Real Time Clock X12xx Features & Application

by Xicor Applications Group

What is a Real Time Clock ?

A real time clock is a clock that keeps track of the time even when the system is turned off. Real time clocks run on a special battery that is not connected to the normal power supply of the system. In contrast, clocks that are not real-time do not function when the system is off.

Do not confuse a computer's real-time clock with its CPU clock. Most of the real-time clocks operate at 32.768KHz comparing to the CPU clocks operate at either 33MHz or 50MHz. The CPU clock regulates the execution of instructions and other functions.

Single Chip Solution

Xicor's real time clock is an integration of a real time clock combined with nonvolatile memory to store configuration data, and added the CPU supervisory functions to monitor the overall system's power, all these functions migrated into one single 8-Lead TSSOP package. This single chip solution saved PCB board space and reduced the total cost of the system for our customers.

Y2K Compliant

The X12xx is a real time clock (RTC) with clock/calendar and two alarms provides a real time clock functionality that is controllable, readable, and programmable through a set of registers. The RTC provides the system with seconds, minutes, hours, day, date, month, years, leap year correction, and automatic adjustment for months with less than 31 days, and plus hundred/thousand year digits for year 2000 compliant. The circuit, using a low cost 32.768KHz crystal input, the accuracy of a real time clock is directly dependent upon the frequency of the crystal and the combination of the RC network. (Refer to AN 121 for more information on selecting crystal for RTC).
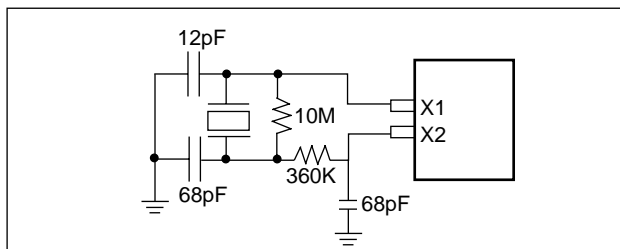

Figure 1. Pulsed interrupt waveform

Dual Alarms

An especially powerful function of the RTC is the dual alarms. The dual alarms gives the user flexibility to program separate events at a specific time of the day. The X12xx can be programmed to generate a single or dual alarm through the use of its alarm mask bits. The X12xx can generate an alarm once every second, minute, hour, or day. Added flexibility is provided in that the alarm is functional either when the device is powered by main battery or when powered by backup battery.

When an alarm occurred, RTC sets an interrupt flag, and activates an interrupt (IRQ) pin with an active low output. This IRQ output is waiting for the microcontroller to acknowledge and perform any pre-assigned tasks. After the completion of the required tasks, then the microcontroller will reset the interrupt flag. Another alternative alarm function provides a pulsed interrupt for a preset 30mS pulse timebase. This pulsed interrupt does not require any reset from the microcontroller and this pulsed interrupt will re-occurred per the alarm setting as shown in figure 2. This pulsed interrupt mode is controlled by setting the IM bit =1 in the control register. This particular pulsed interrupt can be use as a watchdog timer function.
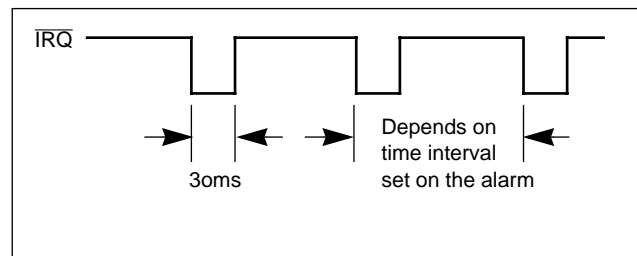

Figure 2. Status Register (SR)

Battery-Backup Switchover Circuit

The X12xx contains an internal circuitry to automatically switch over to use the backup battery when the main battery V_{CC} failed and switch back to use V_{CC} when the main battery required voltage level are completely recovered.

When V_{CC} is lower than Vback by 0.1V, the comparator issue a low signal output which turns on transistor 2, and turns off transistor 1 as shown in Figure 3. This will switch to the backup battery mode. When V_{CC} goes

above Vback by 0.04V, the comparator issue a high signal output which turns on transistors 1, and turns off transistor 2 as shown in Figure 3. This will switch back to the main battery mode.
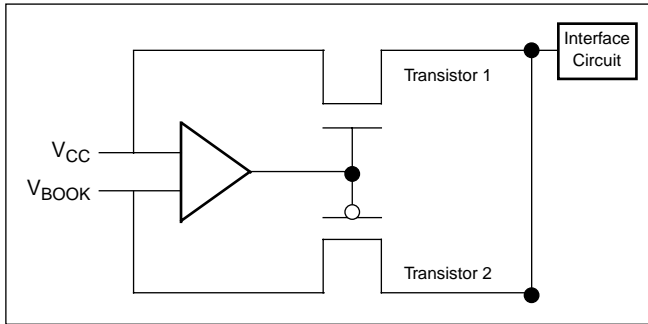

Figure 3. Battery-backup switchover circuit

Nonvolatile EEPROM

The X12xx also provides a 2K to 16K bytes of non-volatile EEPROM array, operates independently from the RTC. Also, having the EEPROM attached to the RTC protects critical system data during these main power failures, is safer than storing data to RAM. The X12xx utilized a 2-wire interface interoperable with I^2C at a data transfer rate of 400KHz. During a read or write operation, the RTC will not be affected. This EEPROM array can be use to store configuration and collected data. Xicor has enhanced the Block Lock operation on the X12xx. These devices now provide the end-user the ability to Block Lock none of the array, 1/4, 1/2, or the entire array. Block Lock also allows the user to protect either the first page, first 2 pages, first 4 pages or first 8 pages. By setting three bits in the Status Register, the user can prevent a write operation from changing data in the Block Locked region. This is especially important when there are configuration parameters, critical data or manufacturing information on the same device as other data that is being changed more often or is of less significance.

In order to perform any write operation, the following steps are required:

1. Perform a Write Enable Operation to set the "Write Enable Latch" (WEL) in the status register.

2. Perform a Write Enable Operation to set both the "Register Write Enable Latch" (RWEL) and the "Write Enable Latch" (WEL) in the status register.

3. Write one to eight bytes of data to the Clock Control Registers or to the memory array with the desired values.

Addr	7	6	5	4	3	2	1	0
003Fh	BAT	AL1	AL0	x	x	RWEL	WEL	RTCF

Notes: Bits [7:0] factory defaulted to be "0's"

Low Power

The functional features of the X12xx are certainly a great benefit to many system designers, but equally important in portable systems is low power to insure long battery life. The RTC can operate as low as 1.5V. It is probable that the majority of the time the X12xx will sit idle in a powered up system. In this type of standby operation, the X12xx will consume a maximum of 10mA. During active write operation, when the 2–wire (I^2C) interface is being driven, the X12xx will typically consume 3mA maximum.

Applications—Data Logging

Generating an alarm is especially useful because the interrupt (IRQ) enable signal can be use to "wake up" a sleeping system. For example, a portable datalogger may need to collect data once every hour. This system could be placed in a low power "sleep mode" when idle. The alarm could be used to "wake up" the system at the appropriate time to collect data. After the collection is completed, software could place the system back into sleep mode where it would remain until the next alarm interrupt.

Applications—Time and Attendance

In a portable system such as a data collection terminal, smart card reader, which required the real time clock to keep track of the day and time of certain task being taking place. After the tasks had completed, usually most of the portable system will return to a standby mode to conserve power. The dual alarm can be set to wake up the system at certain time interval to perform another tasks. For example, in an access control application, when a person try to access the building through certain doors, the day and time of the entry was recorded and this information can be use for accounting, security purposes, and etc.

Applications—Time Stamping

In today's telecommunication system such as a LAN, FAX, router, timekeeping and security is an important issue. For example, FAX machine uses a real time clock to stamp the time when a document was sent and received. This timekeeping provides the user the ability to proof the delivery of the documents. In conjunction with the RTC and the EEPROM, critical system data can be stored in the non-volatile memory array. After a system power fails, all configuration data can auto recalled from the EEPROM memory.

Applications—System Synchronous & Service reminder

RTC is use in a complex system to maintain system synchronous. Xicor's RTC also provide low power sense circuitry to monitor sudden power failures in order to prevent the system processor lockup. RTC is also use to remind service call in all kinds of equipment such as oil change, engine tune-up in automobile, calibration on test equipment and etc.

SUMMARY

Overall, it has been shown that the X12xx real time clock with EEPROM plus CPU supervisor functions provides many of the functions necessary in battery backed portable products. The integration of these features onto a single piece of silicon replaces several separate integrated circuits and is available in an extremely small 8-Lead TSSOP package. The X12xx is also ideally suited for battery backed products because of its low power consumption, particularly when the device is in standby mode.