Am29520A/Am29521A

Multilevel Pipeline Registers

DISTINCTIVE CHARACTERISTICS

- Four 8-bit wide registers
- Provides temporary storage for data/instruction delay/queuing
- Single 4 level or dual 2 level structure
- High-speed IMOX™ ECL internal technology, TTL compatible I/O
- All 4 registers available at three state output
- 24 pin slim (0.3") DIP packages
- 28 pin chip carrier packages

GENERAL DESCRIPTION

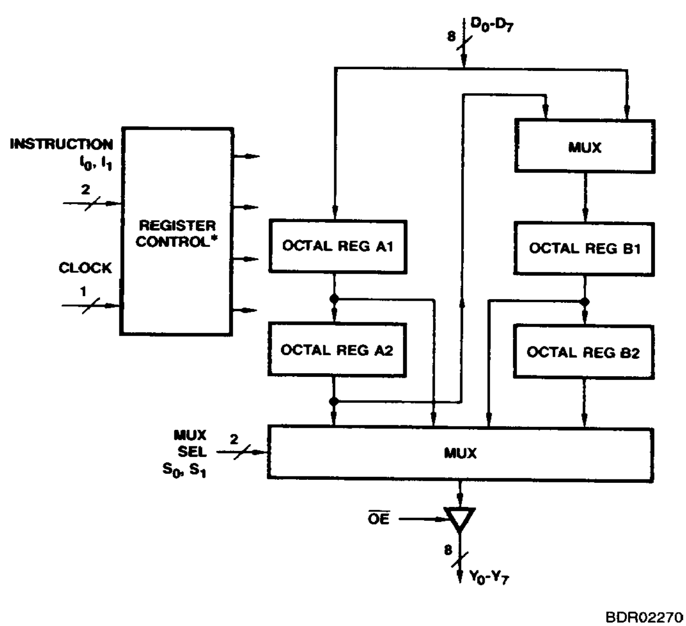
The Am29520A and Am29521A are high speed, dual stack, register files that differ only in the way data is loaded (see Table 1). Both devices contain four 8-bit wide registers whose flexible architecture lends itself to virtually any system. The high output drive allows layout of the devices directly on the system bus for bit slice and array or digital signal processing applications.

In the Am29520A, data may be microprogrammed to cascade through the 4 registers in push-down pattern, no-op to hold data in the registers, or push-down data through one 2 level stack while holding data in the other stack.

The Am29521A also has the cascadable 4 register push-down and no-op features. It can also be microprogrammed to write over the first level register of one stack, while holding data in the other 3 registers.

Advanced Micro Devices

BLOCK DIAGRAM



*Multilevel Pipeline Register

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Publication #	Rev.	Amendment
03569	B	/0

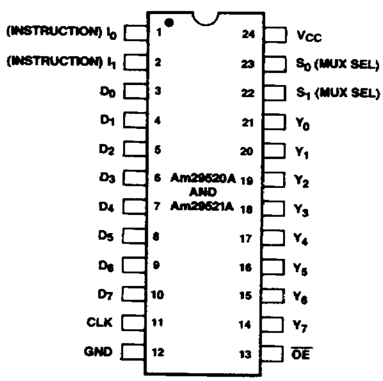
Issue Date: **September 1986**

RELATED PRODUCTS

Part No.	Description
Am29540	FFT Address Sequencer
Am29116	16-bit Bipolar Microprocessor
Am29325	32-bit Floating Point Processor
Am29517A	16 x 16-bit Multiplier
Am29501	8-bit Multi-Port Pipeline Microprocessor
Am29C509	12 x 12 MAC
Am6108	8-bit A/D Converter
Am9128	2K x 8 Static RAM
Am21L47	4K x 1 Static RAM
Am29524	Dual 7 Deep Pipeline Register with 0 and Feedthrough

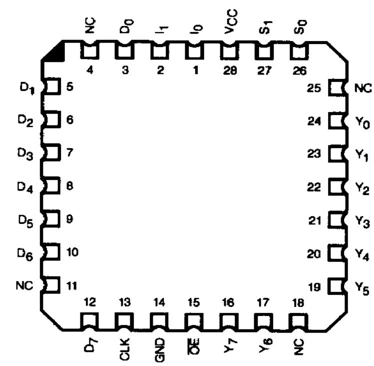
CONNECTION DIAGRAM
Top View

CD3024
PD3024



CDR04471

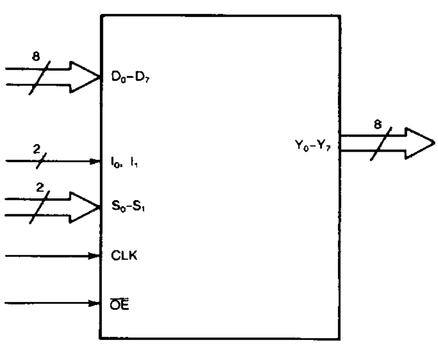
CL 028
PL 028



CD010120

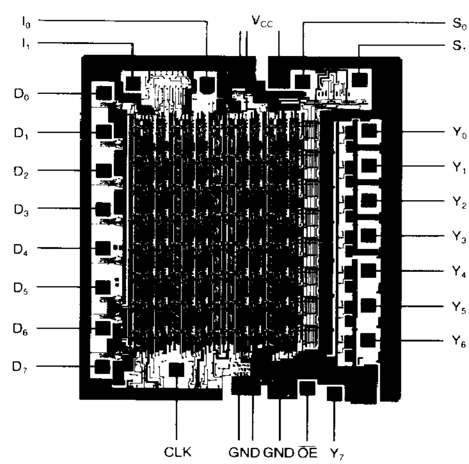
Note: Pin 1 is marked for orientation.

LOGIC SYMBOL



LS002301

METALLIZATION AND PAD LAYOUT



DIE SIZE: 0.117" x 0.133"
Approximate Gate Count = 362

ORDERING INFORMATION

Standard Products

AMD standard products are available in several packages and operating ranges. The order number (Valid Combination) is formed by a combination of: **A. Device Number**
B. Speed Option (if applicable)
C. Package Type
D. Temperature Range
E. Optional Processing

AM29520A __ D C B

E. OPTIONAL PROCESSING
Blank = Standard processing
B = Burn-in

D. TEMPERATURE RANGE
C = Commercial (0 to +70°C)

C. PACKAGE TYPE
P = 24-Pin Plastic DIP (CD3024)
D = 24-Pin Ceramic DIP (PD3024)
J = 28-Pin Plastic Leaded Chip Carrier (PL 028)
L = 28-Pin Ceramic Leadless Chip Carrier (CL 028)

B. SPEED OPTION
Not Applicable

A. DEVICE NUMBER/DESCRIPTION
Am29520A
Am29521A
Multilevel Pipeline Registers

Valid Combinations	
AM29520A	DC, DCB, PC, PCB, LC, JC
AM29521A	DC, DCB, PC, PCB, LC, JC

Valid Combinations

Valid Combinations list configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations, to check on newly released combinations, and to obtain additional data on AMD's standard military grade products.

ORDERING INFORMATION

APL Products

AMD products for Aerospace and Defense applications are available in several packages and operating ranges. APL (Approved Products List) products are fully compliant with MIL-STD-883C requirements. CPL (Controlled Products List) products are processed in accordance with MIL-STD-883C, but are inherently non-compliant because of package, solderability, or surface treatment exceptions to those specifications. The order number (Valid Combination) for APL products is formed by a combination of: **A. Device Number**

B. Speed Option (if applicable)
C. Device Class
D. Package Type
E. Lead Finish

AM29521A __ /B J A

E. LEAD FINISH
A = Hot Solder DIP
C = Gold

D. PACKAGE TYPE
/BLA = 24-Pin CD3024
/B3C = 28-Pin CL 028

C. DEVICE CLASS
/B = Class B

B. SPEED OPTION
Not Applicable

A. DEVICE NUMBER/DESCRIPTION
Am29520A
Am29521A
Multilevel Pipeline Registers

Valid Combinations	
AM29520A	BLA, B3C
AM29521A	BLA, B3C

Valid Combinations

Valid Combinations list configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations or to check for newly released valid combinations.

PIN DESCRIPTION

$D_0 - D_7$ Register Input Port (Input, Active HIGH)
Data to be written to the internal registers is input via this port.

$Y_0 - Y_7$ Register Output Port (Output, Three-State)
Data to be read out of any of the internal registers is output via this three-state port.

I_0, I_1 Instruction Inputs (Input, Active HIGH)
Operational control of the device is determined by these inputs. See Tables 1 and 2 for details.

S_0, S_1 Register Output Select (Input, Active HIGH)
These inputs select which register appears on the Register Output Port. See Table 3 for details.

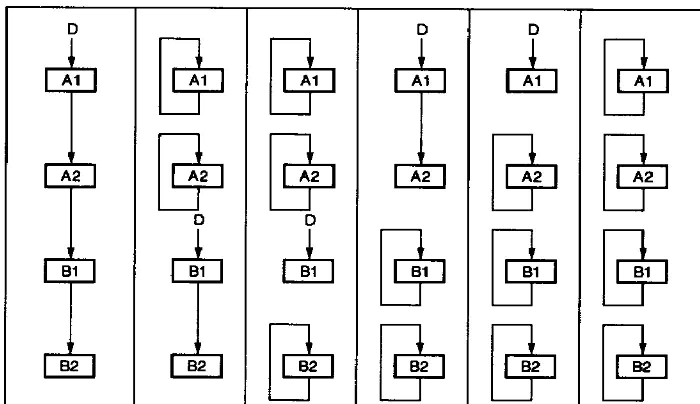
CLK Clock (Input)
The rising edge of the clock loads data into the appropriate registers as determined by the Instruction Inputs.

$\overline{OE}$ $\overline{\text{Output Enable}}$ (Input, Active LOW)
When LOW, the register selected by the Register Output Select Inputs appears on the Register Output Port. When HIGH, the Register Output Port is three-stated.

FUNCTIONAL DESCRIPTION

The following tables describe the operation of the Am29520A/29521A. Table 1 illustrates register operation in response to instruction inputs I_0 and I_1. Note that in the Am29521A, Instructions "LDB" and "LDA" write over register B_1 or A_1 respectively, and hold resident data in the other 3 registers. The Am29520A instead pushes data down the two level stack. Table 2 gives the operand values corresponding to the operations illustrated in Table 1. Table 3 gives the Register Output Select codes required to access a specific register, which then appears at the Register Output Port.

Am29520A/29521A INSTRUCTIONS

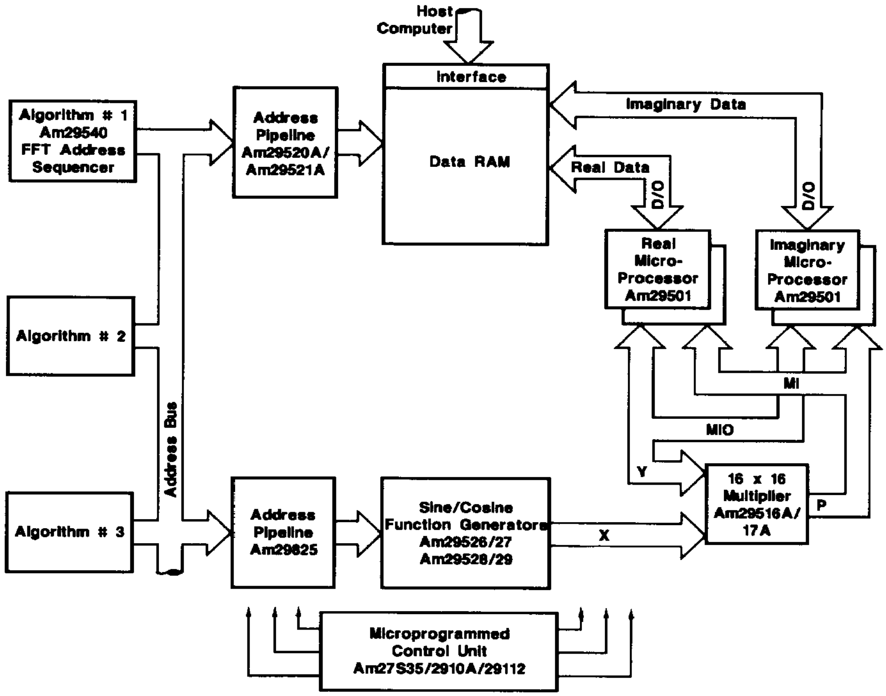


I_1, I_0	00	01		10		11
INST	SHIFT	LDB		LDA		HLD
PART	29520A/29521A	29520A	29521A	29520A	29521A	29520A/29521A

TB000240

TABLE 1. REGISTER LOAD OPERATIONS
(See Table 2 for instruction codes)

Am29500 PROCESSOR



BD002712

Mnemonic	Inputs		Description	
	I_1	I_0	Am29520A Only	Am29521A Only
Shift	0	0	Push A & B	Push A & B
LDB	0	1	Push B	Write Over B_1
LDA	1	0	Push A	Write Over A_1
HLD	1	1	No-Op	No-Op

TABLE 2. INSTRUCTION SET DESCRIPTIONS

S0	S1	Y0 – Y7
1	1	A_1
1	0	A_2
0	1	B_1
0	0	B_2

TABLE 3. SELECT OPERATION DESCRIPTIONS &vc<2>

ABSOLUTE MAXIMUM RATINGS

Storage Temperature .... −65 to +150°C
Temperature Under Bias-T_C .... −55 to +125°C
Supply Voltage to Ground Potential
Continuous .... −0.5 to +7.0V
DC Voltage Applied to Outputs For
High Output State .... −0.5V to $+V_{CC}$ max
DC Input Voltage .... −0.5 to +5.5V
DC Output Current, Into Outputs 30mA
DC Input Current .... −30mA to +5.0mA

Stresses above those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to absolute maximum ratings for extended periods may affect device reliability.

OPERATING RANGES

Commercial (C) Devices
Temperature .... T_A = 0°C to +70°C
Supply Voltage .... +4.75 V to +5.25 V

Military (M) Devices
Temperature .... T_C = −55°C to +125°C
Supply Voltage .... +4.5 V to +5.5 V

Operating ranges define those limits between which the functionality of the device is guaranteed.

DC CHARACTERISTICS over operating range unless otherwise specified

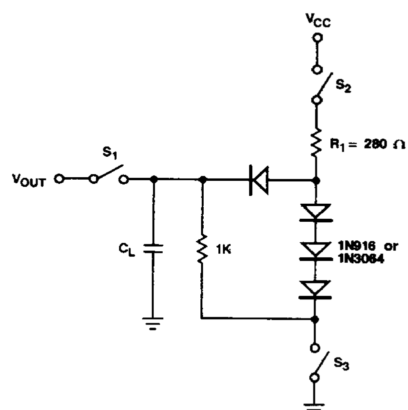
Parameters	Description	Test Conditions (Note 1)		Min.	Max.	Units
V_{OH}	Output HIGH Voltage	V_{CC} = MIN $V_{IN} = V_{IH}$ or V_{IL}	I_{OH} = −6.5 mA (COM'L)	2.4		Volts
			I_{OH} = −2.0 mA (MIL)	2.4		
V_{OL}	Output LOW Voltage	V_{CC} = MIN $V_{IN} = V_{IH}$ or V_{IL}	I_{OL} = 12 mA		0.45	Volts
			I_{OL} = 20 mA		0.50	
V_{IH}	Input HIGH Level	Guaranteed input logical HIGH voltage for all inputs		2.0		Volts
V_{IL}	Input LOW Level	Guaranteed input logical LOW voltage for all inputs			0.8	Volts
V_I	Input Clamp Voltage	V_{CC} = MIN, I_{IN} = −18 mA			−1.2	Volts
I_{IL}	Input LOW Current	V_{CC} = MAX, V_{IN} = 0.5V	$\overline{OE}$		−2.0	mA
			Other Inputs		−0.4	
I_{IH}	Input HIGH Current	V_{CC} = MAX, V_{IN} = 2.7V			50	μA
I_I	Input HIGH Current	V_{CC} = MAX, V_{IN} = 5.5 V			1.0	mA
I_{OZH}	Off State (High Impedance) Output Current	V_{CC} = MAX	V_O = 2.7 V		50	μA
I_{OZL}			V_O = 0.5 V		−50	
I_{SC}	Output Short Circuit Current (Note 2)	V_{CC} = MAX		−30	−100	mA
I_{CC}	Power Supply Current (Note 3)	COM'L Only V_{CC} = MAX	T_A = 0 to +70°C		185	mA
			T_A = +70°C		155	
		MIL Only V_{CC} = MAX	T_C = −55 to +125°C		200	
			T_C = +125°C		150	

Notes: 1. For conditions shown as MIN or MAX, use the appropriate value specified under Operating Ranges for the applicable device type.
2. Not more than one output should be shorted at a time. Duration of the short circuit test should not exceed one second.
3. All inputs LOW.

SWITCHING CHARACTERISTICS over operating range unless otherwise specified

No.	Parameters Symbols		Parameter Description	Test Conditions	COMMERCIAL		MILITARY		Units
					Min.	Max.	Min.	Max.	
1	t_{PD}	t_{PLH}	Clock to Data Output	$R_L = 280\Omega$, $C_L = 50pF$		21		24	ns
		t_{PHL}				22		24	
2	t_{PDSEL}	t_{PLH}	S_0, S_1 to Data Output			20		22	ns
		t_{PHL}				20		22	
3	t_S		Input Data to Clock		10		10		ns
4	t_H				3		3		
5	t_S		Instruction (Register Enable) to Clock		10		10		ns
6	t_H				3		3		
7	t_{PHZ}		$\overline{OE}$ to Output	$C_L = 5$ pF		13		14	ns
8	t_{PLZ}		$\overline{OE}$ to Output	$C_L = 5$ pF		15		16	ns
9	t_{PZH}		$\overline{OE}$ to Output	$R_L = 280\ \Omega$, $C_L = 50$ pF		20		22	ns
10	t_{PZL}		$\overline{OE}$ to Output			21		22	ns
11	t_{PWH}		Clock Pulse Width HIGH		10		10		ns
12	t_{PWL}		Clock Pulse Width LOW		10		10		ns

SWITCHING TEST CIRCUITS

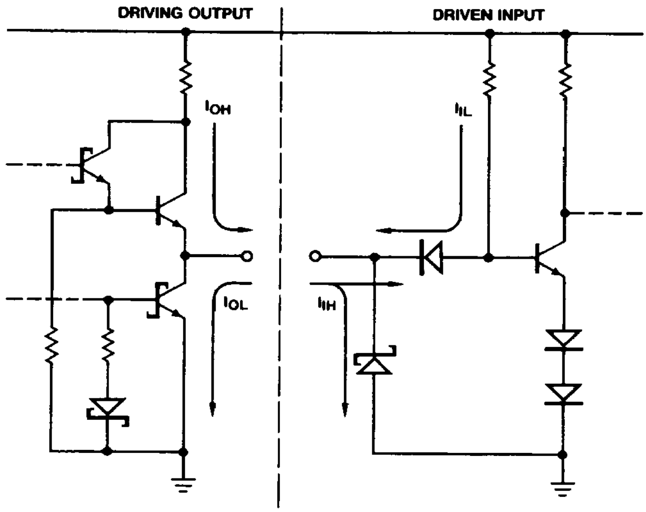


TC001102

Three-State Outputs

Notes: 1. $C_L = 50$ pF includes scope probe, wiring and stray capacitances without device in test fixture.
2. S_1, S_2, S_3 are closed during function tests and all AC tests except output enable tests.
3. S_1 and S_3 are closed while S_2 is open for t_{PZH} test.
S_1 and S_2 are closed while S_3 is open for t_{PZL} test.
4. $C_L = 5.0$ pF for output disable tests.

INPUT/OUTPUT CURRENT INTERFACE CONDITIONS



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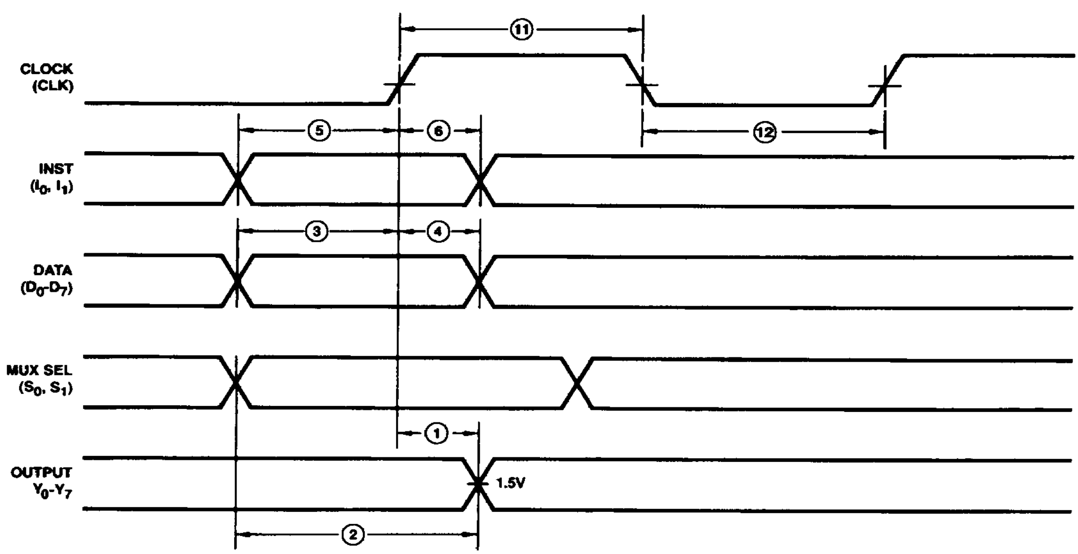
SWITCHING WAVEFORMS

Am29520A/Am29521A



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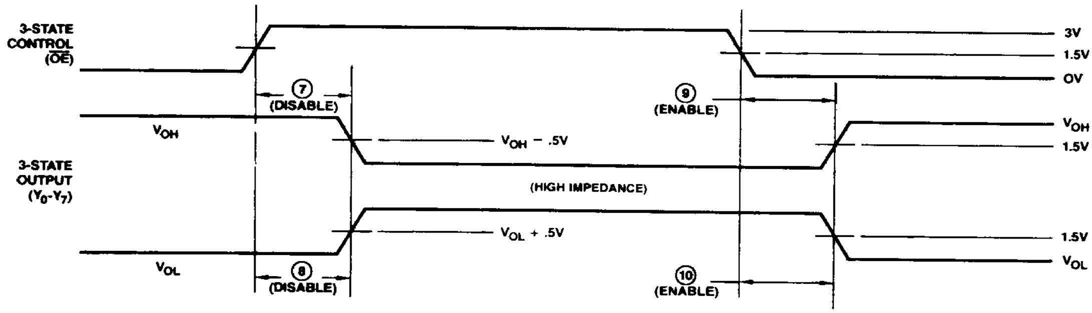
SWITCHING WAVEFORMS (Cont'd.)

THREE STATE TIMING
Am29520A/Am29521A



WFR02942

Test Philosophy and Methods

The following points give the general philosophy that we apply to tests that must be properly engineered if they are to be implemented in an automatic testing environment. The specifics of what philosophies are applied to which test are shown in the data sheet and the data-sheet reconcilation that follow.

Capacitive Loading for AC Testing

Automatic testers and their associated hardware have stray capacitance that varies from one type of tester to another, but is generally around 50 pF. This, of course, makes it impossible to make direct measurements of parameters that call for smaller capacitive load than the associated stray capacitance. Typical examples of this are the so-called "float delays" that measure the propagation delays in to and out of the high-impedance state and are usually specified at a load capacitance of 5.0 pF. In these cases, the test is performed at the higher load capacitance (typically 50 pF) and engineering correlations based on data taken with a bench set up are used to determine the result at the lower capacitance.

Similarly, a product may be specified at more than one capacitive load. Since the typical automatic tester is not capable of switching loads in mid-test, it is impractical to make measurements at both capacitances even though they may both be greater than the stray capacitance. In these cases, a measurement is made at one of the two capacitances. The result at the other capacitance is determined from engineering correlations based on data taken with a bench setup and the knowledge that certain DC tests are performed in order to facilitate this correlation.

AC loads specified in the data sheet are used for bench testing. Automatic tester loads, which simulate the data-sheet loads, may be used during production testing.

Threshold Testing

The noise associated with automatic testing, the long inductive cables, and the high gain of bipolar devices frequently give rise to oscillations when testing high-speed circuits. These oscillations are not indicative of a reject device, but instead, of an overtaxed system. To minimize this problem, thresholds are tested at least once for each input pin. Thereafter, "hard" high and low levels are used for other tests. Generally this means that function and AC testing are performed at "hard" input levels.

AC Testing

AC parameters are specified that cannot be measured accurately on automatic testers because of tester limitations. Data-input hold times fall into this category. In these cases, the parameter in question is tested by correlating the tester to bench data or oscilloscope measurements made on the tester by engineering (supporting data on file).

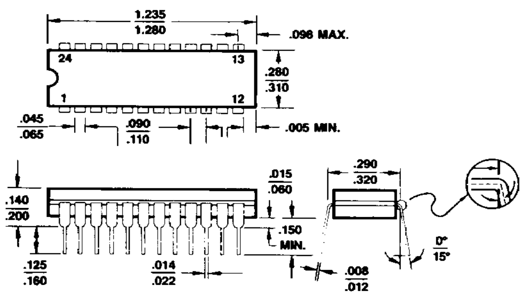
Certain AC tests are redundant since they can be shown to be predicted by other tests that have already been performed. In these cases, the redundant tests are not performed.

Output Short-Circuit Current Testing

When performing I_{OS} tests on devices containing RAM or registers, great care must be taken that undershoot caused by grounding the high-state output does not trigger parasitic elements which in turn cause the device to change state. In order to avoid this effect, it is common to make the measurement at a voltage (V_{output}) that is slightly above the ground. The V_{CC} is raised by the same amount so that the result (as confirmed by Ohm's law and precise bench testing) is identical to the $V_{OUT} = 0$, V_{CC} = Max. case.

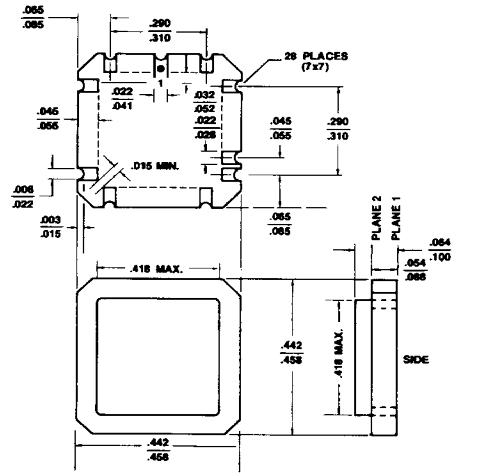
PHYSICAL DIMENSIONS*

CD3024



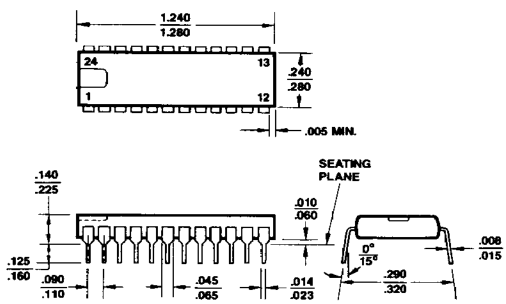
PID # 06850B

CL 028



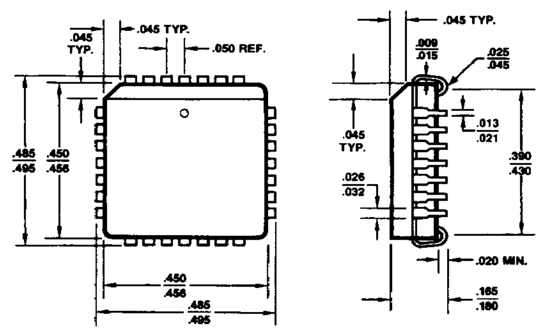
PID # 06595D

PD3024



PID # 07089B

PL 028



PID # 06751D

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