Introduction to ARM Cortex-M4 Architecture

Cortex M4 Highly efficient 1

Cortex M4 Highly efficient 2

The Cortex™-M4 is 2X more efficient on most DSP tasks than leading 16 and 32 bit MCU devices with DSP extensions

Cortex™-M4 Single Cycle MAC

Cortex™-M4 SIMD arithmetic

SIMD(Single instruction Multiple data) Operations

SIMD extensions perform multiple operations in one cycle

$\text{Sum} = \text{Sum} + (A \times C) + (B \times D)$
DSP Example: Cortex™-M4 FIR

Cortex™-M4 Floating Point Unit

- Single-precision floating point math
  - Add, subtract, multiply, divide, MAC and square root
  - Fused MAC

<table>
<thead>
<tr>
<th>OPERATION</th>
<th>CYCLE COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add/Subtract</td>
<td>3</td>
</tr>
<tr>
<td>Divide</td>
<td>34</td>
</tr>
<tr>
<td>Multiply</td>
<td>1</td>
</tr>
<tr>
<td>Multiply Accumulate (MAC)</td>
<td>3</td>
</tr>
<tr>
<td>Fused MAC</td>
<td>3</td>
</tr>
<tr>
<td>Square Root</td>
<td>34</td>
</tr>
</tbody>
</table>

Cortex™-M4 Single Precision Floating Point

- Floating point benefits
  - Extended range, highly accurate measurements
- Cortex™-M4 FPU
  - IEEE 754 standard compliant
  - Single-precision floating point math
- Graph below shows Cortex™-M4 single precision floating point algorithm performance normalized to “Without FPU”

Kinetis Cortex-M4 Core Enhancements

- Up to 32-channel DMA
  - Reduced CPU loading
  - Faster system throughput
- Cross bar switch
  - Concurrent multi-master bus accesses
- Up to 8KB of instruction and 8KB of data cache
  - Optimized bus bandwidth and flash execution performance
- Independent flash banks
  - Concurrent code execution and firmware updating
  - No performance degradation or complex coding routines

K70 Block Diagram

Kinetis Bus Structure
Cross Bar Switch Configuration

- Symmetric crossbar bus switch implementation
- Allows concurrent access from different masters to different slaves
- Slave arbitration utilizes configured on a slave by slave basis
- 32-bit wide and supports byte, 2-byte, 4-byte, and 16-byte burst transfers
- Operates at a 1-to-1 clock frequency with the bus masters

XBS Example