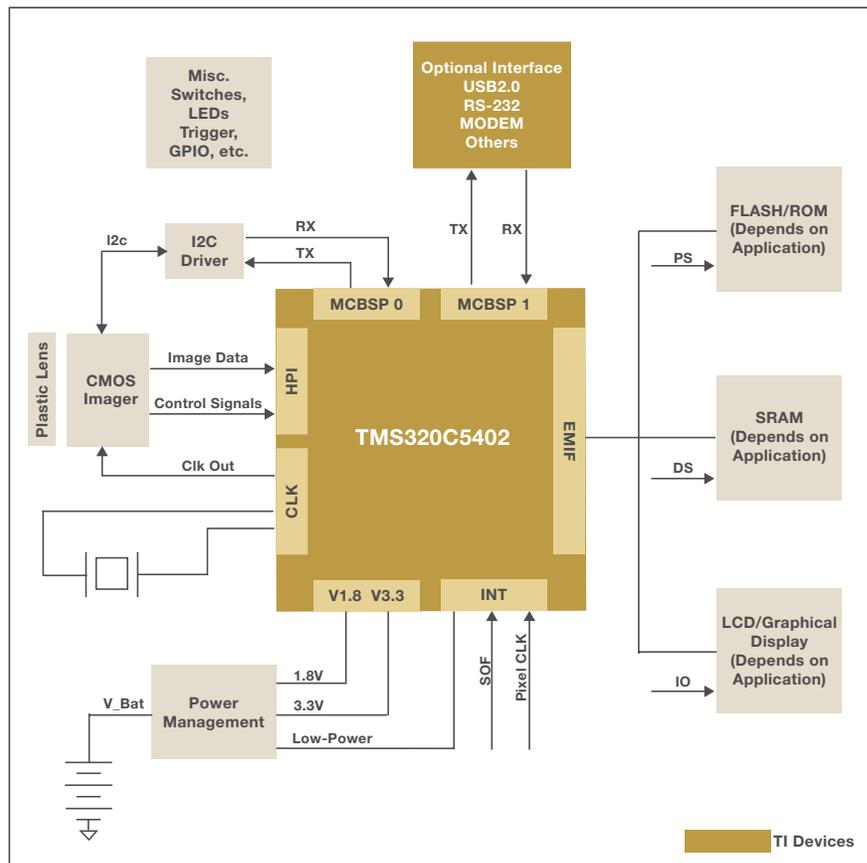# Low-Cost Camera Solution

Benefits

- Reduce system cost of multi-function cameras with integrated hardware and software solution

- Capitalize on small form factor of DSP to design attractive cameras

- Extend battery life with low-power consuming DSP solution

- Increase design flexibility with scaleable DSP solution for addition of new features as system needs change

D3 Engineering
dsp hardware, software, and algorithms
www.d3engineering.com

Target Applications

- **Visual inspection**
- **Toys**
- **Digital cameras**

Solutions for imaging products based on TI DSPs provide developers the flexibility to design a wide range of products. By leveraging the DSP programmability, processing performance, video specific peripherals and support for all major multimedia codecs, developers can design differentiated products with customized features to meet changing market needs.

For developers of low-cost video cameras, this solution from Daisy MM and D3 Engineering offers a cost-effective CMOS camera capture mechanism, based upon the TI TMS320VC5402 DSP. It offers low cost, small size and quality picture resolution, which make it an ideal hardware and software solution for consumer and portable applications. The solution offers many functions and is easily customized to meet system requirements. It also has a mode that can be utilized to play MP3 Audio. In this mode, the camera can be used as a portable MP3 Player with the entire feature set of a standard MP3 Player, including stereo sound.

System Example: CMOS Camera for Low-Cost Applications

Low-Cost Camera Solution

Functional Description

- This solution utilizes a CMOS camera capture to collect the image at VGA resolution (640 x320).

- The TI TMS320VC5402 compresses the image(s), with the JPEG, MJPEG algorithms from on-chip and external memory to display the image to LCD display or other storage means, such as Flash or ROM, depending upon the end application.

- The image can also be transmitted via optional modem, RJ-232, or USB interfaces from the McBSP on the DSP.

- Contains TI power management products, which support battery charge for portable applications.

Getting Started – Development Tools

Tools

- TI TMS320C5000™ DSP Code Composer Studio™ V2.2 Development Tools
- TMDSDSK5416 Board
- Photoclip PHC 5000 Firmware and v2.63 update
- Photoclip PHC 5000 Drivers
- Photoclip PHC 5000 Applications

Documentation

- Photoclip PHC 5000 Data Manual

Additional documentation for this solution is available from Daisy Multimedia and D3 Engineering.

Contact Information for Questions/Support

To purchase this solution or for more information, please contact:
sales@daisymm.com or:
sales@d3engineering.com

Component Selection

Hardware

- TI VC5402 DSP Processor (100 MHz)
- TPS61040: 28-V, 400-mA Switch Boos Converter in SOT-23 for LCD and White LED Applications: Boost converter for the CMOS imager
- BQ24020: bqTINY-II Single-Chip 1-Cell Li-Ion Charger w/USB/AC Supply Mgmt in 3x3mm2 QFN w/Enable, Temp Sense: Charge management for rechargeable option
- UCC3952-1: Single Cell Lithium-Ion Battery Protection IC W/Internal FET And Vov = 4.20V: Battery protection (very important for LiON)
- BQ26500: Complete Battery Fuel Gauge for One and Two Cell Li-Ion Applications
- TPS65011: Buck convertor for memory interface: Multi-Channel 1-cell Li-Ion Power Mgmt IC: USB/AC Charger, 2DC/DC, 2 LDOs, I^{2}C interface in QFN-48
- TPS62220: DC/DC converter for core processor: Adjustable, 400-mA, 95% Efficient Step-Down Converter, 15uA, ThinSOT-23
- CMOS Imager
- I^{2}C Buffer
- Connector - USB
- USB Driver
- Plastic Optics
- PCB 4-Layer/ Assembly
- Discrete Components
- Switches / LED / Misc.
- Flash, SRAM or LCD can be used based on the end application that the camera will be utilized
- Battery

Software

Camera Specifications

- **Image sensor:** CMOS
- **Sensor photo sites:** 0.3 million
- **Size:** 2.8µ x 2.8µ
- **Color Depth:** 8 bit x 3 colors
- **Optics:** all glass, free focus
- **Effective focal length:** 7mm (equivalent to 50mm on 35 mm film)
- **Focus range:** Normal: 50cm - infinity
- **Min shutter speed:** 1/20s
- **Max shutter speed:** 1/1000s
- **Viewfinder:** Optical
- **CD display:** Alpha Numeric LCD
- **Sound output:** Stereo Headphones or built-in Mono Speaker

Still Camera Mode

- **Output resolution:** VGA (640 x 480, 320 x 240 pixels)
- **Output format:** JPEG, 3 levels of JPEG compression
- **Shooting modes:** Auto, Manual
- **White balance:** Auto/Daylight /Fluorescent/ Incandescent /Sunlight and Manual
- **Exposure compensation:** -2EV to +2EV in 0.5EV steps
- **Sequence (Burst) Shooting:** up to 3 pictures
- **Delayed shutter release:** 3/5/10 seconds

- **Flash:** Built-in
- **Flash modes:** Auto/Red-eye reduction/ Forced/Off

Video & PC Camera Mode

- **Output resolution:** 320 x 240/160 x 120
- **Frame rate:** 20/10fps, only storage limited
- **Output format:** AVI (MJPEG)
- **Audio:** On / Off

Power Supply

- **Battery:** 2x1.2V NiMH / 1.5V alkaline (LR6, AM3, AA)
- **Battery life:** 800 shots (450 with flash)
- **DC adapter:** 5V/ 2A

Storage

- **Internal memory:** 16/32/64MB flash memory
- **External media:** Compact Flash Card type 1

Connectivity

- USB 1.1; (USB 2.0 compatible); Video Out
- USB drivers
- Win 98; Driver free for Win Me/2000/XP/ Linux 2.4.19/Mac OS 9.1 and above
- PC camera drivers: Win 98/Me/2000/XP

Image Processing

- **Design is based on Agilent Image processing pipeline covering**
- **Auto white balance (AWB):** Proprietary algorithm; fixed presets are also available (daylight, tungsten, fluorescent, cloudy)
- **Exposure contro:** with or without strobe type flashlight
- **Lens shading correction**
- **CFA Interpolation:** adaptive type using modified gradients
- **Contrast stretching**
- **Adaptive edge enhancement**
- **Baseline JPEG encoder/decoder**
- **MJPEG encoder/decoder**
- **FAT12/16 compatible file system, supporting CF, SD/MMC, SM and NAND medias**
- **Media drivers for CF, SD/MMC, SM and NAND Medias**
- **Driver for USB controller – PDIUS BD12 (Phillips)**
- **Mass storage class driver for USB**

Audio

- **IMA ADPCM codec for voice compression (32 Kbps)**
- **VOR (voice operated recorder) driver for voice recorder**
- **Automated Gain Control (AGC) driver for voice recorder**
- **MPEG1, Layer 3, Mpeg 2 and MPEG 2.5 compatible MP3 decoder. VBR and CBR, 8-320bps**
- **Sample rates supported:** 32, 44.1, 48kHz

Connectivity

- **TCP/IP and UDP protocol stack**
- **HTTP server for WEB server application (streaming MJPEG)**
- **PPP protocol stack and AT-class modem driver**
- **E-mail client for sending pictures as e-mail attachment**

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