Revision History

Rev. No.	History	Issue Date
1.0	Initial issue	Apr.15,2014
2.0	Revise “Chiplus reserves the right to change product or specification without notice” to “Chiplus reserves the right to change product or specification **after approving by customer**.”	Nov. 8, 2021

GENERAL DESCRIPTION

The CS16FS1616(3/5/W) and CS18FS1616(3/5/W) are a 16,789,216-bit high-speed Static Random Access Memory organized as 1M(2M) words by 16(8) bits. The CS16FS1616(3/5/W) (CS18FS1616(3/5/W)) uses 16(8) common input and output lines and have an output enable pin which operates faster than address access time at read cycle, And CS16FS1616(3/5/W) allows that lower and upper byte access by data byte control($\overline{UB}$, $\overline{LB}$).The device is fabricated using advanced CMOS process,6-TR based cell technology and designed for high-speed circuit technology. It is particularly well suited for use in high-density high-speed system applications. The CS16FS1616(3/5/W) is packaged in 12x20mm 48- pin TSOP1 and 48FBGA, The CS18FS1616(3/5/W) is packaged in a 400mil 44-pin TSOP2 and 48FBGA.

FEATURES

- Fast Access Time 8,10,12,15ns(Max)
- CMOS Low Power Dissipation
  Standby (TTL): 35mA (Max.)
  (CMOS): 28mA (Max.)
  Operating: 110mA (8ns, Max.)
  : 90mA (10ns , Max.)
- Single 3.3±0.3V or 5.0±0.5V Power Supply
- Wide range (1.65V~3.6V) of Power Supply
- TTL Compatible inputs and Outputs
- Fully Static Operation, No Clock or Refresh required
- Three State Outputs
- Data Byte Control(x16 Mode)
  $\overline{LB}$: I/O_0~I/O_7, $\overline{UB}$: I/O_8~I/O_{15}
- Standard 48TSOP1 and 48FBGA Package Pin Configurations for 1M x 16
- Standard 44TSOP2 and 48FBGA Package Pin Configurations for 2M x 8
- Operating in Commercial and Industrial Temperature range.

Order Information

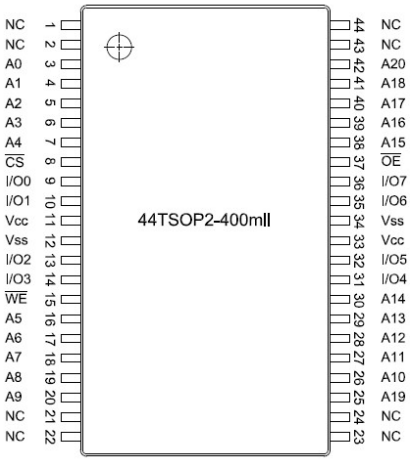
Density	Org.	Part Number	Speed			Package	Temp.
			V_{CC} (V)	t_{AA}(ns)	t_{OE}(ns)		
16Mb	1Mx16	CS16FS16163TC(I)-08	3.3	8	4	48 TSOP1	C : Commercial I : Industrial
		CS16FS1616WTC(I)-08*	3.3	8	4	48 TSOP1	
			2.5	10	5	48 TSOP1	
			1.8	12	6	48 TSOP1	
		CS16FS1616WHC(I)-08	3.3	8	4	48 FBGA	
		CS16FS1616WHC(I)-08*	3.3	8	4	48 FBGA	
			2.5	10	5	48 FBGA	
			1.8	12	6	48 FBGA	
		CS16FS16165TC(I)-10	5	10	5	48 TSOP1	
		CS16FS16163TC(I)-10	3.3	10	5	48 TSOP1	
		CS16FS1616WTC(I)-10*	3.3	10	5	48 TSOP1	
			2.5	10	5	48 TSOP1	
			1.8	15	7	48 TSOP1	
		CS16FS16165HC(I)-10	5	10	5	48 FBGA	
		CS16FS16163HC(I)-10	3.3	10	5	48 FBGA	
		CS16FS1616WHC(I)-10*	3.3	10	5	48 FBGA	
			2.5	10	5	48 FBGA	
			1.8	15	7	48 FBGA	

Density	Org.	Part Number	Speed			Package	Temp.
			V_{CC}(V)	t_{AA}(ns)	t_{OE}(ns)		
16Mb	2Mx8	CS18FS16163GC(I)-08	3.3	8	4	44 TSOP2	C : Commercial I : Industrial
		CS18FS1616WGC(I)-08*	3.3	8	4	44 TSOP2	
			2.5	10	5	44 TSOP2	
			1.8	12	6	44 TSOP2	
		CS18FS16163HC(I)-08	3.3	8	4	48 FBGA	
		CS18FS1616WHC(I)-08*	3.3	8	4	48 FBGA	

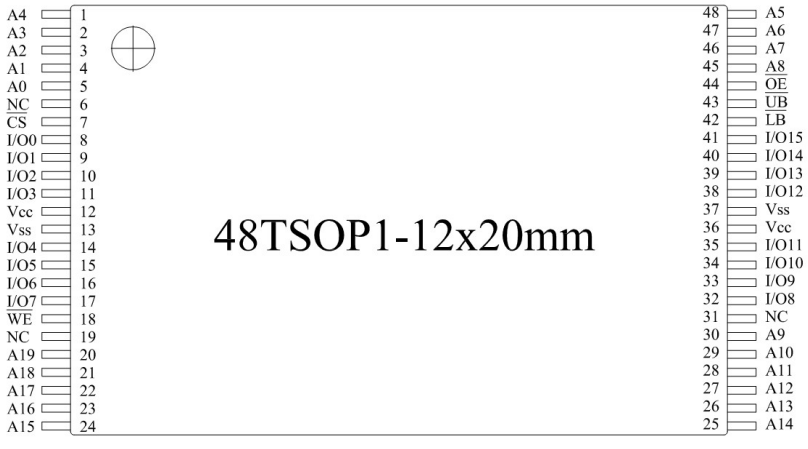
			2.5	10	5	48 FBGA	
			1.8	12	6	48 FBGA	
		CS18FS16165GC(I)-10	5	10	5	44 TSOP2	
		CS18FS16163GC(I)-10	3.3	10	5	44 TSOP2	
		CS18FS1616WGC(I)-10*	3.3	10	5	44 TSOP2	
			2.5	10	5	44 TSOP2	
			1.8	15	7	44 TSOP2	
		CS18FS16165HC(I)-10	5	10	5	48 FBGA	
		CS18FS16163HC(I)-10	3.3	10	5	48 FBGA	
		CS18FS1616WHC(I)-10*	3.3	10	5	48 FBGA	
			2.5	10	5	48 FBGA	
			1.8	15	7	48 FBGA	

***means max. speed**

PIN CONFIGURATIONS



CS18FS1616(3/5/W) - (2Mx8)



CS16FS1616(3/5/W) - (1Mx16)

6x8mm mini-BGA with ball pitch 0.75mm

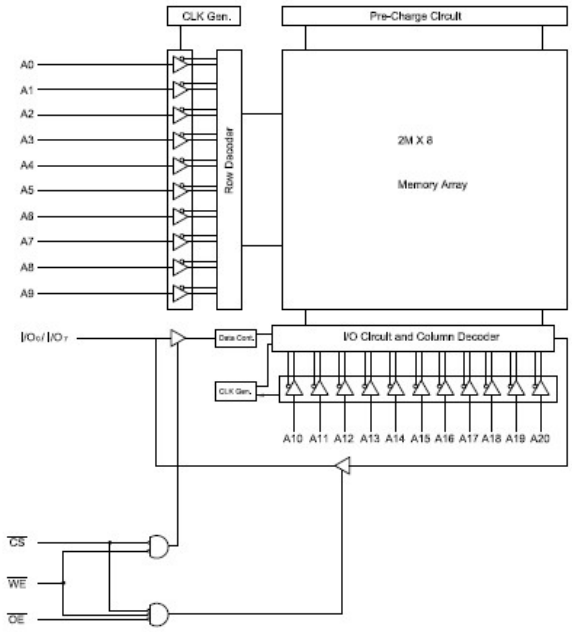
	1	2	3	4	5	6
A	NC	$\overline{OE}$	A0	A1	A2	NC
B	NC	NC	A3	A4	$\overline{CS}$	IO0
C	NC	NC	A5	A6	IO1	IO2
D	Vss	NC	A17	A7	IO3	Vcc
E	Vcc	NC	NC	A16	IO4	Vss
F	NC	NC	A14	A15	IO5	IO6
G	NC	A19	A12	A13	$\overline{WE}$	IO7
H	A18	A8	A9	A10	A11	A20

CS18FS1616(3/5/W) – (2M x 8)
48 ball mini-BGA

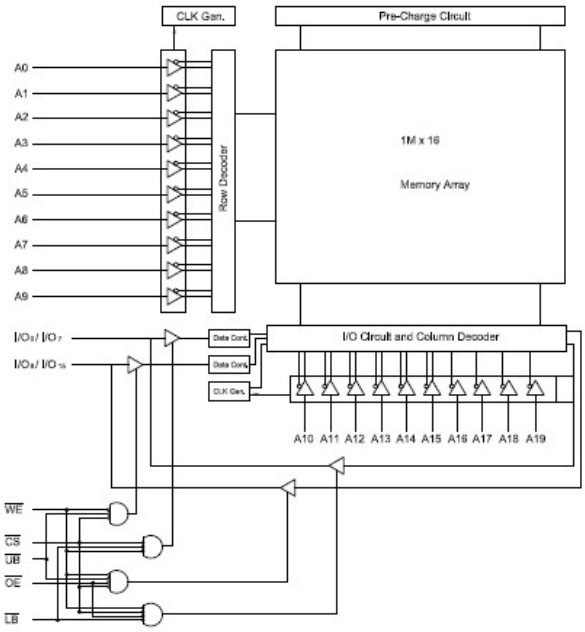
	1	2	3	4	5	6
A	$\overline{LB}$	$\overline{OE}$	A0	A1	A2	NC
B	IO8	$\overline{UB}$	A3	A4	$\overline{CS}$	IO0
C	IO9	IO10	A5	A6	IO1	IO2
D	Vss	IO11	A17	A7	IO3	Vcc
E	Vcc	IO12	NC	A16	IO4	Vss
F	IO14	IO13	A14	A15	IO5	IO6
G	IO15	A19	A12	A13	$\overline{WE}$	IO7
H	A18	A8	A9	A10	A11	NC

CS16FS1616(3/5/W) – (1M x 16)
48ball mini-BGA

● FUNCTIONAL BLOCK DIAGRAM



CS18FS1616(3/5/W) – (2M x 8)



CS16FS1616(3/5/W) – (1M x 16)

Absolute Maximum Ratings*

Parameter		Symbol	Rating	Unit
Voltage on Any Pin Relative to V_{SS}	3.3V Product	V_{in}, V_{OUT}	-0.5 to V_{CC}+0.5V	V
	5.0V Product			
	Wide V_{CC}** Product			
Voltage on V_{CC} Supply Relative to V_{SS}	3.3V Product	V_{in}, V_{OUT}	-0.5 to 4.6	V
	5.0V Product		-0.5 to 7.0	
	Wide V_{CC}** Product		-0.5 to 4.6	
Power Dissipation		P_D	1.0	W
Storage Temperature		T_{STG}	-65 to 150	°C
Operating Temperature Commercial		T_A	0 to 70	°C
Industrial		T_A	-40 to 85	°C

*Stresses greater than those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied.

Exposure to absolute maximum rating conditions for extended periods may affect reliability.

**Wide VCC Range is 1.65V~3.6V

Recommended DC Operating Conditions*(T_A=0 to 70℃)

Parameter	Operating V_{CC}(V)	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	5.0	V_{CC}	4.5	5.0	5.5	V
	3.3	V_{CC}	3.0	3.3	3.6	
	Wide 2.4~3.6	V_{CC}	2.4	2.5/3.3	3.6	
	Wide 1.65~2.2	V_{CC}	1.65	1.8	2.2	
Ground		V_{SS}	0	0	0	V
Input High Voltage	5.0	V_{IH}	2.2	-	V_{CC}+0.5	V
	3.3	V_{IH}	2.0	-	V_{CC}+0.5	
	Wide 2.4~3.6	V_{IH}	2.0	-	V_{CC}+0.3	
	Wide 1.65~2.2	V_{IH}	1.4	-	V_{CC}+0.2	

Input Low Voltage	5.0	V_{IL}	-0.3	-	0.8	V
	3.3	V_{IL}	-0.3	-	0.8	
	Wide 2.4~3.6	V_{IL}	-0.3	-	0.7	
	Wide 1.65~2.2	V_{IL}	-0.2	-	0.4	

*The above parameters are also guaranteed for industrial temperature range.

DC and Operating Characteristics*(T_A=0 to 70℃)

Parameter	Symbol	Test Conditions		Min	Max	Unit
Input Leakage Current	I_{LI}	V_{IN}=V_{SS} to V_{CC}		-2	2	uA
Output Leakage Current**	I_{LO}	$\overline{CS}$ =V_{IH} or $\overline{OE}$ =V_{IH} or $\overline{WE}$ =V_{IL} V_{OUT}=V_{SS} to V_{CC}		-2	2	uA
Operating Current**	I_{CC}	Min.Cycle,100% Duty $\overline{CS}$ =V_{IL}, V_{IN}=V_{IH} or V_{IL},I_{OUT}= 0mA	8ns	-	110	mA
			10ns		90	
			12ns	-	80	
			15ns		70	
Standby Current	I_{SB}	Min. Cycle, $\overline{CS}$ =V_{IH}		-	35	mA
	I_{SB1}	f=0MHz, $\overline{CS}$ ≥V_{CC}-0.2V V_{IN}≥V_{CC}-0.2V or V_{in}≦0.2V		-	28	
Output Low Voltage Level	V_{OL}	V_{CC} =4.5V, I_{OL}=8mA, 5.0V Product		-	0.4	V
		V_{CC}=3.0V, I_{OL}=8mA, 3.3V Product & Wide V_{CC}** Product		-	0.4	
		V_{CC}=2.4V, I_{OL}=1mA, Wide V_{CC}** Product		-	0.4	
		V_{CC}=1.65V, I_{OL}=0.1mA, Wide V_{CC}** Product		-	0.2	
Output High Voltage Level	V_{OH}	V_{CC}=4.5V, I_{OH}= -4mA, 5.0V Product		2.4	-	V
		V_{CC}=3.0V, I_{OH}= -4mA, 3.3V Product & Wide V_{CC}** Product		2.4	-	
		V_{CC}=2.4V, I_{OH}= -1mA, Wide V_{CC}** Product		1.8	-	
		V_{CC}=1.65V, I_{OH}= -0.1mA, Wide V_{CC}** Product		1.4	-	

*The above parameters are also guarantee for industrial temperature range.

**Wide V_{CC} Range is 1.65V ~ 3.6V

Capacitance*(T_A= 25℃, f= 1.0MHz)

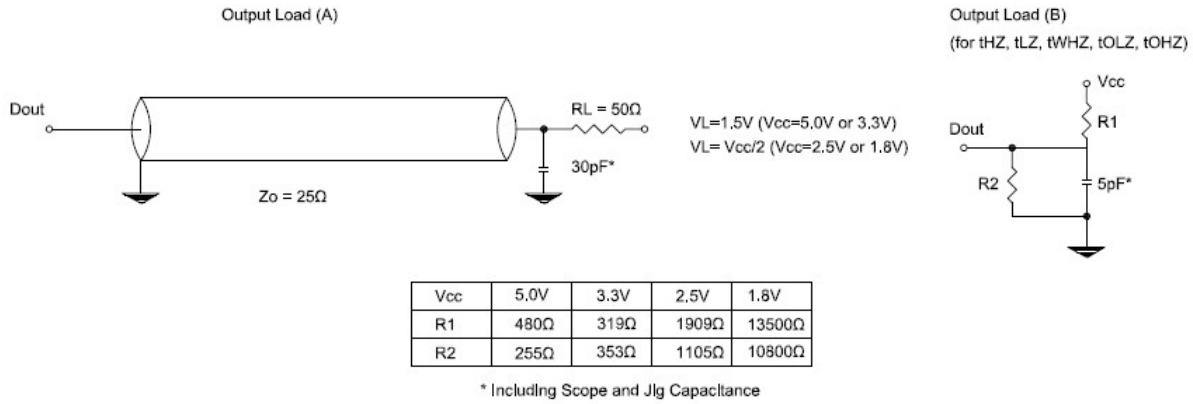
Item	Symbol	Test Conditions	TYP	Max	Unit
Input/ Output Capacitance	$C_{I/O}$	$V_{I/O}$=0V	-	8	pF
Input Capacitance	C_{IN}	V_{IN}=0V	-	6	pF

*Capacitance is sampled and not 100% tested.

Test Conditions*

Parameter	Value
Input/ Output Capacitance	0 to 3.0V (V_{CC}=3.3V or 5.0V)
	0 to 2.5V (V_{CC}=2.5V)
	0 to 1.8V (V_{CC}=1.8V)
Input Rise and Fall Time	1V/1ns
Input and Output Timing Reference Levels	1.5V (V_{CC}=3.3V or 5.0V)
	1/2V_{CC} (V_{CC}= 1.8V or 2.5V)
Output Load	See Fig. 1

*The above parameters are also guaranteed for industrial temperature range.



Vcc	5.0V	3.3V	2.5V	1.8V
R1	480Ω	319Ω	1909Ω	13500Ω
R2	255Ω	353Ω	1105Ω	10800Ω

* Including Scope and Jig Capacitance

Fig 1

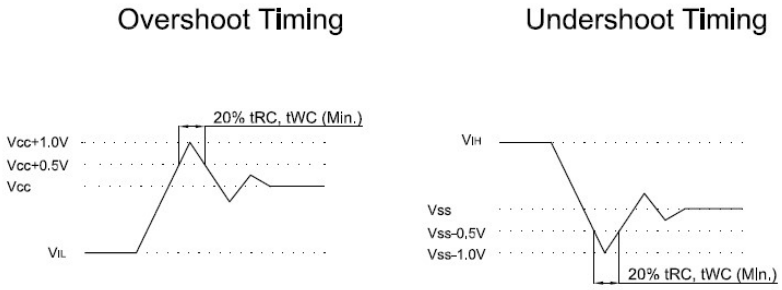


Fig 2

Functional Description (x8 Mode)

$\overline{CS}$	$\overline{WE}$	$\overline{OE}$	Mode	I/O Pin	Supply Current
H	X	X*	Not Select	High-Z	I_{SB},I_{SB1}
L	H	H	Output Disable	High-Z	I_{CC}
L	H	L	Read	D_{OUT}	I_{CC}
L	L	X	Write	D_{IN}	I_{CC}

*X means don't care

Functional Description (x16 Mode)

$\overline{CS}$	$\overline{WE}$	$\overline{OE}$	$\overline{LB}$ **	$\overline{UB}$ **	Mode	I/O Pin		Supply Current
						I/O_0~I/O_7	I/O_8~I/O_{15}	
H	X	X*	X	X	Not Select	High-Z	High-Z	I_{SB}, I_{SB1}
L	H	H	X	X	Output Disable	High-Z	High-Z	I_{CC}
L	X	X	H	H				
L	H	L	L	H	Read	D_{OUT}	High-Z	I_{CC}
			H	L		High-Z	D_{OUT}	
			L	L		D_{OUT}	D_{OUT}	
L	L	X	L	H	Write	D_{IN}	High-Z	I_{CC}
			H	L		High-Z	D_{IN}	
			L	L		D_{IN}	D_{IN}	

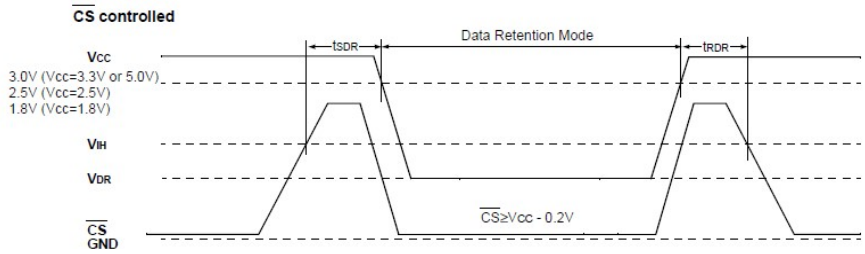
*X means don't care

Data Retention Characteristics*(T_A=0 to 70℃)

Parameter	Product	Operating V_{CC}(V)	Symbol	Test Condition	Min.	Typ.	Max.	Unit
V_{CC} for Data Retention	5.0V Product	5.0	V_{DR}	$\overline{CS}$ ≥V_{CC} - 0.2V	2.0	-	5.5	V
	3.3V Product	3.3			2.0	-	3.6	
	Wide 2.4V~3.6V	2.5/3.3			2.0	-	3.6	
	Wide 1.65V~2.2V	1.8			1.5	-	3.6	
Data Retention Current	5.0V Product	5.0	I_{DR}	V_{CC}=2.0V $\overline{CS}$ ≥V_{CC} - 0.2V V_{IN}≥ V_{CC} - 0.2V or V_{IN}≤0.2V			20	mA
	3.3V Product	3.3					20	
	Wide 2.4V~3.6V	2.5/3.3					28	
	Wide 1.65V~2.2V	1.8		V_{CC}=1.5V, $\overline{CS}$ ≥V_{CC} - 0.2V, V_{IN}≥V_{CC}-			28	

				0.2V or V_{IN}≤0.2V				
Data Retention Set-Up Time			t_{SDR}	See Data Retention Wave form (below)	0	-	-	nS
Recovery Time			t_{RDR}		5	-	-	mS

Data Retention Wave form



Read Cycle*

Parameter	Symbol	8ns		10ns		12ns		15ns		Unit
		Min	Max	Min	Max	Min	Max	Min	Max	
Read Cycle Time	t_{RC}	8	-	10	-	12	-	15	-	ns
Address Access Time	t_{AA}	-	8	-	10	-	12	-	15	ns
Chip Select to Output	t_{CO}	-	8	-	10	-	12	-	15	ns
Output Enable to Valid Output	t_{OE}	-	4	-	5	-	6	-	7	ns
$\overline{UB}$, $\overline{LB}$ Access Time**	t_{BA}	-	4	-	5	-	6	-	7	ns
Chip Enable to Low-Z Output	t_{LZ}	3	-	3	-	3	-	3	-	ns
Output Enable to Low-Z Output	t_{OLZ}	0	-	0	-	0	-	0	-	ns
$\overline{UB}$, $\overline{LB}$ Enable to Low-Z Output**	t_{BLZ}	0	-	0	-	0	-	0	-	ns
Chip Disable to High-Z Output	t_{HZ}	0	4	0	5	0	6	0	7	ns
Output Disable to High-Z Output	t_{OHZ}	0	4	0	5	0	6	0	7	ns

$\overline{UB}$, $\overline{LB}$ Disable to High-Z Output**	t_{BHZ}	0	4	0	5	0	6	0	7	ns
Output Hold from Address Change	t_{OH}	3	-	3	-	3	-	3	-	ns
Chip Selection Power Up Time	t_{PU}	0	-	0	-	0	-	0	-	ns
Chip Selection Power Down Time	t_{PD}	-	8	-	10	-	12	-	15	ns

*The above parameters are also guaranteed for industrial temperature range.

Write Cycle*

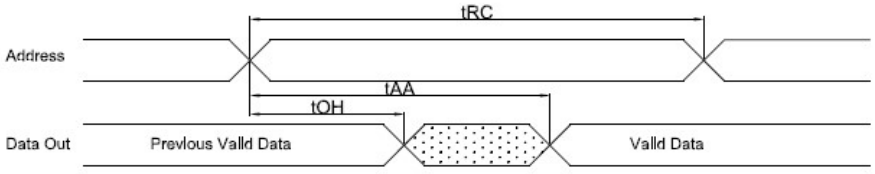
Parameter	Symbol	8ns		10ns		12ns		15ns		Unit
		Min	Max	Min	Max	Min	Max	Min	Max	
Write Cycle Time	t_{WC}	8	-	10	-	12	-	15	-	ns
Chip Select to End of Write	t_{CW}	6	-	7	-	9	-	12	-	ns
Address Set-up Time	t_{AS}	0	-	0	-	0	-	0	-	ns
Address Valid to End of Write	t_{AW}	6	-	7	-	9	-	12	-	ns
Write Pulse Width($\overline{OE}$ High)	t_{WP}	6	-	7	-	9	-	12	-	ns
Write Pulse Width($\overline{OE}$ Low)	t_{WP1}	8	-	10	-	12	-	15	-	ns
$\overline{UB}$, $\overline{LB}$ Valid to End of Write**	t_{BW}	6	-	7	-	9	-	12	-	ns
Write Recovery Time	t_{WR}	0	-	0	-	0	-	0	-	ns
Write to Output High-Z	t_{WHZ}	0	4	0	5	0	6	0	7	ns
Data to Write Time	t_{DW}	4	-	5	-	7		8	-	ns

Overlap										
Data Hold from Write Time	t_{DH}	0	-	0	-	0	-	0	-	ns
End of Write to Output Low-Z	t_{OW}	3	-	3	-	3	-	3	-	ns

*The above parameters are also guaranteed for industrial temperature range.

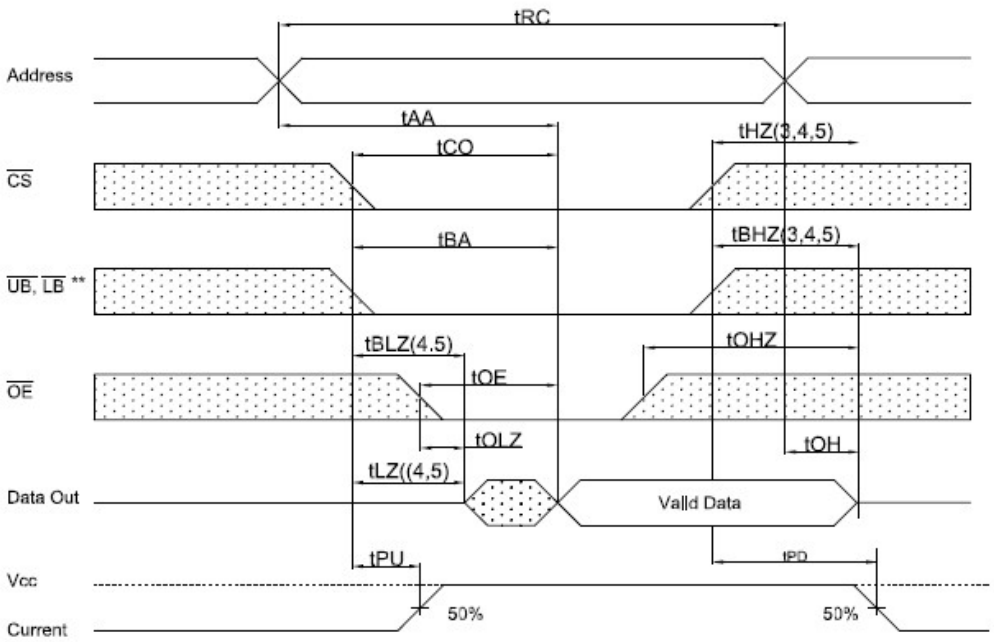
Timing Diagram

Timing Waveform of Read Cycle (1) (Address Controlled, $\overline{CS}$ = $\overline{OE}$ =V_{IL}, $\overline{WE}$ =V_{IH}, $\overline{UB}$, $\overline{LB}$ =V_{IL} **)



** Those parameters are applied for x16 mode only.

Timing Waveform of Read Cycle (2) ($\overline{WE}$ =VIH)

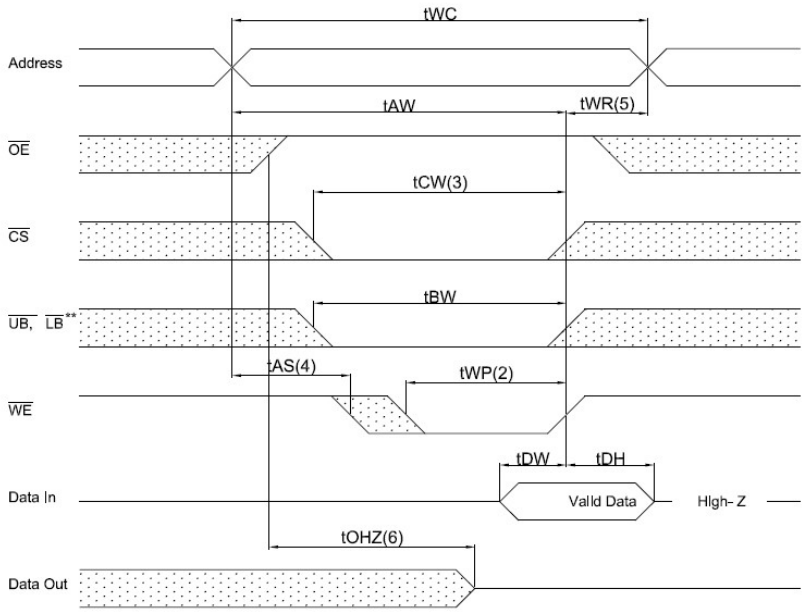


NOTES (Read Cycle)

1. $\overline{WE}$ is high for read cycle
2. All read cycle timing is referenced from the last valid address to the first transition address.
3. t_{HZ} and t_{OHZ} are defined as the time at which the outputs achieve the open circuit condition and are not referenced to V_{OH} or V_{OL} levels.
4. At any given temperature and voltage condition, t_{HZ} (Max.) is less than t_{LZ} (Min.) both for a given device and from device to device.
5. Transition is measured ±200mV from steady state voltage with Load (B). This parameter is sampled and not 100% tested.
6. Device is continuously selected with $\overline{CS}$ =V_{IL}.
7. Address valid prior to coincident with $\overline{CS}$ transition low.
8. For common I/O applications, minimization or elimination of bus contention conditions is necessary during read and write cycle.

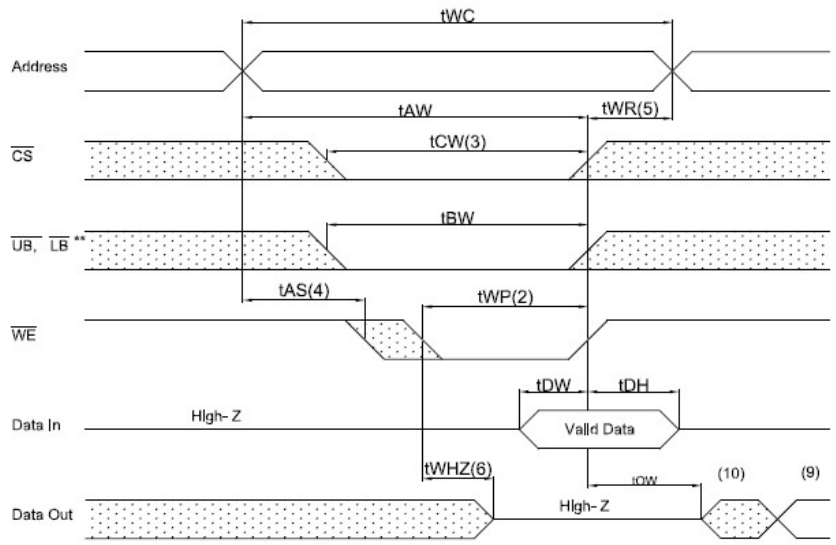
** Those parameters are applied for x16 mode only.

Timing Waveform of Write Cycle (1) ($\overline{OE}$ Clock)



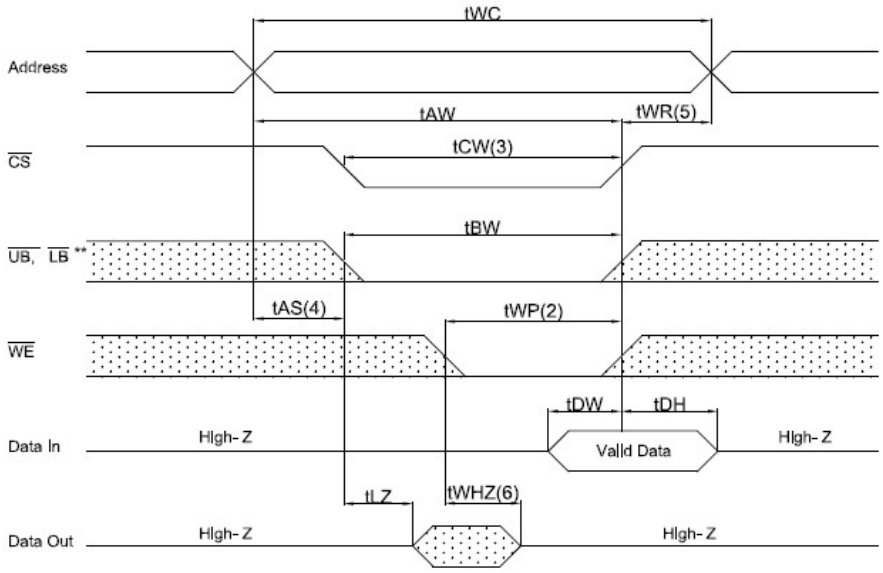
** Those parameters are applied for x16 mode only.

Timing Waveform of Write Cycle (2) ($\overline{OE}$ =Low fixed)



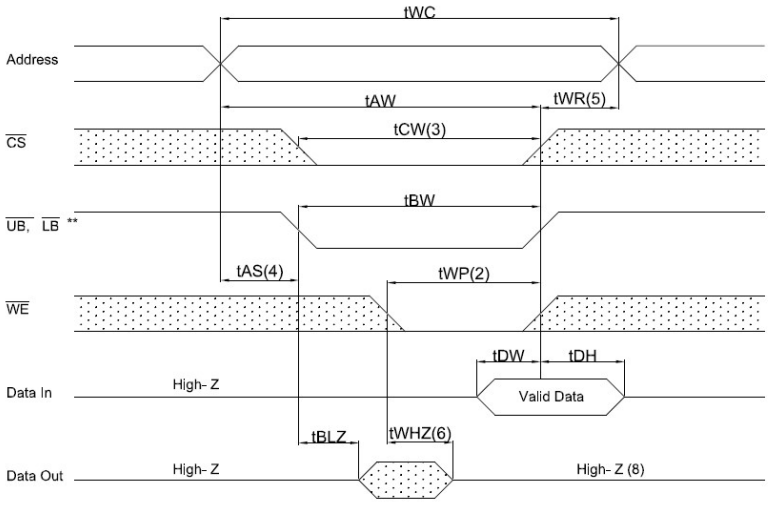
** Those parameters are applied for x16 mode only.

Timing Waveform of Write Cycle (3) ($\overline{CS}$ =Controlled)



** Those parameters are applied for x16 mode only.

Timing Waveform of Write Cycle (4) ($\overline{UB}$, $\overline{LB}$ Controlled)



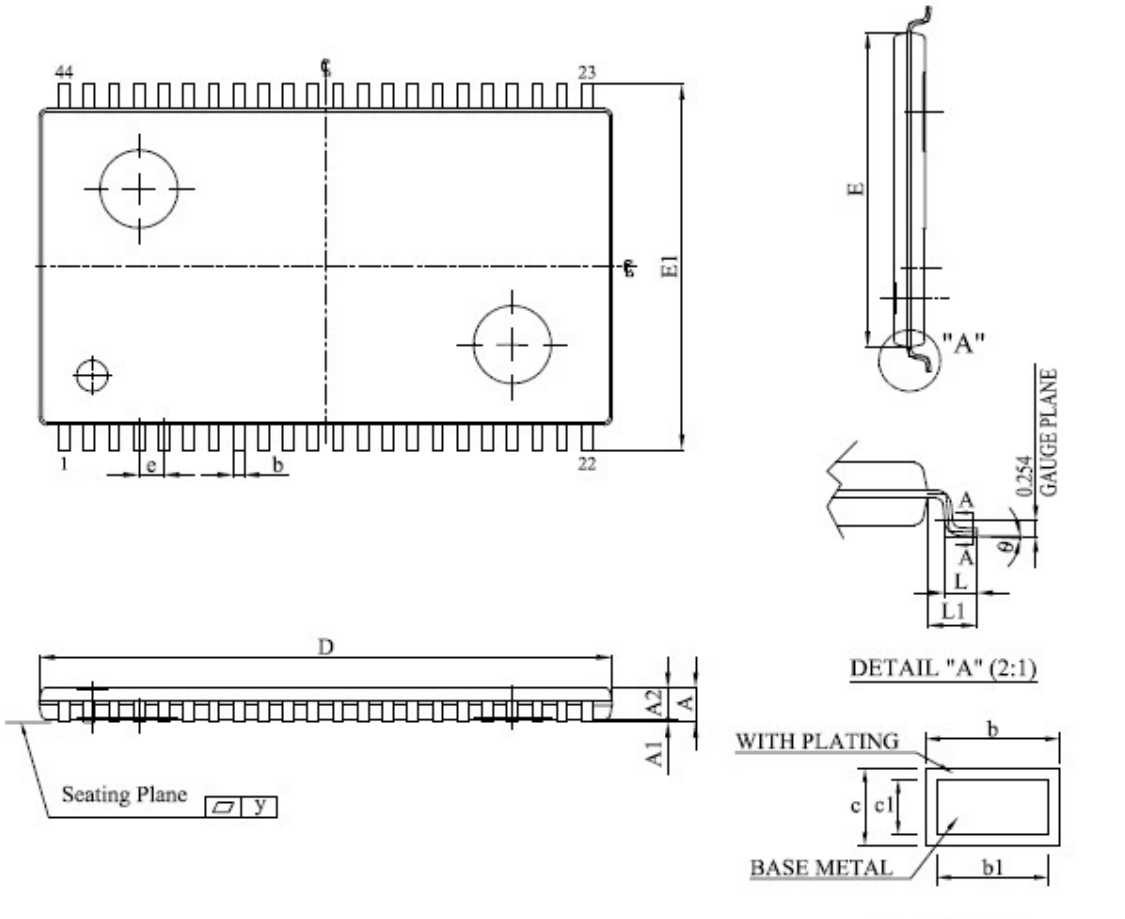
NOTES (Write Cycle)

1. All write cycle timing is referenced from the last valid address to the first transition address.
2. A write occurs during the overlap of a low $\overline{CS}$, $\overline{WE}$, $\overline{LB}$ and $\overline{UB}$. A write begins at the latest transition $\overline{CS}$ going low and $\overline{WE}$ going low ;
   A write ends at the earliest transition $\overline{CS}$ going high or $\overline{WE}$ going high. t_{WP} is measured from the beginning of write to the end of write.
3. t_{CW} is measured from the later of $\overline{CS}$ going low to end of write.
4. t_{AS} is measured from the address valid to the beginning of write.
5. $\overline{WE}$ is measured from the end of write to the address change. t_{WR} applied in case a write ends as $\overline{CS}$ or $\overline{WE}$ going high.
6. If $\overline{OE}$, $\overline{CS}$ and $\overline{WE}$ are in the Read Mode during this period, the I/O pins are in the output low-Z state. Inputs of opposite phase of the output must not be applied because bus contention can occur.
7. For common I/O applications, minimization or elimination of bus contention conditions is necessary during read and write cycle.
8. If $\overline{CS}$ goes low simultaneously with $\overline{WE}$ going or after WE going low, the outputs remain high impedance state.
9. D_{OUT} is the read data of the new address.
10. When $\overline{CS}$ is low : I/O pins are in the output state. The input signals in the opposite phase leading to the output should not be applied.

** Those parameters are applied for x16 mode only

Package outline dimensions

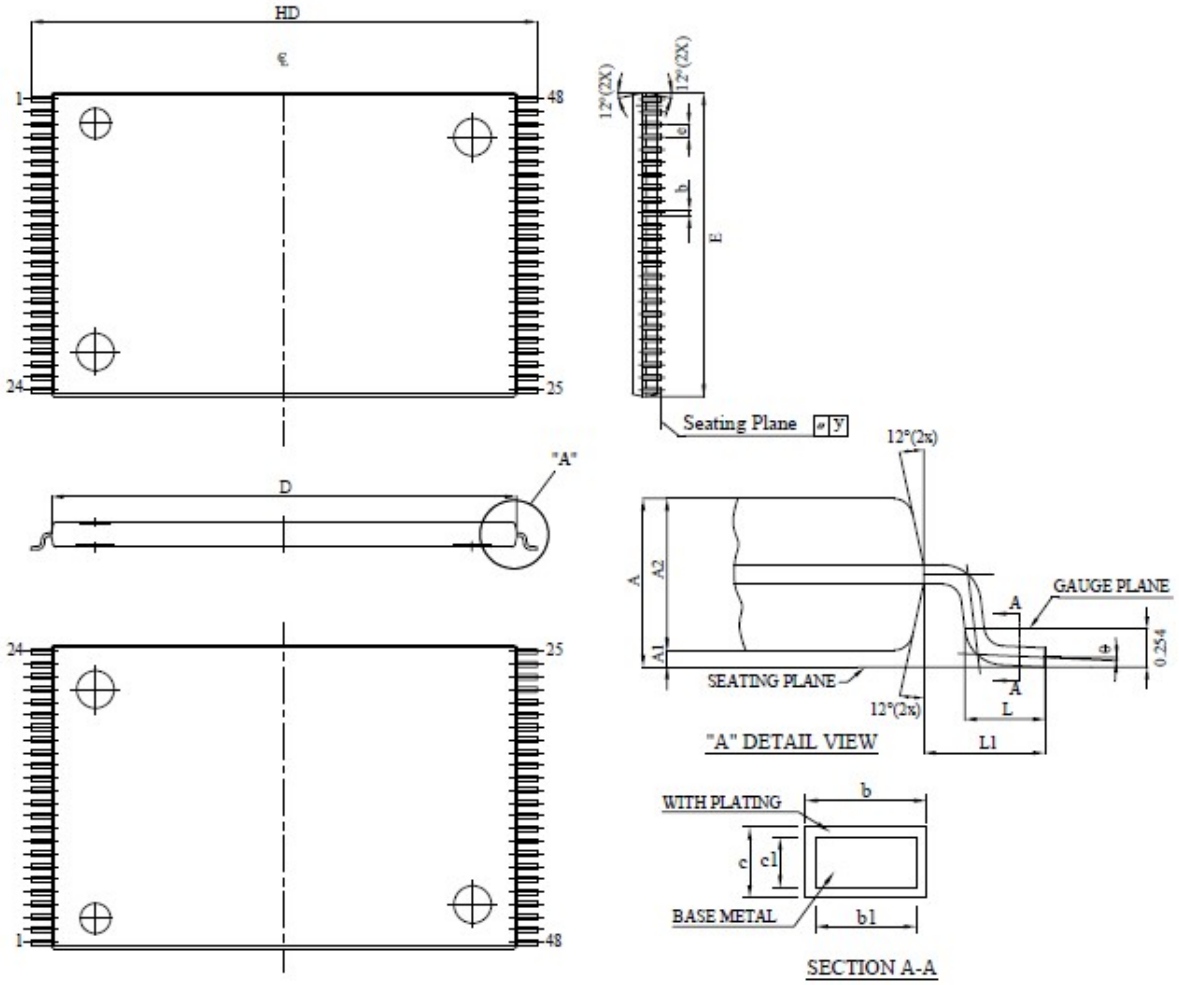
44L-TSOP2-400mil



Note: Plating thickness spec : 0.3 mil ~ 0.8 mil.

SYMBOL / UNIT		A	A1	A2	b	b1	c	c1	D	E	E1	e	L	L1	y	θ
mm	Min.	1.00	0.05	0.95	0.30	0.30	0.12	0.12	18.31	10.06	11.56	0.70	0.40	0.70	–	0°
	Nom.	1.10	0.10	1.00	–	–	–	–	18.41	10.16	11.76	0.80	0.50	0.80	–	–
	Max.	1.20	0.15	1.05	0.45	0.40	0.21	0.16	18.51	10.26	11.96	0.90	0.60	0.90	0.1	8°
inch	Min.	0.0393	0.002	0.037	0.012	0.012	0.005	0.005	0.721	0.396	0.455	0.0275	0.0157	0.0275	–	0°
	Nom.	0.0433	0.004	0.039	–	–	–	–	0.725	0.400	0.463	0.0315	0.0197	0.0315	–	–
	Max.	0.0473	0.006	0.041	0.018	0.016	0.008	0.006	0.729	0.404	0.471	0.0355	0.0237	0.0355	0.004	8°

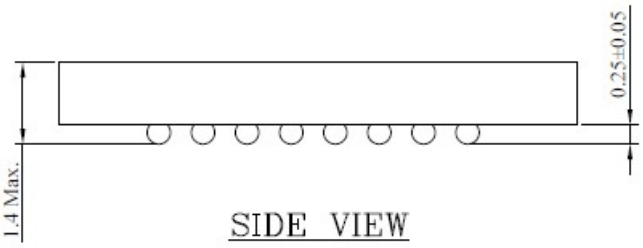
48L-TSOP1-12x20mm



Note: Plating thickness spec : 0.3 mil ~ 0.8 mil.

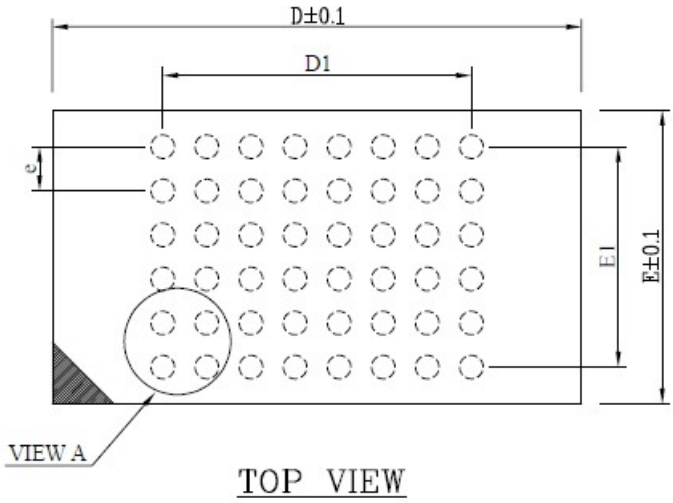
SYMBOL / UNIT		A	A1	A2	b	b1	c	c1	D	E	e	HD	L	L1	y	θ
mm	Min.	1.00	0.05	0.95	0.17	0.17	0.10	0.10	18.30	11.90	0.40	19.80	0.50	0.70	–	0°
	Nom.	1.10	0.10	1.00	0.22	0.20	–	–	18.40	12.00	0.50	20.00	0.60	0.80	–	–
	Max.	1.20	0.15	1.05	0.27	0.23	0.21	0.16	18.50	12.10	0.60	20.20	0.70	0.90	0.1	8°
inch	Min.	0.0393	0.002	0.037	0.007	0.007	0.004	0.004	0.720	0.468	0.016	0.780	0.0197	0.0275	–	0°
	Nom.	0.0433	0.004	0.039	0.009	0.008	–	–	0.724	0.472	0.020	0.787	0.0236	0.0315	–	–
	Max.	0.0473	0.006	0.041	0.011	0.009	0.008	0.006	0.728	0.476	0.024	0.795	0.0276	0.0355	0.004	8°

48ball mini-BGA-6x8mm (ball pitch: 0.75mm)

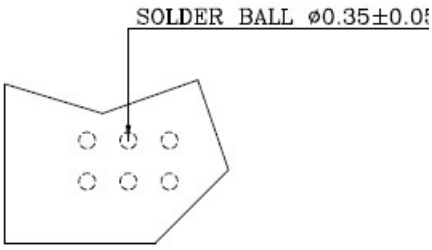


SIDE VIEW

BALL PITCH e = 0.75				
D	E	N	D1	E1
8.0	6.0	48	5.25	3.75



TOP VIEW



VIEW A

NOTES:

1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS.
2. PIN#1 DOT MARKING BY LASER OR PAD PRINT.
3. SYMBOL "N" IS THE NUMBER OF SOLDER BALLS.