Introduction

What do you need to put around your DSP? Most microprocessors usually require some support chips – power management, clock drivers, bus interface, and so on. DSP systems usually contain some additional devices – such as sensors, data acquisition, and such – because they receive, modify, and output real-world signals.

Finally, pull out your DSP Selection Guide and C6000 Product Update sheet to follow along with the last part of the workshop summarizing the C6000 devices, tools, and support.

Outline

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<td>❖ Linear Products</td>
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What goes around a DSP?

Linear

Surround DSP with TI Products

Data Converters
- Analog-to-Digital Converters (ADC)
- Analog input to digital output
- Output is typically interfaced directly to DSP
- Digital-to-Analog Converters (DAC)
- Digital input to analog output
- Input interfaces directly to DSP
- CODEC
- Data converter system
- Combination of ADC and DAC in single package

Power Management
- Power Modules – complete power solutions
- Linear Regulators – regulated power for analog and digital
- DC-DC controllers – efficient power isolation
- Battery Management – for portable applications
- Charge Pumps & Boost Converters – portable applications
- Supervisory Circuits – to monitor processor supply voltages and control reset conditions
- Power Distribution – controlling power to system components for high efficiency
- References – for data converter circuits
What goes around a DSP?

A Typical Real-Time Signal DSP System

RF Front End

Compressed audio or digital data

Power Amp

Power

DAC

Clock Circuits

Real-Time Signal Processing Engine

01011010...01101010

Interface

Digital Radio

Music Traffic

Weather Stocks

Power

Clock Circuits

Control and User Interface

A Real-Time DSP-Based System

Data Converter/AIC/Codec

Resolution? (bits... & ask for ENOB)

Speed? (KSPS or MSPS for high speed, kHz or MHz for precision ADCs, uS for precision DACs)

# of channels needed?

What is it interfacing to?

Clocks

Input frequencies?

Output frequencies desired & number of copies necessary

Supply voltages available/required?

Special needs? (low jitter/jitter cleaner? etc.)

Digital (MSP430/DSP/uP/FPGAASIC)

Clocking Solution

DATA TRANSMISSION

DATA TRAFFIC

STANDARDS

RS232
RS422
RS485
LVDS
1394/Firewire
USB
PCI
CAN
SONET
Gigabit Ethernet
GTL, BTL, etc.

Power

Do you build your own power solutions, use modules, or both?

What Input Voltage(s) & the source of these voltages (Wall, battery, AC/DC, etc.)

What Output Voltage(s), and Output Current(s) do you need?

How would you prioritize size, efficiency, and cost?

What are the most important parameters in the design? (efficiency, form factor, ripple voltage, tolerance, etc.)

Supply Voltage available?

Bandwidth required? (kHz or MHz)

What is the input signal?

# of channels needed?

Most Important Spec(s)?

Another system/subsystem/etc.

Interface

Speed? (k or M bits per second)

Distance?

Standard?

SERDES? –or- Topology needed? (point to point, multidrop, multipoint)

STANDARDS

RS232
RS422
RS485
LVDS
1394/Firewire
USB
PCI
CAN
SONET
Gigabit Ethernet
GTL, BTL, etc.

Analog Circuits – Considerations

OP-AMPs

• Supply Voltage available?

• Bandwidth required? (kHz or MHz)

• What is the input signal?

• # of channels needed?

• Most Important Spec(s)?
What goes around a DSP?

5-6K Analog Interface – DSP Daughter-Card

- Compatible with current C5000 and C6000 series DSK’s
  - C5416, C5510, C6416, C6711, C6713
- Interface card has connectors for flexible demos/prototyping:
  - 2 Signal Conditioning
  - 2 Serial
  - 1 Parallel Site
- Allows trial of hardware and debugging of software
- GPIO access through test points
- Flexible Clocking / Interrupts

5-6K Interface Card

Plug in analog modules for:
- Data Converters
- Signal Conditioning
- Power Management

Analog Cards

- Single-width Serial-Interface Card
- Double-wide Serial-Interface Card

http://focus.ti.com/docs/tool/toolfolder.jhtml?PartNumber=5-6KINTERFACE
What goes around a DSP?

Logic

Welcome to the World of TI Logic

Logic Families

- ABT: Advanced BiCMOS Technology
- AC/ACT: Advanced CMOS
- AHC/T: Advanced High Speed CMOS
- ALB: Advanced LV BiCMOS
- ALVC: Advanced Low Voltage CMOS
- ALVT: Advanced LV BiCMOS Technology
- AVC: Advanced Very-LV CMOS
- AUC: Advanced Ultra-LV CMOS
- BCT: BiCMOS Technology
- CBT: Cross Bar Technology
- CBTLV: CBT Low Voltage Technology
- 74F: 74F Bipolar Technology
- FCT: Fast CMOS Technology
- GTLP: Gunning Transceiver Logic Plus
- HC/T: High Speed CMOS
- LV: Low Voltage HCMOS
- LVC: Low Voltage CMOS
- LVT: Low Voltage BiCMOS Technology

Speed - max t\(pd\) (ns)

I\(OL\) Drive (mA)
What goes around a DSP?

**TI Logic Supports Voltage Migration**

![Diagram showing voltage migration and logic family functions](image)

**Little Logic**

**The Principle**

- Simplified naming
- Quick feet for ASICs

**Example**

- Single Gate
- Dual Gate
- Triple Gate

**Easy Naming from TI**

<table>
<thead>
<tr>
<th>SN74</th>
<th>LVC</th>
<th>1G</th>
<th>00</th>
<th>YEA</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN74</td>
<td>LVC</td>
<td>1G</td>
<td>00</td>
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</tr>
<tr>
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<td>1G</td>
<td>00</td>
<td>YEA</td>
<td>R</td>
</tr>
</tbody>
</table>

- Standard prefix 74 = Commercial
- Product Family
  - AHC, AHCT, LVC, CBT, AUC
- Logic Function
  - 1G - Single Gate
  - 2G – Dual Gate
  - 3G – Triple Gate
- Package Type
  - YEA = NanoStar
  - YZA = NanoFree
  - DCK = SC-70
  - DBV = SOT-23
  - DCU = US-8
  - DCT = SM-8
- Tape & Reel

**Voltages -- AHC=5V, LVC=3V, AUC=1.8V**
What goes around a DSP?

**Features**
- 1.8V optimized performance
- \( V_{CC} \) Specified @ 2.5V, 1.8, 1.5, 1.2
- 0.8V typical
- Balanced Drive
- 3.6V I/O Tolerance
- Bushold (I_{Hold})
- I_{OFF} Spec for Partial Power-down
- ESD protection
- Low noise
- Second Source agreements
- Little Logic, Widebus, Octal

**Advanced Packaging**
- NanoStar - YE
- SOT 23 - DBV (Microgate)
- SC-70 - DCK (PicoGate)
- TSSOP - PW & DGG
- TVSOP - DGV
- LFBGA - GKE & GKF
- VFBGA - GQL

---

**AUC**

*The World’s First 1.8V Logic*

<table>
<thead>
<tr>
<th>Device</th>
<th>( V_{CC} )</th>
<th>Drive</th>
<th>( T_{PD(MAX)} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN74AUC1G00</td>
<td>1.8 V</td>
<td>-8/8 mA</td>
<td>2.5 ns</td>
</tr>
<tr>
<td>SN74AUC16244</td>
<td>1.8 V</td>
<td>-8/8 mA</td>
<td>2.0 ns</td>
</tr>
</tbody>
</table>

---

**CHOOSING LOGIC**

<table>
<thead>
<tr>
<th>PRIMARY CONCERN</th>
<th>SECONDARY CONCERN</th>
<th>5V</th>
<th>3V</th>
<th>2.5V</th>
<th>1.8V</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH SPEED</td>
<td>LOW NOISE</td>
<td>ABT, 74F</td>
<td>ALVC, LVT, LVC</td>
<td>AVC, ALVC, ALVT</td>
<td>AUC</td>
</tr>
<tr>
<td>HIGH DRIVE</td>
<td>LOW NOISE</td>
<td>ABT, 74F</td>
<td>ALVC, LVT, LVC</td>
<td>AVC, ALVC, ALVT</td>
<td>AUC</td>
</tr>
<tr>
<td>LOW NOISE</td>
<td>HIGH DRIVE</td>
<td>ABT, AHC</td>
<td>ALVC, LVT, LVC</td>
<td>AVC, ALVC, ALVT</td>
<td>AUC</td>
</tr>
<tr>
<td>LOW POWER</td>
<td>HIGH DRIVE</td>
<td>ABT, 74F</td>
<td>LVT</td>
<td>AVC, ALVC, ALVT</td>
<td>AUC</td>
</tr>
<tr>
<td>LOW POWER</td>
<td>LOW NOISE</td>
<td>AHC, ABT</td>
<td>LVT</td>
<td>AVC, ALVC, ALVT</td>
<td>AUC</td>
</tr>
</tbody>
</table>

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C6000 Integration Workshop - Wrap Up 17 - 9
What goes around a DSP?
C6000 Summary

TMS320C6000

- Easy to Use
  - Best C engine to date
  - Efficient C Compiler and Assembly Optimizer
  - DSP & Image Libraries include hand-optimized code
  - eXpressDSP Toolset eases system design

- SuperComputer Performance
  - 1.38 ns instruction rate: 720x8 MIPS (1GHz sampled)
  - 2880 16-bit MMACs (5760 8-bit MMACs) at 720 MHz
  - Pipelined instruction set (maximizes MIPS)
  - Eight Execution Unit RISC Topology
  - Highly orthogonal RISC 32-bit instruction set
  - Double-precision floating-point math in hardware

- Fix and Float in the Same Family
  - C62x – Fixed Point
  - C64x – 2nd Generation Fixed Point
  - C67x – Floating Point

C6000 Roadmap

Object Code Software Compatibility

Floating Point

Multi-core C64x™ DSP

1.1 GHz

2nd Generation

C6414
C6415
C6412
C6411
C6416
DM642

1st Generation

C6201
C6202
C6203
C6204
C6205
C6211
C6701
C6711
C6712
C6713
C6712
C6414
C6411
C6415
DM642
C6416

Highest Performance
Hardware Tools

C6416 / C6713 DSK Contents

- DSK Board
- 6V Universal Power Supply
- AC Power Cord
- DSK Code Composer Studio CD ROM*
- DSK Technical Reference Guide
- USB Cable

* DSK version of CCS requires DSK to be connected or CCS cannot startup

Low-Cost Video I/F Demo Platform

(TI Kit# 6444886)

Low-cost video interface demo shows how to connect an inexpensive C6000 DSP to a video decoder through a low-cost FPGA.
**XDS560**

- eXtended Development System (XDS)
- Industry Standard Connections
  - PCI plugs into PC
  - JTAG plugs into DSP target board
- Download code up to 500Kbytes/sec
- Advanced Event Triggering for simple and complex breakpoints
- Real Time Data Exchange (RTDX) can transfer data at 2Mbytes/sec

---

**National Instruments LabVIEW**

- LabVIEW Graphical Development For Debug and Diagnostics of DSP software
- Integrate wide variety of I/O for DSP testing
- Share real time DSP data with RTDX
- Automate routine Code Composer Studio functions from LabVIEW
Hyperception’s VAB

- Easy to use graphical Tool
- Hierarchical:
  - Can write code graphically (down to ASM level instr.)
  - One worksheet can become block in another worksheet
- Block/Component Wizard:
  - You can create an optimized VAB bldg block
  - Create XDAIS algorithms
- If desired, wrap PC interface into standalone EXE
- Outputs:
  - Directly to DSP
  - Burn program to Flash with single-click
  - Create an .OUT file
  - Create Relocatable Object file (i.e. library) to use in CCS

MATLAB® CCS Plug-in

Capabilities:
- DSP program control, memory access, and real time data transfer with RTDX™
- MATLAB automates testing and provides advanced analysis
- Function call support enables hardware-in-loop simulation and debugging
- C28x™ / C5000™ / C6000™ support
- Supports XDS560™ and XDS510™
- Integrated with MATLAB design environment for a complete design solution
Altera FPGA Daughter Card

- FPGA development system fits standard DSK daughter card sockets
- Contains Altera FPGA software including power SOPC builder (shown above)
  - After designing and burning FPGA, DSP can talk to FPGA via memory-mapped addresses (SOPC creates C header file)
- For more info:

Summary of all Hardware Tools

- For a full list of tools available from TI and its 3rd Parties, please check:
  [http://dspvillage.ti.com/docs/catalog/devtools/dsptoolslist.jhtml?familyId=132&toolTypeId=6&toolTypeFlagId=2&templateId=5154&path=templatedata/cm/toolswchrt/data/c6000_devbds](http://dspvillage.ti.com/docs/catalog/devtools/dsptoolslist.jhtml?familyId=132&toolTypeId=6&toolTypeFlagId=2&templateId=5154&path=templatedata/cm/toolswchrt/data/c6000_devbds)

C6000 Integration Workshop - Wrap Up
Software Tools

Tools of the Trade

Largest DSP Third Party Network

- > 650 companies in 3rd party network
- > 1000 algorithms from
- > 100 unique 3rd parties
What’s Next?

Optimizing C Performance

◆ Attend another four-day workshop (see next slide)

◆ Review the Compiler Tutorial
  • See tutorials in CCS online help, or
  • [http://www.ti.com/sc/c6000compiler](http://www.ti.com/sc/c6000compiler)

◆ Read:
  • C6000 Programmer’s Guide (SPRU198)
  • Cache Memory User’s Guide (SPRU656)
  • C6000 Optimizing C Compiler Users Guide (SPRU187)

◆ Look through the many application notes at:
  • [http://www.dspvillage.com](http://www.dspvillage.com)

---

dsp

DSP Workshops Available from TI

◆ Attend another four-day workshop:
  • 4-day C2000 Workshops
  • 4-day C5000 Integration Workshops
  • 4-day C6000 Integration Workshop
  • 4-day C6000 Optimization Workshop
  • 4-day DSP/BIOS Workshop
  • 4-day OMAP Software Workshop
  • 1-day versions of these workshops
  • 1-day Reference Frameworks and XDAIS

◆ Sign up at:
  • [http://www.ti.com/sc/training](http://www.ti.com/sc/training)
C6000 Workshop Comparison

<table>
<thead>
<tr>
<th>Audience</th>
<th>IW6000</th>
<th>OP6000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algorithm Coding and Optimization</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>System Integration (data I/O, peripherals, real-scheduling, etc.)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>C6000 Hardware</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU Architecture &amp; Pipeline Details</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Using Peripherals (EDMA, McBSP, EMIF, HPI, XBUS)</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compiler Optimizer, Assembly Optimizer, Profiler, PBC</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CSL, Hex6x, Absolute Lister, Flashburn, BSL</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Coding &amp; System Topics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C Performance Techniques, Adv. C Runtime Environment</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Calling Assembly From C, Programming in Linear Asm</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Software Pipelining Loops</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>DSP/BIOS, Real-Time Analysis, Reference Frameworks</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Creating a Standalone System (Boot), Programming DSK Flash</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

Where To Go For More Information

www.ti.com is your starting point

- dspvillage.ti.com
  - Getting Started
  - Discussion Groups
  - DSP Knowledge Base
  - Third Party Network
  - eXpressDSP Guided Tour

- analog.ti.com
  - Design Resources
  - Technical Documents
  - Solution/Selection Guides

- Install Code Composer Studio Free Evaluation Tools (FET) from the Essential Guide to DSP CD
- Check out the DSP Selection Guide, it’s your consolidated resource for all pertinent information

Where To Go For More Information

- Sign up for Training
  - 1 day or 4 day workshops
  - 1 day DSK workshops
  - C2000, C5000, C6000
  - DSP/BIOS
  - eXpressDSP

Applications Solutions
Find complete solutions for your application including:
- DSP, Analog, Boards Target Software, Development tools, third party support
For More Information . . .

Internet
Website:  http://www.ti.com
       http://www.dspvillage.com
FAQ:  http://www-k.ext.ti.com/sc/technical_support/knowledgebase.htm
   • Device information
   • Application notes
   • Technical documentation
   • my.ti.com
   • News and events
   • Training

Enroll in Technical Training:  http://www.ti.com/sc/training

USA - Product Information Center (PIC)
Phone:  800-477-8924 or 972-644-5580
Email:  support@ti.com
   • Information and support for all TI Semiconductor products/tools
   • Submit suggestions and errata for tools, silicon and documents

European Product Information Center (EPIC)
Web:  http://www-k.ext.ti.com/sc/technical_support/pic/euro.htm

Phone:  Language Number
Belgium (English)  +32 (0)  27 45 55 32
France            +33 (0)  1 30 70 11 64
Germany           +49 (0)  8161 80 33 11
Israel (English)  1800 949 0107 (free phone)
Italy             800  79 11 37 (free phone)
Netherlands (English)  +31 (0)  546 87 95 45
Spain             +34 902 35 40 28
Sweden (English)  +46 (0)  8587 555 22
United Kingdom    +44 (0)  1604 66 33 99
Finland (English) +358 (0)  9 25 17 39 48
Fax:  All Languages  +49 (0)  8161 80 2045
Email:  epic@ti.com
   • Literature, Sample Requests and Analog EVM Ordering
   • Information, Technical and Design support for all Catalog TI Semiconductor products/tools
   • Submit suggestions and errata for tools, silicon and documents
Looking for Literature on DSP?

- “A Simple Approach to Digital Signal Processing”
  by Craig Marven and Gillian Ewers;
  ISBN 0-4711-5243-9

- “DSP Primer (Primer Series)”
  by C. Britton Rorabaugh;
  ISBN 0-0705-4004-7

- “A DSP Primer : With Applications to Digital Audio and Computer Music”

- “DSP First : A Multimedia Approach”
  James H. McClellan, Ronald W. Schafer, Mark A. Yoder;
  ISBN 0-1324-3171-8

Looking for Literature on ‘C6000 DSP?’

- “Digital Signal Processing Implementation using the TMS320C6000TM DSP Platform”
  by Naim Dahnoun; ISBN 0201-61916-4

- “C6x-Based Digital Signal Processing”
  by Nasser Kehtarnavaz and Burc Simsek;

- “DSP Applications Using C and the TMS320C6x DSK”
  by Rulph Chassaing;
  ISBN 0471207543
Before Leaving …

Let’s Go Home …

- Thank’s for your valuable time today
- Please fill out an evaluation and let us know how we could improve this class
- If you purchased a DSK:
  - Make sure you pack up (or receive) your DSK before leaving
  - If available, you may keep the earbud headphones and audio patch cable
- Workshop lab and solutions files will be available via CDROM or the Internet. Please check with your instructor.
Before Leaving …

*** yep, probably about the last blank page you’ll see this week…maybe…***