

Digital Control Developers Forum

DSPS Fest
2000



*Digital Control Systems Group
DSPS Fest 2000*

THE WORLD LEADER IN DSP AND ANALOG

 TEXAS INSTRUMENTS

Agenda

DSPTS Fest
2000

- | | |
|---------------------------|-----------------|
| ▶▶ Introductions | (05 min) |
| ▶▶ Business Update | (10 min) |
| ▶▶ Product Update | (25 min) |
| ▶▶ Tools Review | (25 min) |
| ▶▶ Applications Review | (25 min) |
| ▶▶ System Solutions | (50 min) |
| ▶▶ Third Party Network | (10 min) |
| ▶▶ Training and Resources | (05 min) |

TMS320™ DSP Platforms Achieve Unequivocal Leadership

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TMS320C2000™



Most Control-
Optimized
DSPs in the World

TMS320C5000™



Lowest Power/
MIPS
DSPs in the World

TMS320C6000™



Highest-
Performance
DSPs in the World

Optimized, not Compromised

Today's Presenters

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- ▶ Tamala Huntley
 - ◆ *DCS Product Marketing*
- ▶ Rod Trautman
 - ◆ *DCS Business Manager*
- ▶ Scott Roller
 - ◆ *DCS Americas Product Marketing Manager*
- ▶ Charlie Murphy
 - ◆ *DCS Tools Manager*
- ▶ David Figoli
 - ◆ *DCS Applications Manager*
- ▶ Zhen Yu, Arefeen Mohammed
 - ◆ *DCS Applications Engineers*

Agenda

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Digital Control Systems (DCS)

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“In 2005, there will be 1.5 billion electric motors digitally controlled. Eventually these 1.5 billion motors will translate into 1.5 billion DSPs”

*- Tom Engibous, Chairman, President and CEO
of Texas Instruments*



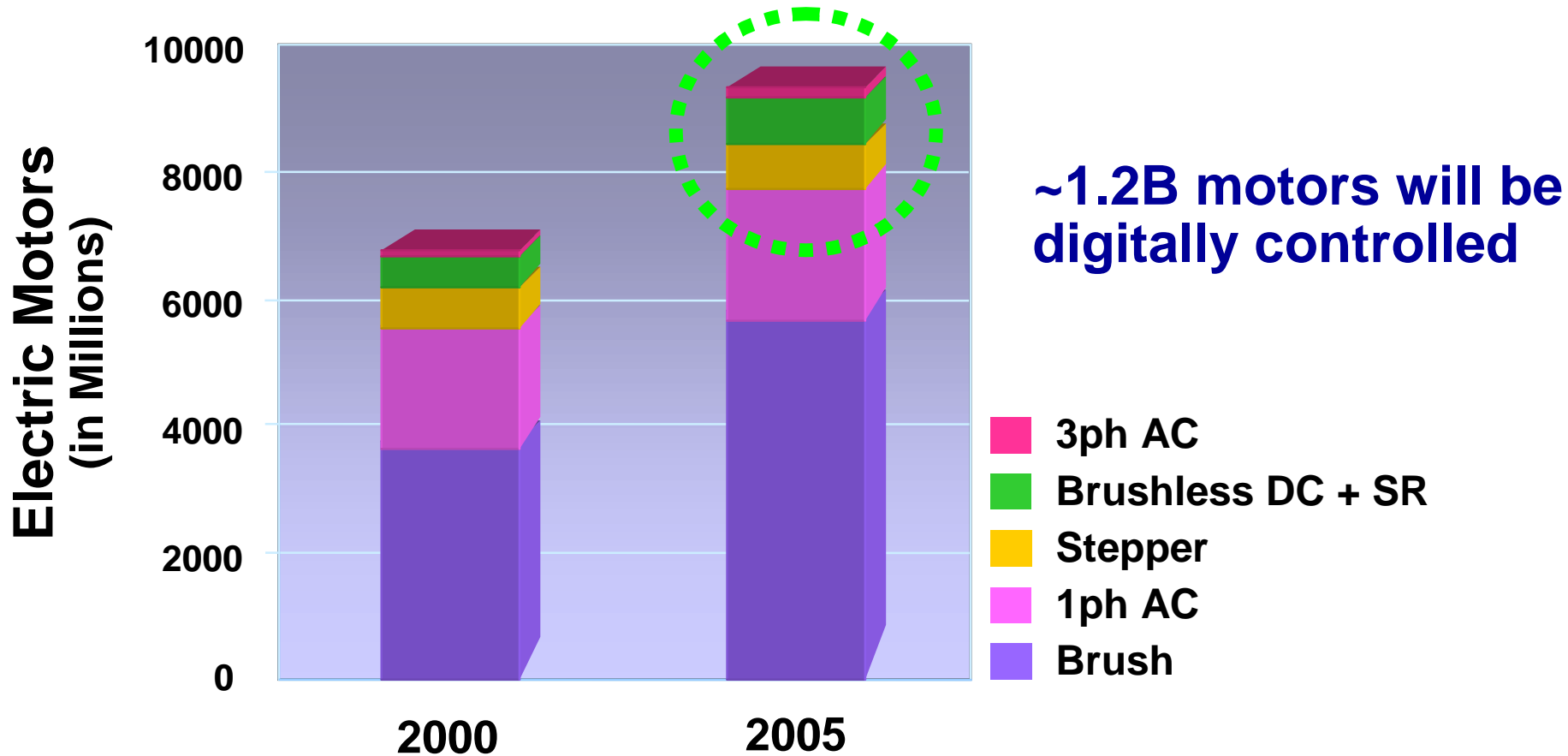
TI Digital Control Systems Group

- ▶ Dedicated Business Unit
- ▶ Vision: TI DSP in every Digital Motor Controller
- ▶ Market Focus: Appliances, HVAC, Industrial Control, Power Supply, Consumer
- ▶ Dedicated DSP Product Line = TMS320C2000

Huge Potential Market

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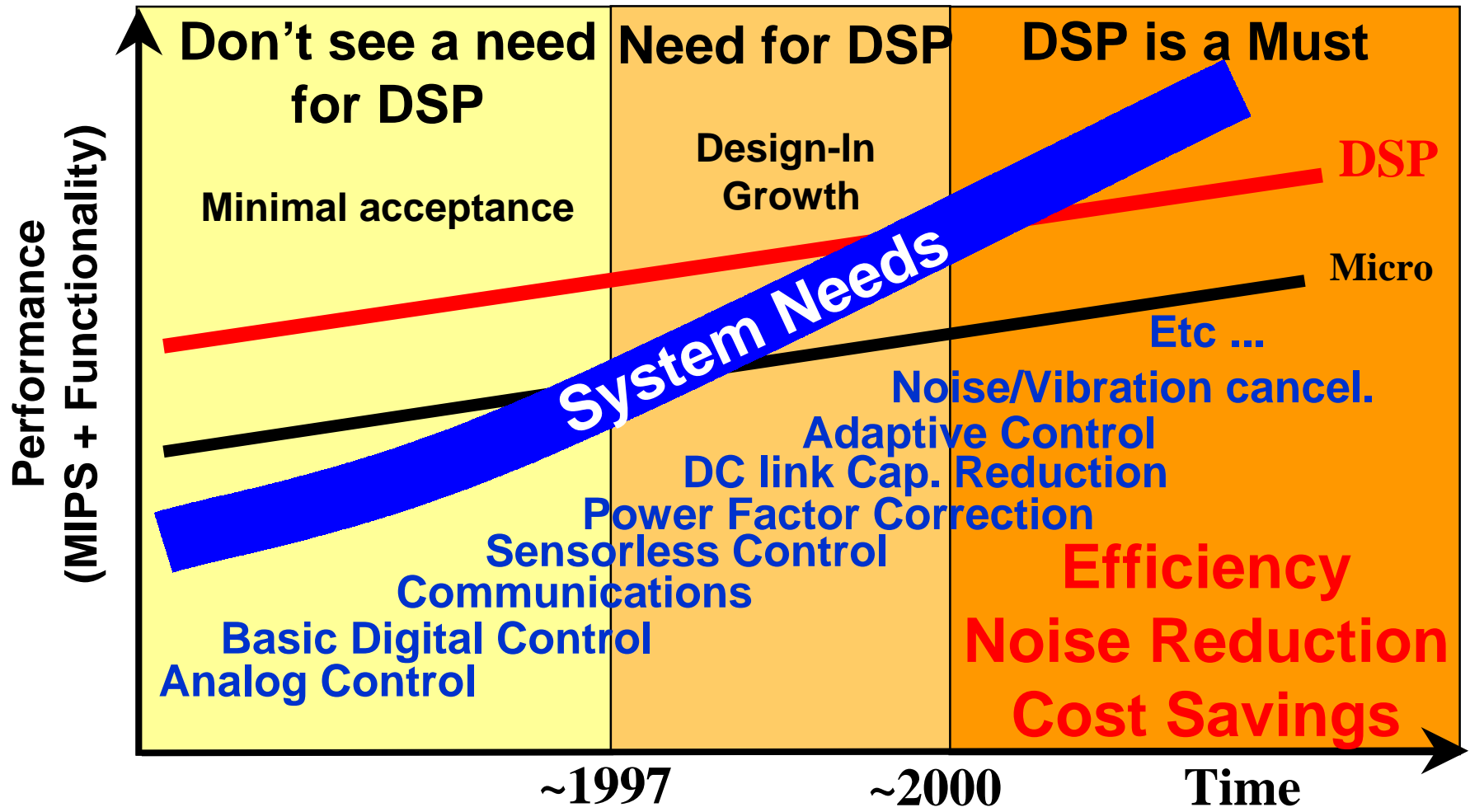
From 6.9B motors in 2000 to 9.5B in 2005



Source: Motion Tech Trends

Market is in Full Swing

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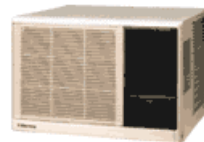
C2000 ... Did You Know ?



- ▶▶ \$2 billion design-ins since 1997
- ▶▶ 80,000 application notes downloads in 1999
- ▶▶ Over 500 hardware tools sold every quarter
- ▶▶ Over 20 new customers every week

美的 Midea

AMETEK®



Electrolux



RAIL KING
The Rail Electric Train



invensys



TI C2000™ DSP Platform Leads Digital Control Market

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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

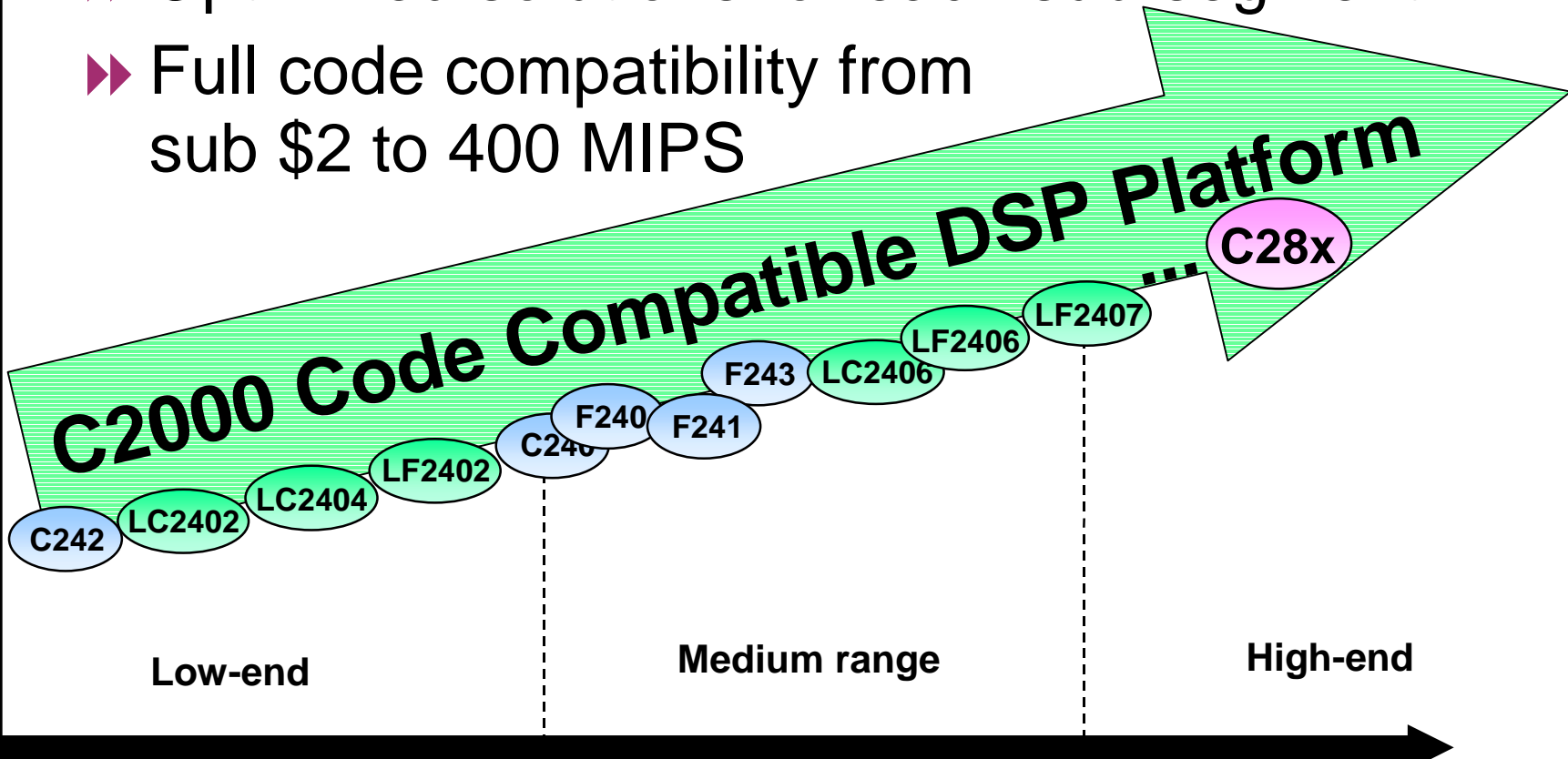
- ▶ Over \$2B in design-ins since 1997
- ▶ Major OEM engagements worldwide
- ▶ Over 1000 customers designing with C2000 DSPs today
- ▶ Largest DSP controller portfolio from sub \$2 to 400 MIPS

C2000 Positioning Summary

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- ▶▶ Product superiority across the board
- ▶▶ Optimized solutions for each sub-segment
- ▶▶ Full code compatibility from sub \$2 to 400 MIPS

Application Spectrum



Low-end

Medium range

High-end

Product Complexity (performance, integration)

A Look into What's Next ...

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Internet-enabled appliances:
Refrigerators that restock
themselves

High-speed, high-density
disk drives boost
digital video recorder and
Internet server applications



Ultra-precise
manufacturing

Efficient hybrid
electric vehicle



Everyone Wins with DSP in DCS

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“The Single Device Having the Most Significant Impact on Expanding the Use of Electric Motor Technology is the DSP.”

– George Gulalo, President, Motion Tech Trends



Agenda

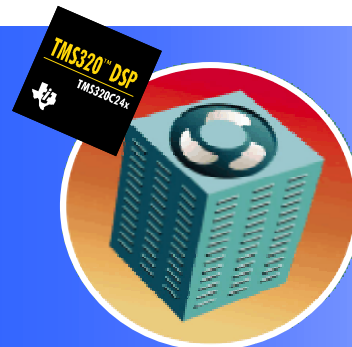
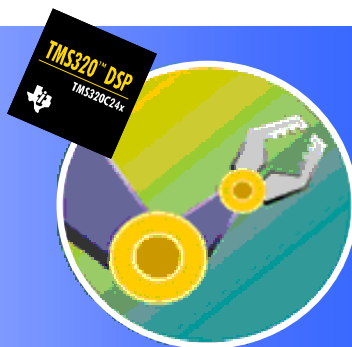
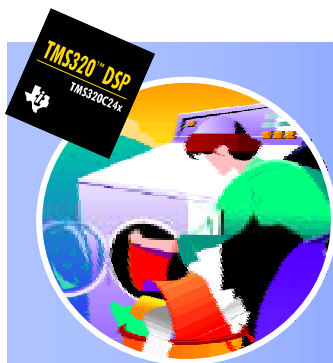
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C2000™ Drives Digital Control Applications

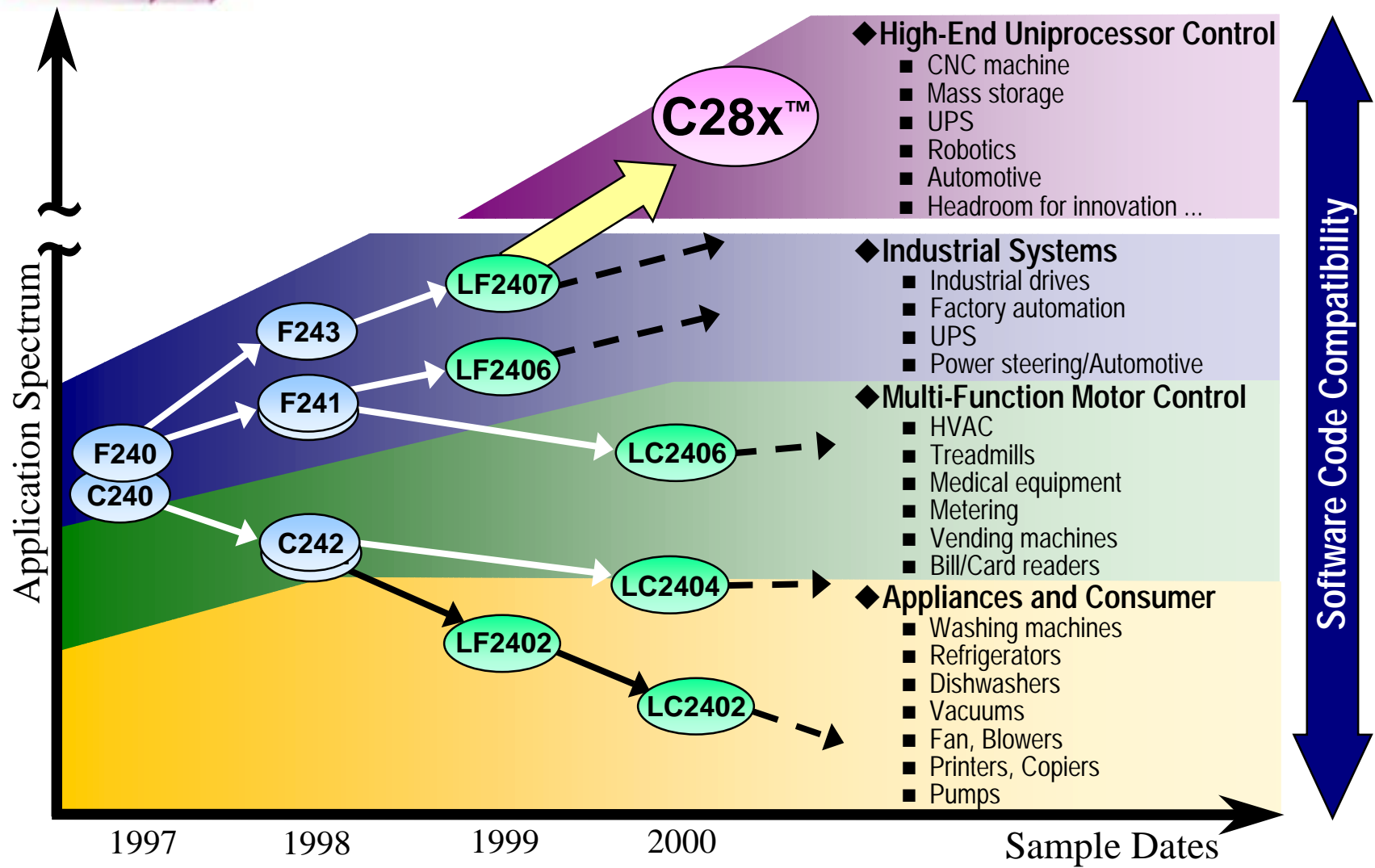
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- ▶▶ Motor Control
 - ▶ Industrial Drives
 - ▶ Factory Automation
 - ▶ Appliance Controllers
 - ▶ Servo Motion Control
 - ▶ Pumps, Fans, HVAC
- ▶▶ Transportation
- ▶▶ Power Supplies
- ▶▶ Consumer Goods
- ▶▶ Office Equipment
- ▶▶ Embedded Networking



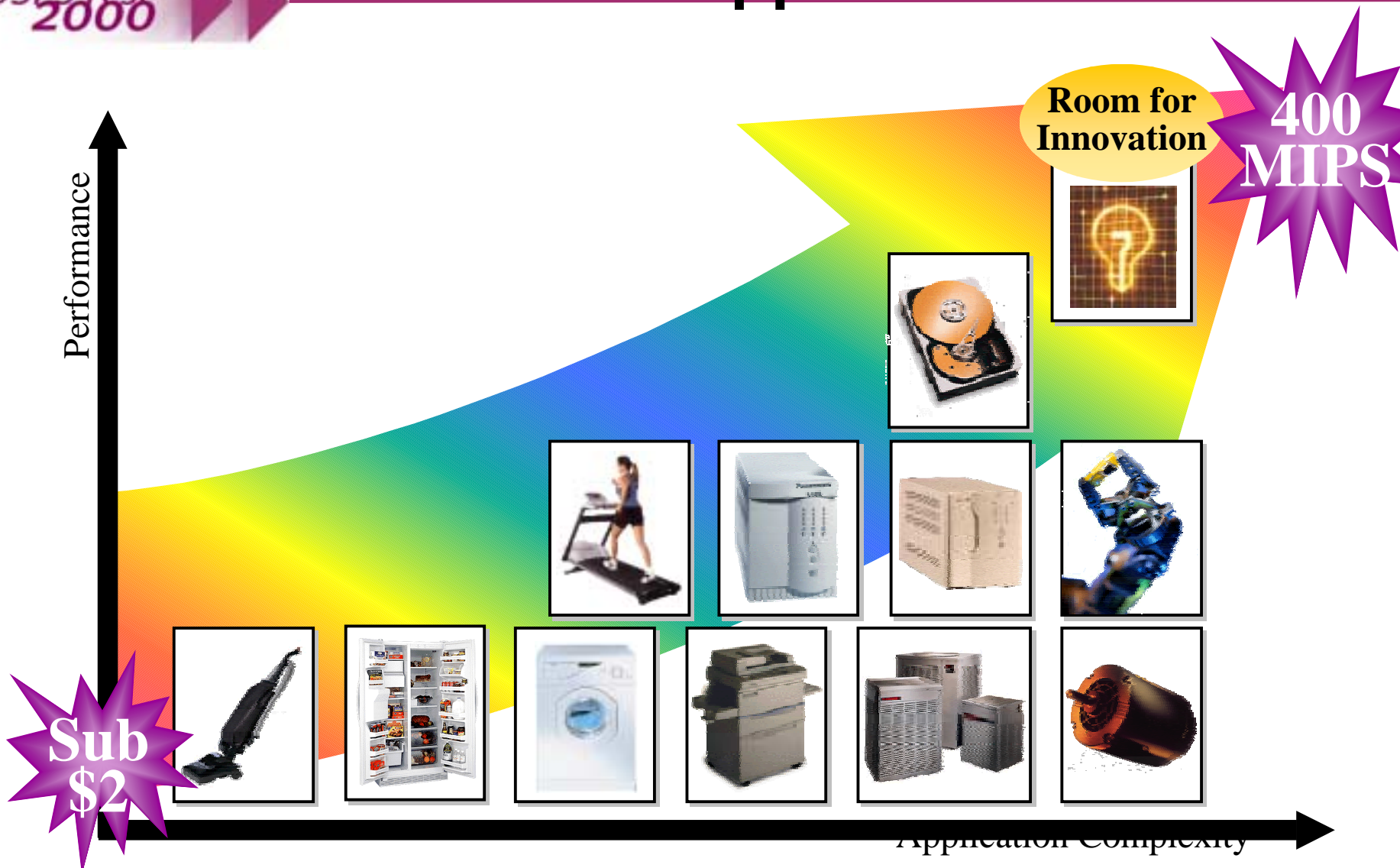
C2000™ DSP Roadmap to the Future

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TMS320C2000 Code Compatible Roadmap for Control Applications

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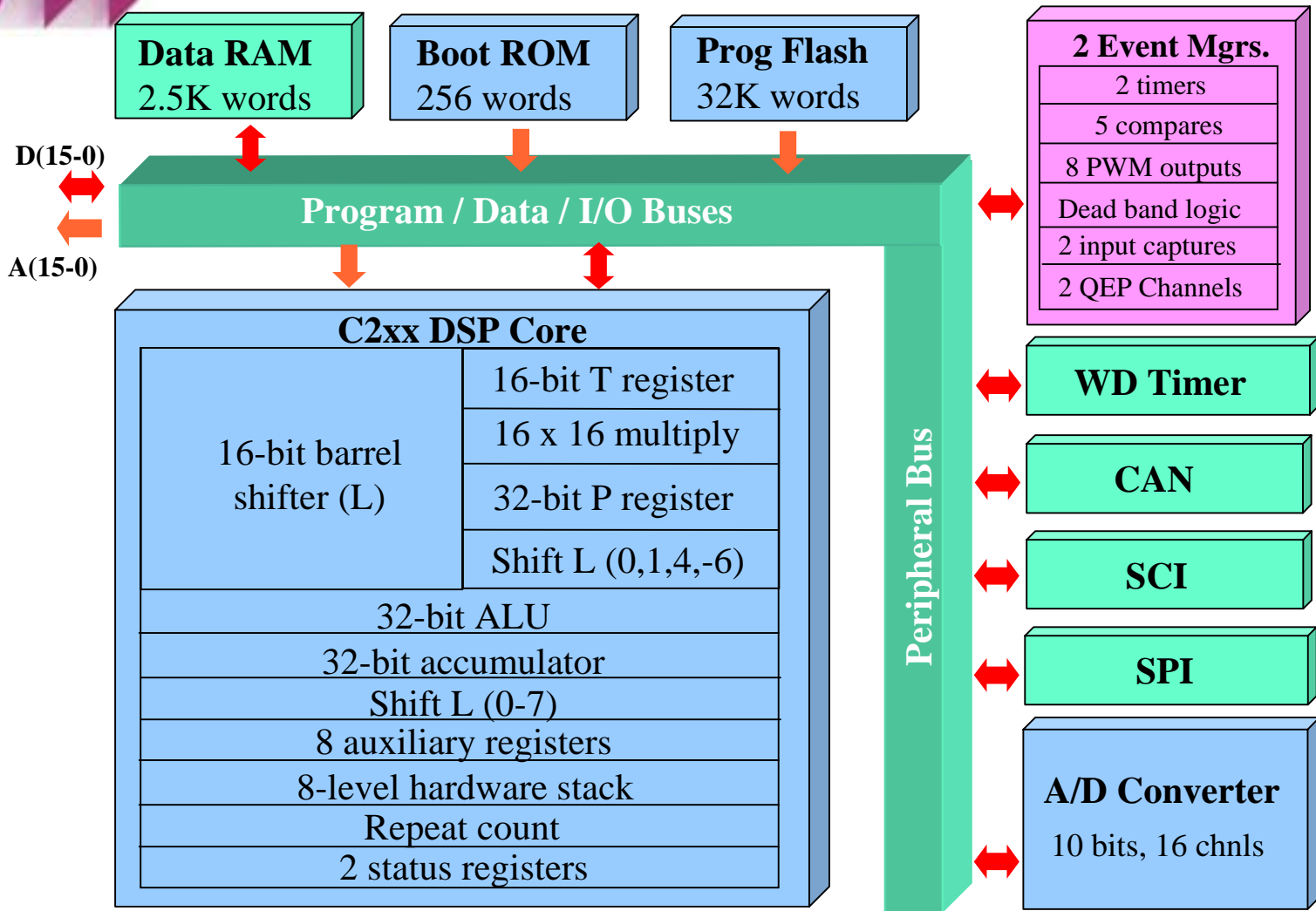


THE WORLD LEADER IN DSP AND ANALOG

TEXAS INSTRUMENTS

TMS320LF2407 : World's Most Integrated DSP Controller

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TMS320C24x: Peripherals are optimized for digital control

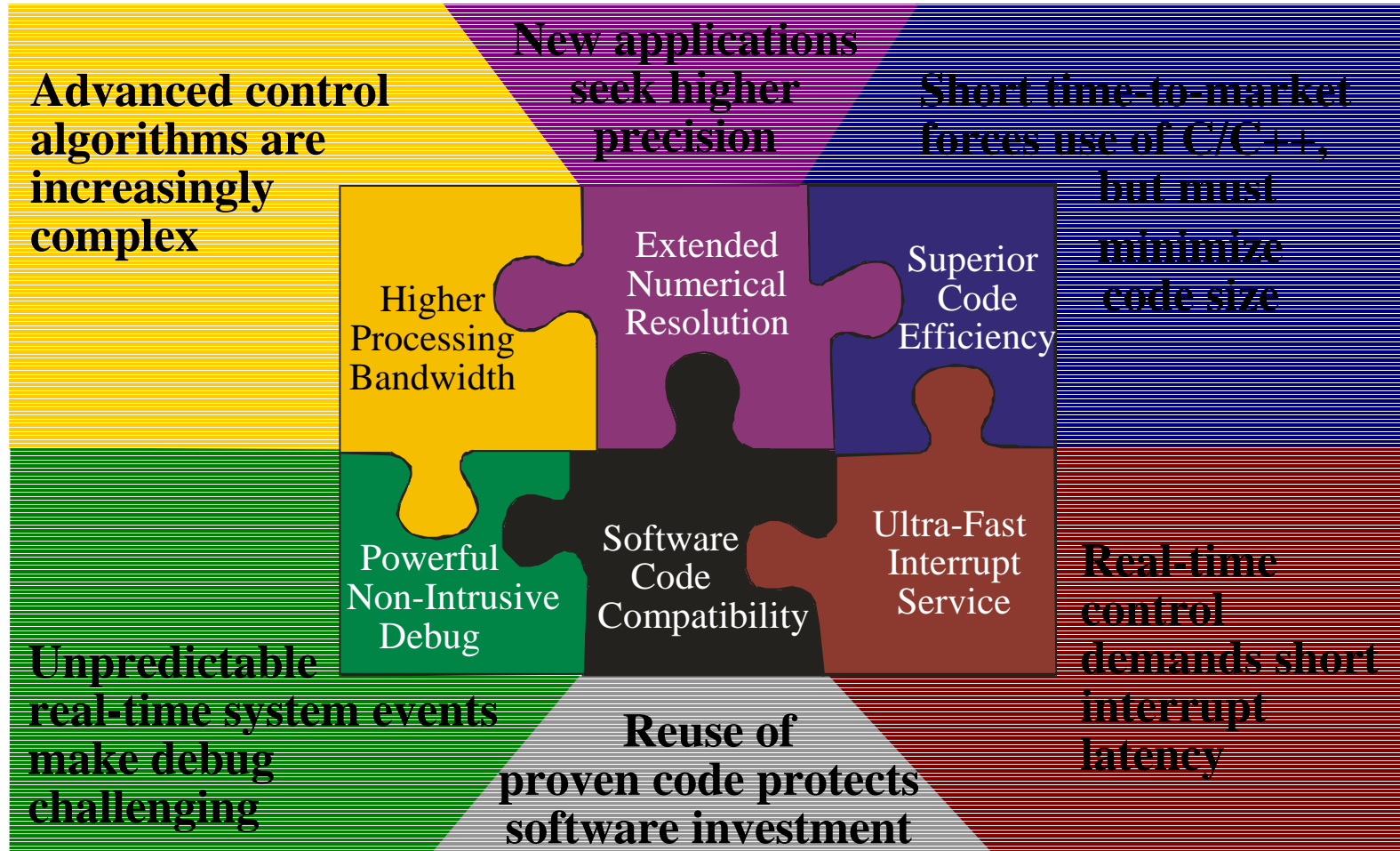
C2000™: Industry's Broadest DSP Controller Portfolio

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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

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TMS320C28x™ DSPs Surpass Designers' Expectations

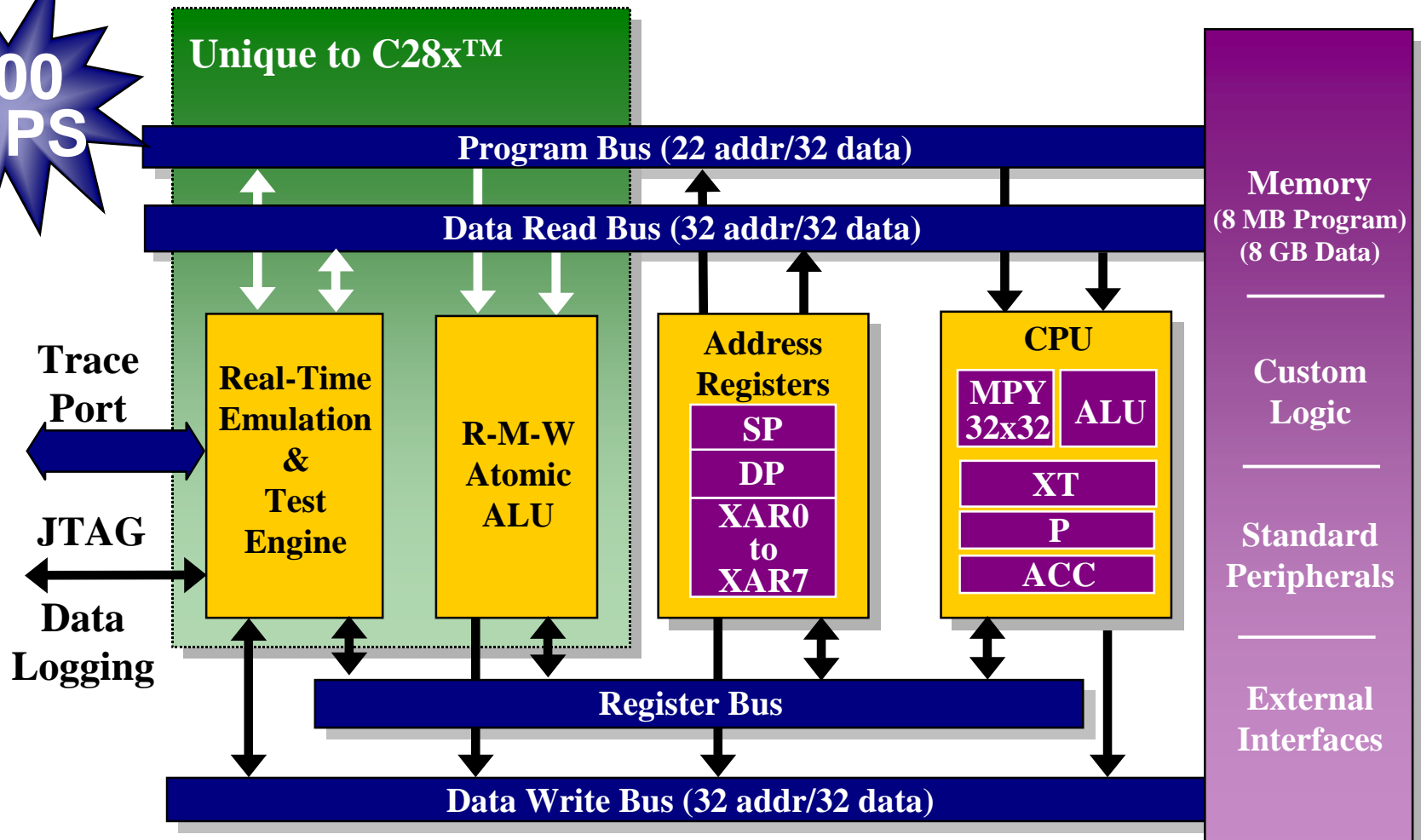
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	C28x™ Delivers	Relative Advantage
	<ul style="list-style-type: none">▶▶ 400 MIPS▶▶ Single-cycle 32x32 MAC with 32/64-bit saturation/scaling	<ul style="list-style-type: none">▶▶ 20x faster
	<ul style="list-style-type: none">▶▶ Best code efficiency▶▶ 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

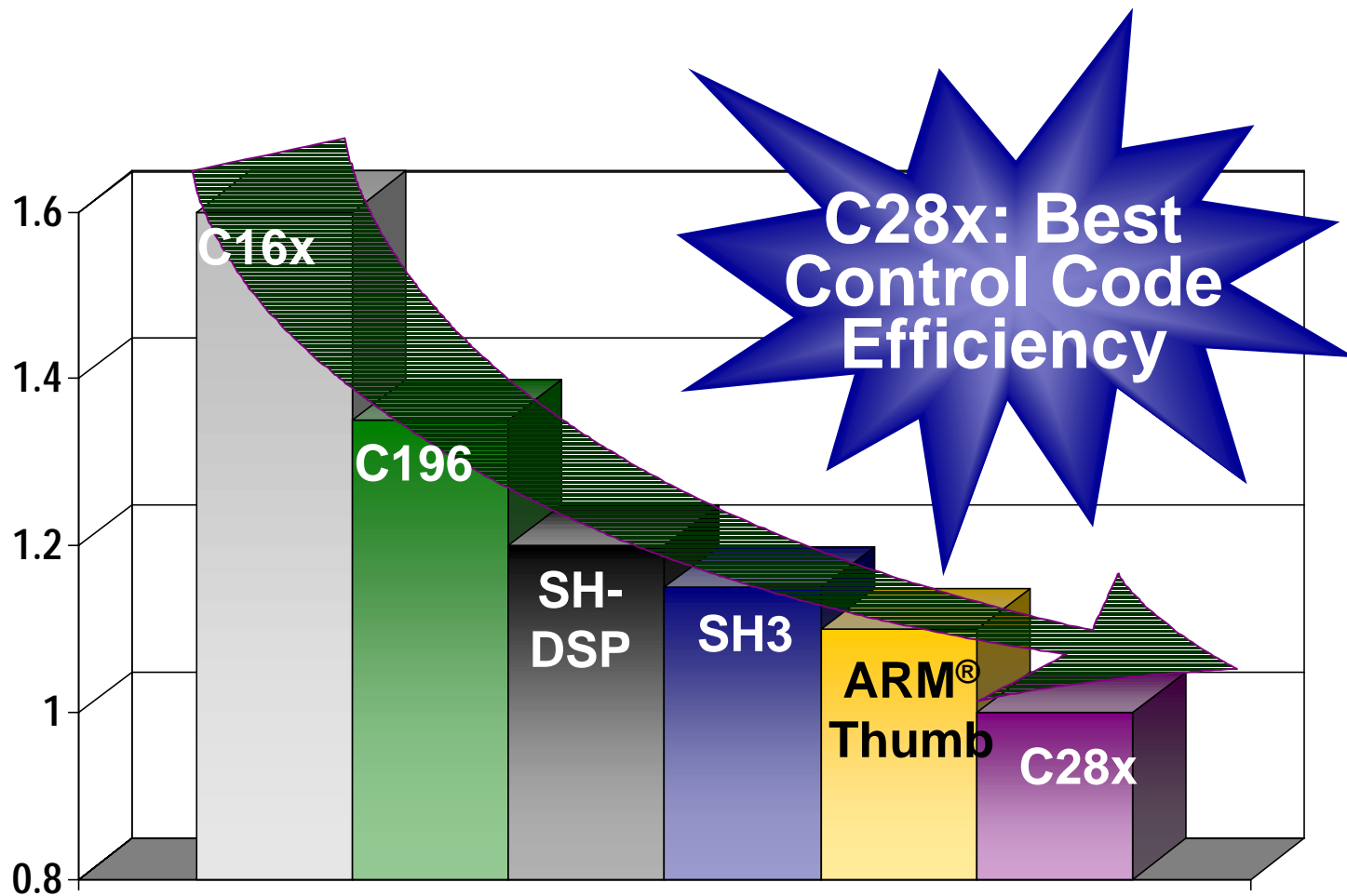
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400
MIPS



Best Code Efficiency for Control Applications

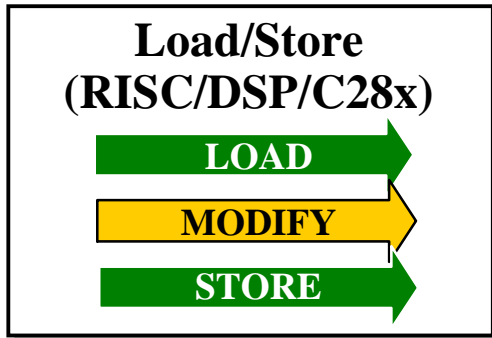
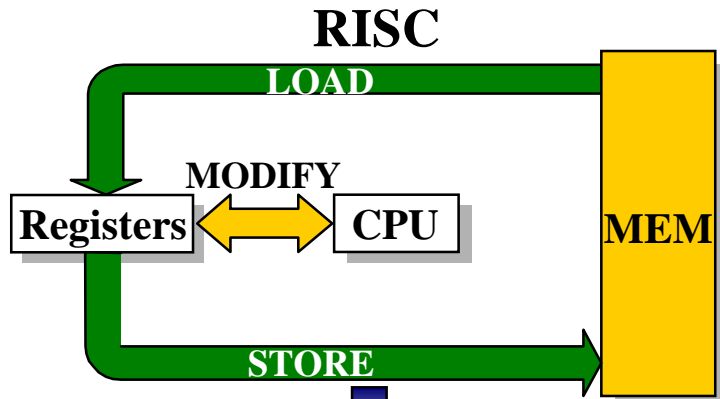
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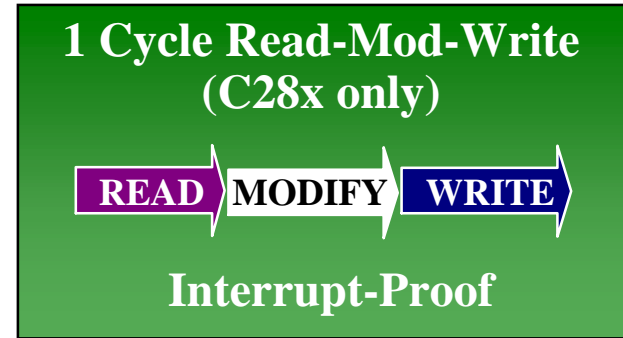
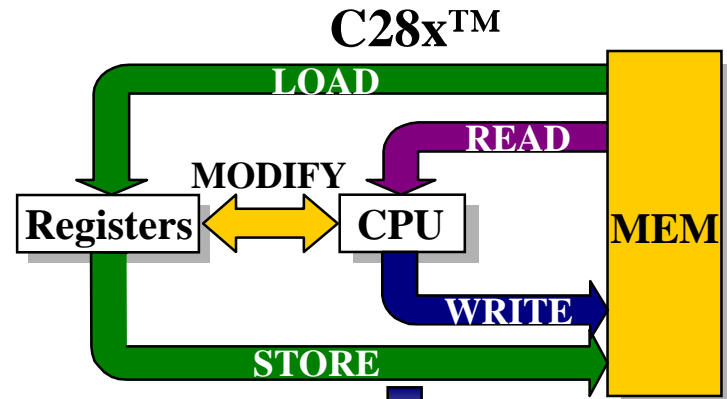
Based on C compiler results of actual servo control code

Atomic Read-Modify-Write Operations

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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



Product Status

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Devices	Status
F240	TMS
C240	TMS
F241	TMS
F243	TMS
C242	TMS
LF2407	TMX Now – TMS in July
LF2406	TMX Now – TMS in July
LF2402	TMX Now – TMS in July
LC2402	In Development – Sampling 12/00
LC2404	In Development – Sampling 12/00
LC2406	In Development – Sampling 12/00
C28x	In Development – OEM sampling 4Q00
	Broad TMX Sampling mid-2001
LF240xA	TMX 10/00 – TMS 12/00
	**LF240xA will include Flash Security feature

TI Analog Components Attach Seamlessly to C2000 DSPs

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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

Power Management Products in Digital Control Systems

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Recommended Power Management Products for C2000 series DSPs							
DSP supply Voltage	SVS	Powering DSP Only	Supply Current				
			System including one or more DSPs				
			<250 mA	250 - 500 mA		500 mA - 3A	>3A
			LDO	LDO	LDO + SVS	SMPS	SMPS
5V	TPS3823-50	TPS7250	TPS7250	TPS7150	TPS7350	TL5001A	N/A
3.3V	TPS3823-33	TPS76333	TPS7233	TPS7133	TPS7333	TL5001A	TPS5633

▶▶ Reference designs available to match power requirements of C24x DSP

▶▶ EASY Opportunity to ATTACH Power Management Products

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C2000 Support Infrastructure: Ultimate Ease-of-Use

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Turn-Key Solutions from TI Third Parties
(Motion Chip)

DMC Third Party Network
(algorithm development, H/W design, etc.)

Application
Notes

DMC Software
Library

Reference
Designs (ADK)

Code Gen Tools
(Asm/Lnk/C-Comp)

Code Composer IDE
w/ Real-time Monitor

JTAG-based Emulators
(XDS510PP)

Development Platforms
(EVM, DSK, MCK)

Pin Compatible Flash & ROM
C2000 Devices

By removing a key software design hurdle for customers, TI could finally convince motor makers to wholeheartedly embrace DSP”

Will Strauss
President of Forward Concepts

Device Development Kits

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GEN1

\$1495

240 EVM

- ◆ TI HLL
- ◆ Assembler

\$199

240 DSK

- ◆ Code Explorer*
- ◆ Assembler
- ◆ SD only

GEN2

\$1995

243 EVM

- ◆ CC 4.10
- ◆ 510PP+

\$199

243 DSK

- ◆ Code Explorer*
- ◆ Assembler

GEN3

\$1995

2407 EVM

- ◆ CC 4.10
- ◆ 510PP+

Tgt \$199

2407 DSK

- ◆ Code Explorer*
- ◆ Assembler

In Development
Release 8/00

* Expect to replace with CC 4.10 by end of year.

Code Generation & Programming

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▶▶ Code Generation Tools, v7.0

- ▶ Highly efficient C-Compiler/Assembler/Linker
- ▶ ANSI C source code compliant.
- ▶ Variety of optimizations for improved code efficiency.
- ▶ Includes archiver, hex conversion and cross reference utilities, and absolute lister.
- ▶ 60 bug fixes, released 1/00

▶▶ Flash Programming Utilities

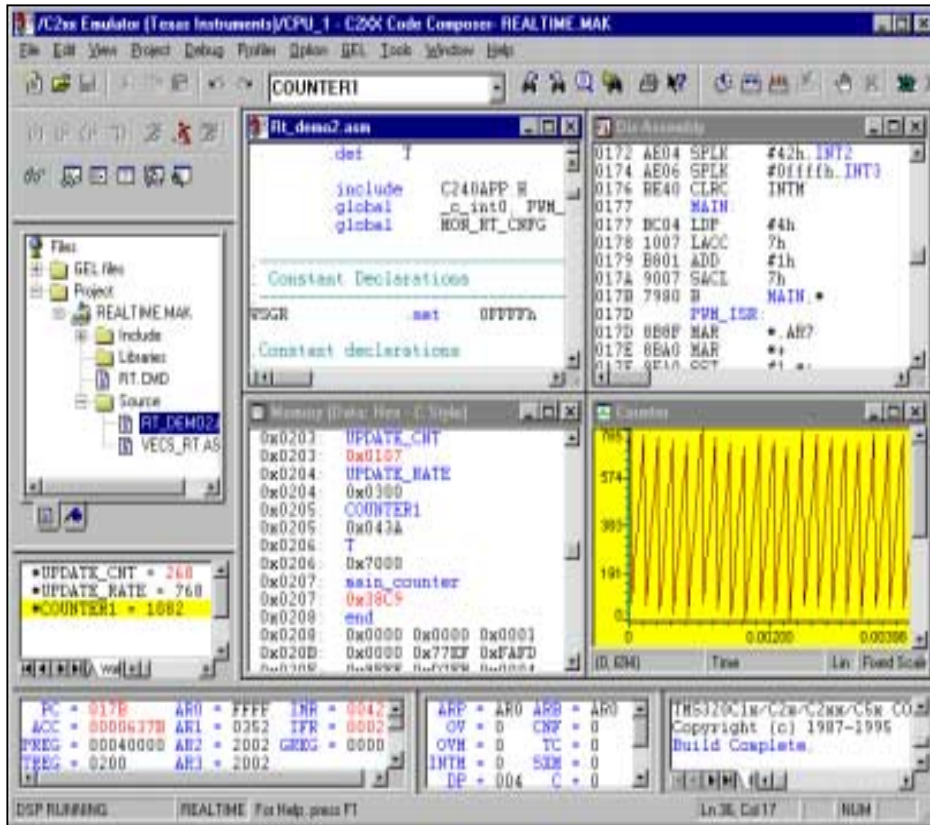
- ▶ Support for JTAG and Serial Port flash programming.
- ▶ LF240x & F240/241/243 utilities available today with free WEB download.

Code Composer 4.10

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Offers Real-time Monitor and Plug-in Capabilities

- ▶ New interface style
- ▶ C2000 Code Gen Tools included
- ▶ Command window plug-in
- ▶ C24x real-time debugging:
 - ▶ Halt the application and still handle interrupts ability to update graphs, watch and memory windows, without halting the processor
 - ▶ Single-stepping of background code while ISR's continue to run in real-time.
 - ▶ Tuning of system parameters, e.g. PID loops, Motors char, etc..
 - ▶ Software switches to control/invoke motor wind-down sequence.
- ▶ Drag and drop setup program
- ▶ Emulation and simulation drivers included



F2407 Evaluation Module

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Part Number: TMDS3P604030
Price: \$1995

F2407 EVM includes:

- ▶▶ TMS320F2407 Evaluation Board with:
 - ▶ 64K of RAM in program & data space
 - ▶ MP7680 DAC (4 channels, 12 bits)
 - ▶ JTAG, UART, and CAN interfaces
 - ▶ Expansion connectors
- ▶▶ C Compiler/Assembler/Linker
- ▶▶ Code Composer IDE, v4.10
- ▶▶ XDS510PP+ Emulator
- ▶▶ +5VDC universal power supply
- ▶▶ Cables and Technical Documentation

F243 DSP Starter Kit

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F243 DSK includes:

- ▶▶ TMS320F243 Target Board
- ▶▶ RS-232 Communication to host PC
- ▶▶ 16K of RAM in program and data space
- ▶▶ Symbolic assembler
- ▶▶ Code Explorer debugger
- ▶▶ A/C adapter and communication cable
- ▶▶ Direct interface to Spectrum Digital's Digital Motor Controller system
- ▶▶ Standard JTAG interface on board



Part Number: TMDS3P701024

Price: \$199

LF2407 DSK to be released in 3Q00

Power Modules

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- ▶▶ 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)

Additional C2000 Enhancements

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- ▶ Emulation
 - ◆ SD 510PP+ (approximates performance of 510 card) now in volume production from SD. Targeted to replace 510PP in TI channel during 4Q00.

- ▶ Production Flash programming (BP Micro)
 - ◆ F241PG support available now
 - ◆ F241FN/'F243/'F240 available now
 - ◆ LF240x available now

- ▶ C2000 Transition to CCS 2.0 Planned for 2Q01

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

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- ▶▶ The DSP Control market is in full swing
- ▶▶ TI's C2000 platform has been widely adopted by DSP Control market.
 - ▶ Over 1000 DINs on C2000 platform, totaling \$2 Billion LNR
 - ▶ Industry's broadest portfolio, from \$2 to 400 MIPS
- ▶▶ 3rd Parties have a huge opportunity to contribute to TI's C2000 DSP Control value web. Here's how:
 - ▶ Code Composer Plug-ins
 - ◆ Flash programming tools
 - ◆ Peripheral driver utilities
 - ◆ Others TBD...
 - ▶ Software Module Development
 - ▶ Turnkey Hardware and Software Algorithms
 - ▶ Hardware Development Platforms
 - ▶ System Engineering / Consulting

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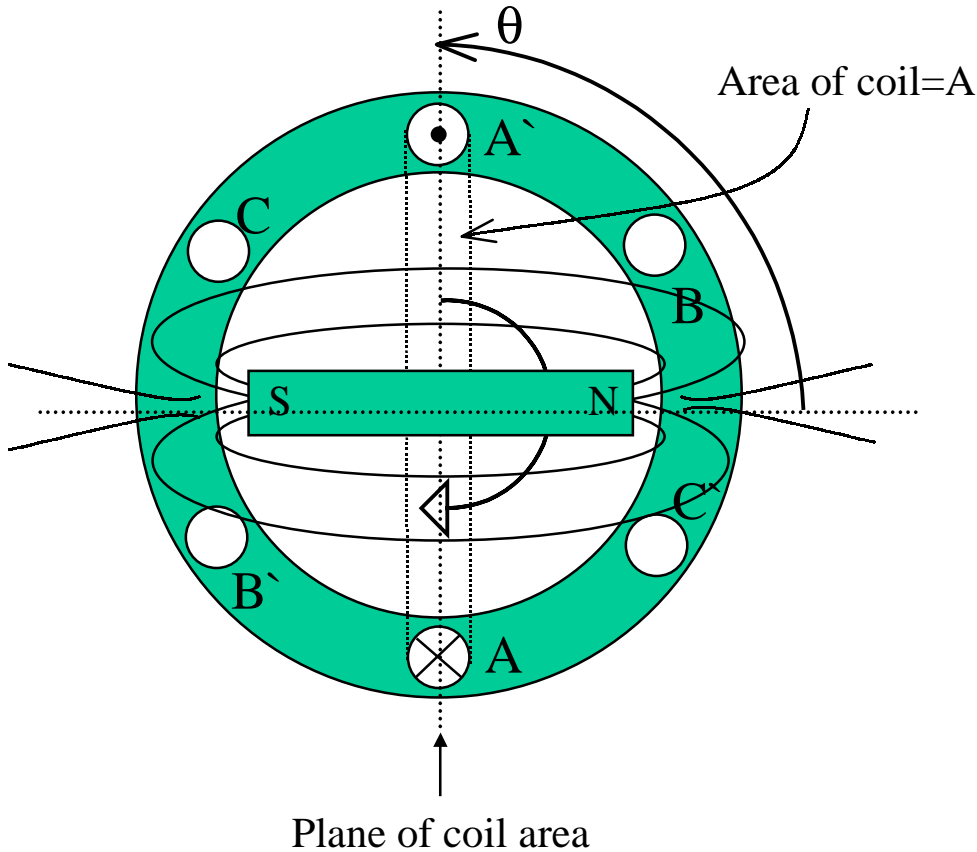
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Field-Oriented Control of Permanent-Magnet Synchronous Motor

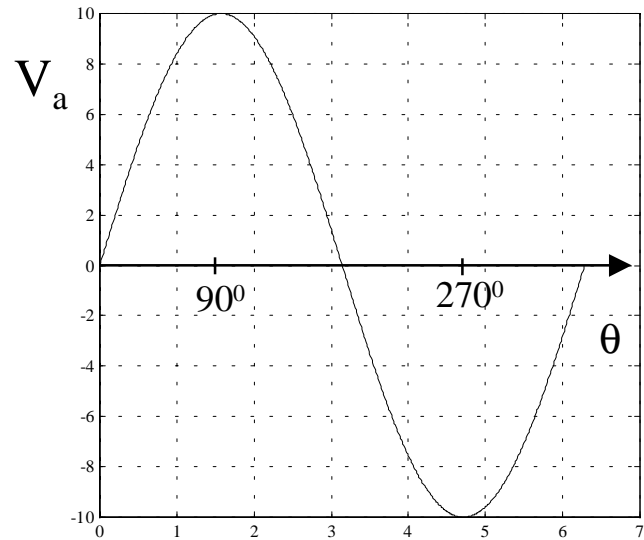
The modular
and
step-by-step development approach
with
DSP

Sinusoidal Back EMF PMSM

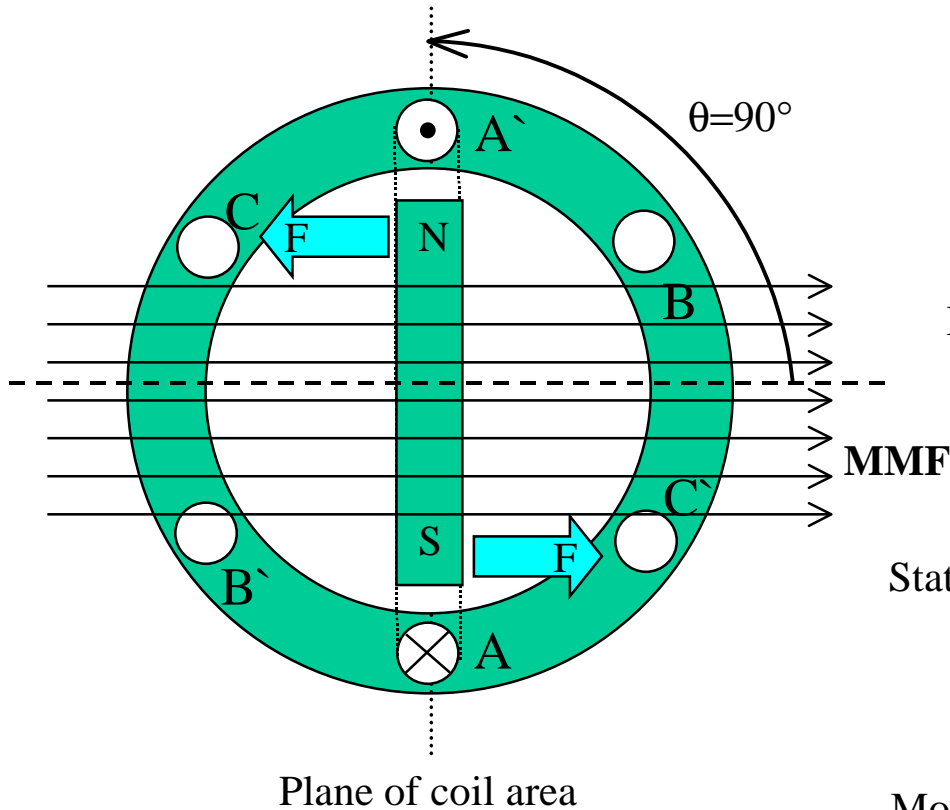


$$\Phi = B \cdot A \cdot \sin(\theta)$$

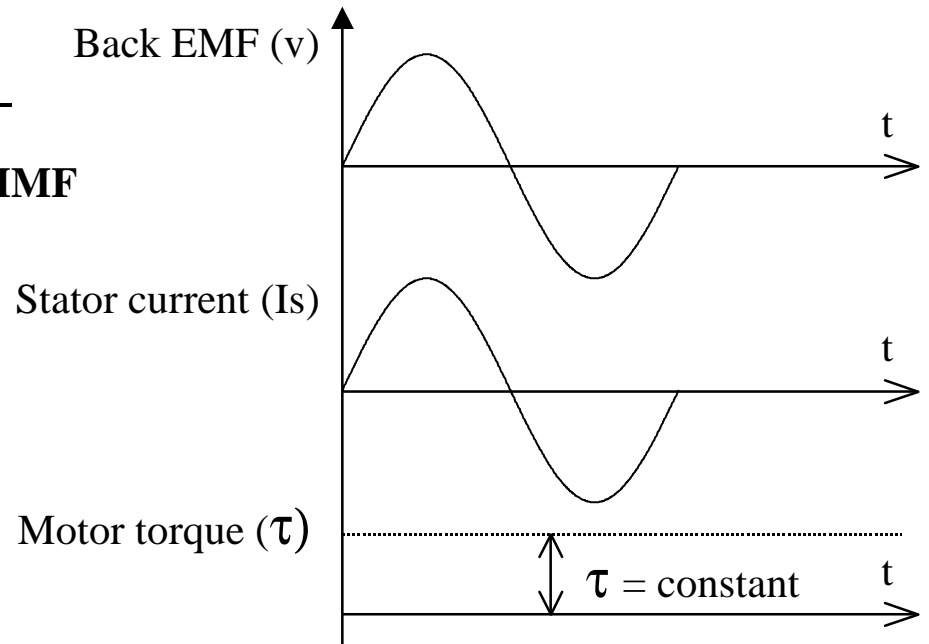
$$v = -\frac{d\Phi}{dt}$$



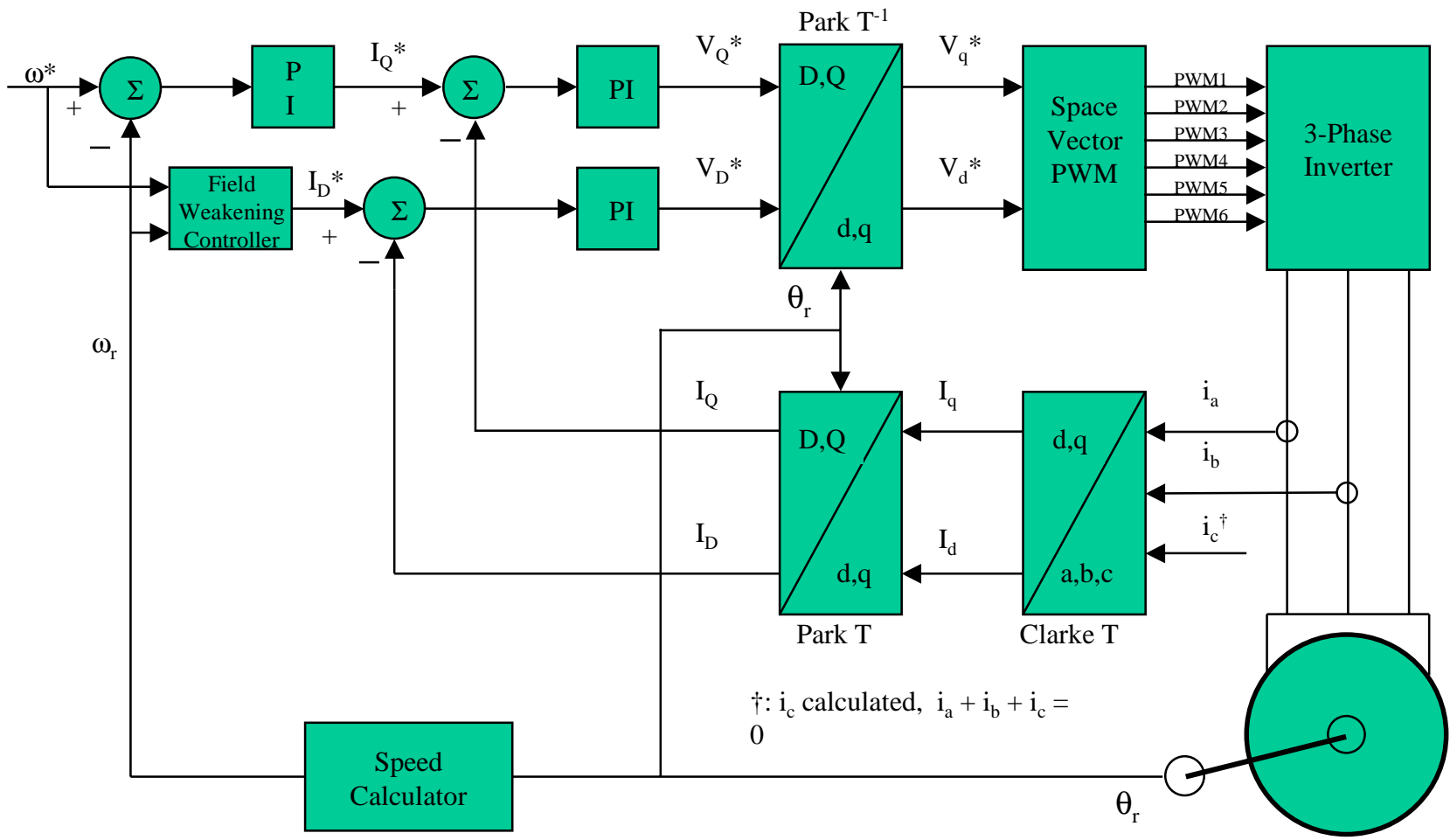
Field-Oriented Control



- ◆ Rotor is “pushed” rather than pulled along.
- ◆ Rotor position knowledge needed.
- ◆ Rotor current & back EMF are in phase.
- ◆ Ideally constant torque with no ripple.



FOC Block Diagram



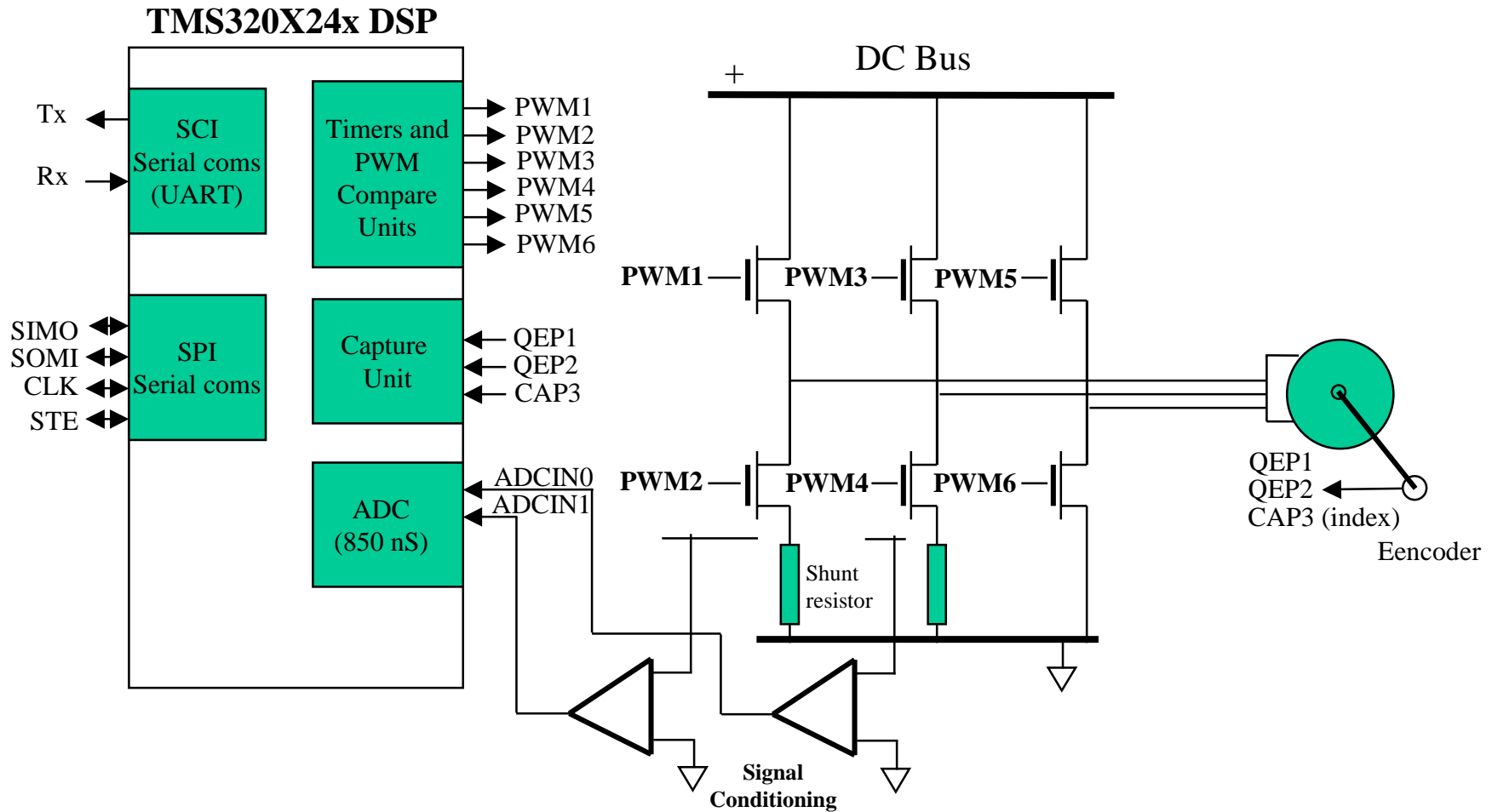
Blocks and Modules

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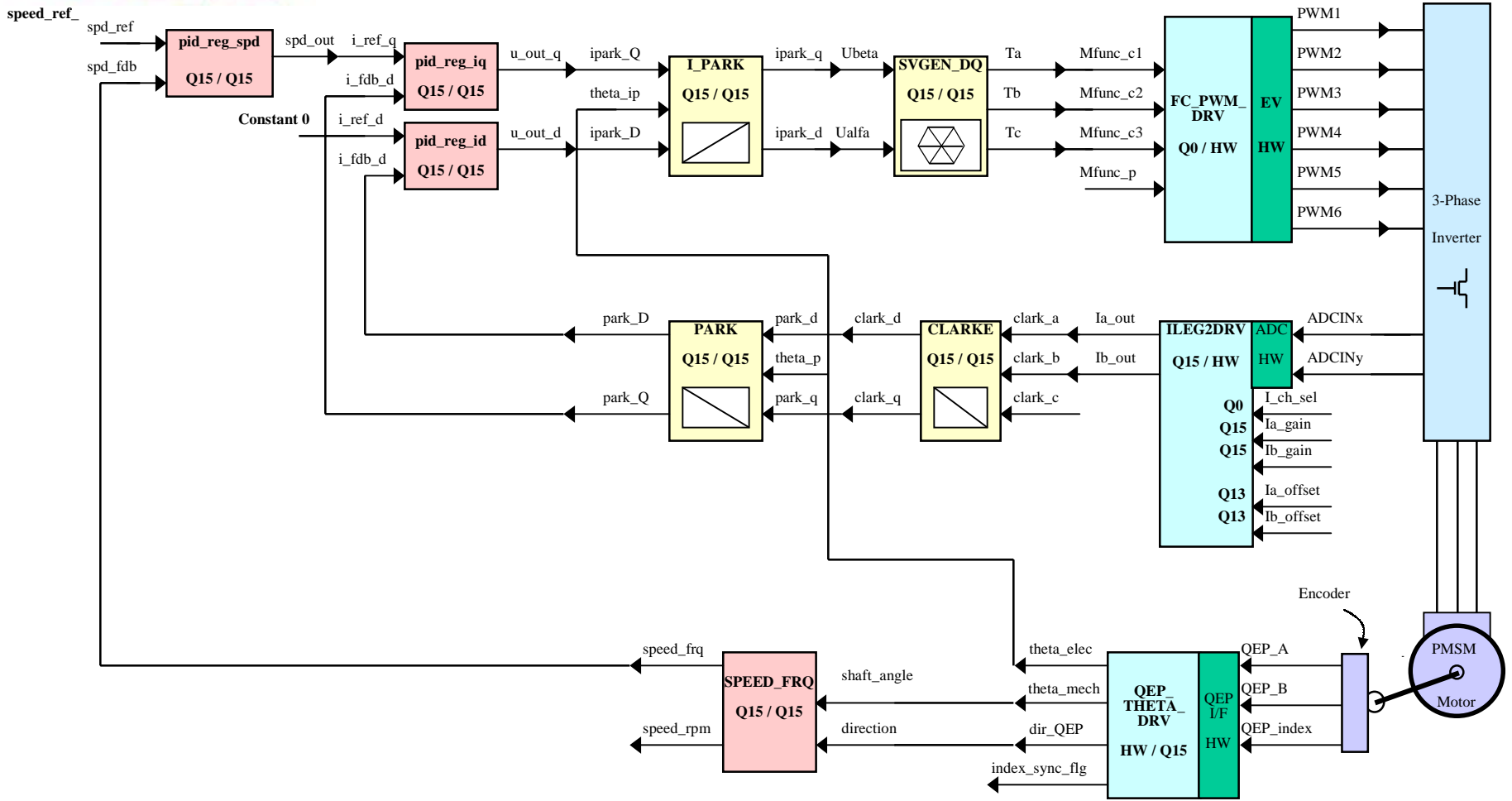
- ▶▶ Representation of system as interconnected blocks
- ▶▶ Blocks are essential functional modules
- ▶▶ Hardware or software blocks/modules
- ▶▶ Same blocks appear in many different systems
- ▶▶ Incremental system development and debug with blocks
- ▶▶ Standard blocks allow quick adaptation

Hardware Implementation

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Modular S/W Implementation

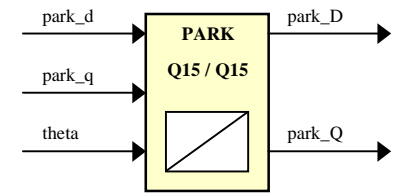
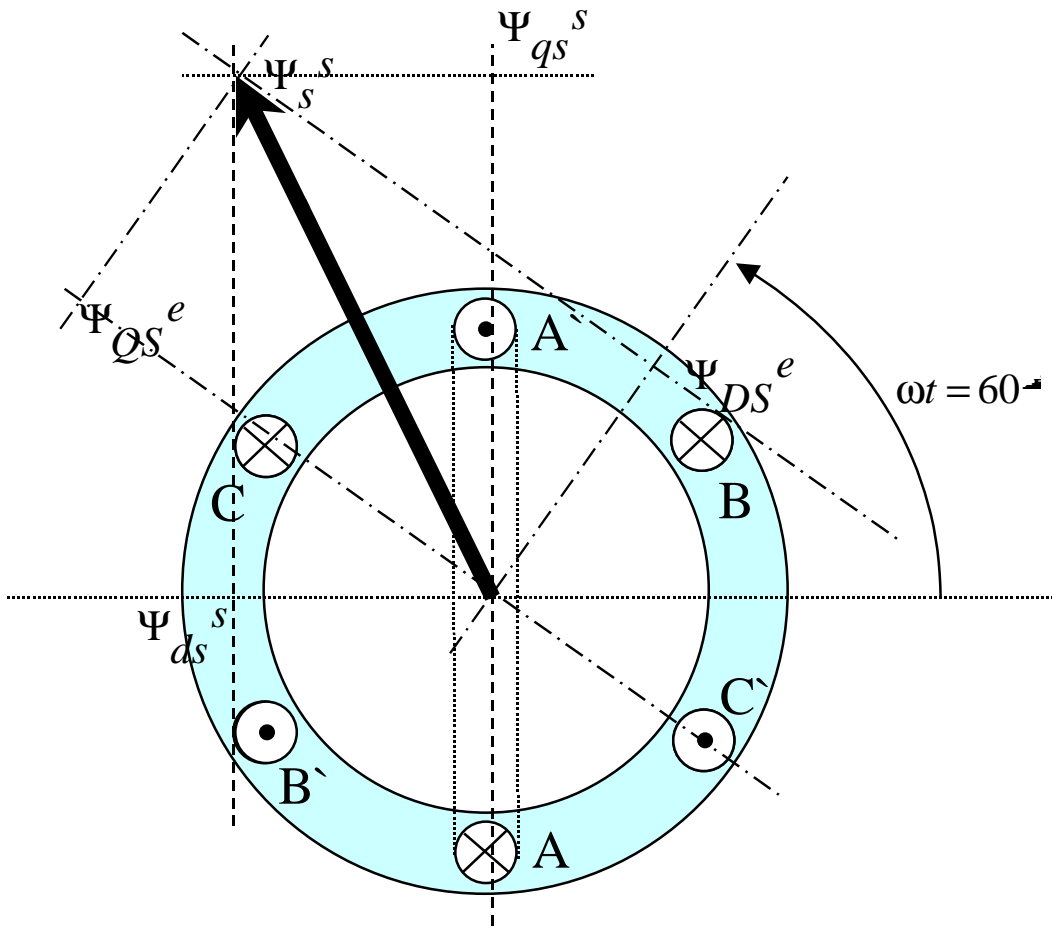


Essential Modules

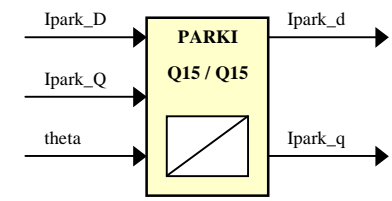
DSPS Fest
2000

- ▶▶ Control functions
 - ▶ PI controller, Low-pass filters
- ▶▶ Standard motor control functions
 - ▶ Park/Inverse Park, Clark, SVPWM, Speed calculator
- ▶▶ Math modules
 - ▶ Sin, Cos, Atan
- ▶▶ Peripheral drivers
 - ▶ Current sensing, PWM, QEP

Park/Inverse Park Transforms



$$\begin{bmatrix} \Psi_{DS}^e \\ \Psi_{QS}^e \end{bmatrix} = \begin{bmatrix} \cos(\omega t) & \sin(\omega t) \\ -\sin(\omega t) & \cos(\omega t) \end{bmatrix} \cdot \begin{bmatrix} \Psi_{ds}^s \\ \Psi_{qs}^s \end{bmatrix}$$



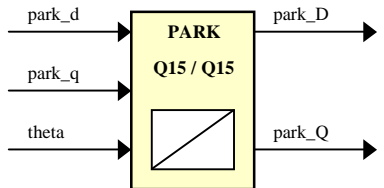
$$\begin{bmatrix} \Psi_{ds}^s \\ \Psi_{qs}^s \end{bmatrix} = \begin{bmatrix} \cos(\omega t) & -\sin(\omega t) \\ \sin(\omega t) & \cos(\omega t) \end{bmatrix} \cdot \begin{bmatrix} \Psi_{DS}^e \\ \Psi_{QS}^e \end{bmatrix}$$

Park Transform Implementation

```

;=====
; Filename:      PARK.asm          Routine:      PARK
; Originator:    Digital Control Systems Group, Texas Instruments
; Description:    id = ialfa * cos_teta + ibeta * sin_teta
;                iq = -ialfa *sin_teta + ibeta * cos_teta
;
;                |~~~~~|
; park_d  o---->|          |----->o park_D
;
; park_q  o---->|  PARK   |
;
; theta_p o---->|          |----->o park_Q
;
;                |_____|
;=====
;(To use this Module, copy this section to main system file)
;
; .ref          PARK,PARK_INIT          ;function call
; .ref          park_d,park_q,theta_p    ;Inputs
; .ref          park_D,park_Q           ;Outputs
;
;Module definitions for external reference.
;
; .def          PARK, PARK_INIT          ;function call
; .def          park_d,park_q,theta_p    ;Inputs
; .def          park_D,park_Q           ;Outputs
; .ref          SINTAB_360
;=====
High_precision .set          0          ; Set to 1 for High prec / Set to 0 for low prec
park_d         .usect "park",1
park_q         .usect "park",1
theta_p        .usect "park",1
park_D         .usect "park",1
park_Q         .usect "park",1
t_ptr          .usect "park",1
ip_val         .usect "park",1
cos_theta      .usect "park",1
sin_theta      .usect "park",1
nxt_entry      .usect "park",1
delta_angle    .usect "park",1
GPR0_park      .usect "park",1
PARK_INIT:     RET
PARK:          ... ..

```



Incremental System Build

- ▶▶ Incremental system development/debug is built in
- ▶▶ Incremental system development/debug relies on modular software blocks
- ▶▶ Incremental system development/debug is flexible/systematic
- ▶▶ Incremental system development/debug applies to multiple processors, drives and motors

Incremental Build

Main_lp_init

```
.if I_Build1
... .. ; init for I_Build1
.endif
.if I_Build2
... .. ; init for I_Build2
.endif
... .. ; init for more I_Builds
ret
```

Main_lp

```
.if I_Build1
; ... .. ; I_Build1 body
.endif
.if I_Build2
; ... .. ; I_Build2 body
.endif
... .. ; more I_Build bodies
ret
```

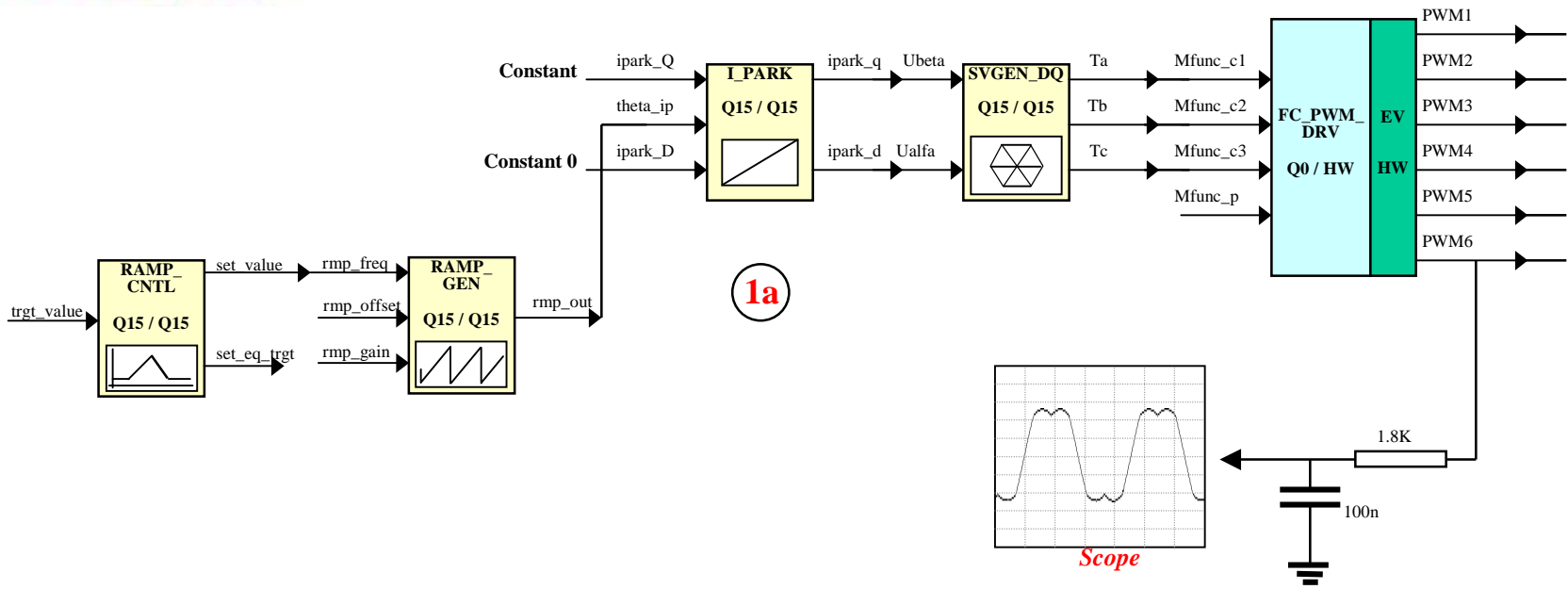
```
I_Build1 .set 1 ; verify forward control path
I_Build2 .set 0 ; verify current sensing and feedback
I_Build3 .set 0 ; current loops and regualtors
; ... .. ; more incremental builds
```

```
_int_c0 DINT ; Reset
; Init processor, reset watch dog timer
; init peripherals, enable drive
call Main_lp_init ;
```

```
Background ... ..
;reset watch dog timer
b Background ;
```

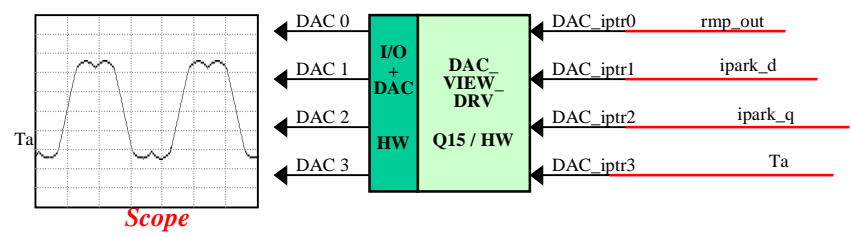
```
_int_c2 ; save context ; T1UF
call Main_lp ;
; restore context
ret
```

PMSM1 - Phase 1 Incremental Build



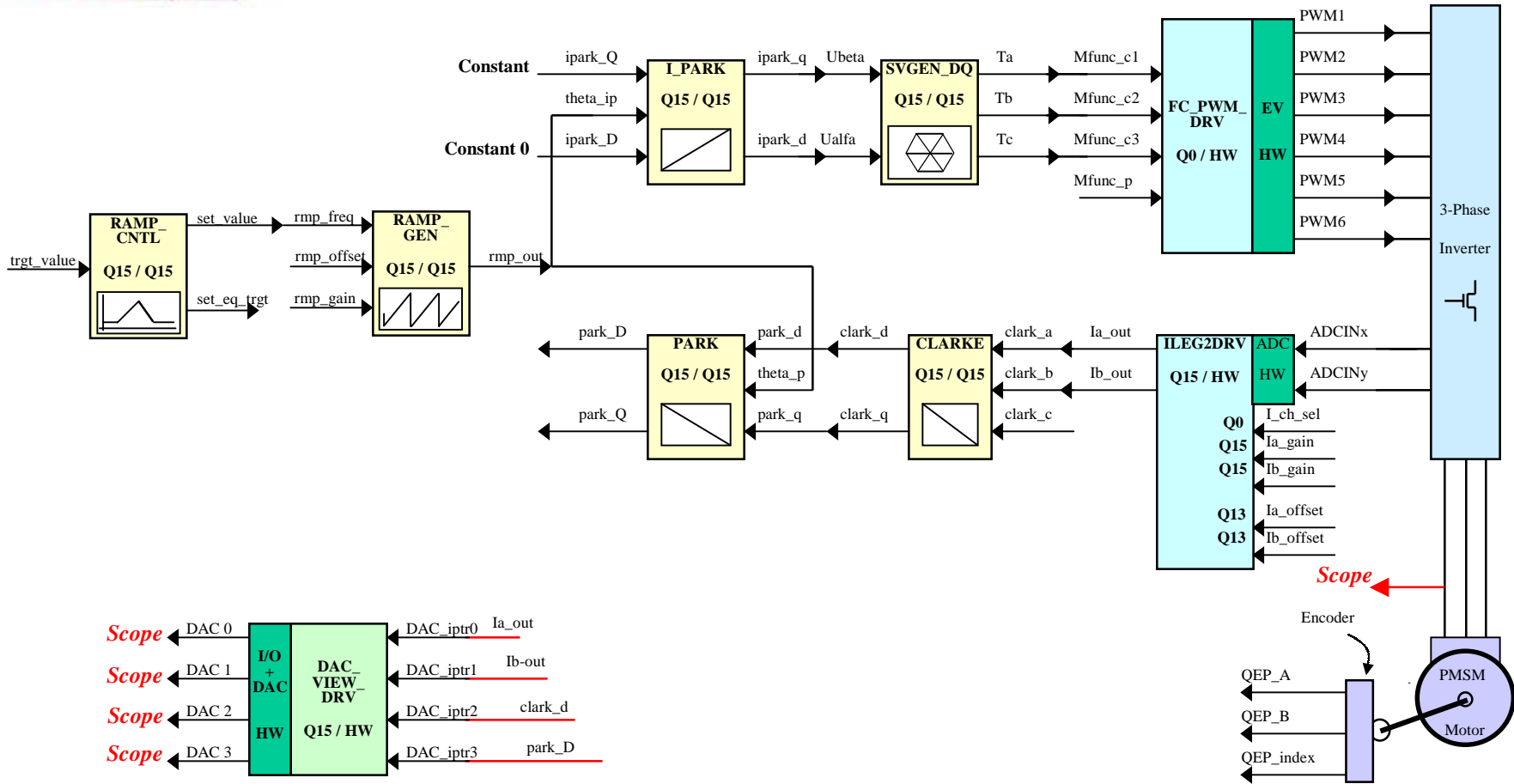
1a

1b



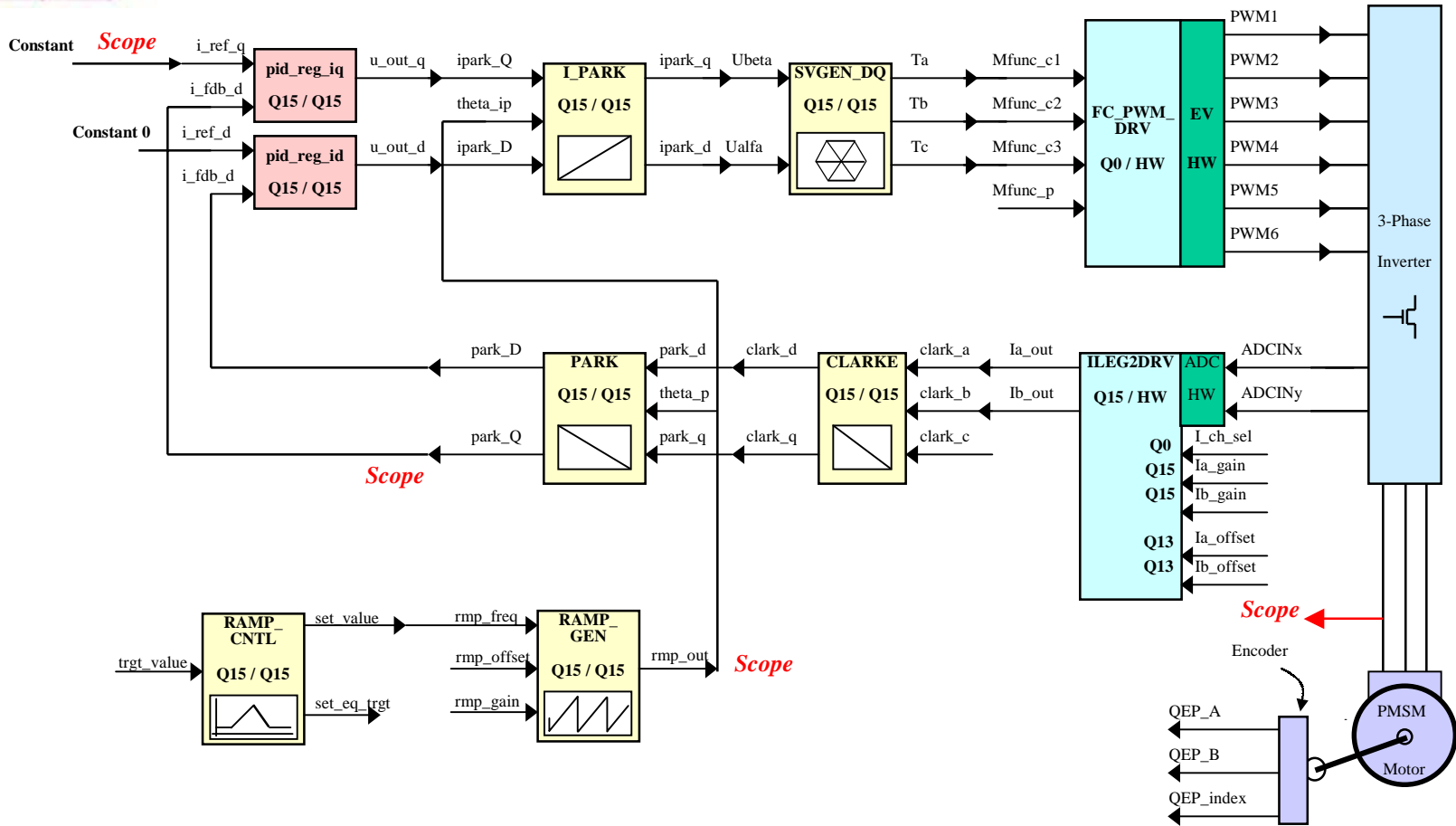
PMSM1 - Phase 2 Incremental Build

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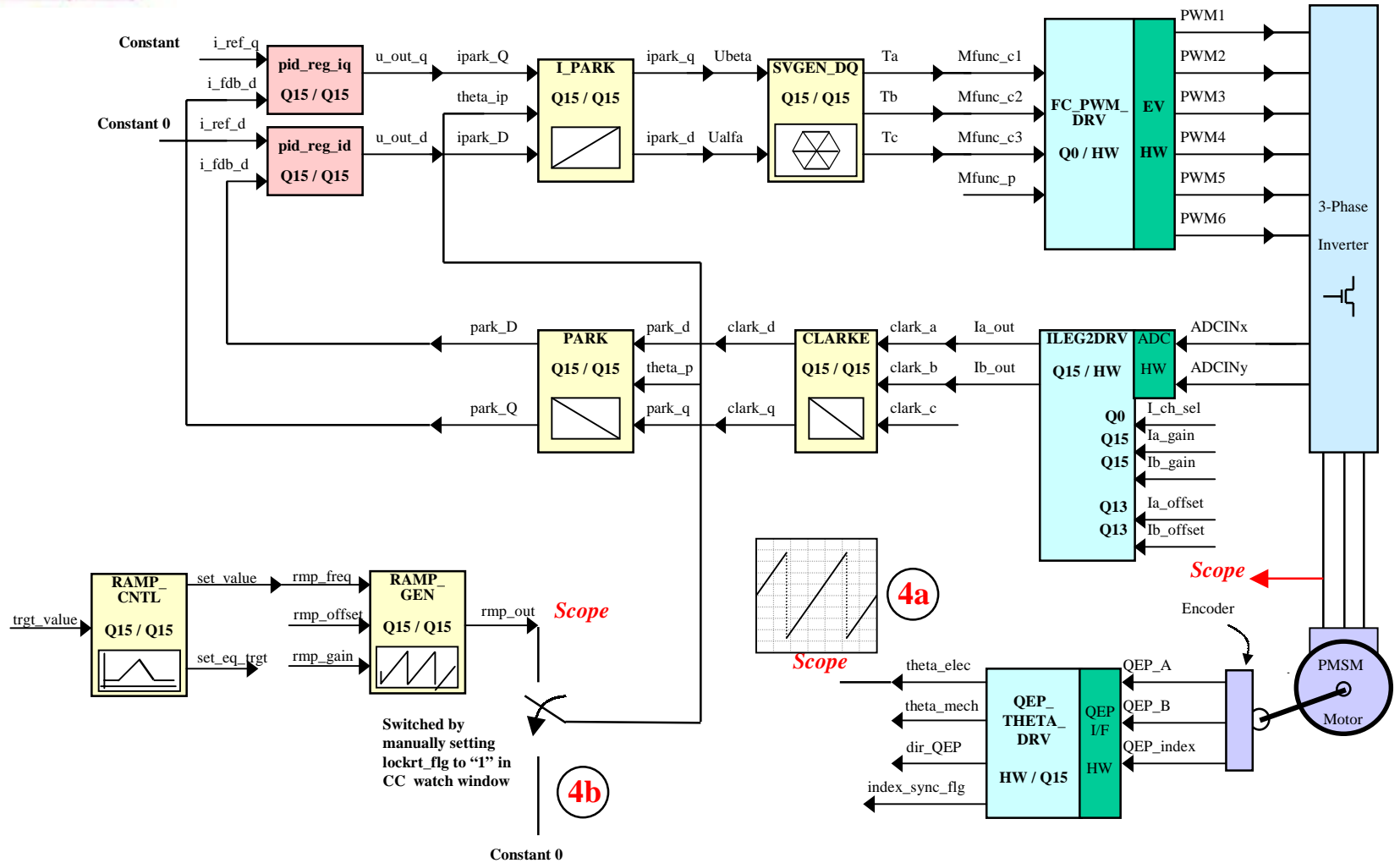
PMSM1 - Phase 3 Incremental Build

3



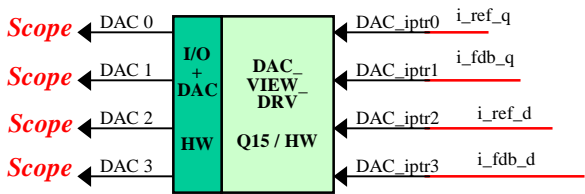
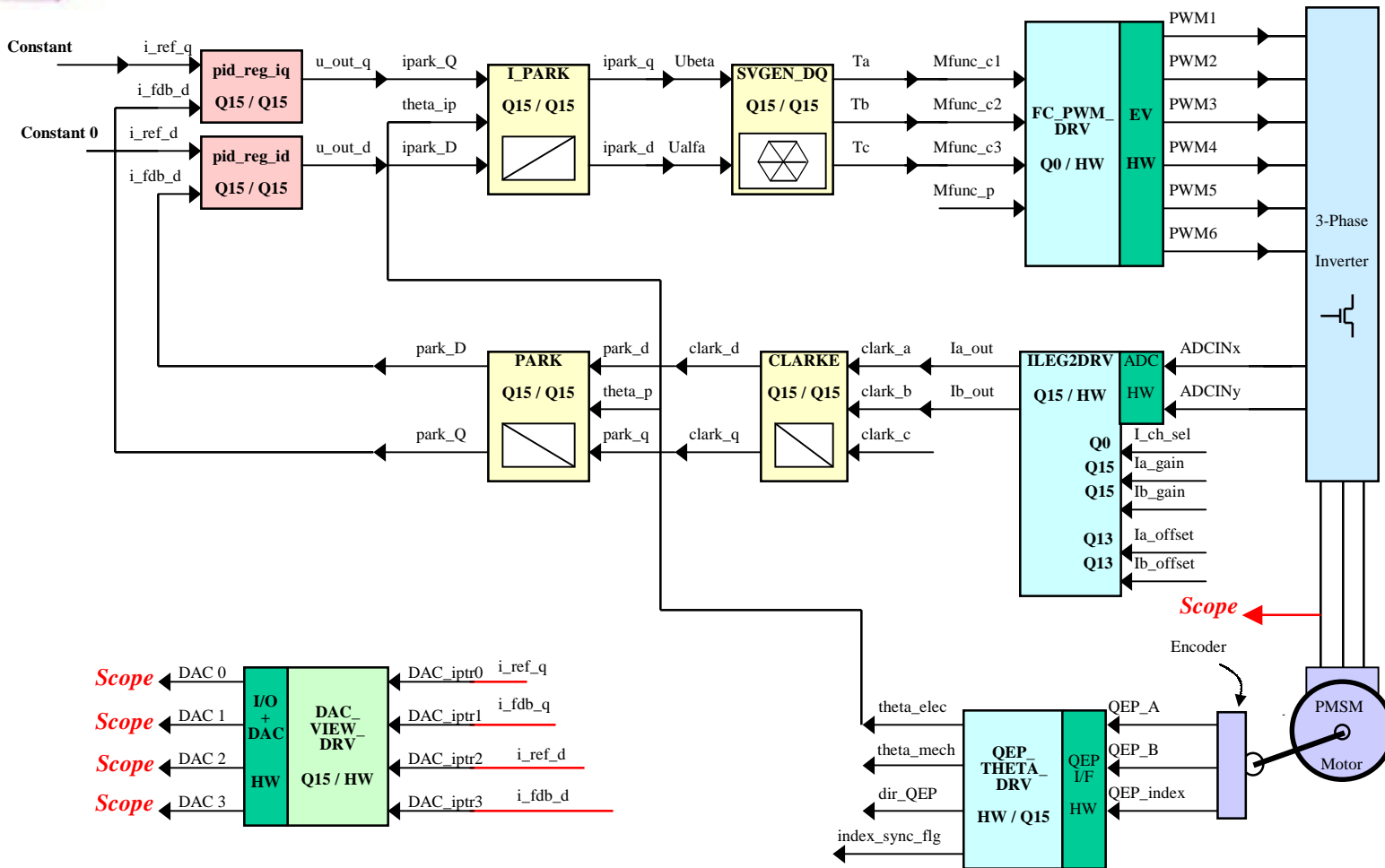
PMSM1 - Phase 4 Incremental Build

DSPS Fest 2000



PMSM1 - Phase 5 Incremental Build

5



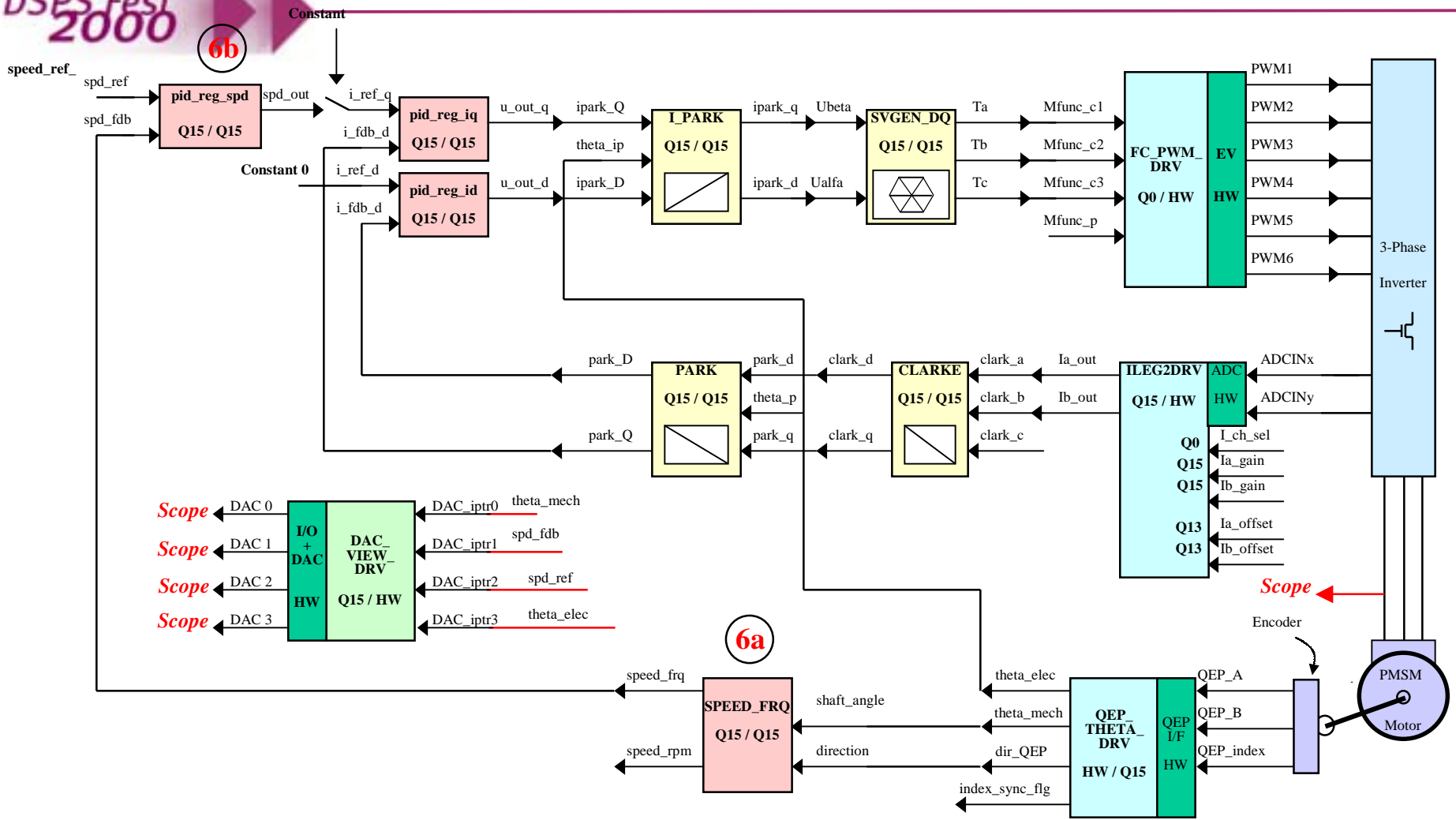
Scope
Encoder

PMSM1 - Phase 6 Incremental Build

6

DSPS Fest 2000

6b



6a

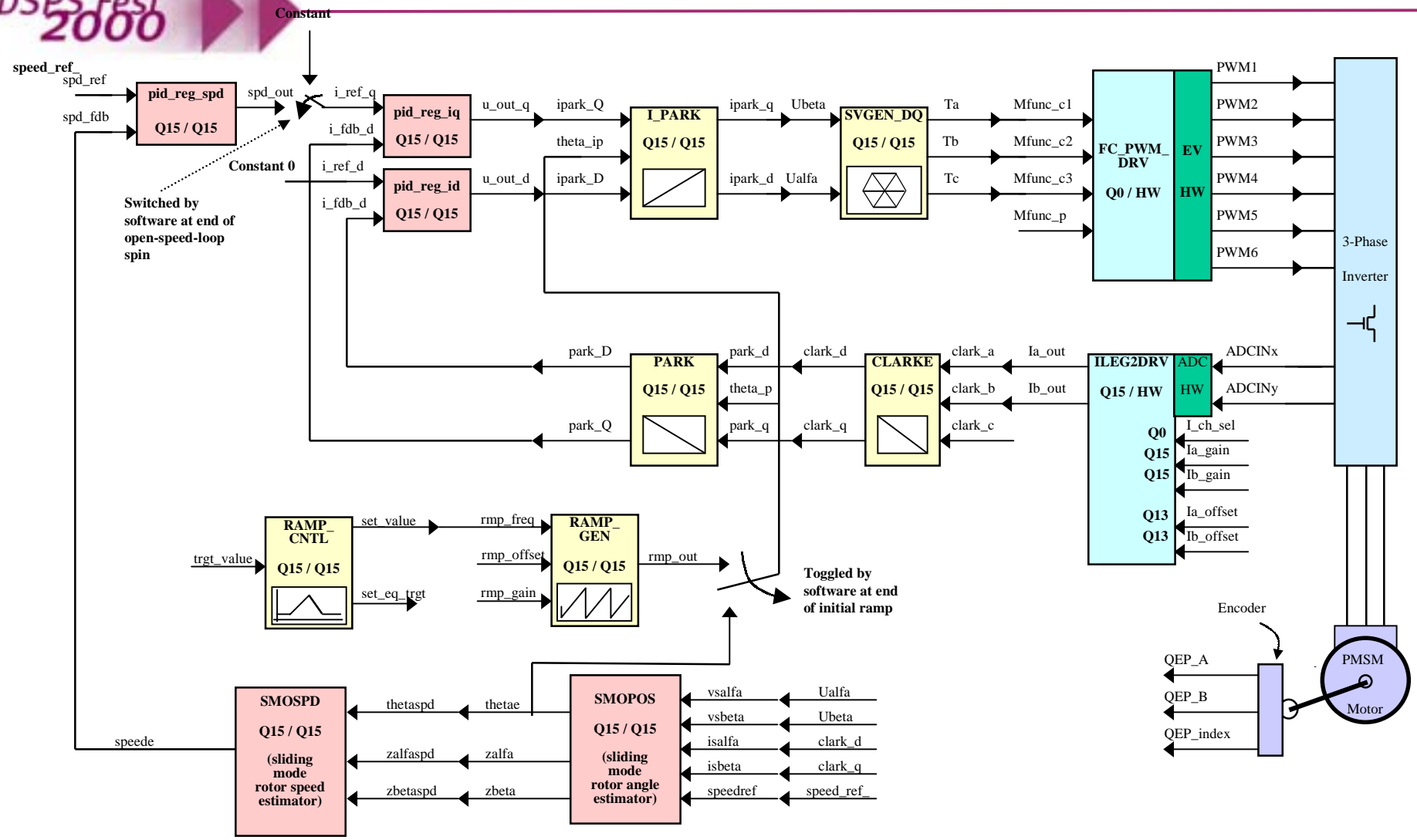
Conclusion

DSPTS Fest
2000

- ▶▶ '24xx DSP family offers the resource and capability to implement advanced motor control algorithms
- ▶▶ '24xx DSP family offers the resource and capability to allow modular implementation of advanced motor control algorithms
- ▶▶ '24xx DSP family offers the resource and capability to allow systematic incremental system development and debug

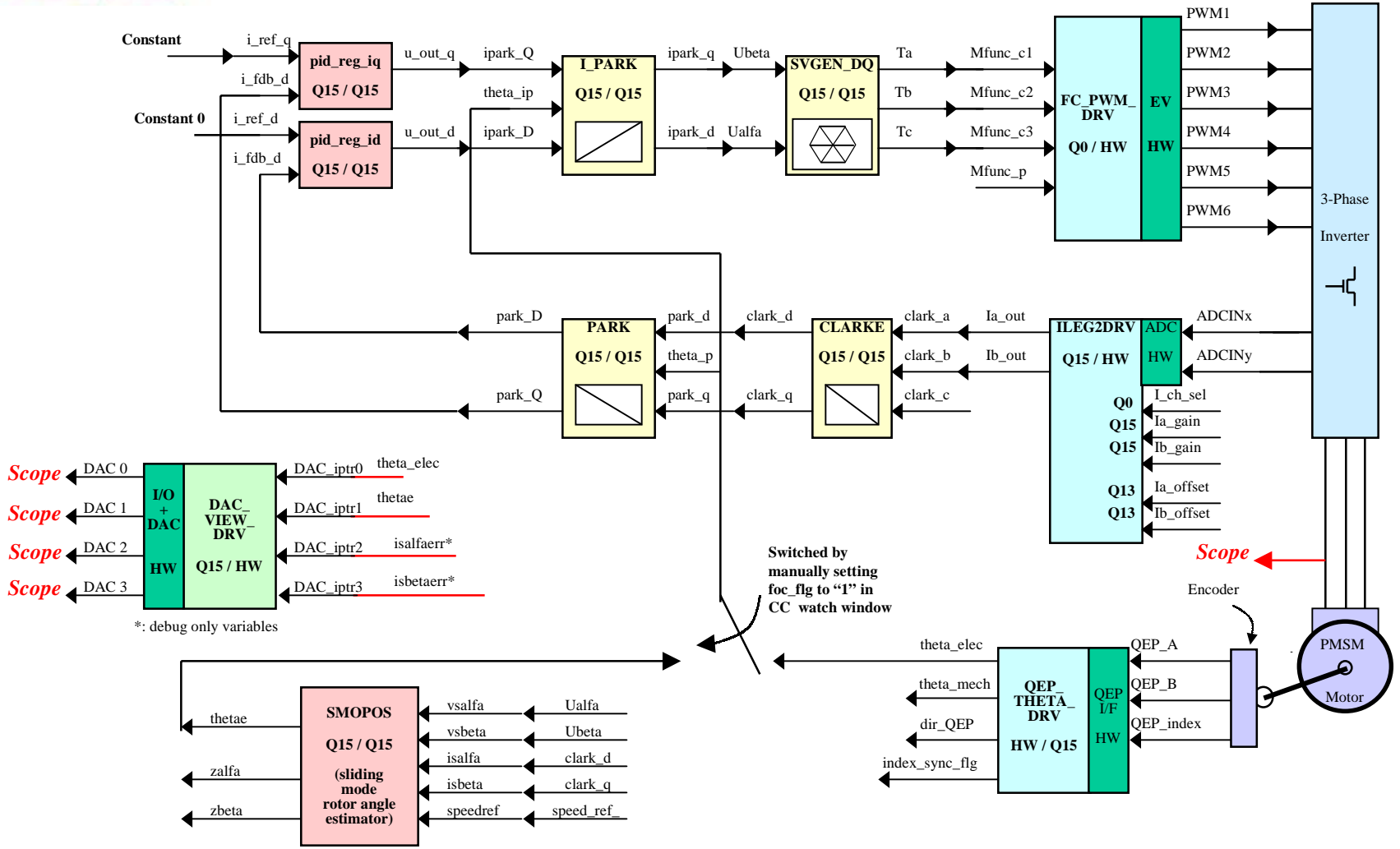
Sensorless FOC of PMSM

DSPTS Fest 2000



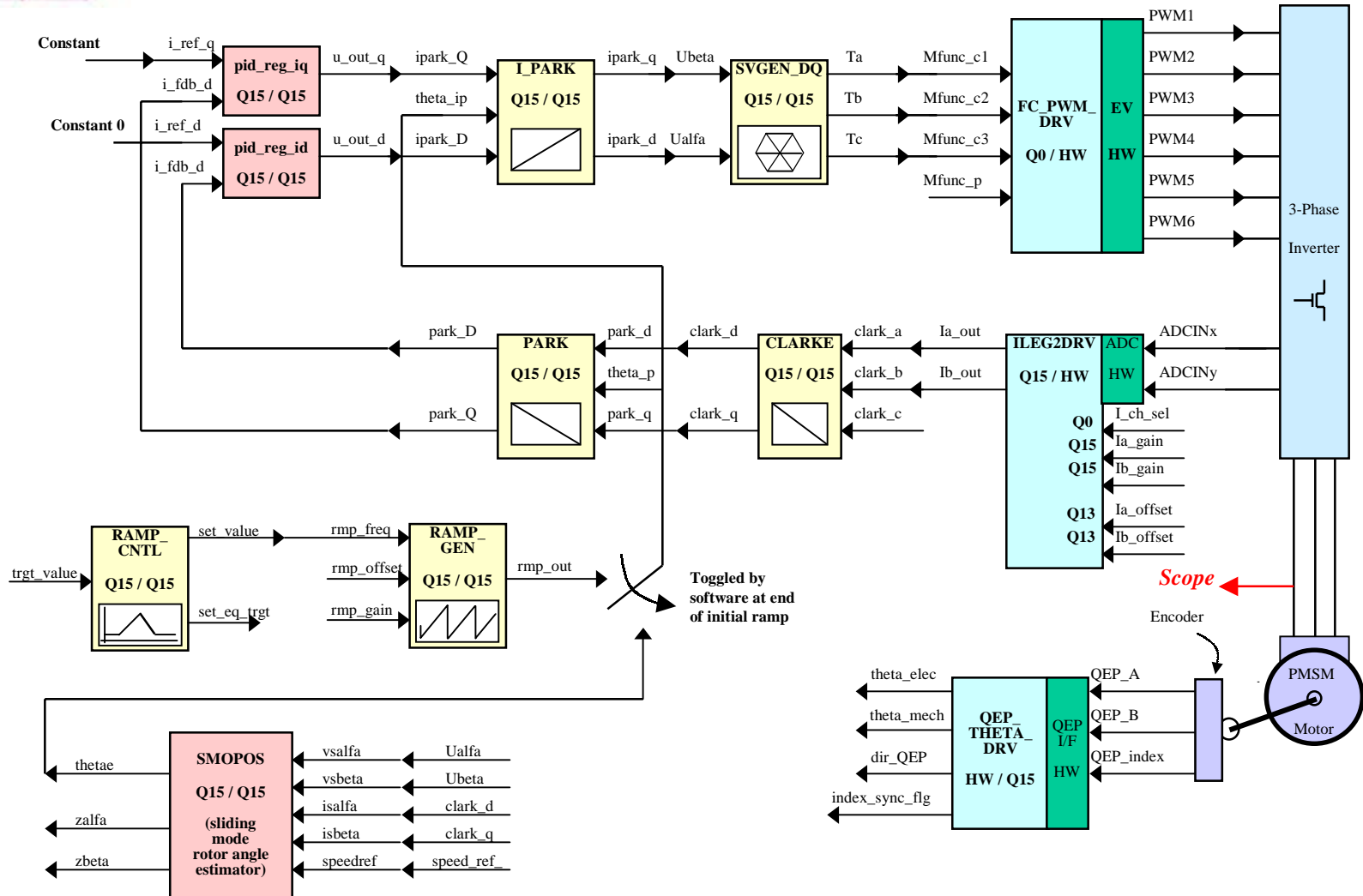
PMSM1 - Phase 7 Incremental Build

7



PMSM1 - Phase 8 Incremental Build

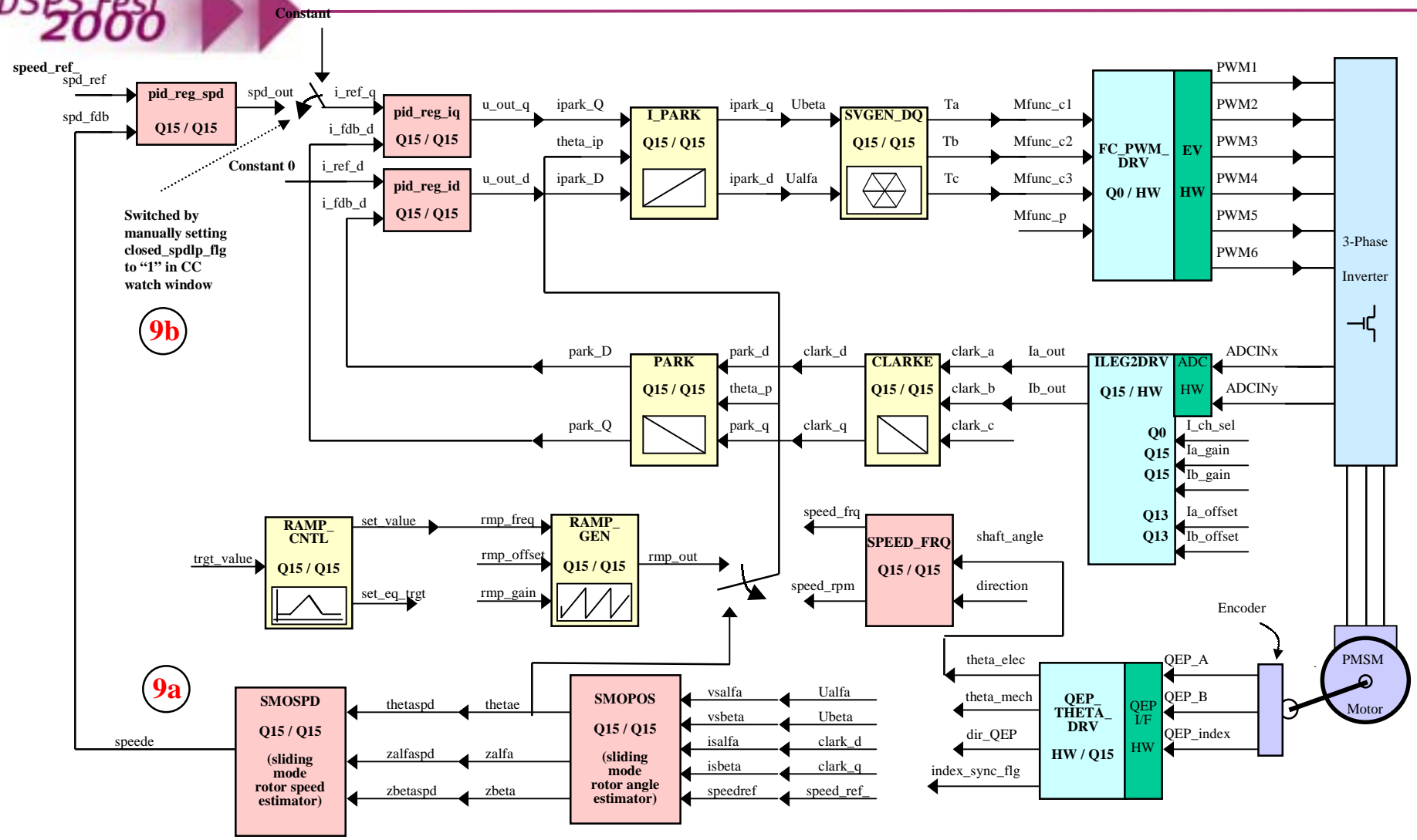
DSPS Fest 2000



PMSM1 - Phase 9 Incremental Build

9

DSPS Fest 2000



Agenda

DSPTS Fest
2000

- ▶▶ Introductions (05 min)
- ▶▶ Business Update (10 min)
- ▶▶ Product Update (25 min)
- ▶▶ Tools Review (25 min)
- ▶▶ Applications Review (25 min)
- ▶▶ System Solutions (50 min)
- ▶▶ Third Party Network (10 min)**
- ▶▶ Training and Resources (05 min)

Digital Control Developers 3P Network

DSPS Fest
2000



To bring together a group of skilled, digital control focused companies/individuals who can not only benefit from access to TI's expansive customer base, but can also help identify NBOs and facilitate and accelerate DINs and DWINs for the Digital Control Systems Group.

Membership Has Its Privileges

DSPS Fest
2000

- ▶ Special Identification on Web Site
- ▶ Tradeshows/Conferences
- ▶ Developer's Kit
 - ◆ Coupon for free DSK Workshop
 - ◆ DMC CD ROM
 - ◆ DMC Literature
- ▶ Channel Access
 - ◆ Monthly Champs Call
- ▶ Free Tools Program
 - ◆ Free EVM w/ "registration"
- ▶ TI Third Party Network Benefits
 - ◆ 3P Mark
 - ◆ 4-day training discount (\$650)
 - ◆ Access to TI Extranet
 - ◆ Tools discounts for resellers...

Guidelines/Requirements

DSPTS Fest
2000

- ▶▶ TI Third Party Network Registration - *required*
- ▶▶ DSP Resource Catalogue Listing - *required*
- ▶▶ Digital Control Specific products and/or services - *required*
- ▶▶ C2000 Endorsements (C28x, S/W Library...) - *optional*

How Do I Join?



- ▶▶ Fill out web registration form

Agenda

DSPTS Fest
2000

- ▶▶ Introductions (05 min)
- ▶▶ Business Update (10 min)
- ▶▶ Product Update (25 min)
- ▶▶ Tools Review (25 min)
- ▶▶ Applications Review (25 min)
- ▶▶ System Solutions (50 min)
- ▶▶ Third Party Network (10 min)
- ▶▶ **Training and Resources (05 min)**

C2000 Hands-On Training

DSPS Fest
2000

1-Day Workshop



FREE F243 DSK
LF2407 DSK Workshop in 1Q01

**C24x Basics - Just
Enough for Beginners**

\$349

4-Day RTC Training



Learn the F243 EVM

**In-depth C24x Core
and Peripheral Training**

\$1495

<http://www.ti.com/sc/docs/training/training.htm>

C2000 Online Training



C2000 Overview
C24x Technical Details
C28x Technical Details
1-day DSK Workshop

<http://ti-training.com/>

Material Available For Web Download

80,000
downloads
in 99

Type	Number Available	Description
Application Notes	60	Variety of topics including ACI, BLDC, PMSM, SR Motors, and CPU/Peripheral reference guides.
Application Design Kits (ADK)	5	Full system designs, including software, technical documentation, and schematics (BLDC, PMSM, ACI, UPS, SRM)
Software Library	15	Segmented 'packages' of source code for functions such as ramp generators, sine and cosine generators, and current sampling.
Flash Programming Utilities	5	Flash programming software for F240, F241/F243, LF24xx (parallel and serial).