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## FIN1047

### 3.3V LVDS 4-Bit Flow-Through High Speed Differential Driver

#### General Description

This quad driver is designed for high speed interconnects utilizing Low Voltage Differential Signaling (LVDS) technology. The driver translates LVTTTL signal levels to LVDS levels with a typical differential output swing of 350mV which provides low EMI at ultra low power dissipation even at high frequencies. This device is ideal for high speed transfer of clock and data.

The FIN1047 can be paired with its companion receiver, the FIN1048, or any other LVDS receiver.

#### Features

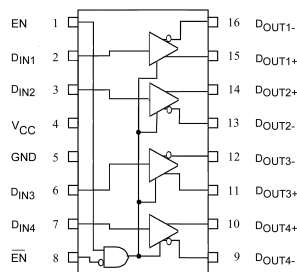
- Greater than 400Mbps data rate
- Flow-through pinout simplifies PCB layout
- 3.3V power supply operation
- 0.4 ns maximum differential pulse skew
- 1.7 ns maximum propagation delay
- Low power dissipation
- Power-Off protection
- Meets or exceeds the TIA/EIA-644 LVDS standard
- Pin compatible with equivalent RS-422 and LVPECL devices
- 16-Lead SOIC and TSSOP packages save space

#### Ordering Code:

| Order Number | Package Number | Package Description                                                          |
|--------------|----------------|------------------------------------------------------------------------------|
| FIN1047M     | M16A           | 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow |
| FIN1047MTC   | MTC16          | 16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  |

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

#### Connection Diagram



#### Pin Descriptions

| Pin Name                                                                          | Description                  |
|-----------------------------------------------------------------------------------|------------------------------|
| D <sub>IN1</sub> , D <sub>IN2</sub> , D <sub>IN3</sub> , D <sub>IN4</sub>         | LVTTTL Data Inputs           |
| D <sub>OUT1+</sub> , D <sub>OUT2+</sub> , D <sub>OUT3+</sub> , D <sub>OUT4+</sub> | Non-Inverting Driver Outputs |
| D <sub>OUT1-</sub> , D <sub>OUT2-</sub> , D <sub>OUT3-</sub> , D <sub>OUT4-</sub> | Inverting Driver Outputs     |
| EN                                                                                | Driver Enable Pin            |
| $\overline{\text{EN}}$                                                            | Inverting Driver Enable Pin  |
| V <sub>CC</sub>                                                                   | Power Supply                 |
| GND                                                                               | Ground                       |

#### Truth Table

| Inputs    |                        |                 | Outputs           |                   |
|-----------|------------------------|-----------------|-------------------|-------------------|
| EN        | $\overline{\text{EN}}$ | D <sub>IN</sub> | D <sub>OUT+</sub> | D <sub>OUT-</sub> |
| H         | L or OPEN              | H               | H                 | L                 |
| H         | L or OPEN              | L               | L                 | H                 |
| H         | L or OPEN              | OPEN            | L                 | H                 |
| X         | H                      | X               | Z                 | Z                 |
| L or OPEN | X                      | X               | Z                 | Z                 |

H = HIGH Logic Level    L = LOW Logic Level  
X = Don't Care        Z = High Impedance

**Absolute Maximum Ratings**(Note 1)

|                                                       |                 |
|-------------------------------------------------------|-----------------|
| Supply Voltage ( $V_{CC}$ )                           | –0.5V to +4.6V  |
| DC Input Voltage ( $V_{IN}$ )                         | –0.5V to +6V    |
| DC Input Voltage ( $V_{OUT}$ )                        | –0.5V to 4.6V   |
| Driver Short Circuit Current ( $I_{OSD}$ )            | Continuous      |
| Storage Temperature Range ( $T_{STG}$ )               | –65°C to +150°C |
| Max Junction Temperature ( $T_J$ )                    | 150°C           |
| Lead Temperature ( $T_L$ )<br>(Soldering, 10 seconds) | 260°C           |
| ESD (Human Body Model)                                | ≥ 9000V         |
| ESD (Machine Model)                                   | ≥ 1200V         |

**Recommended Operating Conditions**

|                                 |                |
|---------------------------------|----------------|
| Supply Voltage ( $V_{CC}$ )     | 3.0V to 3.6V   |
| Input Voltage ( $V_{IN}$ )      | 0 to $V_{CC}$  |
| Operating Temperature ( $T_A$ ) | –40°C to +85°C |

**Note 1:** The "Absolute Maximum Ratings" are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature and output/input loading variables. Fairchild does not recommend operation of circuits outside databook specification.

**DC Electrical Characteristics**

Over supply voltage and operating temperature ranges, unless otherwise specified

| Symbol          | Parameter                                                  | Test Conditions                                                | Min   | Typ<br>(Note 2) | Max            | Units   |
|-----------------|------------------------------------------------------------|----------------------------------------------------------------|-------|-----------------|----------------|---------|
| $V_{OD}$        | Output Differential Voltage                                | $R_L = 100\Omega$ , Driver Enabled,<br>See Figure 1            | 250   | 340             | 450            | mV      |
| $\Delta V_{OD}$ | $V_{OD}$ Magnitude Change from<br>Differential LOW-to-HIGH |                                                                |       | 1.4             | 25             | mV      |
| $V_{OS}$        | Offset Voltage                                             |                                                                | 1.125 | 1.25            | 1.375          | V       |
| $\Delta V_{OS}$ | Offset Magnitude Change from<br>Differential LOW-to-HIGH   |                                                                |       | 1.2             | 25             | mV      |
| $V_{OH}$        | HIGH Output Voltage                                        | $V_{IN} = V_{CC}$                                              |       | 1.4             | 1.6            | V       |
| $V_{OL}$        | LOW Output Voltage                                         | $V_{IN} = 0V$                                                  | 0.9   | 1.05            |                | V       |
| $I_{OFF}$       | Power Off Output Current                                   | $V_{CC} = 0V$ , $V_{OUT} = 0V$ or 3.6V                         | –20   |                 | 20             | $\mu A$ |
| $I_{OS}$        | Short Circuit Output Current                               | $V_{OUT} = 0V$ , Driver Enabled                                |       | –3              | –6             | mA      |
|                 |                                                            | $V_{OD} = 0V$ , Driver Enabled                                 |       | –3.5            | –6             |         |
| $V_{IH}$        | Input HIGH Voltage                                         |                                                                | 2.0   |                 | $V_{CC} + 1.0$ | V       |
| $V_{IL}$        | Input LOW Voltage (Note 3)                                 |                                                                |       | GND             | 0.8            | V       |
| $I_{IN}$        | Input Current                                              | $V_{IN} = 0V$ or $V_{CC}$                                      | –20   |                 | 20             | $\mu A$ |
| $I_{OZ}$        | Disabled Output Leakage Current                            | $V_{OUT} = 0V$ or 4.6V                                         | –20   |                 | 20             | $\mu A$ |
| $I_{I(OFF)}$    | Power-Off Input Current                                    | $V_{CC} = 0V$ , $V_{IN} = 0V$ or 3.6V                          | –20   |                 | 20             | $\mu A$ |
| $V_{IK}$        | Input Clamp Voltage                                        | $I_{IK} = -18\text{ mA}$                                       | –1.5  | –0.7            |                | V       |
| $I_{CC}$        | Power Supply Current                                       | No Load, $V_{IN} = 0V$ or $V_{CC}$ , Driver Enabled            |       | 5               | 8              | mA      |
|                 |                                                            | $R_L = 100\Omega$ , Driver Disabled                            |       | 1.7             | 4              |         |
|                 |                                                            | $R_L = 100\Omega$ , $V_{IN} = 0V$ or $V_{CC}$ , Driver Enabled |       | 16              | 22             |         |
| $I_{PU/PD}$     | Output Power Up/Power Down<br>High Z Leakage Current       | $V_{CC} = 0V$ or 1.5V                                          | –20   |                 | 20             | $\mu A$ |

**Note 2:** All typical values are at  $T_A = 25^\circ\text{C}$  and with  $V_{CC} = 3.3V$ .

**Note 3:** For transient conditions when  $t \leq 5\text{ ns}$  and  $I_{IN} \leq -100\text{ mA}$ ,  $V_{ILmin} = -1.0V$ .

## AC Electrical Characteristics

Over supply voltage and operating temperature ranges, unless otherwise specified

| Symbol       | Parameter                                       | Test Conditions                                                                      | Min | Typ<br>(Note 4) | Max | Units |
|--------------|-------------------------------------------------|--------------------------------------------------------------------------------------|-----|-----------------|-----|-------|
| $t_{PLHD}$   | Differential Propagation Delay<br>LOW-to-HIGH   | $R_L = 100\ \Omega$ , $C_L = 10\ \text{pF}$ ,<br>See Figure 2 (Note 8), and Figure 3 | 0.6 | 1.1             | 1.7 | ns    |
| $t_{PHLD}$   | Differential Propagation Delay<br>HIGH-to-LOW   |                                                                                      | 0.6 | 1.2             | 1.7 | ns    |
| $t_{TLHD}$   | Differential Output Rise Time (20% to 80%)      |                                                                                      | 0.4 |                 | 1.2 | ns    |
| $t_{THLD}$   | Differential Output Fall Time (80% to 20%)      |                                                                                      | 0.4 |                 | 1.2 | ns    |
| $t_{SK(P)}$  | Pulse Skew $ t_{PLH} - t_{PHL} $                |                                                                                      |     |                 | 0.4 | ns    |
| $t_{SK(LH)}$ | Channel-to-Channel Skew<br>(Note 5)             |                                                                                      |     | 0.05            | 0.3 | ns    |
| $t_{SK(HL)}$ | Channel-to-Channel Skew<br>(Note 5)             |                                                                                      |     |                 | 0.3 | ns    |
| $t_{SK(PP)}$ | Part-to-Part Skew (Note 6)                      |                                                                                      |     |                 | 1.0 | ns    |
| $f_{MAX}$    | Maximum Frequency (Note 7)                      | $R_L = 100\ \Omega$ , See Figure 6 (Note 8)                                          | 200 | 250             |     | MHz   |
| $t_{ZHD}$    | Differential Output Enable Time from Z to HIGH  | $R_L = 100\ \Omega$ , $C_L = 10\ \text{pF}$ ,<br>See Figure 4 (Note 8), and Figure 5 |     | 1.7             | 5.0 | ns    |
| $t_{ZLD}$    | Differential Output Enable Time from Z to LOW   |                                                                                      |     | 1.7             | 5.0 | ns    |
| $t_{HZD}$    | Differential Output Disable Time from HIGH to Z |                                                                                      |     | 2.7             | 5.0 | ns    |
| $t_{LZD}$    | Differential Output Disable Time from LOW to Z  |                                                                                      |     | 2.7             | 5.0 | ns    |
| $C_{IN}$     | Input Capacitance                               |                                                                                      |     | 4.2             |     | pF    |
| $C_{OUT}$    | Output Capacitance                              |                                                                                      |     | 5.2             |     | pF    |

**Note 4:** All typical values are at  $T_A = 25^\circ\text{C}$  and with  $V_{CC} = 3.3\text{V}$ .

**Note 5:**  $t_{SK(LH)}$ ,  $t_{SK(HL)}$  is the skew between specified outputs of a single device when the outputs have identical loads and are switching in the same direction.

**Note 6:**  $t_{SK(PP)}$  is the magnitude of the difference in propagation delay times between any specified terminals of two devices switching in the same direction (either LOW-to-HIGH or HIGH-to-LOW) when both devices operate with the same supply voltage, same temperature, and have identical test circuits.

**Note 7:**  $f_{MAX}$  criteria: Input  $t_R = t_F < 1\text{ns}$ , 0V to 3V, 50% Duty Cycle; Output  $V_{OD} > 250\text{ mV}$ , 45% to 55% Duty Cycle; all switching in phase channels.

**Note 8:** Test Circuits in Figures 2, 4, 6 are simplified representations of test fixture and DUT loading.

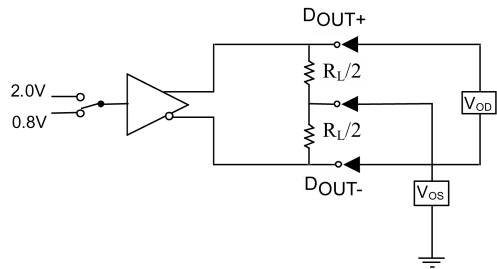
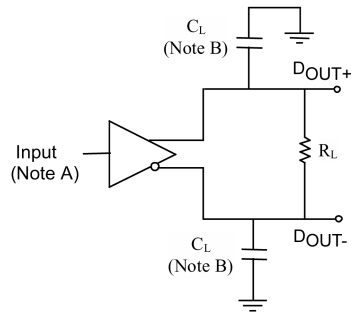


FIGURE 1. Differential Driver DC Test Circuit



**Note A:** All input pulses have frequency = 10 MHz,  $t_R$  or  $t_F$  = 1 ns

**Note B:**  $C_L$  includes all fixture and instrumentation capacitance

FIGURE 2. Differential Driver Propagation Delay and Transition Time Test Circuit

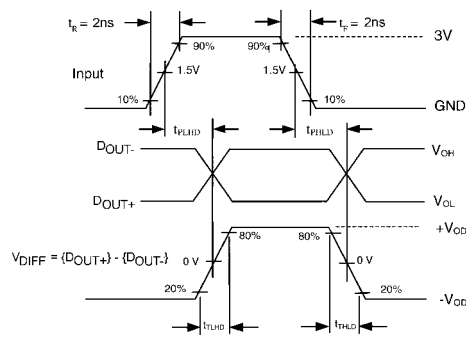
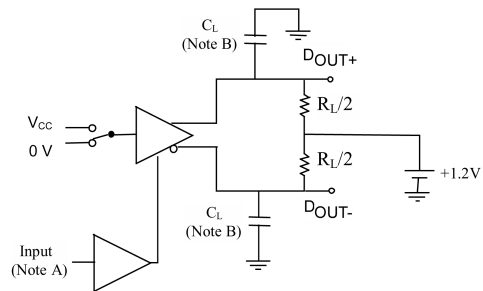


FIGURE 3. AC Waveforms



**Note B:** All input pulses have the frequency = 10 MHz,  $t_R$  or  $t_F$  = 1 ns

**Note A:**  $C_L$  includes all fixture and instrumentation capacitance

FIGURE 4. Differential Driver Enable and Disable Test Circuit

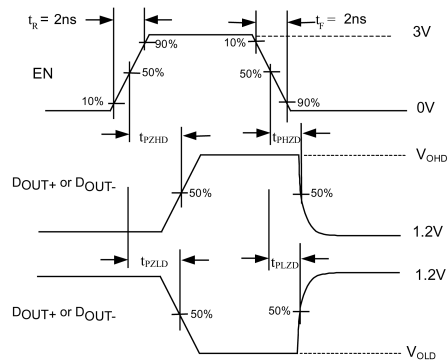
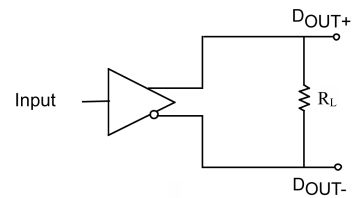


FIGURE 5. Enable and Disable AC Waveforms

FIGURE 6.  $f_{MAX}$  Test Circuit

# DC / AC Typical Performance Curves

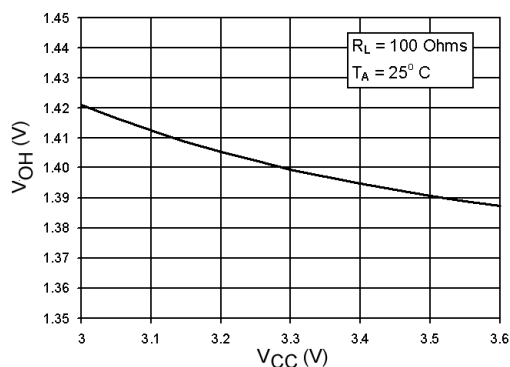


FIGURE 7. Output High Voltage vs. Power Supply Voltage

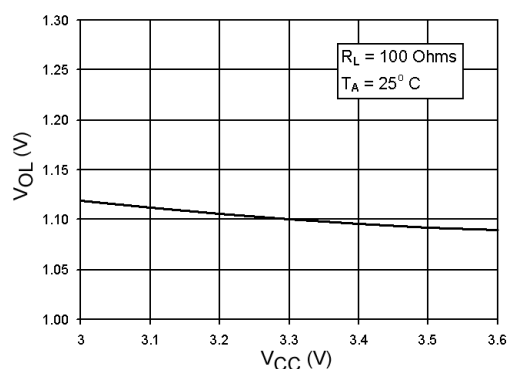


FIGURE 8. Output Low Voltage vs. Power Supply Voltage

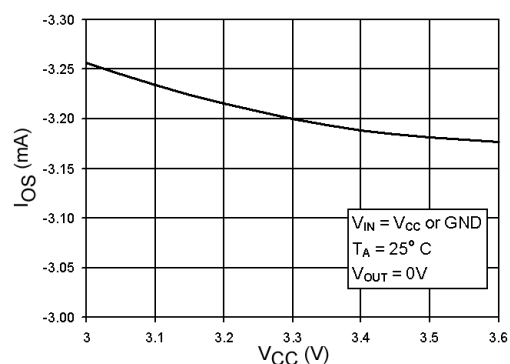


FIGURE 9. Output Short Circuit Current vs. Power Supply Voltage

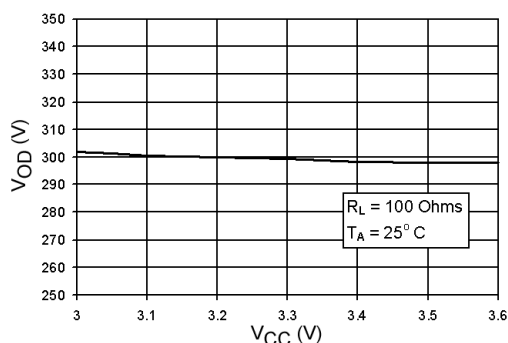


FIGURE 10. Differential Output Voltage vs. Power Supply Voltage

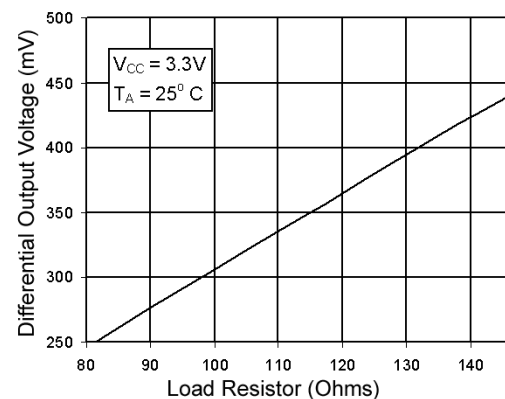


FIGURE 11. Differential Output Voltage vs. Load Resistor

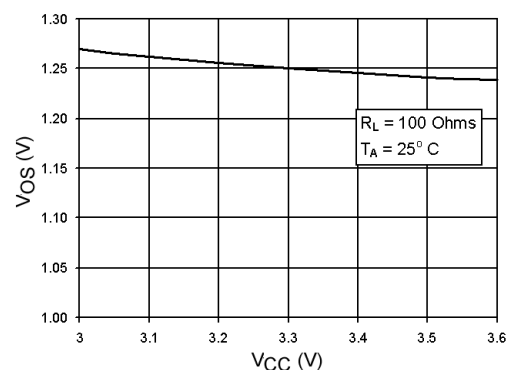


FIGURE 12. Offset Voltage vs. Power Supply Voltage

# DC / AC Typical Performance Curves (Continued)

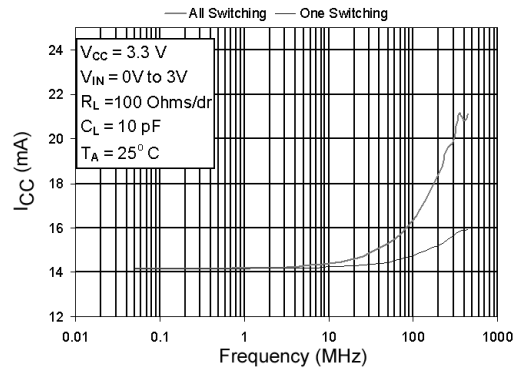


FIGURE 13. Power Supply Current vs. Frequency

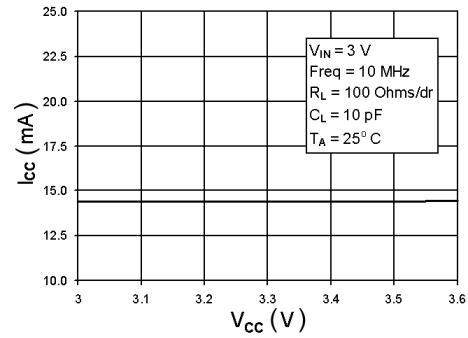


FIGURE 14. Power Supply Current vs. Power Supply Voltage

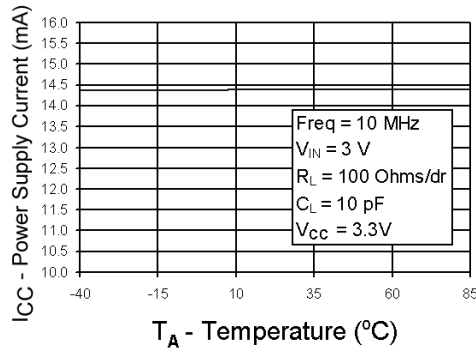


FIGURE 15. Power Supply Current vs. Ambient Temperature

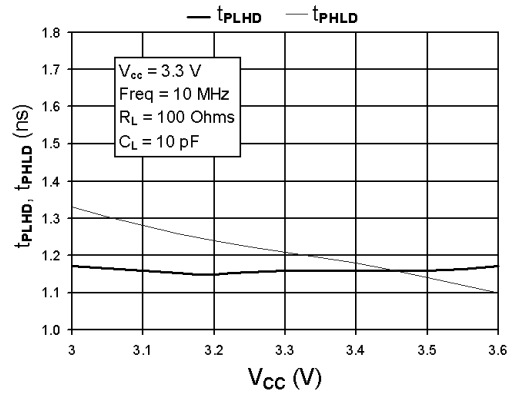


FIGURE 16. Differential Propagation Delay vs. Power Supply Voltage

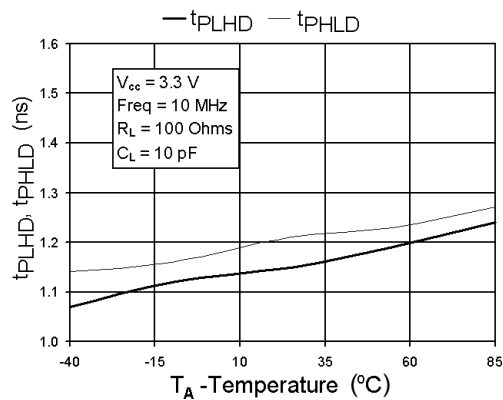


FIGURE 17. Differential Propagation Delay vs. Ambient Temperature

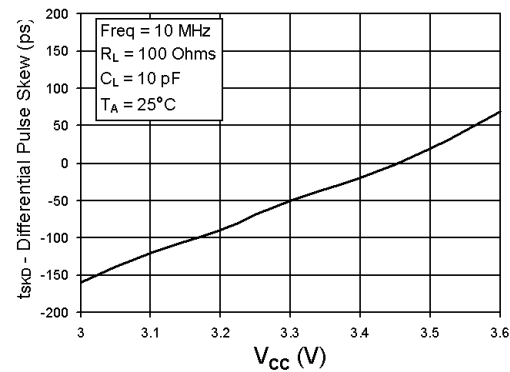


FIGURE 18. Differential Pulse Skew ( $t_{PLH} - t_{PHL}$ ) vs. Power Supply Voltage

# DC / AC Typical Performance Curves (Continued)

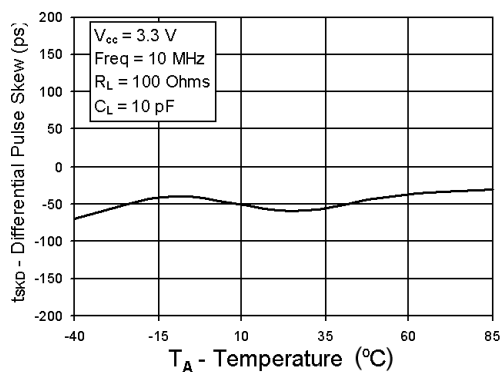


FIGURE 19. Differential Pulse Skew ( $t_{PLH} - t_{PHL}$ ) vs. Ambient Temperature

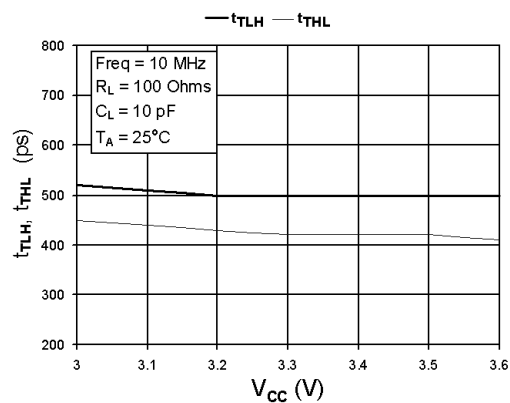


FIGURE 20. Transition Time vs. Power Supply Voltage

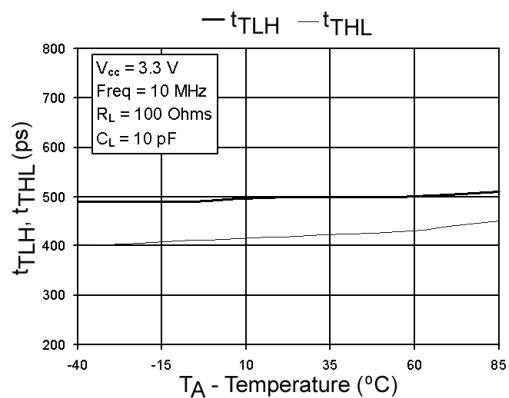
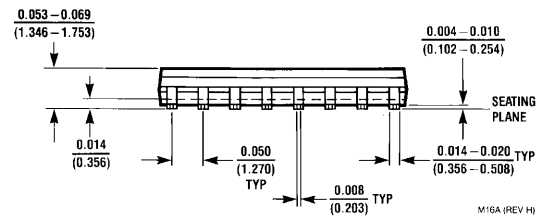


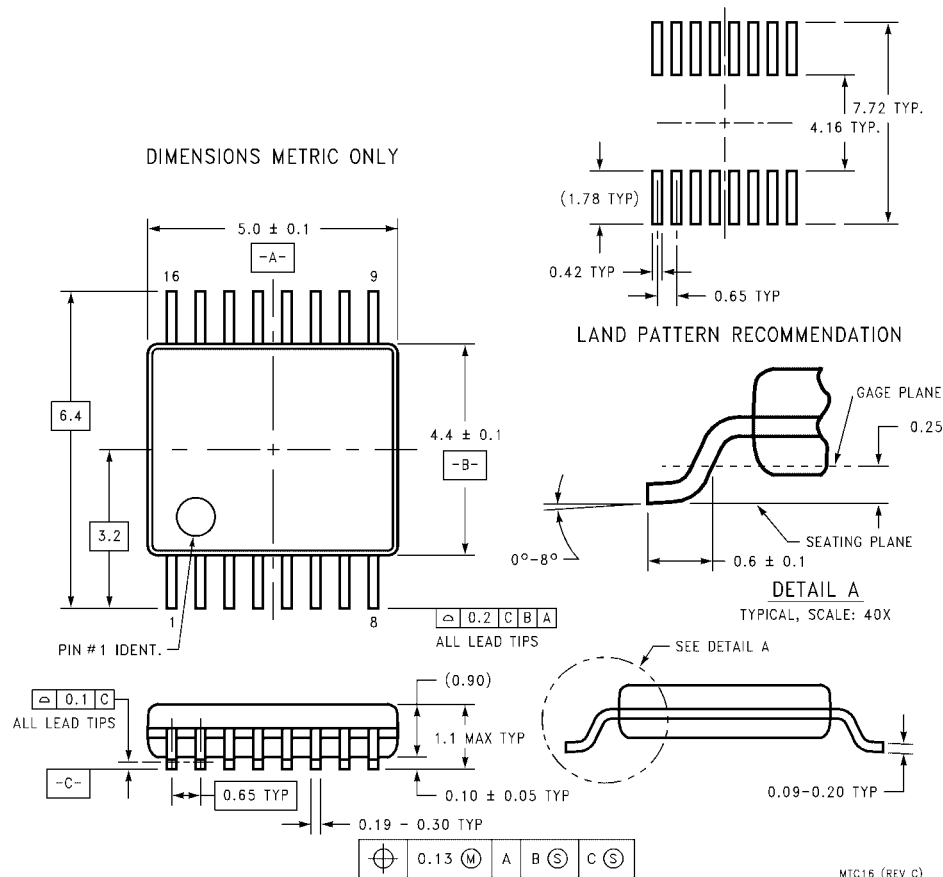
FIGURE 21. Transition Time vs. Ambient Temperature





8

**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



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