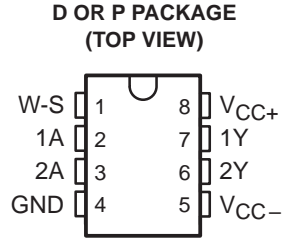


# uA9636AC

## DUAL LINE DRIVER WITH ADJUSTABLE SLEW RATE

SLLS110B – OCTOBER 1980 – REVISED MAY 1995

- Meets or Exceeds the Requirements of ANSI Standards EIA/TIA-423-B and -232-E and ITU Recommendations V.10 and V.28
- Output Slew Rate Control
- Output Short-Circuit-Current Limiting
- Wide Supply Voltage Range
- 8-Pin Package
- Designed to Be Interchangeable With National DS9636A

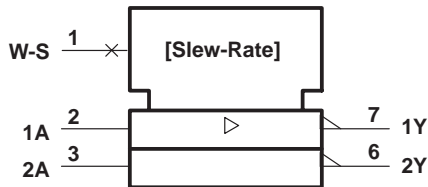


### description

The uA9636AC is a dual, single-ended line driver designed to meet ANSI Standards EIA/TIA-423-B and EIA/TIA-232-E and ITU Recommendations V.10 and V.28. The slew rates of both amplifiers are controlled by a single external resistor,  $R_{(WS)}$ , connected between the wave-shape-control (W-S) terminal and GND. Output current limiting is provided. Inputs are compatible with TTL and CMOS and are diode protected against negative transients. This device operates from  $\pm 12$  V and is supplied in an 8-pin package.

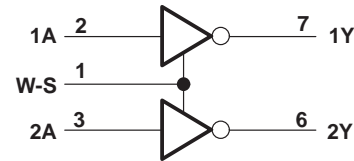
The uA9636AC is characterized for operation from 0°C to 70°C.

### logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

### logic diagram



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS  
INSTRUMENTS**

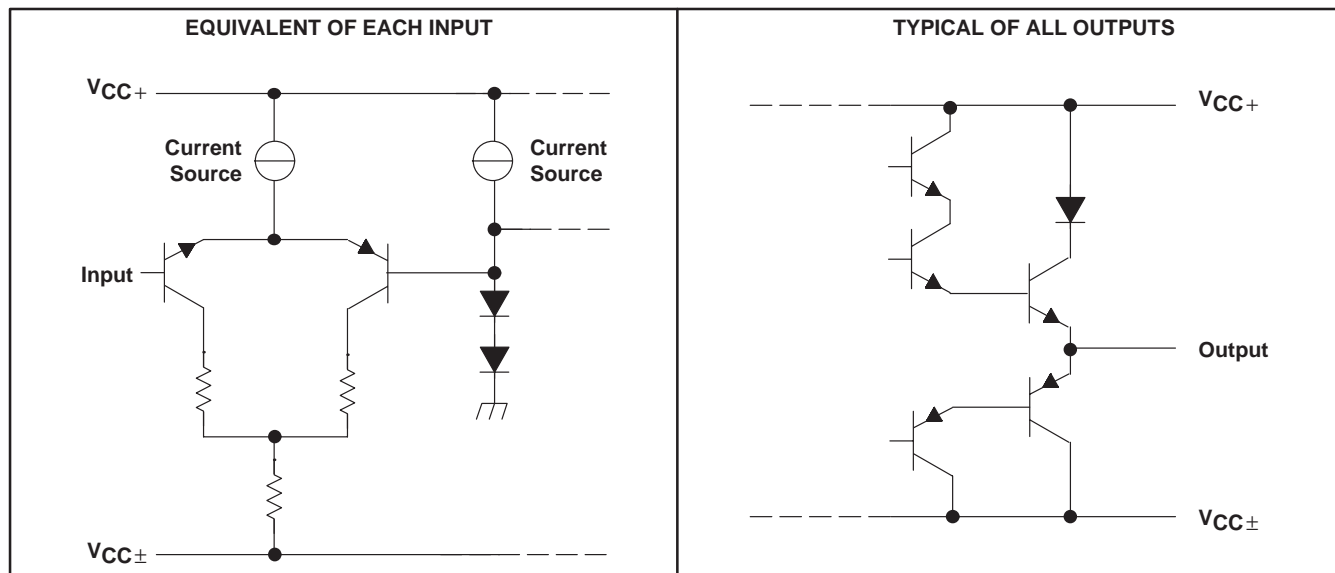
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# uA9636AC DUAL LINE DRIVER WITH ADJUSTABLE SLEW RATE

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## schematics of inputs and outputs



## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

|  |                              |
|--|------------------------------|
| Positive supply voltage range, $V_{CC+}$ (see Note 1)        | $V_{CC-}$ to 15 V            |
| Negative supply voltage range, $V_{CC-}$                     | 0.5 V to -15 V               |
| Output voltage, $V_O$  | $\pm 15$ V                   |
| Output current, $I_O$  | $\pm 150$ mA                 |
| Continuous total power dissipation                           | See Dissipation Rating Table |
| Operating free-air temperature range, $T_A$                  | 0°C to 70°C                  |
| Storage temperature range, $T_{stg}$                         | -65°C to 150°C               |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds | 260°C                        |

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: All voltage values are with respect to the network ground terminal.

DISSIPATION RATING TABLE

| PACKAGE | $T_A \leq 25^\circ\text{C}$<br>POWER RATING | DERATING FACTOR<br>ABOVE $T_A = 25^\circ\text{C}$ | $T_A = 70^\circ\text{C}$<br>POWER RATING |
|---------|---|---|--|
| D       | 725 mW                                      | 5.8 mW/°C   | 464 mW                                   |
| P       | 1000 mW                                     | 8.0 mW/°C   | 640 mW                                   |

## recommended operating conditions

|                                       | MIN   | NOM | MAX   | UNIT       |
|---------------------------------------|-------|-----|-------|------------|
| Positive supply voltage, $V_{CC+}$    | 10.8  | 12  | 13.2  | V          |
| Negative supply voltage, $V_{CC-}$    | -10.8 | -12 | -13.2 | V          |
| High-level input voltage, $V_{IH}$    | 2     |     |       | V          |
| Low-level input voltage, $V_{IL}$     |       |     | 0.8   | V          |
| Wave-shaping resistor, $R_{(WS)}$     | 10    |     | 1000  | k $\Omega$ |
| Operating free-air temperature, $T_A$ | 0     |     | 70    | °C         |



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# uA9636AC

## DUAL LINE DRIVER WITH ADJUSTABLE SLEW RATE

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**electrical characteristics over recommended ranges of free-air temperature, supply voltage, and wave-shaping resistance (unless otherwise noted)**

| PARAMETER        |   | TEST CONDITIONS   |                                    | MIN             | TYP <sup>†</sup> | MAX  | UNIT |
|------------------|---|---|------------------------------------|-----------------|------------------|------|------|
| V <sub>IK</sub>  | Input clamp voltage                       | I <sub>I</sub> = -15 mA                                 |                                    | -1.1            | -1.5             |      | V    |
| V <sub>OH</sub>  | High-level output voltage                 | V <sub>I</sub> = 0.8 V                                  | R <sub>L</sub> = ∞                 | 5               | 5.6              | 6    | V    |
|                  |   |   | R <sub>L</sub> = 3 kΩ to GND       | 5               | 5.6              | 6    |      |
|                  |   |   | R <sub>L</sub> = 450 Ω to GND      | 4               | 5.4              | 6    |      |
| V <sub>OL</sub>  | Low-level output voltage                  | V <sub>I</sub> = 2 V                                    | R <sub>L</sub> = ∞                 | -6 <sup>‡</sup> | -5.7             | -5   | V    |
|                  |   |   | R <sub>L</sub> = 3 kΩ to GND       | -6 <sup>‡</sup> | -5.6             | -5   |      |
|                  |   |   | R <sub>L</sub> = 450 Ω to GND      | -6 <sup>‡</sup> | -5.4             | -4   |      |
| I <sub>IH</sub>  | High-level input current                  | V <sub>I</sub> = 2.4 V                                  |                                    |                 |                  | 10   | μA   |
|                  |   | V <sub>I</sub> = 5.5 V                                  |                                    |                 |                  | 100  |      |
| I <sub>IL</sub>  | Low-level input current                   | V <sub>I</sub> = 0.4 V                                  |                                    |                 | -20              | -80  | μA   |
| I <sub>O</sub>   | Output current (power off)                | V <sub>CC±</sub> = 0, V <sub>O</sub> = ±6 V             |                                    |                 |                  | ±100 | μA   |
| I <sub>OS</sub>  | Short-circuit output current <sup>§</sup> | V <sub>I</sub> = 2 V                                    |                                    | 15              | 25               | 150  | mA   |
|                  |   | V <sub>I</sub> = 0                                      |                                    | -15             | -40              | -150 |      |
| r <sub>O</sub>   | Output resistance                         | R <sub>L</sub> = 450 Ω                                  |                                    |                 | 25               | 50   | Ω    |
| I <sub>CC+</sub> | Positive supply current                   | V <sub>CC</sub> = ±12 V,<br>R <sub>(WS)</sub> = 100 kΩ, | V <sub>I</sub> = 0,<br>Output open |                 | 13               | 18   | mA   |
| I <sub>CC-</sub> | Negative supply current                   | V <sub>CC</sub> = ±12 V,<br>R <sub>(WS)</sub> = 100 kΩ, | V <sub>I</sub> = 0,<br>Output open |                 | -13              | -18  | mA   |

<sup>†</sup> All typical values are at V<sub>CC</sub> = ±12 V, T<sub>A</sub> = 25°C.

<sup>‡</sup> The algebraic convention, in which the less-positive (more-negative) limit is designated as minimum, is used in this data sheet for logic voltage levels, e.g., when -5 V is the maximum, the minimum is a more-negative voltage.

<sup>§</sup> Not more than one output should be shorted to ground at a time.

### switching characteristics, V<sub>CC±</sub> = ±12 V, T<sub>A</sub> = 25°C (see Figure 1)

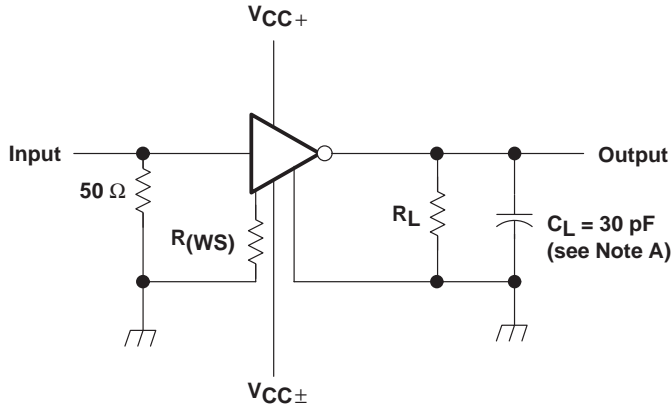
| PARAMETER        |  | TEST CONDITIONS          |                        | MIN                        | TYP | MAX | UNIT |    |
|------------------|--|--------------------------|------------------------|----------------------------|-----|-----|------|----|
| t <sub>TLH</sub> | Transition time, low- to high-level output | R <sub>L</sub> = 450 kΩ, | C <sub>L</sub> = 30 pF | R <sub>(WS)</sub> = 10 kΩ  | 0.8 | 1.1 | 1.4  | μs |
|                  |  |                          |                        | R <sub>(WS)</sub> = 100 kΩ | 8   | 11  | 14   |    |
|                  |  |                          |                        | R <sub>(WS)</sub> = 500 kΩ | 40  | 55  | 70   |    |
|                  |  |                          |                        | R <sub>(WS)</sub> = 1 MΩ   | 80  | 110 | 140  |    |
| t <sub>THL</sub> | Transition time, high- to low-level output | R <sub>L</sub> = 450 kΩ, | C <sub>L</sub> = 30 pF | R <sub>(WS)</sub> = 10 kΩ  | 0.8 | 1.1 | 1.4  | μs |
|                  |  |                          |                        | R <sub>(WS)</sub> = 100 kΩ | 8   | 11  | 14   |    |
|                  |  |                          |                        | R <sub>(WS)</sub> = 500 kΩ | 40  | 55  | 70   |    |
|                  |  |                          |                        | R <sub>(WS)</sub> = 1 MΩ   | 80  | 110 | 140  |    |



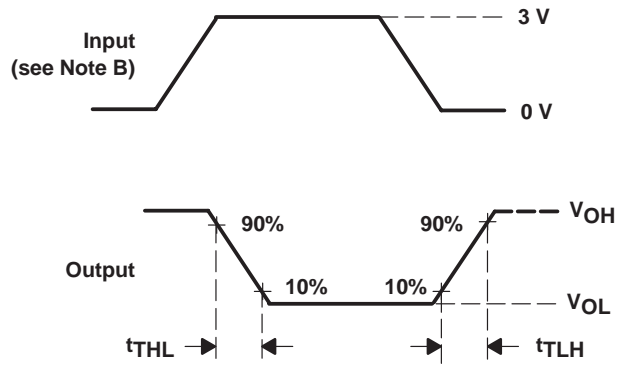
# uA9636AC DUAL LINE DRIVER WITH ADJUSTABLE SLEW RATE

SLLS110B – OCTOBER 1980 – REVISED MAY 1995

## PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE WAVEFORMS

- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. The input pulse is supplied by a generator having the following characteristics:  $t_r \leq 10$  ns,  $t_f \leq 10$  ns,  $Z_0 = 50 \Omega$ ,  $PRR \leq 1$  kHz, duty cycle = 50%.

Figure 1. Test Circuit and Voltage Waveforms

## TYPICAL CHARACTERISTICS

OUTPUT VOLTAGE  
vs  
INPUT VOLTAGE

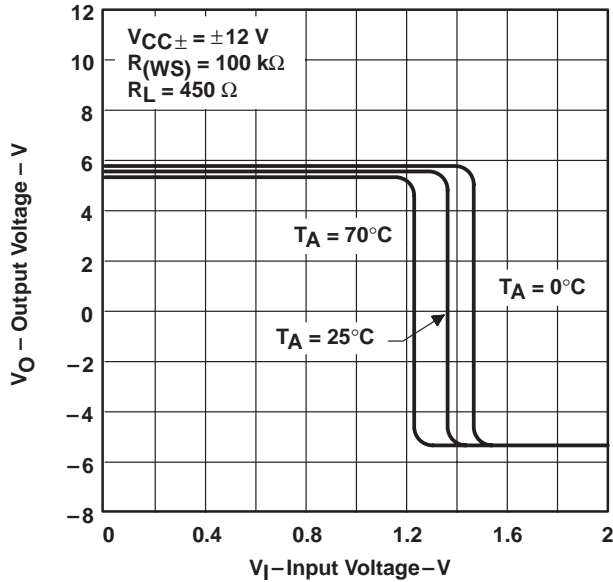


Figure 2

INPUT CURRENT  
vs  
INPUT VOLTAGE

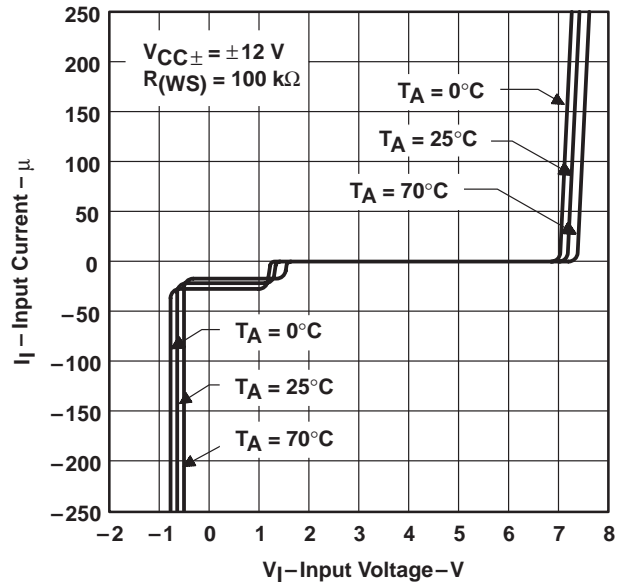
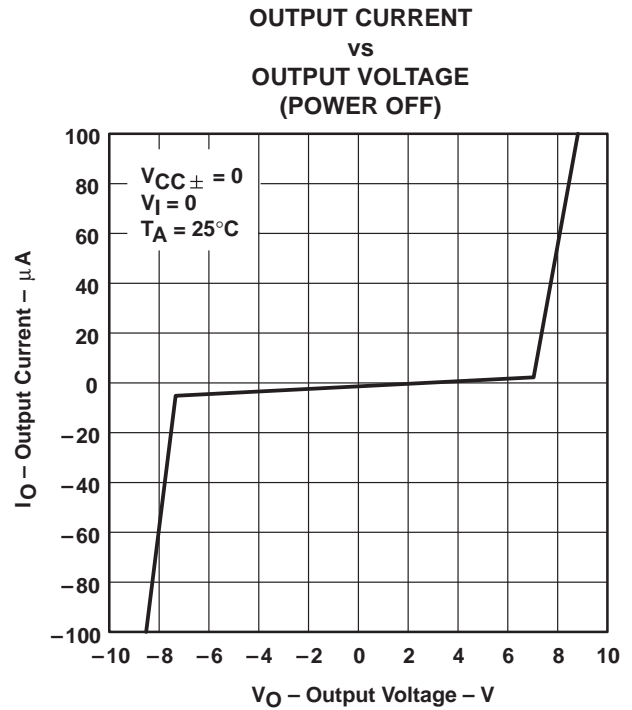
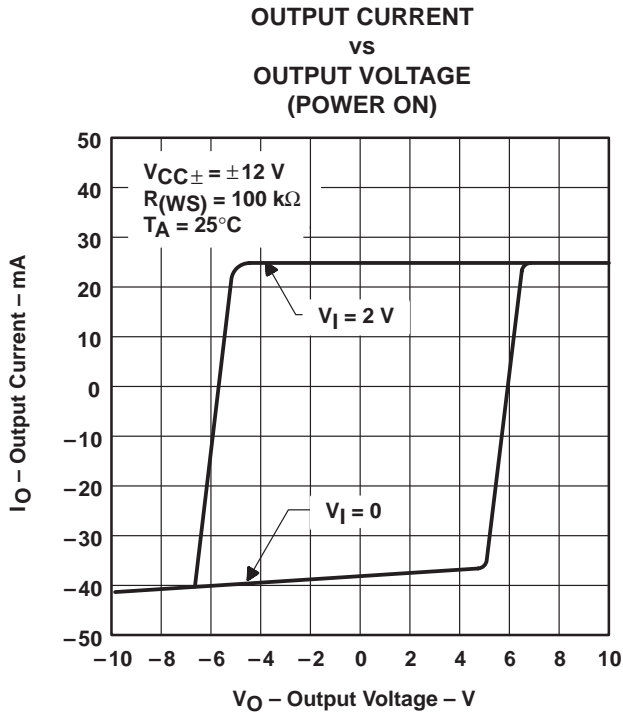
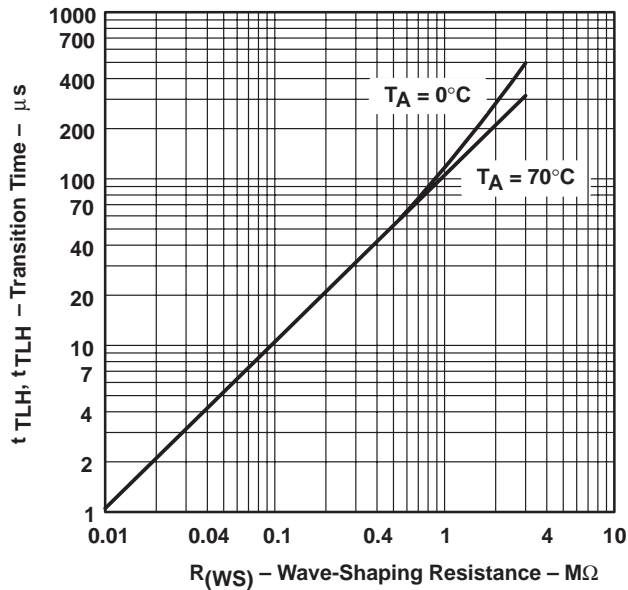


Figure 3

**TYPICAL CHARACTERISTICS**



**TRANSITION TIME  
vs  
WAVE-SHAPING RESISTANCE**



# uA9636AC DUAL LINE DRIVER WITH ADJUSTABLE SLEW RATE

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## APPLICATION INFORMATION

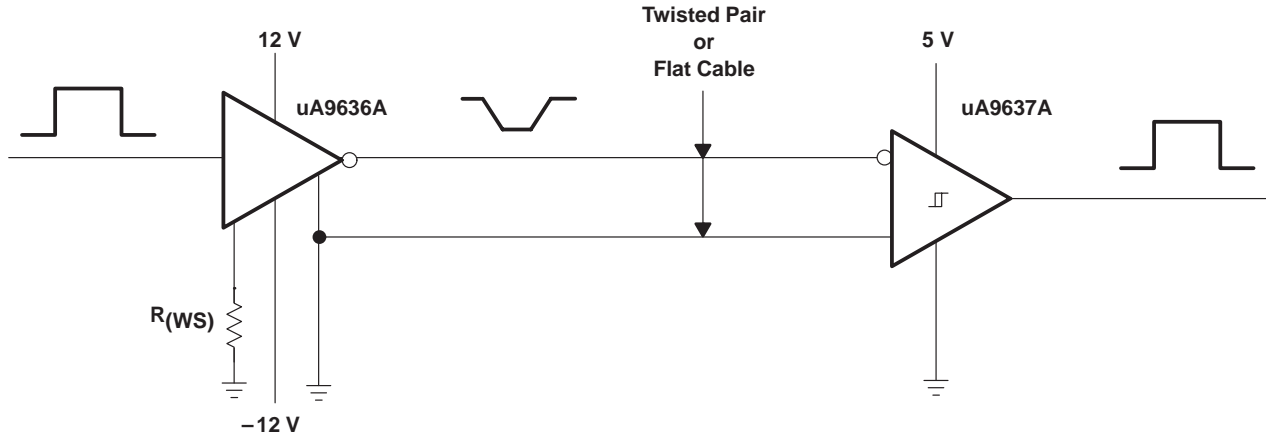


Figure 7. EIA/TIA-423-B System Application

**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| UA9636ACD        | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| UA9636ACDE4      | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| UA9636ACDG4      | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| UA9636ACDR       | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| UA9636ACDRE4     | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| UA9636ACDRG4     | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| UA9636ACJG       | OBSOLETE              | CDIP         | JG              | 8    |             | TBD                     | Call TI          | Call TI                      |
| UA9636ACP        | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| UA9636ACPE4      | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |

<sup>(1)</sup> 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.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

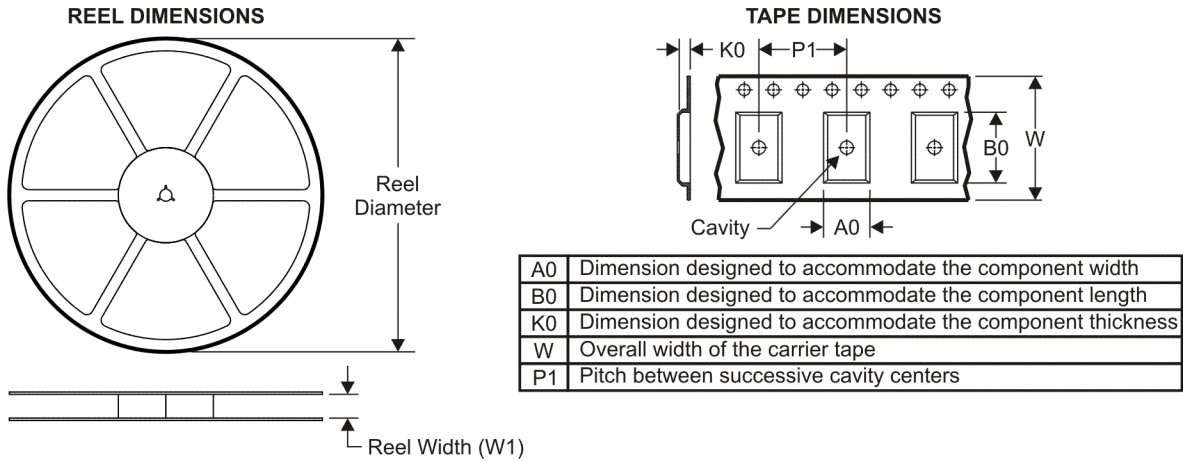
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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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 |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| UA9636ACDR | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 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) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| UA9636ACDR | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |

JG (R-GDIP-T8)

CERAMIC DUAL-IN-LINE



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. This package can be hermetically sealed with a ceramic lid using glass frit.  
 D. Index point is provided on cap for terminal identification.  
 E. Falls within MIL STD 1835 GDIP1-T8

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Falls within JEDEC MS-001 variation BA.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - $\triangle C$  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.
  - $\triangle D$  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AA.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. 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. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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| DLP® Products          | <a href="http://www.dlp.com">www.dlp.com</a>   |
| DSP                    | <a href="http://dsp.ti.com">dsp.ti.com</a>   |
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| Interface              | <a href="http://interface.ti.com">interface.ti.com</a>                               |
| Logic                  | <a href="http://logic.ti.com">logic.ti.com</a>                                       |
| Power Mgmt             | <a href="http://power.ti.com">power.ti.com</a>                                       |
| Microcontrollers       | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a>                   |
| RFID                   | <a href="http://www.ti-rfid.com">www.ti-rfid.com</a>                                 |
| OMAP Mobile Processors | <a href="http://www.ti.com/omap">www.ti.com/omap</a>                                 |
| Wireless Connectivity  | <a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a> |

### Applications

|                               |  |
|-------------------------------|--|
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| Computers and Peripherals     | <a href="http://www.ti.com/computers">www.ti.com/computers</a>                           |
| Consumer Electronics          | <a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>                   |
| Energy and Lighting           | <a href="http://www.ti.com/energy">www.ti.com/energy</a>                                 |
| Industrial                    | <a href="http://www.ti.com/industrial">www.ti.com/industrial</a>                         |
| Medical                       | <a href="http://www.ti.com/medical">www.ti.com/medical</a>                               |
| Security                      | <a href="http://www.ti.com/security">www.ti.com/security</a>                             |
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