

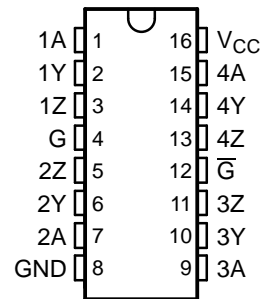
## FEATURES

- Meets or Exceeds the Requirements of ANSI TIA/EIA-422-B and ITU
- Operates From a Single 5-V Supply
- TTL Compatible
- Complementary Outputs
- High Output Impedance in Power-Off Conditions
- Complementary Output-Enable Inputs

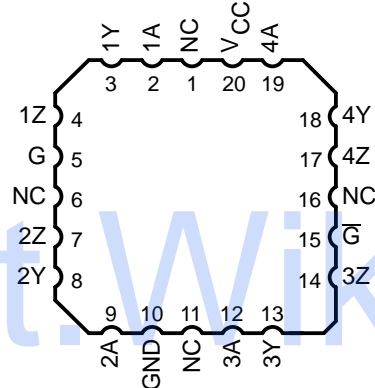
## DESCRIPTION/ORDERING INFORMATION

The AM26LS31 is a quadruple complementary-output line driver designed to meet the requirements of ANSI TIA/EIA-422-B and ITU (formerly CCITT) Recommendation V.11. The 3-state outputs have high-current capability for driving balanced lines such as twisted-pair or parallel-wire transmission lines, and they are in the high-impedance state in the power-off condition. The enable function is common to all four drivers and offers the choice of an active-high or active-low enable (G,  $\bar{G}$ ) input. Low-power Schottky circuitry reduces power consumption without sacrificing speed.

D, DB, N, NS, J, OR W PACKAGE  
(TOP VIEW)



FK PACKAGE  
(TOP VIEW)



## ORDERING INFORMATION

T <sub>A</sub>	PACKAGE (1)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	PDIP – N	Tube	AM26LS31CN	AM26LS31CN
	SOIC – D	Tube	AM26LS31CD	AM26LS31C
		Tape and reel	AM26LS31CDR	
	SOP – NS	Tape and reel	AM26LS31CNSR	26LS31
SSOP – DB	Tape and reel	AM26LS31CDBR	SA31C	
–55°C to 125°C	CDIP – J	Tube	AM26LS31MJB	AM26LS31MJB
	LCCC – FK	Tube	AM26LS31MFKB	AM26LS31MFKB
	CFP – W	Tube	AM26LS31MWB	AM26LS31MWB

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).



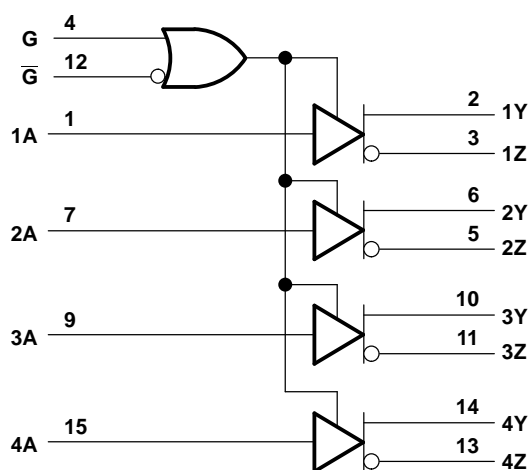
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

FUNCTION TABLE<sup>(1)</sup>  
 (EACH DRIVER)

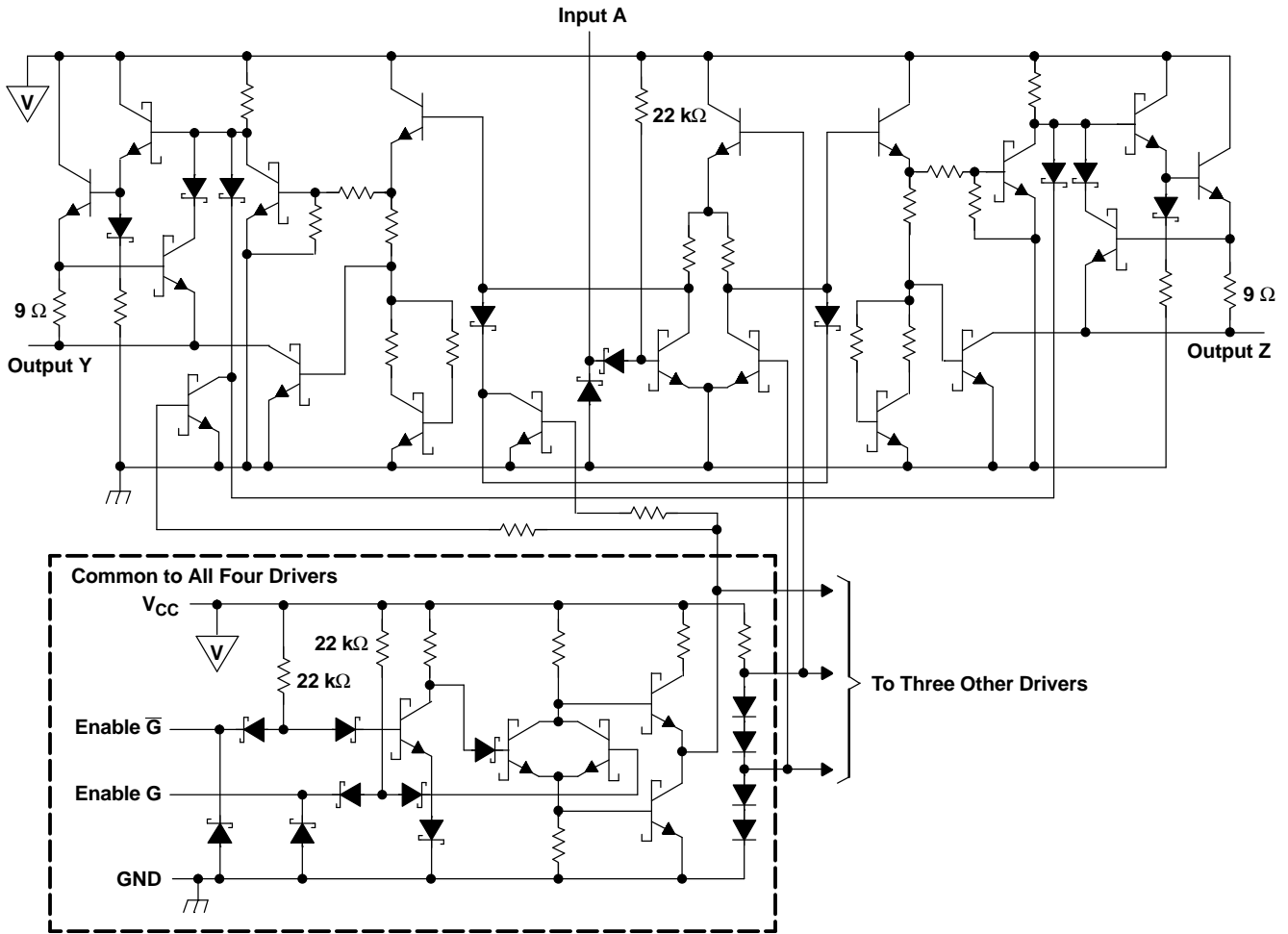
INPUT A	ENABLES		OUTPUTS	
	G	$\bar{G}$	Y	Z
H	H	X	H	L
L	H	X	L	H
H	X	L	H	L
L	X	L	L	H
X	L	H	Z	Z

(1) H = high level, L = low level,  
 X = irrelevant,  
 Z = high impedance (off)

LOGIC DIAGRAM (POSITIVE LOGIC)



**SCHEMATIC (EACH DRIVER)**



All resistor values are nominal.

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

over operating free-air temperature range (unless otherwise noted)

		MIN	MAX	UNIT
$V_{CC}$	Supply voltage <sup>(2)</sup>		7	V
$V_I$	Input voltage		7	V
	Output off-state voltage		5.5	V
$\theta_{JA}$	Package thermal impedance <sup>(3)</sup>	D package	73	°C/W
		DB package	82	
		N package	67	
		NS package	64	
	Lead temperature 1,6 mm (1/16 in) from case for 10 s		260	°C
	Lead temperature 1,6 mm (1/16 in) from case for 60 s	J package	300	°C
$T_{stg}$	Storage temperature range	-65	150	°C

- (1) 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.
- (2) All voltage values, except differential output voltage  $V_{OD}$ , are with respect to network GND.
- (3) The package thermal impedance is calculated in accordance with JESD 51-7.

# AM26LS31C, AM26LS31M QUADRUPLE DIFFERENTIAL LINE DRIVER

SLLS114I–JANUARY 1979–REVISED FEBRUARY 2006

## Recommended Operating Conditions

			MIN	NOM	MAX	UNIT
V <sub>CC</sub>	Supply voltage	AM26LS31C	4.75	5	5.25	V
		AM26LS31M	4.5	5	5.5	
V <sub>IH</sub>	High-level input voltage		2			V
V <sub>IL</sub>	Low-level input voltage				0.8	V
I <sub>OH</sub>	High-level output current				–20	mA
I <sub>OL</sub>	Low-level output current				20	mA
T <sub>A</sub>	Operating free-air temperature	AM26LS31C	0		70	°C
		AM26LS31M	–55		125	

## Electrical Characteristics<sup>(1)</sup>

over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP <sup>(2)</sup>	MAX	UNIT
V <sub>IK</sub>	Input clamp voltage	V <sub>CC</sub> = MIN,	I <sub>I</sub> = –18 mA			–1.5	V
V <sub>OH</sub>	High-level output voltage	V <sub>CC</sub> = MIN,	I <sub>OH</sub> = –20 mA	2.5			V
V <sub>OL</sub>	Low-level output voltage	V <sub>CC</sub> = MIN,	I <sub>OL</sub> = 20 mA			0.5	V
I <sub>OZ</sub>	Off-state (high-impedance-state) output current	V <sub>CC</sub> = MIN,	V <sub>O</sub> = 0.5 V			–20	μA
			V <sub>O</sub> = 2.5 V			20	
I <sub>I</sub>	Input current at maximum input voltage	V <sub>CC</sub> = MAX,	V <sub>I</sub> = 7 V			0.1	mA
I <sub>IH</sub>	High-level input current	V <sub>CC</sub> = MAX,	V <sub>I</sub> = 2.7 V			20	μA
I <sub>IL</sub>	Low-level input current	V <sub>CC</sub> = MAX,	V <sub>I</sub> = 0.4 V			–0.36	mA
I <sub>OS</sub>	Short-circuit output current <sup>(3)</sup>	V <sub>CC</sub> = MAX		–30		–150	mA
I <sub>CC</sub>	Supply current	V <sub>CC</sub> = MAX,	All outputs disabled		32	80	mA

(1) For C-suffix devices, V<sub>CC</sub> min = 4.75 V and V<sub>CC</sub> max = 5.25 V. For M-suffix devices, V<sub>CC</sub> min = 4.5 V and V<sub>CC</sub> max = 5.5 V.

(2) All typical values are at V<sub>CC</sub> = 5 V and T<sub>A</sub> = 25°C.

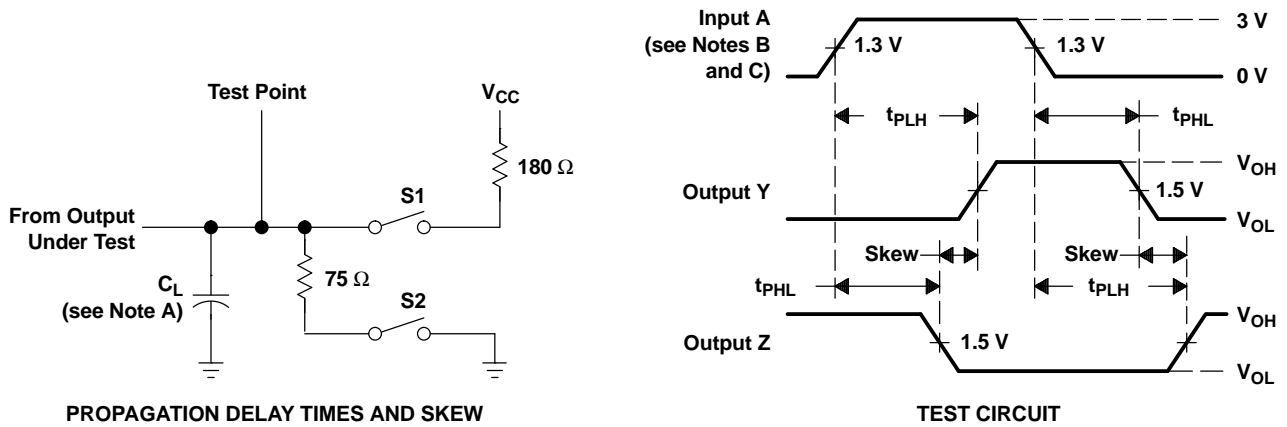
(3) Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

## Switching Characteristics

V<sub>CC</sub> = 5 V (see Figure 1)

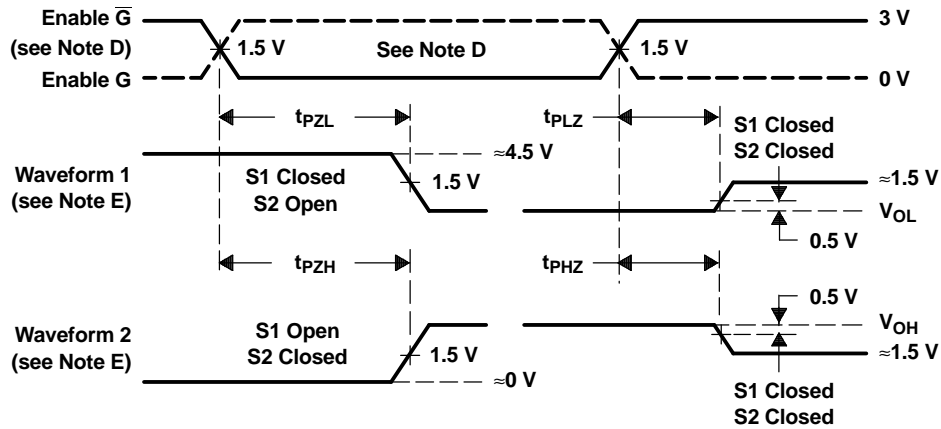
PARAMETER	TEST CONDITIONS	T <sub>A</sub> = 25°C			AM26LS31M		UNIT
		MIN	TYP	MAX	MIN	MAX	
t <sub>PLH</sub>	Propagation delay time, low- to high-level output	C <sub>L</sub> = 30 pF, S1 and S2 open	14	20		30	ns
t <sub>PHL</sub>	Propagation delay time, high- to low-level output		14	20		30	
t <sub>PZH</sub>	Output enable time to high level	C <sub>L</sub> = 30 pF	R <sub>L</sub> = 75 Ω			60	ns
t <sub>PZL</sub>	Output enable time to low level		R <sub>L</sub> = 180 Ω			68	
t <sub>PHZ</sub>	Output disable time from high level	C <sub>L</sub> = 10 pF, S1 and S2 closed	21	30		45	ns
t <sub>PLZ</sub>	Output disable time from low level		23	35		53	
t <sub>SKEW</sub>	Output-to-output skew	C <sub>L</sub> = 30 pF, S1 and S2 open	1	6		9	ns

PARAMETER MEASUREMENT INFORMATION



PROPAGATION DELAY TIMES AND SKEW

TEST CIRCUIT



ENABLE AND DISABLE TIME WAVEFORMS

- NOTES:
- A.  $C_L$  includes probe and jig capacitance.
  - B. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1$  MHz,  $Z_O \approx 50 \Omega$ ,  $t_r \leq 15$  ns,  $t_f \leq 6$  ns.
  - C. When measuring propagation delay times and skew, switches S1 and S2 are open.
  - D. Each enable is tested separately.
  - E. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.

Figure 1. Test Circuit and Voltage Waveforms

TYPICAL CHARACTERISTICS

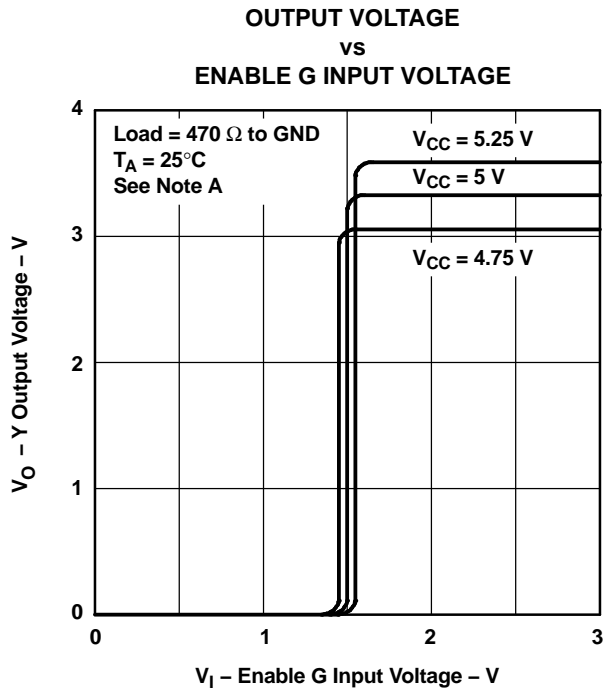


Figure 2.

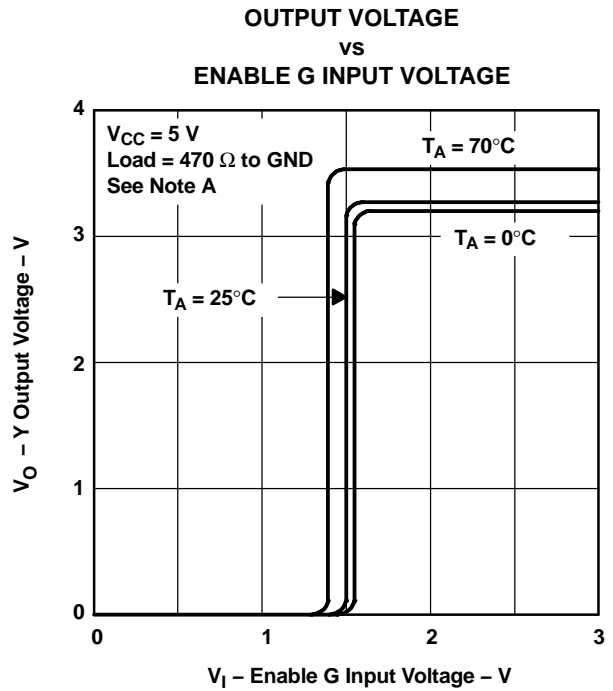


Figure 3.

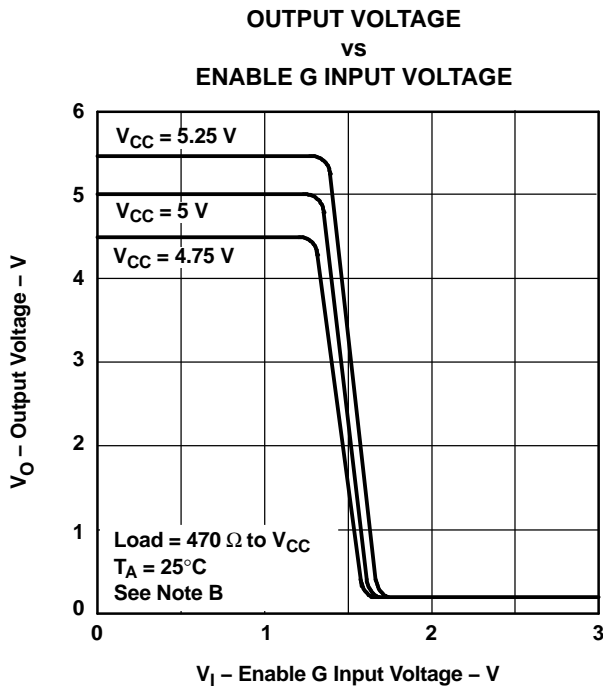


Figure 4.

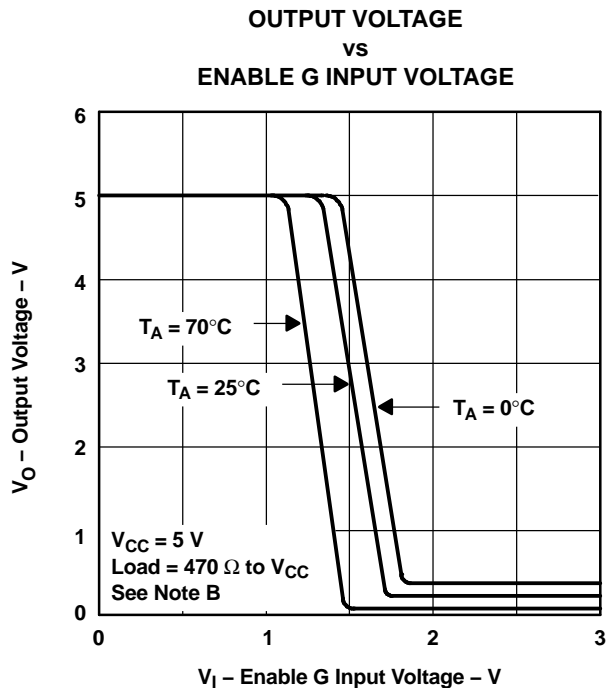


Figure 5.

- A. The A input is connected to  $V_{CC}$  during testing of the Y outputs and to ground during testing of the Z outputs.
- B. The A input is connected to ground during testing of the Y outputs and to  $V_{CC}$  during testing of the Z outputs.

**TYPICAL CHARACTERISTICS (continued)**



Figure 6.



Figure 7.



Figure 8.

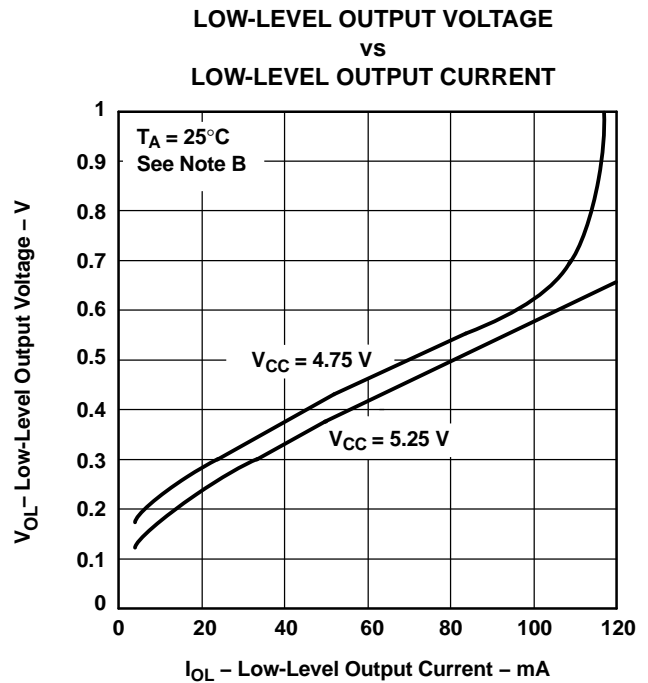


Figure 9.

- A. The A input is connected to  $V_{CC}$  during testing of the Y outputs and to ground during testing of the Z outputs.
- B. The A input is connected to ground during testing of the Y outputs and to  $V_{CC}$  during testing of the Z outputs.

TYPICAL CHARACTERISTICS (continued)



Figure 10.

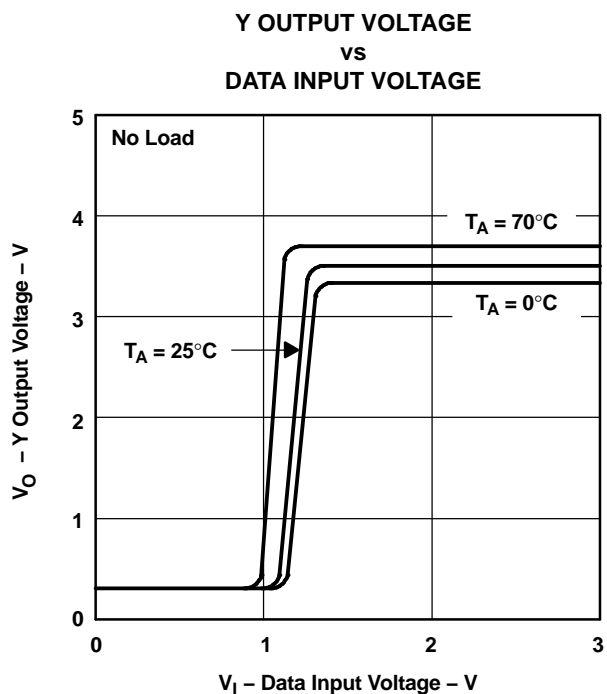


Figure 11.



**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
5962-7802301M2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 7802301M2A AM26LS31 MFKB	<a href="#">Samples</a>
5962-7802301MEA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-7802301ME A AM26LS31MJB	<a href="#">Samples</a>
5962-7802301MFA	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-7802301MF A AM26LS31MWB	<a href="#">Samples</a>
5962-7802301Q2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type		5962- 7802301Q2A AM26LS31M	<a href="#">Samples</a>
AM26LS31-W	ACTIVE	WAFERSALE	YS	0	3921	TBD	Call TI	Call TI			<a href="#">Samples</a>
AM26LS31CD	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	AM26LS31C	<a href="#">Samples</a>
AM26LS31CDBR	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	SA31C	<a href="#">Samples</a>
AM26LS31CDBRE4	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	SA31C	<a href="#">Samples</a>
AM26LS31CDBRG4	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	SA31C	<a href="#">Samples</a>
AM26LS31CDE4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	AM26LS31C	<a href="#">Samples</a>
AM26LS31CDG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	AM26LS31C	<a href="#">Samples</a>
AM26LS31CDR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU   CU SN	Level-1-260C-UNLIM	0 to 70	AM26LS31C	<a href="#">Samples</a>
AM26LS31CDRE4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	AM26LS31C	<a href="#">Samples</a>
AM26LS31CDRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	AM26LS31C	<a href="#">Samples</a>
AM26LS31CN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	AM26LS31CN	<a href="#">Samples</a>

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
AM26LS31CNE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	AM26LS31CN	<a href="#">Samples</a>
AM26LS31CNSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	26LS31	<a href="#">Samples</a>
AM26LS31CNSRG4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	26LS31	<a href="#">Samples</a>
AM26LS31MFKB	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962-7802301M2A AM26LS31 MFKB	<a href="#">Samples</a>
AM26LS31MJB	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-7802301ME A AM26LS31MJB	<a href="#">Samples</a>
AM26LS31MWB	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-7802301MF A AM26LS31MWB	<a href="#">Samples</a>

(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) 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)

(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.

**Important Information and Disclaimer:**The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF AM26LS31, AM26LS31M :**

- Catalog: [AM26LS31](#)
- Military: [AM26LS31M](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

## 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
AM26LS31CDBR	SSOP	DB	16	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
AM26LS31CDR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
AM26LS31CDR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
AM26LS31CDRG4	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
AM26LS31CDRG4	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	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)
AM26LS31CDBR	SSOP	DB	16	2000	367.0	367.0	38.0
AM26LS31CDR	SOIC	D	16	2500	333.2	345.9	28.6
AM26LS31CDR	SOIC	D	16	2500	367.0	367.0	38.0
AM26LS31CDRG4	SOIC	D	16	2500	367.0	367.0	38.0
AM26LS31CDRG4	SOIC	D	16	2500	333.2	345.9	28.6

J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package is hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

W (R-GDFP-F16)

CERAMIC DUAL FLATPACK



- 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 only.
  - E. Falls within MIL STD 1835 GDFP1-F16 and JEDEC MO-092AC

FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.740 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)



4040140/D 01/11

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a metal lid.
  - Falls within JEDEC MS-004



N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - $\triangle C$  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - $\triangle D$  The 20 pin end lead shoulder width is a vendor option, either half or full width.

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.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4211283-4/E 08/12

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

# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN

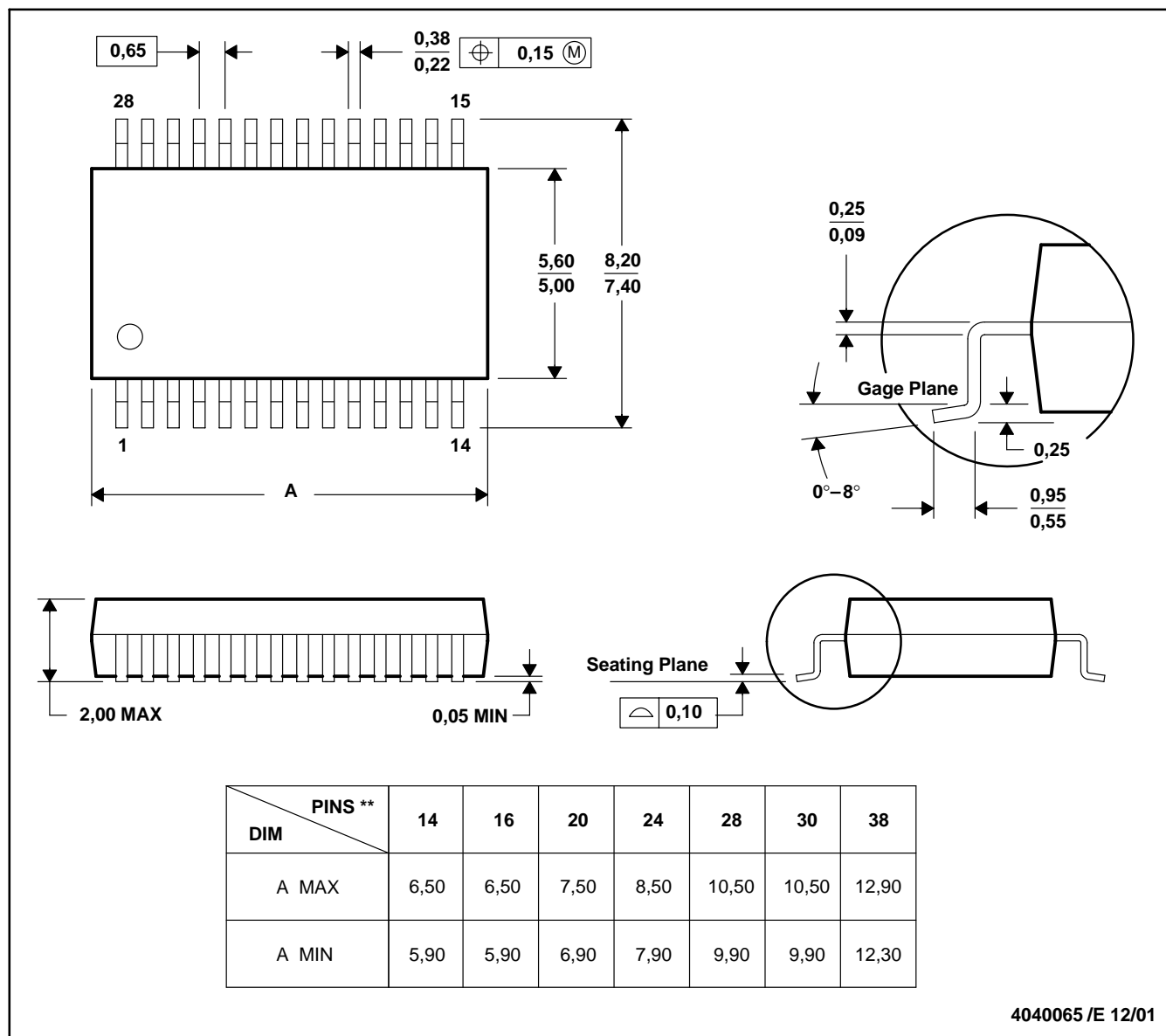


- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

## DB (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion not to exceed 0,15.
  - Falls within JEDEC MO-150

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
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 Applications 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

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
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>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)