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FUJITSU
MICROELECTRONICS, INC.

MB8416-20
MB8416-20L

CMOS 16384-BIT STATIC RANDOM ACCESS MEMORY

DESCRIPTION

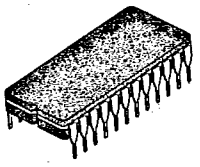
The Fujitsu MB8416 is a 2048 word by 8-bit static random access memory fabricated with high density, high reliability Complementary MOS silicon-gate technology.

The memory utilizes asynchronous circuitry and may be maintained in any state for an indefinite period of time. All input and output pins are TTL-compatible, and a single 5 volt power supply is used. It is possible to retain data at low power supply voltage.

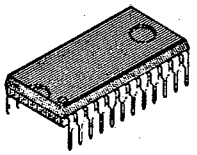
The MB8416 can be optimized for high performance applications such as microcomputer systems where fast access time and ease of use are required. Output Enable ($\overline{G}$) input permits the disable of all outputs when outputs are OR-tied. The MB8416 is packaged in an industry standard 24-pin dual in-line package, or 32-pin leadless chip carrier.

FEATURES

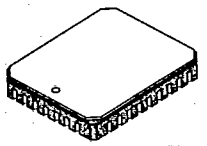
- **Extended temperature range:**
  MB8416-20: −40° to +85°C
  MB8416-20-L: −40° to +70°C
- **Organized as 2048 words by 8-bits**
- **Fast Access Time: 200 ns Max.**
- **Low Standby Power:**
  MB8416-20: 55 μW
  MB8416-20L: 5.5 μW
- **Completely Static Operation, no clocks required**
- **Single +5 Volt Power Supply**
- **TTL Compatible Inputs/Outputs**
- **Low Data Retention Voltage: 2.0V Min.**
- **Pin compatible with HM6116, TC5517 and μPD446**



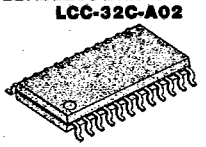
CERDIP PACKAGE
DIP-24C-C03



PLASTIC PACKAGE
DIP-24P-M02

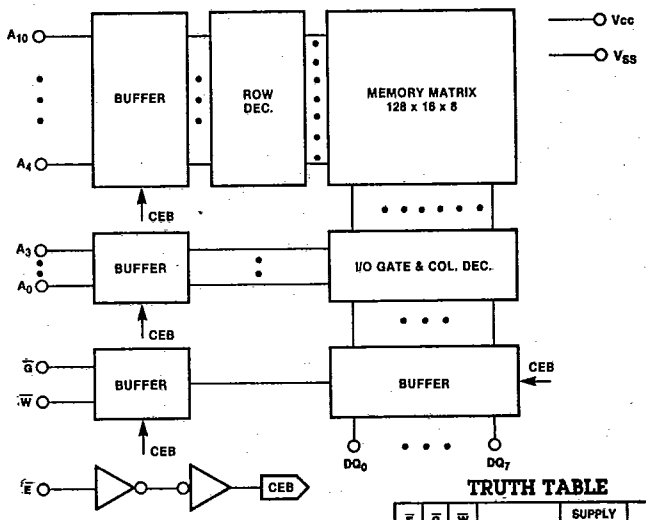


LEADLESS CHIP CARRIER
LCC-32C-A02



PLASTIC FLAT PACKAGE
FPT-24P-M02

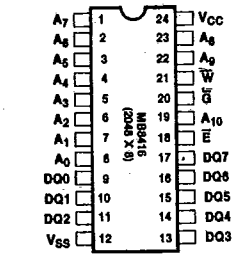
MB8416 BLOCK DIAGRAM

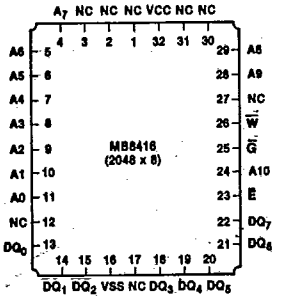


TRUTH TABLE

$\overline{E}$	$\overline{G}$	$\overline{W}$	MODE	SUPPLY CURRENT	I/O PIN
H	X	X	Not Selected	I_{SB}	High-Z
L	H	H	D_{OUT} Disable	I_{CC}	High-Z
L	L	H	Read	I_{CC}	D_{OUT}
L	X	L	Write	I_{CC}	D_{IN}

PIN ASSIGNMENTS





ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Min	Max	Unit
Storage Temperature	Cerdip	T_{stg}	−65	150	°C
	Plastic		−40	125	
Temperature Under Bias		T_{bias}	−40	85	°C
Supply Voltage		V_{CC}	−0.5	8.0	V
Input Voltage		V_{IN}	−0.5	V_{CC} + 0.5	V
Input/Output Voltage		$V_{I/O}$	−0.5	V_{CC} + 0.5	V

NOTE: Permanent device damage may occur if ABSOLUTE MAXIMUM RATINGS are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields. However, it is advised that normal precautions be taken to avoid applications of any voltage higher than maximum rated voltages to this high impedance circuit.

RECOMMENDED OPERATING CONDITIONS (Referenced to V_{SS} = 0V)

Parameter	Symbol		MB8416 Min	MB8416 Typ	MB8416 Max	Unit
Ambient Temperature	T_A	MB8416-20L	−40	—	+70	°C
		MB8416-20	−40	—	+85	
Supply Voltage	V_{CC}		4.5	5.0	5.5	V
Input High Voltage	V_{IH}		2.2	—	V_{CC} + 0.3	V
Input Low Voltage	V_{IL}		−0.3	—	0.8	V

CAPACITANCE

(T_A = 25°C, f = 1 MHz)

Parameter	Symbol	Min	Max	Unit	Condition
Input Capacitance	C_{IN}	—	7	pF	V_{IN} = 0V
Input/Output Capacitance	$C_{I/O}$	—	10	pF	$V_{I/O}$ = 0V

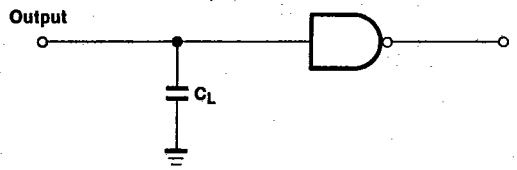
STATIC CHARACTERISTICS

(Recommended Operating Conditions unless otherwise noted.)

Parameter	Condition	Symbol		Min	Max	Units
Standby Supply Current	$\overline{E}$ = V_{CC} − 0.2 to V_{CC} + 0.2V V_{IN} = −0.2V to V_{CC} +0.2V	I_{SB1}	MB8416-20L	—	1	µA
			MB8416-20	—	10	
Standby Supply Current	$\overline{E}$ = V_{IH} V_{IN} = −0.2V to V_{CC} +0.2V	I_{SB2}		—	2	mA
Active Supply Current	$\overline{E}$ = V_{IL} V_{IN} = V_{IL} or V_{IH}; I_{OUT} = 0	I_{CC1}		—	60	mA
Operating Supply Current	Cycle = Min, Duty = 100% I_{OUT} = 0	I_{CC2}		—	60	mA
Input Leakage Current	V_{IN} = 0V to V_{CC}	I_{LI}		−1.0	1.0	µA
Output Leakage Current	$V_{I/O}$ = 0V to V_{CC} $\overline{E}$ = V_{IH}	I_{LO}		−1.0	1.0	µA
Output High Voltage	I_{OUT} = −1.0 mA	V_{OH}		2.4	—	V
Output Low Voltage	I_{OUT} = 4.0 mA	V_{OL}		—	0.4	V

AC TEST CONDITIONS

Input Pulse Levels:	**0.6V to 2.4V**
Input Pulse Rise and Fall Times:	**10 ns**
Input Timing Reference Level:	**0.8V to 2.2V**
Output Timing Reference Level:	**0.8V to 2.2V**
Output Load:	**1 TTL Gate and C_L = 100 pF for all others.**



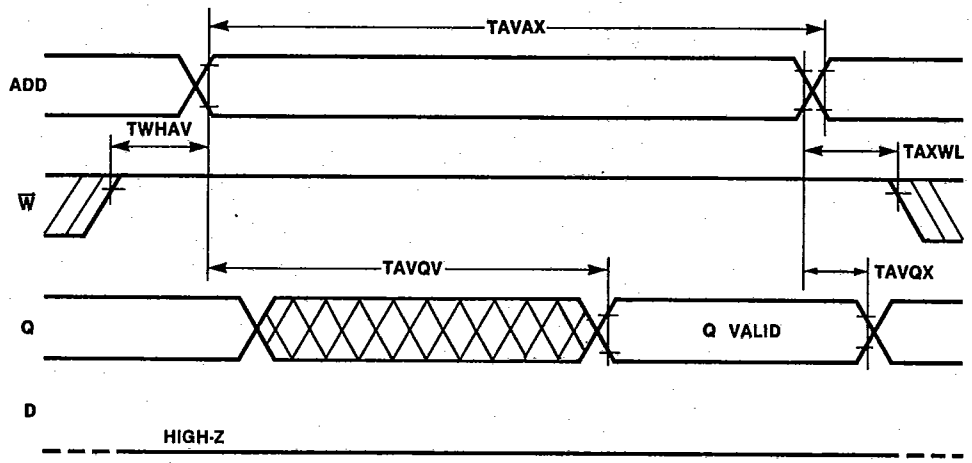
DYNAMIC CHARACTERISTICS

Parameter	Symbol	Min	Max	Unit
Read Cycle Time	TAVAX	200	—	ns
Write Cycle Time	TAVAX	200	—	ns
Address Access Time	TAVQV	—	200	ns
Chip Enable Access Time	TELQV	—	200	ns
Output Hold from Address Change	TAVQX	15	—	ns
Output Low Z from $\overline{E}$	TELQX	15	—	ns
Output High Z from $\overline{E}$	TEHQZ	—	60	ns
Output Low Z from $\overline{G}$	TGLQX	15	—	ns
Output High Z from $\overline{G}$	TGHQZ	—	60	ns
Output Low Z from $\overline{W}$	TWHQX	15	—	ns
Output High Z from $\overline{W}$	TWLQZ	—	60	ns
Output Enable to Output Valid	TGLQV	—	100	ns
Address Set Up Time	TAVEL, TAVWL	0	—	ns
Read Set Up Time	TWHEL, TWHAV	0	—	ns
Read Hold Time	TAXWL, TEHWL	0	—	ns
Write Set Up Time	TWLEL	0	—	ns
Write Hold Time	TEHWH	0	—	ns
Address Valid to End of Write	TAVWH	160	—	ns
Chip Enable to End of Write	TELEH	160	—	ns
Write Pulse Width	TWLWH	140	—	ns
Write Recovery Time	TWHAX, TEHAX	10	—	ns
Data Set Up Time	TDVEH, TDVWH	60	—	ns
Data Hold Time	TWHDX, TEHDX	0	—	ns

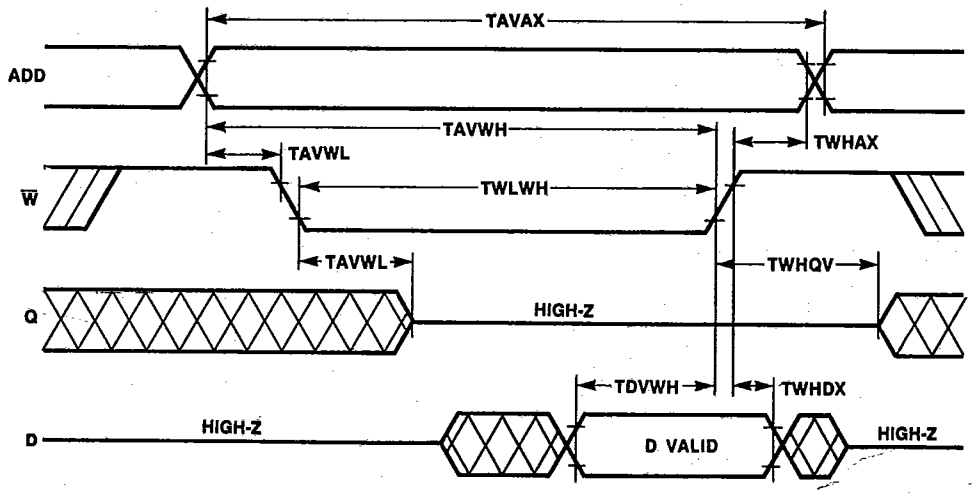
WAVEFORMS

MODE 1: $\overline{W}$ Controlled: ($\overline{E}$ = Low, $\overline{G}$ = Low)

Read Cycle



Write Cycle

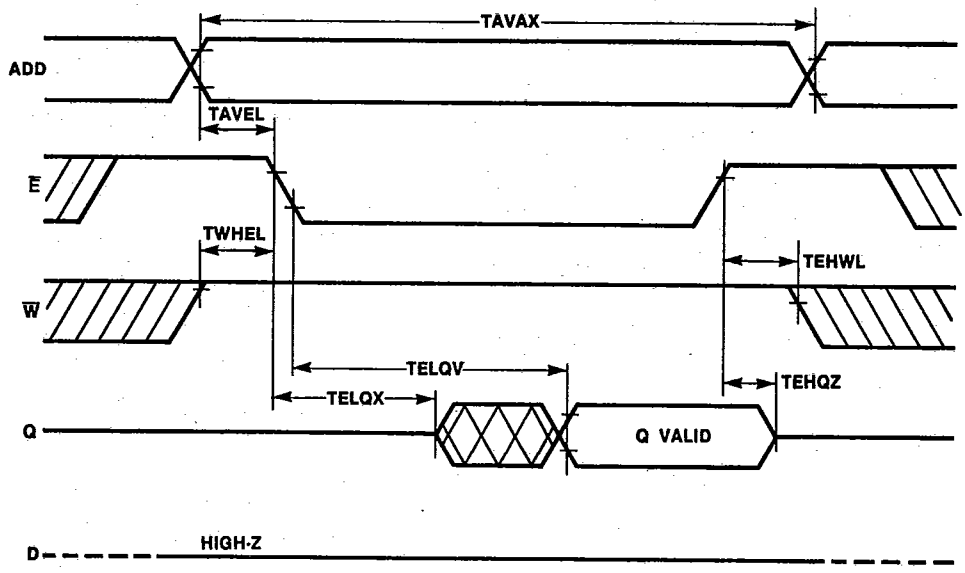


MB8416-20/MB8416-20L

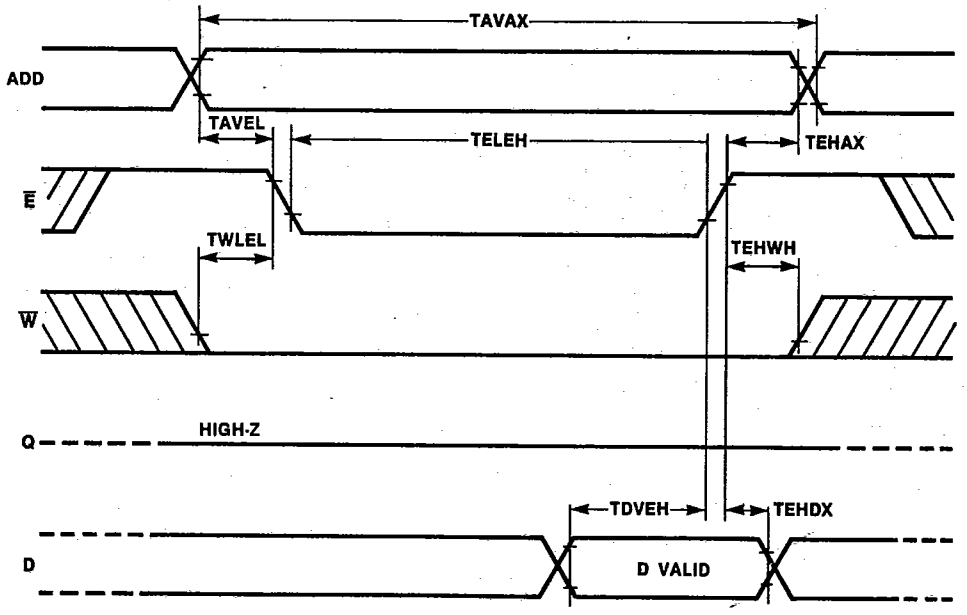
WAVEFORMS (Continued)

MODE 2: $\overline{E}$ Controlled, ($\overline{G}$ = Low)

Read Cycle



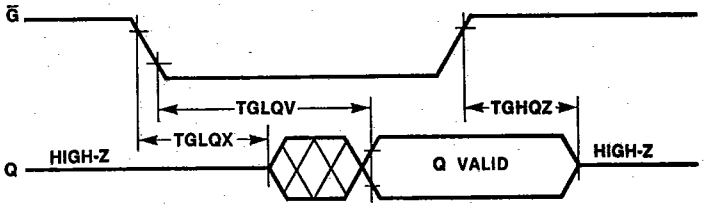
Write Cycle



WAVEFORMS (Continued)

Enable/Disable $\overline{G}$ Controlled; ($\overline{E}$ = Low, $\overline{W}$ = High)

Read Cycle



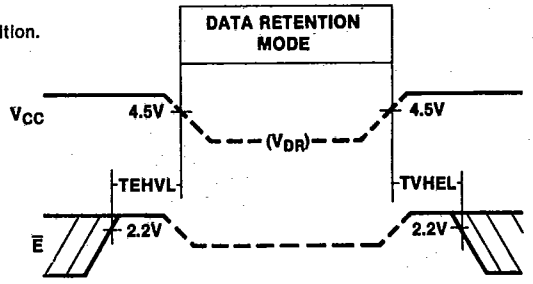
DYNAMIC CHARACTERISTICS

Data Retention Characteristics, NOTES 1, 2, 3 (Recommended operating conditions unless otherwise noted.)

Parameter	Notes	Symbol		Min	Max	Unit
Data Retention Supply Voltage	1	VDR		2.0	5.5	V
Data Retention Supply Current	2	IDR	MB8416-20	—	10	μA
			MB8416-20L	—	1	μA
Data Retention Set Up Time	3	TEHVCL		0	—	ns
Recovery Time	3	TVHEL		60	—	ns

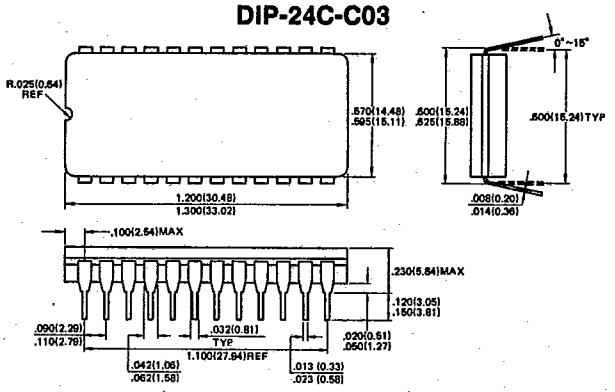
NOTES:

1. $\overline{E}$ = 2.2V to VDR + 0.3V when VDR = 2.5V to 5.5V
   $\overline{E}$ = VDR ± 0.3V when VDR = 2.0 to 2.5V.
2. V_{CC} = VDR = 2.0V, $\overline{E}$ = VDR ± 0.2V V_{IN} = −0.2V to VDR + 0.2V.
3. V_L = 4.5V on the falling transition, V_H = 4.5V on the rising transition.

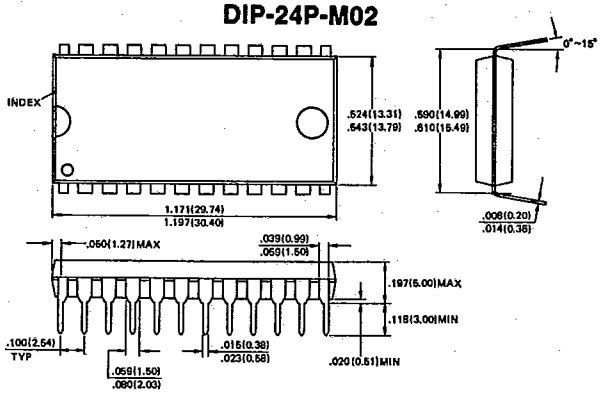


PACKAGE DIMENSIONS Dimensions in Inches (millimeters)

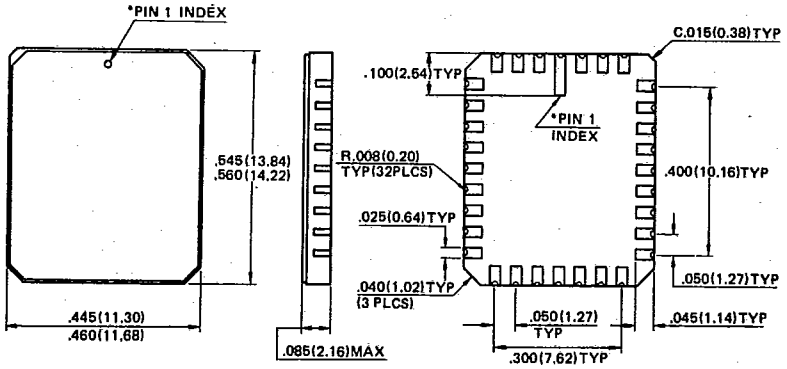
24-LEAD CERDIP DUAL IN-LINE PACKAGE
DIP-24C-C03



24-LEAD PLASTIC DUAL IN-LINE PACKAGE
DIP-24P-M02

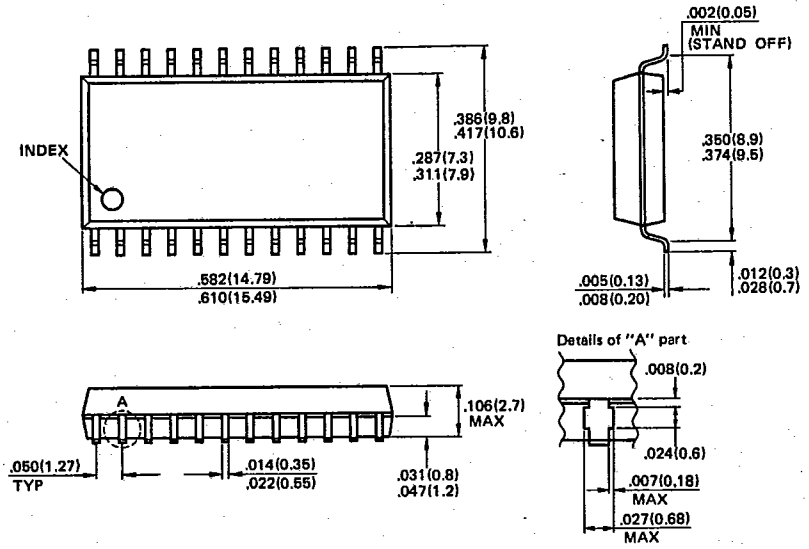


32-PAD CERAMIC (METAL SEAL) LEADLESS CHIP CARRIER
LCC-32-A02



PACKAGE DIMENSIONS Dimensions in inches (millimeters) (Continued)

24-LEAD PLASTIC FLAT PACKAGE
FPT-24P-M02



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