TECHNICAL NOTE

Low Power Function of Mobile RAM™

Auto Temperature Compensated Self Refresh (ATCSR)

CAUTION

This document describes Auto Temperature Compensated Self Refresh (ATCSR), one of low power functions that have been adapted to Mobile RAM.

All related operations and numerical values in this technical note are examples for reference only.

For detail characteristic features, please refer to the corresponding data sheet.

1. Refresh Period is Related to Temperature

The data retention characteristics of DRAM cells depend on temperatures.

When the temperature is high, the self-refresh operation will execute in a short period to prevent data loss and power consumption will increase. In contrast, when the temperature is low, data can be retained even the interval of self-refresh operation is long.

Document No. E0599E20 (Ver.2.0)
Date Published November 2005 (K) Japan
Printed in Japan
URL: http://www.elpida.com

2. Auto Temperature Compensated Self Refresh

2.1 Overview of Auto Temperature Compensated Self Refresh

The Auto Temperature Compensated Self Refresh (ATCSR) function utilizes a built-in temperature sensor to detects the ambient temperature for adjusting self-refresh interval automatically in response to ambient temperature. ATCSR can result in the advantage of low power consumption dramatically.

With conventional temperature compensated self refresh (TCSR), it is necessary for conventional DRAM to change the temperature register from external to adjust the self-refresh cycle. But with a built-in temperature sensor of Mobile RAM, auto temperature compensated self refresh will automatically adjust the interval of self-refresh operation according to ambient temperature variations.

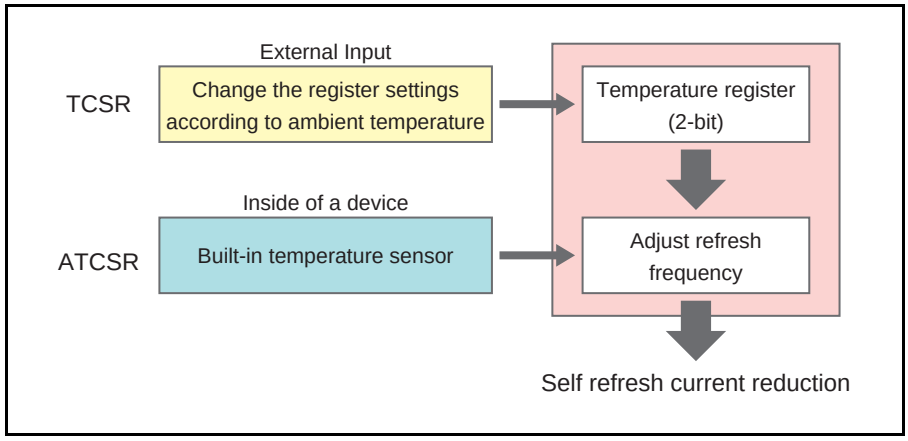

Figure 2-1. Overview of Auto Temperature Compensated Self Refresh

2.2 Advantages of Auto Temperature Compensated Self Refresh

Table 2-1 shows self-refresh current (IDD6) for Mobile RAM utilizing auto temperature compensated self refresh.

Table 2-1. Comparison of Self-Refresh Current (example)

Density	**IDD6 (max.) TA = 85˚C**	**IDD6 (typ.) TA = 45˚C**
64Mb	250μA	100μA
128Mb	200μA	150μA
256Mb	400μA	180μA

3. Auto Temperature Compensated Self Refresh Settings

The on/off status of auto temperature compensated self refresh (enable/disable) can be set by using Extended Mode Registers Set (EMRS).

One bit (A9) is used to set the status.

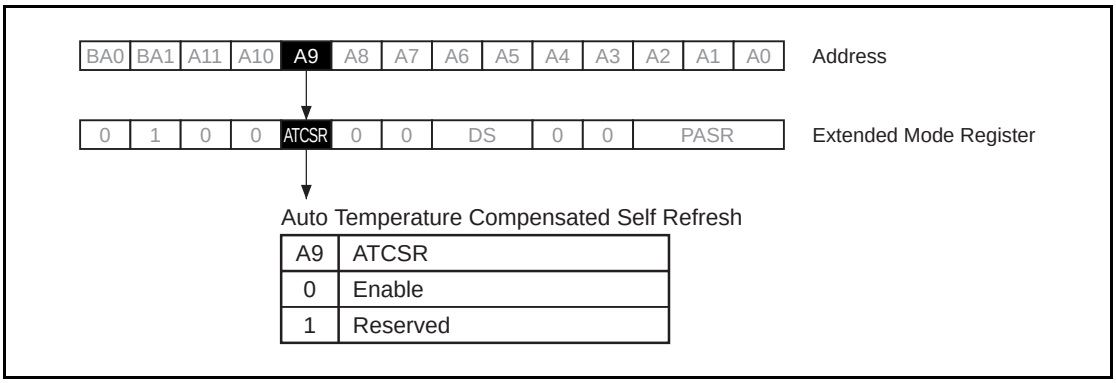

Figure 3-1. Auto Temperature Compensated Self Refresh Settings Using Extended Mode Register Set

4. Auto Temperature Compensated Self Refresh Timing

The entry/exit timing of the auto temperature compensated self refresh is the same as the self-refresh timing of conventional DRAM. Figure 4-1 shows the entry/exit timing for self-refresh.

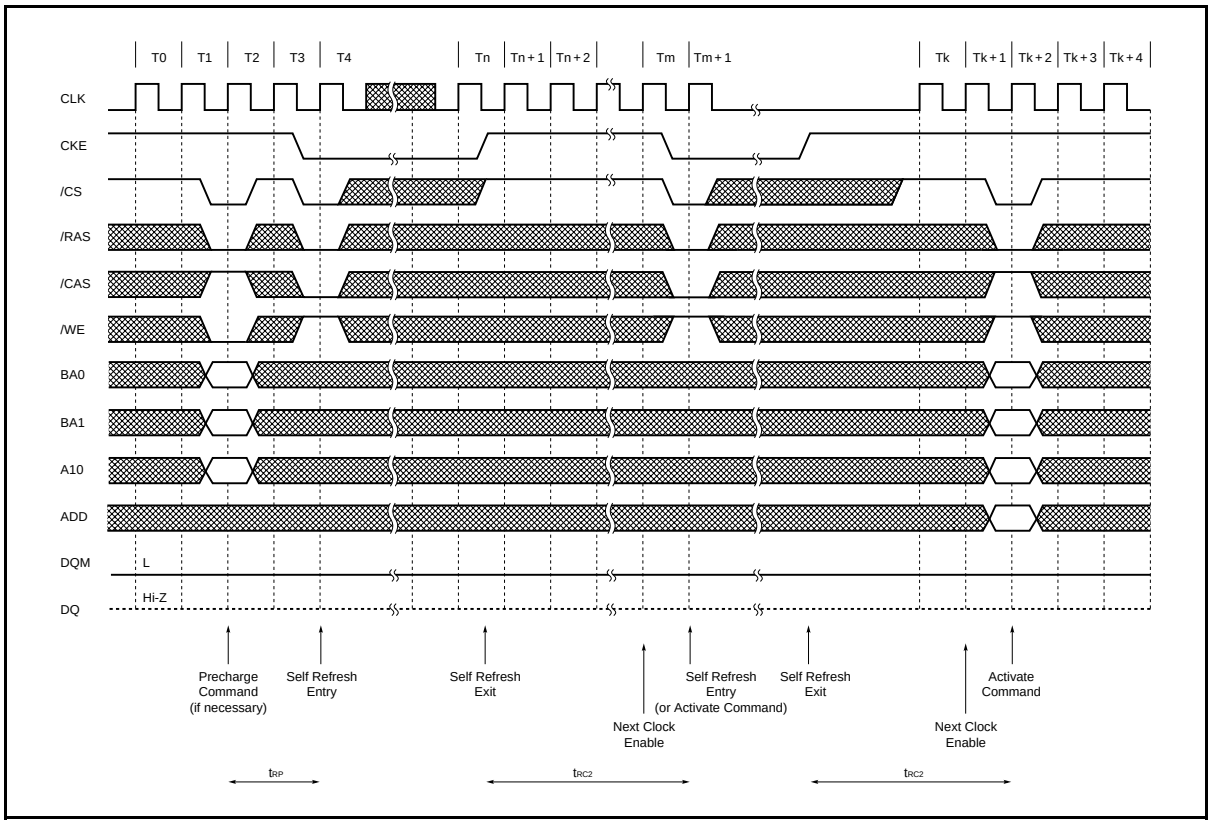

Figure 4-1. Self-Refresh Entry/Exit Timing

Mobile RAM is a trademark of Elpida Memory, Inc.

The information in this document is current as November 2005 but is subject to change without notice.

NOTES FOR CMOS DEVICES

① PRECAUTION AGAINST ESD FOR MOS DEVICES

Exposing the MOS devices to a strong electric field can cause destruction of the gate oxide and ultimately degrade the MOS devices operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it, when once it has occurred. Environmental control must be adequate. When it is dry, humidifier should be used. It is recommended to avoid using insulators that easily build static electricity. MOS devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work bench and floor should be grounded. The operator should be grounded using wrist strap. MOS devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with semiconductor MOS devices on it.

② HANDLING OF UNUSED INPUT PINS FOR CMOS DEVICES

No connection for CMOS devices input pins can be a cause of malfunction. If no connection is provided to the input pins, it is possible that an internal input level may be generated due to noise, etc., hence causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using a pull-up or pull-down circuitry. Each unused pin should be connected to V_{DD} or GND with a resistor, if it is considered to have a possibility of being an output pin. The unused pins must be handled in accordance with the related specifications.

③ STATUS BEFORE INITIALIZATION OF MOS DEVICES

Power-on does not necessarily define initial status of MOS devices. Production process of MOS does not define the initial operation status of the device. Immediately after the power source is turned ON, the MOS devices with reset function have not yet been initialized. Hence, power-on does not guarantee output pin levels, I/O settings or contents of registers. MOS devices are not initialized until the reset signal is received. Reset operation must be executed immediately after power-on for MOS devices having reset function.

CME0107