UM10787

User manual for the I²C-bus RTC PCF85363A demo board OM13514

Rev. 1 — 10 July 2014 **User manual**

Document information

Info	Content
Keywords	PCF85363, OM13514, demo board, how to get started, I²C-bus, RTC, Real-Time Clock, tuning, time stamp, battery switch, elapsed time counter, RAM, OM13518, USB I²C Dongle
Abstract	User manual for the RTC I²C-bus demo board OM13514 which contains the PCF85363A

Revision history

Rev	Date	Description
v.1	20140710	new user manual, first revision

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1. Introduction

The PCF85363A is part of the PCF85x63 family of CMOS Real-Time Clocks (RTCs optimized for low power consumption). Different features sets are available.

The OM13514 is the ideal evaluation and demo board to be used in the design phase of any project; just power and I²C-bus must be connected.

Separate dedicated demo boards and user manuals are available for the RTCs:

Table 1. Demo board overview

Demo board	Documentation	Related products
OM11059A	UM10698	PCF85063ATL and PCF85063TP
OM11059	UM10699	PCF85063BTL
OM13515	UM10788	PCF85063AT
OM13510	UM10766	PCF85263A
OM13518	UM10789	USB I²C dongle

2. Key features

2.1 Demo board OM13514

The RTC PCF85363ATL with I²C-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.

Demo board features:

- Straight forward evaluation of the new tiny RTC PCF85363 with
  - Battery back-up
  - 2 alarm facilities with 2 configurable interrupt outputs
  - Time stamp
  - 64 Byte of RAM
  - Tracking time or stopwatch, with 1/100 s resolution
- Easy access to all pins despite of the tiny package:
  - Connector P1 100mil (2.54 mm) pin pitch
  - Access to all pins
- Battery on board for autonomous operation
  - Can be switched off by placing Jumper J3 to V_{DD}
- Push bottom SW-TS to trigger time stamp
- Easy measurements of power consumption
  - Jumper J2 to open, to link in a µA-meter
- A scratch pad area is available to host some custom circuitry.

2.2 Real time clock PCF85363A

- Very small form factor: leadless package (DFN2626-10 for PCF85363ATL) just 2.6 × 2.6 × 0.5 mm, TSSOP8 and TSSOP10 packages will be released too.
- Counting: 100th 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}
- 64 byte battery backed-up RAM
- 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 the quartz tolerance

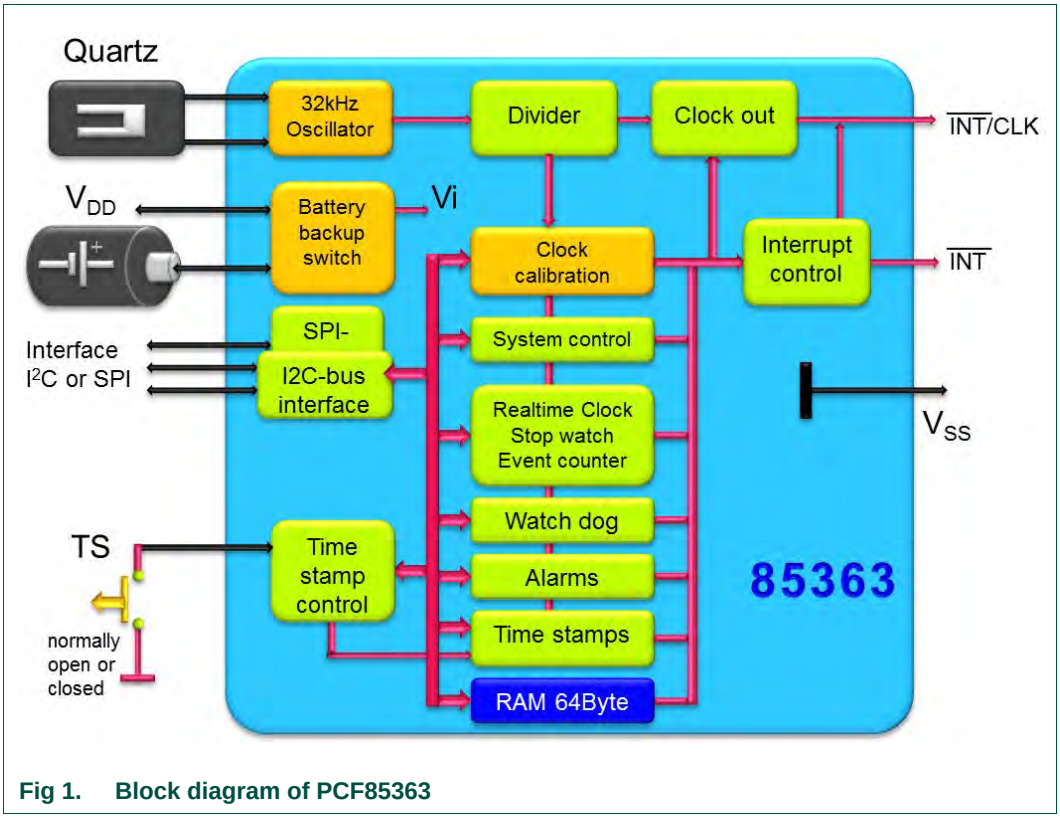


Fig 1. Block diagram of PCF85363

3. Hardware set-up

3.1 General requirement for the RTC PCF85363A

The RTC circuit just requires one external part: a 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 I²C-bus interface works up to 400 kHz. Supply voltage: 1.8 V to 5.5 V. The RTC, excluding the I²C-bus interface, is however operating down to a lower voltage. It is recommended to have a decoupling capacitor of 100 nF each on the V_{DD}-V_{SS} and V_{BAT}-V_{SS} rails close by.

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

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

3.2 Demo board OM13514

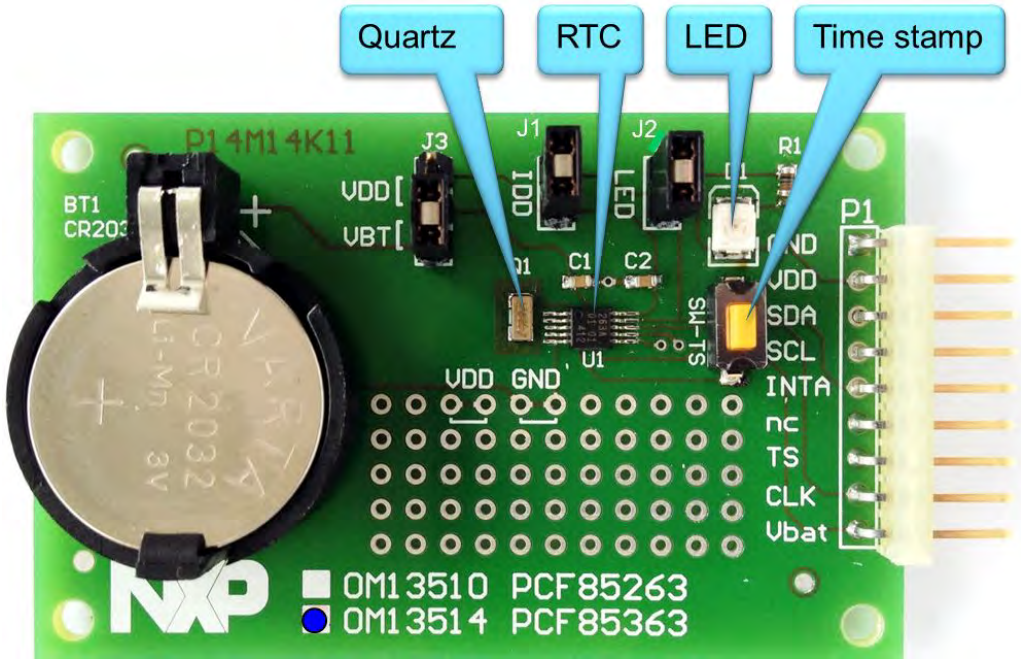


Fig 2. Demo board OM13514

3.3 Out of the box

Connections

- Hardware start-up: all pins are accessible on connector P1
  - GND
  - V_{DD}, 3 V to 5.5 V
  - Connect I²C-bus: SDA, SCL pull ups are assumed to be on the I²C master board

Optional

  - Activate coin-cell battery by setting Jumper J3 to VBT
  - Connect interrupt(s). For visualizing an interrupt an LED can be switched in by Jumper J2
  - Connect CLKOUT. After power up, 32 kHz is the output to calibrate the oscillator or it may be used as reference frequency e.g. as clock for the microcontroller (LED on demo board will light up dimmed)
- Time stamp
  - With the SW-TS push button a time stamp event can be initiated
  - The TS input must be configured for a mechanical switch: therefore set the TSIM bit = 1
- Software start-up
  - I²C-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

4. Circuit diagram

4.1 Demo board circuit diagram

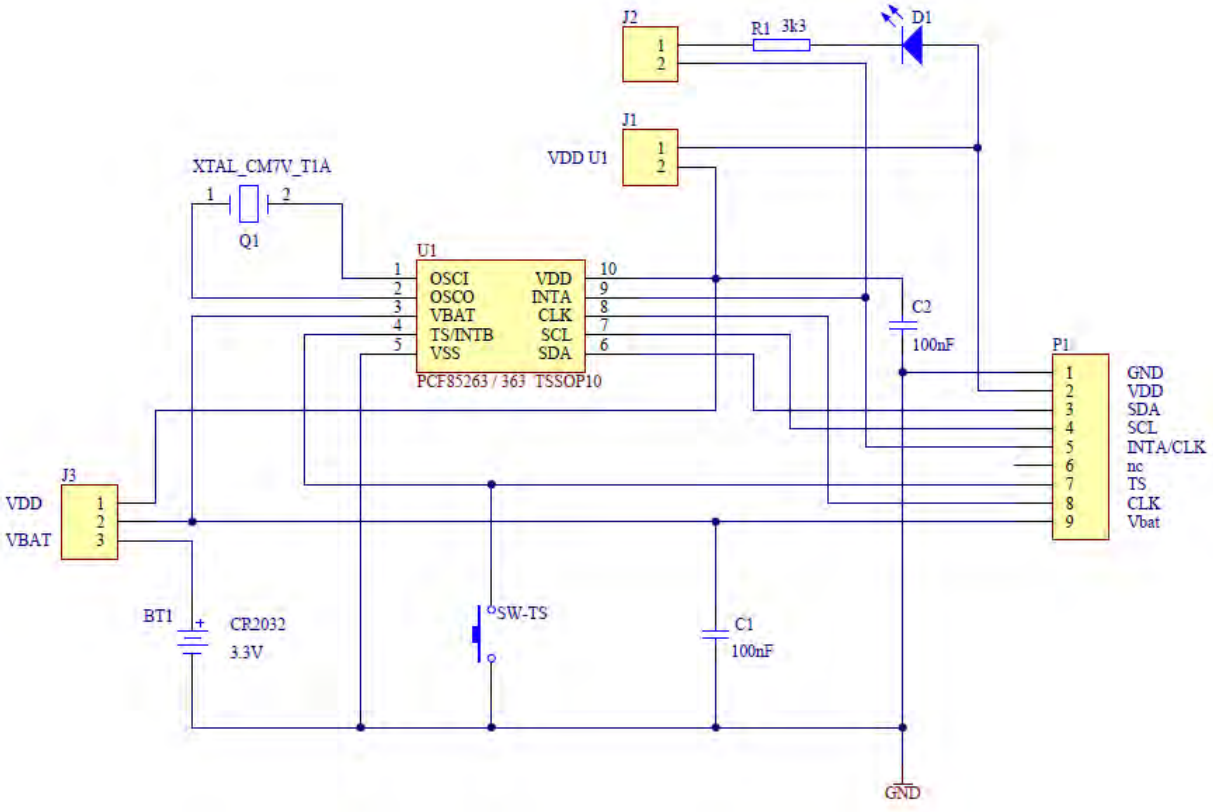


Fig 3. Demo board schematic

4.2 Incorporate it with an application in development

This board can be connected via connector P1 to the application to be developed.

5. Graphical User Interface with OM13518 USB-I²C-bus dongle

5.1 USB-I²C dongle

Details are described in the user manual UM10789

The OM13518 dongle is a ready to run module. It creates a virtual COM-port via an USB connection. It provides three I²C-bus connections with 5 V option to power the application (max 450 mA).

Power consumption: module/total: <50 mA/max 500 mA

I²C-bus clock frequency: 245 Hz – 400 kHz

USB driver for Windows: Windows XP, Windows 7, Windows 8

Size: 50 mm × 40 mm × 15 mm

Fig 4. A) Dongle OM13518, B) connected to the evaluation board OM13514

5.2 Software GUI

The software control via a GUI allows a fast start to communicate to the different circuits.

Aside from the detailed GUI pages for the Real-Time Clocks, a UNIVERSAL INTERFACE allows to communicate with any I²C-bus device by entering directly the hex codes. Example: s A2 28 p

Where s stands for the I²C START and p for the I²C STOP condition.

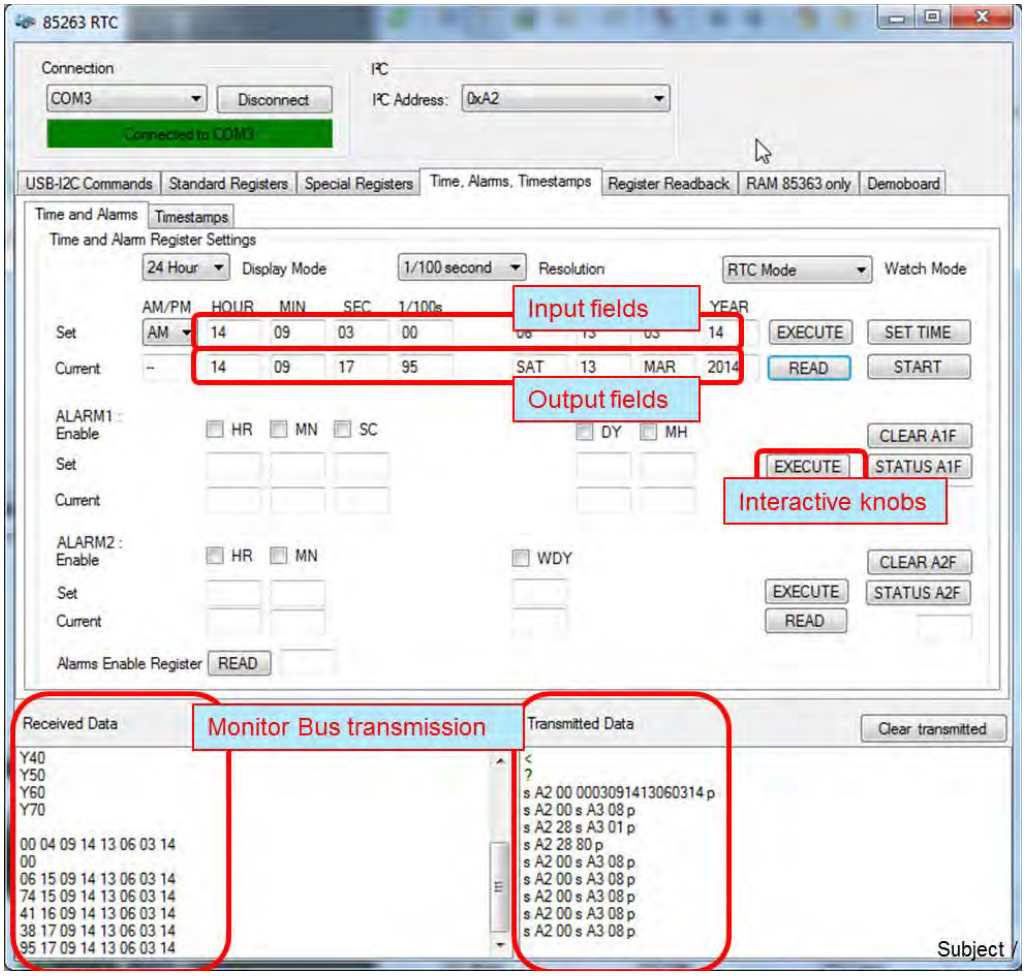


Fig 5. GUI-page example: *Time, Alarms, Timestamps*

6. RTC tuning

6.1 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.

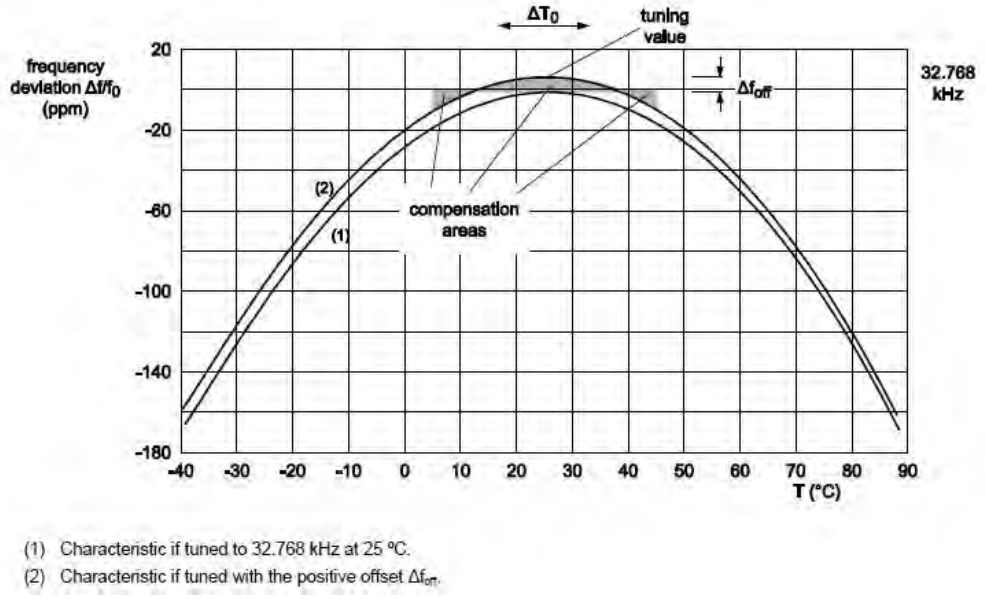
The PCF85363 has a tuning facility where tolerances can be compensated. Tuning procedure:

- 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 4 hours (mode 0) 1 second is corrected by making it shorter or longer. The moment in time of correction can be made visible by enabling the interrupt OIEA or OIEB. The clock frequency of 1 Hz is corrected over time.
- Corrections can also be applied every 8 minutes by using mode 1. This mode will consume slightly more power.
- The correction range is sufficiently large to implement also a temperature compensation.

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 6.



(1) Characteristic if tuned to 32.768 kHz at 25 °C.
(2) Characteristic if tuned with the positive offset Δf_{off}.

Fig 6. Frequency, averaged over the temperature range from 5 °C to 45 °C

7. 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

[3] **UM10789** – User Manual for USB-I²C-bus interface OM13518 with a GUI for the RTCs PCF85263 and PCF85363

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