

DSLVD1047 3.3V LVDS 四通道高速差动线路驱动器

1 特性

- 旨在用于信号传输速率高达 400Mbps 的应用
- 3.3V 电源设计
- 300ps 典型差动偏斜
- 400ps 最大差动偏斜
- 1.7ns 最大传播延迟
- $\pm 350\text{mV}$ 差动信号传输
- 低功耗 (3.3V 静态条件下为 13mW)
- 能够与现有 5V LVDS 接收器交互操作
- 在断电模式下, LVDS 输出端具有高阻抗
- 直通引脚排列可简化 PCB 布局
- 符合或超出 TIA/EIA-644 LVDS 标准
- 工业工作温度范围 (-40°C 至 $+85^{\circ}\text{C}$)
- 可采用 TSSOP 封装

2 应用

- 多功能打印机
- 板对板通信
- 测试和测量
- 打印机
- 数据中心互连
- 实验室仪表
- 超声波扫描仪

3 说明

DSLVD1047 器件是一款四路 CMOS 直通差动线路驱动器, 专为需要超低功耗和高数据速率的应用而设计。该器件旨在使用低电压差动信号 (LVDS) 技术支持超过 400Mbps (200MHz) 的数据速率。

DSLVD1047 接受低电压 TTL/CMOS 输入电平, 并将其转换为低电压 (350mV) 差动输出信号。

此外, 该驱动器支持可用于禁用输出级的 TRI-STAT 功能, 可禁用负载电流, 从而将器件降至功率为 13mW (典型值) 的超低空闲功耗状态。

DSLVD1047 采用了直通引脚排列, 可简化 PCB 布局。

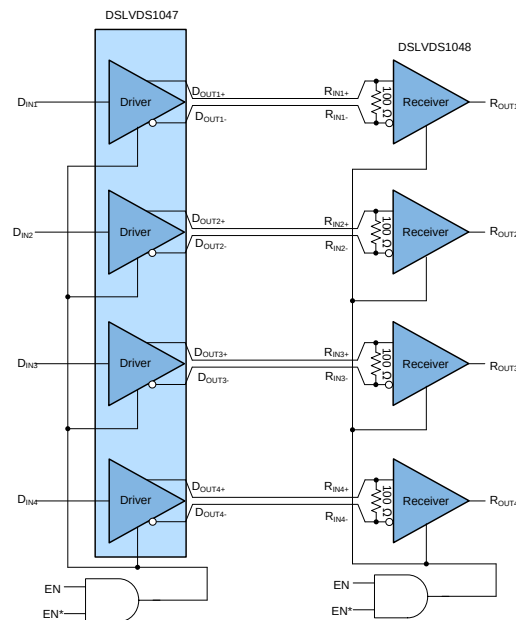
EN 和 EN* 输入将接受 AND 运算并控制 TRI-STATE 输出。这些使能端由四个驱动器共用。和配套的线路接收器 (DSLVD1048) 为高速点对点接口应用提供了大功率伪 ECL 器件的替代产品。

器件信息⁽¹⁾

器件型号	封装	封装尺寸 (标称值)
DSLVD1047	TSSOP (16)	5.00mm × 4.40mm

(1) 如需了解所有可用封装, 请参阅数据表末尾的可订购产品附录。

图 1. 703A I2C



目录

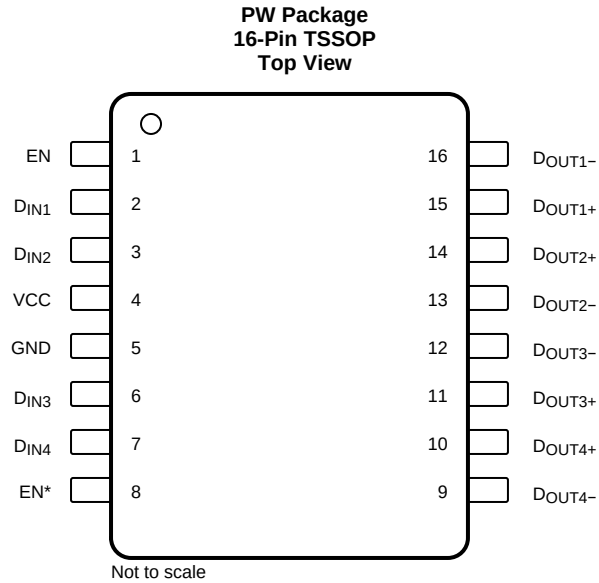
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4 修订历史记录

注：之前版本的页码可能与当前版本有所不同。

日期	修订版本	说明
2018 年 9 月	*	最初发布版本。

5 Pin Configuration and Functions



Pin Functions

PIN		I/O	DESCRIPTION
NO.	NAME		
2	D _{IN1}	I	Driver input pin, TTL/CMOS compatible
3	D _{IN2}		
6	D _{IN3}		
7	D _{IN4}		
10	D _{OUT4+}	O	Non-inverting driver output pin, LVDS levels
11	D _{OUT3+}		
14	D _{OUT2+}		
15	D _{OUT1+}		
9	D _{OUT4-}	O	Inverting driver output pin, LVDS levels
12	D _{OUT3-}		
13	D _{OUT2-}		
16	D _{OUT1-}		
1	EN	I	Driver enable pin: When EN is low, the driver is disabled. When EN is high and EN* is low or open, the driver is enabled. If both EN and EN* are open circuit, then the driver is disabled.
8	EN*	I	Driver enable pin: When EN* is high, the driver is disabled. When EN* is low or open and EN is high, the driver is enabled. If both EN and EN* are open circuit, then the driver is disabled.
5	GND	—	Ground pin
4	V _{CC}	—	Power supply pin, +3.3 V ± 0.3 V

6 Specifications

6.1 Absolute Maximum Ratings

See ⁽¹⁾

			MIN	MAX	UNIT
Supply voltage (V _{CC})			-0.3	4	V
Input voltage (D _{IN})			-0.3	V _{CC} + 0.3	V
Enable input voltage (EN, EN*)			-0.3	V _{CC} + 0.3	V
Output voltage (D _{OUT+} , D _{OUT-})			-0.3	3.9	V
Short-circuit duration	(D _{OUT+} , D _{OUT-})		Continuous		
Maximum package power dissipation at +25°C	PW0016A package		866		mW
	Derate PW0016A package	above +25°C	6.9		mW/°C
Lead temperature	Soldering (4 s)		260		°C
Maximum junction temperature			150		°C
Storage temperature, T _{stg}			-65	150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$ Electrostatic discharge ⁽¹⁾	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽²⁾		±1200	V
	Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽³⁾		±200	
	Machine Model		±1200	

- (1) ESD Ratings:
HBM (1.5 kΩ, 100 pF)
EIAJ (0 Ω, 200 pF)
- (2) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (3) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

			MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}			3	3.3	3.6	V
Operating free air temperature, T_A			-40	25	85	°C

6.4 Thermal Information

THERMAL METRIC ⁽¹⁾		DSLVD51047	UNIT
		PW (TSSOP)	
		16 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	114	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	51	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	59	°C/W
ψ_{JT}	Junction-to-top characterization parameter	8	°C/W
ψ_{JB}	Junction-to-board characterization parameter	58	°C/W

- (1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

6.5 Electrical Characteristics

Over supply voltage and operating temperature ranges, unless otherwise specified⁽¹⁾⁽²⁾⁽³⁾

PARAMETER	TEST CONDITIONS	PIN	MIN	TYP	MAX	UNIT
V _{OD1} Differential output voltage	R _L = 100 Ω (Figure 18)	D _{OUT-} D _{OUT+}	250	310	450	mV
ΔV _{OD1} Change in magnitude of V _{OD1} for complementary output states				1	35	mV
V _{OS} Offset voltage			1.125	1.17	1.375	V
ΔV _{OS} Change in magnitude of V _{OS} for complementary output states				1	25	mV
V _{OH} Output high voltage				1.33	1.6	V
V _{OL} Output low voltage			0.9	1.02		V
V _{IH} Input high voltage		D _{IN} , EN, EN*	2		V _{CC}	V
V _{IL} Input low voltage			GND		0.8	V
I _{IH} Input high current	V _{IN} = V _{CC} or 2.5 V			2	15	μA
I _{IL} Input low current	V _{IN} = GND or 0.4 V			2	15	μA
V _{CL} Input clamp voltage	I _{CL} = -18 mA		-1.5	-0.8		V
I _{OS} Output short-circuit current ⁽⁴⁾	ENABLED, D _{IN} = V _{CC} , D _{OUT+} = 0 V or D _{IN} = GND, D _{OUT-} = 0 V	D _{OUT-} D _{OUT+}		-4	-8	mA
I _{OSD} Differential output short-circuit current ⁽⁴⁾	ENABLED, V _{OD} = 0 V			-4.2	-9	mA
I _{OFF} Power-off leakage	V _{OUT} = 0 V or 3.6 V, V _{CC} = 0 V or Open		-20	±1	20	μA
I _{OZ} Output TRI-STATE current	EN = 0.8 V and EN* = 2.0 V V _{OUT} = 0 V or V _{CC}		-10	±1	10	μA
I _{CC} No load supply current drivers enabled	D _{IN} = V _{CC} or GND	V _{CC}		4	8	mA
I _{CCL} Loaded supply current drivers enabled	R _L = 100 Ω all channels, D _{IN} = V _{CC} or GND (all inputs)			20	30	mA
I _{CCZ} No load supply current drivers disabled	D _{IN} = V _{CC} or GND, EN = GND, EN* = V _{CC}			2.2	6	mA

- (1) Current into device pins is defined as positive. Current out of device pins is defined as negative. All voltages are referenced to ground except: V_{OD1} and ΔV_{OD1}.
- (2) All typicals are given for: V_{CC} = 3.3 V, T_A = +25°C.
- (3) The DSLVD1047 is a current mode device and only functions within datasheet specifications when a resistive load is applied to the driver outputs typical range is (90 Ω to 110 Ω).
- (4) Output short circuit current (I_{OS}) is specified as magnitude only, minus sign indicates direction only.

6.6 Switching Characteristics

 $V_{CC} = +3.3V \pm 10\%$, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ ^{(1) (2) (3)}

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PHLD}	Differential propagation delay high to low	$R_L = 100\ \Omega$, $C_L = 15\ \text{pF}$ (Figure 19 and Figure 20)	0.5	0.9	1.7	ns
t_{PLHD}	Differential propagation delay low to high		0.5	1.2	1.7	ns
t_{SKD1}	Differential pulse skew $ t_{PHLD} - t_{PLHD} $ ⁽⁴⁾			0.3	0.4	ns
t_{SKD2}	Channel-to-channel skew ⁽⁵⁾			0.4	0.5	ns
t_{SKD3}	Differential part-to-part skew ⁽⁶⁾		0		1	ns
t_{SKD4}	Differential part-to-part skew ⁽⁷⁾		0		1.2	ns
t_{TLH}	Rise time			0.5	1.5	ns
t_{THL}	Fall time			0.5	1.5	ns
t_{PHZ}	Disable time high to Z	$R_L = 100\ \Omega$, $C_L = 15\ \text{pF}$ (Figure 21 and Figure 22)		2	5	ns
t_{PLZ}	Disable time low to Z			2	5	ns
t_{PZH}	Enable time Z to high			3	7	ns
t_{PZL}	Enable time Z to low			3	7	ns
f_{MAX}	Maximum operating frequency ⁽⁸⁾		200	250		MHz

(1) All typicals are given for: $V_{CC} = 3.3\ \text{V}$, $T_A = +25^\circ\text{C}$.

(2) Generator waveform for all tests unless otherwise specified: $f = 1\ \text{MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 1\ \text{ns}$, and $t_f \leq 1\ \text{ns}$.

(3) C_L includes probe and jig capacitance.

(4) t_{SKD1} $|t_{PHLD} - t_{PLHD}|$ is the magnitude difference in differential propagation delay time between the positive going edge and the negative going edge of the same channel.

(5) t_{SKD2} is the differential channel-to-channel skew of any event on the same device.

(6) t_{SKD3} , differential part-to-part skew, is defined as the difference between the minimum and maximum specified differential propagation delays. This specification applies to devices at the same V_{CC} and within 5°C of each other within the operating temperature range.

(7) t_{SKD4} , part to part skew, is the differential channel-to-channel skew of any event between devices. This specification applies to devices over recommended operating temperature and voltage ranges, and across process distribution. t_{SKD4} is defined as $|Max - Min|$ differential propagation delay.

(8) f_{MAX} generator input conditions: $t_r = t_f < 1\ \text{ns}$ (0% to 100%), 50% duty cycle, 0 V to 3 V. Output criteria: duty cycle = 45% / 55%, $V_{OD} > 250\ \text{mV}$, all channels switching.

6.7 Typical Characteristics

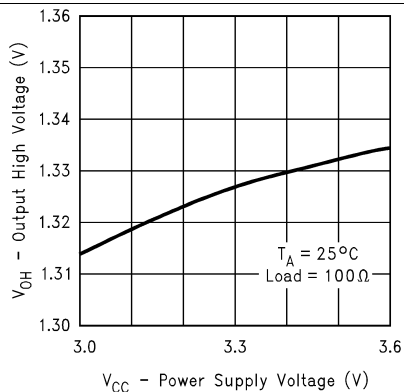


Figure 2. Output High Voltage vs Power Supply Voltage

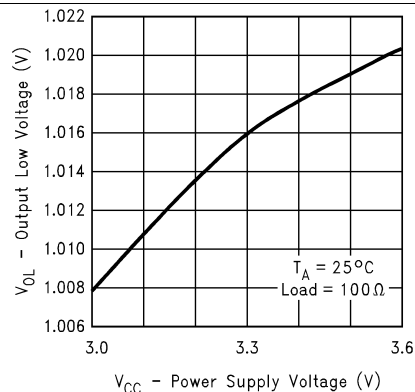


Figure 3. Output Low Voltage vs Power Supply Voltage

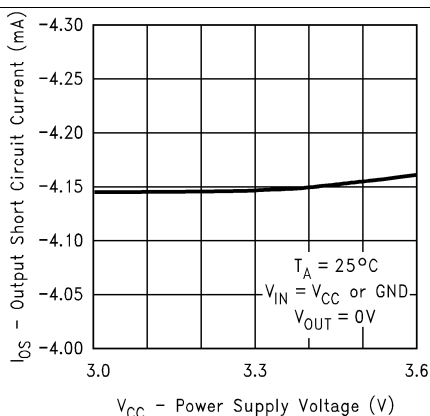


Figure 4. Output Short Circuit Current vs Power Supply Voltage

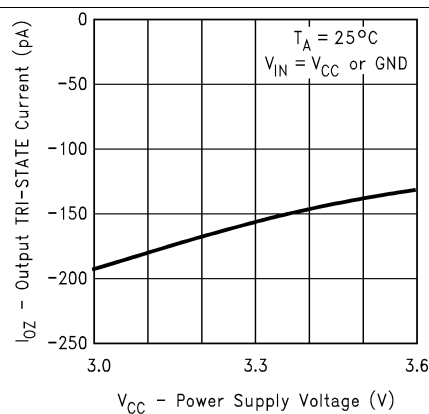


Figure 5. Output TRI-STATE Current vs Power Supply Voltage

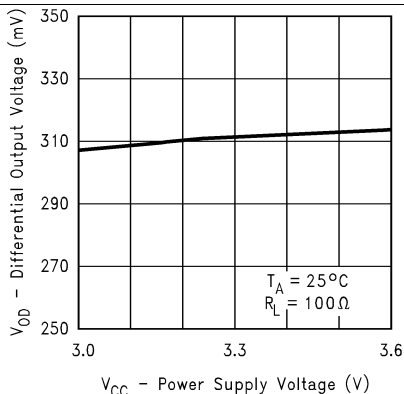


Figure 6. Differential Output Voltage vs Power Supply Voltage

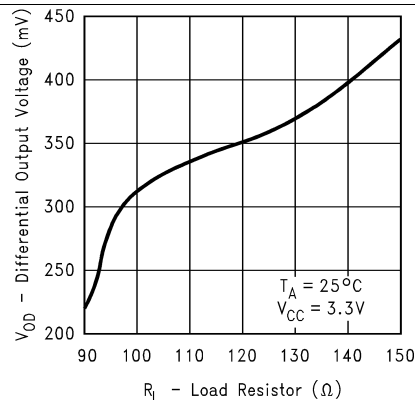
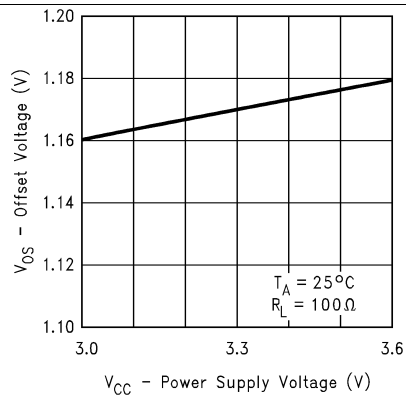
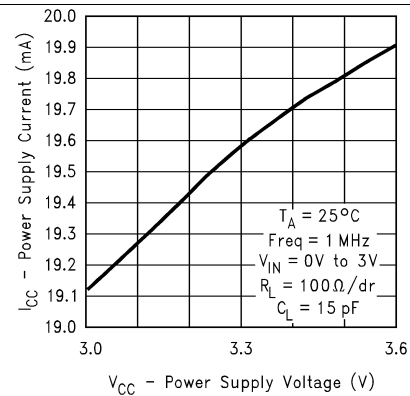
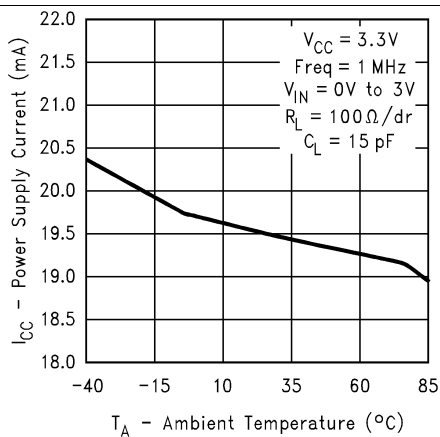
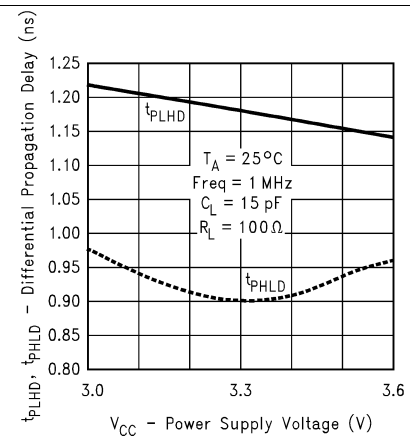
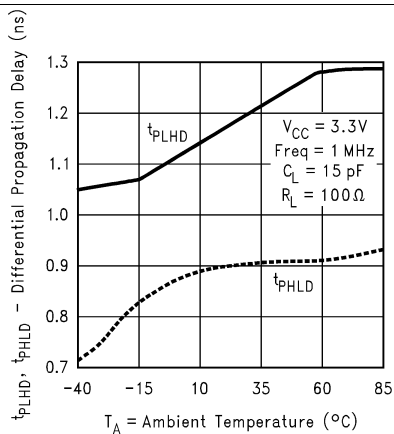
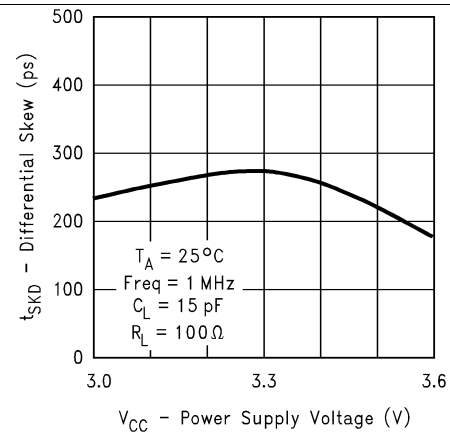


Figure 7. Differential Output Voltage vs Load Resistor

Typical Characteristics (continued)

Figure 8. Offset Voltage vs Power Supply Voltage

Figure 9. Power Supply Current vs Power Supply Voltage

Figure 10. Power Supply Current vs Ambient Temperature

Figure 11. Differential Propagation Delay vs Power Supply Voltage

Figure 12. Differential Propagation Delay vs Ambient Temperature

Figure 13. Differential Skew vs Power Supply Voltage

Typical Characteristics (continued)

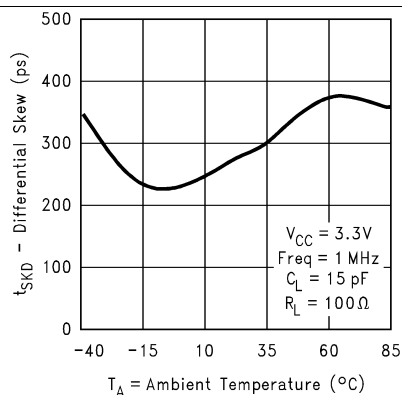


Figure 14. Differential Skew vs Ambient Temperature

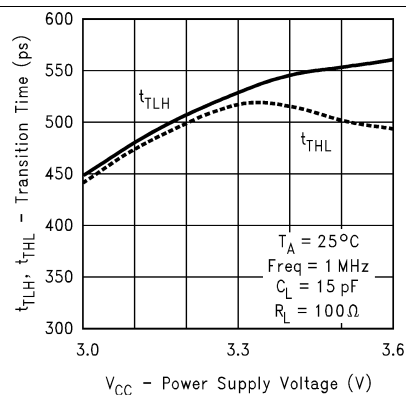


Figure 15. Transition Time vs Power Supply Voltage

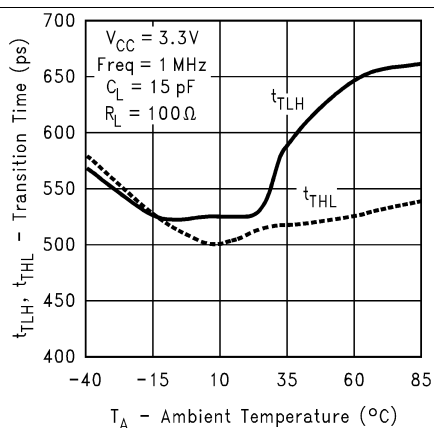


Figure 16. Transition Time vs Ambient Temperature

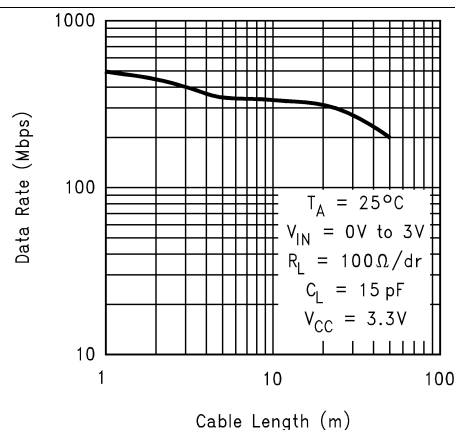


Figure 17. Data Rate vs Cable Length

7 Parameter Measurement Information

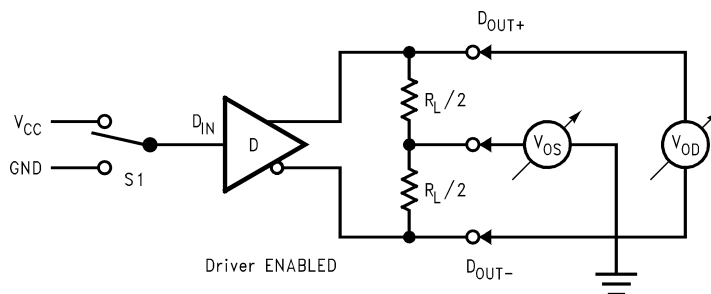


Figure 18. Driver V_{OD} and V_{OS} Test Circuit

Parameter Measurement Information (continued)

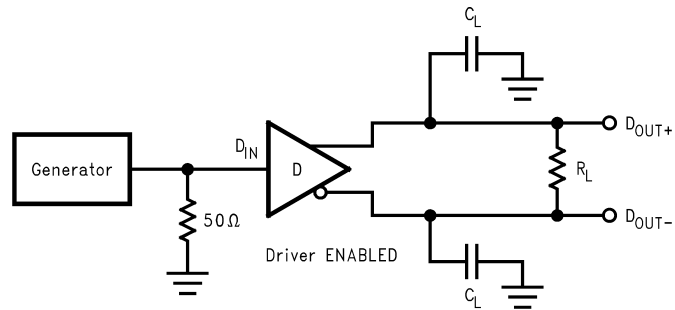


Figure 19. Driver Propagation Delay and Transition Time Test Circuit

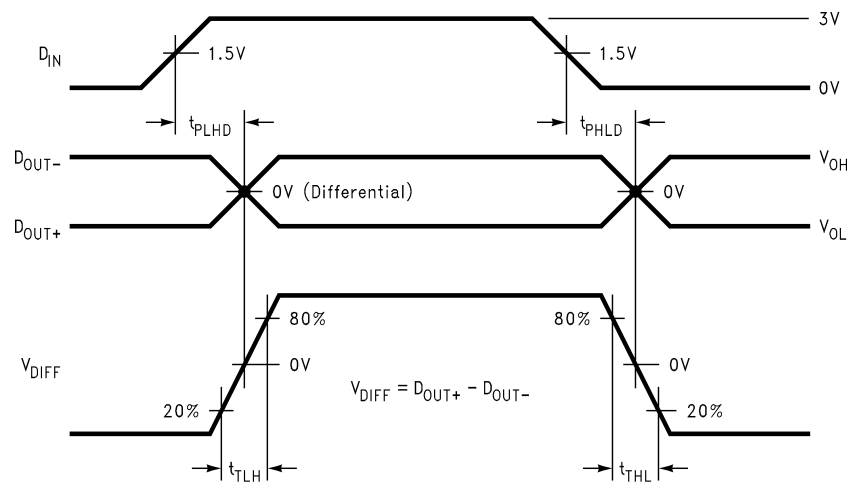


Figure 20. Driver Propagation Delay and Transition Time Waveforms

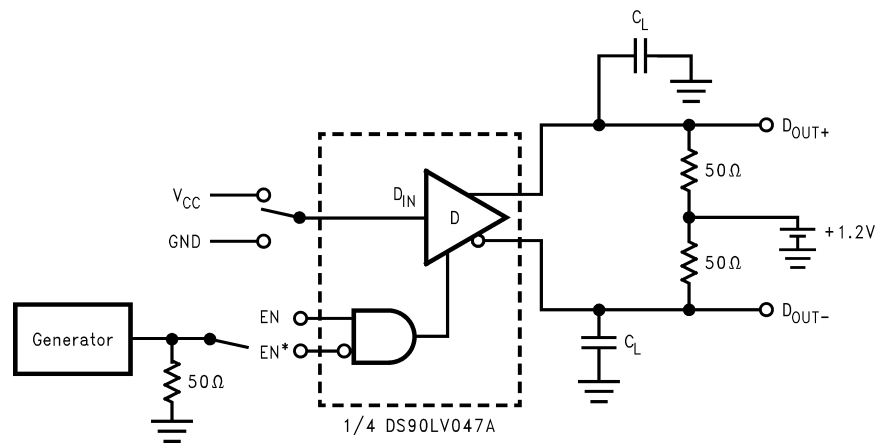


Figure 21. Driver TRI-STATE Delay Test Circuit

Parameter Measurement Information (continued)

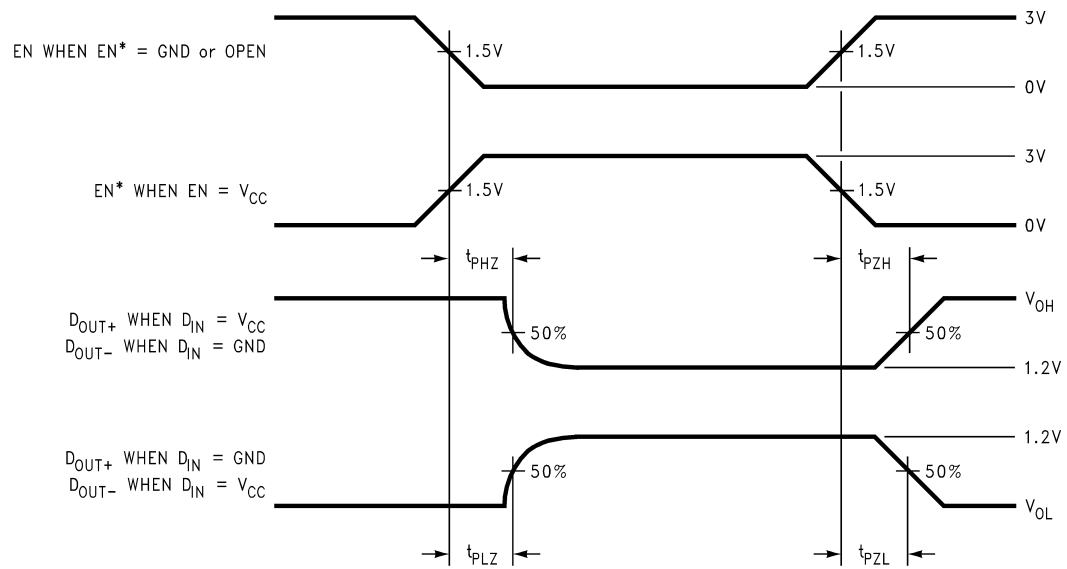


Figure 22. Driver TRI-STATE Delay Waveform

8 Detailed Description

8.1 Overview

LVDS drivers and receivers are intended to be primarily used in an uncomplicated point-to-point configuration as is shown in [Figure 24](#). This configuration provides a clean signaling environment for the fast edge rates of the drivers. The receiver is connected to the driver through a balanced media which may be a standard twisted pair cable, a parallel pair cable, or simply PCB traces. Typically, the characteristic differential impedance of the media is in the range of 100 Ω . A termination resistor of 100 Ω (selected to match the media), and is located as close to the receiver input pins as possible. The termination resistor converts the driver output current (current mode) into a voltage that is detected by the receiver. Other configurations are possible such as a multi-receiver configuration, but the effects of a mid-stream connector(s), cable stub(s), and other impedance discontinuities as well as ground shifting, noise margin limits, and total termination loading must be taken into account.

The DSLVD1047 differential line driver is a balanced current source design. A current mode driver, generally speaking has a high output impedance and supplies a constant current for a range of loads (a voltage mode driver on the other hand supplies a constant voltage for a range of loads). Current is switched through the load in one direction to produce a logic state and in the other direction to produce the other logic state. The output current is typically 3.1 mA, a minimum of 2.5 mA, and a maximum of 4.5 mA. The current mode driver requires that a resistive termination be employed to terminate the signal and to complete the loop as shown in [Figure 24](#). AC or unterminated configurations are not allowed. The 3.1-mA loop current develops a differential voltage of 310 mV across the 100- Ω termination resistor which the receiver detects with a 250-mV minimum differential noise margin, (driven signal minus receiver threshold (250 mV – 100 mV = 150 mV). The signal is centered around +1.2 V (Driver Offset, V_{OS}) with respect to ground as shown in [Figure 23](#).

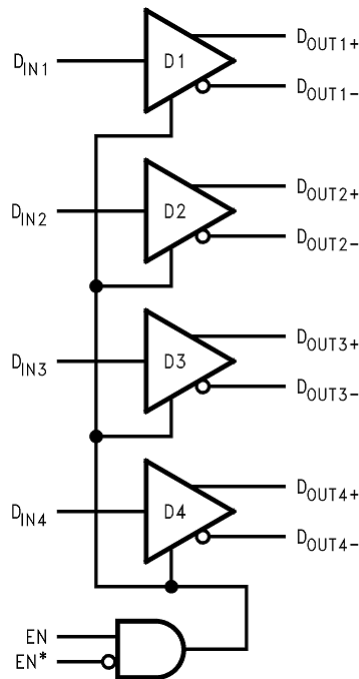
NOTE

The steady-state voltage (V_{SS}) peak-to-peak swing is twice the differential voltage (V_{OD}) and is typically 620 mV.

The current mode driver provides substantial benefits over voltage mode drivers, such as an RS-422 driver. Its quiescent current remains relatively flat versus switching frequency. Whereas the RS-422 voltage mode driver increases exponentially in most case from 20 MHz to 50 MHz. This is due to the overlap current that flows between the rails of the device when the internal gates switch. Whereas the current mode driver switches a fixed current between its output without any substantial overlap current. This is similar to some ECL and PECL devices, but without the heavy static I_{CC} requirements of the ECL/PECL designs. LVDS requires > 80% less current than similar PECL devices. AC specifications for the driver are a tenfold improvement over other existing RS-422 drivers.

The TRI-STATE function allows the driver outputs to be disabled, thus obtaining an even lower power state when the transmission of data is not required.

8.2 Functional Block Diagram



8.3 Feature Description

8.3.1 LVDS Fail-Safe

This section addresses the common concern of fail-safe biasing of LVDS interconnects, specifically looking at the DSLVD1047 driver outputs and the DSLVD1048 receiver inputs.

The LVDS receiver is a high-gain, high-speed device that amplifies a small differential signal (20 mV) to CMOS logic levels. Due to the high gain and tight threshold of the receiver, take care to prevent noise from appearing as a valid signal.

The internal fail-safe circuitry of the receiver is designed to source or sink a small amount of current, providing fail-safe protection (a stable known state of HIGH output voltage) for floating, terminated, or shorted receiver inputs.

1. **Open Input Pins.** The DSLVD1048 is a quad receiver device, and if an application requires only 1, 2, or 3 receivers, the unused channel(s) inputs must be left OPEN. Do not tie unused receiver inputs to ground or any other voltages. The input is biased by internal high value pullup and pulldown resistors to set the output to a HIGH state. This internal circuitry ensures a HIGH, stable output state for open inputs.
2. **Terminated Input.** If the DSLVD1047 driver is disconnected (cable unplugged), or if the DSLVD1047 driver is in a TRI-STATE or power-off condition, the receiver output is again in a HIGH state, even with the end of cable 100-Ω termination resistor across the input pins. The unplugged cable can become a floating antenna which can pick up noise. If the cable picks up more than 10 mV of differential noise, the receiver may see the noise as a valid signal and switch. To insure that any noise is seen as common-mode and not differential, a balanced interconnect must be used. Twisted pair cable offers better balance than flat ribbon cable.
3. **Shorted Inputs.** If a fault condition occurs that shorts the receiver inputs together, thus resulting in a 0-V differential input voltage, the receiver output remains in a HIGH state. Shorted input fail-safe is not supported across the common-mode range of the device (GND to 2.4 V). It is only supported with inputs shorted and no external common-mode voltage applied.

Feature Description (continued)

External lower value pullup and pulldown resistors (for a stronger bias) may be used to boost fail-safe in the presence of higher noise levels. The pullup and pulldown resistors should be in the 5-k Ω to 15-k Ω range to minimize loading and waveform distortion to the driver. The common-mode bias point should be set to approximately 1.2 V (less than 1.75 V) to be compatible with the internal circuitry.

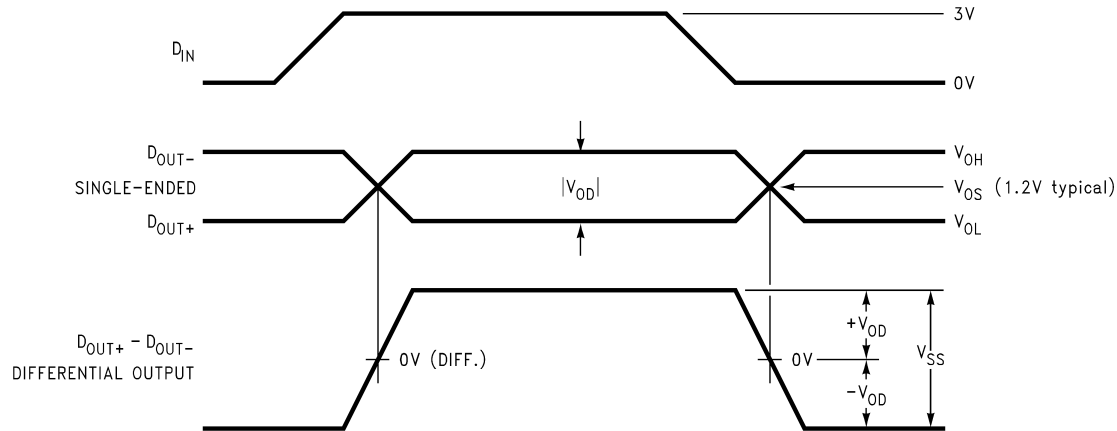


Figure 23. Driver Output Levels

8.4 Device Functional Modes

Table 1 lists the functional modes DSLVD1047.

Table 1. Truth Table

ENABLES		INPUT	OUTPUTS	
EN	EN*	D _{IN}	D _{OUT+}	D _{OUT-}
H	L or Open	L	L	H
		H	H	L
All other combinations of ENABLE inputs		X	Z	Z

9 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

9.1 Application Information

The DSLVDS1047 has a flow-through pinout that allows for easy PCB layout. The LVDS signals on one side of the device easily allows for matching electrical lengths of the differential pair trace lines between the driver and the receiver as well as allowing the trace lines to be close together to couple noise as common-mode. Noise isolation is achieved with the LVDS signals on one side of the device and the TTL signals on the other side.

9.2 Typical Application

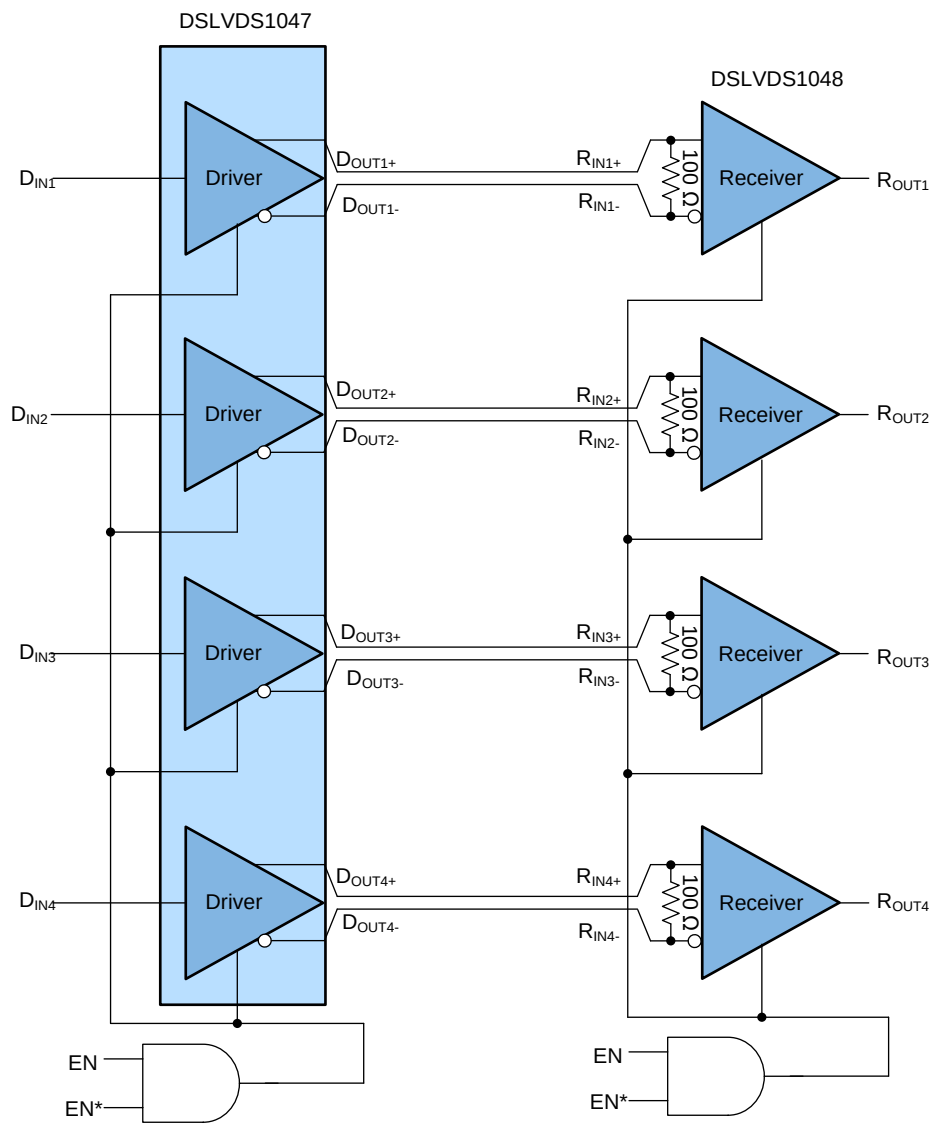


Figure 24. Point-to-Point Application

Typical Application (continued)

9.2.1 Design Requirements

When using LVDS devices, it is important to remember to specify controlled impedance PCB traces, cable assemblies, and connectors. All components of the transmission media should have a matched differential impedance of about 100 Ω . They should not introduce major impedance discontinuities.

Balanced cables (for example, twisted pair) are usually better than unbalanced cables (ribbon cable) for noise reduction and signal quality. Balanced cables tend to generate less EMI due to field canceling effects and also tend to pick up electromagnetic radiation as common-mode (not differential mode) noise which is rejected by the LVDS receiver.

For cable distances < 0.5 M, most cables can be made to work effectively. For distances $0.5 \text{ M} \leq d \leq 10 \text{ M}$, CAT5 (Category 5) twisted pair cable works well, is readily available and relatively inexpensive.

Table 2. Design Requirements

DESIGN PARAMETERS	EXAMPLE VALUE
Driver Supply Voltage (V_{CC})	3.0 to 3.6 V
Driver Input Voltage	0 to 3.6 V
Driver Signaling Rate	DC to 400 Mbps
Interconnect Characteristic Impedance	100 Ω
Termination Resistance	100 Ω
Number of Receiver Nodes	1
Ground shift between driver and receiver	± 1 V

9.2.2 Detailed Design Procedure

9.2.2.1 Probing LVDS Transmission Lines

Always use high impedance ($> 100 \text{ k}\Omega$), low capacitance ($< 2 \text{ pF}$) scope probes with a wide bandwidth (1 GHz) scope. Improper probing gives deceiving results.

9.2.2.2 Data Rate vs Cable Length Graph Test Procedure

A pseudo-random bit sequence (PRBS) of 2^9-1 bits was programmed into a function generator (Tektronix HFS9009) and connected to the driver inputs through 50- Ω cables and SMB connectors. An oscilloscope (Tektronix 11801B) was used to probe the resulting eye pattern, measured differentially at the input to the receiver. A 100- Ω resistor was used to terminate the pair at the far end of the cable. The measurements were taken at the far end of the cable, at the input of the receiver, and used for the jitter analysis for this graph (Figure 17). The frequency of the input signal was increased until the measured jitter (t_{jcs}) equaled 20% with respect to the unit interval (t_{ui}) for the particular cable length under test. Twenty percent jitter is a reasonable place to start with many system designs. The data used was NRZ. Jitter was measured at the 0-V differential voltage of the differential eye pattern. The DSLVDS1047 and DSLVDS1048 can be evaluated using the new DS90LV047-048AEVM.

Figure 25 shows very good typical performance that can be used as a design guideline for data rate vs cable length. Increasing the jitter percentage increases the curve respectively, allowing the device to transmit faster over longer cable lengths. This relaxes the jitter tolerance of the system allowing more jitter into the system, which could reduce the reliability and efficiency of the system. Alternatively, decreasing the jitter percentage has the opposite effect on the system. The area under the curve is considered the safe operating area based on the above signal quality criteria. For more information on eye pattern testing, please see [AN-808 Long Transmission Lines and Data Signal Quality](#) (SNLA028).

9.2.3 Application Curve

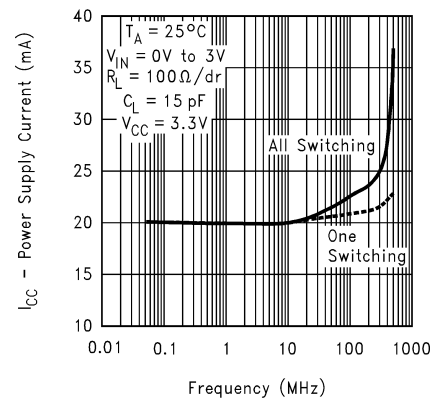


Figure 25. Power Supply Current vs Frequency

10 Power Supply Recommendations

Although the DSLVDS1047 draws very little power while at rest. At higher switching frequencies there is a dynamic current component which increases the overall power consumption. The DSLVDS1047 power supply connection must take this additional current consumption into consideration for maximum power requirements.

11 Layout

11.1 Layout Guidelines

- Use at least 4 PCB layers (top to bottom); LVDS signals, ground, power, TTL signals.
- Isolate TTL signals from LVDS signals, otherwise the TTL may couple onto the LVDS lines. It is best to put TTL and LVDS signals on different layers which are isolated by a power/ground plane(s).
- Keep drivers and receivers as close to the (LVDS port side) connectors as possible.

11.1.1 Power Decoupling Recommendations

Bypass capacitors must be used on power pins. Use high frequency ceramic (surface mount is recommended) 0.1- μ F and 0.001- μ F capacitors in parallel at the power supply pin with the smallest value capacitor closest to the device supply pin. Additional scattered capacitors over the printed-circuit board improves decoupling. Multiple vias must be used to connect the decoupling capacitors to the power planes. A 10- μ F (35-V) or greater solid tantalum capacitor must be connected at the power entry point on the printed-circuit board between the supply and ground.

11.1.2 Differential Traces

Use controlled impedance traces which match the differential impedance of your transmission medium (that is, cable) and termination resistor. Run the differential pair trace lines as close together as possible as soon as they leave the IC (stubs must be < 10 mm long). This helps eliminate reflections and ensure noise is coupled as common-mode. In fact, we have seen that differential signals which are 1 mm apart radiate far less noise than traces 3 mm apart since magnetic field cancellation is much better with the closer traces. In addition, noise induced on the differential lines is much more likely to appear as common-mode which is rejected by the receiver.

Match electrical lengths between traces to reduce skew. Skew between the signals of a pair means a phase difference between signals, which destroys the magnetic field cancellation benefits of differential signals and EMI, results.

NOTE

The velocity of propagation, $v = c/E_r$ where c (the speed of light) = 0.2997mm/ps or 0.0118 in/ps

Do not rely solely on the autoroute function for differential traces. Carefully review dimensions to match differential impedance and provide isolation for the differential lines. Minimize the number of vias and other discontinuities on the line.

Avoid 90° turns (these cause impedance discontinuities). Use arcs or 45° bevels.

Within a pair of traces, the distance between the two traces must be minimized to maintain common-mode rejection of the receivers. On the printed-circuit board, this distance must remain constant to avoid discontinuities in differential impedance. Minor violations at connection points are allowable.

11.1.3 Termination

Use a termination resistor which best matches the differential impedance of your transmission line. The resistor must be between 90 Ω and 130 Ω . Remember that the current mode outputs need the termination resistor to generate the differential voltage. LVDS does not work without resistor termination. Typically, connecting a single resistor across the pair at the receiver end will suffice.

Layout Guidelines (continued)

Surface mount 1% to 2% resistors are best. PCB stubs, component lead, and the distance from the termination to the receiver inputs must be minimized. The distance between the termination resistor and the receiver should be < 10 mm (12 mm maximum).

11.2 Layout Example

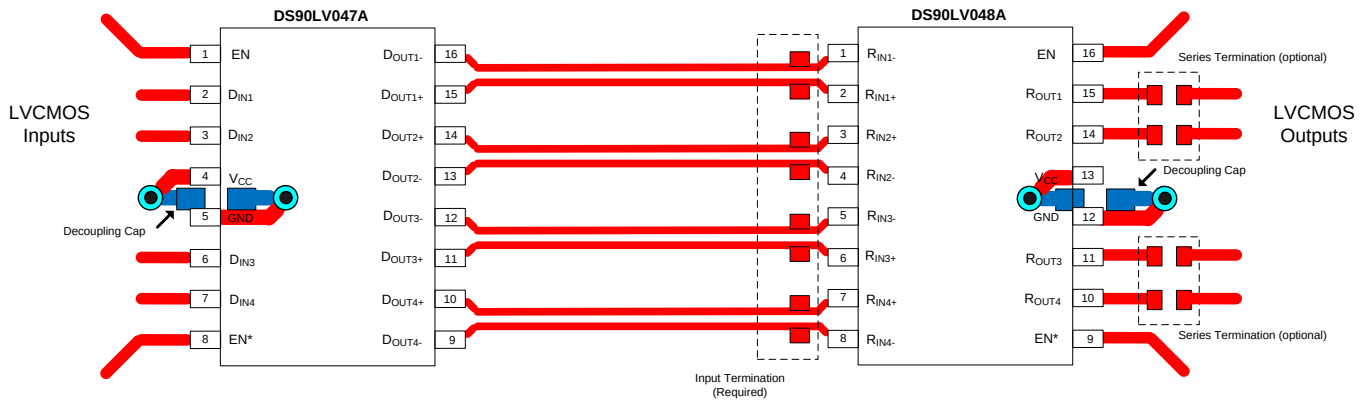


Figure 26. Layout Recommendation

12 器件和文档支持

12.1 接收文档更新通知

要接收文档更新通知，请导航至 TI.com.cn 上的器件产品文件夹。单击右上角的通知我进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

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设计支持 **TI 参考设计支持** 可帮助您快速查找有帮助的 E2E 论坛、设计支持工具以及技术支持的联系信息。

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ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

12.5 术语表

SLYZ022 — **TI 术语表**。

这份术语表列出并解释术语、缩写和定义。

13 机械、封装和可订购信息

以下页面包含机械、封装和可订购信息。这些信息是指定器件的最新可用数据。数据如有变更，恕不另行通知，且不会对此文档进行修订。如需获取此数据表的浏览器版本，请查阅左侧的导航栏。

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
DSLVDS1047PWR	Active	Production	TSSOP (PW) 16	2500 LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	DSLVDS 1047
DSLVDS1047PWR.B	Active	Production	TSSOP (PW) 16	2500 LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	DSLVDS 1047
DSLVDS1047PWT	Active	Production	TSSOP (PW) 16	250 SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	DSLVDS 1047
DSLVDS1047PWT.B	Active	Production	TSSOP (PW) 16	250 SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	DSLVDS 1047

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

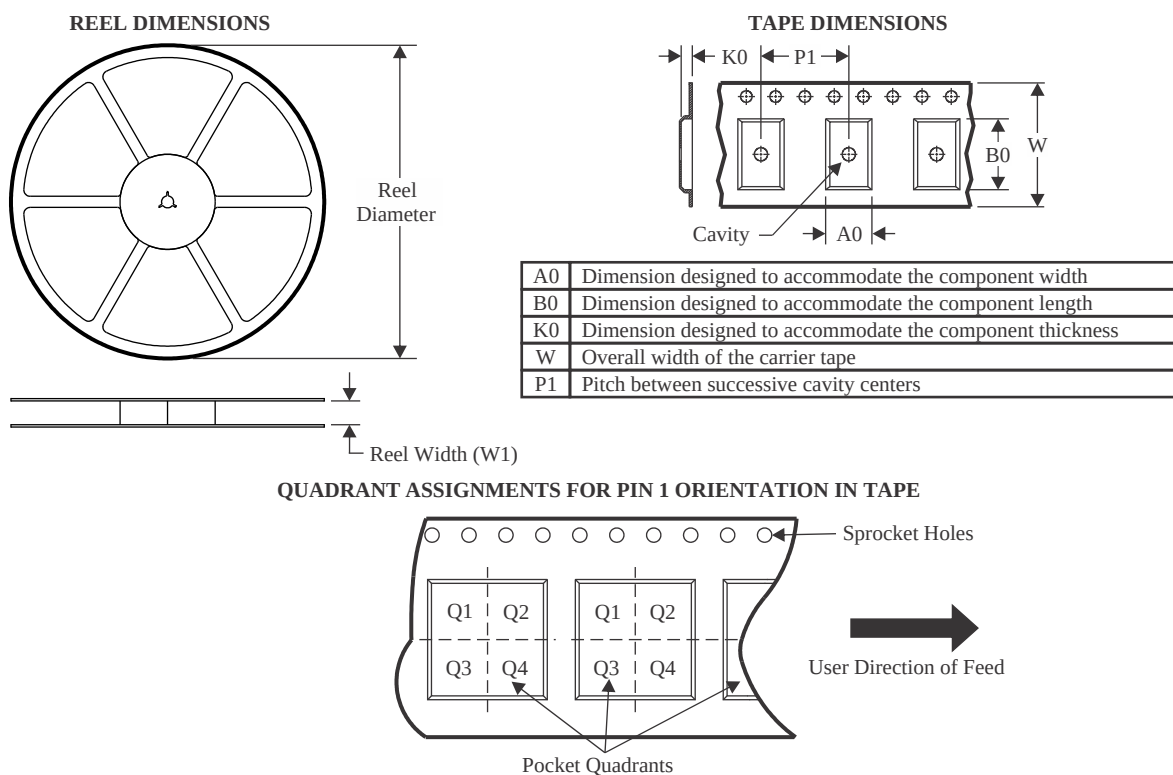
⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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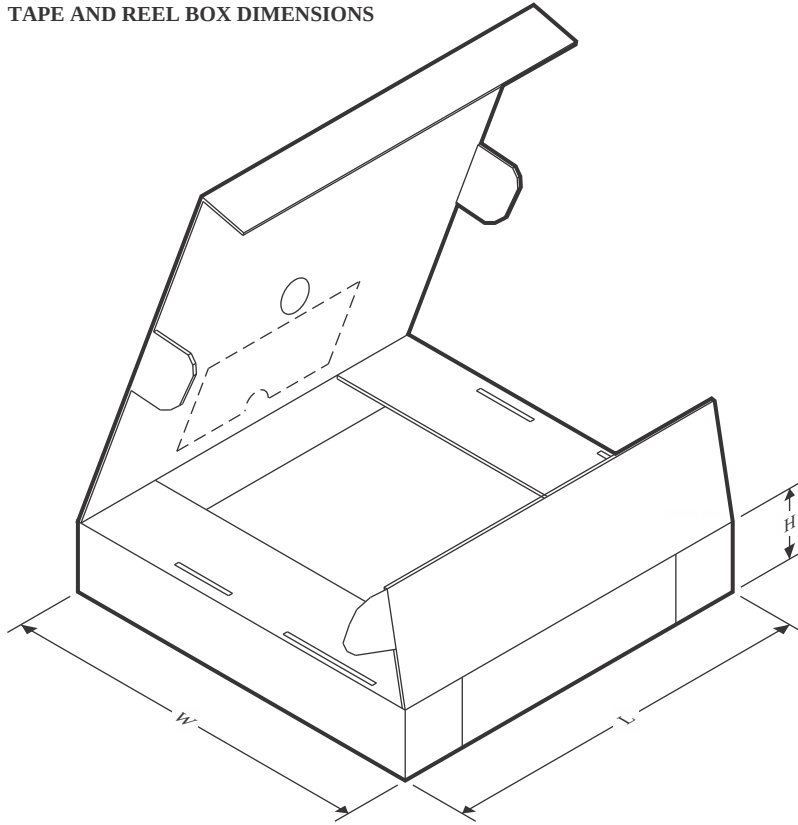
TAPE AND REEL INFORMATION



*All dimensions are nominal

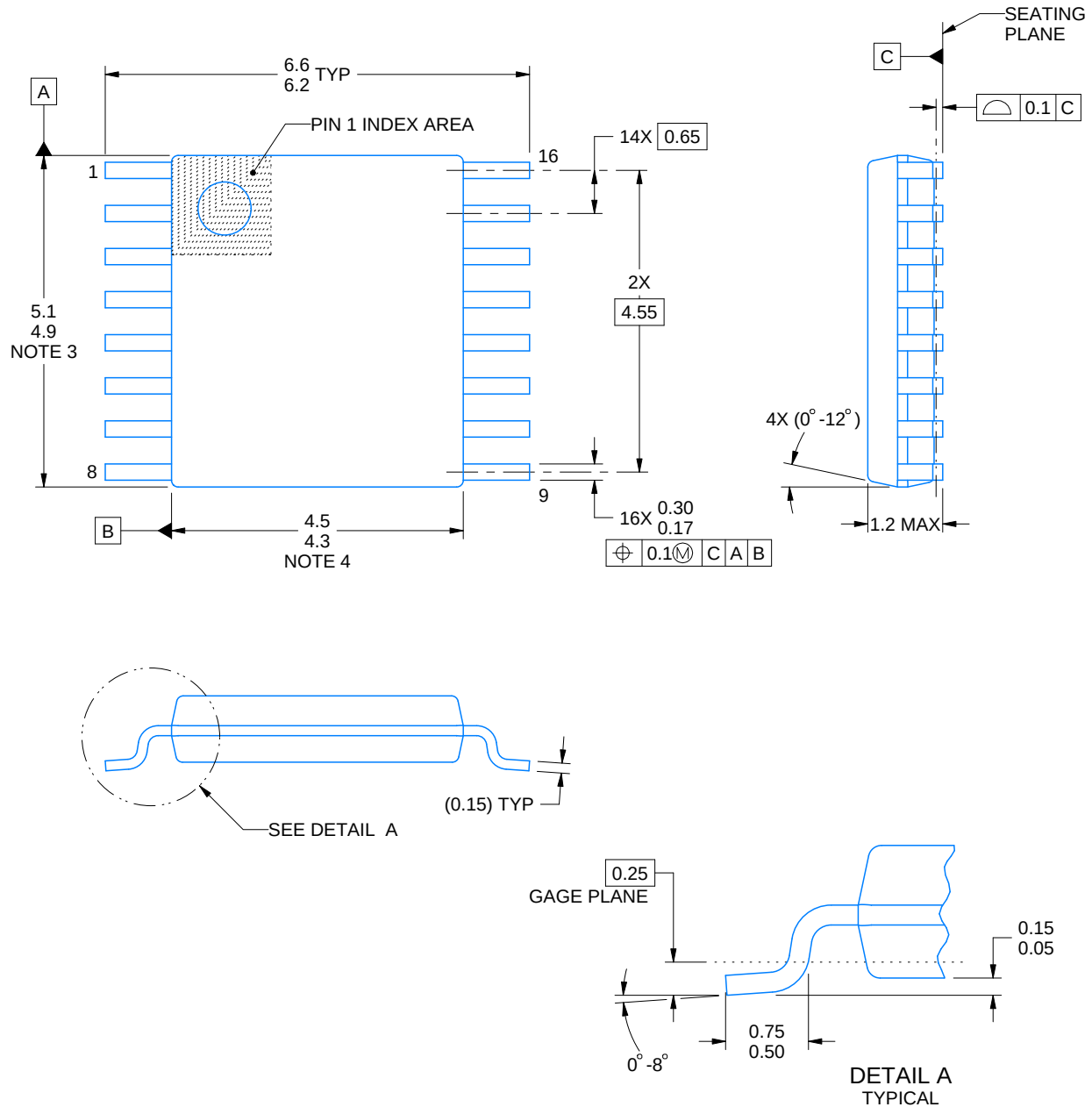
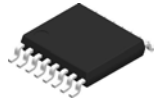
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
DSLVD1047PWR	TSSOP	PW	16	2500	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
DSLVD1047PWT	TSSOP	PW	16	250	177.8	12.4	6.9	5.6	1.6	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DSLVD1047PWR	TSSOP	PW	16	2500	367.0	367.0	35.0
DSLVD1047PWT	TSSOP	PW	16	250	210.0	185.0	35.0



4220204/B 12/2023

NOTES:

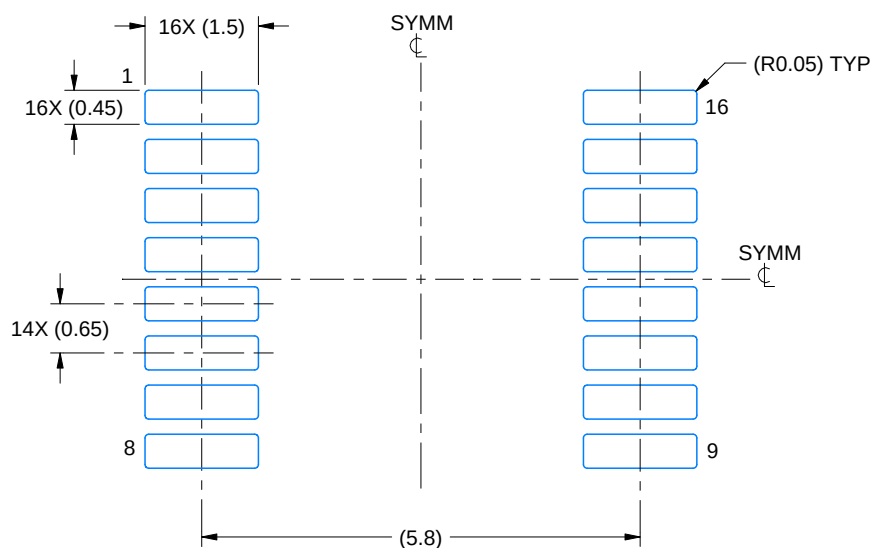
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

EXAMPLE BOARD LAYOUT

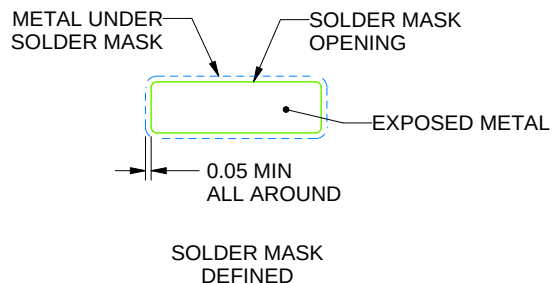
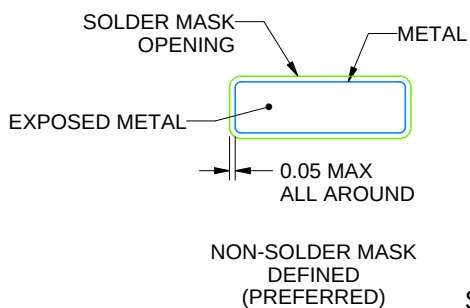
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

4220204/B 12/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

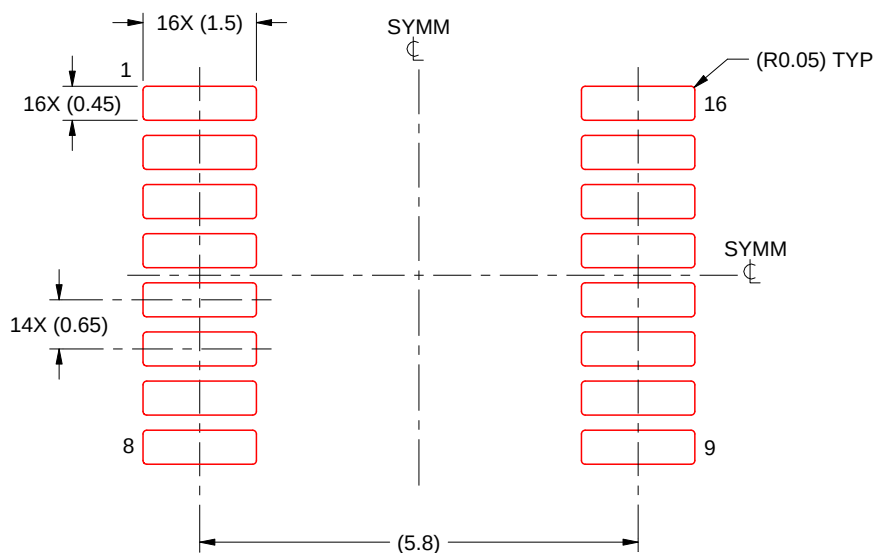
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



4220204/B 12/2023

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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