

# LM9704 Real Time Digital Image Processor

## General Description

The LM9704 contains all functions needed to build an SXGA or VGA digital still and video camera. It incorporates a 16 bit RISC microprocessor, a flexible image processing pipeline, hardware JPEG compression, and the required peripheral modules in a single IC. This architecture allows a very fast click-to-click time and full resolution video without sacrificing image quality or cost; because the computation extensive operations are processed by circuitry dedicated to image processing. The highly optimized memory management provided by the LM9704 keeps the memory cost of the complete camera to a minimum.

A chip set comprising of the LM9704 and a National SXGA or VGA CMOS image sensor complemented by a lens, battery, compact flash, power management for the battery, and LCD (optional) yields a complete high performance cost effective digital still and/or video camera.

## Features

- Embedded 16 bit RISC processor system
  - Up to 16M-bytes of external memory addressing space
  - 32K-bytes Internal RAM
  - 6 channel DMA
  - 8 channel versatile timer
  - Interrupt controller
  - 16 input wake up module
  - Full duplex USART
  - $\infty$ wire/SPI serial port
  - 16 general purpose IOs (GPIO)
- Glueless CMOS image sensor interface
- ACCESS.bus serial interface for imager sensor control
- Integrated USB v1.1 for connection to PC
- Raw Image Data Processor
  - Defective pixel correction
  - Digital gain and brightness adjustment
  - Raw data statistics measurement engine
- Color Image processing
  - Bayer to RGB Interpolation
  - Fully programmable color correction
  - Image sharpening
  - Programmable gamma correction
  - Thumbnail generation
  - RGB to YCrCb conversion
  - Digital gain
- Hardware JPEG Compression for both video and snapshot.
- System management
  - Internal Clock generation from 12MHz Crystal
  - Power management
  - Reset generation
- JTAG based serial on-chip debug interface

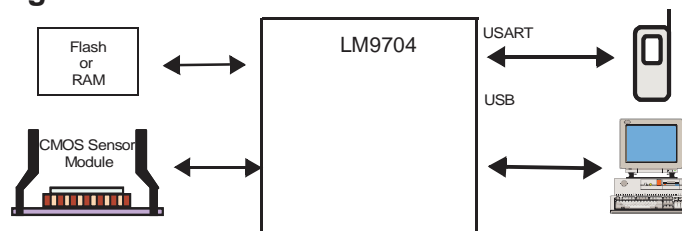
## Applications

- PC Cameras
- Dual Mode Cameras
- Digital Still Cameras
- Clip-on Cameras for PDA's, Cell Phones, etc.
- Embedded Cameras for PDA's, Cell Phones, etc.
- Industrial Cameras

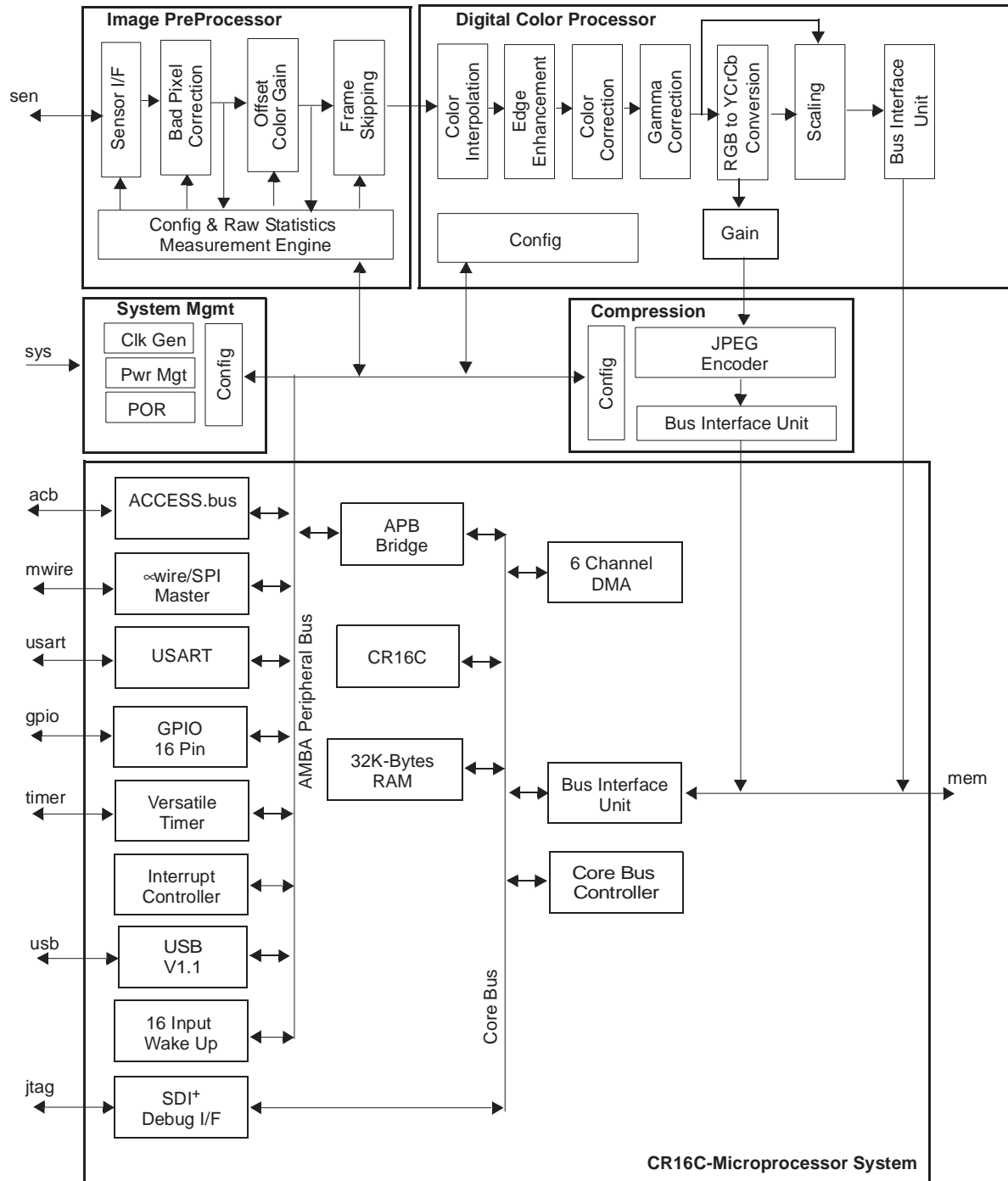
## Key Specifications

Array Formats	CIF, VGA, SXGA
Input Color Format	Bayer Pattern
Digital Image Processor	10 bit (12 bit internal)
Compression <ul style="list-style-type: none"> <li>- Format</li> <li>- Ratio</li> </ul>	Base Line JPEG Programmable
Video In Frame Rate	up to 15MHz pixel clock
Video Outputs <ul style="list-style-type: none"> <li>- USART</li> <li>- USB</li> </ul>	up to 921.6K-bits per second 960K-byte/s
External CR16C Memory <ul style="list-style-type: none"> <li>- Memory Type</li> <li>- Address Space</li> <li>- Speed</li> </ul>	SRAM, Flash, Compact Flash, EEPROM up to 16 Mbyte up to 36MHz
Serial Interfaces <ul style="list-style-type: none"> <li>- ACCESS.bus</li> <li>- <math>\infty</math>wire/SPI</li> </ul>	up to 400KHz up to 6.0 MHz
16 bit RISC Processor <ul style="list-style-type: none"> <li>- MIPS</li> <li>- Internal Memory</li> </ul>	up to 36 32K-bytes
Clock Speed	up to 60 Mhz from 12MHz Crystal
Power Supply <ul style="list-style-type: none"> <li>- Core</li> <li>- IO</li> </ul>	2.25 to 2.75 Volt 2.7 to 3.6 Volt
Average Power Dissipation	95mW
Package	128 Pin Laminated CSP
Operating temperature	-10°C to +85°C

## System Block Diagram



# Overall Chip Block Diagram



Chip Block Diagram  
Figure 1.

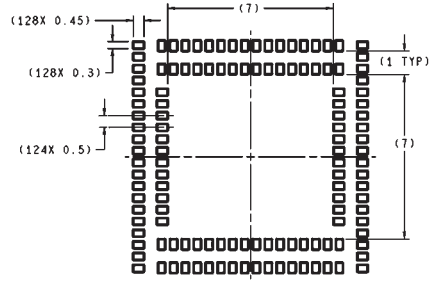
## Ordering Information

Item	Description	Part Number
LM9704	LM9704 Real Time Digital Image Processor	LM9704SL

## Related Products

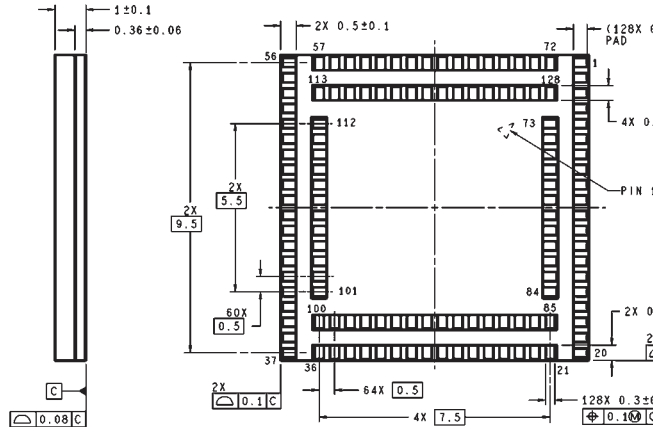
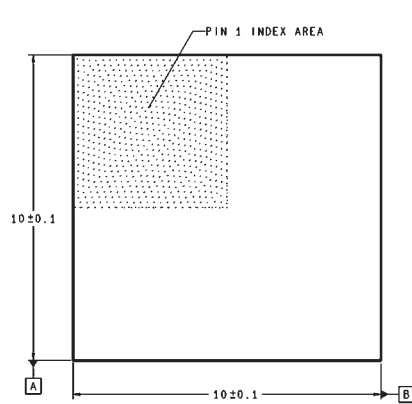
Item	Description	Part Number
Development Kit	LM9704 digital image processor camera development kit. This kit includes the above mentioned camera base board, a power supply board, status LCD board, power adapter, windows application software SNAPS DEV.	LM9704DEV-KIT
Camera Board	LM9704/02 digital image processor camera base board.	LM9704CAMBOARD LM9702CAMBOARD
Software Development Kit	This kit includes CR16C software development tools, National's Camera Operating System (NCOS) & an iTAG emulator.	CR16-IM04-00
Compact-Flash Adaptor	This is a small 16 bit CompactFlash adaptor board that can be attached to the LM9704CamBoard/LM9702CamBoard allowing CompactFlash cards to be connected to the main system memory bus	LM97COMPACFLASH
SD/MMC Adaptor	This is a small SD/MMC adaptor board that can be attached to the LM9704CamBoard/LM9702CamBoard allowing SD and MMC cards to be connected to the LM9702/LM9704 digital image processor	LM97SDCARD
Head Boards	VGA color sensor LM9627 VGA monochrome sensor LM9617 VGA color sensor LM9628 VGA monochrome sensor LM9618 128x100 monochrome sensor LM9630 VGA monochrome sensor LM9637 VGA color sensor LM9647 SXGA monochrome sensor LM9638 SXGA color sensor LM9648	LM9627HEADBOARD LM9617HEADBOARD LM9628HEADBOARD LM9618HEADBOARD LM9630HEADBOARD LM9637HEADBOARD LM9647HEADBOARD LM9638HEADBOARD LM9648HEADBOARD
Lens Kits	1/3" lens kit for the LM9627, LM9617, LM9628 or LM9618 1/5" lens kit for the LM9630 1/4" lens kit for the LM9647, LM9637 1/2" lens kit for the LM9648, LM9638	LM96-1/3LENSKIT LM96-1/5LENSKIT LM96-1/4LENSKIT LM96-1/2LENSKIT

## Packaging Information



RECOMMENDED LAND PATTERN  
1:1 RATIO WITH PACKAGE SOLDER PADS

DIMENSIONS ARE IN MILLIMETERS



SLB

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