Am9111/Am91L11/Am2111 FAMILY

256x4 Static R/W Random Access Memories

2

PART NUMBER	Am2111	Am2111-2	Am9111A Am91L11A Am2111-1	Am9111B Am91L11B	Am9111C Am91L11C	Am9111D
ACCESS TIME	1000ns	650ns	500ns	400ns	300ns	250ns

DISTINCTIVE CHARACTERISTICS

- 256 x 4 organization for small memory systems
- Low operating power dissipation
  125mW Typ; 290mW maximum – standard power
  100mW Typ; 175mW maximum – low power
- DC standby mode reduces power up to 84%
- Logic voltage levels identical to TTL
- High output drive – two full TTL loads
- High noise immunity – full 400mV
- Single 5 volt power supply –
  tolerances: ±5% commercial, ±10% military
- Uniform switching characteristics – access times insensitive to supply variations, addressing patterns and data patterns
- Both military and commercial temperature ranges available
- Bussed input and output data on common pins.
- Output disable control
- Zero address set-up and hold times for simplified timing
- 100% MIL-STD-883 reliability assurance testing

FUNCTIONAL DESCRIPTION

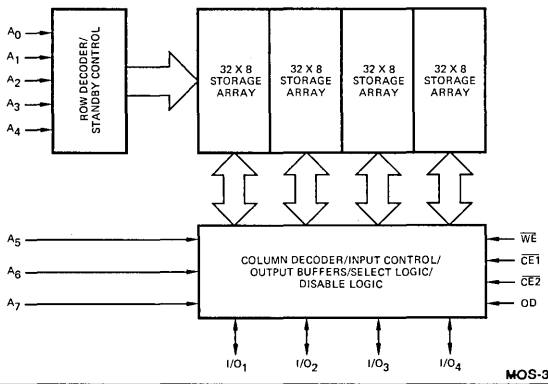
The Am9111/Am91L11 series of devices are high performance, low power, 1024-bit, static, read/write random access memories. They offer a wide range of access times including versions as fast as 200ns. Each memory is implemented as 256 words by 4 bits per word. This organization permits efficient design of small memory systems and allows finer resolution of incremental memory depth. The input data and output data signals are bussed together to share common I/O pins. This feature not only decreases the package size, but helps eliminate external logic in bus-oriented memory systems.

These memories may be operated in a DC standby mode for reductions of as much as 84% of the normal power dissipation. Data can be retained with a power supply as low as 1.5 volts. The low power Am91L11 series offer reduced power dissipation during normal operating conditions and even lower dissipation in the stand-by mode.

The Chip Enable input control signals act as high order address lines and they control the write amplifier and the output buffers. The Output Disable signal provides independent control over the output state of enabled chips.

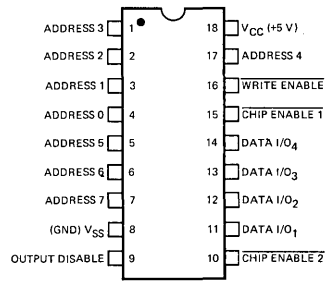
These devices are all fully static and no refresh operations or sense amplifiers or clocks are required. Input and output signal levels are identical to TTL specifications, providing simplified interfacing and high noise immunity. The outputs will drive two full TTL loads for increased fan-out and better bus interfacing capability.

Am9111 BLOCK DIAGRAM



MOS-350

CONNECTION DIAGRAM
Top View



Note: Flat Pack version available in 24-pin package.

MOS-351

ORDERING INFORMATION

Ambient Temperature Specification	Package Type	Power Type	Access Times					
			1000ns	650ns	500ns	400ns	300ns	250ns
0°C to +70°C	Molded DIP	Standard	P2111	P2111-2	P2111-1 AM9111APC	AM9111BPC	AM9111CPC	AM9111DPC
		Low			AM91L11APC	AM91L11BPC	AM91L11CPC	
	Hermetic DIP	Standard	C2111	C2111-2	C2111-1 AM9111ADC	AM9111BDC	AM9111CDC	AM9111DDC
		Low			AM91L11ADC	AM91L11BDC	AM91L11CDC	
5°C to +125°C	Hermetic DIP	Standard			AM9111ADM	AM9111BDM	AM9111CDM	
		Low			AM91L11ADM	AM91L11BDM	AM91L11CDM	
	Hermetic Flat Pack	Standard			AM9111AFM	AM9111BFM		
		Low			AM91L11AFM	AM91L11BFM		

MAXIMUM RATINGS above which the useful life may be impaired

Storage Temperature	−65°C to +150°C
Ambient Temperature Under Bias	−55°C to +125°C
V_{CC} With Respect to V_{SS}, Continuous	−0.5V to +7.0V
DC Voltage Applied to Outputs	−0.5V to +7.0V
DC Input Voltage	−0.5V to +7.0V
Power Dissipation	1.0W

ELECTRICAL CHARACTERISTICS

Am9111PC, Am9111DC, Am91L11PC, Am91L11DC, Am2111
T_A = 0°C to +70°C
V_{CC} = +5.0V ±5%

Parameters	Description	Test Conditions			Am9111/Am91L11 Family Min.	Am9111/Am91L11 Family Max.	Am2111 Family Min.	Am2111 Family Max.	Units
V_{OH}	Output HIGH Voltage	V_{CC} = MIN.		I_{OH} = −200μA	2.4				Volts
				I_{OH} = −150μA			2.2		
V_{OL}	Output LOW Voltage	V_{CC} = MIN.		I_{OL} = 3.2mA		0.4			Volts
				I_{OL} = 2.0mA				0.45	
V_{IH}	Input HIGH Voltage				2.0	V_{CC}	2.2	V_{CC}	Volts
V_{IL}	Input LOW Voltage				−0.5	0.8	−0.5	0.65	Volts
I_{LI}	Input Load Current	V_{CC} = MAX., 0V ≤ V_{IN} ≤ 5.25V				10		10	μA
I_{LO}	I/O Leakage Current	$V_{\overline{CE}} = V_{IH}$		$V_{OUT} = V_{CC}$		5.0		15	μA
				V_{OUT} = 0.4V		−10		−50	
I_{CC1}	Power Supply Current	Data out open, V_{CC} = Max., $V_{IN} = V_{CC}$	T_A = 25°C	Am9111A/B		50		60	mA
				Am9111C/D/E		55			
				Am91L11A/B		31			
				Am91L11C		34			
I_{CC2}			T_A = 0°C	Am9111A/B		55		70	
				Am9111C/D/E		60			
				Am91L11A/B		33			
				Am91L11C		36			

ELECTRICAL CHARACTERISTICS

Am9111DM, Am9111FM, Am91L11DM, Am91L11FM
T_A = −55°C to +125°C
V_{CC} = +5.0V ±10%

Parameters	Description	Test Conditions			Am9111/Am91L11 Family Min.	Am9111/Am91L11 Family Max.	Units
V_{OH}	Output HIGH Voltage	I_{OH} = −200μA		V_{CC} = 4.75V	2.4		Volts
				V_{CC} = 4.5V	2.2		
V_{OL}	Output LOW Voltage	V_{CC} = MIN., I_{OL} = 3.2mA				0.4	Volts
V_{IH}	Input HIGH Voltage				2.0	V_{CC}	Volts
V_{IL}	Input LOW Voltage				−0.5	0.8	Volts
I_{LI}	Input Load Current	V_{CC} = MAX., 0V ≤ V_{IN} ≤ 5.5V				10	μA
I_{LO}	Output Leakage Current	$V_{\overline{CE}} = V_{IH}$		$V_{OUT} = V_{CC}$		10	μA
				V_{OUT} = 0.4V		−10	
I_{CC1}	Power Supply Current	Data out open, V_{CC} = Max., $V_{IN} = V_{CC}$	T_A = 25°C	Am9111A/Am9111B		50	mA
				Am9111C		55	
				Am91L11A/Am91L11B		31	
				Am91L11C		34	
I_{CC3}			T_A = −55°C	Am9111A/Am9111B		60	
				Am9111C		65	
				Am91L11A/Am91L11B		37	
				Am91L11C		40	

CAPACITANCE

Parameters	Description	Test Conditions		Typ.	Max.	Units
C_{IN}	Input Capacitance, V_{IN} = 0V	T_A = 25°C, f = 1 mHz	Am2111	4.0	8.0	pF
			Am9111/Am91L11	3.0	6.0	
C_{OUT}	Output Capacitance, V_{OUT} = 0V		Am2111	10	15	pF
			Am9111/Am91L11	8.0	11	

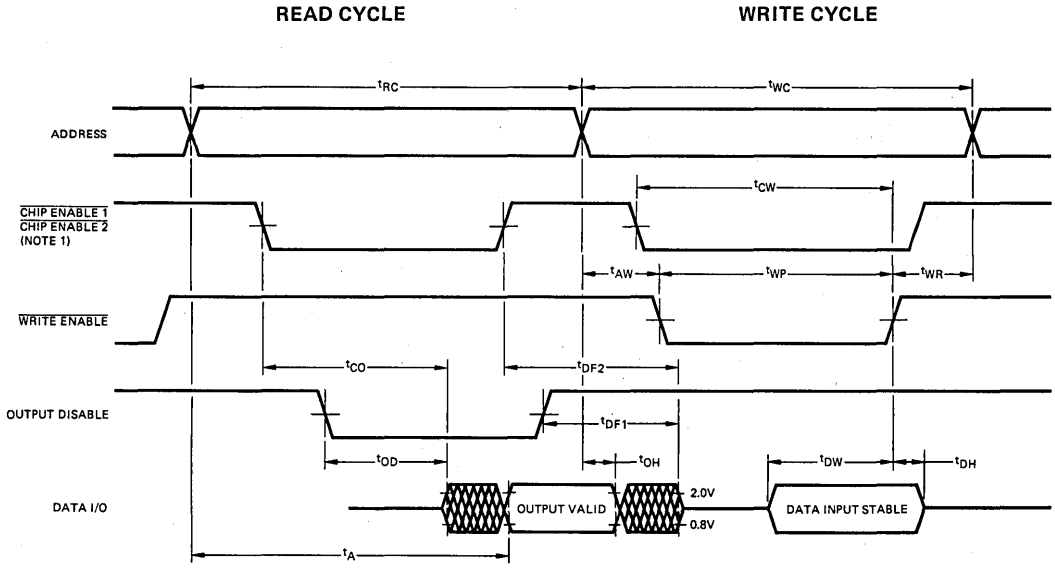
SWITCHING CHARACTERISTICS over operating temperature and voltage range

Output Load = 1 TTL Gate + 100pF — T_A = 0 to 70°C — V_{CC} = +5V ±5%
Transition Times = 10ns — T_A = −55 to +125°C — V_{CC} = +5V ±10%
Input Levels, Output References = 0.8V and 2.0V

		2111		2111-2		2111-1		9111A 91L11A		9111B 91L11B		9111C 91L11C		9111D		
Parameters	**Description**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Units**
t_{RC}	Read Cycle Time	1000		650		500		500		400		300		250		ns
t_A	Access Time		1000		650		500		500		400		300		250	ns
t_{CO}	Chip Enable to Output ON Delay (Note 1)		800		400		350		200		175		150		125	ns
t_{OD}	Output Disable to Output ON Delay		700		350		300		175		150		125		100	ns
t_{OH}	Previous Read Data Valid with Respect to Address Change	0		0		0		40		40		40		30		ns
t_{DF1}	Output Disable to Output OFF Delay	0	200	0	150	0	150	5.0	125	5.0	100	5.0	100	5.0	75	ns
t_{DF2}	Chip Enable to Output OFF Delay	0	200	0	150	0	150	10	150	10	125	10	125	10	100	ns
t_{WC}	Write Cycle Time	1000		650		500		500		400		300		250		ns
t_{AW}	Address Set-up Time	150		150		100		0		0		0		0		ns
t_{WP}	Write Pulse Width	750		400		300		175		150		125		100		ns
t_{CW}	Chip Enable Set-up Time (Note 1)	900		550		400		175		150		125		100		ns
t_{WR}	Address Hold Time	50		50		50		0		0		0		0		ns
t_{DW}	Input Data Set-up Time	700		400		280		150		125		100		85		ns
t_{DH}	Input Data Hold Time	100		100		100		0		0		0		0		ns

ote: 1. Both $\overline{CE1}$ and $\overline{CE2}$ must be LOW to enable the chip.

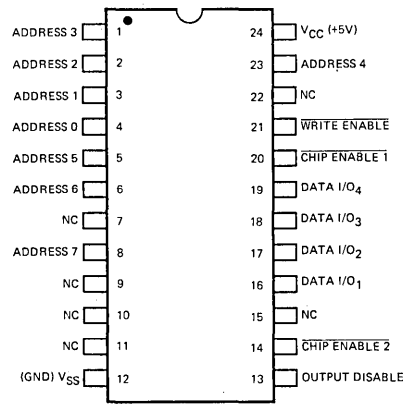
SWITCHING WAVEFORMS



MOS-352

CONNECTION DIAGRAM
Top View

Flat Package



Pin 1 is marked for orientation.

MOS-353

DEFINITION OF TERMS

FUNCTIONAL TERMS

$\overline{CE1}$, $\overline{CE2}$ Chip Enable Signals. Read and Write cycles can be executed only when both $\overline{CE1}$ and $\overline{CE2}$ are LOW.

$\overline{WE}$ Active LOW Write Enable. Data is written into the memory if $\overline{WE}$ is LOW and read from the memory if WE is HIGH.

Static RAM A random access memory in which data is stored in bistable latch circuits. A static memory will store data as long as power is supplied to the chip without requiring any special clocking or refreshing operations.

N-Channel An insulated gate field effect transistor technology in which the transistor source and drain are made of N-type material, and electrons serve as the carriers between the two regions. N-Channel transistors exhibit lower thresholds and faster switching speeds than P-Channel transistors.

SWITCHING TERMS

t_{OD} Output enable time. Delay time from falling edge of OD to output on.

t_{RC} Read Cycle Time. The minimum time required between successive address changes while reading.

t_A Access Time. The time delay between application of an address and stable data on the output when the chip is enabled.

t_{CO} Access Time from Chip Enable. The minimum time during which the chip enable must be LOW prior to reading data on the output.

t_{OH} Minimum time which will elapse between change of address and any change of the data output.

t_{DF1} Time delay between output disable HIGH and output data float.

t_{DF2} Time delay between chip enable OFF and output data float.

t_{WC} Write Cycle Time. The minimum time required between successive address changes while writing.

t_{AW} Address Set-up Time. The minimum time prior to the falling edge of the write enable during which the address inputs must be correct and stable.

t_{WP} The minimum duration of a LOW level on the write enable guaranteed to write data.

t_{WR} Address Hold Time. The minimum time after the rising edge of the write enable during which the address must remain steady.

t_{DW} Data Set-up Time. The minimum time that the data input must be steady prior to the rising edge of the write enable.

t_{DH} Data Hold Time. The minimum time that the data input must remain steady after the rising edge of the write enable.

t_{CW} Chip Enable Time during Write. The minimum duration of a LOW level on the Chip Select prior to the rising edge of $\overline{WE}$ to guarantee writing.

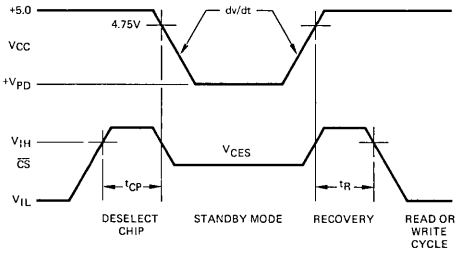
POWER DOWN STANDBY OPERATION

The Am9111/Am91L11 Family is designed to maintain storage in a standby mode. The standby mode is entered by lowering V_{CC} to around 1.5–2.0 volts (see table and graph below). When the voltage to the device is reduced, the storage cells are isolated from the data lines, so their contents will not change. The standby mode may be used by a battery operated backup power supply system, or, in a large system, memory pages not being accessed can be placed in standby to save power. A standby recovery time must elapse following restoration of normal power before the memory may be accessed.

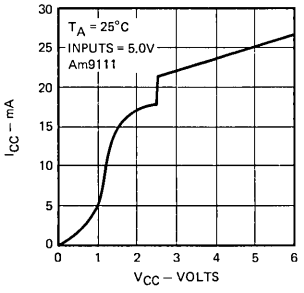
To ensure that the output of the device is in a high impedance OFF state during standby, the chip select should be held at V_{IH} or V_{CES} during the entire standby cycle.

STANDBY OPERATING CONDITIONS OVER TEMPERATURE RANGE

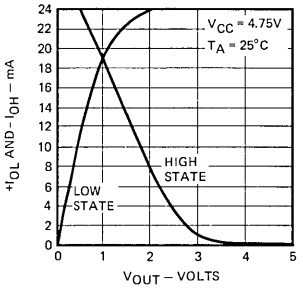
Parameters	Description	Test Conditions			Min.	Typ.	Max.	Units
V_{PD}	V_{CC} in Standby Mode				1.5			
I_{PD}	I_{CC} in Standby Mode	$T_A = 0°C$, All Inputs = V_{PD}	$V_{PD} = 1.5V$	Am91L11		11	25	mA
				Am9111		13	31	
			$V_{PD} = 2.0V$	Am91L11		13	31	
				Am9111		17	41	
		$T_A = -55°C$, All Inputs = V_{PD}	$V_{PD} = 1.5V$	Am91L11		11	28	mA
				Am9111		13	34	
			$V_{PD} = 2.0V$	Am91L11		13	34	
				Am9111		17	46	
dv/dt	Rate of Change of V_{CC}						1.0	V/μs
t_R	Standby Recovery Time				t_{RC}			ns
t_{CP}	Chip Deselect Time				0			ns
V_{CES}	$\overline{CE}$ Bias in Standby				V_{PD}			Volts



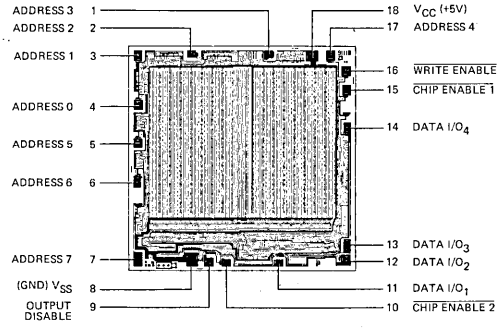
Typical Power Supply Current Versus Voltage



Typical Output Current Versus Voltage



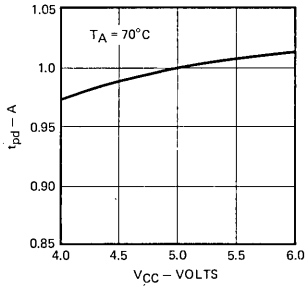
Metallization and Pad Layout



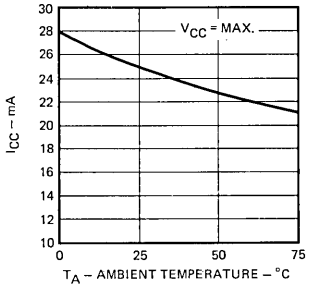
DIE SIZE: 0.132" X 0.131"

(Pin numbers shown are for DIP versions only)

Access Time Versus V_{CC} Normalized to V_{CC} = +5.0 Volts



Typical Power Supply Current Versus Ambient Temperature



MOS-354

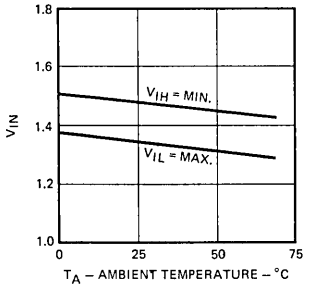
Am9111 FAMILY — APPLICATION INFORMATION

These memory products provide all of the advantages of AMD's other static N-channel memory circuits: +5 only power supply, all TTL interface, no clocks, no sensing, no refreshing, military temperature range available, low power versions available, high speed, high output drive, etc. In addition, the Am9111 series features a 256 x 4 organization with common pins used for both Data In and Data Out signals.

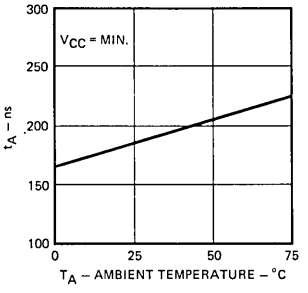
This bussed I/O approach cuts down the package pin count allowing the design of higher density memory systems. It also provides a direct interface to bus-oriented systems, eliminating bussing logic that could otherwise be required. Most microprocessor systems, for example, transfer information on a bidirectional data bus. The Am9111 memories can connect directly to such a processor since the common I/O pins act as a bidirectional data bus.

The Output Disable control signal is provided to prevent signal contention for the bus lines, and to simplify tri-state bus control in the external circuitry. If the chip is enabled and the output is enabled and the memory is in the Read state, then the output buffers will be impressing data on the bus lines. At that point, if the external system tries to drive the bus with data, in preparation for a write operation, there will be conflict for domination of the bus lines. The Output Disable signal allows the user direct control over the output buffers, independent of the state of the memory. Although there are alternative ways to resolve the conflict, normally Output Disable will be held high during a write operation.

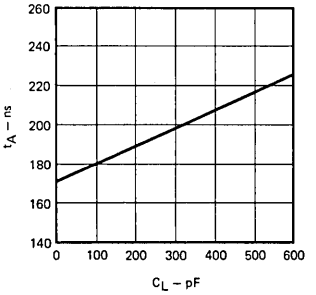
Typical V_{IN} Limits Versus Ambient Temperature



Typical t_A Versus Ambient Temperature



Typical t_A Versus C_L



MOS-355