TEXAS INSTRUMENTS
DS90LV047A
JAJS616D – MAY 2000 – REVISED JULY 2016

DS90LV047A 3V LVDSクワッドCMOS差動ライン・ドライバ

1 特長

- 400Mpbs (200MHz)を超えるスイッチング速度
- フロースルーのピン配置によりPCBレイアウトを簡素化
- 差動スキュー標準値: 300ps
- 差動スキュー最大値: 400ps
- 最大伝搬遅延: 1.7ns
- 3.3V電源の設計
- ±350mVの差動信号
- 低消費電力(3.3V静的で13mW)
- 既存の5V LVDSレシーバと相互運用可能
- 電源オフ時にLVDS出力が高インピーダンス
- TIA/EIA-644 LVDS規格に準拠
- 工業用動作温度範囲
  (-40℃～+85℃)
- 表面実装SOICおよび薄型TSSOPパッケージで利用可能

2 アプリケーション

- マルチファンクションのプリンタ
- LVDS - LVCMOS変換

3 概要

DS90LV047Aデバイスは、クワッドCMOSフロースルー差動ライン・ドライバで、非常に低い消費電力と高いデータ速度を必要とするアプリケーション用に設計されています。このデバイスは、低電圧差動信号(LVDS)テクノロジを活用し、400Mbps (200MHz)を超えるデータ転送速度をサポートするよう設計されています。

DS90LV047Aは低電圧のTTL/CMOS入力レベルを受け付け、低電圧(350mV)の差動出力信号へ変換します。

さらに、ドライバはTRI-STATE機能をサポートし、出力ステージのディセーブルと負荷電流のディセーブルを行うため、デバイスはアイドル状態で13mW (標準値)と極めて低い消費電力を実現します。DS90LV047Aはフロースルーのピン配置を採用しているため、PCBレイアウトが簡単になります。

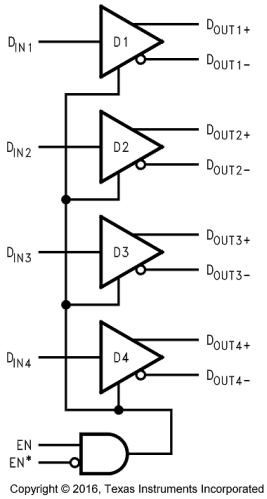
ENおよびEN*入力は互いにAND接続され、TRI-STATE出力を制御します。イネーブルは4つのドライバすべてに共通です。DS90LV047Aおよびコンパニオン・ライン・レシーバ(DS90LV048A)は、消費電力の大きい疑似ECLデバイスの新しい代替品として、高速のポイント・ツー・ポイント・インターフェイス・アプリケーション用に使用できます。

製品情報(1)

型番	パッケージ	本体サイズ(公称)
DS90LV048A	SOIC (16)	9.90mm×3.91mm
	TSSOP (16)	5.00mm×4.40mm

(1) 提供されているすべてのパッケージについては、データシートの末尾にある注文情報を参照してください。

機能図



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4 改訂履歴

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

Revision C (April 2013) から **Revision D** に変更 **Page**

- 「*ESD定格*」の表、「*熱に関する情報*」セクション、「*機能説明*」セクション、「*デバイスの機能モード*」セクション、「*アプリケーションと実装*」セクション、「*電源に関する推奨事項*」セクション、「*レイアウト*」セクション、「*デバイスおよびドキュメントのサポート*」セクション、「*メカニカル、パッケージ、および注文情報*」セクションを追加 ... 1

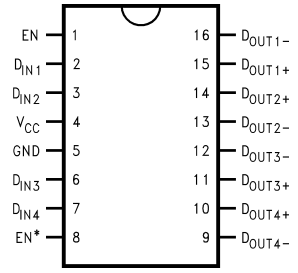
Revision B (April 2013) から **Revision C** に変更 **Page**

- Changed layout of National Semiconductor Data Sheet to TI format ... 15

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5 Pin Configuration and Functions

D or PW Package
16-Pin SOIC or TSSOP
Top View



Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
D_{IN}	2, 3, 6, 7	I	Driver input pin, TTL/CMOS compatible
D_{OUT+}	10, 11, 14, 15	O	Non-inverting driver output pin, LVDS levels
D_{OUT-}	9, 12, 13, 16	O	Inverting driver output pin, LVDS levels
EN	1	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.
EN*	8	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.
GND	5	—	Ground pin
V_{CC}	4	—	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	D0016A package			1088	mW
	PW0016A package			866	
	Derate D0016A package	above +25°C		8.5	mW/°C
	Derate PW0016A package	above +25°C		6.9	
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.

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6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge(1)	Human-body model (HBM)	±10000	V
		Machine Model	±1200	

(1) ESD Ratings:
HBM (1.5 kΩ, 100 pF)
EIAJ (0 Ω, 200 pF)

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)		DS90LV047A PW (TSSOP) 16 PINS	UNIT
$R_{\theta JA}$	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 17)	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		−10	2	+10	µA
I_{IL}	Input low current	V_{IN} = GND or 0.4 V		−10	−2	+10	µA
V_{CL}	Input clamp voltage	I_{CL} = −18 mA		−1.5	−0.8		V

(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 DS90LV047A 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).

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Electrical Characteristics (continued)

Over supply voltage and operating temperature ranges, unless otherwise specified[1][2][3]

PARAMETER		TEST CONDITIONS	PIN	MIN	TYP	MAX	UNIT
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+}		−4.2	−9	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

(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 ± 10%, T_A = −40°C to +85°C[1][2][3]

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PHLD}	Differential propagation delay high to low	R_L = 100 Ω, C_L = 15 pF (Figure 18 and Figure 19)	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	0.3	0.4	ns
t_{SKD2}	Channel-to-channel skew[5]		0	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 Ω, C_L = 15 pF (Figure 20 and Figure 21)		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 V, T_A = +25°C.
(2) Generator waveform for all tests unless otherwise specified: f = 1 MHz, Z_O = 50 Ω, t_r ≤ 1 ns, and t_f ≤ 1 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 ns (0% to 100%), 50% duty cycle, 0 V to 3 V. Output criteria: duty cycle = 45% / 55%, VOD > 250 mV, all channels switching.

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6.7 Typical Characteristics

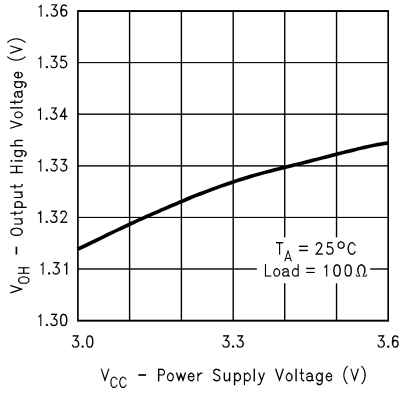


Figure 1. Output High Voltage vs Power Supply Voltage

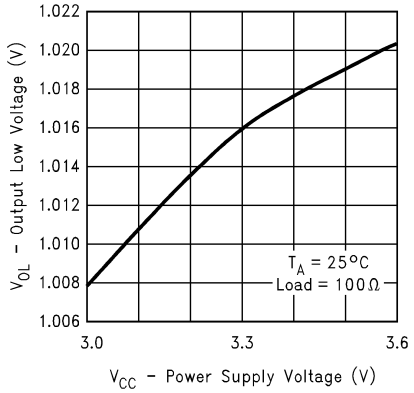


Figure 2. Output Low Voltage vs Power Supply Voltage

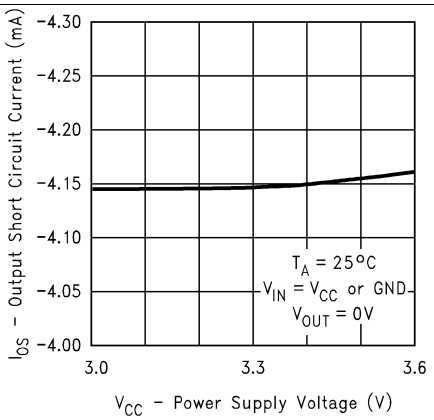


Figure 3. Output Short Circuit Current vs Power Supply Voltage

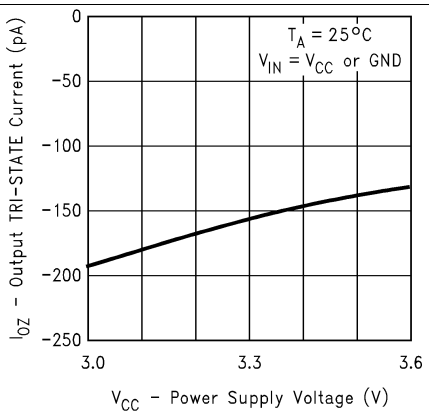


Figure 4. Output TRI-STATE Current vs Power Supply Voltage

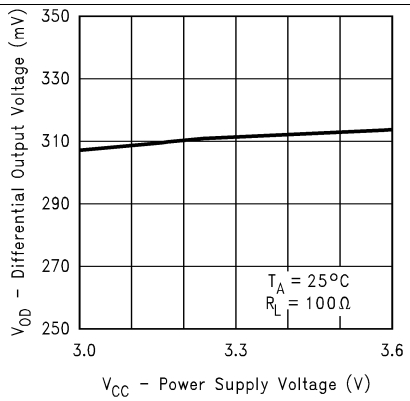


Figure 5. Differential Output Voltage vs Power Supply Voltage

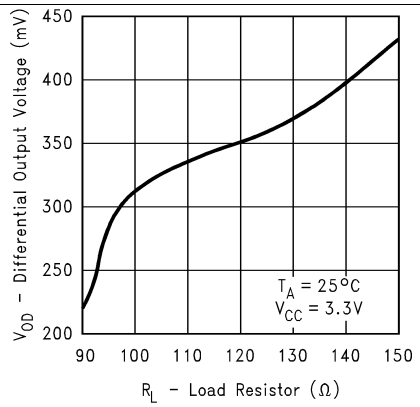


Figure 6. Differential Output Voltage vs Load Resistor

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Typical Characteristics (continued)

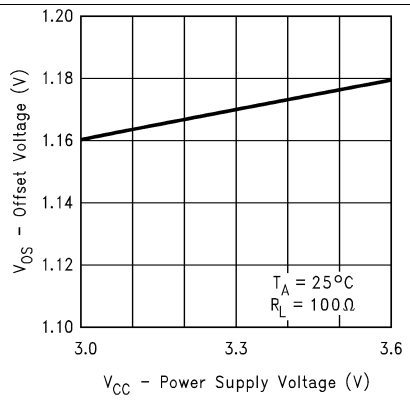


Figure 7. Offset Voltage vs Power Supply Voltage

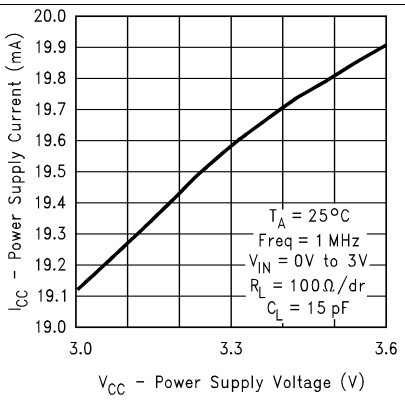


Figure 8. Power Supply Current vs Power Supply Voltage

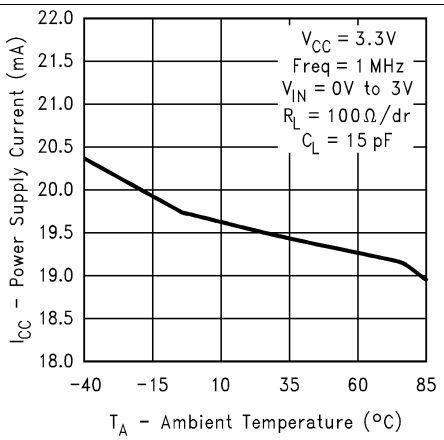


Figure 9. Power Supply Current vs Ambient Temperature

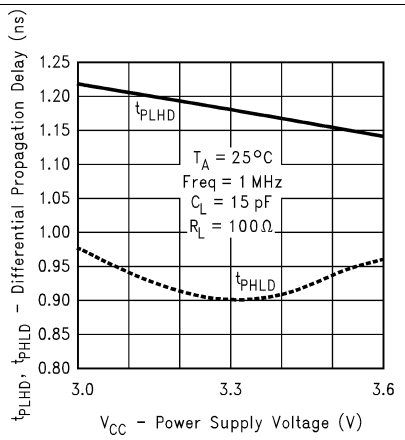


Figure 10. Differential Propagation Delay vs Power Supply Voltage

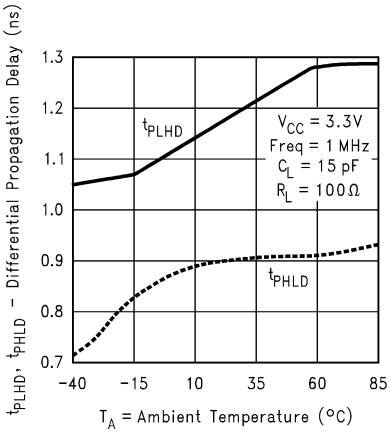


Figure 11. Differential Propagation Delay vs Ambient Temperature

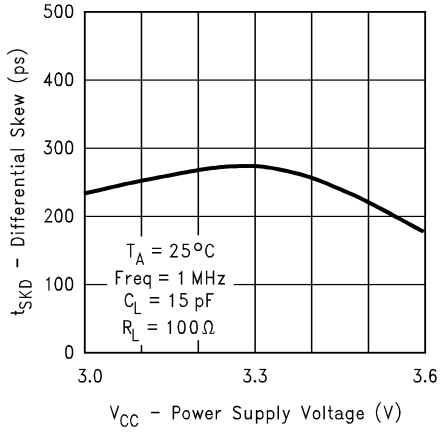


Figure 12. Differential Skew vs Power Supply Voltage

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Typical Characteristics (continued)

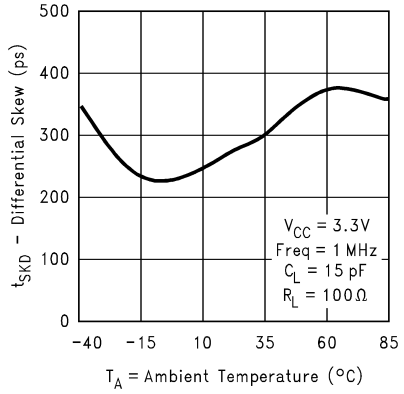


Figure 13. Differential Skew vs Ambient Temperature

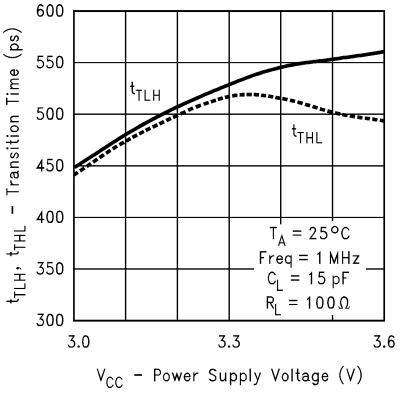


Figure 14. Transition Time vs Power Supply Voltage

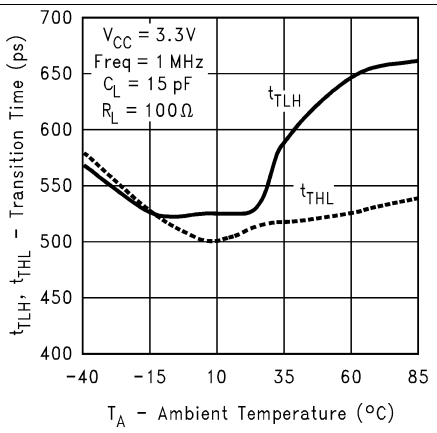


Figure 15. Transition Time vs Ambient Temperature

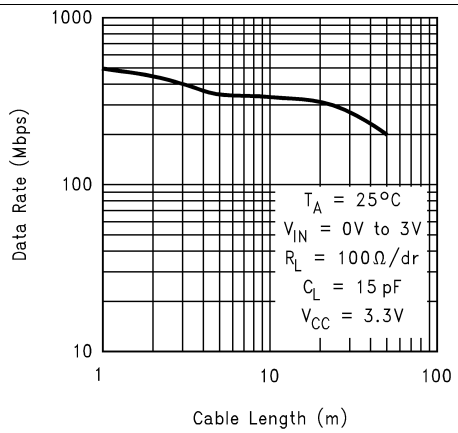


Figure 16. Data Rate vs Cable Length

7 Parameter Measurement Information

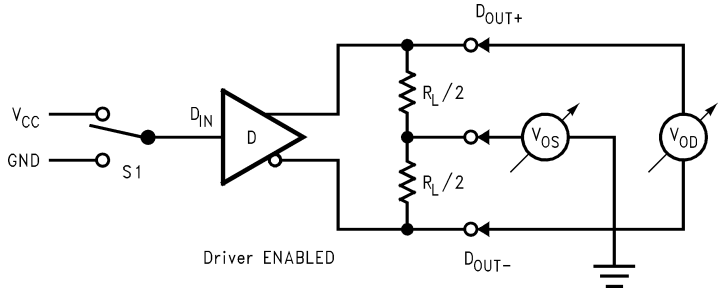


Figure 17. Driver V_{OD} and V_{OS} Test Circuit

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Parameter Measurement Information (continued)

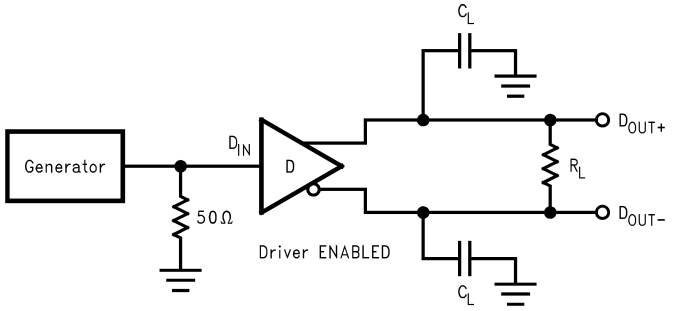


Figure 18. Driver Propagation Delay and Transition Time Test Circuit

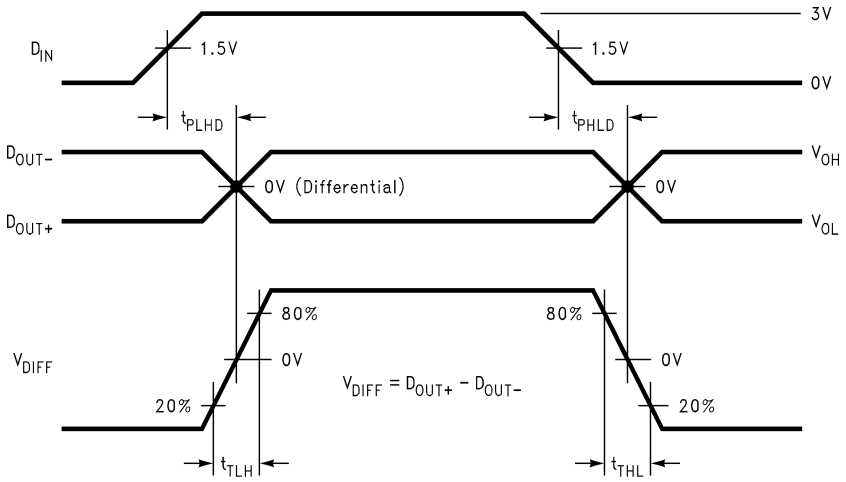


Figure 19. Driver Propagation Delay and Transition Time Waveforms

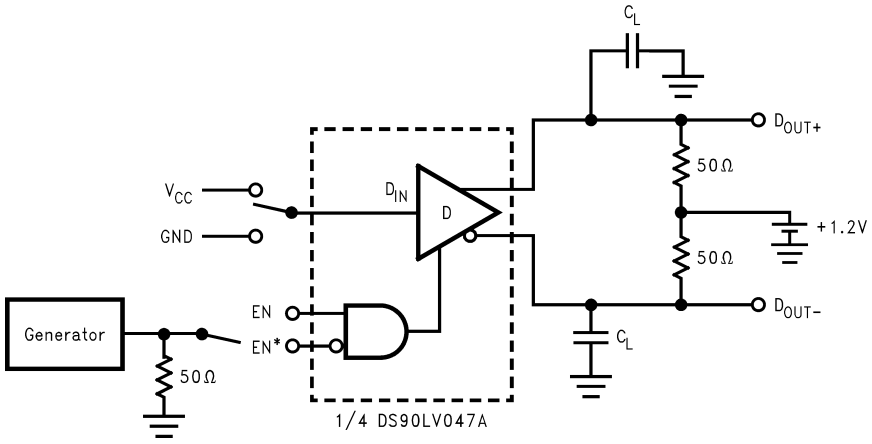


Figure 20. Driver TRI-STATE Delay Test Circuit

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Parameter Measurement Information (continued)

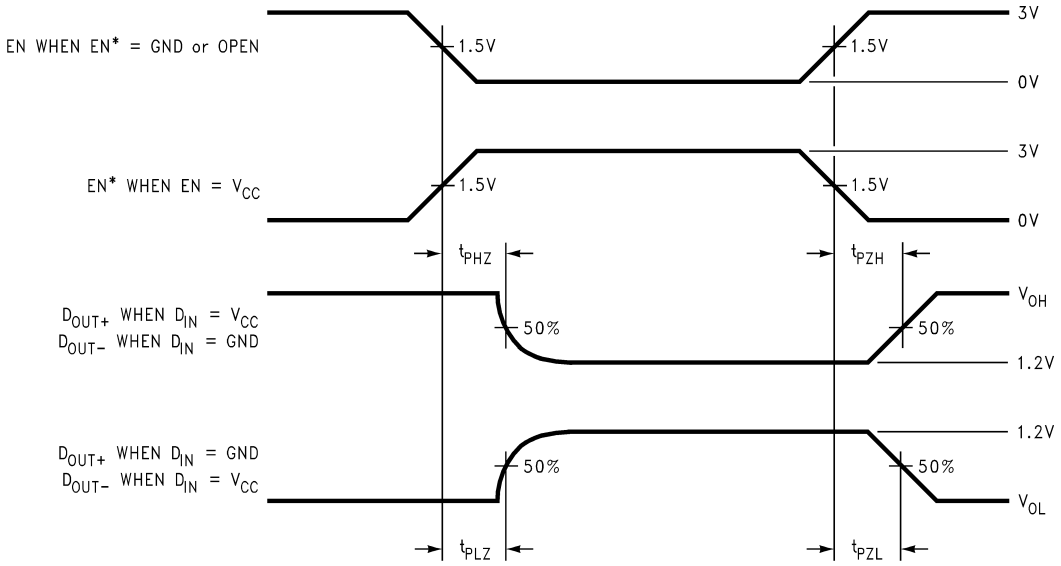


Figure 21. Driver TRI-STATE Delay Waveform

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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 23. 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 DS90LV047A 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** (as discussed above) that a resistive termination be employed to terminate the signal and to complete the loop as shown in Figure 23. 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 22.

NOTE

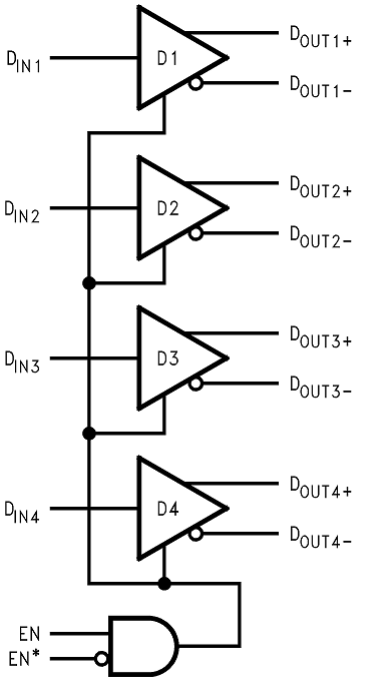
The steady-state voltage (V_{SS}) peak-to-peak swing is twice the differential voltage (V_{OD}) and is typically 620 mV.

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.

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8.2 Functional Block Diagram



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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 DS90LV047A driver outputs and the DS90LV048A 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 DS90LV048A 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 DS90LV047A driver is disconnected (cable unplugged), or if the DS90LV047A 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.

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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-kΩ to 15-kΩ 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.

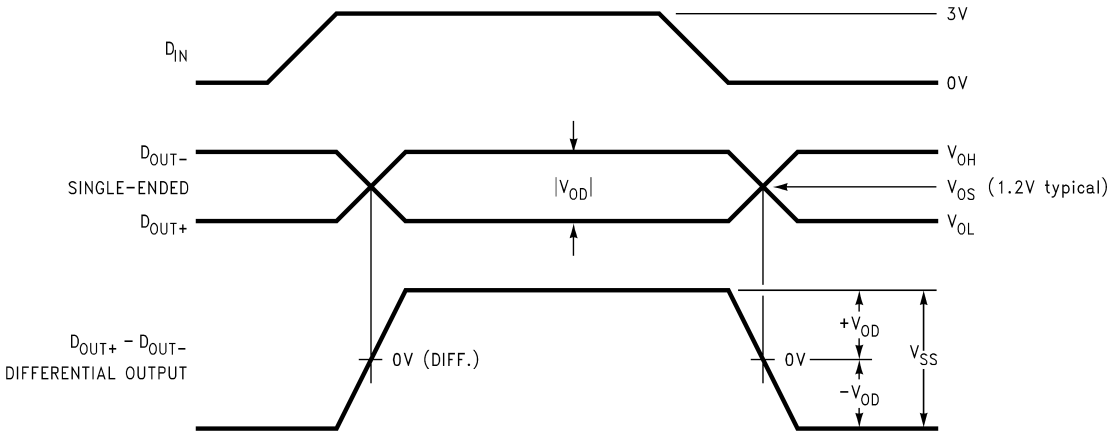


Figure 22. Driver Output Levels

8.4 Device Functional Modes

Table 1 lists the functional modes DS90LV047A.

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 DS90LV047A 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

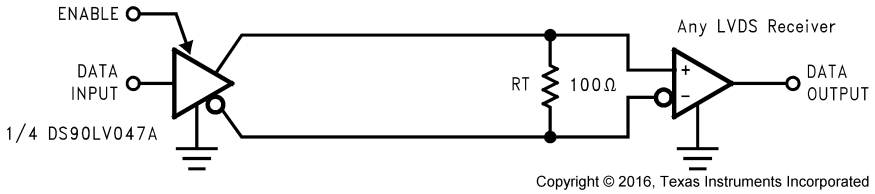


Figure 23. Point-to-Point Application

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 M ≤ d ≤ 10 M, CAT5 (Category 5) twisted pair cable works well, is readily available and relatively inexpensive.

9.2.2 Detailed Design Procedure

9.2.2.1 Probing LVDS Transmission Lines

Always use high impedance (> 100 kΩ), low capacitance (< 2 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 16). The frequency of the input signal was increased until the measured jitter (t_{tcs}) equaled 20% with respect to the unit interval (t_{tui}) 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 DS90LV047A and DS90LV048A can be evaluated using the new DS90LV047-048AEVM.

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Typical Application (continued)

Figure 24 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

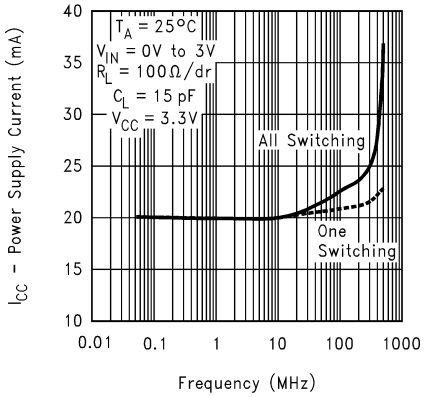


Figure 24. Power Supply Current vs Frequency

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10 Power Supply Recommendations

Although the DS90LV047A draws very little power while at rest. At higher switching frequencies there is a dynamic current component which increases the overall power consumption. The DS90LV047A 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-µF and 0.001-µF 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-µF (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/Er 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 or 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 or 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.

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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

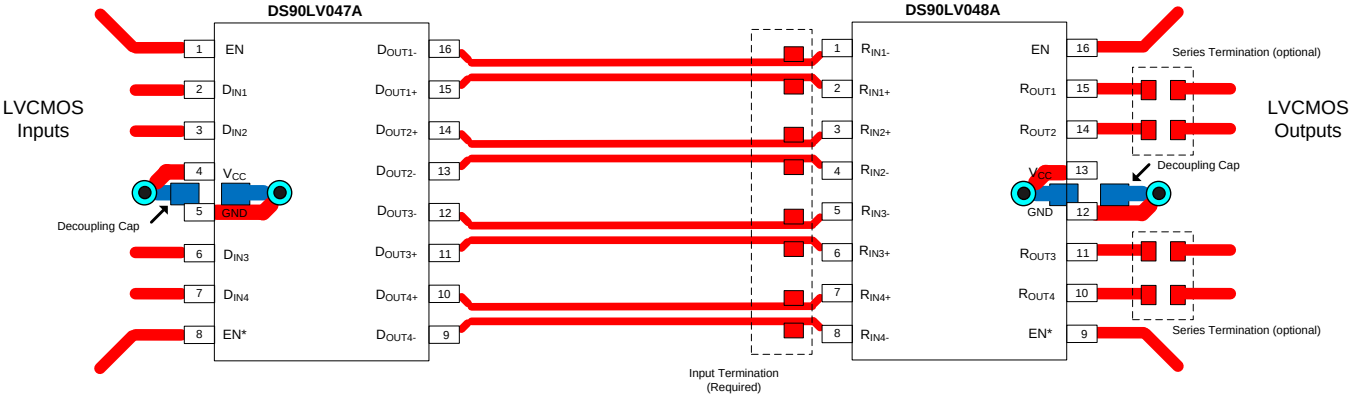


Figure 25. Layout Recommendation

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12 デバイスおよびドキュメントのサポート

12.1 ドキュメントのサポート

12.1.1 関連資料

関連資料については、以下を参照してください。

- *『LVDSオーナー・マニュアル』*(SNLA187)
- *『AN-808、長い伝送ラインとデータ信号の品質』*(SNLA028)
- *『AN-977、LVDS信号の品質: アイ・パターンを使用したジッタ測定のテスト・レポート #1』*(SNLA166)
- *『AN-971、LVDSテクノロジの概要』* (SNLA165)
- *『AN-916、ケーブル選択の実践的ガイド』*(SNLA219)
- *『AN-805、差動ライン・ドライバの消費電力の計算』* (SNOA233)
- *『AN-903、差動終端技法の比較』* (SNLA034)
- *『AN-1194、LVDSインターフェイスのフェイルセーフ・バイアス法』*(SNLA051)

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12.6 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

13 メカニカル、パッケージ、および注文情報

以降のページには、メカニカル、パッケージ、および注文に関する情報が記載されています。これらの情報は、指定のデバイスに対して提供されている最新のデータです。このデータは予告なく変更されることがあり、ドキュメントが改訂される場合もあります。本データシートのブラウザ版を使用されている場合は、画面左側の説明をご覧ください。

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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)
DS90LV047ATM/NOPB	Active	Production	SOIC (D) | 16	48 | TUBE	Yes	SN	Level-1-260C-UNLIM	-40 to 85	DS90LV047A TM
DS90LV047ATM/NOPB.B	Active	Production	SOIC (D) | 16	48 | TUBE	Yes	SN	Level-1-260C-UNLIM	-40 to 85	DS90LV047A TM
DS90LV047ATMTC/NOPB	Active	Production	TSSOP (PW) | 16	92 | TUBE	Yes	SN	Level-1-260C-UNLIM	-40 to 85	DS90LV 047AT
DS90LV047ATMTCX/NOPB	Active	Production	TSSOP (PW) | 16	2500 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	DS90LV 047AT
DS90LV047ATMX/NOPB	Active	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	DS90LV047A TM
DS90LV047ATMX/NOPB.B	Active	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	DS90LV047A TM

(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.

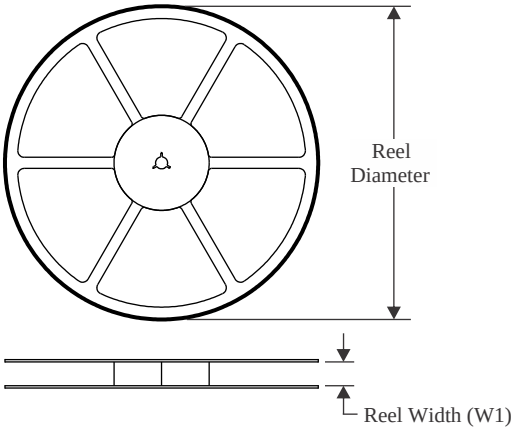
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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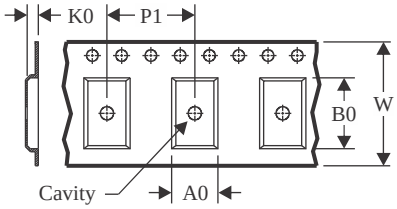
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TAPE AND REEL INFORMATION

REEL DIMENSIONS

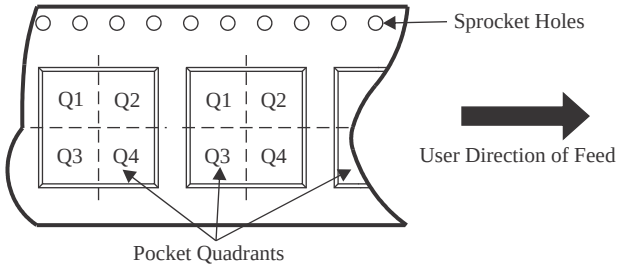


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

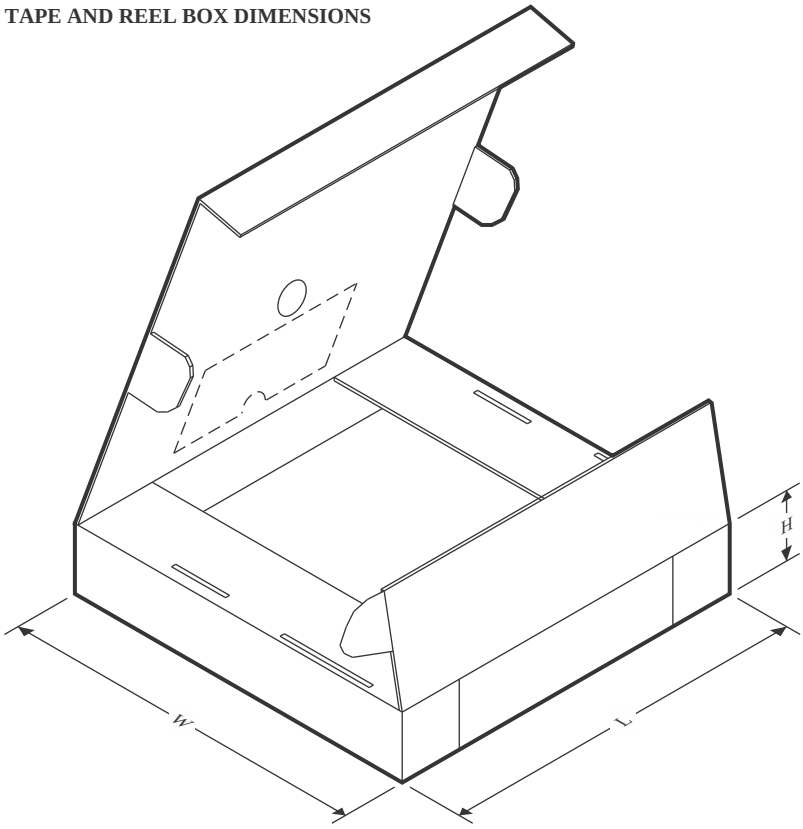
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
DS90LV047ATMTCX/ NOPB	TSSOP	PW	16	2500	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
DS90LV047ATMX/NOPB	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.3	8.0	16.0	Q1

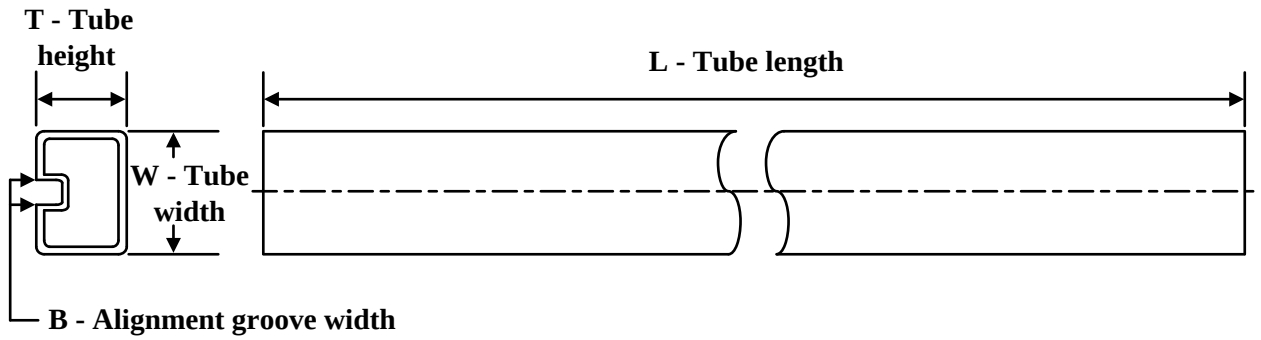
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DS90LV047ATMTCX/ NOPB	TSSOP	PW	16	2500	367.0	367.0	35.0
DS90LV047ATMX/NOPB	SOIC	D	16	2500	367.0	367.0	35.0

TUBE



*All dimensions are nominal

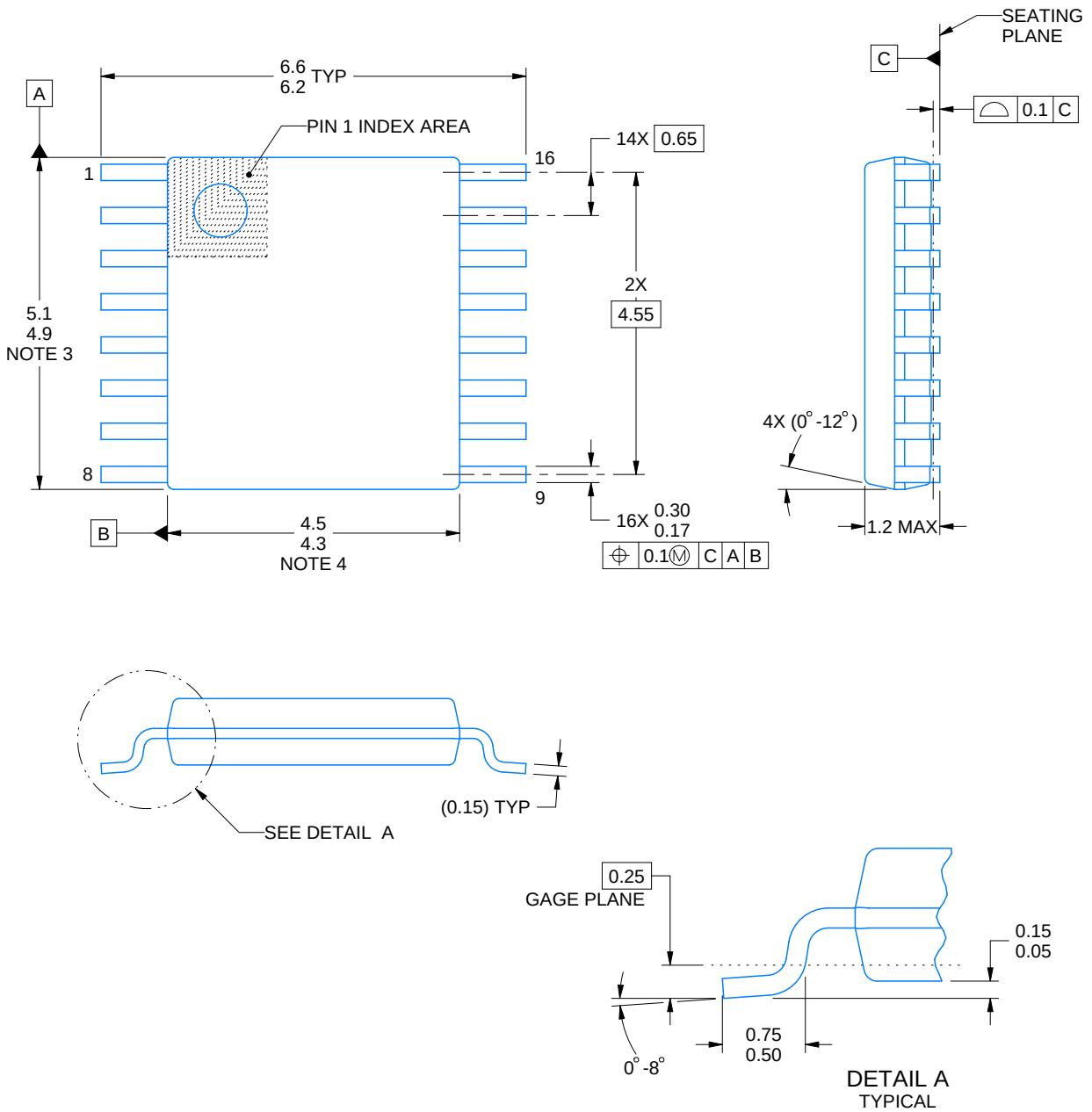
Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
DS90LV047ATM/NOPB	D	SOIC	16	48	495	8	4064	3.05
DS90LV047ATM/NOPB.B	D	SOIC	16	48	495	8	4064	3.05
DS90LV047ATMTC/NOPB	PW	TSSOP	16	92	495	8	2514.6	4.06

PACKAGE OUTLINE

PW0016A

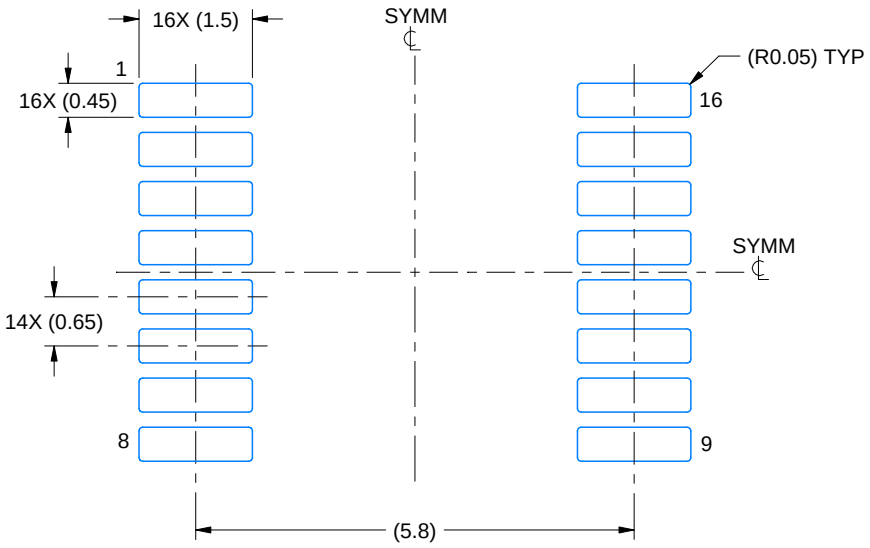
TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X

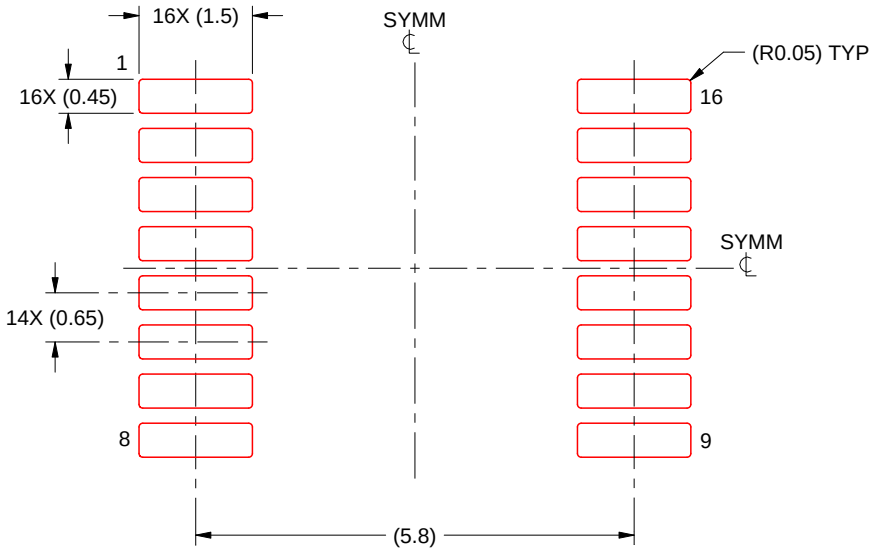


SOLDER MASK DETAILS

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.



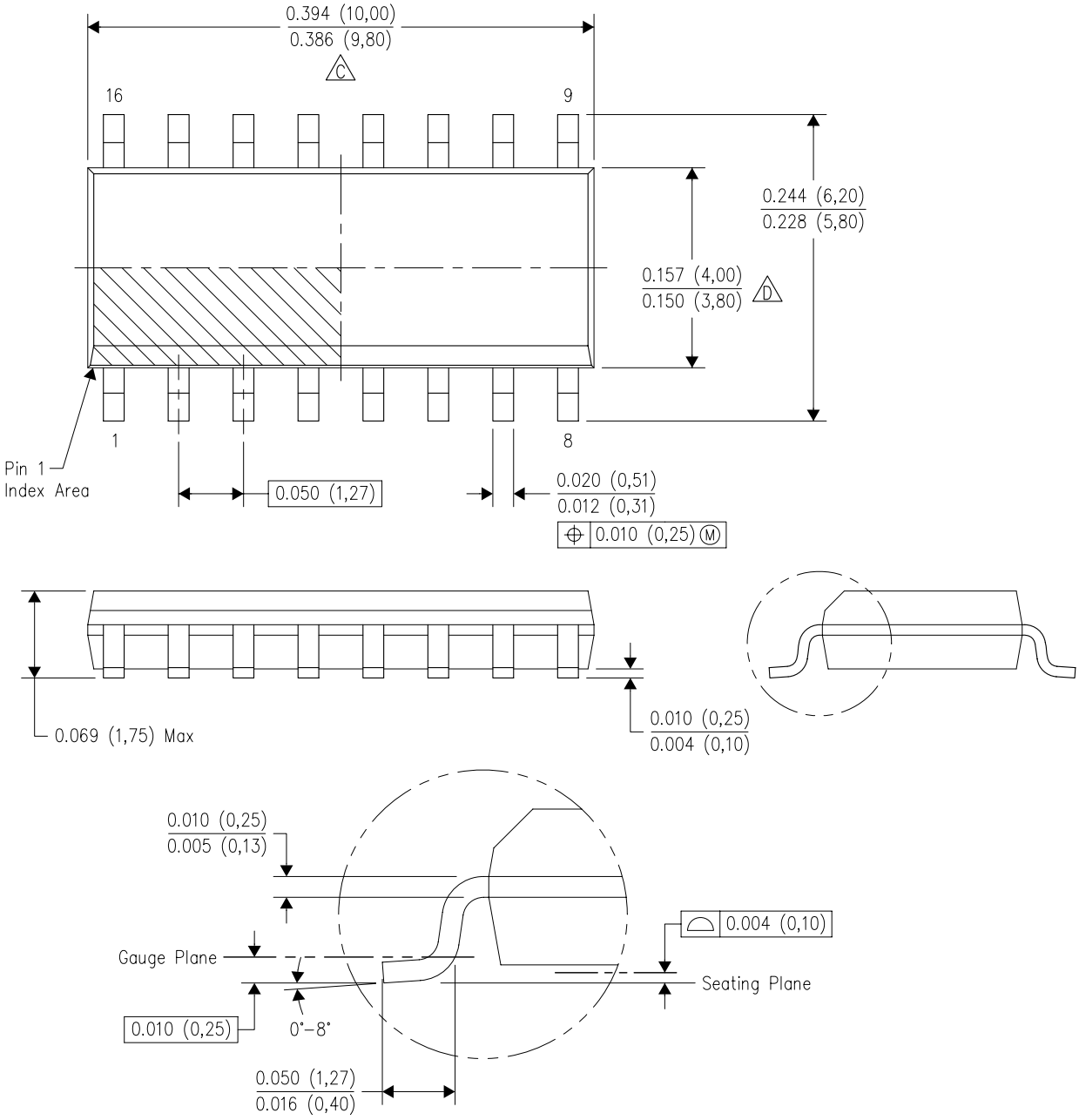
SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

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.

D (R–PDSO–G16) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AC.

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