USB-I<sup>2</sup>C-bus interface OM13518 with a GUI for the RTCs PCF85263 and PCF85363

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Abstract	User manual for the universal USB-I <sup>2</sup> C-bus interface dongle OM13518



#### USB-I<sup>2</sup>C-bus dongle OM13518 with a GUI

**Revision history** 

Rev	Date	Description	
v.1	20140519	first revision	

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## 1. Introduction

The OM13518 dongle is an easy to use interface handler between the USB of a PC and the I<sup>2</sup>C-bus. The software control via a Graphical User Interface (GUI) allows a fast start to communicate with different circuits.

- USB-2 is used for data and the 5 V power supply.
- Three I<sup>2</sup>C-bus ports are wired in parallel.
- Cables to connect up the I<sup>2</sup>C-bus are enclosed.

## 2. Key features

## 2.1 USB-I<sup>2</sup>C interface module

The OM13518 dongle is a ready to run module. It creates a virtual COM-port via an USB connection. It provides three  $I^2$ C-bus connections with 5 V option to power the application (max 450 mA).

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

**I<sup>2</sup>C-bus clock frequency:** 245 Hz – 400 kHz

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

Size: 50 mm × 40 mm × 15 mm

#### 2.2 Software

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 I<sup>2</sup>C-bus device by entering directly the hex codes. Example: s A2 28 p

Where s stands for the  $I^2C$  START and p for the  $I^2C$  STOP condition.

## 3. Dongle

## 3.1 Circuit diagram

The dongle establishes the connection between the PC (USB port) and the  $I^2$ C-bus interface.



## 3.2 Interfacing I<sup>2</sup>C-bus peripherals

The  $l^2$ C-bus peripherals are connected directly with the  $l^2$ C-bus. The 3 connectors Con1, Con2, and Con3 are connected in parallel and carry the four signals as also imprinted on the package:

**+5 V:** Optional 5 V supply can be used. Total consumption of all 3 outputs must be kept below 450 mA.

SCL: Serial CLock line

SDA: Serial DAta line

GND: Ground

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There is no need for external pull-up resistors, since 10 k $\Omega$  pull-ups are already built in the OM13518 dongle.

#### Installation 4.

## 4.1 Hardware and driver installation

#### 4.1.1 The box contains:

- One dongle
- One USB cable
- Three I<sup>2</sup>C-bus cables:
  - One with female connector dedicated for NXP-RTC evaluation boards
  - Two cables for custom use via solder connection
  - The signal assignment is imprinted on the interface module \_



#### 4.1.2 Driver

First install the USB software driver before connecting the interface module.

- Unpack the file : cp210x\_vcp\_win\_xp\_s2k3\_vista\_7\_8\_v6\_6\_1.zip
- Install the driver in administrator mode

#### 4.1.3 Hardware

- Connect the USB cable with the dongle and with the PC and let the device to install. Connect the I<sup>2</sup>C-bus cable to your application; turn on the power in case an external one is needed.
- 2. The red LED will light up to indicate that the OM13518 successfully started up.
- 3. Now the system is ready for starting the GUI software

#### 4.2 GUI Installation

- 1. Unpack the file NXP\_USB-I2C-RTC\_GUI\_V02.zip. The latest version can be downloaded from the OM13518 home page.
- 2. Run the exe file: NXP\_USB-I2C-RTC\_GUI\_V02.exe
- 3. A start window will pop op
- 4. Choose the right com port in the drop down list
- 5. Press Connect: Status changes to Connected and turns green

Connection COM7	Conviedt	IPC Address:	0xA2	•
- 0	0М7 👻	Disconnect		
USB-12C Command	Connected to	COM7	e, Alarms, Timestamps	Register Readba
Status, Firmwar	re, Y-Parameter	Direct Command		

## 5. Features of the Graphical User Interface (GUI)

The GUI can be used as a universal l<sup>2</sup>C-bus interface for controlling any peripheral circuit. Alternatively some specific windows are available e.g. for the Real-Time Clocks PCF85263 and PCF85363.

## 5.1 Universal I<sup>2</sup>C-bus interface

The Universal  $I^2C$  interface allows controlling any circuit by entering directly the  $I^2C$ -bus instructions. It is part of the Tab *USB-I2C Commands*.

Connection	NC	NMO.
COMB   Disconnect  Downocket to DOM	IfC Address: 0xA2	
		RTC GUI V02
USB-12C Commands Standard Registers Sp	ecial Registers Time 6 Timestamps Register	Readback RAM 85363 only Demoboard
1 sa2 28 sa3 0A p		> Send Corpmand
		45
Save Configuration		
Read Configuration 5		
Reset the dongle		
Reset dongle (Y-Parameters)		
Reset USB-PC		
Status, Firmware, Y-Parameter		
Received Data	Gear received Transmitted Data	Clear transmitted
80 00 00 00 00 00 00 00 00 00 00	s a2 28 s a3 0A p	
3	(	2

Procedure and details:

- 1. Universal I<sup>2</sup>C-bus interface control, type in the following format:
- Writing data, e.g.: s A2 28 04 p press Send Command (s = START, A2 = slave address, 28 04 = data, p = STOP)
- Reading data, e.g.: s A2 28 s A3 0A p: press Send Command setting address pointer, then reading 10 bytes (0Ah)
- 2. The sent data will be reflected in the field *Transmitted Data*.
- 3. The read data bytes are listed in the field *Received Data*.
- 4. Configuration can be saved on the PC (see section 5.2.1).
- Configuration can be reloaded to continue with the used presetting for further tasks (see section 5.2.1.2).

- 6. Tabs on the GUI of the RTCs: PCF85263, PCF85363, to follow
- 7. Hovering the mouse-pointer over a function button, tool tips will pop up for explanations.
- 8. Pressing ▼ will open the list of possible options to select from.

	S Timestamps			
Time and Ala	m Register Setti	ings	8	-
	24 Hour	Display Mode	1 second	Resolution
TIME :		24 Hour Mode o		WDAY DA
Set	AM Note:	The default is 24	Hour Mode	
Current				
ALARM1				1
Enable		HR MN	SC	
Set				
	_			
			1 second	
			i i second	R
			1 second	3

#### 5.2 GUI pages for the RTC PCF85263 and PCF85363

The objective is to have a fast and straight forward control of all the functions of the RTC.

The principle for controlling is explained on the window *Time, Alarms, Timestamps* in Fig 7.

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Connection				IR	3						
COM3		Dise	connect	1	C Address: Ox	A2		-			
	Connected I	to COM3									
										6	
SB-I2C Comma	nds Stan	dard Regi	sters Spe	ecial Reg	isters Time, A	arms, Time	stamps Re	egister Read	dback R	AM 85363 only	Demoboard
Time and Alarm	THING BEEN	And the second s									
Time and Ala					1 /100				Trees		
	24 Hour	♥ Dis	play Mode		1/100 secon	nd 🔻 F	Resolution		RIC	Mode •	Watch Mode
	AM/PM	HOUR	MIN	SEC	1/100s	In	put fiel	ds	YEAR		
Set	АМ 👻	14	09	03	00	00	15	03	14	EXECUTE	SET TIME
Current	-	14	09	17	95	SAT	13	MAR	2014	READ	START
ALARM1 :						C	utput fi	elds			
Enable		HR	MN	SC 📃			DY	MH	·		CLEAR A1F
Set					1					EXECUTE	STATUS A1F
Current		_	-				_		In	teractive I	knobs
											uno bo
ALARM2 : Enable		HR	MN			V	VDY				CLEAR A2F
Set		-								EXECUTE	STATUS A2F
Current		-	-							READ	
		DEAD		-							
Alarms Enal	ble Register	READ	_	-							
eceived Data	Ĩ					T	nsmitted Dat	2		1	
		woni	IOF BL	is trai	nsmissior		insinitted Da	a			Clear transmitted
10 50						1 2			- T		
60 70							2 00 000309 2 00 s A3 08		4p		
04 09 14 13 0	6 03 14						2 28 s A3 01 2 28 80 p	P			
15 09 14 13 0						s A	2 00 s A3 08 2 00 s A3 08				
15 09 14 13 0	6 03 14					= s A	2 00 s A3 08	p			
16 09 14 13 0 17 09 14 13 0	6 03 14						2 00 s A3 08 2 00 s A3 08				619.00
	6 03 14					-					Subject

## 5.2.1 Save and read back the configuration

#### 5.2.1.1 All the setting can be saved

- 1. Work with the GUI until you have the IC configured as desired.
- 2. Save the desired configuration to a file as follows: *USB-I2C-Commands* tab, *Save Configuration*, select a directory and name (see Fig 8).

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Connection COM8	Disconnect      Disconnect	IR Address: Do	A2 •]		12	
SB-I2C Commands	S Standard Registers Spec	al Registers   Time, Ala	arms, Timestamps   Register Readback		-	
		ve a Xml File		end Command	110	-
Save	e Configuration	ganize • New folde	er + AWS_System (C:) + LocalData + 12	C_BUS_Platform + Project_Time_c	ontrol ++	Search Project
Read	d Configuration	2006		Name	Туре	Size
		2007		TCTRL_V_202	XML Document	16)
		2009		TCTRL_V_201	XML Document	16 1
		2010	=			
		2012	0			
		2013				
		2014	n			
		L Outlook				
		AININT &	- 1		m	
		File name:	L_V_203			
		Save as type: XML F	Files			
			2			
	. (6)	Hide Folders				Save

3. If the GUI succeeds in writing the file, it will produce a pop-up window and then just press OK (see Fig 9).

	Save Configuration	File written successfully
	Reset the dongle	
Fig 9.	Confirmation window	

#### File Format:

The file is written in standard XML format, which almost all Operating Systems can read (see Fig 10).



#### 5.2.1.2 Reload the settings

1. Read back a saved configuration file with *Read Configuration* (see Fig 11):

Connection COM8	PC PC Address: 0xA2	• N	9
USB-I2C Commands Standard Registers	Special Registers   Time, Alama, Timestamps   Re	RTC G	
	Organize + New folder	à de la companya de l	
	2005	* Name	Type Size
Save Configuration	<u>4</u> 2006	TCTRL_V_202	XML Document 15 K
Save Computation	2007	TCTRLV_201	XML Document 16.)
Read Configuration	2008		
riedu consiguratori	2009	11	
	2011	E	
	4 2012	.0	
	<u>//</u> 2013		
	2014		
	L2C_BUS_Platform		
	Project_Time_control		
	Utlock		
	MININT	(* (*)]	
	File name: TCTRL_V_202		<ul> <li>XML Files</li> </ul>
			Open 🔻

2. If the GUI manages to read in the files successfully, it will produce a pop-up window and then just press OK (see Fig 12).

Connection COM8	Disconne     Disconne     disconne	IPC IPC Addi	ress: OxA2	•		NM RTC GUI	V02
USB-12C Commands	Standard Registers	Special Registers	Time, Alarms, Timestamps	Register Readback	RAM 85363 only	Demoboard	
_		C			Send Command		
Save	Configuration		File read successfully				
Read	Configuration		ОК				

## 5.3 Examples

#### 5.3.1 Setting the clock and reading it

1. Perform a Software reset: Reset tab, function SWR (see Fig 13).

USB-12C Com Resets Fla		Special Registers	Time, Alarms, Timestamps	Register Readba
	Reset Settings : Register 0.25 CPR SWR	CTS	Send So	ear Timescaler Cou ftware Reset Com ear Prescaler Com
g 13. Reset of the	software			

- 2. Select menu Special Registers and press SWR.
- 3. Set the time and read back to verify that the clock is running (see Fig 7).
- A valid time and date can be entered in the Set row, then press EXECUTE
- The SET TIME programs the actual time based on your PC (see Fig 7 and Fig 14).
- *READ* reads the current time and date of the RTC (see Fig 7 and Fig 14).

• *START* will continuously read the time at about once every second (see Fig 7 and Fig 14).

There are options to change from 24 hour to 12 hour mode, activate the 1/100s resolution and change the RTC from *RTC mode* (clock mode) to *stop watch mode* (see Fig 7 and Fig 14).

	24 Hour		splay Mod	e	1/100 secon	nd 🔻 Reso	lution		RTC	Mode -	Watch Mode
TIME :	AM/PM	HOUR	MIN	SEC	1/100s	- WDAY	DAY	MONTH	YEAR	>	
Set	AM 🔻	15	48	00	00	02	15	04	14	EXECUTE	SET TIME
Current	-	15	57	06	11	TUE	15	APR	2014	READ	START

#### 5.3.2 Blinking the LED at the interrupt output with the help of the watchdog

Procedure and details:

1. Perform a Software reset: Reset tab, function SWR (see Fig 15).

USB-I2C Commands Standard Registers Special R Resets Flags Watch Dog Offset	Registers Time, Alarms, Timestamps Register Readback RAM 85363 on
Resets Flags Watch Dog Offset	
Fig 15. Software reset	CTS I Send Clear Timescaler Command 0x25 Send Software Reset Command 0x2C Send Clear Prescaler Command 0xA4

2. Enable INTA for interrupt mode (see Fig 16).

				1					
USB-I2C C	Commands Stan	dard Registers	Special Registers	Time, Al	arms, Timesta	amps   Regi	ster Readback	RAM 8	5363 onl
Timestam	p OSC Settings	Battery Switc	h PIN Settings	Function	Interrupt A	Interrupt B	RAM Setting	STOP	
	PIN Settings	: Register 0x27H	1						
	0	0 0	disabled	T IN	A	•	> SET I	BYTE	
		- I I							
							B0 : INTAI B1 : INTAI		(PIN 9)
							- DI.INTA	FIMEI	
	i i i	i i	i -				- B2 : TSPN	1[0]	(PIN 4)
		- <u>i</u> i					<ul> <li>B3 : TSPN</li> </ul>	4[1]	
Fig 16.	Enable the I	NTA for inte	errupt mode						

3. Enable INTA for Watchdog (pulse at each time countdown occurs) (see Fig 17).

ſ	USB-I2C Corr	nmands Stand	ard Registers	Special Registers	Time, A	arms, Timesta	imps Regi	ster Readback	RAM 85363 onl
	Timestamp	OSC Settings	Battery Switch	PIN Settings	Function	Interrupt A	Interrupt B	RAM Setting	STOP
	l l	-INTA Settings	: Register 0x29H	1	_				
		0 0	0 0	0 0 0	) 1	>	SET BYT	E	
						ВО	: WDIEA	(WatchDog)	
						B1	: BSIEA	(Battery Switch)	)
I			1.1.1	1 1					
F	ig 17. Er	able the IN	TA for Wat	chdog					

4. Enable the watchdog for a repeat every 2 seconds for example (see Fig 18).

USB-I2C Commands Standard Registers Special Registers Time, Alarms,	Timestamps Register Readback RAM 85363 only Demoboard					
Resets Flags Watch Dog Offset						
Watch Dog Settings : Register 0x2DH						
repeat         0         0         0         1         0         1 second           1         1         1         1         1         1         1         1           1         1         1         1         1         1         1         1         1	Watchdog Duration          >         2 seconds           B0 : WDS[0] (WatchDog Step Size)           B1 : WDS[1]					
	B2 : WDR[0] (WatchDog Register Bits) READ WD-COUNTER B3 : WDR[1] B4 : WDR[2] B5 : WDR[3] B6 : WDR[4]					
	B7 : WDM (WatchDog Mode, single shot or continuous)					
Fig 18. Enable the watchdog for a repeat every 2 seconds						

5. Observe the LED flashing every 2 seconds!!!

#### 5.3.3 Interactive quartz frequency offset correction:

The quartz crystals come with a tolerance of typical  $\pm$  20 ppm. To correct the actual offset of the quartz in use, take the following steps:

- 1. Measure the frequency at CLKout pin, e.g. 32 768.51 Hz
- 2. Write the measured frequency in the entry field, it automatically calculates the offset and the needed correction value. 15.19 ppm or 7 correction pulses.
- 3. By activating SET BYTE the offset value is programmed in to the RTCs offset register.

**Note**: The offset calibration operates at the time counter level and will not result in any observable change in frequency.

Resets Rags	Watch Dog	Offset		_				
Offset Setting : I	Register 0x24	SH .			artz Load Cap 7 pF	acitance		Correction Mode
msb	0 0	OFFSET[7			Offset in deci 7	mal Offset in pp 15.19	π> (	SET BYTE
Enter measured	crystal freque	ncy in (Hz	): 32768.51	_	> 30.51710	3 us	Period	in us :
						V V		
		Diffe	arence to the ideal p	eriod in us :	0.000475	us		
						Ŷ		
		Diffe	erence to the ideal p	period in ppm :	145.56396	5 ppm		
						V		
		Offs	et Register value in	decimal :	7 correcti	on pulses in normal m	ode	
		Offs	et Register value in	binary :	0000011	1		

## 5.3.4 Dedicated drop down menus are integrated for e.g.:

- Register overview: reading all the values at once
- Back-up battery control
- Timestamp
- Watch dog
- RAM

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## USB-I<sup>2</sup>C-bus dongle OM13518 with a GUI

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