

CAST

ALTERA

JPEG-C

Baseline JPEG Codec Megafunction

The JPEG-C megafunction is a standalone and high-performance, half-duplex, JPEG codec for still image and video compression applications.

One of the fastest available JPEG codecs, the JPEG-C can operate at Full HD (1080p30) or higher rates, even in low cost Cyclone-III devices. Full compliance with the Baseline Sequential DCT mode of the ISO/IEC 10918-1 JPEG standard makes the JPEG-C megafunction ideal for interoperable systems and devices. In addition to the standard Baseline JPEG streams, the megafunction is also capable of supporting the video payload of many (de facto) standard motion JPEG container formats. The JPEG-C 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 megafunction fits in a variety of Altera devices, requiring, for example, approximately 10,200 LEs for a Cyclone-III implementation. Its heavily optimized architecture enables a very high performance, reaching processing rates of up to 134 MSamples/sec in a Stratix-II device.

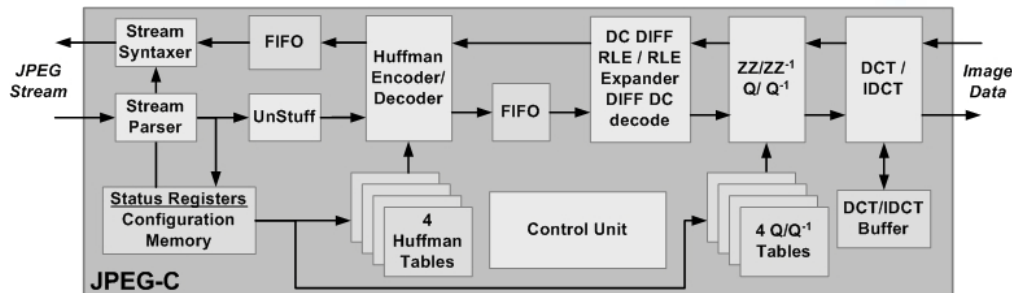
The megafunction is designed with easy to use, fully controllable and FIFO-like, streaming input and output interfaces. Being carefully designed, rigorously verified and production-proven, the JPEG-C is a reliable and easy to integrate megafunction. Its deliverables include a complete verification environment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

Applications

The JPEG-C megafunction 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



Features

JPEG Compliance

- Programmable Huffman Tables (two DC, two AC)
- Programmable quantization tables (up to four)
- Up to four color components
- Supports all possible scan configurations and all JPEG formats for input and output data
- Supports any image size up to 64K x 64K
- Supports DNL and restart markers

Additional Processing Capabilities

- Motion JPEG payload support
- Rate-Control (optional)

Designed for Easy Integration

- Standalone operation
- Simple and zero latency streaming interfaces
- Encoding Mode
 - Single clock per input sample processing rate
 - Fully programmable through standard JPEG marker segments
 - Automatic JPEG markers generation on the output
 - Automatic program-once encode-many operation
- Decoding Mode
 - Automatic self-programming by JPEG markers parsing
 - Marker errors catching
 - Broadcasting of decoded image parameters for controlling peripherals such as a block-to-raster scan converter

Designed for High Quality

- Robust verification environment includes bit-accurate software model
- ASIC and FPGA proven in multiple designs
- Easily fits most Altera device families (see implementation results table)

Functional Description

In the encoding mode the JPEG-C 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 then input to the JPEG-C in an MCU block scan order.

Consuming a single clock cycle per input image sample, the JPEG-C can address the most demanding image and video compression applications. The JPEG-C 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.

The decoding path is fully self-configured by parsing the marker segments that are present in the input Baseline JPEG stream. The megafunction checks also the input JPEG marker segments against errors and signals in case it detects any. The decoded image parameters are made available for controlling peripherals such as a block-to-raster scan converter.

Following the parsing of the marker segments, the JPEG-C decodes the entropy coded data segment(s) and outputs the decoded image samples in their native MCU block scan order. Designed for continuous data flow, the JPEG-C can address the most demanding image and video decompression applications.

Implementation Results

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

Altera Device	Logic	Fmax (MHz)	Special Features
Cyclone EP1C20-6	15,305 LEs	86 MHz	12 M4K
Cyclone-II EP2C20-6	12,986 LEs	85 MHz	12 M4K 37 DSP
Cyclone-III EP3C10-6	10,154 LEs	120 MHz	9 M9K 36 DSP 9-bit
Stratix-II EP2S30-3	11,015 ALUTs	134 MHz	11 M4K / 1 M512 36 DSP
Hardcopy-II HC210	97,873 HCELLs	192 MHz	12 M4K 36 DSP

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 Megafunctions

- CMMI-JPEG Multimedia Interface – adds an AHB interface to the JPEG-C megafunction.