UHT-JPEG-E
Ultra High Throughput JPEG Encoder Megafunction

Implements an advanced 8-bit Baseline and 12-bit Extended Sequential DCT JPEG encoder, compliant to the ITU T.81 and ISO/IEC 10918-1 standards. Featuring a scalable architecture able to process up to 32 samples per clock cycle, the UHT-JPEG-E megafunction is designed to enable ultra high frame rate SD and HD encoding, and Ultra HD (4K/8K and beyond) video encoding, even in low-end ASIC or FPGA silicon.

The encoder megafunction is able to process all popular input formats, and it outputs complete JPEG byte streams, which are decodable by any standard-compliant decoder and suitable as JPEG payload in Motion-JPEG streams. The UHT-JPEG-E allows regulation of either the JPEG's quality factor, or the output stream bit-rate. Under the Constant Bit Rate (CBR) mode of operation, the megafunction is suitable for a wide range of video streaming applications; it allows real-time control over the compression ratio as well as the end-to-end latency, via regulation of the transmission of buffer size.

The UHT-JPEG-E is easy to use and integrate. It requires minimal host intervention, as it only needs to be programmed once per video sequence. Once programmed, it can encode an arbitrary number of video frames without the need of any further intervention or assistance by the host system CPU. Streaming interfaces for the pixel and compressed stream data, a microprocessor-like interface to its registers, and optional AMBA AHB or AXI bus wrappers ease the SoC integration. Even more importantly the low-bandwidth external memory interface is independent of the memory type and can work with on-chip SRAMs or off-chip DDR memories, and is tolerant to latencies, which makes it suitable for share-memory architectures.

The UHT-JPEG-E has been designed for reuse, following proven practices that ensure trouble free implementation, technology mapping and verification. The megafunction is available in RTL source code or as a targeted FPGA netlist.

Applications
The minimal silicon and memory resources make the Ultra-High Throughput JPEG encoder ideal for high-frame rate ED or HD, or Ultra-HD and Beyond UHD video compression, in a variety of applications including: professional cameras, office automation equipment, medical/industrial/scientific imaging, surveillance and video conferencing.

Block Diagram

Features

Baseline & Extended JPEG Compliance
- 4:1:4, 4:2:2, 4:2:0 and 4:0:0
- 8, 10 or 12 bits per color
- Image size up to 64k x 64k
- Motion JPEG payload encoding

Ultra-High Throughput & Small Silicon Footprint
- Scalable throughput up to 32 samples per clock cycle
- Ultra-high frame rate SD & HD, and Ultra HD even in low-end silicon.
  - 500 MSamples/sec with just 30KLEs and more than 2 GSamples/sec feasible on Cyclone V

Low Processing Latency
- 16 or 32 video lines depending on sampling format

Compression Modes
- Constant Quality Factor (CQP) – Variable Bit-rate (VBR) encoding mode
  - Programmable quantization Quality Factor (1 to 100)
- Constant Bit Rate (CBR) video encoding mode
  - Motion JPEG video oriented rate control option with programmable nominal output frame size and transmission buffer size
  - On-the-fly nominal output frame size changes

Easy Integration
- CPU-less, standalone operation
- Simple, microcontroller like, status/control interface
- Streaming capable pixel and compressed data interfaces
- Optional AMBA-AHB or AXI wrappers
- Receives raster image data, and outputs complete JPEG streams
- Flexible external memory interface, independent of external memory type and tolerant to latencies
- High quality deliverables, including bit-accurate model, shelf-checking testbench and extensive documentation

Trouble-Free Technology Mapping
- Portable HDL source code
- Scan-ready design
- No need for specially constrained timing paths
- Safe CDC transfers