Keywords: RTC, TCXO, real time clock, I2C, SPI, MEMS, electromechanical systems

APPLICATION NOTE 5143

Feature Comparison of the DS323x Real-Time Clocks

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Sep 23, 2011

Abstract: This application note explains the differences between several Maxim real-time clocks (RTCs), including the DS3231, DS3232, DS3234, DS32B35, and DS32C35, to help customers identify the proper solution for their application. The DS3231M, which has a built-in microelectronic mechanical systems (MEMS) resonator instead of a crystal, is also discussed.

Maxim, a leader in real-time clocks (RTCs), has designed several devices to meet the needs of the ever-demanding RTC market. These products provide completely integrated, extremely accurate, and temperature-compensated RTC solutions. Much of a RTC's accuracy is dependent on the crystal accuracy across temperature. Thus, temperature compensation of the crystal characteristics allows for higher accuracy on these devices.

This application note explains the differences between several RTCs (the DS3231, DS3232, DS3234, DS32B35, and DS32C35) to help customers identify the proper solution for their application. The DS3231M, which has a built-in microelectronic mechanical systems (MEMS) resonator instead of a crystal, is also discussed.

DS3231

The DS3231 is an extremely accurate I²C-integrated temperature-compensated crystal oscillator (TCXO) and crystal. Some of the key features of this product include:

- Accuracy ±2ppm from 0°C to +40°C
- Accuracy ±3.5ppm from -40°C to +85°C
- Battery backup input for continuous timekeeping
- Operating temperature ranges
  - Commercial: 0°C to +70°C
  - Industrial: -40°C to +85°C
- Low-power consumption
- RTC counts seconds, minutes, hours, day, date, month, and year with leap year compensation valid up to 2100
- Two time-of-day alarms
- Programmable square-wave output
- Fast (400kHz) I²C interface
- 3.3V operation
- Digital temp sensor output: ±3°C accuracy

Active-low RST output/pushbutton reset debounce input
- Underwriters Laboratories (UL) recognized

DS3231M

The DS3231M is the industry's first temperature-compensated RTC with an internal MEMS resonator. This allows the device to be used in high-vibration environments, removing malfunctions due to crystal mechanical failures. This device is also available in a space-saving 8-pin 150-mil SOIC package.

DS3232

The DS3232, an accurate I²C RTC with integrated crystal and SRAM, is similar to the DS3231. However, it has the following modifications:

1. The addition of the I²C timeout function. This limits the minimum frequency at which the I²C interface can be operated.

2. The 32kHz output driver is changed to push-pull. This removes the need for an external pullup resistor, resulting in space savings. This also allows faster edges on the clock, along with power savings in the device.

3. On battery switchover, the BB32kHz bit can be used to selectively enable/disable the 32kHz output.

4. The 32kHz output on the DS3232 is designed to drive low when turned off. The DS3231 is switched to a high impedance state when switched off.

5. On the DS3232, the temperature-conversion rate can now be controlled using 2 CRATE bits. These bits control the sample rate of the device. The sample rate determines how often the temperature sensor makes a conversion and applies compensation to the oscillator. Decreasing the sample rate decreases the overall power consumption by decreasing the frequency at which the temperature sensor operates.

6. The DS3232 has 236 bytes of battery-backed SRAM.

DS3234

The DS3234, an accurate SPI™ bus RTC with integrated crystal and SRAM, is similar to the DS3232 but has the following changes:

1. Address and data are transferred serially by an SPI bidirectional interface.

2. It integrates 256 bytes of battery-backed SRAM.

DS32B35 and DS32C35

The DS32B35 and DS32C35 use the same die as the DS3231. However, these devices have several modifications:

1. The addition of a FRAM die with a separate I²C slave address. Application note 3886, "Benefits of the

DS32X35 accurate Real-Time Clock with Ferroelectric Random Access Memory (RTC + FRAM)", explains the advantages of FRAM over other kinds of memory. The DS32B35 has 2KB FRAM, versus 8KB for the DS32C35.

2. Both SDA and SCL pins of the two I²C interfaces are tied together within the package and may be tied together externally.

3. V_{CC} for both die is internally connected and may be tied together externally.

4. GND for both die is NOT connected internally. These must be tied together externally for proper operation.

Table 1 illustrates some of the primary differences of parts in the DS323x series.

Table 1. Key Differences of the DS3231/DS3231M/DS3232/DS3234/DS32B35/DS32C35

Part	I/O	User RAM	Alarms	Reset Output	SQW Freq	Osc. Stop Flag	Thermal Sample Rate	Battery Backup
DS3231	I²C	—	2	Yes	1Hz, 1.024kHz, 4.096kHz, 8.192kHz	Yes	Programmable	Yes
DS3232	I²C	236B SRAM						
DS3234	SPI	256B SRAM						
DS32B35	I²C	2KB FRAM						
DS32C35	I²C	8KB FRAM						
DS3231M	I²C	—			1Hz			

Conclusion

This application note illustrates the differences between the DS3231, DS3232, DS3234, DS32B35, and DS32C35 to help customers choose the appropriate product for their application. The MEMS resonator-based DS3231M is also discussed. For more design considerations, see application note 504, "Design Considerations for Maxim Real-Time Clocks."

Related Parts		
DS3231	Extremely Accurate I²C-Integrated RTC/TCXO/Crystal	Free Samples
DS3231M	±5ppm, I²C Real-Time Clock	Free Samples
DS3232	Extremely Accurate I²C RTC with Integrated Crystal and SRAM	Free Samples
DS3234	Extremely Accurate SPI Bus RTC with Integrated Crystal and SRAM	Free Samples
DS32B35	Accurate I²C RTC with Integrated TCXO/Crystal/FRAM	

More Information
For Technical Support: http://www.maximintegrated.com/support
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APPLICATION NOTE 5143, AN5143, AN 5143, APP5143, Appnote5143, Appnote 5143