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FAIRCHILD SEMICONDUCTOR™

June 2001
Revised August 2003

# 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 LVTTL 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

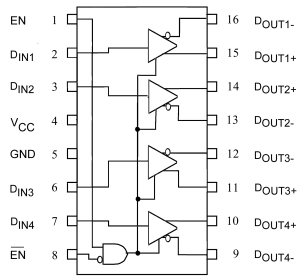
- Greater than 400Mbs data rate
- Flow-through pinout simplifies PCB layout
- 3.3V power supply operation
- 0.4 ns maximum differential pulse skew
- 1.7 ns maximum propagation delay
- Low power dissipation
- Power-Off protection
- Meets or exceeds the TIA/EIA-644 LVDS standard
- Pin compatible with equivalent 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 |
|---|---|
| $D_{IN1}$, $D_{IN2}$, $D_{IN3}$, $D_{IN4}$ | LVTTL Data Inputs |
| $D_{OUT1+}$, $D_{OUT2+}$, $D_{OUT3+}$, $D_{OUT4+}$ | Non-Inverting Driver Outputs |
| $D_{OUT1-}$, $D_{OUT2-}$, $D_{OUT3-}$, $D_{OUT4-}$ | Inverting Driver Outputs |
| EN | Driver Enable Pin |
| $\overline{EN}$ | Inverting Driver Enable Pin |
| $V_{CC}$ | Power Supply |
| GND | Ground |

## Truth Table

| Inputs | | | Outputs | |
|---|---|---|---|---|
| EN | $\overline{EN}$ | $D_{IN}$ | $D_{OUT+}$ | $D_{OUT-}$ |
| 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

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## 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 ($T_L$) (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 (Note 2) | Max | Units |
|---|---|---|---|---|---|---|
| $V_{OD}$ | Output Differential Voltage | $R_L$ = 100Ω, Driver Enabled, See Figure 1 | 250 | 340 | 450 | mV |
| $\Delta V_{OD}$ | $V_{OD}$ Magnitude Change from 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 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 | µA |
| $I_{OS}$ | 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 | µA |
| $I_{OZ}$ | Disabled Output Leakage Current | $V_{OUT}$ = 0V or 4.6V | −20 | | 20 | µA |
| $I_{I(OFF)}$ | Power-Off Input Current | $V_{CC}$ = 0V, $V_{IN}$ = 0V or 3.6V | −20 | | 20 | µA |
| $V_{IK}$ | Input Clamp Voltage | $I_{IK}$ = −18 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 Ω, Driver Disabled | | 1.7 | 4 | |
| | | $R_L$ = 100 Ω, $V_{IN}$ = 0V or $V_{CC}$, Driver Enabled | | 16 | 22 | |
| $I_{PU/PD}$ | Output Power Up/Power Down High Z Leakage Current | $V_{CC}$ = 0V or 1.5V | −20 | | 20 | µA |

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

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



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## AC Electrical Characteristics

Over supply voltage and operating temperature ranges, unless otherwise specified

| Symbol | Parameter | Test Conditions | Min | Typ (Note 4) | Max | Units |
|---|---|---|---|---|---|---|
| $t_{PLHD}$ | Differential Propagation Delay LOW-to-HIGH | $R_L$ = 100 Ω, $C_L$ = 10 pF, See Figure 2 (Note 8), and Figure 3 | 0.6 | 1.1 | 1.7 | ns |
| $t_{PHLD}$ | Differential Propagation Delay 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 |
| $t_{SK(LH)}$ $t_{SK(HL)}$ | Channel-to-Channel Skew (Note 5) | | | 0.05 | 0.3 | ns |
| $t_{SK(PP)}$ | Part-to-Part Skew (Note 6) | | | | 1.0 | ns |
| $f_{MAX}$ | Maximum Frequency (Note 7) | $R_L$ = 100Ω, See Figure 6 (Note 8) | 200 | 250 | | MHz |
| $t_{ZHD}$ | Differential Output Enable Time from Z to HIGH | $R_L$ = 100Ω, $C_L$ = 10 pF, 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°C and with $V_{CC}$ = 3.3V.

**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 $t_R = t_F$ < 1ns, 0V to 3V, 50% Duty Cycle; Output $V_{OD}$ > 250 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.



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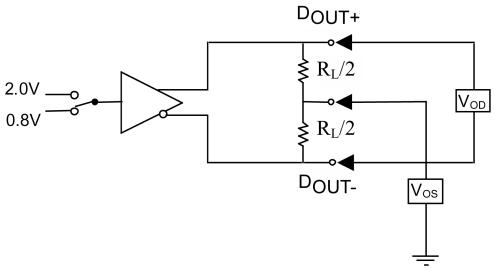
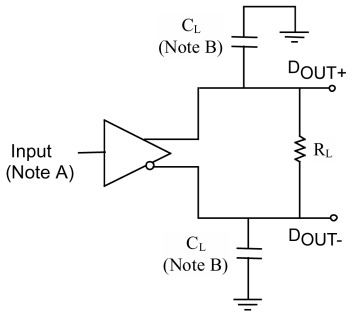



**FIGURE 1. Differential Driver DC Test Circuit**




**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**

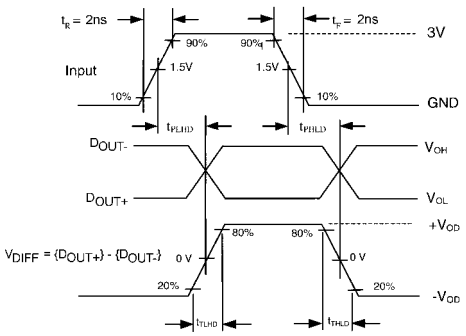
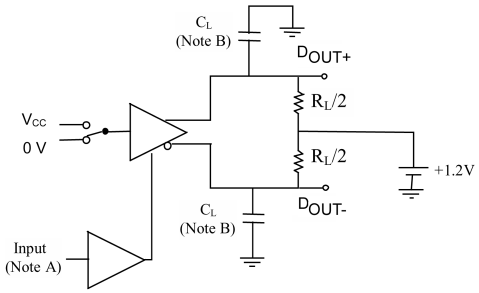



**FIGURE 3. AC Waveforms**




**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**

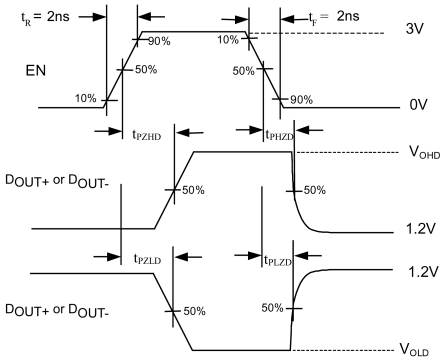



**FIGURE 5. Enable and Disable AC Waveforms**

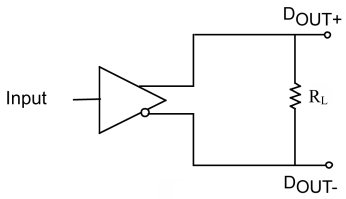



**FIGURE 6. $f_{MAX}$ Test Circuit**



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## DC / AC Typical Performance Curves

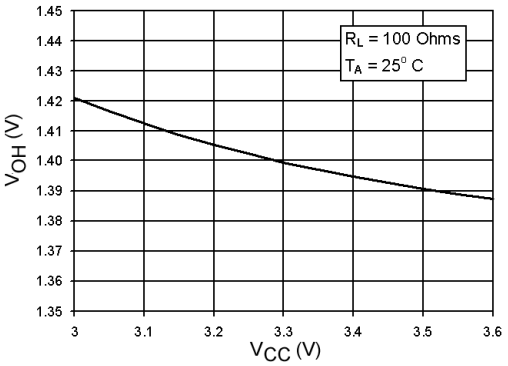



**FIGURE 7. Output High Voltage vs. Power Supply Voltage**

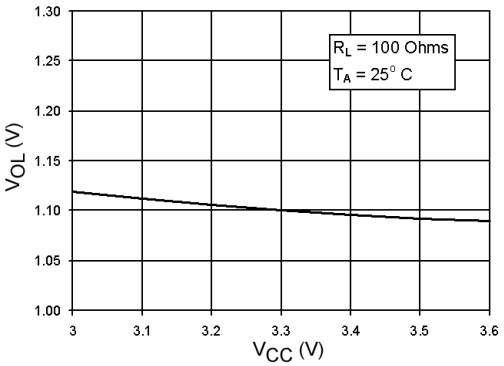



**FIGURE 8. Output Low Voltage vs. Power Supply Voltage**

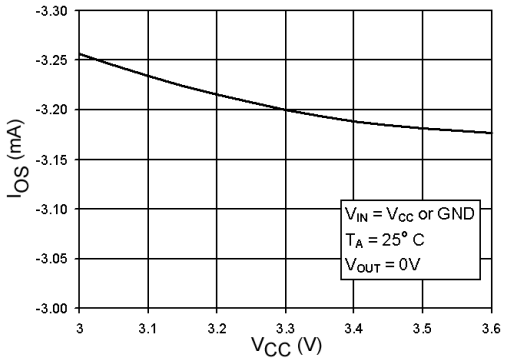



**FIGURE 9. Output Short Circuit Current vs. Power Supply Voltage**

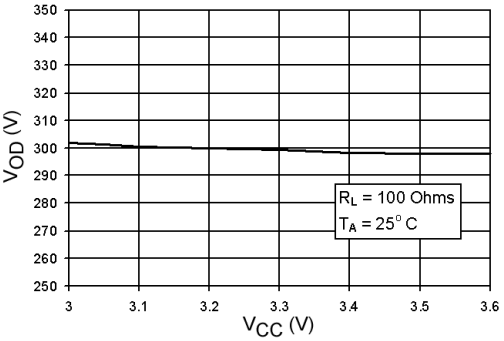



**FIGURE 10. Differential Output Voltage vs. Power Supply Voltage**

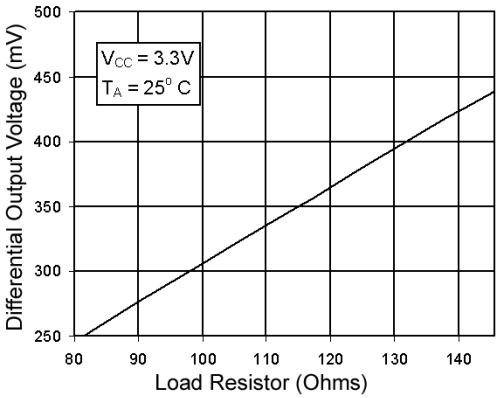



**FIGURE 11. Differential Output Voltage vs. Load Resistor**

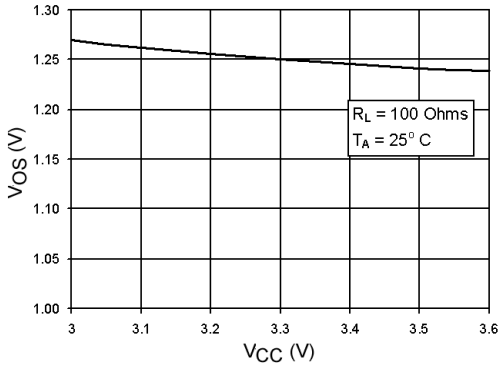



**FIGURE 12. Offset Voltage vs. Power Supply Voltage**



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## DC / AC Typical Performance Curves (Continued)

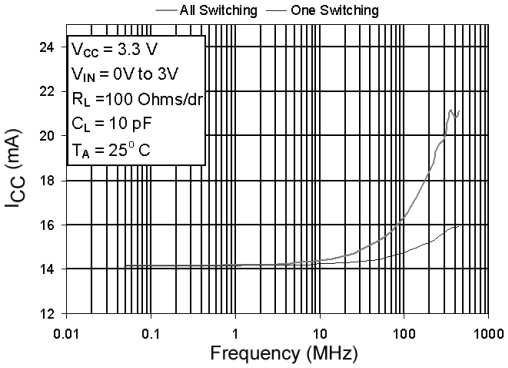



**FIGURE 13. Power Supply Current vs. Frequency**

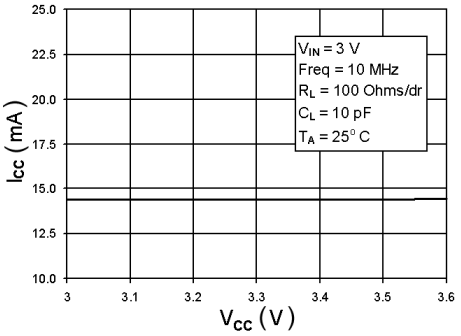



**FIGURE 14. Power Supply Current vs. Power Supply Voltage**

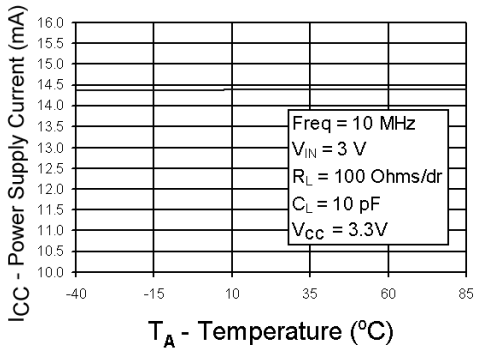



**FIGURE 15. Power Supply Current vs. Ambient Temperature**

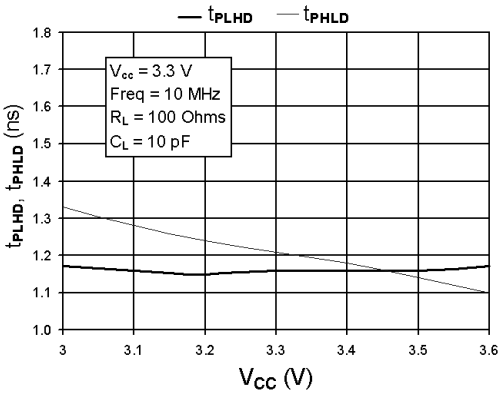



**FIGURE 16. Differential Propagation Delay vs. Power Supply Voltage**

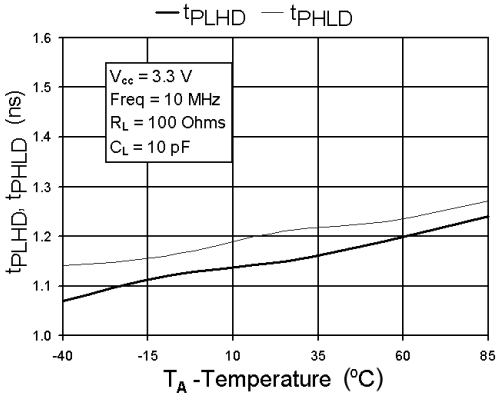



**FIGURE 17. Differential Propagation Delay vs. Ambient Temperature**

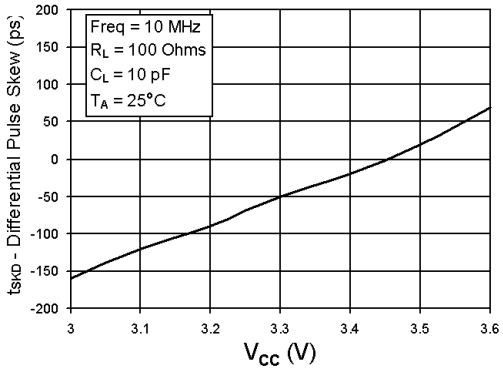



**FIGURE 18. Differential Pulse Skew ($t_{PLH}$ - $t_{PHL}$) vs. Power Supply Voltage**



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## DC / AC Typical Performance Curves (Continued)

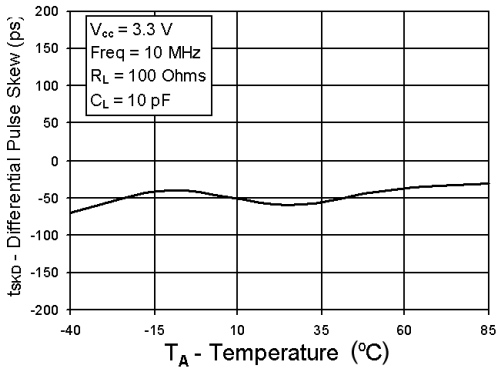



**FIGURE 19. Differential Pulse Skew ($t_{PLH}$ - $t_{PHL}$) vs. Ambient Temperature**

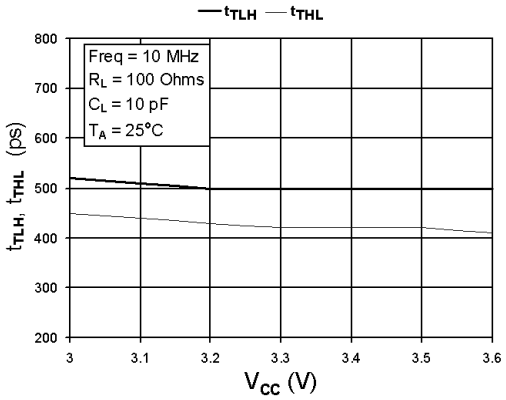



**FIGURE 20. Transition Time vs. Power Supply Voltage**

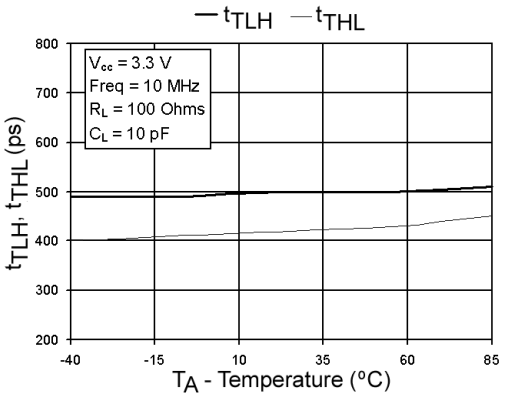
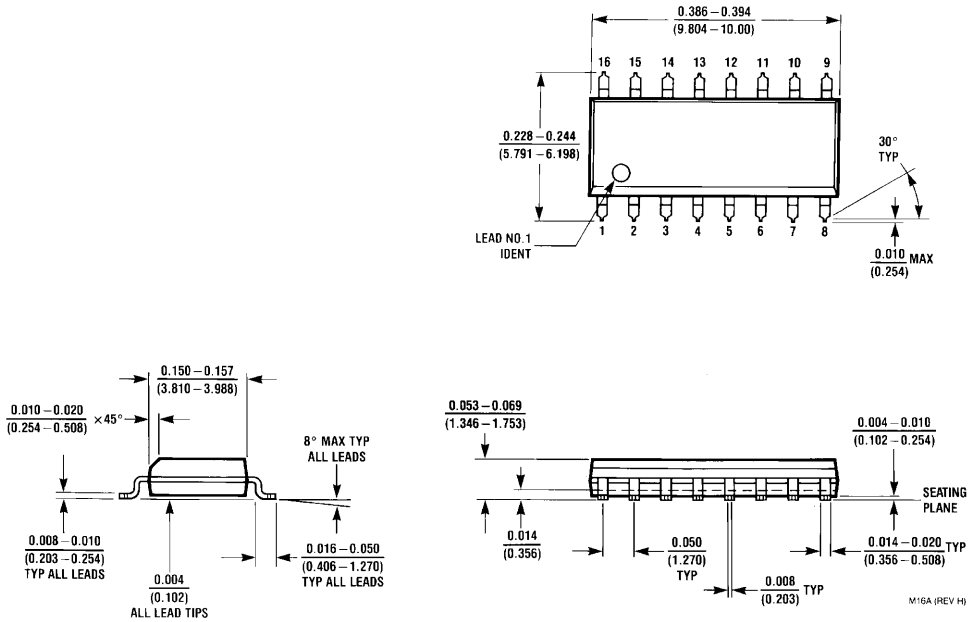



**FIGURE 21. Transition Time vs. Ambient Temperature**



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## Physical Dimensions inches (millimeters) unless otherwise noted

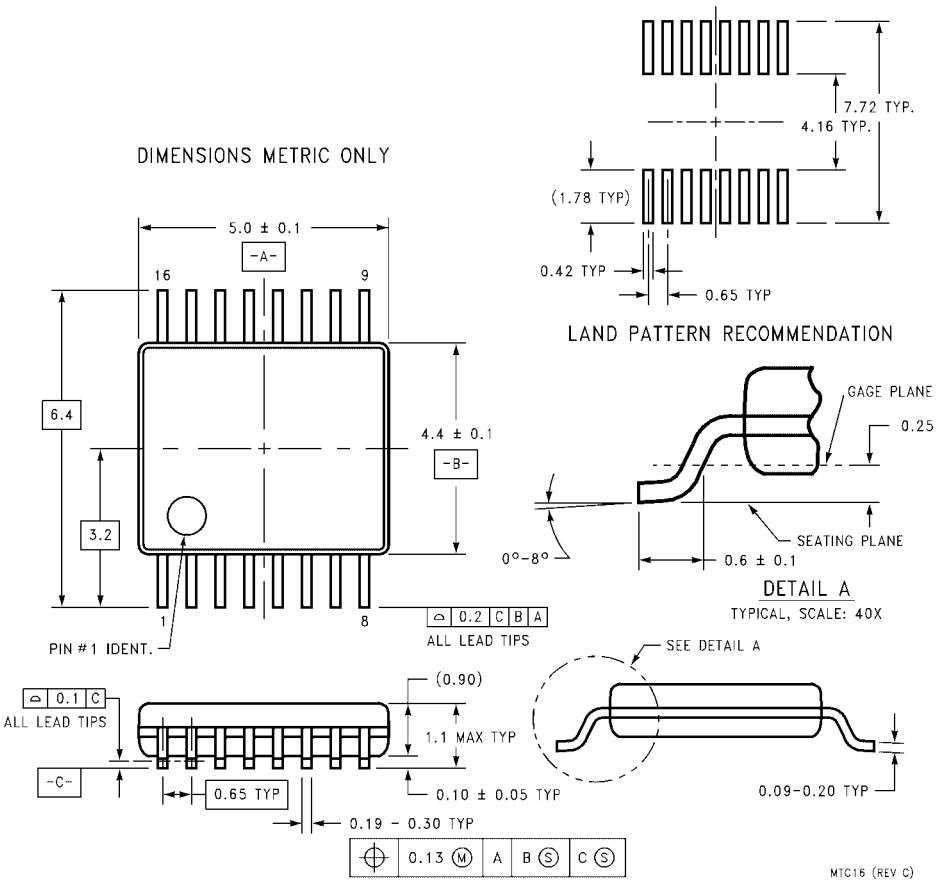



**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow**
**Package Number M16A**



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




**16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide**
**Package Number MTC16**

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