

# UT54LVDM031LV Low Voltage Bus-LVDS Quad Driver

Data Sheet

December 2005

www.aeroflex.com/LVDS



## +FEATURES

- ❑ >400.0 Mbps (200 MHz) switching rates
- ❑  $\pm 340\text{mV}$  nominal differential signaling
- ❑ 3.3 V power supply
- ❑ TTL compatible inputs
- ❑ Cold sparing all pins
- ❑ Ultra low power CMOS technology
- ❑ 3.0ns maximum, propagation delay
- ❑ 0.4ns maximum, differential skew
- ❑ Radiation-hardened design; total dose irradiation testing to MIL-STD-883 Method 1019
  - Total-dose: 300 krad(Si)
  - Latchup immune ( $\text{LET} > 100 \text{ MeV-cm}^2/\text{mg}$ )
- ❑ Packaging options:
  - 16-lead flatpack (dual in-line)
- ❑ Standard Microcircuit Drawing 5962-06201
  - QML Q and V compliant part

## INTRODUCTION

The UT54LVDM031LV Quad Bus-LVDS Driver is a quad CMOS differential line driver designed for applications requiring ultra low power dissipation and high data rates. The device is designed to support data rates in excess of 400.0 Mbps (200 MHz) utilizing Low Voltage Differential Signaling (LVDS) technology.

The UT54LVDM031LV accepts low voltage TTL input levels and translates them to low voltage (340mV) differential output signals. In addition, the driver supports a three-state function that may be used to disable the output stage, disabling the load current, and thus dropping the device to an ultra low idle power state.

The UT54LVDM031LV and companion quad line **receiver** **UT54LVDS032LV** provide new alternatives to high power pseudo-ECL devices for high speed point-to-point interface applications.

All pins have Cold Spare buffers. These buffers will be high impedance when  $V_{DD}$  is tied to  $V_{SS}$ .

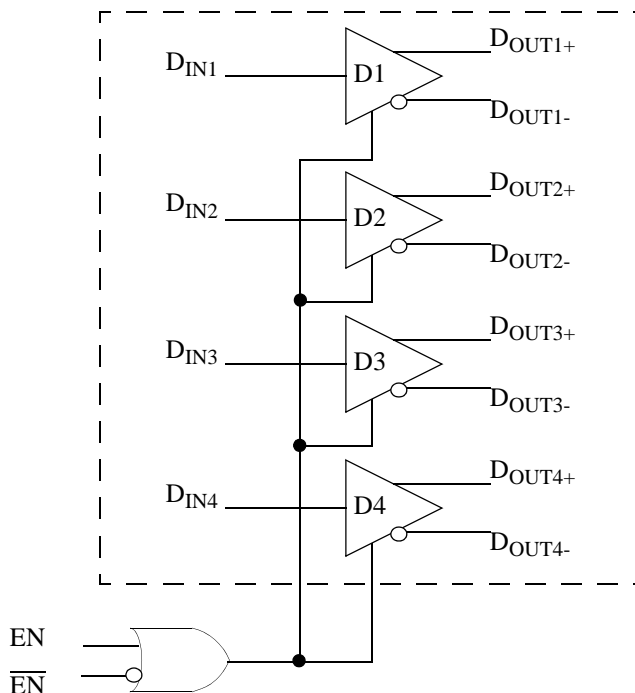


Figure 1. UT54LVDM031LV Bus-LVDS Quad Driver Block Diagram

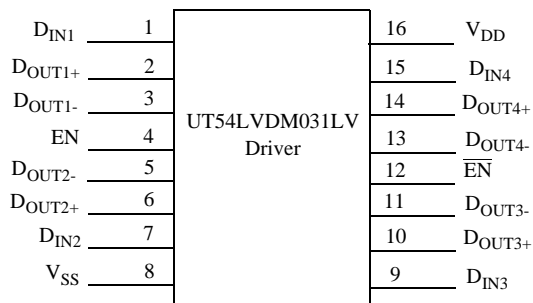


Figure 2. UT54LVDM031LV Pinout

## TRUTH TABLE

Enables		Input	Output	
EN	$\overline{\text{EN}}$	$\text{D}_{\text{IN}}$	$\text{D}_{\text{OUT}+}$	$\text{D}_{\text{OUT}-}$
L	H	X	Z	Z
All other combinations of ENABLE inputs		L	L	H
		H	H	L

## PIN DESCRIPTION

Pin No.	Name	Description
1, 7, 9, 15	$\text{D}_{\text{IN}}$	Driver input pin, TTL/CMOS compatible
2, 6, 10, 14	$\text{D}_{\text{OUT}+}$	Non-inverting driver output pin, LVDS levels
3, 5, 11, 13	$\text{D}_{\text{OUT}-}$	Inverting driver output pin, LVDS levels
4	EN	Active high enable pin, OR-ed with $\overline{\text{EN}}$
12	$\overline{\text{EN}}$	Active low enable pin, OR-ed with EN
16	$\text{V}_{\text{DD}}$	Power supply pin, $+3.3\text{V} \pm 0.3\text{V}$
8	$\text{V}_{\text{SS}}$	Ground pin

## APPLICATIONS INFORMATION

The UT54LVDM031LV Bus-LVDS driver's intended use is for both point-to-point (single termination) and multipoint (double termination) data transmissions over controlled impedance media. The transmission media may be printed-circuit board traces, backplanes, or cables. Note: The ultimate rate and distance of data transfer is dependent upon the attenuation characteristics of the media, the noise coupling to the environment, and other application specific characteristics.

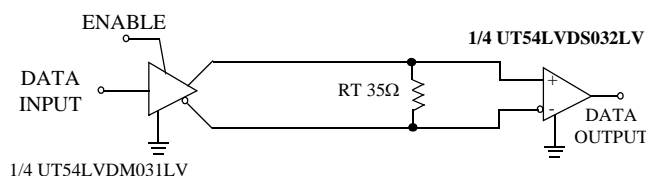
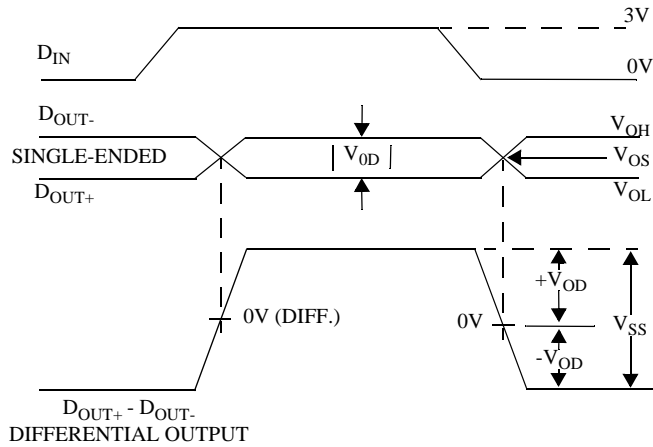


Figure 3. Point-to-Point Application

The UT54LVDM031LV differential line driver is a balanced current source design. A current mode driver, 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 current mode **requires** (as discussed above) that a resistive termination be employed to terminate the signal and to complete the loop as shown in Figure 3. AC or unterminated configurations are not allowed. The 10mA loop current will develop a differential voltage of 350mV across the 35Ω termination resistor which the receiver detects with a 250mV minimum differential noise margin neglecting resistive line losses (driven signal minus receiver threshold (340mV - 100mV = 250mV)). The signal is centered around +1.2V (Driver Offset,  $\text{V}_{\text{OS}}$ ) with respect to ground as shown in Figure 4. **Note:** The steady-state voltage ( $\text{V}_{\text{SS}}$ ) peak-to-peak swing is twice the differential voltage ( $\text{V}_{\text{OD}}$ ) and is typically 700mV.



Note: The footprint of the UT54LVDM031LV is the same as the industry standard Quad Differential (RS-422) Driver.

**Figure 4. Bus-LVDS Driver Output**

## ABSOLUTE MAXIMUM RATINGS<sup>1</sup>

(Referenced to  $V_{SS}$ )

SYMBOL	PARAMETER	LIMITS
$V_{DD}$	DC supply voltage	-0.3 to 4.0V
$V_{IO}$	Voltage on any pin during operation	-0.3 to ( $V_{DD} + 0.3V$ )
	Voltage on any pin during cold spare	-.3 to 4.0V
$T_{STG}$	Storage temperature	-65 to +150°C
$P_D$	Maximum power dissipation	1.25 W
$T_J$	Maximum junction temperature <sup>2</sup>	+150°C
$\Theta_{JC}$	Thermal resistance, junction-to-case <sup>3</sup>	10°C/W
$I_I$	DC input current	±10mA

### Notes:

- Stresses outside the listed absolute maximum ratings may cause permanent damage to the device. This is a stress rating only, and functional operation of the device at these or any other conditions beyond limits indicated in the operational sections of this specification is not recommended. Exposure to absolute maximum rating conditions for extended periods may affect device reliability and performance.
- Maximum junction temperature may be increased to +175°C during burn-in and life test.
- Test per MIL-STD-883, Method 1012.

## RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	LIMITS
$V_{DD}$	Positive supply voltage	3.0 to 3.6V
$T_C$	Case temperature range	-55 to +125°C
$V_{IN}$	DC input voltage	0V to $V_{DD}$

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 cases between 20 MHz - 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 design. 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 Three-State function allows the driver outputs to be disabled, thus obtaining an even lower power state when the transmission of data is not required.

**DC ELECTRICAL CHARACTERISTICS<sup>1,2</sup>**(V<sub>DD</sub> = 3.3V ± 0.3V; -55°C < T<sub>C</sub> < +125°C)

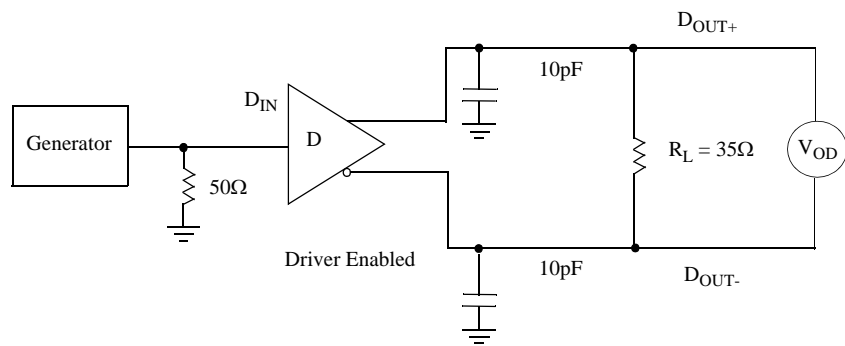
SYMBOL	PARAMETER	CONDITION	MIN	MAX	UNIT
V <sub>IH</sub>	High-level input voltage	(TTL)	2.0	V <sub>DD</sub>	V
V <sub>IL</sub>	Low-level input voltage	(TTL)	V <sub>SS</sub>	0.8	V
V <sub>OL</sub>	Low-level output voltage	R <sub>L</sub> = 35Ω	0.855		V
V <sub>OH</sub>	High-level output voltage	R <sub>L</sub> = 35Ω		1.750	V
I <sub>IN</sub>	Input leakage current	V <sub>IN</sub> = V <sub>DD</sub> or GND, V <sub>DD</sub> = 3.6V	-10	+10	μA
I <sub>CS</sub>	Cold Spare Leakage Current	V <sub>IN</sub> =3.6V, V <sub>DD</sub> =V <sub>SS</sub>	-20	+20	μA
V <sub>OD</sub> <sup>1</sup>	Differential Output Voltage	R <sub>L</sub> = 35Ω (figure 5)	250	400	mV
ΔV <sub>OD</sub> <sup>1</sup>	Change in Magnitude of V <sub>OD</sub> for Complementary Output States	R <sub>L</sub> = 35Ω (figure 5)		35	mV
V <sub>OS</sub>	Offset Voltage	R <sub>L</sub> = 35Ω, $(V_{OS} = \frac{V_{OH} + V_{OL}}{2})$	1.055	1.550	V
ΔV <sub>OS</sub>	Change in Magnitude of V <sub>OS</sub> for Complementary Output States	R <sub>L</sub> = 35Ω (figure 5)		35	mV
V <sub>CL</sub> <sup>3</sup>	Input clamp voltage	I <sub>CL</sub> = +18mA		-1.5	V
I <sub>OS</sub> <sup>2,3</sup>	Output Short Circuit Current	V <sub>IN</sub> = V <sub>DD</sub> , V <sub>OUT+</sub> = 0V or V <sub>IN</sub> = GND, V <sub>OUT-</sub> = 0V		4.5	mA
I <sub>OZ</sub> <sup>3</sup>	Output Three-State Current	EN = 0.8V and $\overline{EN}$ = 2.0 V, V <sub>OUT</sub> = 0V or V <sub>DD</sub> , V <sub>DD</sub> = 3.6V	-10	+10	μA
I <sub>CCL</sub> <sup>3</sup>	Loaded supply current, drivers enabled	R <sub>L</sub> = 35Ω all channels V <sub>IN</sub> = V <sub>DD</sub> or V <sub>SS</sub> (all inputs)		60.0	mA
I <sub>CCZ</sub> <sup>3</sup>	Loaded supply current, drivers disabled	D <sub>IN</sub> = V <sub>DD</sub> or V <sub>SS</sub> EN = V <sub>SS</sub> , $\overline{EN}$ = V <sub>DD</sub>		6.0	mA

**Notes:**

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 differential voltages.

2. Output short circuit current (I<sub>OS</sub>) is specified as magnitude only, minus sign indicates direction only. Only one output at a time for 1 second.

3. Guaranteed by characterization.



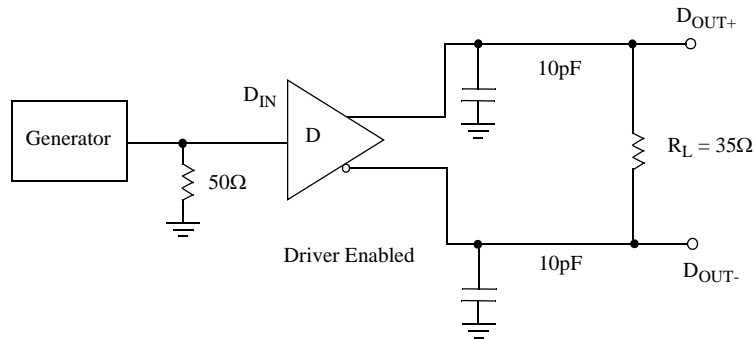
**Figure 5. Driver  $V_{OD}$  and  $V_{OS}$  Test Circuit or Equivalent Circuit**

**AC SWITCHING CHARACTERISTICS**<sup>1, 2, 3</sup>(V<sub>DD</sub> = +3.3V ± 0.3V, T<sub>A</sub> = -55 °C to +125 °C)

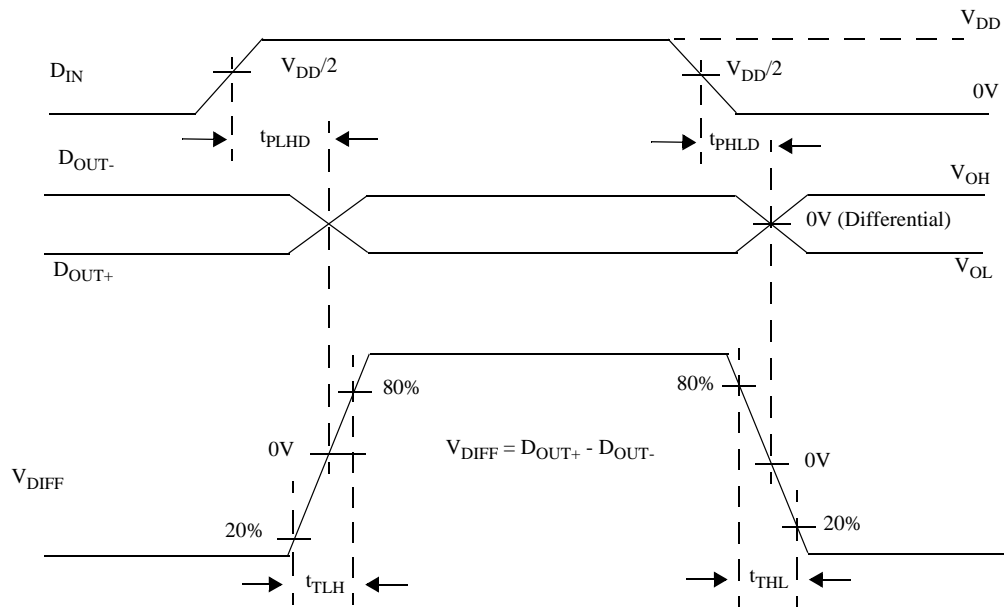
SYMBOL	PARAMETER	MIN	MAX	UNIT
t <sub>PHLD</sub> <sup>6</sup>	Differential Propagation Delay High to Low (figures 6 and 7)	0.5	1.8	ns
t <sub>PLHD</sub> <sup>6</sup>	Differential Propagation Delay Low to High (figures 6 and 7)	0.5	1.8	ns
t <sub>SKD</sub>	Differential Skew (t <sub>PHLD</sub> - t <sub>PLHD</sub> ) (figures 6 and 7)	0	0.4	ns
t <sub>SK1</sub>	Channel-to-Channel Skew <sup>1</sup> (figures 6 and 7)	0	0.5	ns
t <sub>SK2</sub> <sup>5</sup>	Chip-to-Chip Skew (figure 6 and 7)		1.3	ns
t <sub>TLH</sub> <sup>4</sup>	Rise Time (figures 6 and 7)		1.5	ns
t <sub>THL</sub> <sup>4</sup>	Fall Time (figures 6 and 7)		1.5	ns
t <sub>PHZ</sub>	Disable Time High to Z (figures 8 and 9)		5.0	ns
t <sub>PLZ</sub>	Disable Time Low to Z (figures 8 and 9)		5.0	ns
t <sub>PZH</sub>	Enable Time Z to High (figures 8 and 9)		7.0	ns
t <sub>PZL</sub>	Enable Time Z to Low (figures 8 and 9)		7.0	ns

**Notes:**

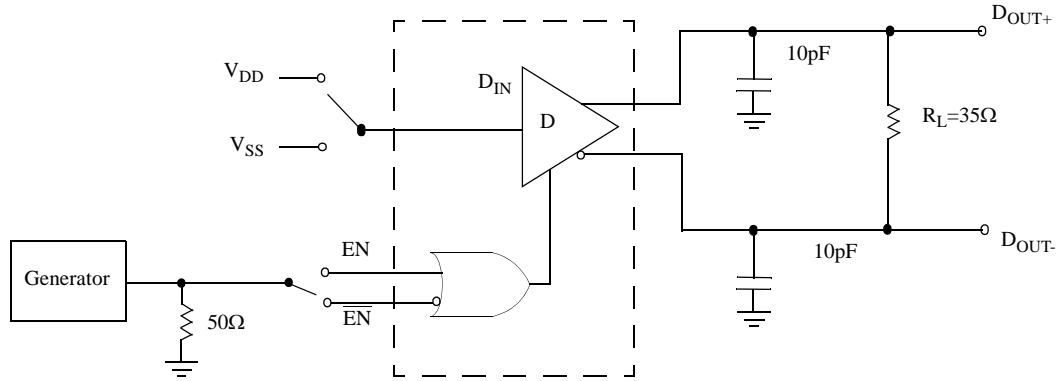
1. Channel-to-Channel Skew is defined as the difference between the propagation delay of the channel and the other channels in the same chip with an event on the inputs.
2. Generator waveform for all tests unless otherwise specified: f = 1 MHz, Z<sub>O</sub> = 50, t<sub>r</sub> ≤ 1ns, and t<sub>f</sub> ≤ 1ns.
3. C<sub>L</sub> includes probe and jig capacitance.
4. Guaranteed by characterization
5. Chip to Chip Skew is defined as the difference between the minimum and maximum specified differential propagation delays.
6. May be tested at higher load capacitance and the limit interpolated from characterization data to guarantee this parameter.



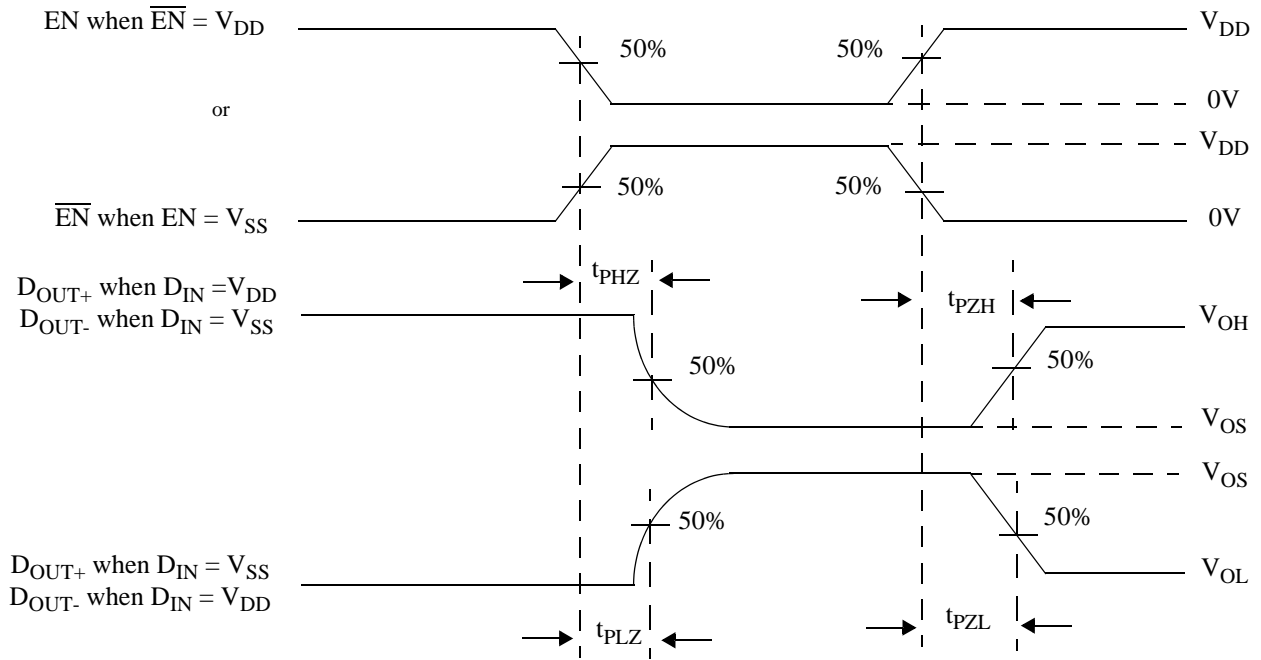
**Figure 6. Driver Propagation Delay and Transition Time Test Circuit or Equivalent Circuit**



**Figure 7. Driver Propagation Delay and Transition Time Waveforms**



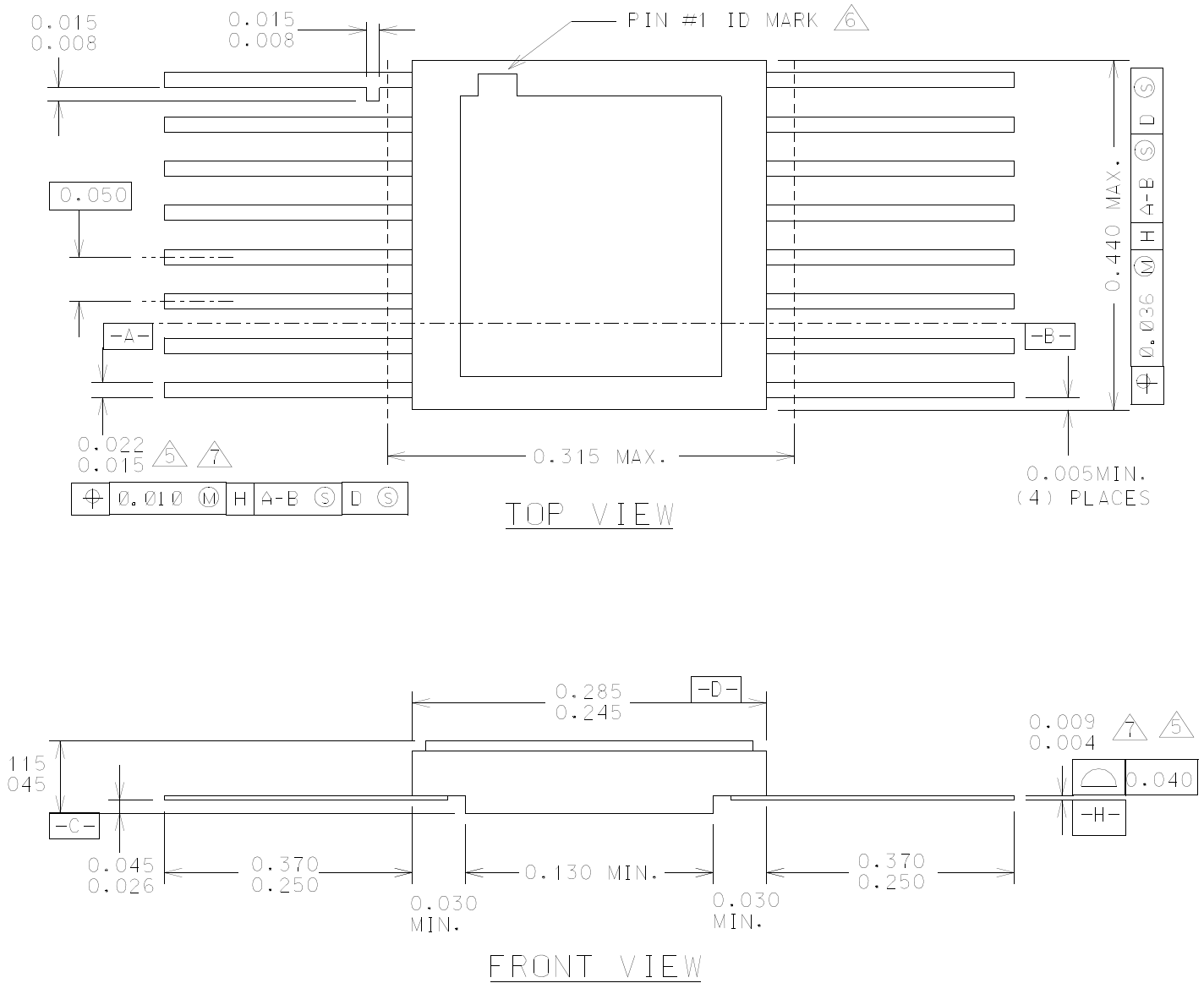
**Figure 8. Driver Three-State Delay Test Circuit or Equivalent Circuit**



**Figure 9. Driver Three-State Delay Waveform**



## PACKAGING



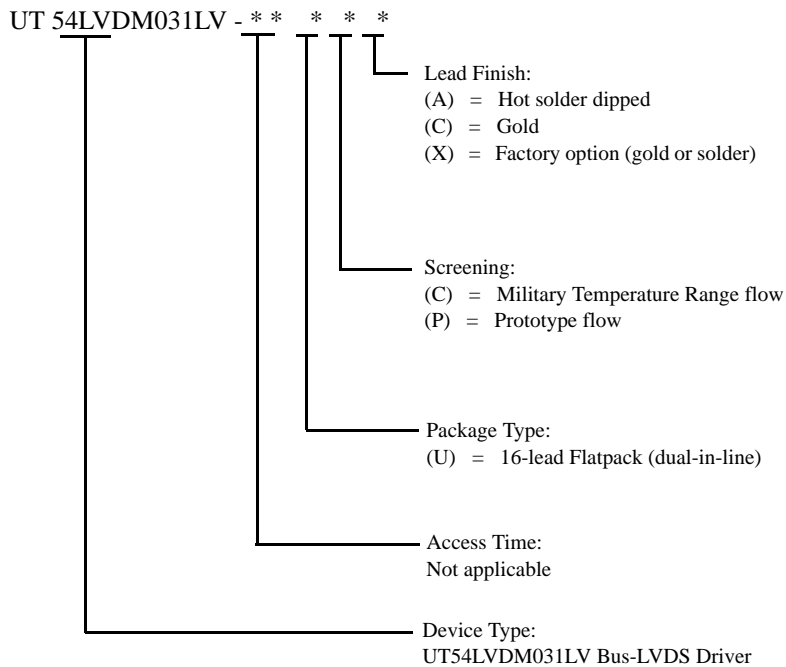
**Notes:**

1. All exposed metalized areas are gold plated over electroplated nickel per MIL-PRF-38535.
2. The lid is electrically connected to VSS.
3. Lead finishes are in accordance to MIL-PRF-38535.
4. Package dimensions and symbols are similar to MIL-STD-1835 variation F-5A.
- △ Lead position and coplanarity are not measured.
- △ ID mark symbol is vendor option.
- △ With solder, increase maximum by 0.003.

### Figure 10. 16-pin Ceramic Flatpack

## ORDERING INFORMATION

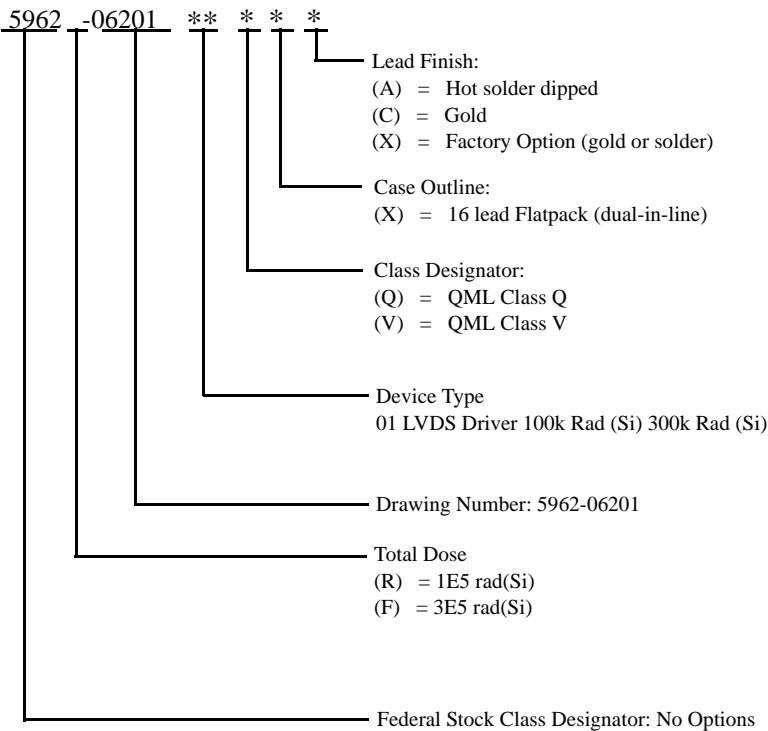
### UT54LVDM031LV BUS-LVDS QUAD DRIVER:



#### Notes:

1. Lead finish (A,C, or X) must be specified.
2. If an "X" is specified when ordering, then the part marking will match the lead finish and will be either "A" (solder) or "C" (gold).
3. Prototype flow per Aeroflex Colorado Springs Manufacturing Flows Document. Tested at 25°C only. Lead finish is GOLD ONLY. Radiation neither tested nor guaranteed.
4. Military Temperature Range flow per Aeroflex Colorado Springs Manufacturing Flows Document. Devices are tested at -55°C, room temp, and 125°C. Radiation neither tested nor guaranteed.

**UT54LVDM031LV QUAD BUS-LVDS DRIVER: SMD**



**Notes:**

- 1.Lead finish (A,C, or X) must be specified.
- 2.If an “X” is specified when ordering, part marking will match the lead finish and will be either “A” (solder) or “C” (gold).
- 3.Total dose radiation must be specified when ordering. QML Q and QML V not available without radiation hardening.

**COLORADO**

Toll Free: 800-645-8862  
Fax: 719-594-8468

**INTERNATIONAL**

Tel: 805-778-9229  
Fax: 805-778-1980

**NORTHEAST**

Tel: 603-888-3975  
Fax: 603-888-4585

**SE AND MID-ATLANTIC**

Tel: 321-951-4164  
Fax: 321-951-4254

**WEST COAST**

Tel: 949-362-2260  
Fax: 949-362-2266

**CENTRAL**

Tel: 719-594-8017  
Fax: 719-594-8468

[www.aeroflex.com](http://www.aeroflex.com)    [info-ams@aeroflex.com](mailto:info-ams@aeroflex.com)

Aeroflex Colorado Springs, Inc. reserves the right to make changes to any products and services herein at any time without notice. Consult Aeroflex or an authorized sales representative to verify that the information in this data sheet is current before using this product. Aeroflex does not assume any responsibility or liability arising out of the application or use of any product or service described herein, except as expressly agreed to in writing by Aeroflex; nor does the purchase, lease, or use of a product or service from Aeroflex convey a license under any patent rights, copyrights, trademark rights, or any other of the intellectual rights of Aeroflex or of third parties.



Our passion for performance is defined by three attributes represented by these three icons: solution-minded, performance-driven and customer-focused