An Introduction to C55x Digital Signal Processors from Texas Instruments

Fixed-point DSP solutions designed for high-performance, ultra-low power applications.
C55x DSP Solutions: High Performance and Low Power

Single 50-200 MHz TMS320C55x Fixed-Point Digital Signal Processor (DSP) enables high performance and low power through increased parallelism and total focus on power savings.

Industry-leading active power enables computationally-intensive applications, such as voice triggering and encoding, to run on battery for extended period of time.

Development tools include the award-winning eXpressDSP, Code Composer Studio (CCS) Integrated Development Environment (IDE), DSP/BIOS, TI's algorithm standard, and the industry’s largest third-party network.
## C55x Product Family

- **C5545** brings the ultra-low power and optimized performance of the C55xx family to the smallest package ever offered.

- Even with the 7x7mm package, 4-layer boards are still possible without the use of high density interconnects (HDI) or other expensive fabrication techniques.

### Specifications:

<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency Options</th>
<th>Pin-to-Pin Compatible</th>
<th>Integrated Peripherals</th>
<th>On-Chip Memory</th>
<th>Co-Processor</th>
<th>Integrated Power Management</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5515</td>
<td>60/75/100/120 MHz</td>
<td>Yes</td>
<td>USB, LCD, SAR, ADC, EMIF</td>
<td>256-320KB</td>
<td>FFT</td>
<td>3 LDOs</td>
<td>10x10mm 0.65mm pitch</td>
</tr>
<tr>
<td>C5505</td>
<td>60/75/100/120/150 MHz</td>
<td>Yes</td>
<td>USB, LCD, SAR, ADC, EMIF</td>
<td>256-320KB</td>
<td>FFT</td>
<td>1-3 LDOs</td>
<td>10x10mm 0.65mm pitch</td>
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<tr>
<td>C5517</td>
<td>75/175/200 MHz</td>
<td>Yes</td>
<td>USB, UHPI, SAR, ADC, EMIF, McBSP</td>
<td>256-320KB</td>
<td>FFT</td>
<td>3 LDOs</td>
<td>10x10mm 0.65mm pitch</td>
</tr>
<tr>
<td>C553x</td>
<td>50/100 MHz</td>
<td>Yes</td>
<td>USB, LCD, SAR, ADC</td>
<td>64-320KB</td>
<td>FFT</td>
<td>1-3 LDOs</td>
<td>12x12mm 0.8mm pitch</td>
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<tr>
<td>C5545</td>
<td>60/100 MHz</td>
<td>Yes</td>
<td>USB, LCD, SAR, ADC</td>
<td>320KB</td>
<td>FFT</td>
<td>3 LDOs</td>
<td>7x7mm 0.5mm pitch</td>
</tr>
</tbody>
</table>

For more information: [www.ti.com/c55x](http://www.ti.com/c55x)
C55x Architecture

- The functional architecture presented here represents the broad set of capabilities supported across the C55x product family.
- The unique features of the C5517 functional architecture are covered later in this presentation.
- The availability of features varies depending on the device you choose.
- For more information, refer to the datasheets in the C55x product folders at [www.ti.com/c55x](http://www.ti.com/c55x).
C55x Architecture: Processing & Memory

- C55x Core: Highly optimized, pipelined engine for 16-bit DSP computations, including parallel execution of the frequently used operations such as Multiply and Accumulate.

- To prevent engine starvation, the C55xx family is designed with multiple data and address for up to four 16-bit data reads and two 16-bit data writes in a single cycle.

- The busses have access to the on-chip 320KB memory which is divided into single-access, Zero-Wait State RAM and 64KB of dual-access RAM that performs two accesses per cycle.

- Similarly, the 128KB of ROM is single-access containing bootloader code, FFT coprocessor routines, and useful constants, giving the application more available memory.

* Availability of features varies by device. Refer to the data sheet. For more information: www.ti.com/c55x
The core and memory is connected to the rest of the system through a switched central resource and DMA which allows for parallel, behind the scenes data transfer.

On-chip LDOs save BOM cost and offer integrated power-on-reset monitoring and RTC-only functionality.

With the hardware accelerator, FFT conversions up to 1024 points are 4 to 6 times more energy efficient and compute 2.2 to 3.8 times faster than when performed on the already optimized core.

Real-time clock supports RTC-only mode for 169 microwatt consumption.

Many combinations of peripherals available through pin muxing enable you to tailor fit to any application.

* Availability of features varies by device. Refer to the data sheet.

For more information: www.ti.com/c55x
C55x Architecture: Peripherals

- Data gets passed to the DSP through many serial peripherals.
- I²S handles streaming audio from CODECs or ADC/DAC.
- SPI, eMMC/SD, UART, and I²C handle bootloading, storing data, or communicating with other processors.
- The ultra-low-power C55 makes a great bus-powered USB device for communication to a host.
- USB is also a common way to charge up the battery.
- C5505/15 and C5517 devices come equipped with an EMIF to communicate with off-chip, parallel memories like NOR, NAND, SRAM, and SDRAM or FPGAs.

* Availability of features varies by device. Refer to the data sheet.

For more information: www.ti.com/c55x
C5517 Architecture

The software-compatible C5517:

- Boosts processing performance to 200 MHz (400 MMACs per sec)
- Supports additional peripherals:
  - 16-bit UHPI
  - McBSP
  - McSPI
- Provides a faster bootloader

196-pin, 0.65mm package

For more information: www.ti.com/c55x
C55x Software Support

• **C55x Chip Support Library (CSL)**
  - Standard
  - Low Power

• **C55x DSP Library (DSPLIB)**

• **Code Composer Studio (CCS)**
  Integrated Development Environment (IDE)

• C55x DSP Software Overview
C55x Development Tools

C5535 eZdsp:  http://www.ti.com/tool/TMDX5535EZDSP

C5517 EVM :  http://www.ti.com/tool/tmdsevm5517

C5545 BoosterPack: Coming Soon
For More Information

- C55x Product Folder: http://www.ti.com/c55x
- C55x CSL: http://www.ti.com/tool/sprc133
- C55x DSP Library (DSPLIB): http://www.ti.com/tool/sprc100
- C55x Tools with programmer, boot image creator, board support package, gel file, schematics, BOM, etc.:
  - C5505 eZdsp: http://www.ti.com/tool/tmdx5505ezdsp
  - C5515 EVM: http://www.ti.com/tool/tmdxevm5515
  - C5535 eZdsp: http://www.ti.com/tool/TMDX5535EZDSP
  - C5517 EVM: http://www.ti.com/tool/tmdsevm5517
- C55x DSP Training Series: http://c55x-dsp-training-series
- For questions regarding topics covered in this training, visit the support forums at the TI E2E Community website: http://e2e.ti.com