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## MSM27C401CZ

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524,288-Word x 8-Bit One Time PROM

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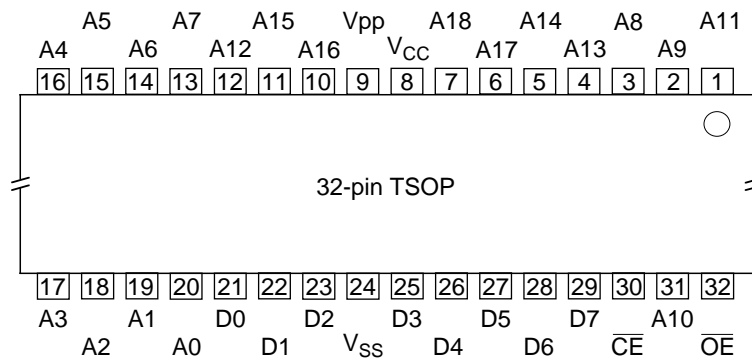
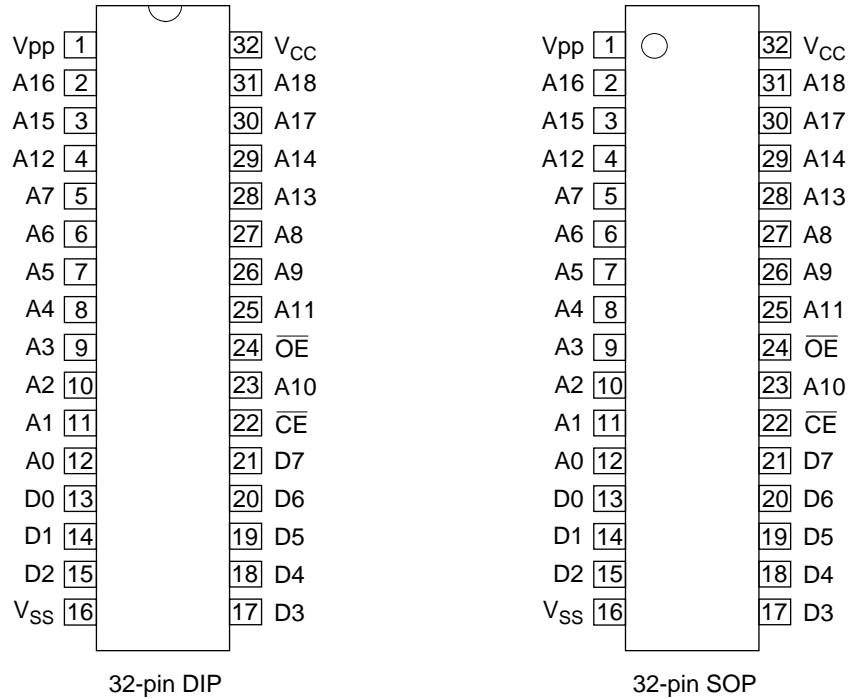
### DESCRIPTION

The MSM27C401CZ is a 4Mbit electrically Programmable Read-Only Memory organized as 524,288 word x 8bit. The MSM27C401CZ operates on a single +3V-5V power supply and is TTL compatible. Since the MSM27C401CZ operates asynchronously, external clocks are not required, making this device easy-to-use. The MSM27C401CZ is suitable as large-capacity fixed memory for microcomputers and data terminals. It is manufactured using a CMOS double silicon gate technology and is offered in 32-pin DIP, 32-pin SOP or 32-pin TSOP packages.

### FEATURES

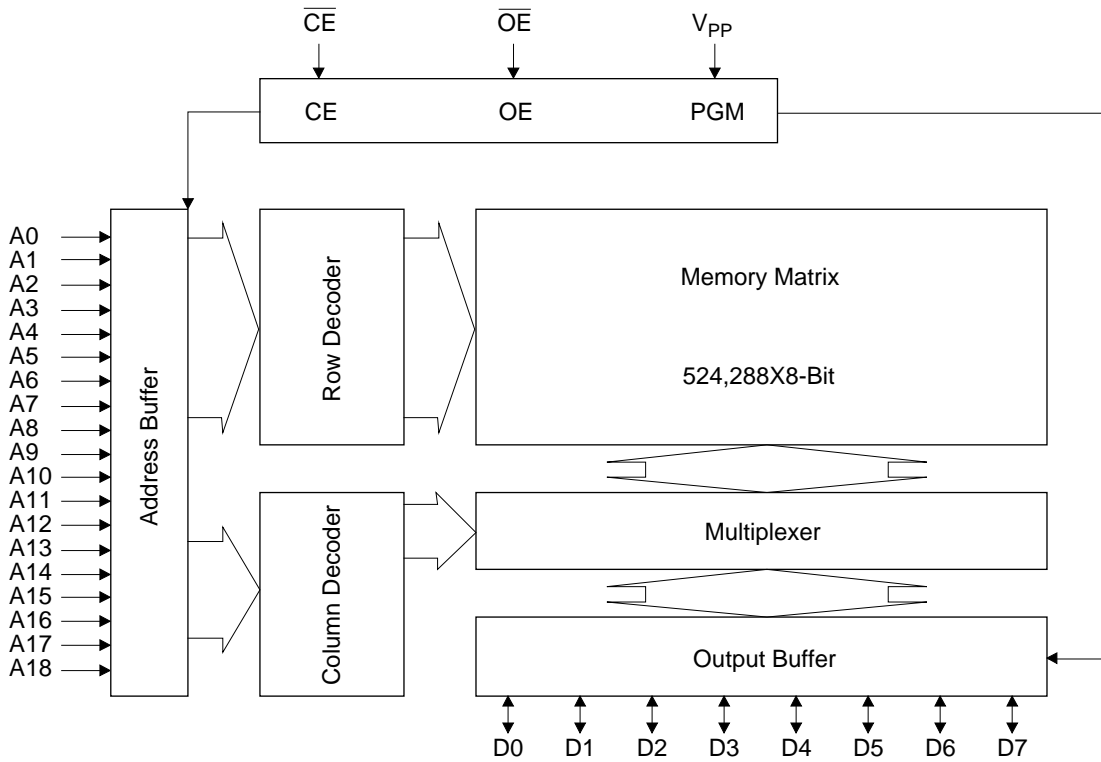
- 524,288 word x 8bit
- Single +3V-5V power supply
- Access time
  - 150ns access time ( $V_{CC}=+3V$ )
  - 120ns access time ( $V_{CC}=+3.3V$ )
  - 80ns access time ( $V_{CC}=+5V$ )
- Input / Output TTL compatible
- Three-state output
- Packages
  - 32-pin plastic DIP (DIP32-P-600-2.54)
  - 32-pin plastic SOP (SOP32-P-525-1.27-K)
  - 32-pin plastic TSOP (TSOP I 32-P-814-0.50-K)

## PIN CONFIGURATION (TOP VIEW)



PIN NAMES	FUNCTIONS
A0 - A18	Address input
D0 - D7	Data output
$\overline{CE}$	Chip enable
$\overline{OE}$	Output enable
V <sub>CC</sub>	Power supply voltage
V <sub>SS</sub>	GND
V <sub>PP</sub>	Program Power supply voltage

**BLOCK DIAGRAM**



**FUNCTION TABLE**

MODE	$\overline{CE}$	$\overline{OE}$	$V_{PP}$	$V_{CC}$	D0 - D7
READ	L	L	*	2.7V to 5.5V	$D_{OUT}$
OUTPUT DISABLE	L	H			Hi-Z
STAND-BY	H	*			Hi-Z
PROGRAM	L	H	11.5V	6.25V	$D_{IN}$
PROGRAM INHIBIT	H	H			Hi-Z
PROGRAM VERIFY	H	L			$D_{OUT}$

\*: Don't Care

**ABSOLUTE MAXIMUM RATINGS**

Parameter	Symbol	Condition	Value	Unit
Operating temperature under bias	$T_{opr}$	-	0 to 70	°C
Storage temperature	$T_{stg}$	-	-55 to 125	°C
Input voltage	$V_I$	relative to $V_{SS}$	-0.5 to $V_{CC} + 0.5$	V
Output voltage	$V_O$		-0.5 to $V_{CC} + 0.5$	V
Power supply voltage	$V_{CC}$		-0.5 to 7	V
Program power supply voltage	$V_{PP}$		-0.5 to 12.5	V
Power dissipation per package	$P_D$	-	1.0	W

**RECOMMENDED OPERATING CONDITIONS FOR READ**

(Ta=0 to 70°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
$V_{CC}$ power supply voltage	$V_{CC}$	$V_{CC}=2.7V - 5.5V$	2.7	-	5.5	V
$V_{PP}$ power supply voltage	$V_{PP}$		-0.5	-	$V_{CC}+0.5$	V
Input "H" level	$V_{IH}$		2.2	-	$V_{CC}+0.5$	V
Input "L" level	$V_{IL}$		-0.5	-	0.6	V

Voltage is relative to  $V_{SS}$

**ELECTRICAL CHARACTERISTICS (Read operation)****DC Characteristics 1**(V<sub>CC</sub>=3V±0.3V, T<sub>a</sub>=0 to 70°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input leakage current	I <sub>LI</sub>	V <sub>I</sub> =0 to V <sub>CC</sub>	-	-	10	μA
Output leakage current	I <sub>LO</sub>	V <sub>O</sub> =0 to V <sub>CC</sub>	-	-	10	μA
V <sub>CC</sub> power supply current (Standby)	I <sub>CS1</sub>	$\overline{CE}=V_{CC}$	-	-	10	μA
	I <sub>CS2</sub>	$\overline{CE}=V_{IH}$	-	-	1	mA
V <sub>CC</sub> power supply current (Read)	I <sub>CCA</sub>	$\overline{CE}=V_{IL}$ , $\overline{OE}=V_{IH}$ t <sub>c</sub> =150ns	-	-	15	mA
V <sub>PP</sub> power supply current	I <sub>PP</sub>	V <sub>PP</sub> =V <sub>CC</sub>	-	-	10	μA
Input "H" level	V <sub>IH</sub>	-	2.0	-	V <sub>CC</sub> +0.5	V
Input "L" level	V <sub>IL</sub>	-	-0.5	-	0.6	V
Output "H" level	V <sub>OH</sub>	I <sub>OH</sub> =-200μA	V <sub>CC</sub> -0.4	-	-	V
Output "L" level	V <sub>OL</sub>	I <sub>OL</sub> =1mA	-	-	0.4	V

Voltage is relative to V<sub>SS</sub>**DC Characteristics 2**(V<sub>CC</sub>=3.3V±0.3V, T<sub>a</sub>=0 to 70°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input leakage current	I <sub>LI</sub>	V <sub>I</sub> =0 to V <sub>CC</sub>	-	-	10	μA
Output leakage current	I <sub>LO</sub>	V <sub>O</sub> =0 to V <sub>CC</sub>	-	-	10	μA
V <sub>CC</sub> power supply current (Standby)	I <sub>CS1</sub>	$\overline{CE}=V_{CC}$	-	-	10	μA
	I <sub>CS2</sub>	$\overline{CE}=V_{IH}$	-	-	1	mA
V <sub>CC</sub> power supply current (Read)	I <sub>CCA</sub>	$\overline{CE}=V_{IL}$ , $\overline{OE}=V_{IH}$ t <sub>c</sub> =120ns	-	-	20	mA
V <sub>PP</sub> power supply current	I <sub>PP</sub>	V <sub>PP</sub> =V <sub>CC</sub>	-	-	10	μA
Input "H" level	V <sub>IH</sub>	-	2.0	-	V <sub>CC</sub> +0.5	V
Input "L" level	V <sub>IL</sub>	-	-0.5	-	0.6	V
Output "H" level	V <sub>OH</sub>	I <sub>OH</sub> =-200μA	V <sub>CC</sub> -0.4	-	-	V
Output "L" level	V <sub>OL</sub>	I <sub>OL</sub> =1mA	-	-	0.4	V

Voltage is relative to V<sub>SS</sub>

**DC Characteristics 3**(V<sub>CC</sub>=5V±0.5V, Ta=0 to 70°C)

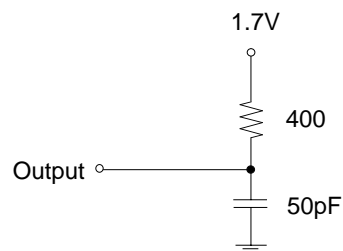
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input leakage current	I <sub>LI</sub>	V <sub>I</sub> =0 to V <sub>CC</sub>	-	-	10	μA
Output leakage current	I <sub>LO</sub>	V <sub>O</sub> =0 to V <sub>CC</sub>	-	-	10	μA
V <sub>CC</sub> power supply current (Standby)	I <sub>CS1</sub>	$\overline{CE}=V_{CC}$	-	-	50	μA
	I <sub>CS2</sub>	$\overline{CE}=V_{IH}$	-	-	1	mA
V <sub>CC</sub> power supply current (Read)	I <sub>CCA</sub>	$\overline{CE}=V_{IL}$ , $\overline{OE}=V_{IH}$ tc=80ns	-	-	35	mA
V <sub>PP</sub> power supply current	I <sub>PP</sub>	V <sub>PP</sub> =V <sub>CC</sub>	-	-	10	μA
Input "H" level	V <sub>IH</sub>	-	2.2	-	V <sub>CC</sub> +0.5	V
Input "L" level	V <sub>IL</sub>	-	-0.5	-	0.8	V
Output "H" level	V <sub>OH</sub>	I <sub>OH</sub> =-400μA	2.4	-	-	V
Output "L" level	V <sub>OL</sub>	I <sub>OL</sub> =2.1mA	-	-	0.45	V

Voltage is relative to V<sub>SS</sub>**AC Characteristics 1**(V<sub>CC</sub>=3V±0.3V, Ta=0 to 70°C)

Parameter	Symbol	Condition	Min.	Max.	Unit
Access cycle time	T <sub>C</sub>	-	150	-	ns
Address access time	T <sub>ACC</sub>	$\overline{CE}=\overline{OE}=V_{IL}$	-	150	ns
$\overline{CE}$ access time	T <sub>CE</sub>	$\overline{OE}=V_{IL}$	-	150	ns
$\overline{OE}$ access time	T <sub>OE</sub>	$\overline{CE}=V_{IL}$	-	80	ns
Output disable time	T <sub>CHZ</sub>	$\overline{OE}=V_{IL}$	0	70	ns
	T <sub>OHZ</sub>	$\overline{CE}=V_{IL}$	0	65	ns
Output hold time	T <sub>OH</sub>	$\overline{CE}=\overline{OE}=V_{IL}$	0	-	ns

## Measurement conditions

Input signal level	-----	0V/3V
Input timing reference level	-----	0.8V/2.0V
Output load	-----	50pF
Output timing reference level	-----	0.8V/2.0V



**AC Characteristics 2** $(V_{CC}=3.3V\pm 0.3V, T_a=0 \text{ to } 70^\circ\text{C})$ 

Parameter	Symbol	Condition	Min.	Max.	Unit
Access cycle time	$T_C$	-	120	-	ns
Address access time	$T_{ACC}$	$\overline{CE}=\overline{OE}=V_{IL}$	-	120	ns
$\overline{CE}$ access time	$T_{CE}$	$\overline{OE}=V_{IL}$	-	120	ns
$\overline{OE}$ access time	$T_{OE}$	$\overline{CE}=V_{IL}$	-	70	ns
Output disable time	$T_{CHZ}$	$\overline{OE}=V_{IL}$	0	60	ns
	$T_{OHZ}$	$\overline{CE}=V_{IL}$	0	55	ns
Output hold time	$T_{OH}$	$\overline{CE}=\overline{OE}=V_{IL}$	0	-	ns

## Measurement conditions

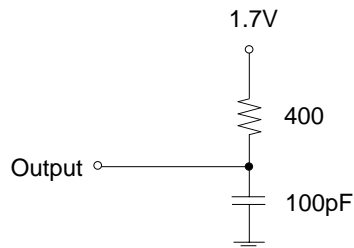
Input signal level	-----	0V/3V
Input timing reference level	-----	0.8V/2.0V
Output load	-----	100pF
Output timing reference level	-----	0.8V/2.0V

**AC Characteristics 3** $(V_{CC}=5V\pm 0.5V, T_a=0 \text{ to } 70^\circ\text{C})$ 

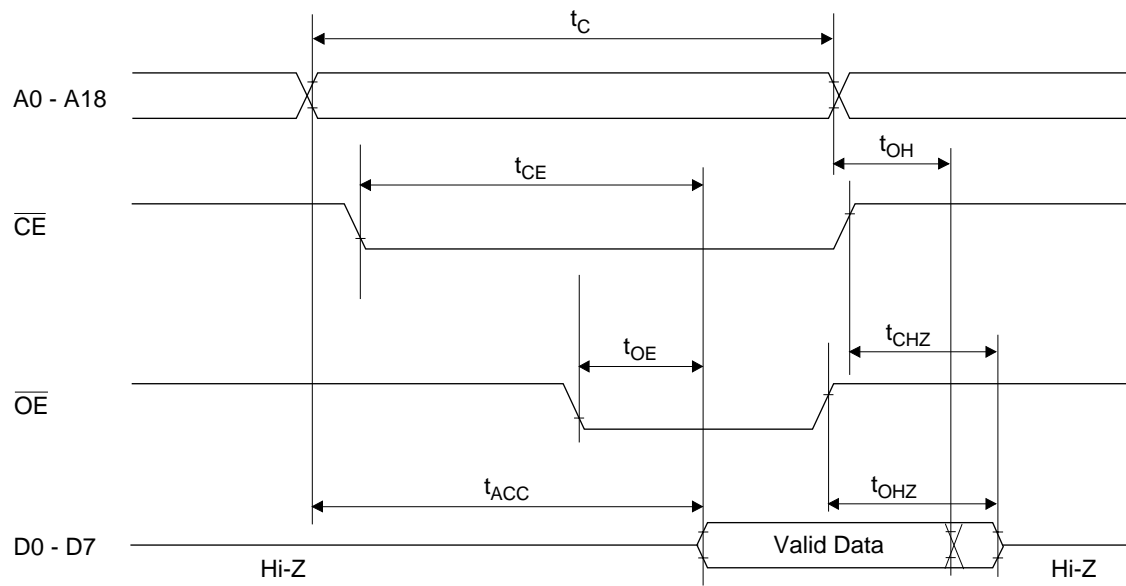
Parameter	Symbol	Condition	Min.	Max.	Unit
Access cycle time	$T_C$	-	80	-	ns
Address access time	$T_{ACC}$	$\overline{CE}=\overline{OE}=V_{IL}$	-	80	ns
$\overline{CE}$ access time	$T_{CE}$	$\overline{OE}=V_{IL}$	-	80	ns
$\overline{OE}$ access time	$T_{OE}$	$\overline{CE}=V_{IL}$	-	50	ns
Output disable time	$T_{CHZ}$	$\overline{OE}=V_{IL}$	0	40	ns
	$T_{OHZ}$	$\overline{CE}=V_{IL}$	0	35	ns
Output hold time	$T_{OH}$	$\overline{CE}=\overline{OE}=V_{IL}$	0	-	ns

## Measurement conditions

Input signal level	-----	0V/3V
Input timing reference level	-----	0.8V/2.0V
Output load	-----	1TTL gate + 100pF
Output timing reference level	-----	0.8V/2.0V



## TIMING CHART (READ CYCLE)





**ELECTRICAL CHARACTERISTICS (Programming operation)****DC Characteristics**

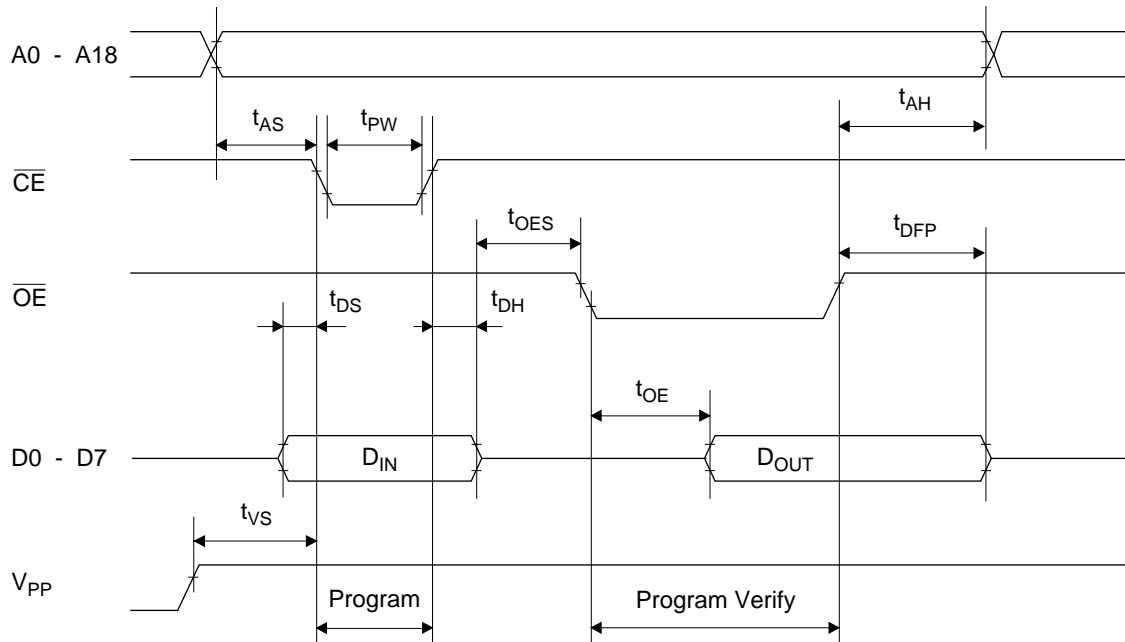
(Ta=25°C±5°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input leakage current	I <sub>LI</sub>	V <sub>I</sub> =V <sub>CC</sub> +0.5V	-	-	10	μA
V <sub>PP</sub> power supply current (Program)	I <sub>PP2</sub>	$\overline{CE}$ =V <sub>IL</sub>	-	-	50	mA
V <sub>CC</sub> power supply current	I <sub>CC</sub>	-	-	-	80	mA
Input "H" level	V <sub>IH</sub>	-	2.2	-	V <sub>CC</sub> +0.5	V
Input "L" level	V <sub>IL</sub>	-	-0.5	-	0.8	V
Output "H" level	V <sub>OH</sub>	I <sub>OH</sub> =-400μA	2.4	-	-	V
Output "L" level	V <sub>OL</sub>	I <sub>OL</sub> =2.1mA	-	-	0.45	V
Program voltage	V <sub>PP</sub>	-	11.25	11.5	11.75	V
V <sub>CC</sub> power supply voltage	V <sub>CC</sub>	-	6.0	6.25	6.5	V

Voltage is relative to V<sub>SS</sub>**AC Characteristics**(V<sub>CC</sub>=6.25V±0.25V, V<sub>pp</sub>=11.5V±0.25V, Ta=25°C±5°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Address set-up time	T <sub>AS</sub>	-	2	-	-	μs
$\overline{OE}$ set-up time	T <sub>OES</sub>	-	2	-	-	μs
Data set-up time	T <sub>DS</sub>	-	2	-	-	μs
Address hold time	T <sub>AH</sub>	-	0	-	-	μs
Data hold time	T <sub>DH</sub>	-	2	-	-	μs
Output float delay from $\overline{OE}$	T <sub>DFP</sub>	-	0	-	130	ns
V <sub>PP</sub> voltage set-up time	T <sub>VS</sub>	-	2	-	-	μs
Program pulse width	T <sub>PW</sub>	-	23	25	27	μs
Data valid from $\overline{OE}$	T <sub>OE</sub>	-	-	-	150	ns

### Programming Waveform

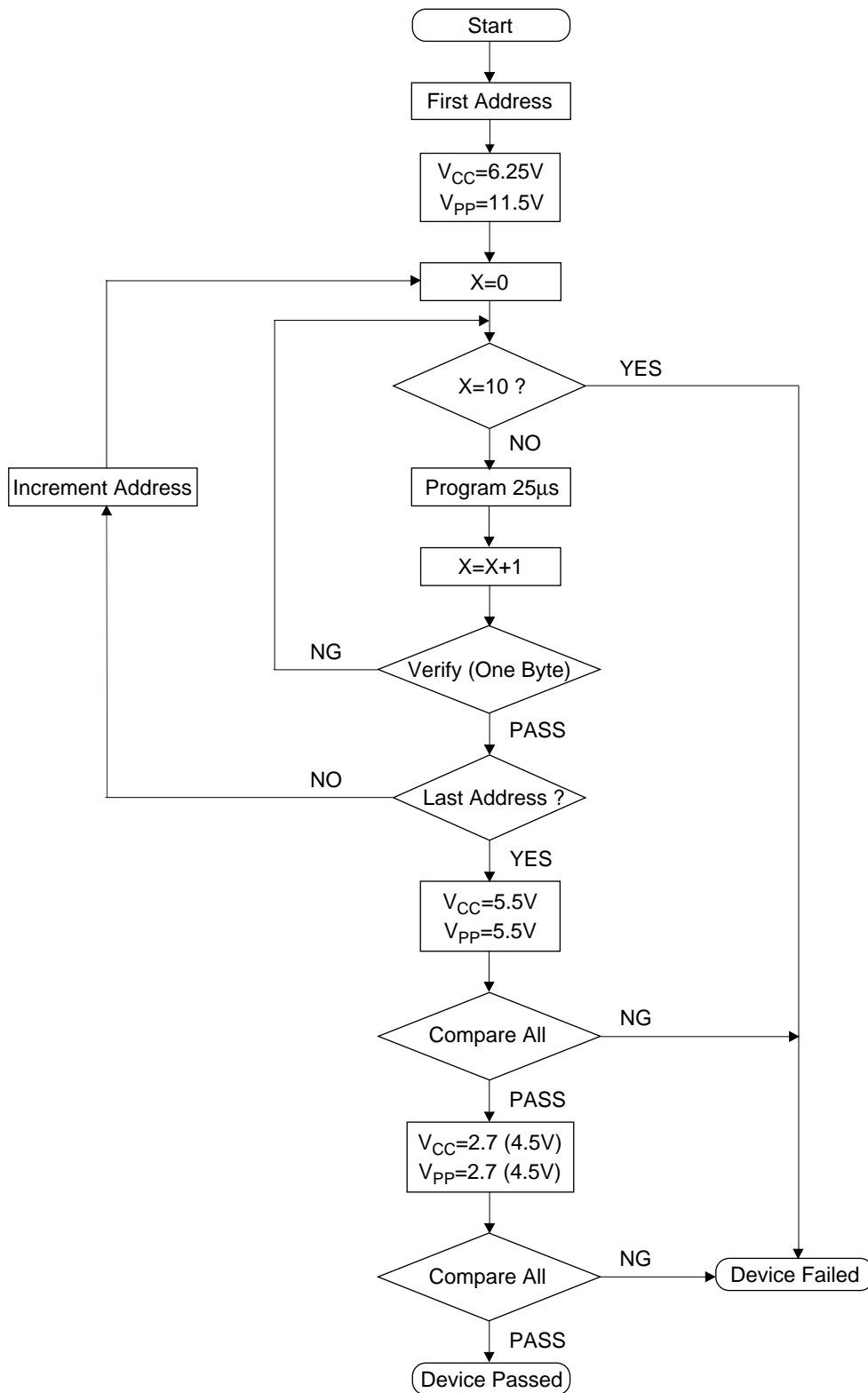


### PIN Capacitance

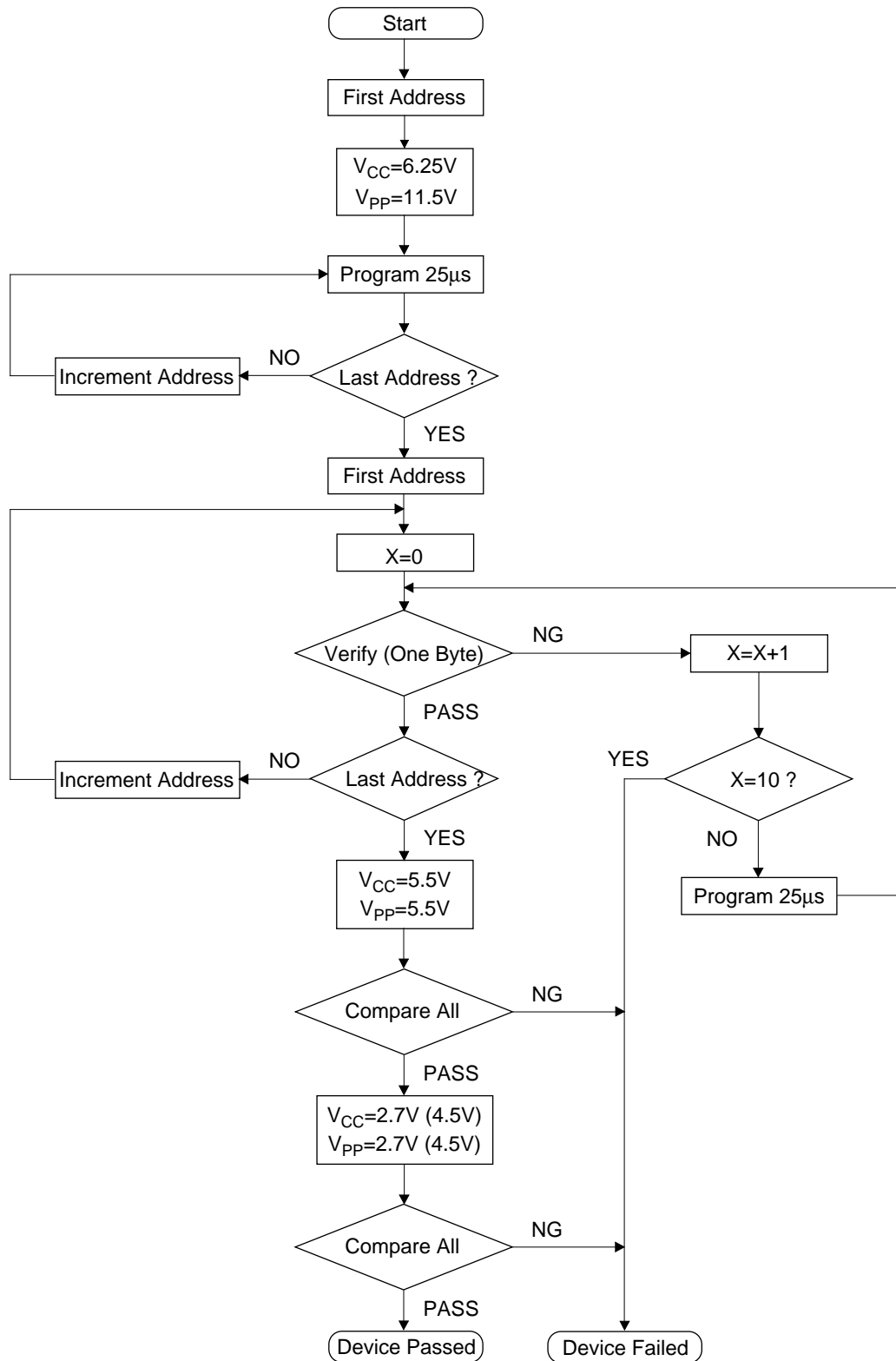
( $V_{CC}=5V$ ,  $T_a=25^\circ C$ ,  $f=1MHz$ )

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input	$C_{IN}$	$V_I=0V$	-	-	12	pF
Output	$C_{OUT}$	$V_O=0V$	-	-	15	

## High Speed Programming Algorithm ( I )



## High Speed Programming Algorithm ( II )



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