

## Features

- Industry-standard Architecture
- 12 ns Maximum Pin-to-pin Delay
- Zero Power – 25  $\mu$ A Maximum Standby Power (Input Transition Detection)
- CMOS and TTL Compatible Inputs and Outputs
- Advanced Electrically-erasable Technology
  - Reprogrammable
  - 100% Tested
- Latch Feature Holds Inputs to Previous Logic State
- High-reliability CMOS Process
  - 20 Year Data Retention
  - 100 Erase/Write Cycles
  - 2,000V ESD Protection
  - 200 mA Latchup Immunity
- Commercial and Industrial Temperature Ranges
- Dual-in-line and Surface Mount Standard Pinouts
- PCI Compliant
- Green Package Options (Pb/Halide-free/RoHS Compliant) Available

## 1. Description

The ATF22V10CZ/CQZ is a high-performance CMOS (electrically-erasable) programmable logic device (PLD) which utilizes Atmel's proven electrically-erasable Flash memory technology. Speeds down to 12 ns with zero standby power dissipation are offered. All speed ranges are specified over the full 5V  $\pm$ 10% range for industrial temperature ranges; 5V  $\pm$ 5% for commercial range 5-volt devices. The ATF22V10CZ/CQZ provides a low voltage and edge-sensing "zero" power CMOS PLD solution with "zero" standby power (5  $\mu$ A typical). The ATF22V10CZ/CQZ provides a "zero" power CMOS PLD solution with 5V operating voltages, powering down automatically to the zero power-mode through Atmel's patented Input Transition Detection (ITD) circuitry when the device is idle, offering "zero" (25  $\mu$ A worst case) standby power. This feature allows the user to manage total system power to meet specific application requirements and enhance reliability. Pin "keeper" circuits on input and output pins eliminate static power consumed by pull-up resistors. The "CQZ" combines the low high-frequency  $I_{CC}$  of the "Q" design with the "Z" feature.

The ATF22V10CZ/CQZ incorporates a superset of the generic architectures, which allows direct replacement of the 22V10 family and most 24-pin combinatorial PLDs. Ten outputs are each allocated 8 to 16 product terms. Three different modes of operation, configured automatically with software, allow highly complex logic functions to be realized.

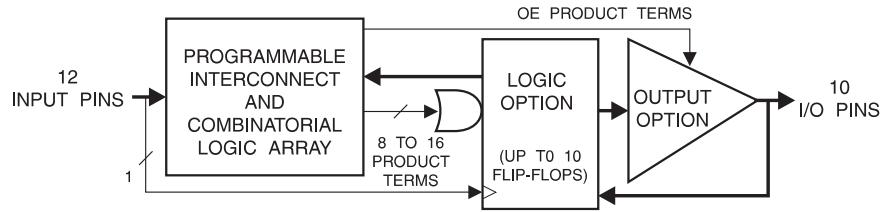


High-  
performance  
EE PLD

ATF22V10CZ  
ATF22V10CQZ



**Figure 1-1. Block Diagram**

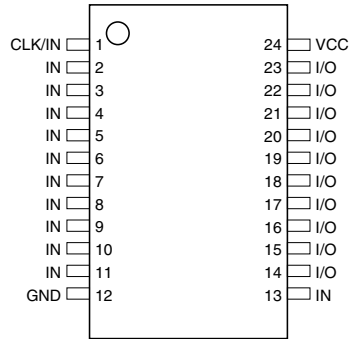


## 2. Pin Configurations

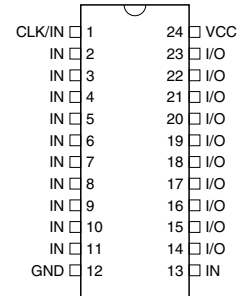
**Table 2-1. Pin Configurations (All Pinouts Top View)**

Pin Name	Function
CLK	Clock
IN	Logic Inputs
I/O	Bi-directional Buffers
VCC	+5V Supply

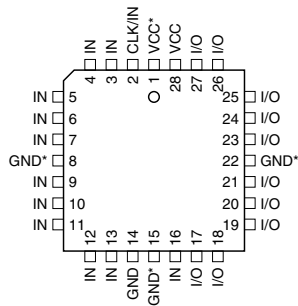
**Figure 2-1. TSSOP**



**Figure 2-2. DIP/SOIC**



**Figure 2-3. PLCC**



Note: For PLCC, P1, P8, P15 and P22 can be left unconnected. For superior performance, connect VCC to pin 1 and GND to 8, 15, and 22.

### 3. Absolute Maximum Ratings\*

Temperature Under Bias.....	-40°C to +85°C
Storage Temperature.....	-65°C to +150°C
Voltage on Any Pin with Respect to Ground.....	-2.0V to +7.0V <sup>(1)</sup>
Voltage on Input Pins with Respect to Ground During Programming.....	-2.0V to +14.0V <sup>(1)</sup>
Programming Voltage with Respect to Ground.....	-2.0V to +14.0V <sup>(1)</sup>

**\*NOTICE:** Stresses beyond those listed 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 beyond 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.

**Note:** 1. Minimum voltage is -0.6V DC, which may undershoot to -2.0V for pulses of less than 20 ns. Maximum output pin voltage is  $V_{CC} + 0.75V$  DC, which may overshoot to 7.0V for pulses of less than 20 ns.

### 4. DC and AC Operating Conditions

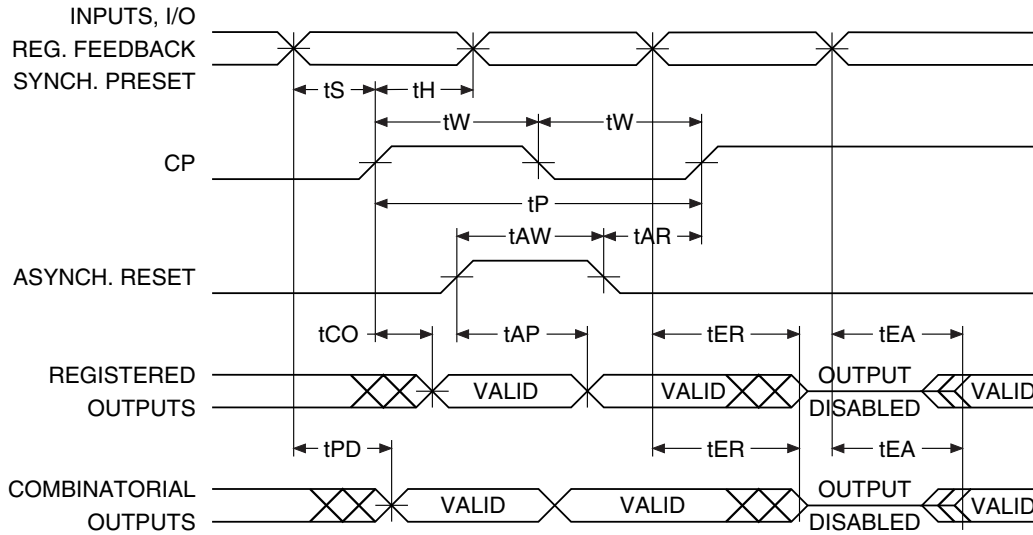
	Commercial	Industrial
<b>Operating Temperature (Ambient)</b>	0°C - 70°C	-40°C - 85°C
<b>V<sub>CC</sub> Power Supply</b>	5V ± 5%	5V ± 10%

## 4.1 DC Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Units	
$I_{IL}$	Input or I/O Low Leakage Current	$0 \leq V_{IN} \leq V_{IL} \text{ (Max)}$ $3.5 \leq V_{IN} \leq V_{CC}$			-10	$\mu\text{A}$	
$I_{IH}$	Input or I/O High Leakage Current				10	$\mu\text{A}$	
$I_{CC}$	Clocked Power Supply Current	$V_{CC} = \text{Max}$ Outputs Open, $f = 15 \text{ MHz}$	CZ-12, 15	Com	90	150	$\text{mA}$
			CZ-15	Ind	90	180	$\text{mA}$
			CQZ-20	Com	40	60	$\text{mA}$
			CQZ-20	Ind	40	80	$\text{mA}$
$I_{SB}$	Power Supply Current, Standby	$V_{CC} = \text{Max}$ $V_{IN} = \text{MAX}$ Outputs Open	CZ-12, 15	Com	5	25	$\mu\text{A}$
			CZ-15	Ind	5	50	$\mu\text{A}$
			CQZ-20	Com	5	25	$\mu\text{A}$
			CQZ-20	Ind	5	50	$\mu\text{A}$
$I_{OS}^{(1)}$	Output Short Circuit Current	$V_{OUT} = 0.5\text{V}$			-130	$\text{mA}$	
$V_{IL}$	Input Low Voltage		-0.5		0.8	V	
$V_{IH}$	Input High Voltage		2.0		$V_{CC} + 0.75$	V	
$V_{OL}$	Output Low Voltage	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{CC} = \text{Min}$ , $I_{OL} = 16 \text{ mA}$			0.5	V	
$V_{OH}$	Output High Voltage	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{CCIO} = \text{Min}$ , $I_{OH} = -4.0 \text{ mA}$	2.4			V	

Note: 1. Not more than one output at a time should be shorted. Duration of short circuit test should not exceed 30 sec.

## 4.2 AC Waveforms



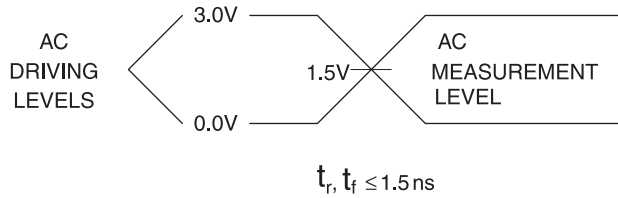
## 4.3 AC Characteristics<sup>(1)</sup>

Symbol	Parameter	-12		-15		-20		Units
		Min	Max	Min	Max	Min	Max	
$t_{PD}$	Input or Feedback to Non-registered Output	3	12	3	15	3	20	ns
$t_{CF}$	Clock to Feedback		6		4.5		8	ns
$t_{CO}$	Clock to Output	2	8	2	8	2	12	ns
$t_S$	Input or Feedback Setup Time	10		10		14		ns
$t_H$	Input Hold Time	0		0		0		ns
$t_W$	Clock Width	6		6		10		ns
$f_{MAX}$	External Feedback $1/(t_S + t_{CO})$		55.5		55.5		38.5	MHz
	Internal Feedback $1/(t_S + t_{CF})$		62		69		45.5	MHz
	No Feedback $1/(t_P)$		83.3		83.3		50.0	MHz
$t_{EA}$	Input to Output Enable - Product Term	3	12	3	15	3	20	ns
$t_{ER}$	Input to Output Disable - Product Term	2	15	3	15	3	20	ns
$t_{PZX}$	OE Pin to Output Enable	2	12	2	15	2	20	ns
$t_{PXZ}$	OE Pin to Output Disable	2	15	2	15	2	20	ns
$t_{AP}$	Input or I/O to Asynchronous Reset of Register	3	10	3	15	3	22	ns
$t_{SP}$	Setup Time, Synchronous Preset	10		10		14		ns
$t_{AW}$	Asynchronous Reset Width	7		8		20		ns
$t_{AR}$	Asynchronous Reset Recovery Time	5		6		20		ns
$t_{SPR}$	Synchronous Preset to Clock Recovery Time	10		10		14		ns

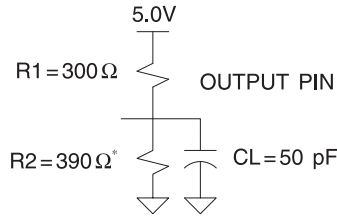
Note: 1. See ordering information for valid part numbers.

## 4.4 Input Test Waveforms

### 4.4.1 Input Test Waveforms and Measurement Levels



### 4.4.2 Output Test Loads



Note: Similar competitor devices are specified with slightly different loads. These load differences may affect output signals' delay and slew rate. Atmel devices are tested with sufficient margins to meet compatible device specification conditions.

## 4.5 Pin Capacitance

**Table 4-1.** Pin Capacitance ( $f = 1 \text{ MHz}$ ,  $T = 25\text{C}^{(1)}$ )

	Typ	Max	Units	Conditions
$C_{IN}$	8	10	pF	$V_{IN} = 0\text{V}$ ; $f = 1.0 \text{ MHz}$
$C_{I/O}$	8	10	pF	$V_{OUT} = 0\text{V}$ ; $f = 1.0 \text{ MHz}$

Note: 1. Typical values for nominal supply voltage. This parameter is only sampled and is not 100% tested.

## 4.6 Power-up Reset

The registers in the ATF22V10CZ/CQZ are designed to reset during power-up. At a point delayed slightly from  $V_{CC}$  crossing  $V_{RST}$ , all registers will be reset to the low state. The output state will depend on the polarity of the buffer.

This feature is critical for state machine initialization. However, due to the asynchronous nature of reset and the uncertainty of how  $V_{CC}$  actually rises in the system, the following conditions are required:

1. The  $V_{CC}$  rise must be monotonic and start below 0.7V.
2. The clock must remain stable during  $T_{PR}$ .
3. After  $T_{PR}$  occurs, all input and feedback setup times must be met before driving the clock pin high.

## 4.7 Preload of Register Outputs

The ATF22V10CZ/CQZ's registers are provided with circuitry to allow loading of each register with either a high or a low. This feature will simplify testing since any state can be forced into the registers to control test sequencing. A JEDEC file with preload is generated when a source file

with vectors is compiled. Once downloaded, the JEDEC file preload sequence will be done automatically by most of the approved programmers after the programming.

## 5. Electronic Signature Word

There are 64 bits of programmable memory that are always available to the user, even if the device is secured. These bits can be used for user-specific data.

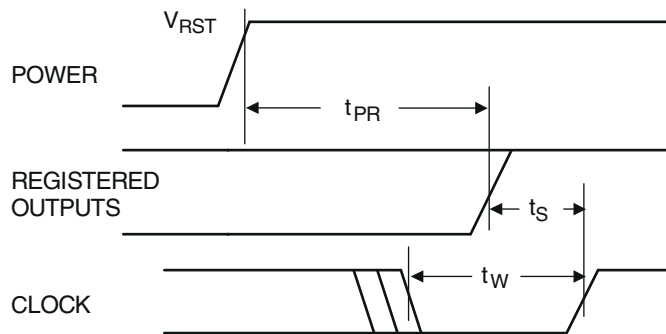
## 6. Security Fuse Usage

A single fuse is provided to prevent unauthorized copying of the ATF22V10CZ/CQZ fuse patterns. Once programmed, fuse verify and preload are inhibited. However, the 64-bit User Signature remains accessible. The security fuse should be programmed last, as its effect is immediate.

## 7. Programming/Erasing

Programming/erasing is performed using standard PLD programmers. See CMOS PLD Programming Hardware & Software Support for information on software/programming.

**Figure 7-1.** Programming/Erasing Timing



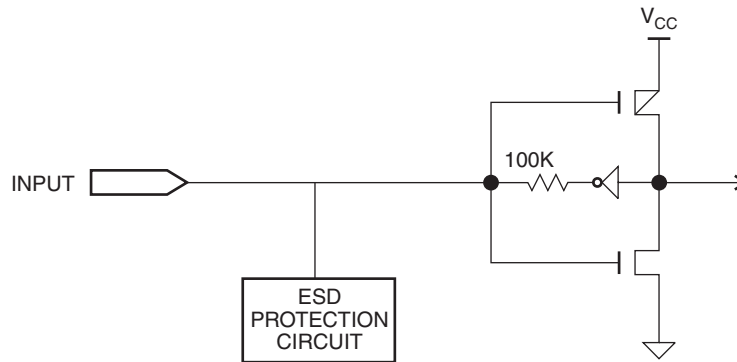
**Table 7-1.** Programming/Erasing

Parameter	Description	Typ	Max	Units
$T_{PR}$	Power-up Reset Time	600	1000	ns
$V_{RST}$	Power-up Reset Voltage	3.8	4.5	V

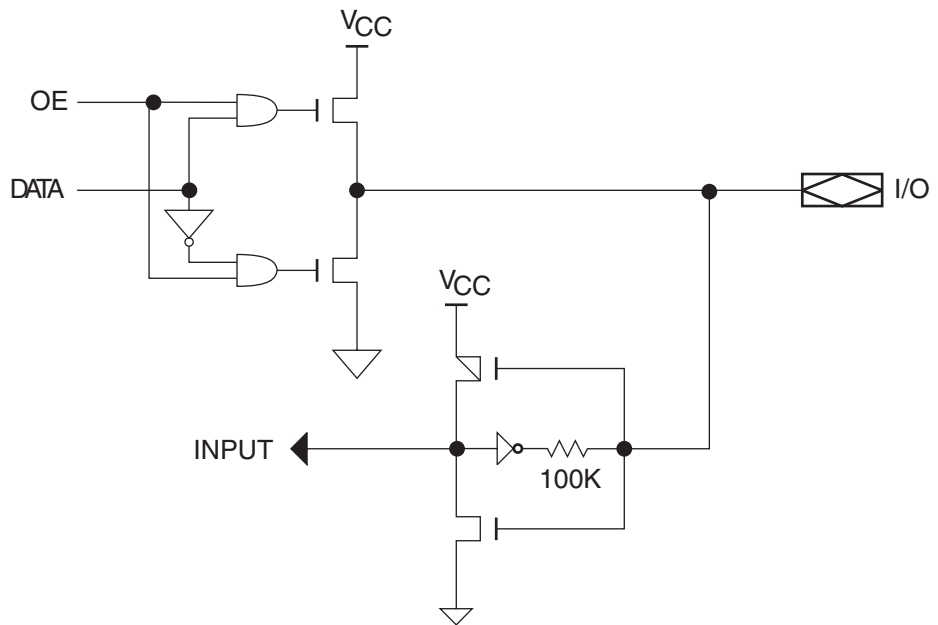
## 8. Input and I/O Pull-ups

All ATF22V10CZ/CQZ family members have internal input and I/O pin-keeper circuits. Therefore, whenever inputs or I/Os are not being driven externally, they will maintain their last driven state. This ensures that all logic array inputs and device outputs are at known states. These are relatively weak active circuits that can be easily overridden by TTL-compatible drivers (see input and I/O diagrams below).

**Figure 8-1.** Input Diagram



**Figure 8-2.** I/O Diagram



## 9. Compiler Mode Selection

**Table 9-1.** Compiler Mode Selection

	<b>PAL Mode (5828 Fuses)</b>	<b>GAL Mode (5892 Fuses)</b>
Synario	ATF22V10C (DIP) ATF22V10C (PLCC)	ATF22V10C DIP (UES) ATF22V10C PLCC (UES)
WINCUPL	P22V10 P22V10LCC	G22V10 G22V10LCC



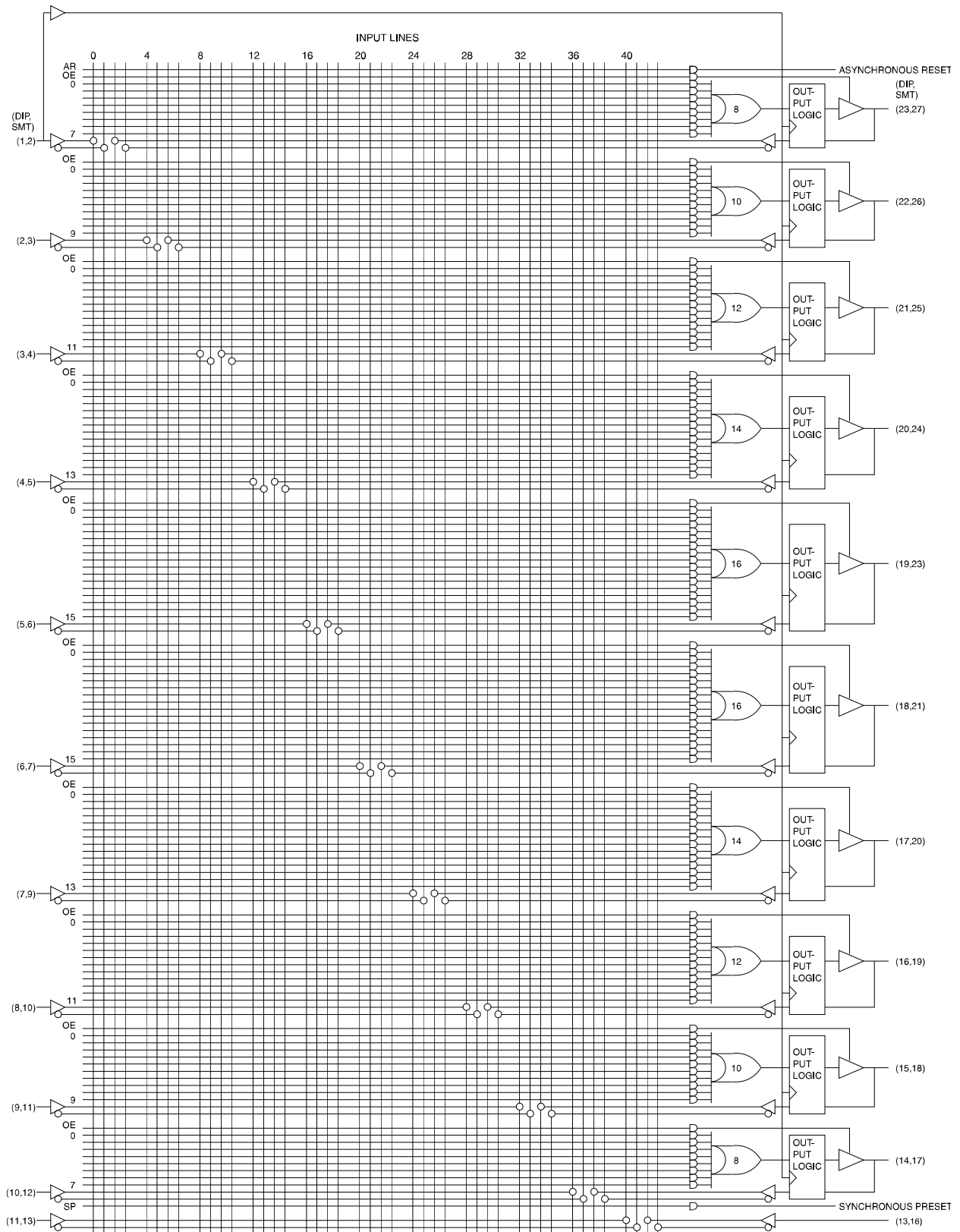
## 10. Functional Logic Diagram Description

The Functional Logic Diagram describes the ATF22V10CZ/CQZ architecture.

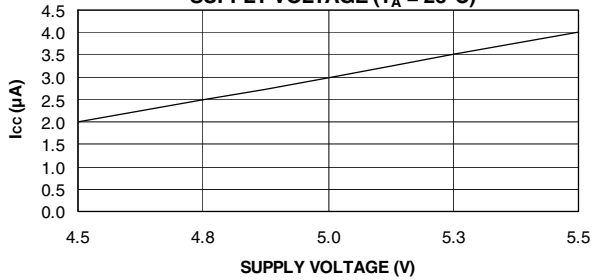
The ATF22V10CZ/CQZ has 12 inputs and 10 I/O macrocells. Each macrocell can be configured into one of four output configurations: active high/low, registered/combinatorial output. The universal architecture of the ATF22V10CZ/CQZ can be programmed to emulate most 24-pin PAL devices.

Unused product terms are automatically disabled by the compiler to decrease power consumption. A security fuse, when programmed, protects the contents of the ATF22V10CZ/CQZ. Eight bytes (64 fuses) of User Signature are accessible to the user for purposes such as storing project name, part number, revision or date. The User Signature is accessible regardless of the state of the security fuse.

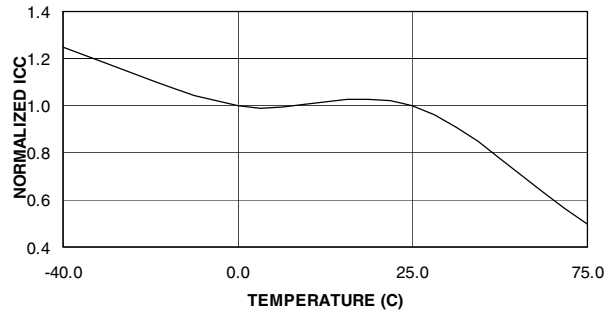
**Figure 10-1. Functional Logic Diagram**



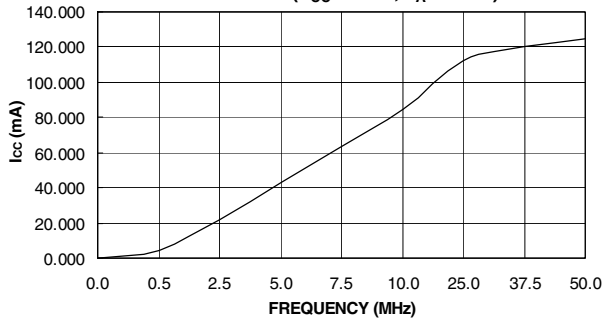
**ATF22V10CZ/CQZ STAND-BY  $I_{CC}$  vs. SUPPLY VOLTAGE ( $T_A = 25^\circ\text{C}$ )**



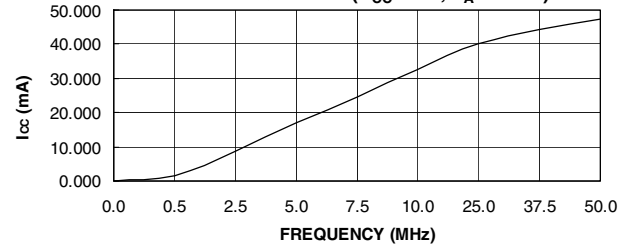
**NORMALIZED  $I_{CC}$  vs. TEMP**



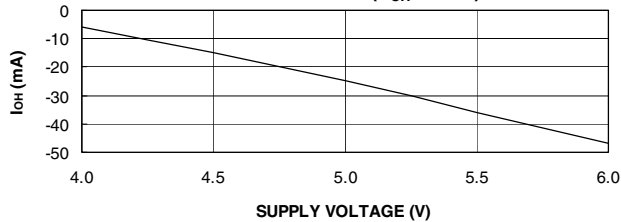
**ATF22V10CZ SUPPLY CURRENT vs. INPUT FREQUENCY ( $V_{CC} = 5.0\text{V}$ ,  $T_A = 25^\circ\text{C}$ )**



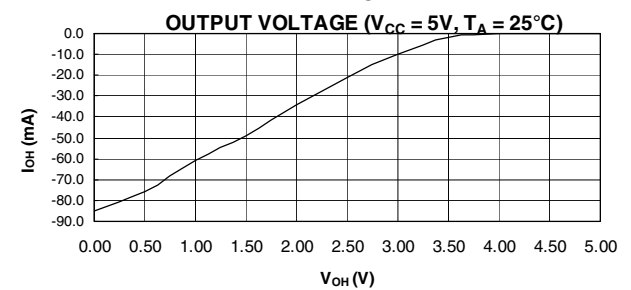
**ATF22V10CQZ SUPPLY CURRENT vs. INPUT FREQUENCY ( $V_{CC} = 5\text{V}$ ,  $T_A = 25^\circ\text{C}$ )**



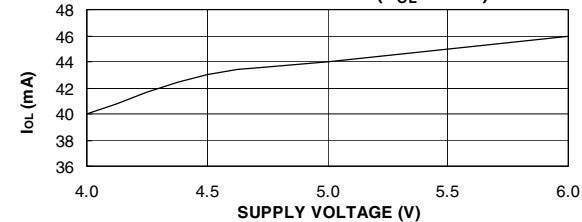
**ATF22V10CZ/CQZ OUTPUT SOURCE CURRENT vs SUPPLY VOLTAGE ( $V_{OH} = 2.4\text{V}$ )**



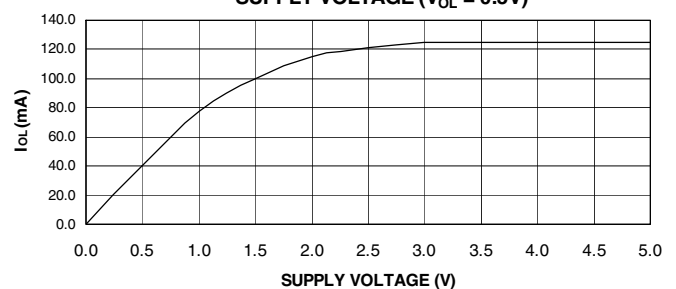
**ATF22V10CZ/CQZ OUTPUT SOURCE CURRENT vs. OUTPUT VOLTAGE ( $V_{CC} = 5\text{V}$ ,  $T_A = 25^\circ\text{C}$ )**



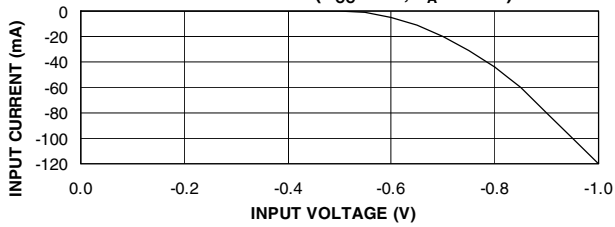
**ATF22V10CZ/CQZ OUTPUT SINK CURRENT vs. SUPPLY VOLTAGE ( $V_{OL} = 0.5\text{V}$ )**



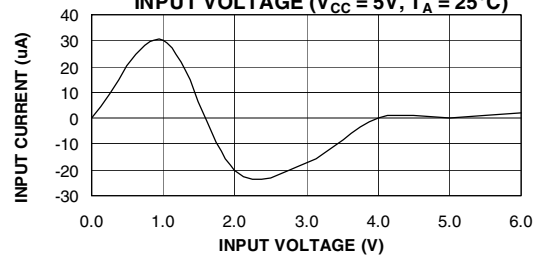
**ATF22V10CZ/CQZ OUTPUT SINK CURRENT vs. SUPPLY VOLTAGE ( $V_{OL} = 0.5\text{V}$ )**



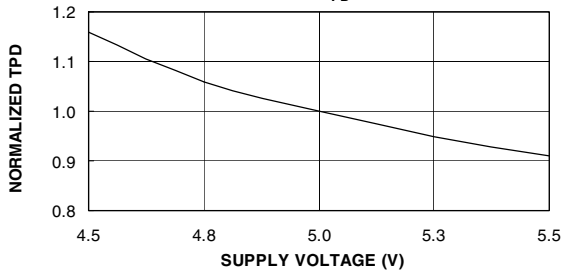
**ATF22V10CZ/CQZ INPUT CLAMP CURRENT VS INPUT VOLTAGE ( $V_{CC} = 5V, T_A = 35^\circ C$ )**



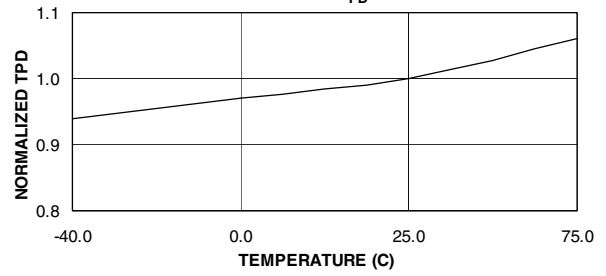
**ATF22V10CZ/CQZ INPUT CURRENT VS INPUT VOLTAGE ( $V_{CC} = 5V, T_A = 25^\circ C$ )**



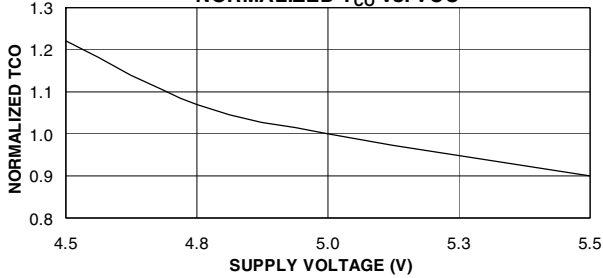
**NORMALIZED  $T_{PD}$  vs. VCC**



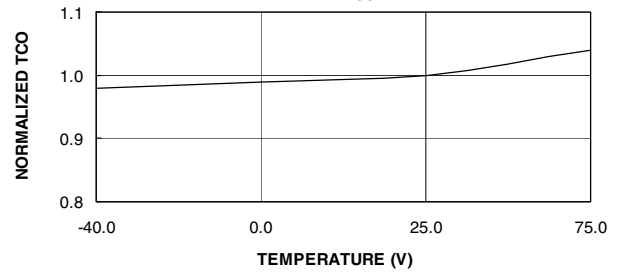
**NORMALIZED  $T_{PD}$  vs. TEMP**



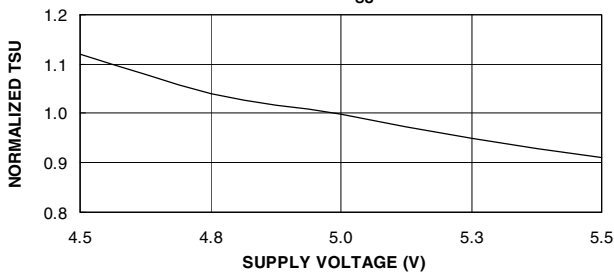
**NORMALIZED  $T_{CO}$  vs. VCC**



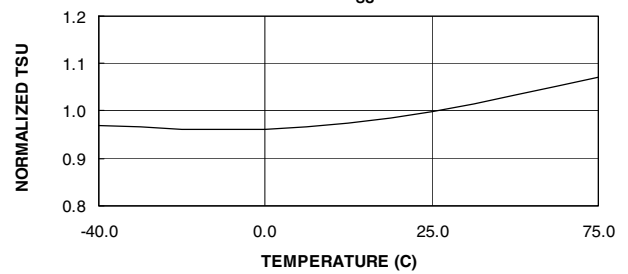
**NORMALIZED  $T_{CO}$  vs TEMP**



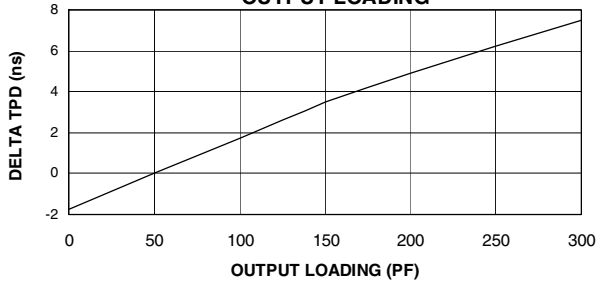
**NORMALIZED  $T_{SU}$  vs VCC**



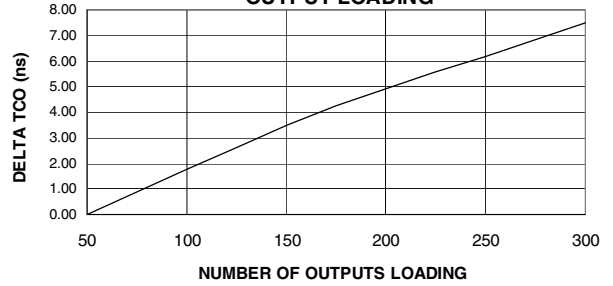
**NORMALIZED  $T_{SU}$  vs. TEMP**



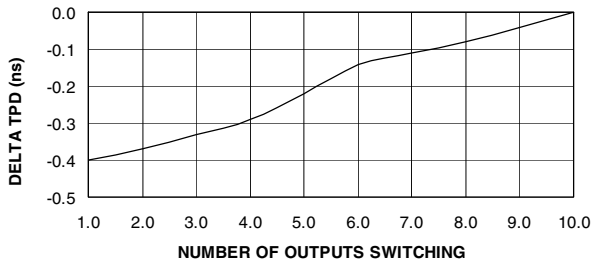
**ATF22V10C DELTA  $T_{PD}$  vs. OUTPUT LOADING**



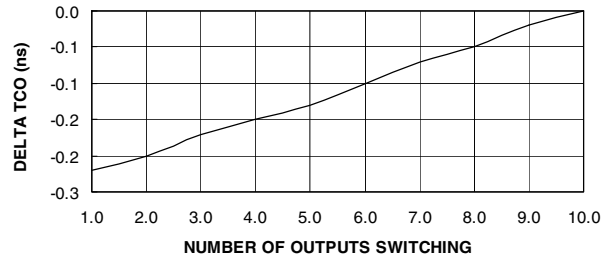
**ATF22V10C DELTA  $T_{CO}$  vs. OUTPUT LOADING**



**DELTA  $T_{PD}$  vs. # OF OUTPUT SWITCHING**



**DELTA  $T_{CO}$  vs. # OF OUTPUT SWITCHING**



## 11. Ordering Information

### 11.1 Standard Package Options

$t_{PD}$ (ns)	$t_s$ (ns)	$t_{CO}$ (ns)	Ordering Code	Package	Operation Range		
12	10	8	ATF22V10CZ-12JC	28J	Commercial (0°C to 70°C)		
			ATF22V10CZ-12PC	24P3			
			ATF22V10CZ-12SC	24S			
			ATF22V10CZ-12XC	24X			
15	4.5	8	ATF22V10CZ-15JC	28J	Commercial (0°C to 70°C)		
			ATF22V10CZ-15PC	24P3			
			ATF22V10CZ-15SC	24S			
			ATF22V10CZ-15XC	24X			
					ATF22V10CZ-15JI	28J	Industrial (-40°C to +85°C)
					ATF22V10CZ-15PI	24P3	
					ATF22V10CZ-15SI	24S	
					ATF22V10CZ-15XI	24X	
20	14	12	ATF22V10CQZ-20JC	28J	Commercial (0°C to 70°C)		
			ATF22V10CQZ-20PC	24P3			
			ATF22V10CQZ-20SC	24S			
			ATF22V10CQZ-20XC	24X			
					ATF22V10CQZ-20JI	28J	Industrial (-40°C to +85°C)
					ATF22V10CQZ-20PI	24P3	
					ATF22V10CQZ-20SI	24S	
					ATF22V10CQZ-20XI	24X	

### 11.2 ATF22V10CQZ Green Package Options (Pb/Halide-free/RoHS Compliant)

$t_{PD}$ (ns)	$t_s$ (ns)	$t_{CO}$ (ns)	Ordering Code	Package	Operation Range
20	14	12	ATF22V10CQZ-20JU	28J	Industrial (-40°C to +85°C)
			ATF22V10CQZ-20PU	24P3	
			ATF22V10CQZ-20SU	24S	
			ATF22V10CQZ-20XU	24X	

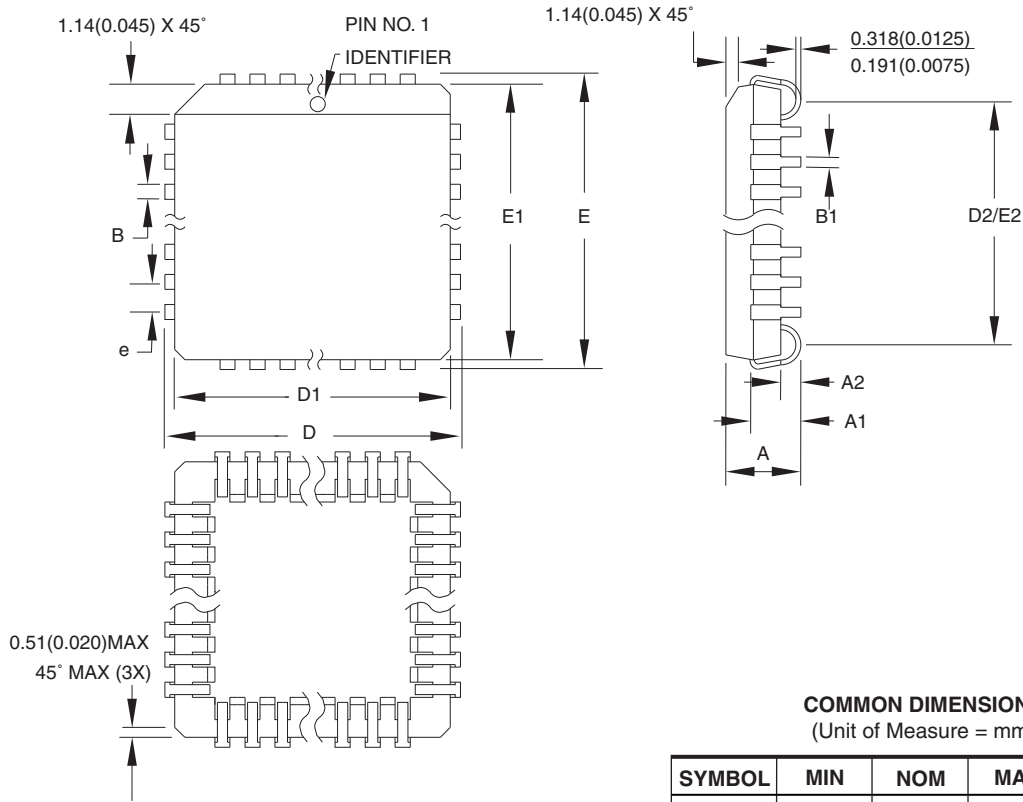
### 11.3 Using “C” Product for Industrial

To use commercial product for Industrial temperature ranges, down-grade one speed grade from the “I” to the “C” device (7 ns “C” = 10 ns “I”) and de-rate power by 30%.

Package Type	
<b>28J</b>	28-lead, Plastic J-leaded Chip Carrier (PLCC)
<b>24P3</b>	24-pin, 0.300", Plastic Dual Inline Package (PDIP)
<b>24S</b>	24-lead, 0.300" Wide, Plastic Gull-Wing Small Outline (SOIC)
<b>24X</b>	24-lead, 4.4 mm Wide, Plastic Thin Shrink Small Outline (TSSOP)

12. Packaging Information

12.1 28J – PLCC



COMMON DIMENSIONS  
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	4.191	-	4.572	
A1	2.286	-	3.048	
A2	0.508	-	-	
D	12.319	-	12.573	
D1	11.430	-	11.582	Note 2
E	12.319	-	12.573	
E1	11.430	-	11.582	Note 2
D2/E2	9.906	-	10.922	
B	0.660	-	0.813	
B1	0.330	-	0.533	
e	1.270 TYP			

- Notes:
1. This package conforms to JEDEC reference MS-018, Variation AB.
  2. Dimensions D1 and E1 do not include mold protrusion. Allowable protrusion is .010"(0.254 mm) per side. Dimension D1 and E1 include mold mismatch and are measured at the extreme material condition at the upper or lower parting line.
  3. Lead coplanarity is 0.004" (0.102 mm) maximum.

10/04/01



2325 Orchard Parkway  
San Jose, CA 95131

TITLE

28J, 28-lead, Plastic J-leaded Chip Carrier (PLCC)

DRAWING NO.

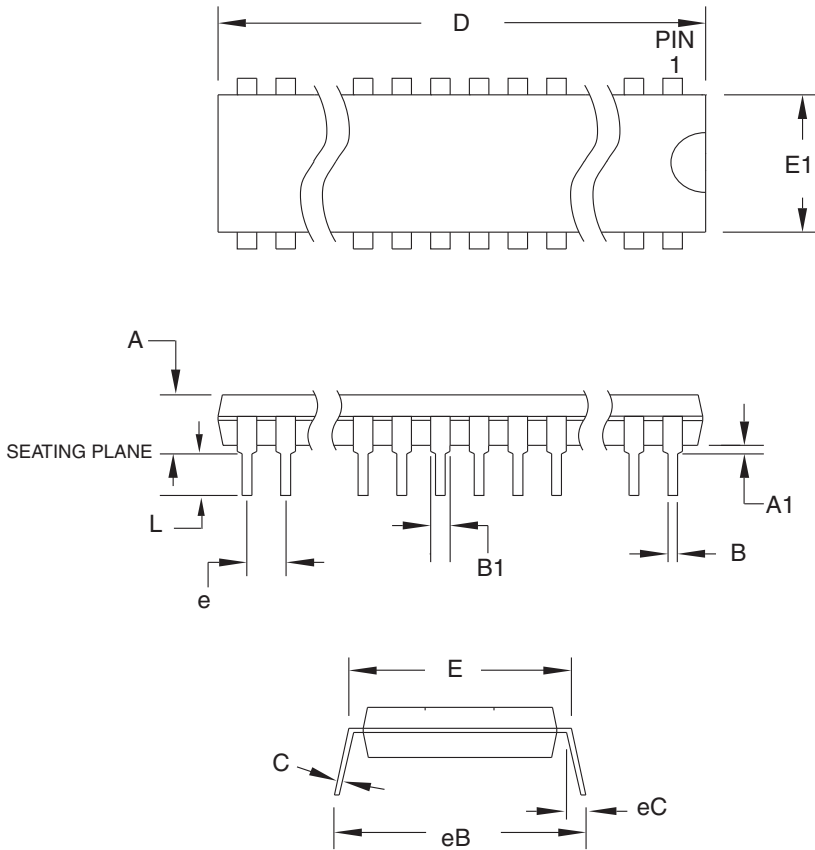
28J

REV.

B



## 12.2 24P3 – PDIP



**COMMON DIMENSIONS**  
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	–	–	5.334	
A1	0.381	–	–	
D	31.623	–	32.131	Note 2
E	7.620	–	8.255	
E1	6.096	–	7.112	Note 2
B	0.356	–	0.559	
B1	1.270	–	1.651	
L	2.921	–	3.810	
C	0.203	–	0.356	
eB	–	–	10.922	
eC	0.000	–	1.524	
e	2.540 TYP			

- Notes:
1. This package conforms to JEDEC reference MS-001, Variation AF.
  2. Dimensions D and E1 do not include mold Flash or Protrusion. Mold Flash or Protrusion shall not exceed 0.25 mm (0.010").

6/1/04



2325 Orchard Parkway  
San Jose, CA 95131

**TITLE**

**24P3**, 24-lead (0.300"/7.62 mm Wide) Plastic Dual  
Inline Package (PDIP)

**DRAWING NO.**

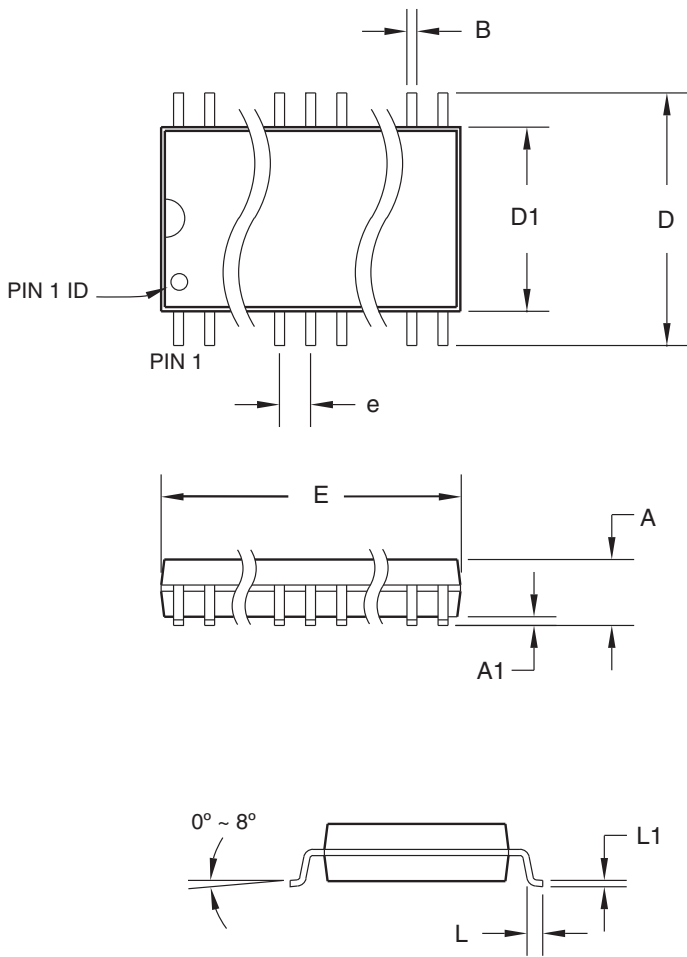
24P3

**REV.**

D



12.3 24S – SOIC



**COMMON DIMENSIONS**  
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	–	–	2.65	
A1	0.10	–	0.30	
D	10.00	–	10.65	
D1	7.40	–	7.60	
E	15.20	–	15.60	
B	0.33	–	0.51	
L	0.40	–	1.27	
L1	0.23	–	0.32	
e	1.27 BSC			

06/17/2002



2325 Orchard Parkway  
San Jose, CA 95131

**TITLE**

**24S, 24-lead (0.300" body) Plastic Gull Wing Small Outline (SOIC)**

**DRAWING NO.**

24S

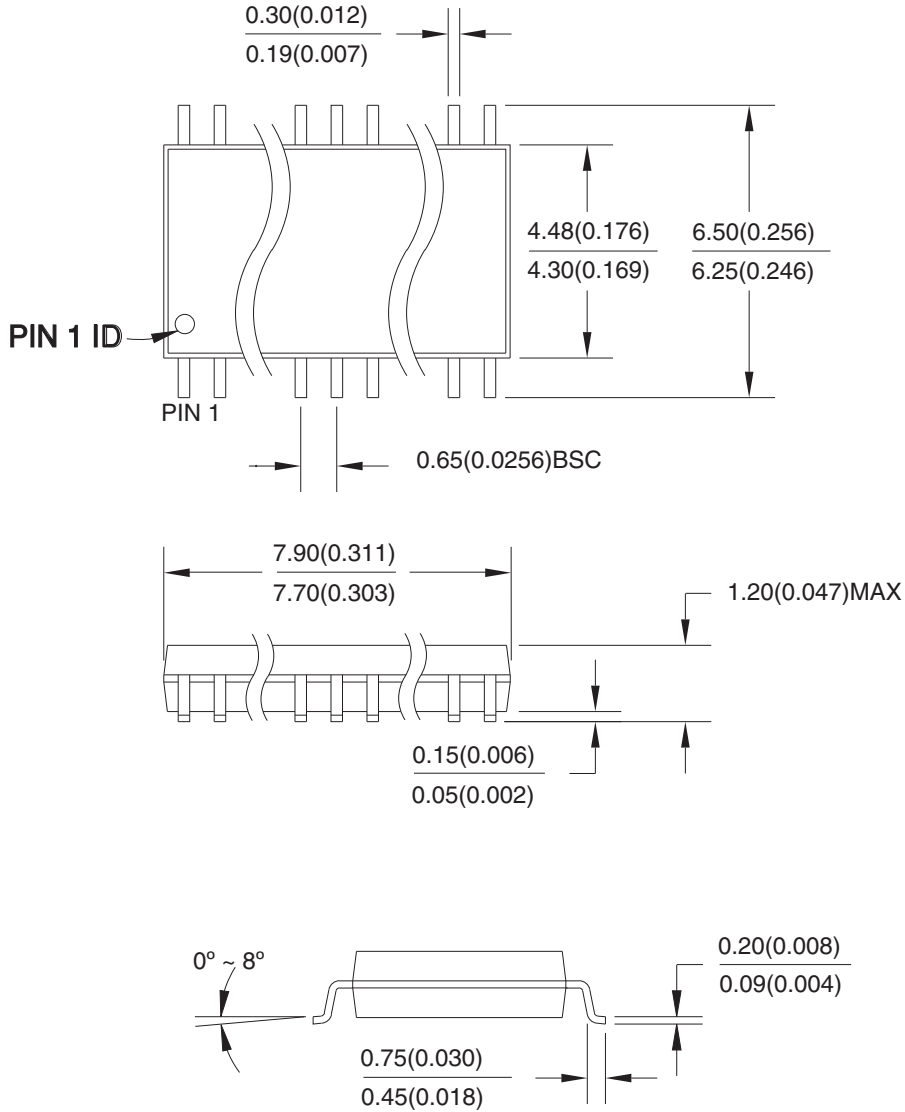
**REV.**

B



## 12.4 24X – TSSOP

Dimensions in Millimeter and (Inches)\*  
 JEDEC STANDARD MO-153 AD  
 Controlling dimension: millimeters



04/11/2001



2325 Orchard Parkway  
 San Jose, CA 95131

**TITLE**

**24X**, 24-lead (4.4 mm body width) Plastic Thin Shrink Small Outline Package (TSSOP)

**DRAWING NO.**

24X

**REV.**

A

### 13. Revision History

Version No./Release Date	History
Revision I – November 2005	1. Added Green Package options



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