

CMOS high density programmable macro logic

PML2552

FEATURES

- Full connectivity
- Erasable version and one time programmable version available
- Scan test
- Power down mode
- Power on reset
- 100% testable
- SNAP development system
 - Supports third-party schematic entry formats
 - TTL Macro library
 - Versatile netlist format for design portability
- Power dissipation (TTL) = 630mW
- Power dissipation (CMOS) = 525mW
- Power dissipation (Power-Down mode) = 52mW
- Security fuse for copy protection
- Reprogrammable

PROPAGATION DELAYS

- Delay per internal NAND gate = 15ns (typ)
- 50MHz flip-flop toggle rate

APPLICATIONS

- Low-end gate array replacement
- Instrumentation
- Bus arbitration functions
- Wide multiplexers and decoders
- Multiple independent state machines
- General purpose logic integration and microprocessor support logic
- PAL[®] and glue logic replacement

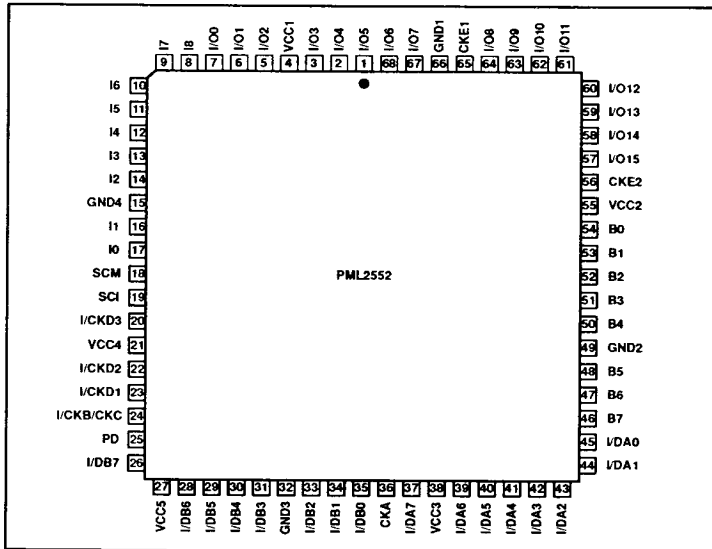
DESCRIPTION

The Philips Semiconductors PML family of PLDs provides "instant gate array" capabilities for general purpose logic integration applications. The PML2552 is the first high density CMOS-PML product. Fabricated with the Philips Semiconductors high-performance EPROM process, it is an ideal way to reduce NRE costs, inventory problems and quality concerns. The PML2552 incorporates the PML folded NAND array architecture which provides 100% connectivity to eliminate routing restrictions. What distinguishes the PML2552 from the "classic" PLD architectures is its flexibility and the potent flip-flop building blocks. The device utilizes a folded NAND architecture, which enables the designer to implement multiple levels of logic on a single chip. The PML2552

eliminates the NRE costs, risks, and hard to use design tools associated with semicustom and full custom approaches. It allows the system designer to manage reliable functionality, in less time and space plus a faster time to market. The PML2552 is ideal in today's instrumentation, industrial control, EISA, NuBus[™], bus interface and dense state machine applications in conjunction with the state-of-the-art CMOS processors. It is capable of replacing large amounts of TTL, SSI and MSI logic and literally allows the designer to build a system on the chip.

The SNAP development software gives easy access to the density and flexibility of the PML2552 through a variety of design entry formats, including schematic, logic equations, and state equations in any combination.

PIN CONFIGURATION



ORDERING INFORMATION

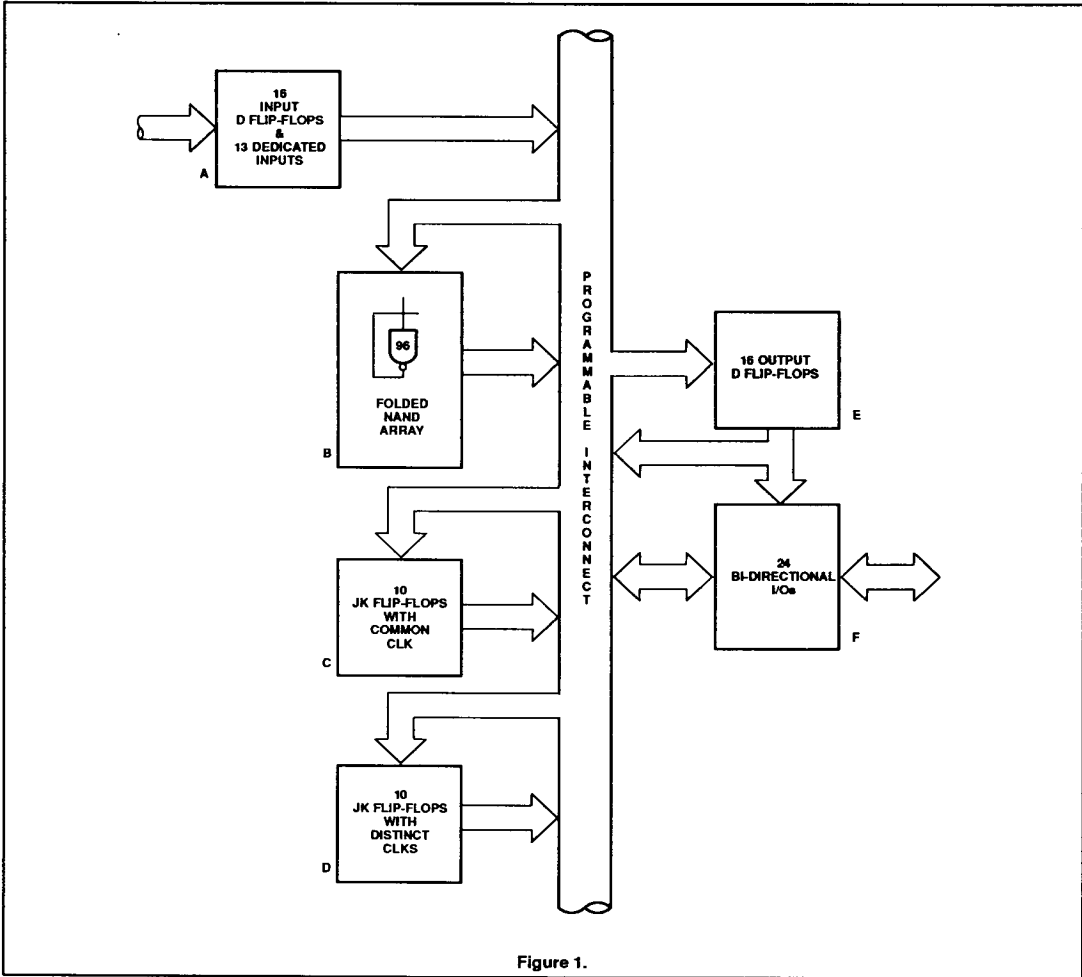
DESCRIPTION	t _{PD} (MAX)	ORDER CODE	DRAWING NUMBER
68-pin Plastic Leaded Chip Carrier	35ns	PML2552-35A	0398E
68-pin "J" Leaded Ceramic Cerquad Package	35ns	PML2552-35KA	1473A
68-pin Plastic Leaded Chip Carrier	50ns	PML2552-50A	0398E
68-pin "J" Leaded Ceramic Cerquad Package	50ns	PML2552-50KA	1473A

PAL is a registered trademark of Advanced Micro Devices, Inc.
NuBus is a trademark of Texas Instruments, Inc.

CMOS high density programmable macro logic

PML2552

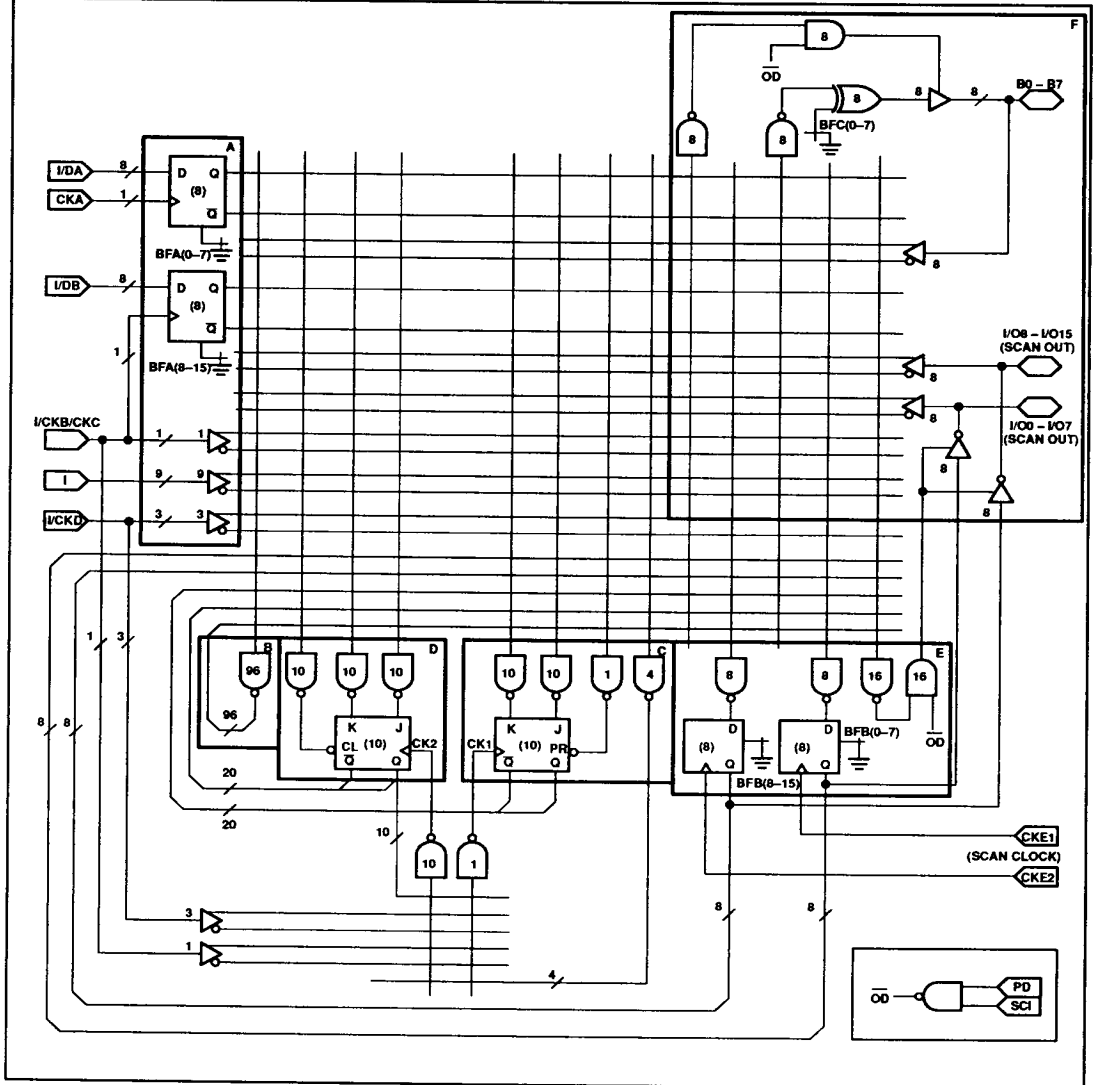
FUNCTIONAL BLOCK DIAGRAM



CMOS high density programmable macro logic

PML2552

LOGIC DIAGRAM



CMOS high density programmable macro logic

PML2552

STRUCTURE

- 112 possible foldback NAND gates:
 - 96 internal NAND
 - 16 from the I/O macros
- 114 additional logic terms
- 53 possible inputs (with programmable polarity)
 - 29 dedicated inputs
 - 24 bidirectional I/Os
- 24 bidirectional pins
- 52 flip-flops
- 24 possible outputs with individual Output Enable control (8 with programmable polarity)
- Multiple independent clocks
- 20 Buried JK-type flip-flops with foldback (JKFFs):
 - 10 JKFFs with one shared preset signal and one shared clocked signal originating from the clock array.
 - 10 JKFFs with 10 independent clock signals originating from the clock array and 10 independent clear signals
- 258 inputs per NAND gate
- Bypassable Input D-type flip-flop (DFFs)/Combinatorial Inputs:
 - 16 DFFs/combinatorial inputs
 - DFFs clocked in two groups of eight
 - DFFs not bypassed in unprogrammed state
 - Independent bypass fuse on each DFF
- Inputs/bypassable D-type flip-flop outputs/foldback NAND gates:
 - 16 output DFFs/combinatorial inputs/outputs with individual Output Enable control
 - DFFs clocked in two groups of eight
 - DFFs not bypassed in unprogrammed state
 - Independent bypass fuse on each DFF
 - The DFF can be used as an internal DFF or an internal foldback NAND gate.
- Combinatorial inputs:
 - 9 dedicated inputs to the NAND array
 - 3 inputs optional to NAND array and/or clock array
 - 1 input optional to NAND array and/or clock array, and/or clock of Input D Flip-Flops (Group B)
- Separate clock array:
 - Separate clock array for JKFFs clock inputs
 - 4 inputs to clock array originated from NAND array
 - 4 inputs (with programmable polarity) directly from input pins
 - 10 inputs from Q outputs of JKFFs with clear
- Dedicated clocks:
 - One dedicated clock for input DFFs (Group A)
 - Two dedicated clocks for output DFFs
- Scan test feature:
 - Scan chain is implemented through the 20 buried JKFFs and 16 output DFFs
 - Pins SCI, SCM, and CKE1 are used to operate the scan test
- Power down mode
 - Dedicated pin (PD) freezes the circuit when brought to logic "1". The circuit remains in the same state prior to the logic "0" to logic "1" transition of the "PD" pin.
 - When in the power down mode, the SCI pin acts as the 3-State pin for the 24 outputs.
- Power on reset:
 - All flip-flops (16 input DFFs, 20 buried JKFFs, and 16 output DFFs) are reset to logic "0" after V_{CC} power on.

ARCHITECTURE

The core of the PML2552 is a programmable NAND array of 96 NAND gates and 20 buried JKFFs. The output of each NAND gate folds back upon itself and all other NAND gates and flip-flops. The 'Q' and 'Q̄' output of each flip-flop also folds back in the same manner. Thus, total connectivity of all logic functions is achieved in the PML2552. Any logic function can be created within the core without wasting valuable I/O pins. Furthermore, a speed advantage is acquired by implementing multi-level logic within a fast internal core without incurring any delays from the I/O buffers. Figure 1 shows the functional block diagram of the PML2552.

Macro Cells

There are 16 bypassable DFFs on the input to the NAND array. These flip-flops are split in two banks of 8 (Bank A and Bank B). Each bank of flip-flops has a common clock. In the

unprogrammed state of the device the flip-flops are active. In order to bypass any DFF, its respective bypass fuse (BFA_x) must be programmed.

The 16 I/O pins (IO₀ - IO₁₅) and their respective D flip-flop macros can be used in any one of the following configurations:

1. As combinatorial input(s). Each of the 16 3-State outputs can be individually disabled by the associated NAND term and the pin is used as an inverting or non-inverting input.
2. As registered DFF outputs. These DFFs are split into two banks of 8, and each bank is clocked separately. The bypass fuse BFB_x (see PML2552 Logic Diagram) is used to bypass any one of these DFFs. The flip-flops are all active in an unprogrammed device.
3. As combinatorial outputs. By programming the bypass (BFB_x) fuse of any one of the DFFs, the flip-flop(s) is bypassed. The I/O pin can then be used as a combinatorial output.
4. As Internal foldback DFFs or foldback NAND gates. When the I/O pin is used as an input, the output macro can be used as an internal DFF or a foldback NAND term. If the bypass fuse is programmed, the macro will act as a foldback NAND term. Otherwise it will act as an internal DFF.

The 8 bidirectional pins (B0-B7) can be used as either combinatorial inputs or outputs with programmable polarity. The Exclusive-OR polarity gates are non-inverting in the unprogrammed state.

The NAND signal labeled 'OD' (Output Disable) shown on the PML2552 logic diagram is used for the Power Down mode operation. This signal disables the outputs when the device enters the Power Down mode and SCI is high.

Clock Array

The 20 buried JKFFs can be clocked through the 'Clock Array'. The Clock Array consists of 11 NAND terms. Ten of these terms are connected to the clock inputs of the Bank A flip-flops that can be clocked individually. One NAND gate is connected to Bank B flip-flops that have a common clock. There are 18 inputs to the clock array. Four come directly from the input pins (with programmable polarity), 4 inputs are from 4 NAND gates connected directly to the folded NAND array, 10 inputs are from the Q outputs of the JKFFs with clear.

CMOS high density programmable macro logic

PML2552

SCAN TEST FEATURE

With the rise in the ratio of devices on a chip to the number of I/O pins, Design For Testability is becoming an essential factor in logic design methodology. The PML2552 incorporates a variable length scan test feature which permits access to the internal flip-flop nodes without requiring a separate external I/O pin for each node accessed. Figure 2 (Scan Mode Operation) shows how a scan chain is implemented through the 20 buried JKFFs and 16 output DFFs. Two dedicated pins, SCI (Scan In) and SCM (Scan Mode), are used to operate the scan test. The SCM pin is used to put the circuit in scan mode. When this pin is brought to a logic "1", the circuit enters the scan mode.

In this mode it is possible to shift an arbitrary test pattern into the flip-flops. The SCI pin is used to input the pattern. The inverted outputs of flip-flops D0 - D15 are observable on pins I/O0 - I/O15.

The following are features and characteristics of the device when in Scan Mode:

1. CKE1 is the common scan-clock for all the flip-flops when in scan mode. CKE1 overrides all clock resources of normal operational mode.
2. The Preset (PR) and Clear (CL) functions of the flip-flops are disabled.
3. Scan overrides the bypass fuse of the flip-flops. This means that all the

bypassable DFFs remain intact during scan operation even though they may have been bypassed during normal operation.

4. To observe the SCAN data, the output buffers must be enabled by the Output Enable (tri-ctrl) terms.
5. The outputs of the flip-flops are complemented on pins I/O0 - I/O15.
6. All external inputs to flip-flops in the scan chain are disabled when the device enters the scan mode.
7. Blowing the security fuse does not disable the Scan Test feature.

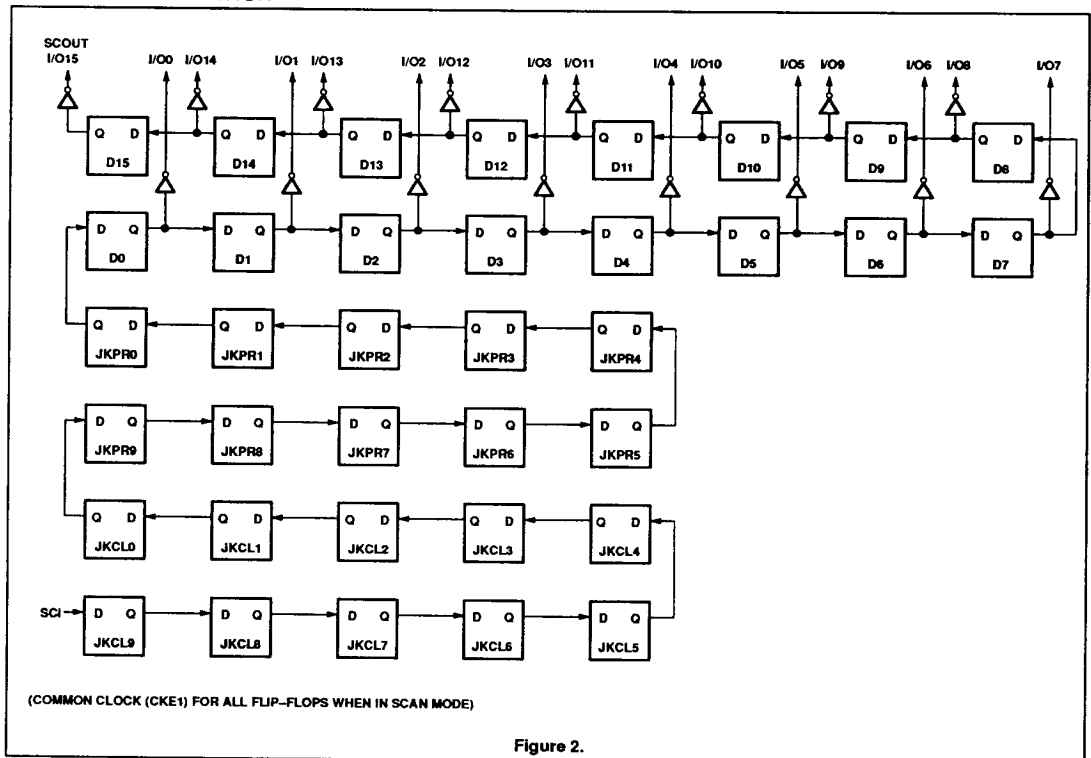
SCAN MODE OPERATION

Figure 2.

CMOS high density programmable macro logic

PML2552

SCAN TEST STRATEGY

The scan test pattern is design dependent and the user must make considerations for Design For Testability (DFT) during the initial stages of the design. A typical test sequence is to pre-load (i.e., enter a state); revert to normal operation (i.e., activate the next state transition); go back to scan mode to check the result. Note that the scan test feature available in the PML2552 is a variable length scan chain. The DATA entered at SCI (JKCL9) can be accessed anywhere between 21 clock cycles (at I/O0) to 36 clock cycles (at I/O15). For the strategy discussed here, DATA is read out after 36 clocks at I/O15 (i.e., D15). The following operation sequence suggests a possible scan test method.

A conservative test policy demands proof that the test facility is working. Thus, to prove Scan Chain holds and maintains correct data:

- a. Fill chain with several patterns (for example, all ones and all zeros).
- b. Retrieve same patterns.

The user is responsible for managing an external test memory buffer for applied vectors and results, as part of the test equipment.

1. Parallel readout of I/O0 - I/O15 is possible, but assume only I/O15 is used for this strategy.
2. The first DATA entered at SCI (or JKCL9) will be the content of D15 after 36 clocks. This DATA will be inverted at the output pin I/O15 (i.e., SCOUT). The last DATA entering the scan chain will be the content of JKCL9. Thus, the scan chain resembles a first-in-first-out shift register with inverted outputs (I/O0 - I/O15).
3. 'Test Data' is read in at the SCI input and read out of the SCOUT output pin (I/O15). To enter 'Test Data':
 - a. Put device in Scan Mode by applying the scan control signals (SCM=1).
 - b. Clock device with scan clock (CKE1).
 - c. Apply consecutive serial test vectors.
 - d. Read back results as new 'Test Data' (States) are applied. The first 36 outputs read at SCOUT (I/O15) are random ('old') data (e.g., remnant of Step 1).
 - e. Apply 36 'Test Data' until the chain is full.
4. To apply 'Test Data' (States), exit Scan Mode and apply on system clock together with any other possible test vectors.

5. To read result of the state transition, re-enter scan and apply the scan clock (CKE1). The result of the state transition in JKCL9 will be available at SCOUT (I/O15) after 36 clocks. The results can be stored in a user defined test memory buffer in inverted logic representation.
6. As the results are being read and stored, new 'Test Data' can be entered via SCI.
7. Repeat for all test patterns of interest.
8. Figure 3 (FLOW_CHART) depicts a flow chart version of the test sequence.

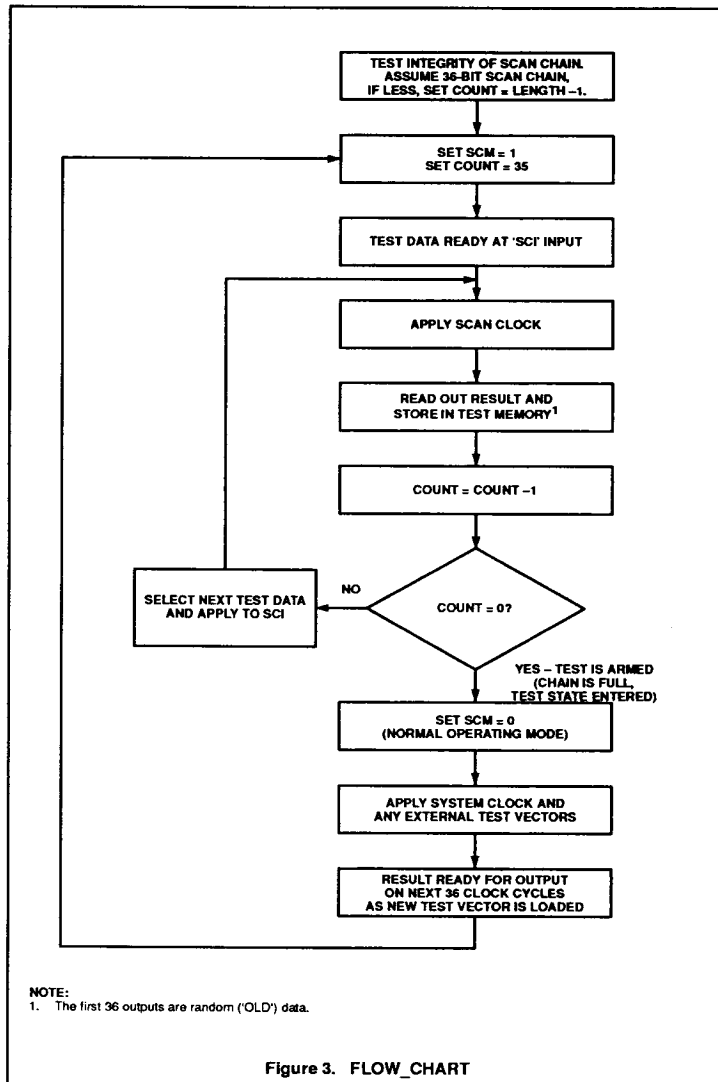


Figure 3. FLOW_CHART

CMOS high density programmable macro logic

PML2552

A Simple Example

Assume the last three cells of the scan chain (JKCL9, JKCL8, JKCL7 in Figure 4 contain a 3-bit up counter. Our test vector will be a single clock applied to the counter. Suppose we wish to first check the *State 5* (i.e., 101) to *State 6* (i.e., 110) transition, then the *State 3* (i.e., 011) to *State 4* (i.e., 100) transition. Assume the scan chain has been pre-verified and we may begin.

Enter scan mode (set $SCM=1$)! apply 36 bits in sequence so that the value 101 (i.e., State 5) resides in the last three cells. Exit scan mode (set $SCM=0$) and apply a single clock to the counter. Now the value 110 (i.e., State 6) resides in the last three cells. Re-enter scan mode (set $SCM=1$) and read back 36 bits from position I/O15. Note that the outputs are complemented and are also read back in the reverse order. Therefore the value for *STATE 6* read at I/O15 will be 100 which is the complement of *STATE 6* (110) read in the reverse order.

As this is being read back, apply a new state, serially equal to the value 011 (i.e., State 3). This state should be loaded on the last three clock cycles during which *STATE 6* is being read back at I/O15. After *STATE 3* has been loaded (and *STATE 6* read back), exit scan mode and apply a single clock which will invoke the *STATE 3* (i.e., 011) to *STATE 4* (i.e., 100) transition. Re-enter scan mode and read back 36 bits at I/O15. The last three bits should contain 110 which is the complement of *State 4* read in the reverse order. Figure 4 (SCAN_EXAMPLE) shows a flow diagram of this example. Note that the States will always be complemented and read back in the reverse at I/O15. Other sequences may be applied in the same manner.

A possible alternative to this example is to read back the output states at I/O0 (D0) instead of I/O15 (JKCL9). This will allow the outputs to be read back after 21 clock cycles rather than the 36 used in the above example.

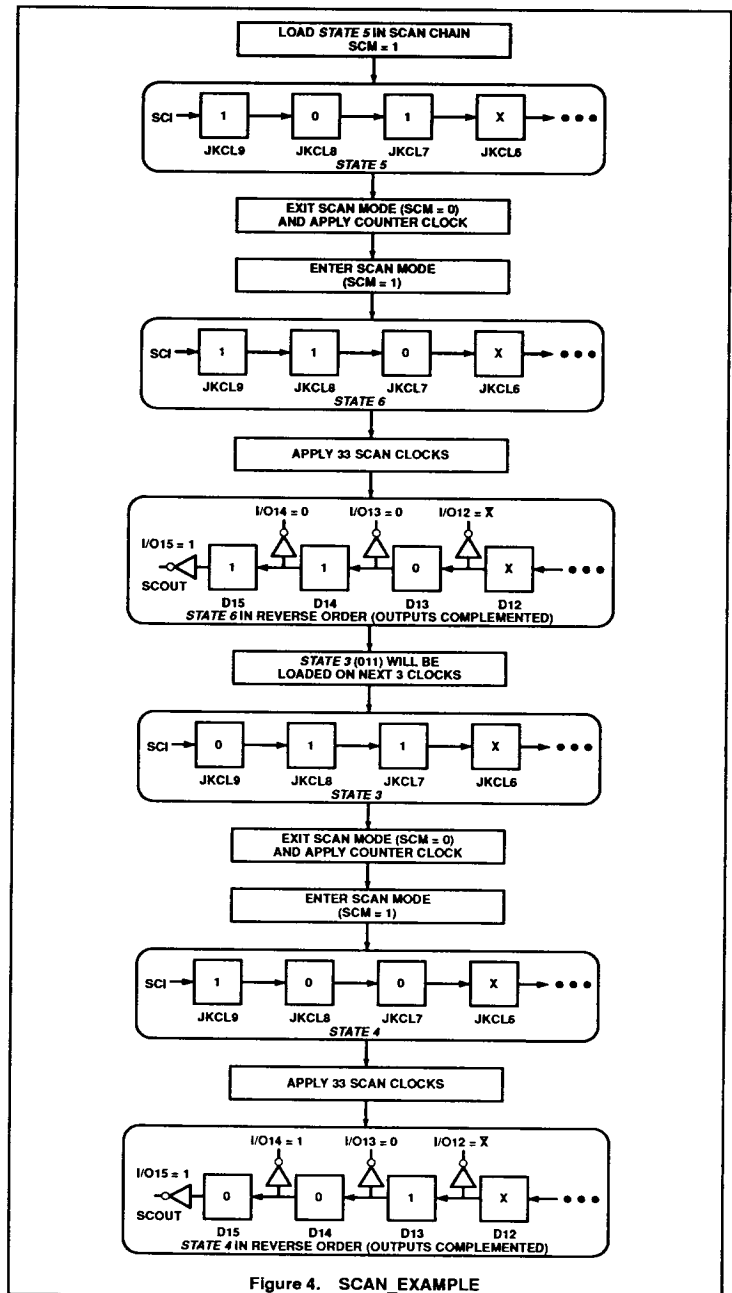


Figure 4. SCAN_EXAMPLE

CMOS high density programmable macro logic

PML2552

POWER DOWN

The PML2552 offers the user controlled capability of putting the device to "sleep" where power dissipation is reduced to very low levels. When brought to a logic "1", the PD pin freezes the circuit while reducing the power. All data is retained. This not only includes that of the registers, but also the state of each foldback gate. For those cases where it is desirable to 3-State the outputs, that can be accomplished by raising the SCI pin to a logic "1".

There is one point that should be noted while the circuit is in its power-down mode. The switching of any external clock pin will cause a disruption of the data. All clocks must be frozen before the circuit goes into power-down and stay that way until it powered back up. Clocks that are internally generated and feed the clock array are automatically stopped by the power-down circuitry. Any other input can toggle without any loss of data.

NOTE:

1. During power down, external clocks (CKA, CKB/CKC, CK1, CK2) should not change.
2. SCM must be "0" as in normal operation mode.
3. External clock recovery time (low-to-high) is 60ns (high-speed) and 70ns (standard) after the device is powered up.
4. Power Down Timing Diagrams on pages 17 and 18 are for combinatorial operation only.

ABSOLUTE MAXIMUM RATINGS¹

SYMBOL	PARAMETER	RATINGS	UNIT
V _{CC}	Supply voltage	+7	V _{DC}
V _{IN}	Input voltage	+5.5	V _{DC}
V _{OUT}	Output voltage	+5.5	V _{DC}
I _{IN}	Input currents	-30 to +30	mA
I _{OUT}	Output currents	+100	mA
T _{amb}	Operating temperature range	0 to +75	°C
T _{stg}	Storage temperature range	-65 to +150	°C

NOTE:

1. Stresses above those listed may cause malfunction or permanent damage to the device. This is a stress rating only. Functional operation at these or any other condition above those indicated in the operational and programming specification of the device is not implied.

DEVELOPMENT TOOLS

The PM2552 is supported by the Philips Semiconductors SNAP software development package and a multitude of hardware and software development tools. These include industry standard PLD programmers and CAD software.

SNAP**Features**

- Schematic entry using DASH™ 4.0 or above or OrCAD™ SDT III
- State Equation Entry
- Boolean Equation Entry
- Allows design entry in any combination of above formats
- Simulator
 - Logic and fault simulation
 - Timing model generation for device timing simulation
 - Synthetic logic analyzer format
- Macro library for standard TTL and user defined functions
- Device independent netlist generation
- JEDEC fuse map generated from netlist

SNAP (Synthesis, Netlist, Analysis and Program) is a versatile development tool that speeds the design and testing of PML. SNAP

combines a user-friendly environment and powerful modules that make designing with PML simple. The SNAP environment gives the user the freedom to design independent of the device architecture.

The flexibility in the variations of design entry methodologies allows design entry in the most appropriate terms. SNAP merges the inputs, regardless of the type, into a high-level netlist for simulation or compilation into a JEDEC fuse map. The JEDEC fuse map can then be transferred from the host computer to the device programmer.

SNAP's simulator uses a synthetic logic analyzer format to display and set the nodes of the design. The SNAP simulator provides complete timing information, setup and hold-time checking, plus toggle and fault grading analysis.

SNAP operates on an IBM® PC/XT, PC/AT, PS/2, or any compatible system with DOS 2.1 or higher. A minimum of 640K bytes of RAM is required together with a hard disk.

DESIGN SECURITY

The PML2552 has a programmable security fuse that controls the access to the data programmed in the device. By using this programmable feature, proprietary design implemented in the device cannot be copied or retrieved.

THERMAL RATINGS

TEMPERATURE	
Maximum junction	150°C
Maximum ambient	75°C
Allowable thermal rise ambient to junction	75°C

DASH is a trademark of Data I/O Corporation.

OrCAD is a trademark of OrCAD, Inc.

IBM is a registered trademark of International Business Machines Corporation.

CMOS high density programmable macro logic

PML2552

DC ELECTRICAL CHARACTERISTICS

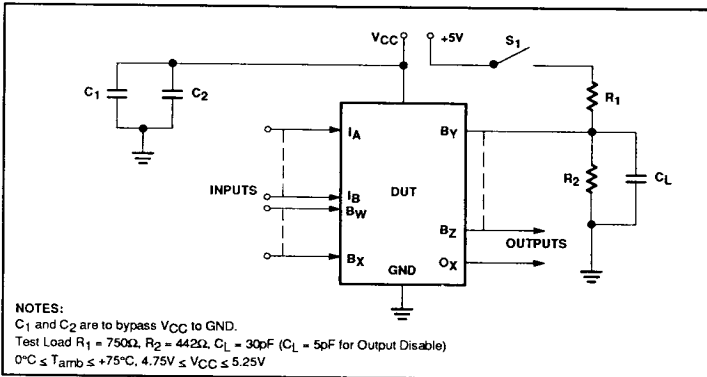
$0^{\circ}\text{C} \leq T_{\text{amb}} \leq +75^{\circ}\text{C}$, $4.75\text{V} \leq V_{\text{CC}} \leq 5.25\text{V}$

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNIT	
			MIN	TYP ¹	MAX		
Input voltage							
V_{IL}	Low	$V_{\text{CC}} = \text{MIN}$	-0.3		0.8	V	
V_{IH}	High	$V_{\text{CC}} = \text{MAX}$	2.0		$V_{\text{CC}} + 0.3$	V	
Output voltage							
V_{OL}	Low	$V_{\text{CC}} = \text{MIN}$, $I_{\text{OL}} = 5\text{mA}$			0.45	V	
V_{OH}	High	$V_{\text{CC}} = \text{MIN}$, $I_{\text{OH}} = -2\text{mA}$	2.4			V	
Input current							
I_{IL}	Low	$V_{\text{IN}} = \text{GND}$			-10	μA	
I_{IH}	High	$V_{\text{IN}} = V_{\text{CC}}$			10	μA	
Output current							
$I_{\text{O(OFF)}}$	Hi-Z state	$V_{\text{OUT}} = V_{\text{CC}}$ $V_{\text{OUT}} = \text{GND}$			10 -10	μA μA	
I_{OH}	Output High	$V_{\text{CC}} = \text{MIN}$, $V_{\text{OUT}} = 2.4\text{V}$			-2	mA	
I_{OL}	Output Low	$V_{\text{CC}} = \text{MIN}$, $V_{\text{OUT}} = 0.45\text{V}$			5	mA	
I_{OS}	Short-circuit ⁶	$V_{\text{OUT}} = \text{GND}$			-100	mA	
I_{CC}	V_{CC} supply current	$V_{\text{CC}} = \text{MAX}$, No load $f = 1\text{MHz}$	CMOS input ²		60	100 ⁶	mA mA
I_{SB}	Standby V_{CC} supply current	$V_{\text{CC}} = \text{MAX}$, No load $\text{PD} = V_{\text{IH}}$	TTL input ³ CMOS input TTL input		65 1.0 1.5	120 ⁶ 10 10	mA mA mA
Capacitance							
C_{IN}	Input	$V_{\text{CC}} = 5\text{V}$, $T_{\text{amb}} = +25^{\circ}\text{C}$, $V_{\text{IN}} = 2.0\text{V}$			8	pF	
C_{B}	I/O	$V_{\text{CC}} = 5\text{V}$, $T_{\text{amb}} = +25^{\circ}\text{C}$, $V_{\text{IO}} = 2.0\text{V}$			16	pF	

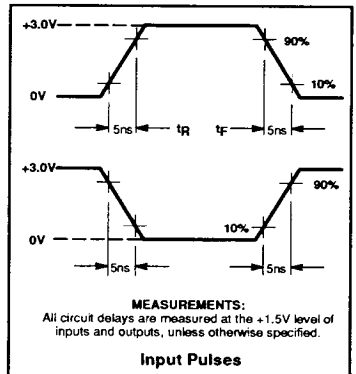
NOTES:

1. All typical values are at $V_{\text{CC}} = 5\text{V}$, $T_{\text{amb}} = +25^{\circ}\text{C}$.
2. CMOS inputs: $V_{\text{IL}} = \text{GND}$, $V_{\text{IH}} = V_{\text{CC}}$.
3. TTL inputs: $V_{\text{IL}} = 0.45\text{V}$, $V_{\text{IH}} = 2.4\text{V}$.
4. All voltage values are with respect to network ground terminal.
5. Duration of short-circuit should not exceed one second. Test one at a time.
6. ΔI_{CC} vs. Frequency = 4mA/MHz max.

TEST LOAD CIRCUITS



VOLTAGE WAVEFORMS



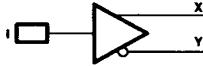
CMOS high density programmable macro logic

PML2552

MACRO CELL AC SPECIFICATIONS

Min: 0°C, 5.25V; Typ: 25°C, 5.0V; Max: 75°C, 4.75V (SNAP Resource Summary Designations in Parentheses)

Input Buffer
(DIN552, NIN552, BDIN55, BNIN552
CDIN552, CNIN552, CKDIN552, CKNIN552, IDFF552*)



SYMBOL	PARAMETER		LIMITS						UNIT
	To (Output)	From (Input)	PML2552-35			PML2552-50			
			MIN	TYP	MAX	MIN	TYP	MAX	
t _{PHL}	X	I	5	7	10	7	10	15	ns
t _{PLH}	X	I	5	7	10	7	10	15	ns
t _{PHL}	Y	I	5	7	10	7	10	15	ns
t _{PLH}	Y	I	5	7	10	7	10	15	ns

* When D flip-flop is bypassed.

Input Pins: 8–14, 16, 17, 20, 22–24.

Bidirectional Pins: 1–3, 5–7, 46–48, 50–54, 57–64, 67, 68.

Bypassed D flip-flop at pins 26, 28–31, 33–35, 37, 39–45.

Internal NAND of Main Array
(FBNAND, NAND)



SYMBOL	PARAMETER		LIMITS			LIMITS			UNIT
	To (Output)	From (Input)	PML2552-35			PML2552-50			
			MIN	TYP	MAX	MIN	TYP	MAX	
t _{PHL}	Y	X	10	15	20	12	18	25	ns
t _{PLH}	Y	X	10	15	20	12	18	25	ns

Internal NAND of Clock Array
(NAND)



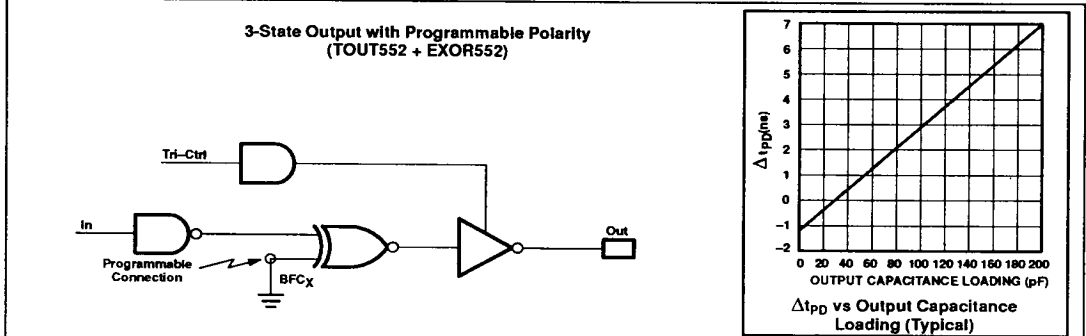
SYMBOL	PARAMETER		LIMITS			LIMITS			UNIT
	To (Output)	From (Input)	PML2552-35			PML2552-50			
			MIN	TYP	MAX	MIN	TYP	MAX	
t _{PHL}	Y	X	5	7	10	7	10	15	ns
t _{PLH}	Y	X	5	7	10	7	10	15	ns

CMOS high density programmable macro logic

PML2552

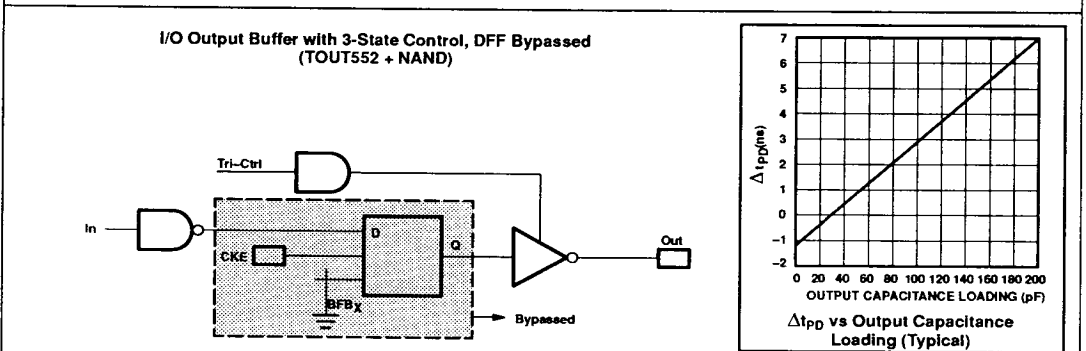
MACRO CELL AC SPECIFICATIONS (Continued)

Min: 0°C, 5.25V; Typ: 25°C, 5.0V; Max: 75°C, 4.75V (SNAP Resource Summary Designations in Parentheses)



SYMBOL	PARAMETER		LIMITS						UNIT
	To (Output)	From (Input)	PML2552-35			PML2552-50			
			MIN	TYP	MAX	MIN	TYP	MAX	
t_{PHL}	Out	In	12	18	25	17	25	35	ns
t_{PLH}	Out	In	12	18	25	17	25	35	ns
t_{OE}^4	Out	Tri-Ctrl	5	7	10	7	10	15	ns
t_{OD}^4	Out	Tri-Ctrl	5	7	10	7	10	15	ns

Bidirectional Pins: 46-48, 50-54.



SYMBOL	PARAMETER		LIMITS						UNIT
	To (Output)	From (Input)	PML2552-35			PML2552-50			
			MIN	TYP	MAX	MIN	TYP	MAX	
t_{PHL}	Out	In	12	18	25	17	25	35	ns
t_{PLH}	Out	In	12	18	25	17	25	35	ns
t_{OE}^4	Out	Tri-Ctrl	5	7	10	7	10	15	ns
t_{OD}^4	Out	Tri-Ctrl	5	7	10	7	10	15	ns

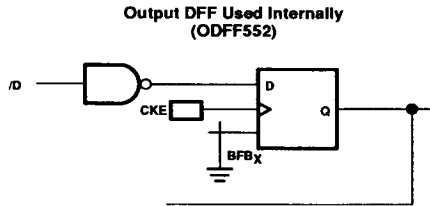
I/O Pins: 1-3, 5-7, 57-64, 67, 68.

Notes on page 481.

CMOS high density programmable macro logic

PML2552

MACRO CELL AC SPECIFICATIONS (Continued) (SNAP Resource Summary Designations in Parentheses)
D FLIP-FLOP



SYMBOL	PARAMETER	LIMITS						UNIT
		PML2552-35			PML2552-50			
		MIN	TYP	MAX	MIN	TYP	MAX	
f_{CKE}	Flip-flop toggle rate			50			35	MHz
$t_{w_{CKE\ High}}$	Clock HIGH	10			14			ns
$t_{w_{CKE\ Low}}$	Clock LOW	10			14			ns
$t_{SETUP\ /D}$	/D setup time to CKE	15			20			ns
$t_{HOLD\ /D}$	/D hold time to CKE	4			6			ns

SYMBOL	PARAMETER		LIMITS						UNIT
	From (Input)	To (Output)	PML2552-35			PML2552-50			
			MIN	TYP	MAX	MIN	TYP	MAX	
t_{PLH}	CKE ↑	Q	10	15	20	14	20	25	ns
t_{PHL}	CKE ↓	Q	10	15	20	14	20	25	ns

CMOS high density programmable macro logic

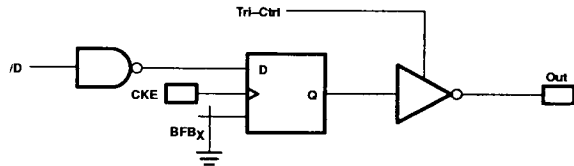
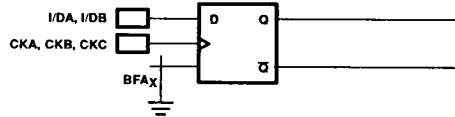
PML2552

MACRO CELL AC SPECIFICATIONS (Continued) (SNAP Resource Summary Designations in Parentheses) D FLIP-FLOP (Continued)

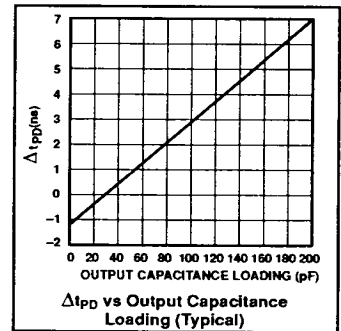
Input and Output (IDFF552 & ODF552)

INPUTS		OUTPUTS	
CK	D	Q	\bar{Q}
L	X	Q_0	\bar{Q}_0
↑	H	H	L
↑	L	L	H

NOTE:
 Q_0, \bar{Q}_0 represent previous stable condition of Q, \bar{Q} .



SYMBOL	LIMITS						UNIT
	PML2552-35			PML2552-50			
	MIN	TYP	MAX	MIN	TYP	MAX	
$f_{CKA, CKB, CKC}$			50			35	MHz
t_w CKA, CKB, CKC High	10			14			ns
t_w CKA, CKB, CKC Low	10			14			ns
t_{SETUP} I/DA, I/DB	5			7			ns
t_{HOLD} I/DA, I/DB	5			7			ns
f_{CKE}			50			35	MHz
t_w CKE High	10			14			ns
t_w CKE Low	10			14			ns
t_{SETUP} /D	15			20			ns
t_{HOLD} /D	4			6			ns



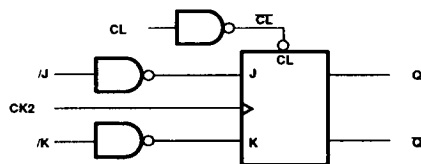
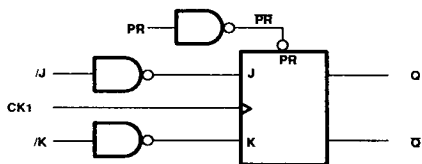
SYMBOL	PARAMETER		LIMITS						UNIT
	From (Input)	To (Output)	PML2552-35			PML2552-50			
			MIN	TYP	MAX	MIN	TYP	MAX	
t_{PLH}	CKA, CKB/CKC ↑	Q, \bar{Q}	5	7	10	7	10	15	ns
t_{PHL}		Q, \bar{Q}	5	7	10	7	10	15	ns
t_{PLH}	CKE ↑	Out	12	18	25	17	25	35	ns
t_{PHL}		Out	12	18	25	17	25	35	ns

CMOS high density programmable macro logic

PML2552

MACRO CELL AC SPECIFICATIONS (Continued) (SNAP Resource Summary Designations in Parentheses)
JK FLIP-FLOPS

(JKPR552)						(JKCL552)					
INPUTS				OUTPUTS		INPUTS				OUTPUTS	
PR	CK	J	K	Q	\bar{Q}	CL	CK	J	K	Q	\bar{Q}
L	X	X	X	H	L	L	X	X	X	L	H
H	\uparrow	L	L	Q_0	\bar{Q}_0	H	\uparrow	L	L	Q_0	\bar{Q}_0
H	\uparrow	H	L	H	L	H	\uparrow	H	L	H	L
H	\uparrow	L	H	L	H	H	\uparrow	L	H	L	H
H	\uparrow	H	H	TOGGLE		H	\uparrow	H	H	TOGGLE	
H	L	X	X	Q_0	\bar{Q}_0	H	L	X	X	Q_0	\bar{Q}_0



SYMBOL	PARAMETER	LIMITS						UNIT
		PML2552-35			PML2552-50			
		MIN	TYP	MAX	MIN	TYP	MAX	
f_{CK1}	CK1 toggle frequency			50			35	MHz
f_{CK2}	CK2 toggle frequency			50			35	MHz
$t_{w_{CK1}} \text{ High}$	CK1 clock HIGH	10			14			ns
$t_{w_{CK1}} \text{ Low}$	CK1 clock LOW	10			14			ns
$t_{w_{CK2}} \text{ High}$	CK2 clock HIGH	10			14			ns
$t_{w_{CK2}} \text{ Low}$	CK2 clock LOW	10			14			ns
$t_{SETUP} /J, /K$	/J, /K setup time to CK1, CK2	27			35			ns
$t_{HOLD} /J, /K$	/J, /K hold time to CK1, CK2	0			0			ns
$t_{w \text{ PR Low}}$	Preset Low period	10			14			ns
$t_{w \text{ CL Low}}$	Clear Low period	10			14			ns

SYMBOL	PARAMETER		LIMITS						UNIT
	From (Input)	To (Output)	PML2552-35			PML2552-50			
			MIN	TYP	MAX	MIN	TYP	MAX	
t_{PLH}	CK1,2	Q, \bar{Q}	2	3.5	5	3	5	7	ns
t_{PHL}	CK1,2	Q, \bar{Q}	2	3.5	5	3	5	7	ns
t_{PLH}	PR	Q, \bar{Q}	12	18	25	17	24	30	ns
t_{PHL}	PR	Q, \bar{Q}	12	18	25	17	24	30	ns
t_{PLH}	CL	Q, \bar{Q}	12	18	25	17	24	30	ns
t_{PHL}	CL	Q, \bar{Q}	12	18	25	17	24	30	ns

CMOS high density programmable macro logic

PML2552

AC ELECTRICAL CHARACTERISTICS0°C ≤ T_{amb} ≤ +75°C, 4.75V ≤ V_{CC} ≤ 5.25V, V_{PP} = V_{CC},R₁ = 750Ω, R₂ = 442Ω, C_L = 5pF for Output Disable) (See Test Load Circuit Diagram)

SYMBOL	PARAMETER	LIMITS				UNIT
		PML2552-35		PML2552-50		
		MIN	MAX	MIN	MAX	
Scan mode operation¹						
t _{SCMS}	Scan Mode (SCM) Setup time	15		15		ns
t _{SCMH}	Scan Mode (SCM) Hold time	25		30		ns
t _{IS}	Data Input (SCI) Setup time	5		5		ns
t _{IH}	Data Input (SCI) Hold time	5		5		ns
t _{CKO}	Clock to Output (I/O) delay		30		40	ns
t _{CKH}	Clock High	10		15		ns
t _{CKL}	Clock Low	10		15		ns
Power down, power up²						
t ₁	Input (I, bypassed I/DA, I/DB, I/O, B) setup time before power down	40		50		ns
t ₂	Input hold time	30		35		ns
t ₃	Power Up recovery time		60		70	ns
t ₄	Output hold time	0		0		ns
t ₅	Input setup time before Power Up	20		25		ns
t _{OE}	SCI to Output Enable time ³		40		50	ns
t _{OD}	SCI to Output Disable time ³		40		50	ns
t ₆	Power Down setup time	10		15		ns
t ₇	Power Up to Output valid		70		80	ns
Power-on reset						
t _{PPR1}	Power-on reset output register (Q = 0) to output (I/O) delay		10		15	ns
t _{PPR2}	Power-on reset input register (Q = 0), buried JK Flip-Flop (Q = 0) to output (B, bypassed I/O) delay		40		50	ns

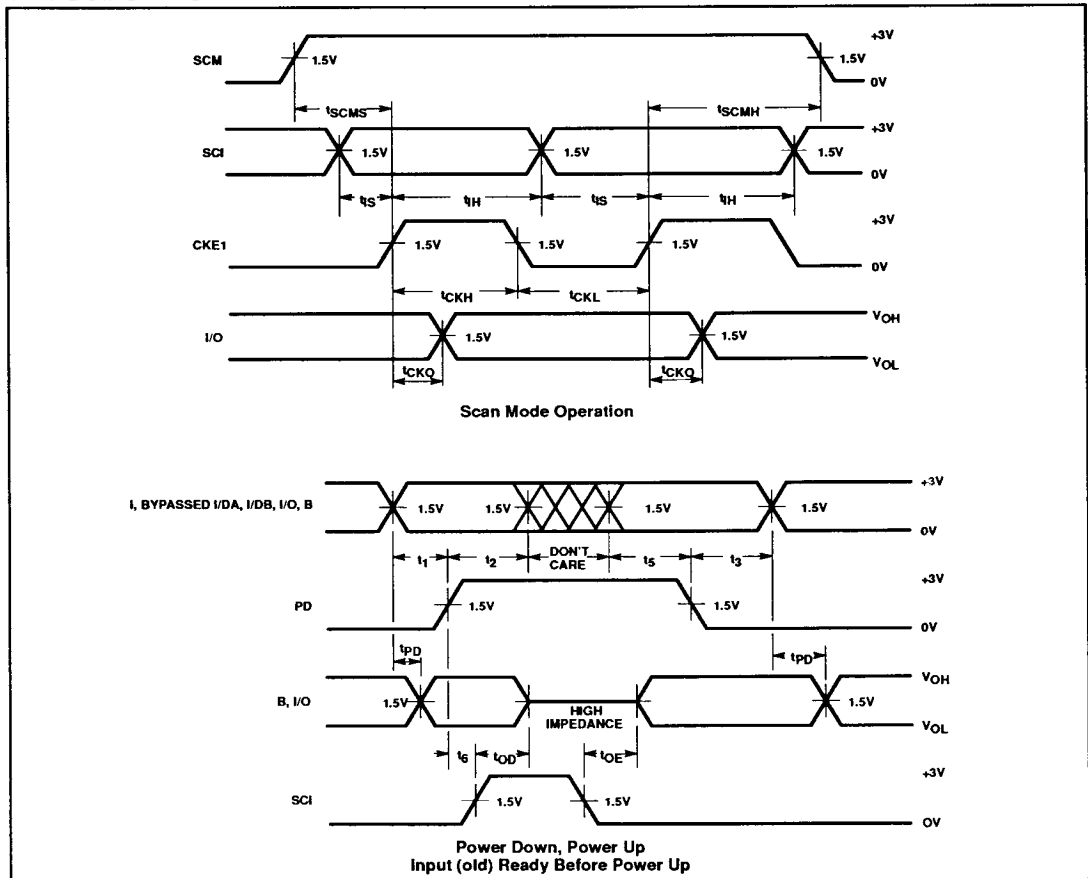
NOTES:

- SCM recovery time is 50ns after SCM operation. 50ns after SCM operation, normal operations can be resumed.
- Timings are measured without foldbacks.
- Transition is measured at steady state High level (-500mV) or steady state Low level (+500mV) on the output from 1.5V level on the input with specified test load (R₁ = 750Ω, R₂ = 442Ω, C_L = 5pF). This parameter is sampled and not 100% tested.
- For 3-State output; output enable times are tested with C_L = 30pF to the 1.5V level, and S₁ is open for high-impedance to High tests and closed for high-impedance to Low tests. Output disable times are tested with C_L = 5pF. High-to-High impedance tests are made to an output voltage of V_T = (V_{OH} - 0.5V) with S₁ open, and Low-to-High impedance tests are made to the V_T = (V_{OL} + 0.5V) level with S₁ closed.

CMOS high density programmable macro logic

PML2552

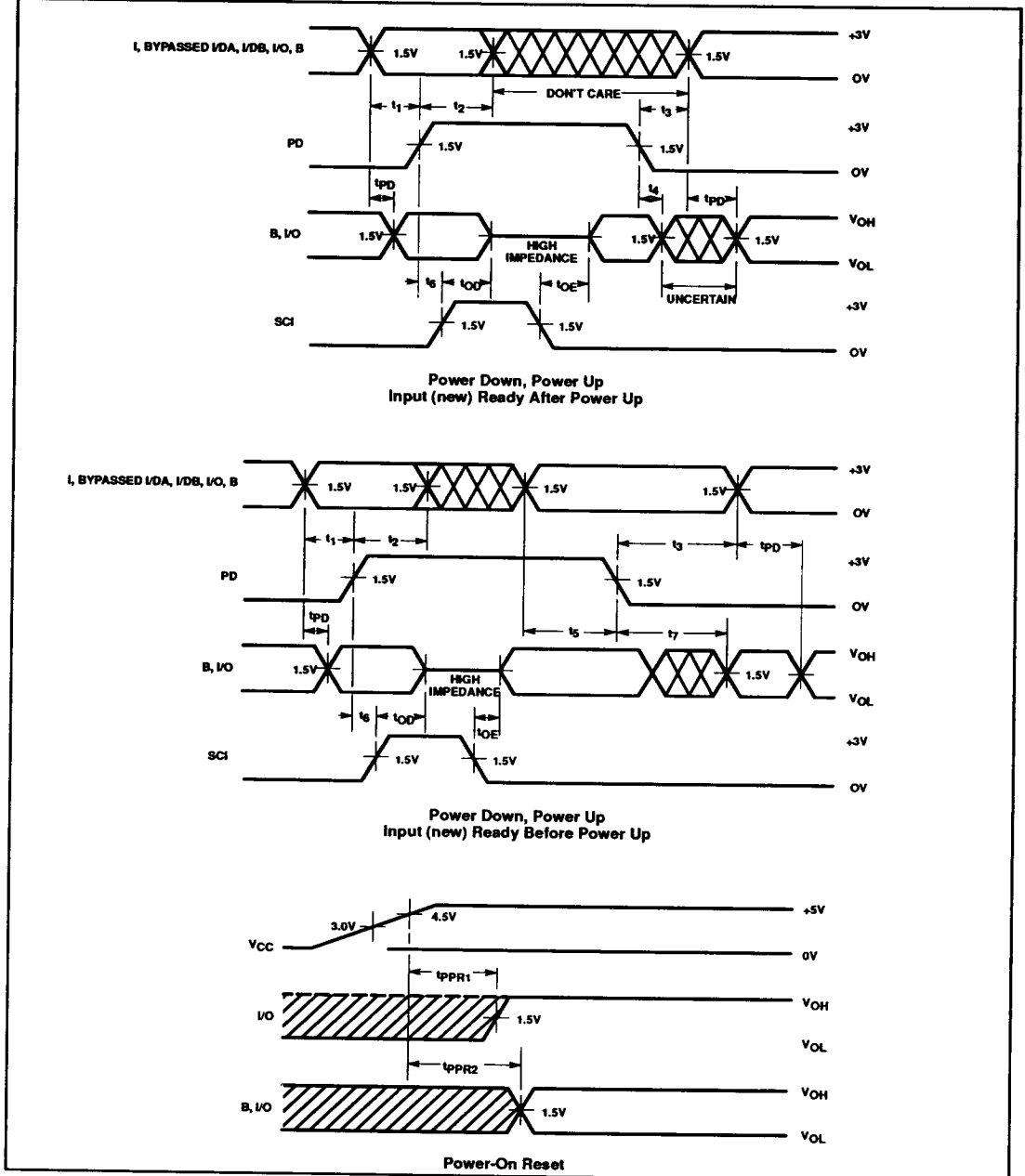
TIMING DIAGRAMS



CMOS high density programmable macro logic

PML2552

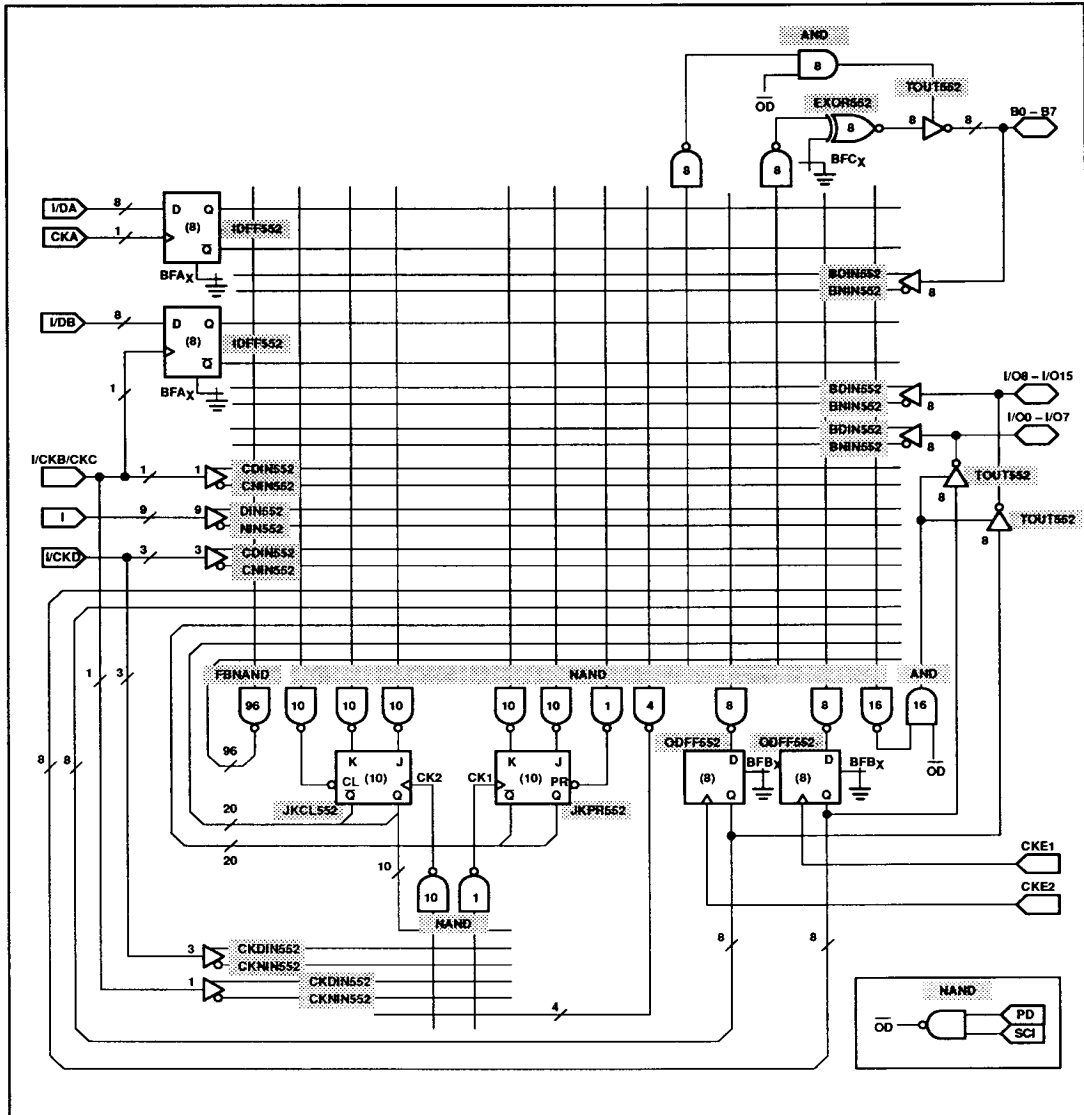
TIMING DIAGRAMS (Continued)



CMOS high density programmable macro logic

PML2552

SNAP RESOURCE SUMMARY DESIGNATIONS



CMOS high density programmable macro logic

PML2552**ERASURE CHARACTERISTICS
(For Quartz Window Packages
Only)**

The erasure characteristics of the PML2552 device is such that erasure begins to occur upon exposure to light with wavelengths shorter than approximately 4000 Angstroms (Å). It should be noted that sunlight and certain types of fluorescent lamps have wavelengths in the 3000 – 4000Å range. Data shows that constant exposure to room level fluorescent lighting could erase a typical PML2552 in approximately three years, while it would take approximately one week to cause erasure when exposed to direct sunlight. If the PML2552 is to be exposed to

these types of lighting conditions for extended periods of time, opaque labels should be placed over the window to prevent unintentional erasure.

The recommended erasure procedure for the PML2552 is exposure to shortwave ultraviolet light which has a wavelength of 2537 Angstroms (Å). The integrated dose (i.e., UV intensity × exposure time) for erasure should be a minimum of 15Wsec/cm². The erasure time with this dosage is approximately 30 to 35 minutes using an ultraviolet lamp with a 12,000μW/cm² power rating. The device should be placed within one inch of the lamp tubes during erasure. The maximum integrated dose a CMOS EPLD can be

exposed to without damage is 7258Wsec/cm² (1 week @ 12,000μW/cm²). Exposure of these CMOS EPLDs to high intensity UV light for longer periods may cause permanent damage.

The maximum number of guaranteed erase/write cycles is 50. Data retention exceeds 20 years.

**PROGRAMMING/SOFTWARE
SUPPORT**

Refer to Section 9 (*Development Software*) and Section 10 (*Third-party Programmer/Software Support*) of this data handbook for additional information.