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**128K x 32 SRAM Module**

**PUMA2S4000 -20/25/35**  
**PUMA 67S4000/A/B-20/25/35**  
**PUMA 77S4000/A/B-20/25/35**

**Description**

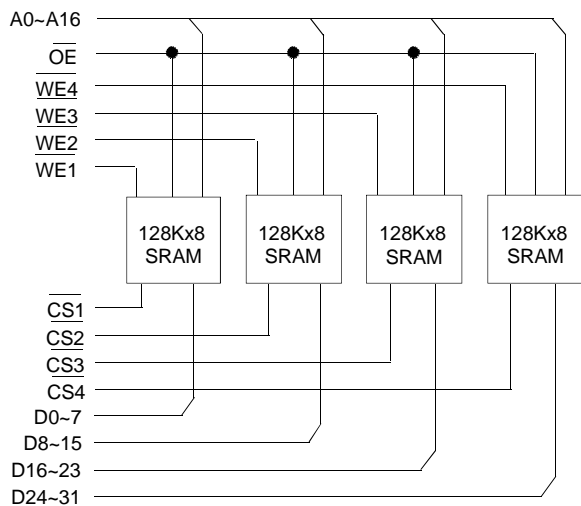
Available in PGA (PUMA 2), JLCC (PUMA 67) and Gullwing (PUMA 77) footprints. The PUMA \*\*S4000 is a 4 Mbit SRAM module, user configurable as 128K x 32, 256K x 16 or 512K x 8. The device is available with fast access times of 20, 25 and 35ns. The device may be screened in accordance with MIL-STD-883C.

**Features**

- 4 Megabit SRAM module.
- Fast Access Times of 20/25/35 ns.
- Output Configurable as 32 / 16 / 8 bit wide.
- Upgradeable footprint.
- Operating Power 3740 / 2310 / 1595 mW (Max). Low Power Standby (L version) 220 mW (Max).
- TTL Compatible Inputs and Outputs.
- May be screened in accordance with MIL-STD-883.
- PUMA 2 - 66 pin ceramic PGA.
- PUMA 67 - 68 pin ceramic JLCC.
- PUMA 77 - 68 pin ceramic Gullwing.

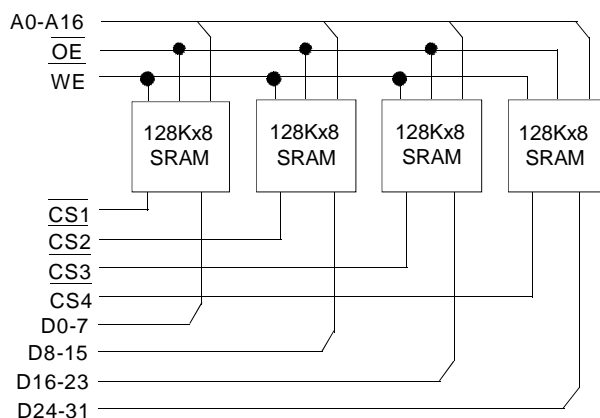
**Block Diagram**

PUMA 2S4000, 67S4000A/B and 77S4000A/B



**Block Diagram**

PUMA 67S4000 and 77S4000



**Pin Functions**

<u>A0~A16</u>	Address Input	<u>D0~D31</u>	Data Inputs/Outputs
<u>CS1~4</u>	Chip Select	<u>WE1~4</u>	Write Enables
<u>OE</u>	Output Enable	Vcc	Power (+5V)
GND	Ground		

**DC OPERATING CONDITIONS****Absolute Maximum Ratings** <sup>(1)</sup>

Voltage on any pin relative to GND <sup>(2)</sup>	$V_T$	-0.5V to +7.0	V
Power Dissipation	$P_T$	4	W
Storage Temperature	$T_{STG}$	-65 to +150	°C

Notes (1) Stresses above those listed may cause permanent damage. 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 device reliability.

**Recommended Operating Conditions**

		<i>min</i>	<i>typ</i>	<i>max</i>	
Supply Voltage	$V_{CC}$	4.5	5.0	5.5	V
Input High Voltage	$V_{IH}$	2.2	-	6.0	V
Input Low Voltage	$V_{IL}$	-0.5	-	0.8	V
Operating Temperature	$T_A$	0	-	70	°C
	$T_{AI}$	-40	-	85	°C (Suffix <b>I</b> )
	$T_{AM}$	-55	-	125	°C (Suffix <b>M, MB</b> )

**DC Electrical Characteristics** ( $V_{CC}=5V\pm 10\%$ ,  $T_A=-55^\circ\text{C}$  to  $+125^\circ\text{C}$ )

Parameter	Symbol	Test Condition	<i>min</i>	<i>typ</i>	<i>max</i>	Unit	
Input Leakage Current	$I_{LI1}$	$V_{IN}=0V$ to $V_{CC}$	-8	-	8	$\mu\text{A}$	
Output Leakage Current	$I_{LO}$	$\overline{CS}^{(1)}=V_{IH}$ or $\overline{OE}=V_{IH}$ , $V_{IO}=0V$ to $V_{CC}$ $\overline{WE}=V_{IL}$	-8	-	8	$\mu\text{A}$	
Operating Supply Current	32 bit	$I_{CC32}$	Min cycle, duty=100%, $I_{IO}=0\text{mA}$ , $\overline{CS}=V_{IL}$	-	-	680	mA
	16 bit	$I_{CC16}$	As above	-	-	420	mA
	8 bit	$I_{CC8}$	Min cycle, duty=100%, $I_{IO}=0\text{mA}$ , $\overline{CS}=V_{IL}$	-	-	290	mA
Standby Supply Current (TTL)		$I_{SB1}$	$\overline{CS}^{(1)}\geq V_{IH}$ , $V_{CC}=5.5V$	-	-	160	mA
	-L Version	$I_{SB2}$	$\overline{CS}^{(1)}\geq V_{IH}$ , $V_{IL}\leq V_{IN}\leq V_{IH}$ , $f=0\text{Hz}$	-	-	40	mA
Output Voltage Low	$V_{OL}$	$I_{OL}=8.0\text{mA}$	-	-	0.4	V	
Output Voltage High	$V_{OH}$	$I_{OH}=-4.0\text{mA}$	2.4	-	-	V	

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

**Capacitance** ( $V_{CC}=5V\pm 10\%$ ,  $T_A=25^\circ\text{C}$ ) Note: (1) On the standard module,  $\overline{WE}=30\text{pF}$  max.

Parameter	Symbol	Test Condition	<i>typ</i>	<i>max</i>	Unit	
Input Capacitance	Address, $\overline{OE}$	$C_{IN1}$	$V_{IN}=0V$	-	30	pF
	$\overline{WE}1\sim 4^{(1)}$ , $\overline{CS}1\sim 4$	$C_{IN2}$	$V_{IN}=0V$	-	16	pF
I/O Capacitance	D0~D31	$C_{IO}$	$V_{IO}=0V$	-	30	pF (8 bit mode)

These parameters are calculated, not measured.

## Operating Modes

The table below shows the logic inputs required to control the operating modes of each of the SRAMs on the modules.

Mode	$\overline{CS}$	$\overline{OE}$	$\overline{WE}$	$V_{CC}$ Current	I/O Pin	Reference Cycle
Not Selected	1	X	X	$I_{SB1}, I_{SB2}$	High Z	Power Down
Output Disable	0	1	1	$I_{CC}$	High Z	-
Read	0	0	1	$I_{CC}$	$D_{OUT}$	Read Cycle
Write	0	X	0	$I_{CC}$	$D_{IN}$	Write Cycle

1 =  $V_{IH}$ ,

0 =  $V_{IL}$ ,

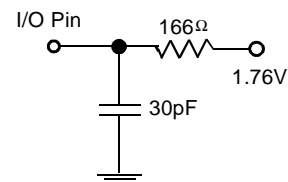
X = Don't Care

Note:  $\overline{CS}$  above is accessed through  $\overline{CS1-4}$  (and  $\overline{WE}$  by  $\overline{WE1-4}$  on the PUMA 2S4000, 67S4000A, 77S4000A). For correct operation,  $\overline{CS1-4}$  (and  $\overline{WE1-4}$ ) must operate simultaneously for 32 bit operation, in pairs for 16 bit operation, or singly for 8 bit operation.

## AC Test Conditions

- \*Input pulse levels: 0.0V to 3.0V
- \*Input rise and fall times: 3 ns
- \*Input and Output timing reference levels: 1.5V
- \* $V_{CC} = 5V \pm 10\%$
- \*PUMA module is tested in 32 bit mode.

## Output Load



**AC OPERATING CONDITIONS****Read Cycle**

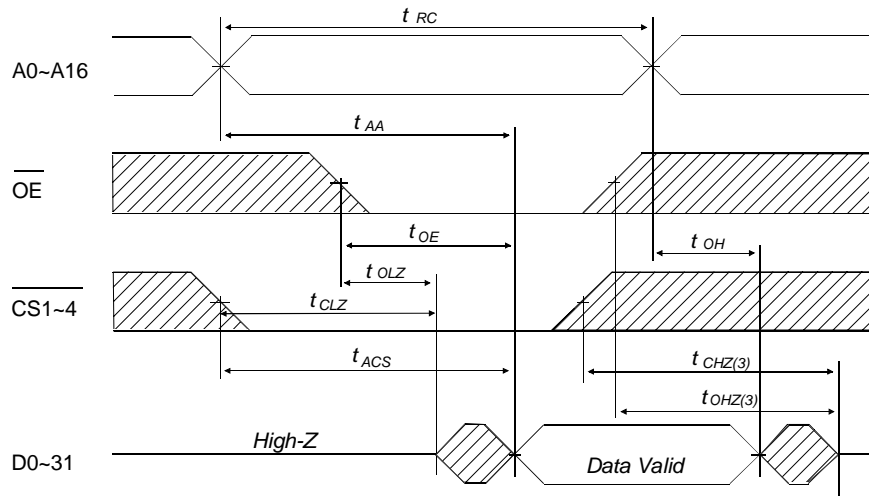
Parameter	Symbol	20		25		35		Units
		min	max	min	max	min	max	
Read Cycle Time	$t_{RC}$	20	-	25	-	35	-	ns
Address Access Time	$t_{AA}$	-	20	-	25	-	35	ns
Chip Select Access Time	$t_{ACS}$	-	20	-	25	-	35	ns
Output Enable to Output Valid	$t_{OE}$	-	9	-	8	-	12	ns
Output Hold from Address Change	$t_{OH}$	5	-	5	-	5	-	ns
Chip Selection to Output in Low Z	$t_{CLZ}$	6	-	5	-	5	-	ns
Output Enable to Output in Low Z	$t_{OLZ}$	0	-	0	-	0	-	ns
Chip Deselection to Output in High Z <sup>(3)</sup>	$t_{CHZ}$	0	9	-	15	-	15	ns
Output Disable to Output in High Z <sup>(3)</sup>	$t_{OHZ}$	0	9	-	15	-	15	ns

**Write Cycle**

Parameter	Symbol	20		25		35		Unit
		min	max	min	max	min	max	
Write Cycle Time	$t_{WC}$	20	-	25	-	35	-	ns
Chip Selection to End of Write	$t_{CW}$	15	-	16	-	20	-	ns
Address Valid to End of Write	$t_{AW}$	15	-	16	-	20	-	ns
Address Setup Time	$t_{AS}$	0	-	0	-	0	-	ns
Write Pulse Width	$t_{WP}$	15	-	15	-	20	-	ns
Write Recovery Time	$t_{WR}$	0	-	5	-	5	-	ns
Data to Write Time Overlap	$t_{DW}$	0	15	10	-	15	-	ns
Output Active from End of Write	$t_{OW}$	15	-	3	-	3	-	ns
Data Hold from Write Time	$t_{DH}$	2*	-	2*	-	2*	-	ns
Write to Output High Z	$t_{WHZ}$	5	-	0	10	0	10	ns

\* Note : Only applies to PUMA 67S4000/A otherwise  $t_{DH}(\text{min}) = 0$

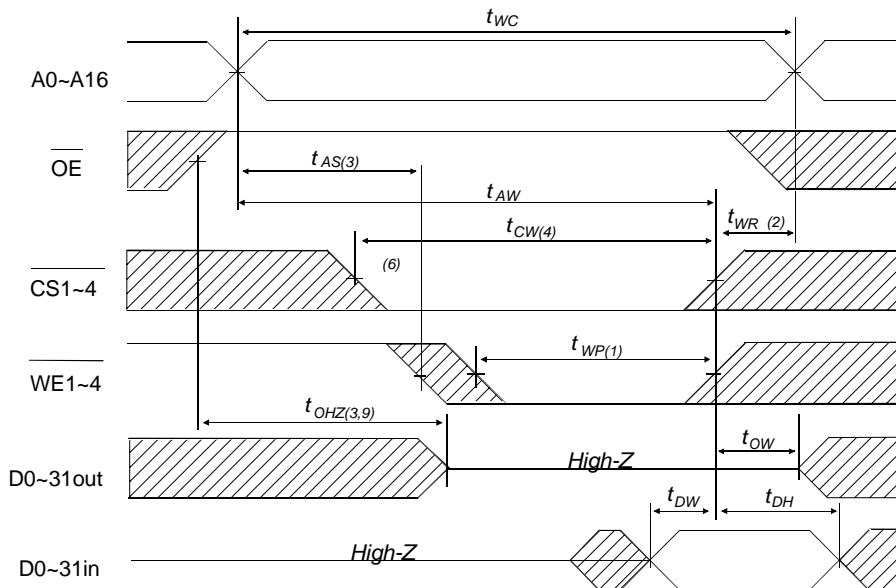
**Read Cycle Timing Waveform<sup>(1,2)</sup>**



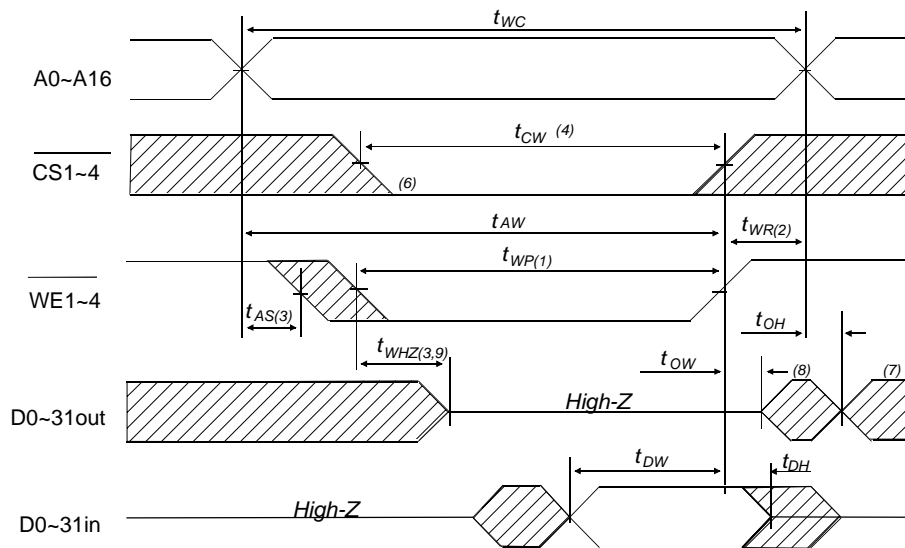
Notes:

- (1) During the Read Cycle,  $\overline{WE}$  is high for the modules.
- (2) Address valid prior to or coincident with  $\overline{CS}$  transition Low.
- (3)  $t_{CHZ}$  and  $t_{OHZ}$  are defined as the time at which the outputs achieve the open circuit conditions and are not referenced to output voltage levels. These parameters are sampled and not 100% tested.

**Write Cycle No.1 Timing Waveform**



### Write Cycle No.2 Timing Waveform <sup>(5)</sup>



### AC Characteristics Notes

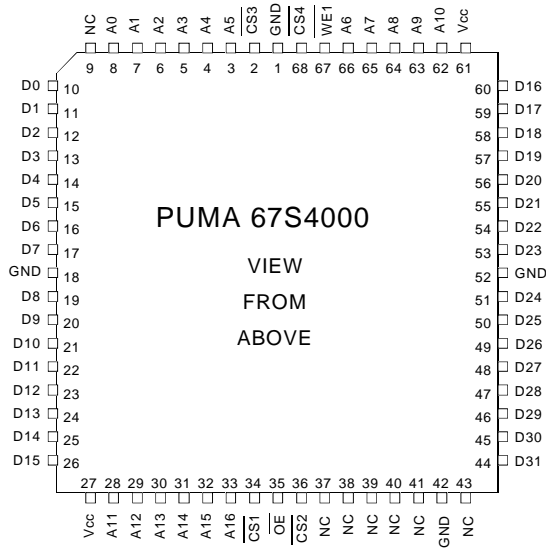
- (1) A write occurs during the overlap ( $t_{WP}$ ) of a low  $\overline{CS}$  and a low  $\overline{WE}$ .
- (2)  $t_{WR}$  is measured from the earlier of  $\overline{CS}$  or  $\overline{WE}$  going high to the end of write cycle.
- (3) During this period, I/O pins are in the output state. Input signals out of phase must not be applied.
- (4) If the  $\overline{CS}$  low transition occurs simultaneously with the  $\overline{WE}$  low transition or after the  $\overline{WE}$  low transition, outputs remain in a high impedance state.
- (5)  $\overline{OE}$  is continuously low. ( $\overline{OE}=V_{IL}$ )
- (6)  $D_{OUT}$  is in the same phase as written data of this write cycle.
- (7)  $D_{OUT}$  is the read data of next address.
- (8) If  $\overline{CS}$  is low during this period, I/O pins are in the output state. Input signals out of phase must not be applied.
- (9)  $t_{WHZ}$  and  $t_{OHZ}$  are defined as the time at which the outputs achieve the open circuit conditions and are not referenced to output voltage levels. These parameters are sampled and not 100% tested.

$\overline{WE}$  above refers to  $\overline{WE1-4}$  on the PUMA 2S4000, 67S4000A AND 77S4000A.

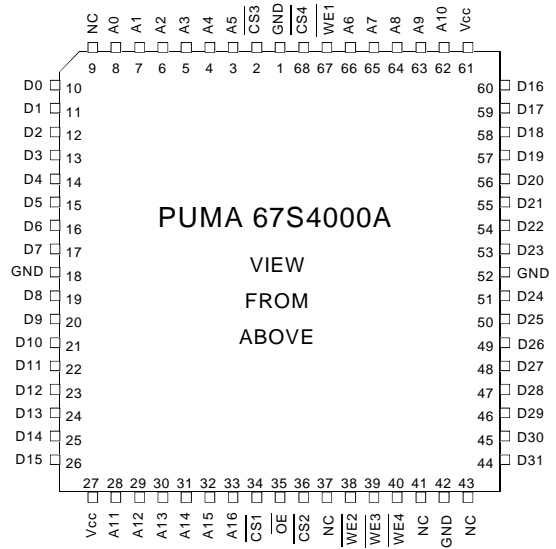


**Pin Definitions**

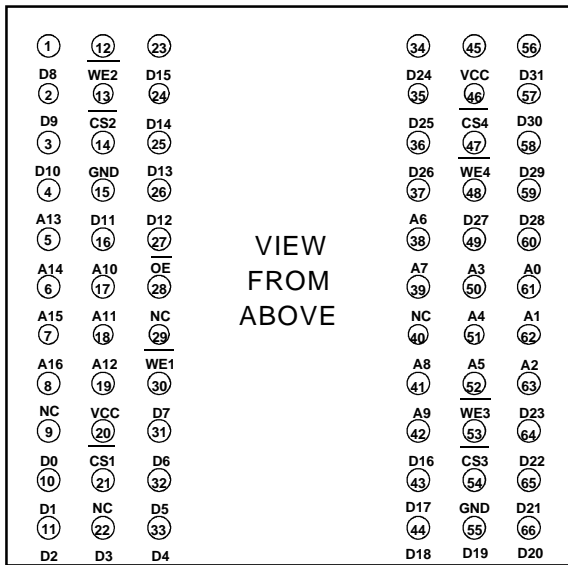
PUMA 67S4000 / PUMA 77S4000



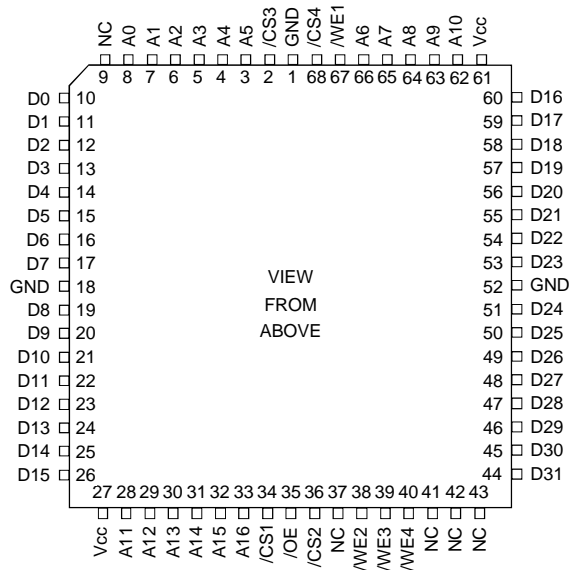
PUMA 67S4000A / PUMA 77S4000A



PUMA 2S4000



PUMA 67S4000B / PUMA 77S4000B



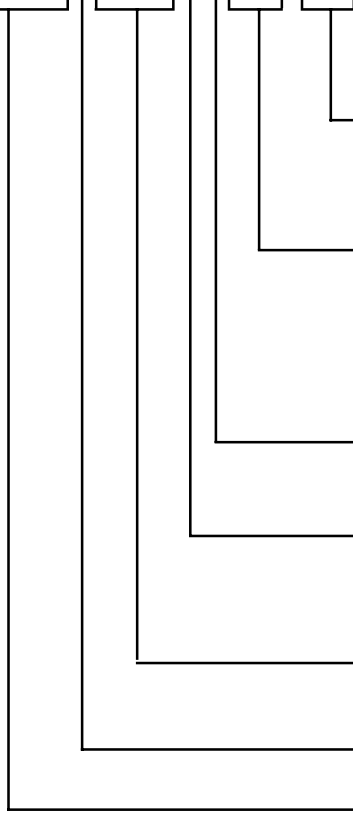
**SCREENING****Military Screening Procedure**

**MultiChip Screening Flow** for high reliability product is in accordance with Mil-883 method 5004 .

<b>MB MULTICHIP MODULE SCREENING FLOW</b>		
<b>SCREEN</b>	<b>TEST METHOD</b>	<b>LEVEL</b>
<b>Visual and Mechanical</b> Internal visual Temperature cycle Constant acceleration	2010 Condition B or manufacturers equivalent 1010 Condition C (10 Cycles, -65°C to +150°C) 2001 Condition B (Y1 & Y2) (10,000g)	100% 100% 100%
<b>Burn-In</b> Pre-Burn-in electrical Burn-in	Per applicable device specifications at $T_A=+25^\circ\text{C}$ $T_A=+125^\circ\text{C}$ , 160hrs minimum.	100% 100%
<b>Final Electrical Tests</b> Static (DC)  Functional  Switching (AC)	Per applicable Device Specification a) @ $T_A=+25^\circ\text{C}$ and power supply extremes b) @ temperature and power supply extremes a) @ $T_A=+25^\circ\text{C}$ and power supply extremes b) @ temperature and power supply extremes a) @ $T_A=+25^\circ\text{C}$ and power supply extremes b) @ temperature and power supply extremes	100% 100% 100% 100% 100% 100%
<b>Percent Defective allowable (PDA)</b>	Calculated at post-burn-in at $T_A=+25^\circ\text{C}$	10%
<b>Hermeticity</b> Fine Gross	1014 Condition A Condition C	100% 100%
<b>Quality Conformance</b>	Per applicable Device Specification	Sample
<b>External Visual</b>	2009 Per vendor or customer specification	100%

## Ordering Information

### PUMA 2S4000ALMB- 20



Speed	20 = 20 ns
	25 = 25 ns
	35 = 35 ns
Screening	Blank = Commercial Temperature
	I = Industrial Temperature
	M = Military Temperature
	MB = Processed in accordance with MIL-STD-883
Power	Blank = Standard Power
	L = Low Power
WE Option	Blank = <u>Single WE</u> (PUMA 67 / 77 only)
	<u>WE1~4</u> (PUMA 2 only)
	A = WE1~4 (PUMA 67 / 77 only)
	B = Pinout variant
Organisation	4000 = 128Kx 32, user configurable as 256K x 16 and 512K x 8
Technology	S = SRAM MEMORY
Package	PUMA 2 = JEDEC 66 Pin Ceramic PGA package
	PUMA 67 = JEDEC 68 J-Leaded Ceramic Surface Mount package
	PUMA 77 = JEDEC 68 Leaded Gull Wing Ceramic Surface Mount package

#### Note :

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Products are not authorised for use as critical components in life support devices without the express written approval of a company director.