Am2965/Am2966

Octal Dynamic Memory Drivers with Three-State Outputs

Advanced Micro Devices

DISTINCTIVE CHARACTERISTICS

- **Controlled rise and fall characteristics**
  Internal resistors provide symmetrical drive to HIGH and LOW states, eliminating need for external series resistor.
- **Output swings designed to drive 16K and 64K RAMs**
  V_{OH} guaranteed at V_{CC} – 1.15V. Undershoot going LOW guaranteed at less than 0.5V.
- **Large capacitive drive capability**
  35mA min source or sink current at 2.0V. Propagation delays specified for 50pF and 500pF loads.
- **Pin-compatible with 'S240 and 'S244**
  Non-inverting Am2966 replaces 74S244; inverting Am2965 replaces 74S240. Faster than 'S240/244 under equivalent load.
- **No-glitch outputs**
  Outputs forced into OFF state during power up and down. No glitch coming out of three-state.

GENERAL DESCRIPTION

The Am2965 and Am2966 are designed and specified to drive the capacitive input characteristics of the address and control lines of MOS dynamic RAMs. The unique design of the lower output driver includes a collector resistor to control undershoot on the HIGH-to-LOW transition. The upper output driver pulls up to V_{CC} – 1.15V to be compatible with MOS memory and is designed to have a rise time symmetrical with the lower output's controlled fall time. This allows optimization of Dynamic RAM performance.

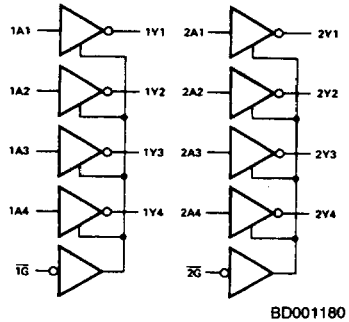
The Am2965 and Am2966 are pin-compatible with the popular 'S240 and 'S244 with identical 3-state output enable controls. The Am2965 has inverting drivers and the Am2966 has non-inverting drivers.

The inclusion of an internal resistor in the lower output driver eliminates the requirement for an external series resistor, therefore reducing package count and the board area required. The internal resistor controls the output fall and undershoot without slowing the output rise.

These devices are designed for use with the Am2964 Dynamic Memory Controller where large dynamic memories with highly capacitive input lines require additional buffering. Driving eight address lines or four $\overline{RAS}$ and four $\overline{CAS}$ lines with drivers on the same silicon chip also provides a significant performance advantage by minimizing skew between drivers. Each device has specified skew between drivers to improve the memory access worst case timing over the min and max t_{PD} difference of unspecified devices.

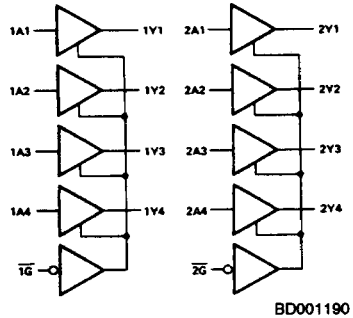
BLOCK DIAGRAM

Am2965



BD001180

Am2966

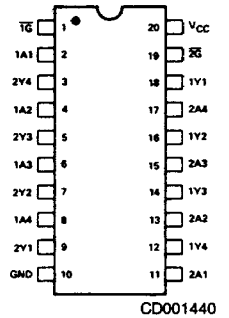


BD001190

Publication# 05409 Rev. C Amendment/0
Issue Date: July 1991

CONNECTION DIAGRAM
Top View

DIPs*



CD001440

Note: Pin 1 is marked for orientation

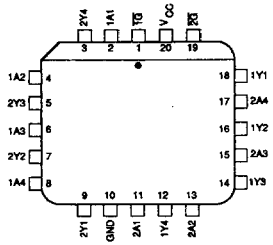
Am2965

Inputs		Outputs
$\overline{G}$	A	Y
H	X	Z
L	H	L
L	L	H

Am2966

Inputs		Outputs
$\overline{G}$	A	Y
H	X	Z
L	L	L
L	H	H

Plastic Leaded Chip Carrier



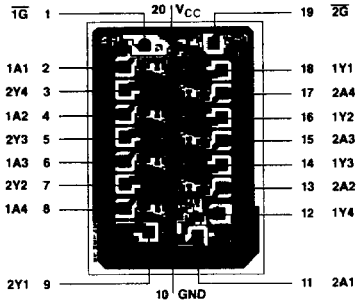
05409-001A

CD012030

*Also available in 20-Pin Small Outline package for Am2966 only; pinout identical to DIPs.

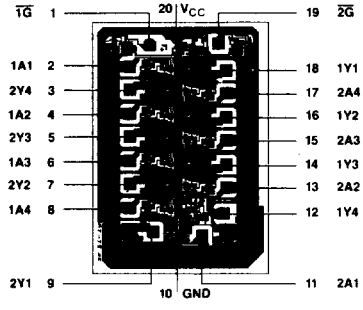
METALLIZATION AND PAD LAYOUT

Am2965



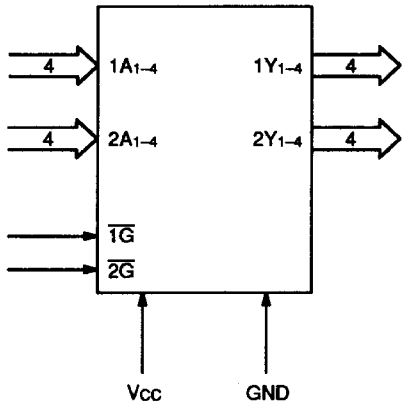
DIE SIZE 0.094" x 0.060"

Am2966



DIE SIZE 0.094" x 0.066"

LOGIC SYMBOL



05409-002A

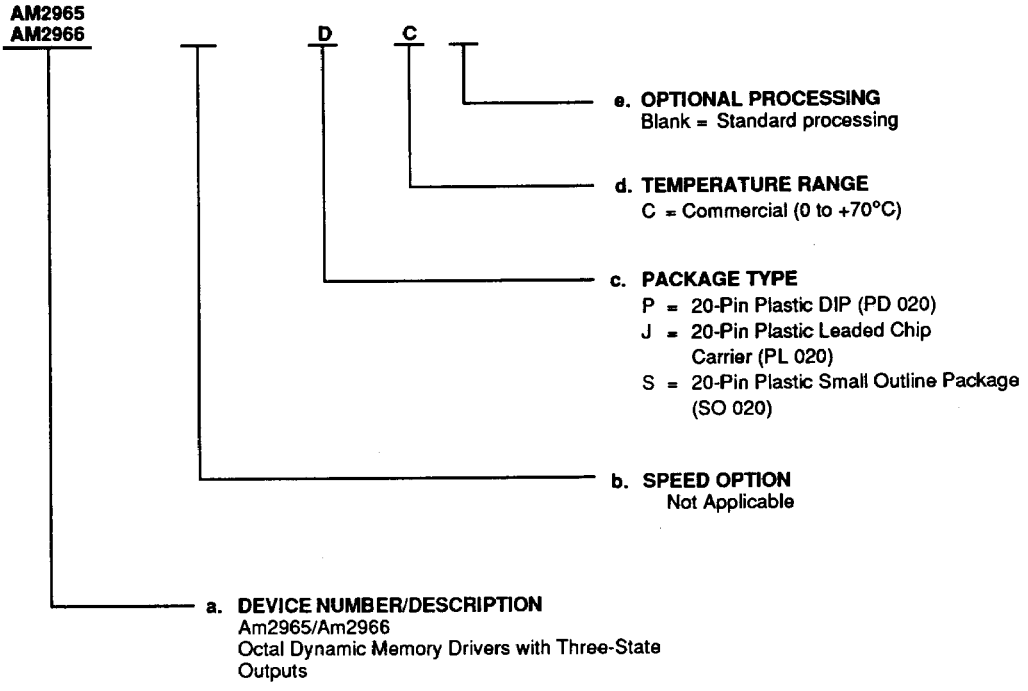
Parameter	PD	PLCC	SOIC	Units
θ_{JA}	71	72	75	°C/Watt
θ_{JC}	22	18	16	

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**



Valid Combinations	
AM2965	JC, PC
AM2966	JC, PC, SC

Valid Combinations

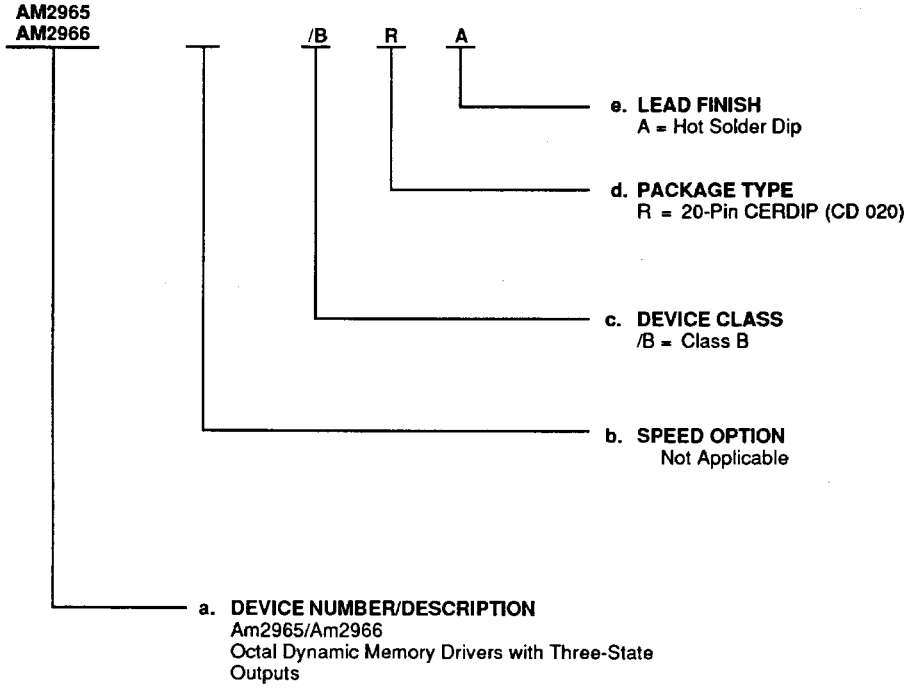
Valid Combinations list configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations or to check on newly released combinations, and to obtain additional data on AMD's standard military grade products.

MILITARY 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. 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



Valid Combinations	
AM2965 AM2966	/BRA

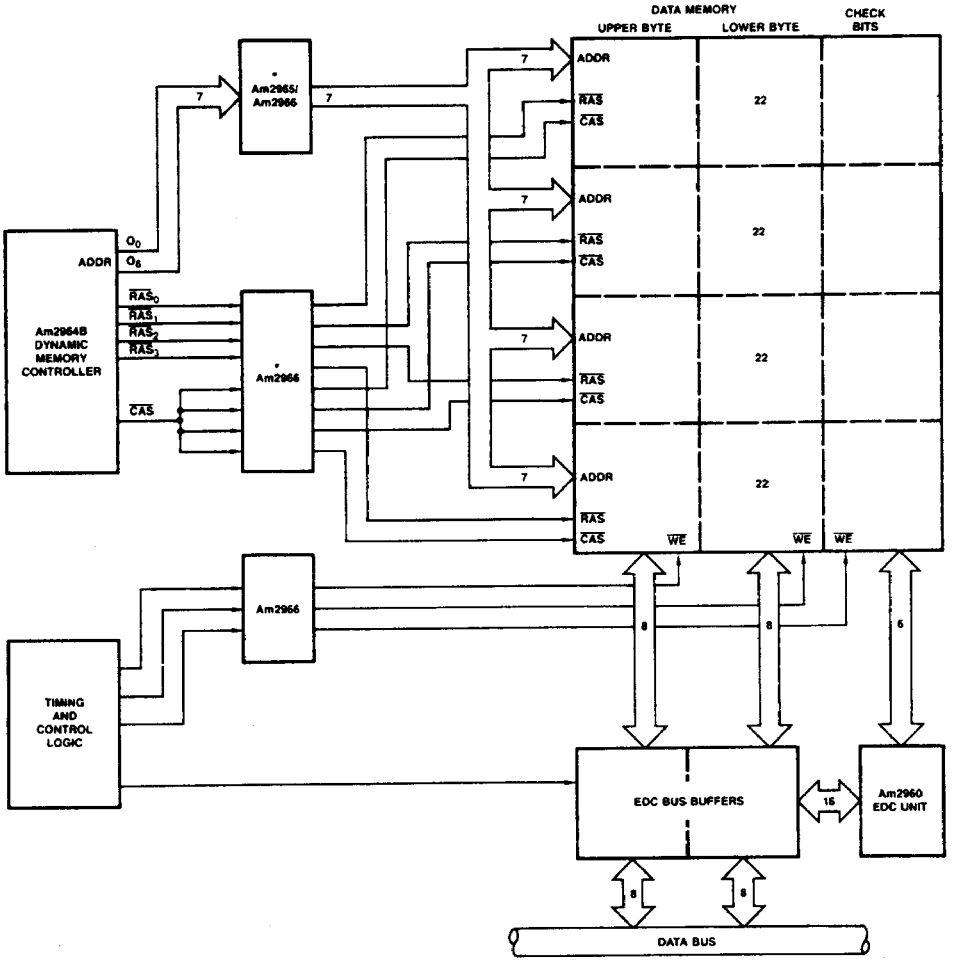
Valid Combinations

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.

Group A Tests

Group A tests consists of Subgroups
1, 2, 3, 7, 8, 9, 10, 11

APPLICATION



AF000401

*Address and $\overline{RAS}/\overline{CAS}$ drivers each drive 22 RAM inputs at each output. Timing skew is minimized by using one device for address lines and one device for $\overline{RAS}/\overline{CAS}$, spreading the $\overline{CAS}$ loading over four drivers to equalize the capacitive load on each driver.

DYNAMIC MEMORY CONTROL WITH ERROR DETECTION AND CORRECTION

ABSOLUTE MAXIMUM RATINGS

Storage Temperature ..... −65°C to +150°C
Temperature (Case)
Under Bias ..... −55°C to +125°C
Supply Voltage to Ground Potential
Continous ..... −0.5V to +7.0V
DC Voltage Applied to Outputs For
High Output State ..... −0.5V to V_{CC} Max
DC Input Voltage ..... −0.5V to +7.0V
DC Output Current, Into Outputs 200mA
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 ..... 0°C to +70°C
Supply Voltage ..... +4.75V to +5.25V

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

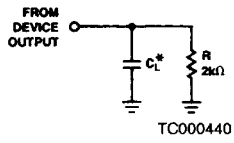
Operating ranges define those limits over which the functionality of the device is guaranteed.

DC CHARACTERISTICS over operating ranges unless otherwise specified (for APL Products, Group A Subgroups 1, 2, 3, 7, and 8 are tested unless otherwise noted)

Parameters	Descriptions		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} = −1mA	V_{CC} −1.15	V_{CC} −0.7V		Volts
V_{OL}	Output LOW Voltage		V_{CC} = MIN, V_{IN} = V_{IH} or V_{IL}	I_{OL} = 1mA			0.5	Volts
				I_{OL} = 12mA			0.8	
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} = −18mA				−1.2	Volts
I_{IL}	Input LOW Current		V_{CC} = MAX, V_{IN} = 0.4V	DATA			−200	μA
				$\overline{1G}$, $\overline{2G}$			−400	
I_{IH}	Input HIGH Current		V_{CC} = MAX, V_{IN} = 2.7V				20	μA
I_I	Input HIGH Current		V_{CC} = MAX, V_{IN} = 7.0V				0.1	mA
I_{OZH}	Off-State Current		V_O = 2.7V				100	μA
I_{OZL}	Off-State Current		V_O = 0.4V				−200	μA
I_{OL}	Output Sink Current		V_{OL} = 2.0V		50			mA
I_{OH}	Output Source Current		V_{OH} = 2.0V		−35			mA
I_{SC}	Output Short Circuit Current (Note 3)		V_{CC} = MAX		−60 (see I_{OH}		−200	mA
I_{CC}	Supply Current	Am2965	All Outputs HIGH	V_{CC} = MAX Outputs Open		24	50	mA
			All Outputs LOW			86	125	
			All Outputs Hi-Z			86	125	
		Am2966	All Outputs HIGH	V_{CC} = MAX Outputs Open		53	75	
			All Outputs LOW			92	130	
			All Outputs Hi-Z			116	150	

Notes: 1. For conditions shown as MIN or MAX, use the appropriate value specified under Operating Range for the applicable device type.
2. Typical limits are at V_{CC} = 5.0V, 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.

SWITCHING TEST CIRCUIT



*t_{pd} specified at C = 50 and 500pF.

Figure 1. Capacitive Load Switching.

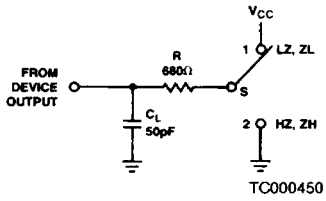
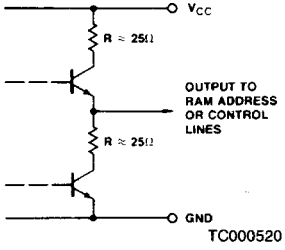


Figure 2. Three-State Enable/Disable.

TYPICAL OUTPUT DRIVER



SWITCHING CHARACTERISTICS (T_A = +25°C, V_{CC} = 5.0 V) for APL Products, Group A Subgroups 9, 10, and 11 are tested unless otherwise noted)

Parameters	Description	Test Conditions		Min	Typ	Max	Units
t_{PLH}	Propagation Delay Time from LOW-to-HIGH Output	Figure 1 Test Circuit Figure 3 Voltage Levels and Waveforms	C_L = 0pF		6	(Note 4)	ns
			C_L = 50pF	6	9	15	
			C_L = 500pF	18	22	30	
t_{PHL}	Propagation Delay Time from HIGH-to-LOW Output		C_L = 0pF		4	(Note 4)	ns
			C_L = 50pF	5	7	15	
			C_L = 500pF	18	22	30	
t_{PLZ}	Output Disable Time from LOW, HIGH	Figures 2 and 4, S = 1			11	20	ns
t_{PHZ}		Figures 2 and 4, S = 2			6.5	12	
t_{PZL}	Output Enable Time from LOW, HIGH	Figures 2 and 4, S = 1			12	20	ns
t_{PZH}		Figures 2 and 4, S = 2			12	20	
t_{SKEW}	Output-to-Output Skew	Figures 1 and 3, C_L = 50pF			±0.5	±3.0 (Note 5)	ns
V_{ONP}	Output Voltage Undershoot	Figures 1 and 3, C_L = 50pF			0	−0.5	Volts

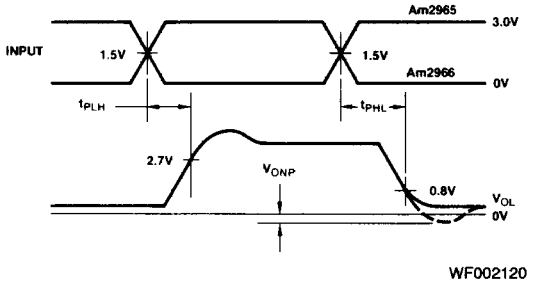
SWITCHING CHARACTERISTICS over operating ranges unless otherwise specified (Note 6)

Parameters	Description	Test Conditions		COMMERCIAL		MILITARY		Units
				Min	Max	Min	Max	
t_{PLH}	Propagation Delay Time LOW-to-HIGH Output	Figures 1 and 3	C_L = 50pF	4	17	4	20	ns
			C_L = 500pF	18	35	18	40	
t_{PHL}	Propagation Delay Time HIGH-to-LOW Output	Figures 1 and 3	C_L = 50pF	4	17	4	20	ns
			C_L = 500pF	18	35	18	40	
t_{PLZ}	Output Disable Time from LOW, HIGH	Figures 2 and 4	S = 1		24		24	ns
t_{PHZ}			S = 2		16		16	
t_{PZL}	Output Enable Time from LOW, HIGH	Figures 2 and 4	S = 1		28		28	ns
t_{PZH}			S = 2		28		28	
V_{ONP}	Output Voltage Undershoot	Figures 1 and 3, C_L = 50pF			−0.5		−0.5	Volts

Notes: 4. Typical time shown for reference only – not tested.
5. Time Skew specification is guaranteed by design but not tested.
6. AC performance over the operating temperature range is guaranteed by testing defined in Group A, Subgroup 9.
7. T_C = −55 to +125°C for Flatpak versions.

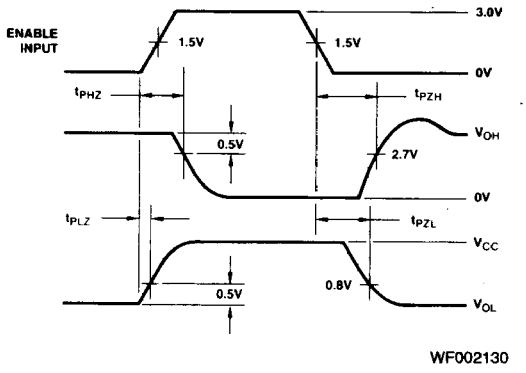
TYPICAL SWITCHING CHARACTERISTICS

SWITCHING TEST WAVEFORMS



$t_r = t_f = 2.5ns$
f = 2.5MHz
$t_{pw} = 200ns$

Figure 3. Output Drive Levels.



$t_r = t_f = 2.5ns$
f = 1MHz
$t_{pw} = 800ns$

Figure 4. Three-State Control Levels.

The RAM Driver symmetrical output design offers significant improvement over a standard Schottky output by providing a balanced drive output impedance (≈25Ω both HIGH and LOW), and by pulling up to MOS V_{OH} levels (V_{CC} – 1.5V). External resistors, not required with the RAM Driver, protect standard Schottky drivers from error causing undershoot but also slow the output rise by adding to the internal R.

The RAM Driver is optimized to drive LOW at maximum speed based on safe undershoot control and to drive HIGH with a symmetrical speed characteristic. This is an optimum approach, because the dominant RAM loading characteristic is input capacitance.

The curves shown below provide performance characteristics typical of both the inverting (Am2965) and non-inverting (Am2966) RAM Drivers.

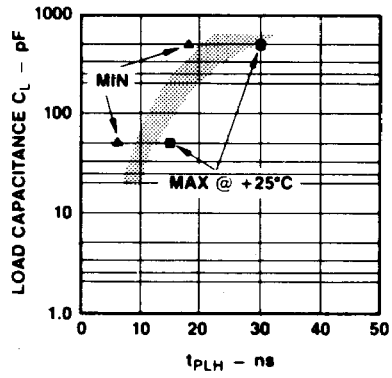


Figure 5. t_{PLH} for V_{OH} = 2.7 Vol vs. C_L.

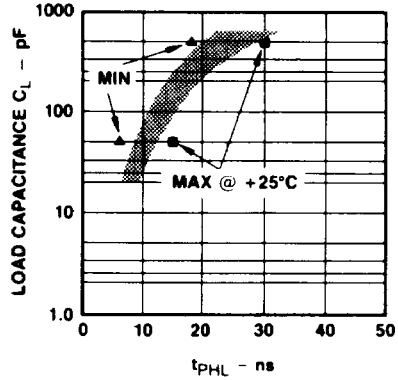


Figure 6. t_{PHL} for V_{OL} = 0.8 Volts vs. C_L.

The curves above depict the typical tPLH and tPHL for the RAM Driver outputs as a function of load capacitance. The minimums and maximums are shown for worst case design. The typical band is provided as a guide for intermediate capacitive loads.