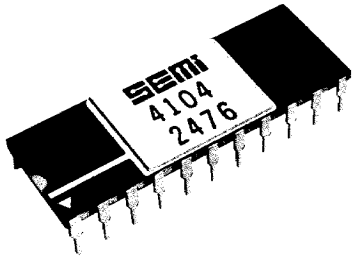
SEMI 4104 150NSEC, STATIC, TTL IN/OUT, 1024X4 N-[illegible]

FEATURES

- Access time as low as 150 ns max
- Cycle time as low as 350 ns max
- Static—no refresh required
- TTL Compatible Inputs/Outputs
- On Chip Address Register
- 1Kx4 Organization Ideal for Microprocessor Applications
- Low Operating Power 450 mw typ
- Low Standby Power 35mw typ
- Data Retention Mode, $V_{DD} = 4V$; $V_{BB} = -4V$
- Standard 22 pin dip
- Non-Inverted Data Output
- Voltage Compatible with Popular Microprocessors

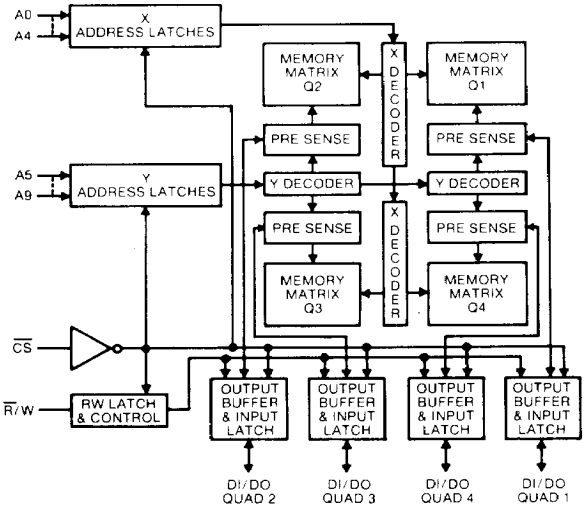
GENERAL DESCRIPTION



The SEMI 4104 is an N-Channel MOS Random Access Memory, organized as 1024 words by four bits. It uses a fully static memory cell which eliminates the need for any refresh or charge pump circuitry. All inputs can be driven by standard TTL devices and the three state data output can directly drive one TTL load of any type.

The $\overline{\text{Chip Select}}$ input provides for simple memory expansion and low system power, by putting unselected devices into a high output impedance and low power state. For additional power savings V_{DD} and V_{BB} can be reduced significantly, thus allowing data to be retained economically under battery power.

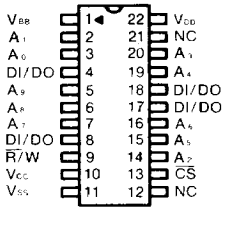
BLOCK DIAGRAM



PIN CONFIGURATION

A_N	Address Inputs
DI/DO	Data Input/Data Output
$\overline{CS}$	$\overline{\text{Chip}}$ Select Input
R/W	Read/Write Input
N/C	No Internal Connection
V_{SS}	Ground
V_{BB}	Supply Voltage (—5V)
V_{CC}	Supply Voltage (+5V)
V_{DD}	Supply Voltage (+12V)

TOP VIEW



RECOMMENDED OPERATING CONDITIONS T_{AMB} = 0°C to 70°C

PARAMETER	SYMBOL	MIN	NOM	MAX	UNIT
Supply Voltage	V_{DD}	11.4	12.0	12.6	Vdc
Output Reference Voltage	V_{CC}	4.75	5.0	5.25	Vdc
Substrate Voltage	V_{BB}	−4.5	−5	−5.5	Vdc
Input High Level	V_{IH}	2.4	—	5.25	Vdc
Input Low Level	V_{IL}	−0.1	—	0.7	Vdc
Chip Select High Level	V_{CH}	8	12	15	Vdc
Chip Select Low Level	V_{CL}	1	—	0.5	Vdc

DC ELECTRICAL CHARACTERISTICS (Full Operating Voltage and Temperature Range Unless Otherwise Noted)

CHARACTERISTICS	SYMBOL	4104A MIN	4104A MAX	4104B MIN	4104B MAX	UNIT	CONDITIONS
Input Current	I_{IN}	−20	+20	−20	+20	μA	V_{IN} = 0.7V or 5V
Chip Select Input Current	I_{CS}	−20	+20	−20	+20	μA	V_{CS} = 0.5V or 12V
Output "Low" Voltage	V_{OL}	—	0.5	—	0.5	Vdc	I_{OL} = 2.0 mA Fig. 5
Output "High" Voltage	V_{OH}	2.7	—	2.7	—	Vdc	I_{OH} = 500 μA Fig. 5
Output Current (Unselected)	I_{DO}	−20	+20	−20	+20	μA	V_{OUT} = 2.7V, V_{CS} = 12V
Supply Current (Selected and Averaged over one cycle) 4104A / 4104B: T_{CSW} 200 / 150; T_C 350 / 300. For Other Conditions See Figure 3	I_{DD}	—	50	—	55	mA	T_{AMB} = 25°C, V_{DD} = 12V, V_{CC} = 5V, V_{BB} = −5V, V_{CS} = 12V
Supply Current (Unselected) T_{AMB} = 25°C	I_{DD}	—	5	—	5	mA	V_{DD} = 12V
Supply Current (Unselected) T_{AMB} = 70°C7	I_{DD}	—	15	—	15	mA	V_{CC} = 5V
Substrate Current	I_{BB}	—	−3	—	−3	mA	V_{BB} = −5V
Reference Supply Current	I_{CC}	—	100	—	100	μA	V_{CS} = 12V
Standby Current at Reduced Voltages T_{AMB} = 25°C	I_{DDS}	—	2	—	2	mA	V_{CS} = 4V to 15V, V_{DD} = 4V, V_{BB} = −4V, V_{CC} = OV
Standby Current at Reduced Voltages T_{AMB} = 70°C	I_{DDS}	—	6	—	6	mA	V_{CS} = 4V to 15V, V_{DD} = 4V, V_{BB} = −4V, V_{CC} = OV

READ CYCLE — AC CHARACTERISTICS

CHARACTERISTICS	SYMBOL	4104A MIN	4104A MAX	4104B MIN	4104B MAX	UNIT	CONDITIONS
Chip Select Read Pulse Width	T_{CSR}	200	—	150	—	ns	FULL OPERATING VOLTAGE AND TEMPERATURE RANGE
Chip Select Rise and Fall Time*	T_{CR}, T_{CF}	—	100	—	100	ns	
Set Up Time	T_P	0	—	0	—	ns	
Access Time	T_A	—	200	—	150	ns	
Cycle Time, T_{CR} = T_{CF} = 10ns	T_C	350	—	300	—	ns	
Data Hold Time	T_H	100	—	100	—	ns	
Output Recovery Time	T_{DR}	10	—	10	—	ns	
Read Recovery Time	T_{CRR}	125	—	125	—	ns	

WRITE CYCLE — AC CHARACTERISTICS

CHARACTERISTICS	SYMBOL	4104A MIN	4104A MAX	4104B MIN	4104B MAX	UNIT	CONDITIONS
Chip Select Write Pulse Width	T_{CSW}	200	—	150	—	ns	FULL OPERATING VOLTAGE AND TEMPERATURE RANGE
Chip Select Rise and Fall Time*	T_{CR}, T_{CF}	—	100	—	100	ns	
Set Up Time	T_P	0	—	0	—	ns	
Cycle Time, T_{CR} = T_{CF} = 10 ns	T_C	350	—	300	—	ns	
Data Hold Time	T_H	100	—	100	—	ns	
Write Recovery Time	T_{CWR}	125	—	125	—	ns	

*Typical Chip Select Rise and Fall Time (T_{CR} and T_{CF}) is 10 ns For Read and Write Cycle

CAPACITANCE (Over Full Temperature Range and Worst Case Voltage Conditions)

CHARACTERISTICS	SYMBOL	MIN	TYP	MAX	UNIT	CONDITIONS
Input Capacitance (Except Chip Select)	C_{IN}	—	4	6	pF	V_{IN} 2.4V
Input Capacitance Chip Select	C_{CS}	—	6	10	pF	V_{CS} = 12V or 0V
Output Capacitance	C_O	—	6	8	pF	V_O = 2.7V, V_{CS} 12V

ABSOLUTE MAXIMUM RATINGS (See Note 1) (Referenced to GND)

RATING	SYMBOL	VALUE	UNIT
Supply Voltages	V_{DD}	−.5 to +18	Vdc
	V_{CC}	−.5 to +7	Vdc
	V_{BB}	+.5 to −18	Vdc
Input & Output Voltages (Except Chip Select)	V_I, V_O	V_{BB} to +15	Vdc
Chip Select Input Voltage	V_{CS}	V_{BB} to +15	Vdc
Power Dissipation	P_D	1.6 (Note 2)	W
Operating Ambient Temperature Range	T_{AMB}	0 to +70	°C
Storage Temperature Range		−65 to +150	°C

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 application of any voltage higher than maximum rated voltages to this high impedance circuit.

NOTE 1: Permanent device damage may occur if ABSOLUTE MAXIMUM RATINGS are exceeded. Functional operation should be restricted to RECOMMENDED OPERATING CONDITIONS. Exposure to higher than recommended or maximum voltages for extended periods of time could affect device reliability.

NOTE 2: At 25°C ambient. Derate 13.5mw/°C.

Figure 1 — READ CYCLE

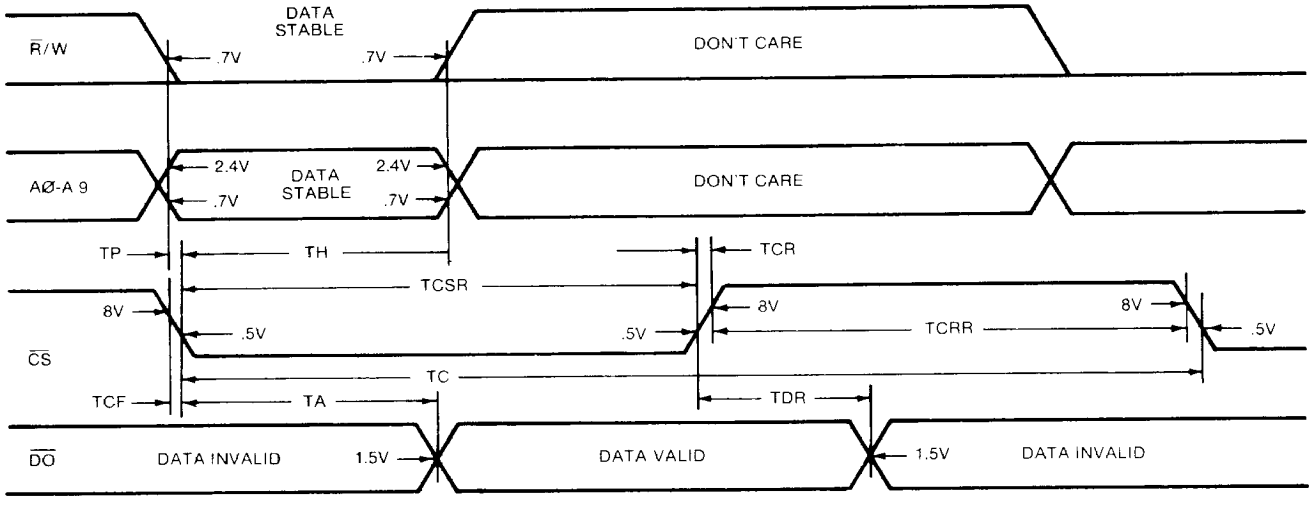
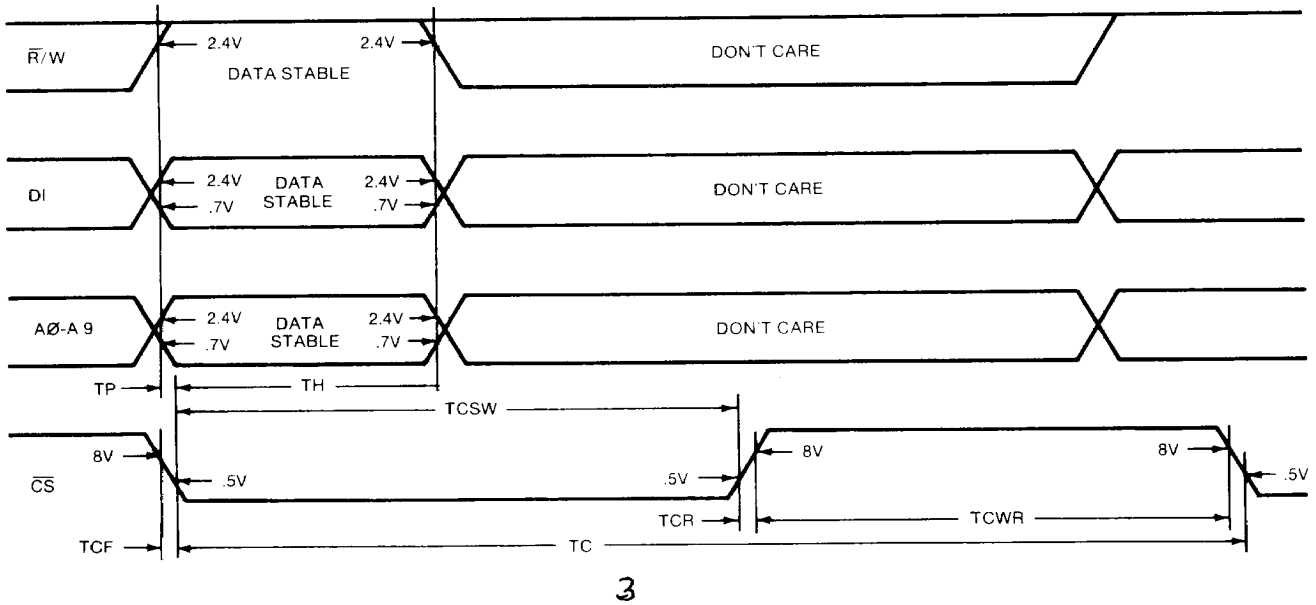


Figure 2 — WRITE CYCLE



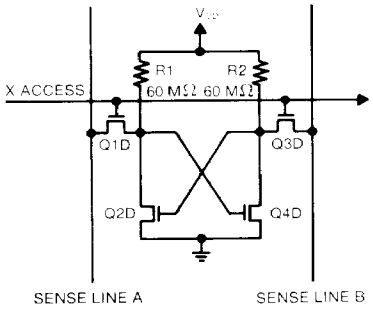


Figure 3 — MEMORY CELL

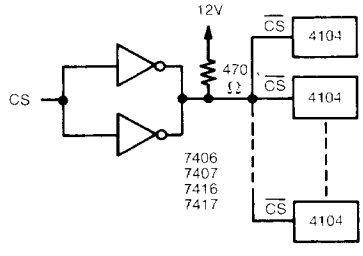


Figure 4 — TYPICAL CHIP SELECT DRIVER

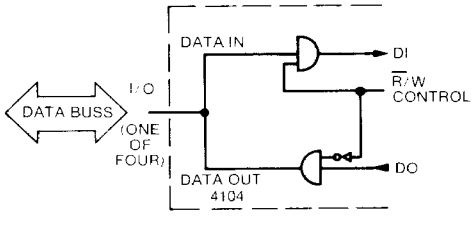
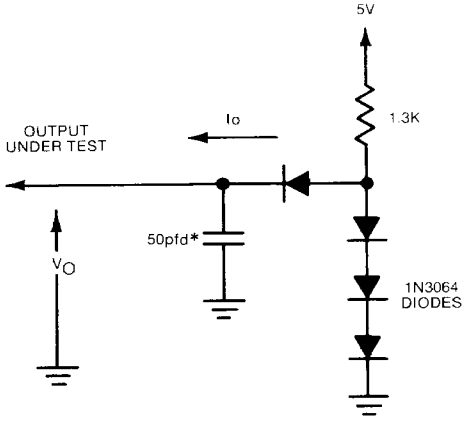


Figure 5 — COMMON DATA I/O



*Capacitance loading to simulate effect of seven additional outputs plus one TTL input

Figure 6 — OUTPUT TEST LOAD

FUNCTIONAL DESCRIPTION

EMM/SEMI 4104 is a 4096 bit static RAM with memory cells organized in four arrays of 32 rows by 32 columns (1024 words x 4 bits). Each four bit word is addressed by simultaneously decoding the X addresses (A_0 through A_4) for the rows and the Y addresses (A_5 through A_9) for the columns. Data is written or read in parallel on four common input/output pins (DI/DO). The operation of the memory is controlled by chip select ($\overline{CS}$) and read/write ($\overline{R}/W$).

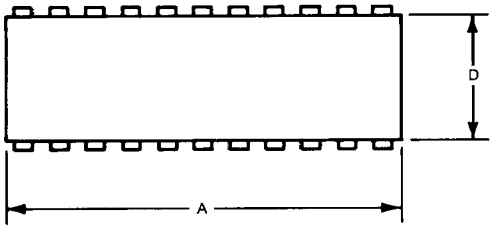
When $\overline{CS}$ is high, all pins are in an inoperative high impedance state, and power is supplied only to the memory elements. When $\overline{CS}$ is low, the memory is enabled for reading or writing.

The negative going edge of $\overline{CS}$ begins timing for a read cycle. Data on $\overline{R}/W$ and address pins (A_N) must be stable for time T_H. $\overline{R}/W$ and A_N will then have been latched into D type flip flops and no longer need to be held stable. Output data will be presented on the four output pins (DI/DO) within time T_A and will remain until time T_{DR} after $\overline{CS}$ goes high. Data will then be invalid. After time T_C another read or write cycle can be initiated.

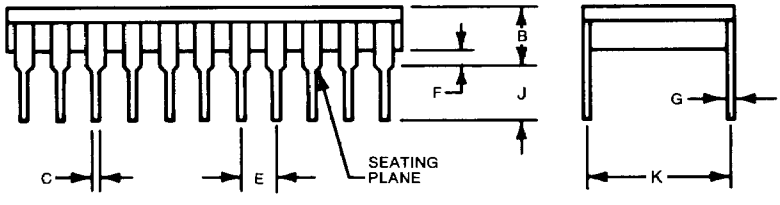
The negative going edge of $\overline{CS}$ also begins timing for a write cycle. $\overline{R}/W$, A_N and DI must be held stable for time T_H. These inputs will then have been latched and DI will be entered within time T_{CSW}. Another read or write cycle can be initiated after time T_C.

The memory cells (because they are cross coupled high impedance static cells) will retain data down to $V_{DD} = 4V$, $V_{BB} = -4V$.

CERAMIC PACKAGE DIMENSIONS

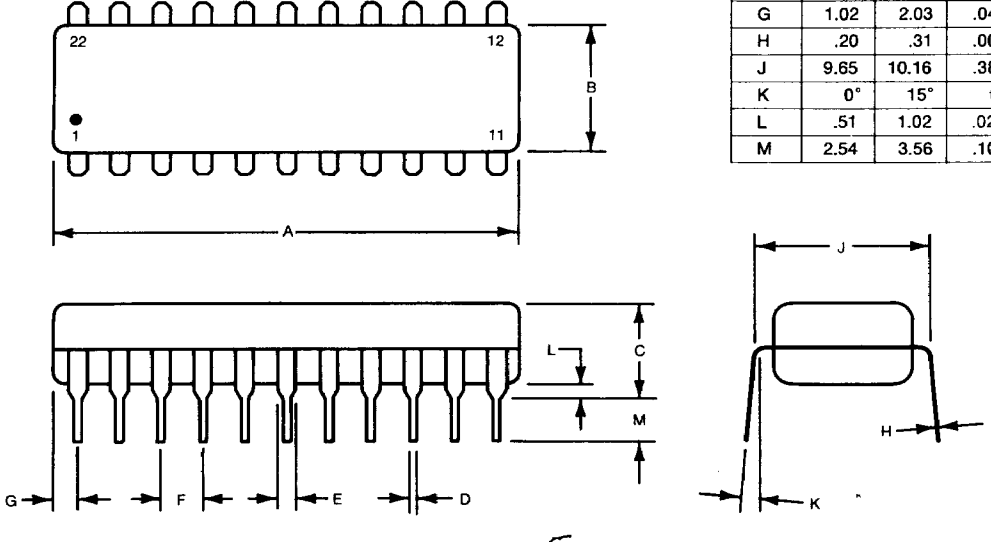


DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	27.1	27.8	1.065	1.095
B	—	3.56	—	0.140
C	0.38	0.53	0.015	0.023
D	8.64	10.8	0.340	0.425
E	2.29	2.79	0.090	0.110
F	0.64	1.65	0.025	0.065
G	0.20	0.30	0.008	0.012
J	2.54	3.81	0.100	0.150
K	10.2 REF		0.4 REF	



PLASTIC PACKAGE DIMENSIONS

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	27.9	29.72	1.100	1.17
B	8.64	9.14	.340	.360
C	4.32	5.08	.170	.200
D	.36	.56	.014	.022
E	.76	1.52	.030	.060
F	2.41	2.67	.095	.105
G	1.02	2.03	.040	.080
H	.20	.31	.008	.012
J	9.65	10.16	.380	.400
K	0°	15°	0°	15°
L	.51	1.02	.020	.040
M	2.54	3.56	.100	.140



ORDERING INFORMATION

Part Number	Speed Access	Cycle	Package	Temperature Range
4104ACC	200	350	Ceramic	0°C to +70°C
4104ACP	200	350	Plastic	0°C to +70°C
4104BCC	150	300	Ceramic	0°C to +70°C
4104BCP	150	300	Plastic	0°C to +70°C

WARNING:

MOS CIRCUITS ARE SUBJECT TO DAMAGE FROM STATIC DISCHARGE

Internal static discharge circuits are provided to minimize part damage due to environmental static electrical charge build-ups. Industry established recommendations for handling MOS circuits include:

1. Ship and store product in conductive shipping tubes or in conductive foam plastic. Never ship or store product in non-conductive plastic containers or non-conductive plastic foam material.
2. Handle MOS parts only at conductive work stations.
3. Ground all assembly and repair tools.

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