AN923
Application note

Managing century information using serial real-time clocks and TIMEKEEPER® NVRAMs

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Introduction

ST's serial real-time clocks (RTCs) and TIMEKEEPER® NVRAMs all include at least one byte of year data in binary-coded decimal (BCD) format. Many devices include additional bits for tracking the century, effectively extending the year register. Applications can use software to further extend the century/year data to any desired resolution. The amount of software required depends on the resources built into the chip and the resolution needed by the application.

1   Devices with no century data

M48T02/12, M48T08/08Y/18

A few devices have only a single byte of year information. The BCD year register represents a 2-digit number in the range 00 to 99. The result is that the software must interpret what the 2-digit number means. For example, 85 might be interpreted as 1985, or 2085, or 2185. So the software must maintain the upper two digits of the year, outside of the RTC.

The reader should note that the upper two digits of the 4-digit year are considered the century value. So, for the devices listed above, the software must maintain the century information in non-volatile memory such as flash or EEPROM, and increment the century value whenever the year value, in the RTC, rolls over from 99 to 00.

2   Devices with one bit of century data

M41ST85W, M41T0, M41T00, M41T00AUD, M41T00CAP, M41T00S, M41T11, M41T56, M41T80, M41T81, M41T81S, M41T94, M48T35AV, M48T35/Y, M48T58

Most ST clock devices include at least one bit of century information. When enabled (CEB is set), the century bit will toggle at the end of every century, at midnight of December 31 of the year ending in 99. User software must interpret the bit's meaning. For example, users can let 0 represent 2000-2099 and 1 represent 2100-2199, but other mappings may also be used. By adding more bits in software, the century information can be extended to whatever resolution is desired.

3 Devices with two bits of century data

M41ST87W, M41T60, M41T62, M41T63, M41T64, M41T65, M41T66, M41T82, M41T83, M41T93

Many of ST's newer RTCs include 2 century bits (CB1, CB0) which function as a 2-bit binary counter that increments at the end of each century. The user may arbitrarily assign the meaning of CB1:CB0 to represent any century value, but the simplest way of using these bits is to extend the year register by mapping them directly to bits 9 and 8 (with the year register comprising bits 7:0). Higher order century bits can be maintained in the application software.

Figure 1: Two-bit binary counter (century bits CB1:CB0)
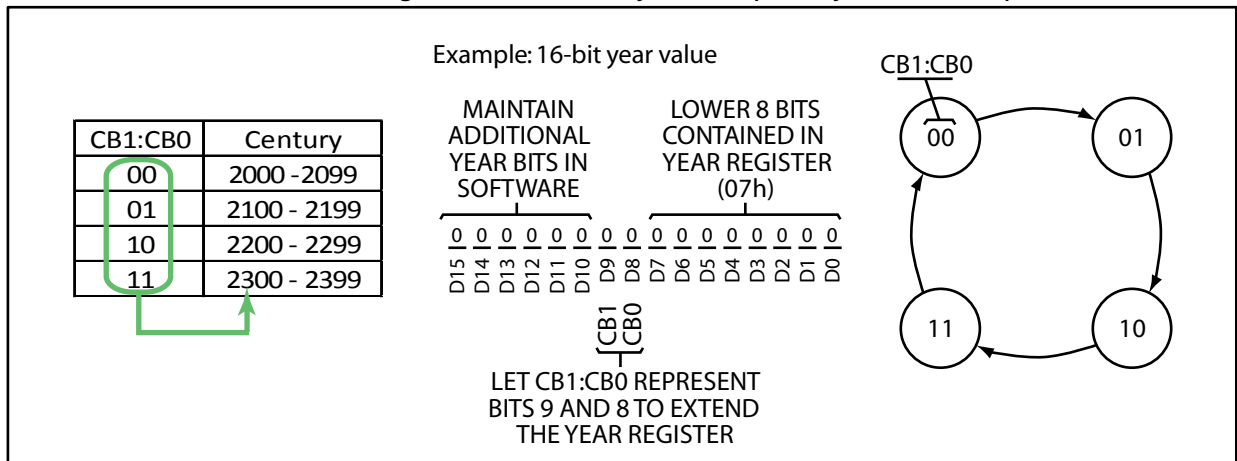
In this example, CB1:CB0 represent the two lower bits of the century byte.

4 Devices with a full byte of century data

M48T201V/Y, M48T37V/Y

Lastly, a few ST TIMEKEEPER devices include a full byte of century information. In addition to the byte of year data, there is another, upper byte for the century, thus comprising a full 4-digit (16-bit BCD) year parameter. These devices will automatically track the century through the year 9999. However, to go beyond that, user software would still need to add a bit to support the years 10000-19999.

The following table summarizes the type of century data provided by the various ST RTC and TIMEKEEPER devices.

Table 1: Century data provided according to device

Device	Century support				Product family
	Byte [(1)]	CB1/CB0 [(2)]	CEB/CB [(3)]	None [(4)]	
M41ST85W			●		Serial RTCs
M41ST87W		●			
M41T0			●		
M41T00			●		
M41T00AUD			●		
M41T00CAP			●		
M41T00S			●		
M41T11			●		
M41T56			●		
M41T60		●			
M41T62		●			
M41T63		●			
M41T64		●			
M41T65		●			
M41T66		●			
M41T80			●		
M41T81			●		
M41T81S			●		
M41T82		●			
M41T83		●			
M41T93		●			
M41T94			●		
M48T201V/Y	●				TIMEKEEPER supervisor
M48T02/12				●	TIMEKEEPER NVRAM
M48T08/08Y/18				●	
M48T35/Y			●		
M48T35AV			●		
M48T37V/Y	●				
M48T58			●		

Notes:

[(1)]1 byte (BCD) which increments once per century

[(2)]2 century bits which increment once per century

[(3)]1 century bit which toggles once per century

[(4)]No century information

5   Support for leap year

Leap year occurs every four years, in years which are multiples of 4. For example, 2012 was a leap year. An exception to that is any year which is a multiple of 100. For example, the year 2100 is not a leap year. A contradiction to that is that years which are multiples of 400 are indeed leap years. Hence, while 2100 is not a leap year, 2400 is.

During any year which is a multiple of 4, ST RTC and TIMEKEEPER devices will automatically insert leap day, February 29. Therefore, the application software must correct for this during the exception years (2100, 2200, etc.) as noted above.

For more information about ST's TIMEKEEPER NVRAM's and serial real-time clocks, please contact a local ST sales office or visit www.st.com.

6 Revision history

Table 2: Document revision history

Date	Revision	Changes
May-2000	1	Initial release
08-Apr-2013	2	Updated title, updated devices in *Table 1: "Century data provided according to device"*, removed obsolete contact information
14-Aug-2013	3	Complete rewrite of document
07-Jan-2015	4	Removed M41TC8025 device from document

IMPORTANT NOTICE – PLEASE READ CAREFULLY