

# OTP Memory IPs Added to the Lineup of 180nm, 90nm, and 65nm Technology Products

The OTP memory is one of nonvolatile memories which do not lose their contents even when the power is cut off. FUJITSU has added OTP memory IPs to its 180nm, 90nm, and 65nm technology products. This article introduces the features, methods, and applications of OTP memory IPs.

\*OTP: One Time Programmable

## Overview

Like EEPROM and Flash memories, the OTP (One Time Programmable) memory is one of nonvolatile memories which do not lose their contents even when the power is cut off. Its applications include trimming in analog circuits, security key storage for HDMI, firmware configuration data of a programmable logic device, and products IDs.

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### Application in multi-time programming (MTP)

Although an OTP memory can be programmed just once, MTP functions are emulated by changing the memory address space. While so many time re-writing is impossible as a Flash memory, replacing Flash memory with the emulated MTP is cost effective for cases that require just few-time re-writing.

### Small macro area

Since it does not have erase functions like a Flash memory, the whole macro is very compact.

**Table 1** Overview of our OTP memories.

## Product Features

### Logic process compatible

Unlike a Flash memory, an OTP memory IP does not require any special process. Since it is manufactured using the pure logic processes for a standard cell logic circuitry, it can be implemented with various other IPs and realized at a low cost.

### Charge pump option

While a high voltage is necessary to program 180nm and 90nm OTPs, they can be programmed without any external high voltage supply if a charge pump option is used. This option eases field programming.

**Table 1** Outline of OTP Memories

OTP memory	180nm	90nm		65nm
Method	1Poly-EPROM	e-fuse	Gate destruction	e-fuse
Erasing	UV	Not possible	Not possible	Not possible
Memory capacity	16K-bit to 512K-bit	4K-bit to 2.5K-bit	4K-bit to 2M-bit	4K-bit to 2.5K-bit
Process	CS80B	CS100A_LL	CS100A_LL	CS200L
Additional process	1 mask	None	None	None
Writing	6.5V or CP*	2.4V	6.5V or CP*	2.4V

\*CP: Charge pump

## Methods

### ■ EPROM type (180nm)

0/1 states are generated by differences of threshold voltages of transistors caused by accumulated electrical charges in floating gates.

### ■ Gate oxide film destruction type (90nm)

0/1 states are generated by rupturing gate oxide films of transistors.

### ■ Electrical fuse (e-fuse) type (90nm, 65nm)

0/1 states are generated by resistance changes caused by large currents in silicided polysilicon.

## Applications

### ■ Encryption code

A typical example is the HDCP key used for HDMI.

### ■ Analog trimming

Analog designs handle low currents and voltages. Changes in inner element characteristics due to process or temperature fluctuations may deteriorate accuracies. High precision is realized by adopting a trimming circuit to adjust the characteristics with the compensation values stored in an OTP memory.

### ■ Selection of functions

When several MPU interfaces such as Intel and MIPS are supported for the same chip, for instance, the function is selected by a function-selector with an OTP memory.

**Table 2** OTP Memory Applications

Form	Memory macro	Fuse replacement	Pseudo-MTP
Memory capacity	1K-bit to 512K-bit	8-bit to 256-bit	32-bit to 32K-bit
Application	MCU SOC Digital consumer	Analog IC LCD driver	Analog IC LCD driver SOC Digital consumer
Purpose	Code storage ROM replacement Parameter setting	Encryption code Trimming Parameter setting Memory redundancy	Trimming Parameter setting

### ■ Product ID, unique data

Traceability is furnished by writing the product ID, the unique data for the IC, or the manufacturing information in an OTP memory.

### ■ Programs

It can be used to store programs such as firmware.

### ■ Fuse replacement

An OTP replaces conventional laser trimming. It reduces the circuit area and improves reliability such as moisture resistance by adopting an OTP memory.

**Table 2** presents applications of OTP memories, **Table 3** the lineup of e-fuse 90nm/65nm products, **Table 4** the lineup of 180nm OTPs, and **Table 5** the lineup of 90nm OTPs. \*

**Table 3** Lineup of e-fuse 90nm/65nm Products

Memory capacity	Status
1×4-bit	Available
1×8-bit	Available
1×16-bit	Available
1×32-bit	Available
1×48-bit	Available
1×64-bit	Available
32×32-bit	Available
80×32-bit	Available

**Table 4** Lineup of 180nm OTPs

Memory capacity	Status
8K×32-bit	Available
32×32-bit	To be developed
1×32-bit 8 times MTP	To be developed

**Table 5** OTP Memory Applications

Memory capacity	Status
4K×128-bit	Available
2K×32-bit	Available
4K×16-bit	Available
1K×8-bit	Available