FUJITSU SEMICONDUCTOR
DATA SHEET

DS05-11154-1E

MEMORY

Registered

16 M × 72 BIT SYNCHRONOUS DYNAMIC RAM DIMM

MB8516SR72CA-102/-103/-102L/-103L

168-pin, 4 Clock, 1-bank, based on 16 M × 4 Bit SDRAMs with SPD

■ DESCRIPTION

The Fujitsu MB8516SR72CA is a fully decoded, CMOS Synchronous Dynamic Random Access Memory (SDRAM) Module consisting of eighteen MB81F64442C devices which organized as four banks of 16 M × 4 bits and a 2K-bit serial EEPROM on a 168-pin glass-epoxy substrate.

The MB8516SR72CA features a fully synchronous operation referenced to a positive edge clock whereby all operations are synchronized at a clock input which enables high performance and simple user interface coexistence.

The MB8516SR72CA is optimized for those applications requiring high speed, high performance and large memory storage, and high density memory organizations.
This module is ideally suited for server system, workstations, high-end PCs, and other applications where enhanced performance is needed.

■ PRODUCT LINE & FEATURES

Parameter			MB8516SR72CA-102/-102L	MB8516SR72CA-103/-103L
CL-t_{RCD}-t_{RP}			2-2-2 clk min.	3-2-2 clk min.
Clock Frequency			100 MHz max.	100 MHz max.
Burst Mode Cycle Time	Registered Mode	CL = 2*	10ns min.	15ns min.
		CL = 3*	10ns min.	10ns min.
Output Valid from Clock	Registered Mode	CL = 2*	6 ns	8 ns
		CL = 3*	6 ns	6 ns
Power Dissipation	Two Banks Active		13540 mW max.	
	Self Refresh Mode		495 mW max. (Std. power) 455 mW max. (Low power)	

Note * : For registered mode, actual CAS Latency is added one cycle to the CAS Latency of device because of a delay by registers.

- Registered 168-pin DIMM Socket Type (Lead pitch: 1.27 mm)
- Conformed to JEDEC Standard
- Organization: 16,777,216 words × 72 bits
- Memory: MB81F64442C (16 M × 4, 4-bank) × 18 pcs
- 3.3 V ±0.3 V Supply Voltage
- All input/output LVTTL compatible
- Conformed to Intel PC/100 spec
- 4096 Refresh Cycle every 65.6 ms
- Auto and Self Refresh
- CKE Power Down Mode
- DQM Byte Masking (Read/Write)
- Serial Presence Detect (SPD) with Serial EEPROM: Intel SPD spec Rev 1.2A Format
- Module size: 1.70” (height) × 5.25” (length) × 0.32” (thickness)

MB8516SR72CA-102/-103/-102L/-103L

■ PACKAGE

168-pin plastic DIMM (socket type)

Under development

(MDS-168P-P43)

Package and Ordering Information

– 168-pin DIMM, order as MB8516SR72CA-xxxDG (DG = Std. power ver., Gold pad)
MB8516SR72CA-xxxLDG (LDG = Low power ver., Gold pad)

■ PIN ASSIGNMENTS

Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name
1	V_{SS}	29	$DQMB_1$	57	DQ_{18}	85	V_{SS}	113	$DQMB_5$	141	DQ_{50}
2	DQ_0	30	$\overline{S}_0$	58	DQ_{19}	86	DQ_{32}	114	N.C.	142	DQ_{51}
3	DQ_1	31	N.C.	59	V_{CC}	87	DQ_{33}	115	$\overline{RAS}$	143	V_{CC}
4	DQ_2	32	V_{SS}	60	DQ_{20}	88	DQ_{34}	116	V_{SS}	144	DQ_{52}
5	DQ_3	33	A_0	61	N.C.	89	DQ_{35}	117	A_1	145	N.C.
6	V_{CC}	34	A_2	62	N.C.	90	V_{CC}	118	A_3	146	N.C.
7	DQ_4	35	A_4	63	N.C.	91	DQ_{36}	119	A_5	147	REGE
8	DQ_5	36	A_6	64	V_{SS}	92	DQ_{37}	120	A_7	148	V_{SS}
9	DQ_6	37	A_8	65	DQ_{21}	93	DQ_{38}	121	A_9	149	DQ_{53}
10	DQ_7	38	A_{10}	66	DQ_{22}	94	DQ_{39}	122	BA_0	150	DQ_{54}
11	DQ_8	39	BA_1	67	DQ_{23}	95	DQ_{40}	123	A_{11}	151	DQ_{55}
12	V_{SS}	40	V_{CC}	68	V_{SS}	96	V_{SS}	124	V_{CC}	152	V_{SS}
13	DQ_9	41	V_{CC}	69	DQ_{24}	97	DQ_{41}	125	CLK_1	153	DQ_{56}
14	DQ_{10}	42	CLK_0	70	DQ_{25}	98	DQ_{42}	126	N.C.	154	DQ_{57}
15	DQ_{11}	43	V_{SS}	71	DQ_{26}	99	DQ_{43}	127	V_{SS}	155	DQ_{58}
16	DQ_{12}	44	N.C.	72	DQ_{27}	100	DQ_{44}	128	CKE_0	156	DQ_{59}
17	DQ_{13}	45	$\overline{S}_2$	73	V_{CC}	101	DQ_{45}	129	N.C.	157	V_{CC}
18	V_{CC}	46	$DQMB_2$	74	DQ_{28}	102	V_{CC}	130	$DQMB_6$	158	DQ_{60}
19	DQ_{14}	47	$DQMB_3$	75	DQ_{29}	103	DQ_{46}	131	$DQMB_7$	159	DQ_{61}
20	DQ_{15}	48	N.C.	76	DQ_{30}	104	DQ_{47}	132	N.C.	160	DQ_{62}
21	CB_0	49	V_{CC}	77	DQ_{31}	105	CB_4	133	V_{CC}	161	DQ_{63}
22	CB_1	50	N.C.	78	V_{SS}	106	CB_5	134	N.C.	162	V_{SS}
23	V_{SS}	51	N.C.	79	CLK_2	107	V_{SS}	135	N.C.	163	CLK_3
24	N.C.	52	CB_2	80	N.C.	108	N.C.	136	CB_6	164	N.C.
25	N.C.	53	CB_3	81	N.C. (WP)	109	N.C.	137	CB_7	165	SA_0
26	V_{CC}	54	V_{SS}	82	SDA	110	V_{CC}	138	V_{SS}	166	SA_1
27	$\overline{WE}$	55	DQ_{16}	83	SCL	111	$\overline{CAS}$	139	DQ_{48}	167	SA_2
28	$DQMB_0$	56	DQ_{17}	84	V_{CC}	112	$DQMB_4$	140	DQ_{49}	168	V_{CC}

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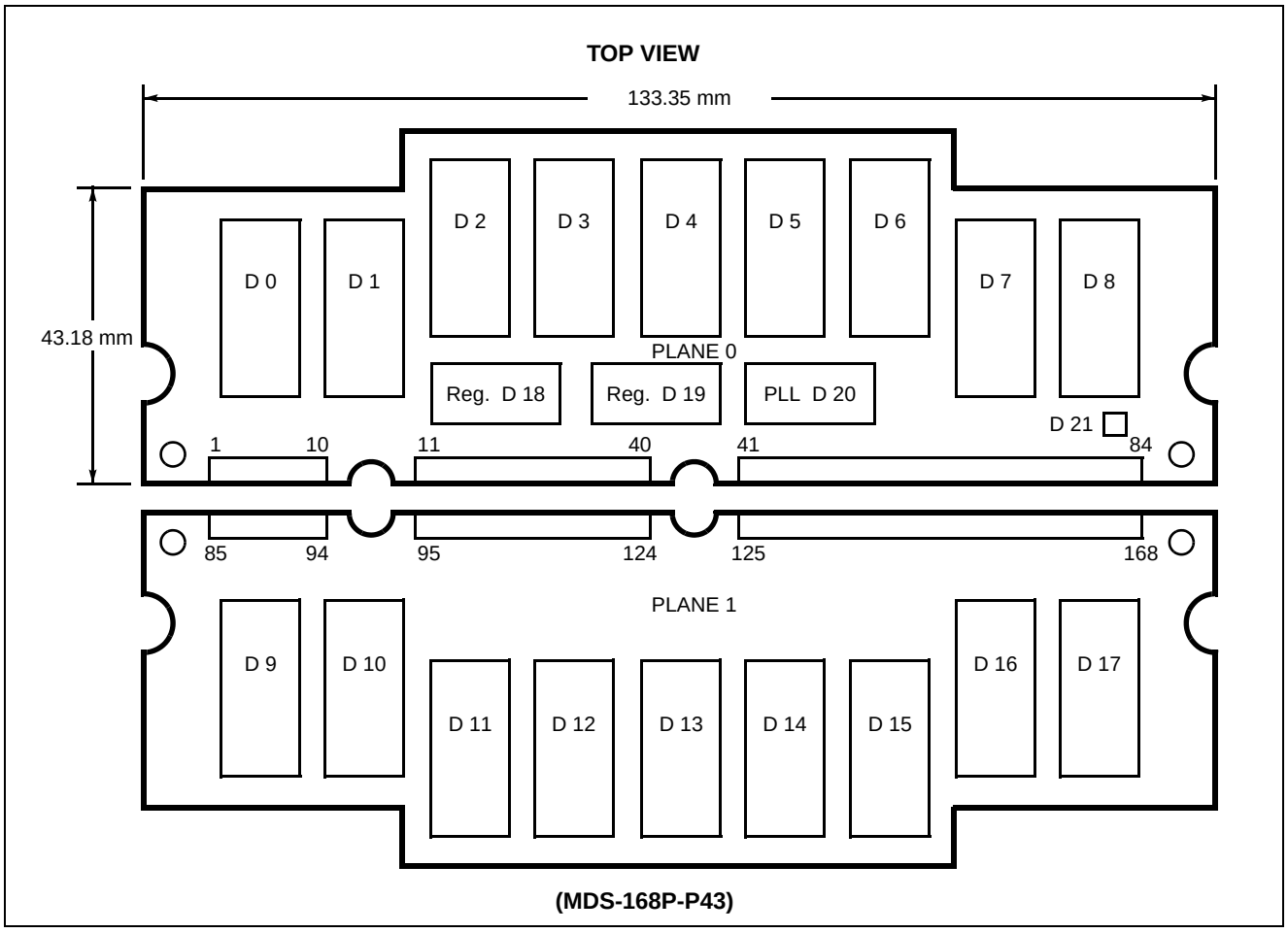

■ PIN DESCRIPTIONS

Symbol	I/O	Function	Symbol	I/O	Function
A_0 to A_{11}	I	Address Input	DQ_0 to DQ_{63}	I/O	Data Input/Data Output
BA_0, BA_1	I	Bank Select (Bank Address)	CB_0 to CB_7	I/O	ECC Data Input/Output
$\overline{RAS}$	I	Row Address Strobe	V_{CC}	—	Power Supply (+3.3 V)
$\overline{CAS}$	I	Column Address Strobe	V_{SS}	—	Ground (0 V)
$\overline{WE}$	I	Write Enable	N.C.	—	No Connection
CLK_0 to CLK_3	I	Clock Input	SA_0 to SA_2	I	Serial PD Address Input
CKE_0	I	Clock Enable	SCL	I	Serial PD Clock
$\overline{S}_0$, $\overline{S}_2$	I	Chip Select	SDA	I/O	Serial PD Address & Data Input/Output
REGE *1	I	Register Enable	WP	I	Serial PD Write Protect
$DQMB_0$ to $DQMB_7$	I	Data (DQ) Mask	—		

Notes: *1. REGE pin is to switch the module function mode to Registered Mode, or Buffered Mode. For Registered Mode function, REGE = V_{IH}.

■ SERIAL-PD INFORMATION

Byte	Function Described		Hex Value	
			-102/-102L	-103/-103L
0	Defines Number of Bytes Written into Serial Memory at Module Manufacture	128 Byte	80h	80h
1	Total Number of Bytes of SPD Memory Device	256 Byte	08h	08h
2	Fundamental Memory Type	SDRAM	04h	04h
3	Number of Row Addresses	12	0Ch	0Ch
4	Number of Column Addresses	10	0Ah	0Ah
5	Number of Module Banks	1 bank	01h	01h
6	Data Width	72 bit	48h	48h
7	Data Width (Continuation)	+0	00h	00h
8	Interface Type	LVTTL	01h	01h
9	SDRAM Cycle Time (Highest CAS Latency)	10 / 10 ns	A0h	A0h
10	SDRAM Access from Clock (Highest CAS Latency)	6 / 6 ns	60h	60h
11	DIMM Configuration Type	ECC	02h	02h
12	Refresh Rate/Type	Self, Normal	80h	80h
13	Primary SDRAM Width	×4	04h	04h
14	Error Checking SDRAM Width	×4	04h	04h
15	Minimum Clock Delay for Back to Back Random Column Addresses	1 Cycle	01h	01h
16	Burst Lengths Supported	1, 2, 4, 8, Page	8Fh	8Fh
17	Number of Banks on Each SDRAM Device	4 bank	04h	04h
18	CAS Latency Supported	2, 3	06h	06h
19	CS Latency	0	01h	01h
20	Write Latency	0	01h	01h
21	SDRAM Module Attributes	Registered	1Fh	1Fh
22	SDRAM Device Attributes : General	*1	0Eh	0Eh
23	SDRAM Cycle Time (2nd. Highest CAS Latency)	10 / 15 ns	A0h	F0h
24	SDRAM Access from Clock (2nd. Highest CAS Latency)	6 / 8 ns	60h	80h
25	SDRAM Cycle Time (3rd. Highest CAS Latency)	No Support	00h	00h
26	SDRAM Access from Clock (3rd. Highest CAS Latency)	No Support	00h	00h
27	Minimum Row Precharge Time (t_{RP})	20 / 20 ns	14h	14h
28	Row Activate to Row Activate Minimum (t_{RRD})	20 / 20 ns	14h	14h
29	RAS to CAS Delay Min. (t_{RCD})	20 / 20 ns	14h	14h
30	Minimum RAS Pulse Width	50 / 50 ns	32h	32h
31	Module Bank Density	128 MByte	20h	20h
32	Command and Address Signal Input Setup Time	2 ns	20h	20h
33	Command and Address Signal Input Hold Time	1 ns	10h	10h
34	Data Signal Input Setup Time	2 ns	20h	20h
35	Data Signal Input Hold Time	1 ns	10h	10h
36 to 61	Unused Storage Locations	—	00h	00h
62	SPD Data Revision Code	1.2	12h	12h
63	Checksum for Byte 0 to 62	*2	3Fh	AFh
64 to 71	Manufacturer's JEDEC ID Code Per JEP-108E	Optional	00h	00h
72	Manufacturing Location	Optional	00h	00h
73 to 90	Manufacturer's Part Number	Optional	00h	00h
91 to 92	Revision Code	Optional	00h	00h
93 to 94	Manufacturing Data	Optional	00h	00h
95 to 98	Assembly Serial Number	Optional	00h	00h
99 to 125	Manufacturer Specific Data	Optional	00h	00h
126	Intel Specification Frequency	100 MHz	64h	64h
127	Intel Specification Details for 100 MHz Support	CL = 2, 3 / 3	8Fh	8Dh
128+	Unused Storage Locations	—	—	—

Note: Any write operation must NOT be executed into the addresses of Byte 0 to Byte 127. Some or all data stored into Byte 0 to Byte 127 may be broken.

*1. Byte 22: SDRAM Device Attributes

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
TBD	TBD	Upper V_{CC} tolerance	Lower V_{CC} tolerance	Supports Write 1 /Read Burst	Supports Precharge All	Supports Auto-Precharge	Supports Early RAS Precharge
0	0	0	0	1	1	1	0

*2. Byte 63: Checksum for Byte 0 to 62
This byte is the checksum for Byte 0 through 62. This byte contains the value of the low 8-bits of the arithmetic sum of Byte 0 through 62.

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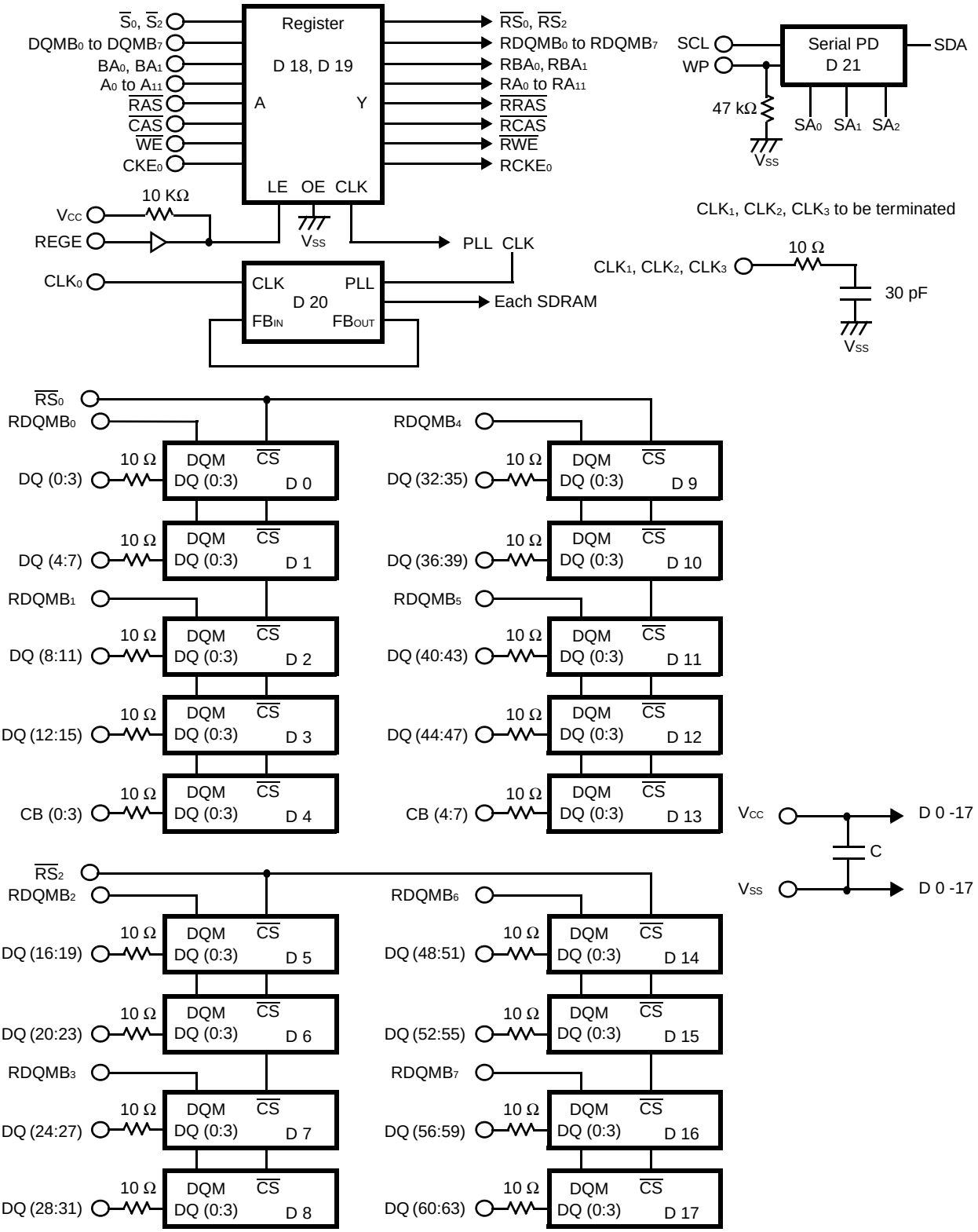
BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS (See WARNING)

Parameter	Symbol	Value		Unit
		Min.	Max.	
Supply Voltage*	V_{CC}	–0.5	+4.6	V
Input Voltage*	V_{IN}	–0.5	+4.6	V
Output Voltage*	V_{OUT}	–0.5	+4.6	V
Storage Temperature	T_{STG}	–55	+125	°C
Power Dissipation	P_D	—	21	W
Output Current (D.C.)	I_{OUT}	–50	+50	mA

* : Voltages referenced to V_{SS} (= 0 V)

WARNING: Semiconductor devices can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of absolute maximum ratings. Do not exceed these ratings.

■ RECOMMENDED OPERATING CONDITIONS

Parameter	Notes	Symbol	Value			Unit
			Min.	Typ.	Max.	
Supply Voltage	*1	V_{CC}	3.0	3.3	3.6	V
		V_{SS}	0	0	0	V
Input High Voltage, All Inputs	*1, 2	V_{IH}	2.0	—	V_{CC} +0.5	V
Input Low Voltage, All Inputs	*1, 3	V_{IL}	–0.5	—	0.8	V
Ambient Temperature		T_A	0	—	+70	°C

*1. Voltages referenced to V_{SS} (=0V)

*2. Overshoot limit: V_{IH} (max.) = V_{CC} +1.5 V with a pulse-width ≤ 5 ns.

*3. Undershoot limit: V_{IL} (min.) = –1.5 V with a pulse-width ≤ 5 ns.

WARNING: The recommended operating conditions are required in order to ensure the normal operation of the semiconductor device. All of the device's electrical characteristics are warranted when the device is operated within these ranges.

Always use semiconductor devices within their recommended operating conditionranges. Operation outside these ranges may adversely affect reliability and could result in device failure.

No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their FUJITSU representatives beforehand.

■ CAPACITANCE

(V_{CC} = +3.3 V, f = 1 MHz, T_A = +25°C)

Parameter		Symbol	Value		Unit
			Min.	Max.	
Input Capacitance	A_0 to A_{11}, BA_0, BA_1	C_{IN1}	—	8	pF
	$\overline{RAS}$, $\overline{CAS}$, $\overline{WE}$	C_{IN2}	—	9	pF
	$\overline{S}_0$, $\overline{S}_2$	C_{IN3}	—	10	pF
	CKE_0	C_{IN4}	—	14	pF
	CLK_0 to CLK_3	C_{IN5}	—	38	pF
	$DQMB_0$ to $DQMB_7$	C_{IN6}	—	9	pF
	SCL	C_{IN7}	—	5	pF
	SA_0, SA_1, SA_2	C_{IN8}	—	6	pF
	REGE	C_{IN9}	—	23	pF
Input/Output Capacitance	SDA	C_{SDA}	—	6	pF
	DQ_0 to DQ_{63}	C_{DQ}	—	13	pF
	CB_0 to CB_7	C_{CB}	—	13	pF

■ DC CHARACTERISTICS

(At recommended operating conditions unless otherwise noted.) Notes 1, 2, 3

Parameter	Notes	Symbol	Condition	Value			Unit
				Min.	Max.		
					Std. ver.	Low ver.	
Operating Current (Average Power Supply Current)	*4	I_{CC1S}	Burst Length = 1, t_{RC} = min for BL = 1, t_{CK} = min, One Bank Active, Outputs Open, Address changed up to 1 time during t_{CK}(min.), 0 V ≤ V_{IN} ≤ V_{IL} max V_{IH} min ≤ V_{IN} ≤ V_{CC}	—	2130		mA
		I_{CC1D}	Burst Length = 1 (each Bank), t_{RC} = min for BL = 1 (each Bank), t_{CK} = min, Two Banks Active, Outputs Open, Address changed up to 1 time during t_{CK}(min.), 0 V ≤ V_{IN} ≤ V_{IL} max V_{IH} min ≤ V_{IN} ≤ V_{CC}	—	3760		mA
Precharge Standby Current (Power Supply Current)	*4	I_{CC2P}	CKE = V_{IL}, t_{CK} = min, All Banks Idle, Power Down Mode, 0 V ≤ V_{IN} ≤ V_{IL} max V_{IH} min ≤ V_{IN} ≤ V_{CC}	—	155	137	mA
		I_{CC2PS}	CKE = V_{IL}, CLK = V_{IH} or V_{IL}, All Banks Idle, Power Down Mode, 0 V ≤ V_{IN} ≤ V_{IL} max V_{IH} min ≤ V_{IN} ≤ V_{CC}	—	137	128	mA
		I_{CC2N}	CKE = V_{IH}, t_{CK} = min, All Banks Idle, NOP commands only, Input signals (except to CMD) are changed one time during 3 clock cycles, 0 V ≤ V_{IN} ≤ V_{IL} max V_{IH} min ≤ V_{IN} ≤ V_{CC}	—	390		mA
		I_{CC2NS}	CKE = V_{IH}, CLK = V_{IH} or V_{IL}, All Banks Idle, Input Signals are Stable, 0 V ≤ V_{IN} ≤ V_{IL} max V_{IH} min ≤ V_{IN} ≤ V_{CC}	—	155		mA

(Continued)

MB8516SR72CA-102/-103/-102L/-103L

(Continued)

Parameter	Notes	Symbol	Condition	Value			Unit
				Min.	Max.		
					Std. ver.	Low ver.	
Active Standby Current (Power Supply Current)	*4	I_{CC3P}	CKE = V_{IL}, t_{CK} = min, Any Bank Active, 0 V ≤ V_{IN} ≤ V_{IL} max V_{IH} min ≤ V_{IN} ≤ V_{CC}	—	155	137	mA
		I_{CC3PS}	CKE = V_{IL}, CLK = V_{IH} or V_{IL}, Any Bank Active, 0 V ≤ V_{IN} ≤ V_{IL} max V_{IH} min ≤ V_{IN} ≤ V_{CC}	—	137	128	mA
		I_{CC3N}	CKE = V_{IH}, t_{CK} = min, Any Bank Active, NOP commands only, Input signals (except to CMD) are changed one time during 3 clock cycles, 0 V ≤ V_{IN} ≤ V_{IL} max V_{IH} min ≤ V_{IN} ≤ V_{CC}	—	570		mA
		I_{CC3NS}	CKE = V_{IH}, CLK = V_{IH} or V_{IL}, Any Bank Active, 0 V ≤ V_{IN} ≤ V_{IL} max V_{IH} min ≤ V_{IN} ≤ V_{CC}	—	155		mA
Burst Mode Current (Average Power Supply Current)	*4	I_{CC4}	t_{CK} = min, Gapless data, Burst Length = 4, Outputs open, Multiple-banks Active, 0 V ≤ V_{IN} ≤ V_{IL} max V_{IH} min ≤ V_{IN} ≤ V_{CC}	—	1835		mA
Auto-refresh Current (Average Power Supply Current)	*4	I_{CC5}	Auto Refresh, t_{CK} = min, t_{RC} = min, 0 V ≤ V_{IN} ≤ V_{IL} max V_{IH} min ≤ V_{IN} ≤ V_{CC}	—	4456		mA
Self-refresh Current (Average Power Supply Current)	*4	I_{CC6}	Self-refresh, t_{CK} = min, CKE ≤ 0.2 V, 0 V ≤ V_{IN} ≤ V_{IL} max V_{IH} min ≤ V_{IN} ≤ V_{CC}	—	137	128	mA
Input Leakage Current	REGE	I_{LI}	0 V ≤ V_{IN} ≤ V_{CC} All other pins not under test = 0 V	–50	50		µA
	Others			–10	10		
Output Leakage Current		I_{LO}	Output is disabled (Hi-Z) 0 V ≤ V_{IN} ≤ V_{CC}	–10	10		µA
LVTTL Output High Voltage	*5	V_{OH}	I_{OH} = –2.0 mA	2.4	—		V
LVTTL Output Low Voltage	*5	V_{OL}	I_{OL} = +2.0 mA	—	0.4		V

Notes: *1. An initial pause (DESL on NOP) of 200 μs is required after power-on followed by a minimum of eight Auto-refresh cycles.

*2. Values of I_{CC1S}, I_{CC1D} and I_{CC4} are for when one side of the double-sided module is in standby mode (I_{CC2N})and the other side is in active.

*3. DC characteristics is the Serial PD standby state (V_{IN} = GND or V_{CC}).

*4. I_{CC} depends on the output termination, load conditions, clock cycle rate and signal clock rate. The specified values are obtained with the output open and no termination resistors.

*5. Voltages referenced to V_{SS} (= 0 V)

MB8516SR72CA-102/-103/-102L/-103L

■ AC CHARACTERISTICS

(SDRAM Component Specifications) Notes 1, 2, 3

(1) BASE CHARACTERISTICS

(At recommended operating conditions unless otherwise noted.)

No.	Parameter	Notes		Symbol	MB8516SR72CA -102/-102L		MB8516SR72CA -103/-103L		Unit
					Min.	Max.	Min.	Max.	
1	Clock Period	*4	CL = 2	t_{CK2}	10	—	15	—	ns
			CL = 3	t_{CK3}	10	—	10	—	
2	Clock High Time			t_{CH}	3	—	3	—	ns
3	Clock Low Time			t_{CL}	3	—	3	—	ns
4	Input Setup Time	Registered Mode		t_{SI}	3.5	—	3.5	—	ns
5	Input Hold Time	Registered Mode		t_{HI}	2.5	—	2.5	—	ns
6	Output Valid from Clock (t_{CK} = min)	*4, *5, *6	CL = 2	t_{AC2}	—	6	—	8	ns
			CL = 3	t_{AC3}	—	6	—	6	
7	Output in Low-Z			t_{LZ}	0	—	0	—	ns
8	Output in High-Z	*4, *7	CL = 2	t_{HZ2}	3	6	3	8	ns
			CL = 3	t_{HZ3}	3	6	3	6	
9	Output Hold Time			t_{OH}	3	—	3	—	ns
10	Time between Refresh			t_{REF}	—	65.6	—	65.6	ms
11	Transition Time			t_T	0.5	2	0.5	2	ns
12	CKE Setup Time for Power Down Exit Time	Registered Mode		t_{CKSP}	3.5	—	3.5	—	ns

(2) BASE VALUES FOR CLOCK COUNT/LATENCY

No.	Parameter	Notes		Symbol	MB8516SR72CA -102/-103/-102L/-103L		Unit
					Min.	Max.	
1	$\overline{RAS}$ Cycle Time	*8		t_{RC}	70	—	ns
2	$\overline{RAS}$ Precharge Time			t_{RP}	20	—	ns
3	$\overline{RAS}$ Active Time			t_{RAS}	50	110000	ns
4	$\overline{RAS}$ to $\overline{CAS}$ Delay Time	*9		t_{RCD}	20	—	ns
5	Write Recovery Time			t_{WR}	10	—	ns
6	Data-in to Precharge Lead Time			t_{DPL}	10	—	ns
7	Data-in to Active/Refresh Command Period	*4	CL = 2	t_{DAL2}	1 cyc + t_{RP}	—	ns
			CL = 3	t_{DAL3}	2 cyc + t_{RP}	—	
8	Mode Register Set Cycle Time			t_{RSC}	20	—	ns
9	$\overline{RAS}$ to $\overline{RAS}$ Bank Active Delay Time			t_{RRD}	20	—	ns

(3) CLOCK COUNT FORMULA (*10)

$$\text{Clock} \geq \frac{\text{Base Value}}{\text{Clock Period}} \quad \text{(Round off a whole number)}$$

(4) LATENCY (The latency values on these parameters are fixed regardless of clock period.)

No.	Parameter	Notes		Symbol	MB8516SR72CA -102/-103/-102L/-103L	Unit
					Registered Mode	
1	CKE to Clock Disable			I_{CKE}	2	Cycle
2	DQM to Output in High-Z			I_{DQZ}	3	Cycle
3	DQM to Input Data Delay			I_{DQD}	1	Cycle
4	Last Output to Write Command Delay			I_{OWD}	1	Cycle
5	Write Command to Input Data Delay			I_{DWD}	1	Cycle
6	Precharge to Output in High-Z Delay	*4	CL = 2	I_{ROH2}	3	Cycle
			CL = 3	I_{ROH3}	4	
7	Burst Stop Command to Output in High-Z Delay	*4	CL = 2	I_{BSH2}	3	Cycle
			CL = 3	I_{BSH3}	4	
8	$\overline{CAS}$ to $\overline{CAS}$ Delay (min)			I_{CCD}	1	Cycle
9	$\overline{CAS}$ Bank Delay (min)			I_{CBD}	1	Cycle

Notes: *1. An initial pause (DESL on NOP) of 200 μs is required after power-up followed by a minimum of eight Auto-refresh cycles.

*2. 1.4 V or V_{REF} is the reference level for measuring timing of signals.
Transition times are measured between V_{IH} (min) and V_{IL} (max).

*3. AC characteristics assume t_T = 1 ns and 50 pF of capacitance load.

*4. For Registered Mode, actual CAS Latency is added one cycle to the CAS Latency of this value because of a delay by registers.

*5. Assumes t_{RCD} is satisfied.

*6. t_{AC} also specifies the access time at burst mode except for first access.

*7. Specified where output buffer is no longer driven.

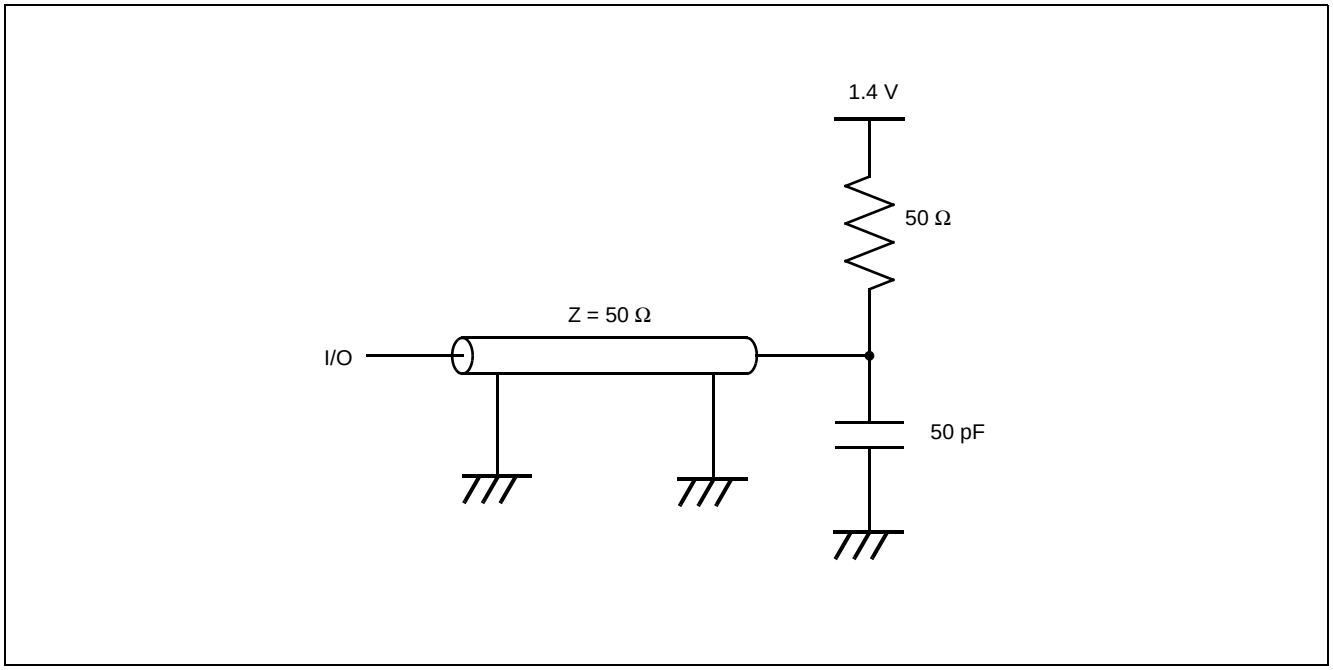
*8. Actual clock count of t_{RC} (I_{RC}) will be sum of clock count of t_{RAS} (I_{RAS}) and t_{RP} (I_{RP}).

*9. Operation within the t_{RCD} (min) ensures that access time is determined by t_{RCD} (min) +t_{AC} (max) ; if t_{RCD} is greater than the specified t_{RCD} (min), access time is determined by t_{AC}.

*10. All base values are measured from the clock edge at the command input to the clock edge for the next command input.
All clock counts are calculated by a simple formula:
clock count equals base value divided by clock period (round off to a whole number).

*Source: See MB81F64442C Data Sheet for details on the electrical.

■ AC OPERATING TEST CONDITION (Example of AC Test Load Circuit)



■ SERIAL PRESENCE DETECT(SPD) FUNCTION

1. PIN DESCRIPTIONS

SCL (Serial Clock)

SCL input is used to clock all data input/output of SPD.

SDA (Serial Data)

SDA is a common pin used for all data input/output of SPD. The SDA pull-up resistor is required due to the open-drain output.

SA_0, SA_1, SA_2 (Address)

Address inputs are used to set the least significant three bits of the eight bits slave address. The address inputs must be fixed to select a particular module and the fixed address of each module must be different each other.

2. SPD OPERATIONS

CLOCK and DATA CONVENTION

Data states on the SDA can change only during SCL= Low. SDA state changes during SCL = High are indicated start and stop conditions. Refer to Fig. 1 below.

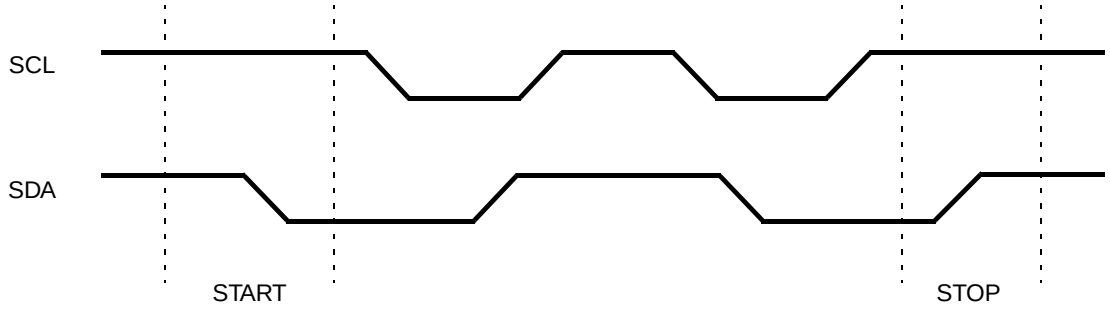
START CONDITION

All commands are preceded by a start condition, which is a transition of SDA state from High to Low when SCL = High. SPD will not respond to any command until this condition has been met.

STOP CONDITION

All read or write operation must be terminated by a stop condition, which is a transition of SDA state from Low to High when SCL = High. The stop condition is also used to make the SPD into the state of standby power mode after a read sequence.

Fig. 1 – START AND STOP CONDITIONS



START = High to Low transition of SDA state when SCL is High

STOP = Low to High transition of SDA state when SCL is High

ACKNOWLEDGE

Acknowledge is a software convention used to indicate successful data transfer. The transmitting device, either master or slave, will release the bus after transmitting eight bits. During the ninth clock cycle the receiver will put the SDA line to Low in order to acknowledge that it received the eight bits of data.

The SPD will respond with an acknowledge when it received the start condition followed by slave address issued by master.

In the read operation, the SPD will transmit eight bits of data, release the SDA line and monitor the line for an acknowledge. If an acknowledge is detected and no stop condition is issued by master, the SPD will continue to transmit data. If an acknowledge is not detected, the SPD will terminated further data transmissions. The master must then issue a stop condition to return the SPD to the standby power mode.

In the write operation, upon receipt of eight bits of data the SPD will respond with an acknowledge, and await the next eight bits of data, again responding with an acknowledge until the stop condition is issued by master.

SLAVE ADDRESS ADDRESSING

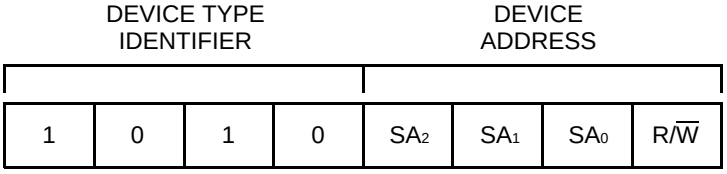
Following a start condition, the master must output the eight bits slave address. The most significant four bits of the slave address are device type identifier. For the SPD this is fixed as 1010[B]. Refer to the Fig. 2 below.

The next three significant bits are used to select a particular device. A system could have up to eight SPD devices —namely up to eight modules— on the bus. The eight addresses for eight SPD devices are defined by the state of the SA_0, SA_1 and SA_2 inputs.

The last bit of the slave address defines the operation to be performed. When R/$\overline{W}$ bit is “1”, a read operation is selected, when R/$\overline{W}$ bit is “0”, a write operation is selected.

Following the start condition, the SPD monitors the SDA line comparing the slave address being transmitted with its slave address (device type and state of SA_0, SA_1, and SA_2 inputs). Upon a correct compare the SPD outputs an acknowledge on the SDA line. Depending on the state of the R/$\overline{W}$ bit, the SPD will execute a read or write operation.

Fig. 2 – SLAVE ADDRESS

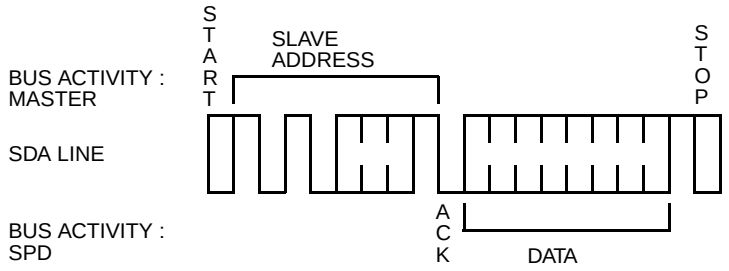


3. READ OPERATIONS

CURRENT ADDRESS READ

Internally the SPD contains an address counter that maintains the address of the last data accessed, incriminated by one. Therefore, if the last access (either a read or write operation) was to address(n), the next read operation would access data from address(n+1). Upon receipt of the slave address with the R/$\overline{W}$ bit = "1", the SPD issues an acknowledge and transmits the eight bits of data during the next eight clock cycles. The master terminates this transmission by issuing a stop condition, omitting the ninth clock cycle acknowledge. Refer to Fig. 3 for the sequence of address, acknowledge and data transfer.

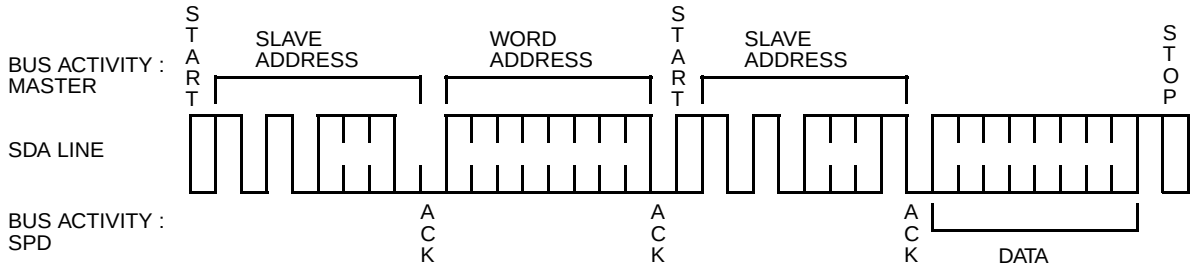
Fig. 3 – CURRENT ADDRESS READ



RANDOM READ

Random Read operations allow the master to access any memory location in a random manner. Prior to issuing the slave address with the R/$\overline{W}$ bit = "1", the master must first perform a "dummy" write operation on the SPD. The master issues the start condition, and the slave address followed by the word address. After the word address acknowledge, the master immediately reissues the start condition and the slave address with the R/$\overline{W}$ bit = "1". This will be followed by an acknowledge from the SPD and then by the eight bits of data. The master terminates this transmission by issuing a stop condition, omitting the ninth clock cycle acknowledge. Refer to Fig. 4 for the sequence of address, acknowledge and data transfer.

Fig. 4 – RANDOM READ

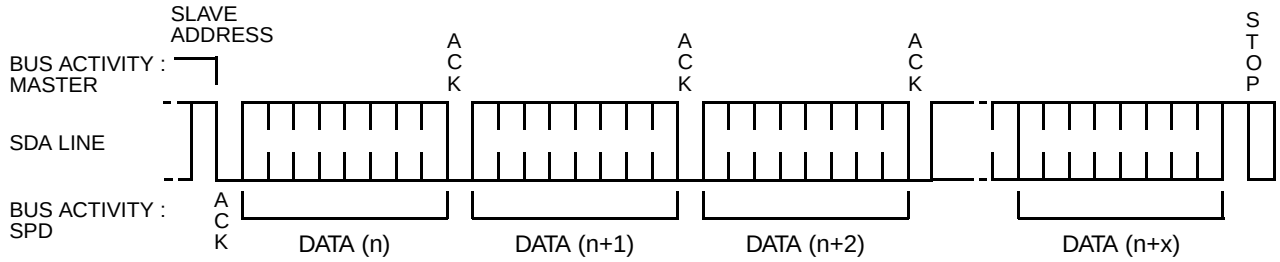


SEQUENTIAL READ

Sequential Read can be initiated as either a current address read or random read. The first data are transmitted as with the other read mode, however, the master now responds with an acknowledge, indicating it requires additional data. The SPD continues to output data for each acknowledge received. The master terminates this transmission by issuing a stop condition, omitting the ninth clock cycle acknowledge. Refer to Fig. 5 for the sequence of address, acknowledge and data transfer.

The data output is sequential, with the data from address(n) followed by the data from address(n+1). The address counter for read operations increments all address bits, allowing the entire memory contents to be serially read during one operation. At the end of the address space (address 255), the counter "rolls over" to address 0 and the SPD continues to output data for each acknowledge received.

Fig. 5 – SEQUENTIAL READ



4. DC CHARACTERISTICS

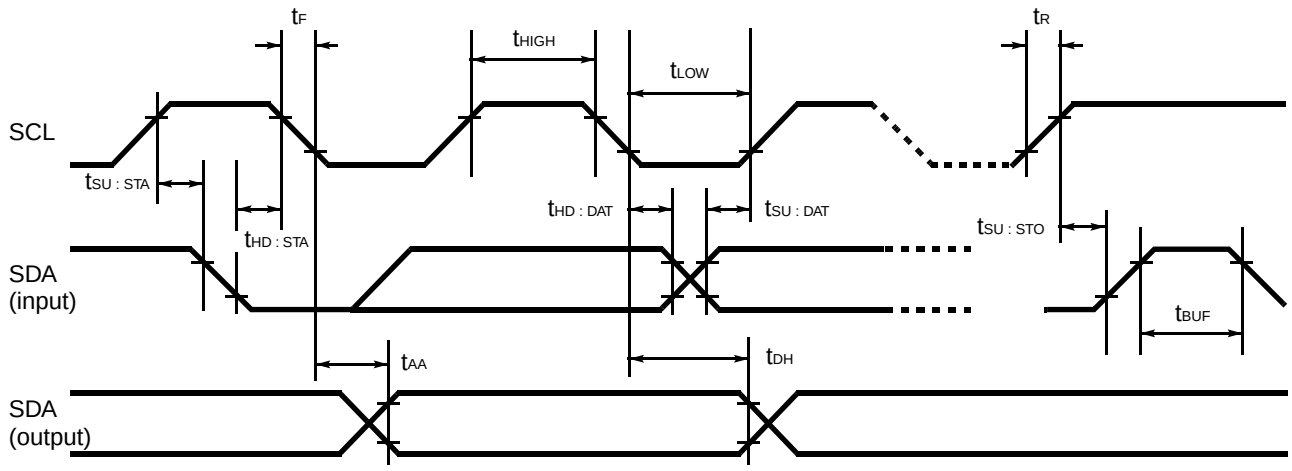
Parameter	Note	Symbol	Condition	Value		Unit
				Min.	Max.	
Input Leakage Current		S_{ILI}	$0\ V \le V_{IN} \le V_{CC}$	–10	10	µA
Output Leakage Current		S_{ILO}	$0\ V \le V_{OUT} \le V_{CC}$	–10	10	µA
Output Low Voltage	*1	S_{VOL}	I_{OL} = 3.0 mA	—	0.4	V

Note: *1. Referenced to V_{SS}.

5. AC CHARACTERISTICS

No.	Parameter	Symbol	Value		Unit
			Min.	Max.	
1	SCL Clock Frequency	f_{SCL}	—	100	KHz
2	Noise Suppression Time Constant at SCL, SDA Inputs	T_I	—	100	ns
3	SCL Low to SDA Data Out Valid	t_{AA}	—	3.5	µs
4	Time the Bus Must Be Free Before a New Transmission Can Start	t_{BUF}	4.7	—	µs
5	Start Condition Hold Time	$t_{HD:STA}$	4.0	—	µs
6	Clock Low Period	t_{LOW}	4.7	—	µs
7	Clock High Period	t_{HIGH}	4.0	—	µs
8	Start Condition Setup Time	$t_{SU:STA}$	4.7	—	µs
9	Data in Hold Time	$t_{HD:DAT}$	0	—	µs
10	Data in Setup Time	$t_{SU:DAT}$	250	—	ns
11	SDA and SCL Rise Time	t_R	—	1	µs
12	SDA and SCL Fall Time	t_F	—	300	ns
13	Stop Condition Setup Time	$t_{SU:STO}$	4.7	—	µs
14	Data Out Hold Time	t_{DH}	100	—	ns
15	Write Cycle Time	t_{WR}	—	15	ms

Fig. 6 – TIMING WAVEFORM



MB8516SR72CA-102/-103/-102L/-103L

■ PACKAGE DIMENSIONS

168-pin plastic DIMM (socket type)
(MDS-168P-P43)

Under development

Dimension in mm (inches)

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