The JPEG-E megafuction is a standalone and high-performance JPEG encoder for still image and video compression applications.

One of the fastest available JPEG encoders, the JPEG-E can encode at Full HD (1080p60) video, even in Cyclone-V devices and 4K (1096x1724@25) video in Stratix-V devices. Full compliance with the Baseline Sequential DCT mode of the ISO/IEC 10918-1 JPEG standard makes the JPEG-E megafuction ideal for interoperable systems and devices. In addition to generating standalone Baseline JPEG streams, the megafuction is also capable of producing the (de facto) standard video payload of many motion JPEG container formats. The JPEG-E can also be enhanced with an optional add-on bit-rate control block, which will benefit the bandwidth constraint applications.

Evaluation designs show that the megafuction fits in a variety of Altera devices, requiring, for example, approximately 5,800 slices for a Cyclone-IV implementation. Its heavily optimized architecture enables a very high performance, reaching processing rates of up to 400 MSamples/sec in a Stratix-V device.

The megafuction is designed with easy to use, fully controllable and FIFO-like, Avalon Streaming input and output interfaces. Being carefully designed, rigorously verified and production-proven, the JPEG-E is a reliable and easy to integrate megafuction. Its deliverables include a complete verification environment and a bit-accurate software model.

Applications

The JPEG-E megafuction is suitable for implementing a variety of digital imaging applications, including:

- Digital cameras and camcorders
- Office automation equipment (multi-function printers, scanners, etc)
- Medical imaging systems
- Video conference systems
- Surveillance systems

Block Diagram
Functional Description

The JPEG-E is configured by feeding it with JPEG headers, which contain table specification data, image format definitions and encoding options. The megafunction's configuration can be optionally modified after the encoding of one or more frames. The image samples, in any color space, are input to the JPEG-E in an MCU block scan order.

Consuming a single clock cycle per input image sample, the JPEG-E can address the most demanding image and video compression applications. The JPEG-E outputs a complete JPEG-compliant data stream, including JPEG headers, the size of which can be dynamically controlled when the optional rate-control block is utilized.

Implementation Results

JPEG-E reference designs have been evaluated in a variety of technologies. The following Altera results are obtained after speed optimization during synthesis and place and route, while assuming that all megafunction I/Os are routed off-chip.

<table>
<thead>
<tr>
<th>Altera Device</th>
<th>Logic</th>
<th>Fmax (MHz)</th>
<th>Special Features</th>
<th>Quartus Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclone-III EP3C10-6</td>
<td>5,858 LEs</td>
<td>170</td>
<td>7 M9K 18 DSP 9-bit</td>
<td>9.1</td>
</tr>
<tr>
<td>Cyclone-IV EP4CGX22-6</td>
<td>5,792 LEs</td>
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<td>7 M9K 19 DSP 9-bit</td>
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<tr>
<td>Stratix-II EP2S15-3</td>
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<td>7 M9K 15 DSP 18-bit</td>
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<tr>
<td>Cyclone-V 5CGXFC7-6</td>
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<td>7 M10K 11 DSP blocks</td>
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<td>7 M20K 11 DSP blocks</td>
<td>11.1</td>
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</tbody>
</table>

Support

The megafunction as delivered is warranted against defects for ninety days from purchase. Thirty days of phone and email technical support are included, starting with the first interaction. Additional maintenance and support options are available.

Verification

The megafunction has been verified through extensive synthesis, place and route and simulation runs. It has also been embedded in several products, and is proven in both ASIC and FPGA technologies.

Deliverables

The megafunction is available in ASIC (synthesizable HDL) and FPGA (netlist) forms, and includes everything required for successful implementation. The Altera version includes:

- Post-synthesis VQM or QXP netlist
- Sophisticated self-checking Testbench (Verilog versions use Verilog 2001)
- Software (C++) Bit-Accurate Model and test vector generator
- Simulation scripts, test vectors and expected results
- Place and route scripts
- Comprehensive user documentation, including detailed specifications and a system integration guide

Related Meafunctions

- JPEG-E-X Baseline/Extended Sequential JPEG Encoder – adds support for 12 bits per sample
- SVE-JPEG-E SpeedView Enabled JPEG Encoder that produces SpeedView enabled JPEG data streams.
- CMMI-JPEG Multimedia Interface – adds an AHB interface to the JPEG-E core.