

TMS320C2000™ : The Motor Control DSP

The World's First DSPs Optimized for Control

Platform Update
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Three DSP Breakthroughs Announced in 2000

Impacting Future of Broadband, Emerging & Mass Markets

DSPS Fest
2000

C2000™ DSP

Motor
Control
DSP

**TI C28x™ DSP Core:
The world's first control
optimized DSPs**

- Up to 400 extended precision MIPS
- Best C/C++ Control Code Efficiency
- Software compatible with C24x™ DSP

C5000™ DSP

Personal
DSP

**TI C55x™ DSP Core:
The world's lowest
mW/MIPS DSPs**

- As low as 0.05mW/MIPs for longest battery life
- Best code density
- Software compatible with C54x™ DSP

C6000™ DSP

Broadband
Infrastructure
DSP

**TI C64x™ DSP Core:
The world's highest
performance DSPs**

- Scalable to 1.1GHz
- Best DSP compiler, ease of use
- Software compatible with C62x™ DSP

TI C2000™ DSP Platform Leads Digital Control Market

FIRST

- ▶ **First** single-chip DSP motor controller (1996)
- ▶ **First** DSP with on-chip Flash memory (1997)
- ▶ **First** turn-key solution for DSP motor control (1999)
- ▶ **First** DSP core specifically designed for control (2000)

BROADEST

- ▶ Over \$2B in design-ins since 1997
- ▶ Major OEM engagements worldwide
- ▶ Over 1000 customers designing with C2000 DSPs today
- ▶ Largest DSP controller portfolio from sub \$2 to 400 MIPS

C2000™ Drives

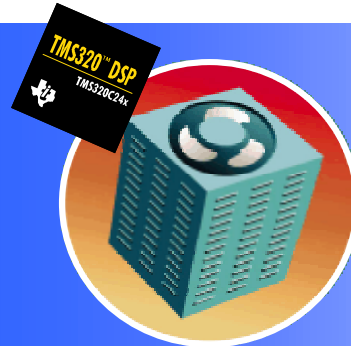
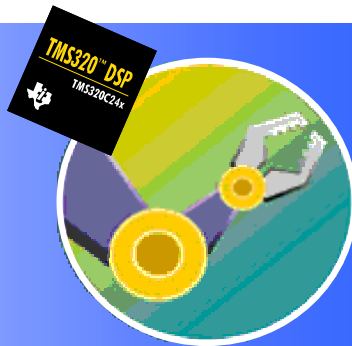
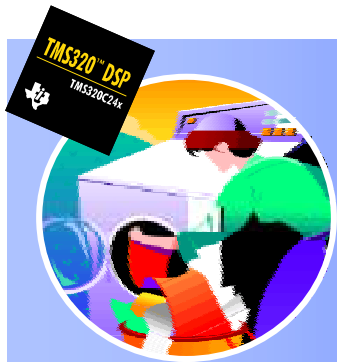
Digital Control Applications

▶▶ Motor Control

- ▶ Industrial Drives
- ▶ Factory Automation
- ▶ Appliance Controllers
- ▶ Servo Motion Control
- ▶ Pumps, Fans, HVAC

▶▶ Transportation

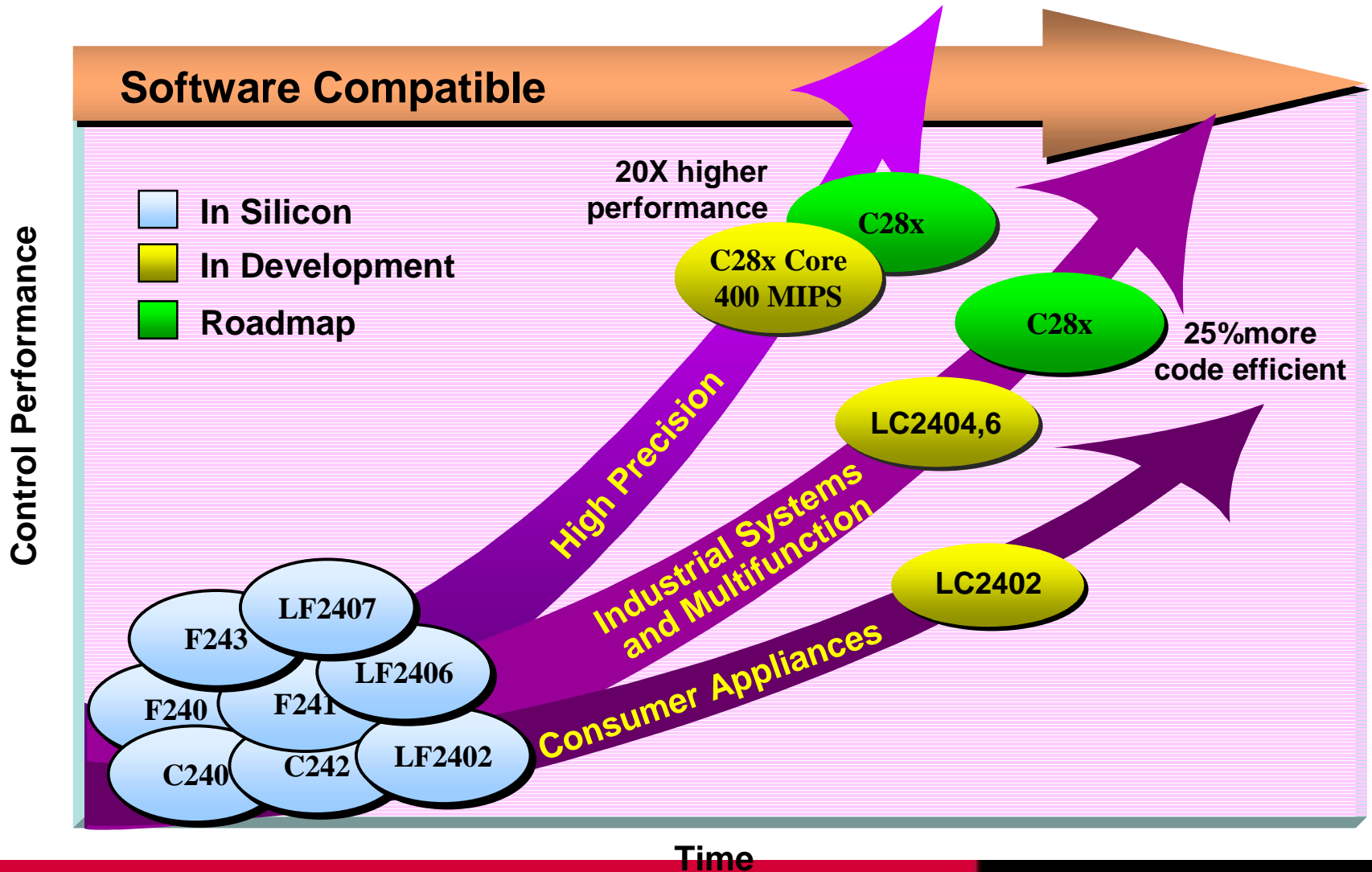
- ▶▶ Power Supplies
- ▶▶ Consumer Goods
- ▶▶ Office Equipment
- ▶▶ Embedded Networking



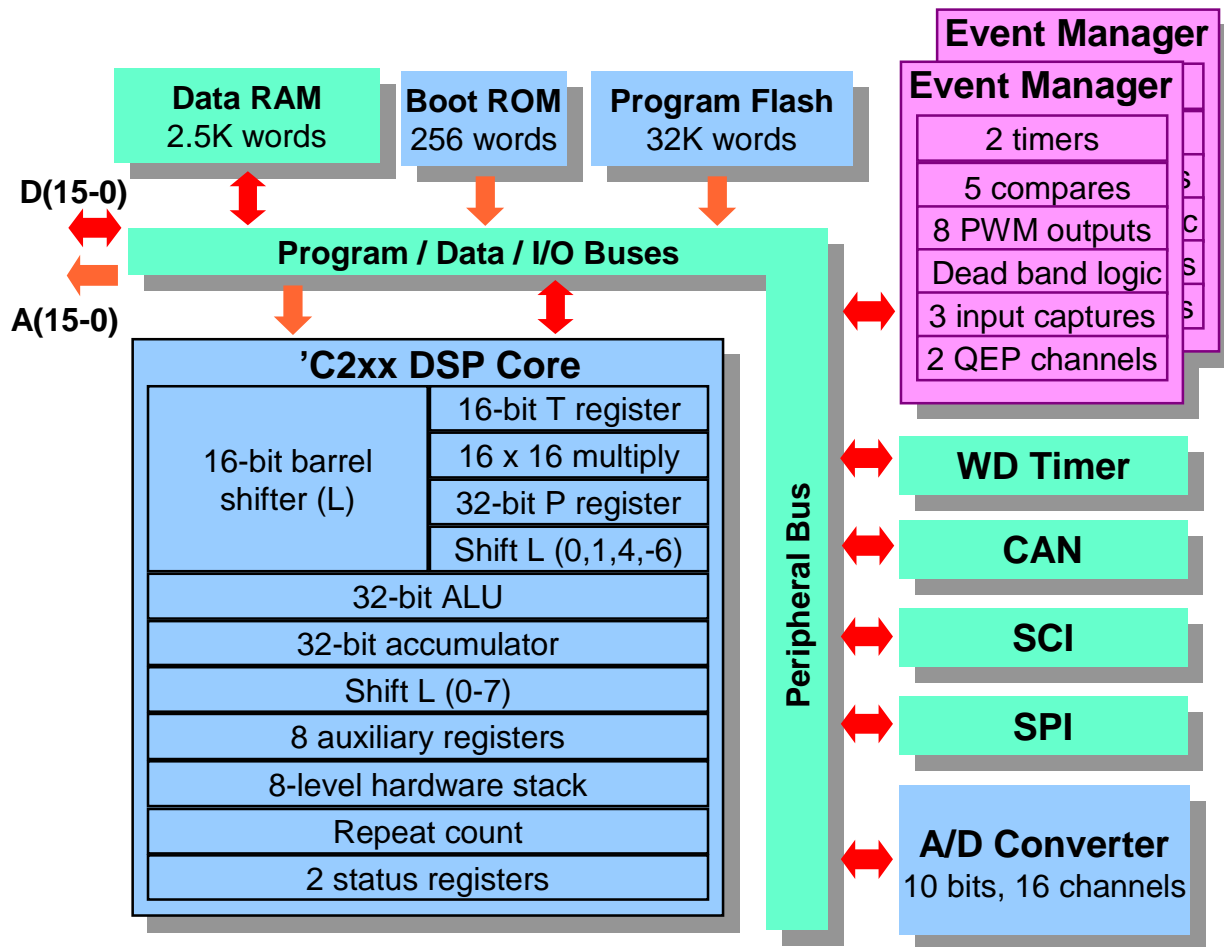
C2000™ Motor Control DSPs

The World's First Control Optimized DSPs

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2000



TMS320LF2407 : World's Most Integrated DSP Controller

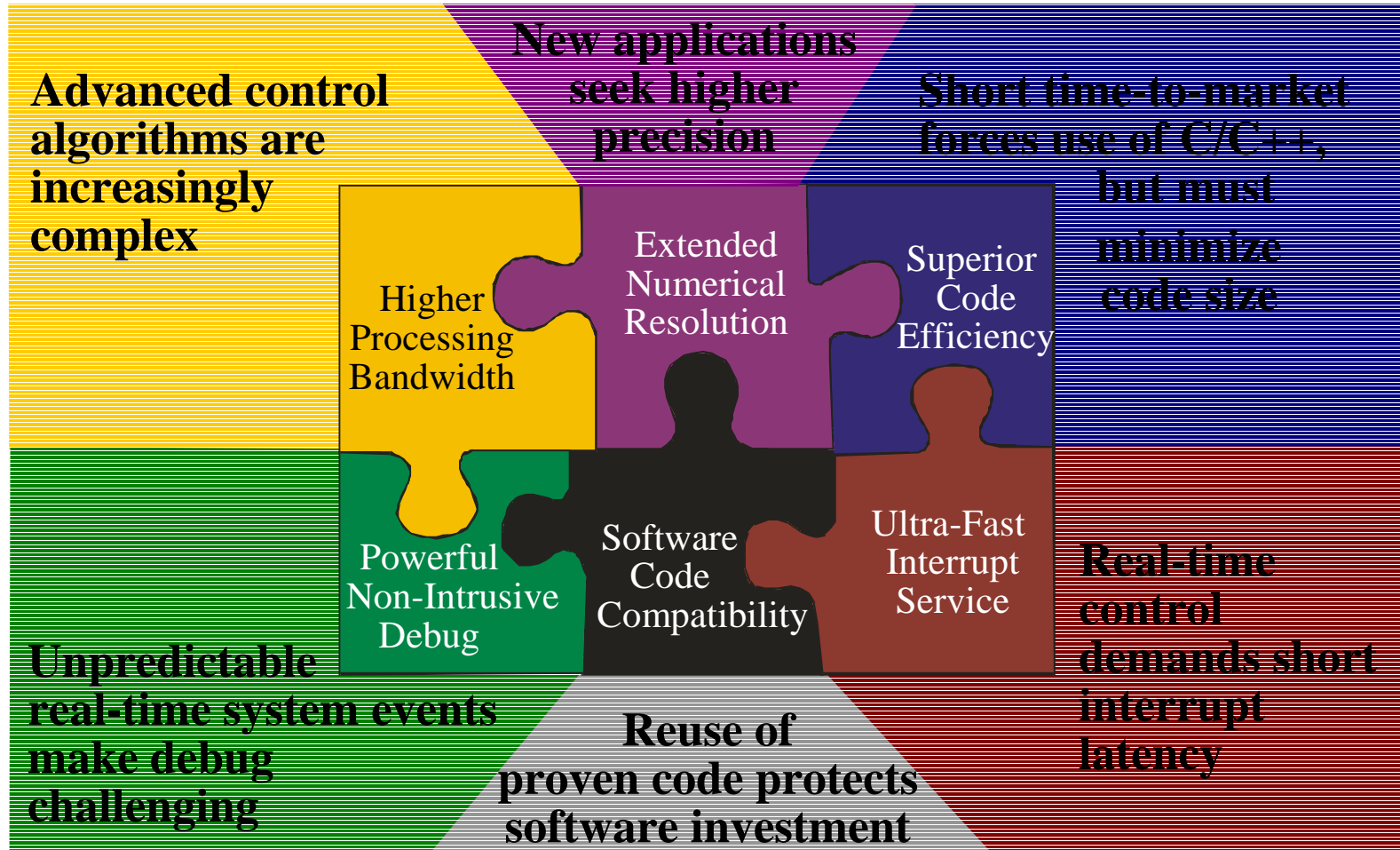


'C2000™: Industry's Broadest DSP Controller Portfolio







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	'F240	'C240	'F241	'C242	'F243	'LF2402	'LC2402	'LC2404	'LF2406	'LC2406	'LF2407
MIPS	20	20	20	20	20	30/40	30/40	30/40	30/40	30/40	30/40
MEMORY											
Flash	16K	—	8K	—	8K	8K	—	—	32K	—	32K
ROM	—	16K	—	4K	—	—	4K	16K	—	32K	—
RAM	544	544	544	544	544	544	544	1.5K	2.5K	2.5K	2.5K
Boot ROM	—	—	—	—	—	Yes	—	—	Yes	—	Yes
EVENT MGR											
GP Timers	3	3	2	2	2	2	2	4	4	4	4
CMP/PWM	9/12	9/12	5/8	5/8	5/8	5/8	5/8	10/16	10/16	10/16	10/16
CAPI/QEP	4/2	4/2	3/2	3/2	3/2	3/2	3/2	6/4	6/4	6/4	6/4
10-BIT ADC											
Channels	16	16	8	8	8	8	8	16	16	16	16
Conv. Time	6.6µs	6.6µs	850ns	850ns	850ns	500ns	500ns	500ns	500ns	500ns	500ns
COMMS											
SCI (UART)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SPI	Yes	Yes	Yes	—	Yes	—	—	Yes	Yes	Yes	Yes
CAN	—	—	Yes	—	Yes	—	—	—	Yes	Yes	Yes
GPIO	28	28	26	26	32	21	21	41	41	41	41
WATCHDOG	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
EMIF	Yes	Yes	No	No	Yes	No	No	No	No	No	Yes
VOLTAGE	5V	5V	5V	5V	5V	3.3V	3.3V	3.3V	3.3V	3.3V	3.3V
PACKAGING	132 PQFP	132 PQFP	64 PQFP	64 PQFP	144 TQFP	64 PQFP	64 PQFP	100 TQFP	100 TQFP	100 TQFP	144 TQFP
PRODUCTION	Today	Today	Today	Today	Today	Today	4Q00	4Q00	Today	4Q00	Today

High-End Digital Control: A Unique Set of Stringent Requirements

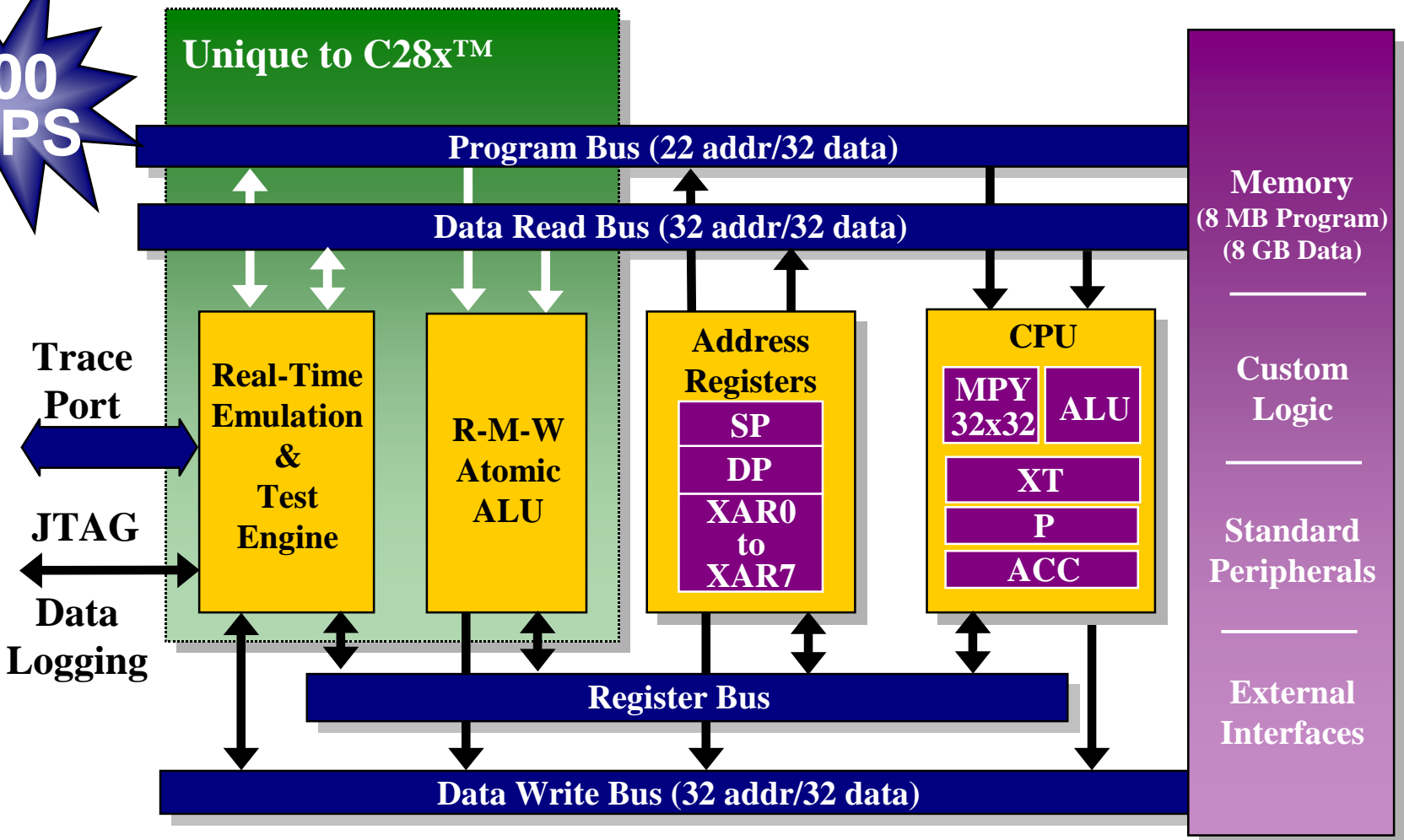


TMS320C28x™ DSPs Surpass High-End Control Designers' Expectations

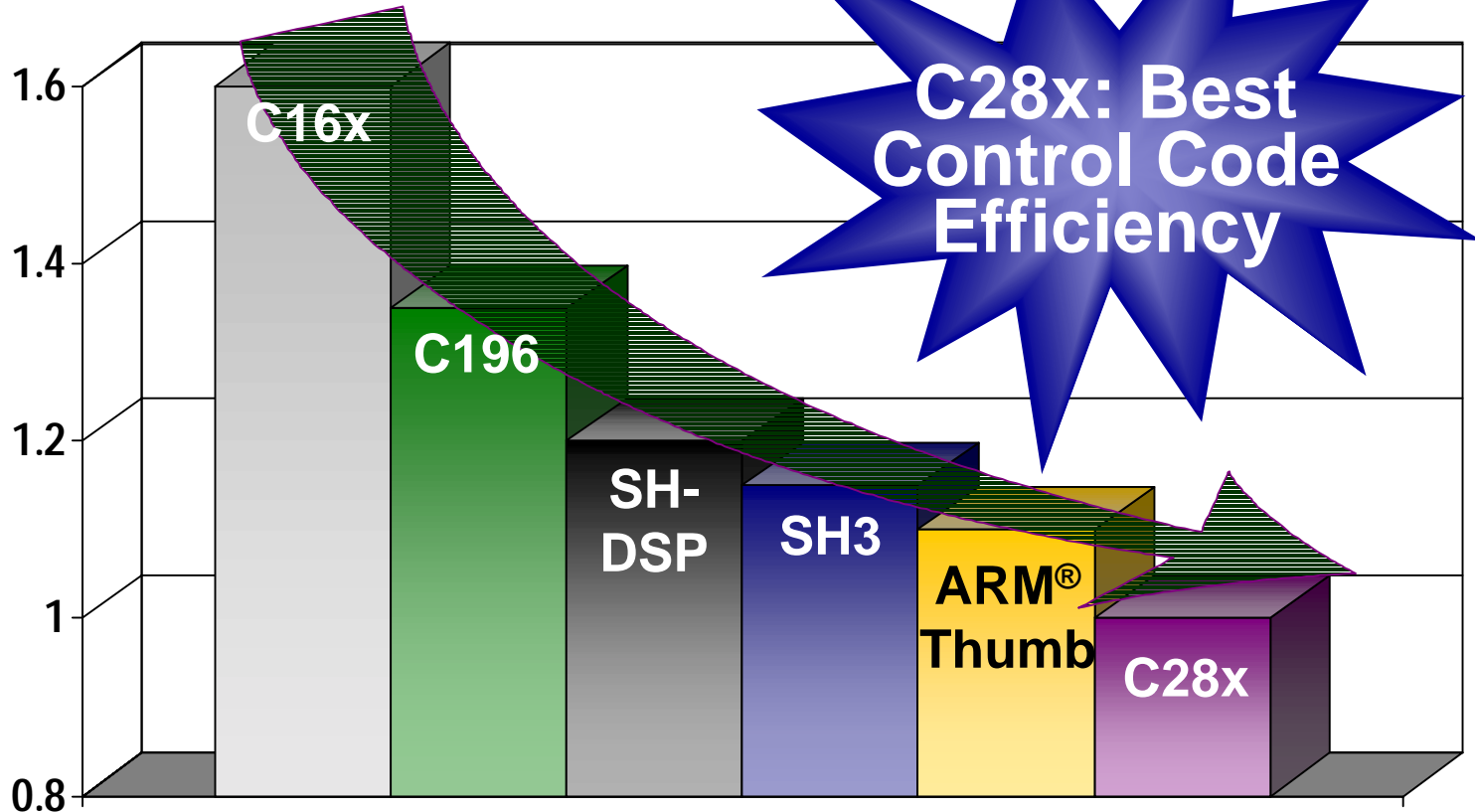
	C28x™ Delivers	Relative Advantage
	<ul style="list-style-type: none"> ▶▶ 400 MIPS ▶▶ Single-cycle 32x32 MAC with 32/64-bit saturation/scaling 	<ul style="list-style-type: none"> ▶▶ 20x faster
	<ul style="list-style-type: none"> ▶▶ Best code efficiency ▶▶ 8-GByte linear address space 	<ul style="list-style-type: none"> ▶▶ 25% more efficient than best RISC competition
	<ul style="list-style-type: none"> ▶▶ 20–40ns interrupt response ▶▶ Interrupt-proof atomic read-modify-write instructions 	<ul style="list-style-type: none"> ▶▶ 10x faster
	<ul style="list-style-type: none"> ▶▶ Unique real-time debug feature and 20+ Mbit/second data logging 	<ul style="list-style-type: none"> ▶▶ 20x faster
	<ul style="list-style-type: none"> ▶▶ Software code compatibility from sub \$2 to 400 MIPS 	<ul style="list-style-type: none"> ▶▶ Unique
		

TMS320C28x™ : An Innovative Approach Combines the Best of RISC/CISC/DSP

**400
MIPS**



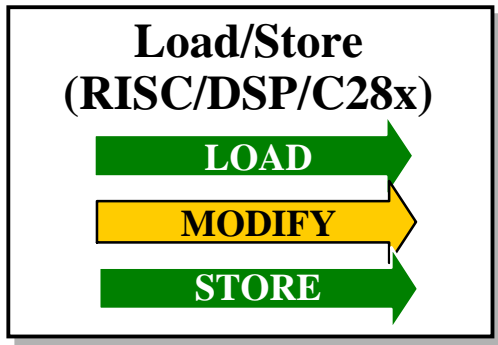
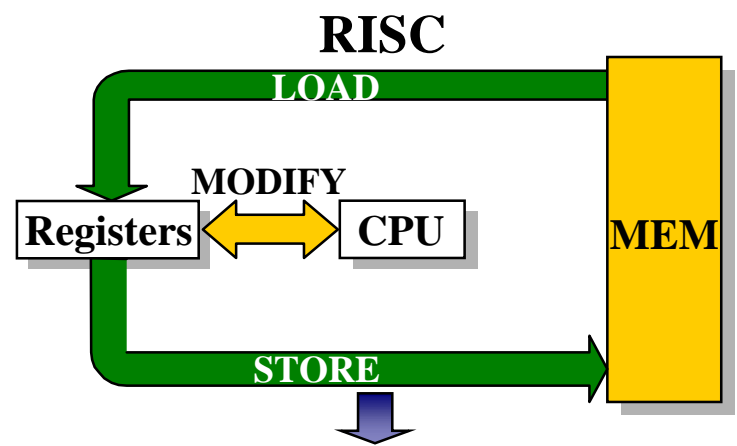
Best Code Efficiency for Control Applications Reduces Total System Cost



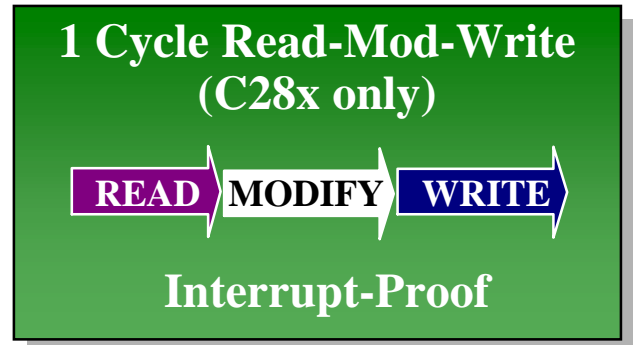
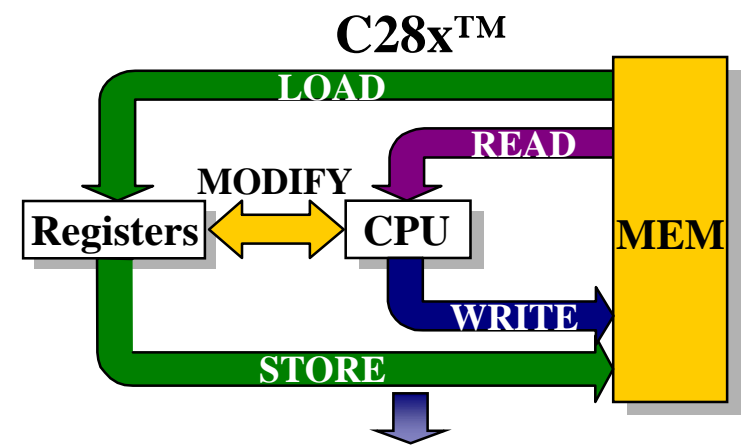
Based on C compiler results of actual servo control code

Atomic Read-Modify-Write Operations

Enhances Performance, Code Density, Integrity



Disable Interrupts
 LOAD Reg,mem
 OPERATE Reg,Operand
 STORE Reg,mem
 Enable Interrupts



OPERATE mem,Operand

5x Faster
5x Smaller
Uninterruptible

TMS320C28x™ Product Features

▶▶ The TMS320C28x Family

- ▶ 'C28x 32-bit Fixed Point DSP Core
- ▶ Up to 400 MIPS Processing Power
- ▶ Code Compatible with all C24x devices
- ▶ 1.8 volt core and 3.3V peripherals
- ▶ Up to 128k of Flash Memory
- ▶ Enhanced Motor Control Peripherals
- ▶ Integrated High Performance 12-bit ADC
- ▶ Improved communications ports including CAN, UART, etc..
- ▶ Enhanced Tool Suites with C and C++ support



TI Confidential Information - Do Not

Reproduce

C2000™ TI Foundation Software

▶▶ Peripheral Drivers

- ▶ Drivers enable peripheral configuration and control
- ▶ Both Assembly and C versions available

▶▶ Function Libraries

- ▶ DMCLib (Motor Control Library)
- ▶ General Purpose control functions

▶▶ Application Technology Development Kits (TDKs)

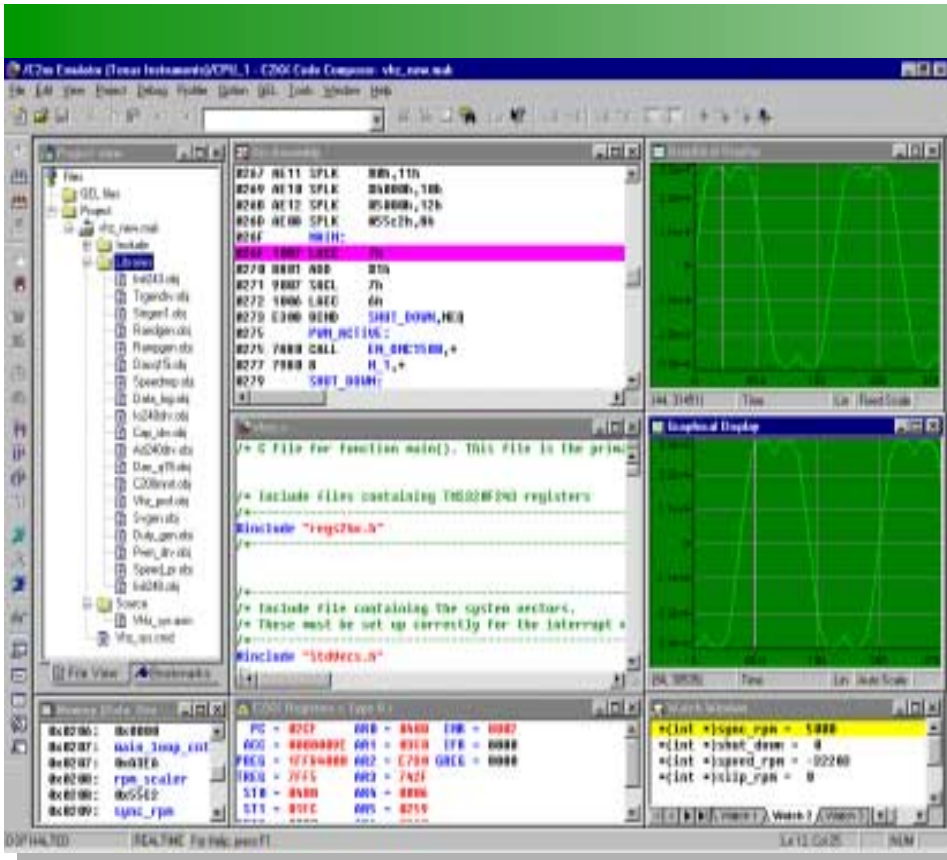
- ▶ Motor Control TDKs under development
 - ◆ AC Induction
 - ◆ Brushless DC
 - ◆ PM Synchronous
- ▶ Others TBD

TI Confidential Information - Do Not

Reproduce

Code Composer 4.1 Release for C2000™

Offers Plug-in Capabilities and Real-time Monitor



- ▶ Same IDE as C6000/C5000 CCS
- ▶ C2000 Code Gen Tools packaged with CC4.1 release
- ▶ Full Plug-In Capabilities
- ▶ Real-Time Monitor (RTM) integrated into CC4.1 and enables:
 - ▶ Interrogation / modification of device memory while application code runs.
 - ▶ Single-stepping of background code while ISR's run in real-time.
 - ▶ Tuning of system parameters, e.g. PID loops, Motors char, etc..
 - ▶ Software switches to control/invoke motor wind-down sequence.

Hardware Development Tools

DS/PS Fest
2000



Evaluation Modules

- ▶▶ F24x development board
- ▶▶ C-Compiler/Asm/Lnk
- ▶▶ Code Composer v4.10
- ▶▶ XDS510PP Emulator
- ▶▶ Power Supply
- ▶▶ Price: \$1995

DSP Starter Kits

- ▶▶ F24x evaluation board
- ▶▶ DSK Assembler
- ▶▶ Code Explorer
Debugger
- ▶▶ Serial Comms Link
- ▶▶ Power Supply
- ▶▶ Price: \$195

Power Modules

- ▶▶ Interfaces to EVM or
standalone operation
- ▶▶ Protection features
provide convenient s/w
development platform
- ▶▶ Rated up to 3/4HP
- ▶▶ Support 3ph and 1ph
motors (BLDC, ACI, SR)

TI Analog Components Attach Seamlessly to C2000 DSPs

Voltage Regulators

TPS7250 TPS7233

UA7850

Supply Voltage Supervisors

TLC7701 TPS3823-33

Voltage Regulators with Supply Voltage Supervisor

TPS7350 TPS7333

Operational Amplifiers

TLC22xx TLE20xx

TLV22xx TLE21xx

High-Speed RS-232/RS-485

Controller Area Network (CAN)

SN75LBC031 SN75C189 SN75LBC184

Analog-to-Digital Converters

TLV2544/8 TLV2554/8

TLV157x THS1206

- ▶▶ Direct C2000 interface
- ▶▶ Designed for ease of use with C2000 DSPs
- ▶▶ Meets typical C2000 system application requirements



TI & 3rd Parties Winning Together in the Embedded Control Market

- ▶▶ C2000™: The Most Control-optimized DSPs in the world
 - ▶ Best C/C++ Code Efficiency for Control
 - ▶ Industry's broadest portfolio, from sub-\$2 to 400 MIPS
 - ▶ Code compatibility across C2000™ platform protects software investment

- ▶▶ 3rd Parties opportunities with TI's C2000™ DSP Platform
 - ▶ Code Composer Plug-ins
 - ▶ XDAIS Compliant Software Algorithms
 - ▶ Hardware Development Platforms
 - ▶ System Engineering / Consulting

- ▶▶ University opportunities with TI's C2000™ DSP Platform
 - ▶ Research Grants
 - ▶ XDAIS Compliant Software Algorithms
 - ▶ System Engineering / Consulting