

# Mobile Phone

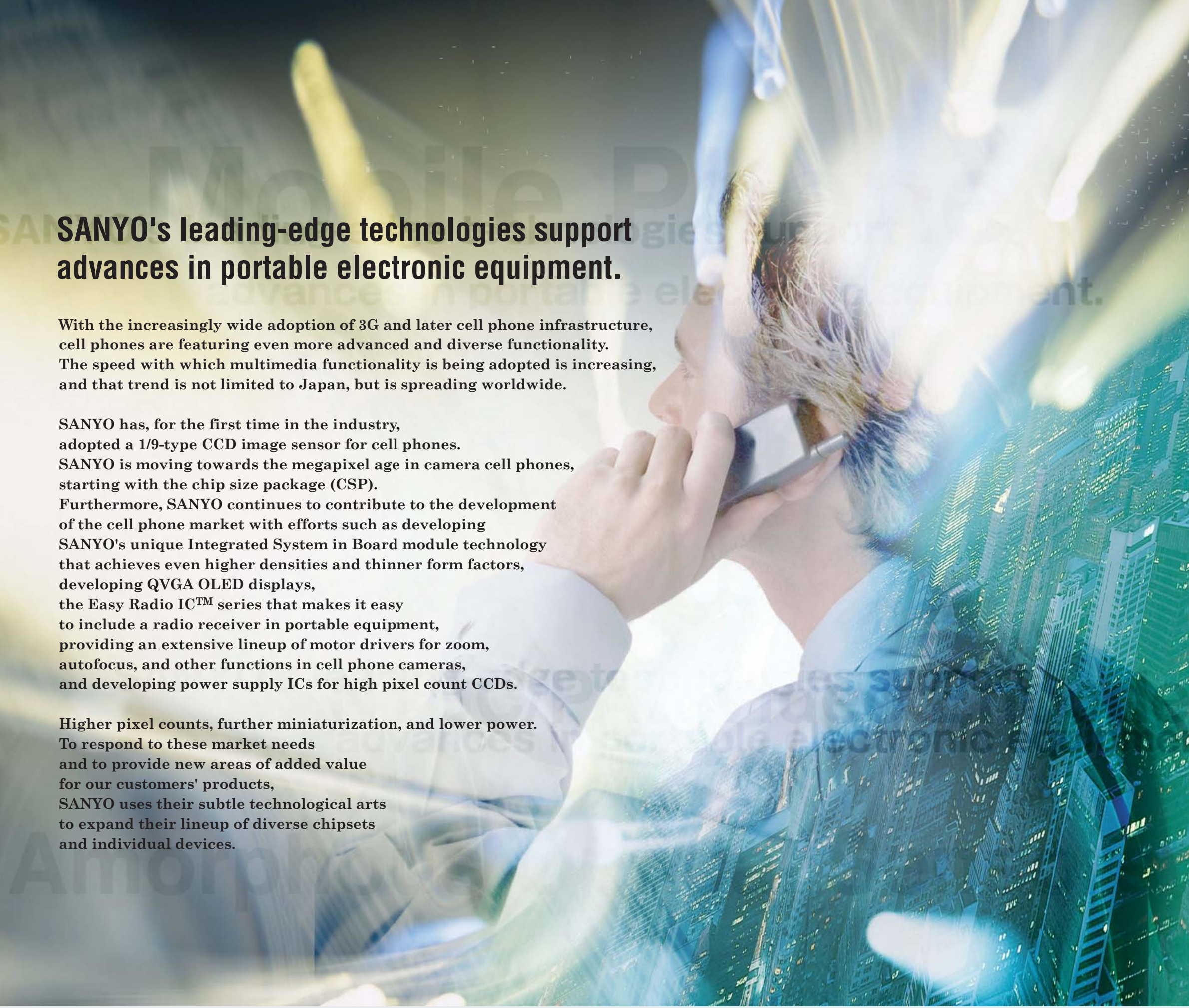
SANYO's leading-edge technologies support  
advances in portable electronic equipment



SANYO's leading-edge technologies support  
advances in portable electronic equipment

## NTSC/PAL Video Encode

## Amorphous Optical Sensor Sensors



## SANYO's leading-edge technologies support advances in portable electronic equipment.

With the increasingly wide adoption of 3G and later cell phone infrastructure, cell phones are featuring even more advanced and diverse functionality. The speed with which multimedia functionality is being adopted is increasing, and that trend is not limited to Japan, but is spreading worldwide.

SANYO has, for the first time in the industry, adopted a 1/9-type CCD image sensor for cell phones. SANYO is moving towards the megapixel age in camera cell phones, starting with the chip size package (CSP). Furthermore, SANYO continues to contribute to the development of the cell phone market with efforts such as developing SANYO's unique Integrated System in Board module technology that achieves even higher densities and thinner form factors, developing QVGA OLED displays, the Easy Radio IC™ series that makes it easy to include a radio receiver in portable equipment, providing an extensive lineup of motor drivers for zoom, autofocus, and other functions in cell phone cameras, and developing power supply ICs for high pixel count CCDs.

**Higher pixel counts, further miniaturization, and lower power.**  
**To respond to these market needs and to provide new areas of added value for our customers' products, SANYO uses their subtle technological arts to expand their lineup of diverse chipsets and individual devices.**

#### Notes on Package Types and Naming

The package names used in this documentation are designed to indicate rough classification of the packages used, and do not necessarily indicate the formal name of each individual package.

Refer to the delivery specifications document for the particular product for the package dimensions figure and the formal name of the package.

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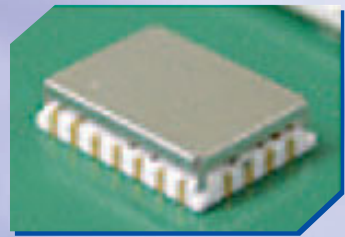
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Here we introduce several technologies that SANYO has pushed to the limits.

## SANYO Group Cell Phone Components



**FEM**  
(Front End Module)



**POSCAP**



**Vibration Motor**



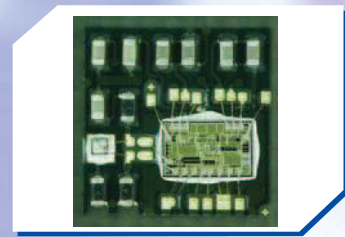
**SAW Filer**



**ASM**  
(Antena Switch Module)



**Die Electric Filter & Duplexer**



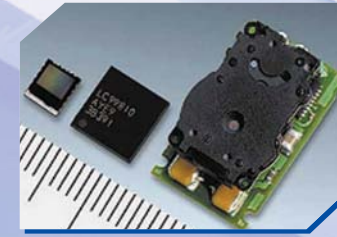
**Integrated System in Board**



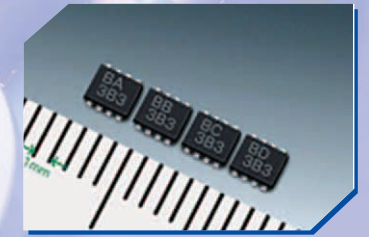
**SAW Duplexer**



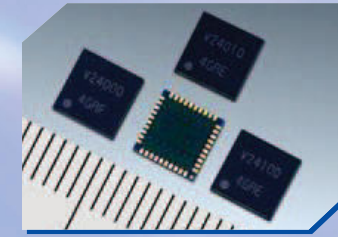
**RGB Chip LED**



**Mega Pixel CCD Camera Module**



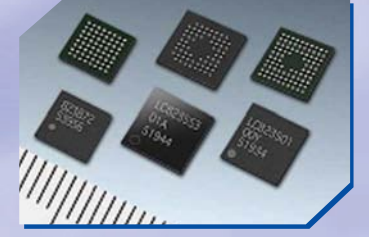
**Small discrete devices**



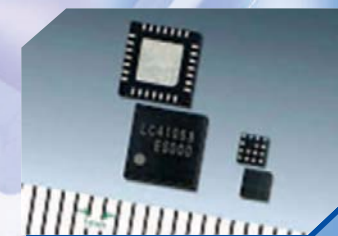
**FM Tuner IC**



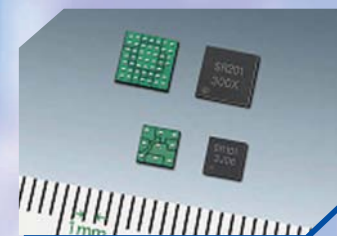
**Amorphous Optical Sensor**



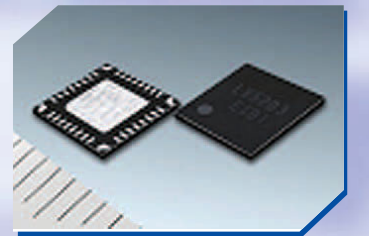
**Sound Generator IC**



**Charge Pump**



**DC/DC**



**LED Driver**



**LCD**  
(SANYO EPSON IMAGING DEVICES CORPORATION)



**Battery**



**Speaker**

# Integrated System in Board

Integrated System in Board is a type of SiP (system in package) technology, and is a module technology that achieves high densities and thinner form factors by using SANYO's unique substrate and mounting technologies. The Integrated System in Board lineup consists of three types of process: ISB-Solo, ISB-Duo, and ISB-Quad. Which process is used is selected based on the application.

In addition to standard products, customer specified circuit blocks can also be converted to Integrated System in Board using an optimal process, thus creating a new module device in a short time.

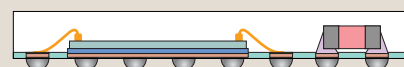
## Integrated System in Board Process Lineup

### ISB-Solo

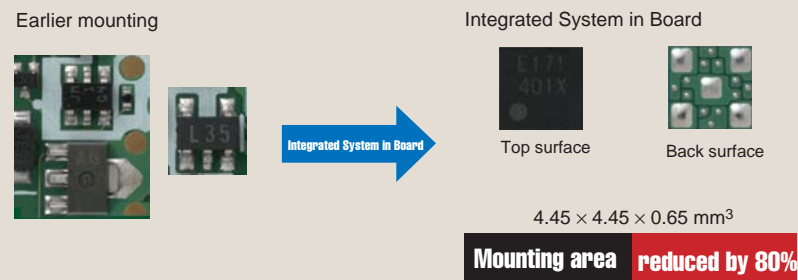


- Thickness of only 0.45 mm (0.65 mm if resistors are included) realizes excellent thermal radiation and short development TAT
- Optimal for SiP implementation of small-scale block that includes semi-power semiconductors.

#### Assembly structure examples



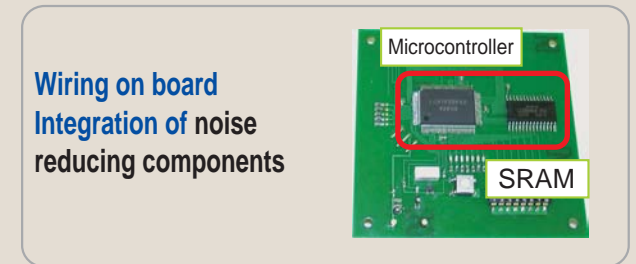
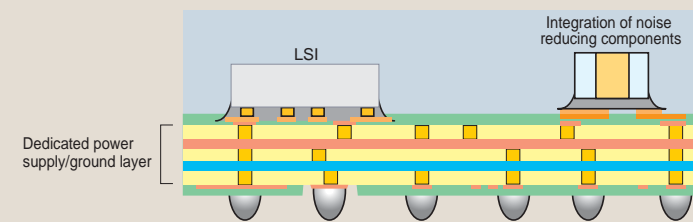
#### Application example (Cell phone charger circuit block)



## Noise suppression effect (measured)

### Reasons noise can be reduced by Integrated System in Board

- Reduced wiring area due to implementation as miniature modules
- Integration of noise reducing components
- Supply voltage stabilization by using dedicated layers for power supply and ground

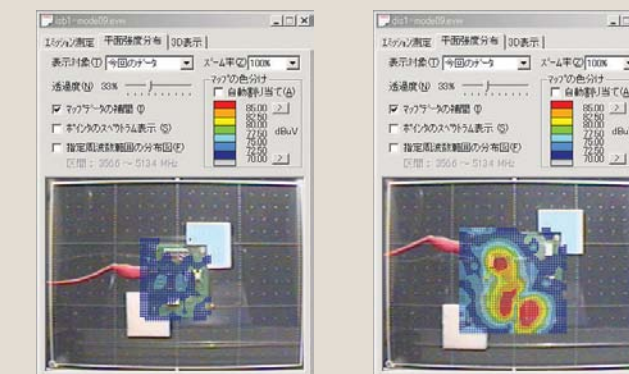


Noise is reduced significantly

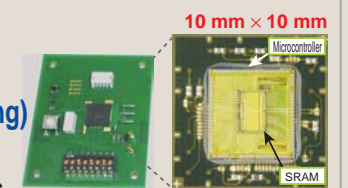
### Surface scan using a field probe

#### ISB-Duo (2-layer ISB)

#### Separate microcontroller and SRAM



Integrated System in Board stack structure (high-density mounting) Integration of noise reducing components



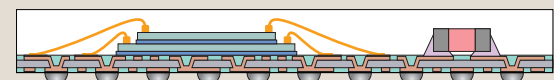
Evaluation results using a microcontroller and SRAM (Surface probe method - 30 MHz to 1 GHz)

### ISB-Duo

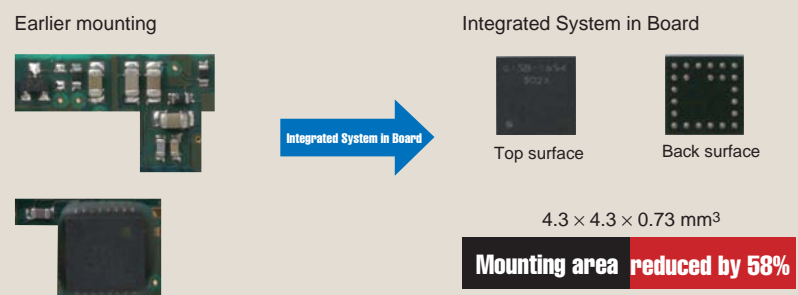


- Adopts unique SANYO-developed 0.2 mm thickness high-density substrate (2 layers) Line 40 μm / Space 40 μm at 25 μm thickness copper foil, Via diameter 100 μm / Via land diameter 150 μm
- Thickness of only 0.53 mm (0.73 mm if resistors are included) realizes high-density mounting
- Optimal for SiP implementation of high-frequency (up to 10 GHz) blocks, blocks that require performance or EMC workarounds based on component placement/wiring pattern, and blocks that require partial high-density mounting.

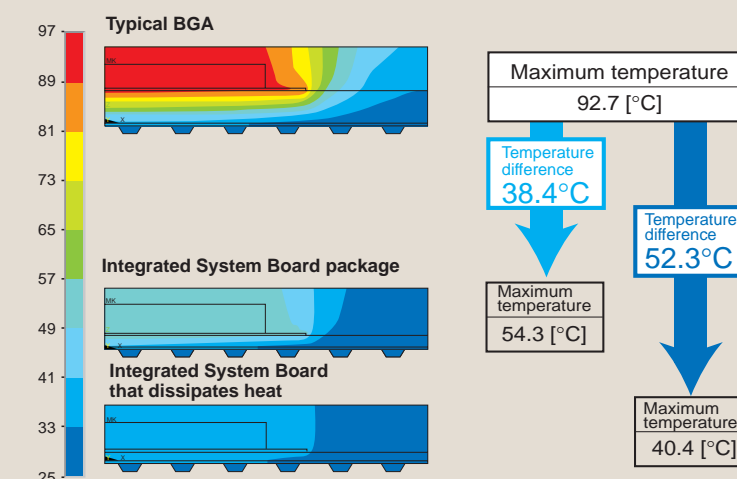
#### Assembly structure examples



#### Application example (Clock detector block)



## Heat dissipation effect (simulation)



#### Analysis conditions

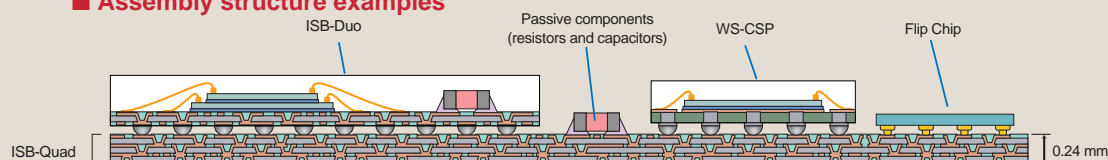
Chip heat generation	3 [W]
Chip size	4X4X0.3 [mm³]
Land size	5X5X0.03 [mm³]
Atmospheric temperature	25 [°C]
Cooling conditions	Ideal cooling of the solder lower surface; 25 [°C]
Analysis model	1/4 model (since symmetrical)

### ISB-Quad



- Adopts unique SANYO-developed 0.24 mm thickness high-density substrate (4 layers)
- Thickness of only 0.6 mm realizes high-density mounting
- Optimal for SiP implementation of high-frequency (up to 10 GHz) blocks, blocks that require performance or EMC workarounds based on component placement/wiring pattern, and subsystems that require high-density mounting.
- Chip-on-Board type

#### Assembly structure examples



# Integrated System in Board Application Products (Standard Products)

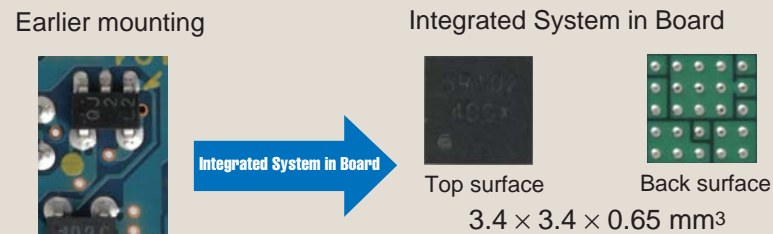
Here we introduce examples of ICs used for cell phones implemented as modules using Integrated System in Board.

## Thin Form, Miniature 1 or 2 Channel DC/DC Converter Power Supplies

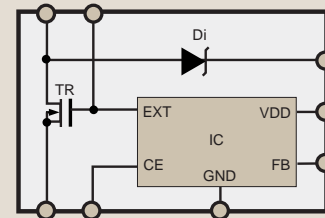
### SR Series

These products combine a step-up DC/DC converter, n-channel power MOSFET, and Schottky barrier diode devices in a single module. A switching step-up power supply can easily be implemented with just the addition of external voltage setting resistor, coil, and capacitor components.

#### Compared to discrete components with Integrated System in Board ■ Block Diagram (SR10010)



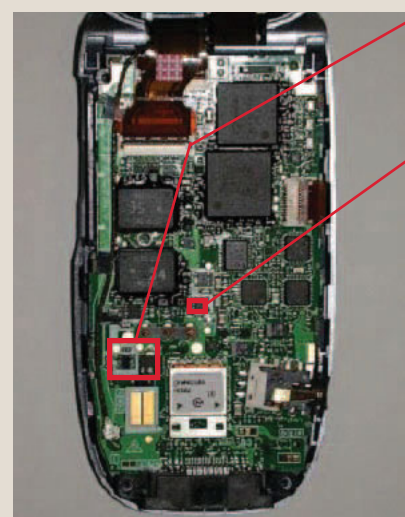
Mounting area reduced by 35%



#### Product lineup

Type No.	Number of channels	Type	Oscillator frequency	Withstand voltage	Size	Status
SR10010	1ch	Step-up type	180 kHz	20 V	3.4 × 3.4 × 0.65 mm <sup>3</sup>	ES samples/MP support
SR10020			300 kHz	20 V		ES samples/MP support
SR10030			180 kHz	30 V		ES samples/MP support
SR10110			100 kHz	20 V		In volume production
SR10210			100 kHz	20 V		In volume production
SR103XX	2ch	Step-down type - power supply type	—	—	—	Under development
SR20010			180 kHz	20 V	5.0 × 5.0 × 0.65 mm <sup>3</sup>	ES samples/MP support

#### Earlier mounted



2002

Charge control circuit  
10.0 × 10.0 = 100.0 mm<sup>2</sup>  
+  
Regulator IC  
3.0 × 3.0 = 9.0 mm<sup>2</sup>

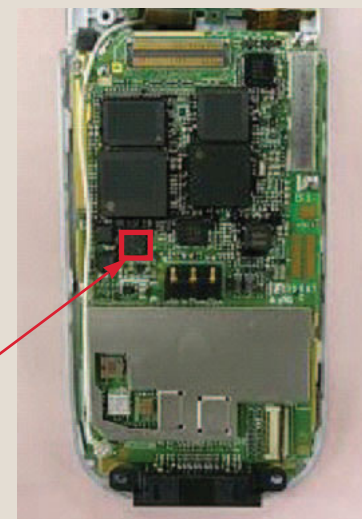
Mounting area reduced by 80%

Size: 109.0 mm<sup>2</sup> → 19.80 mm<sup>2</sup>



ISB-E17-0  
4.45 × 4.45 = 19.80 mm<sup>2</sup>

#### Integrated system in Board



2004

NTSC/PAL encoder+Video driver+Audio codec+Speaker amplifier

## LC822964

New product

### Featuring

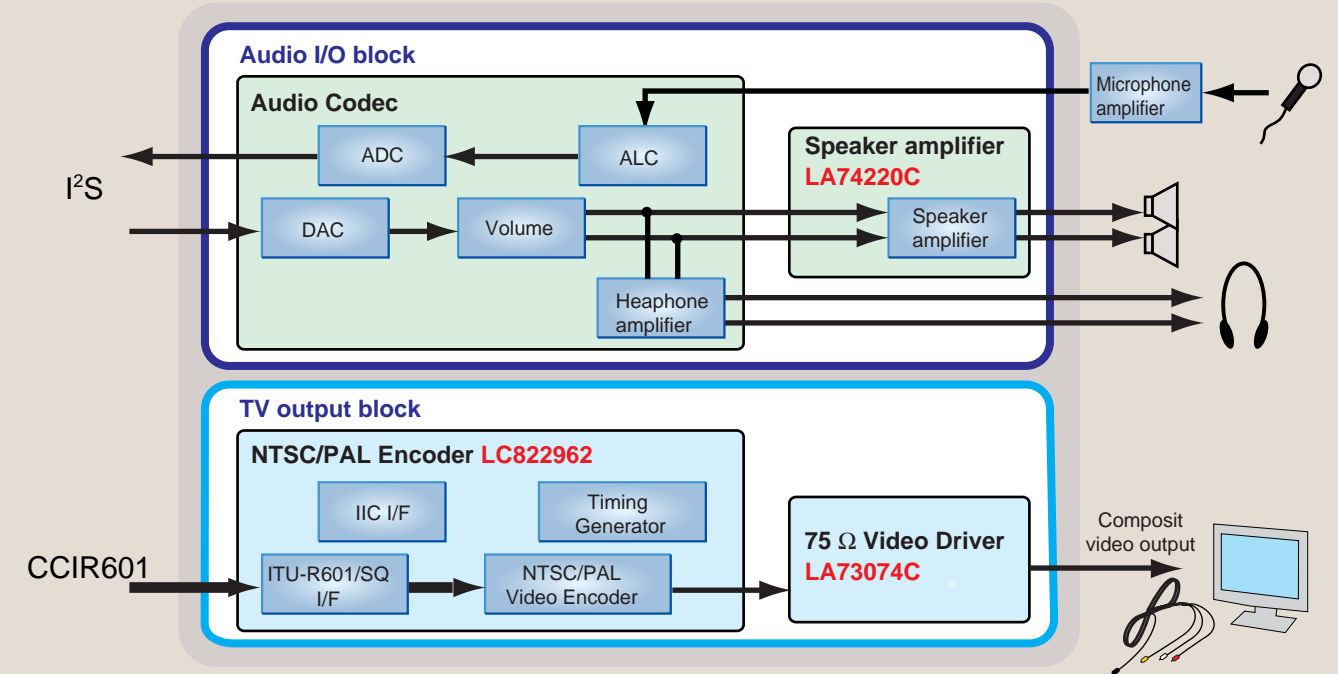
#### Video Block

- One output system  
Low-cost version specialized for cell phones
- Supports a wide variety of input data (ITU-R601/SQ)
- No output coupling capacitors required
- High performance
- Switching noise does not appear on the screen due to the use of charge pump technology
- Voltage sag does not occur
- Built-in 6th order low-pass filter:  $f_c = 7.5$  MHz
- Standby mode power consumption: 0  $\mu$ A

#### Audio Block

- D/A converter signal-to-noise ratio: 98 dB (A weighting), THD: 84 dB at 48 kHz
- A/D converter signal-to-noise ratio: 90 dB (A weighting), THD: 80 dB at 48 kHz
- Programmable ALC/noise gate
- Stereo/monaural microphone interface
- Built-in headphone driver
- Low power consumption
- 450 mW output ( $V_{cc} = 3.6$  V, 1 kHz, THD = 1%)
- Power saving and standby functions

#### Block Diagram



Current mounting area  
84.88 mm<sup>2</sup> + Passive components

#### Sound I/O Block

- Audio codec  
5.2 × 5.2 × 0.8 mm<sup>3</sup>
- Speaker amplifier  
5.0 × 5.0 × 0.8 mm<sup>3</sup>

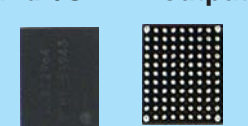
#### TV Output Block

- NTSC/PAL encoder  
5.0 × 5.0 × 1.0 mm<sup>3</sup>
- Video driver  
2.8 × 2.8 × 0.8 mm<sup>3</sup>

Mounting area can be reduced by over 50%

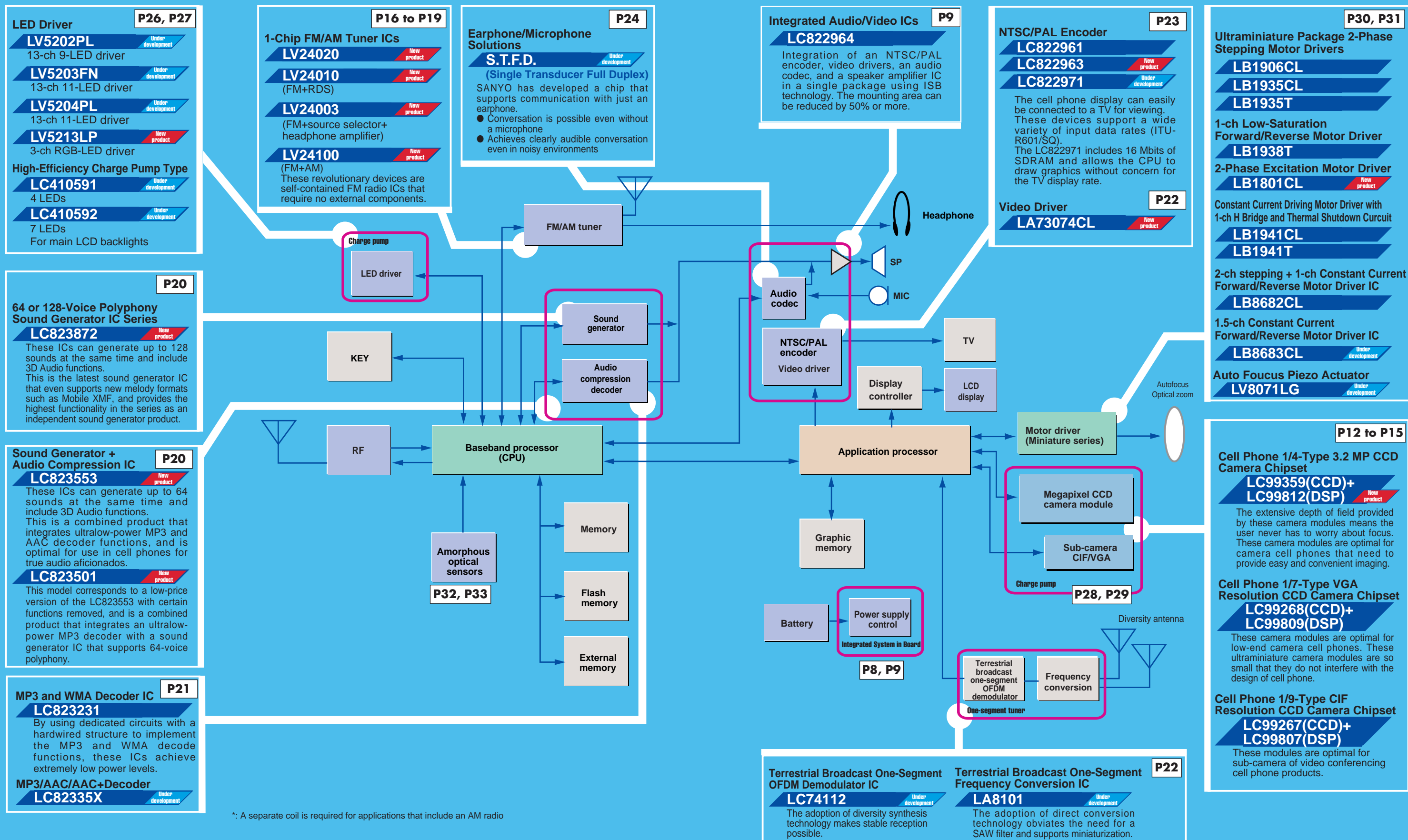
Integrated System in Board  
45 mm<sup>2</sup> (6.0 × 7.5 mm<sup>2</sup>)

#### Sound I/O + TV output



# Cell Phone Block Diagram Examples

Since the next generation of cell phones will include an even wider variety of functions than ever before, we expect that dedicated multimedia processors and devices will be required. SANYO provides a wide range of devices required by next generation cell phones, and can provide powerful support for your cell phone development efforts.



\*: A separate coil is required for applications that include an AM radio

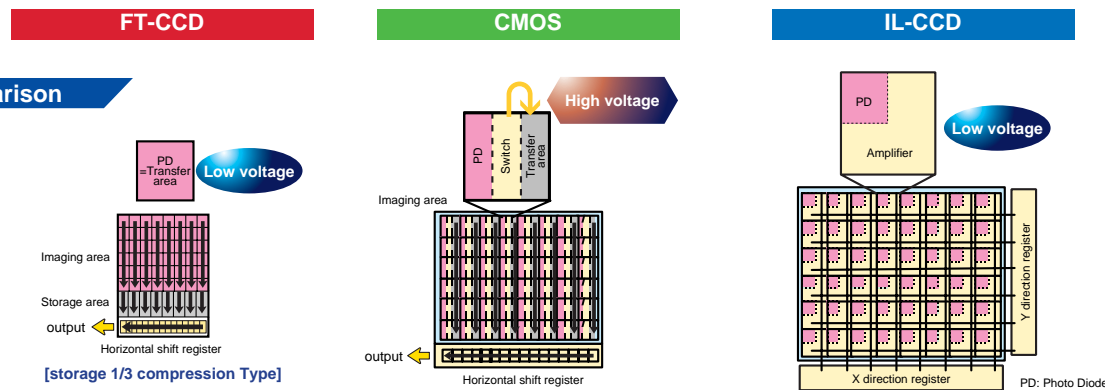
High image quality, ultraminiature size, and low power makes these devices optimal for use in cell phones

# Frame Transfer Full-Color CCD Sensors

SANYO fabricates frame transfer (FT) CCD sensors using unique technologies with ultrafine design rules and provides them as modules assembled using advanced leading-edge mounting technologies. SANYO makes a point of providing fine and delicate semiconductor devices in forms that our customers will find approachable and easy to use.

## Frame Transfer CCD

Achieves the industry's smallest optical size class by using the frame transfer CCD, which makes it possible to reduce feature sizes while maintaining sensitivity. Sensitivity was increased by adopting a simple single-layer gate gap structure and thin-film polysilicon.



### Device Density Comparison

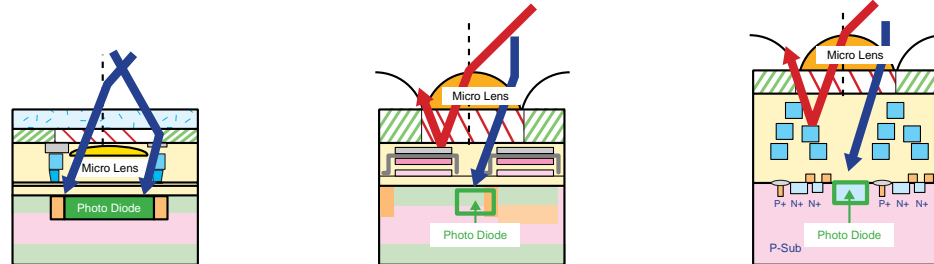
Comparison of chip sizes required to acquire the same imaging device area

High sensitivity

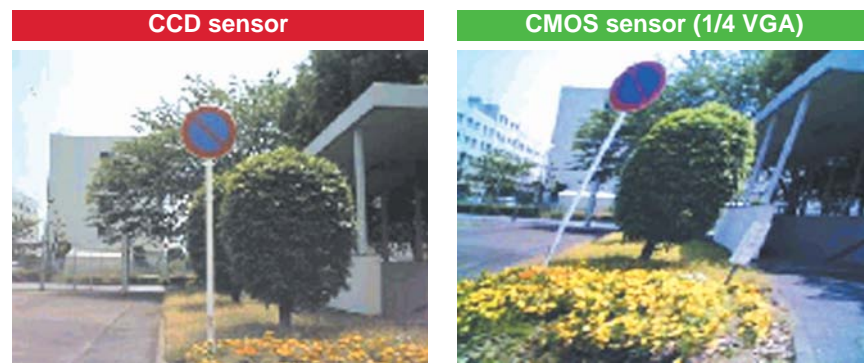
### Cross Section Comparison

The FT CCD method uses no elements that block the entrance of light, and thus they can capture light from a wider range of incidence angles.

Reducing the device height is possible



### Comparison of Differences in Electronic Shutter Types

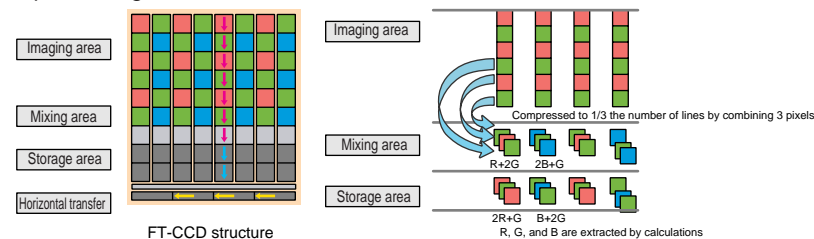


### Newly developed

In the 1.0-MP CCD, SANYO developed a new charge accumulation method. Low moiré, high sensitivity, and a high frame rate achieved by pixel addition during preview and spatial filter processing.

High sensitivity

Low moiré



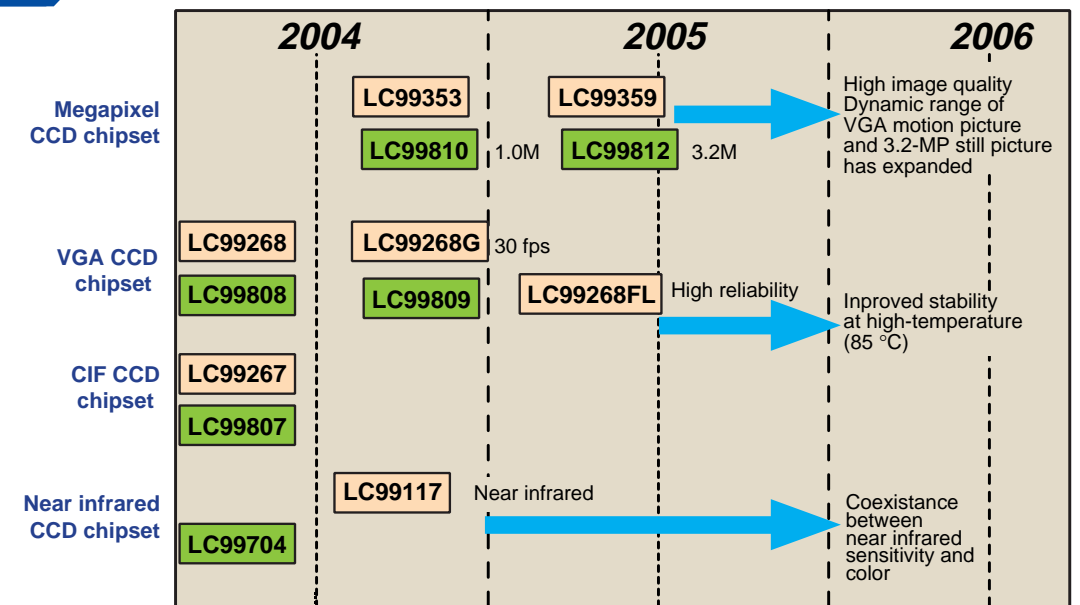
CCD drive circuit and image processing implemented in a single package

## Multifunction DSP chip

A charge pump type voltage step-up circuit that features minimal noise generation, and the supply voltages required for system drive are generated efficiently with just the supply of a single +2.9 V power supply. This design is also effective at achieving reduced power consumption.

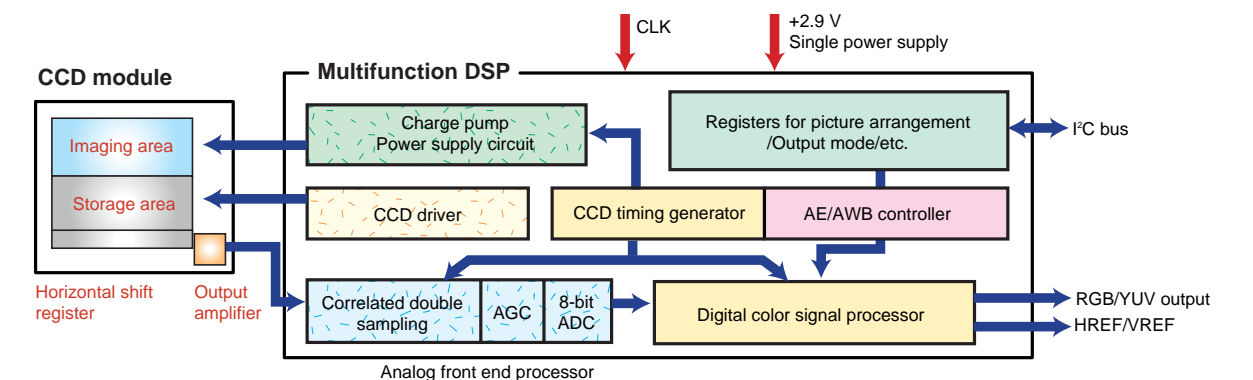
SANYO implemented, in a single package, the timing generator circuit required for system drive and all the analog and digital processing required to accept the CCD output by taking advantage of the SANYO CMOS analog/digital hybrid process and MCP (multi-chip package) technologies.

### Roadmap



Chip Set	Color/B&W	Resolution		Sensitivity		Dynamic Range	Frame Rate	Output
		Still	Motion	Still	Motion			
LC99359	Color	3.2M	VGA	Low	High	Normal	30	Digital
LC99268FL	Color	VGA	VGA	High	←	Wide	15	Digital
LC99117	B&W	CIF	CIF	Very High	←	Wide	30	Digital

### CCD Module Basic Structure Example



High image quality, ultraminiature size, and low power makes these devices optimal for use in cell phone

# 1/4-Type 3.2 MP CCD Camera Module for Cell Phones

HyperEye™

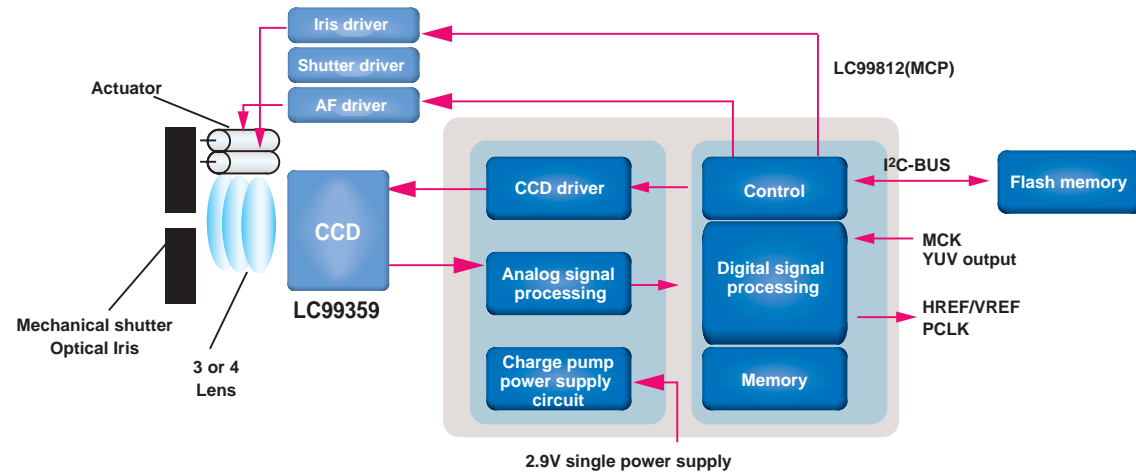
The stable and reliable image quality provided by CCD image sensors. The simultaneity of an image in which the whole image was captured at the same instant. A great depth of field that makes focusing unnecessary. Even if the camera is only a cell phone camera, the instant captured is, for the user, still an important instant in their life. This is why SANYO is committed to providing products that make no compromises.

1/4-Type 3.2 MP CCD Chipset

## LC99359+LC99812

HyperEye™

### Chipset Example



### Introducing the Component Devices

3.2 MP Frame Transfer CCD Image Sensor

## LC99359

New product

- Diagonal: 1/4 type
- 3.2M pixels
- Effective pixels: 2079 × 1554 (H × V)
- Square pixels (1.8 × 1.8 μm<sup>2</sup>)
- Color filters: Primary color (RGB) Bayer
- Package: CSP

High performance DSP for LC99359

## LC99812

New product

- On-chip CCD driving timing generator and CCD driver
- On-chip power supply circuit for driving charge pump type CCD
- AGC
- YUV and RGB output signal
- Power saving mode
- Built-in smear correction circuit, automatic dropout correction circuit
- Shading correction
- Noise control circuit
- Timing generator to drive the mechanical shutter
- Scaling and zoom functions
- Timing generator for auto-focus control, auto-exposure control, autowhite balance control, and mechanical iris control
- Supply voltage: 2.9 V (single-voltage operation)
- Package: BGA128

## Great Depth of Field

This is a truly easy-to-use camera, since it has a wide range, from close at hand to far away, over which subjects are in focus, and thus it is difficult to accidentally create blurred out of focus images.



Far Near



When used in applications such as cell phones, this camera can easily take photographs such as the one shown above, since the user can check a preview image while shooting.

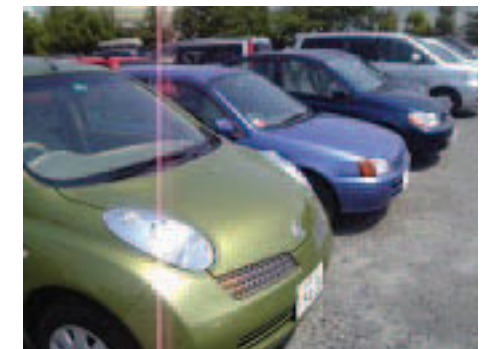
## Mechanical Shutter

Smear does not occur during still imaging when used in a module that includes a mechanical shutter.

Module that includes a 2-stage (f/3.5 and f/7.0) optical aperture



Including a mechanical shutter



Not including a mechanical shutter

## Modules that use this CCD Chipset

	IGT99353M-SUB1	IGT99268GC-ST1	IGT99268C-ST1	IGT99267J-ST	IGT99267J-SUB
Photo					
Type	1/4.5 1.0 MP	1/7 VGA	1/7 VGA	1/9 CIF	1/9 CIF
CCD sensor	LC99353	LC99268GFB	LC99268FBX	LC99267FB	LC99267FB
DSP	LC99810	LC99809	LC99808	LC99807	LC99807
Size		8X8X5.3 mm <sup>3</sup> (Typ.)	8X8X5.3 mm <sup>3</sup> (Typ.)	8.4X10.3X5.1 mm <sup>3</sup> (Typ.)	8.4X16.0X5.1 mm <sup>3</sup> (Typ.)
Remark	Mechanical shutter	VGA 30 fps	VGA 15 fps		Connector on board



An FM radio can be easily included in a limited space in a small product

# System-on-chip FM Radio ICs for Miniature Cell Phones

FM Radio IC

## Easy Radio IC™ LV24000 Series

New product

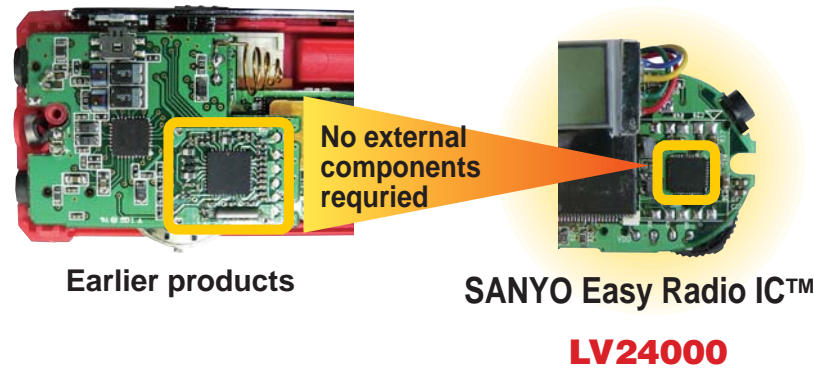
The LV24000 family devices are FM radio ICs that require absolutely no external components.\* These devices include not only the FM radio function, but source selector, master volume control, tone controls, headphone amplifier, and other functions in the same tiny  $5.0 \times 5.0 \times 0.8 \text{ mm}^3$  VQLP package. These ICs are superb for adding new FM radio functionality in the small limited space available in existing products, such as cell phones and other portable electronic equipment.

### Featuring

- Absolutely no external components required
- Absolutely no adjustments required
- Low IF frequency (110 kHz) adopted for improved selectivity
- No FM detection discriminator required
- Built-in adjacent channel interference function (114 and 190 kHz)
- New tuning technique
- Ultrahigh sensitivity reception achieved by low-noise mixer input circuit
- Low-current standby mode obviates the need for a power supply switch
- RDS composite output
- Three-wire bus interface adopted (clock, data, and NR-W)
- Digital AFC function
- Soft muting and high-blend stereo (3-stage programmable)
- Supports manual search, automatic search, and auto-preset functions
- Supports reception in all regions worldwide (all Japanese, European, and US bands can be received by changing just the software)
- Master volume control
- FM: 76 to 108 MHz
- Source selector function (LV24001)
- Headphone amplifier (LV24002)

Not only reducing the device prices but also reducing the various costs during development

### Comparison with earlier products



### Including All the Functions

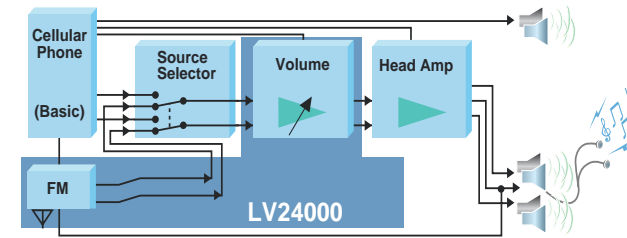
- FM function (LV24020)
- FM+AM function (LV24100)
- FM+RDS function (LV24010)
- FM+amplifier function (LV24003)

An adjustment-free FM radio function can be included with absolutely no external components. Since an ultraminiature  $5.0 \times 5.0 \times 0.8 \text{ mm}^3$  package is used, this device is extremely useful for including an FM radio function in cell phones, PDAs, memory audio players, and other portable electronic equipment.

### Application Example

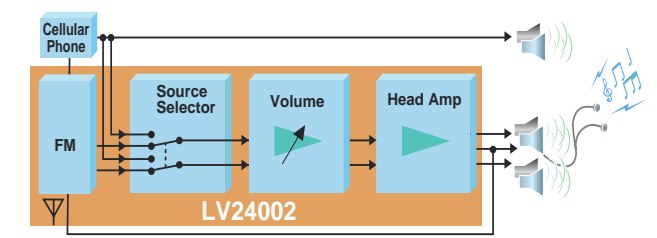
#### Cell phone (1)

LV24000: FM radio function

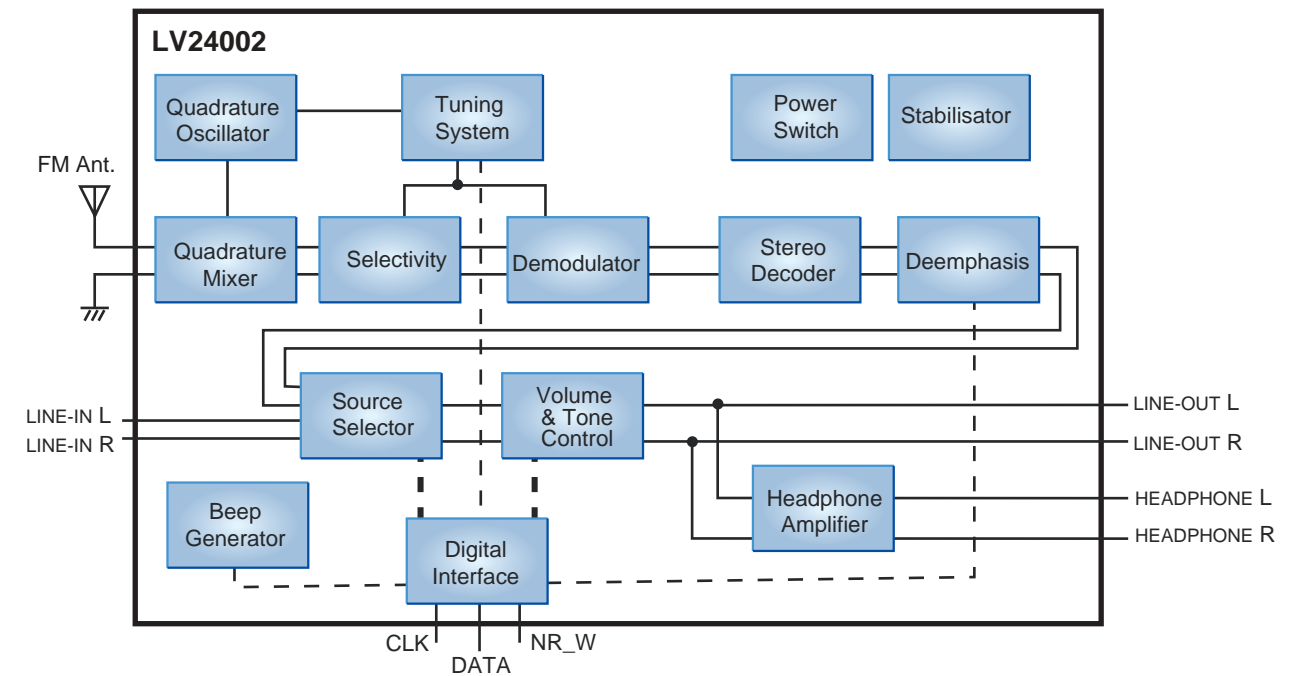


#### Cell phone (2)

LV24002: FM radio + source selector + headphone amplifier functions



### LV24002 Block diagram



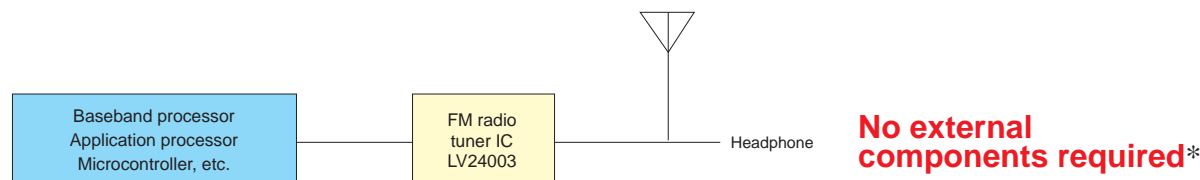
\*: A separate coil is required for applications that include an AM radio

An FM radio can be easily included in a limited space in a small product

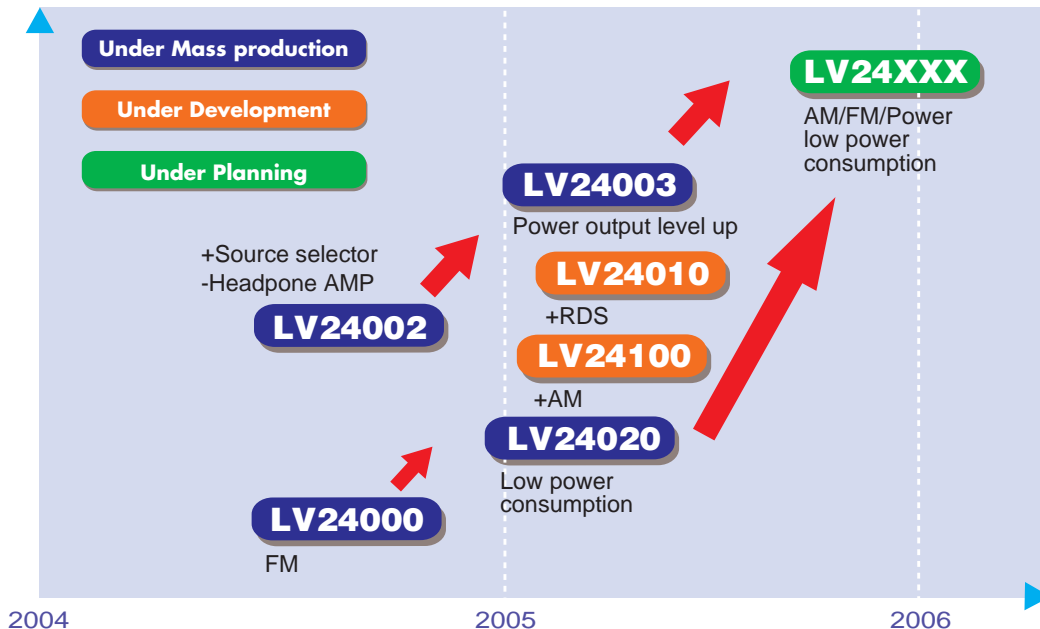
# System-on-chip FM Radio ICs Easy Radio IC™ Series

## Function and lineup

		LV24000	LV24002	LV24020	LV24100	LV24010	LV24003	LV24200
Function & Spec	FM	Supported	Supported	Supported	Supported	Supported	Supported	Supported
	Master Volume	Supported	Supported	—	—	—	Supported	—
	Tone Control	Supported	Supported	—	—	—	Supported	—
	Beep Generator	Supported	Supported	—	—	—	Supported	—
	Source Selector	—	Supported	—	—	—	Supported	—
	Headphone Amplifier	—	4mW at 32Ω	—	—	—	10mW at 32Ω	—
	AM	—	—	—	Supported	—	—	—
	RDS Demodulator	—	—	—	—	Supported	—	—
	uP I/F	3 wire	3 wire	3 wire	3 wire	3 wire	3 wire	I <sup>2</sup> C/SPI/ 3 WIRE
	Tuning	Soft	Soft	Soft	Soft	Soft	Soft	Self
Icco	18mA	22mA	14mA	14mA	14mA	20mA	14mA	
Schedule	MP	Available	Available	Available	Available	Available	Available	Available
Package	VQLP40	Supported	Supported	Supported	Supported	Supported	Supported	Supported
	TSSOP24	Supported	—	T.B.D	T.B.D	T.B.D	T.B.D	T.B.D



## SANYO Easy Radio IC Road Map



This is **what has changed** since the earlier products!  
Three points about the Easy Radio IC™

- No external components required\***  
Makes cost reductions possible
- Miniature package**  
Ultraminiature 5 × 5 × 0.8 mm<sup>3</sup> size
- High-sensitivity reception**  
Achieves clear audio

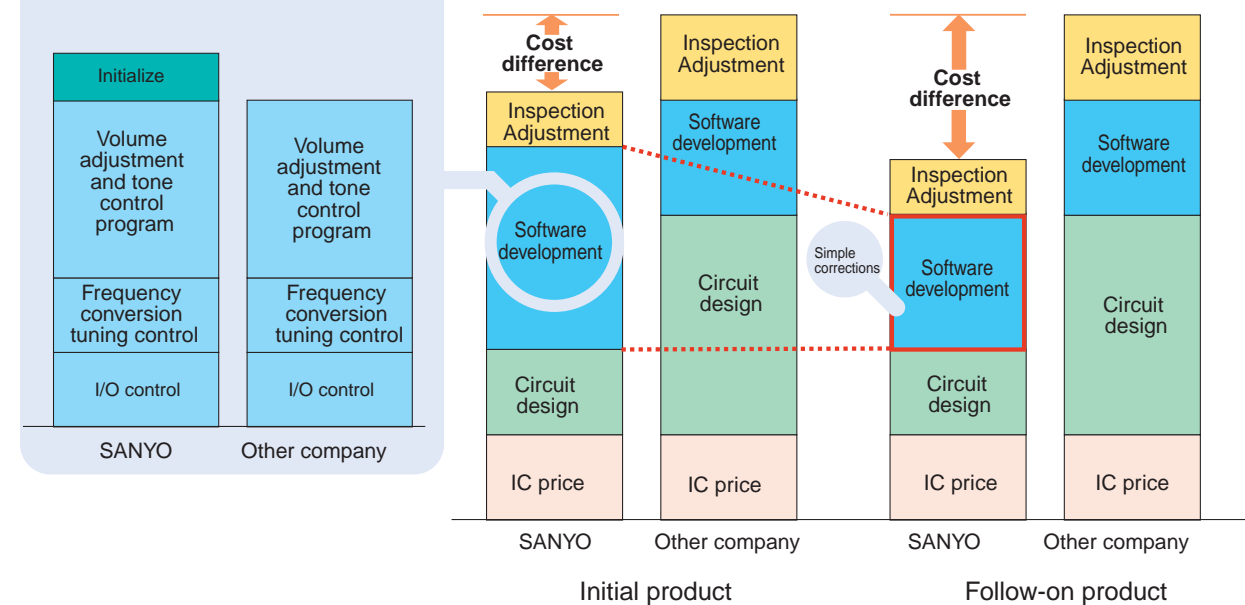
## Changing Total Costs

- The analog circuit design technology (know-how based on long experience) that has been necessary up to now is no longer required.
- Although even more time will be required to create the initialization block during software development, this block will be able to correct product sample-to-sample variations, radically **reducing the testing and adjustment during the manufacturing process**, and as a result, reduce total costs. Furthermore, since software once developed can be reused in later products, this effort is not wasted.

### Comparison of software development costs

#### Itemized comparison of software development costs

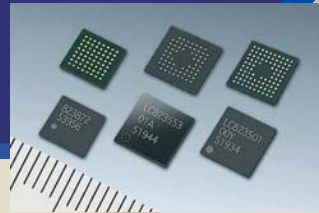
Although the first initialization is required, this can correct for product sample-to-sample variations.



SANYO can provide sample software and algorithms to even further reduce the burden on software developers.

\*: A separate coil is required for applications that include an AM radio

## Sound Generator IC (MIDI)



SANYO has developed ICs that, in addition to support for even more sounds, also include new functions such as support for new standard melody formats and 3D audio.

Integrates 128-voice polyphony + PCM, 3D surround, 3D positioning\* and Mobile XMF support

### LC823872

New product

#### Featuring

- Capable of generating up to 128-voice polyphony in a full PCM sound generator  
128 GM sounds + 47 drum sets + 32 sound effects sounds (conforms to GM1)
- Includes a 3D surround function and a 3D positioning\* function that allows the specification of positioning information that positions the generated sound at an arbitrary position in three-dimensional space.
- Supports not only the Mobile XMF new melody format but also a variety of other formats
- User Customized Sound function that allows the user to register arbitrary sounds
- Supports up to four songs worth of MIDI data and can play up to four channels of ADPCM (PCM) data at the same time
- Includes a 4-band parametric equalizer that can provide optimal equalization for the speakers used
- Supports karaoke and Java applications: JSR135, JSR2348. Supports special effects such as pitch bend, vibrato, delay, reverb, chorus, Doppler, and compression.
- Supply voltage: internal 1.5 V, I/O 1.8 to 2.8 V
- Package: FBGA64 (5x5x1.2 mm)

Integrates 64-voice polyphony + PCM, 3D surround, 3D positioning, Mobile XMF support and MP3/AAC decoding

### LC823553

New product

#### Featuring

- Capable of generating up to 64-voice polyphony in a full PCM sound generator (conforms to GM1)
- Includes a 3D surround function and a 3D positioning\* function that allows the specification of positioning information that positions the generated sound at an arbitrary position in three-dimensional space.
- Supports not only the Mobile XMF new melody format but also a variety of other formats
- User Customized Sound function that allows the user to register arbitrary sounds
- Supports up to four songs worth of MIDI data and can play up to four channels of ADPCM (PCM) data at the same time
- Includes a 4-band parametric equalizer that can provide optimal equalization for the speakers used
- Supports karaoke and Java applications: JSR135, JSR2348
- Includes an MP3 and AAC decoder function. The industry's lowest power consumption: 8.5 mW for both MP3 and AAC
- Built-in 8-band graphic equalizer
- Supply voltage: internal 1.8/1.3 V, I/O 2.85 V
- Package: WL-CSP64 (6.1x6.1x0.9 mm<sup>3</sup>)

Integrates 64-voice polyphony + PCM, 3D surround and MP3/AAC decoding

### LC823501

New product

#### Featuring

- Capable of generating up to 64-voice polyphony in a full PCM sound generator (conforms to GM1)
- Integrated 3D surround function that creates a rich feeling of spaciousness
- Includes an MP3 decoder function. The industry's lowest power consumption: 8.5 mW for MP3
- User Customized Sound function that allows the user to register arbitrary sounds
- Supports up to four songs worth of MIDI data and can play up to four channels of ADPCM (PCM) data at the same time
- Includes a 4-band parametric equalizer that can provide optimal equalization for the speakers used
- Supports karaoke and Java applications: JSR135
- Supply voltage: internal 1.8/1.3 V, I/O 2.85 V
- Package: PFBGA89 (6.0x6.0x0.8 mm<sup>3</sup>)

\*: 3D positioning function  
Function that can create a realistic impression of space even from cell phones that cannot provide an adequate speaker separation.

Support for 24 hours of playback

## Audio Compression IC

Although previous audio playback periods have been largely limited to 3 to 5 hours, it is now possible to achieve playing times of 24 hours or longer by adopting SANYO audio compression ICs.

MP3/WMA Decoder

### LC823231

#### Featuring

- Ultralow power (MP3: 10 mW, WMA: 15 mW)
- Supported formats
  - MPEG1, MPEG2, MPEG2.5 (all sampling frequencies, all bit rates)
  - WMA
- Digital volume and tone control circuits
- Digital equalizer and audio leakage prevention functions (D/A converter based)
- $\Delta\Sigma$  D/A converter and class D amplifier
- PCM I/O interface
- Sleep mode
- Crystal oscillator frequency: 16.9344 MHz (44.1 kHz x 384)
- Sampling frequencies other than 44.1 kHz supported with built-in PLL circuit

Single-Chip Audio

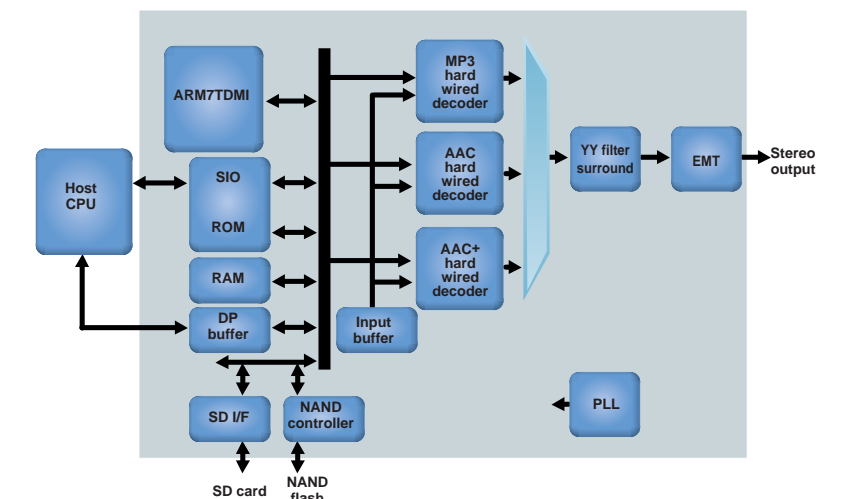
### LC82335X

Under development

The LC82335X ICs support MP3, AAC, and AAC+.

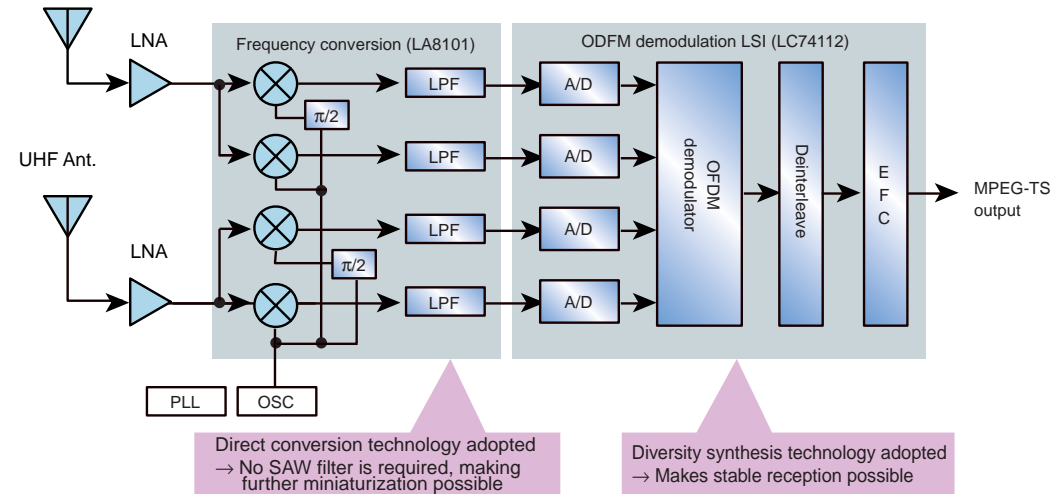
By implementing the MP3, AAC, and AAC+ decoding functions in a hardwired structure, these ICs achieve an ultralow power consumption that would be impossible in a DSP based structure.

- Hardwired MP3, hardwired AAC, and hardwired AAC+.
- Ultralow power consumption: 10 mW
- Buffer size: 10 KB
- Built-in YY filter
- SD interface
- ARM7TDMI



# Terrestrial Digital One-Segment Chipset

Miniature reception modules with low power consumption that achieve stable reception under rapidly changing conditions are required for cell phones and other portable terminals. SANYO has established independently developed diversity synthesis technology and the industry's first direct conversion technology that together meet these requirements.



Direct conversion technology adopted  
→ No SAW filter is required, making further miniaturization possible

Diversity synthesis technology adopted  
→ Makes stable reception possible

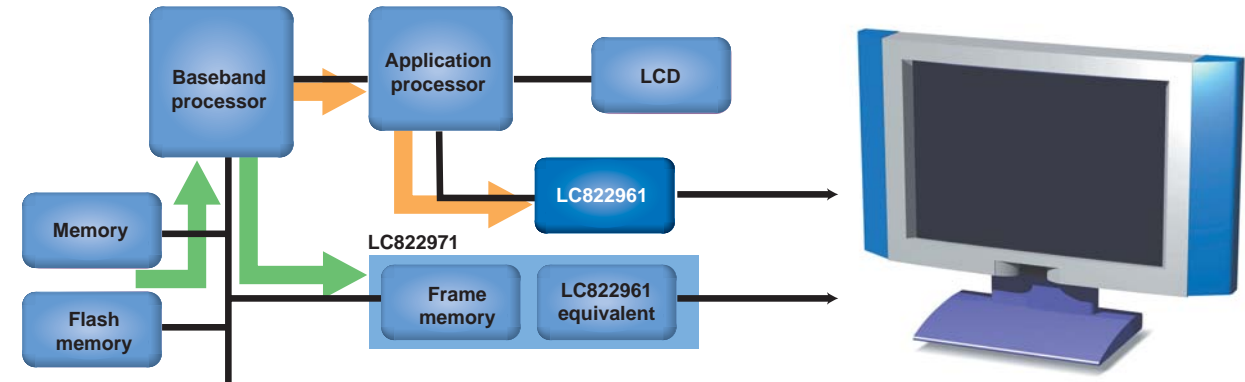
**Due to the adoption of direct conversion technology**

- Large external components such as a SAW filter are not required
- Image cancellation using analog circuits is no longer required, and at the same time as reducing the size of the circuit and the power consumption, circuit performance does not degrade over time or due to temperature fluctuations.

**This approach achieves antenna diversity, which is effective at improving reception performance.**

# NTSC/PAL Video Encoder

This IC makes it possible to display the cell phone's LCD screen contents or image data that was taken with the camera and is stored in the camera's memory on a TV (video input).



NTSC/PAL Encoder

## LC822961

## LC822963

New product

Converts base band processor generated video and provides other functions for TV output.

- Miniature package (CSP42: 3.3 × 3.78 mm<sup>2</sup>)
- 10-bit D/A converter with built-in 75Ω driver
- Supports a wide variety of input data rates (ITU-R601/SQ)
- The LC822963 is an MCP package version of the LC822961 audio operational amplifier (LA6358N).
- Application examples: TV games, video players

NTSC/PAL Encoder with On-Chip DRAM

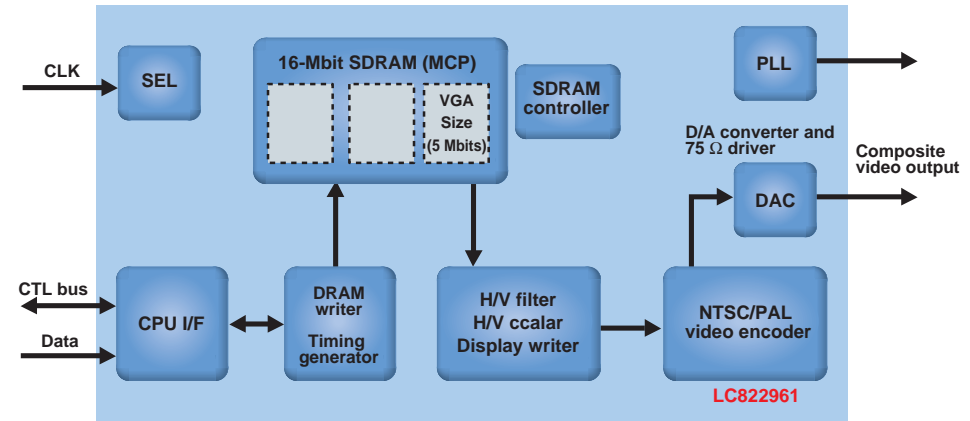
## LC822971

Under development

Data written to memory can be continuously output to a TV without being sequentially updated using the internal frame memory.

Once the data has been written it can be displayed with essentially no load on the microcontroller.

- On-chip 16 Mbit SDRAM. Allows drawing by the CPU without concern for the TV display rate.
- Rotation processing (at write), enlargement processing (at display)
- The NTSC/PAL encoder block is the same as that in the LC822961.
- Application examples: Photograph album shows, business presentation tools



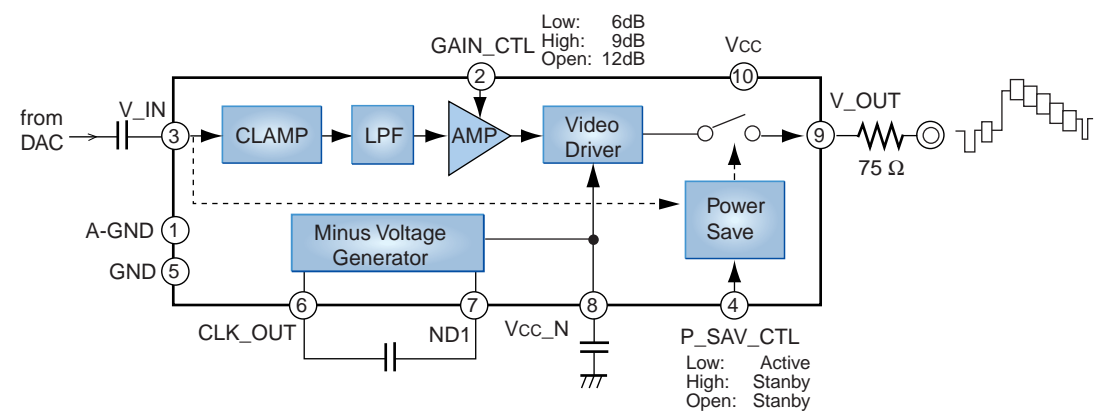
# Cell Phone Video Drivers

Video driver

## LA73074CL

New product

- No output coupling capacitors required
- Low-voltage drive (2.7 to 3.6 V)
- Voltage sag does not occur
- Built-in sixth-order low-pass filter (fc = 7.5 MHz)
- Standby mode power consumption: 0 μA
- The amplifier gain can be selected (6, 9, or 12 dB)



# Earphone Mic Solutions

Under development

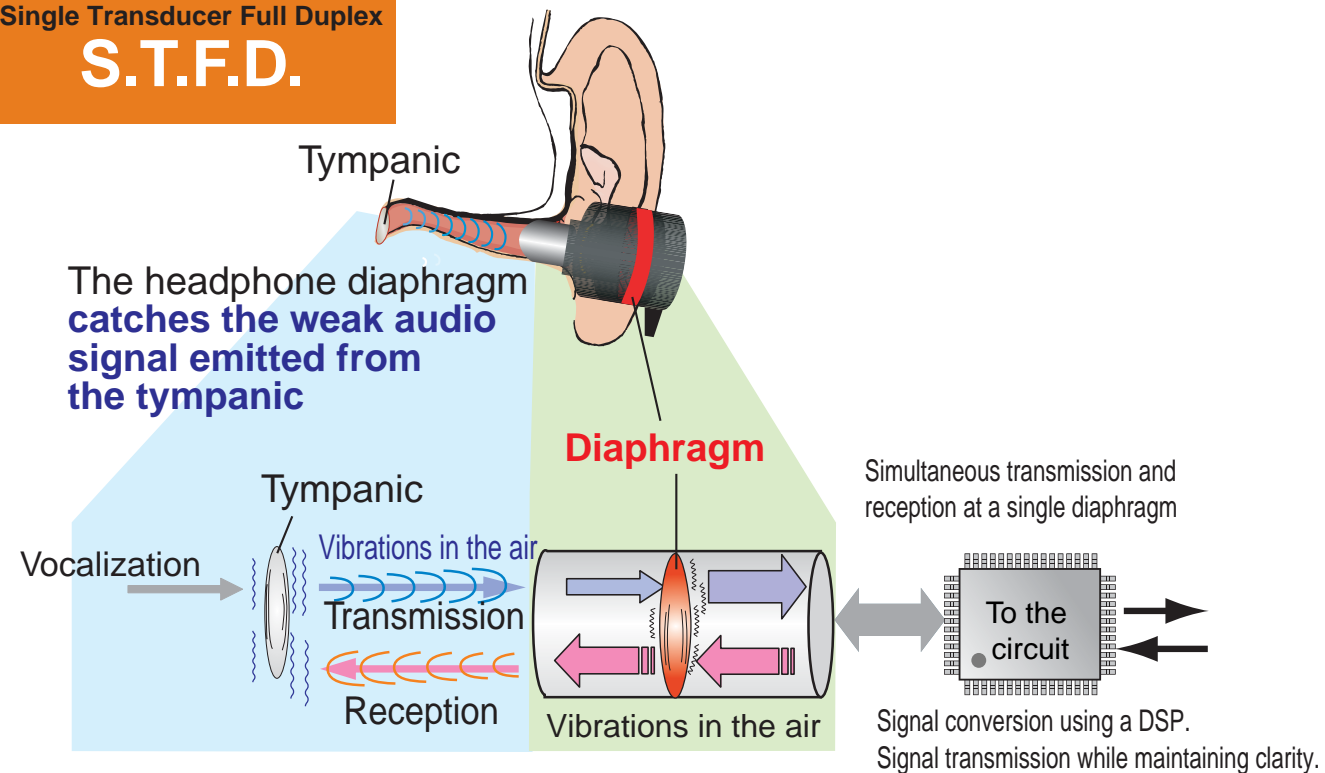
## What is an earphone mic?

SANYO is developing a chip that can support phone conversations with just an earphone.

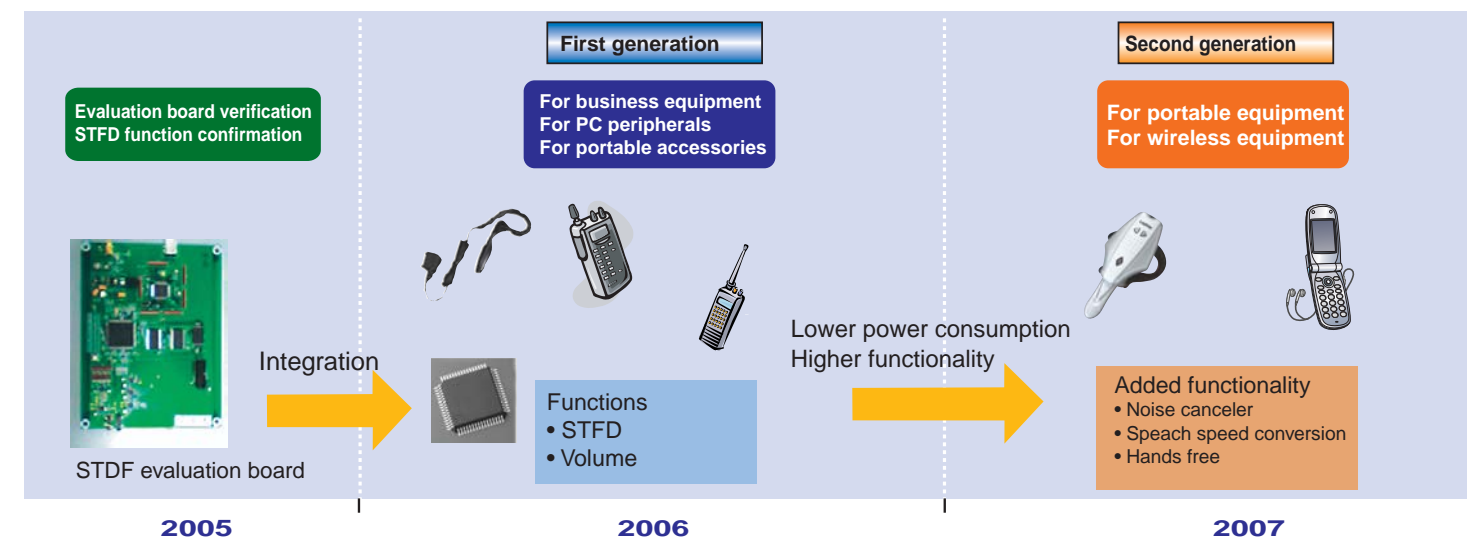
Conversation is possible without taking off your earphones.

- **STFD (single transduce full duplex) technology makes a separate microphone unnecessary!**  
Increased flexibility in end product design
- **Phone conversions are possible even in crowds or noisy environments**  
Since the sound is picked up directly in the ear, wind and other sounds can be reduced.
- **Better audio quality than bone conduction microphones**  
Since an even clearer voice sound is possible, it is easy to identify the speaker.
- **New applications in various other wireless markets**  
Phone conversations are possible without removing one's earphones when listening to music.

### Single Transducer Full Duplex S.T.F.D.



## Development roadmap



# LED Driver ICs

SANYO provides LED drivers that support automatic gradation production using full-color LEDs and can provide high-capacity outputs up to a total of 500 mA using a switching power supply technique as well as white LEDs for backlights using a charge pump method optimal for white LEDs.

## Switching power supply LED drivers

These are LED drivers that can provide a high-capacity output up to a total of 500 mA using a switching power supply technique, and cover applications such as main LCD backlights, sub-LCD backlights, camera flash systems, and full-color LED indicators.

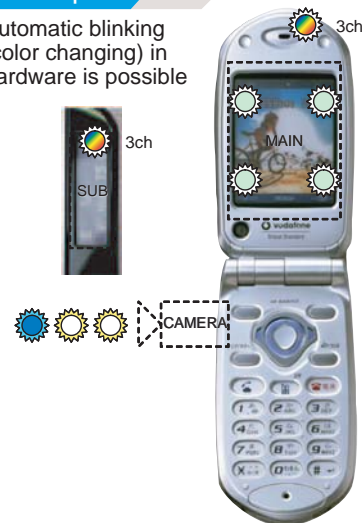
Gradation production using full-color LEDs is also supported (automatic).

### LV5202PL

Under development

- 13-channel 9-lamp LED driver (Main LED: 4, Sub RGB: 1, Lighting LED: 3, Singe RGB:1)
- Supports 3-color backlights appropriate for simply monochrome displays for sub-displays.
- Switching power supply technique: Can provide up to 500 mA output
- Supports I<sup>2</sup>C bus
- Ultraminiature package:QFN32 (4.0x4.0x1.0 mm<sup>3</sup>)

Automatic blinking (color changing) in hardware is possible

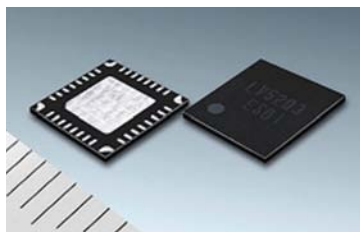


9 LEDs   2 RGB AUTO   Switching 500 mA   I<sup>2</sup>C =

### LV5203FN

Under development

- 13-channel 11-lamp LED driver (Main LED: 4, Sub LED: 2, Lighting LED: 4, Singe RGB: 1)
- Switching power supply technique: Can provide up to 500 mA output
- Three-wire serial bus support
- Ultraminiature package:VQFN32 (5.0x5.0x0.85 mm<sup>3</sup>)



11 LEDs   1 RGB AUTO   Switching 500 mA   3-wire Serial =

### LV5204PL

Under development

- 13-channel 11-lamp LED driver (Main LED: 4, Sub LED: 2, Lighting LED: 4, Singe RGB: 1)
- Switching power supply technique: Can provide up to 500 mA output
- Supports I<sup>2</sup>C bus
- Ultraminiature package:VQLP32 (4.0x4.0x0.85 mm<sup>3</sup>)



11 LEDs   1 RGB AUTO   Switching 500 mA   I<sup>2</sup>C =

Drivers for 3-color LEDs that have an external control interface

### LV5213PL

Under development

- 3-channel 1-lamp LED driver (Singe RGB: 1)
- Switching power supply technique: Can provide up to 80 mA output
- Three-wire serial bus support
- Ultraminiature package: VCT16 (2.6x2.6x0.85 mm<sup>3</sup>)

1 LED   1 RGB AUTO   Switching 80 mA   3-wire Serial =

## Charge pump type LED driver

This is a 4-lamp white LED driver for main LCD backlights that allows the brightness to be adjusted with an external PWM input.

Generates the optimal voltages for white LEDs with a high-efficiency charge pump type step-up circuit.

Can provide a constant current output up to a total of 140 mA.

### LC410591

Under development

- 4 channels (Main LED:4 )
- Charge pump power supply technique: Can provide up to 104 mA output
- Supports brightness adjustment over a serial data input (10 steps)
- Power saving mode
- Soft start function
- Input voltage 2.7 to 5.5 V
- Ultraminiature package:VQFN16 (4.0x4.0x0.85 mm<sup>3</sup>)

4 LEDs   Charge pump 104 mA   3-wire Serial =

### LC410592

Under development

- Two groups for a total of 7 channels (Main LED: 4, Sub LED: 3)
- Charge pump power supply technique: Can provide up to 140 mA output
- Supports brightness adjustment using an external PWM input (input for each group)
- Automatic switching between 1x and -0.5x step-up modes
- Power saving mode
- Soft start function
- Input voltage 2.7 to 5.5 V
- Ultraminiature package:VQFN16 (4.0x4.0x0.85 mm<sup>3</sup>)

7 LEDs   Charge pump 140 mA   PWM Control =

# New Charge Pump ICs

## Features of New Charge Pump ICs

CCD image sensors require a high drive voltage of 10 to 20 V. This 10 to 20 V level is created by stepping up the 3 V power supply level.

Since conventional charge pump voltage step-up technologies suffer from increased power loss when used to step up the original voltage by over three times, their use in cell phones was problematic.

SANYO has, however, discovered a way of fusing their high level analog circuit and device technologies to overcome this problem.

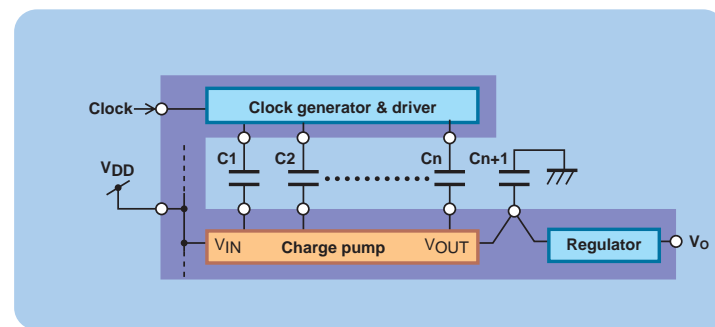
This new charge pump technology can step up a regulated voltage by a factor of three or higher with an efficiency as high as 70%. Furthermore it can provide an output current of several tens of mA.

SANYO was the first in the industry to develop a high-performance charge pump.

This new charge pump technology can provide both positive and negative stepped up levels, can be combined into multiple stages, and can provide multiple output levels. Thus this circuit technology is optimal for use in future camera cell phones that include a megapixel-class CCD image sensor.

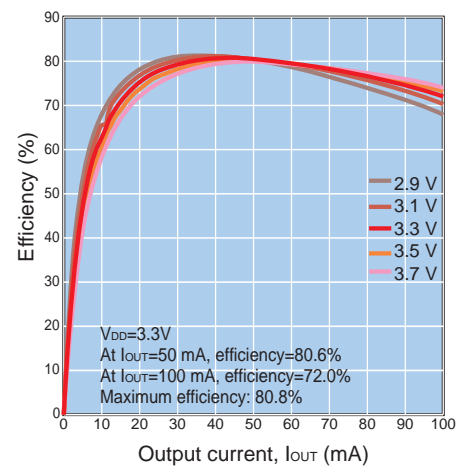
- High efficiency (Prior to the regulator: 90 to 95 %)
- Coilless, low noise
- Supports high output current designs
- The only external components are thin form capacitors (no coils or diodes required)
- Can provide both positive and negative stepped-up outputs
- Supports fine step-up step sizes  $+0.5 \times n \times V_{DD}$
- Supports fine step-up step sizes  $-0.5 \times n \times V_{DD}$  (n: integer)
- Optimal for use as the power supply in portable equipment

### IPBlock diagram

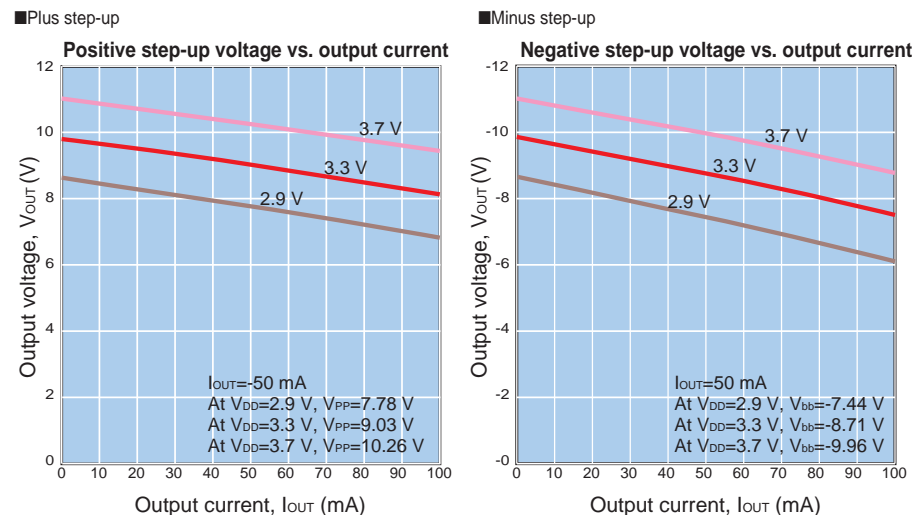


### Sample characteristics of a high-current charge pump (single supply voltage $\rightarrow \pm 3\times$ )

Dependency of efficiency on the supply voltage



### Output voltages from positive and negative step-up operation

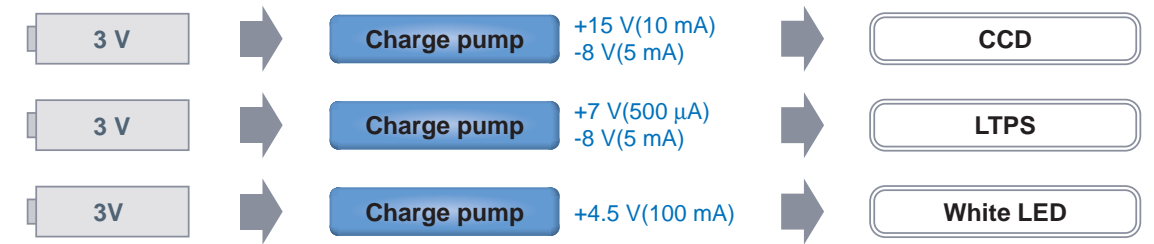


This IC is based on a unique SANYO idea and is a high-efficiency charge pump IC that was newly-developed taking advantage of CMOS technologies that fuse SANYO's circuit and process technologies. This IC is optimal for power supplies in portable electronic equipment.

This IC introduces technologies that completely overturn the previous common knowledge that although charge pump circuits were low noise, they suffered from poor efficiency.

## Charge pump power supply application

The ability to provide a stepped-up voltage with low noise makes this circuit optimal for embedding in modules.



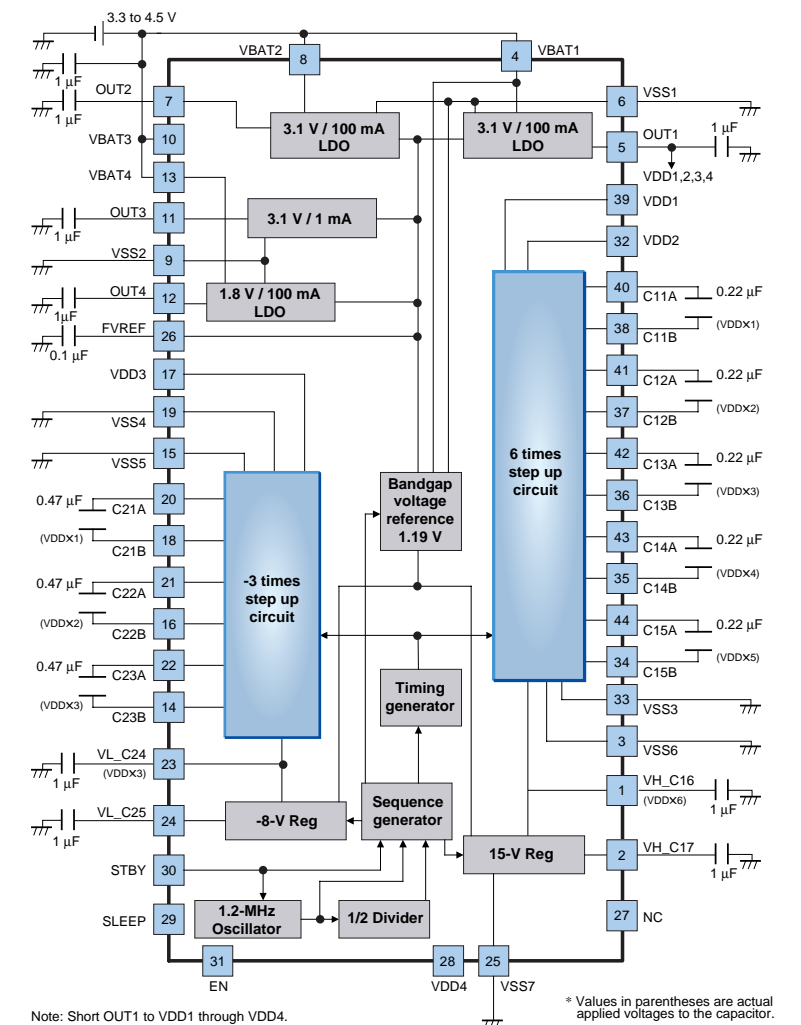
### CCD Power Supply IC for Camera Cell Phones

## LV5711FN

Under development

- Regulates a 3.3 to 4.5 V battery level to 3.1 V and steps up that level 3x and 6x using a charge pump, to provide the two regulated power supply levels required by the CCD image sensor.
- $V_H = +15.0\text{ V}$
- $V_L = -8\text{ V}$
- Two independent charge pump systems are provided for  $V_H$  and  $V_L$
- Built-in regulators for the analog system power supply, vertical driver system, and DSP core

### Block diagram



Note: Short OUT1 to VDD1 through VDD4.

\* Values in parentheses are actual applied voltages to the capacitor.

# Motor Drivers for Cell Phones

Demand for camera cell phones is increasing rapidly not only in Japan, but in most markets around the world as well. While compact, high image quality cameras are in demand in the cell phone market, there are also increasing desires for high-level camera functions such as mechanical shutters and autofocus. SANYO developed even further their motor driver technologies nurtured through years of experience in the digital camera field and provides these technologies for use in camera cell phones as ultraminiature package motor drivers that require few external components.

Motor Driver ICs for Cell Phones

## Miniature Driver Series

### Camera Cell Phone Driver Lineup

	Shutter	Iris diaphragm	Focus	Zoom
Voice Coil Motor	LB1941T/CL Constant Current	LB1938T/CL 800 mA	LB8681CL <small>New product</small> Constant Current 1.5 ch	
Stepping Motor (2-phase excitation)	LB8682PL Constant Current 1 ch + 2 ch		LB1801CL <small>New product</small> Comp.IN	LB1801CL <small>New product</small> Comp.IN
Stepping Motor (1-2-phase excitation)			LB8686PL <small>Under development</small> 1.5 ch X 2	LB1800CL <small>Comp.IN</small>
PIEZO (SIDM)			LV8071LG <small>Under development</small>	LB1800CL <small>Comp.IN</small>

Two-phase excitation motor drivers

## LB1801CL

**New product**

### For autofocus and zoom

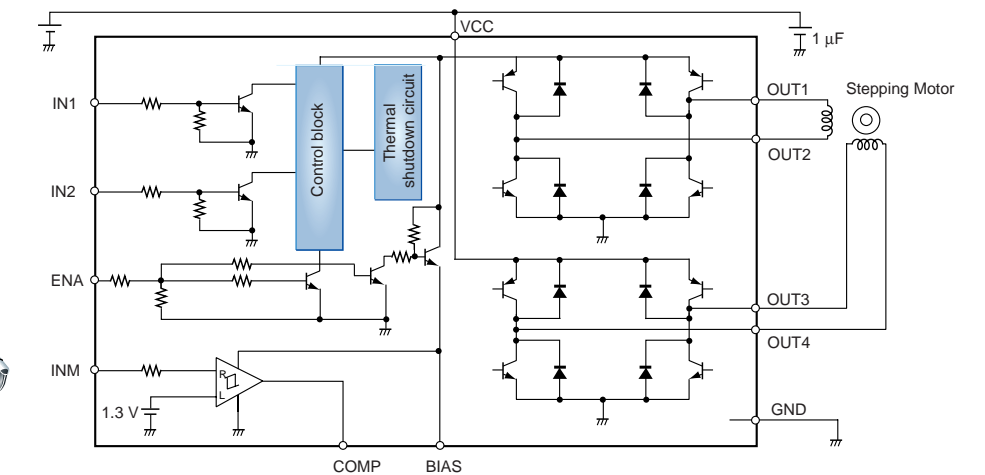
- Supports an FR position detection output
  - Low saturation voltage output
  - Two-phase excitation driver
  - Low-voltage drive
- Drive is possible from 2.2 V

### Compact Package

12-pin 2.8 mm □ Package



### Block diagram



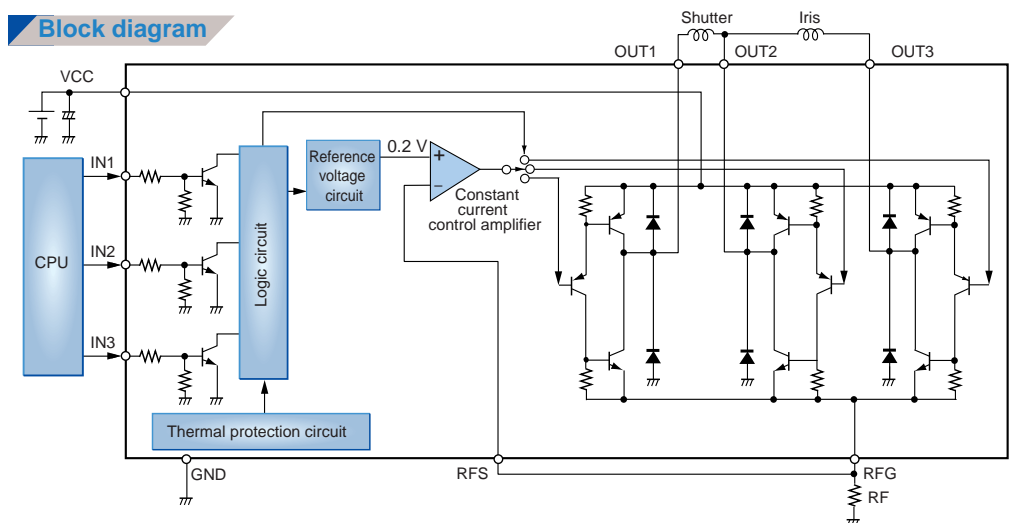
Constant current driver with H bridge x 1.5 ch

## LB8683CL

**Under development**

### For Shutter and Iris Diaphragm System

### Block diagram



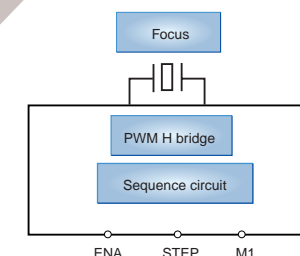
Auto Focus Piezo actuator

## LV8071LG

**Under development**

### For Auto-Focus Motors

### Block diagram



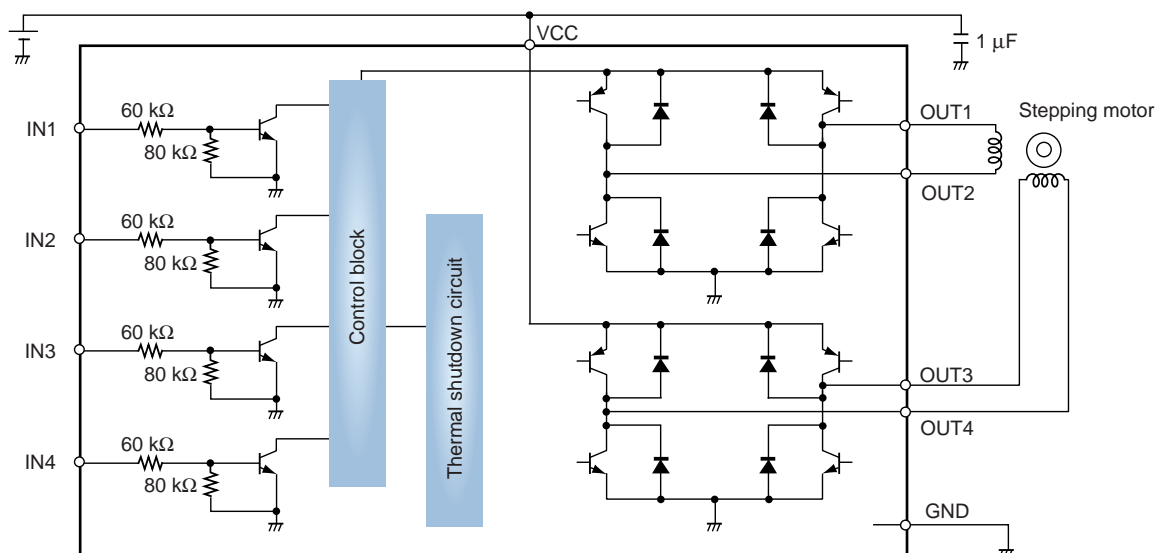
Lens Driver IC for Cell Phones

## LB1906CL

### For Auto-Focus Motors

Saturated control and 1-2 phase excitation drivers

### Block diagram





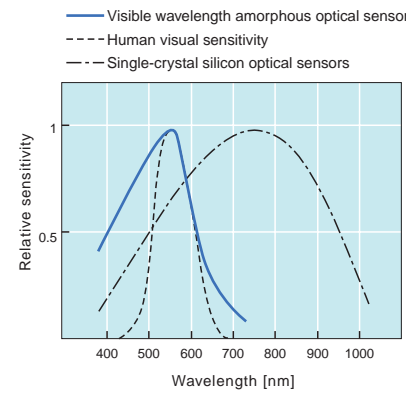
# Amorphous Optical Sensors

Amorphous Silicon Solar Cells

## Amorphous Optical Sensors

These devices are a type of photodiode that can detect the presence/absence of ambient light, or the intensity of ambient light.

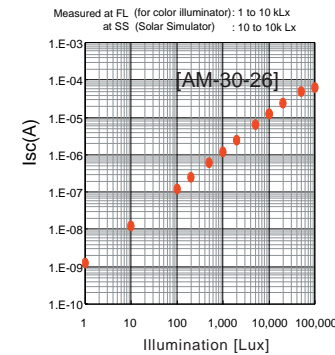
### Amorphous optical sensor spectral sensitivity



### High sensitivity in the visible region

The human eye is sensitive to light with wavelengths from about 400 nm to about 700 nm. Since these amorphous optical sensors have sensitivity to essentially the same wavelengths, they provide sensing that is close to that of the human eye.

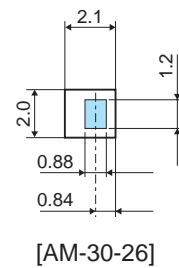
### Illumination-dependent characteristics of ISC



### The output current is proportional to the illumination

Since the output current changes proportionally to the light striking the sensor, these devices provide precise detection.

### Amorphous optical sensor pattern examples



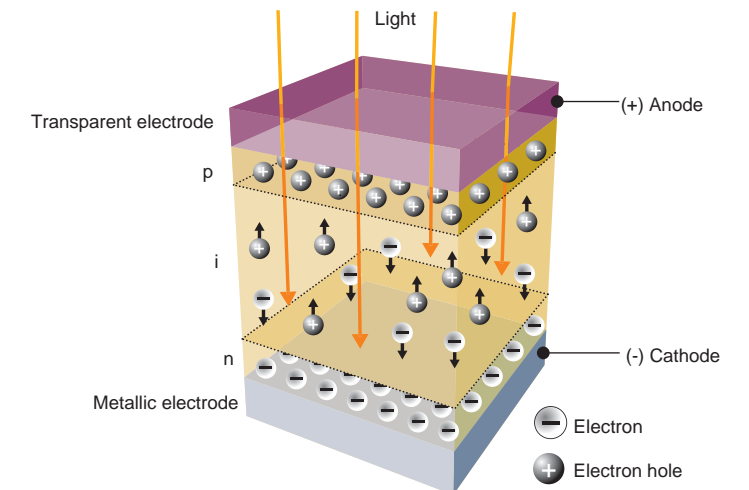
### Flexible pattern geometries and sizes

These devices support designs with sizes and shapes that correspond to the target application.

These devices are a type of photodiode that can detect light with about the same sensitivity as the human eye. Since these devices flexibly support a wide range of end product designs and sizes, they can be used to control the LCD backlight and button lamps in cell phones to implement power saving automatic brightness adjustment

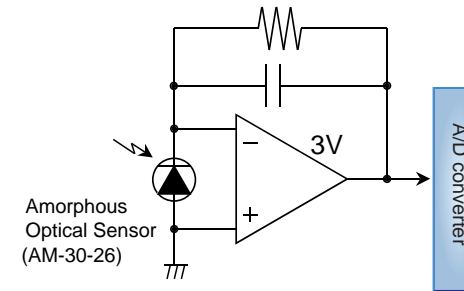
## Amorphous Optical Sensor Structure

Like amorphous silicon solar cells, amorphous optical sensor use the photovoltaic effect in semiconductors. When light hits a semiconductor, electrons and holes are created, the electrons diffuse in the n-type semiconductor, and the holes diffuse in the p-type semiconductor. As a result, a current will flow when the two semiconductor types are connected externally.



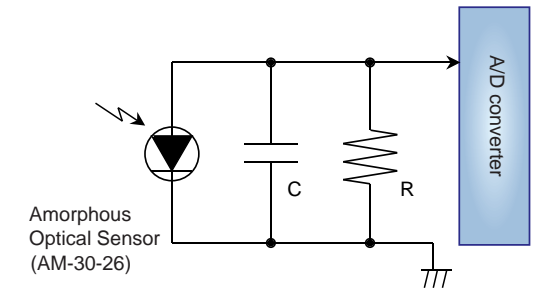
## Amorphous Optical Sensor Circuit Examples

### With an operational amplifier



The current output from the amorphous optical sensor is converted to a voltage, and signal processing is applied to that voltage. Normally, an operational amplifier is used for linear amplification.

### Without an operational amplifier



The amorphous optical sensor is connected to a resistor and the voltage is input directly to an A/D converter for discrimination.

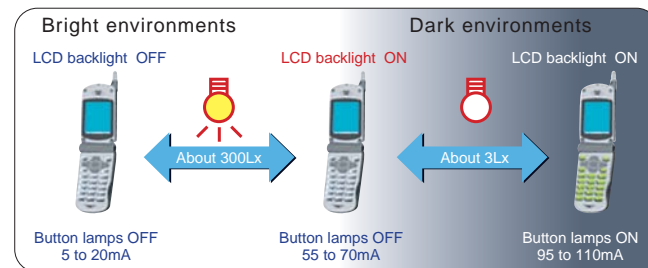
## Amorphous Optical Sensor Application Examples

### Automatic adjustment of LCD backlight and operating panel buttons

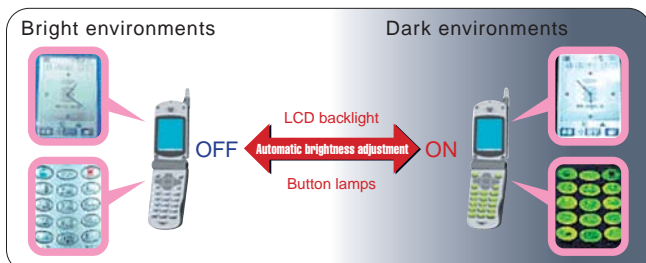
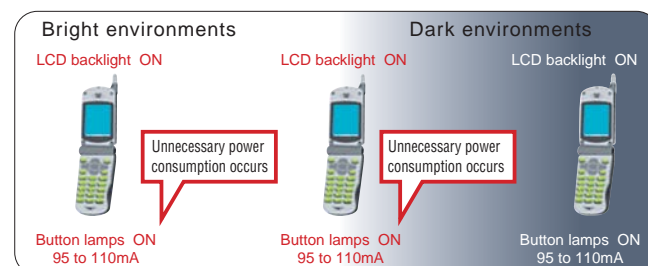
These sensors can be used to sense the ambient illumination level and automatically turn off these lamps in bright operating environments. This reduces unnecessary power consumption and creates LCD screen display that is easy to see whatever the ambient lighting.

- Increased operating time for portable electronic equipment due to reduced power consumption!
- LCD backlight level automatically adjusted to just the right level for viewing according to the ambient illumination level

### Cell phone with built-in optical sensor



### Cell phone without built-in optical sensor



## Amorphous Optical Sensor Product Lineup

Type No.	External dimensions (mm)	Short-circuit current (Isc, typical)	Dark current (V <sub>R</sub> = 50 mV) MAX.
AM-30-26	2.1 × 2.0 mm <sup>2</sup> (glass thickness: 0.4 mm)	1.2 μA *1	10 pA

\*1 : at 1000Lux, Fluorescent Light for color illuminator

Contact your SANYO sales representative for details on these products

# SANYO's Lineup of High-Reliability Discrete Devices

## Bipolar Transistor for LNA

Low noise, High gain transistors  
( $f_T=20$  GHz)  
SBFP405M, SBFP420M...etc.

## GaAs MMIC products for antenna switches and local switches

Low insertion loss MMIC / High isolation MMIC  
SPM3211, SPM3212, SPM3215, SPM3218...etc.

## Devices for Li-ion batteries

Ultralow on-resistance MOSFET series  
ECH8601, FTD2017A...etc.  
Schottky barrier diodes  
SBS804...etc.

## Junction FETs for ECM

Ultrathin package: VTFP  
TF218TH, TF208TH, TF202(SSFP)...etc.

## Devices for CCD camera module

Ultrahigh-frequency transistors  
EC3H02B, 2SC5538, 2SC5539...etc.  
Schottky barrier diodes  
EC2D01B, SB0203EJ...etc.

## Bipolar transistor for VCO

Low phase noise transistors  
EC3H02B, EC3H09B...etc.

## Transistors for LCD backlight circuits

Precise interface control MOSFETs  
5LN01S, 5LP01S  
MCH6614(2 in 1)...etc.

Complex devices  
MCH5809, CPH5809(MOS + SBD)...etc.

## Power management switches

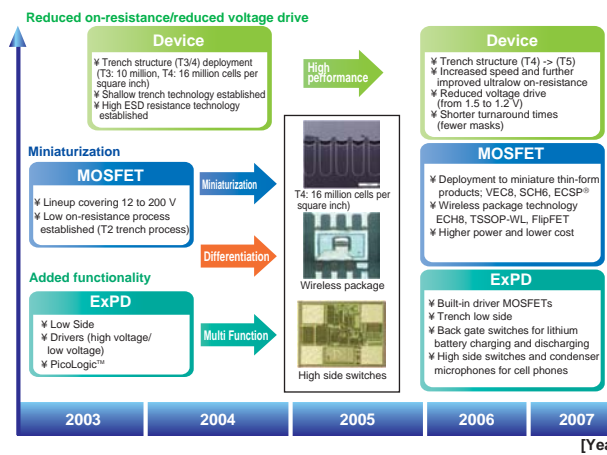
Ultralow on-resistance MOSFET series  
VEC2301, SCH2602, ECH8603  
MCH6307...etc.



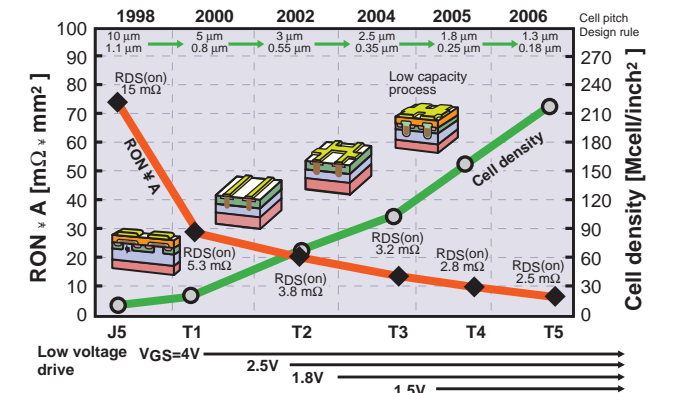
SANYO supplies high-performance GaAs switching ICs that feature the industry's smallest package size and smallest number of external components. SANYO discrete devices have been always leading the cell phone and mobile equipment markets. SANYO is also developing devices that support the need for higher speeds and larger data capacities for image and video data due to the inclusion of high pixel count cameras in this equipment.

## Ultralow on-resistance MOS devices for power management

### Low and medium output MOS device development roadmap

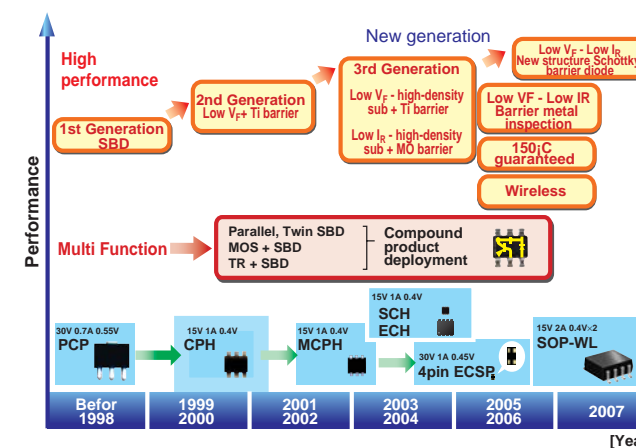


### Ultralow on-resistance MOS device generation map

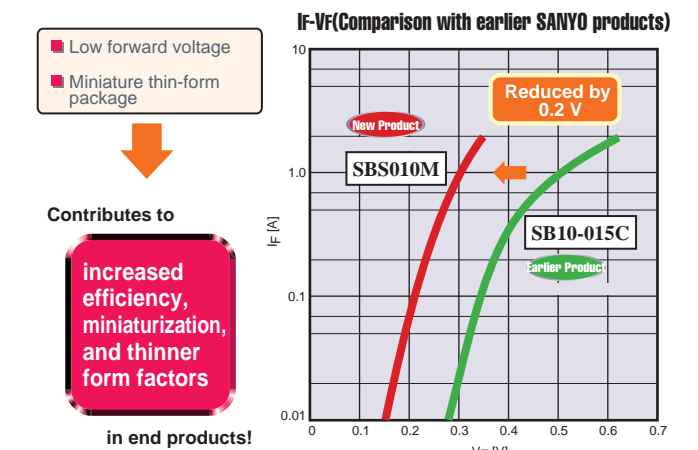


## Low VF/IR Schottky barrier diodes for power management

### Low VF/IR Schottky barrier diode development roadmap

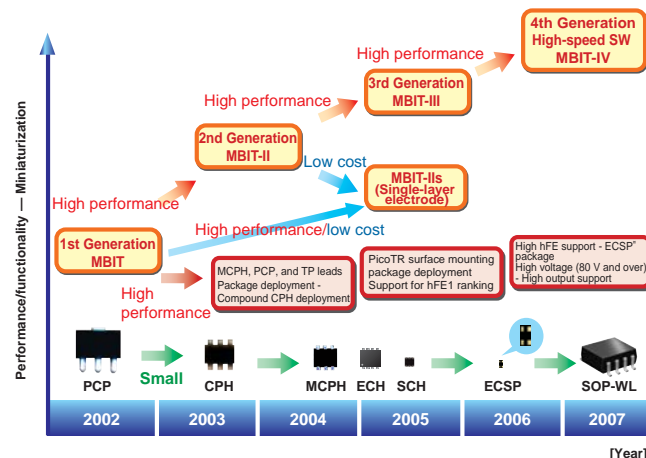


### Vf - I comparison data for earlier and low-Vf devices Schottky barrier diodes

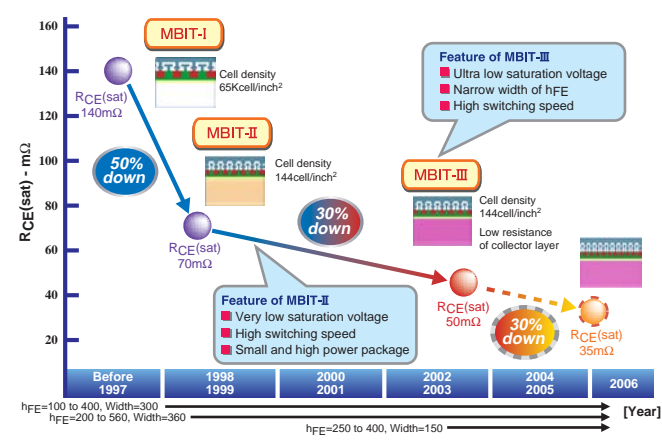


## LCD backlight ultralow saturation voltage transistors

### Ultralow saturation voltage transistor development roadmap



### Low saturation voltage transistor generation map



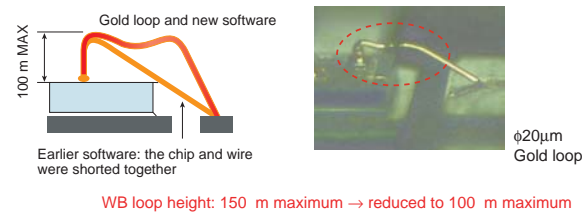
# SANYO's Lineup of High-Reliability Discrete Devices

SANYO supplies high-performance GaAs switching ICs that feature the industry's smallest package size and smallest number of external components. SANYO discrete devices have been always leading the cell phone and mobile equipment markets. SANYO is also developing devices that support the need for higher speeds and larger data capacities for image and video data due to the inclusion of high pixel count cameras in this equipment.

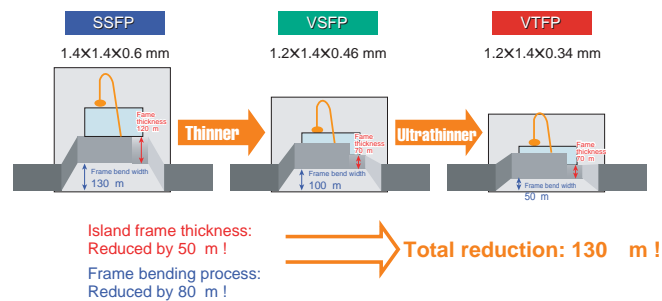
## FETs for Cell phone ECM

### Thin-form package technology

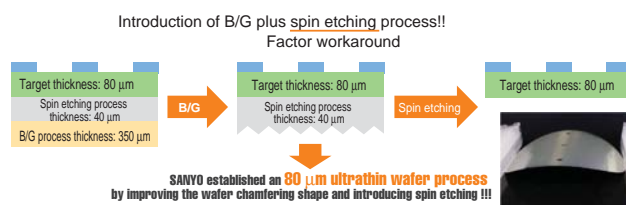
#### Gold loop and new software (M loop)



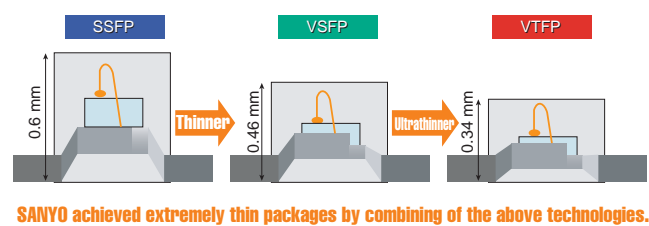
#### Thinner island frame and improved frame bending process



#### Establishment of an ultrathin wafer process (4 inch)

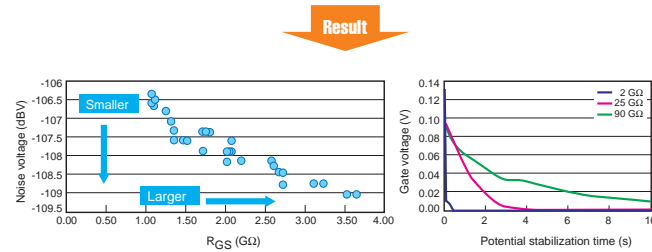
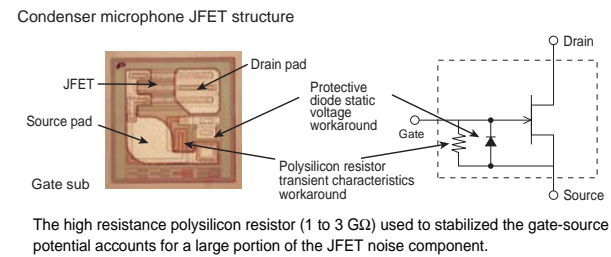


#### Total package height

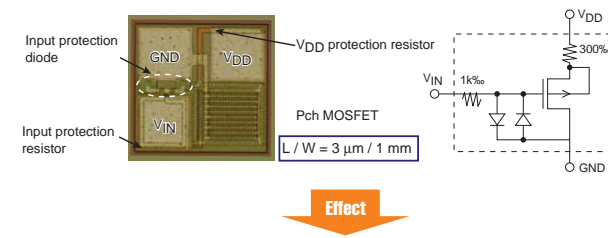


### High signal-to-noise ratio technology

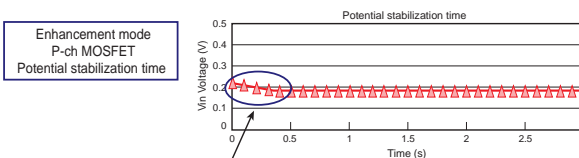
#### JFET noise component



#### Improved signal-to-noise ratio due to p-channel MOSFET development

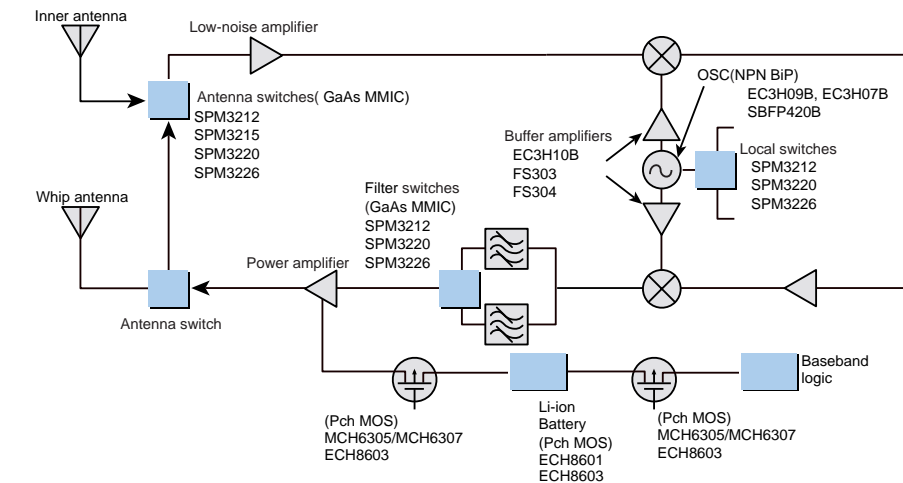


	Noise voltage (dBV)	Insertion loss (dBV)	Signal-to-noise ratio (dB)	Signal-to-noise ratio evaluation
Pch MOSFET	-113 to -114	-5.0 to -5.5	68 to 68.5	○
JFET	-105 to -107	-1.5 to -3.5	62 to 64	○

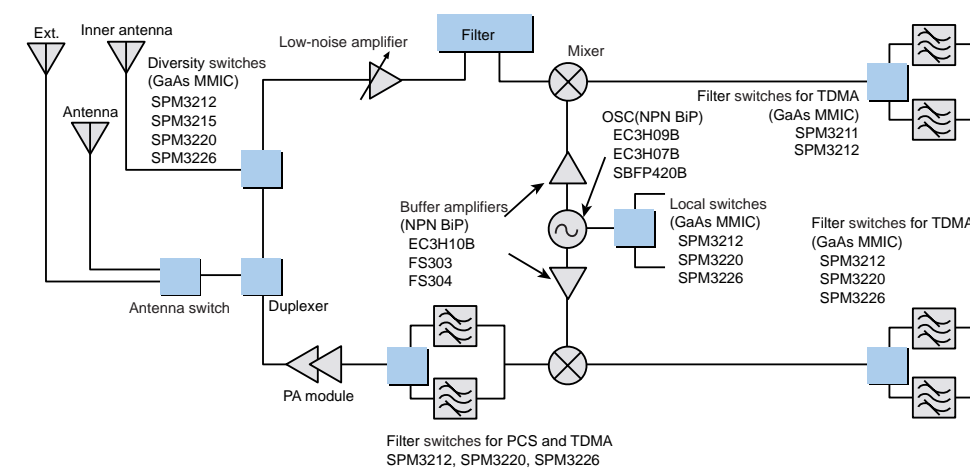


The potential stabilization time becomes under 1 second in enhancement mode p-channel MOSFETs.

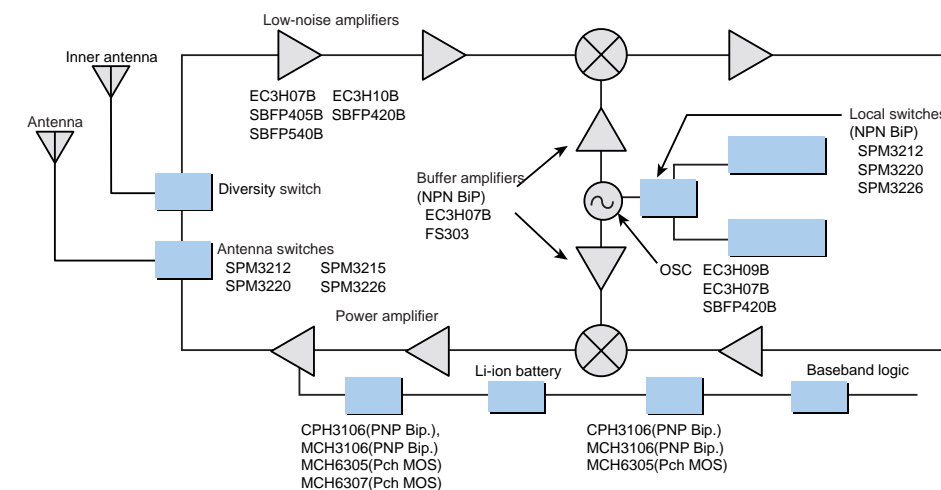
## Digital Cell Phone 0.8 GHz, 1.5 GHz



## CDMA/TDMA (IS136)



## PHS



# SANYO's Lineup of High-Reliability Discrete Devices

As miniaturization and efficiency advance and improve in portable equipment, the needs for further miniaturization and lower power consumption in discrete devices are increasing even faster. SANYO responds to these needs by providing an extensive line of products that contribute to reduced mounting areas and reduced parts counts in application circuits

## Microwave Device Series

### ● High-frequency silicon transistors for VCO

Usage	Type No.	Package	Size (mm)	f <sub>T</sub> typ. (GHz)	V <sub>CEO</sub> (V)	I <sub>C</sub> (mA)	P <sub>C</sub> (mW)	N <sub>F</sub> typ.(dB)	S <sub>21e</sub> <sup>2</sup>   typ.(dB)	Notes
Oscillator	EC3H09B	ECSP	1.0 × 0.6	11.2	4	70	100	1.5	6	
	EC3H11B	ECSP	1.0 × 0.6	10.5	4	80	100	1.5	5	
	SPFP420B	ECSP	1.0 × 0.6	25	4.5	35	100	1.1	17	
	SPFP540B	ECSP	1.0 × 0.6	29	4.5	80	100	0.9	8.5	
	2SC5781	SSFP	1.4 × 0.8	11.2	4	70	100	1.5	6	
	2SC5783	SSFP	1.4 × 0.8	10.5	4	80	100	1.5	5	
	Buffer	EC3H07B	ECSP	1.0 × 0.6	12.5	4	30	100	1.5	10.5
EC3H10B		ECSP	1.0 × 0.6	12.5	4	40	100	1.3	8.5	
2SC5646		SSFP	1.4 × 0.8	10	4	30	100	1.5	9.5	
2SC5782		SSFP	1.4 × 0.8	12.5	4	40	100	1.3	8.5	
Oscillator + Buffer	FS301 (TR1 Side)	ECSP	1.2 × 0.8	12.5	4	30	100	1.5	10.5	2SC5645
	(TR2 Side)			25	4.5	35	100	1.1	17	SBFP420
	FS303 (TR1 Side)	ECSP	1.2 × 0.8	12.5	4	30	100	1.5	10.5	2SC5645
	(TR2 Side)			11.2	4	70	100	1.5	8.5	2SC5781
	FS304 (TR1 Side)	ECSP	1.2 × 0.8	12.5	4	40	100	1.3	10.5	2SC5782
	(TR2 Side)			11.2	4	70	100	1.5	8.5	2SC5781

### ● GaAs MMIC products for Antenna switches, local switches and other switches

Usage	Type No.	Package	Size (mm)	Control Voltage (V)	Isolation typ.(dB)	Insertion Loss typ.(dB)	Pin1dB typ.(dBm)	Notes
Switch	SPM3220	ECSP	1.2 × 0.8	3	**16	**0.5	§ 26	0.4 to 2.5 GHz Use
	SPM3226	ECSP	1.2 × 0.8	2.4 to 5	**18	**0.35	§ 22(2.8V)	0.4 to 2.5 GHz Use
	SPM3227	ECSP	1.2 × 0.8	2.4 to 5	**18	**0.35	§ 22(2.8V)	0.4 to 2.5 GHz Use
	SPM3211	MCPH6	2.1 × 2.0	3	**16	**0.55	§ 28	0.4 to 2.5 GHz Use
	SPM3212	MCPH6	2.1 × 2.0	3	**16	**0.55	§ 28	0.4 to 2.5 GHz Use
	SPM3215	MCPH6	2.1 × 2.0	3	**13	**1.1	§ 26	0.4 to 2.5 GHz Use
	SPM3501	MCPH6	2.1 × 2.0	3	■ 13	■ 1.0	□ 20	Up to 6 GHz Use

SPM3211: Reverse control IC of SPM3212  
 SPM3215: Single control IC  
 SPM3226: Reverse control IC of SPM3227

\*\* Measured frequency: 2.5 GHz § Measured frequency: 1 to 2.5 GHz  
 ■ Measured frequency: 5.8 GHz □ Measured frequency: 5 to 6 GHz

## Power MOSFETs+ Schottky Barrier Diodes for logic block

Type No.	Package	Size (mm)	V <sub>DSS</sub> (V)	I <sub>D</sub> (A)	P <sub>D</sub> (W)	R <sub>DS(on)</sub> V <sub>GS</sub> =2.5V max. (Ω)	V <sub>RRM</sub> (V)	I <sub>O</sub> (A)	V <sub>F</sub> max. (V)	I <sub>R</sub> max. (μA)
MCH5801	MCPH5	2.1 × 2.0	20	1.5	0.8	280m	15	0.5	0.45	200
MCH5815	MCPH5	2.1 × 2.0	12	1.5	0.8	450m	15	0.5	0.45	200
CPH5802	CPH5	2.8 × 2.9	20	2	0.9	200m	15	1	0.4	500
CPH5811	CPH5	2.8 × 2.9	20	3	0.9	82m	15	1	0.4	500

## Ultralow on-resistance Power MOSFETs for RF and logic block

Type No.	Package	Size (mm)	V <sub>DSS</sub> (V)	R <sub>DS(on)</sub> V <sub>GS</sub> =4.5V Max. (Ω)	R <sub>DS(on)</sub> V <sub>GS</sub> =2.5V Max. (Ω)	R <sub>DS(on)</sub> V <sub>GS</sub> =1.5V Max. (Ω)	I <sub>D</sub> (A)	C <sub>iss</sub> typ(pF)	Polarity
SCH1302	SCH6	1.6 × 1.6	20	*0.165	0.22	○ 0.39	2	410	Pch
SCH2601(Pch) (Nch)	SCH6	1.6 × 1.6	30	*1.9	2.8	—	0.4	40	Pch+Nch
			30	*0.9	1.15	—	0.7	30	
SCH2602(Pch) (Nch)	SCH6	1.6 × 1.6	12	0.31	0.47	0.67	1.5	160	Pch+Nch
			30	*3.7	5.2	—	0.35	7	
3LP03M	MCP	2.1 × 2.0	30	*1.9	2.8	—	250m	40	Pch
3LN03M	MCP	2.1 × 2.0	30	*0.9	1.15	—	350m	30	Nch
MCH3411	MCPH6	2.1 × 2.0	30	*90m	118m	—	3	270	Nch
MCH6305	MCPH6	2.1 × 2.0	20	65m	98m	—	4	680	Pch
MCH6307	MCPH6	2.1 × 2.0	12	46m	66m	○ 98m	5	940	Pch
CPH6311	CPH6	2.8 × 2.9	20	42m	60m	—	5	1230	Pch
ECH8603	ECH8	2.8 × 2.9	20	54m	87m	—	4	800	Pch Dual
ECH8611	ECH8	2.8 × 2.9	12	40m	65m	—	5	1230	Pch Dual
VEC2302	VEC8	2.8 × 2.9	30	168m	—	—	3	510	Pch Dual
VEC2303	VEC8	2.8 × 2.9	12	49m	75m	107m	4	940	Pch Dual

\*V<sub>GS</sub>=4V, ○V<sub>GS</sub>=1.8V

## Low saturation voltage transistors for logic block

Type No.	Package	Size (mm)	V <sub>CEO</sub> (V)	I <sub>C</sub> (A)	P <sub>C</sub> (W)	h <sub>FE</sub> Min. to Max.	V <sub>CE(sat)</sub> Max. (mV)	Polarity
15C01S	SMCP	1.6 × 1.6	15	0.6	0.2	300 to 800	300	NPN
30C02S	SMCP	1.6 × 1.6	15	0.8	0.2	300 to 800	280	NPN
SCH2101	SCH6	1.6 × 1.6	12	0.8	0.4	300 to 800	240	PNP
SCH2201	SCH6	1.6 × 1.6	15	0.8	0.4	300 to 800	280	NPN+NPN
SCH2503(PNP) (NPN)	SCH6	1.6 × 1.6	30	0.6	0.4	200 to 500	220	PNP+NPN
			30	0.6	0.4	300 to 800	190	
MCH3106	MCPH3	2.1 × 2.0	12	3	0.8	200 to 560	165	PNP
MCH3206	MCPH3	2.1 × 2.0	15	3	0.8	200 to 560	150	NPN
CPH3109	CPH3	2.8 × 2.9	30	3	0.9	200 to 560	230	PNP
CPH3209	CPH3	2.8 × 2.9	30	3	0.9	200 to 560	180	NPN

## Schottky Barrier Diodes for logic block

Type No.	Package	Size (mm)	V <sub>RRM</sub> (V)	I <sub>O</sub> (A)	I <sub>FSM</sub> (A)	V <sub>F</sub> max. (V)	I <sub>R</sub> max. (μA)	Notes
SS1003EJ	ECSP	1.6 × 0.8	30	1	5	0.45	360	
SB1003EJ	ECSP	1.6 × 0.8	30	1	5	0.55	15	
S0503SH	SCH6	1.6 × 1.6	30	0.5	5	0.47	120	
SS1003M	MCPH6	2.1 × 2.0	30	1	5	0.45	15	
SB1003M	MCPH6	2.1 × 2.0	30	1	5	0.55	15	
SBS004M	MCPH3	2.1 × 2.0	15	1	10	0.4	500	
SBS008M	MCPH5	2.1 × 2.0	15	1	10	0.43	90	Parallel type



**SANYO**

**SANYO Electric Co., Ltd.** [www.global-sanyo.com](http://www.global-sanyo.com)

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