Am29516/17 Family

16 x 16-Bit Parallel Multipliers

DISTINCTIVE CHARACTERISTICS

- High speed 16 x 16 multiplier
- Two's complement, unsigned or mixed operands
- Full product multiplexed at output
- Improved speed: 38ns clocked multiply (A devices)
  Reduced power dissipation: 2W (L devices)
- Am29516 pin and functionally compatible with TRW MPY-16HJ — Am29517 optimized for microprogramming, single clock with register enables
- TTL I/O-single +5V supply – 64-pin package

GENERAL DESCRIPTION

The Am29516 and Am29517 are high speed parallel 16 x 16-bit multipliers utilizing internal ECL logic to generate a 32-bit product. 17-bit input registers are provided for the X and Y operands and their associated mode controls X_M and Y_M. These mode controls are used to specify the operands as two's complement or unsigned numbers.

At the output of the multiplier array, a format adjust control (FA), allows the user to select either a full 32-bit product or a left-shifted 31-bit product suitable for two's complement only.

Two 16-bit output registers are provided to hold the most and least significant halves of the product (MSP and LSP) as defined by FA. For asynchronous output, these registers may be made transparent by taking the feedthrough control (FT) high. A round control (RND) allows the rounding of the MSP; this control is registered, and is entered whenever either input register is clocked.

The two halves of the product may be routed to a 16-bit 3-state output port (P) via a multiplexer, and in addition, the LSP is connected to the Y-input port through a separate three-state buffer.

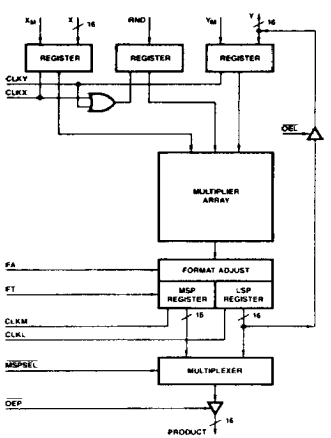
The Am29516 X, Y, MSP and LSP registers have independent clocks (CLKX, CLKY, CLKM, CLKL). The output multiplexer control ($\overline{MSPSEL}$) uses a pin which is a supply ground in the TRW MPY 16HJ. When this control is LOW the function is that of the MPY16HJ, thus allowing full compatibility.

The Am29517 differs in that it has a single clock input (CLK) and three register enables ($\overline{ENX}$, $\overline{ENY}$, $\overline{ENP}$) for the two input registers and the entire product, respectively. This facilitates the use of the part in microprogrammed systems. In both parts data is entered into the registers on the positive edge of the clock.

The Am29516A and Am29517A are higher speed versions of the Am29516 and Am29517, respectively, offering greater than 40% speed improvement while the Am29L516 and Am29L517 low-power versions consume only one-half the power of their standard power counterparts.

BLOCK DIAGRAM

Am29516/29516A/29L516



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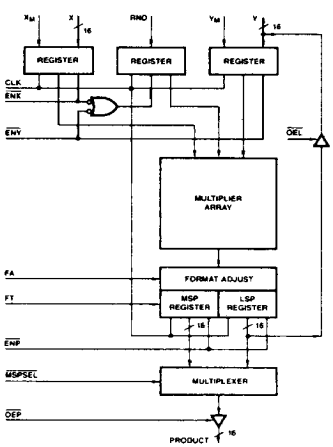
Am29517/29517A/29L517



BD002850

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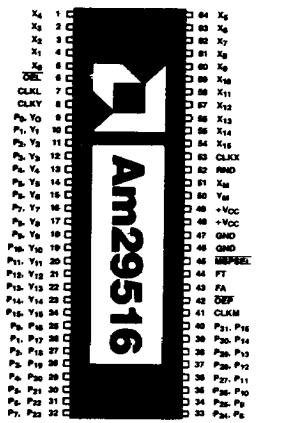
Refer to Page 13-1 for Essential Information on Military Devices

RELATED PRODUCTS

Part No.	Description
Am29501	Multi-port Pipelined Processor
Am29526/27	Sine Function Generator
Am29528/29	Cosine Function Generator
Am29520/21	Pipeline Register
Am29540	Address Generator

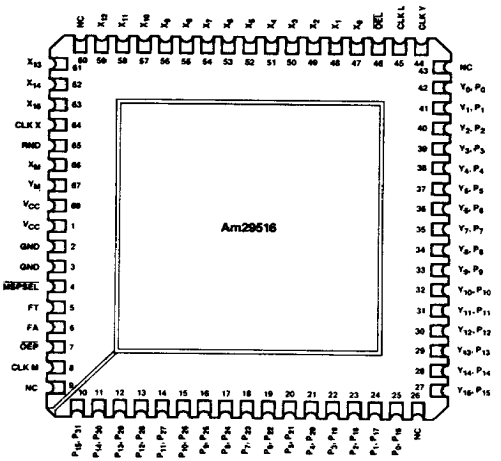
CONNECTION DIAGRAM
Top View

D-64-3



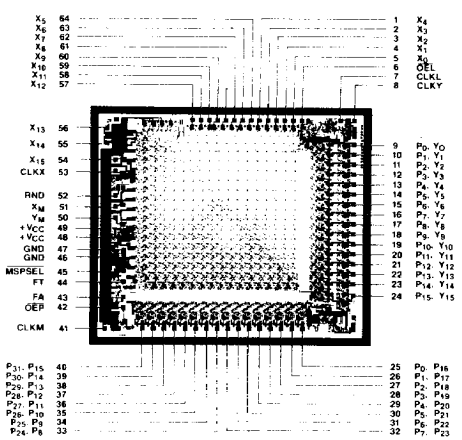
CDR04380

L-68-3



CDR04410

METALLIZATION AND PAD LAYOUT
Am29516A/29L516/29516



STANDARD DEVICE DIE SIZE: 250 X 222 MILS
'A' DEVICE DIE SIZE: 178 X 190 MILS
'L' DEVICE DIE SIZE: 250 X 222 MILS

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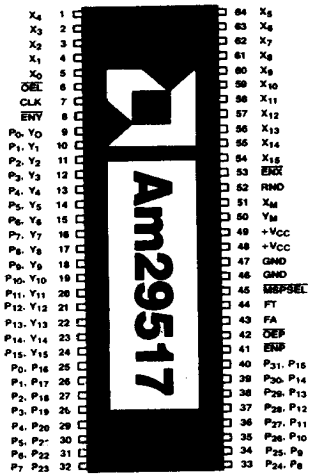
Refer to Page 13-1 for Essential Information on Military Devices

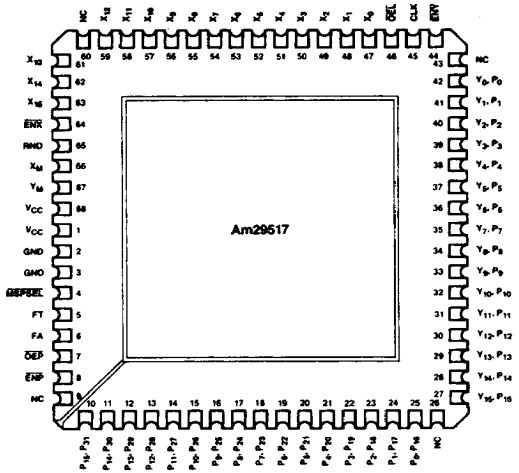
CONNECTION DIAGRAM
Top View

D-64-3



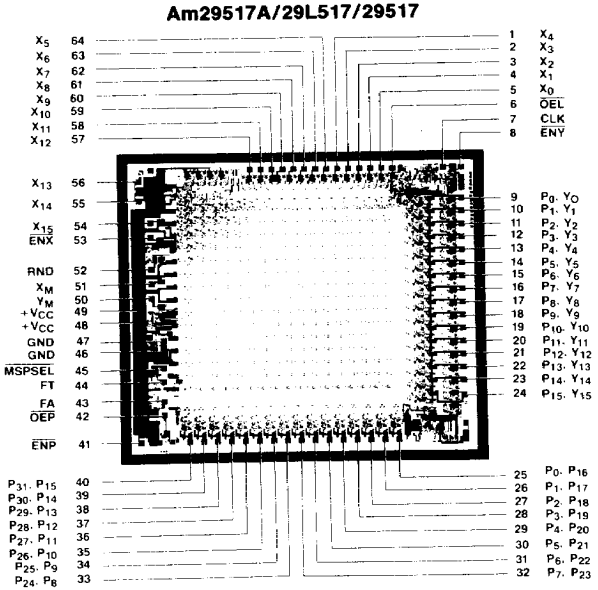
CDR04390

L-68-3



CDR04400

METALLIZATION AND PAD LAYOUT
Am29517A/29L517/29517



STANDARD DEVICE DIE SIZE: 250 X 222 MILS
'A' DEVICE DIE SIZE: 178 X 190 MILS
'L' DEVICE DIE SIZE: 250 X 222 MILS

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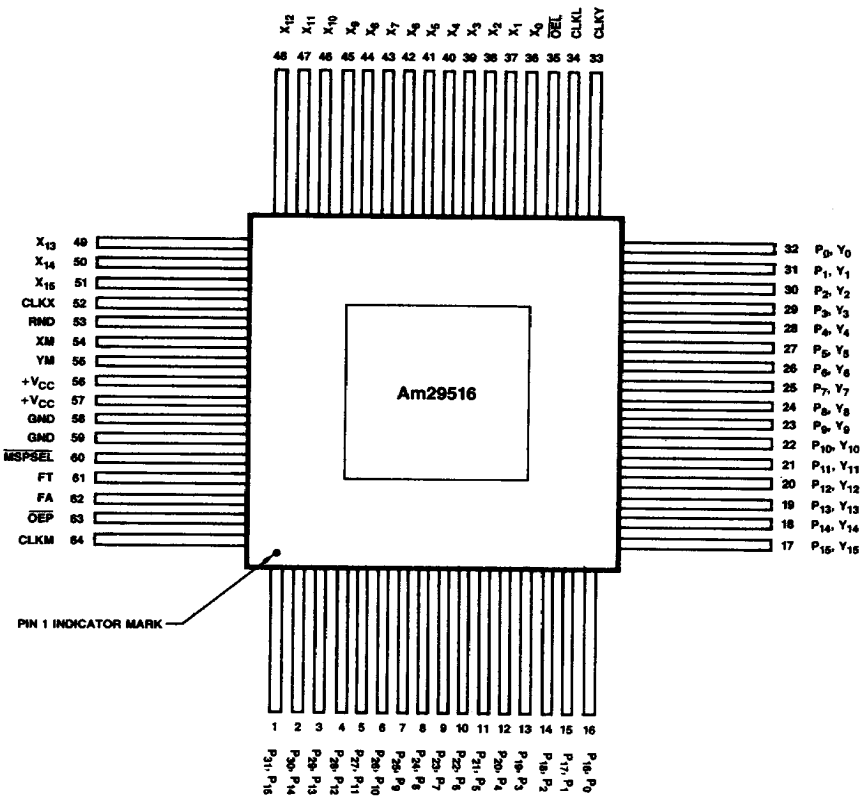
F-64-3S



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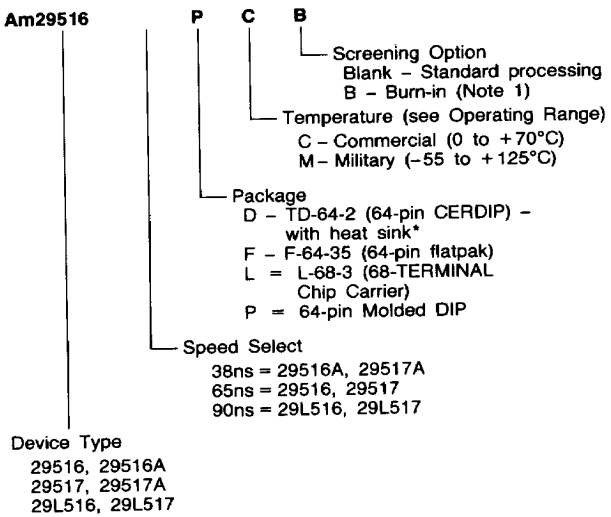
ORDERING INFORMATION

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).



*TD-64-1 (64-pin CERDIP) without heat sink for Low-Power versions

Note 1. 160-hour burn-in –
Heat sink parts: $T_A = 125°C$
Non-heat sink parts: $T_A = 85°C$

Valid Combinations	
Am29516	DC, DCB, DMB – with heat sink FMB, LMB – without heat sink
Am29517 Am29516A Am29517A	DC, DCB, DMB – with heat sink LMB – without heat sink
Am29L516 Am29L517	PC, PCB, DC, DCB, DM, DMB, LMB without heat sink

Valid Combinations

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

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

PIN DESCRIPTION

*Pin No.	Name	I/O	Description
1-5, 54-64	X_0-X_{15}	I	Multiplicand Data inputs.
9-24	Y_0-Y_{15}, P_0-P_{15}	I/O	Multiplier Data inputs or Least Significant Product (LSP) output.
25-40	P_{16}-P_{31}, P_0-P_{15}	O	MSP product port when $\overline{MSPSEL}$ is LOW. LSP product port when $\overline{MSPSEL}$ is HIGH.
51, 50	X_M,Y_M (TCX, TCY)**	I	Mode control inputs for each data word; LOW for unsigned data and HIGH for two's complement data.
43	FA(RS)**	I	Format adjust control selects either a full 32-bit product (HIGH) or a left shifted 31-bit product with the sign bit replicated in the LSP (LOW). This control is normally high, except for certain fractional two's complement applications. (See Multiplier output formats table.)
44	$\overline{FT}$	I	Feedthrough control (HIGH) makes both MSP and LSP registers transparent.
45	$\overline{MSPSEL}$	I	Selects either MSP (LOW) or LSP (HIGH) to be available at the product output port.
52	RND	I	Control for rounding the MSP. Adds a binary one to the most significant bit of the LSP for two's complement and unsigned numbers.
42	$\overline{OEP}$ (TRIM)**	I	Three-state enable for product output port.
6	$\overline{OEL}$ (TRIL)**	I	Three-state enable for routing LSP through Y input/output port.
Am29516 ONLY			
53, 8, 41, 7	CLKX CLKY CLKM CLKL	I	Register Clock, X_{15-0}, X_M, RND Register Clock, Y_{15-0}, Y_M, RND MSP Register Clock LSP Register Clock
Am29517 ONLY			
7, 53 8, 41	CLK $\overline{ENX}$ $\overline{ENY}$ $\overline{ENP}$	I	Clock, All Registers Register Enable, X_{15-0}, X_M, RND Register Enable, Y_{15-0}, Y_M, RND Register Enable MSP, LSP

*DIP Configuration
**TRW MPY 16HJ pin designation

INPUT FORMATS (All Devices)

Fractional Two's Complement Input Format

X_M, Y_M = 1

X_{IN}

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-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}
(Sign)															

Y_{IN}

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-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}
(Sign)															

Integer Two's Complement Input Format

X_M, Y_M = 1

X_{IN}

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-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)															

Y_{IN}

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-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 Input Format

X_M, Y_M = 0

X_{IN}

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	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}

Y_{IN}

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	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}

Unsigned Integer Input Format

X_M, Y_M = 0

X_{IN}

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
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

Y_{IN}

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
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

OUTPUT FORMATS
(All Devices)

Fractional 2's Complement (Shifted)* Output

FA = 0

MSP

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
-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}
(Sign)															

LSP

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-2^{0}	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)															

Fractional 2's Complement Output

FA = 1

MSP

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
-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}
(Sign)															

LSP

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
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}

Integer Two's Complement Output

FA = 1

MSP

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
-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}
(Sign)															

LSP

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
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}

Unsigned Fractional Output

FA = 1

MSP

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
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}

LSP

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
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

FA = 1

MSP

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
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}

LSP

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
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}

*In this format an overflow occurs in the attemped multiplication of the two's complement number 1.000...(−1) with itself, yielding a product of 1.000... or −1.

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

ABSOLUTE MAXIMUM RATINGS

Storage Temperature ..... −65 to +150°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°C to +70°C
Chip Carriers ..... T_C = 0°C to 85°C
Supply Voltage ..... +4.75V to +5.25V

Military (M) Devices
Temperature ..... −55°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

Am29516/29517

Parameters	Description	Test Conditions			Min	Typ (Note 1)	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 2)	V_{CC} = MAX	Y, Product	V_O = 0V	−3		−30	mA
I_{CC}	Power Supply Current (Note 3)		T_A = +25°C			600		mA
		COM'L Devices V_{CC} = MAX	T_A = 0 to +70°C (Note 4)				800	
			T_A = +70°C (Note 4)				750	
		MIL Devices V_{CC} = MAX	T_A = −55 to +125°C				900	
			T_A = +125°C				800	

Notes: 1. Typical limits are at V_{CC} = 5.0V, +25°C ambient and maximum loading.
2. Not more than one output should be shorted at a time. Duration of the short circuit test should not exceed one second.
3. $\overline{OEP}$ and $\overline{OEL}$ LOW with all product (MSP and LSP) bits LOW.
4. Chip Carriers: T_C = 85°C.

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

DC CHARACTERISTICS over operating range unless otherwise specified
Am29516A/29L516/Am29517A/29L517

Parameters	Description	Test Conditions			Min	Typ (Note 1)	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 2)	V_{CC} = MAX	Y, Product	V_O = 0V	−3		−30	mA
I_{CC}	Power Supply Current (Note 3)	COM'L Devices V_{CC} = MAX	T_A = +25°C	A Devices		600		mA
				L Devices		300		
			T_A = 0 to +70°C (Note 4)	A Devices			800	
				L Devices			400	
			T_A = +70°C (Note 4)	A Devices			750	
				L Devices			350	
		MIL Devices V_{CC} = MAX	T_C = −55 to +125°C	A Devices			900	
				L Devices			440	
			T_{CC} = +125°C	A Devices			800	
				L Devices			350	

Notes: 1. Typical limits are at V_{CC} = 5.0V, 25°C ambient and maximum loading.
2. Not more than one output should be shorted at a time. Duration of the short circuit test should not exceed one second.
3. $\overline{OEP}$ and $\overline{OEL}$ LOW with all product (MSP and LSP) bits LOW.
4. Chip Carriers: T_C = 85°C.

SWITCHING CHARACTERISTICS over operating range unless otherwise specified (Note 1)
Am29516/29517

Parameters	Description		Test Conditions	Typ	COMMERCIAL Min	COMMERCIAL Max	MILITARY Min	MILITARY Max	Units
t_{MUC}	Unclocked Multiply Time		Load 1	50		85		95	ns
t_{MC}	Clocked Multiply Time			40		65		75	ns
t_S	X_i, Y_i, RND Set-up Time			10	20		25		ns
t_H	X_i, Y_i, RND Hold Time			0	3		3		ns
t_{PWH}	Clock Pulse Width High			10	15		15		ns
t_{PWL}	Clock Pulse Width Low			10	15		15		ns
t_{PDSEL}	$\overline{MSPSEL}$ to Product Out			20		30		35	ns
t_{PDP}	Output Clock to P			20		30		35	ns
t_{PDY}	Output Clock to Y			20		30		35	ns
t_{PHZ}	$\overline{OEP}$ Disable Time	High to Z	Load 2	12		23		28	ns
t_{PLZ}		Low to Z		15		23		28	ns
t_{PZH}	$\overline{OEP}$ Enable Time	Z to High		25		32		35	ns
t_{PZL}		Z to Low		25		32		35	ns
t_{PHZ}	$\overline{OEL}$ Disable Time	High to Z		12		23		28	ns
t_{PLZ}		Low to Z		15		23		28	ns
t_{PZH}	$\overline{OEL}$ Enable Time	Z to High		25		32		35	ns
t_{PZL}		Z to Low		25		32		35	ns
t_S	Clock Enable Set-up Time (Am29517 Only)		Load 1	5	10		15		ns
t_H	Clock Enable Hold Time (Am29517 Only)			0	3		3		ns
t_{HCL}	Clock Low Hold Time CLKXY Relative to CLKML (See Note 2) (Am29516 Only)			0	0		0		ns

Notes: 1. Switching Characteristics are measured and guaranteed for T_A as specified with 200 Lf/min flowing across the device.
2. To ensure that the correct product is entered in the output registers, new data may not be entered into the input registers before the output registers have been clocked.

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

SWITCHING CHARACTERISTICS over operating range unless otherwise specified (Note 1)

Am29L516/29L517

Parameters	Description		Test Conditions	Typ	COMMERCIAL Min	COMMERCIAL Max	MILITARY* Min	MILITARY* Max	Units
t_{MUC}	Unclocked Multiply Time		Load 1	90		120		135	ns
t_{MC}	Clocked Multiply Time			70		90		100	ns
t_S	X_i, Y_i, RND Set-up Time				25		25		ns
t_H	X_i, Y_i, Hold Time				0		0		ns
t_H	RND Hold Time				3		3		ns
t_{PWH}	Clock Pulse Width High				20		20		ns
t_{PWL}	Clock Pulse Width Low				20		20		ns
t_{PDSEL}	$\overline{MSPSEL}$ to Product Out			25		35		40	ns
t_{PDP}	Output Clock to P			25		35		40	ns
t_{PDY}	Output Clock to Y			25		35		40	ns
t_{PHZ}	$\overline{OEP}$ Disable Time	High to Z	Load 2	20		30		35	ns
t_{PLZ}		Low to Z		20		30		35	ns
t_{PZH}	$\overline{OEP}$ Enable Time	Z to High		25		35		40	ns
t_{PZL}		Z to Low		25		35		40	ns
t_{PHZ}	$\overline{OEL}$ Disable Time	High to Z		20		30		35	ns
t_{PLZ}		Low to Z		20		30		35	ns
t_{PZH}	$\overline{OEL}$ Enable Time	Z to High		25		35		40	ns
t_{PZL}		Z to Low		25		35		40	ns
t_S	Clock Enable Set-up Time (Am29L517 Only)		Load 1	10	15		20		ns
t_H	Clock Enable Hold Time (Am29L517 Only)				3		5		ns
t_{HCL}	Clock Low Hold Time CLKXY Relative to CLKML (See Note 2) (Am29L516 Only)				0		0		ns

Notes: 1. Switching Characteristics are measured and guaranteed for T_A as specified with 200 Lf/min flowing across the device.
2. To ensure that the correct product is entered in the output registers, new data may not be entered into the input registers before the output registers have been clocked.

*PRELIMINARY

SWITCHING CHARACTERISTICS over operating range unless otherwise specified (Note 1)
Am29516A/517A

Parameters	Description		Test Conditions	Typ	COMMERCIAL Min	COMMERCIAL Max	MILITARY Min	MILITARY Max	Units
t_{MUC}	Unclocked Multiply Time		Load 1	45		58		65	ns
t_{MC}	Clocked Multiply Time			30		38		42	ns
t_S	X_i, Y_i Set-up Time			4	7		8		ns
t_H	X_i, Y_i Hold Time			1	3		3		ns
t_S	RND Set-up Time			4	7		8		ns
t_H	RND Hold Time			1	3		3		ns
t_{PWH}	Clock Pulse Width High			7	7		8		ns
t_{PWL}	Clock Pulse Width Low			7	3		3		ns
t_{PDSEL}	$\overline{MSPSEL}$ to Product Out			13		18		21	ns
t_{PDP}	Output Clock to P			15		20		23	ns
t_{PDY}	Output Clock to Y			15		20		23	ns
t_{PHZ}	$\overline{OEP}$ Disable Time	High to Z	Load 2	13		15		17	ns
t_{PLZ}		Low to Z		13		15		17	ns
t_{PZH}	$\overline{OEP}$ Enable Time	Z to High		20		23		25	ns
t_{PZL}		Z to Low		15		23		25	ns
t_{PHZ}	$\overline{OEL}$ Disable Time	High to Z		13		15		17	ns
t_{PLZ}		Low to Z		12		15		17	ns
t_{PZH}	$\overline{OEL}$ Enable Time	Z to High		20		23		25	ns
t_{PZL}		Z to Low		15		23		25	ns
t_S	Clock Enable Set-up Time (Am29517A Only)		Load 1		10		15		ns
t_H	Clock Enable Hold Time (Am29517A Only)				3		3		ns
t_{HCL}	Clock Low Hold Time CLKXY Relative to CLKML (See Note 2) (Am29516A Only)			−1					ns

Notes: 1. Switching Characteristics are measured and guaranteed for T_A as specified with 200 Lf/min flowing across the device.
2. To ensure that the correct product is entered in the output registers, new data may not be entered into the input registers before the output registers have been clocked.

Notes on Testing

Incoming test procedures on this device should be carefully planned, taking into account the high complexity and power levels of the part. The following notes may be useful:

1. Insure the part is adequately decoupled at the test head. Large changes in V_{CC} current as the device switches may cause erroneous function failures due to V_{CC} changes.
2. Do not leave inputs floating during any tests, as they may start to oscillate at high frequency.
3. Do not attempt to perform threshold tests at high speed. Following an input transition, ground current may change by as much as 400mA in 5–8ns. Inductance in the ground cable may allow the ground pin at the device to rise by 100s of millivolts momentarily.
4. Use extreme care in defining input levels for AC tests. Many inputs may be changed at once, so there will be significant noise at the device pins and they may not actually reach V_{IL} or V_{IH} until the noise has settled. AMD recommends using $V_{IL} \leq 0.0V$ and $V_{IH} \geq 3.0V$ for AC tests.
5. To simplify failure analysis, programs should be designed to perform DC, Function, and AC tests as three distinct groups of tests.
6. To assist in testing, AMD offers complete documentation on our test procedures and, in most cases, can provide Fairchild Sentry programs under license.

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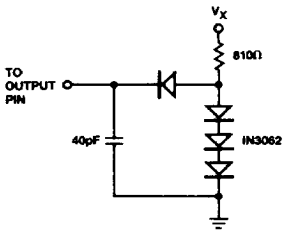
Refer to Page 13-1 for Essential Information on Military Devices

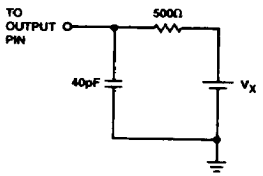
SWITCHING TEST CIRCUIT

Normal Load (Load 1)



TCR01250

Three-State Delay Load (Load 2)



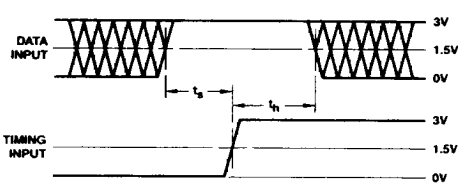
TCR01260

TEST WAVEFORMS
(All Devices)

Test	V_X	Output Waveform – Measurement Level
All t_{PD}s	V_{CC}	V_{OH}, V_{OL}, 1.5V
t_{PHZ}	0.0V	V_{OH}, 0.5V, 0.0V
t_{PLZ}	2.6V	2.6V, 0.5V, V_{OL}
t_{PZH}	0.0V	V_{OH}, 1.5V, 0.0V
t_{PZL}	2.6V	2.6V, 1.5V, V_{OL}

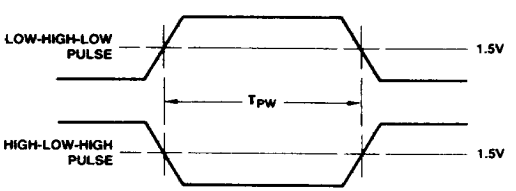
WFR02780

SETUP AND HOLD TIME
(All Devices)



WFR02970

PULSE WIDTH
(All Devices)



WFR02850

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

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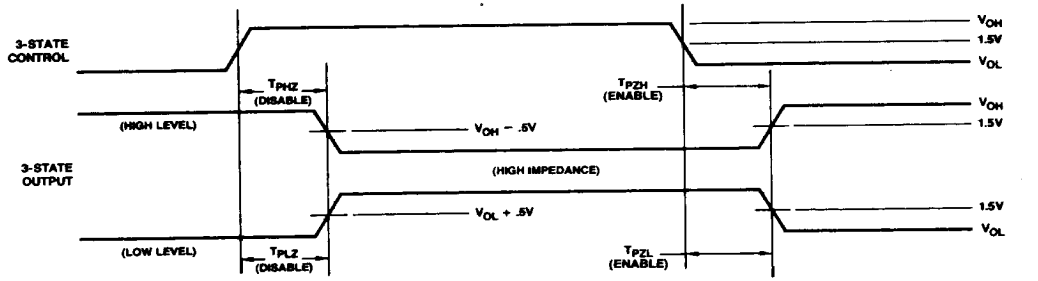
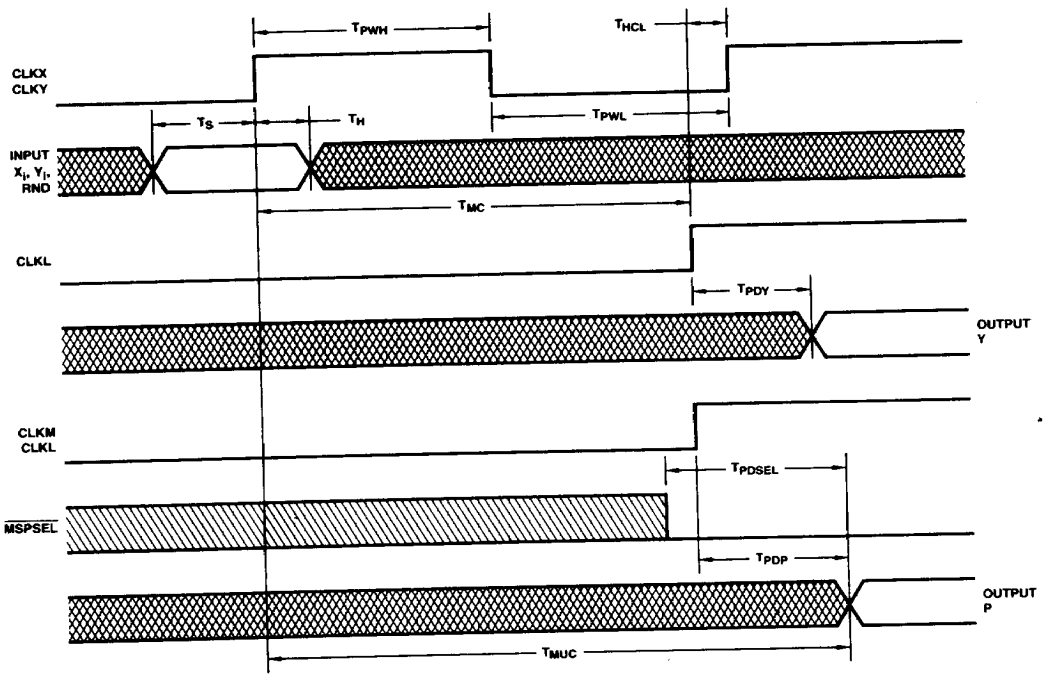
THREE-STATE TIMING DIAGRAM



WFR02730

TIMING DIAGRAM
Am29516/29516A/29L516



WFR02740

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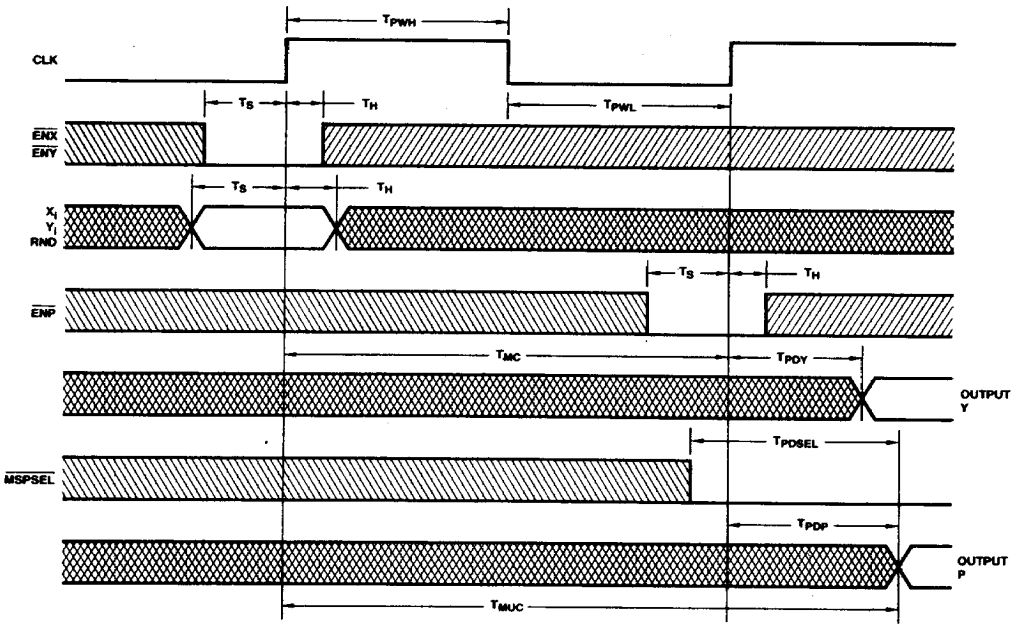
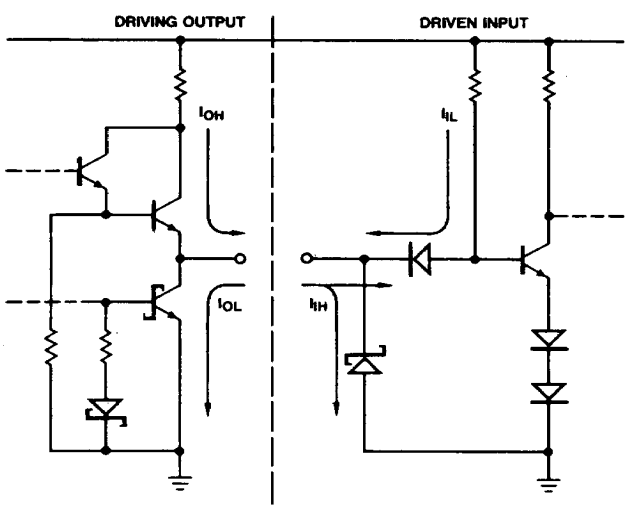
TIMING DIAGRAM
Am29517/29517A/29L517



WFR02750

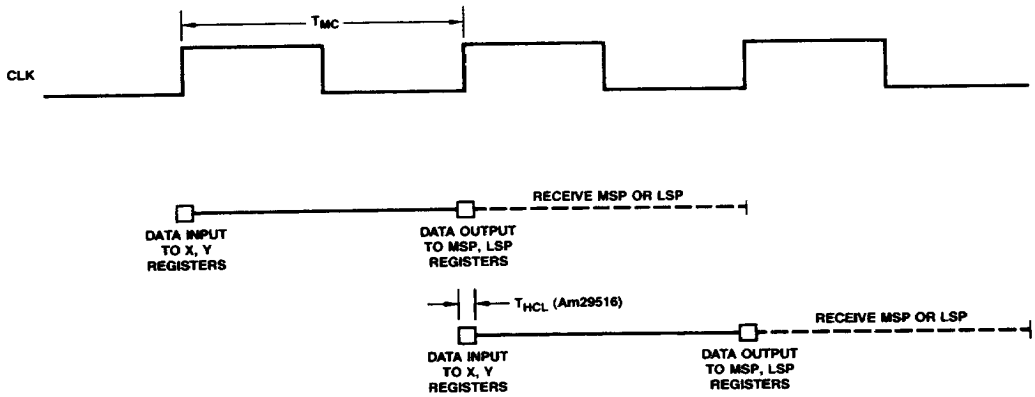
INPUT/OUPUT CURRENT INTERFACE CONDITIONS
(All Devices)



ICR00480

SIMPLIFIED TIMING DIAGRAM

TYPICAL APPLICATION



AFR01700

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