BENCHMARQ

bq3287/bq3287A

Real-Time Clock (RTC) Module

Features

➤ Direct clock/calendar replacement for IBM® AT-compatible computers and other applications

➤ Functionally compatible with the DS1287/DS1287A and MC146818A

➤ 114 bytes of general nonvolatile storage

➤ Integral lithium cell and crystal

➤ 160 ns cycle time allows fast bus operation

➤ Selectable Intel or Motorola bus timing

➤ 14 bytes for clock/calendar and control

➤ BCD or binary format for clock and calendar data

➤ Time of day in seconds, minutes, and hours

  - 12- or 24-hour format

  - Optional daylight saving adjustment

➤ Calendar in day of the week, day of the month, months, and years with automatic leap-year adjustment

➤ Programmable square wave output

➤ Three individually maskable interrupt event flags:

  - Periodic rates from 122 μs to 500 ms

  - Time-of-day alarm once per second to once per day

  - End-of-clock update cycle

➤ Better than one minute per month clock accuracy

General Description

The CMOS bq3287/bq3287A is a low-power microprocessor peripheral providing a time-of-day clock and 100-year calendar with alarm features and battery operation. Other features include three maskable interrupt sources, square-wave output, and 114 bytes of general nonvolatile storage. The bq3287A version is identical to the bq3287, with the addition of the RAM clear input.

The bq3287 is a fully compatible real-time clock for IBM AT-compatible computers and other applications. The bq3287 write-protects the clock, calendar, and storage registers during power failure. The integral backup energy source then maintains data and operates the clock and calendar.
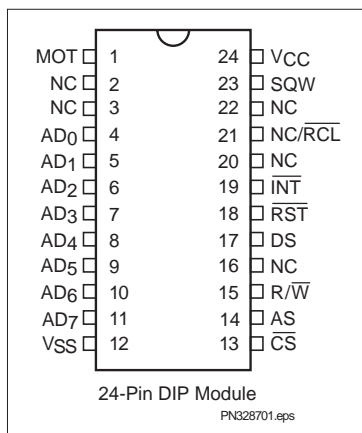
As shipped from Benchmarq, the real time clock is turned off to maximize battery capacity for in-system operation.

The bq3287 is functionally equivalent to the bq3285, except that the battery (16, 20) and crystal (2, 3) pins are not accessible. These pins are connected internally to a coin cell and quartz crystal. The coin cell is sized to provide 10 years of data retention and clock operation in the absence of power. For a complete description of features, operating conditions, electrical characteristics, bus timing, and pin descriptions, see the bq3285 data sheet.

Pin Connections

```
         ┌───────┐
  MOT ▢ │ 1   24 │ ▢ V_CC
   NC ▢ │ 2   23 │ ▢ SQW
   NC ▢ │ 3   22 │ ▢ NC
  AD0 ▢ │ 4   21 │ ▢ NC/RCL
  AD1 ▢ │ 5   20 │ ▢ NC
  AD2 ▢ │ 6   19 │ ▢ INT
  AD3 ▢ │ 7   18 │ ▢ RST
  AD4 ▢ │ 8   17 │ ▢ DS
  AD5 ▢ │ 9   16 │ ▢ NC
  AD6 ▢ │ 10  15 │ ▢ R/W
  AD7 ▢ │ 11  14 │ ▢ AS
  VSS ▢ │ 12  13 │ ▢ CS
         └───────┘
```

24-Pin DIP Module

PN328701.eps

Pin Names

AD_0–AD_7	Multiplexed address/data input/output
MOT	Bus type select input
$\overline{CS}$	Chip select input
AS	Address strobe input
DS	Data strobe input
R/$\overline{W}$	Read/write input
$\overline{INT}$	Interrupt request output
$\overline{RST}$	Reset input
SQW	Square wave output
NC	No connect
$\overline{RCL}$	RAM clear input (bq3287A only)
V_{CC}	+5V supply
V_{SS}	Ground

bq3287/bq3287A

Absolute Maximum Ratings

Symbol	Parameter	Value	Unit	Conditions
V_{CC}	DC voltage applied on V_{CC} relative to V_{SS}	-0.3 to 7.0	V	
V_T	DC voltage applied on any pin excluding V_{CC} relative to V_{SS}	-0.3 to 7.0	V	$V_T \leq V_{CC} + 0.3$
T_{OPR}	Operating temperature	0 to +70	°C	Commercial
		-20 to +70	°C	Extended "I"
T_{STG}	Storage temperature	-40 to +70	°C	Commercial
		-40 to +70	°C	Extended "I"
T_{BIAS}	Temperature under bias	-10 to +70	°C	Commercial
		-20 to +70	°C	Extended "I"
T_{SOLDER}	Soldering temperature	260	°C	For 10 seconds

Note: Permanent device damage may occur if **Absolute Maximum Ratings** are exceeded. Functional operation should be limited to the Recommended DC Operating Conditions detailed in this data sheet. Exposure to conditions beyond the operational limits for extended periods of time may affect device reliability.

Recommended DC Operating Conditions (T_A = T_{OPR})

Symbol	Parameter	Minimum	Typical	Maximum	Unit
V_{CC}	Supply voltage	4.5	5.0	5.5	V
V_{SS}	Supply voltage	0	0	0	V
V_{IL}	Input low voltage	-0.3	-	0.8	V
V_{IH}	Input high voltage	2.2	-	$V_{CC} + 0.3$	V

Note: Typical values indicate operation at T_A = 25°C.

DC Electrical Characteristics (T_A = T_{OPR}, V_{CC} = 5V ± 10%)

Symbol	Parameter	Minimum	Typical	Maximum	Unit	Conditions/Notes
I_{LI}	Input leakage current	-	-	± 1	μA	V_{IN} = V_{SS} to V_{CC}
I_{LO}	Output leakage current	-	-	± 1	μA	AD_0–AD_7, $\overline{INT}$ and SQW in high impedance
V_{OH}	Output high voltage	2.4	-	-	V	I_{OH} = -1.0 mA
V_{OL}	Output low voltage	-	-	0.4	V	I_{OL} = 4.0 mA
I_{CC}	Operating supply current	-	7	15	mA	Min. cycle, duty = 100%, I_{OH} = 0mA, I_{OL} = 0mA
V_{SO}	Supply switch-over voltage	-	3.0	-	V	
V_{PFD}	Power-fail-detect voltage	4.0	4.17	4.35	V	
I_{RCL}	Input current when $\overline{RCL}$ = V_{SS}	-	-	185	μA	Internal 30K pull-up (bq3287A only)
I_{MOTH}	Input current when MOT = V_{CC}	-	-	-185	μA	Internal 30K pull-down

**Note:** Typical values indicate operation at T_A = 25°C, V_{CC} = 5V.

Sept. 1996 D

Power-Down/Power-Up Timing $(T_A = T_{OPR})$

Symbol	Parameter	Minimum	Typical	Maximum	Unit	Conditions
t_F	V_{CC} slew from 4.5V to 0V	300	-	-	µs	
t_R	V_{CC} slew from 0V to 4.5V	100	-	-	µs	
t_{CSR}	$\overline{CS}$ at V_{IH} after power-up	20	-	200	ms	Internal write-protection period after V_{CC} passes V_{PFD} on power-up.
t_{DR}	Data-retention and time-keeping time	10	-	-	years	$T_A = 25°C$.

Note: Clock accuracy is better than $\pm$ 1 minute per month at 25°C for the period of t_{DR}.
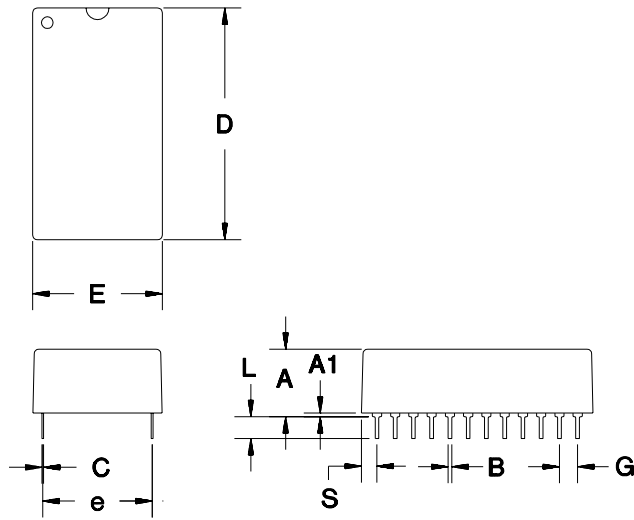
Caution: **Negative undershoots below the absolute maximum rating of -0.3V in battery-backup mode may affect data integrity.**

Power-Down/Power-Up Timing

PD-4

bq3287/bq3287A
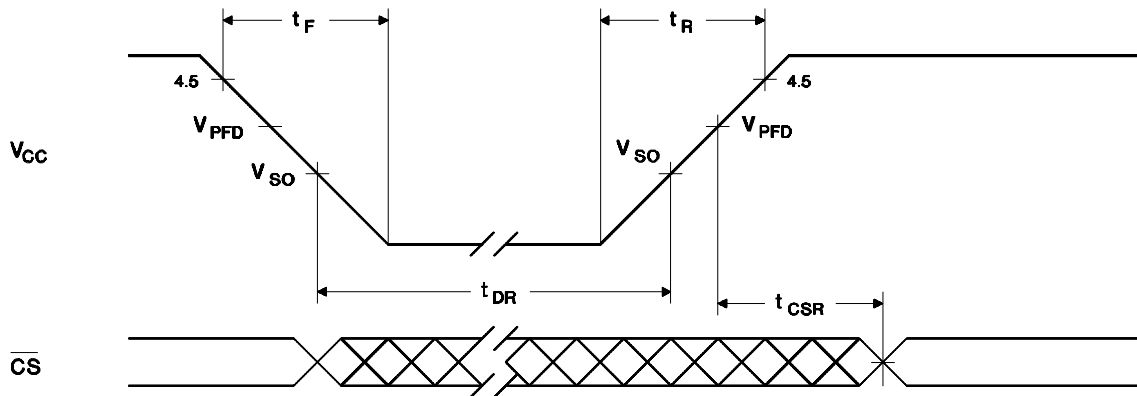
24-Pin MT (T-type module)

24-Pin MT (T-type module)

Dimension	Minimum	Maximum
A	0.360	0.375
A1	0.015	-
B	0.015	0.022
C	0.008	0.013
D	1.320	1.335
E	0.685	0.700
e	0.590	0.620
G	0.090	0.110
L	0.120	0.130
S	0.100	0.120

All dimensions are in inches.

Data Sheet Revision History

Change No.	Page No.	Description	Nature of Change
1	1	Address strobe input	Clarification
1	2	Power-fail detect voltage V_{PFD}	Was 4.1 min, 4.25 max; is 4.0 min, 4.35 max
2	1	Was : "As shipped from Benchmarq, the backup cell is electrically isolated from the memory." Is: "As shipped from Benchmarq, the backup cell is electrically isolated from the active circuitry."	Clarification
2	2, 4	Changed temperature from N (industrial, -40 to +85°C) to I (extended, -20 to +70°C)	Specification change
3	2	I_{RCL} max. was 275; is now 185. Pull-up = 30K I_{MOTH} max. was -275; is now -185. Pull-down = 30K	Changed values

Notes: Change 1 = Nov. 1992 B changes from June 1991 A.
Change 2 = Nov. 1995 C changes from Nov. 1992 B.
Change 3 = Sept. 1996 D changes from Nov. 1995 C.

Ordering Information

bq3287 ___ MT -

Temperature:
blank = Commercial (0 to +70°C)
I = Extended* (-20 to +70°C)

Package Option:
MT = T-type module

RAM Clear Option:
A = RAM clear on pin 21
no mark = No connect on pin 21

Device:
bq3287 Real-Time Clock Module
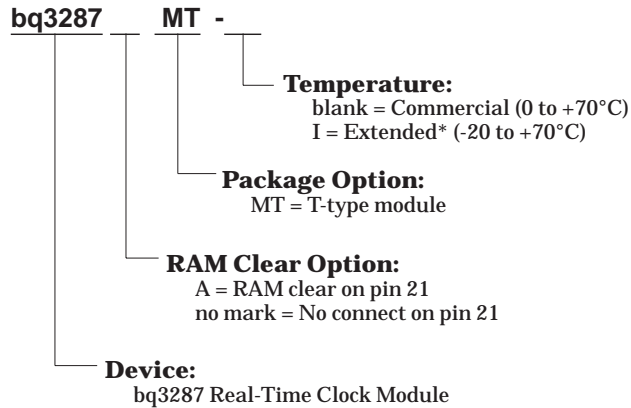
*Contact factory for availability.

PACKAGE OPTION ADDENDUM

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
BQ3287AMT-I	ACTIVE	DIP MODULE	MT	24	15	Pb-Free (RoHS)	Call TI	N / A for Pkg Type
BQ3287AMT-SB2	ACTIVE	DIP MODULE	MT	24	15	Pb-Free (RoHS)	Call TI	N / A for Pkg Type
BQ3287MT-I	ACTIVE	DIP MODULE	MT	24	15	Pb-Free (RoHS)	Call TI	N / A for Pkg Type
BQ3287MT-SB2	ACTIVE	DIP MODULE	MT	24	15	Pb-Free (RoHS)	Call TI	N / A for Pkg Type

[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.
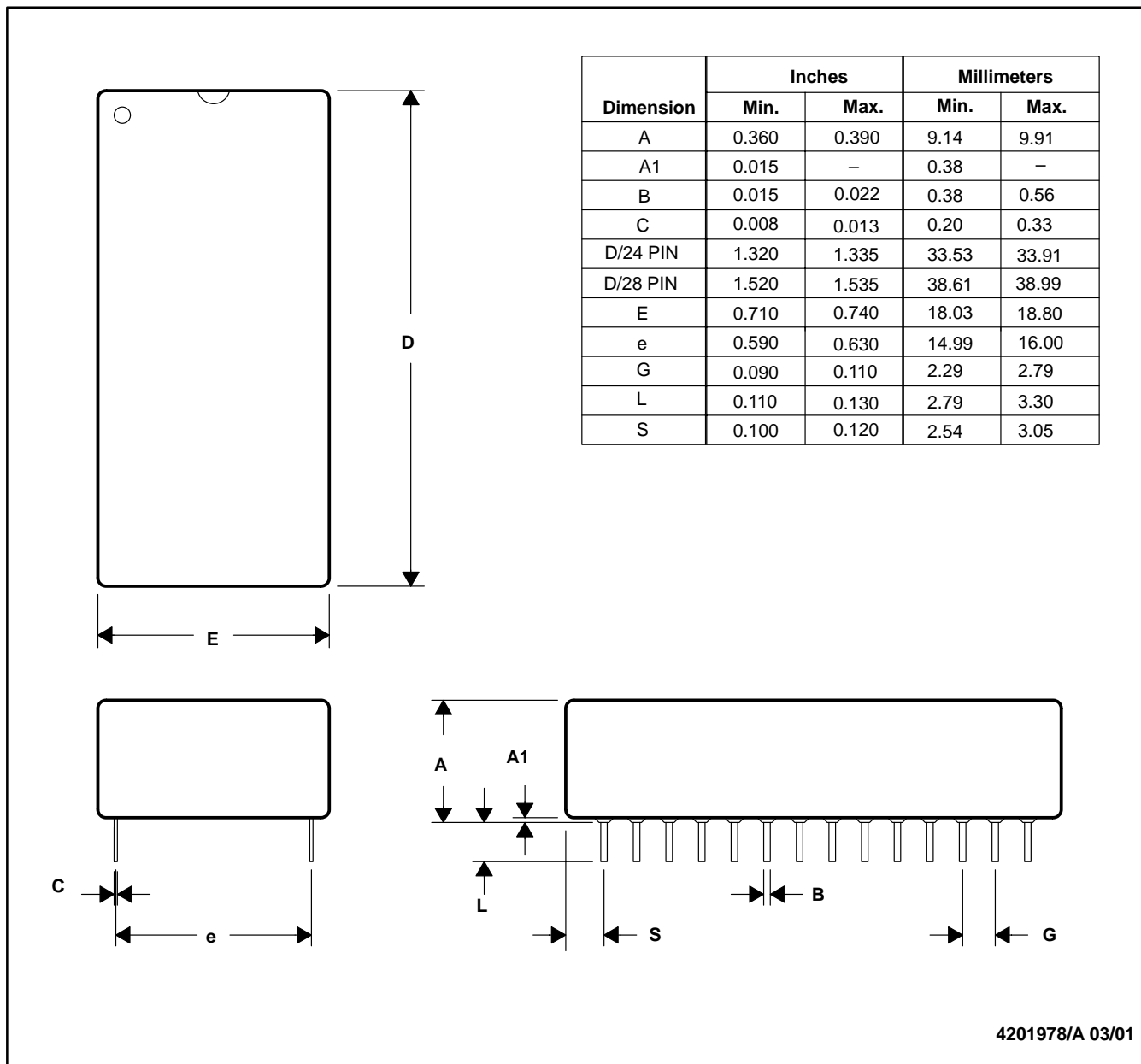
Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. 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.

MT (R-PDIP-T**)

PLASTIC DUAL-IN-LINE

28 PINS SHOWN

Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A	0.360	0.390	9.14	9.91
A1	0.015	–	0.38	–
B	0.015	0.022	0.38	0.56
C	0.008	0.013	0.20	0.33
D/24 PIN	1.320	1.335	33.53	33.91
D/28 PIN	1.520	1.535	38.61	38.99
E	0.710	0.740	18.03	18.80
e	0.590	0.630	14.99	16.00
G	0.090	0.110	2.29	2.79
L	0.110	0.130	2.79	3.30
S	0.100	0.120	2.54	3.05

4201978/A 03/01

NOTES: A. All linear dimensions are in inches (mm).
B. This drawing is subject to change without notice.

TEXAS
INSTRUMENTS

POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265
POST OFFICE BOX 1443 ● HOUSTON, TEXAS 77251–1443

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		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DLP® Products	www.dlp.com	Broadband	www.ti.com/broadband
DSP	dsp.ti.com	Digital Control	www.ti.com/digitalcontrol
Clocks and Timers	www.ti.com/clocks	Medical	www.ti.com/medical
Interface	interface.ti.com	Military	www.ti.com/military
Logic	logic.ti.com	Optical Networking	www.ti.com/opticalnetwork
Power Mgmt	power.ti.com	Security	www.ti.com/security
Microcontrollers	microcontroller.ti.com	Telephony	www.ti.com/telephony
RFID	www.ti-rfid.com	Video & Imaging	www.ti.com/video
RF/IF and ZigBee® Solutions	www.ti.com/lprf	Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2009, Texas Instruments Incorporated