As we move toward a ubiquitous society, the importance of networking technology is growing in all areas of electronics. At the same time, the increasing sophistication of consumer demands for electronic equipment is driving the need for ever higher-performance and lower-power components. Toshiba is committed to providing optimal solutions for three areas to realize truly ubiquitous communication: digital home, automotive and mobile electronics.
Toshiba’s Dynastron CMOS area image sensors designed specifically for camera phone applications are available in versions of 3.2, 2.0 and 1.3 megapixels with a pixel pitch of 2.2 μm. The 2.0- and 1.3-megapixel image sensors integrate an image signal processor (ISP) on the same chip, reducing the workload of a controller. Dynastron is continually evolving by leveraging new technologies including microfabrication. Dynastron will continue to open up new possibilities for mobile handsets such as camera phones.

*: Dynastron is a trademark of Toshiba Corporation.

**2.0-Megapixel Dynatron™ ET8EJ0-AS in a 1/4-Inch Optical Format**

**1.3-Megapixel Dynatron™ ET8EH4-AS in a 1/5-Inch Optical Format**

**Features**
- Integrates an image signal processor (ISP) that supports auto white balance (AWB), auto luminance control (ALC) and automatic blemish correction.
- Dynastron technology provides world-class image quality.
- Advances in process technology and design optimization allowed us to reduce the pixel pitch to 2.2 μm, realizing approx. 2.0 megapixels in a 1/4-inch optical format and approx. 1.3 megapixels in a 1/5-inch optical format.
- The integrated PLL provides great flexibility in the selection of input clocks.
- Supports 15 fps at the highest-resolution output (UXGA: ET8FJ0-AS/SXGA: ET8EH4-AS) and 30 fps at VGA output.
- Command controlled via the I²C bus.

**General Specifications**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical Format</td>
<td>ET8EJ0-AS ET8EH4-AS</td>
</tr>
<tr>
<td>Cell Size</td>
<td>1/4 inch 1/5 inch</td>
</tr>
<tr>
<td>Pixel Count</td>
<td>1,648 (H) × 1,216 (V) (approx. 2.0 megapixels) 1,328 (H) × 1,044 (V) (approx. 1.3 megapixels)</td>
</tr>
<tr>
<td>Output Signaling</td>
<td>YUV422 / RGB565 / RGB444 / RAW YUV422 / RGB565 / RGB444 / RAW</td>
</tr>
<tr>
<td>Frame Rate</td>
<td>15 fps at UXGA output 30 fps at VGA output 15 fps at SXGA output 30 fps at VGA output</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-20°C to 60°C -20°C to 60°C</td>
</tr>
<tr>
<td>ISP</td>
<td>Integrated Integrated</td>
</tr>
</tbody>
</table>

ISP: Image Signal Processor

**ET8EJ0-AS/ET8EH4-AS Outline Block Diagram**

MIPI is a serial bus standard defined by the MIPI Alliance.
**3.2-Megapixel Dynastron™ ET8EE6-AS in a 1/3.2-Inch Optical Format**

### Features
- Dynastron technology provides world-class image quality.
- Advances in process technology and design optimization allowed us to reduce the pixel pitch to 2.2 μm, realizing approx. 3.2 megapixels in a 1/3.2-inch optical format.
- The integrated PLL provides great flexibility in the selection of input clocks.
- Supports a frame rate of 15 fps at the maximum image resolution.
- Offers blemish correction, gain control, etc.
- Command controlled via the I2C bus.

### General Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical Format</td>
<td>1/3.2 inch</td>
</tr>
<tr>
<td>Pixel Count</td>
<td>2,080 (H) × 1,560 (V) (approx. 3.2 megapixels)</td>
</tr>
<tr>
<td>Cell Size</td>
<td>2.2 μm (H) × 2.2 μm (V)</td>
</tr>
<tr>
<td>Output Signaling</td>
<td>RAW</td>
</tr>
<tr>
<td>Frame Rate</td>
<td>15 fps at QXGA output</td>
</tr>
<tr>
<td></td>
<td>30 fps at 3-to-1 vertical pixel binning</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-20˚C to 60˚C</td>
</tr>
<tr>
<td>ISP</td>
<td>None</td>
</tr>
</tbody>
</table>

**ISP:** Image Signal Processor

**VGA Dynastron™ ET8EL6-AS in a 1/10-Inch Optical Format (Under Development)**

### General Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical Format</td>
<td>1/10 inch</td>
</tr>
<tr>
<td>Pixel Count</td>
<td>(Approx. 3.2 megapixels)</td>
</tr>
<tr>
<td>Cell Size</td>
<td>2.2 μm (H) × 2.2 μm (V)</td>
</tr>
<tr>
<td>Output Signaling</td>
<td>YUV422, RGB565</td>
</tr>
<tr>
<td>Frame Rate</td>
<td>30 fps VGA</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-20˚C to 60˚C</td>
</tr>
<tr>
<td>ISP</td>
<td>Integrated</td>
</tr>
</tbody>
</table>

The specifications of the actual device are subject to change.

**Dynastron™ Roadmap**

- Shown in round boxes are optical formats.

---

**Dynastron™ Roadmap**

- Shown in round boxes are optical formats.
High Graphics Performance

3D Graphics LSI for Mobile Handsets

A new addition to the MOBILETURBO series, the TC35711XBG 3D graphics LSI can render 100 mega-polygons* (i.e., 800 megapixels*) a second. The integrated 3D graphics processor is compatible with programmable shaders, the latest programming technology for 3D graphics; it brings a level of realism seen on tabletop game consoles onto mobile handsets.

The TC35296 provides multimedia functionality to high-end cellular phones, with an on-chip MPEG-4 codec supporting VGA-size video at 30 fps.

TC35711XBG<TG2>

**Features**
- Integrates a newly developed 3D graphics processor, which delivers 3D rendering performance of 100 mega-polygons* (800 megapixels*) a second.
- Contains three processors to realize graphics performance equivalent to tabletop game consoles: a high-performance 3D graphics processor, a MeP (Media Embedded Processor) suitable for multimedia processing and an ARM1176JZF-S CPU core designed specifically for mobile handsets.
- Compatible with programmable shaders, the latest programming technology for 3D graphics, which brings realistic shading and reflectivity to mobile handsets.
- Integrates an LCD controller, which supports LCD display of WVGA size (480 x 800) and can display WVGA and TV independently and simultaneously through the video encoder.
- Integrates a 512-Mbit DDR memory in a stack-up configuration in an SiP package.
- Different types of external interfaces are available: SD card, serial I/O, NAND flash memory, DDR memory controller and UART.

**General Specifications**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>90 nm</td>
</tr>
<tr>
<td>Functions</td>
<td>CPU; 3D graphics; LCD interface; SD card interface; serial I/O; UART; DDR memory controller</td>
</tr>
<tr>
<td>Power Supply</td>
<td>I/O: 1.8 to 3.0 V Core: 1.2 V</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>-20 to 70°C</td>
</tr>
<tr>
<td>Package Dimension</td>
<td>13 x 13 mm, 449-pin BGA</td>
</tr>
</tbody>
</table>

TC35296<T5G>

**Features**
- The T5G is a media processor for mobile handsets. It consists of the ARM926EJ-S CPU and three hardware accelerators—a video codec, 3D graphic accelerator and JPEG codec—for faster execution of video or still image shooting and 3D games, which are now popular features in mobile handsets. *1: TC35295<T5GP>
- The video codec supports QVGA-size H.264 decoding with a frame rate of 30 fps. It also supports VGA-size MPEG-4 encoding and decoding with a frame rate of 30 fps.
- The 3D graphic accelerator inherited from the T4G provides substantial improvement in performance in combination with the ARM926EJ-S.
- The JPEG codec supports the shooting of still images having more than 3M pixels in order to satisfy a demand for higher-resolution images. It also offers fast processing that enables continuous shooting at 30 fps or higher.
- The T5G incorporates an LCD controller that supports LCD display of VGA size (480 x 640) and can display TV screens through the video encoder independently and simultaneously.
- Different types of external interfaces are available: SD card, serial I/O, NAND flash memory, SDRAM controller, UART and general-purpose I/O ports.

**General Specifications**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>90-nm CMOS</td>
</tr>
<tr>
<td>Functions</td>
<td>H.264 video decoding; MPEG-4 video encoding and decoding; speech encoding and decoding; audio encoding and decoding; image/speech multiplexing; digital video I/O interface; 2D/3D graphics; JPEG codec; LCD controller</td>
</tr>
<tr>
<td>Power Supply</td>
<td>I/O: 1.8 to 3 V Core: 1.2 V, 2.5 V</td>
</tr>
<tr>
<td>Video Frame Rates</td>
<td>VGA MPEG-4 (640 x 480); Encoding and decoding at 30 fps QVGA H.264 (320 x 240); Decoding at 15 fps</td>
</tr>
<tr>
<td>Image Input Formats</td>
<td>YUV digital (8-bit), ITU-R BT.656 (8-bit)</td>
</tr>
<tr>
<td>Image Output Formats</td>
<td>RGB (24/18/16-bit); ITU-R BT.656 (8-bit); YUV digital (8-bit)</td>
</tr>
<tr>
<td>Package Dimension</td>
<td>12 x 12 x 1.2 mm</td>
</tr>
</tbody>
</table>
The TC90501FLG is an OFDM demodulation IC specifically designed for the ISDB-T 1-segment of Japanese digital TV broadcasting for mobile receivers, and is available for production quantities.

**Features**
- Can receive terrestrial digital broadcasting and ISDB-T 1-segment broadcasting.
- Contains all hardware necessary for OFDM demodulation such as memory and an A/D converter, eliminating the need for external components.
- Housed in a small, thin package (88-pin FLGA) to help miniaturize mobile receivers.
- The self-contained TC90501FLG can run on its own (except for initialization, channel selection, etc.), reducing the workload of the host CPU.

The successors to the TC90501FLG are now being developed: TC90521 (1-segment receiver; 90-nm process) and TC90511 (1/3-segment receiver; 90-nm process).
The TC358722XBG<VEGAMagiq-W>, TC358730XBG<LCD Buffer>, TC358700XBG/TC358705XBG<TLVDS BRIDGE> and TC35890XBG / TC35892XBG are designed for cellular phones with a clamshell hinge. These ICs provide not only fast serial transmissions of image data but also general-purpose functions required for peripheral control.

### LCD Buffering Examples

**Now**
- BB 16-bit parallel (18 to 24-bit RGB)
- LCD Controller RAM VGA/ WVGA
- High-speed serial
- LCD controller for I/F conversion and full frame buffering
- Parallel (18-24-bit RGB)
- Driver: Display QCF/QVGA 18-bit RGB

**Future**
- BB High-speed serial (MDI,MIPITM)
- LCD Controller RAM VGA/ WVGA
- Driver: Display VGA/WVGA 24-bit RGB

### VEGAMagiq-W

**Features**
- MDDI Client interface with data rates of up to 400 Mbps
- Support of dual displays where the primary display is WVGA and the secondary display is QCF+.
- Contains I2C, SPI, GPIO and PWM controllers.
- Input clock frequency range between 32.768 kHz and 20 MHz
- LCD video transfer rate: 800 × 480 pixels (WVGA) at 60 fps

**General Specifications**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>130 nm</td>
</tr>
<tr>
<td>Power Supply</td>
<td>1.5 V (core); 2.6 V (eDRAM); 1.8 to 3 V (I/O); 1.5 and 1.8 V (MDI I/O)</td>
</tr>
<tr>
<td>Package Dimension</td>
<td>6 × 6 mm (100 pins)</td>
</tr>
</tbody>
</table>

### LCD Buffer

**Features**
- Low-power
- Three baseband interfaces: MIPI™ DBI type B, MIPI™ DPI and MIPI™ DBI type C
- Two independent LCD interfaces: MIPI™ DPI and T-HSSI
- LCD buffer for VGA
- PWM generator
- MIPI™ DPI type C output
- System clock (19.2 MHz or 32.768 kHz)

**General Specifications**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>90 nm</td>
</tr>
<tr>
<td>Power Supply</td>
<td>1.8 V (core), 1.8 V (I/O), 2.5 (other)</td>
</tr>
<tr>
<td>Package Dimension</td>
<td>5 × 5 mm (64 pins)</td>
</tr>
</tbody>
</table>

### TLVDS BRIDGE

**Features**
- Toshiba low-power-consumption LVDS I/O buffers
- 250-Mbps high-speed data rate (1 ch)
- 500-Mbps high-speed data rate (2 ch)
- Synchronous and asynchronous transmission modes
- Selectable graphic data bus width (8/16/18/24 bits)
- Selectable transmission mode: Selectable from Similar BT-656 and Simple VSYNC Synchronous modes.
- Host interface: Selectable from I2C and SPI.
- LCD video transfer rate: 640 × 480 pixels (VGA) at 60 fps

**General Specifications**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>130 nm</td>
</tr>
<tr>
<td>Power Supply</td>
<td>1.5 V (core), 1.7 to 3.3 V (I/O), 1.5 V (LVDS I/O)</td>
</tr>
<tr>
<td>Package Dimension</td>
<td>TC358700XBG: 7 × 7 mm (113 pins) TC358705XBG: 6 × 6 mm (81 pins)</td>
</tr>
</tbody>
</table>

### TC35890XBG, TC35892XBG

**Features**
- PWM functionality, keyboard configurations with as many as 96 keys, and general-purpose I/O via an I2C interface
- Up to 24 general-purpose I/O pins
- Low-power operation.

**General Specifications**

<table>
<thead>
<tr>
<th>Feature</th>
<th>TC35890XBG</th>
<th>TC35892XBG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>Max 1.2-mm thick, 3.5 mm × 3.5 mm, 0.5-mm ball pitch</td>
<td>Max 1.2-mm thick, 3.5 mm × 3.5 mm, 0.5-mm ball pitch</td>
</tr>
<tr>
<td>Power Supply</td>
<td>1.7 V to 3.6 V</td>
<td>1.62 V to 2.7 V</td>
</tr>
<tr>
<td>Clock</td>
<td>Crystal oscillator, external clock (32 kHz to 20 MHz)</td>
<td>On-chip RC oscillator, crystal oscillator, external clock (32 kHz to 20 MHz)</td>
</tr>
<tr>
<td>Isolation Between I/O and Power Supply</td>
<td>Dual power supplies supported</td>
<td>–</td>
</tr>
</tbody>
</table>
The market of W-CDMA cellular phones has been rapidly expanding, promoting a movement for greater versatility and use of a wider frequency band. This trend also demands more highly-integrated, smaller RF-LSI chips.

The new RF-LSI chip, TB31345WLG, combines the two previous chips, the TB31341FTG low noise amplifier (LNA) and the TB31342XLG transceiver (TRX). Additionally, the TB31345WLG is housed in the industry’s smallest-class wafer-level chip size package (WCSP*).

The TB31345WLG covers the BAND V (800-MHz) area in addition to the BAND I (2-GHz) area for roaming services.

The receiver’s built-in lowpass filter (LPF) provides excellent characteristics for reducing the GSM and CDMA2000 interference noise.

The SiGe BiCMOS technology enables the TB31345WLG to operate with low power consumption and low error vector magnitude (EVM), thus providing long standby and talk times.

**TB31345WLG**

- **Features**
  - Low current consumption: TX = 66 mA (@ +4 dBm output power in normal operating mode); 69 mA (@ +4 dBm output power in Icc-up HSDPA mode)
  - RX = 36 mA
  - Frequency bands: Band I (2-GHz band), Band V/VI (800-MHz band), Band IX (1.7-GHz band)
  - Low EVM: RX = 10%; TX = 3%
  - Fast lock & low noise: Built-in fractional-N PLL, VCO and loop filter
  - Reduced interference: Receiver’s built-in lowpass filter (LPF) for reducing GSM and CDMA2000 interference noise
  - Small, thin package: 96-pin S-UFLGA96 (4.13 × 4.16 × 0.6 mm), 0.4-mm ball pitch (WCSP*)

*WCSP: Wafer-Level Chip Size Package*
The new mobileLBA-NAND flash memories support a standard NAND flash interface and contain a logical block address access (LBA) controller, which carries out essential functions such as programming/erase block management and error code correction (ECC). This minimizes the workload of a host controller. Samples of high-density mobileLBA-NAND flash memories packaged in MCPs are now available. The new memories offer both single-level cell (SLC) and multi-level cell (MLC) memory areas, allowing applications and data to be stored on the same chip. Manufacturers are free to allocate part of the memory to SLC and the rest of it to MLC. This design allows them to reduce the number of chips in a product, saving space.

### Features
- Various types of memory can be combined in a single package.
- Up to nine layers can be stacked up (including inter-die spacers) in a package with a thickness of 1.4 mm. Up to five layers can be stacked up in a package with a thickness of 1.0 mm.
- Samples of high-density mobileLBA NAND flash memories are now available. The new mobileLBA NAND flash memories reduce the workload of a host controller. Manufacturers can, on the same chip, define an SLC area best suited for high-speed reads and writes, separately from an MLC area optimized for storage of a large amount of data. The 2-Gbit, 4-Gbit and 8-Gbit versions allow their full capacity to be allocated as SLC, while the 16-Gbit and 32-Gbit versions can support up to 8 Gbits of SLC.

### Toshiba MCP Roadmap

**Memory size / Integration**

- **mobileLBA MCPs**
  - 10 × 13.5 mm
  - 1.2 / 1.4 mm pitch
  - 0.65-mm pitch

- **GB-MCP(MCP + GB-NAND)**
  - 12 × 18 mm
  - 1.2 / 1.4 mm pitch
  - 0.65-mm pitch

- **POP(package on package)**
  - 12 × 18 mm
  - 1.2 / 1.4 mm pitch
  - 0.8-mm pitch

- **3 StMCP PSRAM + NOR + NAND**
  - 9 × 12 mm
  - 1.4 / 1.6 mm pitch

- **2 StMCP PSRAM + NOR**
  - 9 × 12 mm
  - 1.4 / 1.6 mm pitch

- **ADQ Mux deMux Burst 3 StMCP**
  - 11 × 14 mm
  - 1.2 / 1.4 mm pitch
  - 3.5 mm pitch

- **x32 SDRAM + NAND**
  - 11 × 14 mm
  - 1.2 / 1.4 mm pitch
  - 3.5 mm pitch

- **512LPST + 1GN + 1GB**
  - 10 × 13.5 mm
  - 1.2 / 1.4 mm pitch

- **64PS + 128NOR + 1GB**
  - 11 × 14 mm
  - 1.2 / 1.4 mm pitch

- **128PS + 256NOR + 1GN**
  - 10 × 13.5 mm
  - 1.2 / 1.4 mm pitch

- **512LPST + 1GN**
  - 10 × 13.5 mm
  - 1.2 / 1.4 mm pitch

- **128PS + 128NOR + 1GN**
  - 10 × 13.5 mm
  - 1.2 / 1.4 mm pitch

- **32PS + 128NOR + 1GN**
  - 9 × 12 mm
  - 1.4 / 1.6 mm pitch

- **32PS + 128NOR + 512N**
  - 9 × 12 mm
  - 1.4 / 1.6 mm pitch

- **512LPST + 1GN + 1GB**
  - 10 × 13.5 mm
  - 1.2 / 1.4 mm pitch

- **512LPST + 1GN + 512N**
  - 10 × 13.5 mm
  - 1.2 / 1.4 mm pitch

**Size:** mm
- M: Mega bit, G: Giga-bit, GB: Giga-byte NAND Flash
- N: NAND Flash, NOR: NOR Flash, PS: Pseudo SRAM
- LPST: Low Power Synchronous DRAM

The above combinations are examples.
Large-Capacity NAND Flash Memory Ideal for File Storage

NAND Flash Memory

To meet the rapidly growing demand for high-capacity storage, Toshiba offers the industry’s largest 16-Gbit NAND flash memory (TC58NVG4D1DTG00) fabricated with the advanced 56-nm process technology.

### Features
- Advanced 56-nm process and multi level cell technologies have enabled the product to have a capacity of 16 Gbits in the same package size as before.
- The new 16-Gbit NAND flash memory provides faster write performance by increasing the page size and optimizing the memory cell control system.
- Stacked-die packaging technologies allow large-capacity memory cards.

#### Roadmap for NAND Flash Memory Chips and Cards

<table>
<thead>
<tr>
<th>NAND Flash Memory Chip</th>
<th>8 Gbits</th>
<th>16 Gbits</th>
<th>32 Gbits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD Memory Card</td>
<td>2 GB</td>
<td>4 GB</td>
<td>8 GB</td>
</tr>
<tr>
<td>miniSD Memory Card</td>
<td>1 GB</td>
<td>2 GB</td>
<td>4 GB</td>
</tr>
<tr>
<td>microSD Memory Card</td>
<td>256 M / 512 M / 1 GB</td>
<td>2 GB</td>
<td>4 GB</td>
</tr>
<tr>
<td>2006</td>
<td>2007</td>
<td>2008</td>
<td>2009</td>
</tr>
</tbody>
</table>

Ultra-Small SD Memory Cards for Mobile Handsets

**SD, miniSD and microSD Memory Cards**

- **SD Memory Cards**
  - SD cards are flash data storage devices jointly developed by Toshiba, Matsushita and SanDisk.
  - SD cards are suitable for holding commercial content requiring copyright protection.

- **miniSD Memory Cards**
  - miniSD cards are an ultra-small-form factor extension to the conventional SD card standard. The packaged miniSD adaptor provides compatibility with all devices equipped with a standard SD slot.

- **microSD Memory Cards**
  - microSD is a flash memory card format for cellular phones, etc. It is smaller than the conventional miniSD cards. microSD cards are used in mobile handsets with a microSD slot. Also, all handsets that support standard SD cards can support microSD cards with an adaptor included in packages.

Memory Capacity: 1 GB, 2 GB, 4 GB, 8 GB
Size: 32(L) × 24(W) × 2.1(T) mm

Memory Capacity: 1 GB, 2 GB, 4 GB
Size: 21.5(L) × 20.0(W) × 1.4(T) mm

Memory Capacity: 512 MB, 1 GB, 2 GB, 4 GB
Size: 15.0(L) × 11.0(W) × 1.0(T) mm

For details, visit—http://www.toshiba.co.jp/index.html

The SD, miniSD and microSD logos are trademarks.
Satisfies a Wide Range of Needs for LCD Modules

TFT LCD Driver Chipsets for Cellular Phones

Toshiba provides a broad offering of high-performance LCD drivers to support the picture-quality and multi-purpose requirements for LCD display.

<table>
<thead>
<tr>
<th>Size</th>
<th>On-Chip RAM</th>
<th>RAM-Less</th>
</tr>
</thead>
<tbody>
<tr>
<td>WVGA</td>
<td>JBT6K71</td>
<td>JBT6K90*</td>
</tr>
<tr>
<td></td>
<td>262 k colors</td>
<td>16 M colors</td>
</tr>
<tr>
<td>VGA</td>
<td>JBT6K74A</td>
<td>JBT6K78</td>
</tr>
<tr>
<td></td>
<td>262 k colors</td>
<td>262 k colors</td>
</tr>
<tr>
<td>CIF</td>
<td>JBT6K85</td>
<td>JBT6K78</td>
</tr>
<tr>
<td></td>
<td>262 k colors</td>
<td>262 k colors</td>
</tr>
<tr>
<td>QVGA</td>
<td>JBT6K98*</td>
<td>JBT6K72</td>
</tr>
<tr>
<td></td>
<td>262 k colors</td>
<td>262 k colors</td>
</tr>
</tbody>
</table>

* Under development  *: P-RAM: Partial-display RAM

■ Single-Chip QVGA Driver with On-Chip RAM (for LTPS TFT LCDs): JBT6K85

On-glass power supply system type

- Display RAM Capacity: 230,400 bytes
- Source Driver Output Pins: 120 (6-multiplexer)
- Color Control: 16,777,216-, 262,144-, 65,536- or 8-color mode
- Input Voltage: Interface = 1.65 to 3.6 V, Power circuitry = 2.6 to 3.6 V
- Interfaces: MPU (M68/i80) / RGB / VSYNC / SPI
- Chip Size: 14.9 x 1.5 mm, chip-on-glass (COG) support

■ ROMless Single-Chip WVGA Driver (for LTPS TFT LCDs): JBT6K90

On-glass power supply system type

- Source Driver Output Pins: 480 (3-multiplexer)
- Color Control: 16,777,216-, 262,144-, 65,536- or 8-color mode
- Input Voltage: Interface = 1.6 to 3.3 V, Power circuitry = 2.7 to 3.3 V
- Interfaces: High-speed interface (T-LVDS) / RGB / I2C
- Chip Size: 21.46 x 1.2 mm, chip-on-glass (COG) support

Optimizes Power Amplifier Efficiency

Power Supply ICs for Cellular Phone (CDMA) Power Amps

The power supply ICs for cellular phone power amps combine bypass MOSFET with a small, high-efficiency, synchronous-current-mode step-down regulator. They are ideal for optimizing the efficiency of CDMA and W-CDMA power amps to increase battery life.

■ Features
  - Small packaging
  - High efficiency: >80%
  - Low Ron bypass MOSFET
  - Variable output voltage
  - High quality: Protection circuitry

■ Product Offerings

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Features</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB62504FMG</td>
<td>Small voltage reference</td>
<td>Available</td>
</tr>
</tbody>
</table>
Drives White LEDs for LCD Backlight at High Efficiency

White LED Drivers

The family of white LED drivers features high brightness with low power consumption, helping to reduce product size. It is ideal for LCD backlight and secondary camera flash applications. Both switching and charge-pump DC/DC converters are available.

Features
- Small packaging: SOT23-6, VOQON24, PLP
- High efficiency: >85% (switching-regulated type)
- Low noise: No inductors required (charge-pumped type)
- Analog dimming control
- Multiple output capability for system integration (charge-pumped type)
- High quality: Protection circuitry (OVD)
- High accuracy: ±5% output current

Product Offerings

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Features</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB62731FUG</td>
<td>Temperature compensation circuit</td>
<td>Available</td>
</tr>
<tr>
<td>TB62732FUG</td>
<td>Small form factor</td>
<td>Available</td>
</tr>
<tr>
<td>TB62734FUG</td>
<td>Analog dimming, OVD</td>
<td>Available</td>
</tr>
<tr>
<td>TB62736FUG</td>
<td>High efficiency, analog dimming</td>
<td>Available</td>
</tr>
<tr>
<td>TB62737FUG/FPG</td>
<td>OVD, high efficiency</td>
<td>Available</td>
</tr>
<tr>
<td>TB62756FUG</td>
<td>PWM dimming, high efficiency</td>
<td>Available</td>
</tr>
<tr>
<td>TB62757FUG/FPG</td>
<td>PWM dimming, OVD, high efficiency</td>
<td>Available</td>
</tr>
<tr>
<td>TB62750FTG</td>
<td>High current (up to 800 mA)</td>
<td>Under development</td>
</tr>
<tr>
<td>TB62752AFUG/TB62755FPG</td>
<td>Multiple output lines (up to 8 LEDs)</td>
<td>Available</td>
</tr>
<tr>
<td>TB62753BFUG</td>
<td>OVD threshold = 31.5 V (typ.)</td>
<td>Available</td>
</tr>
<tr>
<td>TB62754AFUG</td>
<td>Medium-sized LCD backlighting</td>
<td>Available</td>
</tr>
</tbody>
</table>

Charge-Pumped Drivers

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Features</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCA62735AFLG</td>
<td>4-ch constant-current driver</td>
<td>Available</td>
</tr>
<tr>
<td>(Three channels or more must be used)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCA62753FUG</td>
<td>5-V constant-voltage output</td>
<td>Available</td>
</tr>
</tbody>
</table>

Ultra-Compact Package Suitable for Control of Optical Zoom and AF Lens on Cellular Phones

Ultra-Compact Surface-Mount Photointerrupter: TLP848

Ideal for optical zooming and AF lens position detection in digital cameras, digital video cameras and cellular phone cameras.

Features
- Ultra-compact surface-mount package
  - Size: 2.8 × 1.9 × 2.5 mm ⇒ 50% in volume as compared with TLP846 (Toshiba existing product)
  - Detection gap with: 1.2mm ⇒ Same as TLP846 (Toshiba existing product)
- High current transfer ratio: Ic/Ir = 3 to 24%
The TPS856 is a photo-IC that incorporates a photodiode, a current amplifier and a luminous-efficiency correction function in a single chip. This device has high sensitivity and excellent output linearity relative to change in the ambient brightness of the operating environment. The device also features little variation in light current ratio between light sources and so supports operation at a lower voltage than the previous series. Moreover, the power dissipation of this photo-IC is reduced even in standby mode through the use of a newly added standby pin. As a power-saving device with further enhanced functionality, the TPS856 contributes to power saving in various display devices.

### Features

- Small and thin surface-mount package: 1.6 × 1.6 × 0.55 mm (typ.)
- Current linear output type: incorporating a photodiode and a current amplifier in a single chip
- High sensitivity: light current (IL) = 40 to 80 μA @Ev = 100 lx using fluorescent light
- Light current ratio (IL@ incandescent light / IL@ fluorescent): 1.0 x (typ.)
- Low supply voltage: VCC = 1.8 to 5.5 V
- Built-in standby function
- Silicon is used as the chip material. This product can be used in place of a CdS cell.

### Comparisons of the New TPS856 to the Conventional TPS852 and TPS853

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package Dimension</th>
<th>Power Supply (V)</th>
<th>Light Current (μA) @ Ev = 100 lx using fluorescent light</th>
<th>Light Source Ratio (Incandescent Light to Fluorescent Light)</th>
<th>Standby Function</th>
<th>Output Logic (Dark → Bright)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPS852</td>
<td>1.6 × 1.6 × 0.55(t)</td>
<td>2.7 to 5.5</td>
<td>27 to 54</td>
<td>1.2 x (typ.)</td>
<td>No</td>
<td>Low → High</td>
</tr>
<tr>
<td>TPS853</td>
<td>2.1 × 2.0 × 0.7(t)</td>
<td>2.2 to 5.5</td>
<td>37 to 74</td>
<td>1.2 x (typ.)</td>
<td>Yes</td>
<td>Low → High</td>
</tr>
<tr>
<td>TPS856</td>
<td>1.6 × 1.6 × 0.55(t)</td>
<td>1.8 to 5.5</td>
<td>40 to 80</td>
<td>1.0 x (typ.)</td>
<td>Yes</td>
<td>High → Low</td>
</tr>
</tbody>
</table>

### Offers High Brightness with Low Current Drive

**Compact SMD Type LED Lamps**

#### Features

- Package dimensions: 1.6(L) × 0.8(W) × 0.45(H) mm (Including lead length)
- New LED chip structure achieving high-brightness and low-current drive.
- Lead(Pb)-Free reflow soldering

#### Electrical and Optical Characteristics

<table>
<thead>
<tr>
<th>Series Name</th>
<th>Part Number</th>
<th>Color</th>
<th>Dominant Wavelength λd Typ. (nm)</th>
<th>DC Forward Voltage (V) @If = 5 mA</th>
<th>Reverse Current In (μA) @Vn = 4 V</th>
<th>Luminous Intensity (mcd) @If = 5 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLG Series</td>
<td></td>
<td></td>
<td>@ Ta = 25°C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(InGaA  P)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*TLRV1022(T14, F)/(T15, F)</td>
<td>Red 630</td>
<td>630</td>
<td>630</td>
<td>1.8</td>
<td>1.8</td>
<td>10</td>
</tr>
<tr>
<td>*TLRMV1022(T14, F)/(T15, F)</td>
<td>Red 626</td>
<td>626</td>
<td>626</td>
<td>2.1</td>
<td>2.1</td>
<td>10</td>
</tr>
<tr>
<td>*TLSV1022(T14, F)/(T15, F)</td>
<td>Red 613</td>
<td>613</td>
<td>613</td>
<td>2.3</td>
<td>2.3</td>
<td>10</td>
</tr>
<tr>
<td>*TLOV1022(T14, F)/(T15, F)</td>
<td>Orange 605</td>
<td>605</td>
<td>605</td>
<td>2.3</td>
<td>2.3</td>
<td>10</td>
</tr>
<tr>
<td>*TLV1022(T14, F)/(T15, F)</td>
<td>Yellow 587</td>
<td>587</td>
<td>587</td>
<td>2.3</td>
<td>2.3</td>
<td>10</td>
</tr>
<tr>
<td>*TLGV1022(T14, F)/(T15, F)</td>
<td>Green 571</td>
<td>571</td>
<td>571</td>
<td>2.3</td>
<td>2.3</td>
<td>10</td>
</tr>
<tr>
<td>*TLPGV1022(T14, F)/(T15, F)</td>
<td>Pure green 558</td>
<td>558</td>
<td>558</td>
<td>2.3</td>
<td>2.3</td>
<td>10</td>
</tr>
</tbody>
</table>

*: Sealed in a moisture-proof bag
#: For the available luminous intensity bins and further details, contact your nearest Toshiba sales representative.
Toshiba offers a wide range of small, thin discrete devices and general-purpose ICs suitable for mobile handsets. The following introduces the products that are particularly ideal for mobile applications.

1. ESD-protection diodes for interface pins
   Connected between signal lines and ground, ESD-protection diodes protect sensitive electronics from electrostatic discharge.

2. MOSFETs for power management
   Small-signal MOSFETs with low Vth are surface-mount components suitable for on/off control of internal power supply.

3. Small, thin power supply ICs with low standby current
   Series voltage regulator ICs with low standby current and low noise

4. Digital switches for various analog and digital signals
   Selects between external and internal signals or between internal signals.

5. Lithium-ion battery protection MOSFETs
   MOSFET devices that protect lithium-ion batteries from overvoltage and overcharge current.

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Radio-Frequency Devices
http://www.semicon.toshiba.co.jp/eng/product/rf/index.html
Toshiba offers a broad range of RF devices such as variable capacitance diodes, low-noise amps, switches and so on.
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