

Am29510/L510

16 X 16 Multiplier Accumulator

[查询"AM29L510DCB"供应商](#)

DISTINCTIVE CHARACTERISTICS

- Uses two's complement or unsigned inputs and
- Round control
- Output register preload
- 35-bit product accumulator result
 - 32-bit product
 - 3-bit extended product
- IMOX™ processing
 - ECL internal circuitry for speed
 - TTL I/O, Single 5V Supply
- FAST
 - High speed version multiply accumulate time 80ns
 - Low power version multiply accumulate time 110ns

GENERAL DESCRIPTION

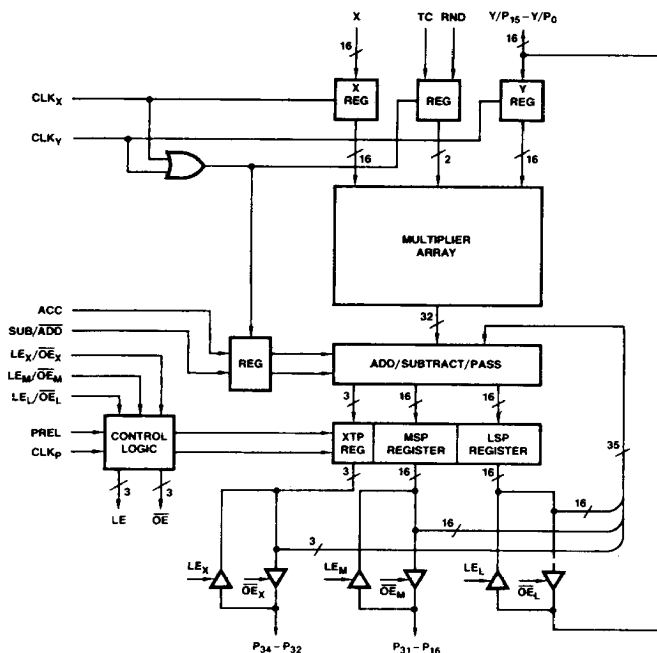
The Am29510 is a high-speed 16 x 16-bit multiplier/accumulator (MAC). The X and Y input registers accept 16-bit inputs in either two's complement or unsigned magnitude format. A third register stores the Two's Complement (TC), Round (RND), Accumulator (ACC), and Subtraction/Addition (SUB/ADD) control bits. This register is clocked whenever the X or Y input registers are clocked.

The 35-bit accumulator/output register contains the full 32-bit multiplier output which is sign extended or zero-filled based on the TC control bit. The accumulator can also be

preloaded from an external source through the bidirectional P port. The operation of the accumulator is controlled by the signals ACC, (Accumulator), SUB/ADD (Subtraction/Addition), and PREL (Preload). Each of the input registers and the output register has independent clocks.

The Am29L510 is a low-power version of the Am29510. The Am29L510 consumes only one-half the power of its standard power counterpart while maintaining nearly two-thirds the speed.

BLOCK DIAGRAM



BDR02280

IMOX is a trademark of Advanced Micro Devices, Inc.

03563B

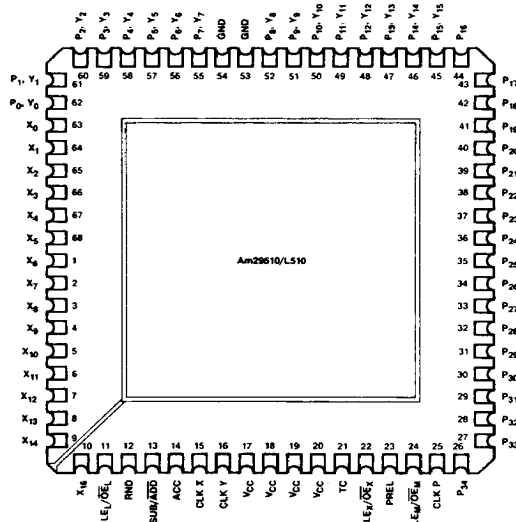
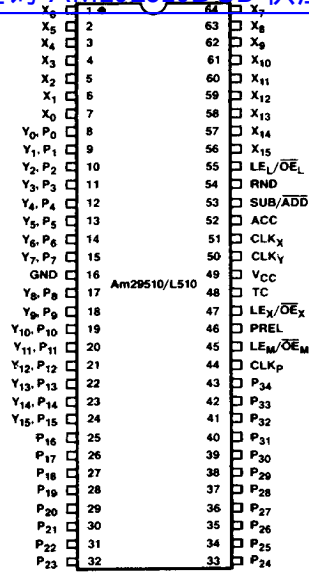
7-26

Refer to Page 13-1 for Essential Information on Military Devices

CONNECTION DIAGRAM Top View

Dual In-Line
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Leadless Chip Carrier

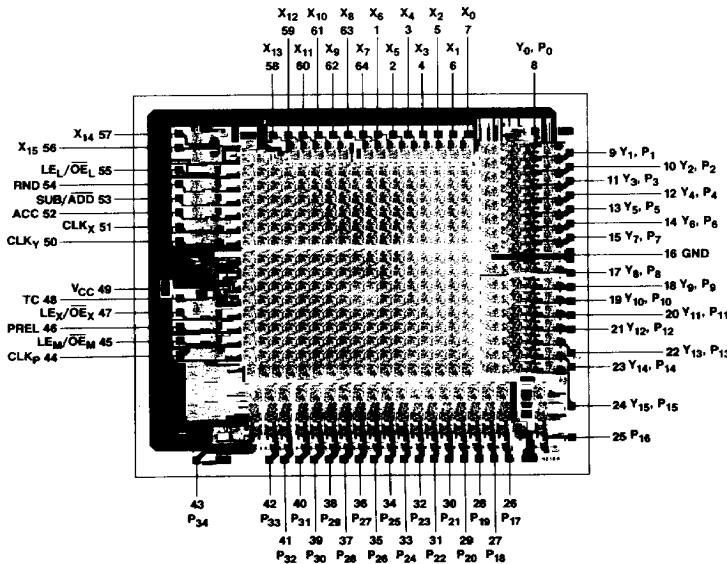


CDR04430

CDR04440

Note: Pin 1 is marked for orientation

METALLIZATION AND PAD LAYOUT



DIE SIZE: .291" x .258"

03563B

ORDERING INFORMATION

AMD products are available in several packages and operating ranges. The order number is formed by a combination of the following: Device number, speed option (if applicable), package type, operating range and screening option (if desired).

Am29510/L510

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Screening Option
Blank - Standard Processing
B - Burn-in (Note 1)

Temperature (See Operating Ranges)
C - Commercial (0 to +70°C)
M - Military (-55 to +125°C)

Package Code
L = 68-Pin Leadless Chip Carrier
D = 64-Pin Top-Brazed with Heat Sink
or 64-Pin Top-Brazed without Heat Sink
P = 64-Pin Molded DIP*

Device Type
Multiplier Accumulator

Note 1. 160-hour burn-in —
Heat sink parts: $T_A = 125^\circ\text{C}$
Non-heat sink parts: $T_A = 85^\circ\text{C}$

Valid Combinations

Am29510	DC, DCB, DMB, LC, LMB, PC*, PCB*
Am29L510	

Valid Combinations

Consult the AMD sales office in your area to determine if a device is currently available in the combination you wish.

PIN DESCRIPTION

*Pin No.	Name	I/O	Description
54	RND	I	Round. When RND is High, a bit with a weight of P_{15} is added to the multiplier product. RND is loaded on the rising edge of CLK_X or CLK_Y .
48	TC	I	Two's Complement. When High, the X and Y inputs are defined as two's complement data, or as unsigned data when Low. The TC control is loaded on the rising edge of CLK_X or CLK_Y .
46	PREL	I	Preload. When High, data is preloaded into the specific output register when its respective Load Enable is High. When Low, the accumulator register is available at the P-port when the Output Enables are Low.
47	LE_X/OE_X	I	Load Enable Extended/Output Enable Extended. Active High Load Enable for the XTP port during preloading. Active Low three-state control for the XTP port during normal operation (see Preload Function). (TSX)**
45	LE_M/OE_M	I	Load Enable Most/Output Enable Most. Active High Load Enable for the MSP port during preloading. Active Low three-state control for the MSP port during normal operation (see Preload Function). (TSM)**
55	LE_L/OE_L	I	Load Enable Least/Output Enable Least. Active High Load Enable for the LSP port during preloading. Active Low three-state control for the LSP port during normal operation (see Preload Function). (TSL)**
51, 50	CLK_X, CLK_Y	I	CLOCKS. Load X and Y data respectively and TC, RND, ACC and SUB/ADD on the rising edge.
44	CLK_P	I	CLOCK. Loads data into the XTP, MSP and LSP registers on the rising edge.
1-7, 56-64	$X_{15}-X_0$	I	Multiplier Data Input. Data is loaded into the X register on the rising edge of CLK_X .
8-15, 17-24	$Y_{15}-Y_0$ $P_{15}-P_0$	I/O	Bidirectional Port. Data is loaded into the Y register on the rising edge of CLK_Y . Product output for Least Significant Product (LSP) and input to preload LSP register.
41-43	$P_{34}-P_{32}$	I/O	Bidirectional Port. Product output for Extended Product (XTP) and input to preload XTP register.
25-40	$P_{31}-P_{16}$	I/O	Bidirectional Port. Product output for the Most Significant Product (MSP) and input to preload MSP register.
52	ACC	I	Accumulate. When High, the multiplier product is accumulated in the accumulator. When Low, the multiplier product is written into the accumulator (see Accumulator Function Table). The ACC control is loaded on the rising edge of CLK_X or CLK_Y .
53	SUB/ADD	I	Subtraction/Addition. When High, the accumulator contents are subtracted from the multiplier product and the result written back into the accumulator. When Low, the multiplier product is added into the accumulator (see Accumulator Function Table). The SUB/ADD control is loaded on the rising edge of CLK_X or CLK_Y .

*DIP Configuration

**TRW TDC1010 Pin Designation

PRELOAD FUNCTION

PREL	LE_X/OE_X	LE_M/OE_M	LE_L/OE_L	Output Register		
				XTP	MSP	LSP
0	0	0	0	Q	Q	Q
0	0	0	1	Q	Q	Z
0	0	1	0	Q	Z	Q
0	0	1	1	Q	Z	Z
0	1	0	0	Z	Q	Q
0	1	0	1	Z	Q	Z
0	1	1	0	Z	Z	Q
0	1	1	1	Z	Z	Z
1	0	0	0	Z	Z	Z
1	0	0	1	Z	Z	PL
1	0	1	0	Z	PL	Z
1	0	1	1	Z	PL	PL
1	1	0	0	PL	Z	Z
1	1	0	1	PL	Z	PL
1	1	1	0	PL	PL	Z
1	1	1	1	PL	PL	PL

Z = output buffers at High impedance (disabled).

Q = output buffers at Low impedance. Contents of output register available through output ports.

PL = output disabled. Preload data supplied to the output pins will be loaded into the output register at the rising edge of CLK_P .

ACCUMULATOR FUNCTION TABLE

PREL	ACC	SUB/ADD	P	OPERATION
L	L	X	Q	Load
L	H	L	Q	Add
L	H	H	Q	Subtract
H	X	X	PL	Preload

DETAILED DESCRIPTION

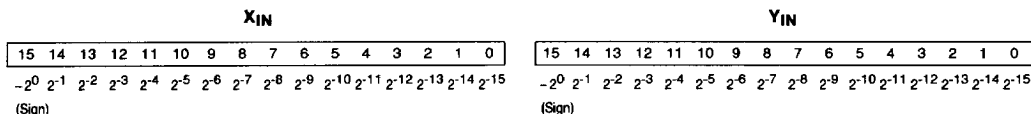
The Am29510 is a high-speed 16 x 16-bit multiplier/accumulator (MAC). It comprises a 16-bit parallel multiplier followed by a 35-bit accumulator. Two 16-bit input registers are provided for the X and Y operands. A third register stores two control bits, TC and RND. TC selects either a two's complement or an unsigned magnitude format for both data inputs. The RND control, when High, causes a bit to be added to the multiplier product with the weight of P_{15} . This causes the most significant 16-bits of the product to be rounded to the value nearest to the full 32-bit product. Using the RND control once during an accumulation causes the most significant 19-bits of the accumulator to be rounded to the value nearest the full 35-bit accumulation. The TC/RND register is clocked whenever the X or Y input registers are clocked.

The 32-bit multiplier output is zero-filled or sign-extended as appropriate to provide a 35-bit input to the accumulator. The accumulator has four functions: the product may be loaded into the accumulator, the product may be added into the

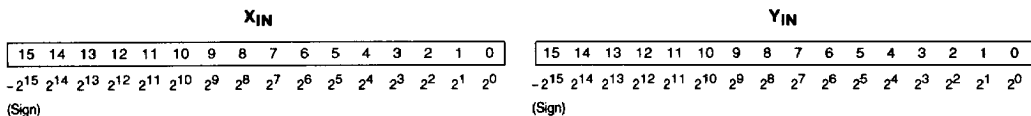
accumulator value, the previous accumulator value may be subtracted from the product and the result stored in the accumulator or the accumulator may be preloaded from an external source. The operation of the accumulator is controlled by the signals ACC, SUB/ADD and PREL. ACC and SUB/ADD are stored in a register clocked whenever the X or Y registers are clocked. ACC in conjunction with SUB/ADD selects one of the first three accumulator functions (see Accumulator Function Table). For output and preloading purposes the accumulator is considered in three sections: Extended Product (XTP, P_{34} - P_{32}) controlled by $LE_X/\overline{OE}_X$, Most Significant Product (MSP, P_{31} - P_{16}) controlled by $LE_M/\overline{OE}_M$ and Least Significant Product (LSP, P_{15} - P_0) controlled by $LE_L/\overline{OE}_L$. When PREL is Low these controls are active-Low Output Enables for three-state output buffers. When PREL is High the output buffers automatically become high impedance, and the controls operate as active-High Load Enables to the three sections of the accumulator to permit preloading of data applied to the bidirectional P port. The P-port has 35 bits, the least significant 16 of which share pins with the Y input.

Am29510/L510 INPUT FORMATS

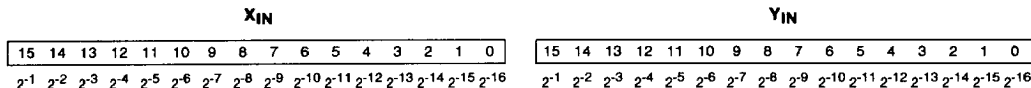
Fractional Two's Complement Input



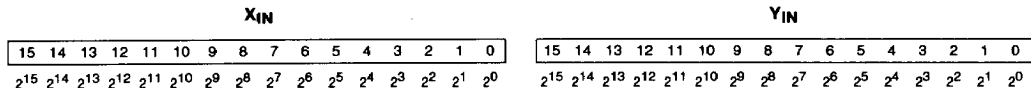
Integer Two's Complement Input



Unsigned Fractional Input



Unsigned Integer Input



Am29510/L510 OUTPUT FORMATS

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Two's Complement Fractional Output

XTP

MSP

LSP

34 33 32	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
-2^4 2^3 2^2	2^1 2^0 2^{-1} 2^{-2} 2^{-3} 2^{-4} 2^{-5} 2^{-6} 2^{-7} 2^{-8} 2^{-9} 2^{-10} 2^{-11} 2^{-12} 2^{-13} 2^{-14}	2^{-15} 2^{-16} 2^{-17} 2^{-18} 2^{-19} 2^{-20} 2^{-21} 2^{-22} 2^{-23} 2^{-24} 2^{-25} 2^{-26} 2^{-27} 2^{-28} 2^{-29} 2^{-30}

(Sign)

Two's Complement Integer Output

XTP

MSP

LSP

34 33 32	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
-2^{34} 2^{33} 2^{32}	2^{31} 2^{30} 2^{29} 2^{28} 2^{27} 2^{26} 2^{25} 2^{24} 2^{23} 2^{22} 2^{21} 2^{20} 2^{19} 2^{18} 2^{17} 2^{16}	2^{15} 2^{14} 2^{13} 2^{12} 2^{11} 2^{10} 2^9 2^8 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0

(Sign)

Unsigned Fractional Output

XTP

MSP

LSP

34 33 32	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
2^2 2^1 2^0	2^{-1} 2^{-2} 2^{-3} 2^{-4} 2^{-5} 2^{-6} 2^{-7} 2^{-8} 2^{-9} 2^{-10} 2^{-11} 2^{-12} 2^{-13} 2^{-14} 2^{-15} 2^{-16}	2^{-17} 2^{-18} 2^{-19} 2^{-20} 2^{-21} 2^{-22} 2^{-23} 2^{-24} 2^{-25} 2^{-26} 2^{-27} 2^{-28} 2^{-29} 2^{-30} 2^{-31} 2^{-32}

Unsigned Integer Output

XTP

MSP

LSP

34 33 32	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
2^{34} 2^{33} 2^{32}	2^{31} 2^{30} 2^{29} 2^{28} 2^{27} 2^{26} 2^{25} 2^{24} 2^{23} 2^{22} 2^{21} 2^{20} 2^{19} 2^{18} 2^{17} 2^{16}	2^{15} 2^{14} 2^{13} 2^{12} 2^{11} 2^{10} 2^9 2^8 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0

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	-30 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**

DIPs	$T_A = 0$ to +70°C
Chip Carriers	$T_C = 0$ to +85°C
Supply Voltage	4.75V to 5.25V

Military (M) Devices

Temperature	$T_C = -55^\circ\text{C}$ to +125°C
Supply Voltage	4.5V to 5.5V

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

DC CHARACTERISTICS over operating range unless otherwise specified
Am29510

Parameters	Description	Test Conditions (Note 1)			Min	Typ (Note 2)	Max	Units
V _{OH}	Output HIGH Voltage	V _{CC} = MIN V _{IN} = V _{IH} or V _{IL}	I _{OH} = -0.4mA		2.4	2.7		Volts
V _{OL}	Output LOW Voltage	V _{CC} = MIN V _{IN} = V _{IH} or V _{IL}	I _{OL} = 4.0mA			.3	.5	Volts
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					.8	Volts
V _I	Input Clamp Voltage	V _{CC} = MIN, I _{IN} = -18mA					-1.5	Volts
I _{IL}	Input LOW Current	V _{CC} = MAX, V _{IN} = 0.4V					-0.4	mA
I _{IH}	Input HIGH Current	V _{CC} = MAX, V _{IN} = 2.4V					75	μA
I _I	Input HIGH Current	V _{CC} = MAX, V _{IN} = 5.5V					1	mA
I _{OZH}	Off State (High Impedance) Output Current	V _{CC} = MAX	Product	V _O = 2.4V			25	μA
I _{OZL}				V _O = 0.4V			-25	
I _{SC}	Output Short Circuit Current (Note 3)	V _{CC} = MAX	Y, Product	V _O = 0V	-3		-30	mA
I _{CC}	Power Supply Current	COM'L and MIL		T _A = 25°C		750	mA	
		COM'L Only V _{CC} = Max		T _A = 0 to +70°C (Note 4)		900		
				T _A = +70°C (Note 4)		725		
		MIL Only V _{CC} = Max		T _{CC} = -55 to +125°C		1000		
				T _{CC} = +125°C		750		

- Notes: 1. For conditions shown as MIN or MAX, use the appropriate value specified under Operating Ranges for the applicable device type.
 2. Typical limits are at $V_{CC} = 5.0\text{V}$, 25°C ambient and maximum loading.
 3. Not more than one output should be shorted at a time. Duration of the short circuit test should not exceed one second.
 4. Chip Carriers: $T_A = 85^\circ\text{C}$.

DC CHARACTERISTICS over operating range unless otherwise specified
Am29L510

Parameters	Description	Test Conditions (Note 1)			Min	Typ (Note 2)	Max	Units
V_{OH}	Output HIGH Voltage	$V_{CC} = \text{MIN}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -0.4\text{mA}$		2.4	2.7		Volts
V_{OL}	Output LOW Voltage	$V_{CC} = \text{MIN}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 4.0\text{mA}$			.5		Volts
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					.8	Volts
V_I	Input Clamp Voltage	$V_{CC} = \text{MIN}$, $I_{IN} = -10\text{mA}$					-1.5	Volts
I_{IL}	Input LOW Current	$V_{CC} = \text{MAX}$, $V_{IN} = 0.4\text{V}$					-0.4	mA
I_{IH}	Input HIGH Current	$V_{CC} = \text{MAX}$, $V_{IN} = 2.4\text{V}$					75	μA
I_I	Input HIGH Current	$V_{CC} = \text{MAX}$, $V_{IN} = 5.5\text{V}$					1	mA
I_{OZH}	Off State (High Impedance) Output Current	$V_{CC} = \text{MAX}$	Product	$V_O = 2.4\text{V}$			25	μA
I_{OZL}	Off State (High Impedance) Output Current	$V_{CC} = \text{MAX}$	Y	$V_O = 0.4\text{V}$			-25	
I_{SC}	Output Short Circuit Current (Note 3)	$V_{CC} = \text{MAX}$	Product	$V_O = 0\text{V}$	-3		-30	mA
				$V_O = 0\text{V}$	-3		-30	
I_{CC}	Power Supply Current	COM'L and MIL		$T_A = 25^\circ\text{C}$		330		mA
		COM'L Only $V_{CC} = \text{Max}$		$T_A = 0 \text{ to } +70^\circ\text{C}$ (Note 4)			450	
				$T_A = +70^\circ\text{C}$ (Note 4)			350	
		MIL Only $V_{CC} = \text{Max}$		$T_{CC} = -55 \text{ to } +125^\circ\text{C}$			535	
				$T_{CC} = +125^\circ\text{C}$			375	

- Notes: 1. For conditions shown as MIN or MAX, use the appropriate value specified under Operating Ranges for the applicable device type.
 2. Typical limits are at $V_{CC} = 5.0\text{V}$, 25°C ambient and maximum loading.
 3. Not more than one output should be shorted at a time. Duration of the short circuit test should not exceed one second.
 4. Chip Carriers, $T_C = 85^\circ\text{C}$.

SWITCHING CHARACTERISTICS over operating range unless otherwise specified

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Parameters	Description	Test Conditions	Typ (Note 1)	COMMERCIAL		MILITARY		Units
				29510		29510		
				Min	Max	Min	Max	
tMA	Multiply Accumulate Time		50	80		90	ns	
tS	Xi, Yi, RND, TC, ACC, SUB/ADD Set-up Time		12	25		30	ns	
tH	Xi, Yi, RND, TC, ACC, SUB/ADD Hold Time		0	5		5	ns	
tS	PREL Setup Time		10	25		30	ns	
tH	PREL Hold Time		0	0		2	ns	
tPWH	Clock Pulse Width High		10	20		25	ns	
tPWL	Clock Pulse Width Low		10	20		25	ns	
tPDP	Output Clock to P		25		40		40	ns
tPDY	Output Clock to Y		25		40		40	ns
tPHZ	LEX/OEX, LEM/OEM to P, LEL/OEL to Y Disable Time	High to Z	21		35		40	ns
tPLZ		Low to Z	20		35		40	ns
tPZH	LEX/OEX, LEM/OEM to P, LEL/OEL to Y Enable Time	Z to High	28		40		40	ns
tPZL		Z to Low	24		40		40	ns
tHCL	Relative Hold Time			0		0		ns

SWITCHING CHARACTERISTICS over operating range unless otherwise specified*

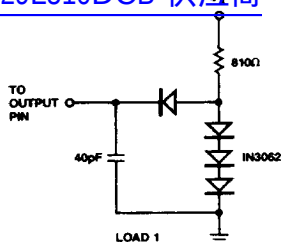
Parameters	Description	Test Conditions	Typ (Note 1)	COMMERCIAL		MILITARY		Units
				29L510		29L510		
				Min	Max	Min	Max	
t _{MA}	Multiply Accumulate Time		70	110		120	ns	
t _S	X _i , Y _i , RND, TC, ACC, SUB/ADD Set-up Time		20	40	45		ns	
t _H	X _i , Y _i , RND, TC, ACC, SUB/ADD Hold Time		-3	0	0		ns	
t _S	PREL Set-up Time		15	27	35		ns	
t _H	PREL Hold Time		-5	0	0		ns	
t _{PWH}	Clock Pulse Width High		15	25	30		ns	
t _{PWL}	Clock Pulse Width Low		15	25	30		ns	
t _{PDP}	Output Clock to P		35		45	50	ns	
t _{PDY}	Output Clock to Y		35		45	50	ns	
t _{PHZ}	LE _X /OE _X , LE _M /OE _M to P, LE _L /OE _L to Y Disable Time	High to Z	24		35	40	ns	
t _{PLZ}		Low to Z	25		35	40	ns	
t _{PZH}	LE _X /OE _X , LE _M /OE _M to P, LE _L /OE _L to Y Enable Time	Z to High	38		45	50	ns	
t _{PZL}		Z to Low	32		40	45	ns	
t _{HCL}	Relative Hold Time			0	0		ns	

Note: 1. Typical limits are V_{CC} = 5V and T_A = 25°C.

SWITCHING TEST CIRCUIT

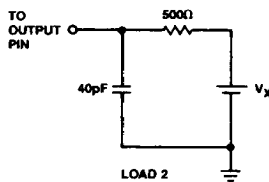
Normal Load

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TCR01270

Three-State Delay Load



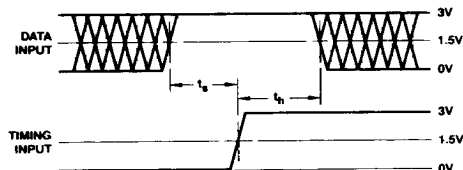
TCR01280

SWITCHING TEST WAVEFORMS

Test	V_X	Output Waveform - Measurement Level
All t_{pDS}	V_{CC}	
t_{PHZ}	0.0V	
t_{PLZ}	2.6V	
t_{pZH}	0.0V	
t_{pZL}	2.6V	

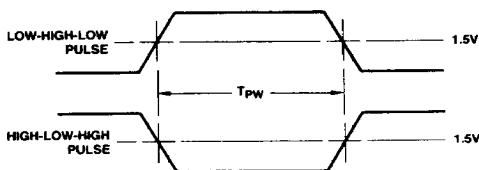
WFR02810

SET-UP AND HOLD TIME



WFR02970

PULSE WIDTH

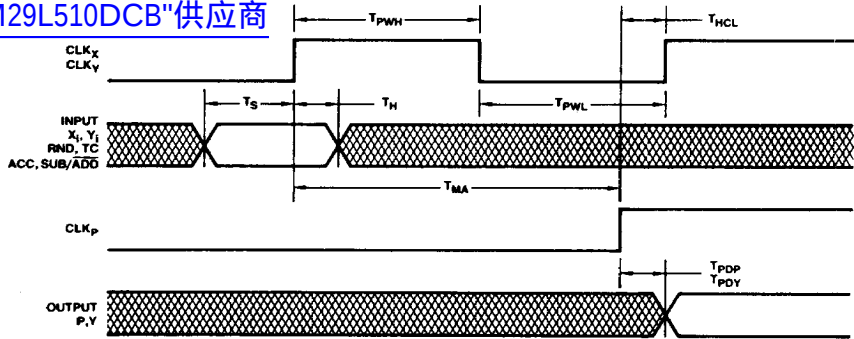


WFR02850

- Notes: 1. Diagram shown for HIGH data only. Output transition may be opposite sense.
2. Cross hatched area is don't care condition.

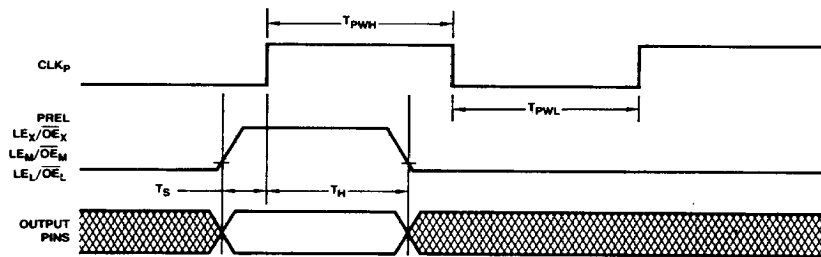
Am29510/L510 TIMING DIAGRAMS

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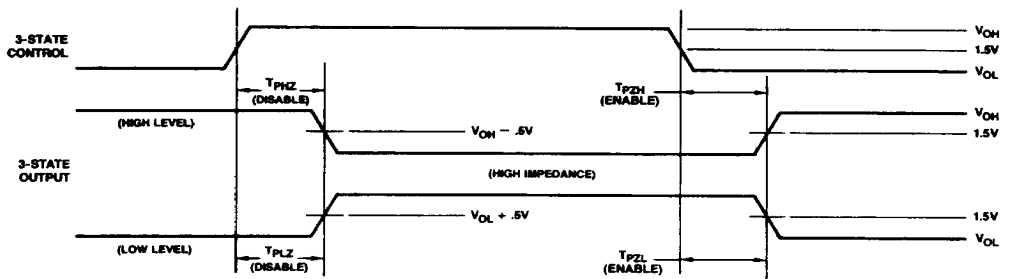
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Am29510/L510 PRELOAD TIMING DIAGRAM



WFR02830

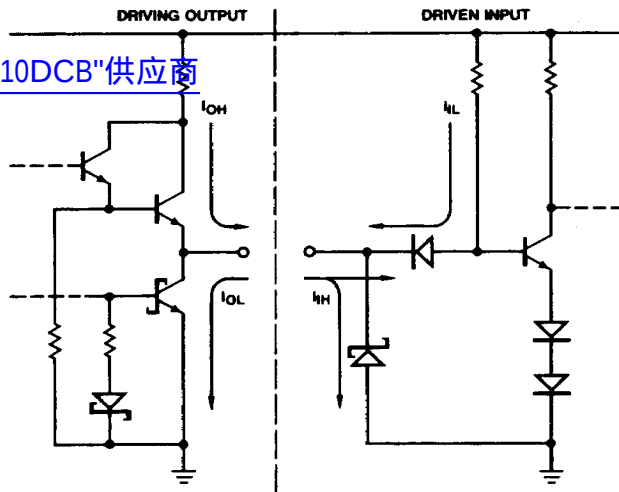
Am29510/L510 THREE-STATE TIMING DIAGRAM



WFR02840

INPUT/OUTPUT CURRENT INTERFACE CONDITIONS

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ICR00490

RELATED PRODUCTS

Part No.	Description
Am29526/527	High speed Sine function generator
Am29528/529	High Speed Cosine function generator
Am29540	Programmable FFT address sequencer
Am29520/21	Multilevel pipeline registers

7