# Present Status and Prospects for Fuji Electric IC Technology

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## 1. Introduction

Fuji Electric ICs (integrated circuits) are specialized for specific applications, and have been developed based on distinguished technologies. For example, we have used high-voltage technology [C/DMOS (complementary/double diffused metal-oxide semiconductor) technology] and sensor technology (photodiodes and piezoelectric resistance sensors) to develop controller ICs for power supplies, flat panel display driver ICs (for plasma and liquid crystal displays), auto-focus ICs for cameras, and pressure sensors and hybrid ICs for automobiles.

The semiconductor market has been subjected to boom-and-bust cycles and there is fierce competition. To survive in this environment, it is important for us to refine the distinguished technologies and develop core technologies to supply unique products not available from other companies. An outline of our technologies, examples of our products, and future prospects are described below.

## 2. Present Status of Fuji Electric ICs

### 2.1 Process/device technologies

Characteristic features of Fuji Electric's process and device technologies are high voltage and analog-digital hybrid technology. Processes to achieve fine machining as well as high voltage have been developed, and methods of improving analog precision have been developed. Typical processes are as follows (Fig. 1).

(1) Bipolar IC

Because of low cost and high precision, this process has been used for controller ICs in automobile ignition systems, pressure sensors, and ICs for power supplies.

(2) Si-gate CMOSIC

This process, a leader in fine machining, developed into a process for standard logic (5V class) and then into a process for higher voltage ICs. Mass production of CMOSICs with a 0.6μm design rule has been realized. CMOSICs are widely used as analog-digital hybrid ICs for power supplies, cellular phones, automatic focusing, and liquid crystal display drivers. This paper introduces high-voltage CMOSIC technology (30V, 60V, and 120V).

(3) C/DMOSIC

This hybrid process combines DMOS technology with a Si-gate CMOS high-voltage construction and is used for power supply ICs and plasma display driver ICs. This is an effective technology to reduce the size of built-in power MOSFETs (metal-oxide-semiconductor field-effect transistors). Figure 2 shows the DMOSIC on-resistance area efficiency. This paper introduces the plasma display driver IC that uses dielectric isolation technology (SOI) as an example.

In addition, Fuji Electric possesses a bump process (solder and gold) suitable for Bi-CMOSIC and bear chip assembly and can satisfy various customer requests.

### 2.2 Packaging technology

Plastic molded packages, including DIP (dual in-line package), SOP (small outline package), QFP (quad flat package) and TSSOP (thin shrink SOP), fine-pitch and thin packages, are available. CSP (chip size package) is also being investigated. As mentioned before, Fuji Electric possesses a bump process suitable for bear chip assembly and has the complete assembly

Fig.1 Fuji Electric IC process technology

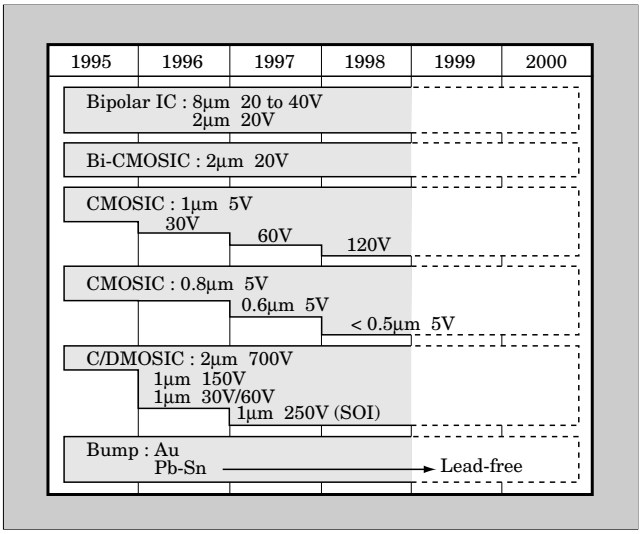


Fig.2 On-resistance area efficiency of Fuji Electric DMOSICs

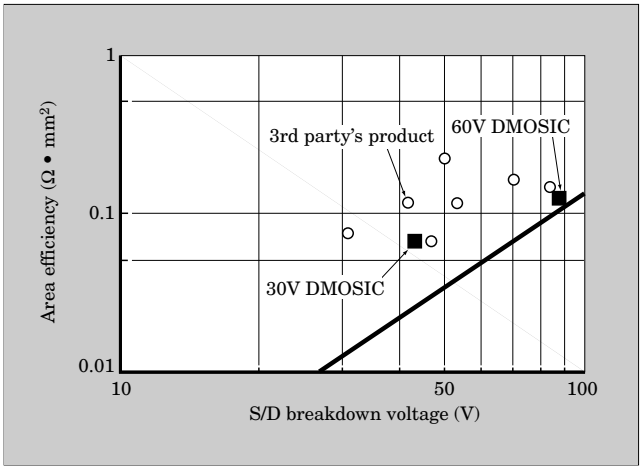



Fig.3 Examples of plastic packages

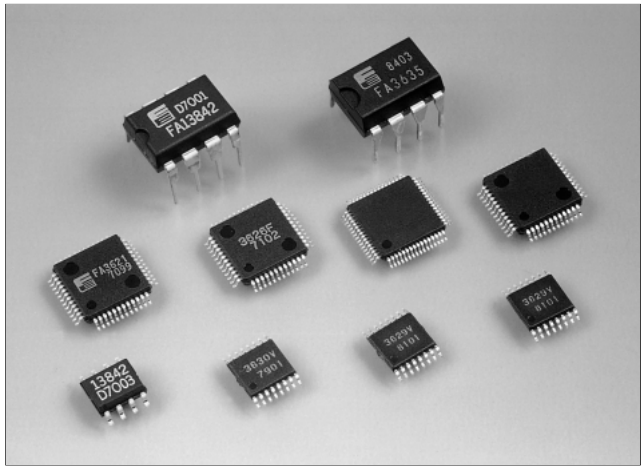
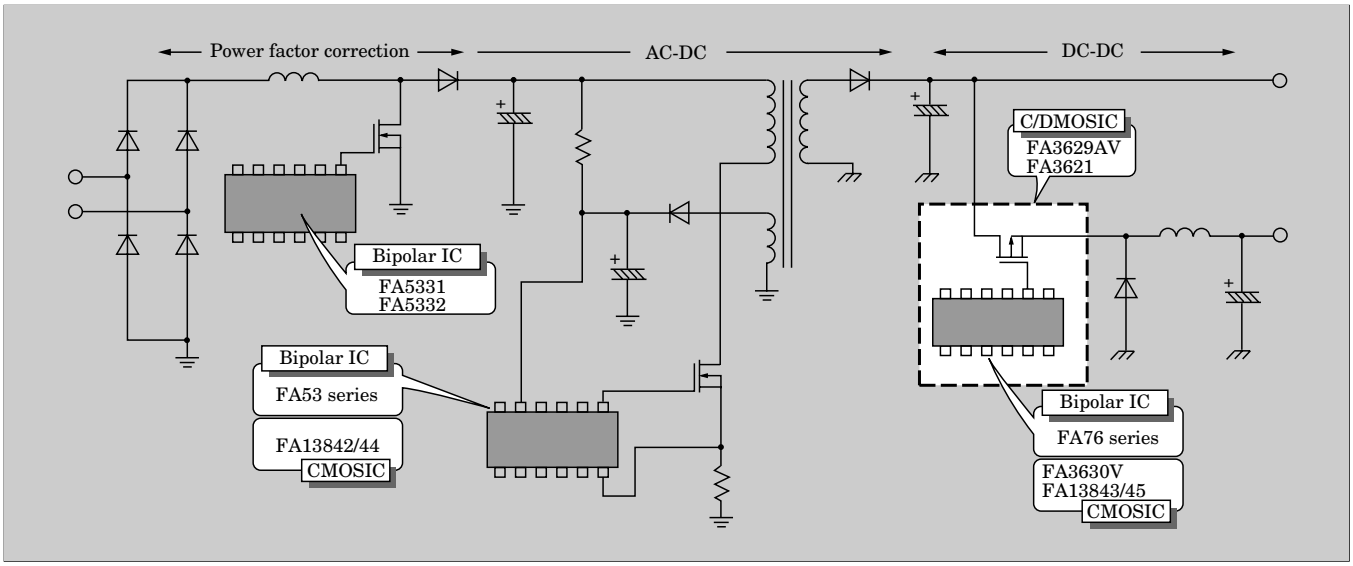


Fig.4 Fuji Electric ICs for power supply and application circuit example




technologies to miniaturize packages (Fig. 3).

Fuji Electric also possesses technologies for modules with lenses and clear resin molded packages for autofocus ICs, and provides a series of high-reliability metal packages and resin-sealed packages for pressure sensors.

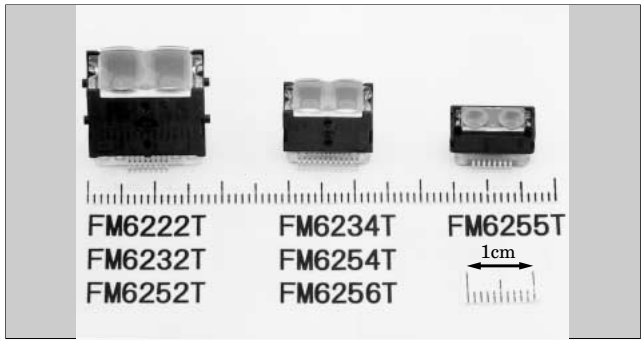
### 2.3 Fuji Electric ICs

Having started from full-custom ICs, Fuji Electric product development is now focusing on application specific standard product (ASSP) ICs.

A typical product is the power supply IC. In response to the need for resource and energy conservation for global environment protection, a low power consumption CMOS and a power factor correction IC series have been developed (Fig. 4 and Table 1).

Regarding autofocus ICs for cameras, a series of modules with lenses have been developed, and the development of small modules suitable for thin cameras (APS) and low-priced analog sensors (in addition to the conventional digital sensors) has been completed

Fig.5 Fuji Electric autofocus IC modules




(Fig. 5 and Table 2).

The color plasma display driver IC has been used to produce large-screen TVs and monitors. This paper introduces an advanced product line of small liquid crystal controllers, as well as pressure sensors used for diesel engines.

Table 1 Fuji Electric ICs for power supplies

(a) AC-DC converter

| Classification \ Item | | Type number | $D_{max}$ | Application circuits | | | MOSFET drive | Mode | | Protection circuit | | | Number of pins |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Flyback | Forward | Power factor correction | | Voltage | Current | OCP | OVP | OTP | |
| For controllers | Bipolar IC | FA5301 | 100% | ○ | | | | ○ | | ○ | | | 16 pins |
| | | FA5304 | 46% | | ○ | | ○ | ○ | | ○ | ○ | | 8 pins |
| | | FA5305 | 46% | | ○ | | ○ | ○ | | ○ | ○ | | 8 pins |
| | | FA5310 | 46% | | ○ | | ○ | ○ | | ○ | ○ | | 8 pins |
| | | FA5311 | 70% | ○ | | | ○ | ○ | | ○ | ○ | | 8 pins |
| | | FA5314 | 46% | | ○ | | ○ | ○ | | ○ | ○ | | 8 pins |
| | | FA5315 | 70% | ○ | | | ○ | ○ | | ○ | ○ | | 8 pins |
| | | FA5316 | 46% | | ○ | | ○ | ○ | | ○ | ○ | | 8 pins |
| | | FA5317 | 70% | ○ | | | ○ | ○ | | ○ | ○ | | 8 pins |
| | | FA5321 | 50% | | ○ | | ○ | | ○ | ○ | ○ | ○ | 16 pins |
| | | FA5331 | 92% | | | ○ | ○ | | | ○ | ○ | | 16 pins |
| | | FA5332 | 92% | | | ○ | ○ | | | ○ | ○ | | 16 pins |
| | MOSIC | FA13842 | 96% | ○ | | | ○ | | ○ | | | | 8 pins |
| | | FA13844 | 48% | | ○ | | ○ | | ○ | | | | 8 pins |

(b) DC-DC converter

| Classification \ Item | | Type number | Number of channels | Voltage control range | | | | Application circuits | | | MOS-FET drive | Number of pins |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2.5 to 22V | 3.6 to 22V | 1.4 to 12V | 10 to 50V | Step-down | Step-up | Up & down | | |
| For controllers | Bipolar IC | FA7610 | 1 | | ○ | | | | ○ | ○ | | 8 pins |
| | | FA7611 | 2 | | ○ | | | ○ | ○ | ○ | | 16 pins |
| | | FA7612 | 1 | | ○ | | | ○ | | | | 8 pins |
| | | FA7613 | 1 | ○ | | | | ○ | | ○ | | 16 pins |
| | | FA7615 | 2 | | ○ | | | ○ | ○ | ○ | | 16 pins |
| | | FA7616 | 2 | | | ○ | | | ○ | ○ | | 16 pins |
| | | FA7617 | 1 | | ○ | | | | | ○ | | 8 pins |
| | | FA7622 | 2 | | ○ | | | ○ | ○ | ○ | ○ | 20 pins |
| | | FA7630 | 2 | | ○ | | | ○ | | ○ | ○ | 20 pins |
| | MOSIC | FA3630 | 2 | ○ | | | | ○ | ○ | ○ | ○ | 16 pins |
| | | FA13843 | 1 | | | | | | ○ | ○ | ○ | 8 pins |
| | | FA13845 | 1 | | | | | | ○ | ○ | ○ | 8 pins |
| For controllers with a built-in MOSFET | MOSIC | FA3621 | 6 | | | | | ○ | ○ | ○ | ○ | 8 pins |
| | | FA3629 | 3 | | ○ | | | | ○ | ○ | ○ | 16 pins |
| | | FA36XX | 1 | | | | ○ | ○ | | | | 8 pins |

Table 2 Fuji Electric autofocus ICs

| Application \ Type | Digital sensor, 21μm-pitch | Analog sensor, 21μm-pitch | Analog sensor, 12μm-pitch |
|---|---|---|---|
| Zoom of 3× or less | FM6234T | FM6254T | FM6255T |
| Zoom of 3× or greater | FM6232T | FM6252T | (FM6256T) |

Note: Products enclosed in parentheses are “under development”.

## 3. Future Prospects

For Fuji Electric ICs to survive in the future, as a matter of course, they must satisfy market needs. Further, it is necessary that they possess unique technology not available from other companies as well as flexible design technology to comply with diversified requirements within a short time. Fuji Electric is working to introduce an IP (intellectual property) core and to develop CAD (computer-aided design) technology, presented in this paper as system design technology.

## 4. Conclusion

The present status and prospects for Fuji Electric’s IC technology have been described. Further with our characteristic technologies, we will continue to develop and supply products that satisfy user needs.