



# 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  $\mu$ s 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

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.

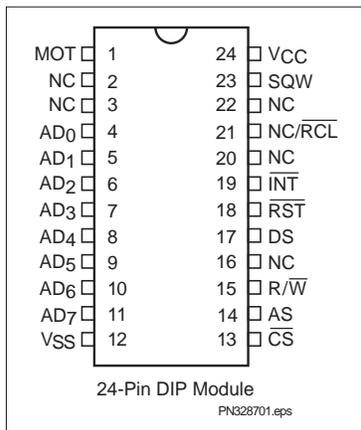
As shipped from Benchmarq, the real time clock is turned off to maximize battery capacity for in-system operation.

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.

### 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

### Pin Connections



### Pin Names

AD <sub>0</sub> -AD <sub>7</sub>	Multiplexed address/data input/output	$\overline{\text{RST}}$	Reset input
MOT	Bus type select input	SQW	Square wave output
$\overline{\text{CS}}$	Chip select input	NC	No connect
AS	Address strobe input	$\overline{\text{RCL}}$	RAM clear input (bq3287A only)
DS	Data strobe input	VCC	+5V supply
R/ $\overline{\text{W}}$	Read/write input	VSS	Ground
$\overline{\text{INT}}$	Interrupt request output		

## bq3287/bq3287A

### Absolute Maximum Ratings

Symbol	Parameter	Value	Unit	Conditions
V <sub>CC</sub>	DC voltage applied on V <sub>CC</sub> relative to V <sub>SS</sub>	-0.3 to 7.0	V	
V <sub>T</sub>	DC voltage applied on any pin excluding V <sub>CC</sub> relative to V <sub>SS</sub>	-0.3 to 7.0	V	V <sub>T</sub> ≤ V <sub>CC</sub> + 0.3
T <sub>OPR</sub>	Operating temperature	0 to +70	°C	Commercial
		-20 to +70	°C	Extended "I"
T <sub>STG</sub>	Storage temperature	-40 to +70	°C	Commercial
		-40 to +70	°C	Extended "I"
T <sub>BIAS</sub>	Temperature under bias	-10 to +70	°C	Commercial
		-20 to +70	°C	Extended "I"
T <sub>SOLDER</sub>	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<sub>A</sub> = T<sub>OPR</sub>)

Symbol	Parameter	Minimum	Typical	Maximum	Unit
V <sub>CC</sub>	Supply voltage	4.5	5.0	5.5	V
V <sub>SS</sub>	Supply voltage	0	0	0	V
V <sub>IL</sub>	Input low voltage	-0.3	-	0.8	V
V <sub>IH</sub>	Input high voltage	2.2	-	V <sub>CC</sub> + 0.3	V

**Note:** Typical values indicate operation at T<sub>A</sub> = 25°C.

### DC Electrical Characteristics (T<sub>A</sub> = T<sub>OPR</sub>, V<sub>CC</sub> = 5V ± 10%)

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

**Note:** Typical values indicate operation at T<sub>A</sub> = 25°C, V<sub>CC</sub> = 5V.

Sept. 1996 D

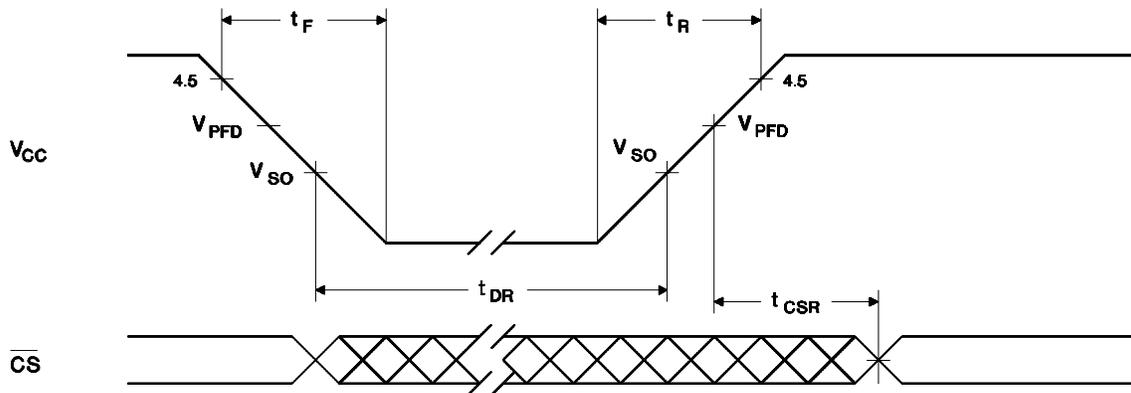
**Power-Down/Power-Up Timing** ( $T_A = T_{OPR}$ )

Symbol	Parameter	Minimum	Typical	Maximum	Unit	Conditions
$t_F$	$V_{CC}$ slew from 4.5V to 0V	300	-	-	$\mu s$	
$t_R$	$V_{CC}$ slew from 0V to 4.5V	100	-	-	$\mu s$	
$t_{CSR}$	$\overline{CS}$ 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	$T_A = 25^\circ C$ .

**Note:** Clock accuracy is better than  $\pm 1$  minute per month at  $25^\circ C$  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**

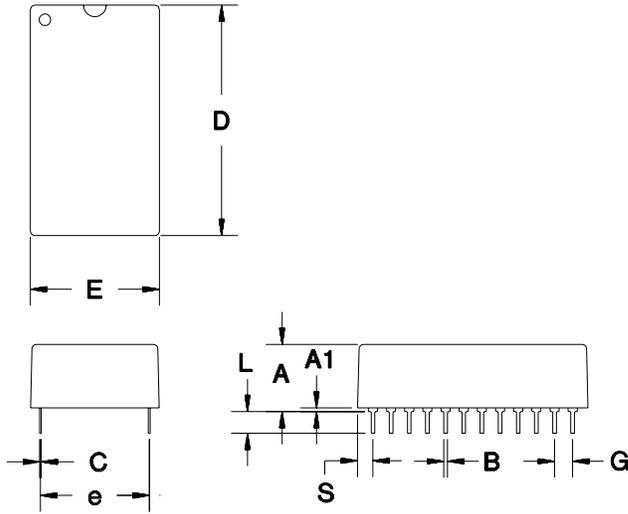


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**bq3287/bq3287A**

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**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

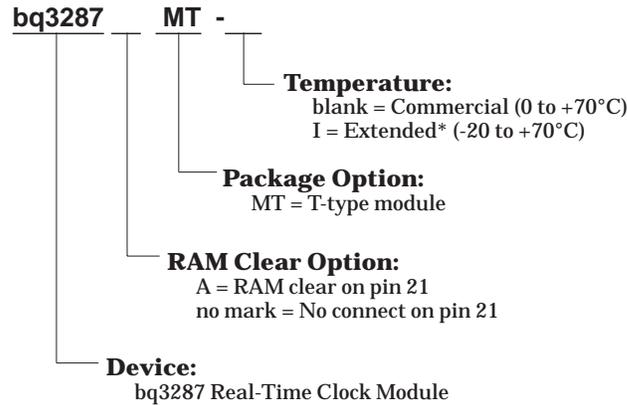
All dimensions are in inches.

**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**



\*Contact factory for availability.

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
BQ3287AMT-I	LIFEBUY	DIP MODULE	MT	24	15	Pb-Free (RoHS)	Call TI	N / A for Pkg Type	-20 to 70		
BQ3287AMT-SB2	LIFEBUY	DIP MODULE	MT	24	15	Pb-Free (RoHS)	Call TI	N / A for Pkg Type	0 to 70		
BQ3287MT-I	LIFEBUY	DIP MODULE	MT	24	15	Pb-Free (RoHS)	Call TI	N / A for Pkg Type	-20 to 70		
BQ3287MT-SB2	LIFEBUY	DIP MODULE	MT	24	15	Pb-Free (RoHS)	Call TI	N / A for Pkg Type	0 to 70		

(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.

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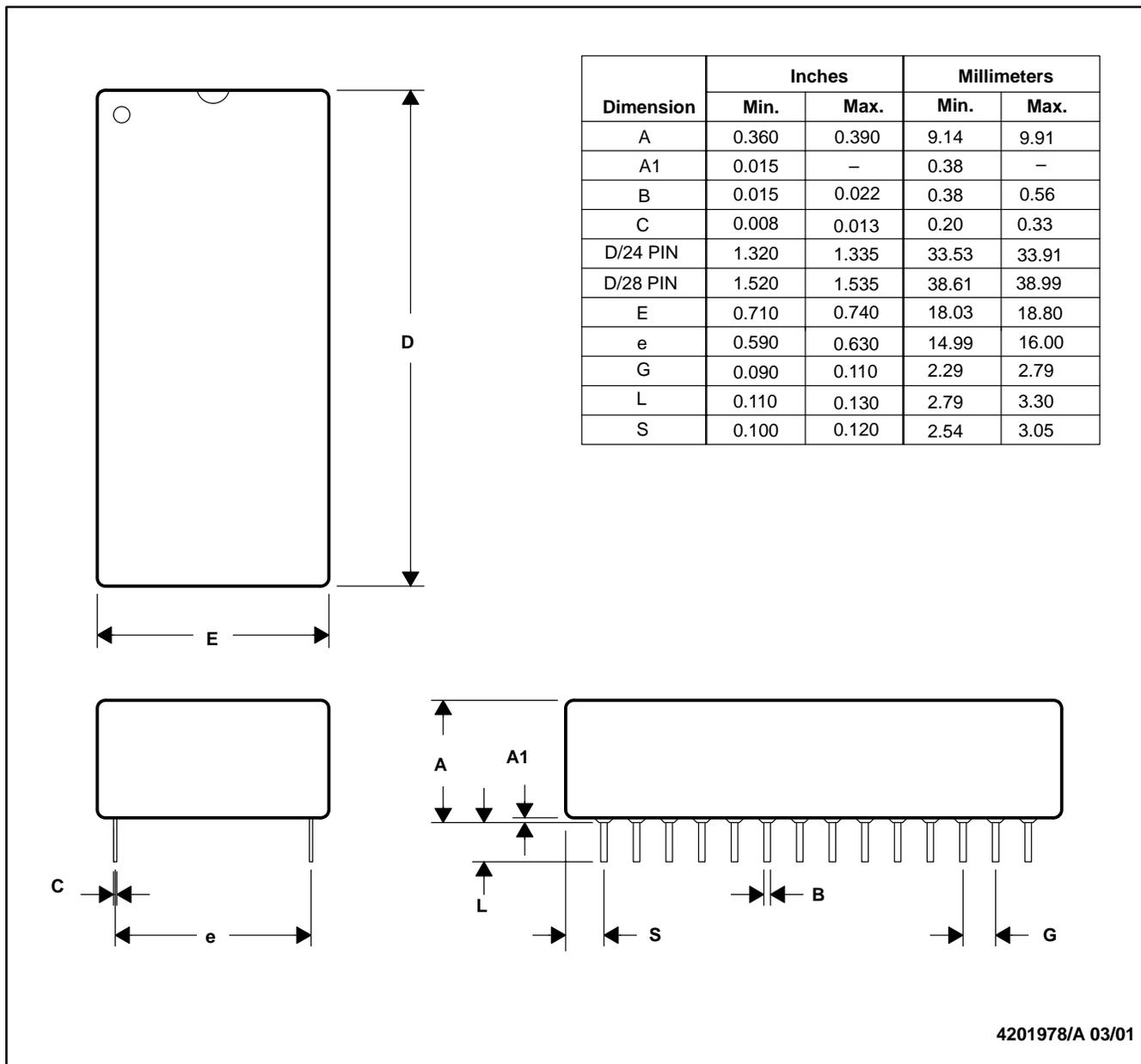
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MT (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE

28 PINS SHOWN



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

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