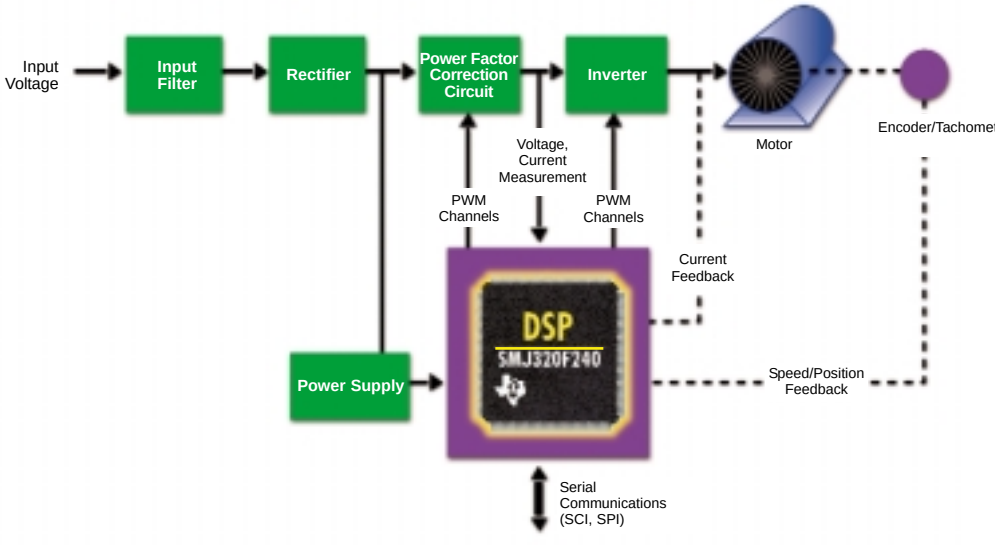
Technosoft™ Motion Control (MCK) is an easy to use development board designed by Technosoft especially for motor control applications using the ‘F240 DSP. The MCK is an EVM-like board that includes ready to run examples of speed control algorithms for ac and dc brushless motors in order to speed up the development process. The MCK offers the basic tools needed to quickly evaluate, develop and implement motor control algorithms. It also offers additional functionality with an on-board three phase inverter and a Permanent Magnet Synchronous brushless motor.

Debuggers/Emulators

The Code Composer™ Simulator is an inexpensive software program that uses the host processor and memory to perform assembly instruction and C-level simulation of the ‘C2xLP core and non-real time debug without the hardware in place. Useful features include the ability to simulate external interrupts and I/O transfers and to monitor opcode and addresses at each phase of the pipeline.

Code Composer is the DSP industry’s first fully integrated development environment (IDE) with DSP-specific functionality. With its familiar MD-Visual C++ like environment, Code Composer enables designers to edit, build and debug, profile and to manage projects from a single unified environment to help you get started quickly. Other unique features include graphical signal analysis, injection/extraction of data signals via file I/O, multi-processor debugging, automated testing and customization via the C-interpretive scripting language. Code Composer is compatible with TI’s XDS510 Emulators, code generation tools and third-party development boards.

SMJ320F240 TYPICAL APPLICATION



With a high level of peripheral integration and powerful computational abilities, the SMJ320F240 become the center of many different control applications.

TI Worldwide Technical Support

Internet

TI Semiconductor Home Page
http://www.ti.com/sc

TI Distributors
http://www.ti.com/sc/docs/distmenu.htm

Product Information Centers

Americas

Phone	+1(972) 644-5580
Fax	+1(972) 480-7800
Email	sc-infomaster@ti.com

Europe, Middle East, and Africa

Phone	
Deutsch	+49-(0) 8161 80 3311
English	+44-(0) 1604 66 3399
Español	+34-(0) 90 23 54 0 28
Francais	+33-(0) 1-30 70 11 64
Italiano	+33-(0) 1-30 70 11 67
Fax	+44-(0) 1604 66 33 34
Email	epic@ti.com

Japan

Phone	
International	+81-3-3457-0972
Domestic	0120-81-0026
Fax	
International	+81-3-3457-1259
Domestic	0120-81-0036
Email	pic-japan@ti.com

Asia

Phone		
International	+886-2-23786800	
Domestic	Local Access Code	TI Number
Australia	1-800-881-011	-800-800-1450
China	10810	-800-800-1450
Hong Kong	800-96-1111	-800-800-1450
India	000-117	-800-800-1450
Indonesia	001-801-10	-800-800-1450
Korea	080-551-2804	-
Malaysia	1-800-800-011	-800-800-1450
New Zealand	000-911	-800-800-1450
Philippines	105-11	-800-800-1450
Singapore	800-0111-111	-800-800-1450
Taiwan	080-006800	-
Thailand	0019-991-1111	-800-800-1450
Fax	886-2-2378-6808	
Email	tiasia@ti.com	

A042799

TEXAS INSTRUMENTS

SGUB044

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

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

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third–party products or services does not constitute a license from TI 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 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. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

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

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265