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## FIN1104 LVDS 4 Port High Speed Repeater

### General Description

This 4 port repeater is designed for high speed interconnects utilizing Low Voltage Differential Signaling (LVDS) technology. The FIN1104 accepts and outputs LVDS levels with a typical differential output swing of 330 mV which provides low EMI at ultra low power dissipation even at high frequencies. The FIN1104 provides a  $V_{BB}$  reference for AC coupling on the inputs. In addition the FIN1104 can directly accept LVPECL, HSTL, and SSTL-2 for translation to LVDS.

### Features

- Greater than 800 Mbps data rate
- 3.3V power supply operation
- 3.5 ps maximum random jitter and 135 ps maximum deterministic jitter
- Wide rail-to-rail common mode range
- LVDS receiver inputs accept LVPECL, HSTL, and SSTL-2 directly
- Ultra low power consumption
- 20 ps typical channel-to-channel skew
- Power off protection
- > 7.5 kV HBM ESD Protection
- Meets or exceeds the TIA/EIA-644-A LVDS standard
- Available in space saving 24-Lead TSSOP package
- Open circuit fail safe protection
- $V_{BB}$  reference output

### Ordering Code:

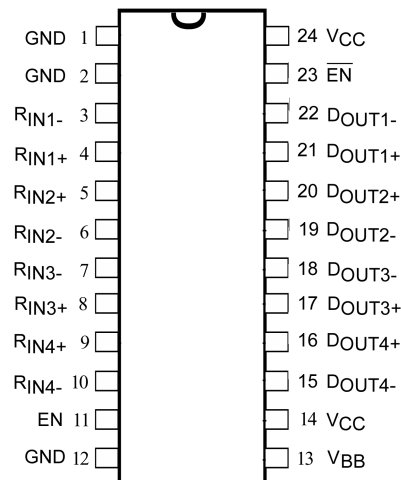
Order Number	Package Number	Package Description
FIN1104MTC	MTC24	24-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

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

### Pin Descriptions

Pin Name	Description
$R_{IN1+}$ , $R_{IN2+}$ , $R_{IN3+}$ , $R_{IN4+}$	Non-inverting LVDS Input
$R_{IN1-}$ , $R_{IN2-}$ , $R_{IN3-}$ , $R_{IN4-}$	Inverting LVDS Input
$D_{OUT1+}$ , $D_{OUT2+}$ , $D_{OUT3+}$ , $D_{OUT4+}$	Non-inverting Driver Output
$D_{OUT1-}$ , $D_{OUT2-}$ , $D_{OUT3-}$ , $D_{OUT4-}$	Inverting Driver Output
EN	Driver Enable Pin for All Output
$\overline{EN}$	Inverting Driver Enable Pin for all Outputs
$V_{CC}$	Power Supply
GND	Ground
$V_{BB}$	Reference Voltage Output

### Connection Diagram

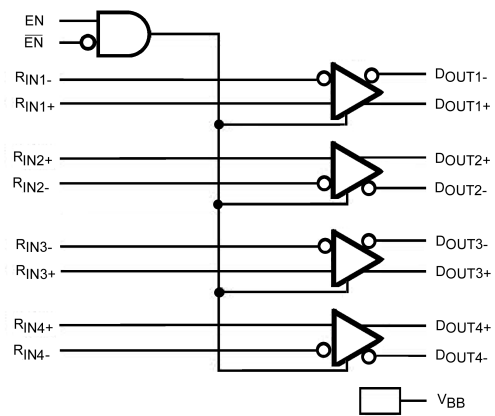


**Function Table**

Inputs				Outputs	
EN	$\overline{\text{EN}}$	D <sub>IN+</sub>	D <sub>IN-</sub>	D <sub>OUT+</sub>	D <sub>OUT-</sub>
H	L	H	L	H	L
H	L	L	H	L	H
H	L	Fail Safe Case		H	L
X	H	X	X	Z	Z
L	X	X	X	Z	Z

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

**Functional Diagram**



**Absolute Maximum Ratings**(Note 1)

Supply Voltage ( $V_{CC}$ )	-0.5V to +4.6V
LVDS DC Input Voltage ( $V_{IN}$ )	-0.5V to +4.6V
LVDS DC Output Voltage ( $V_{OUT}$ )	-0.5V to +4.6V
Driver Short Circuit Current ( $I_{OSD}$ )	Continuous 10 mA
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)	7500V
ESD (Machine Model)	400V

**Recommended Operating Conditions**

Supply Voltage ( $V_{CC}$ )	3.0V to 3.6V
Magnitude of Differential Voltage ( $ V_{ID} $ )	100 mV to $V_{CC}$
Common Mode Voltage Range ( $V_{IC}$ )	(0V + $ V_{ID} /2$ ) to ( $V_{CC} -  V_{ID} /2$ )
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**

Symbol	Parameter	Test Conditions	Min	Typ (Note 2)	Max	Units
$V_{TH}$	Differential Input Threshold HIGH	See Figure 1; $V_{IC} = +0.05V, +1.2V, \text{ or } V_{CC} - 0.05V$			100	mV
$V_{TL}$	Differential Input Threshold LOW	See Figure 1; $V_{IC} = +0.05V, +1.2V, \text{ or } V_{CC} - 0.05V$	-100			mV
$V_{IH}$	Input HIGH Voltage ( $\overline{EN}$ or $\overline{EN}$ )		2.0		$V_{CC}$	V
$V_{IL}$	Input LOW Voltage ( $\overline{EN}$ or $\overline{EN}$ )		GND		0.8	V
$V_{OD}$	Output Differential Voltage		250	330	450	mV
$\Delta V_{OD}$	$V_{OD}$ Magnitude Change from Differential LOW-to-HIGH	$R_L = 100 \Omega$ , Driver Enabled, See Figure 2			25	mV
$V_{OS}$	Offset Voltage		1.125	1.23	1.375	V
$\Delta V_{OS}$	Offset Magnitude Change from Differential LOW-to-HIGH				25	mV
$I_{OS}$	Short Circuit Output Current	$D_{OUT+} = 0V$ and $D_{OUT-} = 0V$ , Driver Enabled		-3.4	-6	mA
		$V_{OD} = 0V$ , Driver Enabled		$\pm 3.4$	$\pm 6$	mA
$I_{IN}$	Input Current ( $\overline{EN}, \overline{EN}, D_{INX+}, D_{INX-}$ )	$V_{IN} = 0V$ to $V_{CC}$ ; Other Input = $V_{CC}$ or 0V (for Differential Inputs)			$\pm 20$	$\mu A$
$I_{OFF}$	Power Off Input or Output Current	$V_{CC} = 0V, V_{IN}$ or $V_{OUT} = 0V$ to 3.6V			$\pm 20$	$\mu A$
$I_{CCZ}$	Disabled Power Supply Current	Drivers Disabled		5.4	11	mA
$I_{CC}$	Power Supply Current	Drivers Enabled, Any Valid Input Condition		30.4	41	mA
$I_{OZ}$	Disabled Output Leakage Current	Driver Disabled, $D_{OUT+} = 0V$ to 3.6V or $D_{OUT-} = 0V$ to 3.6V			$\pm 20$	$\mu A$
$V_{IC}$	Common Mode Voltage Range	$ V_{ID}  = 100 \text{ mV}$ to $V_{CC}$	$0V +  V_{ID} /2$		$V_{CC} - ( V_{ID} /2)$	V
$C_{IN}$	Input Capacitance			2.6		pF
		Enable Input		2.1		pF
		LVDS Input		2.8		pF
$C_{OUT}$	Output Capacitance			2.8		pF
$V_{BB}$	Output Reference Voltage	$V_{CC} = 3.3V, I_{BB} = 0$ to $-275 \mu A$	1.125	1.2	1.375	V

**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 (Note 3)	Max	Units	
$t_{PLHD}$	Differential Output Propagation Delay LOW-to-HIGH	$R_L = 100 \Omega, C_L = 5 \text{ pF},$ $V_{ID} = 200 \text{ mV to } 450 \text{ mV},$ $V_{IC} =  V_{ID} /2 \text{ to } V_{CC} - ( V_{ID} /2),$ Duty Cycle = 50%, See Figure 1 and Figure 3	0.75	1.1	1.75	ns	
$t_{PHLD}$	Differential Output Propagation Delay HIGH-to-LOW		0.75	1.1	1.75	ns	
$t_{TLHD}$	Differential Output Rise Time (20% to 80%)		0.29	0.4	0.58	ns	
$t_{THLD}$	Differential Output Fall Time (80% to 20%)		0.29	0.4	0.58	ns	
$t_{SK(P)}$	Pulse Skew $ t_{PLH} - t_{PHL} $				0.02	0.2	ns
$t_{SK(LH)}$	Channel-to-Channel Skew (Note 4)				0.02	0.15	ns
$t_{SK(HL)}$	Channel-to-Channel Skew (Note 4)				0.02	0.15	ns
$t_{SK(PP)}$	Part-to-Part Skew (Note 5)					0.5	ns
$f_{MAX}$	Maximum Frequency (Note 6)(Note 7)			400	800		MHz
$t_{PZH}$	Differential Output Enable Time from Z to HIGH		$R_L = 100 \Omega, C_L = 5 \text{ pF},$ See Figure 2 and Figure 3		2.2	5	ns
$t_{PZH}$	Differential Output Enable Time from Z to LOW			2.5	5	ns	
$t_{PHZ}$	Differential Output Disable Time from HIGH to Z			1.8	5	ns	
$t_{PLZ}$	Differential Output Disable Time from LOW to Z			2.1	5	ns	
$t_{DJ}$	LVDS Data Jitter, Deterministic	$V_{ID} = 300 \text{ mV}, \text{PRBS} = 2^{23} - 1,$ $V_{IC} = 1.2 \text{ V at } 800 \text{ Mbps}$		85	135	ps	
$t_{RJ}$	LVDS Clock Jitter, Random (RMS)	$V_{ID} = 300 \text{ mV},$ $V_{IC} = 1.2 \text{ V at } 400 \text{ MHz}$		2.1	3.5	ps	

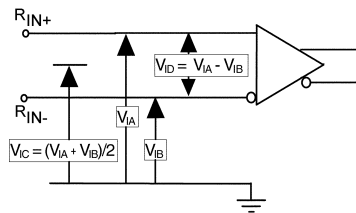
**Note 3:** All typical values are at  $T_A = 25^\circ\text{C}$  and with  $V_{CC} = 3.3\text{V}$ .

**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.

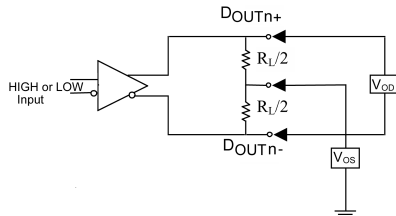
**Note 5:**  $t_{SK(PP)}$  is the magnitude of the difference in propagation delay times between any specified terminals of two devices switching in the same direction (either Low-to-HIGH or HIGH-to-LOW) when both devices operate with the same supply voltage, same temperature, and have identical test circuits.

**Note 6:** Passing criteria for maximum frequency is the output  $V_{OD} > 200 \text{ mV}$  and the duty cycle is 45% to 55% with all channels switching.

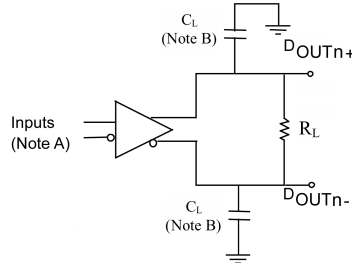
**Note 7:** Output loading is transmission line environment only;  $C_L$  is  $< 1 \text{ pF}$  of stray test fixture capacitance.



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



**FIGURE 2. Differential Driver DC Test Circuit**



**Note A:** All LVDS input pulses have frequency = 10 MHz,  $t_R$  or  $t_F < 0.5 \text{ ns}$

**Note B:**  $C_L$  includes all probe and test fixture capacitances

**FIGURE 3. Differential Driver Propagation Delay and Transition Time Test Circuit**

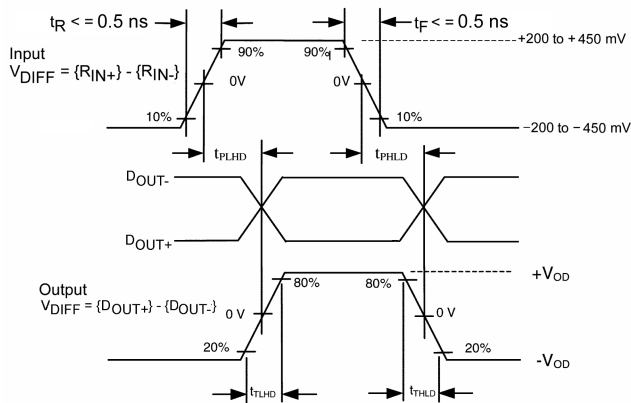
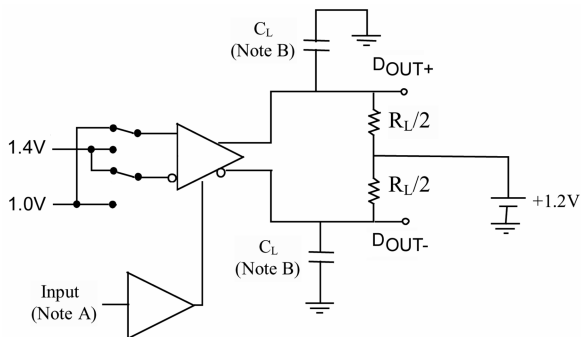


FIGURE 4. AC Waveform



Note A: All LVTTTL input pulses have frequency = 10MHz,  $t_R$  or  $t_F \le 2 \text{ ns}$   
 Note B:  $C_L$  includes all probe and jig capacitances

FIGURE 5. Differential Driver Enable and Disable Circuit

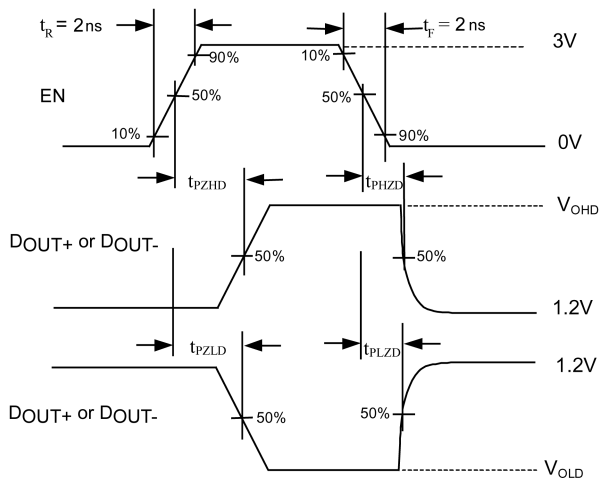
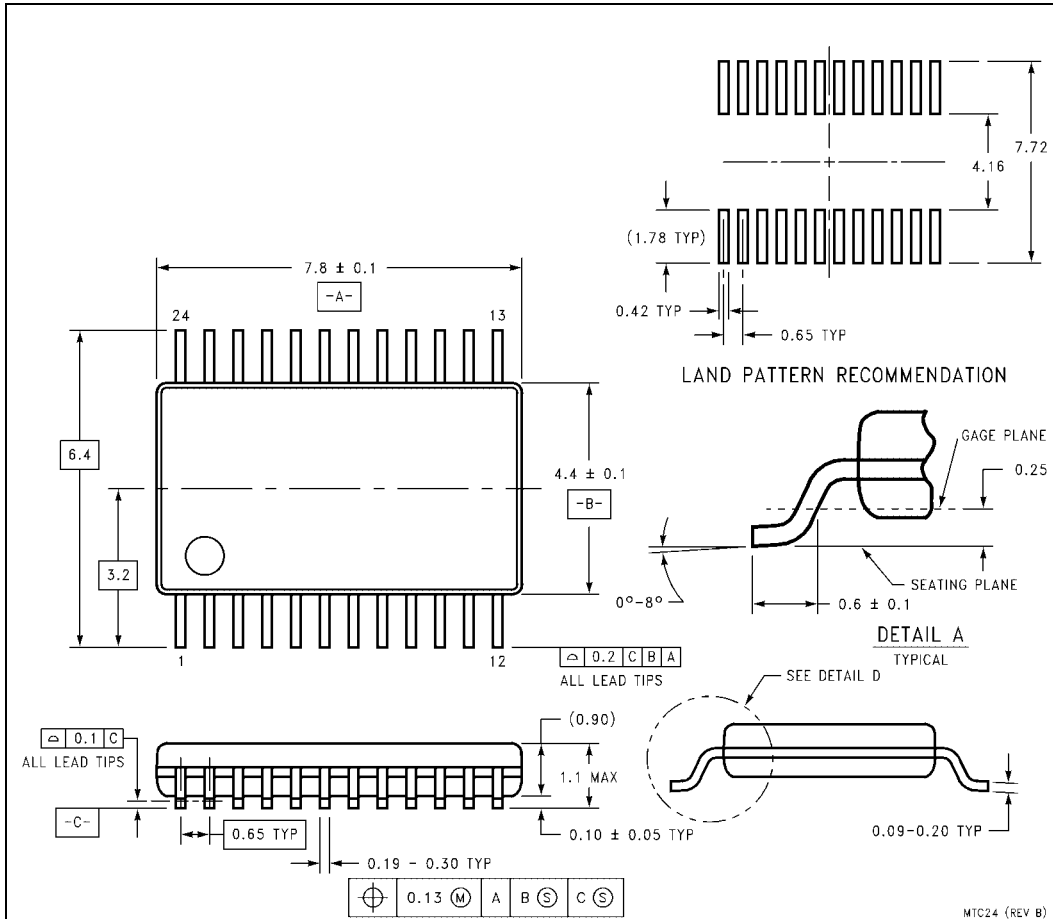


FIGURE 6. Enable and Disable AC Waveforms



24-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  
Package Number MTC24

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