NEC

NEC Electronics Inc.

μPD4016
2,048 x 8-BIT
STATIC NMOS RAM

Revision 3

Description

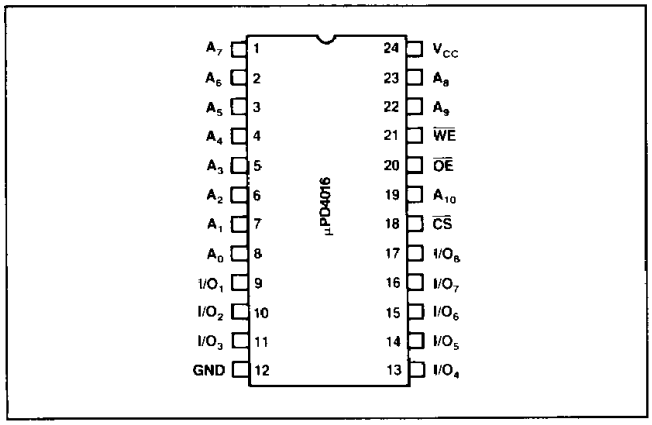
The μPD4016 is a 16,384-bit static Random-access Memory device organized as 2,048 words by 8 bits. Using a scaled NMOS technology, its design provides the ease-of-use features associated with nonclocked static memories. The μPD4016 has a three-state output and offers a standby mode with an attendant 75% savings in power consumption. It features equal access and cycle times and provides an output enable function that eliminates the need for external bus buffers. The μPD4016 is packaged in a 600-mil-wide standard 24-pin dual-in-line package which is plug-compatible with 16K EPROMS.

Features

- ☐ Scaled NMOS technology
- ☐ Completely static memory: no clock, no refresh
- ☐ Equal access and cycle times
- ☐ Single +5V power supply
- ☐ Automatic power-down
- ☐ All inputs and outputs directly TTL-compatible
- ☐ Common I/O capability
- ☐ $\overline{OE}$ eliminates need for external bus buffers
- ☐ Three-state outputs
- ☐ Plug-compatible with 16K 5V EPROMS (600 mil)
- ☐ Low power dissipation in standby mode
- ☐ Available in a standard 24-pin dual-in-line package (600-mil width)
- ☐ 4 performance ranges:

Device	Access Time	R/W Cycle Time	Power Supply Active	Power Supply Standby
μPD4016C-1	250ns	250ns	60mA	15mA
μPD4016C-2	200ns	200ns	60mA	15mA
μPD4016C-3	150ns	150ns	60mA	15mA
μPD4016C-5	120ns	120ns	60mA	15mA

Pin Configuration



Pin Identification

Pin No.	Pin Symbol	Description
1–8, 22, 23	A_0–A_{10}	Address Inputs
9–11, 13–17	I/O_1–I/O_8	Data Input/Output
12	GND	Ground
18	$\overline{CS}$	Chip Select
20	$\overline{OE}$	Output Enable
21	$\overline{WE}$	Write Enable
24	V_{CC}	+5V Power Supply

Truth Table

$\overline{CS}$	$\overline{OE}$	$\overline{WE}$	Mode	I/O	Power
H	X	X	Not Selected	High-Z	Standby
L	L	H	Read	D_{OUT}	Active
L	H	L	Write	D_{IN}	Active
L	L	L	Write	D_{IN}	Active

Absolute Maximum Ratings*

Temperature Under Bias	−10°C to +85°C
Storage Temperature, T_{ST}	−55°C to +125°C
Voltage on any Pin with Respect to Ground	−1.5V to +7V
DC Output Current, I_O	20mA
Power Dissipation, P_D	1W

*COMMENT: Exposing the device to stresses above those listed in Absolute Maximum Ratings could cause permanent damage. The device is not meant to be operated under conditions outside the limits described in the operational sections of this specification. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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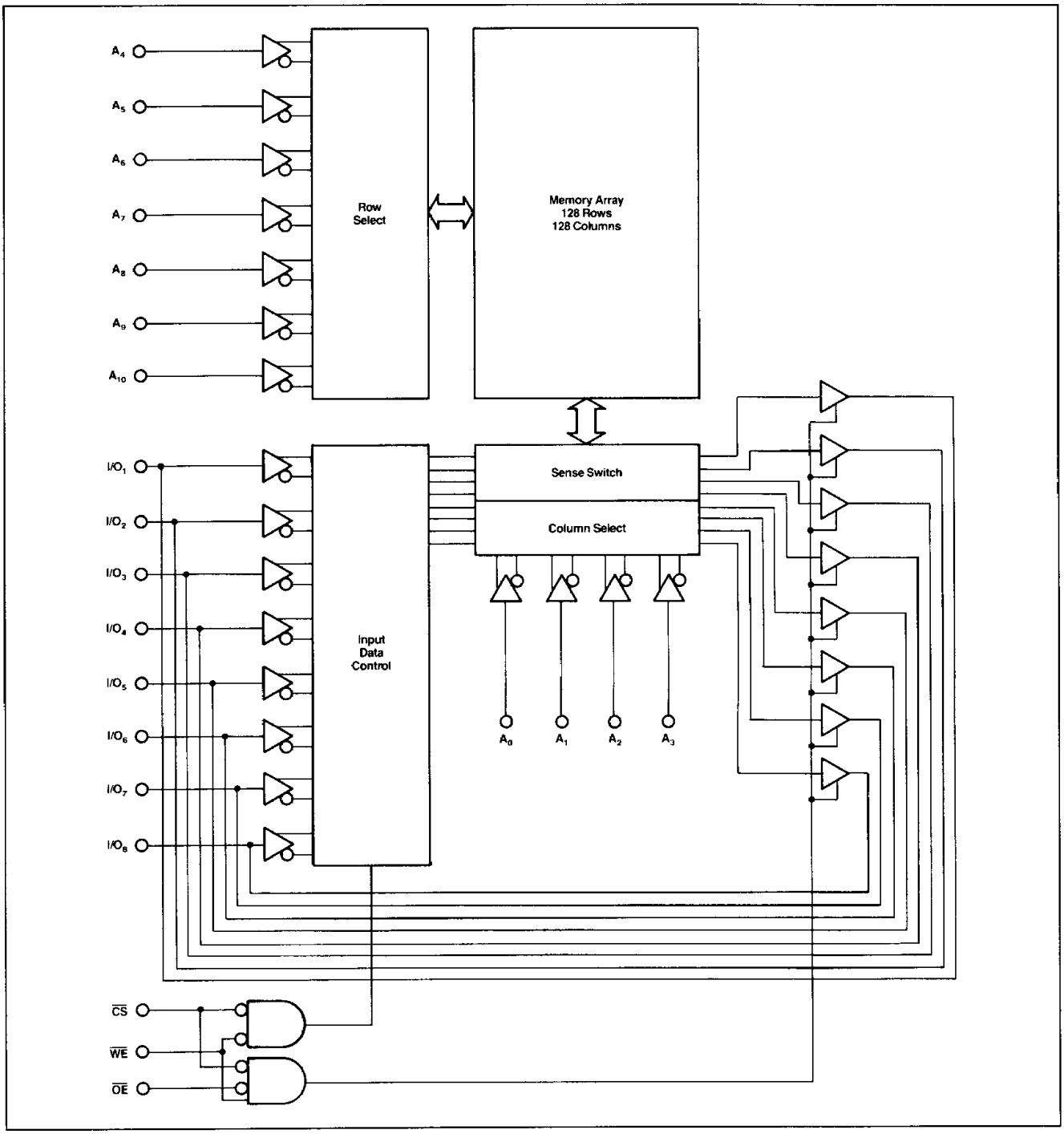
Block Diagram



Capacitance ①

T_A = 25°C; f = 1MHz

Parameter	Symbol	Limits Min	Typ	Max	Unit	Test Conditions
Input Capacitance	C_{IN}			5	pF	V_{IN} = 0V
I/O Capacitance	$C_{I/O}$			7	pF	$V_{I/O}$ = 0V

Note: ① This parameter is sampled and not 100% tested.

DC Characteristics

T_A = 0°C to +70°C; V_{CC} = 5V ± 10%

Parameter	Symbol	Limits Min	Typ	Max	Unit	Test Conditions ①
Input Leakage Current	I_{LI}			10	μA	V_{CC} = Max V_{IN} = GND to V_{CC}
Output Leakage Current	I_{LO}			10	μA	V_{CC} = Max; $\overline{CS}$ = V_{IH} V_{OUT} = GND to V_{CC}
Operating Current	I_{CC}			60	mA	V_{CC} = Max; $\overline{CS}$ = V_{IL} (outputs open)
Standby Current	I_{SB}			15	mA	V_{CC} = Min to Max; $\overline{CS}$ = V_{IH}
Input Low Voltage	V_{IL}	−1.5		0.8	V	
Input High Voltage	V_{IH}	2.0		6.0	V	
Output Low Voltage	V_{OL}			0.4	V	I_{OL} = 4mA
Output High Voltage	V_{OH}	2.4			V	I_{OH} = 1mA
Output Short-circuit Current	I_{OS}		70		mA	V_{OUT} = GND to V_{CC}

Note: ① Input pulse levels: 0.8V to 2.2V
Input rise and fall times: 10ns
Input timing reference levels: 1.5V
Output timing reference levels: 1.5V

Figure 1. Loading Conditions Test Circuit

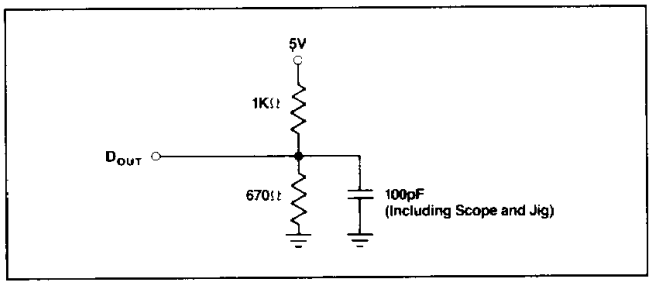
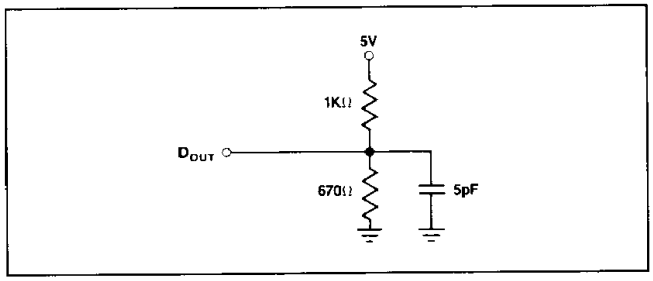


Figure 2. Input Pulse Test Circuit



AC Characteristics

T_A = 0°C to +70°C; V_{CC} = 5V ± 10%

Read Cycle

Parameter	Symbol	Limits ① 4016-5 Min	4016-5 Max	4016-3 Min	4016-3 Max	4016-2 Min	4016-2 Max	4016-1 Min	4016-1 Max	Unit	Notes
Read Cycle Time	t_{RC}	120		150		200		250		ns	②
Address Access Time	t_{AA}		120		150		200		250	ns	
Chip Select Access Time	t_{ACS}		120		150		200		250	ns	③
Output Hold from Address Change	t_{OH}	10		10		10		10		ns	
Chip Selection to Output in Low-Z	t_{LZ}	10		10		10		10		ns	④ ⑤
Chip Deselection to Output in High-Z	t_{HZ}		45		50		60		80	ns	④ ⑤
Output Enable to Output Valid	t_{OE}		50		70		90		110	ns	
Output Enable to Output in Low-Z	t_{OLZ}	10		10		10		10		ns	④ ⑤
Output Disable to Output in High-Z	t_{OHZ}		45		50		60		80	ns	④ ⑤
Chip Selection to Power-up Time	t_{PU}	0		0		0		0		ns	⑤
Chip Deselection to Power-down Time	t_{PD}		60		70		90		110	ns	⑤

Write Cycle

Parameter	Symbol	Limits ① 4016-5 Min	4016-5 Max	4016-3 Min	4016-3 Max	4016-2 Min	4016-2 Max	4016-1 Min	4016-1 Max	Unit	Notes
Write Cycle Time	t_{WC}	120		150		200		250		ns	
Chip Selection to End of Write	t_{CW}	90		120		160		200		ns	
Address Valid to End of Write	t_{AW}	80		90		120		150		ns	
Address Set-up Time	t_{AS}	0		0		0		0		ns	
Write Pulse Width	t_{WP}	70		80		100		130		ns	⑥
Write Recovery Time	t_{WR}	10		10		10		10		ns	
Data Valid to End of Write	t_{DW}	45		50		60		80		ns	
Data Hold Time	t_{DH}	0		0		0		0		ns	
Write Enabled to Output in High-Z	t_{WZ}		45		50		60		80	ns	⑤ ⑦
Output Active from End of Write	t_{OW}	10		10		10		10		ns	⑤ ⑦

Notes: ① See Part No. Package Width table below.
② All read cycle timings are referenced from the last valid address to the first transition address.
③ Address valid prior to or coincident with $\overline{CS}$ transition low.
④ Transition is measured ± 200mV from steady-state voltage with specified load of Figure 1.
⑤ This parameter is sampled and not 100% tested.
⑥ If $\overline{CS}$ and $\overline{OE}$ are both low before write enabled, $t_{WP} \geq t_{WZ} + t_{DW}$.
⑦ Transition is measured ± 200mV from steady-state voltage with specified load of Figure 2.

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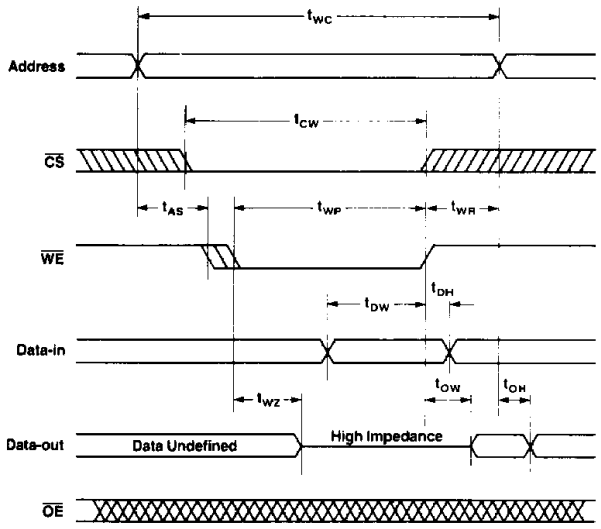
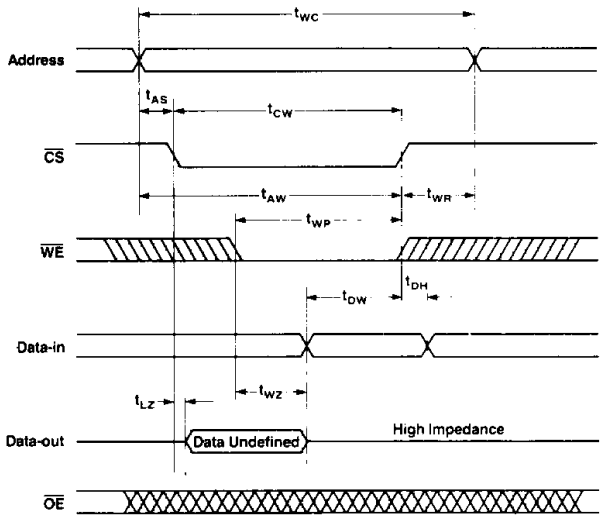
Timing Waveforms

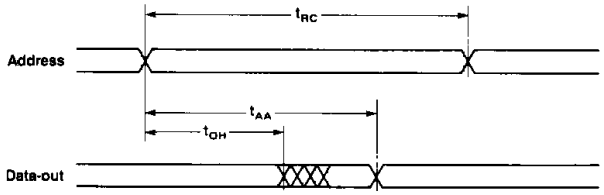
Write Cycle No. 1 ($\overline{WE}$ Controlled)



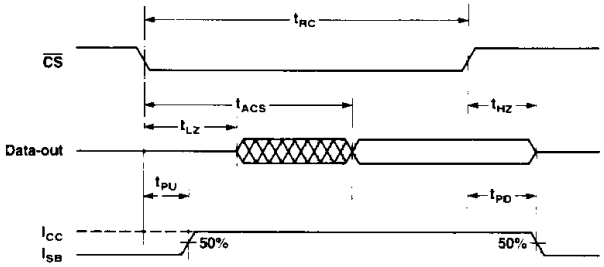
Write Cycle No. 2 ($\overline{CS}$ Controlled)



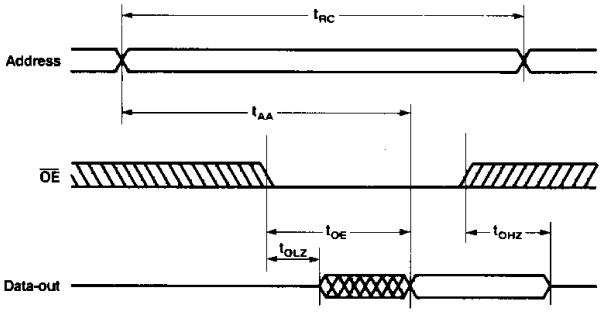
Read Cycle No. 1 ① ② ③



Read Cycle No. 2 ① ③ ④



Read Cycle No. 3 ① ②



Notes: ① $\overline{WE}$ is high for read cycles.
② Device is continuously selected, $\overline{CS}$ = V_{IL}.
③ $\overline{OE}$ = V_{IL}.
④ Address valid prior to or coincident with $\overline{CS}$ transition low.