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## FIN1032

### 3.3V LVDS 4-Bit High Speed Differential Receiver

#### General Description

This quad receiver is designed for high speed interconnect utilizing Low Voltage Differential Signaling (LVDS) technology. The receiver translates LVDS levels, with a typical differential input threshold of 100mV, to LVTTTL signal levels. LVDS 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 FIN1032 can be paired with its companion driver, the FIN1031, or any other Fairchild LVDS driver.

#### Features

- Greater than 400Mbps data rate
- 3.3V power supply operation
- 0.4ns maximum differential pulse skew
- 2.5ns maximum propagation delay
- Low power dissipation
- Power OFF protection
- Fail safe protection for open-circuit, shorted and terminated conditions
- 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                                                          |
|--------------|----------------|------------------------------------------------------------------------------|
| FIN1032M     | M16A           | 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow |
| FIN1032MTC   | MTC16          | 16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  |

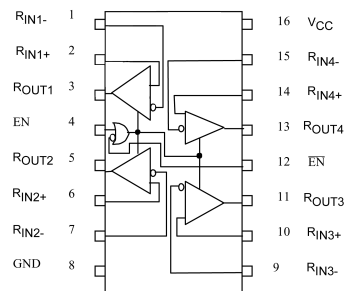
Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

#### Function Table

| Inputs |                        |                     |            | Outputs   |
|--------|------------------------|---------------------|------------|-----------|
| EN     | $\overline{\text{EN}}$ | $R_{IN+}$           | $R_{OUT-}$ | $R_{OUT}$ |
| H      | X                      | H                   | L          | H         |
| H      | X                      | L                   | H          | L         |
| H      | X                      | Fail Safe Condition |            | H         |
| X      | L                      | H                   | L          | H         |
| X      | L                      | L                   | H          | L         |
| X      | L                      | Fail Safe Condition |            | H         |
| L      | H                      | X                   |            | Z         |

H = HIGH Logic Level    L = LOW Logic Level    X = Don't Care  
Z = High Impedance    Fail Safe = Open, Shorted, Terminated

#### Connection Diagram



#### Pin Descriptions

| Pin Name                                          | Description                 |
|---------------------------------------------------|-----------------------------|
| $R_{OUT1}$ , $R_{OUT2}$ , $R_{OUT3}$ , $R_{OUT4}$ | LVTTL Data Outputs          |
| $R_{IN1+}$ , $R_{IN2+}$ , $R_{IN3+}$ , $R_{IN4+}$ | Non-Inverting LVDS Inputs   |
| $R_{IN1-}$ , $R_{IN2-}$ , $R_{IN3-}$ , $R_{IN4-}$ | Inverting LVDS Inputs       |
| EN                                                | Driver Enable Pin           |
| $\overline{\text{EN}}$                            | Inverting Driver Enable Pin |
| $V_{CC}$                                          | Power Supply                |
| GND                                               | Ground                      |

**Absolute Maximum Ratings**(Note 1)

|                                                       |                 |
|-------------------------------------------------------|-----------------|
| Supply Voltage ( $V_{CC}$ )                           | –0.5V to +4.6 V |
| DC Input Voltage ( $V_{IN}$ )                         | –0.5V to +4.6 V |
| DC Input Voltage ( $V_{OUT}$ )                        | –0.5V to 6 V    |
| DC Output Current ( $I_O$ )                           | 16 mA           |
| 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)                                | $\geq 10,000$ V |
| ESD (Machine Model)                                   | $\geq 500$ V    |

**Recommended Operating Conditions**

|                                                     |                    |
|-----------------------------------------------------|--------------------|
| Supply Voltage ( $V_{CC}$ )                         | 3.0 V to 3.6 V     |
| Magnitude of Differential Voltage<br>( $ V_{ID} $ ) | 100 mV to $V_{CC}$ |
| Common-Mode Input Voltage ( $V_{IC}$ )              | 0.05 V to 2.35V    |
| 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   |
|--------------|------------------------------------------------------|---------------------------------------------------------------------------------------------------------|----------------|-----------------|----------|---------|
| $V_{TH}$     | Differential Input Threshold HIGH                    | See Figure 1 and Table 1                                                                                |                |                 | 100      | mV      |
| $V_{TL}$     | Differential Input Threshold LOW                     | See Figure 1 and Table 1                                                                                | –100           |                 |          | mV      |
| $I_{IN}$     | Input Current                                        | $V_{IN} = 0V$ or $V_{CC}$                                                                               |                |                 | $\pm 20$ | $\mu A$ |
| $I_{I(OFF)}$ | Power-OFF Input Current                              | $V_{CC} = 0V$ , $V_{IN} = 0V$ or 3.6V                                                                   |                |                 | $\pm 20$ | $\mu A$ |
| $V_{IH}$     | Input High Voltage (EN or $\overline{EN}$ )          |                                                                                                         | 2.0            |                 | $V_{CC}$ | V       |
| $V_{IL}$     | Input Low Voltage (EN or $\overline{EN}$ )           |                                                                                                         | GND            |                 | 0.8      | V       |
| $V_{OH}$     | Output HIGH Voltage                                  | $I_{OH} = -100 \mu A$                                                                                   | $V_{CC} - 0.2$ |                 |          | V       |
|              |                                                      | $I_{OH} = -8 mA$                                                                                        | 2.4            |                 |          |         |
| $V_{OL}$     | Output LOW Voltage                                   | $I_{OH} = 100 \mu A$                                                                                    |                |                 | 0.2      | V       |
|              |                                                      | $I_{OL} = 8 mA$                                                                                         |                |                 | 0.5      |         |
| $V_{IK}$     | Input Clamp Voltage                                  | $I_{IK} = -18 mA$                                                                                       | –1.5           |                 |          | V       |
| $I_{OZ}$     | Disabled Output Leakage Current                      | EN = 0.8 and $\overline{EN} = 2V$ , $V_{OUT} = 3.6V$ or 0V                                              |                |                 | $\pm 20$ | $\mu A$ |
| $I_{OS}$     | Output Short Circuit Test                            | Receiver Enabled, $V_{OUT} = 0V$<br>(one output shorted at a time)                                      | –15            |                 | –100     | mA      |
| $I_{CCZ}$    | Disabled Power Supply Current                        | Receiver Disabled                                                                                       |                |                 | 5        | mA      |
| $I_{CC}$     | Power Supply Current                                 | Receiver Enabled, ( $R_{IN+} = 1V$ and $R_{IN-} = 1.4V$ )<br>or ( $R_{IN+} = 1.4V$ and $R_{IN-} = 1V$ ) |                |                 | 15       | mA      |
| $I_{PU/PD}$  | Output Power Up/Power Down<br>High Z Leakage Current | $V_{CC} = 0V$ to 1.5V                                                                                   |                |                 | $\pm 20$ | $\mu A$ |
| $C_{IN}$     | Input Capacitance                                    |                                                                                                         |                | 3.5             |          | pF      |
| $C_{OUT}$    | Output Capacitance                                   |                                                                                                         |                | 6               |          | pF      |

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

## AC Electrical Characteristics

Over supply voltage and operating temperature ranges, unless otherwise specified

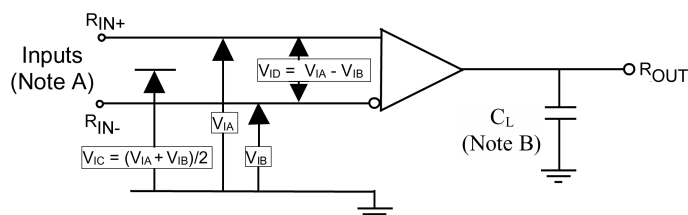
| Symbol       | Parameter                                | Test Conditions                                                                                                 | Min | Typ<br>(Note 3) | Max | Units |
|--------------|------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----|-----------------|-----|-------|
| $t_{PLH}$    | Propagation Delay LOW-to-HIGH            | $ V_{ID}  = 400 \text{ mV}$ , $C_L = 10 \text{ pF}$ ,<br>$R_L = 1 \text{ k}\Omega$<br>See Figure 1 and Figure 2 | 1.0 |                 | 2.5 | ns    |
| $t_{PHL}$    | Propagation Delay HIGH-to-LOW            |                                                                                                                 | 1.0 |                 | 2.5 | ns    |
| $t_{TLH}$    | Output Rise Time (20% to 80%)            |                                                                                                                 |     | 0.7             | 1.2 | ns    |
| $t_{THL}$    | Output Fall Time (80% to 20%)            |                                                                                                                 |     | 0.7             | 1.2 | ns    |
| $t_{SK(P)}$  | Pulse Skew $ t_{PLH} - t_{PHL} $         |                                                                                                                 |     |                 | 0.4 | ns    |
| $t_{SK(LH)}$ | Channel-to-Channel Skew<br>(Note 4)      |                                                                                                                 |     |                 | 0.3 | ns    |
| $t_{SK(HL)}$ | Channel-to-Channel Skew<br>(Note 4)      |                                                                                                                 |     |                 | 0.3 | ns    |
| $t_{SK(PP)}$ | Part-to-Part Skew (Note 5)               |                                                                                                                 |     |                 | 1.0 | ns    |
| $f_{MAX}$    | Maximum Operating Frequency<br>(Note 6)  | $R_L = 1 \text{ k}\Omega$ , $C_L = 10 \text{ pF}$ ,<br>see Figure 1 and Figure 2                                | 200 | 325             |     | MHz   |
| $t_{ZH}$     | LVTTL Output Enable Time from Z to HIGH  | $R_L = 1 \text{ k}\Omega$ , $C_L = 10 \text{ pF}$ ,<br>See Figure 3 and Figure 4                                |     |                 | 5.0 | ns    |
| $t_{ZL}$     | LVTTL Output Enable Time from Z to LOW   |                                                                                                                 |     |                 | 5.0 | ns    |
| $t_{HZ}$     | LVTTL Output Disable Time from HIGH to Z |                                                                                                                 |     |                 | 5.0 | ns    |
| $t_{LZ}$     | LVTTL Output Disable Time from LOW to Z  |                                                                                                                 |     |                 | 5.0 | ns    |

**Note 3:** All typical values are at  $T_A = 25^\circ\text{C}$  and with  $V_{CC} = 3.3\text{V}$ .

**Note 4:**  $t_{SK(LH)}$ ,  $t_{SK(HL)}$  is the skew between specified outputs of a single device when the outputs have identical loads and are switching in the same direction.

**Note 5:**  $t_{SK(PP)}$  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 6:**  $f_{MAX}$  Criteria: Input  $t_R = t_F < 1 \text{ ns}$ ,  $V_{ID} = 300 \text{ mV}$ , (1.05V to 1.35V pp), 50% duty cycle; Output duty cycle 40% to 60%,  $V_{OL} < 0.5\text{V}$ ,  $V_{OH} > 2.4\text{V}$ . All channels switching in phase.



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

**Note B:**  $C_L$  includes all probe and jig capacitances

**FIGURE 1. Differential Receiver Voltage Definitions and Propagation Delay and Transition Time Test Circuit**

**TABLE 1. Receiver Minimum and Maximum Input Threshold Test Voltages**

| Applied Voltages (V) |          | Resulting Differential Input Voltage (mV) | Resulting Common Mode Input Voltage (V) |
|----------------------|----------|-------------------------------------------|-----------------------------------------|
| $V_{IA}$             | $V_{IB}$ | $V_{ID}$                                  | $V_{IC}$                                |
| 1.25                 | 1.15     | 100                                       | 1.2                                     |
| 1.15                 | 1.25     | -100                                      | 1.2                                     |
| 2.4                  | 2.3      | 100                                       | 2.35                                    |
| 2.3                  | 2.4      | -100                                      | 2.35                                    |
| 0.1                  | 0        | 100                                       | 0.05                                    |
| 0                    | 0.1      | -100                                      | 0.05                                    |
| 1.5                  | 0.9      | 600                                       | 1.2                                     |
| 0.9                  | 1.5      | -600                                      | 1.2                                     |
| 2.4                  | 1.8      | 600                                       | 2.1                                     |
| 1.8                  | 2.4      | -600                                      | 2.1                                     |
| 0.6                  | 0        | 600                                       | 0.3                                     |
| 0                    | 0.6      | -600                                      | 0.3                                     |

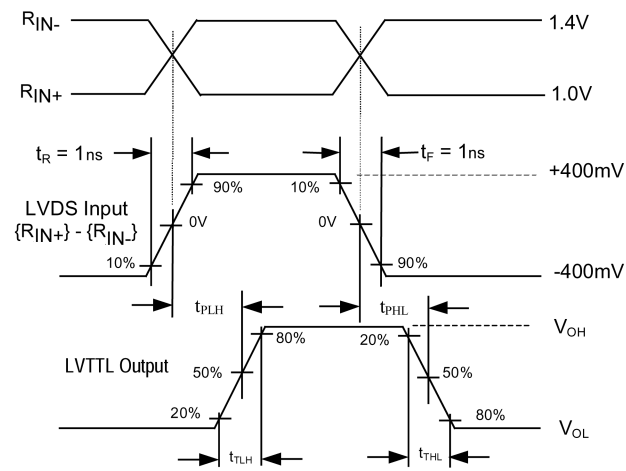


FIGURE 2. LVDS Input to LVTTTL Output AC Waveforms

## Test Circuit for LVTTTL Outputs

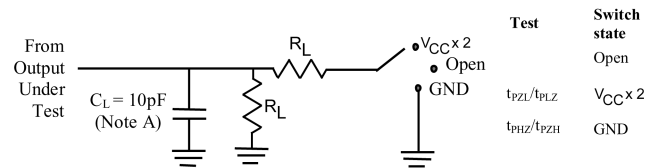
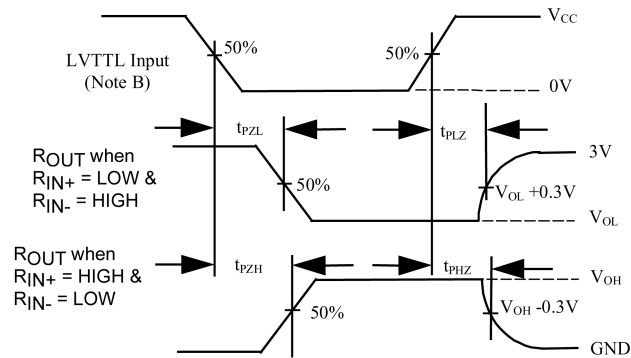


FIGURE 3. AC Loading Circuit for LVTTTL Outputs

## Voltage Waveforms Enable and Disable Times

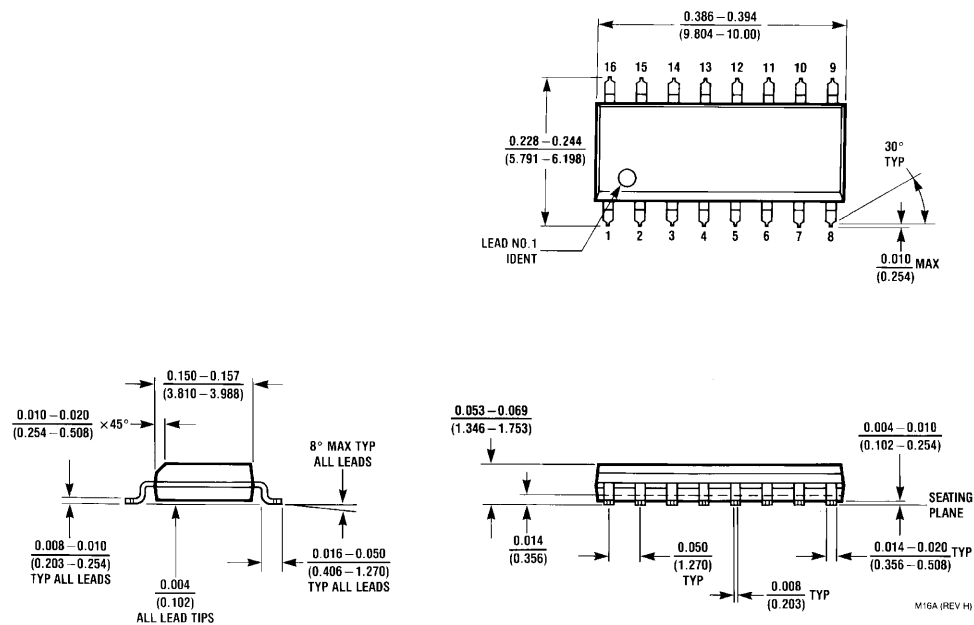


**Note A:**  $C_L$  includes probes and jig capacitance

**Note B:** All LVTTTL input pulses have the following characteristics: Frequency = 10 MHz  $t_R$  or  $t_F \leq 2$  ns

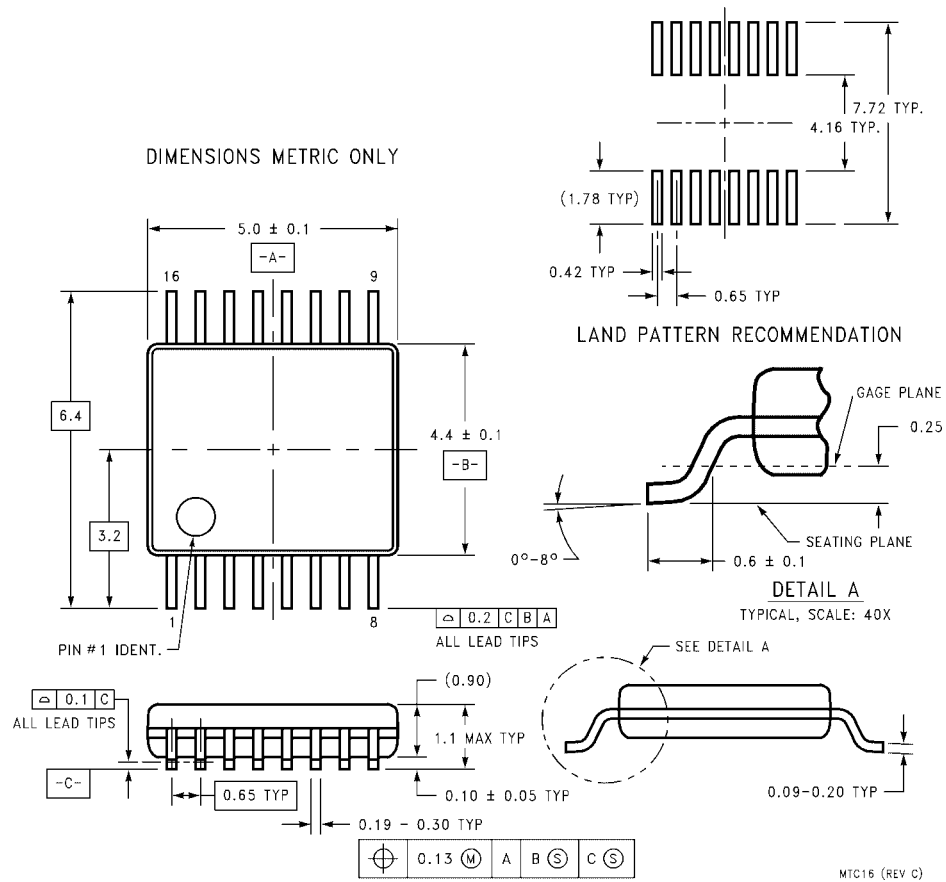
FIGURE 4. LVTTTL Outputs Test Circuit and AC Waveforms

# Physical Dimensions inches (millimeters) unless otherwise noted



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

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



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