

# Supporting High Picture Quality Equivalent to Compact Digital Cameras - 8-Megapixel Compatible Cell Phone Camera Engine Solution “CE131”

OOYA Akitaka, MATSUMOTO Hisami, KAWAGUCHI Hiroshi

## Abstract

The cameras incorporated in cell phones have now evolved to have a similar picture quality to that of compact digital cameras. This paper introduces the CE131 camera engine that is compatible with the highest pixel values among the cell phone camera engines of the 8 megapixel range. Development has been undertaken by NEC Electronics based on expertise that has been acquired via the camera engine solutions business.

## Keywords

camera cell phone, camera engine, 8 megapixels, size reduction, high picture quality

## 1. Introduction

Recently, most cell phones are equipped with a camera function and it is already considered to be indispensable for cell phones to be equipped with a data communication function.

The performance and functions required for camera engines have been advancing year by year, until they now include the provision of multiple functions such as image stabilization, face detection and noise reduction under low light conditions. Size reductions and the provision of extra pixels and a higher picture quality are also featured.

At the present time, the camera cell phone has evolved into a system that has very advanced technological requirements including a high picture quality that is comparable to that of the compact digital cameras.

The camera LSI for cell phones (usually referred to as the

camera engine) is now required to be capable of performing the requisite processing for correcting picture quality deteriorations such as the increased noise and degradation of color and S/N that result from the size reduction and pixel increase of the CMOS sensor.

To meet the above requirements, we have developed the “CE131” cell phone camera engine with a 5M/8M-pixel compatibility by increasing the color processing and operation frequency and by also upgrading the image correction functions including those for noise reduction and contour enhancement ( **Photo** ).

## 2. Development of the Cell Phone Camera Engine “CE131” Featuring Compact Size and Large Number of Pixels

We have developed an image processing camera engine “CE131” with up to 8-megapixel compatibility for use with cell phones.

The camera engine “CE131” is provided with all of the technological functions required to support the development of cell phone cameras. These include the technology for combining the sensor and lens and that for module design as well as image tuning and a consultation service.

It has the following main features.

### (1) An I/F and High-performance Image Processing Engine Matching the Most Advanced Compact Megapixel Image Sensors

Targeting specifically at use with the CMOS sensor that is currently the mainstream device in the cell phone market, the

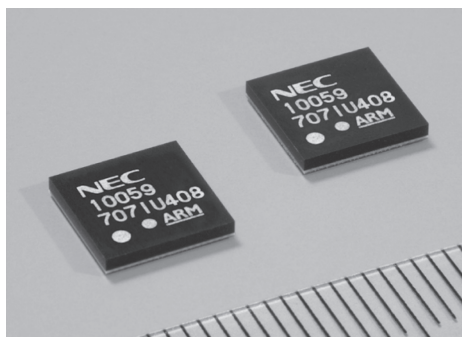


Photo Cell phone camera engine “CE131.”

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CE131 incorporates a parallel I/F used by the most advanced compact megapixel image sensors and a high-speed serial I/F compatible with serial CCP2. It also mounts a high-sensitivity noise reduction featuring improved functionality under low light conditions and a color correction capability that enables more natural color reproduction.

It also incorporates a high-performance image processing engine with functions such as an image distortion correction function and a shading correction function for dealing with deterioration in peripheral resolution. These functions are able to deal with problems accompanying lens unit size reductions and can thus support cell phone size reductions.

### (2) Incorporation of the Latest Compact Digital Camera Functions in a CPU + SDRAM SIP Package

The CPU uses the ARM9, which is SIP packaged with an SDRAM in order to improve the processing capability. The latest functions available with compact digital cameras, such as image stabilization (still and moving images), face detection, smile detection, eye closing detection, iris correction and backlight correction are also added by means of software. These functions have also been optimally updated in order to be compatible with current advances.

### (3) Smooth Compatibility with Sensor/Lens Changes Thanks to the Software Platform Open Architecture

Camera engine “CE131” is implemented as a software platform based on the software developed together with it, so that even when the image sensor or lens is changed, the compatibility can be ensured by modifying the software corresponding to the changed function. This choice of architecture allows the development to quickly adopt effective measures.

Except when a completely new function is added, control is possible with the same command interface as for previous products. The development can therefore be advanced easily without the need to modify the users’ control software.

### (4) Support System

At the same time as the release of camera engine “CE131,” we have prepared a support system for matching the customers’ systems including the peripheral circuitry, the circuit system including the telephone circuitry, the board pattern and the lens/sensor combination.

With regard to the picture quality, which is regarded as being most important for a cell phone camera, we have performed image tuning according to customer requests and are thus able to propose an optimum picture quality based on quantitative evaluation using a dedicated simulator.

In addition, we also provide a consulting service and

Table 1 Comparison of specifications between camera engines CE130 and CE131.

Item	CE130	CE131
Package	10 × 10 × 1.42mm 277-pin BGA	8 × 8 × 1.36mm 181-pin BGA
System/CPU clocks	66MHz/133MHz	100MHz/200MHz
Compatible sensors	Max. 5M pixels Primary color Bayer CCD Primary color Bayer CMOS	Max. 8M pixels Primary color Bayer CMOS
Sensor I/F	12 bit Parallel	12 bit Parallel Sub LVDS CCP2 Class 2
Optical corrections	Aberration correction, flaw correction, smear correction	Aberration correction, flaw correction, distortion correction
I/O	GPIO × 78	GPIO × 43 *1
Other	JPEG encoder	JPEG encoder NR LSI *2

\*1 GPIO: General-Purpose Input/Output

\*2 NR: Noise Reduction

Table 2 Product lineup of CE131 camera engine.

Compatible Pixels	Product Name	SIP Structure
5M	CE131	CE131 + 128M-bit SDRAM
5M	CE131F	CE131 + 128M-bit SDRAM + 8M-bit FROM
8M	CE131S	CE131 + 256M-bit SDRAM

support for other technologies that are necessary for the ongoing development of cell phone cameras.

### (5) Reduced Size and Improved Performance from Previous Camera Engine “CE130”

The “CE131” camera engine has succeeded in reducing the size and in improving the performance by enhancing its functions and performance compared to the previous CE130 model and also in selecting the minimum number of required functions ( Table 1 ).

### (6) The Product Lineup Targets the High-end Market

We have prepared a lineup of three products offering camera engine systems that can meet customers’ requirements ( Table 2 ).

## 3. Conclusion

In the above, we introduced the image processor system LSI “CE131.” In the future, we intend to develop more advanced image processor system LSIs, reduce LSI power consump-

tion and to build system technology platforms by anticipating market needs. This strategy is intended to enable the cell phone camera to advance further and to eventually achieve a picture quality that exceeds that of the compact digital cameras.

### Authors' Profiles

**OOYA Akitaka**

Team Manager,  
SoC Systems Division,  
2nd SoC Operations Unit,  
NEC Electronics Corporation

**MATSUMOTO Hisami**

Team Manager,  
SoC Systems Division,  
2nd SoC Operations Unit,  
NEC Electronics Corporation

**KAWAGUCHI Hiroshi**

Group Manager,  
SoC Systems Division,  
2nd SoC Operations Unit,  
NEC Electronics Corporation