

**OKI Semiconductor**This version: Feb. 1999  
Previous version: May. 1997**MSM6587****524,288-Word x 1-Bit Serial Register****GENERAL DESCRIPTION**

The MSM6587 is a serial register in 524,288 words x 1 bit configuration featuring medium speed operation with low-power consumption.

The MSM6587 has a built-in internal address generator circuit allowing continuous serial read/write operation by external clock input. The internal address is automatically incremented or decremented by one by read/write operation. Address increment or decrement can be selected by external input.

Address designation in units of 1024 words in the direction of words is possible by an external serial address input.

A refresh timer and refresh counter are built in to eliminate the need of the external refresh circuit and to realize low power consumption.

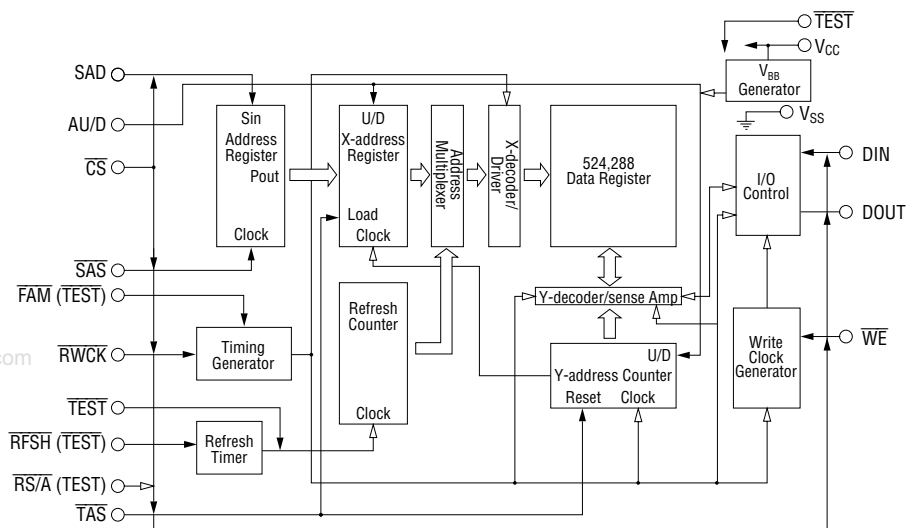
18-pin plastic QFJ (PLCC) is used as the package and the operating temperature range is between 0°C and 70°C.

The MSM6587 is suitable for storing large capacity data with battery backup. A solid state recording and playback system can easily be constructed in combination with OKI's voice synthesizer ICs.

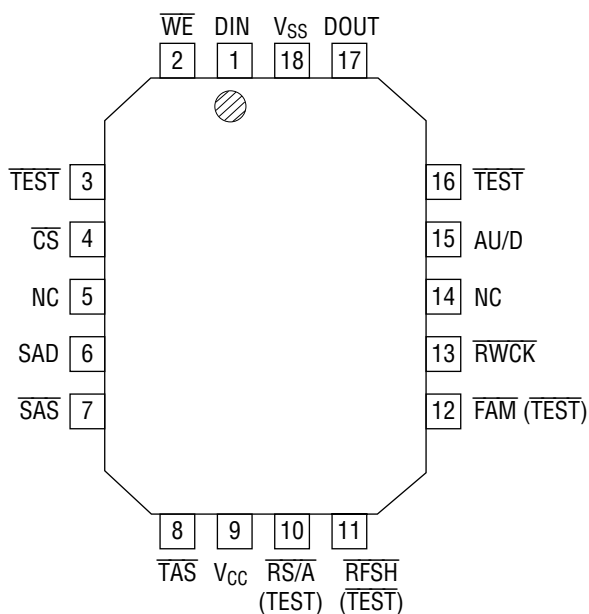
**FEATURES**

- Configuration : 524,288 x 1 bit
- Serial access operation
  - Serial access time : 1.5  $\mu$ s (3.0  $\mu$ s)
  - Serial read/write cycle time : 2.0  $\mu$ s (4.0  $\mu$ s)
  - Fast mode read/write cycle time : 0.4  $\mu$ s (0.4  $\mu$ s)
  - Times in parentheses indicate ones in self-refresh mode.
- Low current consumption : 100  $\mu$ A max. (for data holding, Vcc=4.0 V)
- Wide operating supply voltage range : Single 3.5 to 5.5 V
- Auto-refresh/self-refresh changeable
- Package:
  - 18-pin plastic QFJ (PLCC) (QFJ18-P-R290-1.27) (Product name : MSM6587JS)

## BLOCK DIAGRAM



## PIN CONFIGURATION (TOP VIEW)



NC: No connection

**18-Pin Plastic QFJ**

## PIN DESCRIPTIONS

Pin	Symbol	Description
1	DIN	Data input
2	$\overline{\text{WE}}$	Write enable
3, 16	$\overline{\text{TEST}}$	Test input
4	$\overline{\text{CS}}$	Chip select
6	SAD	Serial address data
7	$\overline{\text{SAS}}$	Serial address strobe
8	$\overline{\text{TAS}}$	Transfer address strobe
9	V <sub>CC</sub>	Power supply (+5V)
10	$\overline{\text{RS/A (TEST)}}$	Self-refresh/auto-refresh select (Test input)
11	$\overline{\text{RFSH (TEST)}}$	Refresh clock input (Test input)
12	$\overline{\text{FAM (TEST)}}$	Fast access mode select (Test input)
13	$\overline{\text{RWCK}}$	Read/write clock
15	AU/D	Address up/down select
17	DOUT	Data output
18	V <sub>SS</sub>	Ground (0V)

## ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Rating	Unit
Terminal Voltage	$V_T$	$T_a = 25^\circ\text{C}$ , relative to $V_{SS}$	-1.0 to +7.0	V
Output Short-Circuit Current	$I_{OS}$	$T_a = 25^\circ\text{C}$	50	mA
Power Dissipation	$P_D$	$T_a = 25^\circ\text{C}$	1	W
Operating Temperature	$T_{op}$	—	0 to 70	$^\circ\text{C}$
Storage Temperature	$T_{STG}$	—	-55 to +150	$^\circ\text{C}$

## RECOMMENDED OPERATING CONDITIONS

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(Ta = 0 to 70°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	$V_{CC}$	3.5	5.0	5.5	V
Supply Voltage	$V_{SS}$	0	0	0	V
"H" Input Voltage	$V_{IH}$	$V_{CC} - 0.5$	$V_{CC}$	$V_{CC} + 0.5$	V
"L" Input Voltage	$V_{IL}$	-0.5	0	+0.5	V

## ELECTRICAL CHARACTERISTICS

## DC Characteristics

(V<sub>CC</sub> = 3.5 V to 5.5 V, Ta = 0 to 70°C)

Parameter	Symbol	Condition	Min.	Max.	Unit
"H" Output Voltage	$V_{OH}$	$I_{OH} = -0.5\text{ mA}$	$V_{CC} - 0.5$	—	V
"L" Output Voltage	$V_{OL}$	$I_{OL} = 0.5\text{ mA}$	—	0.4	V
Input Leakage Current	$I_{LI}$	$V_I = 0\text{ V to } V_{CC}$	-1	+1	$\mu\text{A}$
Output Leakage Current	$I_{LO}$	$V_O = 0\text{ V to } V_{CC}$	-1	+1	$\mu\text{A}$
Supply Current (in operating state)	$I_{CC1}$	$V_{CC} = 4\text{ V}$ , $t_{RWC} = 2\text{ }\mu\text{s}$	—	5	mA
Supply Current (in standby state)	$I_{CC2}$	$V_{CC} = 4\text{ V}$	—	100	$\mu\text{A}$
Supply Current (FAM)	$I_{CC3}$	$V_{CC} = 4\text{ V}$ , $t_{RWC} = 0.4\text{ }\mu\text{s}$	—	15	mA

## AC Characteristics

(V<sub>CC</sub> = 3.5 V to 5.5 V, T<sub>a</sub> = 0 to 70°C)

Parameter	Symbol	MSM6587-SELF		MSM6587-AUTO		Unit
		Min.	Max.	Min.	Max.	
Refresh Cycle	t <sub>REF</sub>	—	—	—	100	ms
Read/Write Cycle Time	t <sub>RWC</sub>	4,000	—	2,000	—	ns
Access Time	t <sub>ACC</sub>	—	3,000	—	1,500	ns
Output Turn-off Delay Time	t <sub>OFF</sub>	0	50	0	50	ns
Input Signal Rise/Fall Time	t <sub>T</sub>	3	50	3	50	ns
RWCK Precharge Time	t <sub>RWP</sub>	1,000	—	500	—	ns
RWCK Pulse Width	t <sub>RW</sub>	3,000	10,000	1,500	10,000	ns
SAS Cycle Time	t <sub>SSC</sub>	100	—	100	—	ns
SAS Precharge Time	t <sub>SAP</sub>	50	—	50	—	ns
SAS Pulse Width	t <sub>SAS</sub>	50	—	50	—	ns
Address Setup Time	t <sub>AS</sub>	0	—	0	—	ns
Address Hold Time	t <sub>AH</sub>	50	—	50	—	ns
TAS Setup Time	t <sub>ATS</sub>	50	—	50	—	ns
TAS to RWCK Setup Time	t <sub>TRS</sub>	50	—	50	—	ns
TAS Pulse Width	t <sub>TAS</sub>	50	—	50	—	ns
Read Command Setup Time	t <sub>RRS</sub>	0	—	0	—	ns
Read Command Hold Time	t <sub>RRH</sub>	250	—	250	—	ns
Write Command Setup Time	t <sub>WRS</sub>	0	—	0	—	ns
Write Command Hold Time	t <sub>WRH</sub>	50	—	50	—	ns
Write Command Pulse Width	t <sub>WP</sub>	50	—	50	—	ns
WE to RWCK Lead Time	t <sub>RWL</sub>	50	—	50	—	ns
Data Setup Time	t <sub>DS</sub>	0	—	0	—	ns
Data Hold Time	t <sub>DH</sub>	50	—	50	—	ns
RWCK to WE Delay Time	t <sub>RWD</sub>	100	—	100	—	ns
AU/D Setup Time	t <sub>UDS</sub>	0	—	0	—	ns
AU/D Hold Time	t <sub>UDH</sub>	50	—	50	—	ns
AU/D to TAS Setup Time	t <sub>UDTS</sub>	0	—	0	—	ns
RFSH Setup Time	t <sub>RFS</sub>	—	—	500	—	ns
RFSH Precharge Time	t <sub>RFP</sub>	—	—	500	—	ns
RFSH Pulse Width	t <sub>RF</sub>	—	—	1,500	10,000	ns
RFSH RWCK Precharge Time	t <sub>RRP</sub>	—	—	500	—	ns
Fast RWCK Precharge Time	t <sub>FC</sub>	400	—	400	—	ns
Fast RWCK Mode Cycle	t <sub>FAC</sub>	—	300	—	300	ns
Fast Mode Access Time	t <sub>FCP</sub>	100	—	100	—	ns
Fast RWCK Mode Cycle Time	t <sub>FR</sub>	300	—	300	—	ns
Fast Mode Setup Time	t <sub>FS</sub>	0	—	0	—	ns
Fast Mode Hold Time	t <sub>FH</sub>	50	—	50	—	ns

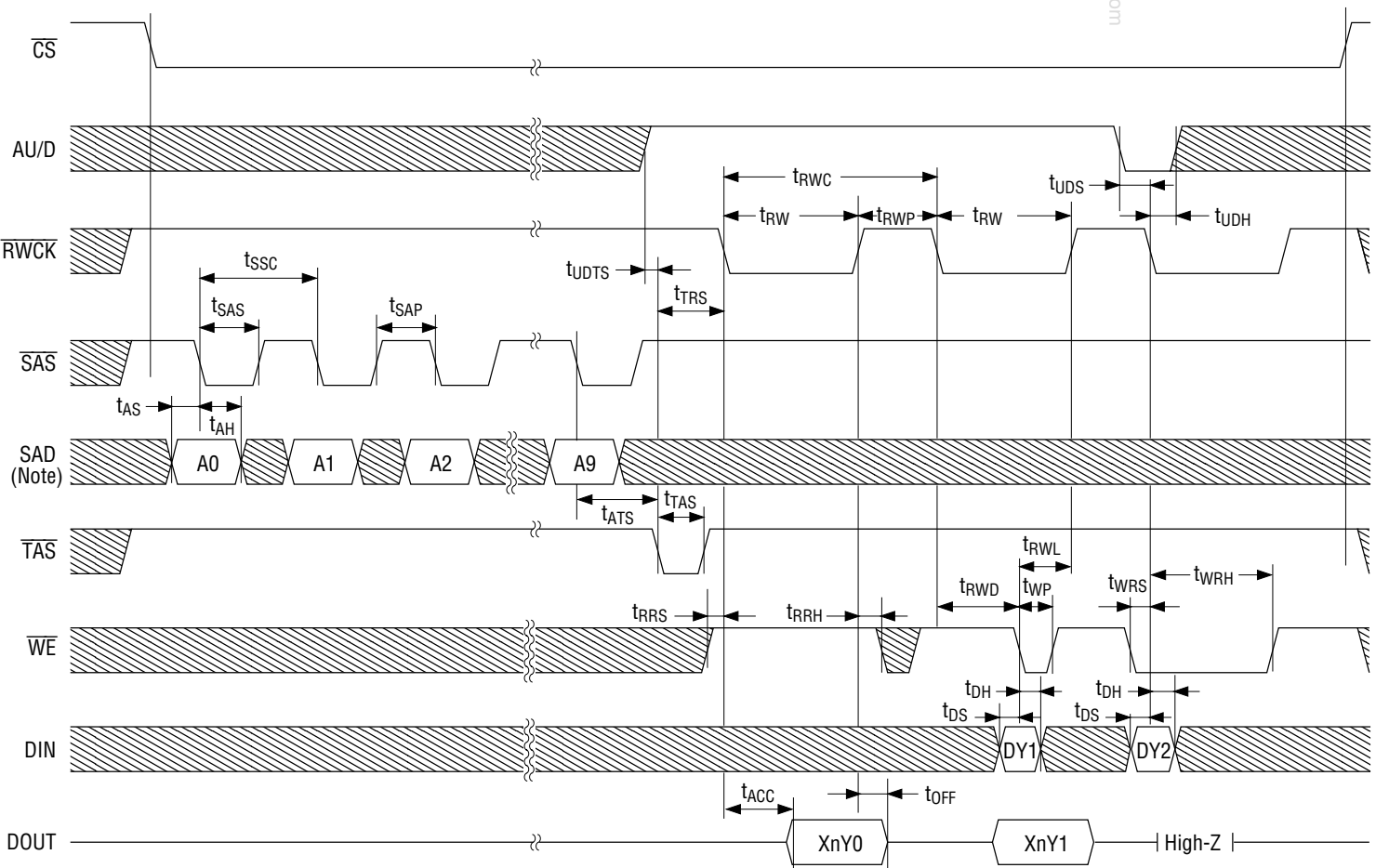
**AC Characteristics (Continued)**

Parameter	Symbol	MSM6586-SELF		MSM6586-AUTO		Unit
		Min.	Max.	Min.	Max.	
Fast Mode Width	$t_{FCC}$	4,000	100,000	2,000	100,000	ns
Slow Mode Setup Time	$t_{SS}$	0	—	0	—	ns
Slow Mode Hold Time	$t_{SH}$	50	—	50	—	ns

Note: 1. Up/down switching for internal addresses is not available in fast mode.  
2. Switching to the fast mode should be made satisfying the timings of  $t_{FS}$  and  $t_{SS}$  at the "L" level of RWCK.

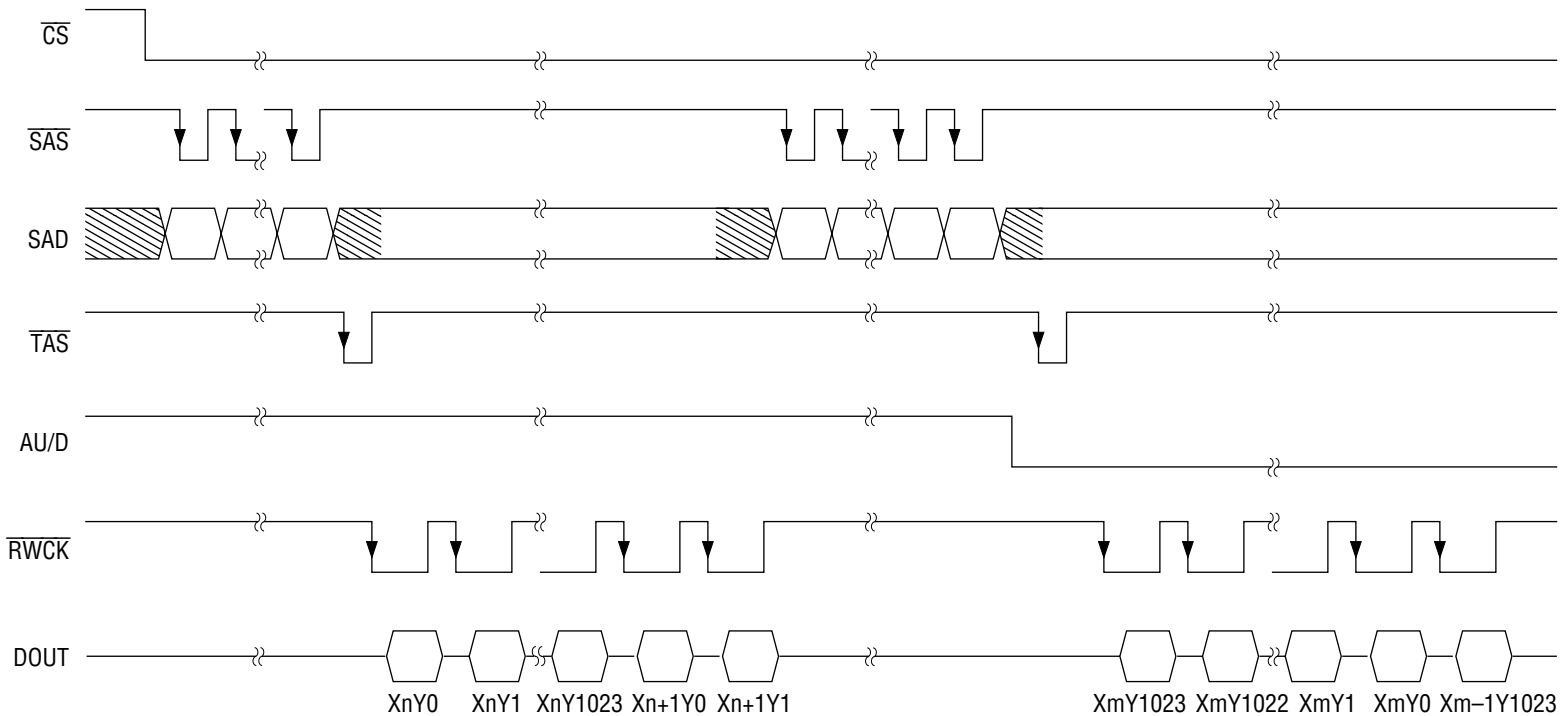
## TIMING DIAGRAMS

### Read/Write/Read Modify Write Cycle



Note: Out of ten bits from A0 to A9, only the nine bits from A0 to A8 are effective. Fix A9 to "L".

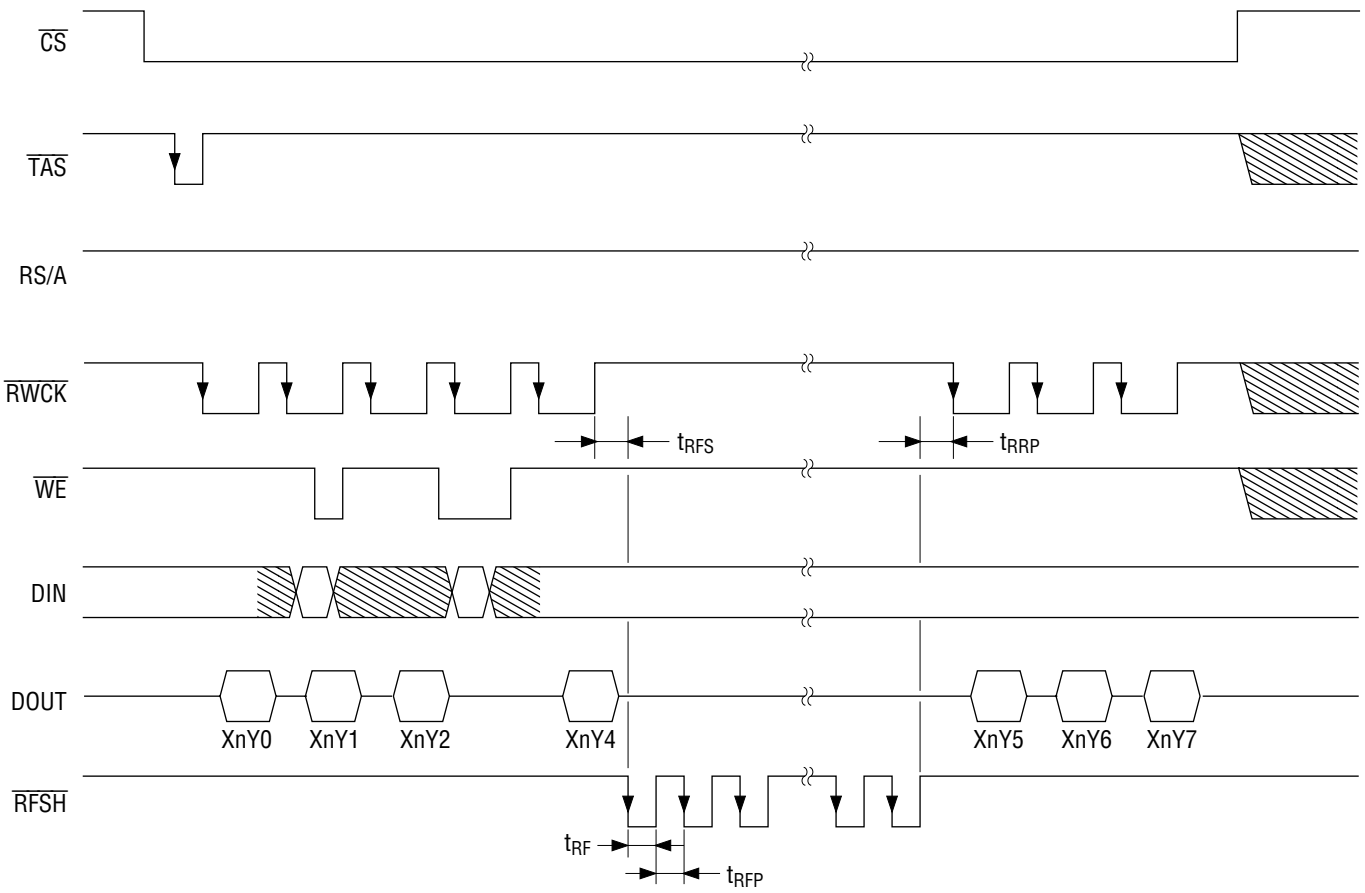
# Address Up/Down Select Mode



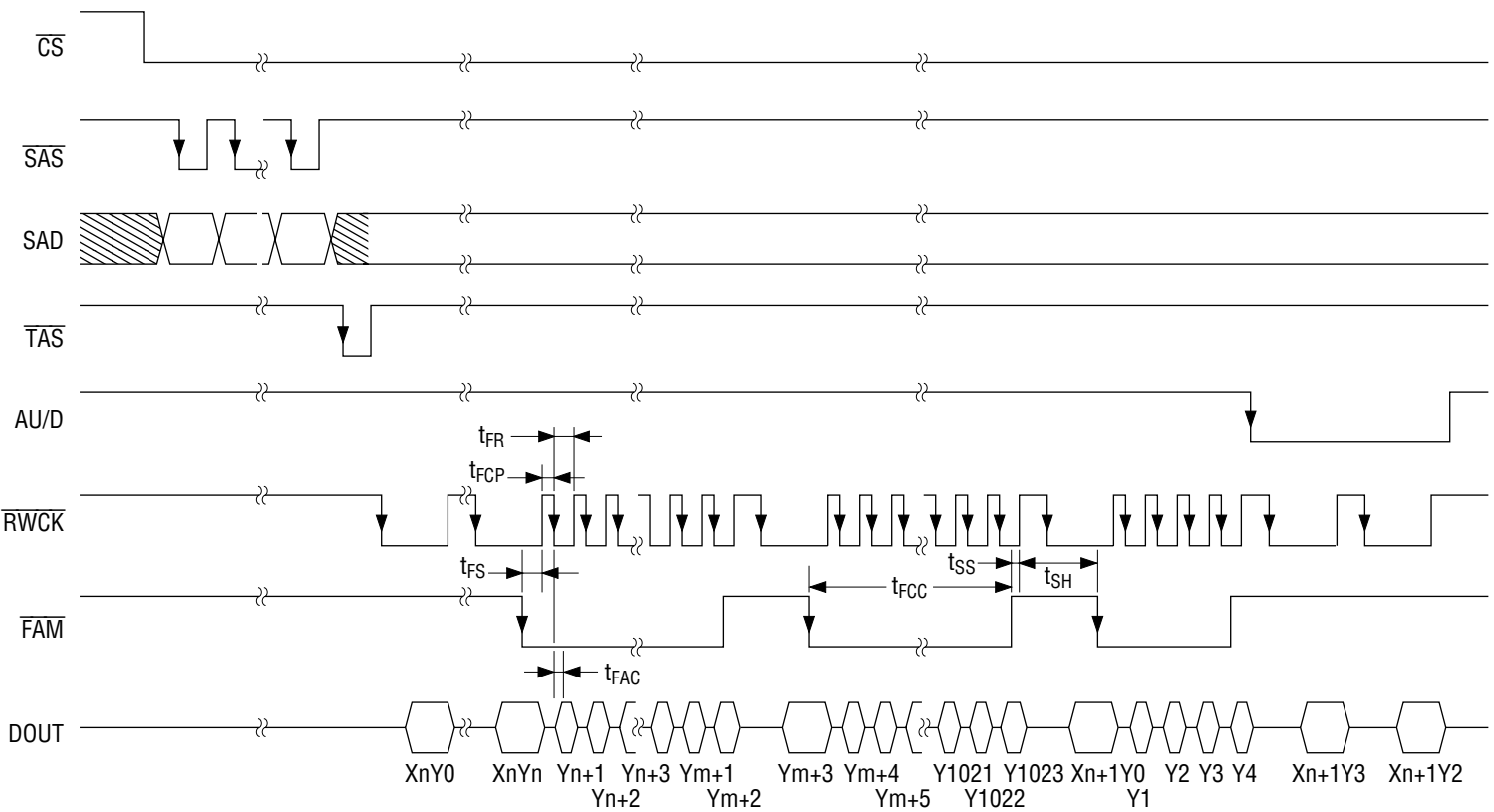
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# Auto-Refresh Mode



# Fast Access Mode



## FUNCTIONAL DESCRIPTION

### Serial Address Input (SAD)

Pin for inputting the start address for read/write. Address data can be input in units of 1024 words. The 1,024 address data can be input as 10-bit (A0-A9) serial from the SAD pin. (A0-A8 has enable address, A9 keeps "L".)

### Serial Address Strobe ( $\overline{\text{SAS}}$ )

Pin for the clock used to store the serial address data into the internal register.

### Address Transfer Strobe ( $\overline{\text{TAS}}$ )

Input pin for setting the serial address data stored in the address register to the internal address counter.

When the  $\overline{\text{TAS}}$  falls, and the Y address is set to address 0 in the increment mode or to address 1023 in the decrement mode.

### Read/Write Clock ( $\overline{\text{RWCK}}$ )

Input pin for the data register information read/write clock.

Internal operation starts at the falling edge of  $\overline{\text{RWCK}}$ . The information in the data register is output to the DOUT pin in the read mode, and the information at the DIN pin is written into the data register in the write mode. The internal address counter is automatically incremented or decremented also when  $\overline{\text{RWCK}}$  falls.

### Write Enable ( $\overline{\text{WE}}$ )

Input pin for selecting the read mode, write mode or read modify write mode.

The read mode is set when  $\overline{\text{WE}}$  is "H", and the write mode is set when  $\overline{\text{WE}}$  is "L". When  $\overline{\text{WE}}$  falls from "H" to "L" while  $\overline{\text{RWCK}}$  is active, the read modify write mode is set.

### Data Input (DIN)

Input pin for write data.

The information at the data input pin is stored at the falling edge of  $\overline{\text{RWCK}}$  in the write mode, and at the falling edge of  $\overline{\text{WE}}$  in the read modify write mode.

### Data Output (DOUT)

The data output pin is always kept in the high impedance state when  $\overline{\text{RWCK}}$  or  $\overline{\text{CS}}$  is kept at "H". When "H" or "L" information is read in the read operation, the output pin is set to "H" or "L" and holds the read information until  $\overline{\text{RWCK}}$  is again set to "H". In the early write mode the output pin maintains the high impedance state, so I/O common operation by connecting DIN and DOUT is possible.

### Address Up/Down Select (AU/D)

Input pin for selecting the direction of automatic address updating.

When the  $\overline{\text{TAS}}$  signal is input with the AU/D pin set to "H", the internal address counters are set to the externally set address for X and to address 0 for Y. Then the address is incremented by 1 every time  $\overline{\text{RWCK}}$  is input.

When the  $\overline{\text{TAS}}$  signal is input with the AU/D pin set to "L", the internal address counters are set to the externally set address in the same way for X but set to address 1023 for Y. Then the address is decremented by 1 every time  $\overline{\text{RWCK}}$  is input. In either case, the X address is automatically incremented or decremented by 1 when read/write operation for 1024 words ends. The AU/D pin setting change is possible in any read/write cycle so long as the timing specifications for  $t_{\text{UDS}}$ ,  $t_{\text{UDH}}$  are satisfied.

**Chip Select ( $\overline{\text{CS}}$ )**

Input pin for disabling all input and output pins. This pin enables parallel use of multiple MSM6587s by connecting the data input and output pins.

**Self/Auto Refresh Select ( $\overline{\text{RS/A}}$  (TEST))**

Pin for selecting a refresh mode in order to retain memory cell data.

If the  $\overline{\text{RS/A}}$  pin is set to "L" level, the self-refresh mode is selected and no external refresh control is required. If the  $\overline{\text{RS/A}}$  pin is set to "H" level, the auto-refresh mode is selected and refresh operation is required to retain memory cell data.

**Refresh Clock Input ( $\overline{\text{RFSH}}$  (TEST))**

Input pin for controlling the external refresh when the auto refresh mode is selected.

When the auto-refresh mode is selected, 1024 refresh operations are required within 100ms via the  $\overline{\text{RFSH}}$  pin while the  $\overline{\text{RWCK}}$  is at "H" level.

**Fast Access Mode Select ( $\overline{\text{FAM}}$  (TEST))**

Pin for fast read/write operations. Fast read/write is possible by keeping the  $\overline{\text{FAM}}$  pin at "L" level. The fast access mode is set or released by inputting "L" level or "H" level to the  $\overline{\text{FAM}}$  pin when the  $\overline{\text{RWCK}}$  pin is at "L" level, and when  $t_{\text{FS}}$  and  $t_{\text{SS}}$  are satisfied.

When 1024-word data access is complete, be sure to insert a normal cycle in order to increment or decrement the X address.

**Test (TEST,  $\overline{\text{TEST}}$ )**

The TEST pin is fixed to "L" level.

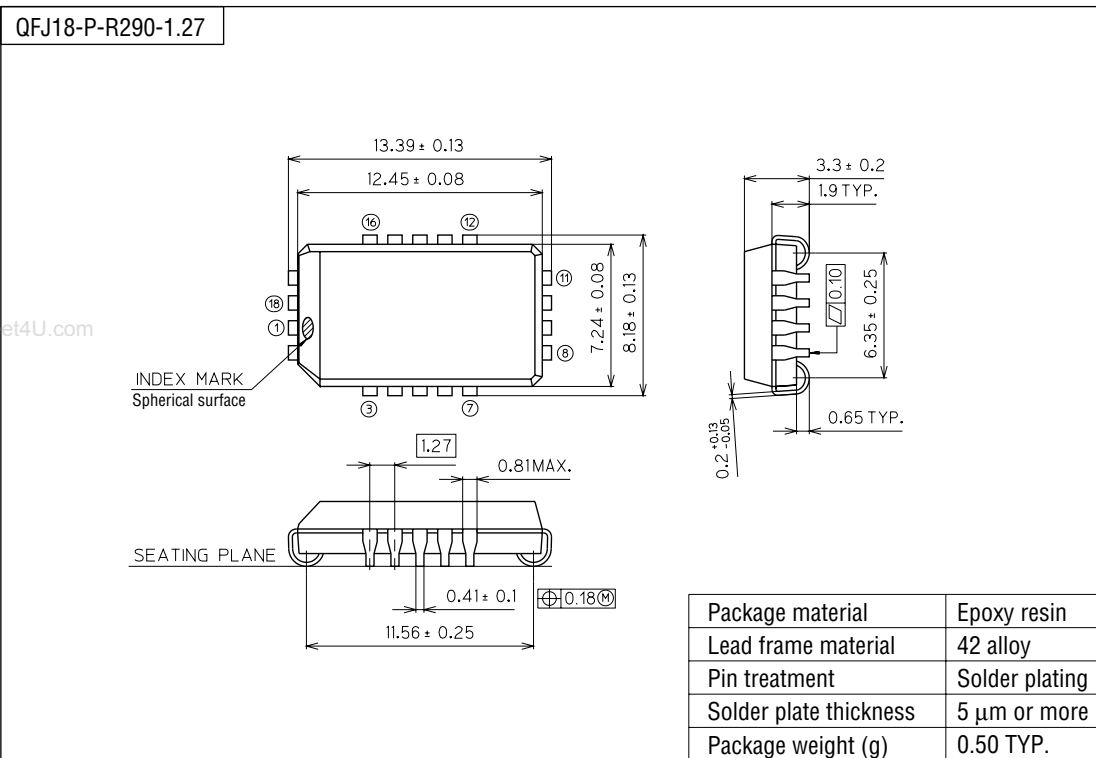
The  $\overline{\text{TEST}}$  pin is fixed to "H" level.

**Turning the power ON**

To stabilize the device, it is required to pause for over 100 $\mu$ s after the  $V_{\text{CC}}$  reaches the specified voltage. Then it is needed to add eight or more  $\overline{\text{RWCK}}$  cycles (read cycles or pseudo data write cycles).

# PACKAGE DIMENSIONS

(Unit : mm)



## Notes for Mounting the Surface Mount Type Package

The SOP, QFP, TSOP, TQFP, LQFP, SOJ, QFJ (PLCC), SHP, and BGA are surface mount type packages, which are very susceptible to heat in reflow mounting and humidity absorbed in storage. Therefore, before you perform reflow mounting, contact Oki's responsible sales person on the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).

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