TMS320C66x multicore DSPs for high-performance computing

Delivering the industry’s most power efficient, scalable solutions for high-performance computing

Texas Instruments’ multicore DSPs are bringing new lows in power consumption to High-Performance Computing (HPC) systems. Utilizing the highest performing floating-point DSP core on the market today, TI’s TMS320C6678 and TMS320TCI6609 multicore DSPs deliver tremendous power efficiency for HPC systems. A half-length PCIe card providing >500 Giga-Floating Point Operations per Second (GFLOPS) of performance while consuming only 50 Watts of power, is available to HPC developers today, while full-length cards providing 1 and 2 teraflops of performance will be available soon. These new PCIe cards enable faster and more efficient systems for many high-performance computing applications including:

- Oil and gas exploration
- Financial modeling
- Molecular dynamics
- Supercomputing
- Fluid dynamics
- Computational chemistry
- High-performance imaging
- Weather and atmospheric modeling

Key features

- >500-GFLOPS PCIe cards available today – half-length, single-width, 50W
- Standard programming model and support for OpenMP
- Free multicore software development kit and scientific programming examples
- Optimized math and imaging libraries
- Low-cost evaluation modules available for faster development

Quad-DSPC 8681 PCIe card (half-length, single width) delivering >500 GFLOPS at 50 W
With its small size and low power consumption, the Advantech DSPC-8681 card makes a perfect add-on accelerator card for all desktop and server systems. The DSPC-8681 comes with TI’s multicore software development kit (MCSDK), Code Composer Studio™ (CCStudio) integrated development environment, and demo software to enable rapid development. In addition, a full-length, octal-DSP card will be available in early 2012.

The DSPC-8681E is powered by TI’s C6678 DSP, the industry’s highest performing multicore DSP in production today, featuring eight 1.25-GHz DSP cores and delivering 160 single-precision GFLOPS and 60 double-precision GFLOPS in just 10W.

The table below lists some important attributes and benchmarks of both the C6678 DSP as well as for the quad-DSP PCIe card. The Fast Fourier Transform (FFT) is one of the most important signal processing benchmarks in HPC. The benchmark in the table was computed using a complex data series of length 4096. Another important function which serves as the building block for many larger and more complex linear algebra functions is the Generalized Matrix Multiply (GEMM) benchmark. In the table we show the results for a single-precision GEMM (SGEMM) which was computed for real data of size 4000×4000. The measured GFLOPS (Giga-Floating Point Operations per Second) was computed by taking the theoretical operations required and dividing by the measured time of the computation.

### Key Attributes

<table>
<thead>
<tr>
<th></th>
<th>C6678</th>
<th>DSPC-8681</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-/Double-pre</td>
<td>160/60</td>
<td>512/192</td>
</tr>
<tr>
<td>precision</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLOPS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cores</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td>Processor speed</td>
<td>1.25</td>
<td>1</td>
</tr>
<tr>
<td>L2 memory (MB)</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td>L3 memory (GB) ECC</td>
<td>Up to 8</td>
<td>4</td>
</tr>
<tr>
<td>Memory BW (GB/s)</td>
<td>12.8</td>
<td>42.6</td>
</tr>
<tr>
<td>Power consumption (W)</td>
<td>10</td>
<td>50 (board power)</td>
</tr>
</tbody>
</table>

### Benchmarks (GFLOPS)

<table>
<thead>
<tr>
<th></th>
<th>C6678</th>
<th>DSPC-8681</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFT (SP) (4096 pt)</td>
<td>60</td>
<td>192</td>
</tr>
<tr>
<td>FFT GFLOPS/W</td>
<td>6</td>
<td>3.85</td>
</tr>
<tr>
<td>SGEMM (4k matrix multiply)</td>
<td>54.4</td>
<td>175</td>
</tr>
<tr>
<td>SGEMM GFLOPS/W</td>
<td>5.4</td>
<td>3.5</td>
</tr>
</tbody>
</table>

**Benchmarks**

The table below lists some important attributes and benchmarks of both the C6678 DSP as well as for the quad-DSP PCIe card. The Fast Fourier Transform (FFT) is one of the most important signal processing benchmarks in HPC. The benchmark in the table was computed using a complex data series of length 4096. Another important function which serves as the building block for many larger and more complex linear algebra functions is the Generalized Matrix Multiply (GEMM) benchmark. In the table we show the results for a single-precision GEMM (SGEMM) which was computed for real data of size 4000×4000. The measured GFLOPS (Giga-Floating Point Operations per Second) was computed by taking the theoretical operations required and dividing by the measured time of the computation.

**TMS320TCI6609**

TI’s TCI6609 DSP for high-performance computing packs the performance of the DSPC-8681 into a single die, using advanced packaging methods to provide 32 cores in a single package. This new DSP will increase the achievable computing density on a single PCIe card, achieving >2 TFLOPS at only 200W on a full-length card with four TCI6609 DSPs.
Get started today

In addition to the DSPC-8168, low-cost evaluation modules (EVMs) from TI are also available. The TMDXEVM6678L EVM includes TI’s multicore software development kit (MCSDK) and Code Composer Studio™ integrated development environment, as well as multicore computing examples to allow programmers to quickly come up to speed on the C66x DSPs right away. EVMs start at just U.S. $399.

TI’s multicore DSPs support standard programming languages such as C and OpenMP so developers can easily migrate their applications to take advantage of the power savings and performance. TI provides many optimized libraries for scientific computing that make it easier to achieve maximum performance without having to spend time optimizing code.

For additional information on TI’s multicore DSPs, software and low-cost EVMs, please visit www.ti.com/c66multicore.

For additional information on Advantech’s PCIe DSP cards, please visit www.advantech.com/products.

A comprehensive low-cost evaluation module (EVM) starting at U.S. $399 enables easier development and evaluation of TI’s C66x multicore DSPs.
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 TI.

Reproduction of TI 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. Information of third parties may be subject to additional restrictions.

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.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal and regulatory requirements concerning such use. TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

- **Products**
  - Audio: [www.ti.com/audio](http://www.ti.com/audio)
  - Amplifiers: [amplifier.ti.com](http://amplifier.ti.com)
  - Data Converters: [dataconverter.ti.com](http://dataconverter.ti.com)
  - DLP® Products: [www.dlp.com](http://www.dlp.com)
  - DSP: [dsp.ti.com](http://dsp.ti.com)
  - Clocks and Timers: [www.ti.com/clocks](http://www.ti.com/clocks)
  - Interface: [interface.ti.com](http://interface.ti.com)
  - Logic: [logic.ti.com](http://logic.ti.com)
  - Power Mgmt: [power.ti.com](http://power.ti.com)
  - Microcontrollers: [microcontroller.ti.com](http://microcontroller.ti.com)
  - RFID: [www.ti-rfid.com](http://www.ti-rfid.com)
  - OMAP Mobile Processors: [www.ti.com/omap](http://www.ti.com/omap)
  - Wireless Connectivity: [www.ti.com/wirelessconnectivity](http://www.ti.com/wirelessconnectivity)

- **Applications**
  - Communications and Telecom: [www.ti.com/communications](http://www.ti.com/communications)
  - Energy and Lighting: [www.ti.com/energy](http://www.ti.com/energy)
  - Industrial: [www.ti.com/industrial](http://www.ti.com/industrial)
  - Medical: [www.ti.com/medical](http://www.ti.com/medical)
  - Transportation and Automotive: [www.ti.com/automotive](http://www.ti.com/automotive)
  - Video and Imaging: [www.ti.com/video](http://www.ti.com/video)

**TI E2E Community Home Page** [e2e.ti.com](http://e2e.ti.com)

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

Copyright © 2011, Texas Instruments Incorporated