

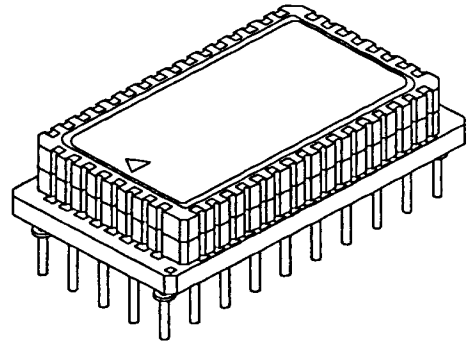
**PRELIMINARY**

**DESCRIPTION:**

The DPZ256X16A3 "DENSE-STACK" module is a revolutionary new memory subsystem using Dense-Pac Microsystems' ceramic Stackable Leadless Chip Carriers (SLCC) mounted on a co-fired ceramic substrate. It offers 4 Megabits of FLASH EEPROM in a single package envelope of .990" x .540" x .294".

The DPZ256X16A3 is built with two stacked SLCC packages each containing two 128K x 8 FLASH memory devices. Each SLCC is hermetically sealed making the module suitable for commercial, industrial and military applications.

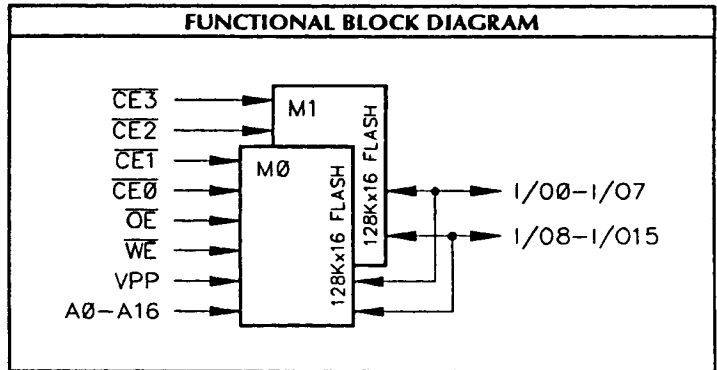
By using SLCCs, the "Dense-Stack" family of modules offers a higher board density of memory than available with conventional through-hole, surface mount, module, or most hybrid techniques.



**FEATURES:**

- Organization: 256K x 16
- Fast Access Times:  
120\*, 150, 170, 200, 250ns (max.)
- Fully Static Operation  
- No clock or refresh required
- TTL Compatible Inputs and Outputs
- Common Data Inputs and Outputs
- Automatic Erase Function  
- Reduces CPU overhead
- 10,000 Erase/Program Cycles (min.)
- 50 - Pin PGA "DENSE-STACK" Package

\* Available in commercial only.



PIN-OUT DIAGRAM					PIN NAMES							
A	B	C	D	E	(TOP VIEW) A B C D E	A0 - A16	Address Inputs					
1	CE1	N.C.	N.C.	N.C.	1	□	○	○	○	○	I/O0 - I/O15	Data Input/Output
2	VSS	CE3	N.C.	VPP	2	○	○	○	○	○	CE0 - CE3	Chip Enables
3	N.C.	A16	WE	N.C.	3	○	○	○	○	○	WE	Write Enable
4	A14	A12	A7	A8	4	○	○	○	○	○	OE	Output Enable
5	A6	A5	OE	A11	5	○	○	○	○	○	Vpp	Programming Voltage (+12.5V)
6	A4	A3	A2	CE0	6	○	○	○	○	○	VDD	Power (+5V)
7	A1	A0	I/O13	I/O12	7	○	○	○	○	○	VSS	Ground
8	I/O10	I/O9	I/O8	I/O15	8	○	○	○	○	○	N.C.	No Connect
9	VSS	I/O1	I/O3	I/O5	9	○	○	○	○	○		
10	I/O0	I/O2	I/O4	I/O6	10	○	○	○	○	○		

\*\* CE0 and CE2 control I/O0 - I/O7, CE1 and CE3 control I/O8 - I/O15.

---

**PRELIMINARY**

---

**DEVICE OPERATION:**

The FLASH devices are electrically erasable and programmable memory that functions similar to an EPROM device, but can be erased without being removed from the system and exposed to ultraviolet light. Each 128K x 8 device can be erased individually eliminating the need to re-program the entire module when partial code changes are required.

**READ:**

With  $V_{PP} = 0V$  to  $V_{DD}$  ( $V_{PPL0}$ ), the devices are read-only memories and can be read like a standard EPROM. By selecting the device to be read (see *Truth Table and Functional Block Diagram*), the data programmed into the device will appear on the appropriate I/O pins.

When  $V_{PP} = +12.5V \pm 5.0V$  ( $V_{PPH1}$ ), reads can be accomplished in the same manner as described above but must be preceded by writing 00H to the command register prior to reading the device. When  $V_{PP}$  is raised to  $V_{PPH1}$  the contents of the command register default to 00H and remain that way until the command register is altered.

**STANDBY:**

When the appropriate  $\overline{CE}$ 's are raised to a logic-high level, the standby operation disables the FLASH devices reducing the power consumption substantially. The outputs are placed in a high-impedance state, independent of the  $\overline{OE}$  input. If the module is deselected during programming, erasure, or autoerase, the device upon which the operation was being performed, will continue to draw active current until the operation is completed.

**PROGRAM:**

The programming and erasing functions are accessed via the command register when high voltage is applied to  $V_{PP}$ . The contents of the command register control the functions of the memory device (see *Command Definition Table*).

The command register is not an addressable memory location. The register stores the address, data, and command information required to execute the command. When  $V_{PP} = V_{PPL0}$  the command register is reset to 00H returning the device to the read-only mode.

The command register is written by enabling the device upon which that the operation is to be performed (see *Functional Block Diagram*). While the device is enabled bring  $\overline{WE}$  to a logic-low ( $V_{IL}$ ), the address is latched on the falling edge of  $\overline{WE}$  and data is latched on the rising edge of  $\overline{WE}$ . Programming is initiated by writing 40H (*program setup command*) to the command register. On the next falling edge of  $\overline{WE}$  the address to be programmed will be latched followed by the data being latched on the rising edge of  $\overline{WE}$  (see *AC Operating and Characteristics Table*).

**PROGRAM VERIFY:**

The FLASH devices are programmed one byte at a time. Each byte may be programmed sequentially or at random. Following each programming operation, the byte must be verified.

To initiate the program-verify mode, C0H must be written to the command register of the device just programmed. The programming operation is terminated on the rising edge of  $\overline{WE}$  the program-verify command is written to the command register.

After the program-verify command is written to the command register, the memory device applies an internally generated margin voltage to the byte just written. After waiting 6 $\mu$ s the data byte can be verified by doing a read. If true data is read from the device, the byte write was successful and the next byte may be programmed.

If the device fails to verify, the program/verify operation is repeated up to 20 times.

**ERASE:**

The erase function is a command-only operation and can only be executed while  $V_{PP} = V_{PPH1}$ .

To setup the chip-erase, 20H must be written to the command register. The chip-erase is then executed by once again writing 20H to the command register (see *AC Operating and Characteristics Table*).

To ensure a reliable erasure, all bits in the device to be erased should be programmed to their charged state (*data = 00H*) prior to starting the erase operation. With the algorithm provided, this operation should take approximately 2 minutes.

**ERASE VERIFY:**

The erase operation erases all bytes in the device selected in parallel. Upon completion of the erase operation, each byte must be verified. This operation is initiated by writing A0H to the command register. The address to be verified must be supplied because it is latched on the falling edge of  $\overline{WE}$ .

The memory device internally generates a margin voltage and applies it to the addressed byte. If FFH is read from the device, it indicates the byte is erased. The erase/verify command is issued prior to each byte verification to latch the address of the byte to be verified. This continues until FFH is not read from the device or the last address for the device being erased is read.

If FFH is not read from the byte being verified, an additional erase operation is performed. Verification then resumes from the last byte verified. Once all locations in the device being erased are verified, the erase operation is complete. The verify operation should now be terminated by writing a valid command such as program set-up to the command register.

## PRELIMINARY

**AUTOMATIC ERASE:**

An automatic erase function is also available eliminating the need to program all locations to 00H or do an erase verify. The automatic erase will program all locations to 00H and do a continuous erase/verify until all locations in the device are erased.

To setup the chip-erase, 30H must be written to the command register. The chip-erase is then executed by once again writing 30H to the command register (see *AC Operating Characteristics Table*).

To determine if the automatic erase cycle is complete, the most-significant (MSB) I/O pin for the device being erased (I/O7, I/O15) is read. If the data = 0 on each of these bits, the cycle is not complete. The erase cycle is complete when the data = 1 on the MSB of the device being erased.

**DESIGN CONSIDERATIONS:**

V<sub>PP</sub> traces should use similar trace widths and layout considerations as the V<sub>DD</sub> power bus. The V<sub>PP</sub> supply traces should also be decoupled to help decrease voltage spikes.

Power-up sequencing should be such that V<sub>PP</sub> doesn't go above V<sub>DD</sub> + 2.0V before V<sub>DD</sub> reaches a steady state voltage, while on power-down V<sub>PP</sub> should be below V<sub>DD</sub> + 2.0V before V<sub>DD</sub> is lowered.

It is recommended that a 4.7μF to 10μF electrolytic capacitor be placed near the memory module connected across V<sub>DD</sub> and V<sub>SS</sub> for bulk storage. Decoupling capacitors should also be placed near the module connected across V<sub>PP</sub> and V<sub>SS</sub>.

COMMAND DEFINITION TABLE							
COMMAND	Bus Cycles Req'd	First Bus Cycle			Second Bus Cycle		
		Operation	Address	Data	Operation	Address	Data
Read Memory	1	Write	X	00H	-	-	-
Setup Erase / Erase	2	Write	X	20H	Write	X	20H
Erase Verify	2	Write	EA	A0H	Read	X	EVD
Setup Autoerase / Autoerase	2	Write	X	30H	Write	X	30H
Setup Program / Program	2	Write	X	40H	Write	PA	PD
Program Verify	2	Write	X	C0H	Read	X	PVD
Reset	2	Write	X	FFH	Write	X	FFH

EA = Address to Verify  
EVD = Data Read from Location EA

PA = Address to Program  
PD = Data to be Programmed at Location PA  
PVA = Data to be Read from Location PA at Program Verify

TRUTH TABLE							
MODE	DESCRIPTION	C <sub>EN</sub>	WE	OE	V <sub>PP</sub>	I/O Pins	Supply Current
READ ONLY	Not Selected	H	X	X	V <sub>PL0</sub>	High-Z	Standby
	Output Disable	L	H	H	V <sub>PL0</sub>	High-Z	Active
	Read	L	H	L	V <sub>PL0</sub>	DOUT	Active
COMMAND PROGRAM	Not Selected	H	X	X	V <sub>PPH</sub>	High-Z	Standby
	Output Disable	L	H	H	V <sub>PPH</sub>	High-Z	Active
	Read	L	H	L	V <sub>PPH</sub>	DOUT	Active
	Write	L	L	H	V <sub>PPH</sub>	DIN	Active

## PRELIMINARY

RECOMMENDED OPERATING RANGE <sup>1</sup>					
Symbol	Characteristic	Min.	Typ.	Max.	Unit
V <sub>DD</sub>	Supply Voltage	4.5	5.0	5.5	V
V <sub>PP</sub>	Programming Voltage <sup>2</sup>	12.0	12.5	13.0	V
V <sub>IL</sub>	Input LOW Voltage	-0.3 <sup>3</sup>		0.8	V
V <sub>IH</sub>	Input HIGH Voltage	2.2		V <sub>DD</sub> +1.0	V
T <sub>A</sub>	Operating Temp.	-55	+25	+125	°C

CAPACITANCE <sup>5</sup> : T <sub>A</sub> = 25°C, F = 1.0MHz				
Symbol	Parameter	Max.	Unit	Condition
C <sub>ADR</sub>	Address Input	40	pF	V <sub>IN</sub> <sup>3</sup> = 0V
C <sub>CE</sub>	Chip Enable	10		
C <sub>WE</sub>	Write Enable	40		
C <sub>OE</sub>	Output Enable	40		
C <sub>I/O</sub>	Data Input/Output	30		

ABSOLUTE MAXIMUM RATINGS <sup>4</sup>			
Symbol	Parameter	Value	Unit
T <sub>STC</sub>	Storage Temperature	-65 to +150	°C
T <sub>BIAS</sub>	Temperature Under Bias	-55 to +125	°C
V <sub>I/O</sub>	Input/Output Voltage <sup>1</sup>	-0.6 to +7.0 <sup>3</sup>	V
V <sub>PP</sub>	V <sub>PP</sub> Supply Voltage <sup>1</sup> During Erase/Program	-0.6 to +14.0	V
V <sub>DD</sub>	Supply Voltage <sup>1</sup>	-0.6 to +7.0	V

DC OUTPUT CHARACTERISTICS					
Symbol	Parameter	Conditions	Min.	Max.	Unit
V <sub>OH</sub>	HIGH Voltage	I <sub>OH</sub> = -400µA	2.4	-	V
V <sub>OL</sub>	LOW Voltage	I <sub>OL</sub> = 2.1mA	-	0.45	V

DC OPERATING CHARACTERISTICS: Over operating ranges						
Symbol	Characteristics	Test Conditions	TYP. (*)	Limits		Unit
				Min.	Max.	
I <sub>IN</sub>	Input Leakage Current	V <sub>IN</sub> = 0V to V <sub>DD</sub>	-	-8	+8	µA
I <sub>OUT</sub>	Output Leakage Current	V <sub>I/O</sub> = 0V to V <sub>DD</sub> , CE or OE = V <sub>IH</sub> , or WE = V <sub>IL</sub>	-	-8	+8	µA
I <sub>CC1</sub>	Active Supply Current	CE <sub>0</sub> = V <sub>IL</sub> , CET = V <sub>IH</sub> or CET = V <sub>IL</sub> , CE <sub>0</sub> = V <sub>IH</sub> V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> , I <sub>OUT</sub> = 0mA, f = 0MHz	x8	10	20	mA
			x16	15	35	
I <sub>CC2</sub>	Operating Supply Current	CE <sub>0</sub> = V <sub>IL</sub> , CET = V <sub>IH</sub> or CET = V <sub>IL</sub> , CE <sub>0</sub> = V <sub>IH</sub> V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> , I <sub>OUT</sub> = 0mA, f = 8MHz	x8	20	55	mA
			x16	50	100	
I <sub>CC3</sub>	V <sub>DD</sub> Programming Current	Programming in Progress	x8	5	15	mA
			x16	6	25	
I <sub>CC4</sub>	V <sub>DD</sub> Erase Current	Erasure in Progress	x8	15	45	mA
			x16	25	80	
I <sub>SB1</sub>	Standby Current (TTL)	CE = V <sub>IH</sub>			4	mA
I <sub>SB2</sub>	Full Standby Supply Current (CMOS)	CE = V <sub>DD</sub> - 0.2V			80	µA
I <sub>PP5</sub>	V <sub>PP</sub> Leakage Current	V <sub>PP</sub> = V <sub>PPLO</sub>			80	µA
I <sub>PP1</sub>	V <sub>PP</sub> Read Current	V <sub>PP</sub> = V <sub>PPRH</sub>			2.5	mA
I <sub>PP2</sub>	V <sub>PP</sub> Programming Current	V <sub>PP</sub> = V <sub>PPRH</sub> , Programming in Progress	x8	8	35	mA
			x16	12	65	
I <sub>PP3</sub>	V <sub>PP</sub> Erase Current	V <sub>PP</sub> = V <sub>PPRH</sub> , Erasure in Progress	x8	40	85	mA
			x16	75	165	

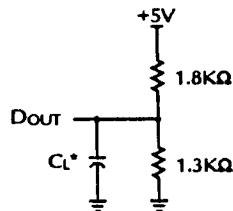
\* Typical measurements made at +25°C, Cycle = min., V<sub>DD</sub> = 5.0V.

PRELIMINARY

AC TEST CONDITIONS	
Input Pulse Levels	0V to 3.0V
Input Pulse Rise and Fall Times	5ns
Input and Output Timing Reference Levels	1.5V
Output Timing Reference Levels During Verify	0.8V and 2.4V

Figure 1. Output Load

\* Including Probe and Jig Capacitance.

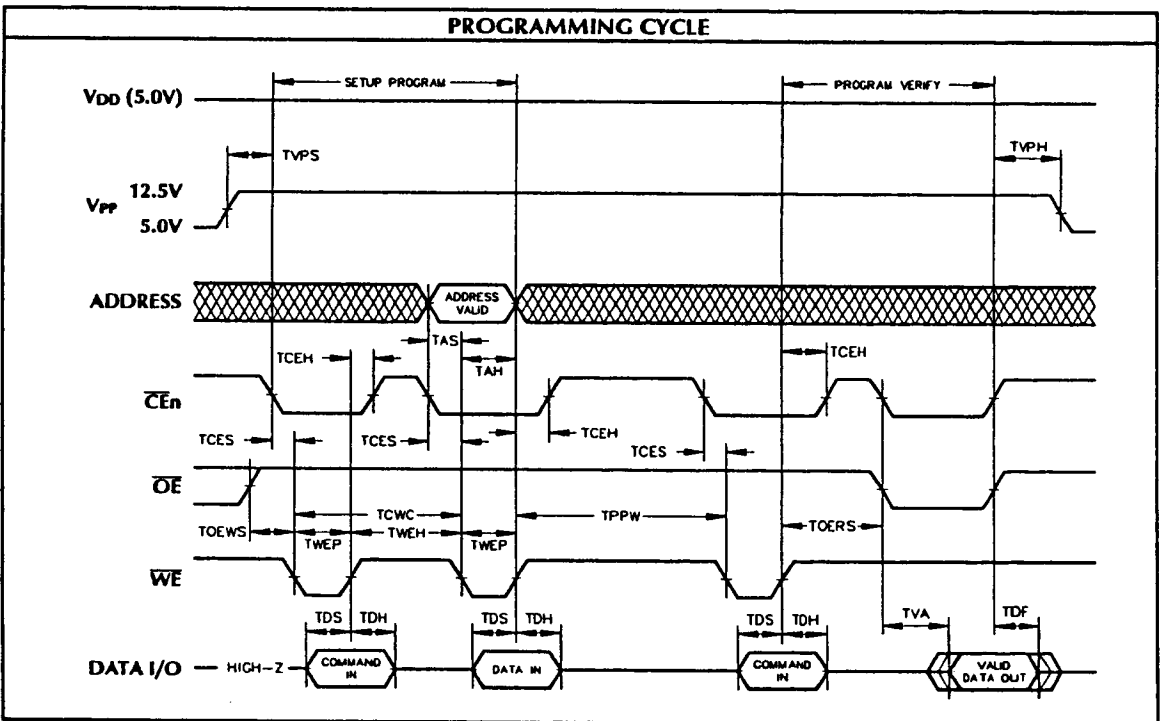
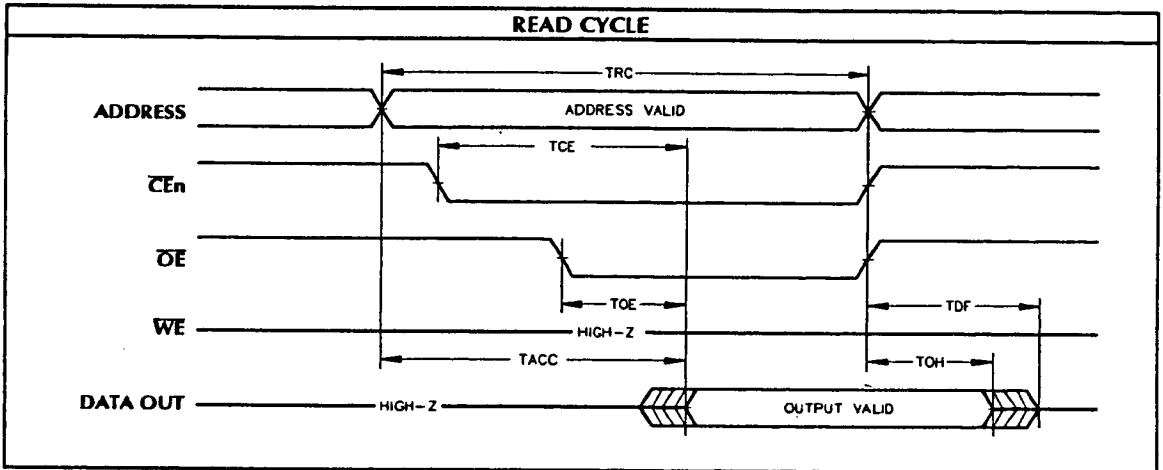


OUTPUT LOAD		
Load	Cl	Parameters Measured
1	100 pF	except tDF
2	30 pF	tDF

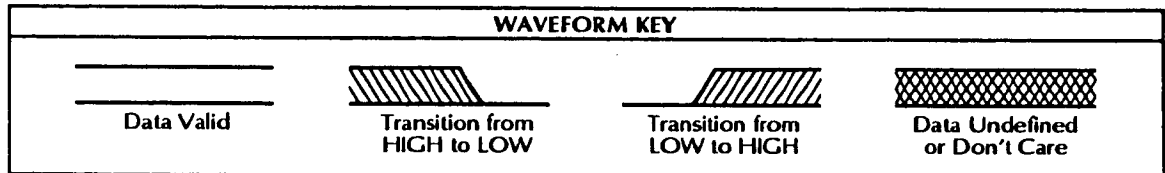
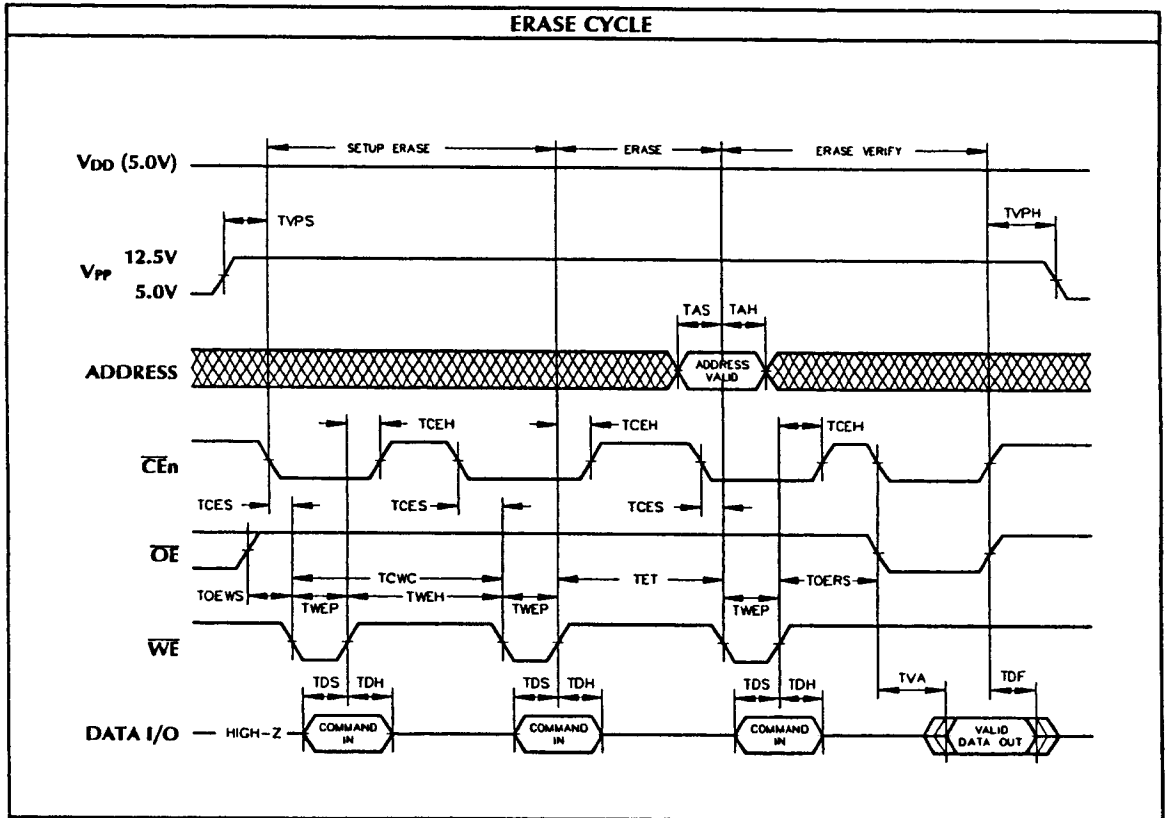
AC OPERATING CONDITIONS AND CHARACTERISTICS - READ CYCLE: Over operating ranges													
No.	Symbol	Parameter	-120		-150		-170		-200		-250		Unit
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
1	tCE	Chip Enable Access Time		120		150		170		200		250	ns
2	tACC	Address Access Time		120		150		170		200		250	ns
3	tOE	Output Enable Access Time		60		70		75		80		90	ns
4	tDF	Output Disable to Output in HIGH-Z <sup>5, 6</sup>	0	40	0	50	0	55		60		70	ns
5	tOH	Output Hold from Address Change	5		5		5		5		5		ns

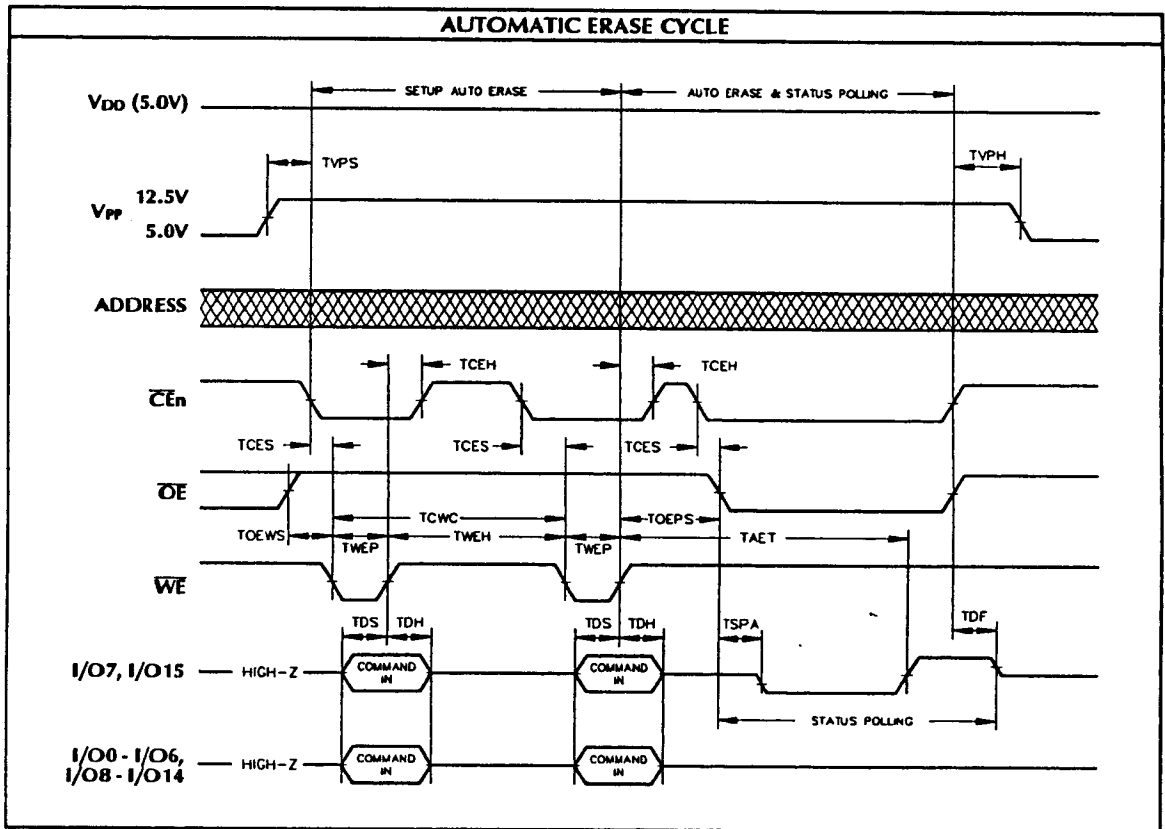
AC OPERATING CONDITIONS AND CHARACTERISTICS - WRITE CYCLE: Over operating ranges													
No.	Symbol	Parameter	-120		-150		-170		-200		-250		Unit
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
6	tCWC	Write Cycle Time	120		150		170		200		250		ns
7	tAS	Address Setup Time	0		0		0		0		0		ns
8	tAH	Address Hold Time	60		60		60		60		60		ns
9	tDS	Data Setup Time	50		50		50		50		50		ns
10	tDH	Data Hold Time	10		10		10		10		10		ns
11	tCES	Chip Enable Setup Time	0		0		0		0		0		ns
12	tCEH	Chip Enable Hold Time	15		15		15		15		15		ns
13	tVPS	VPP Setup Time <sup>7, 8</sup>	100		100		100		100		100		ns
14	tVPH	VPP Hold Time <sup>7, 8</sup>	100		100		100		100		100		ns
15	tWEP	Write Enable Pulse Width	70		70		80		80		90		ns
16	tWEH	Write Enable Pulse Width HIGH Time	20		20		20		20		20		ns
17	tOEPS	Output Enable Setup Time before Command Programming	0		0		0		0		0		ns
18	tOERS	Output Enable Setup Time before Verify	6		6		6		6		6		μs
19	tVA	Verify Access Time		120		150		170		200		250	ns
20	tOEPS	Output Enable Setup Time before Status Polling	20		20		20		20		20		ns
21	tSPA	Status Polling Access Time		120		150		170		200		250	ns
22	tPPW	Standby Time before Programming	25		25		25		25		25		μs
23	tET	Standby Time in Erase	11		11		11		11		11		ms
24	tAET	Total Erase Time in Autoerase <sup>9</sup>	0.5	30	0.5	30	0.5	30	0.5	30	0.5	30	s

PRELIMINARY



PRELIMINARY





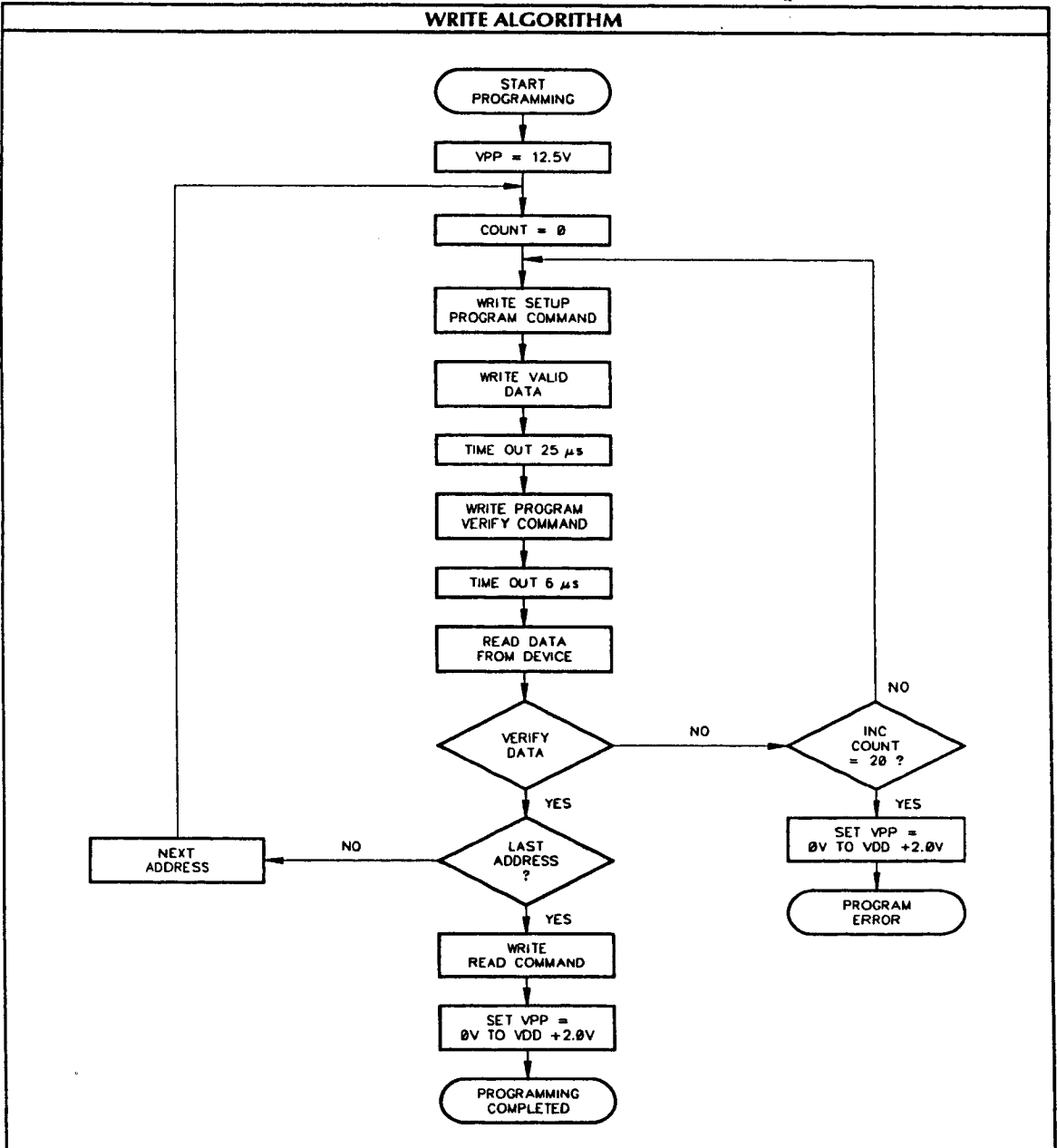
NOTES:

1. All voltages are with respect to Vss.
2. When operating device at temperatures less than 0°C (-55°C to 0°C), VPP must be 7.4 Vdc above VDD during Program/Erase functions.
3. -2.0V min. for pulse width less than 20ns (VIL min. = -0.6V at DC level).
4. Stresses greater than those under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
5. This parameter is guaranteed and not 100% tested.
6. Transition is measured at the point of ±500mV from steady state voltage.
7. VCC must be applied before VPP and removed after VPP.
8. VPP must not exceed 14V, including overshoot.
9. The total erase times shown are for one (1) 128Kx8 device, to erase the entire module would be 4x the times shown.

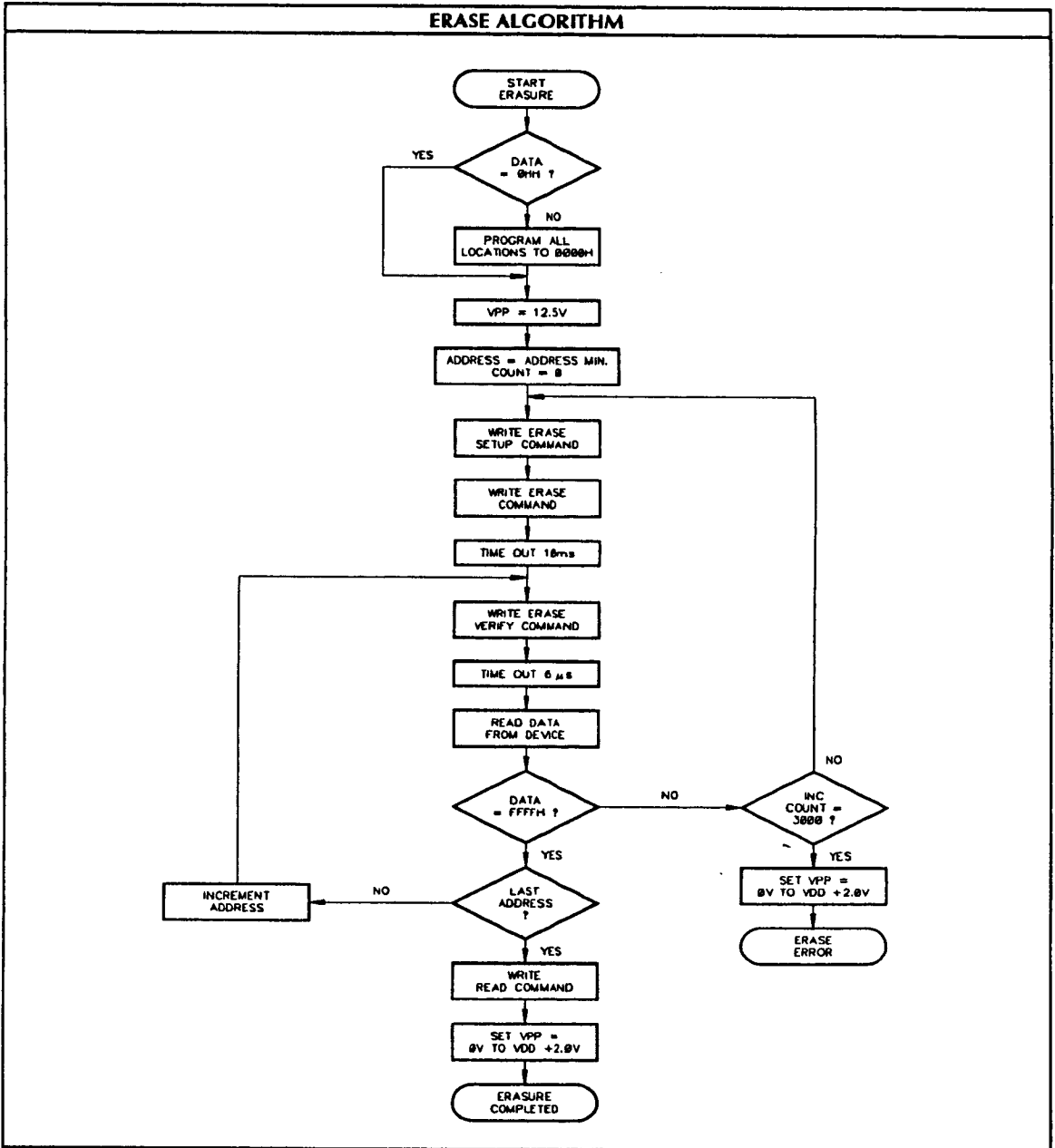


PRELIMINARY

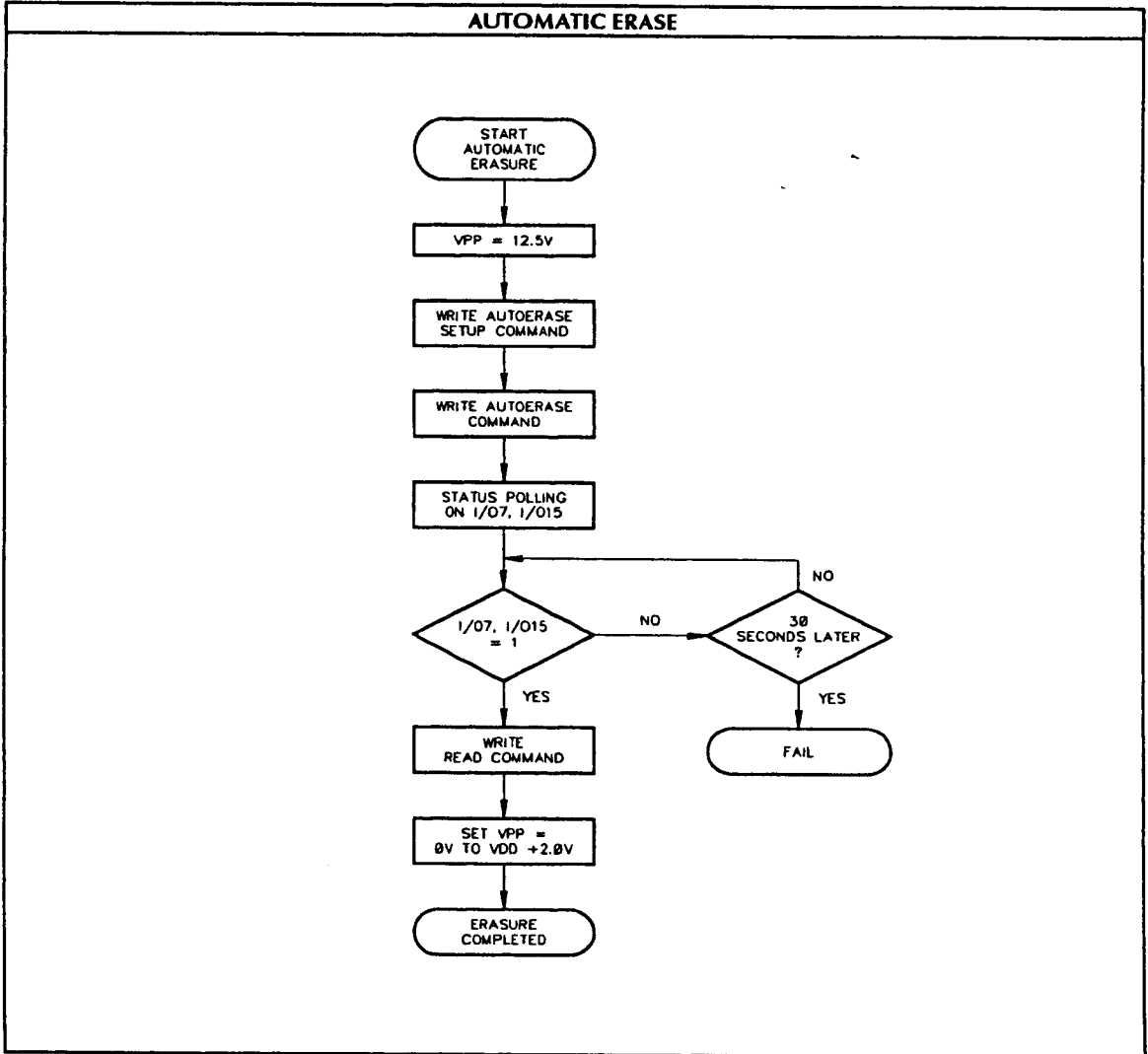
WRITE ALGORITHM



PRELIMINARY



PRELIMINARY



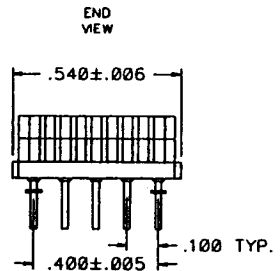
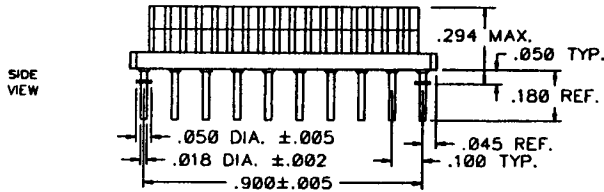
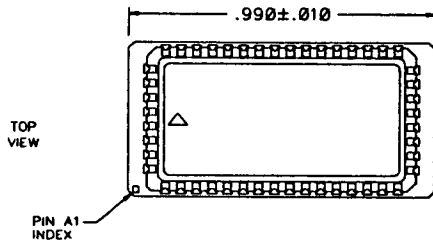
PRELIMINARY

ORDERING INFORMATION

DP Z 256 X 16 A3 - XX X  
 PREFIX TYPE DEPTH DESIG. WIDTH PACKAGE SPEED GRADE

- C COMMERCIAL 0°C to +70°C
- I INDUSTRIAL -40°C to +85°C
- M MILITARY -55°C to +125°C
- B MIL-PROCESSED -55°C to +125°C
- 12 120ns (COMMERCIAL ONLY)
- 15 150ns
- 17 170ns
- 20 200ns
- 25 250ns
- 50 PIN PGA/3-D DENSE-STACK
- BYTE CONTROLLED WITHOUT LOGIC
- FLASH EEPROM

MECHANICAL DRAWING



**Dense-Pac Microsystems, Inc.**

7321 Lincoln Way ♦ Garden Grove, California 92641-1428  
 (714) 898-0007 ♦ (800) 642-4477 (Outside CA) ♦ FAX: (714) 897-1772