Keywords: timekeeping accuracy, temperature compensation, crystal, real-time clocks

APPLICATION NOTE 701

Using the DS32kHz with Maxim Real-Time Clocks

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Abstract: This application note describes how to reduce current consumption when using the DS32kHz with Maxim real-time clocks (RTCs).

Overview

This application note is intended to answer some frequently asked questions about using the DS32kHz temperature-compensated crystal oscillator (TCXO) and Maxim real-time clocks (RTCs).

Using the DS32kHz

The DS32kHz has four pins that are required for operation: V_{CC}, V_{BAT}, GND, and 32kHz_OUT. The V_{CC}, V_{BAT}, and GND are power-supply connections and must either be connected to a positive supply or grounded. The 32kHz_OUT signal is intended to drive the X1 input of the RTC. The X2 pin of the RTC should be allowed to float when driving the X1 input with an oscillator.

The DS32kHz I_{CC} and I_{BAT} specifications are measured with no output load. The input characteristics of the oscillator on a RTC determine how much additional current the DS32kHz will consume. The additional current can significantly increase the size of the battery needed for operation.

Choosing an RTC

Maxim Integrated has a wide selection of RTCs from which to choose. Some of these devices were designed using a P-WELL process while the more recent devices have been designed using the first-generation N-WELL process. The second-generation N-WELL RTCs incorporate improvements that reduce the current consumption of the TCXO/RTC combination. The following data shows the current consumed by typical devices from each process. The data were taken at a battery voltage of 3.5V at +25°C.

KEY:
Ind = Individual Currents; DS32kHz with output open, RTC with crystal attached and running.
Direct = DS32kHz driving the RTC X1 input directly.
RC = DS32kHz driving the RTC with a 1MΩ resistor in series with a 100pF capacitor to the X1 input.

Table 1. N-WELL (First Generation)		
Mode	**DS32kHz I_{BAT} (µA)**	**DS1306 I_{BAT} (nA)**
Ind	1.60	518
Direct	11.9	386
RC	2.14	584

Table 2. N-WELL (Second Generation)		
Mode	**DS32kHz IBAT (µA)**	**DS1337 I_{CC} (nA)**
Ind	1.59	612
Direct	3.73	626
RC	2.11	622

Table 3. P-WELL		
Mode	**DS32kHz I_{BAT} (µA)**	**DS1202 I_{BAT} (nA)**
Ind	1.63	625
Direct	87.1	3410
RC	2.17	685

Note the RTC in each of the aforementioned tables are different RTCs. This accounts for the difference in the clock currents when comparing the tables.

If the RTC has an oscillator-enable bit, the oscillator must be enabled. If the bit is not enabled, additional current is drawn and the clock may not operate.

Table 4. RTC LIST		
P-WELL Devices	**First Generation N-WELL Devices**	**Second Generation N-WELL Devices**
DS1202	DS12885	DS1337
DS12885	DS1302	DS1338
DS1283	DS1305/DS1306	DS1339
DS1284	DS1307	DS1672
DS1384	DS1315	
DS14285	DS1500/DS1501	
DS1384	DS1315	
	DS1602	
	DS1670/DS1673/DS1677	
	DS1685	
	DS1688/DS1689	
	DS17285/DS17485/DS17885	

Summary

When using P-WELL and first-generation N-WELL RTC devices, use an RC circuit to achieve the minimum possible timekeeping current.

The second-generation N-WELL devices use only slightly more current with an RC circuit.

Related Parts		
DS1284	Watchdog Timekeepers	
DS12885	Real-Time Clocks	Free Samples
DS12R885	RTCs with Constant-Voltage Trickle Charger	Free Samples
DS1302	Trickle-Charge Timekeeping Chip	Free Samples
DS1305	Serial Alarm Real-Time Clock	Free Samples
DS1306	Serial Alarm Real-Time Clock	Free Samples
DS1307	64 x 8, Serial, I²C Real-Time Clock	Free Samples
DS1308	Low-Current I²C RTC with 56-Byte NV RAM	Free Samples

DS1315	Phantom Time Chip	Free Samples
DS1337	I²C Serial Real-Time Clock	Free Samples
DS1338	I²C RTC with 56-Byte NV RAM	Free Samples
DS1339	I²C Serial Real-Time Clock	Free Samples
DS1340	I²C RTC with Trickle Charger	Free Samples
DS1341	Low-Current I²C RTCs for High-ESR Crystals	Free Samples
DS1342	Low-Current I²C RTCs for High-ESR Crystals	Free Samples
DS1371	I²C, 32-Bit Binary Counter Watchdog Clock	Free Samples
DS1374	I²C, 32-Bit Binary Counter Watchdog RTC with Trickle Charger and Reset Input/Output	Free Samples
DS1384	Watchdog Real Time Clocks Controller	
DS1390	Low-Voltage SPI/3-Wire RTCs with Trickle Charger	Free Samples
DS1391	Low-Voltage SPI/3-Wire RTCs with Trickle Charger	Free Samples
DS1392	Low-Voltage SPI/3-Wire RTCs with Trickle Charger	Free Samples
DS1393	Low-Voltage SPI/3-Wire RTCs with Trickle Charger	Free Samples
DS14285	Real-Time Clock with NV RAM Control	
DS1500	Y2K-Compliant Watchdog RTC with NV Control	Free Samples
DS1501	Y2K-Compliant Watchdog Real-Time Clocks	Free Samples
DS1558	Watchdog Clocks with NV RAM Control	Free Samples
DS1602	Elapsed Time Counter	
DS1670	Portable System Controller	Free Samples
DS1672	I²C 32-Bit Binary Counter RTC	Free Samples
DS1673	Portable System Controller	Free Samples
DS1677	Portable System Controller	Free Samples
DS1678	Real-Time Event Recorder	
DS1685	3V/5V Real-Time Clock	Free Samples
DS1688	3 Volt/5 Volt Serialized Real-Time Clock with NV RAM Control	
DS1689	3 Volt/5 Volt Serialized Real Time Clock with NV RAM Control	
DS17285	3V/5V Real-Time Clocks	Free Samples
DS17485	3V/5V Real-Time Clocks	Free Samples

DS17885	3V/5V Real-Time Clocks	Free Samples
DS32KHZ	32.768kHz Temperature-Compensated Crystal Oscillator	Free Samples

More Information
For Technical Support: http://www.maximintegrated.com/support
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Other Questions and Comments: http://www.maximintegrated.com/contact

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