# UM10766

## User manual for the I2C-bus RTC PCF85263A demo board OM13510

**Rev. 3 — 2 May 2016** **User manual**

### Document information

| Info | Content |
|---|---|
| **Keywords** | PCF85263, OM13510, demo board, how to get started, I²C-bus, RTC, Real-Time Clock, tuning, time stamp, battery switch, elapsed time counter |
| **Abstract** | User manual for the RTC I²C-bus demo board OM13510 which contains the PCF85263A |

### Revision history

| Rev | Date | Description |
|---|---|---|
| v.3 | 20160502 | Fig 4: Corrected ID mark |
| v.2 | 20151103 | Revised user manual |
| v.1 | 20131115 | new user manual, first revision |

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# 1. Introduction

The PCF85263A is part of the PCF85x63 family of CMOS Real-Time Clocks (RTCs optimized for low power consumption). Different features sets are available.

The OM13510 is the ideal evaluation and demo board to be used in the design phase of any project; just power and $I^2C$-bus must be connected.

A separate dedicated demo board and a user manual is available for the $I^2C$-bus RTCs PCF85063ATL and PCF85063TP: OM11059A and UM10698

# 2. Key features

## 2.1 Demo board OM13510

The RTC PCF85263ATL with $I^2C$-bus is mounted together with a quartz crystal, a lithium battery plus the blocking capacitor, buffering the supply voltage. A push button allows activating the time stamp. All signals are accessible on a line of pins, overcoming the difficulties to contact the tiny package directly.

## 2.2 Real time clock PCF85263A

- Very small form factor: leadless package (DFN2626-10 for PCF85263ATL) just 2.6 × 2.6 × 0.5 mm, SO8, TSSOP8 and TSSOP10 packages will be released too.
- Counting: $100^{th}$ seconds, seconds, minutes, hours, days, week days, month and years
- Three timestamp register sets
- Battery back-up circuit, accepting battery voltage larger or smaller than $V_{DD}$
- The oscillator is based on a 32.768 kHz quartz crystal
- Stop-watch mode for elapsed time counting. From 0 to 999’999 hours with a resolution of 1/100 second.
- Two independent alarms
- WatchDog timer
- Two independent interrupt generators/outputs
- Generates an interrupt automatically every second or every minute, independent of alarm facility
- Programmable offset register for frequency adjustment to compensate quartz tolerance

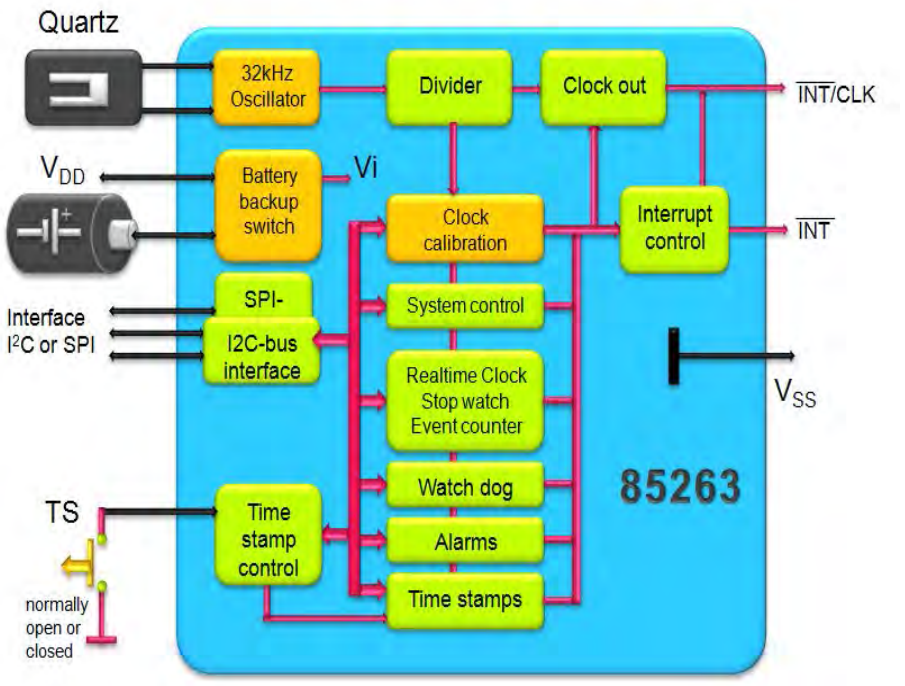


**Fig 1. Block diagram of PCF85263A**

# 3. Hardware set-up

## 3.1 General requirement for the RTC PCF85263A

The RTC circuit just requires one external part: tuning fork quartz as resonator. The oscillation capacitors are integrated and therefore there is no need for external capacitors. The quartz crystal must be placed close to the RTC circuit, avoiding long lines which may pick up noise. Avoid any tracks with high frequency signals (fast edges) close to the RTC, quartz, or quartz interconnect.

The $I^2C$-bus interface works up to 400 kHz. Supply voltage: 1.8 V to 5.5 V. The RTC, excluding the $I^2C$-bus interface, is however operating down to a lower voltage. It is recommended to have a decoupling capacitor of 100 nF on the $V_{DD}$-$V_{SS}$ rails close by.

Due to the low power consumption of below 1 µW, no precautions for heat dissipations are required, even in sealed housing environment.

Frequencies of 1 Hz to 32.768 kHz at CLKOUT can be used to measure the frequency for calibration and/or be used for general purpose e.g. as reference for frequency generation with a PLL.

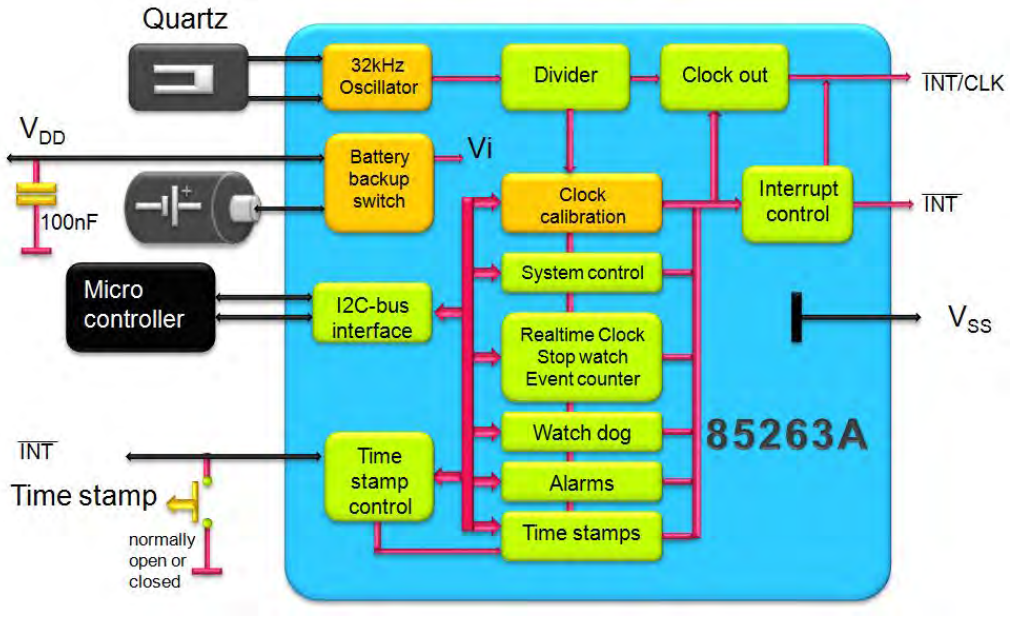


Fig 2. Interfacing to the microcontroller

## 3.2 Demo boards for OM13510

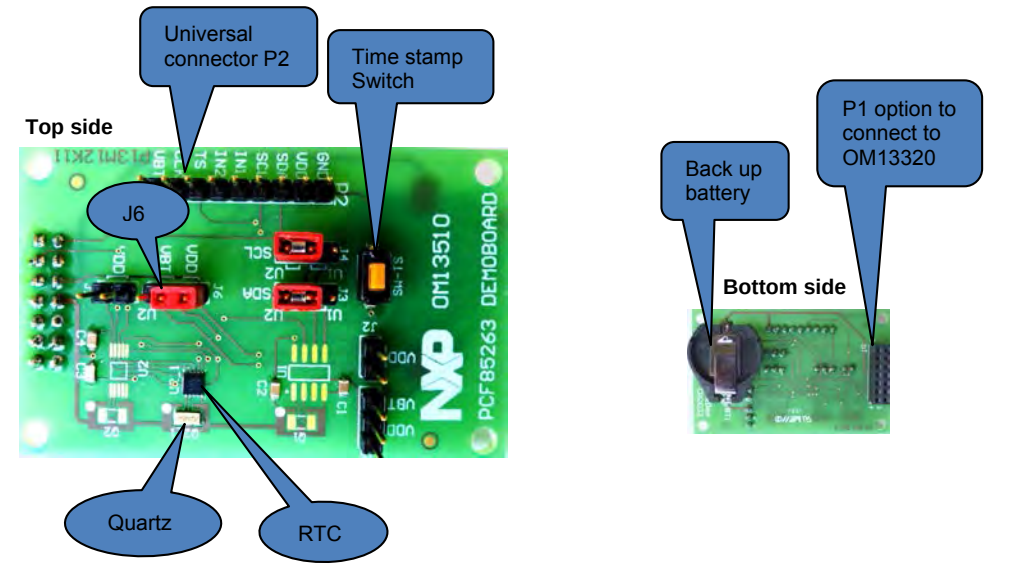


Fig 3. PCF13263 Demo board OM13510 (original version)

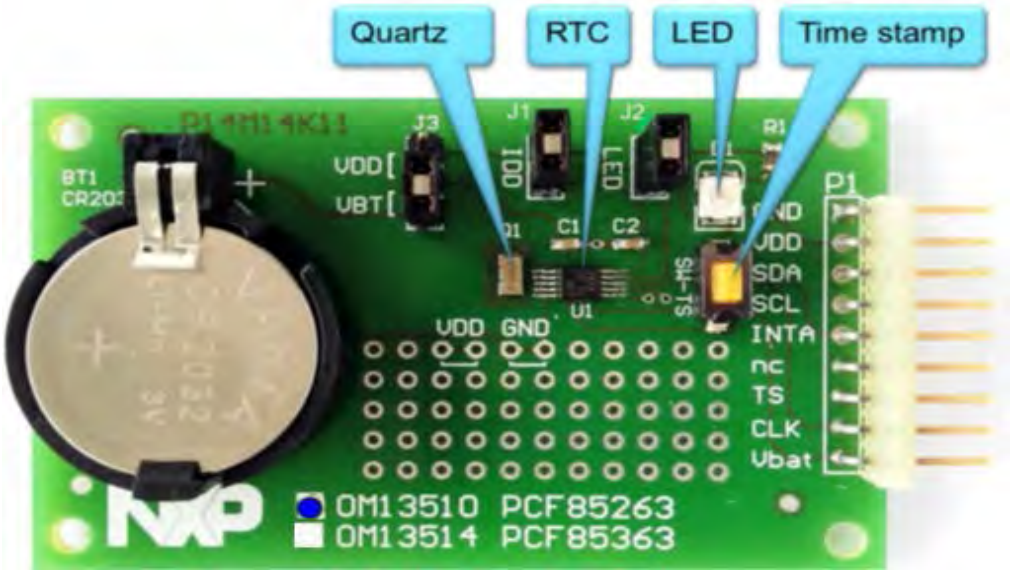


**Fig 4. PCF85263A Demo board OM13510 (newer version)**

## 3.3 Out of the box

Connect to:

- Hardware start-up: all pins are accessible on connector P2
  - GND and $V_{DD}$, 3 V to 5.5 V
  - Connect $I^2C$-bus: SDA, SCL pull ups assumed on $I^2C$ master board

Optional

  - Activate coin-cell battery by setting Jumper J6 to VBT
  - Connect interrupt(s)
  - Connect CLK-out. After power up, 32 kHz is the output to calibrate the oscillator or it may be used as reference frequency
- Time stamp
  - With TS push button a time stamp can be initiated
  - The TS input must be configured for a mechanical switch: therefore set the TSIM bit = 1
- Software start-up:
  - $I^2C$-bus address: 1010 001R/W
  - Write oscillator calibration value: register 24h
  - Set parameters: registers 25h to 2Bh
  - Write actual time: registers 00h to 07h

Read current time: registers 00h to 07h

## 3.4 Demo board features

- Straight forward evaluation of the new tiny RTC PCF85263 with
  - Battery back-up
  - 2 alarm facilities with 2 configurable interrupt outputs
  - Time stamp
  - Tracking time or stopwatch, with 1/100 s resolution
- Easy access to all pins despite of the tiny package:
  - Connector P2 100mil (2.54 mm) pin pitch
  - Access to all pins
- Battery on board for autonomous operation
  - Can be switched off
- Interfacing with the FM+ development board OM13320
  - Connector P1
- Push bottom to trigger time stamp
- Easy measurements of power consumption

– Jumper J2 to open to link in µA-meter

- Future boards may include alternative packages

# 4. Circuit diagram

## 4.1 Demo board circuit diagram

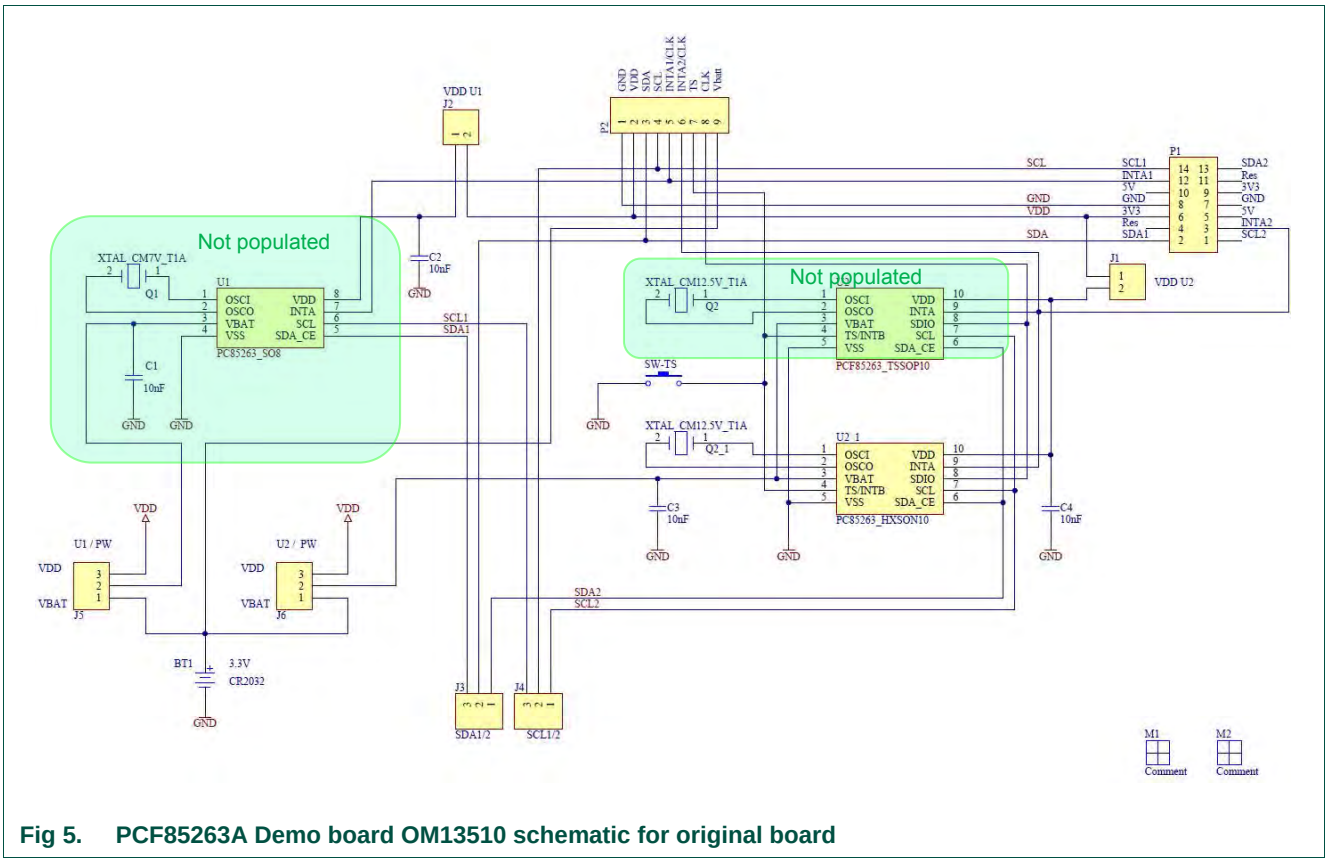


**Fig 5. PCF85263A Demo board OM13510 schematic for original board**

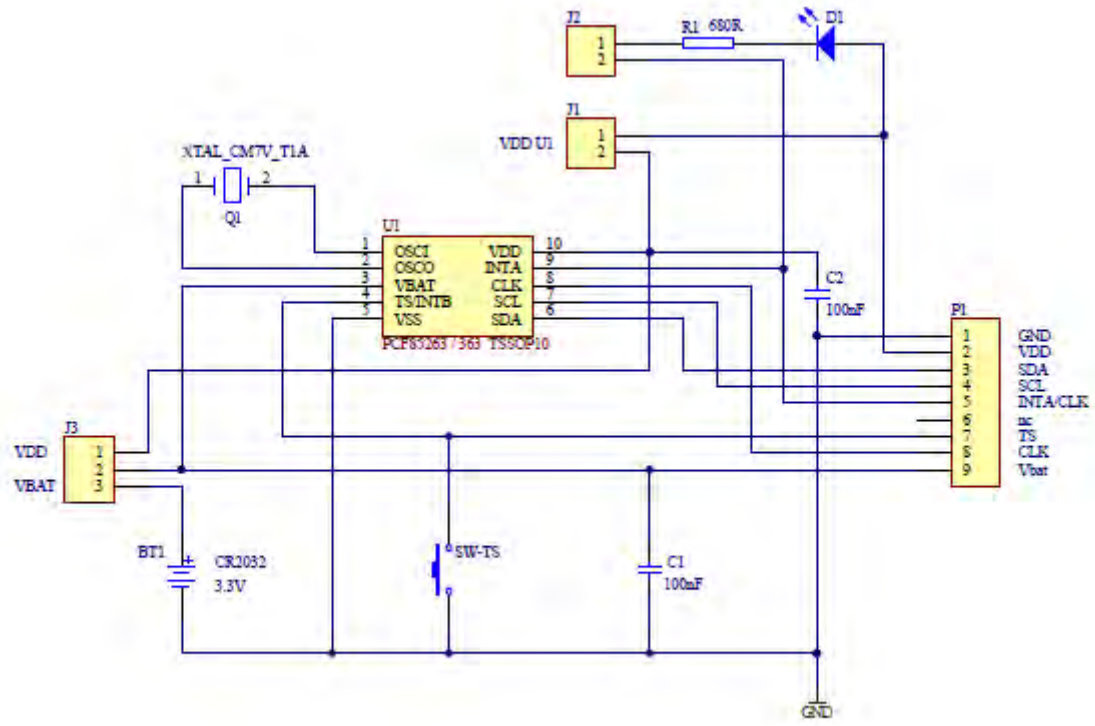


Fig 6. PCF85263A Demo board OM13510 schematic for newer board

### 4.2 Incorporate it with an application in development

This board can be connected via connector P2 to the application to be developed.

### 4.3 OM13510 in conjunction with the FM+ demo board OM13320

Connector P2 features the pinning of the universal FM+ demo board. Next generation firmware will feature a GUI to control the RTC.

## 5. RTC tuning

### 5.1 Frequency tuning

The 32 kHz quartzes are typically sold with a tolerance at room temperature of either ±20 ppm or ±10 ppm. 11.5 ppm corresponds to 1 s/day.

The quartzes feature a characteristic load capacity of either 7 pF or 12.5 pF. Oscillators utilizing 7 pF quartzes feature slightly lower power consumption, where the quartzes of 12.5 pF have largest production quantities. The tracks between quartz and RTC represent also some parasitic capacitances and must be kept short.

The PCF85263 has a tuning facility where tolerances can be compensated. Tuning procedure:

- Measure the 32xxx Hz (f) signal at the CLKOUT pin.
- The offset is calculated in ppm as

  $\Delta f_{[ppm]} = 10^6 \times (f - 32768) / 32768)$
- Consult the offset table in the data sheet. Take the correction value and write it into the register 02h.
- The correction is done by means of inhibition or addition: the oscillator runs at constant speed, then every 2 hours (mode 0) 1 second is corrected by making it shorter or longer. This is not easily visible at the CLKOUT.
- Corrections can also be applied every 4 minutes by using mode 1. This mode will consume slightly more power.

The 32 kHz quartzes are of the type tuning fork and feature a parabolic frequency response over temperature. When the application is dominantly used over a limited temperature range, it is often helpful to tune the frequency to be slightly higher at the turn-over point. The error around 25 °C (clock goes too fast) is then compensated during the time when temperature is lower or higher. For example, for operation between 5 °C and 45 °C, tune the clock 8 ppm faster than the value for 25 °C would be. See Fig 7.

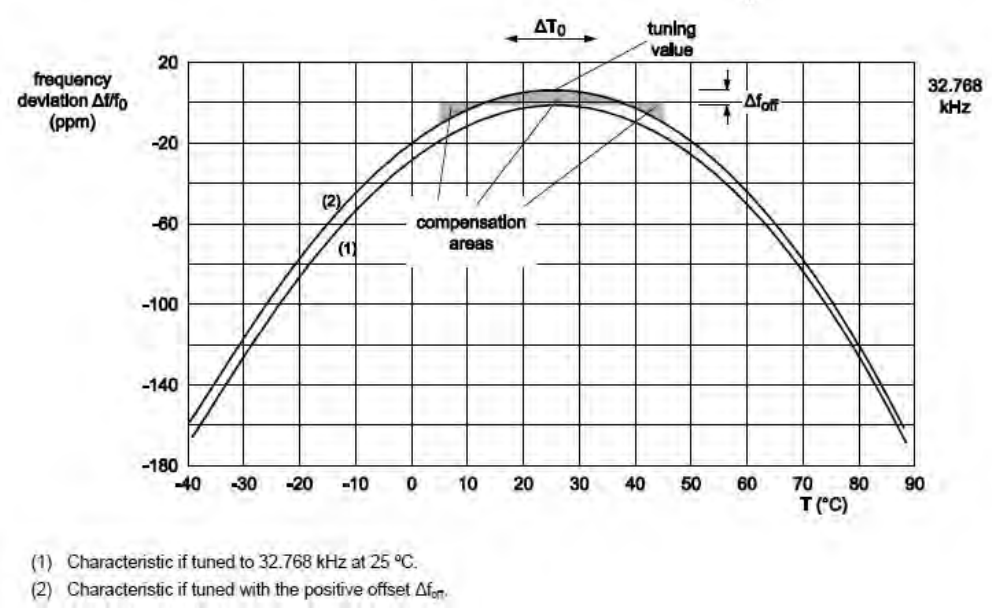


**Fig 7. Temperature averaged over application range 5 °C to 45 °C**

## 6. References

[1] AN11247 - Improved timekeeping accuracy with PCF85063, PCF8523 and PCF2123 using an external temperature sensor

[2] UM10301 - User Manual for NXP Real Time Clocks PCF85x3, PCA8565 and PCF2123, PCA2125

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