ZR36050

PRODUCT BRIEF

JPEG IMAGE COMPRESSION PROCESSOR

FEATURES

- Low cost JPEG Baseline image compression / expansion
  - Discrete Cosine Transform (DCT) and inverse (IDCT)
  - Quantization / dequantization
  - Variable length coding / decoding
- Full support of the JPEG Baseline standard, including:
  - Bit and byte stuffing
  - JPEG markers including restart (RST), application (APP), and comment (COM)
- JPEG Lossless compression / expansion
- 29.5, 27 and 21 MByte/sec versions available
- Real-time compression/expansion of CCIR 601 video
  - up to 720 x 480, 30 frames/sec or 720x756, 25 frames/sec
- Interfaces directly to other Zoran JPEG family products:
  - ZR36015 Raster-to-Block Converter
  - ZR36011 Color Space Converter
  - ZR36016 Integrated Color Space/Raster-to-Block Converter
  - ZR36055 Motion JPEG Controller
- Bit rate control feature
  - Guarantees predetermined compressed file size
- Fast Preview feature
  - Enables preview of “thumbnail” version of images
- Standby mode for very low power consumption
- 100-pin plastic quad flat pack (PQFP) packaging

APPLICATIONS

- Computer and multimedia add-in boards
- Motion JPEG CCIR 601 video compression / expansion
- Color printers, scanners, copiers and FAX machines
- Digital still cameras and peripherals
- Videophones and teleconferencing
- Security systems
- Industrial systems
- Medical imaging systems

DESCRIPTION

The ZR36050 is a high speed JPEG Image Compression Processor that performs the algorithm specified by the JPEG Baseline and JPEG Lossless standards for high quality image compression and expansion of continuous-tone color or monochrome images. The ZR36050 is designed to interface directly other members of the Zoran JPEG product family together providing a low cost, total solution for still and motion video image compression. A functional block diagram of the ZR36050 is shown in Figure 1.

The ZR36050 executes the JPEG Baseline encoding operation by first performing a 2-D Discrete Cosine Transform (DCT) operation on 8 x 8 blocks of image data, converting the image data into its spatial frequency components. It then quantizes these coefficients according to a user defined “quantization” table, which quantizes the high frequency coefficients more coarsely than the low frequency coefficients. (The human visual system is less sensitive to higher spatial frequencies, therefore, the high frequency coefficients can be quantized more coarsely than the low frequency coefficients with negligible effect on image quality.) Due to the coarser quantization of the high-frequency coefficients, the result is long strings of zero valued coefficients. These quantized coefficients are then scanned in zig-zag order and characterized in terms of their nonzero values and zero run lengths. Finally, the ZR36050 performs Huffman coding accord-

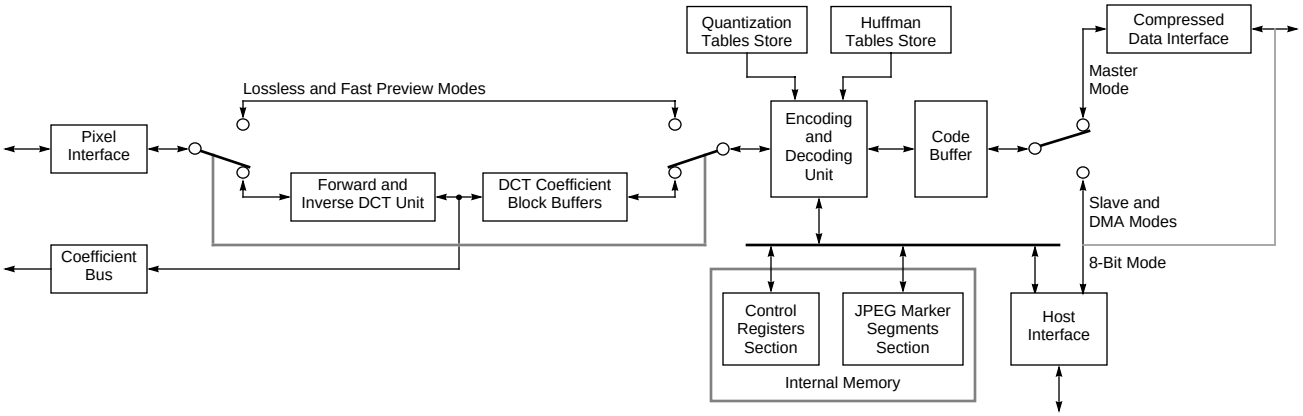

Figure 1. ZR36050 Functional Block Diagram

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ing to user-defined Huffman tables, whereby variable length bit patterns code the nonzero values (values that occur frequently use the shortest codes). Together, these techniques greatly reduce the amount of memory needed to store an image.

The ZR36050 executes the JPEG Baseline decoding operation by performing Huffman decoding, inverse zigzag modified-run-length-coding, dequantization and an inverse 2-D DCT, resulting in an expanded image.

FULL JPEG BASELINE SUPPORT

The ZR36050 JPEG Image Processor fully implements the JPEG Baseline Standard. Bit stuffing, byte stuffing and all JPEG markers including the restart (RST), application (APP), and comment (COM)are supported. No additional hardware or host intervention is required. As JPEG files become more common, JPEG compatibility becomes an increasingly important feature.

BIT RATE CONTROL FEATURE

The ZR36050 has the unique ability to perform bit rate control, i.e., the ability to preset the size of each individual compressed image file. Without this mechanism, the size of a JPEG compressed image is highly data dependent for a given set of quantization tables (images with fine detail generate considerably larger files than files generated from smooth images). The ability to perform bit rate control is critical for applications where predictable file size for compressed images is required, or where communications bandwidth is strictly limited. For example, if a PC multimedia add-in board does not employ a bit rate control mechanism, peaks in the data rate may exceed the PC bus/disk drive throughput. To prevent a system failure, frames may have to be dropped or every video frame may require inordinately high compression to insure that the maximum data rate never exceeds the throughput. PC multimedia add-in boards employing the ZR36050 bit rate control feature guarantee the size of each individual compressed frame (while optimizing image quality), thereby ensuring that the PC bus/disk throughput is never exceeded. The result is superior image quality and system reliability.

FAST PREVIEW FEATURE

The ZR36050 has the ability to generate a “thumbnail” version of an image directly from the JPEG Baseline compressed data. This thumbnail image is 1/64 the area of the full size image and is generated up to 25 times faster than full image expansion requires. This feature is particularly useful for systems in which previewing large databases of images is desired.

JPEG LOSSLESS SUPPORT

The ZR36050 supports a subset of the JPEG Lossless standard. The ZR36050 executes the JPEG Lossless algorithm by performing one dimensional differential prediction followed by variable-length encoding for compression. The corresponding inverse operation is executed for expansion. JPEG Lossless image compression/expansion is required for applications such as medical imaging for which absolutely no loss of data can be tolerated.

LOW SYSTEM COST

The ZR36050 operates as a dedicated processor requiring only minimal host intervention. The host processor controls the operation of the device by writing parameter values into the ZR36050 internal memory. Once initialized, the ZR36050 operates continuously until it has completed the compression or expansion of an image.

ZORAN JPEG PRODUCT FAMILY

The **ZR36050 JPEG Image Processor** is the central component of the Zoran JPEG family of products. Other components in the Zoran JPEG family are designed to interface directly to the ZR36050. In different combinations, these devices provide a cost effective solution for a variety of high performance Motion JPEG and still JPEG image compression applications. The other members of the Zoran JPEG family of products include the following:

The **ZR36015 Raster-to-Block Converter**, a bi-directional device which formats image data into the 8x8 pixels blocks as required by the JPEG algorithm for compression. Similarly, for expansion, the ZR36015 format the 8x8 pixel block generated by JPEG expansion into raster data ready for display. The ZR36015 operates at 15 megapixels/sec for color images and 30 megapixels/sec for monochrome images. The ZR36015 is available in a 100-pin PQFP package.

The **ZR36011 Color Space Converter**, which performs bi-directional conversion between RGB <--> YCrCb color spaces and CMY <--> YCrCb color spaces. 4:2:2 and 4:1:1 data formats are supported by both devices. The ZR36011 operates at 15 Mpixels/sec and is available in a 100-pin PQFP package.

The **ZR36016 Integrated Color Space/Raster-to-Block Converter**, which combines the functionality of the ZR36011 and ZR36015 into a single-pin PQFP package.

The **ZR36055 Motion JPEG Controller**, which operates in conjunction with the ZR36050 JPEG Image Processor for performing Motion JPEG image compression on the PC. The ZR36055 provides control of the pixel buffer, compressed code buffer, video decoder, video encoder, and overlay/scaler devices. It also provides raster-to-block conversion and an interface to the ISA bus. The ZR36055 is available in a 160-pin PQFP package.

Zoran is the leading supplier of high performance, cost effective solutions for JPEG image compression and will continue to introduce new products to serve the JPEG market.

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