



# 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.

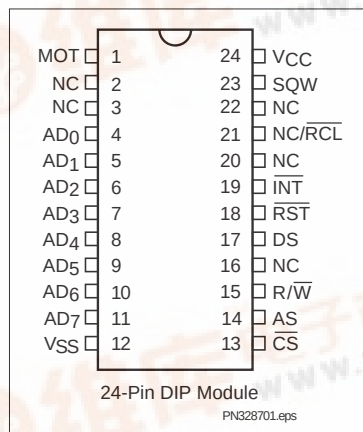
As shipped from Benchmarq, the real time clock is turned off to maximize battery capacity for in-system operation.

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                     | V <sub>CC</sub>         | +5V supply                     |
| R/ $\overline{\text{W}}$         | Read/write input                      | V <sub>SS</sub>         | 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 $\overline{\text{RCL}}$ = V <sub>SS</sub> | -       | -       | 185     | μA   | Internal 30K pull-up (bq3287A only)                                                  |
| I <sub>MOT</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.

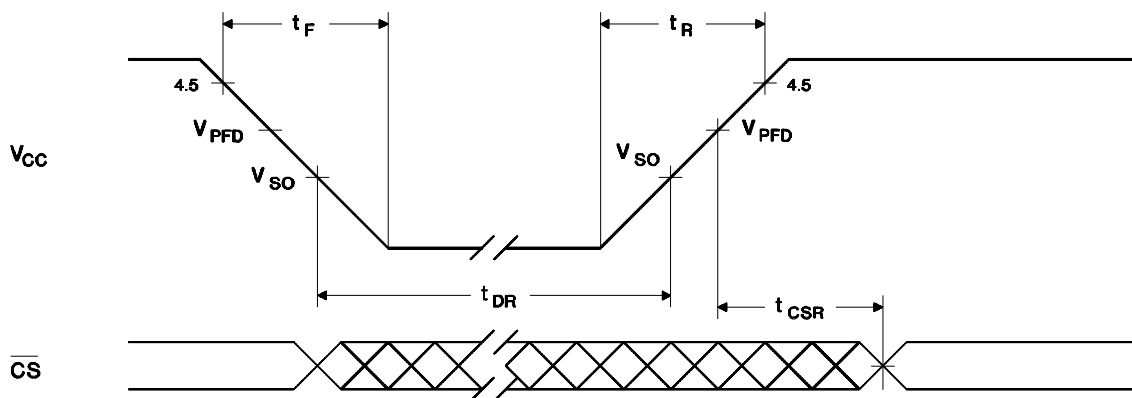
Sept. 1996 D

**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.

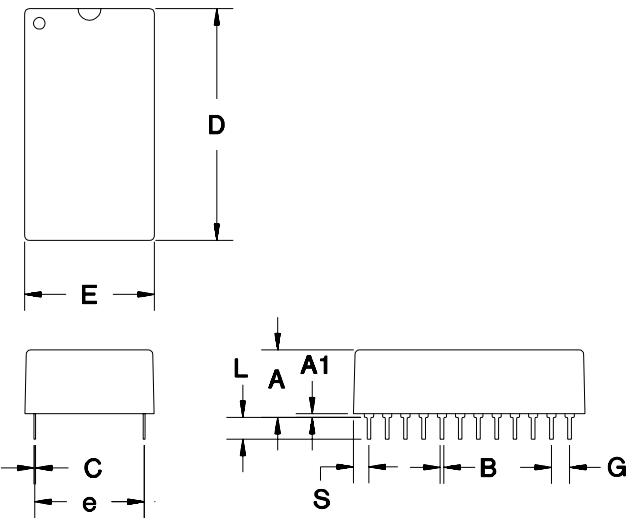
**Power-Down/Power-Up Timing**

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   |

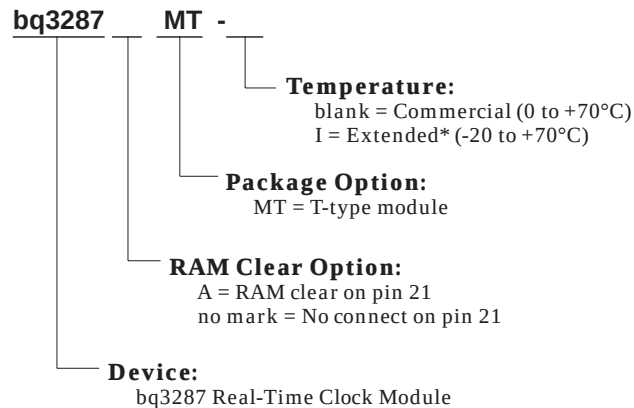
All dimensions are in inches.

## 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;<br>is 4.0 min, 4.35 max |
| 2          | 1        | Was : "As shipped from Benchmarq, the backup cell is electrically isolated from the memory."<br>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<br>$I_{MOTH}$ 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.

## **IMPORTANT NOTICE**

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

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

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.