



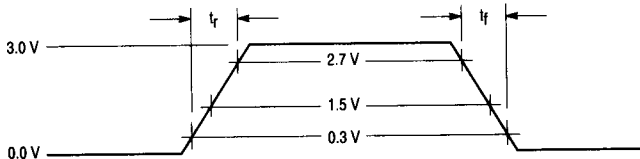
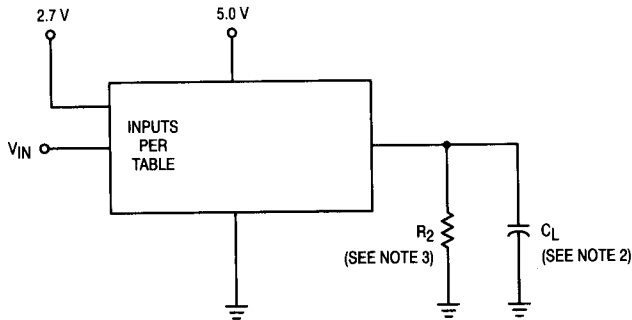
4-Bit Arithmetic Logic Unit

ELECTRICALLY TESTED PER:
MIL-M-38510/33803

The 54F381 performs three arithmetic and three logic operations on two 4-bit words, A and B. Two additional Select input codes force the Function outputs to LOW or HIGH. Carry Propagate and Generate outputs are provided for use with the 'F182 Carry Lookahead Generator for high-speed expansion to longer word lengths. For ripple expansion, refer to the 'F382 ALU data sheet.

- Low Input Loading Minimizes Drive Requirements
- Performs Six Arithmetic and Logic Functions
- Selectable Low (Clear) and High (Preset) Functions
- Carry Generate and Propagate Outputs for use with Carry Lookahead Generator

TEST CIRCUIT



NOTES:

1. Pulse generator has the following characteristics:
 $t_r = t_f \leq 2.5$ ns, PRR ≤ 1.0 MHz, $Z_{OUT} = 50 \Omega$
2. $C_L = 50$ pF $\pm 10\%$ including scope probe, wiring and stray capacitance, without package in test fixture.
3. $R_L = 499 \Omega \pm 5.0\%$.
4. Voltage measurements are to be made with respect to network ground terminal.
5. Terminal conditions (pins not designated may be high ≥ 2.0 V, low ≤ 0.8 V, or open).

Military 54F381



AVAILABLE AS:

- 1) JAN: JM38510/33803BXA
- 2) SMD: 5962-8671001
- 3) 883: 54F381/BXAJC

X = CASE OUTLINE AS FOLLOWS:
PACKAGE: CERDIP: R
CERFLAT: S
LCC: 2

THE LETTER "M" APPEARS
BEFORE THE / ON LCC.

PIN ASSIGNMENTS

| FUNCT. | DIL 732-03 | FLATS 737-02 | LCC 756A-02 | BURN-IN (COND. A) |
|----------------|---------------|-----------------|----------------|----------------------|
| A ₁ | 1 | 1 | 1 | VCC |
| B ₁ | 2 | 2 | 2 | VCC |
| A ₀ | 3 | 3 | 3 | VCC |
| B ₀ | 4 | 4 | 4 | VCC |
| S ₀ | 5 | 5 | 5 | VCC |
| S ₁ | 6 | 6 | 6 | VCC |
| S ₂ | 7 | 7 | 7 | VCC |
| F ₀ | 8 | 8 | 8 | OPEN |
| F ₁ | 9 | 9 | 9 | OPEN |
| GND | 10 | 10 | 10 | GND |
| F ₂ | 11 | 11 | 11 | OPEN |
| F ₃ | 12 | 12 | 12 | OPEN |
| G | 13 | 13 | 13 | OPEN |
| P | 14 | 14 | 14 | OPEN |
| C _n | 15 | 15 | 15 | VCC |
| B ₃ | 16 | 16 | 16 | VCC |
| A ₃ | 17 | 17 | 17 | VCC |
| B ₂ | 18 | 18 | 18 | VCC |
| A ₂ | 19 | 19 | 19 | VCC |
| VCC | 20 | 20 | 20 | VCC |

BURN-IN CONDITIONS:
VCC = 5.0 V MIN/6.0 V MAX

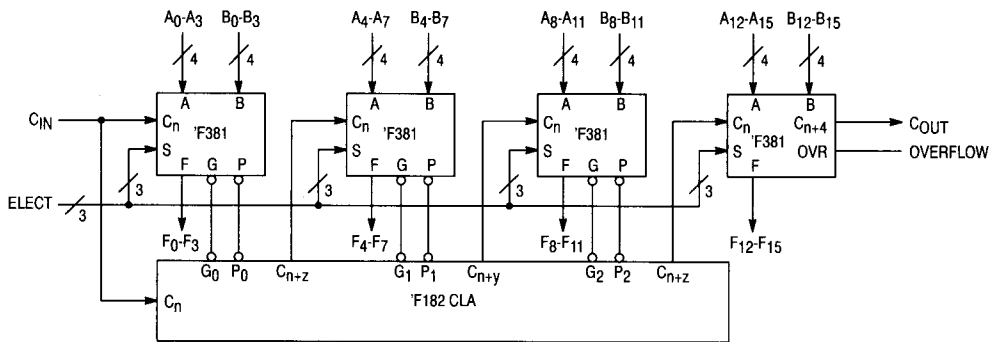
FUNCTIONAL DESCRIPTION

Signals applied to the Select inputs S_0 - S_2 determine the mode of operation, as indicated in the Function Select Table. An extensive listing of input and output levels is shown in the Truth Table. The circuit performs the arithmetic functions for either active-HIGH or active-LOW operands, with output levels in the same convention. In the Subtract operating modes, it is necessary to force a carry (HIGH for active-HIGH

operands, LOW for active-LOW operands) into the C_n input of the least significant package.

The Carry Generate (\bar{G}) and Carry Propagate (\bar{P}) outputs supply input signals to the 'F182 carry lookahead generator for expansion to longer word length, as shown in Figure 1. Note that an 'F382 ALU is used for the most significant package. Typical delays for Figure 1 are given in Figure 2.

Figure 1. 16-Bit Lookahead Carry ALU Expansion



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| FUNCTION SELECT TABLE | | | |
|-----------------------|-------|-------|--------------|
| Select | | | Operation |
| S_0 | S_1 | S_2 | |
| L | L | L | Clear |
| H | L | L | B Minus A |
| L | H | L | A Minus B |
| H | H | L | A Plus B |
| L | L | H | $A \oplus B$ |
| H | L | H | $A + B$ |
| L | H | H | AB |
| H | H | H | Preset |

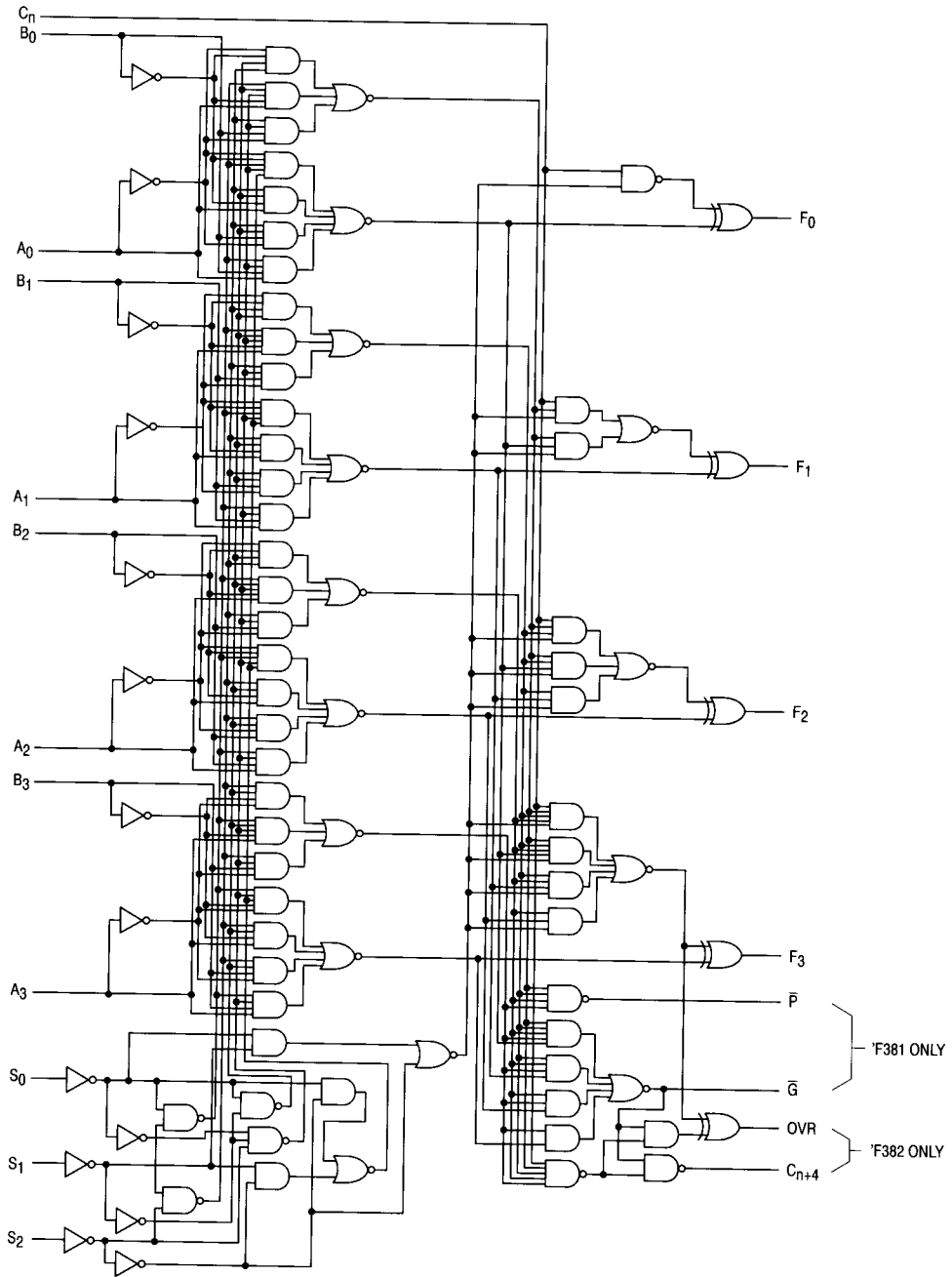
H = HIGH Voltage Level
L = LOW Voltage Level

Figure 2. 16-Bit Delay Tabulation

| Path Segment | Toward F | Output C_{n+4}, over |
|----------------------------------|----------|-------------------------------|
| A_1 or B_1 to \bar{P} | 7.2 ns | 7.2 ns |
| \bar{P}_1 to $C_n + J$ ('F182) | 6.2 ns | 6.2 ns |
| C_n to F | 8.1 ns | — |
| C_n to C_{n+4}, over | — | 8.0 ns |
| Total Delay | 21.5 ns | 21.4 ns |

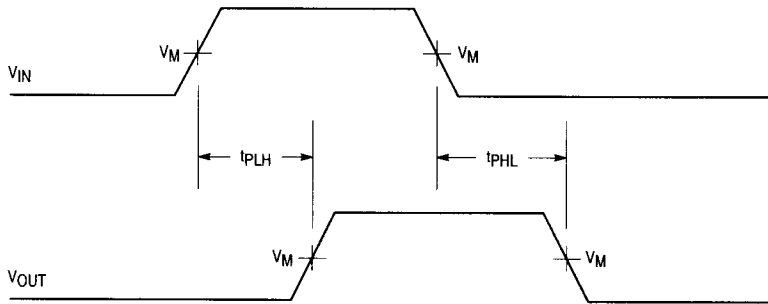
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LOGIC DIAGRAM

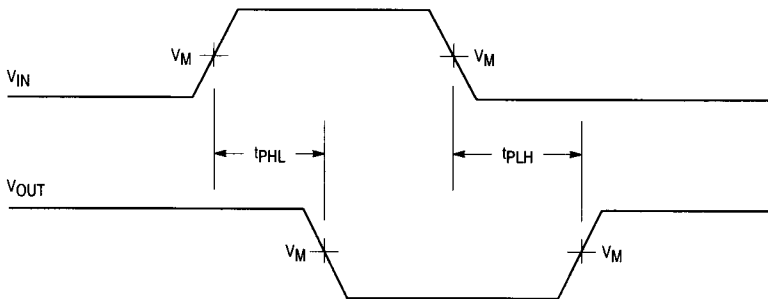


SWITCHING WAVEFORMS

Non-Inverting Waveforms



Inverting Waveforms



$V_M = 1.5 \text{ V}$
 $PRR \leq 1.0 \text{ MHz}$
 $t_r = t_f \leq 2.5 \text{ ns}$
 Input Amplitude (Base \rightarrow Top) = 0 \rightarrow 3.0 V

TRUTH TABLE

| Function | Inputs | | | | | | Outputs | | | | | | | |
|-----------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------|-----------|---|---|
| | S ₀ | S ₁ | S ₂ | C _n | A _n | B _n | F ₀ | F ₁ | F ₂ | F ₃ | \bar{G} | \bar{P} | | |
| CLEAR | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 0 | 0 | 0 | | |
| B MINUS A | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | | |
| | | | | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | |
| | | | | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| | | | | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | | | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | | | | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| | | | | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| | | | | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| A MINUS B | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | | |
| | | | | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | |
| | | | | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | |
| | | | | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | |
| | | | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | | | | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| | | | | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| | | | | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| A PLUS B | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | | |
| | | | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | |
| | | | | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | |
| | | | | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | |
| | | | | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| | | | | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | | | | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| A ⊕ B | 0 | 0 | 1 | X | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | | |
| | | | | X | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | | | | X | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | |
| | | | | X | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| A + B | 1 | 0 | 1 | X | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | | |
| | | | | X | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | | | | X | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | | | | X | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | |
| AB | 0 | 1 | 1 | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | | | X | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | |
| | | | | X | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | | | X | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | |
| PRESET | 1 | 1 | 1 | X | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | | | | X | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | | | | X | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | | | | X | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | | |

1 = HIGH Voltage Level
0 = LOW Voltage Level
X = Immaterial

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| Symbol | Parameter | Limits | | | | | | Unit | Test Condition (Unless Otherwise Specified) |
|--------------------|------------------------------|------------|------|-------------|------|-------------|------|------|---|
| | | + 25°C | | + 125°C | | - 55°C | | | |
| | | Subgroup 1 | | Subgroup 2 | | Subgroup 3 | | | |
| | | Min | Max | Min | Max | Min | Max | | |
| V _{OH} | Logical "1" Output Voltage | 2.5 | | 2.5 | | 2.5 | | V | V _{CC} = 4.5 V, I _{OH} = -1.0 mA, V _{IN} = 2.0 V or 0.8 V (all inputs). |
| V _{OL} | Logical "0" Output Voltage | | 0.5 | | 0.5 | | 0.5 | V | V _{CC} = 4.5 V, I _{OL} = 20 mA, V _{IN} = 0.8 V or 2.0 V (all inputs). |
| V _{IC} | Input Clamping Voltage | | -1.2 | | | | | V | V _{CC} = 4.5 V, I _{IN} = -18 mA, other inputs are open. |
| I _{IH} | Logical "1" Input Current | | 20 | | 20 | | 20 | μA | V _{CC} = 5.5 V, V _{IH} = 2.7 V, other inputs are open. |
| I _{IHH} | Logical "1" Input Current | | 100 | | 100 | | 100 | μA | V _{CC} = 5.5 V, V _{IHH} = 7.0 V, other inputs are open. |
| I _{OS} | Output Short Circuit Current | -60 | -150 | -60 | -150 | -60 | -150 | mA | V _{CC} = 5.5 V, V _{IN} = 4.5 V, other inputs are GND, V _{OUT} = 0 V. |
| I _{OD} | Diode Current | 60 | | 60 | | 60 | | mA | V _{CC} = 5.5 V, V _{IN} = 4.5 V (S ₀ , S ₁ , C _n), other inputs are GND, V _{OUT} = 2.5 V. |
| I _{IL(S)} | Logical "0" Input Current | -0.12 | -0.6 | -0.12 | -0.6 | -0.12 | -0.6 | mA | V _{CC} = 5.5 V, V _{IN} = 0.5 V (S), other inputs are open. |
| I _{IL} | Logical "0" Input Current | -0.12 | -2.4 | -0.12 | -2.4 | -0.12 | -2.4 | mA | V _{CC} = 5.5 V, V _{IN} = 0.5 V (A, B, & C _n), other inputs are open. |
| I _{CC} | Power Supply Current Off | | 89 | | 89 | | 89 | mA | V _{CC} = 5.5 V, V _{IN} = 4.5 V (all inputs), S = GND. |
| V _{IH} | Logical "1" Input Voltage | 2.0 | | 2.0 | | 2.0 | | V | V _{CC} = 4.5 V. |
| V _{IL} | Logical "0" Input Voltage | | 0.8 | | 0.8 | | 0.8 | V | V _{CC} = 4.5 V. |
| | Functional Tests | Subgroup 7 | | Subgroup 8A | | Subgroup 8B | | | per Truth Table with V _{CC} = 4.5 V, (Repeat at), V _{CC} = 5.5 V, V _{INL} = 0.5 V, V _{INH} = 2.5 V. |

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| Symbol | Parameter | Limits | | | | | | Unit | Test Condition (Unless Otherwise Specified) |
|-------------------|---|------------|------|-------------|------|-------------|------|------|--|
| | | + 25°C | | + 125°C | | - 55°C | | | |
| | | Subgroup 9 | | Subgroup 10 | | Subgroup 11 | | | |
| | | Min | Max | Min | Max | Min | Max | | |
| t _{PHL1} | Propagation Delay /Data-Output C _N to F _N | 2.5 | 8.0 | 2.5 | 12 | 2.5 | 12 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PLH1} | Propagation Delay /Data-Output C _N to F _N | 2.5 | 12 | 2.5 | 15 | 2.5 | 15 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PHL2} | Propagation Delay /Data-Output A _N to F _N | 3.0 | 12.5 | 3.0 | 15 | 3.0 | 15 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PLH2} | Propagation Delay /Data-Output A _N to F _N | 3.0 | 15 | 3.0 | 17 | 3.0 | 17 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PHL3} | Propagation Delay /Data-Output B _N to F _N | 3.0 | 12.5 | 3.0 | 16 | 3.0 | 16 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PLH3} | Propagation Delay /Data-Output B _N to F _N | 3.0 | 15 | 3.0 | 17 | 3.0 | 17 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PHL4} | Propagation Delay /Data-Output S _N to F _N | 3.0 | 14 | 3.0 | 16 | 3.0 | 16 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PLH4} | Propagation Delay /Data-Output S _N to F _N | 3.0 | 20 | 3.0 | 21 | 3.0 | 21 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PHL5} | Propagation Delay /Data-Output A _N to \bar{G} | 3.0 | 10 | 3.0 | 13.5 | 3.0 | 13.5 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PLH5} | Propagation Delay /Data-Output A _N to \bar{G} | 3.0 | 11.5 | 3.0 | 13.5 | 3.0 | 13.5 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PHL6} | Propagation Delay /Data-Output B _N to \bar{G} | 3.0 | 10 | 3.0 | 13.5 | 3.0 | 13.5 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PLH6} | Propagation Delay /Data-Output B _N to \bar{G} | 3.0 | 11.5 | 3.5 | 13 | 3.5 | 13 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PHL7} | Propagation Delay /Data-Output A _N to \bar{P} | 3.0 | 9.5 | 3.0 | 12.5 | 3.0 | 12.5 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PLH7} | Propagation Delay /Data-Output A _N to \bar{P} | 2.0 | 11 | 2.0 | 14 | 2.0 | 14 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |

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| Symbol | Parameter | Limits | | | | | | Unit | Test Condition (Unless Otherwise Specified) |
|--------------------|--|------------|------|-------------|------|-------------|------|------|--|
| | | + 25°C | | + 125°C | | - 55°C | | | |
| | | Subgroup 9 | | Subgroup 10 | | Subgroup 11 | | | |
| | | Min | Max | Min | Max | Min | Max | | |
| t _{PHL8} | Propagation Delay /Data-Output B _n to \bar{P} | 3.0 | 9.5 | 3.0 | 12.5 | 3.0 | 12.5 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PLH8} | Propagation Delay /Data-Output B _n to \bar{P} | 2.0 | 11 | 2.0 | 14 | 2.0 | 14 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PHL9} | Propagation Delay /Data-Output S _n to \bar{G} | 3.0 | 13.5 | 3.0 | 18 | 3.0 | 18 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PLH9} | Propagation Delay /Data-Output S _n to \bar{G} | 3.0 | 14 | 3.0 | 17 | 3.0 | 17 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PHL10} | Propagation Delay /Data-Output S _n to \bar{P} | 3.0 | 13.5 | 3.0 | 18 | 3.0 | 18 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |
| t _{PLH10} | Propagation Delay /Data-Output S _n to \bar{P} | 3.0 | 14 | 3.0 | 16 | 3.0 | 16 | ns | V _{CC} = 5.0 V, C _L = 50 pF, R _L = 499 Ω. |