

# **DS8922,DS8922A,DS8923A**

*DS8922/DS8922A/DS8923A TRI-STATE RS-422 Dual Differential Line Driver and Receiver Pairs*



Literature Number: SNLS373A

## DS8922/DS8922A/DS8923A TRI-STATE® RS-422 Dual Differential Line Driver and Receiver Pairs

### General Description

The DS8922/22A and DS8923A are Dual Differential Line Driver and Receiver pairs. These devices are designed specifically for applications meeting the ST506, ST412 and ESDI Disk Drive Standards. In addition, the devices meet the requirements of the EIA Standard RS-422.

These devices offer an input sensitivity of 200 mV over a  $\pm 7V$  common mode operating range. Hysteresis is incorporated (typically 70 mV) to improve noise margin for slowly changing input waveforms. An input fail-safe circuit is provided such that if the receiver inputs are open the output assumes the logical one state.

The DS8922A and DS8923A drivers are designed to provide unipolar differential drive to twisted pair or parallel wire transmission lines. Complementary outputs are logically ANDed and provide an output skew of 0.5 ns (typ.) with propagation delays of 12 ns.

Both devices feature TRI-STATE outputs. The DS8922/22A have independent control functions common to a driver and receiver pair. The DS8923A has separate driver and receiver control functions.

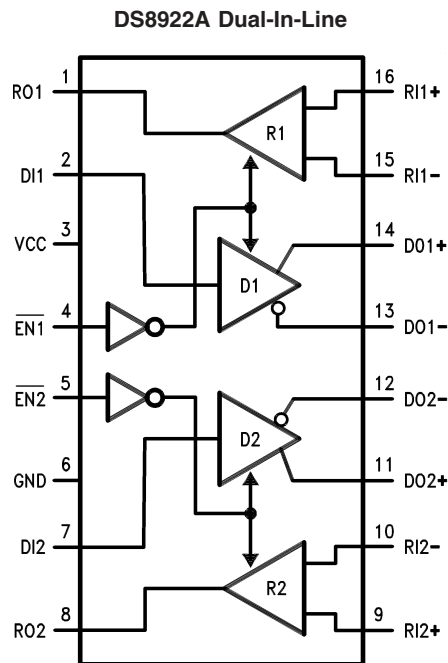
Power up/down circuitry is featured which will TRI-STATE the outputs and prevent erroneous glitches on the transmission lines during system power up or power down operation.

The DS8922/22A and DS8923A are designed to be compatible with TTL and CMOS.

### Features

- 12 ns typical propagation delay
- Output skew— $\pm 0.5$  ns typical
- Meets the requirements of EIA Standard RS-422
- Complementary Driver Outputs
- High differential or common-mode input voltage ranges of  $\pm 7V$
- $\pm 0.2V$  receiver sensitivity over the input voltage range
- Receiver input fail-safe circuitry
- Receiver input hysteresis—70 mV typical
- Glitch free power up/down
- TRI-STATE outputs

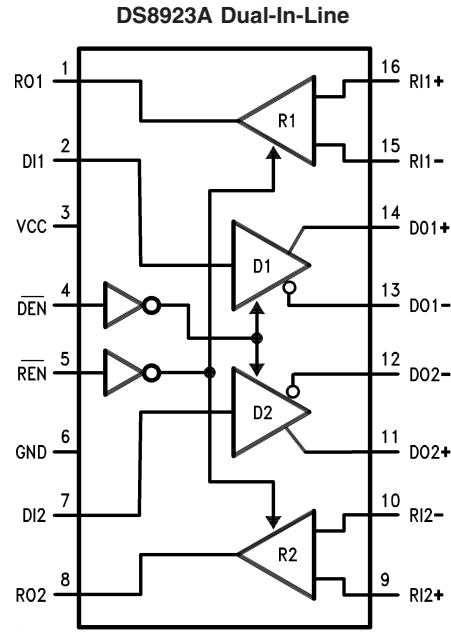
### Connection Diagrams



00851101

Order Number DS8922M, DS8922N,  
DS8922AM or DS8922AN  
See NS Package Number M16A or N16E

**Connection Diagrams** (Continued)



00851102

**Order Number DS8923AM, DS8923AN,  
See NS Package Number M16A or N16E**

**DS8922/22A**

$\overline{EN1}$	$\overline{EN2}$	RO1	RO2	DO1	DO2
0	0	ACTIVE	ACTIVE	ACTIVE	ACTIVE
1	0	HI-Z	ACTIVE	HI-Z	ACTIVE
0	1	ACTIVE	HI-Z	ACTIVE	HI-Z
1	1	HI-Z	HI-Z	HI-Z	HI-Z

**DS8923A**

$\overline{DEN}$	$\overline{REN}$	RO1	RO2	DO1	DO2
0	0	ACTIVE	ACTIVE	ACTIVE	ACTIVE
1	0	ACTIVE	ACTIVE	HI-Z	HI-Z
0	1	HI-Z	HI-Z	ACTIVE	ACTIVE
1	1	HI-Z	HI-Z	HI-Z	HI-Z

**Absolute Maximum Ratings** (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage	7V
Drive Input Voltage	-0.5V to +7V
Output Voltage	5.5V
Receiver Output Sink Current	50 mA
Receiver Input Voltage	±10V
Differential Input Voltage	±12V
Maximum Package Power Dissipation @ +25°C	
M Package	1300 mW
N Package	1450 mW

Derate M Package	10.4 mW/°C above +25°C
Derate N Package	11.6 mW/°C above +25°C
Storage Temperature Range	-65°C to +165°C
Lead Temp. (Soldering, 4 seconds)	260°C
ESD Rating (HBM)	2000V+

**Recommended Operating Conditions**

	Min	Max	Units
Supply Voltage	4.5	5.5	V
Temperature (T <sub>A</sub> )	0	70	°C

**DS8922/22A and DS8923A Electrical Characteristics** (Notes 2, 3, 4)

Symbol	Conditions	Min	Typ	Max	Units
<b>RECEIVER</b>					
V <sub>TH</sub>	-7V ≤ V <sub>CM</sub> ≤ +7V	-200	±35	+200	mV
V <sub>HYST</sub>	-7V ≤ V <sub>CM</sub> ≤ +7V	15	70		mV
R <sub>IN</sub>	V <sub>IN</sub> = -7V, +7V (Other Input = GND)	4.0	6.0		kΩ
I <sub>IN</sub>	V <sub>IN</sub> = 10V			3.25	mA
	V <sub>IN</sub> = -10V			-3.25	mA
V <sub>OH</sub>	V <sub>CC</sub> = MIN, I <sub>OH</sub> = -400 μA	2.5			V
V <sub>OL</sub>	V <sub>CC</sub> = MAX, I <sub>OL</sub> = 8 mA			0.5	V
I <sub>SC</sub>	V <sub>CC</sub> = MAX, V <sub>OUT</sub> = 0V	-15		-100	mA
<b>DRIVER</b>					
V <sub>OH</sub>	V <sub>CC</sub> = MIN, I <sub>OH</sub> = -20 mA	2.5			V
V <sub>OL</sub>	V <sub>CC</sub> = MIN, I <sub>OL</sub> = +20 mA			0.5	V
I <sub>OFF</sub>	V <sub>CC</sub> = 0V, V <sub>OUT</sub> = 5.5V			100	μA
VTI  -  VT				0.4	V
VT		2.0			V
V <sub>OS</sub> - V <sub>OS</sub>				0.4	V
I <sub>SC</sub>	V <sub>CC</sub> = MAX, V <sub>OUT</sub> = 0V	-30		-150	mA
<b>DRIVER and RECEIVER</b>					
I <sub>OZ</sub> TRI-STATE Leakage	V <sub>CC</sub> = MAX	V <sub>OUT</sub> = 2.5V		50	μA
		V <sub>OUT</sub> = 0.4V		-50	μA
I <sub>CC</sub>	V <sub>CC</sub> = MAX	ACTIVE		76	mA
		TRI-STATE		78	mA
<b>DRIVER and ENABLE INPUTS</b>					
V <sub>IH</sub>		2.0			V
V <sub>IL</sub>				0.8	V
I <sub>IL</sub>	V <sub>CC</sub> = MAX, V <sub>IN</sub> = 0.4V		-40	-200	μA
I <sub>IH</sub>	V <sub>CC</sub> = MAX, V <sub>IN</sub> = 2.7V			20	μA
I <sub>I</sub>	V <sub>CC</sub> = MAX, V <sub>IN</sub> = 7.0V			100	μA
V <sub>CL</sub>	V <sub>CC</sub> = MIN, I <sub>IN</sub> = -18 mA			-1.5	V

## Receiver Switching Characteristics

(Figures 1, 2, 3)

Parameter	Conditions	Min	Typ	Max		Units
				8922	8922A/23A	
$T_{pLH}$	CL = 30 pF		12	22.5	20	ns
$T_{pHL}$	CL = 30 pF		12	22.5	20	ns
$ T_{pLH} - T_{pHL} $	CL = 30 pF		0.5	5	3.5	ns
Skew (Channel to Channel)	CL = 30 pF		0.5	3.0	2.0	ns
$T_{pLZ}$	CL = 15 pF S2 Open		15			ns
$T_{pHZ}$	CL = 15 pF S1 Open		15			ns
$T_{pZL}$	CL = 30 pF S2 Open		20			ns
$T_{pZH}$	CL = 30 pF S1 Open		20			ns

## Driver Switching Characteristics

Parameter	Conditions	Min	Typ	Max		Units
				8922	8922A/23A	

### SINGLE ENDED CHARACTERISTICS (Figures 4, 5, 6, 8)

$T_{pLH}$	CL = 30 pF		12	15	15	ns
$T_{pHL}$	CL = 30 pF		12	15	15	ns
$T_{TLH}$	CL = 30 pF		5	10	10	ns
$T_{THL}$	CL = 30 pF		5	10	10	ns
$ T_{pLH} - T_{pHL} $	CL = 30 pF		0.5			ns
Skew	CL = 30 pF (Note 5)		0.5	5	3.5	ns
Skew (Channel to Channel)			0.5	3.0	2.0	ns
$T_{pLZ}$	CL = 30 pF		15			ns
$T_{pHZ}$	CL = 30 pF		15			ns
$T_{pZL}$	CL = 30 pF		20			ns
$T_{pZH}$	CL = 30 pF		20			ns

### DIFFERENTIAL SWITCHING CHARACTERISTICS (Note 6), (Figure 4)

$T_{pLH}$	CL = 30 pF		12	15	15	ns
$T_{pHL}$	CL = 30 pF		12	15	15	ns
$ T_{pLH} - T_{pHL} $	CL = 30 pF		0.5	6.0	2.75	ns

**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the device should be operated at these limits. The Table of "Electrical Characteristics" provides conditions for actual device operation.

**Note 2:** All currents into device pins are shown as positive values; all currents out of the device are shown as negative; all voltages are referenced to ground unless otherwise specified. All values shown as max or min are classified on absolute value basis.

**Note 3:** All typical values are  $V_{CC} = 5V$ ,  $T_A = 25^\circ C$ .

**Note 4:** Only one output at a time should be shorted.

**Note 5:** Difference between complementary outputs at the 50% point.

**Note 6:** Differential Delays are defined as calculated results from single ended rise and fall time measurements. This approach in establishing AC performance specifications has been taken due to limitations of available Automatic Test Equipment (ATE).

The calculated ATE results assume a linear transition between measurement points and are a result of the following equations:

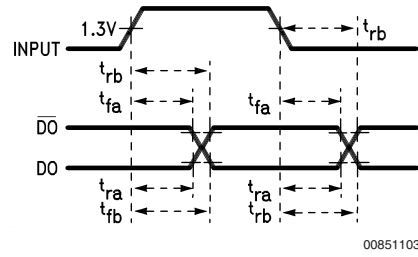
$$T_{cp} = \frac{(T_{fb} \times T_{rb}) - (T_{ra} \times T_{fa})}{T_{rb} - T_{ra} - T_{fa} + T_{fb}}$$

Where:

$T_{cp}$  = Crossing Point

$T_{ra}$ ,  $T_{rb}$ ,  $T_{fa}$  and  $T_{fb}$  are time measurements with respect to the input.

## Switching Time Waveforms



00851103

## AC Test Circuits and Switching Waveforms

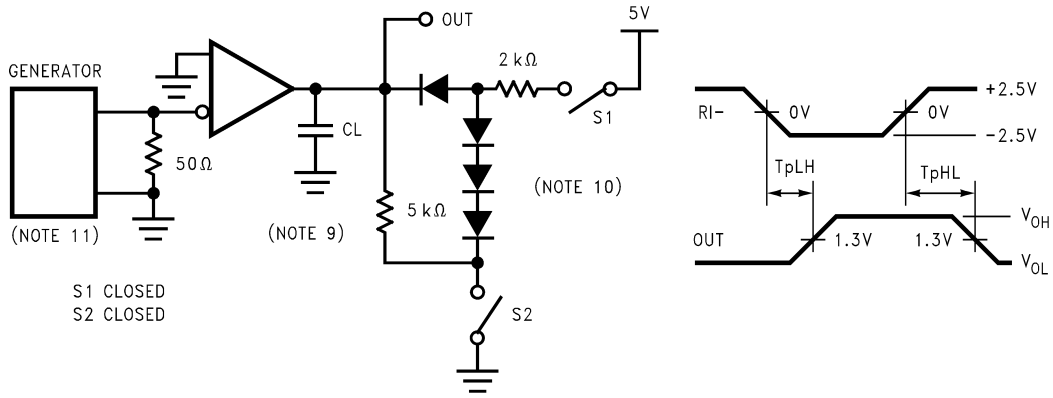


FIGURE 1.

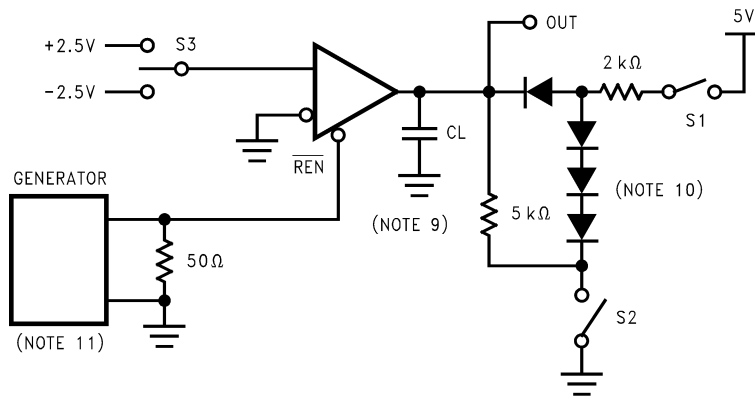
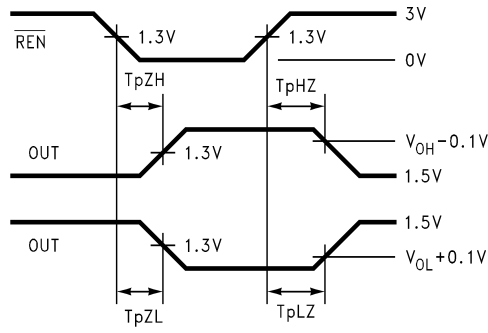


FIGURE 2.

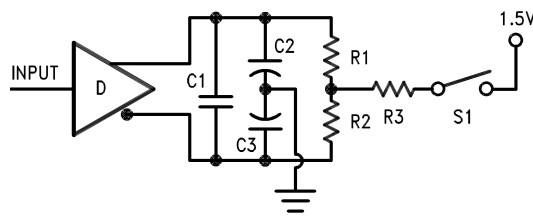
AC Test Circuits and Switching Waveforms (Continued)



00851106

	S1	S2	S3
$T_{PLZ}$	Closed	Open	+2.5V
$T_{PHZ}$	Open	Closed	-2.5V
$T_{PZL}$	Closed	Open	+2.5V
$T_{PZH}$	Open	Closed	-2.5V

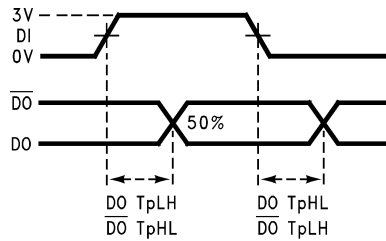
FIGURE 3.



NOTE:  $C1=C2=C3=30\text{ pF}$ ,  $R1=R2=50\ \Omega$ ,  $R3=500\ \Omega$

00851107

FIGURE 4.



00851108

FIGURE 5.

AC Test Circuits and Switching Waveforms (Continued)

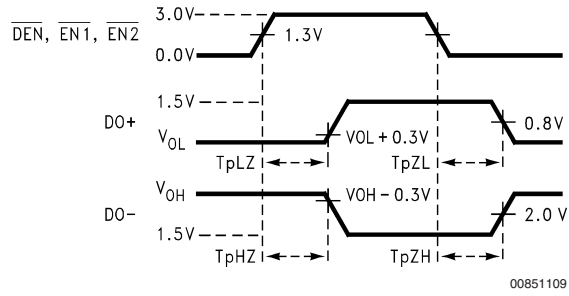


FIGURE 6.

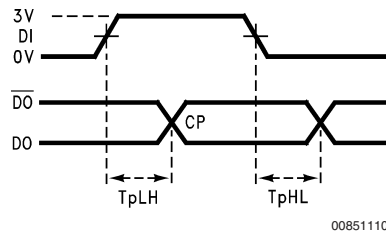


FIGURE 7.

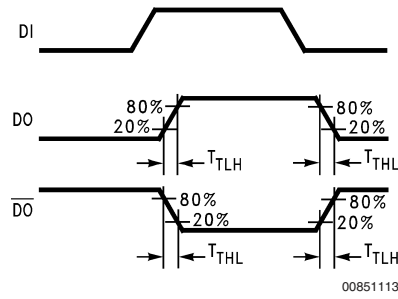
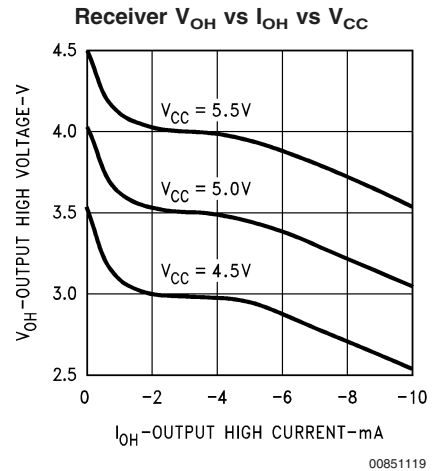
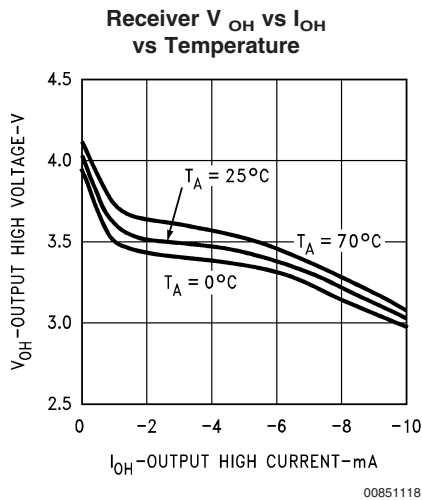
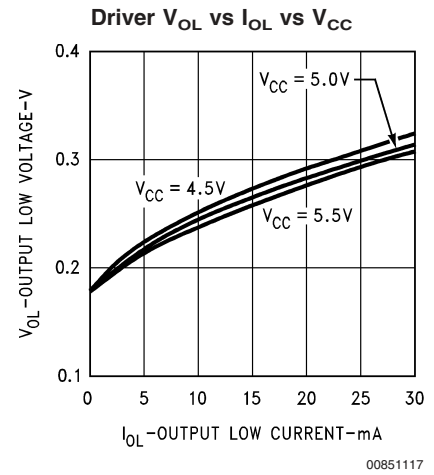
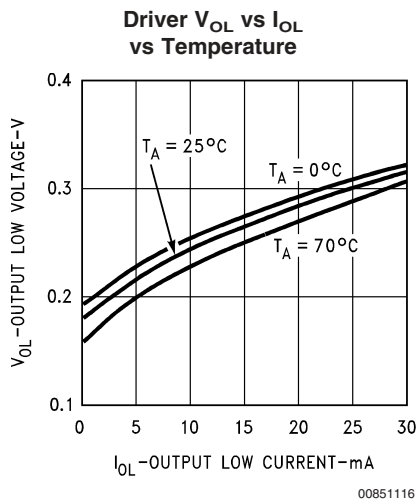
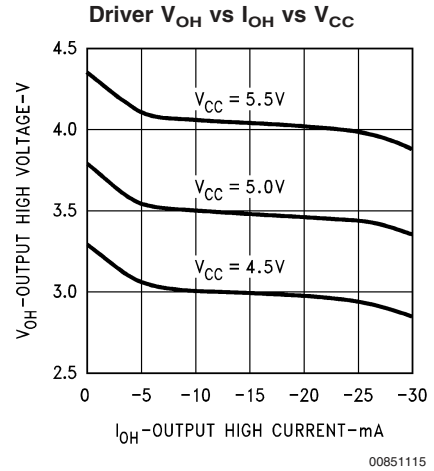
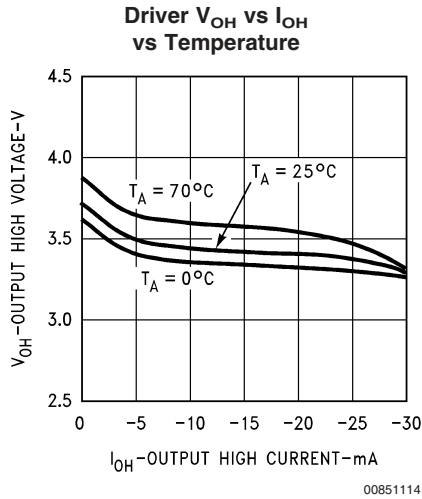
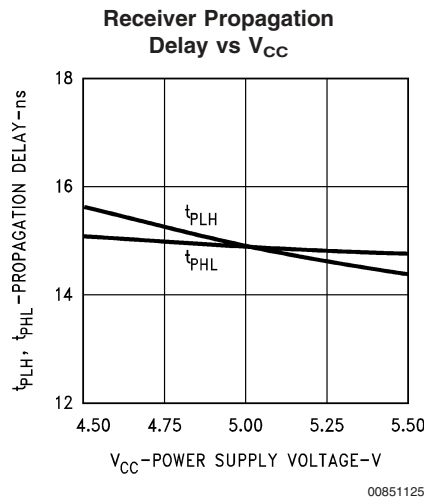
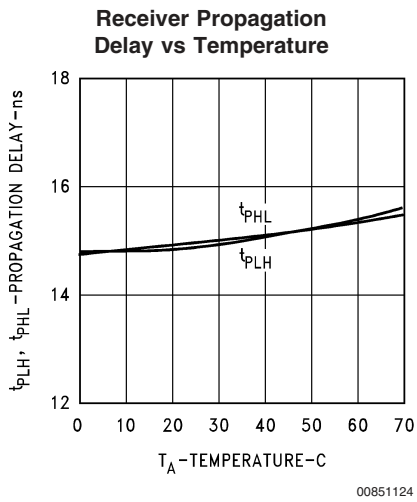
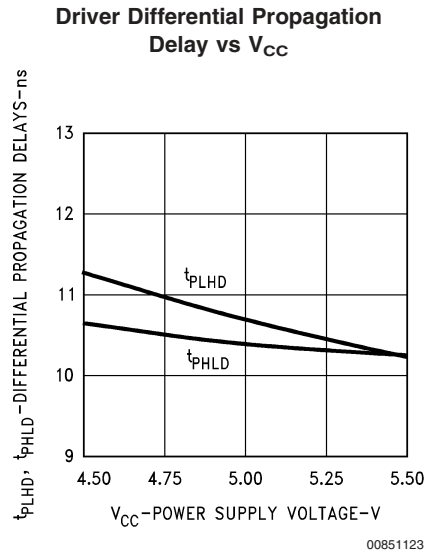
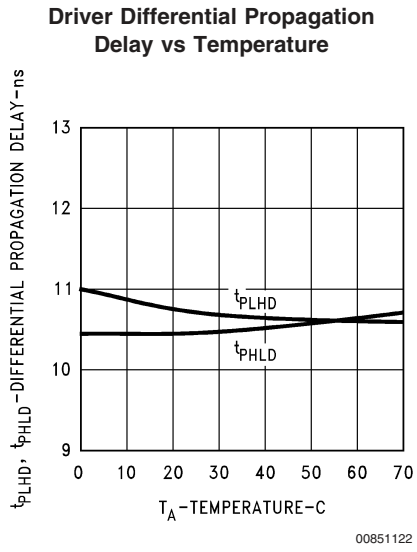
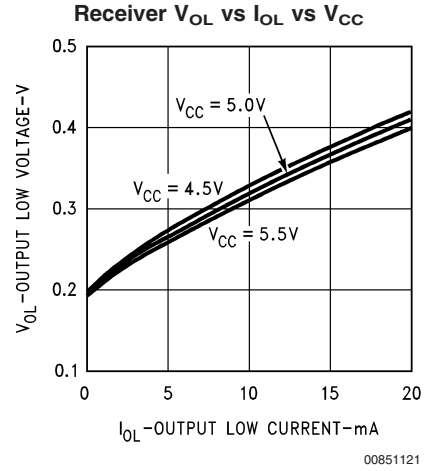
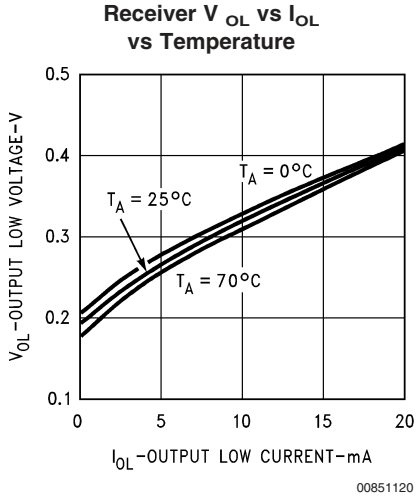


FIGURE 8.

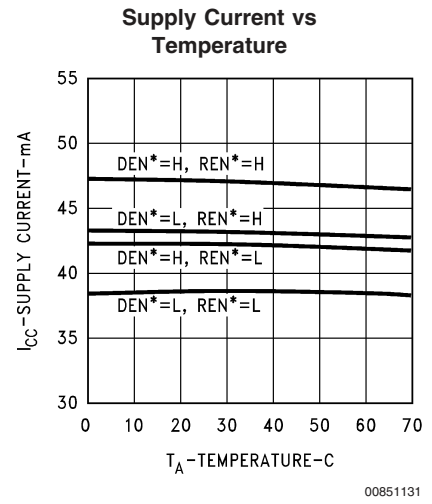
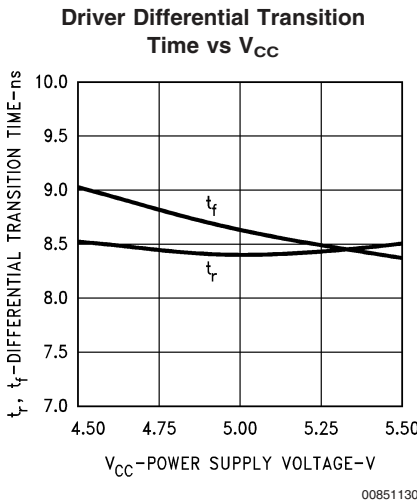
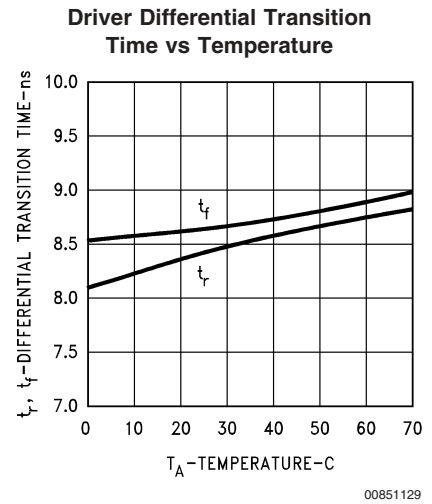
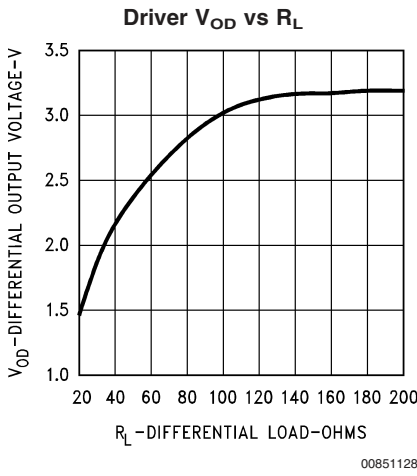
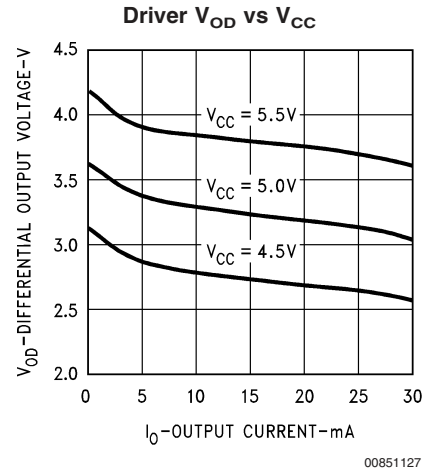
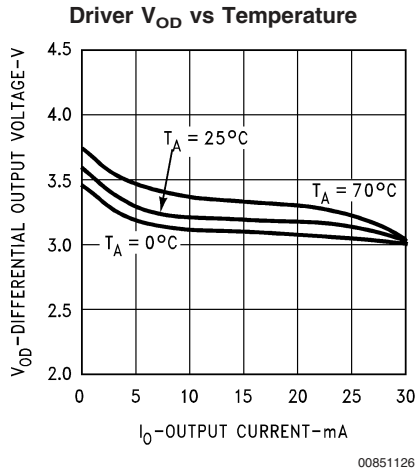
# Typical Performance Characteristics (DS8923A)



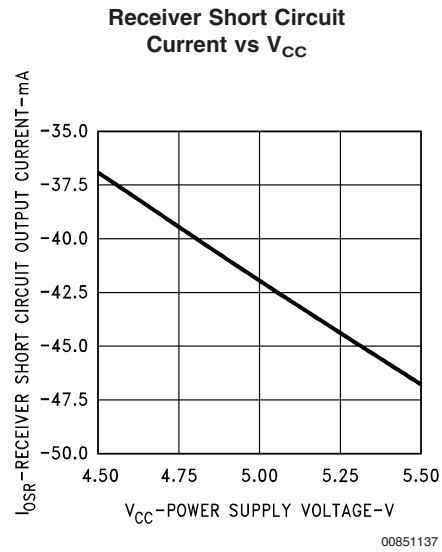
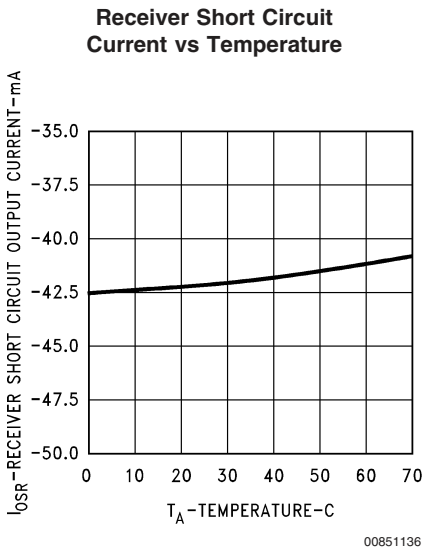
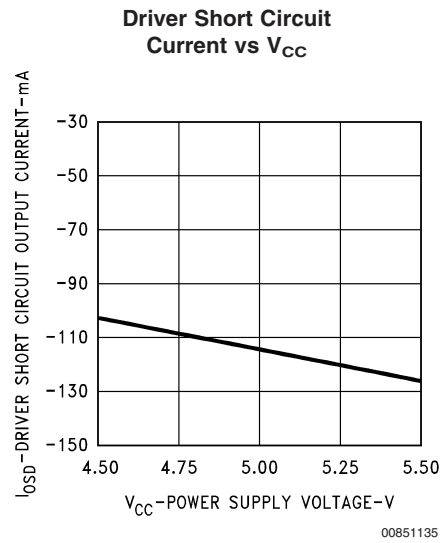
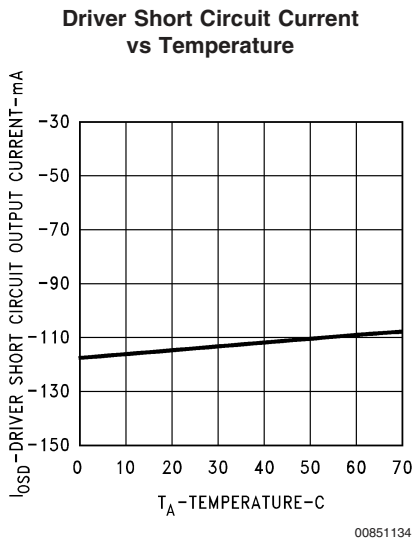
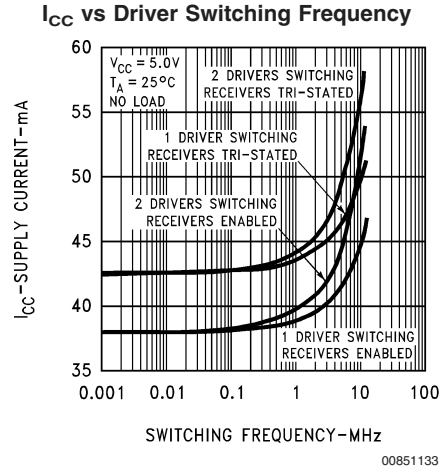
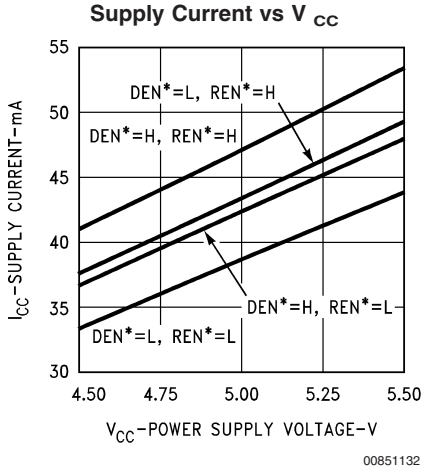
Typical Performance Characteristics (DS8923A) (Continued)



Typical Performance Characteristics (DS8923A) (Continued)

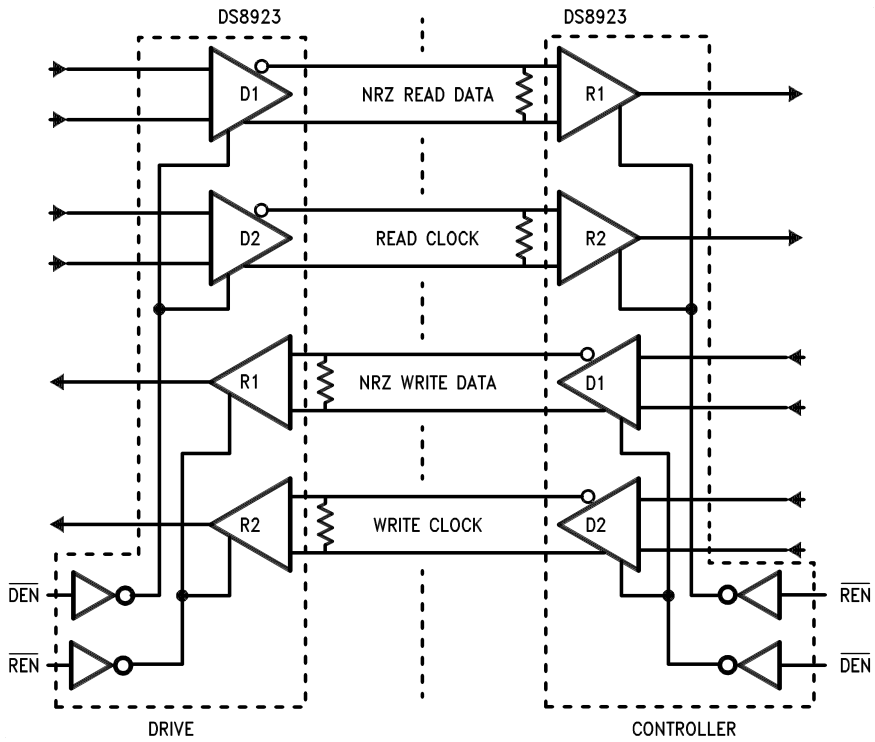


Typical Performance Characteristics (DS8923A) (Continued)



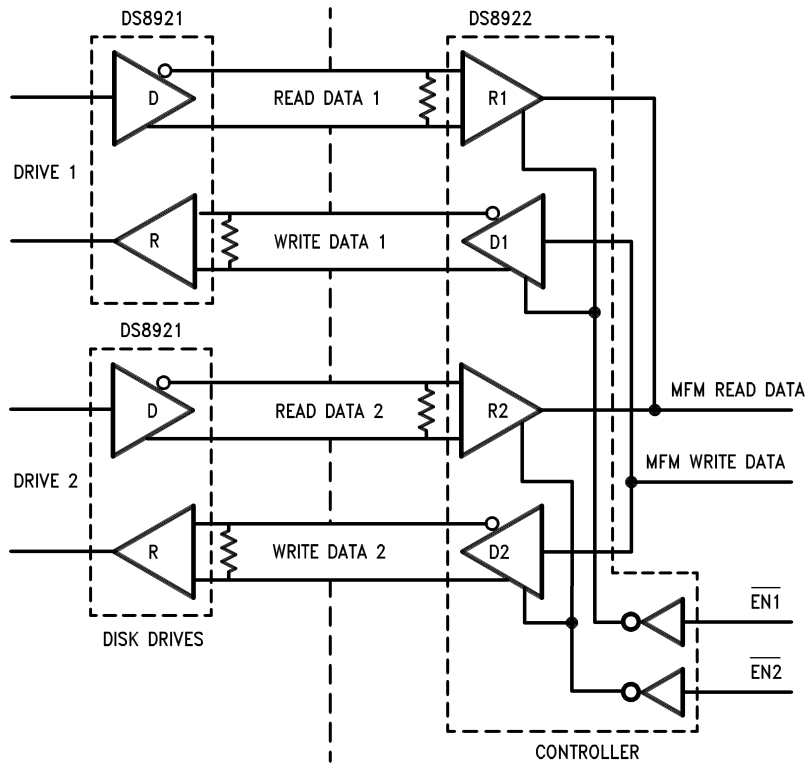
# Typical Applications

## ESDI Application



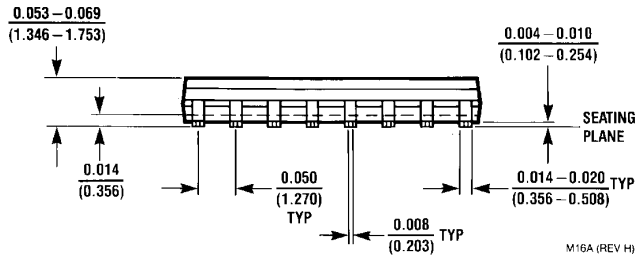
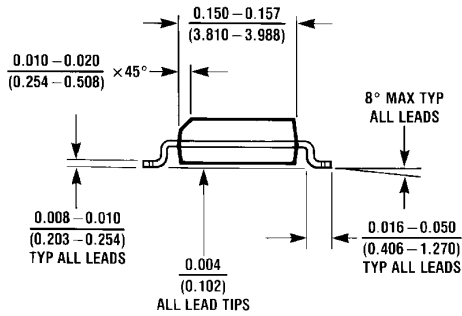
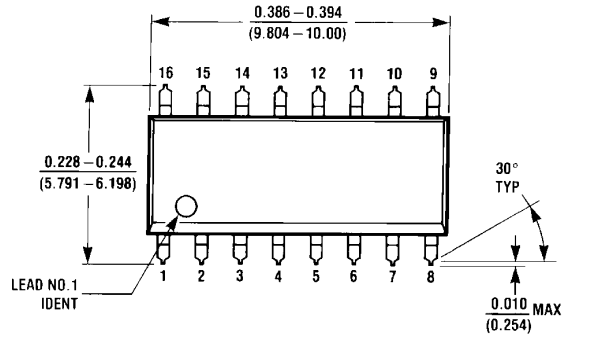
00851111

## ST504 and ST412 Applications



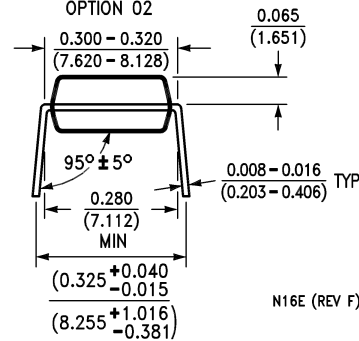
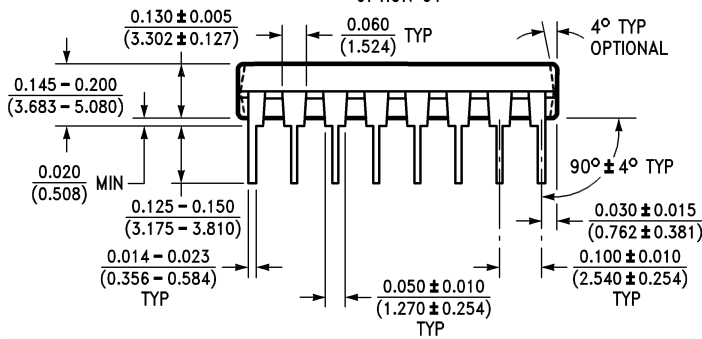
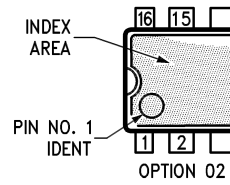
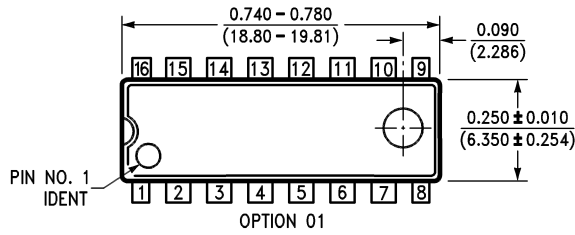
00851112

**Physical Dimensions** inches (millimeters) unless otherwise noted



M16A (REV H)

**SO Package (M)**  
**Order Number DS8922M, DS8922AM, or DS8923AM**  
**NS Package Number M16A**



N16E (REV F)

**Molded Dual-In-Line Package (N)**  
**Order Number DS8922N, DS8922AN, or DS8923AN**  
**NS Package Number N16E**

## Notes

### LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

### BANNED SUBSTANCE COMPLIANCE

National Semiconductor certifies that the products and packing materials meet the provisions of the Customer Products Stewardship Specification (CSP-9-111C2) and the Banned Substances and Materials of Interest Specification (CSP-9-111S2) and contain no "Banned Substances" as defined in CSP-9-111S2.



**National Semiconductor**  
Americas Customer  
Support Center  
Email: [new.feedback@nsc.com](mailto:new.feedback@nsc.com)  
Tel: 1-800-272-9959

[www.national.com](http://www.national.com)

**National Semiconductor**  
Europe Customer Support Center  
Fax: +49 (0) 180-530 85 86  
Email: [europa.support@nsc.com](mailto:europa.support@nsc.com)  
Deutsch Tel: +49 (0) 69 9508 6208  
English Tel: +44 (0) 870 24 0 2171  
Français Tel: +33 (0) 1 41 91 8790

**National Semiconductor**  
Asia Pacific Customer  
Support Center  
Email: [ap.support@nsc.com](mailto:ap.support@nsc.com)

**National Semiconductor**  
Japan Customer Support Center  
Fax: 81-3-5639-7507  
Email: [jpn.feedback@nsc.com](mailto:jpn.feedback@nsc.com)  
Tel: 81-3-5639-7560

## 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>
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

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>

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