M5M5V416BWG

PRELIMINARY

Notice: This is not a final specification.
Some parametric limits are subject to change

4194304-BIT (262144-WORD BY 16-BIT) CMOS STATIC RAM

DESCRIPTION

The M5M5V416B is a family of low voltage 4-Mbit static RAMs organized as 262,144-words by 16-bit, fabricated by Mitsubishi's high-performance 0.25µm CMOS technology.

The M5M5V416B is suitable for memory applications where a simple interfacing, battery operating and battery backup are the important design objectives.

M5M5V416BWG is packaged in a CSP (chip scale package), with the outline of 7mm x 8.5mm, ball matrix of 6 x 8 (48pin) and ball pitch of 0.75mm. It gives the best solution for a compaction of mounting area as well as flexibility of wiring pattern of printed circuit boards.

From the point of operating temperature, the family is divided into three versions; "Standard", "W-version", and "I-version". Those are summarized in the part name table below.

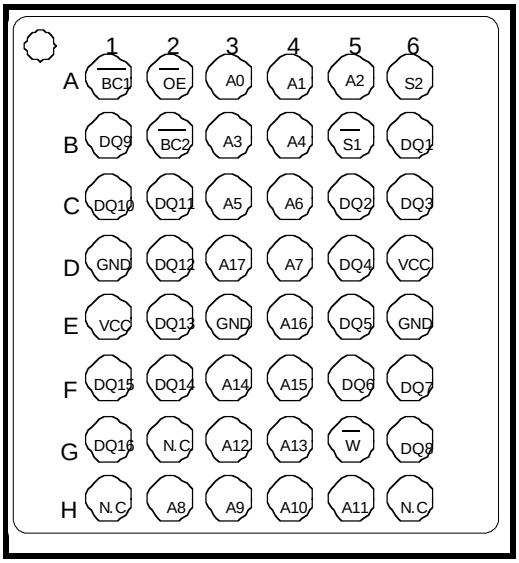
FEATURES

- Single +2.7~+3.6V power supply
- Small stand-by current: 0.3µA(3V,typ.)
- No clocks, No refresh
- Data retention supply voltage =2.0V to 3.6V
- All inputs and outputs are TTL compatible.
- Easy memory expansion by $\overline{S1}$, S2, $\overline{BC1}$ and $\overline{BC2}$
- Common Data I/O
- Three-state outputs: OR-tie capability
- $\overline{OE}$ prevents data contention in the I/O bus
- Process technology: 0.25µm CMOS
- Package: 48pin 7mm x 8.5mm CSP

Version, Operating temperature	Part name	Power Supply	Access time max.	Stand-by current Icc(PD), Vcc=3.0V						Active current Icc1 (3.0V, typ.)
				typical *		Ratings (max.)				
				25°C	40°C	25°C	40°C	70°C	85°C	
Standard 0 ~ +70°C	M5M5V416BWG -70L	2.7 ~ 3.6V	70ns	---	---	---	---	20µA	---	40mA (10MHz) 5mA (1MHz)
	M5M5V416BWG -85L		85ns							
	M5M5V416BWG -10L		100ns							
	M5M5V416BWG -70H	2.7 ~ 3.6V	70ns	0.3µA	1µA	1µA	3µA	10µA	---	
	M5M5V416BWG -85H		85ns							
	M5M5V416BWG -10H		100ns							
W-version -20 ~ +85°C	M5M5V416BWG -70LW	2.7 ~ 3.6V	70ns	---	---	---	---	20µA	40µA	
	M5M5V416BWG -85LW		85ns							
	M5M5V416BWG -10LW		100ns							
	M5M5V416BWG -70HW	2.7 ~ 3.6V	70ns	0.3µA	1µA	1µA	3µA	10µA	20µA	
	M5M5V416BWG -85HW		85ns							
	M5M5V416BWG -10HW		100ns							
I-version -40 ~ +85°C	M5M5V416WG -70LI	2.7 ~ 3.6V	70ns	---	---	---	---	20µA	40µA	
	M5M5V416BWG -85LI		85ns							
	M5M5V416BWG -10LI		100ns							
	M5M5V416BWG -70HI	2.7 ~ 3.6V	70ns	0.3µA	1µA	1µA	3µA	10µA	20µA	
	M5M5V416BWG -85HI		85ns							
	M5M5V416BWG -10HI		100ns							

* "typical" parameter is sampled, not 100% tested.

PIN CONFIGURATION (TOP VIEW)



Outline: 48FHA
NC: No Connection

Pin	Function
A0 ~ A17	Address input
DQ1 ~ DQ16	Data input / output
$\overline{S1}$	Chip select input 1
S2	Chip select input 2
$\overline{W}$	Write control input
$\overline{OE}$	Output enable input
$\overline{BC1}$	Lower Byte (DQ1 ~ 8)
$\overline{BC2}$	Upper Byte (DQ9 ~ 16)
Vcc	Power supply
GND	Ground supply

M5M5V416BWG

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4194304-BIT (262144-WORD BY 16-BIT) CMOS STATIC RAM

FUNCTION

The M5M5V416BWG is organized as 262,144-words by 16-bit. These devices operate on a single +2.7~3.6V power supply, and are directly TTL compatible to both input and output. Its fully static circuit needs no clocks and no refresh, and makes it useful.

The operation mode are determined by a combination of the device control inputs $\overline{BC1}$, $\overline{BC2}$, $\overline{S1}$, S2 , $\overline{W}$ and $\overline{OE}$. Each mode is summarized in the function table.

A write operation is executed whenever the low level $\overline{W}$ overlaps with the low level $\overline{BC1}$ and/or $\overline{BC2}$ and the low level $\overline{S1}$ and the high level S2. The address(A0~A17) must be set up before the write cycle and must be stable during the entire cycle.

A read operation is executed by setting $\overline{W}$ at a high level and $\overline{OE}$ at a low level while $\overline{BC1}$ and/or $\overline{BC2}$ and $\overline{S1}$ and S2 are in an active state($\overline{S1}$=L,S2=H).

When setting $\overline{BC1}$ at the high level and other pins are in an active stage , upper-byte are in a selectable mode in which both reading and writing are enabled, and lower-byte are in a non-selectable mode. And when setting $\overline{BC2}$ at a high level and other pins are in an active stage, lower-byte are in a selectable mode and upper-byte are in a non-selectable mode.

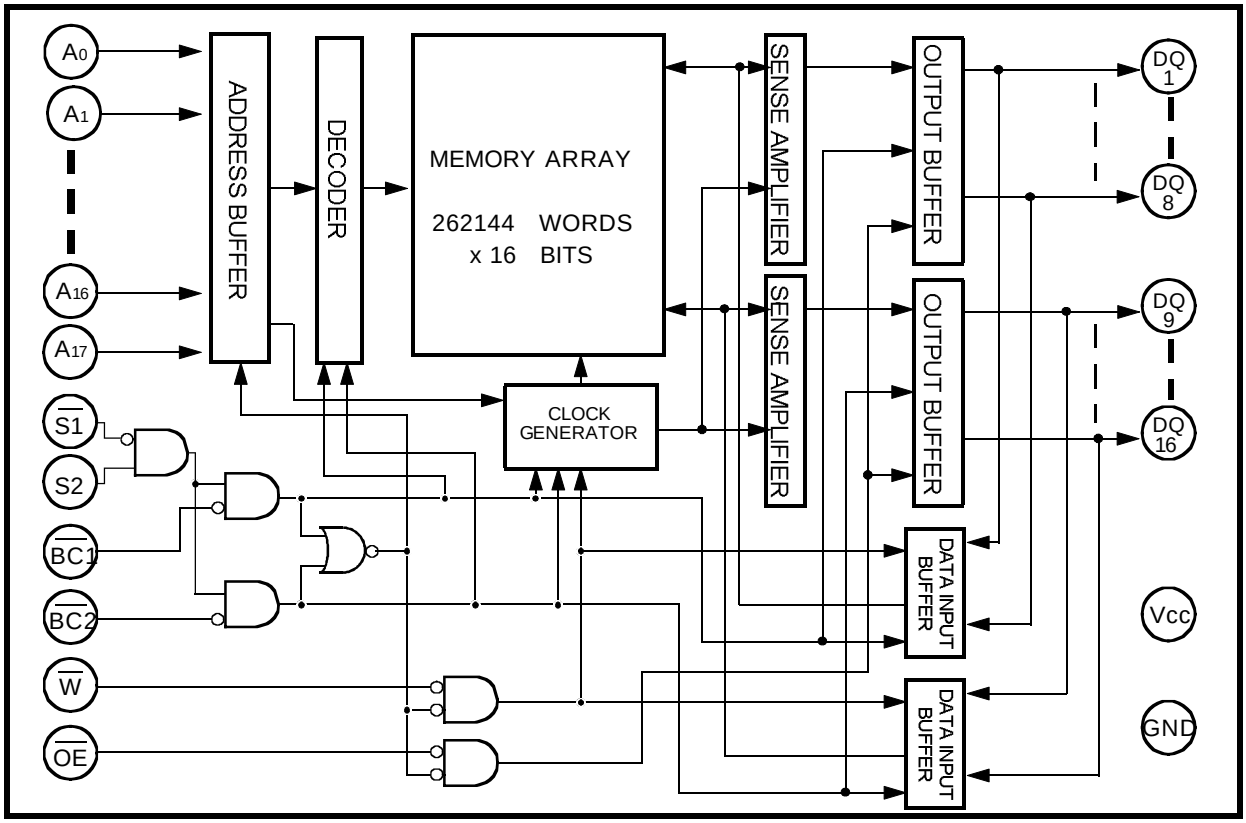
When setting $\overline{BC1}$ and $\overline{BC2}$ at a high level or $\overline{S1}$ at a high level or S2 at a low level, the chips are in a non-selectable mode in which both reading and writing are disabled. In this mode, the output stage is in a high-impedance state, allowing OR-tie with other chips and memory expansion by $\overline{BC1}$, $\overline{BC2}$ and $\overline{S1}$, S2.

The power supply current is reduced as low as 0.3µA(25°C, typical), and the memory data can be held at +2V power supply, enabling battery back-up operation during power failure or power-down operation in the non-selected mode.

FUNCTION TABLE

$\overline{S1}$	S2	$\overline{BC1}$	$\overline{BC2}$	$\overline{W}$	$\overline{OE}$	Mode	DQ1~8	DQ9~16	Icc
H	L	X	X	X	X	Non selection	High-Z	High-Z	Standby
L	L	X	X	X	X	Non selection	High-Z	High-Z	Standby
H	H	X	X	X	X	Non selection	High-Z	High-Z	Standby
X	X	H	H	X	X	Non selection	High-Z	High-Z	Standby
L	H	L	H	L	X	Write	Din	High-Z	Active
L	H	L	H	H	L	Read	Dout	High-Z	Active
L	H	L	H	H	H	———	High-Z	High-Z	Active
L	H	H	L	L	X	Write	High-Z	Din	Active
L	H	H	L	H	L	Read	High-Z	Dout	Active
L	H	H	L	H	H	———	High-Z	High-Z	Active
L	H	L	L	L	X	Write	Din	Din	Active
L	H	L	L	H	L	Read	Dout	Dout	Active
L	H	L	L	H	H	———	High-Z	High-Z	Active

BLOCK DIAGRAM



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4194304-BIT (262144-WORD BY 16-BIT) CMOS STATIC RAM

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Ratings	Units
V_{CC}	Supply voltage	With respect to GND	-0.5* ~ +4.6	V
V_I	Input voltage	With respect to GND	-0.5* ~ Vcc + 0.5	
V_O	Output voltage	With respect to GND	0 ~ Vcc	
P_d	Power dissipation	Ta=25°C	700	mW
T_a	Operating temperature	Standard (-L, -H)	0 ~ +70	°C
		W-version (-LW, -HW)	- 20 ~ +85	
		I-version (-LI, -HI)	- 40 ~ +85	
T_{stg}	Storage temperature		- 65 ~ +150	°C

* -3.0V in case of AC (Pulse width ≦ 30ns)

DC ELECTRICAL CHARACTERISTICS

(Vcc=2.7 ~ 3.6V, unless otherwise noted)

Symbol	Parameter	Conditions			Limits Min	Limits Typ	Limits Max	Units
V_{IH}	High-level input voltage				2.2		Vcc+0.3V	V
V_{IL}	Low-level input voltage				-0.3 *		0.6	
V_{OH1}	High-level output voltage 1	I_{OH}= -0.5mA			2.4			
V_{OH2}	High-level output voltage 2	I_{OH}= -0.05mA			Vcc-0.5V			
V_{OL}	Low-level output voltage	I_{OL}=2mA					0.4	
I_I	Input leakage current	V_I =0 ~ Vcc					±1	µA
I_O	Output leakage current	$\overline{BC1}$ and $\overline{BC2}$=VIH or $\overline{S1}$=VIH or S2=VIH or $\overline{OE}$=VIH, VI/O=0 ~ Vcc					±1	
Icc1	Active supply current (AC,MOS level)	$\overline{BC1}$ and $\overline{BC2}$≦ 0.2V, $\overline{S1}$≦ 0.2V, S2 ≧ Vcc-0.2V other inputs ≦0.2V or ≧Vcc-0.2V Output - open (duty 100%)		f= 10MHz	-	40	50	mA
				f= 1MHz	-	5	10	
Icc2	Active supply current (AC,TTL level)	$\overline{BC1}$ and $\overline{BC2}$=VIL , $\overline{S}$=VIL ,S2=VIH other pins =VIH or VIL Output - open (duty 100%)		f= 10MHz	-	40	50	
				f= 1MHz	-	5	10	
Icc3	Stand by supply current (AC,MOS level)	< 1 > $\overline{S1}$ ≧ Vcc - 0.2V, other inputs = 0 ~ Vcc < 2 > S2 ≦ 0.2V, other inputs = 0 ~ Vcc < 3 > $\overline{BC1}$ and $\overline{BC2}$ ≧ Vcc - 0.2V $\overline{S1}$ ≦ 0.2V, S2 ≧ Vcc - 0.2V Other inputs=0~Vcc	-LW, -LI	+70 ~ +85°C	-	-	48	µA
			-L, -LW, -LI	+70°C	-	-	24	
			-HW, -HI	+70 ~ +85°C	-	-	24	
			-H, -HW, -HI	+40 ~ +70°C	-	-	12	
				+25 ~ +40°C	-	1	3.6	
			-H	0 ~ +25°C	-	0.3	1.2	
			-HW	- 20 ~ +25°C	-	0.3	1.2	
			-HI	- 40 ~ +25°C	-	0.3	1.2	
Icc4	Stand by supply current (AC,TTL level)	$\overline{BC1}$ and $\overline{BC2}$=VIH or $\overline{S1}$=VIH or S2=VIL Other inputs= 0 ~ Vcc			-	-	0.5	mA

Note 1: Direction for current flowing into IC is indicated as positive (no mark)

* -3.0V in case of AC (Pulse width ≦ 30ns)

Note 2: Typical value is for Vcc=3.0V and Ta=25°C

CAPACITANCE

(Vcc=2.7 ~ 3.6V, unless otherwise noted)

Symbol	Parameter	Conditions	Limits Min	Limits Typ	Limits Max	Units
C_I	Input capacitance	V_I=GND, V_I=25mVrms, f=1MHz			10	pF
C_O	Output capacitance	V_O=GND, V_O=25mVrms, f=1MHz			10	

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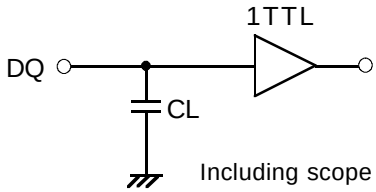
AC ELECTRICAL CHARACTERISTICS

(Vcc=2.7 ~ 3.6V, unless otherwise noted)

(1) TEST CONDITIONS

Supply voltage	2.7V~3.6V
Input pulse	V_{IH}=2.4V,V_{IL}=0.4V
Input rise time and fall time	5ns
Reference level	V_{OH}=V_{OL}=1.5V Transition is measured ±500mV from steady state voltage.(for t_{en},t_{dis})
Output loads	Fig.1,CL=30pF CL=5pF (for ten,tdis)



Including scope and jig capacitance

Fig.1 Output load

(2) READ CYCLE

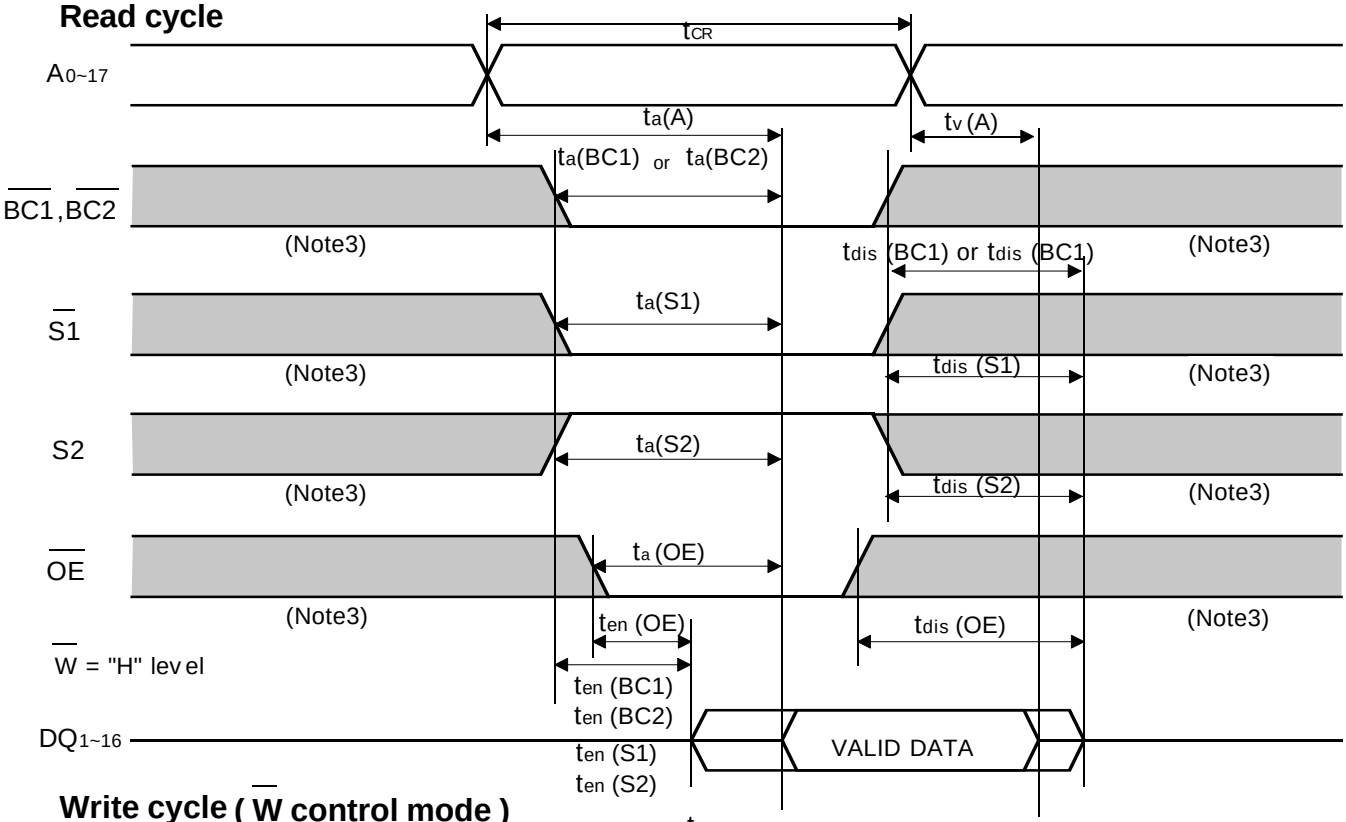
Symbol	Parameter	Limits						Units
		70L,70H,70LW 70HW,70LI,70HI		85L,85H,85LW 85HW,85LI,85HI		10L,10H,10LW 10HW,10LI,10HI		
		Min	Max	Min	Max	Min	Max	
t_{CR}	Read cycle time	70		85		100		ns
t_a(A)	Address access time		70		85		100	ns
t_a(S1)	Chip select 1 access time		70		85		100	ns
t_a(S2)	Chip select 2 access time		70		85		100	ns
t_a(BC1)	Byte control 1 access time		70		85		100	ns
t_a(BC2)	Byte control 2 access time		70		85		100	ns
t_a(OE)	Output enable access time		35		45		50	ns
t_{dis}(S1)	Output disable time after $\overline{S1}$ high		25		30		35	ns
t_{dis}(S2)	Output disable time after S2 low		25		30		35	ns
t_{dis}(BC1)	Output disable time after $\overline{BC1}$ high		25		30		35	ns
t_{dis}(BC2)	Output disable time after $\overline{BC2}$ high		25		30		35	ns
t_{dis}(OE)	Output disable time after $\overline{OE}$ high		25		30		35	ns
t_{en}(S1)	Output enable time after S1 low	10		10		10		ns
t_{en}(S2)	Output enable time after S2 high	10		10		10		ns
t_{en}(BC1)	Output enable time after $\overline{BC1}$ low	10		10		10		ns
t_{en}(BC2)	Output enable time after BC2 low	10		10		10		ns
t_{en}(OE)	Output enable time after OE low			5		5		ns
t_V(A)	Data valid time after address	10		10		10		ns

(3) WRITE CYCLE

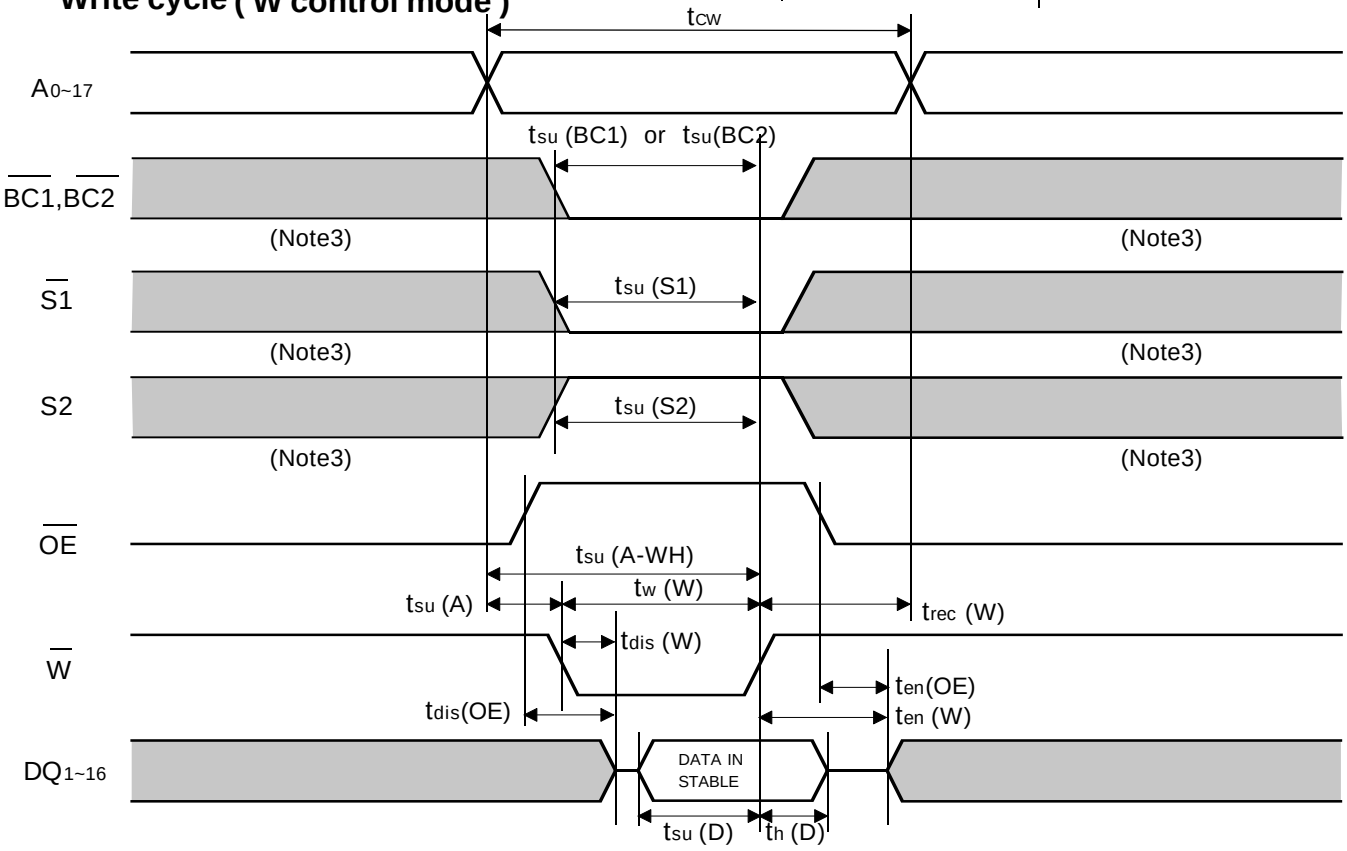
Symbol	Parameter	Limits						Units
		70L,70H,70LW 70HW,70LI,70HI		85L,85H,85LW 85HW,85LI,85HI		10L,10H,10LW 10HW,10LI,10HI		
		Min	Max	Min	Max	Min	Max	
t_{CW}	Write cycle time	70		85		100		ns
t_w(W)	Write pulse width	55		60		75		ns
t_{su}(A)	Address setup time	0		0		0		ns
t_{su}(A-WH)	Address setup time with respect to $\overline{W}$	65		70		85		ns
t_{su}(BC1)	Byte control 1 setup time	65		70		85		ns
t_{su}(BC2)	Byte control 2 setup time	65		70		85		ns
t_{su}(S1)	Chip select 1 setup time	65		70		85		ns
t_{su}(S2)	Chip select 2 setup time	65		70		85		ns
t_{su}(D)	Data setup time	35		35		40		ns
t_h(D)	Data hold time	0		0		0		ns
t_{rec}(W)	Write recovery time	0		0		0		ns
t_{dis}(W)	Output disable time from $\overline{W}$ low		25		30		35	ns
t_{dis}(OE)	Output disable time from $\overline{OE}$ high		25		30		35	ns
t_{en}(W)	Output enable time from $\overline{W}$ high	5		5		5		ns
t_{en}(OE)	Output enable time from $\overline{OE}$ low	5		5		5		ns

(4)TIMING DIAGRAMS

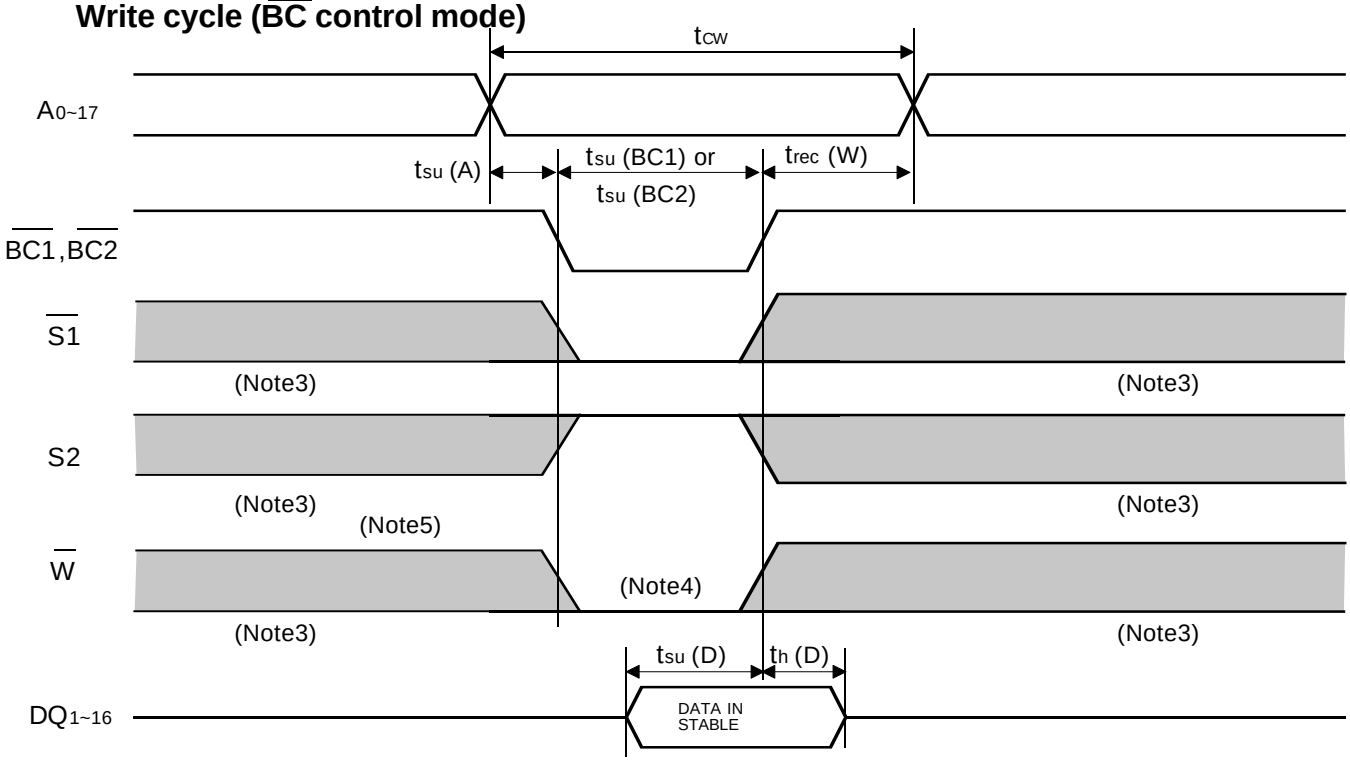
Read cycle



Write cycle (W control mode)

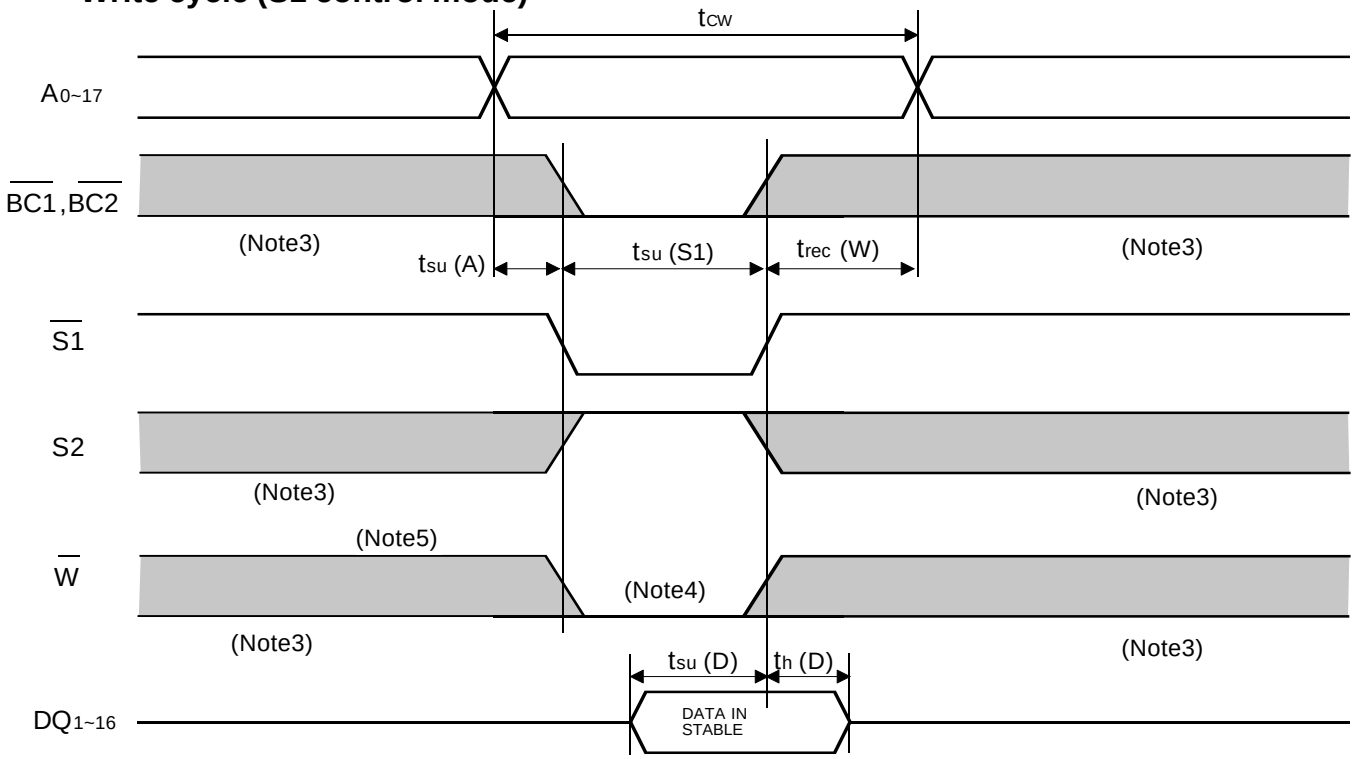


Write cycle ($\overline{BC}$ control mode)

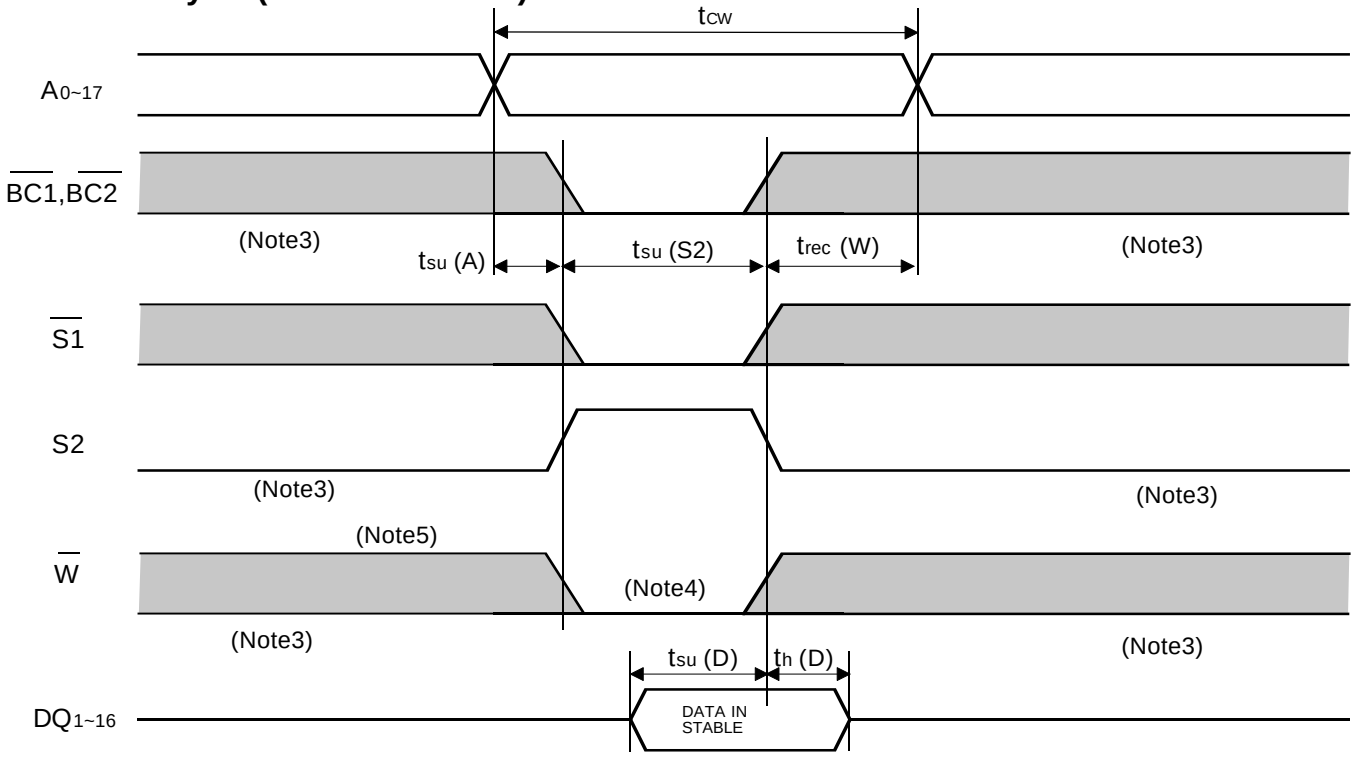


Note 3: Hatching indicates the state is "don't care".
Note 4: A Write occurs during S1 low, S2 high overlaps BC1 and/or BC2 low and W low.
Note 5: When the falling edge of W is simultaneously or prior to the falling edge of BC1 and/or BC2 or the falling edge of S1 or rising edge of S2, the outputs are maintained in the high impedance state.
Note 6: Don't apply inverted phase signal externally when DQ pin is in output mode.

Write cycle ($\overline{S1}$ control mode)



Write cycle (S2 control mode)



POWER DOWN CHARACTERISTICS

(1) ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test conditions			Limits			Units
					Min	Typ	Max	
V_{CC} (PD)	Power down supply voltage				2.0			V
V_I (BC)	Byte control input $\overline{BC1}$ & $\overline{BC2}$				2.0			V
V_I ($\overline{S1}$)	Chip select input $\overline{S1}$				2.0			V
V_I (S2)	Chip select input S2						0.2	V
I_{CC} (PD)	Power down supply current	Vcc=3.0V 1) $\overline{BC1}$ and $\overline{BC2} \geqq$ Vcc-0.2V, $\overline{S1} \leqq$0.2V or S2 $\geqq$ Vcc-0.2V, other inputs=0~3V 2) $\overline{S1} \geqq$Vcc - 0.2V, other inputs=0~3V 3) S2 $\leqq$0.2V, other inputs=0~3V	-LW, -LI	+70 ~ +85°C	-	-	40	µA
			-L, -LW, -LI	+70°C	-	-	20	µA
			-HW, -HI	+70 ~ +85°C	-	-	20	µA
			-H, -HW, -HI	+40 ~ +70°C	-	-	10	µA
				+25 ~ +40°C	-	1	3	µA
			-H	0 ~ +25°C	-	0.3	1	µA
			-HW	-20 ~ +25°C	-	0.3	1	µA
			-HI	-40 ~ +25°C	-	0.3	1	µA

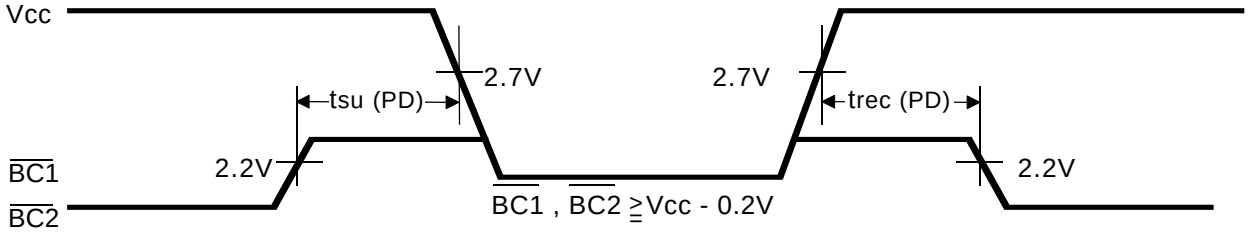
Typical value is for Ta=25°C

(2) TIMING REQUIREMENTS

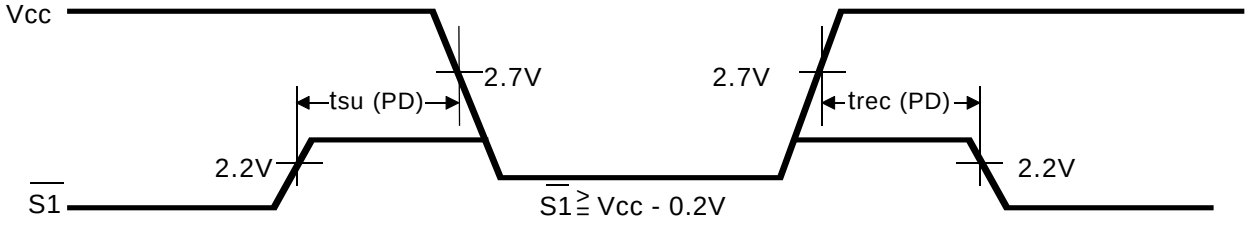
Symbol	Parameter	Test conditions	Limits			Units
			Min	Typ	Max	
t_{su} (PD)	Power down set up time		0			ns
t_{rec} (PD)	Power down recovery time		5			ms

(3) TIMING DIAGRAM

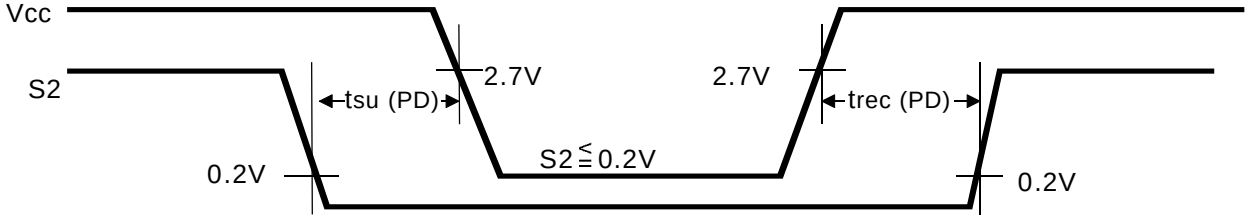
$\overline{BC}$ control mode



$\overline{S1}$ control mode



S2 control mode



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4194304-BIT (262144-WORD BY 16-BIT) CMOS STATIC RAM

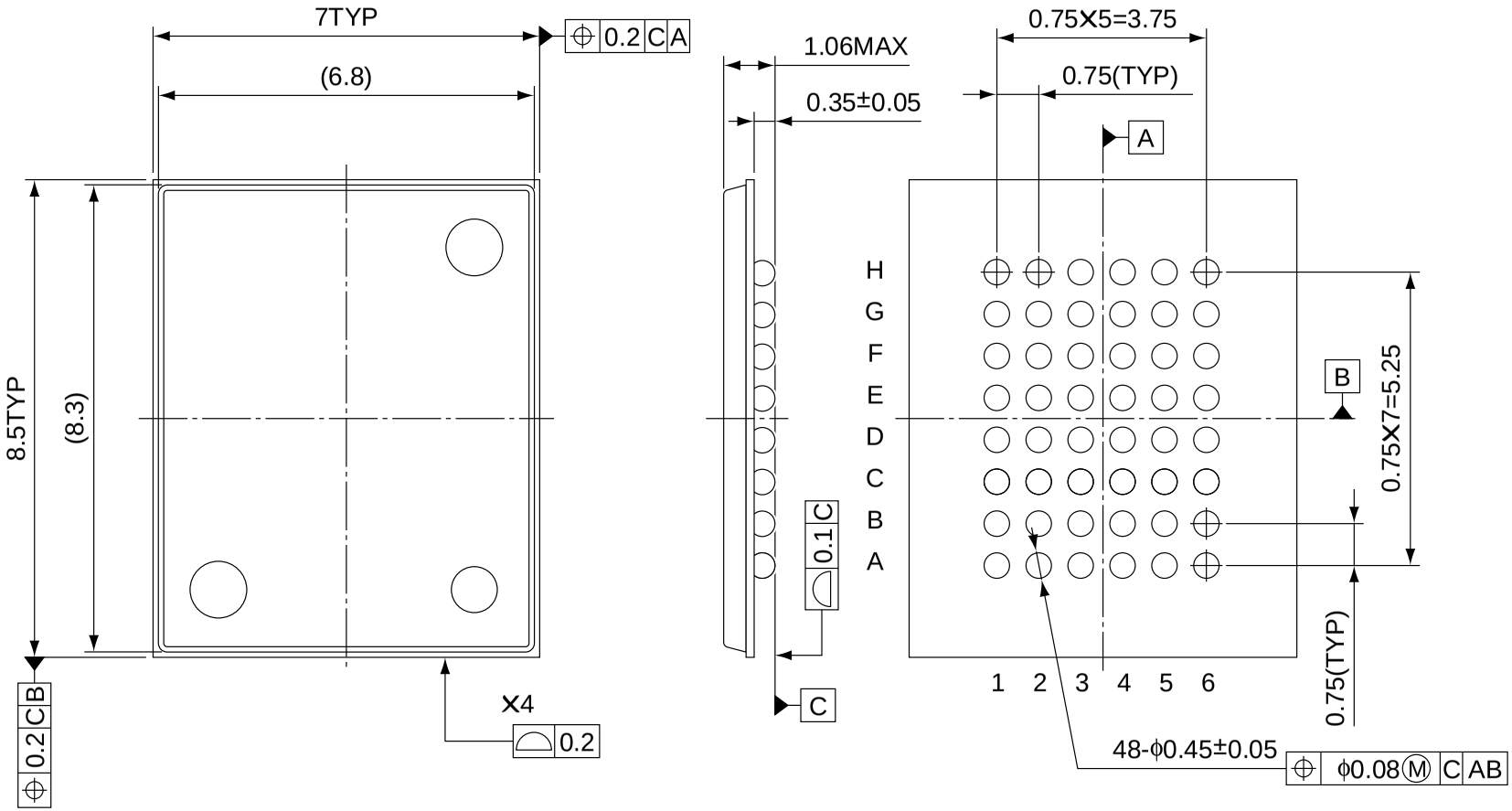
Revision History

Revision No.	History	Date	Remark
W01	The first edition	'98 . 07 . 23	Preliminary
W02	Font problem fixed	'98 . 08 . 27	Preliminary
W03	70ns version added	'98 . 12 . 16	Preliminary

48FHA

48pin 7.0X8.5mm body M-CSP

EIAJ Package Code	JEDEC Code	Weight(g)
–	–	



Mar.'98