

CAST

ALTERA

JPEG-C

Baseline JPEG Codec Megafunction

Features

Baseline ISO/IEC 10918-1 JPEG Compliance

- Programmable Huffman Tables (two DC, two AC) and
- Programmable quantization tables (four)
- Up to 4 color components (optionally extendable to 255 components)
- Supports all possible scan configurations and all JPEG formats for input/output data
- Any image size up to 64k x 64k
- Supports DNL and restart markers

Additional Image Processing Capabilities

- Motion JPEG encoding/decoding
- Rate-Control (optional)
- Decompressing at various resolution via downscaling in the frequency domain (optional)

Designed for Easy Integration

- Encoding Mode
 - Single clock per input sample
 - Fully programmable through standard JPEG stream marker segments
 - Automatic headers generation
 - Automatic program-once encode-many operation
- Decoding Mode
 - Stand-alone operation
 - Automatic self-programming by JPEG stream headers parsing
 - Header errors catching
 - Broadcasting of decoded image parameters for controlling peripherals such as a raster to block converter

Designed for High Quality

- Robust verification environment includes bit-accurate software model
- ASIC and FPGA proven in multiple designs
- Scan-ready design architecture

Implements a high-performance, half-duplex image or video encoder/decoder (codec) that complies with the baseline ISO/IEC 10918-1 JPEG standard.

One of the fastest available JPEG megafunctions, the JPEG-C provides a high-performance solution for a variety of image and video decompression applications. It can, for example, encode or decode over 30 frames/sec of 4:3 HDTV, 1440x1152, 4:2:0.

In addition to processing baseline JPEG streams, the megafunction can compress or decompress non-standard motion JPEG streams. It also has two options. Encoding can be enhanced with an optional add-on bit-rate control block, which may benefit applications that have tight bandwidth constraints. Decoding may be enhanced with an optional IDCT block that enables down-scaling in the frequency domain, a feature that allows decompression at various resolutions from the same compressed stream.

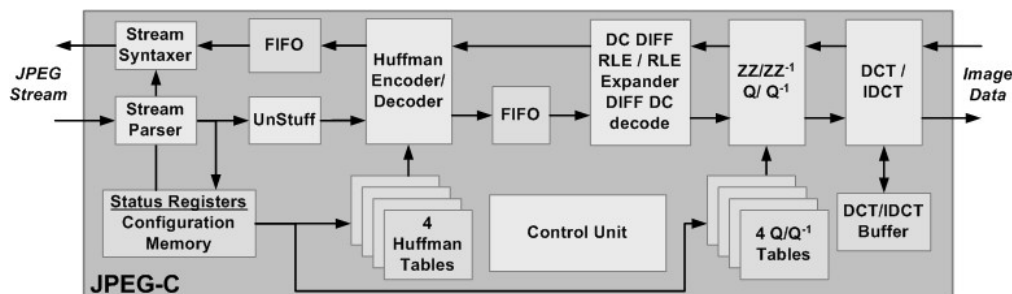
The megafunction includes FIFO-like pixel and stream input/output interfaces, and other standard interfaces (e.g. AMBA) are also available. The megafunction is designed for reliability and ease of integration, and has been proven in a number of ASIC and FPGA designs. The deliverables include a software bit-accurate model that facilitates system-on-chip verification.

Applications

The JPEG-C can be utilized for a variety of multimedia applications including:

- Office automation equipment (Multifunction printers, scanners, digital copiers etc)
- Digital cameras & camcorders
- Video production, video conference
- Display-projection systems
- Surveillance systems

Block Diagram



Functional Description

For encoding, the JPEG-C is automatically configured by feeding it with JPEG headers, which contain table specification, image format, and encoding options data. The megafunction's configuration can be modified after the encoding of one or multiple frames. Image samples in any color space format are input to the JPEG-C in a MCU block by MCU block, raster scan order.

Consuming a single clock cycle per image sample while encoding, the JPEG-C can address the most demanding frame-based video compression applications. The JPEG-C outputs a complete JPEG-compliant data stream, including JPEG headers, the size of which can be dynamically controlled if the optional rate-control block is used.

The JPEG-C's decoding path is highly autonomous, since it is self-configured (with table, image format and encoding options) by parsing the incoming JPEG stream's headers. The megafunction parses and checks all JPEG marker segments and signals in case it detects an error. Decoded image parameters are made available for controlling peripherals such as a block-to-raster converter.

Designed for continuous data flow decoding, the JPEG-C can address the most demanding frame-based video decompression applications. Optional decoding at various resolutions from the same JPEG data-stream without the need for any extra buffering is enabled when the IDCT block is configured during synthesis to support downscaling in the frequency domain.

Implementation Results

JPEG-C 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.

Altera Device	Logic	Frequency	Special Features
Apex 20KE EP20K400E-1	15,548 LEs	56 MHz	34 ESB
Apex-II EP2A15-C7	15,810 LEs	69 MHz	22 ESB
Stratix EP1S10-C5	11,629 LEs	95 MHz	11 M4K / 1 M512 36 DSP
Cyclone EP1C20-C6	15,305 LEs	86 MHz	12 M4K
Cyclone-II EP2C20-C6	12,986 LEs	85 MHz	12 M4K 37 DSP
Stratix-II EP2S30-C3	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 simulation and rigorous code coverage measurements. Being embedded in numerous of products, the megafunction is silicon proven in both FPGA and ASIC 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 EDIF netlist
- Sophisticated self-checking Testbench (Verilog versions use Verilog 2001)
- Simulation script, vectors, expected results, and comparison utility
- Place and route script
- Comprehensive user documentation, including detailed specifications and a system integration guide
- Software (C++) Bit-Accurate Model