



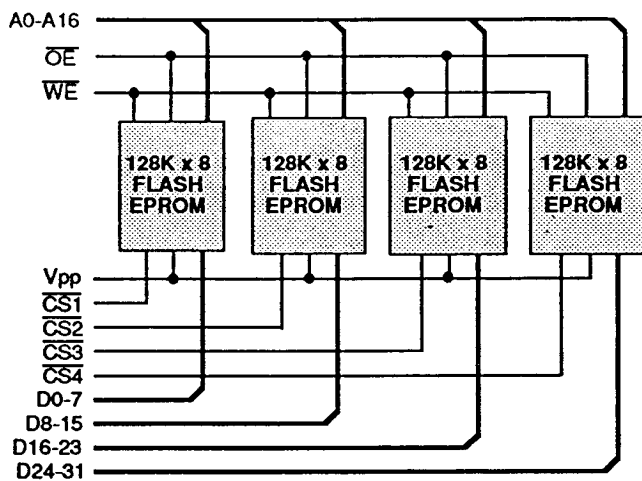
Mosaic
Semiconductor
Inc.

4,194,304 bit CMOS FLASH Memory Module

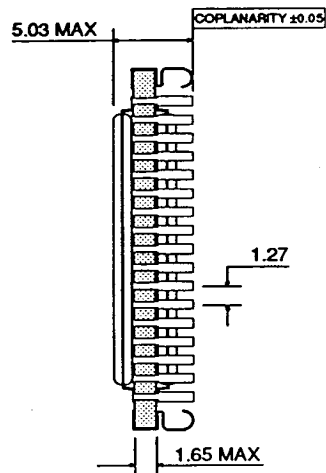
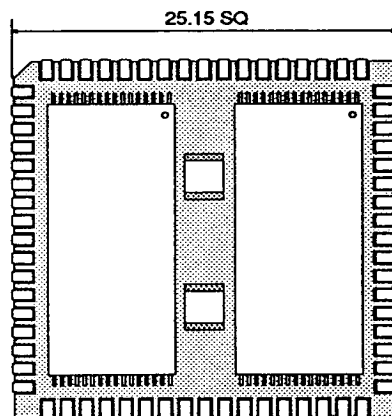
Features

Fast access times of 120/150/200 ns.
Utilizes 68 J leaded surface mount FR4 epoxy substrate.
JEDEC standard package dimensions.
User Configurable as 32 / 16 / 8 bit wide output.
Operating Power 240 / 130 / 75 mW (typical)
Low Power Standby 2.2 mW (max)
Single High Voltage for Erase/Write : $V_{pp}=12.0V\pm5\%$.
Fast Programming - Byte $10\mu s$, Module 2 sec. (typ)
Flash Electrical Erase of Module in 1 second (typical)
 10^4 Erase/Write Cycle Endurance min. (10^5 typ)
Uses Command Register Architecture for all operations.
On board decoupling capacitors.

Block Diagram



Package Details Dimensions in mm.



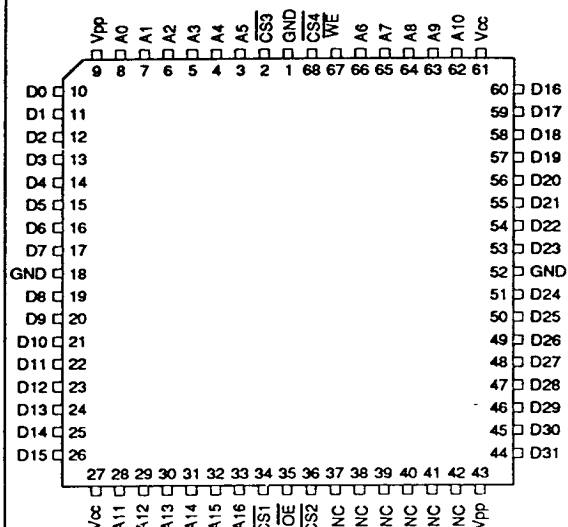
PUMA 68F4003

PUMA 68F4003-12/15/20

Issue 1.0 : September 1991

ADVANCE PRODUCT INFORMATION

Pin Definition



Pin Functions

- A0-A16** Address Inputs
- D0-D31** Data Input/Output
- CS1-4** Chip Selects
- OE** Output Enable
- WE** Write Enables
- NC** No Connect
- V_{pp}** Write/Erase Input Voltage
- V_{cc}** Power (+5V)
- GND** Ground

GENERAL DESCRIPTION

The PUMA 68F4003 is a 4,194,304 bit CMOS FLASH Memory which is configurable as 8, 16 or 32 bit wide output using CS1-4, allowing flexibility in a wide range of applications.

FLASH memory combines the functionality of EPROM with on-board electrical Write/Erase. The PUMA 68F4003 utilizes devices which use a Command Register to manage these functions, allowing fixed power supply during Write/Erase and maximum EPROM

compatibility. During Write cycles, the command register internally latches address and data needed for the Write and Erase operations, thus simplifying the external control circuitry.

FLASH technology reliably stores data even after 10,000 Write/Erase cycles and utilizes a single program supply of $12V \pm 5\%$. Additionally, the interactive program algorithm allows a typical room temperature program time of 2 seconds for the entire module (in 32 bit mode). The typical module erasure time is less than 1 second.

Absolute Maximum Ratings ⁽¹⁾

Temperature Under Bias	T_{OPR}	-40 to +85 °C
Storage Temperature	T_{STG}	-65 to +150 °C
Voltage on Any Pin with respect to GND ⁽²⁾	V_{T1}	-2.0 to +7.0 V
Voltage on A9 pin with respect to GND ⁽³⁾	V_{T2}	-2.0 to 13.5 V
Voltage on V_{PP} pin with respect to GND ⁽³⁾	V_{PT}	-2.0 to +14.0 V
V_{CC} Supply Voltage ⁽²⁾	V_{CC}	-2.0 to +7.0 V
Output Short Circuit Current ⁽⁴⁾	I_{SC}	100 mA

Notes : (1) Stresses above those listed may cause permanent damage to the device. These are stress ratings 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 device reliability.

(2) Minimum DC input voltage is -0.5V. During transitions inputs may undershoot to -2.0V for periods less than 20 ns. Maximum DC voltage on output pins is $V_{CC}+0.5V$, which may overshoot to $V_{CC}+2.0V$ for periods less than 20 ns.

(3) Minimum DC input voltage is -0.5V. During transitions inputs may undershoot to -2.0V for periods less than 20 ns. Maximum DC input voltage is +13.5V, which may overshoot to +14.0V for periods less than 20 ns.

(4) Output shorted for no more than one second. No more than one output shorted at any one time.

Recommended Operating Conditions

		<i>min</i>	<i>typ</i>	<i>max</i>	
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Programming Voltage	Read V_{PPR}	-0.5	5.0	12.6	V
	Write/Erase/Verify V_{PPW}	11.4	12.0	12.6	V
Input High Voltage	TTL V_{IH}	2.0	-	$V_{CC}+0.5$	V
	CMOS V_{IHC}	$0.7 V_{CC}$	-	$V_{CC}+0.5$	V
Input Low Voltage	TTL V_{IL}	-0.5	-	0.8	V
	CMOS V_{ILC}	-0.5	-	0.8	V
Operating Temperature	T_A	0	-	70	°C
	T_{AI}	-40	-	85	°C (-I suffix)
	T_{AI}	-55	-	125	°C (-M, -MB suffix)

Capacitance ($T_A=25^\circ\text{C}, f=1\text{MHz}$)

Parameter		Symbol	Test Condition	<i>typ</i>	<i>max</i>	Unit
Input Capacitance	Address, \overline{OE}	C_{IN1}	$V_{IN}=0V$	-	24	pF
	V_{PP}	C_{IN2}	$V_{IN}=0V$	-	24	pF
	Other pins	C_{IN3}	$V_{IN}=0V$	-	6	pF
Output Capacitance	32 bit	C_{OUT32}	$V_{OUT}=0V$	-	12	pF
	16 bit	C_{OUT16}	$V_{OUT}=0V$	-	24	pF
	8 bit	C_{OUT8}	$V_{OUT}=0V$	-	48	pF

Note: These parameters are calculated, not measured.

DC Electrical Characteristics ($T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$, $V_{CC} = 5\text{V} \pm 10\%$)

Parameter	Symbol	Test Condition	min	typ ⁽²⁾	max	Unit
I/P Leakage Current Address, $\overline{\text{OE}}$	I_{L11}	$V_{CC} = V_{CC} \text{ max, } V_{IN} = 0\text{V or } V_{CC}, V_{PP} = V_{PPL}$	-	-	± 4	μA
Other Pins	I_{L12}	$V_{CC} = V_{CC} \text{ max, } V_{IN} = 0\text{V or } V_{CC}$	-	-	± 1	μA
Output Leakage Current	I_{LO}	$V_{CC} = V_{CC} \text{ max, } V_{OUT} = 0\text{V or } V_{CC}, 8 \text{ bit}$	-	-	± 40	μA
V_{PP} Read Current	I_{PP1}	$V_{PP} = V_{PPH}$	-	-	800	μA
Device Identifier Current	I_{ID}	$A9 = V_{ID}$	-	-	2	mA
V_{CC} Operating Current	32 bit	$\overline{\text{CS}} = V_{IL}^{(1)}, \overline{\text{OE}} = V_{IH}^{(1)}, I_{OUT} = 0\text{mA, } f = 6\text{MHz}$	-	48	120	mA
	16 bit	As above	-	26	62	mA
	8 bit	As above	-	15	33	mA
V_{CC} Write/Erase Current	32 bit	$\overline{\text{CS}} = V_{IL}^{(1)}, \text{Write/Erase in progress}$	-	48	120	mA
	16 bit	As above	-	26	62	mA
	8 bit	As above	-	15	33	mA
V_{PP} Write/Erase Current	32 bit	$V_{PP} = V_{PPH}, \text{Write/Erase in progress}$	-	40	120	mA
	16 bit	As above	-	21	61	mA
	8 bit	As above	-	11	31	mA
Standby Supply Current	TTL	$I_{SB1}, V_{CC} = V_{CC} \text{ max, } \overline{\text{CS}} = V_{IH}^{(1)}$	-	-	4	mA
	CMOS	$I_{SB2}, V_{CC} = V_{CC} \text{ max, } \overline{\text{CS}} = V_{IH}^{(1)}$	-	-	400	μA
Device Identifier Voltage	V_{ID}	$A9 = V_{ID}$	11.5	-	13.0	V
V_{PP} Voltage During	Read Only	$V_{PPL}, \text{Write/Erase Inhibited if } V_{PP} = V_{PPL}$	0	-	$V_{CC} + 2.0$	V
	Read/Write	V_{PPH}	11.4	-	12.6	V
Output Low Voltage	V_{OL}	$I_{OL} = 2.1\text{mA.}$	-	-	0.45	V
Output High Voltage	TTL loading	$V_{OH1}, I_{OH} = -2.5\text{mA.}$	2.4	-	-	V
	CMOS loading	$V_{OH2}, I_{OH} = -100\mu\text{A.}$	$V_{CC} - 0.4$	-	-	V

Notes (1) $\overline{\text{CS}}$ above are accessed through $\overline{\text{CS}}1-4$. These inputs must be operated simultaneously for 32 bit operation, in pairs in 16 bit mode and singly for 8 bit mode.

(2) Typical figures are measured at 25°C and nominal V_{CC}

(3) Maximum active current is the sum of $I_{CC}(I_{CP})$ and I_{PP} .

(4) **CAUTION:** the PUMA 68F4003 must not be removed from or inserted into a socket when V_{CC} or V_{PP} is applied.

ERASE AND PROGRAMMING PERFORMANCE

Parameter	min	typ	max	Units	Comments
Erase Times	32 bit	-	1	30	sec Excludes 00_{16} Programming Prior to Erasure
Program Times	32 bit	-	2	24	sec Excludes System-Level Overhead
Write/Erase Cycles	10^4	10^5	-	cycles	Not 100% tested

AC Test Conditions

- * Module tested in 32bit mode.
- * Input pulse levels: 0V to 3V.
- * Input rise and fall times: $\leq 10\text{ns}$.
- * Input and Output timing reference levels: 1.5V
- * Output load : 1 TTL gate plus 100 pF.

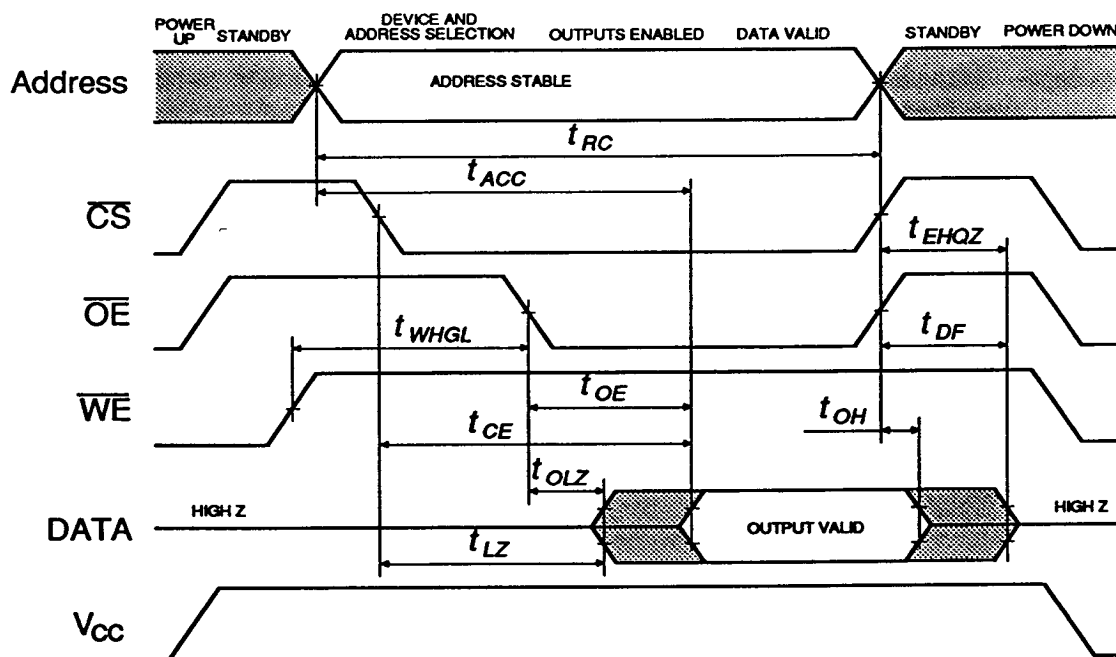
READ**AC Characteristics**

Parameter	Symbol	-12		-15		-20		Unit
		min	max	min	max	min	max	
Read Cycle Time	t_{RC}	120	-	150	-	200	-	ns
Chip Select Access Time	t_{CS}	-	120	-	150	-	200	ns
Address Access Time	t_{ACC}	-	120	-	150	-	200	ns
Output Enable Access Time	t_{OE}	-	50	-	55	-	60	ns
Chip Select to Output in Low $Z^{(2)}$	t_{LZ}	0	-	0	-	0	-	ns
Output Enable to Output in Low $Z^{(2)}$	t_{OLZ}	0	-	0	-	0	-	ns
Output Disable to Output in High $Z^{(1,2)}$	t_{DF}	-	30	-	35	-	40	ns
Output Hold Time	t_{OH}	0	-	0	-	0	-	ns
Write Recovery Time	t_{WHGL}	6	-	6	-	6	-	μ s

Notes: (1) t_{DF} is defined as the time at which the outputs achieve the open circuit conditions and are not referenced to output voltage levels.

(2) These parameters are not tested but guaranteed by design.

(3) The 120ns part is not available over Industrial Temperature range at the present time.

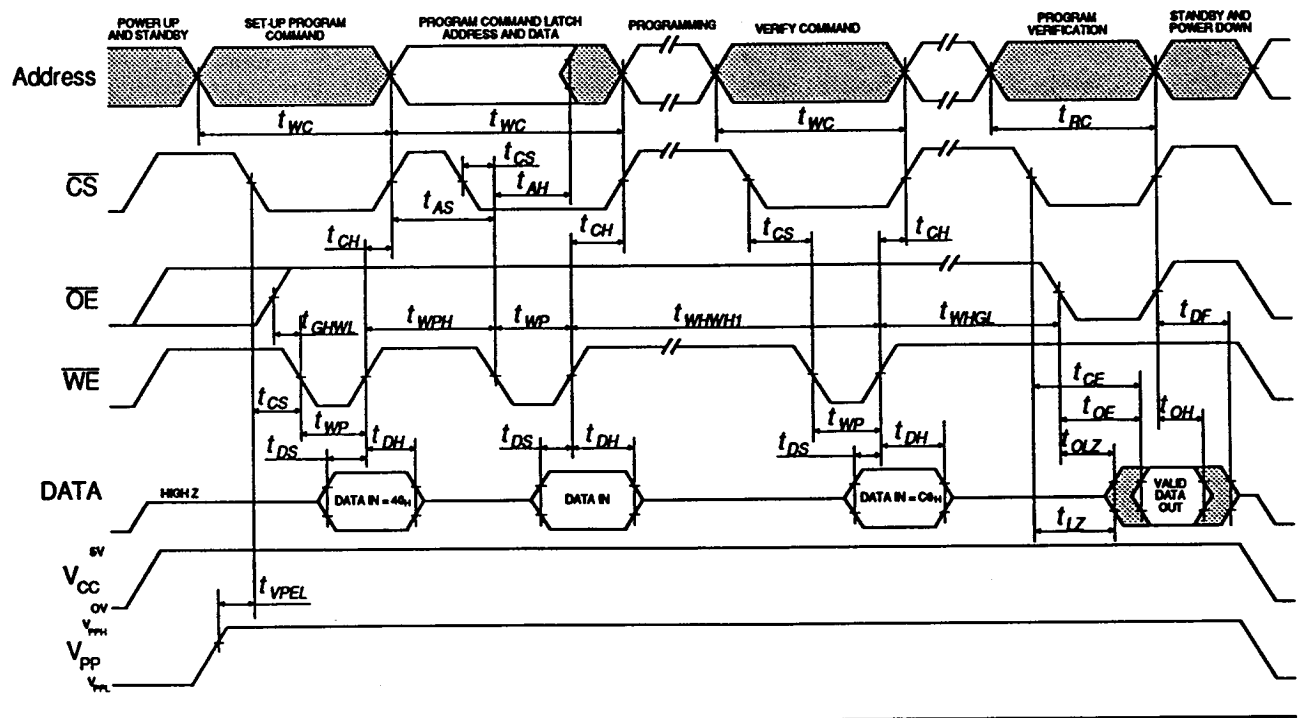
Read Cycle Timing Waveform

WRITE/ERASE/PROGRAM ⁽¹⁾**AC Characteristics**

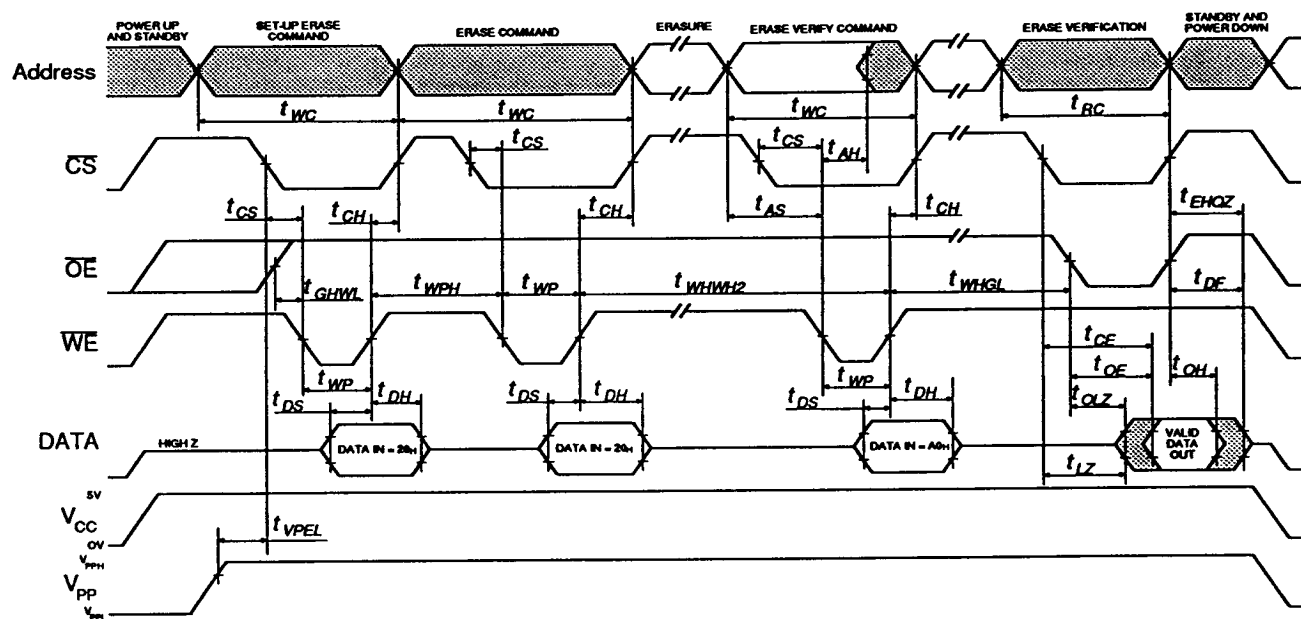
Parameter	Symbol	-12		-15		-20		Unit
		min	max	min	max	min	max	
Write Cycle Time	t_{WC}	120	-	150	-	200	-	ns
Address Setup Time	t_{AS}	0	-	0	-	0	-	ns
Address Hold Time	t_{AH}	60	-	60	-	60	-	ns
Data Setup Time	t_{DS}	50	-	50	-	50	-	ns
Data Hold Time	t_{DH}	10	-	10	-	10	-	ns
Write Recovery Time	t_{WHGL}	6	-	6	-	6	-	μ s
Read Recovery Time	t_{GHWL}	0	-	0	-	0	-	μ s
Chip Select Setup Time	t_{CS}	20	-	20	-	20	-	ns
Chip Select Hold Time	t_{CH}	0	-	0	-	0	-	ns
Write Pulse Width	t_{WP}	45	-	50	-	60	-	ns
Write Pulse Width High	t_{WPH}	20	-	20	-	20	-	ns
Duration of Programming Operation	t_{WHWH1}	10	25	10	25	10	25	μ s
Duration of Erase Operation	t_{WHWH2}	9.5	10.5	9.5	10.5	9.5	10.5	ms
V_{PP} Setup Time to Chip Select Low	t_{VPEL}	100	-	100	-	100	-	ns
V_{CC} Setup Time	t_{VCS}	2	-	2	-	2	-	μ s
V_{PP} Rise Time	t_{VPPR}	500	-	500	-	500	-	ns
V_{PP} Fall Time	t_{VPPF}	500	-	500	-	500	-	ns

Notes (1) Read timing characteristics during read/write operations are the same as during read only operations. Refer to AC Characteristics for read only operations.

(2) The 120ns part is not available over Industrial Temperature range at the present time.

Programming Timing Waveform

Erase Timing Waveform



MODULE DESCRIPTION

When normal TTL/CMOS logic levels are applied to the V_{PP} pin, the module displays normal EPROM Read, Standby, Output Disable and Device Identifier operations. However, when high voltage (V_{PPH}) is applied to V_{PP} the Write/Erase options are available as well as the Read.

BUS OPERATIONS

Read Two control functions are provided, both of which must be logically active to obtain data at the outputs. \overline{CS} selects the module and controls the power, while \overline{OE} gates data from the output pins - see the Read Cycle Timing Waveform for details.

Write Module Write/Erase are accessed via the command register while V_{PP} is at V_{PPH} . Note that the register itself does not occupy an addressable memory location, but is simply a latch used to store the command and address/data information required to execute the command.

With \overline{CE} and \overline{WE} at V_{IL} the command register is accessed; addresses are latched on the falling edge of

\overline{WE} and data latched on the rising edge of \overline{WE} . The three most significant register bits (D7-D5) encode the command function while all other bits (D4-D0) must be zero. The exception to this is the Reset command when data FF_H is written to the register and Identifier mode when 90_H is written to the register.

Output Disable When \overline{OE} is at V_{IH} the output pins are placed in a high impedance state and output from the module is disabled.

Standby If \overline{CS} is held at V_{IH} the power consumption of the module is substantially reduced because most of the on-board circuitry is disabled. The outputs are placed in a high impedance state (independent of \overline{OE}).

If the PUMA 68F4003 module is deselected and placed in Standby mode during Write/Erase and Verify cycles, the module will continue to draw normal active current until the operation is terminated.

Device Identifier Placing a high voltage (V_D) on pin A9 of the module causes the manufacturer and device codes to be output. This can be used to match the correct Write/Erase algorithms to the module.

PUMA 68F4003 Bus Operations

OPERATION		$V_{PP}^{(1)}$	A0	A9	\overline{CS}	\overline{OE}	\overline{WE}	D0 - D7
READ ONLY	Read	V_{PPL}	A0	A9	V_{IL}	V_{IL}	V_{IH}	Data out
	Output Disable	V_{PPL}	X	X	V_{IL}	V_{IH}	V_{IH}	Tri-State
	Standby	V_{PPL}	X	X	V_{IH}	X	X	Tri-State
	Manufacturer Identifier ⁽²⁾	V_{PPL}	V_{IL}	$V_{ID}^{(3)}$	V_{IL}	V_{IL}	V_{IH}	Data = 89H
	Device Identifier ⁽²⁾	V_{PPL}	V_{IH}	$V_{ID}^{(3)}$	V_{IL}	V_{IL}	V_{IH}	Data = B4H
READ/WRITE	Read	V_{PPH}	A0	A9	V_{IL}	V_{IL}	V_{IH}	Data Out ⁽⁴⁾
	Output Disable	V_{PPH}	X	X	V_{IL}	V_{IH}	V_{IH}	Tri-State
	Standby	V_{PPH}	X	X	V_{IH}	X	X	Tri-State
	Write	V_{PPH}	A0	A9	V_{IL}	V_{IH}	V_{IL}	Data In ⁽⁵⁾

Notes (1) V_{PPL} may be GND, a NC with a resistor tied to GND, or $\leq V_{CC} + 2.0V$. V_{PPH} is the programming voltage specified for the device - refer to the DC Characteristics. When $V_{PP} = V_{PPL}$ memory contents can be read but not Written or Erased

(2) Manufacturer and Device codes may also be accessed via the command register. In this mode all addresses except A0 and A9 must be at V_{IL} .

(3) $11.5V \leq V_D \leq 13.0V$

(4) Read operations with $V_{PP} = V_{PPH}$ may access array data or identifier codes (see page 7).

(5) Refer to Command Definition table for valid Data In during a Write operation.

(6) X can be V_{IL} or V_{IH}

(7) Above bus operations are for a single device. D0-D7 are replaced by D8-D15 for device 2, D16-D23 for device 3, and D24-D31 for device 4.

COMMAND DEFINITIONS

With the V_{pp} pin at a low voltage the Command Register contents default to 00_H , enabling Read-only operations. A high voltage on V_{pp} enable Read/Write modes with device operation selected by writing data into the Register - see the Command Definition table for details.

Note that the following descriptions refer to the commands for the PUMA 68F4003 operating in 8 bit mode. The actual data presented to the module will change with the configured word width i.e. for the Erase Verify command of $A0_H$, if the PUMA is in 16 bit mode $A0A0_H$ will be placed on the data bus and in 32 bit mode the data would be $A0A0A0A0_H$.

Read While V_{pp} is high the memory contents can be Read by first writing 00_H into the Command Register. A delay of $6\mu s$ is required before reading the first location, but all subsequent Read operations take t_{acc} . This mode remains enabled until the Command Register contents are altered.

On power up the Register contents will be 00_H , ensuring that the memory contents are not changed during the V_{pp}/V_{cc} power transition. If the V_{pp} pin is hard wired to a high voltage the memory will power up enabled for Read until the Register contents are altered.

Intelligent Identifier In order to use the correct programming and erase algorithms on PROM devices, these parts usually have built in codes to identify manufacturer and specific device. However, to access these codes address line A9 has to be placed at a high voltage, which is not considered good practise and can lead to complications on PCB design.

The PUMA 68F4003 module uses both of these codes to supplement traditional PROM programming methodology, but the identifiers are accessed through the Command Register without placing a high voltage on A9. Writing 90_H into the Register starts this process with a subsequent Read from 00000_H retrieving the manufacturer code of 89_H and a Read from 00001_H giving the device code $B4_H$. To terminate this sequence another valid command must be written to the Register.

Set-up Program/Program Set-up program is a command only operation which prepares the memory for byte programming, initiated by writing 40_H into the command register.

Once Set-up program has been performed, the next WE pulse causes data to be latched on the rising edge and the address is latched on the falling edge of this pulse. Internal programming begins on the rising edge and is terminated with the next rising edge of Write Enable used to write the program-verify command.

Program-Verify This module is programmed byte by byte, which can occur sequentially or at random, but the byte just written must be verified.

Writing $C0_H$ to the command register begins this operation, which also terminates the programming operation. The last byte written will be verified; no new address information is required as the previous address is latched. A Read Cycle can now be performed in order to compare the data just written with the byte contents. This process is shown by the Programming Algorithm.

Set-up Erase/Erase Set-up erase is a command only operation which prepares the memory for electrical erasure of all contents, initiated by writing 20_H to the Command Register.

In order to start erasure 20_H must again be written to the register; this two-step sequence ensures that accidental erasure will not occur. Additionally, if the V_{pp} pin is not at a high voltage the memory contents are protected against erasure.

Erase-Verify The Erase command erases all the contents of the memory, but after this operation all bytes must be verified. This is accomplished by writing $A0_H$ to the Command Register, with the address of the byte to be verified supplied as it is latched on the falling edge of the Write-Enable pulse. Reading FF_H from the addressed byte indicates that it is erased. This command must be issued prior to each byte verification to latch its address.

If the data read is not FF_H another erase operation must be performed. Verification can then continue from the address of the last verified byte, and once all bytes have been verified the erase procedure is complete. This process is shown by the Erase algorithm.

The verify operation is halted by writing another valid command e.g. Set-up Program, into the command register.

Reset This command, which consists of two consecutive writes of FF_H , will safely abort either Erase or Program operations after the Set-up commands. Memory contents will not be altered, and a valid command must then be written to place the device in the desired state.

ALGORITHM NOTES

It can be seen that the Programming and Erase algorithms both terminate with the Command Register being loaded with a Read command. If devices on the PUMA 68F4003 are being Programmed/Erased sequentially (i.e. it is configured in 8 bit mode) then at the termination of the sequence all devices which have been accessed must be returned to the Read mode before correct operation can resume.

PUMA 68F4003 Command Definitions

COMMAND	Bus Cycles Req'd	First Bus Cycle			Second Bus Cycle		
		Operation ⁽¹⁾	Addr ⁽²⁾	Data ⁽³⁾	Operation ⁽¹⁾	Addr ⁽²⁾	Data ⁽³⁾
Read Memory ⁽⁸⁾	1	Write	X	00 _H	Read	RA	RD
Read Identifier Codes ⁽⁴⁾	2	Write	X	90 _H	Read	IA	ID
Set-up Erase/Erase ⁽⁵⁾	2	Write	X	20 _H	Write	X	20 _H
Erase Verify ⁽⁵⁾	2	Write	EA	A0 _H	Read	X	EVD
Set-up Program/Program ⁽⁶⁾	2	Write	X	40 _H	Write	PA	PD
Program Verify ⁽⁶⁾	2	Write	X	C0 _H	Read	X	PVD
Reset ⁽⁷⁾	2	Write	X	FF _H	Write	X	FF _H

Notes (1) See Bus Operations Table.

(2) IA = Identifier address. 00_H for Manufacturers code and 01_H for device code.

EA = Address of memory location to be read during Erase Verify.

PA = Address of memory location to be programmed.

RA = Address of memory location to be Read.

Addresses are latched on the falling edge of Write Enable pulse.

(3) ID = Data read from location IA during device identification. (Manufacturer = 89_H, Device = B4_H)

EVD = Data read from location EA during Erase Verify.

PD = Data to be programmed at location PA. Data is latched on the rising edge of Write Enable.

RD = Data to be read from location RA during Read operation.

PVD = Data to be read from location PA during Program Verify. PA is latched on the Program command.

(4) Following the Read Identifier command, two read operations access the manufacturer and device codes.

(5) See the Erase Algorithm.

(6) See the Programming Algorithm.

(7) The second bus cycle must be followed by the desired command register write.

(8) Wait 6μs after the first Read command before accessing data. When the second bus command is a Read command, all subsequent Read operations take t_{ACC}.

(9) Above command definitions are for a single device only.

Parallel Erase If the PUMA 68F4003 is used in 32 or 16 bit mode then two or four devices will be accessed simultaneously. This reduces the total Erase time, but because individual devices will erase at different rates care must be taken that each device is verified separately. When a device is completely erased and verified a masking code should be used to prevent further erasure e.g. writing the Read Command to the appropriate device. Any other devices will continue to Erase until verified.

Timing Delays Four timing delays are associated with the Program and Erase algorithms described:

(1) When V_{pp} first turns on the capacitors on the V_{pp} line cause an RC ramp, the rise time of which is proportional to the number of devices being erased and the capacitance per device. V_{pp} must reach its final value 100ns before any commands are executed.

(2) The second timing delay is the erase time pulse width of 10ms, which should be timed by a routine run by the local microprocessor. This operation must be terminated before servicing any system interrupts which may occur during the routine. An Erase/Verify command should be written after each

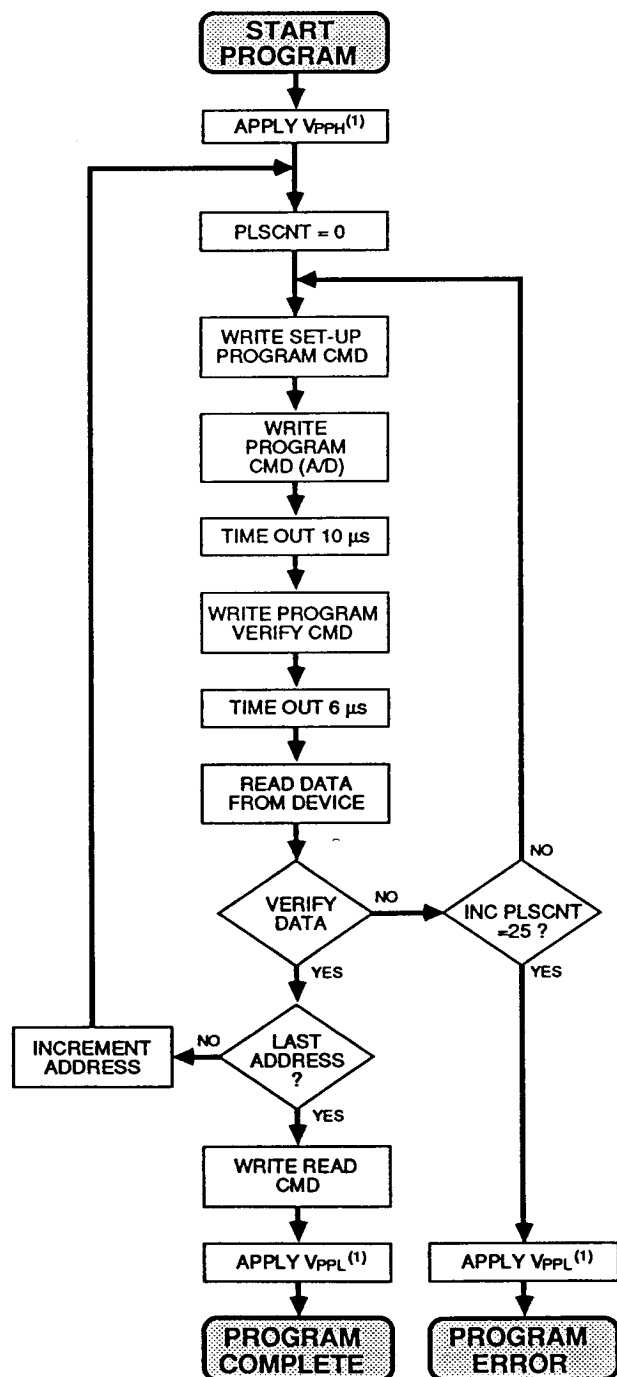
erase pulse, otherwise the device(s) may continue to erase until the memory cells are driven into depletion. A symptom of this over erasure is an error attempting to Write the next time; occasionally it may be possible to recover this situation by programming all of the locations with 00_H.

(3) Each Write pulse width is 10μs, and since the algorithm is interactive each byte is verified after a Write pulse. The program operation must be terminated at the conclusion of the timing routine or prior to servicing any interrupts which may occur during this operation.

(4) A fourth delay which is associated with both the Write and Erase algorithms has a Write recovery time of 6μs. In order to improve memory cell operation, an internally generated margin voltage is applied to the addressed cell during Write/Erase Verify. It is during this 6μs delay that the internal circuitry is changing voltage levels between the Erase/Write level and those used for Verify and Read operations. Any attempt to Read the device(s) during this period will result in possible false data appearing on the outputs.

PROGRAMMING ALGORITHM

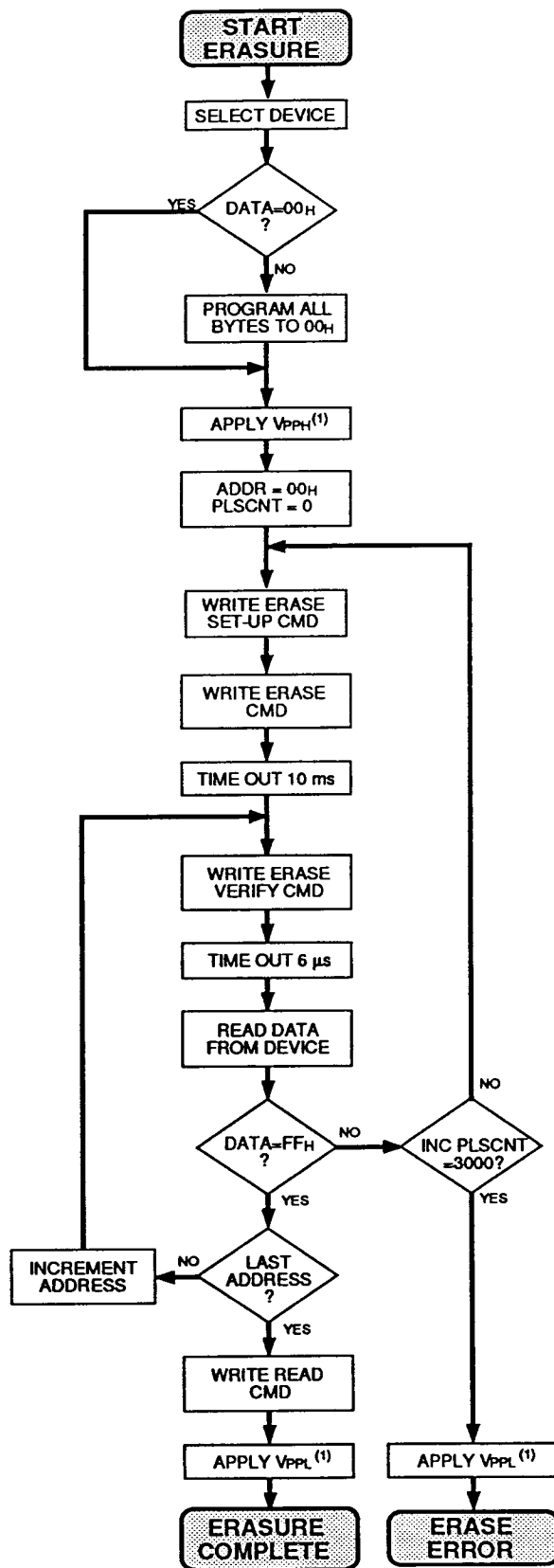
These algorithms **MUST BE FOLLOWED** to ensure proper and reliable operation, and are shown for a single device only.



Notes

- (1) See DC Characteristics for the value of V_{PPH} . The V_{PP} supply can be hard wired to the device or switchable. When V_{PP} is switched, V_{PPL} may be GND, NC with a resistor tied to GND or less than $V_{CC}+2.0V$

ERASE ALGORITHM



DESIGN CONSIDERATIONS

Two Line Control Two Read signals are provided for output control to accommodate large memory arrays, giving the lowest possible memory power dissipation and ensuring bus contention does not occur.

To use this feature efficiently, an address decoder output should drive the CS line while the system read signal controls all memories in parallel. This ensures that only enabled memories have active outputs and deselected devices are in the low power Standby condition.

Supply Decoupling Flash memory power-switching characteristics require careful decoupling. Three supply current issues have to be considered - Standby, Active and transient current peaks caused by rising and falling edges of CS.

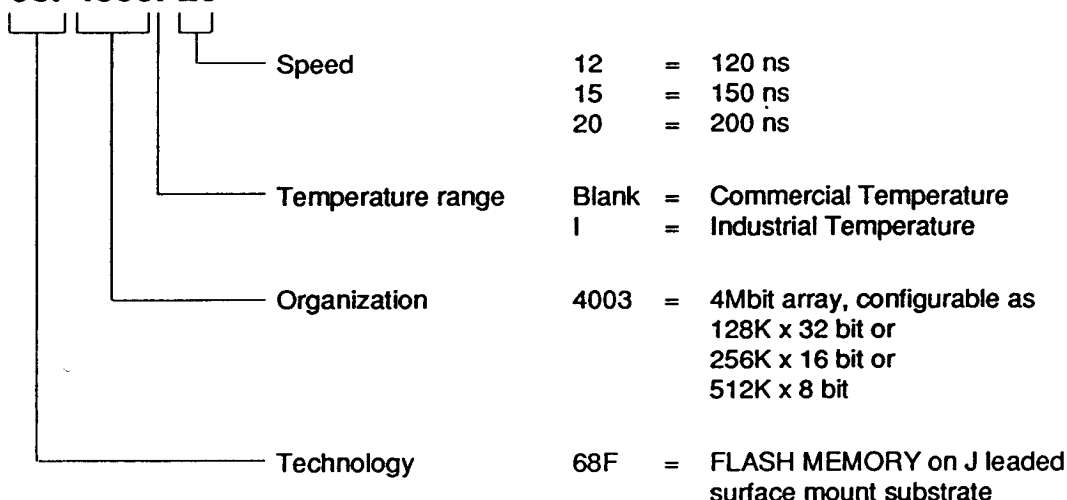
Two line control and correct decoupling capacitor selection will help to suppress these transient voltage peaks. This module has three on-board decoupling capacitors of 0.1 μ F connected between V_{CC} and GND. Additionally, a 0.1 μ F or larger capacitor should be placed close to the module between V_{PP} and GND.

It is recommended that a 4.7 μ F electrolytic capacitor should be placed between V_{CC} and GND every two PUMA 68F4003 modules. This capacitor will smooth out voltage dips in the supply caused by PCB track inductance and will supply charge to the onboard capacitors as needed.

V_{PP} Trace Because Flash memories are designed to be programmed in situ, the PCB designer must be made aware of the V_{PP} supply trace. This should be made similar to the V_{CC} bus as the V_{PP} pin supplies the memory cell current for Programming and Erase.

Power Up/Down This Flash module is protected against accidental writes caused by power transitions, powering up in the Read only mode. Additionally, by using two step command register sequences this protection is further enhanced. While these functions are sufficient in most cases, it is recommended that V_{CC} should reach a steady state value before V_{PP} is greater than $V_{CC}+2.0V$, and during power down V_{PP} should be less than $V_{CC}+2.0V$ before lowering V_{CC} .

Ordering Information

PUMA 68F4003I-20

The policy of the company is one of continuous development and while the information presented in this data sheet is believed to be accurate, no liability is assumed for any data contained within. The company reserves the right to make changes without notice at any time.

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12