



## PA7128 PEEL™ Array Programmable Electrically Erasable Logic Array

### Features

- **CMOS Electrically Erasable Technology**
    - Reprogrammable in 28-pin DIP, SOIC and PLCC packages
  - **Versatile Logic Array Architecture**
    - 12 I/Os, 14 inputs, 36 registers/latches
    - Up to 36 logic cell output functions
    - PLA structure with true product-term sharing
    - Logic functions and registers can be I/O-buried
  - **Flexible Logic Cell**
    - Up to 3 output functions per logic cell
    - D,T and JK registers with special features
    - Independent or global clocks, resets, presets, clock polarity and output enables
    - Sum-of-products logic for output enables
  - **High-Speed Commercial and Industrial Versions**
- As fast as 9ns/15ns (tpdi/tpdx), 83.3MHz (fMAX)
  - Industrial grade available for 4.5 to 5.5V Vcc and -40 to +85 °C temperatures
- **Ideal for Combinatorial, Synchronous and Asynchronous Logic Applications**
    - Integration of multiple PLDs and random logic
    - Buried counters, complex state-machines
    - Comparitors, decoders, other wide-gate functions
  - **Development and Programmer Support**
    - ICT PLACE Development Software
    - Fitters for ABEL, CUPL and other software
    - Programming support by ICT PDS-3 and other popular third-party programmers.

### General Description

The PA7128 is a member of the Programmable Electrically Erasable Logic (PEEL™) Array family based on ICT's CMOS EEPROM technology. PEEL™ Arrays free designers from the limitations of ordinary PLDs by providing the architectural flexibility and speed needed for today's programmable logic designs. The PA7128 offers a versatile logic array architecture with 12 I/O pins, 14 input pins and 36 registers/latches (12 buried logic cells, 12 input registers/latches, 12 buried I/O registers/latches). Its logic array implements 50 sum-of-products logic functions that share 64 product terms. The PA7128's logic and I/O cells (LCCs, IOCs) are extremely flexible offering up to three output functions per cell (a total of 36 for all 12 logic cells). Cells are configurable as D, T and JK registers with independent

or global clocks, resets, presets, clock polarity and other special features, making the PA7128 suitable for a variety of combinatorial, synchronous and asynchronous logic applications. The PA7128 offers pin compatibility and super-set functionality to popular 28-pin PLDs, such as the 26V12. Thus, designs that exceed the architectures of such devices can be expanded upon. The PA7128 supports speeds as fast as 9ns/15ns (tpdi/tpdx) and 83.3MHz (fMAX) at moderate power consumption 105mA (75mA typical). Packaging includes 28-pin DIP, SOIC and PLCC (see Figure 1). Development and programming support for the PA7128 is provided by ICT and popular third-party development tool manufacturers.

Figure 1. Pin Configuration

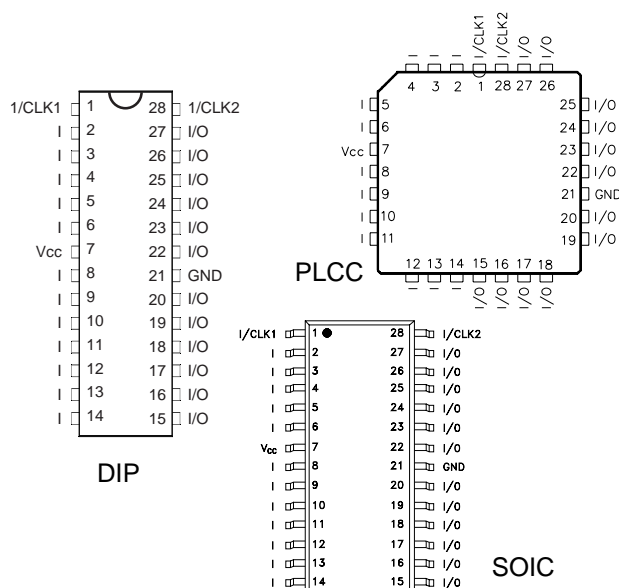
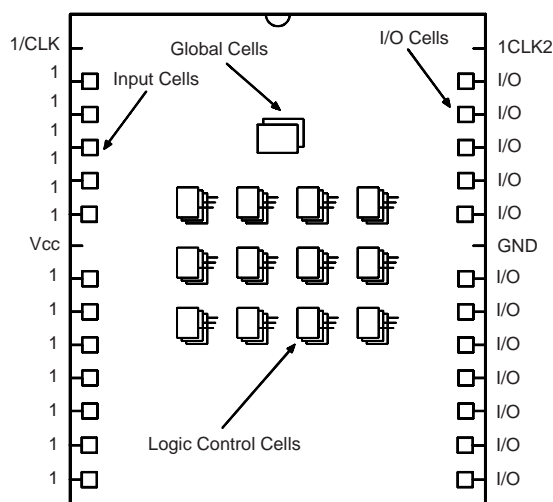


Figure 2. Block Diagram





This device has been designed and tested for the recommended operating conditions. Proper operation outside of these levels is not guaranteed. Exposure to absolute maximum ratings may cause permanent damage

**Table 2. Absolute Maximum Ratings**

Symbol	Parameter	Conditions	Ratings	Unit
VCC	Supply Voltage	Relative to Ground	-0.5 to + 7.0	V
VI, VO	Voltage Applied to Any Pin	Relative to Ground <sup>1</sup>	-0.5 to VCC + 0.6	V
IO	Output Current	Per pin (IOL, IOH)	±25	mA
TST	Storage Temperature		-65 to + 150	°C
TLT	Lead Temperature	Soldering 10 seconds	+300	°C

**Table 3. Operating Ranges**

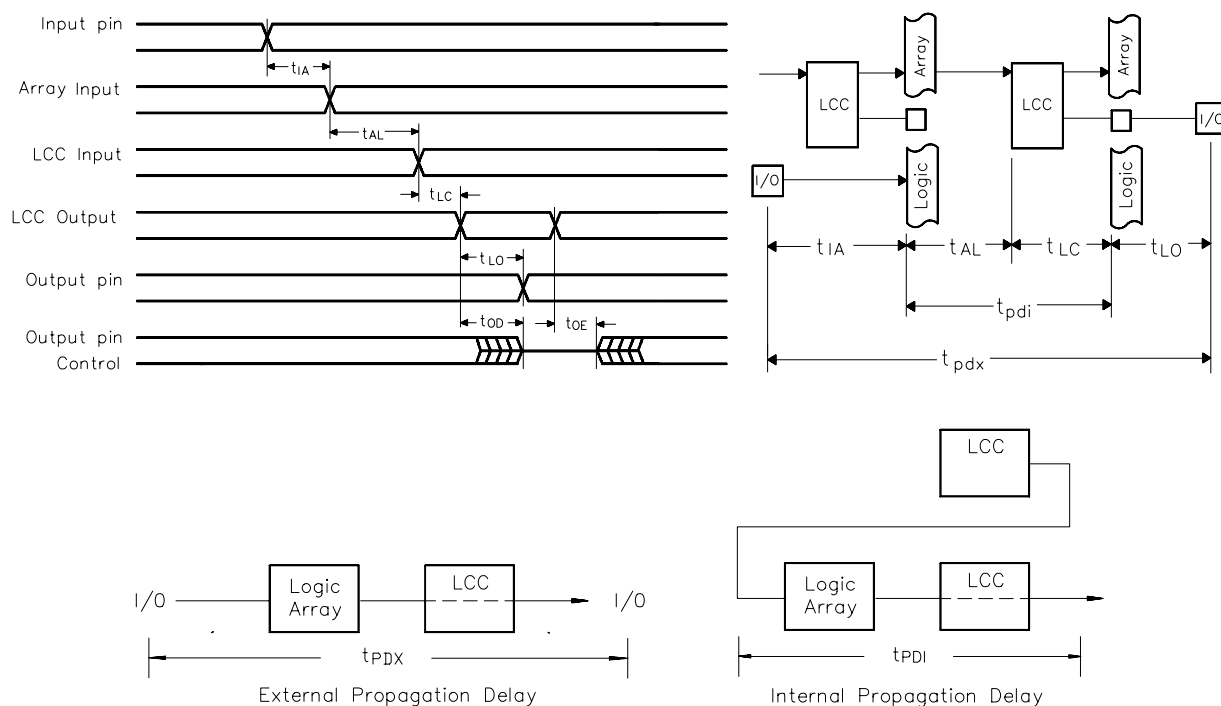
Symbol	Parameter	Conditions	Min	Max	Unit
VCC	Supply Voltage	Commercial	4.75	5.25	V
		Industrial	4.5	5.5	
TA	Ambient Temperature	Commercial	0	+70	°C
		Industrial	-40	+85	
TR	Clock Rise Time	See Note 2		20	ns
TF	Clock Fall Time	See Note 2		20	ns
TRVCC	VCC Rise Time	See Note 2		250	ms

**Table 4. D.C. Electrical Characteristics** Over the recommended operating conditions

Symbol	Parameter	Conditions	Min	Max	Unit	
VOH	Output HIGH Voltage - TTL	VCC = Min, IOH = -4.0mA	2.4		V	
VOHC	Output HIGH Voltage - CMOS	VCC = Min, IOH = -10µA	VCC - 0.3		V	
VOL	Output LOW Voltage - TTL	VCC = Min, IOL = 16mA		0.5	V	
VOLC	Output LOW Voltage - CMOS	VCC = Min, IOL = -10µA		0.15	V	
VIH	Input HIGH Level		2.0	VCC + 0.3	V	
VIL	Input LOW Level		-0.3	0.8	V	
IIL	Input Leakage Current	VCC = Max, GND ≤ VIN ≤ VCC		±10	µA	
IOZ	Output Leakage Current	I/O = High-Z, GND ≤ VO ≤ VCC		±10	µA	
ISC	Output Short Circuit Current <sup>4</sup>	VCC = 5V, VO = 0.5V, TA= 25°C	-30	-120	mA	
ICC <sup>11</sup>	VCC Current	VIN = 0V or VCC <sup>3,11</sup> f = 25MHz All outputs disabled <sup>4</sup>	-15	75 (typ.) <sup>19</sup>	105	mA
			-20		105	
			I-20		115	
CIN <sup>7</sup>	Input Capacitance <sup>5</sup>	TA = 25°C, VCC = 5.0V @ f = 1 MHz		6	pF	
COU <sup>7</sup>	Output Capacitance <sup>5</sup>			12	pF	

**A.C Electrical Characteristics Combinatorial**

Symbol	Parameter <sup>6,12</sup>	-15		-20 / I -20		Unit
		Min	Max	Min	Max	
tPDI	Propagation delay Internal (tAL + tLC)		9		12	ns
tPDX	Propagation delay External (tIA + tAL + tLC + tLO)		15		20	ns
tIA	Input or I/O pin to array input		2		3	ns
tAL	Array input to LCC		8		10	ns
tLC	LCC input to LCC output <sup>10</sup>		1		2	ns
tLO	LCC output to output pin		4		5	ns
tOD, tOE	Output Disable, Enable from LCC output <sup>7</sup>		4		5	ns
tOX	Output Disable, Enable from input pin <sup>7</sup>		15		20	ns

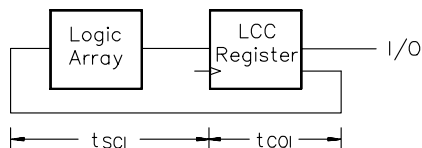
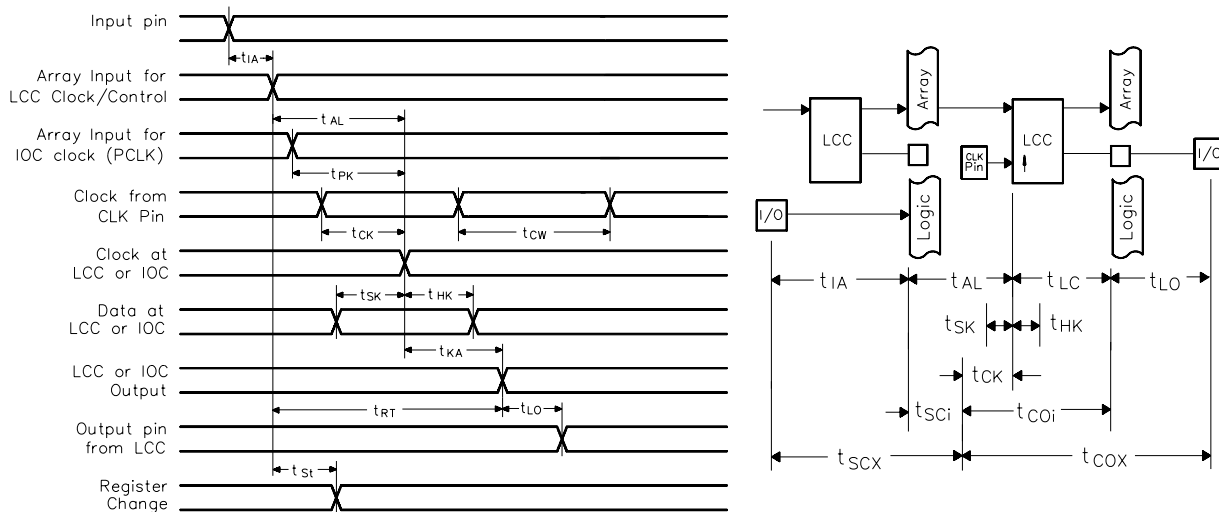
**Combinatorial Timing - Waveforms and Block Diagram**




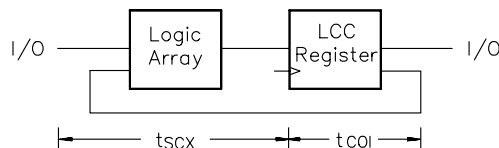
**A.C. Electrical Characteristics Sequential**

Symbol	Parameter <sup>6,12</sup>	-20		-20 / I-20		Unit
		Min	Max	Min	Max	
tSCI	Internal set-up to system clock <sup>8</sup> - LCC <sup>14</sup> (tAL + tSK + tLC - tCK)	5		7		ns
tSCX	Input <sup>16</sup> (EXT.) set-up to system clock, - LCC (tIA + tSCI)	7		10		ns
tCOI	System-clock to Array Int. - LCC/IOC/INC <sup>14</sup> (tCK + tLC)		7		9	ns
tCOX	System-clock to Output Ext. - LCC (tCOI + tLO)		11		14	ns
tHX	Input hold time from system clock - LCC	0		0		ns
tSK	LCC Input set-up to async. clock <sup>13</sup> - LCC	2		2		ns
tAK	Clock at LCC or IOC - LCC output	1		1		ns
tHK	LCC input hold time from system clock - LCC	4		4		ns
tSI	Input set-up to system clock - IOC/INC <sup>14</sup> (tSK - tCK)	0		0		ns
tHI	Input hold time from system clock - IOC/INC <sup>14</sup> (tSK - tCK)	4		5		ns
tPK	Array input to IOC PCLK clock		6		7	ns
tSPI	Input set-up to PCLK clock <sup>17</sup> - IOC/INC (tSK-tPK-tIA)	0		0		ns
tHPI	Input hold from PCLK clock <sup>17</sup> - IOC/INC (tPK+tIA-tSK)	6		8		ns
tSD	Input set-up to system clock - IOC/INC Sum-D <sup>15</sup> (tIA + tAL + tLC + tSK - tCK)	7		10		ns
tHD	Input hold time from system clock - IOC Sum-D	0		0		ns
tSDP	Input set-up to PCLK clock (tIA + tAL + tLC + tSK - tPK) - IOC Sum-D	7		10		ns
tHDP	Input hold time from PCLK clock - IOC Sum-D	0		0		ns
tCK	System-clock delay to LCC/IOC/INC		6		7	ns
tCW	System-clock low or high pulse width	6		7		ns
fMAX1	Max. system-clock frequency Int/Int 1/(tSCI + tCOI)		83.3		62.5	MHz
fMAX2	Max. system-clock frequency Ext/Int 1/(tSCX + tCOI)		71.4		52.6	MHz
fMAX3	Max. system-clock frequency Int/Ext 1/(tSCI + tCOX)		62.5		47.6	MHz
fMAX4	Max. system-clock frequency Ext/Ext 1/(tSCX + tCOX)		55.5		41.6	MHz
fTGL	Max. system-clock toggle frequency 1/(tCW + tCW)		83.3		71.4	MHz
tPR	LCC presents/reset to LCC output		1		2	ns
tST	Input to Global Cell present/reset (tIA + tAL + tPR)		11		15	ns
tAW	Asynch. preset/reset pulse width	8		8		ns
tRT	Input to LCC Reg-Type (RT)		7		9	ns
tRTV	LCC Reg-Type to LCC output register change		1		2	ns
tRTC	Input to Global Cell register-type change (tRT + tRTV)		8		11	ns
tRW	Asynch. Reg-Type pulse width	10		10		ns
tRESET	Power-on reset time for registers in clear state <sup>2</sup>		5		5	µs

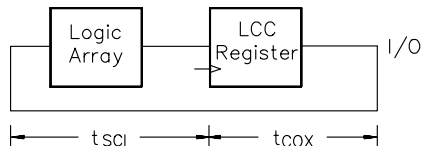
## Sequential Timing - Waveforms and Block Diagram



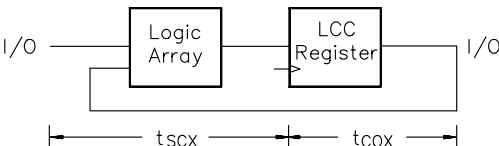
Internal Set-up, Internal Feedback (Int/Int)  
 $f_{MAX1} = 1/t_{sci} + t_{coi}$



External Set-up, Internal Feedback (Ext/Int)  
 $f_{MAX2} = 1/t_{scx} + t_{coi}$



Internal Set-up, External Feedback (Int/Ext)  
 $f_{MAX3} = 1/t_{sci} + t_{cox}$



External Set-up, External Feedback (Ext/Ext)  
 $f_{MAX4} = 1/t_{scx} + t_{cox}$

### Notes:

- Minimum DC input is -0.5V, however inputs may under-shoot to -2.0V for periods less than 20ns.
- Test points for Clock and VCC in  $t_r$ ,  $t_f$ ,  $t_{CL}$ ,  $t_{CH}$ , and  $t_{RESET}$  are referenced at 10% and 90% levels.
- I/O pins are 0V or VCC.
- Test one output at a time for a duration of less than 1 sec.
- Capacitances are tested on a sample basis.
- Test conditions assume: signal transition times of 5ns or less from the 10% and 90% points, timing reference levels of 1.5V (unless otherwise specified).
- $t_{OE}$  is measured from input transition to  $V_{REF}$  (0.1V (See test loads at end of Section 6 for  $V_{REF}$  value)).  $t_{OD}$  is measured from input transition to  $V_{OH}-0.1V$  or  $V_{OL}+0.1V$ .
- "System-clock" refers to pin 1 or pin 28 high speed clocks.
- For T or JK registers in toggle (divide by 2) operation only.
- For combinatorial and async-clock to LCC output delay.
- ICC for a typical application: This parameter is tested with the device programmed as a 10-bit D-type counter.
- Test loads are specified in Section 5 of this Data Book.
- "Async. clock" refers to the clock from the Sum term (OR gate).
- The "LCC" term indicates that the timing parameter is applied to the LCC register. The "IOC" term indicates that the timing parameter is applied to the IOC register. The "LCC/IOC" term indicates that the timing parameter is applied to both the LCC and IOC registers. The "LCC/IOC/INC" term indicates that the timing parameter is applied to the LCC, IOC and INC registers.
- This refers to the Sum-D gate routed to the IOC register for an additional buried register
- The term "Input" without any reference to another term refers to an (external) input pin.
- The parameter  $t_{spi}$  indicates that the PCLK signal to the IOC register is always slower than the data from the pin or input by the absolute value of  $(t_{sk} - t_{pk} - t_{ia})$ . This means that no set-up time for the data from the pin or input is required, i.e. the external data and clock can be sent to the device simultaneously. Additionally, the data from the pin must remain stable for  $t_{spi}$  time, i.e. to wait for the PCLK signal to arrive at the IOC register.
- Typical (typ) lcc is measured at  $T_A = 25^\circ C$ , Freq = 25MHz,  $V_{CC} = 5V$ .



**Table 2. Ordering Information**

Part Number	Speed	Temperature	Package
PA7128P-15	9/15ns	C	P28
PA7128J-15			J28
PA7128S-15			S28
PA7128P-20	12/20ns	C	P28
PA7128PI-20		I	
PA7128J-20	12/20ns	C	J28
PA7128JI-20		I	
PA7128S-20	12/20ns	C	S28
PA7128SI-20		I	

**Part Number**

Device      Suffix

**PA7128P-15**

**Package**

T = Plastic 600mil DIP  
 J = Plastic (J) Leaded Chip Carrier  
 S = SOIC

**Speed**

-15 = 9ns/15ns tpdi/tpdx  
 -20 = 12ns/20ns tpdi/tpdx

**Temperature Range**

(Blank) = Commercial 0 to 70°C  
 I = Industrial -40 to +85°C