

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.

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 detect 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.

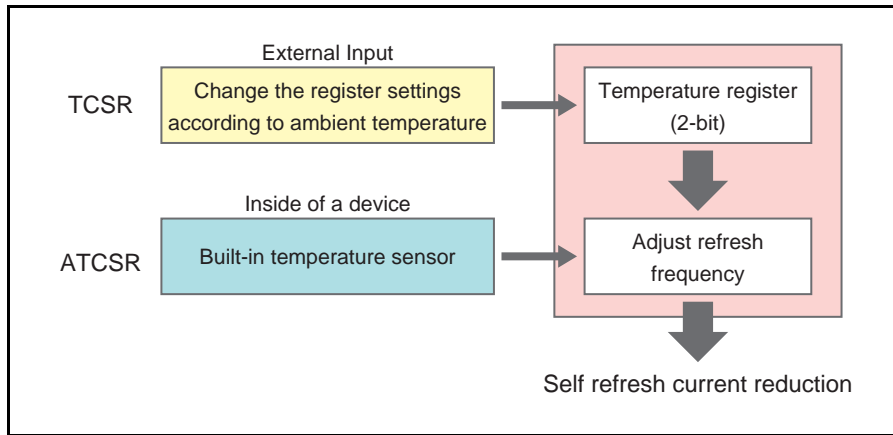


Figure 2-1. Overview of Auto Temperature Compensated Self Refresh

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.

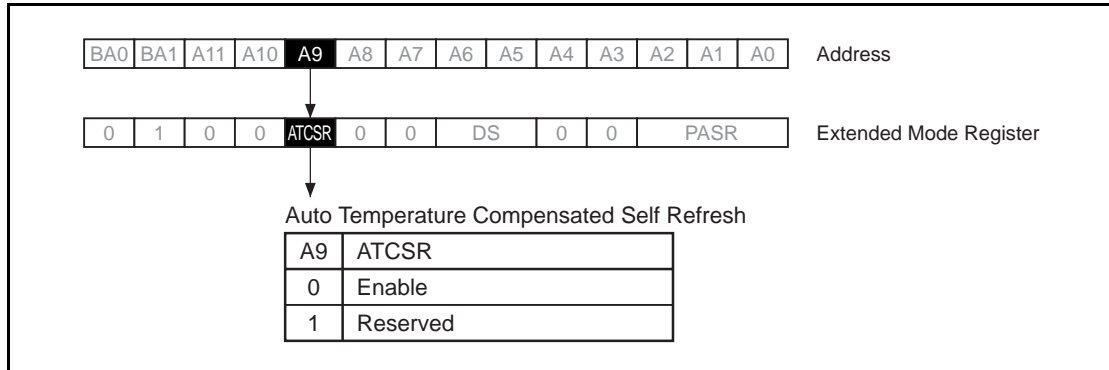


Figure 3-1. Auto Temperature Compensated Self Refresh Settings Using Extended Mode Register Set

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.

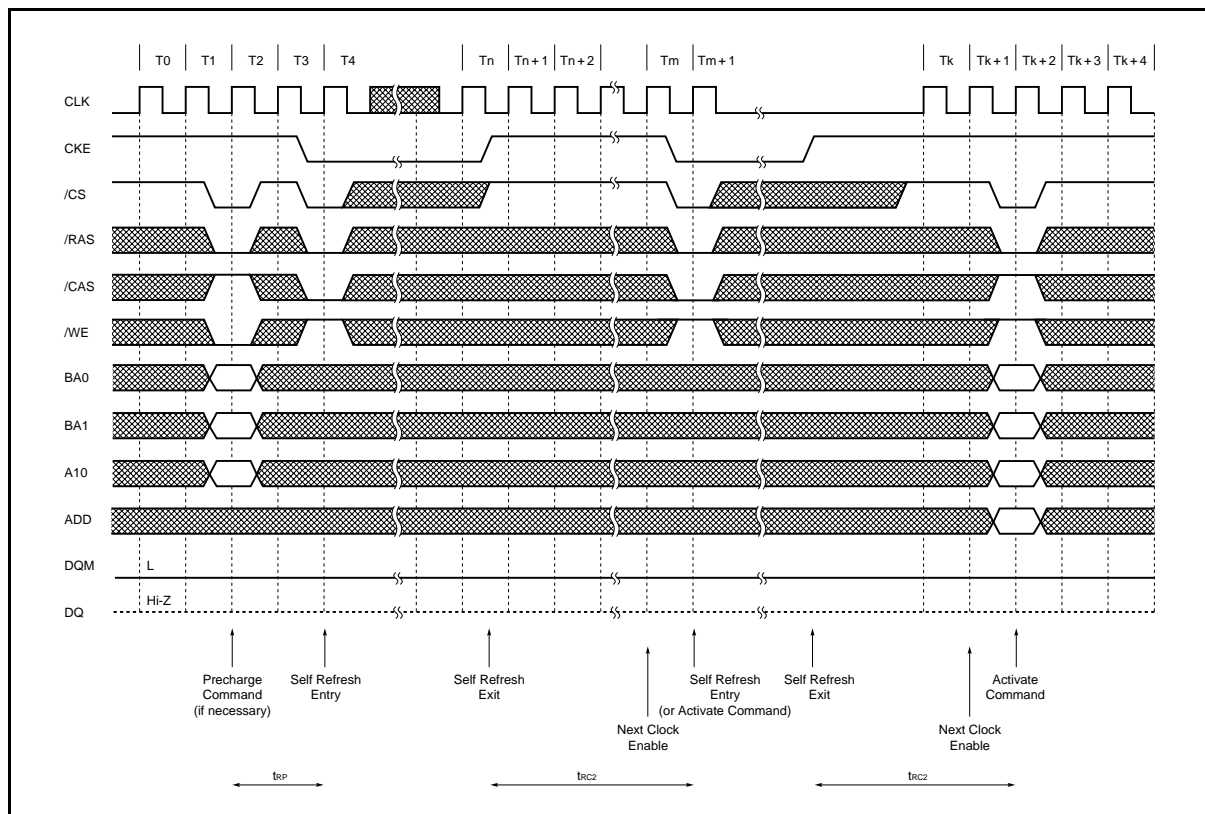


Figure 4-1. Self-Refresh Entry/Exit Timing

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

The information in this document is subject to change without notice. Before using this document, confirm that this is the latest version.

No part of this document may be copied or reproduced in any form or by any means without the prior written consent of Elpida Memory, Inc.

Elpida Memory, Inc. does not assume any liability for infringement of any intellectual property rights (including but not limited to patents, copyrights, and circuit layout licenses) of Elpida Memory, Inc. or third parties by or arising from the use of the products or information listed in this document. No license, express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of Elpida Memory, Inc. or others.

Descriptions of circuits, software and other related information in this document are provided for illustrative purposes in semiconductor product operation and application examples. The incorporation of these circuits, software and information in the design of the customer's equipment shall be done under the full responsibility of the customer. Elpida Memory, Inc. assumes no responsibility for any losses incurred by customers or third parties arising from the use of these circuits, software and information.

[Product applications]

Elpida Memory, Inc. makes every attempt to ensure that its products are of high quality and reliability. However, users are instructed to contact Elpida Memory's sales office before using the product in aerospace, aeronautics, nuclear power, combustion control, transportation, traffic, safety equipment, medical equipment for life support, or other such application in which especially high quality and reliability is demanded or where its failure or malfunction may directly threaten human life or cause risk of bodily injury.

[Product usage]

Design your application so that the product is used within the ranges and conditions guaranteed by Elpida Memory, Inc., including the maximum ratings, operating supply voltage range, heat radiation characteristics, installation conditions and other related characteristics. Elpida Memory, Inc. bears no responsibility for failure or damage when the product is used beyond the guaranteed ranges and conditions. Even within the guaranteed ranges and conditions, consider normally foreseeable failure rates or failure modes in semiconductor devices and employ systemic measures such as fail-safes, so that the equipment incorporating Elpida Memory, Inc. products does not cause bodily injury, fire or other consequential damage due to the operation of the Elpida Memory, Inc. product.

[Usage environment]

This product is not designed to be resistant to electromagnetic waves or radiation. This product must be used in a non-condensing environment.

If you export the products or technology described in this document that are controlled by the Foreign Exchange and Foreign Trade Law of Japan, you must follow the necessary procedures in accordance with the relevant laws and regulations of Japan. Also, if you export products/technology controlled by U.S. export control regulations, or another country's export control laws or regulations, you must follow the necessary procedures in accordance with such laws or regulations.

If these products/technology are sold, leased, or transferred to a third party, or a third party is granted license to use these products, that third party must be made aware that they are responsible for compliance with the relevant laws and regulations.

M01E0107