

**NOT RECOMMENDED FOR NEW DESIGNS**

**High-Speed CMOS Logic  
Octal Bus Transceiver/Register, Three-State**

**Features**

- Independent Registers for A and B Buses
- Non-Inverting
- Three-State Outputs
- Drives 15 LSTTL Loads
- Typical Propagation Delay = 12ns (A to B, B to A) at  $V_{CC} = 5V, C_L = 15pF, T_A = 25^{\circ}C$
- Fanout (Over Temperature Range)
  - Standard Outputs . . . . . 10 LSTTL Loads
  - Bus Driver Outputs . . . . . 15 LSTTL Loads
- Wide Operating Temperature Range . . .  $-55^{\circ}C$  to  $125^{\circ}C$
- Balanced Propagation Delay and Transition Times
- Significant Power Reduction Compared to LSTTL Logic ICs
- HC Types
  - 2V to 6V Operation
  - High Noise Immunity:  $N_{IL} = 30\%, N_{IH} = 30\%$  of  $V_{CC}$  at  $V_{CC} = 5V$

**Description**

The CD74HC646 is an octal bus transceiver/register with three-state non-inverting outputs. This device is a bus transceiver with D-type flip-flops which act as internal storage registers. Data on the A bus or the B bus can be clocked into the registers on the Low-to-High transition of either CAB or CBA clock inputs. Outputs enable ( $\overline{OE}$ ) and direction (DIR) inputs control the transceiver functions. Data present at the high impedance output can be stored in either register or both but only one of the two buses can be enabled as outputs at any one time. The select controls (SAB and SBA) can multiplex stored and transparent (real time) data. The direction control determines which data bus will receive data when the output enable ( $\overline{OE}$ ) is Low. In the high impedance mode (output enable High), A data can be stored in one register and B data can be stored in the other register. The clocks are not gated with the direction (DIR) and output enable ( $\overline{OE}$ ) terminals; data at the A or B terminals can be clocked into the storage flip-flops at any time.

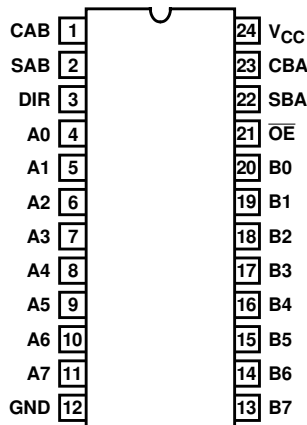
**Ordering Information**

PART NUMBER	TEMP. RANGE ( $^{\circ}C$ )	PACKAGE
CD74HC646M	-55 to 125	24 Ld SOIC
CD74HC646M96	-55 to 125	24 Ld SOIC

NOTE: When ordering, use the entire part number. The suffix 96 denotes tape and reel.

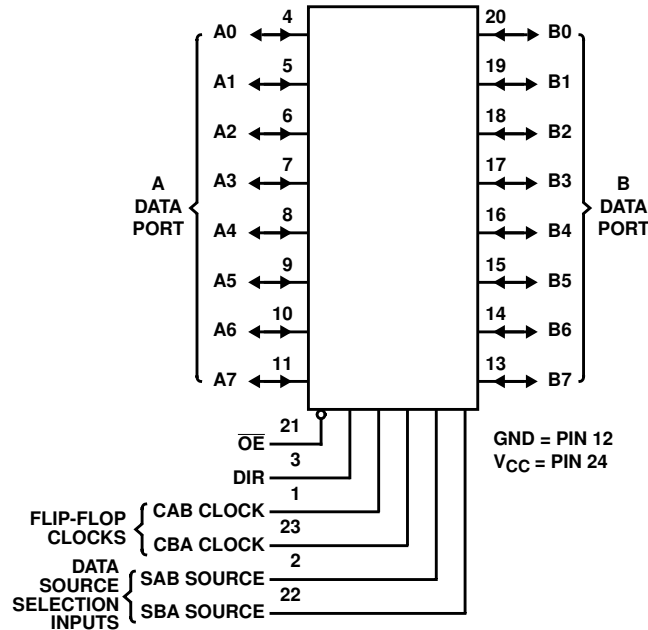
**Pinout**

CD74HC646  
(SOIC)  
TOP VIEW



# CD74HC646

## Functional Diagram



FUNCTION TABLE

INPUTS						DATA I/O (NOTE 1)		OPERATION OR FUNCTION
$\overline{OE}$	DIR	CAB	CBA	SAB	SBA	A0 THRU A7	B0 THRU B7	
X	X	$\uparrow$	X	X	X	Input	Not Specified	Store A, B Unspecified
X	X	X	$\uparrow$	X	X	Not Specified	Input	Store B, A Unspecified
H	X	$\uparrow$	$\uparrow$	X	X	Input	Input	Store A and B Data
H	X	H or L	H or L	X	X			Isolation, Hold Storage
L	L	X	X	X	L	Output	Input	Real-Time B Data to A Bus
L	L	X	H or L	X	H			Stored B Data to A Bus
L	H	X	X	L	X	Input	Output	Real-Time A Data to B Bus
L	H	H or L	X	H	X			Stored A Data to B Bus

NOTE:

- The data output functions may be enabled or disabled by various signals at the  $\overline{OE}$  and DIR inputs. Data inputs functions are always enabled, i.e., data at the bus pins will be stored on every low-to-high transition on the clock inputs. To prevent excess currents in the High-Z modes all I/O terminals should be terminated with 10k $\Omega$  resistors.

# CD74HC646

## Absolute Maximum Ratings

DC Supply Voltage, $V_{CC}$ .....	-0.5V to 7V
DC Input Diode Current, $I_{IK}$	
For $V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$ .....	$\pm 20mA$
DC Output Diode Current, $I_{OK}$	
For $V_O < -0.5V$ or $V_O > V_{CC} + 0.5V$ .....	$\pm 20mA$
DC Drain Current, per Output, $I_O$	
For $-0.5V < V_O < V_{CC} + 0.5V$ .....	$\pm 35mA$
DC Output Source or Sink Current per Output Pin, $I_O$	
For $V_O > -0.5V$ or $V_O < V_{CC} + 0.5V$ .....	$\pm 25mA$
DC $V_{CC}$ or Ground Current, $I_{CC}$ .....	$\pm 50mA$

## Thermal Information

Thermal Resistance (Typical)	$\theta_{JA}$ (°C/W)
M (SOIC) Package (Note 2) .....	46
Maximum Junction Temperature .....	150°C
Maximum Storage Temperature Range .....	-65°C to 150°C
Maximum Lead Temperature (Soldering 10s) .....	300°C
(SOIC - Lead Tips Only)	

## Operating Conditions

Temperature Range, $T_A$ .....	-55°C to 125°C
Supply Voltage Range, $V_{CC}$	
HC Types .....	.2V to 6V
DC Input or Output Voltage, $V_I$ , $V_O$ .....	0V to $V_{CC}$
Input Rise and Fall Time	
2V .....	1000ns (Max)
4.5V .....	500ns (Max)
6V .....	400ns (Max)

*CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.*

### NOTE:

- The package thermal impedance is calculated in accordance with JESD 51-7.

## DC Electrical Specifications

PARAMETER	SYMBOL	TEST CONDITIONS		$V_{CC}$ (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS	
		$V_I$ (V)	$I_O$ (mA)		MIN	TYP	MAX	MIN	MAX	MIN	MAX		
<b>HC TYPES</b>													
High Level Input Voltage	$V_{IH}$	-	-	2	1.5	-	-	1.5	-	1.5	-	V	
				4.5	3.15	-	-	3.15	-	3.15	-	V	
				6	4.2	-	-	4.2	-	4.2	-	V	
Low Level Input Voltage	$V_{IL}$	-	-	2	-	-	0.5	-	0.5	-	0.5	V	
				4.5	-	-	1.35	-	1.35	-	1.35	V	
				6	-	-	1.8	-	1.8	-	1.8	V	
High Level Output Voltage CMOS Loads	$V_{OH}$	$V_{IH}$ or $V_{IL}$	-0.02	-0.02	2	1.9	-	-	1.9	-	1.9	-	V
			-0.02	-0.02	4.5	4.4	-	-	4.4	-	4.4	-	V
			-0.02	-0.02	6	5.9	-	-	5.9	-	5.9	-	V
High Level Output Voltage TTL Loads	$V_{OH}$	$V_{IH}$ or $V_{IL}$	-	-	-	-	-	-	-	-	-	V	
			-6	-6	4.5	3.98	-	-	3.84	-	3.7	-	V
			-7.8	-7.8	6	5.48	-	-	5.34	-	5.2	-	V
Low Level Output Voltage CMOS Loads	$V_{OL}$	$V_{IH}$ or $V_{IL}$	0.02	0.02	2	-	-	0.1	-	0.1	-	0.1	V
			0.02	0.02	4.5	-	-	0.1	-	0.1	-	0.1	V
			0.02	0.02	6	-	-	0.1	-	0.1	-	0.1	V
Low Level Output Voltage TTL Loads	$V_{OL}$	$V_{IH}$ or $V_{IL}$	-	-	-	-	-	-	-	-	-	V	
			6	6	4.5	-	-	0.26	-	0.33	-	0.4	V
			7.8	7.8	6	-	-	0.26	-	0.33	-	0.4	V
Input Leakage Current	$I_I$	$V_{CC}$ or GND	-	6	-	-	$\pm 0.1$	-	$\pm 1$	-	$\pm 1$	$\mu A$	
Quiescent Device Current	$I_{CC}$	$V_{CC}$ or GND	0	6	-	-	8	-	80	-	160	$\mu A$	
Three-State Leakage Current	$I_{OZ}$	$V_{IL}$ or $V_{IH}$	$V_O = V_{CC}$ or GND	6	-	-	$\pm 0.5$	-	$\pm 5$	-	$\pm 10$	$\mu A$	

## CD74HC646

### Prerequisite for Switching Specifications

PARAMETER	SYMBOL	V <sub>CC</sub> (V)	25°C			-40°C TO 85°C			-55°C TO 125°C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
<b>HC TYPES</b>												
Maximum Frequency	f <sub>MAX</sub>	2	6	-	-	5	-	-	4	-	-	MHz
		4.5	30	-	-	25	-	-	20	-	-	MHz
		6	35	-	-	29	-	-	23	-	-	MHz
Setup Time Data to Clock	t <sub>SU</sub>	2	60	-	-	75	-	-	90	-	-	ns
		4.5	12	-	-	15	-	-	18	-	-	ns
		6	10	-	-	13	-	-	15	-	-	ns
Hold Time Data to Clock	t <sub>H</sub>	2	35	-	-	45	-	-	55	-	-	ns
		4.5	7	-	-	9	-	-	11	-	-	ns
		6	6	-	-	8	-	-	9	-	-	ns
Clock Pulse Width	t <sub>W</sub>	2	80	-	-	100	-	-	120	-	-	ns
		4.5	16	-	-	20	-	-	24	-	-	ns
		6	14	-	-	17	-	-	20	-	-	ns

### Switching Specifications $C_L = 50\text{pF}$ , Input $t_r, t_f = 6\text{ns}$

PARAMETER	SYMBOL	TEST CONDITIONS	V <sub>CC</sub> (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
<b>HC TYPES</b>											
Propagation Delay Store A Data to B Bus Store B Data to B Bus	t <sub>PHL</sub> , t <sub>PLH</sub>	C <sub>L</sub> = 50pF	2	-	-	220	-	275	-	330	ns
			4.5	-	-	44	-	55	-	66	ns
		C <sub>L</sub> = 15pF	5	-	18	-	-	-	-	-	ns
		C <sub>L</sub> = 50pF	6	-	-	37	-	47	-	56	ns
A Data to B Bus B Data to A Bus	t <sub>PLH</sub> , t <sub>PHL</sub>	C <sub>L</sub> = 50pF	2	-	-	135	-	170	-	205	ns
			4.5	-	-	27	-	34	-	41	ns
		C <sub>L</sub> = 15pF	5	-	12	-	-	-	-	-	ns
		C <sub>L</sub> = 50pF	6	-	-	23	-	29	-	35	ns
Select to Data	t <sub>PLH</sub> , t <sub>PHL</sub>	C <sub>L</sub> = 50pF	2	-	-	170	-	215	-	255	ns
			4.5	-	-	34	-	43	-	51	ns
		C <sub>L</sub> = 15pF	5	-	14	-	-	-	-	-	ns
		C <sub>L</sub> = 50pF	6	-	-	29	-	37	-	43	ns

## CD74HC646

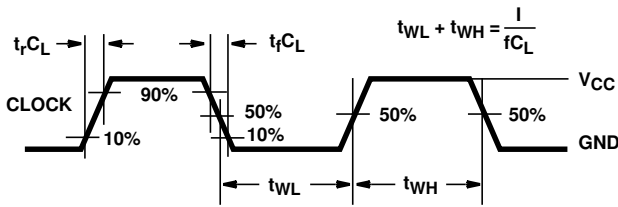
### Switching Specifications $C_L = 50\text{pF}$ , Input $t_r, t_f = 6\text{ns}$ (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	$V_{CC}$ (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
Three-State Disabling Time Bus to Output or Register to Output	$t_{PLZ}, t_{PHZ}$	$C_L = 50\text{pF}$	2	-	-	175	-	220	-	265	ns
			4.5	-	-	35	-	44	-	53	ns
		$C_L = 15\text{pF}$	5	-	14	-	-	-	-	-	ns
		$C_L = 50\text{pF}$	6	-	-	30	-	37	-	45	ns
Three-State Enabling Time Bus to Output or Register to Output	$t_{PZL}, t_{PZH}$	$C_L = 50\text{pF}$	2	-	-	175	-	220	-	265	ns
			4.5	-	-	35	-	44	-	53	ns
		$C_L = 15\text{pF}$	5	-	14	-	-	-	-	-	ns
		$C_L = 50\text{pF}$	6	-	-	30	-	37	-	45	ns
Output Transition Time	$t_{TLH}, t_{THL}$	$C_L = 50\text{pF}$	2	-	-	60	-	75	-	90	ns
			4.5	-	-	12	-	15	-	18	ns
		$C_L = 50\text{pF}$	6	-	-	10	-	13	-	15	ns
Input Capacitance	$C_{IN}$	$C_L = 50\text{pF}$	-	10	-	10	-	10	-	10	pF
Three-State Output Capacitance	$C_O$	-	-	-	-	20	-	20	-	20	pF
Maximum Frequency	$f_{MAX}$	$C_L = 15\text{pF}$	5	-	60	-	-	-	-	-	MHz
Power Dissipation Capacitance (Notes 3, 4)	$C_{PD}$	-	5	-	52	-	-	-	-	-	pF

**NOTES:**

3.  $C_{PD}$  is used to determine the dynamic power consumption, per package.
4.  $P_D = V_{CC}^2 C_{PD} f_i \Sigma V_{CC}^2 C_L f_o$  where  $f_i$  = Input Frequency,  $f_o$  = Output Frequency,  $C_L$  = Output Load Capacitance,  $V_{CC}$  = Supply Voltage.

Test Circuits and Waveforms



NOTE: Outputs should be switching from 10%  $V_{CC}$  to 90%  $V_{CC}$  in accordance with device truth table. For  $f_{MAX}$ , input duty cycle = 50%.

FIGURE 1. HC CLOCK PULSE RISE AND FALL TIMES AND PULSE WIDTH

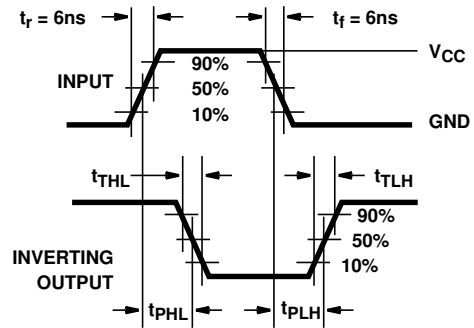


FIGURE 2. HC TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

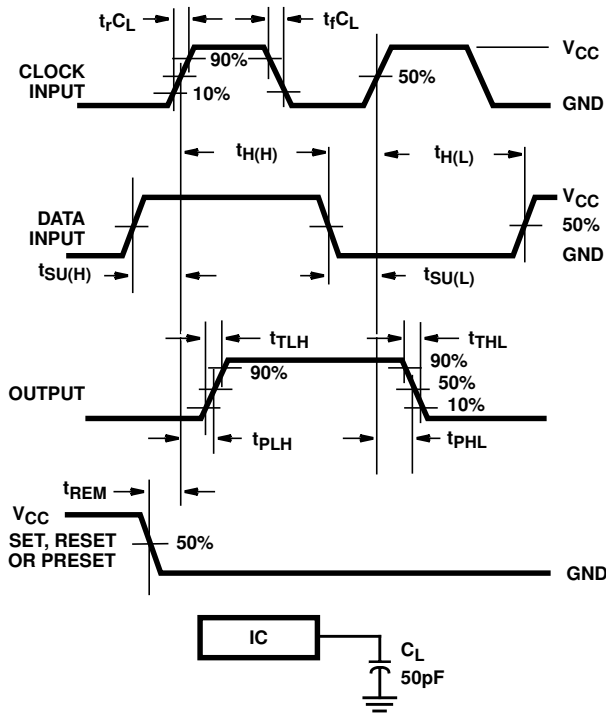


FIGURE 3. HC SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

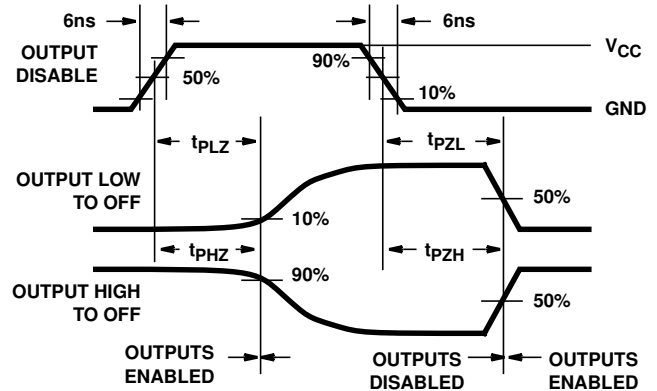
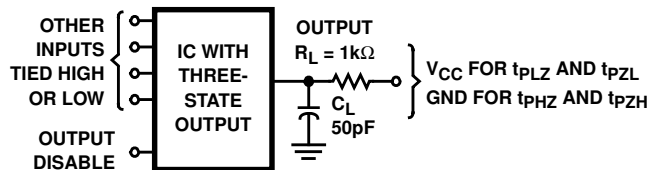


FIGURE 4. HC THREE-STATE PROPAGATION DELAY WAVEFORM



NOTE: Open drain waveforms  $t_{PLZ}$  and  $t_{PZL}$  are the same as those for three-state shown on the left. The test circuit is Output  $R_L = 1k\Omega$  to  $V_{CC}$ .  $C_L = 50pF$ .

FIGURE 5. HC THREE-STATE PROPAGATION DELAY TEST CIRCUIT

**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>
CD74HC646EN	OBSOLETE	PDIP	NT	24		TBD	Call TI	Call TI
CD74HC646ENE4	OBSOLETE	PDIP	NT	24		TBD	Call TI	Call TI
CD74HC646M	OBSOLETE	SOIC	DW	24		TBD	Call TI	Call TI
CD74HC646M96	OBSOLETE	SOIC	DW	24		TBD	Call TI	Call TI
CD74HC646M96E4	OBSOLETE	SOIC	DW	24		TBD	Call TI	Call TI
CD74HC646ME4	OBSOLETE	SOIC	DW	24		TBD	Call TI	Call TI

<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.

**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 CD74HC646 :**

- Military: [CD54HC646](#)

NOTE: Qualified Version Definitions:

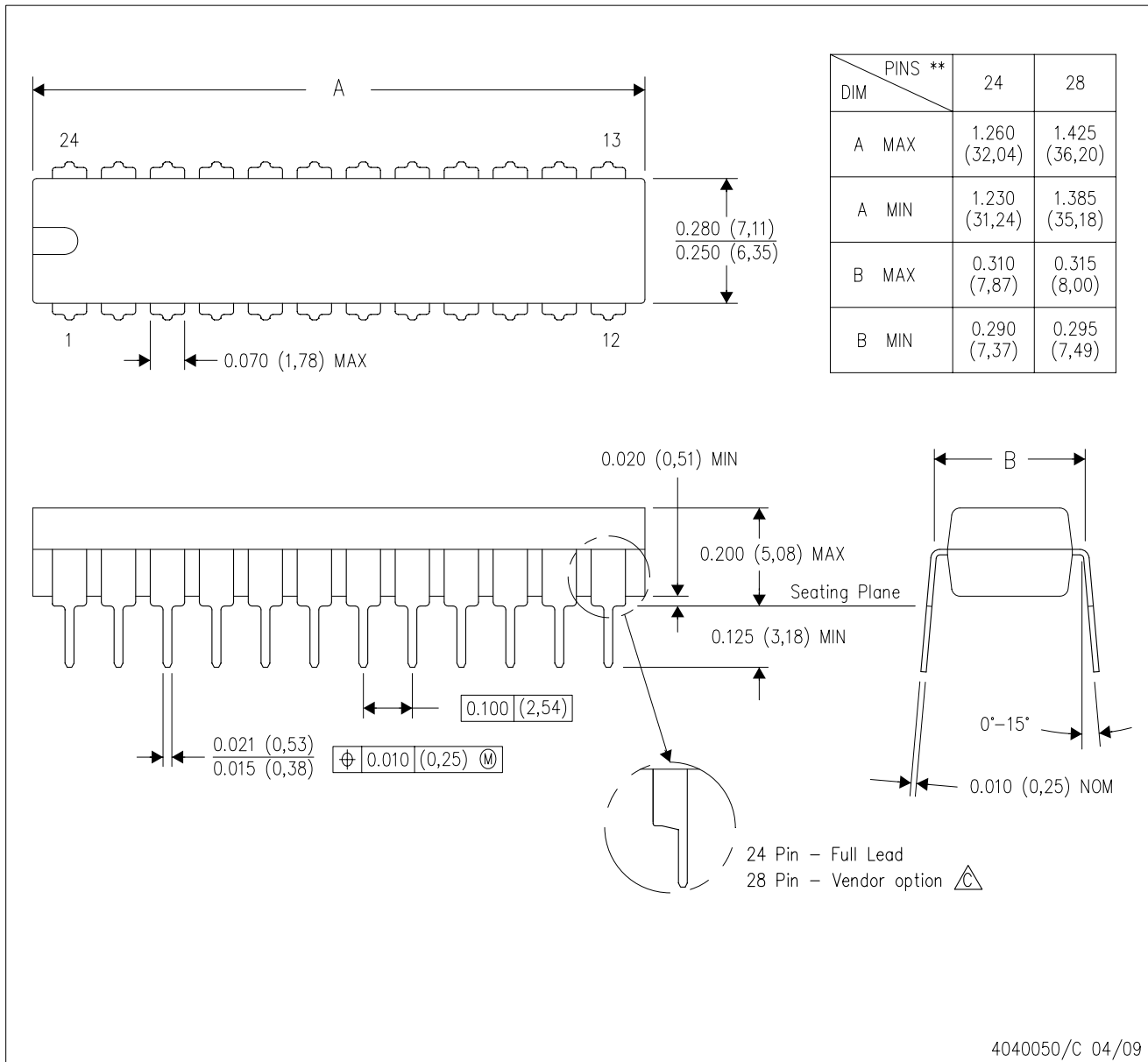
- Military - QML certified for Military and Defense Applications


# MECHANICAL DATA

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

PLASTIC DUAL-IN-LINE PACKAGE

24 PINS SHOWN

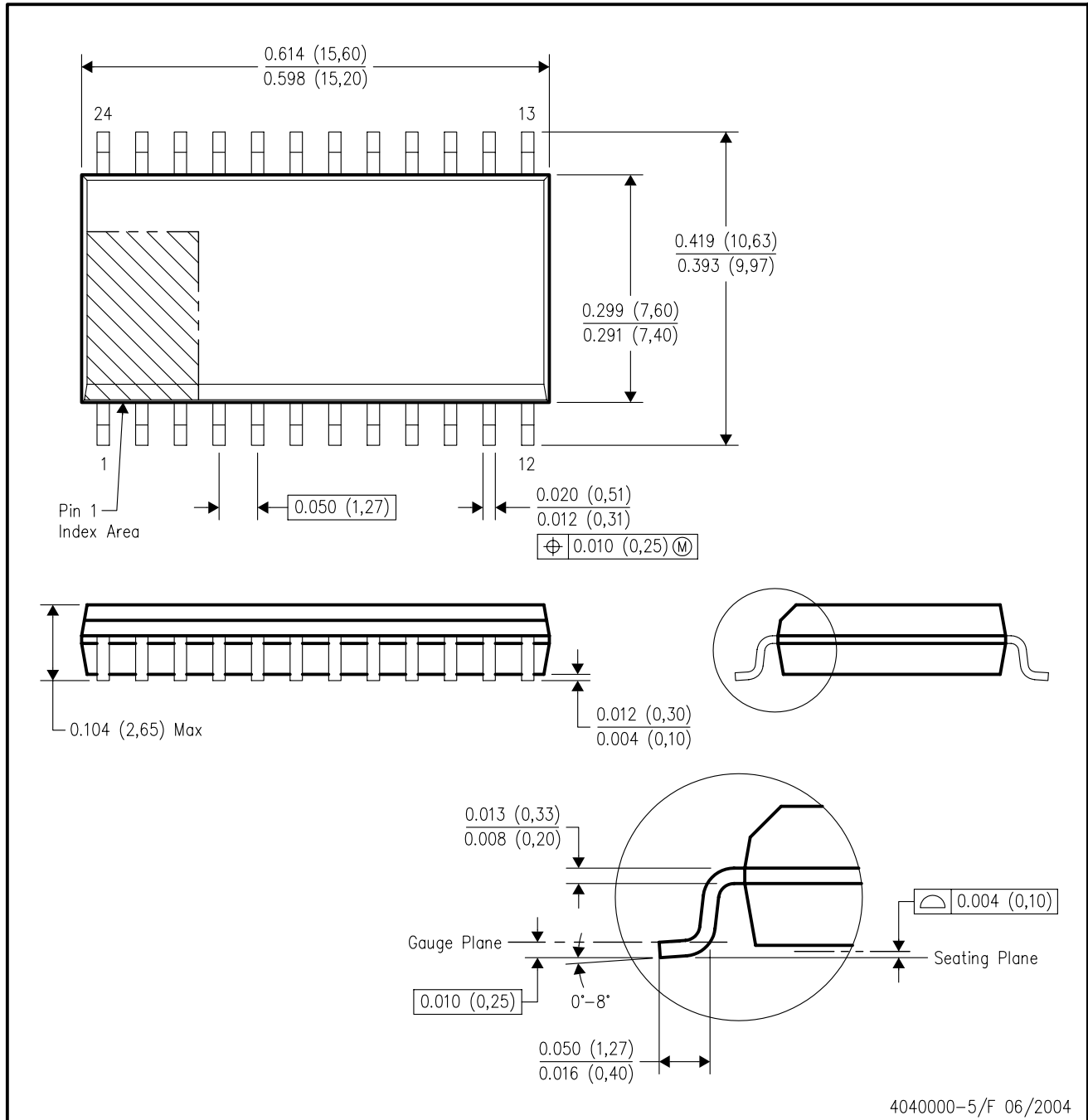


- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  -  The 28 pin end lead shoulder width is a vendor option, either half or full width.



DW (R-PDSO-G24)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - D. Falls within JEDEC MS-013 variation AD.

**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>	Samples (Requires Login)
CD74HC646EN	OBSOLETE	PDIP	NT	24		TBD	Call TI	Call TI	Samples Not Available
CD74HC646ENE4	OBSOLETE	PDIP	NT	24		TBD	Call TI	Call TI	Samples Not Available
CD74HC646M	OBSOLETE	SOIC	DW	24		TBD	Call TI	Call TI	Samples Not Available
CD74HC646M96	OBSOLETE	SOIC	DW	24		TBD	Call TI	Call TI	Samples Not Available
CD74HC646M96E4	OBSOLETE	SOIC	DW	24		TBD	Call TI	Call TI	Samples Not Available
CD74HC646ME4	OBSOLETE	SOIC	DW	24		TBD	Call TI	Call TI	Samples Not Available

<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.

**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 CD74HC646 :**

- Military: [CD54HC646](#)

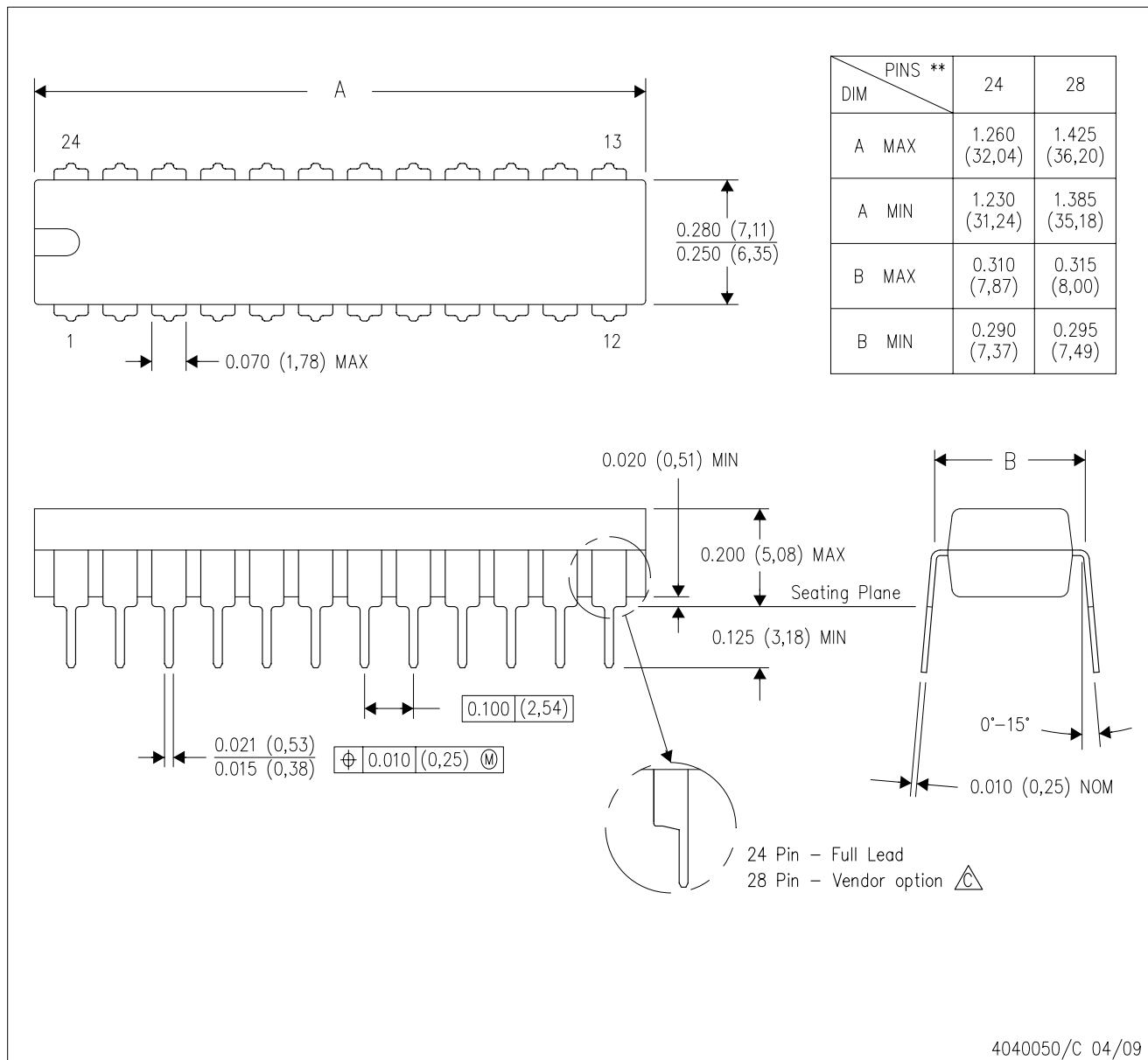
NOTE: Qualified Version Definitions:


- Military - QML certified for Military and Defense Applications

# MECHANICAL DATA

NT (R-PDIP-T\*\*) 24 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  -  The 28 pin end lead shoulder width is a vendor option, either half or full width.



## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

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

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI 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 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. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

### 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>
RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>

### Applications

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>
Transportation and Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
Wireless	<a href="http://www.ti.com/wireless-apps">www.ti.com/wireless-apps</a>

TI E2E Community Home Page

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

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2011, Texas Instruments Incorporated