TMS320C6000™:
The Broadband Infrastructure and Imaging DSP
World’s Highest Performance DSP

Platform Update
August 2000
Henry Wiechman
Worldwide C6000™ DSP Product Marketing Manager
Three DSP Breakthroughs Announced in 2000
Impacting Future of Broadband, Emerging & Mass Markets

**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

THE WORLD LEADER IN DSP AND ANALOG

TEXAS INSTRUMENTS
Performance Driven Markets Endorse C6000™ DSP

- Nearly $2 billion of design-ins spanning a range of performance intensive applications
- Millions of units shipped with 8 different code-compatible catalog products available today
- More than 9,000 developers as measured by tool shipments
- More than 100 third parties committed to the 'C6000 platform offering a variety of hardware and software products
- Two university textbooks available today with others planned
- Widely adopted by communications and imaging markets
  - Designs at 8 of top 10 3G wireless basestation OEMs
  - Programmable ADSL designs at 4 of top 6 PC OEMs
  - Designs in leading-edge network camera, medical imaging, and video infrastructure OEMs
C6000™ DSP Drives Broadband and Imaging with the Highest Programmable Performance

Broadband Communications

- DSL modems
- Pooled modems
- Base station transceivers
- Wireless LAN
- Enterprise PBX
- Speech recognition
- Multimedia gateway
- Professional audio
- Networked camera
- Machine vision
- Security identification
- Industrial scanner
- High speed printer
- Advanced encryption

Wireless 3G Base Stations

Imaging

THE WORLD LEADER IN DSP AND ANALOG
TI Provides Best Price/Performance and Easiest to Use Floating-Point DSPs

600 MFLOPS for $9.95 (volume)

Easiest to Use DSPs

Drives innovation in cost-sensitive audio, industrial automation and precision systems

SAMPLES AVAILABLE NOW

Best Price/Performance Floating-Point DSP

Broad Number of Applications

eXpressDSP™ Software Technology speeds time to market

TI Internal Data - NDA Material
C64x™: Maximizes Performance, Easiest to Use

Highest Performance through VelociTI.2™ VLIW

- More work per cycle
  - Increased parallelism
  - Special purpose instructions
- Very fast clocking
  - New logic techniques for high speed without high power.

Easiest to Use

- Improved orthogonality
- 2x register file
- 25% code size reduction
C6000™ DSPs 1st & 2nd Generation
Spec Summary

<table>
<thead>
<tr>
<th></th>
<th>VelociTI™ C62x™</th>
<th>VelociTI.2™ C64x™</th>
<th>Improvement</th>
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<tbody>
<tr>
<td>MHz</td>
<td>150-300</td>
<td>600-1100</td>
<td>4x</td>
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<tr>
<td>MIPS</td>
<td>1200-2400</td>
<td>4800-8800</td>
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<td>300-600</td>
<td>2400-4400</td>
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<td>General</td>
<td>Special purpose instructions</td>
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<tr>
<td>Imaging</td>
<td>General</td>
<td>Special purpose instructions</td>
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<tr>
<td>Code size reduction</td>
<td></td>
<td>Advanced instruction packing</td>
<td>25%</td>
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<tr>
<td>Overall Performance</td>
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</table>

Software Compatible
C64x™ Performance Speeds Past Competition

Complete benchmark results for C6000 DSPs can be found at www.ti.com/sc/c6000

Eliminates need for ASICs and FPGAs in many communication and imaging applications

- C64x™ solution enables field upgradable applications
- Programmability and flexibility clobbers ASIC
- More than 10x the performance of the industry’s fastest DSP
- C64x™ extends C62x™ leadership with virtually unlimited performance headroom

* Source: Texas Instruments Incorporated
Gigabytes of Bandwidth Fuel World’s Fastest DSP Core for Ultimate Performance

C64x™ DSP Initial Implementation

- L1P Cache Direct Mapped
  - 16K Bytes Total
- L1D Cache 2-Way Set Associative
  - 16K Bytes Total
- L2 Cache/Memory
  - 4 Banks/128K Bytes Total

C64x™ DSP Core

- Instruction Fetch
- Instruction Dispatch
- Instruction Decode
- Control Registers
- In-Circuit Emulation
- Data Path 1
  - A Register File
  - L1, S1, M1, D1
- Data Path 2
  - B Register File
  - D2, M2, S2, L2

Enhanced DMA Controller

- Timer 0
- Timer 1
- Timer 2
- Power Down Logic
- PLL

Three External Buses Providing Over 1.8 Gigabytes Bandwidth

- 64-bit synchronous external memory interface (EMIF)
- 16-bit EMIF for I/O
- 32-bit HPI

Three McBSPs with 128 Channel Support

- McBSP 0
- McBSP 1
- McBSP 2

Enhanced DMA (EDMA)

L1/L2 Cache Architecture

- 32-bit HPI
- 16-bit EMIF
- 64-bit synchronous external memory interface (EMIF)
Achieves 80-90% performance vs. hand coded assembly

Performance statistics backed up with real code examples downloadable today

Out-of-the-box C code focus has produced more than 20% performance improvement

Unique compiler feedback

Support for C++
C6000™ DSP Foundation Software

Check out www.ti.com for details

System Software
- APIs for configuring and controlling peripherals
  - CSL (Chip Support Library)
  - BSL (Board Support Library)

Function libraries
- DSPLib (DSP Library)
  - General purpose DSP kernels
- ImageLib (Imaging & Video Library)
  - Imaging kernels

Application Technology Demonstration Kits (TDKs)
- Demonstrate C6000 capabilities in various applications
  - Multi-channel Vocoder TDK available today
  - Imaging TDK (alpha release in progress)
  - Others TBD
C6000™ DSP Multi-Channel Vocoder TDK Now Online

Demo code now available
- G.726/729/729A/723.1/EFR-GSM/EVRC vocoders
- G.165/168 echo cancellation

First third party plug-in now available
- Signals and Software Ltd complete
- Others in progress including Commetrex, Radisys, and Delphi
- Third parties to offer source code licensing on their web site
- Featured third party algorithms are eXpressDSP™ compliant
TI Data Converters
Optimized for TI DSPs

- Acquisition of Burr-Brown adds new analog expertise, enhances product portfolio, and accelerates new product development of DSP solutions

- 50 new converters in 2000 to support digital signal processing solutions

- The TI Data Converter Difference
  - Integrated FIFOs optimize DMA transfers
  - Core, I/O, and system power requirements suited for new low power DSPs
  - Code Composer Studio software plug-ins speed time-to-evaluate
  - Common connector evaluation boards interface easily with DSP evaluation boards
TMS320C6000™ DSP Compatible
Data Converters

New ADC Family:
- 10/12-bit, 6/8 MSPS
- Simultaneous sampling inputs
- Channel auto-scan
- Integrated 16X FIFO
- Integrated voltage ref
- Flexible DSP interface

ADC Eval. board:
Direct connect to DSP DSKs and EVMs, featuring the common-connector interface (TMS320C6211, 'C6701, 'C6201, 'C5402)

Add’l Tools:
Application reports, data converter CCS™ configuration plug-ins
Features

- AC97 Version 2.1 Compliant Codec
- 18-Bit Audio Codec
- SNR: 95dB (typ)
- Power Dissipation: 139mW @ 3.3V
- 4 Modes of Operation: 2 Channel / 6 Channel I2S / Quad / Modem
- Variable Sampling Rates (KHz):
  - 8000  • 22050
  - 11025 • 44100
  - 16000 • 48000

Applications

- Telecom
- USB Applications
- Teleconferencing
- Web TV

TLV320AIC27

18-Bit 48KSPS Audio-Band DSP codec
Performance/Integration

Power Management Roadmap for C6000™ DSP

LDOs
- TPS767D3xx (dual, 1A each, SVS)
- UC385-ADJ (5A)
- UCC383 (3A)
- TPS751xx (1.5A, power good)
- TPS752xx (2.0A, power good)
- TPS753xx (1.5A, reset)
- TPS754xx (2.0A, reset)
- TPS767xx (1A, power on reset)
- TPS768xx (1A, power good)
- TPS777xx (750mA, SVS)

Switching DC/DC Regulation
- TPS56300 (dual, 3.3/5Vin, sequencing)
- TPS5602 (dual, 4.5-25Vin)
- TPS56100 (5V input)
- TPS5615/18/33 (12V input)

Supply Voltage Supervisors
- TPS3305-18 (1.8/3.3V, dual, WDI)
- TPS3306-15 (1.5/3.3V, dual, WDI, PFI)
- TPS312x (1.5 or 1.8V single)
- TPS3801 (3.3V, pico gate package)

Plug In Power Modules
- PT652x (single, up to 8A)
- PT6937 (dual, up to 8A)

C64x
- 600+MHz

C64x
- 500+MHz

C6203
- 300 MHz
- 1.5/3.3V

C6202
- 250 MHz
- 1.8/3.3V

C6204
- 200 MHz
- 1.5/3.3V

C6205
- 200 MHz
- 1.5/3.3V

C6211
- 150 MHz
- 1.8/3.3V

C6701
- 167 MHz
- 1.9/3.3V

C6711
- 150 MHz
- 1.8/3.3V

C6712
- 100 MHz
- 1.8/3.3V

C6201
- 200 MHz
- 1.8/3.3V

C6712
- 100 MHz
- 1.8/3.3V
C6000™ DSP Call to Action

- Commit your high performance designs to C6000™ DSP: The Broadband Infrastructure and Imaging DSP
  - Eight code-compatible devices, available today, offering scalable, programmable performance to over 1.1GHz
  - eXpressDSP™ real-time software technology, featuring the industry’s best C compiler performance, speeds time to market

- Create eXpressDSP™ compliant solutions
  - Multichannel vocoder and imaging TDK plug-ins
  - C6711 DSK daughter cards

- Continue incorporating C6000™ DSP into university curriculum
  - New DSK and text books for laboratory courses
  - Additional broadband infrastructure and imaging research needed
Backup Slides
More Data Converters Optimized for TMS320C6000™ DSPs

Bridging the Analog & Digital Worlds
14 Bit, 3 MSPS DSPS ADC

**Features**
- TMS320C6000™ DSP compatible parallel interface
- 32-Word FIFO optimizes DMA transfers
- Differential inputs, PGA
- On chip voltage reference

**Key Differentiators**
- Programmable Gain Amplifier (PGA)
- Parallel interface with FIFO
- Designed for TMS320C6000™ DSP

**Applications**
- Communications
- Scanners
- Data acquisition
- Instrumentation
High-Speed Data Acquisition for TMS320C6000™ DSP Applications

✓ with internal FIFO memory (16X, 32X)
✓ without internal FIFO memory

Multi-purpose ADC options:

<table>
<thead>
<tr>
<th>Device</th>
<th>Resolution</th>
<th>Sample Rate</th>
<th>Channels</th>
<th>FIFO</th>
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<tr>
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<td>3 MSPS</td>
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<td>4</td>
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</table>
12 Bit, 40 MSPS ADC

Features

◆ Single 5 V Supply
◆ No Missing Codes over Full Temp Range
◆ On Chip T/H and Internal Reference
◆ 73 dB typical Spurious Free Dynamic Range at f_{IN}= 15.5 MHz
◆ 82 MHz Bandwidth
◆ High Input Impedance (1\text{M}\Omega)

Applications

◆ Wireless Local Loop
◆ Magnetic Resonant Imaging
◆ Medical Ultrasound
◆ Cable Modem Receivers
◆ Wireless Internet Access

Schedule

◆ Samples: today
◆ Production: 8/31/00
16-Bit 22KSPS Voice-Band DSP Codec

**Features**
- 16-bit, 22KSPS
- Low Power Dissipation: 39mW @ 8KSPS
- Powerful Glueless Serial Interface to SPI and TMS320 DSPs
- 3.0V to 5.5V Analog Operation
- Built-in microphone bias and interface
- Supports up to 7 slaves with 1 master
- 85dB SNR for ADC and DAC

**Applications**
- Hands-Free Car Kits
- Cable Modems
- Feature Phones
- Speech Recognition
- USB Headsets
- Digital Cameras w/Voice

**TLV320AIC10**

**Diagram**

- DAC
- A/D
- Binary code: 010001001
- Binary code: 1100011001
TLV320AIC10 Block Diagram

MIC/Hybrid
Op-Amp

Normal
Analog Input

MUX

PGA

S-D
ADC

DEC
FIR

Clock
Generator

Vref

DSP
SI

Analog
Output

PGA

REC
LPF

S-D
DAC

INT
FIR

Transmitter
Op-Amp

Analog
Input

Op-Amp

TLV320AIC10 Block Diagram

MIC/Hybrid
Op-Amp

Normal
Analog Input

MUX

PGA

S-D
ADC

DEC
FIR

Clock
Generator

Vref

DSP
SI

Analog
Output

PGA

REC
LPF

S-D
DAC

INT
FIR

Transmitter
Op-Amp

Analog
Input

Op-Amp
TLV320AIC10 Evaluation Board (AIC10-EVM)

TLV320AIC10, A Complete Mixed Signal CODEC solution for Voice Band Applications!
18-Bit 48KSPS Audio-Band DSP codec

TI-DSP PLATFORM

AIC27 CODEC

DACs

ADCs

Voice/Audio Application

Digital

Data

Control

Analog

Voice/Audio Application