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### Understanding [Embedded - CPLDs \(Complex Programmable Logic Devices\)](#)

Embedded - CPLDs, or Complex Programmable Logic Devices, are highly versatile digital logic devices used in electronic systems. These programmable components are designed to perform complex logical operations and can be customized for specific applications. Unlike fixed-function ICs, CPLDs offer the flexibility to reprogram their configuration, making them an ideal choice for various embedded systems. They consist of a set of logic gates and programmable interconnects, allowing designers to implement complex logic circuits without needing custom hardware.

### Applications of Embedded - CPLDs

#### Details

Product Status	Obsolete
Programmable Type	In System Programmable (min 10K program/erase cycles)
Delay Time tpd(1) Max	15 ns
Voltage Supply - Internal	4.5V ~ 5.5V
Number of Logic Elements/Blocks	-
Number of Macrocells	64
Number of Gates	-
Number of I/O	64
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	100-BQFP
Supplier Device Package	100-PQFP (14x20)
Purchase URL	<a href="https://www.e-xfl.com/product-detail/microchip-technology/atf1504as-15qi100">https://www.e-xfl.com/product-detail/microchip-technology/atf1504as-15qi100</a>

## Description

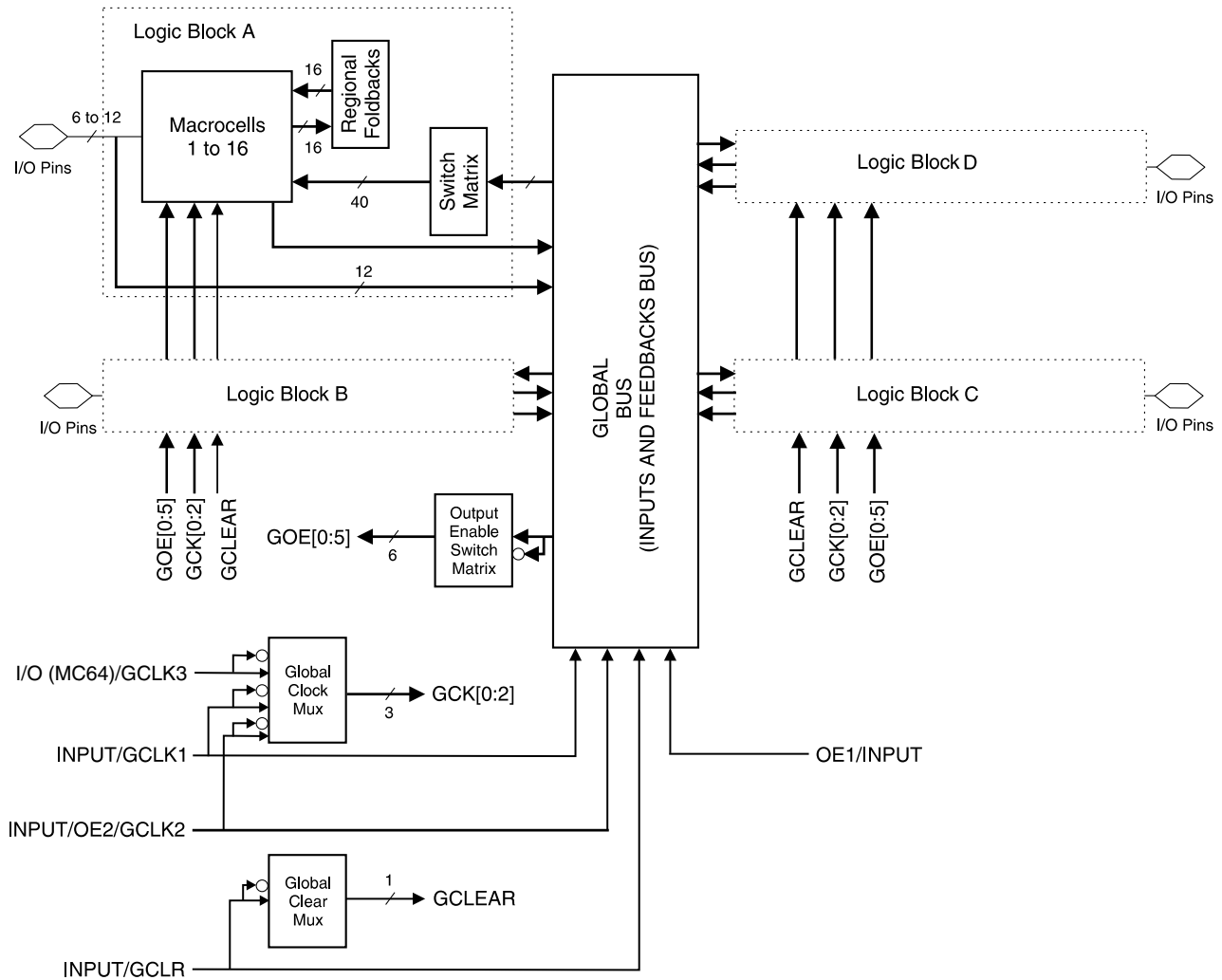
The ATF1504AS is a high-performance, high-density complex programmable logic device (CPLD) that utilizes Atmel's proven electrically-erasable memory technology. With 64 logic macrocells and up to 68 inputs, it easily integrates logic from several TTL, SSI, MSI, LSI and classic PLDs. The ATF1504AS's enhanced routing switch matrices increase usable gate count and the odds of successful pin-locked design modifications.

The ATF1504AS has up to 68 bi-directional I/O pins and four dedicated input pins, depending on the type of device package selected. Each dedicated pin can also serve as a global control signal, register clock, register reset or output enable. Each of these control signals can be selected for use individually within each macrocell.

Each of the 64 macrocells generates a buried feedback that goes to the global bus. Each input and I/O pin also feeds into the global bus. The switch matrix in each logic block then selects 40 individual signals from the global bus. Each macrocell also generates a foldback logic term that goes to a regional bus. Cascade logic between macrocells in the ATF1504AS allows fast, efficient generation of complex logic functions. The ATF1504AS contains four such logic chains, each capable of creating sum term logic with a fan-in of up to 40 product terms.

The ATF1504AS macrocell, shown in Figure 1, is flexible enough to support highly-complex logic functions operating at high speed. The macrocell consists of five sections: product terms and product term select multiplexer, OR/XOR/CASCADE logic, a flip-flop, output select and enable, and logic array inputs.

## Block Diagram



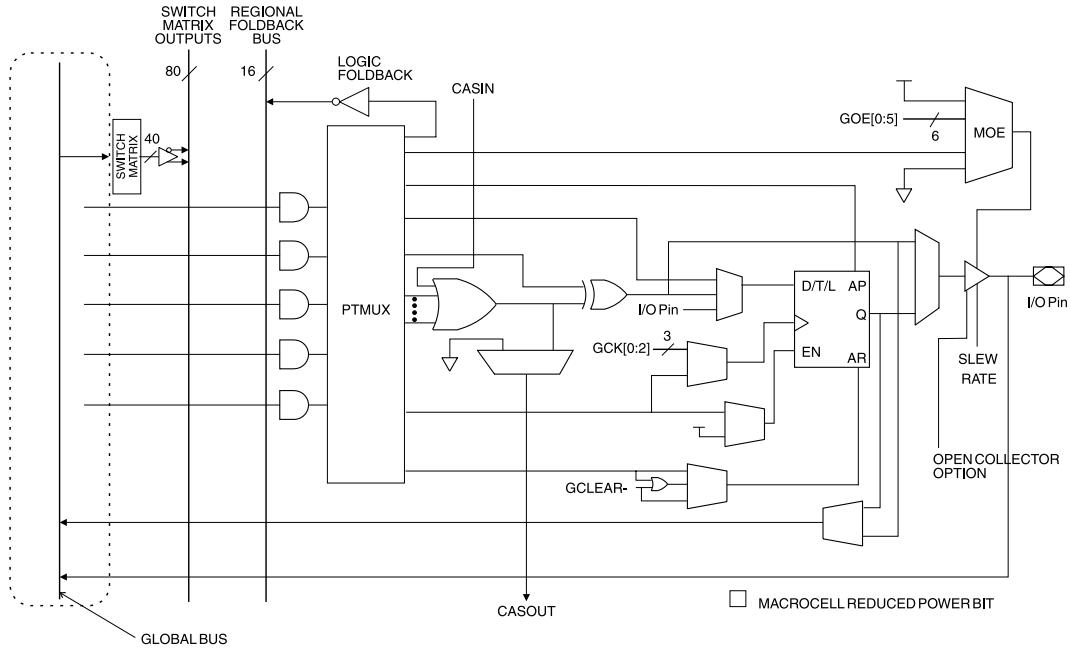
Unused product terms are automatically disabled by the compiler to decrease power consumption. A security fuse, when programmed, protects the contents of the ATF1504AS. Two bytes (16 bits) of User Signature are accessible to the user for purposes such as storing project name, part number, revision or date. The User Signature is accessible regardless of the state of the security fuse.

The ATF1504AS device is an in-system programmable (ISP) device. It uses the industry-standard 4-pin JTAG interface (IEEE Std. 1149.1), and is fully-compliant with JTAG's Boundary-scan Description Language (BSDL). ISP allows the device to be programmed without removing it from the printed circuit board. In addition to simplifying the manufacturing flow, ISP also allows design modifications to be made in the field via software.

## Foldback Bus

Each macrocell also generates a foldback product term. This signal goes to the regional bus and is available to four macrocells. The foldback is an inverse polarity of one of the macrocell's product terms. The sixteen foldback terms in each region allow generation of high fan-in sum terms (up to sixteen product terms) with a nominal additional delay.

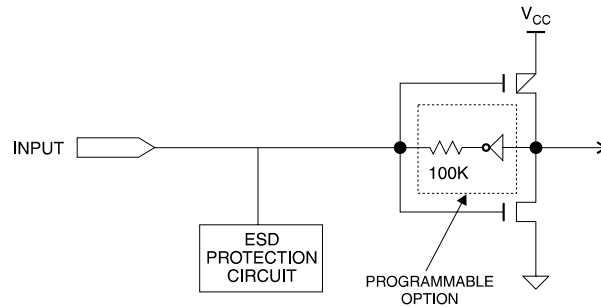
**Figure 1. ATF1504AS Macrocell**



## Programmable Pin-keeper Option for Inputs and I/Os

The ATF1504AS offers the option of programming all input and I/O pins so that pin-keeper circuits can be utilized. When any pin is driven high or low and then subsequently left floating, it will stay at that previous high- or low-level. This circuitry prevents unused input and I/O lines from floating to intermediate voltage levels, which causes unnecessary power consumption and system noise. The keeper circuits eliminate the need for external pull-up resistors and eliminate their DC power consumption.

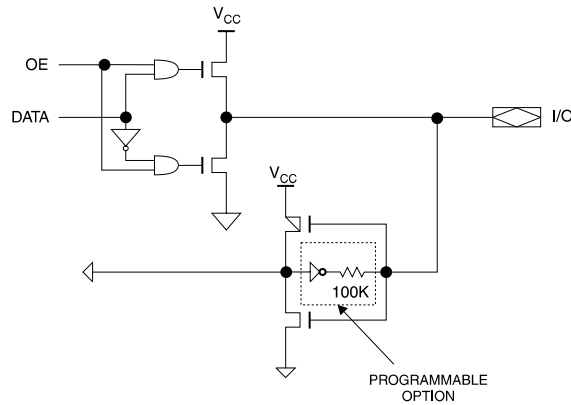
### Input Diagram



## Speed/Power Management

The ATF1504AS has several built-in speed and power management features. The ATF1504AS contains circuitry that automatically puts the device into a low-power standby mode when no logic transitions are occurring. This not only reduces power consumption during inactive periods, but also provides proportional power savings for most applications running at system speeds below 5 MHz. This feature may be selected as a device option.

### I/O Diagram



To further reduce power, each ATF1504AS macrocell has a Reduced Power bit feature. This feature allows individual macrocells to be configured for maximum power savings. This feature may be selected as a design option.

All ATF1504AS also have an optional power-down mode. In this mode, current drops to below 10 mA. When the power-down option is selected, either PD1 or PD2 pins (or both) can be used to power-down the part. The power-down option is selected in the design source file. When enabled, the device goes into power-down when either PD1 or PD2 is high. In the power-down mode, all internal logic signals are latched and held, as are any enabled outputs.

All pin transitions are ignored until the PD pin is brought low. When the power-down feature is enabled, the PD1 or PD2 pin cannot be used as a logic input or output. However, the pin's macrocell may still be used to generate buried foldback and cascade logic signals.

All power-down AC characteristic parameters are computed from external input or I/O pins, with Reduced Power Bit turned on. For macrocells in reduced-power mode (reduced-power bit turned on), the reduced-power adder, tRPA, must be added to the AC parameters, which include the data paths  $t_{LAD}$ ,  $t_{LAC}$ ,  $t_{IC}$ ,  $t_{ACL}$ ,  $t_{ACH}$  and  $t_{SEXP}$ .

The ATF1504AS macrocell also has an option whereby the power can be reduced on a per macrocell basis. By enabling this power-down option, macrocells that are not used in an application can be turned-down, thereby reducing the overall power consumption of the device.

Each output also has individual slew rate control. This may be used to reduce system noise by slowing down outputs that do not need to operate at maximum speed. Outputs default to slow switching, and may be specified as fast switching in the design file.

## Design Software Support

ATF1504AS designs are supported by several industry-standard third-party tools. Automated fitters allow logic synthesis using a variety of high level description languages and formats.

## Power-up Reset

The ATF1504AS is designed with a power-up reset, a feature critical for state machine initialization. At a point delayed slightly from  $V_{CC}$  crossing  $V_{RST}$ , all registers will be initialized, and the state of each output will depend on the polarity of its buffer. However, due to the asynchronous nature of reset and uncertainty of how  $V_{CC}$  actually rises in the system, the following conditions are required:

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

The ATF1504AS has two options for the hysteresis about the reset level,  $V_{RST}$ , Small and Large. During the fitting process users may configure the device with the Power-up Reset hysteresis set to Large or Small. Atmel POF2JED users may select the Large option by including the flag "-power\_reset" on the command line after "filename.POF". To allow the registers to be properly reinitialized with the Large hysteresis option selected, the following condition is added:

4. If  $V_{CC}$  falls below 2.0V, it must shut off completely before the device is turned on again.

When the Large hysteresis option is active,  $I_{CC}$  is reduced by several hundred microamps as well.

## Security Fuse Usage

A single fuse is provided to prevent unauthorized copying of the ATF1504AS fuse patterns. Once programmed, fuse verify is inhibited. However, the 16-bit User Signature remains accessible.

## DC and AC Operating Conditions

	Commercial	Industrial
Operating Temperature (Ambient)	0°C - 70°C	-40°C - 85°C
V <sub>CCINT</sub> or V <sub>CCIO</sub> (5V) Power Supply	5V ± 5%	5V ± 10%
V <sub>CCIO</sub> (3.3V) Power Supply	3.0V - 3.6V	3.0V - 3.6V

## DC Characteristics

Symbol	Parameter	Condition			Min	Typ	Max	Units
I <sub>IL</sub>	Input or I/O Low Leakage Current	V <sub>IN</sub> = V <sub>CC</sub>				-2	-10	μA
I <sub>IH</sub>	Input or I/O High Leakage Current					2	10	
I <sub>OZ</sub>	Tri-state Output Off-state Current	V <sub>O</sub> = V <sub>CC</sub> or GND			-40		40	μA
I <sub>CC1</sub>	Power Supply Current, Standby	V <sub>CC</sub> = Max V <sub>IN</sub> = 0, V <sub>CC</sub>	Std Mode	Com.		105		mA
				Ind.		130		mA
			“L” Mode	Com.		10		μA
				Ind.		10		μA
I <sub>CC2</sub>	Power Supply Current, Power-down Mode	V <sub>CC</sub> = Max V <sub>IN</sub> = 0, V <sub>CC</sub>	“PD” Mode			1	10	mA
I <sub>CC3</sub> <sup>(2)</sup>	Current in Reduced-power Mode	V <sub>CC</sub> = Max V <sub>IN</sub> = 0, V <sub>CC</sub>	Std Power	Com		85		ma
				Ind		105		
V <sub>CCIO</sub>	Supply Voltage	5.0V Device Output		Com.	4.75		5.25	V
				Ind.	4.5		5.5	V
V <sub>CCIO</sub>	Supply Voltage	3.3V Device Output			3.0		3.6	V
V <sub>IL</sub>	Input Low Voltage				-0.3		0.8	V
V <sub>IH</sub>	Input High Voltage				2.0		V <sub>CCIO</sub> + 0.3	V
V <sub>OL</sub>	Output Low Voltage (TTL)	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>CCIO</sub> = MIN, I <sub>OL</sub> = 12 mA		Com.			0.45	V
				Ind.				
	Output Low Voltage (CMOS)	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>CC</sub> = MIN, I <sub>OL</sub> = 0.1 mA		Com.			.2	V
				Ind.			.2	V
V <sub>OH</sub>	Output High Voltage (TTL)	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>CCIO</sub> = MIN, I <sub>OH</sub> = -4.0 mA			2.4			V

Notes: 1. Not more than one output at a time should be shorted. Duration of short circuit test should not exceed 30 sec.  
2. When macrocell reduced-power feature is enabled.

## Pin Capacitance

	Typ	Max	Units	Conditions
C <sub>IN</sub>	8	10	pF	V <sub>IN</sub> = 0V; f = 1.0 MHz
C <sub>I/O</sub>	8	10	pF	V <sub>OUT</sub> = 0V; f = 1.0 MHz

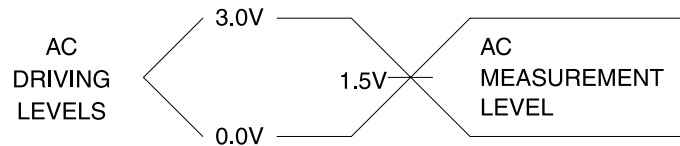
Note: Typical values for nominal supply voltage. This parameter is only sampled and is not 100% tested.  
The OGI pin (high-voltage pin during programming) has a maximum capacitance of 12 pF.

## AC Characteristics (Continued)

Symbol	Parameter	-7		-10		-15		-20		-25		Units
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
$t_{ZX1}$	Output Buffer Enable Delay (Slow slew rate = OFF; $V_{CCIO} = 5.0V$ ; $C_L = 35$ pF)		4.0		5.0		7		9		10	ns
$t_{ZX2}$	Output Buffer Enable Delay (Slow slew rate = OFF; $V_{CCIO} = 3.3V$ ; $C_L = 35$ pF)		4.5		5.5		7		9		10	ns
$t_{ZX3}$	Output Buffer Enable Delay (Slow slew rate = ON; $V_{CCIO} = 5.0V/3.3V$ ; $C_L = 35$ pF)		9		9		10		11		12	ns
$t_{XZ}$	Output Buffer Disable Delay ( $C_L = 5$ pF)		4		5		6		7		8	ns
$t_{SU}$	Register Setup Time	3		3		4		5		6		ns
$t_H$	Register Hold Time	2		3		4		5		6		ns
$t_{FSU}$	Register Setup Time of Fast Input	3		3		2		2		3		ns
$t_{FH}$	Register Hold Time of Fast Input	0.5		0.5		2		2		2.5		ns
$t_{RD}$	Register Delay		1		2		1		2		2	ns
$t_{COMB}$	Combinatorial Delay		1		2		1		2		2	ns
$t_{IC}$	Array Clock Delay		3		5		6		7		8	ns
$t_{EN}$	Register Enable Time		3		5		6		7		8	ns
$t_{GLOB}$	Global Control Delay		1		1		1		1		1	ns
$t_{PRE}$	Register Preset Time		2		3		4		5		6	ns
$t_{CLR}$	Register Clear Time		2		3		4		5		6	ns
$t_{UIM}$	Switch Matrix Delay		1		1		2		2		2	ns
$t_{RPA}$	Reduced-power Adder <sup>(2)</sup>		10		11		13		14		15	ns

- Notes: 1. See ordering information for valid part numbers.  
2. The  $t_{RPA}$  parameter must be added to the  $t_{LAD}$ ,  $t_{LAC}$ ,  $t_{TIC}$ ,  $t_{ACL}$ , and  $t_{SEXP}$  parameters for macrocells running in the reduced-power mode.

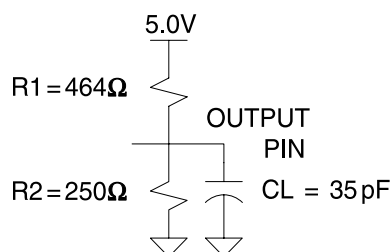
## Input Test Waveforms and Measurement Levels



$t_R$ ,  $t_F = 1.5$  ns typical



## Output AC Test Loads



Note: \*Numbers in parenthesis refer to 3.0V operating conditions (preliminary).

## Power-down Mode

The ATF1504AS includes an optional pin-controlled power-down feature. When this mode is enabled, the PD pin acts as the power-down pin. When the PD pin is high, the device supply current is reduced to less than 10 mA. During power-down, all output data and internal logic states are latched internally and held. Therefore, all registered and combinatorial output data remain valid. Any outputs that were in a high-Z state at the onset will remain at high-Z. During power-down, all input signals except the power-down pin are blocked. Input and I/O hold latches remain active to ensure that pins do not float to indeterminate levels, further reducing system power. The power-down mode feature is enabled in the logic design file or as a fitted or translated s/w option. Designs using the power-down pin may not use the PD pin as a logic array input. However, all other PD pin macrocell resources may still be used, including the buried feedback and foldback product term array inputs.

## Power Down AC Characteristics<sup>(1)(2)</sup>

Symbol	Parameter	-7		-10		-15		-20		-25		Units
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
$t_{IVDH}$	Valid I, I/O before PD High	7		10		15		20		25		ns
$t_{GV DH}$	Valid OE <sup>(2)</sup> before PD High	7		10		15		20		25		ns
$t_{CVDH}$	Valid Clock <sup>(2)</sup> before PD High	7		10		15		20		25		ns
$t_{DHIX}$	I, I/O Don't Care after PD High		12		15		25		30		35	ns
$t_{DHGX}$	OE <sup>(2)</sup> Don't Care after PD High		12		15		25		30		35	ns
$t_{DHCX}$	Clock <sup>(2)</sup> Don't Care after PD High		12		15		25		30		35	ns
$t_{DLIV}$	PD Low to Valid I, I/O		1		1		1		1		1	μs
$t_{DLGV}$	PD Low to Valid OE (Pin or Term)		1		1		1		1		1	μs
$t_{DLCV}$	PD Low to Valid Clock (Pin or Term)		1		1		1		1		1	μs
$t_{DLOV}$	PD Low to Valid Output		1		1		1		1		1	μs

- Notes: 1. For slow slew outputs, add  $t_{SSO}$ .  
2. Pin or product term.  
3. Includes  $t_{RPA}$  due to reduced power bit enabled.

## JTAG-BST/ISP Overview

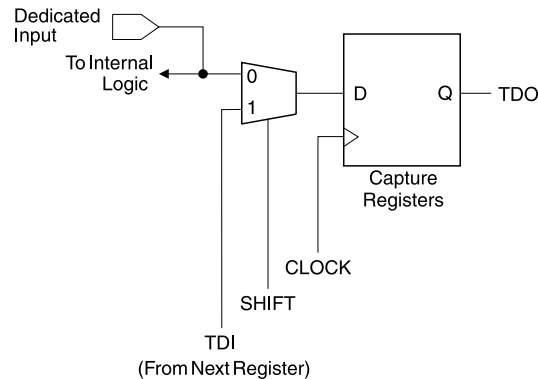
The JTAG boundary-scan testing is controlled by the Test Access Port (TAP) controller in the ATF1504AS. The boundary-scan technique involves the inclusion of a shift-register stage (contained in a boundary-scan cell) adjacent to each component so that signals at component boundaries can be controlled and observed using scan testing principles. Each input pin and I/O pin has its own boundary-scan cell (BSC) in order to support boundary scan testing. The ATF1504AS does not currently include a Test Reset (TRST) input pin because the TAP controller is automatically reset at power-up. The five JTAG modes supported include: SAMPLE/PRELOAD, EXTEST, BYPASS, IDCODE and HIGHZ. The ATF1504AS's ISP can be fully described using JTAG's BSDL as described in IEEE Standard 1149.1b. This allows ATF1504AS programming to be described and implemented using any one of the third-party development tools supporting this standard.

The ATF1504AS has the option of using four JTAG-standard I/O pins for boundary-scan testing (BST) and in-system programming (ISP) purposes. The ATF1504AS is programmable through the four JTAG pins using the IEEE standard JTAG programming protocol established by IEEE Standard 1149.1 using 5V TTL-level programming signals from the ISP interface for in-system programming. The JTAG feature is a programmable option. If JTAG (BST or ISP) is not needed, then the four JTAG control pins are available as I/O pins.

## JTAG Boundary-scan Cell (BSC) Testing

The ATF1504AS contains up to 68 I/O pins and four input pins, depending on the device type and package type selected. Each input pin and I/O pin has its own boundary-scan cell (BSC) in order to support boundary-scan testing as described in detail by IEEE Standard 1149.1. A typical BSC consists of three capture registers or scan registers and up to two update registers. There are two types of BSCs, one for input or I/O pin, and one for the macrocells. The BSCs in the device are chained together through the capture registers. Input to the capture register chain is fed in from the TDI pin while the output is directed to the TDO pin. Capture registers are used to capture active device data signals, to shift data in and out of the device and to load data into the update registers. Control signals are generated internally by the JTAG TAP controller. The BSC configuration for the input and I/O pins and macrocells are shown below.

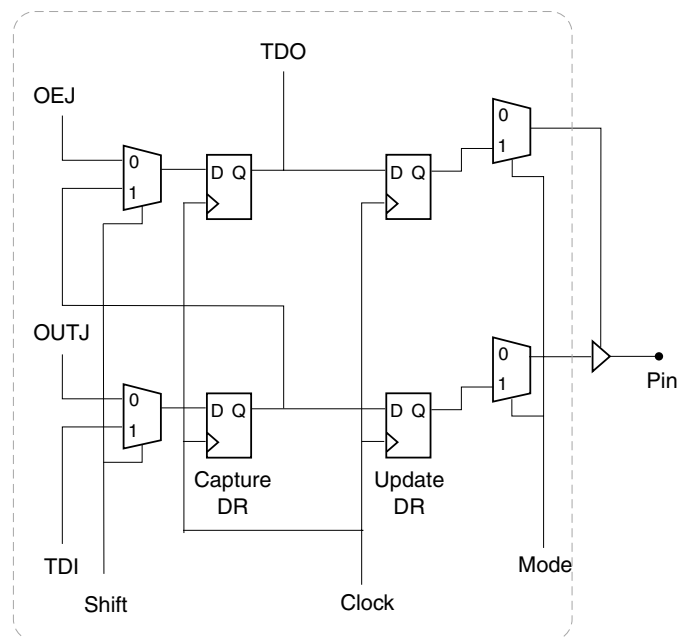
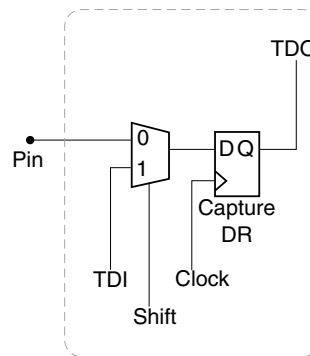
## BSC Configuration for Input and I/O Pins (Except JTAG TAP Pins)



Note: The ATF1504AS has pull-up option on TMS and TDI pins. This feature is selected as a design option.

## BSC Configuration for Macrocell

Pin BSC

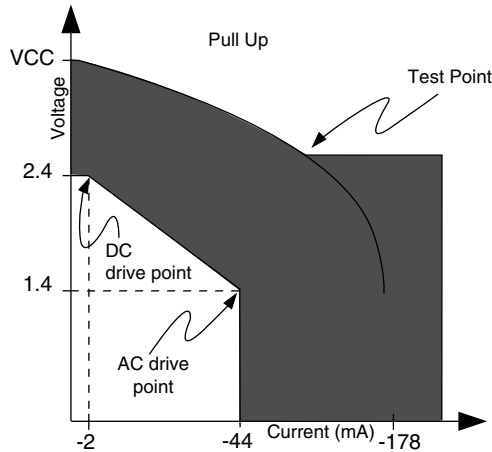


Macrocell BSC

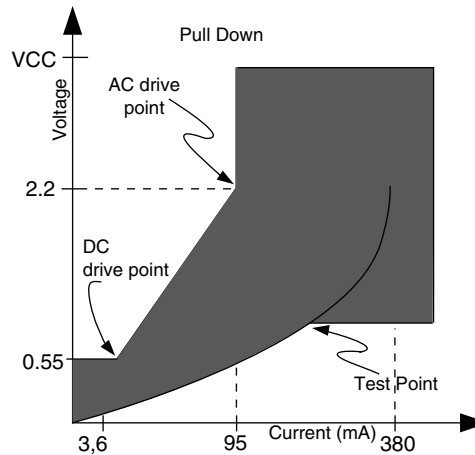
## PCI Compliance

The ATF1504AS also supports the growing need in the industry to support the new Peripheral Component Interconnect (PCI) interface standard in PCI-based designs and specifications. The PCI interface calls for high current drivers, which are much larger than the traditional TTL drivers. In general, PLDs and FPGAs parallel outputs to support the high current load required by the PCI interface. The ATF1504AS allows this without contributing to system noise while delivering low output-to-output skew. Having a programmable high drive option is also possible without increasing output delay or pin capacitance. The PCI electrical characteristics appear on the next page.

### PCI Voltage-to-current Curves for +5V Signaling in Pull-up Mode



### PCI Voltage-to-current Curves for +5V Signaling in Pull-down Mode



## ATF1504AS Dedicated Pinouts

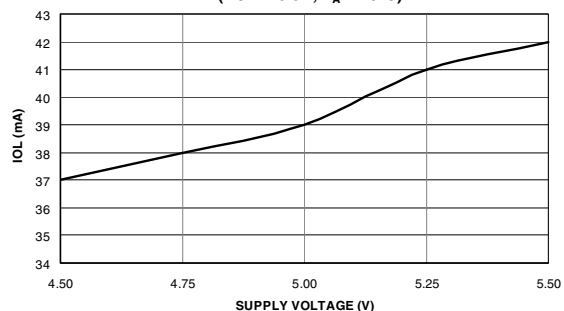
Dedicated Pin	44-lead TQFP	44-lead J-lead	68-lead J-lead	84-lead J-lead	100-lead PQFP	100-lead TQFP
INPUT/OE2/GCLK2	40	2	2	2	92	90
INPUT/GCLR	39	1	1	1	91	89
INPUT/OE1	38	44	68	84	90	88
INPUT/GCLK1	37	43	67	83	89	87
I/O /GCLK3	35	41	65	81	87	85
I/O/PD (1,2)	5, 19	11, 25	17, 37	20, 46	14, 44	12, 42
I/O/TDI (JTAG)	1	7	12	14	6	4
I/O/TMS (JTAG)	7	13	19	23	17	15
I/O/TCK (JTAG)	26	32	50	62	64	62
I/O/TDO (JTAG)	32	38	57	71	75	73
GND	4, 16, 24, 36	10, 22, 30, 42	6, 16, 26, 34, 38, 48, 58, 66	7, 19, 32, 42, 47, 59, 72, 82	13, 28, 40, 45, 61, 76, 88, 97	11, 26, 38, 43, 59, 74, 86, 95
V <sub>CCINT</sub>	9, 17, 29, 41	3, 15, 23, 35	3, 35	3, 43	41, 93	39, 91
V <sub>CCIO</sub>	—	—	11, 21, 31, 43, 53, 63	13, 26, 38, 53, 66, 78	5, 20, 36, 53, 68, 84	3, 18, 34, 51, 66, 82
N/C	—	—	—	—	1, 2, 7, 9, 24, 26, 29, 30, 51, 52, 55, 57, 72, 74, 79, 80	1, 2, 5, 7, 22, 24, 27, 28, 49, 50, 53, 55, 70, 72, 77, 78
# of Signal Pins	36	36	52	68	68	68
# User I/O Pins	32	32	48	64	64	64

OE (1, 2)      Global OE Pins  
 GCLR          Global Clear Pin  
 GCLK (1, 2, 3)      Global Clock Pins  
 PD (1, 2)      Power down pins  
 TDI, TMS, TCK, TDO      JTAG pins used for boundary-scan testing or in-system programming  
 GND          Ground Pins  
 V<sub>CCINT</sub>      VCC pins for the device (+5V - Internal)  
 V<sub>CCIO</sub>      VCC pins for output drivers (for I/O pins) (+5V or 3.3V - I/Os)

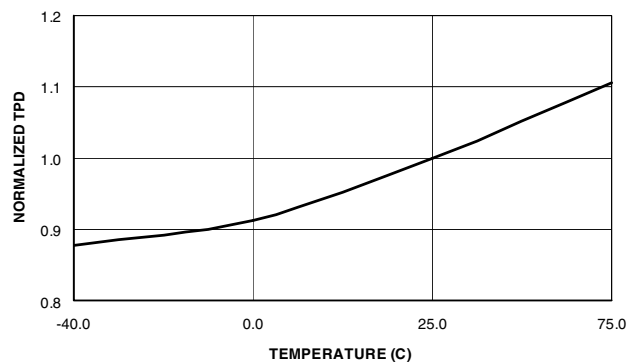
## ATF1504AS I/O Pinouts

MC	PLC	44-lead PLCC	44-lead TQFP	68-lead PLCC	84-lead PLCC	100-lead PQFP	100-lead TQFP	MC	PLC	44-lead PLCC	44-lead TQFP	68-lead PLCC	84-lead PLCC	100-lead PQFP	100-lead TQFP
1	A	12	6	18	22	16	14	33	C	24	18	36	44	42	40
2	A	–	–	–	21	15	13	34	C	–	–	–	45	43	41
3	A/ PD1	11	5	17	20	14	12	35	C/ PD2	25	19	37	46	44	42
4	A	9	3	15	18	12	10	36	C	26	20	39	48	46	44
5	A	8	2	14	17	11	9	37	C	27	21	40	49	47	45
6	A	–	–	13	16	10	8	38	C	–	–	41	50	48	46
7	A	–	–	–	15	8	6	39	C	–	–	–	51	49	47
8/ TDI	A	7	1	12	14	6	4	40	C	28	22	42	52	50	48
9	A	–	–	10	12	4	100	41	C	29	23	44	54	54	52
10	A	–	–	–	11	3	99	42	C	–	–	–	55	56	54
11	A	6	44	9	10	100	98	43	C	–	–	45	56	58	56
12	A	–	–	8	9	99	97	44	C	–	–	46	57	59	57
13	A	–	–	7	8	98	96	45	C	–	–	47	58	60	58
14	A	5	43	5	6	96	94	46	C	31	25	49	60	62	60
15	A	–	–	–	5	95	93	47	C	–	–	–	61	63	61
16	A	4	42	4	4	94	92	48/ TCK	C	32	26	50	62	64	62
17	B	21	15	33	41	39	37	49	D	33	27	51	63	65	63
18	B	–	–	–	40	38	36	50	D	–	–	–	64	66	64
19	B	20	14	32	39	37	35	51	D	34	28	52	65	67	65
20	B	19	13	30	37	35	33	52	D	36	30	54	67	69	67
21	B	18	12	29	36	34	32	53	D	37	31	55	68	70	68
22	B	–	–	28	35	33	31	54	D	–	–	56	69	71	69
23	B	–	–	–	34	32	30	55	D	–	–	–	70	73	71
24	B	17	11	27	33	31	29	56/ TDO	D	38	32	57	71	75	73
25	B	16	10	25	31	27	25	57	D	39	33	59	73	77	75
26	B	–	–	–	30	25	23	58	D	–	–	–	74	78	76
27	B	–	–	24	29	23	21	59	D	–	–	60	75	81	79
28	B	–	–	23	28	22	20	60	D	–	–	61	76	82	80
29	B	–	–	22	27	21	19	61	D	–	–	62	77	83	81
30	B	14	8	20	25	19	17	62	D	40	34	64	79	85	83
31	B	–	–	–	24	18	16	63	D	–	–	–	80	86	84
32/ TMS	B	13	7	19	23	17	15	64	D/ GCLK3	41	35	65	81	87	85

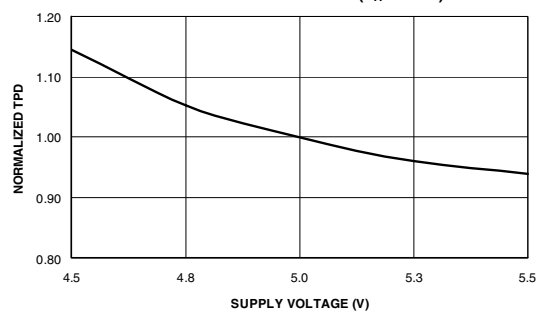
**OUTPUT SINK CURRENT VS. SUPPLY VOLTAGE**  
( $V_{OL} = 0.5V$ ,  $T_A = 25^\circ C$ )



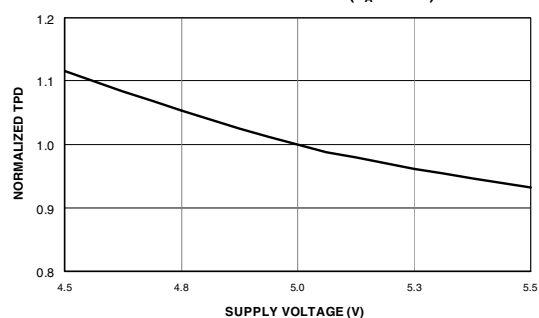
**NORMALIZED TPD**  
**VS. TEMPERATURE ( $V_{CC} = 5.0V$ )**



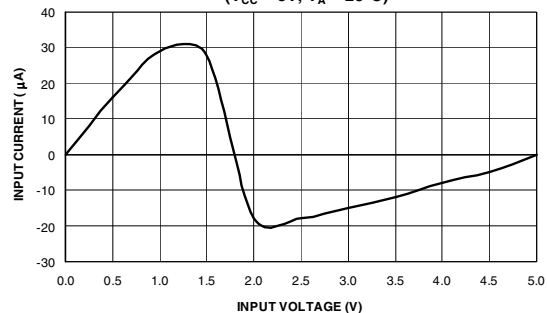
**NORMALIZED TPD**  
**VS. SUPPLY VOLTAGE ( $T_A = 25^\circ C$ )**



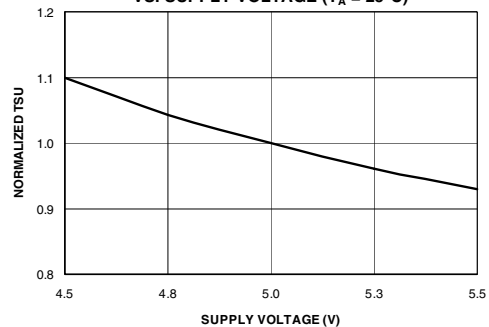
**NORMALIZED TCO**  
**VS. SUPPLY VOLTAGE ( $T_A = 25^\circ C$ )**



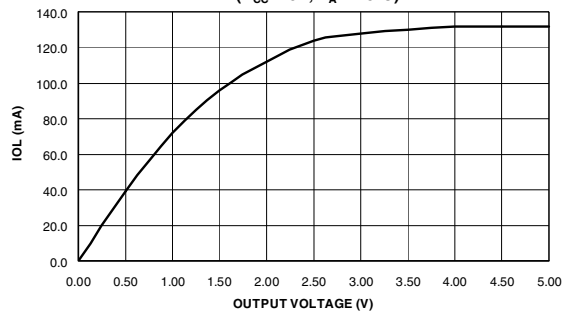
**INPUT CURRENT VS. INPUT VOLTAGE**  
( $V_{CC} = 5V$ ,  $T_A = 25^\circ C$ )



**NORMALIZED TSU**  
**VS. SUPPLY VOLTAGE ( $T_A = 25^\circ C$ )**

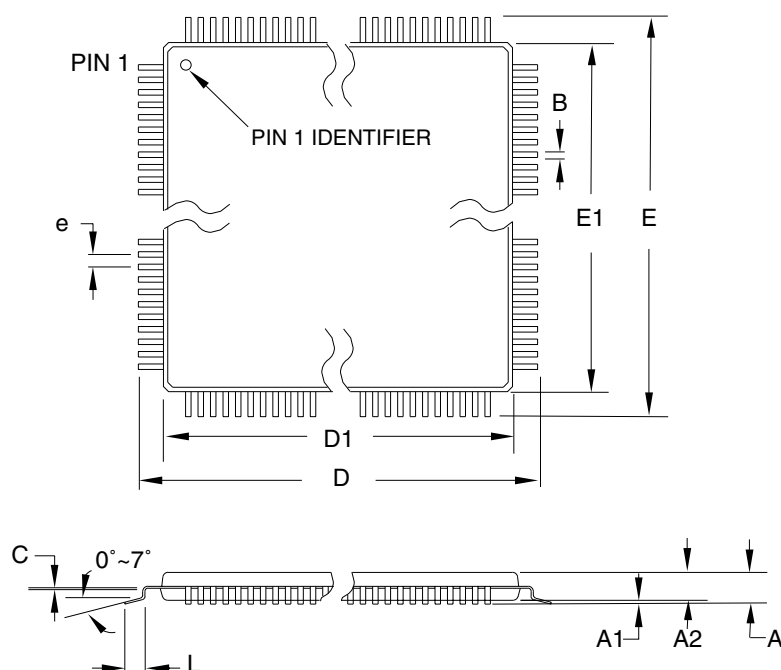


**OUTPUT SINK CURRENT VS. OUTPUT VOLTAGE**  
( $V_{CC} = 5V$ ,  $T_A = 25^\circ C$ )



# Packaging Information

## 44A – TQFP



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

SYMBOL	MIN	NOM	MAX	NOTE
A	—	—	1.20	
A1	0.05	—	0.15	
A2	0.95	1.00	1.05	
D	11.75	12.00	12.25	
D1	9.90	10.00	10.10	Note 2
E	11.75	12.00	12.25	
E1	9.90	10.00	10.10	Note 2
B	0.30	—	0.45	
C	0.09	—	0.20	
L	0.45	—	0.75	
e	0.80 TYP			

- Notes:
1. This package conforms to JEDEC reference MS-026, Variation ACB.
  2. Dimensions D1 and E1 do not include mold protrusion. Allowable protrusion is 0.25 mm per side. Dimensions D1 and E1 are maximum plastic body size dimensions including mold mismatch.
  3. Lead coplanarity is 0.10 mm maximum.

10/5/2001



2325 Orchard Parkway  
San Jose, CA 95131

### TITLE

**44A**, 44-lead, 10 x 10 mm Body Size, 1.0 mm Body Thickness,  
0.8 mm Lead Pitch, Thin Profile Plastic Quad Flat Package (TQFP)

### DRAWING NO.

44A

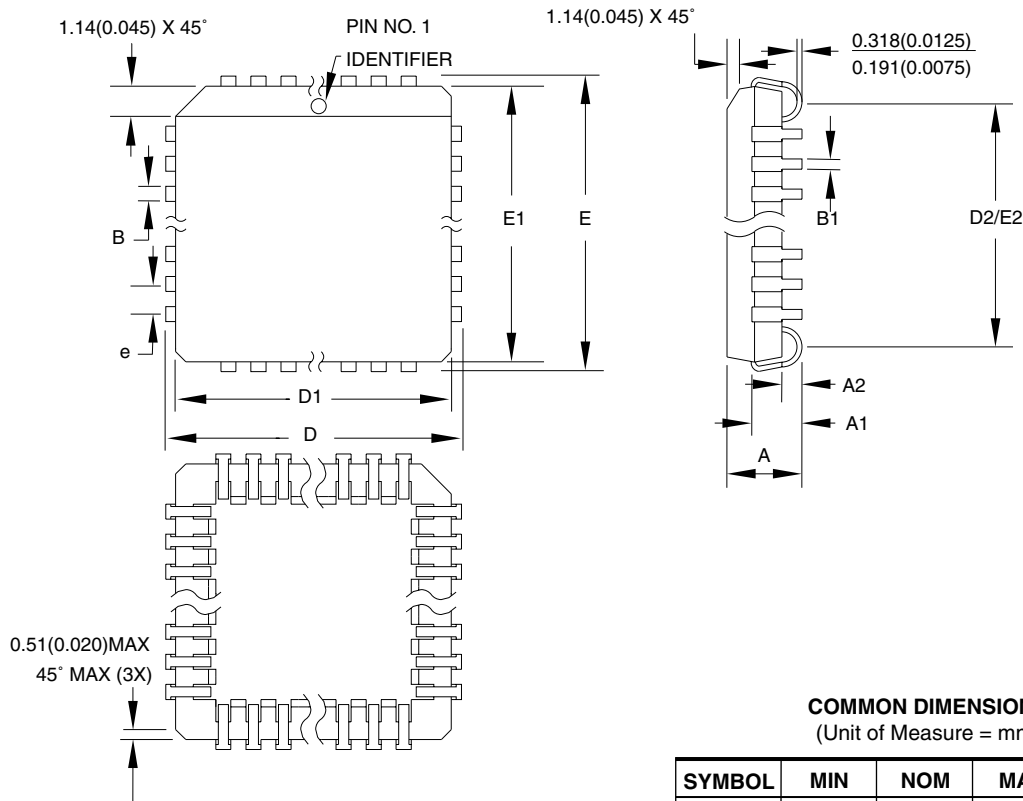
### REV.

B





## 44J – 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	17.399	—	17.653	
D1	16.510	—	16.662	Note 2
E	17.399	—	17.653	
E1	16.510	—	16.662	Note 2
D2/E2	14.986	—	16.002	
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 AC.
  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

**44J**, 44-lead, Plastic J-leaded Chip Carrier (PLCC)

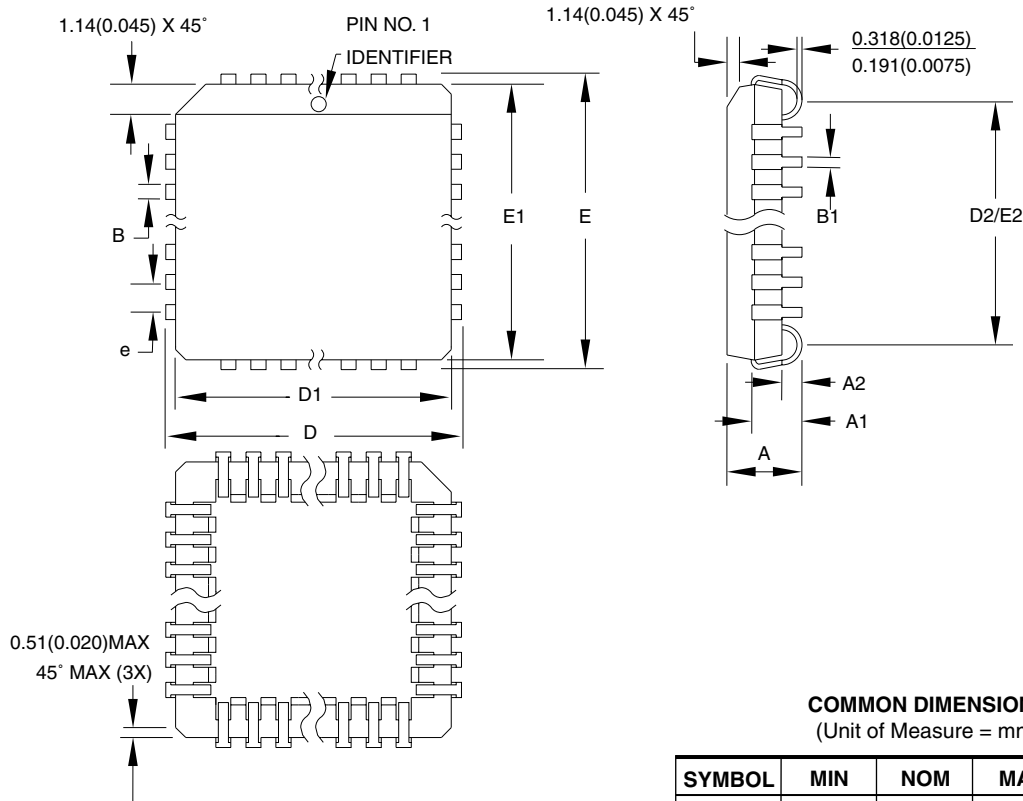
### DRAWING NO.

44J

### REV.

B

## 68J – 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	25.019	—	25.273	
D1	24.130	—	24.333	Note 2
E	25.019	—	25.273	
E1	24.130	—	24.333	Note 2
D2/E2	22.606	—	23.622	
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 AE.
  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**

**68J**, 68-lead, Plastic J-leaded Chip Carrier (PLCC)

**DRAWING NO.**

68J

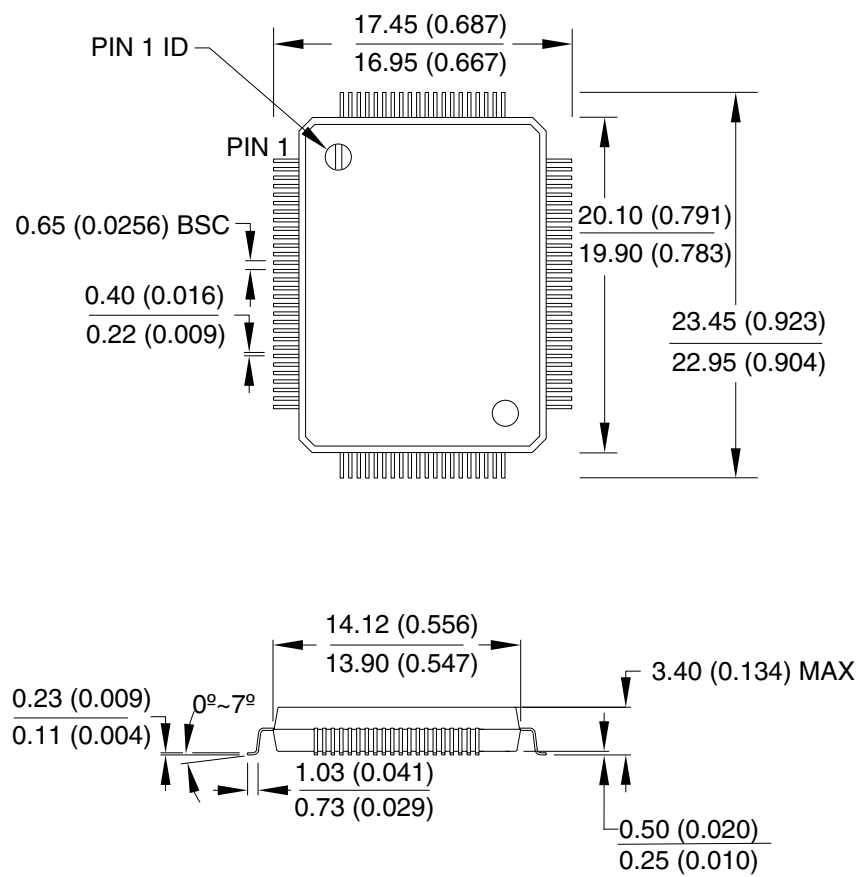
**REV.**

B




100Q1 – PQFP

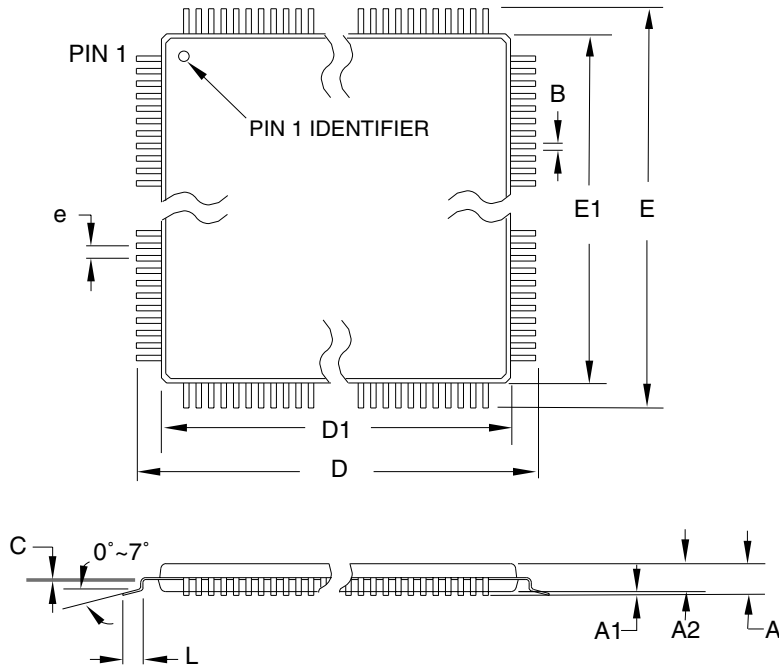
Dimensions in Millimeters and (Inches)\*  
 \*Controlling dimensions: millimeters  
 JEDEC STANDARD MS-022, GC-1



04/11/2001

 2325 Orchard Parkway San Jose, CA 95131	<b>TITLE</b> <b>100Q1</b> , 100-lead, 14 x 20 mm Body, 3.2 mm Footprint, 0.65 mm Pitch, Plastic Quad Flat Package (PQFP)	<b>DRAWING NO.</b> 100Q1	<b>REV.</b> A
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# 100A – TQFP



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

SYMBOL	MIN	NOM	MAX	NOTE
A	–	–	1.20	
A1	0.05	–	0.15	
A2	0.95	1.00	1.05	
D	15.75	16.00	16.25	
D1	13.90	14.00	14.10	Note 2
E	15.75	16.00	16.25	
E1	13.90	14.00	14.10	Note 2
B	0.17	–	0.27	
C	0.09	–	0.20	
L	0.45	–	0.75	
e	0.50 TYP			

- Notes:
1. This package conforms to JEDEC reference MS-026, Variation AED.
  2. Dimensions D1 and E1 do not include mold protrusion. Allowable protrusion is 0.25 mm per side. Dimensions D1 and E1 are maximum plastic body size dimensions including mold mismatch.
  3. Lead coplanarity is 0.08 mm maximum.

10/5/2001



2325 Orchard Parkway  
San Jose, CA 95131

## TITLE

**100A**, 100-lead, 14 x 14 mm Body Size, 1.0 mm Body Thickness,  
0.5 mm Lead Pitch, Thin Profile Plastic Quad Flat Package (TQFP)

## DRAWING NO.

100A

## REV.

C



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