

LM112,LM212,LM312

LM112 LM212 LM312 Operational Amplifiers



Literature Number: SNOSBR9A

LM112/LM212/LM312 Operational Amplifiers

General Description

The LM112 series are micropower operational amplifiers with very low offset-voltage and input-current errors—at least a factor of ten better than FET amplifiers over a -55°C to $+125^{\circ}\text{C}$ temperature range. Similar to the LM108 series, that also use supergain transistors, they differ in that they include internal frequency compensation and have provisions for offset adjustment with a single potentiometer.

These amplifiers will operate on supply voltages of $\pm 2\text{V}$ to $\pm 20\text{V}$, drawing a quiescent current of only $300\text{ }\mu\text{A}$. Performance is not appreciably affected over this range of voltages, so operation from unregulated power sources is easily accomplished. They can also be run from a single supply like the 5V used for digital circuits.

The LM112 series are the first IC amplifiers to improve reliability by including overvoltage protection for the MOS compensation capacitor. Without this feature, IC's have been

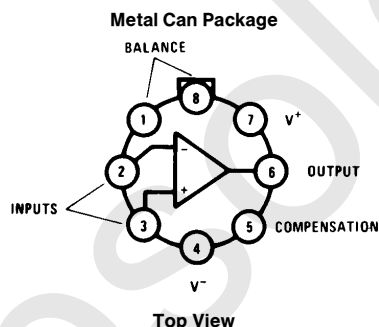
known to suffer catastrophic failure caused by short-duration overvoltage spikes on the supplies. Unlike other internally-compensated IC amplifiers, it is possible to overcompensate with an external capacitor to increase stability margin.

The LM212 is identical to the LM112, except that the LM212 has its performance guaranteed over a -25°C to $+85^{\circ}\text{C}$ temperature range instead of -55°C to $+125^{\circ}\text{C}$. The LM312 is guaranteed over a 0°C to $+70^{\circ}\text{C}$ temperature range.

Features

- Maximum input bias current of 3 nA over temperature
- Offset current less than 400 pA over temperature
- Low noise
- Guaranteed drift specifications

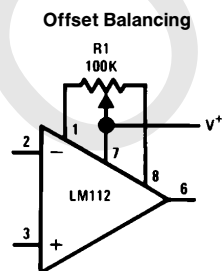
Connection Diagram



TL/H/7751-4

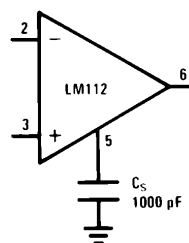
Order Number LM112H, LM212H, LM312H or LM112H/883
See NS Package Number H08C

Auxiliary Circuits



TL/H/7751-2

Overcompensation for Greater Stability Margin



TL/H/7751-3

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.
(Note 5)

	LM112/LM212	LM312
Supply Voltage	$\pm 20\text{V}$	$\pm 18\text{V}$
Power Dissipation (Note 1)	500 mW	500 mW
Differential Input Current (Note 2)	$\pm 10\text{ mA}$	$\pm 10\text{ mA}$
Input Voltage (Note 3)	$\pm 15\text{V}$	$\pm 15\text{V}$
Output Short-Circuit Duration	Continuous	Continuous
Operating Temperature Range		
LM112	-55°C to $+125^{\circ}\text{C}$	0°C to $+70^{\circ}\text{C}$
LM212	-25°C to $+85^{\circ}\text{C}$	
Storage Temperature Range	-65°C to $+150^{\circ}\text{C}$	-65°C to $+150^{\circ}\text{C}$
Lead Temperature (Soldering, 10 sec.)	300°C	300°C
ESD rating to be determined.		

Electrical Characteristics (Note 4)

Parameter	Conditions	LM112/LM212			LM312			Units
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	$T_A = 25^{\circ}\text{C}$		0.7	2.0		2.0	7.5	mV
Input Offset Current	$T_A = 25^{\circ}\text{C}$		0.05	0.2		0.2	1	nA
Input Bias Current	$T_A = 25^{\circ}\text{C}$		0.8	2.0		1.5	7	nA
Input Resistance	$T_A = 25^{\circ}\text{C}$	30	70		10	40		$\text{M}\Omega$
Supply Current	$T_A = 25^{\circ}\text{C}$		0.3	0.6		0.3	0.8	mA
Large Signal Voltage Gain	$T_A = 25^{\circ}\text{C}$, $V_S = \pm 15\text{V}$ $V_{\text{OUT}} = \pm 10\text{V}$, $R_L \geq 10\text{ k}\Omega$	50	300		25	300		V/mV
Input Offset Voltage				3.0			10	mV
Average Temperature Coefficient of Input Offset Voltage			3.0	15		6.0	30	$\mu\text{V}/^{\circ}\text{C}$
Input Offset Current				0.4			1.5	nA
Average Temperature Coefficient of Input Offset Current			0.5	2.5		2.0	10	$\text{pA}/^{\circ}\text{C}$
Input Bias Current				3.0			10	nA
Supply Current	$T_A = 125^{\circ}\text{C}$		0.15	0.4				mA
Large Signal Voltage Gain	$V_S = \pm 15\text{V}$, $V_{\text{OUT}} = \pm 10\text{V}$ $R_L \geq 10\text{ k}\Omega$	25			15			V/mV
Output Voltage Swing	$V_S = \pm 15\text{V}$, $R_L = 10\text{ k}\Omega$	± 13	± 14		± 13	± 14		V
Input Voltage Range	$V_S = \pm 15\text{V}$	± 13.5			± 14			V
Common-Mode Rejection Ratio		85	100		80	100		dB
Supply Voltage Rejection Ratio		80	96		80	96		dB

Note 1: The maximum junction temperature of the LM112 is 150°C , LM212 is 100°C and LM312 is 85°C . For operating at elevated temperatures, devices in the H08 package must be derated based on a thermal resistance of $160^{\circ}\text{C}/\text{W}$, junction to ambient, or $20^{\circ}\text{C}/\text{W}$, junction to case.

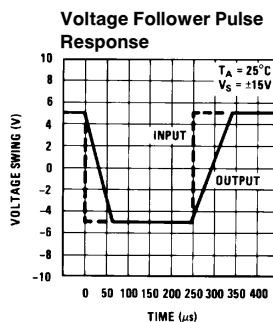
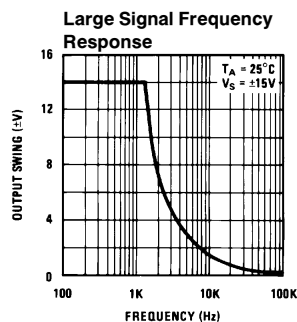
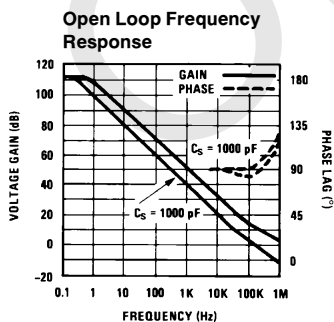
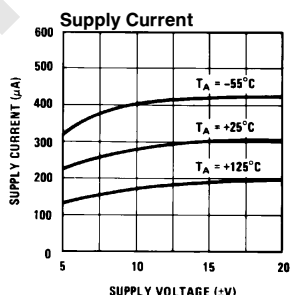
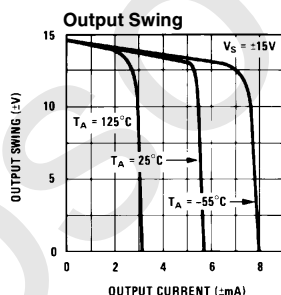
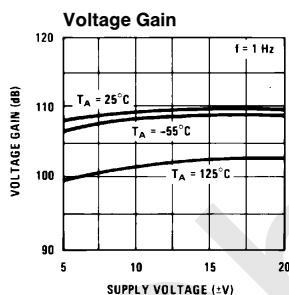
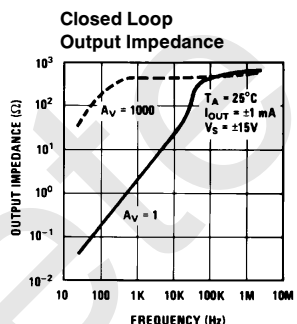
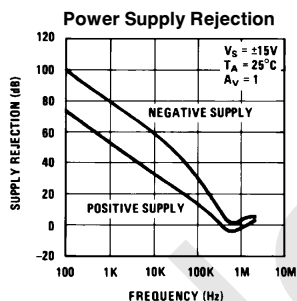
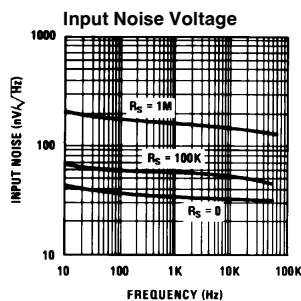
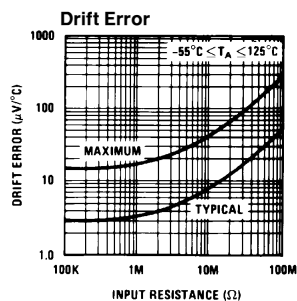
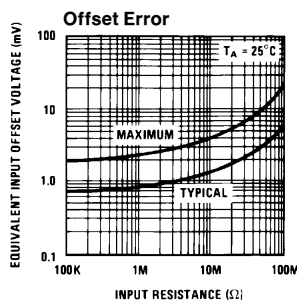
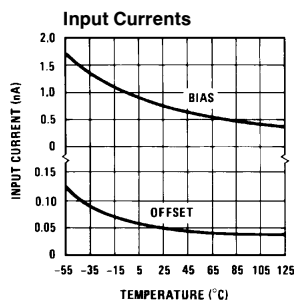
Note 2: The inputs are shunted with shunt diodes for overvoltage protection. Therefore, excessive current will flow if a differential input voltage in excess of 1V is applied between the inputs unless some limiting resistance is used.

Note 3: For supply voltages less than $\pm 15\text{V}$, the absolute maximum input voltage is equal to the supply voltage.

Note 4: These specifications apply for $\pm 5\text{V} \leq V_S \leq \pm 20\text{V}$ and $-55^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$ (LM112), $-25^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ (LM212), $\pm 5\text{V} \leq V_S \leq \pm 15\text{V}$ and $0^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$ (LM312) unless otherwise noted.

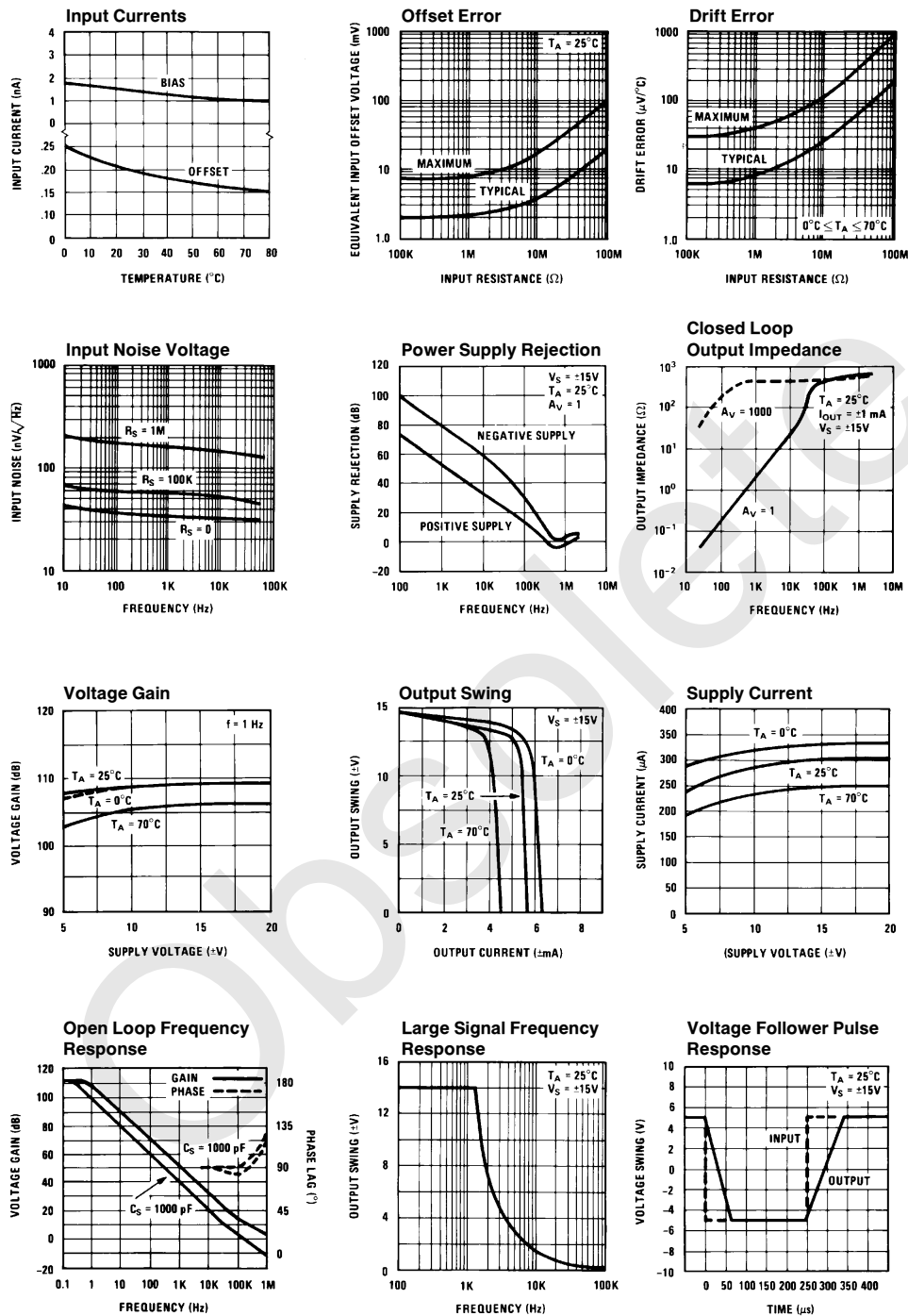
Note 5: Refer to RETS112X for LM112H military specifications.

Typical Performance Characteristics LM112/LM212



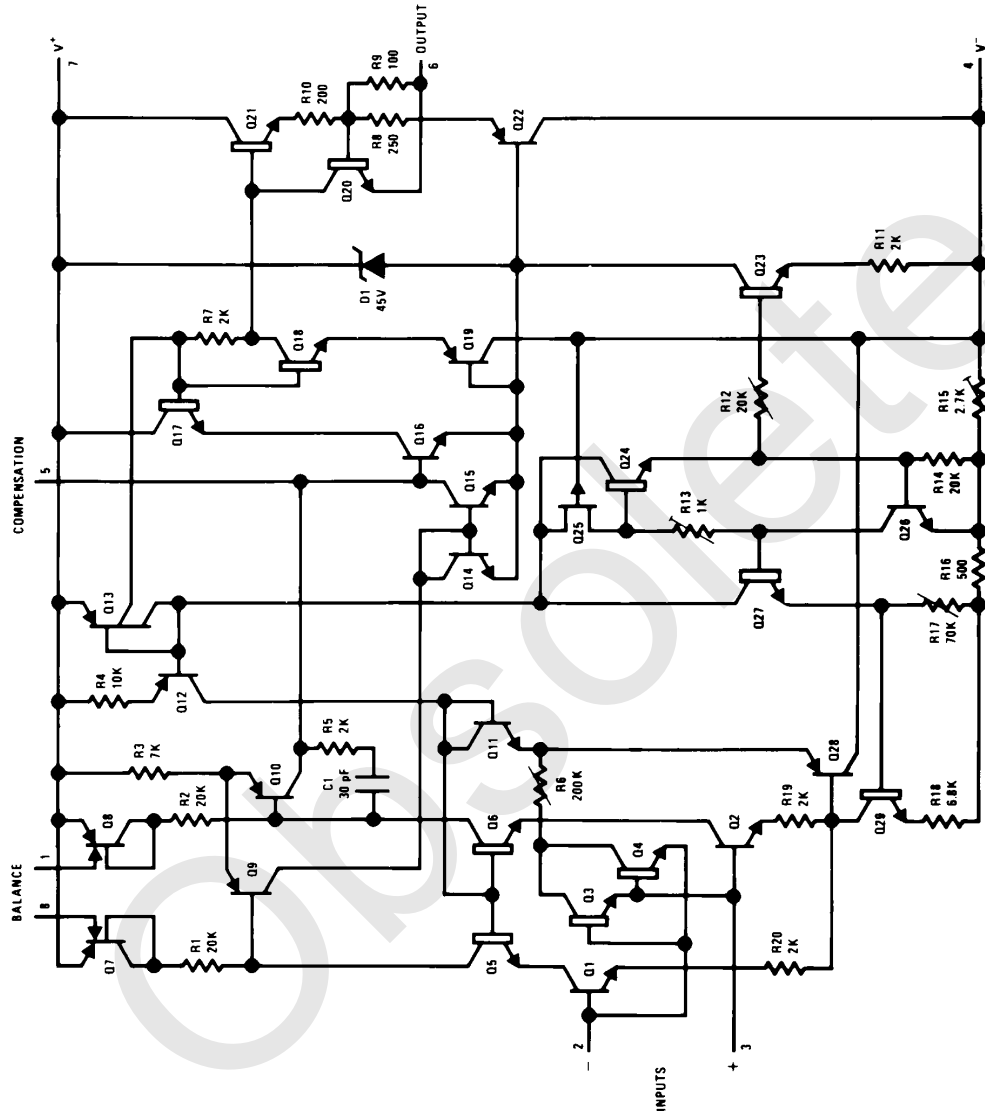
TL/H/7751-5

Typical Performance Characteristics LM312

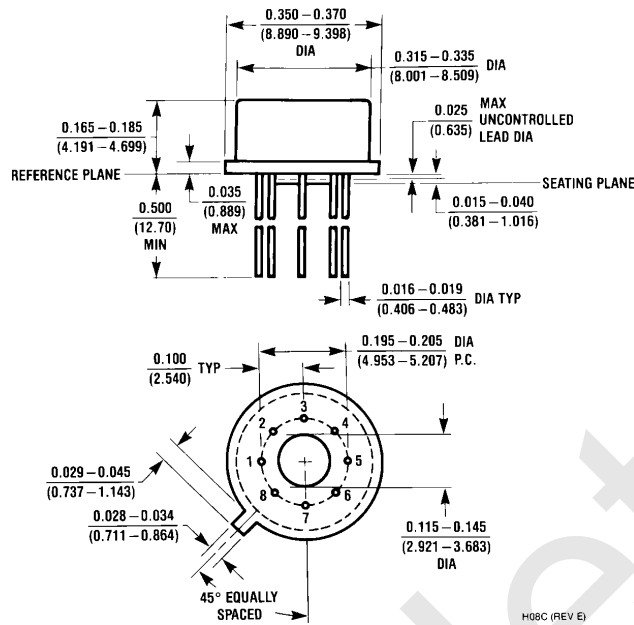


TL/H/7751-6

Schematic Diagram



TL/H/7751-1

Physical Dimensions inches (millimeters)**Metal Can Package (H)**

Order Number LM112H, LM212H, LM312H or LM112H/883
NS Package Number H08C

H08C (REV E)

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 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.



National Semiconductor Corporation
 1111 West Bardin Road
 Arlington, TX 76017
 Tel: 1(800) 272-9959
 Fax: 1(800) 737-7018

National Semiconductor Europe

Fax: (+49) 0-180-530 85 86
 Email: cnjwge@tevm2.nsc.com
 Deutsch Tel: (+49) 0-180-530 85 85
 English Tel: (+49) 0-180-532 78 32
 Français Tel: (+49) 0-180-532 93 58
 Italiano Tel: (+49) 0-180-534 16 80

National Semiconductor Hong Kong Ltd.

13th Floor, Straight Block,
 Ocean Centre, 5 Canton Rd.
 Tsimshatsui, Kowloon
 Hong Kong
 Tel: (852) 2737-1600
 Fax: (852) 2736-9960

National Semiconductor Japan Ltd.

Tel: 81-043-299-2309
 Fax: 81-043-299-2408

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	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Mobile Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Transportation and Automotive	www.ti.com/automotive
Video and Imaging	www.ti.com/video

TI E2E Community Home Page

e2e.ti.com

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