

## DS90LV011A 3V LVDS Single High Speed Differential Driver

Check for Samples: [DS90LV011A](#)

### FEATURES

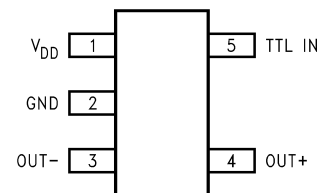
- Conforms to TIA/EIA-644-A Standard
- >400Mbps (200MHz) Switching Rates
- 700 ps (100 ps Typical) Maximum Differential Skew
- 1.5 ns Maximum Propagation Delay
- Single 3.3V Power Supply
- $\pm 350$  mV Differential Signaling
- Power Off Protection (Outputs in TRI-STATE)
- Pinout Simplifies PCB Layout
- Low Power Dissipation (23 mW @ 3.3V Typical)
- SOT-23 5-Lead Package
- SOT-23 Version Pin Compatible with SN65LVDS1
- Fabricated with Advanced CMOS Process Technology
- Industrial Temperature Operating Range
  - (–40°C to +85°C)

### DESCRIPTION

The DS90LV011A is a single LVDS driver device optimized for high data rate and low power applications. The DS90LV011A is a current mode driver allowing power dissipation to remain low even at high frequency. In addition, the short circuit fault current is also minimized. The device is designed to support data rates in excess of 400Mbps (200MHz) utilizing Low Voltage Differential Signaling (LVDS) technology.

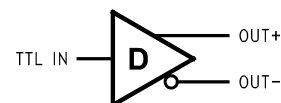
The device is in a 5-lead SOT-23 package. The LVDS outputs have been arranged for easy PCB layout. The differential driver outputs provide low EMI with its typical low output swing of 350 mV. The DS90LV011A can be paired with its companion single line receiver, the DS90LV012A, or with any of TI's LVDS receivers, to provide a high-speed LVDS interface.

### Connection Diagram



**Figure 1. Top View**  
See Package Number DBV (R-PDSO-G5)

### Functional Diagram



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.



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**Absolute Maximum Ratings<sup>(1)</sup>**

|   |                        |
|---|------------------------|
| Supply Voltage ( $V_{DD}$ )               | -0.3V to +4V           |
| LVC MOS input voltage (TTL IN)            | -0.3V to +3.6V         |
| LVDS output voltage ( $OUT_{\pm}$ )       | -0.3V to +3.9V         |
| LVDS output short circuit current         | 24mA                   |
| Maximum Package Power Dissipation @ +25°C |                        |
| DBV Package                               | 902 mW                 |
| Derate DBV Package                        | 7.22 mW/°C above +25°C |
| Thermal Resistance ( $\theta_{JA}$ )      | 138.5°C/Watt           |
| Storage Temperature                       | -65°C to +150°C        |
| Lead Temperature – Soldering              | +260°C (4 sec.)        |
| Maximum Junction Temperature              | +150°C                 |
| ESD Ratings                               |                        |
| HBM (1.5 k $\Omega$ , 100 pF)             | $\geq$ 9kV             |
| EIAJ (0 $\Omega$ , 200 pF)                | $\geq$ 900V            |
| CDM (0 $\Omega$ , 0 pF)                   | $\geq$ 2000V           |
| IEC direct (330 $\Omega$ , 150 pF)        | $\geq$ 4kV             |

(1) “Absolute Maximum Ratings” are those values beyond which the safety of the device cannot be specified. They are not meant to imply that the devices should be operated at these limits. [Electrical Characteristics](#) specifies conditions of device operation.

**Recommended Operating Conditions**

|                             | Min | Typ | Max | Units |
|-----------------------------|-----|-----|-----|-------|
| Supply Voltage ( $V_{DD}$ ) | 3.0 | 3.3 | 3.6 | V     |
| Temperature ( $T_A$ )       | -40 | +25 | +85 | °C    |

## Electrical Characteristics

 Over Supply Voltage and Operating Temperature ranges, unless otherwise specified. <sup>(1)(2)(3)</sup>

| Symbol          | Parameter  | Conditions                                   | Pin                      | Min      | Typ     | Max      | Units   |
|-----------------|--|--|--------------------------|----------|---------|----------|---------|
| $ V_{OD} $      | Output Differential Voltage                              | $R_L = 100\Omega$<br>(Figure 2 and Figure 3) | OUT+,<br>OUT-            | 250      | 350     | 450      | mV      |
| $\Delta V_{OD}$ | $V_{OD}$ Magnitude Change                                |  |                          |          | 3       | 35       | mV      |
| $V_{OS}$        | Offset Voltage   | $R_L = 100\Omega$<br>(Figure 2)              |                          | 1.125    | 1.22    | 1.375    | V       |
| $\Delta V_{OS}$ | Offset Magnitude Change                                  |  |                          | 0        | 1       | 25       | mV      |
| $I_{OFF}$       | Power-off Leakage  | $V_{OUT} = 3.6V$ or GND, $V_{DD} = 0V$       |                          |          | $\pm 1$ | $\pm 10$ | $\mu A$ |
| $I_{OS}$        | Output Short Circuit Current <sup>(4)</sup>              | $V_{OUT+}$ and $V_{OUT-} = 0V$               |                          |          | -6      | -24      | mA      |
| $I_{OSD}$       | Differential Output Short Circuit Current <sup>(4)</sup> | $V_{OD} = 0V$                                |                          |          | -5      | -12      | mA      |
| $C_{OUT}$       | Output Capacitance                                       |  |                          |          | 3       |          | pF      |
| $V_{IH}$        | Input High Voltage                                       |  | TTL IN                   | 2.0      |         | $V_{DD}$ | V       |
| $V_{IL}$        | Input Low Voltage  |  |                          | GND      |         | 0.8      | V       |
| $I_{IH}$        | Input High Current                                       | $V_{IN} = 3.3V$ or 2.4V                      |                          |          | $\pm 2$ | $\pm 10$ | $\mu A$ |
| $I_{IL}$        | Input Low Current  | $V_{IN} = GND$ or 0.5V                       |                          |          | $\pm 1$ | $\pm 10$ | $\mu A$ |
| $V_{CL}$        | Input Clamp Voltage                                      | $I_{CL} = -18$ mA                            |                          | -1.5     | -0.6    |          | V       |
| $C_{IN}$        | Input Capacitance  |  |                          |          | 3       |          | pF      |
| $I_{DD}$        | Power Supply Current                                     | No Load                                      | $V_{IN} = V_{DD}$ or GND | $V_{DD}$ | 5       | 8        | mA      |
|                 |  | $R_L = 100\Omega$                            |                          |          | 7       | 10       | 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  $V_{OD}$ .
- (2) All typicals are given for:  $V_{DD} = +3.3V$  and  $T_A = +25^\circ C$ .
- (3) The DS90LV011A is a current mode device and only function with datasheet specification when a resistive load is applied to the drivers outputs.
- (4) Output short circuit current ( $I_{OS}$ ) is specified as magnitude only, minus sign indicates direction only.

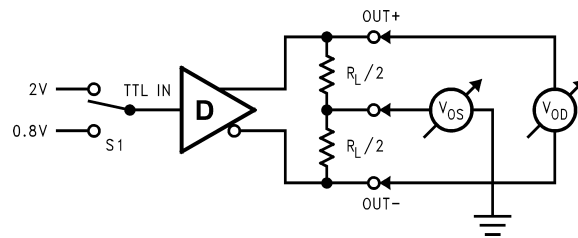
## Switching Characteristics

 Over Supply Voltage and Operating Temperature Ranges, unless otherwise specified. <sup>(1)(2)(3)(4)</sup>

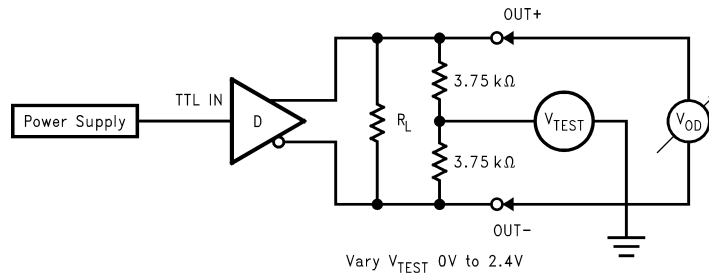
| Symbol     | Parameter  | Conditions   | Min | Typ | Max | Units |
|------------|--|--|-----|-----|-----|-------|
| $t_{PHLD}$ | Differential Propagation Delay High to Low                     | $R_L = 100\Omega$ , $C_L = 15$ pF<br>(Figure 4 and Figure 5) | 0.3 | 1.0 | 1.5 | ns    |
| $t_{PLHD}$ | Differential Propagation Delay Low to High                     |  | 0.3 | 1.1 | 1.5 | ns    |
| $t_{SKD1}$ | Differential Pulse Skew $ t_{PHLD} - t_{PLHD} $ <sup>(5)</sup> |  | 0   | 0.1 | 0.7 | ns    |
| $t_{SKD3}$ | Differential Part to Part Skew <sup>(6)</sup>                  |  | 0   | 0.2 | 1.0 | ns    |
| $t_{SKD4}$ | Differential Part to Part Skew <sup>(7)</sup>                  |  | 0   | 0.4 | 1.2 | ns    |
| $t_{TLH}$  | Transition Low to High Time                                    |  | 0.2 | 0.5 | 1.0 | ns    |
| $t_{THL}$  | Transition High to Low Time                                    |  | 0.2 | 0.5 | 1.0 | ns    |
| $f_{MAX}$  | Maximum Operating Frequency <sup>(8)</sup>                     |  | 200 | 250 |     | MHz   |

- (1) All typicals are given for:  $V_{DD} = +3.3V$  and  $T_A = +25^\circ C$ .
- (2) These parameters are specified by design. The limits are based on statistical analysis of the device performance over PVT (process, voltage, temperature) ranges.
- (3)  $C_L$  includes probe and fixture capacitance.
- (4) Generator waveform for all tests unless otherwise specified:  $f = 1$  MHz,  $Z_O = 50\Omega$ ,  $t_r \leq 1$  ns,  $t_f \leq 1$  ns (10%-90%).
- (5)  $t_{SKD1}$ ,  $|t_{PHLD} - t_{PLHD}|$ , is the magnitude difference in differential propagation delay time between the positive going edge and the negative going edge of the same channel.
- (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  $V_{DD}$  and within  $5^\circ C$  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, 0V to 3V. Output criteria: duty cycle = 45%/55%,  $V_{OD} > 250mV$ . The parameter is specified by design. The limit is based on the statistical analysis of the device over the PVT range by the transitions times ( $t_{TLH}$  and  $t_{THL}$ ).

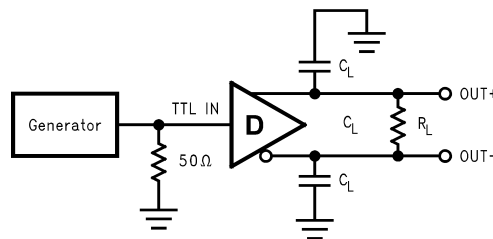
**PARAMETER MEASUREMENT INFORMATION**



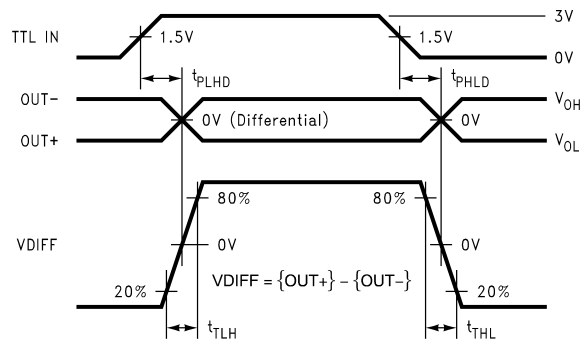
**Figure 2. Differential Driver DC Test Circuit**



**Figure 3. Differential Driver Full Load DC Test Circuit**



**Figure 4. Differential Driver Propagation Delay and Transition Time Test Circuit**



**Figure 5. Differential Driver Propagation Delay and Transition Time Waveforms**

## APPLICATION INFORMATION

**Table 1. Device Pin Descriptions**

| Package Pin Number | Pin Name        | Description                     |
|--------------------|-----------------|---------------------------------|
| <b>SOT-23</b>      |                 |                                 |
| 5                  | TTL IN          | LVTTTL/LVCMOS driver input pins |
| 4                  | OUT+            | Non-inverting driver output pin |
| 3                  | OUT-            | Inverting driver output pin     |
| 2                  | GND             | Ground pin                      |
| 1                  | V <sub>DD</sub> | Power supply pin, +3.3V ± 0.3V  |

### REVISION HISTORY

| Changes from Revision B (April 2013) to Revision C         | Page              |
|--|-------------------|
| • Changed layout of National Data Sheet to TI format ..... | <a href="#">5</a> |

**PACKAGING INFORMATION**

| Orderable Device    | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)         | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples        |
|---------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|----------------|
| DS90LV011ATMF       | NRND          | SOT-23       | DBV             | 5    | 1000        | TBD                     | Call TI                 | Call TI              | -40 to 85    | N01                     |                |
| DS90LV011ATMF/NOPB  | ACTIVE        | SOT-23       | DBV             | 5    | 1000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 85    | N01                     | <b>Samples</b> |
| DS90LV011ATMFX/NOPB | ACTIVE        | SOT-23       | DBV             | 5    | 3000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 85    | N01                     | <b>Samples</b> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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

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**TAPE AND REEL INFORMATION**

**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 |
|---------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| DS90LV011ATMF       | SOT-23       | DBV             | 5    | 1000 | 178.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| DS90LV011ATMF/NOPB  | SOT-23       | DBV             | 5    | 1000 | 178.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| DS90LV011ATMFX/NOPB | SOT-23       | DBV             | 5    | 3000 | 178.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device              | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| DS90LV011ATMF       | SOT-23       | DBV             | 5    | 1000 | 210.0       | 185.0      | 35.0        |
| DS90LV011ATMF/NOPB  | SOT-23       | DBV             | 5    | 1000 | 210.0       | 185.0      | 35.0        |
| DS90LV011ATMFX/NOPB | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |

DBV (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
  - D. Falls within JEDEC MO-178 Variation AA.

DBV (R-PDSO-G5)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
  - D. Publication IPC-7351 is recommended for alternate designs.
  - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

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