



# UM10267

PCA9698 demonstration board OM6281

Rev. 01 — 24 September 2008

User manual

## Document information

Info	Content
<b>Keywords</b>	I2C, PCA9698, GPIO
<b>Abstract</b>	The OM6281 is an add-on to NXP's I <sup>2</sup> C 2005-1 demo board. This daughter board makes it easy to test and design with the PCA9698, a Fast-mode Plus (Fm+) 40-bit GPIO device. These boards, along with the I2CUSB Lite GUI (PC based), provide an easy to use evaluation platform.

**Revision history**

Rev	Date	Description
01	20080924	Initial release

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## 1. Introduction

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The PCA9698 evaluation features headers to access all GPIO bits and LEDs for GPIO (output) demonstration. In addition, a PCA9530 LED dimmer/blinker is on-board to demonstrate the capability of generating a complex dimming/blinking pattern simultaneously on 40 LEDs. The board can be connected in series with other I<sup>2</sup>C-bus demo-boards to create an evaluation system.

The IC communicates to the host via the industry standard I<sup>2</sup>C-bus/SMBus port. The evaluation software runs under MS Windows PC platform.

## 2. Features

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- A complete evaluation platform for the PCA9698 40-bit GPIO
- Easy to use GUI-based software demonstrates the capabilities of the PCA9698
- On-board LEDs for visual experience
- Convenient test points for easy scope measurements and GPIO access
- USB interface to the host PC
- No external power supply required

## 3. Getting started

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### 3.1 Assumptions

Familiarity with the I<sup>2</sup>C-bus is helpful but not required.

### 3.2 Static handling requirements

#### CAUTION



This device is sensitive to ElectroStatic Discharge (ESD). Therefore care should be taken during transport and handling. You must use a ground strap or touch the PC case or other grounded source before unpacking or handling the hardware.

### 3.3 Minimum system requirements

- PC Pentium 60 processor (or equivalent), 8 MB RAM, 10 MB of hard drive space
- One USB port (either 2.0 or 1.1 compatible)
- Windows 98SE, ME, 2000, XP, or Vista
- I<sup>2</sup>C 2005-1 Demonstration board (OM6275)

### 3.4 Power requirements

The NXP Semiconductors I<sup>2</sup>C Demonstration Board 2005-1 and OM6281 hardware obtain power from the PC USB port. Care should be taken not to exceed the USB port current capabilities.

## 4. Installation

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### 4.1 I<sup>2</sup>C 2005-1 board and WIN-I2CUSB Lite software

The OM6281 is a daughter card to the OM6275 I2C2005-1 demo board.

You may download the WIN-I2CUSB Lite Software, the OM6275 user manual UM10206, and find ordering information at the NXP web site [www.standardics.nxp.com/support/boards/](http://www.standardics.nxp.com/support/boards/).

### 4.2 OM6281 connection to I<sup>2</sup>C 2005-1 board

The I<sup>2</sup>C 2005-1 board should be disconnected from your PC. The OM6281 board has a 9-pin female connector that allows the demo board to mount directly onto the I<sup>2</sup>C 2005-1 board at the JP1 location.

Connect the OM6281 board to the I<sup>2</sup>C 2005-1 board before connecting the USB cable. Once the board is connected, connect the USB cable and start the WIN-I2CUSB Lite software. You are now ready to evaluate the PCA9698.

## 5. Hardware description

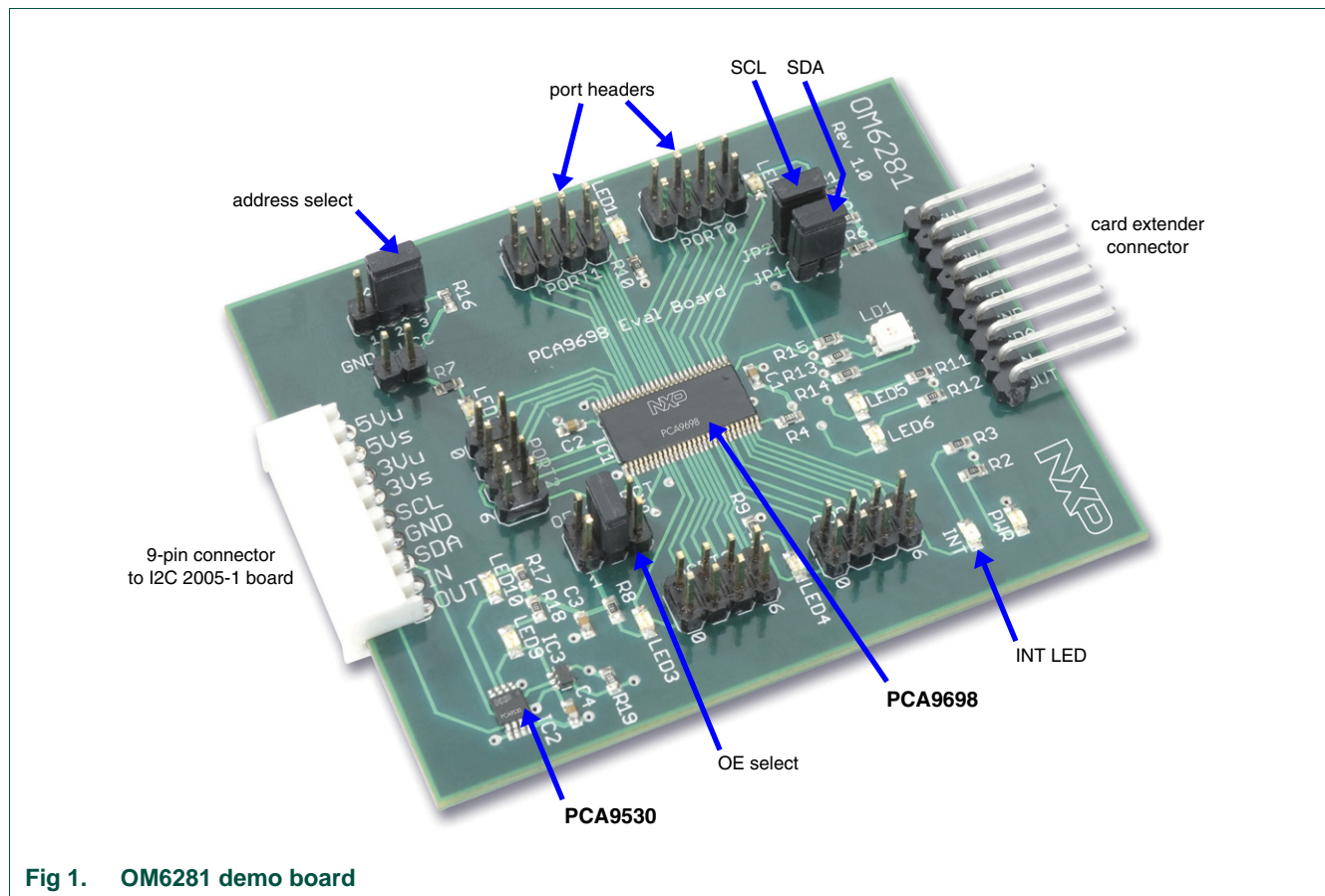
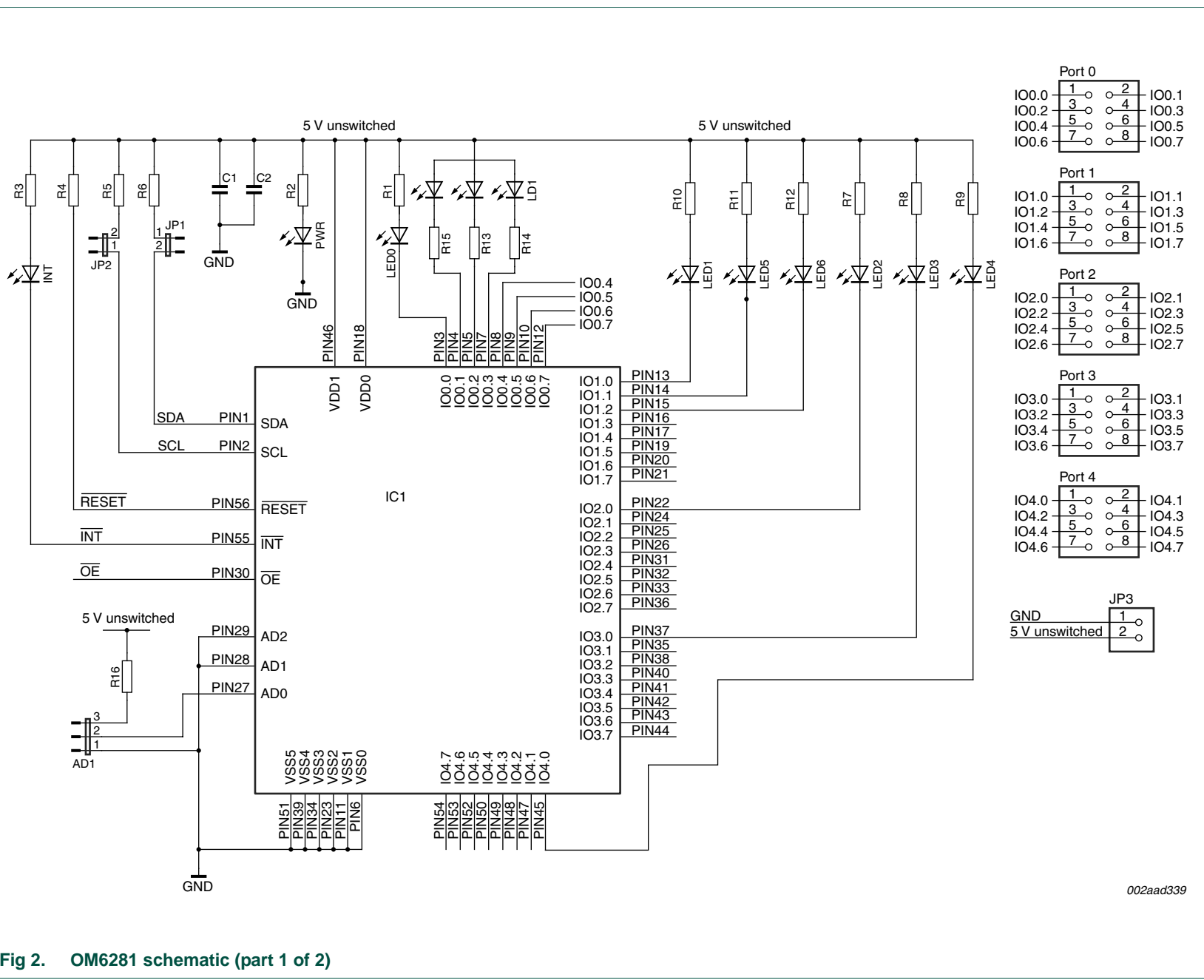


Fig 1. OM6281 demo board

The OM6281 board has 8 jumper headers.

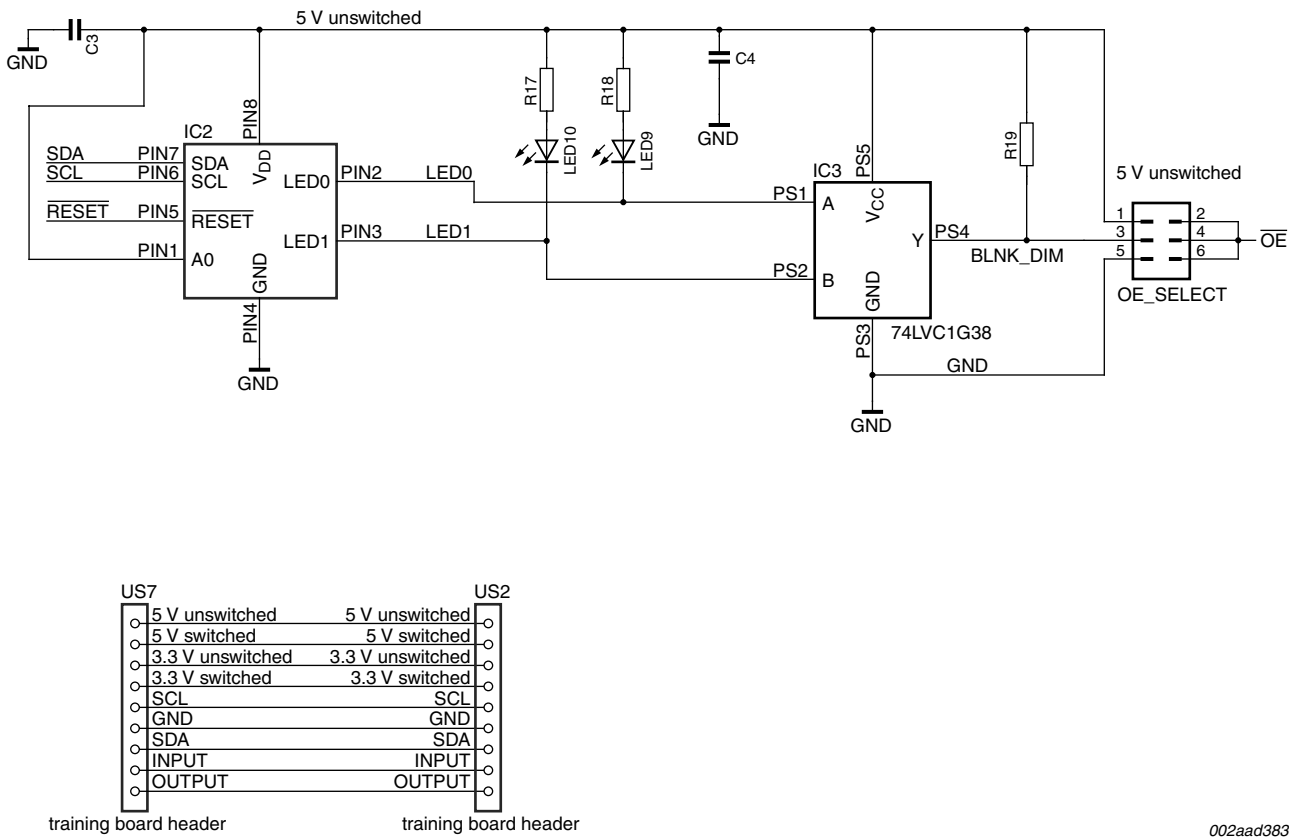
- Port0: Headers for port 0 I/O bits 0.0 through 0.7
- Port1: Headers for port 1 I/O bits 1.0 through 1.7
- Port2: Headers for port 2 I/O bits 2.0 through 2.7
- Port3: Headers for port 3 I/O bits 3.0 through 3.7
- Port4: Headers for port 4 I/O bits 4.0 through 4.7
- AD0: Address selector header. Default is AD0 HIGH (2-3)
- OE\_Select: Output enable selector. Default is  $\overline{\text{OE}}$  LOW (5-6)
- 5 V:  $V_{CC}$  header
- GND: Ground header

6. Schematics



002aad339

Fig 2. OM6281 schematic (part 1 of 2)



002aad383

Fig 3. OM6281 schematic (part 2 of 2)

## 7. OM6281 demonstration board main components

Table 1. OM6281 main components

Device	Description	Address	Location
PCA9698DGG	40-bit Fm+ I <sup>2</sup> C-bus advanced I/O port with $\overline{\text{RESET}}$ , $\overline{\text{OE}}$ , and $\overline{\text{INT}}$	0x42	IC1
PCA9530DP	2-bit I <sup>2</sup> C-bus LED blinker/dimmer	0xC2	IC2
74LVC1G38	2-input NAND gate	n/a	IC3

## 8. PCA9698 evaluation steps

The PCA9698 functions are controlled by WIN-I2CUSB Lite GUI. Refer to the *PCA9698 data sheet* for additional information on the registers and functionality.

### 8.1 Controlling LEDs using GPIO output

1. Connect the hardware as described in [Section 4 "Installation"](#). The PCA9698 address is set to 0x42.
2. Start the GUI software.
3. The main screen will appear.
4. From the 'Device' drop-down menus select 'IO Expanders' and from the subsequent drop-down menu select 'PCA9698 40-bit I/O Expander'.
5. The device configuration screen will be displayed as in [Figure 4](#).
6. Check the 'Auto Write' box on the right to send new register contents as soon as we change them.
7. Select the Bank0 tab. The default configuration is shown as in [Figure 5](#).
8. To enable the outputs, click on the check box IOC0 in the 'Configuration 0' register to enable the output on bit 0. An alternative is to write the hex value directly in the box.
9. The LED connected to Port0.0 is now on.
10. To turn it off, click on the OP0 box to set the output signal HIGH. Verify LED0 is off.
11. Additional LEDs are located at Portx.0 on banks 1-4. An RGB LED is located at Port0.1 to Port0.3. Experiment by turning those LEDs on and off.



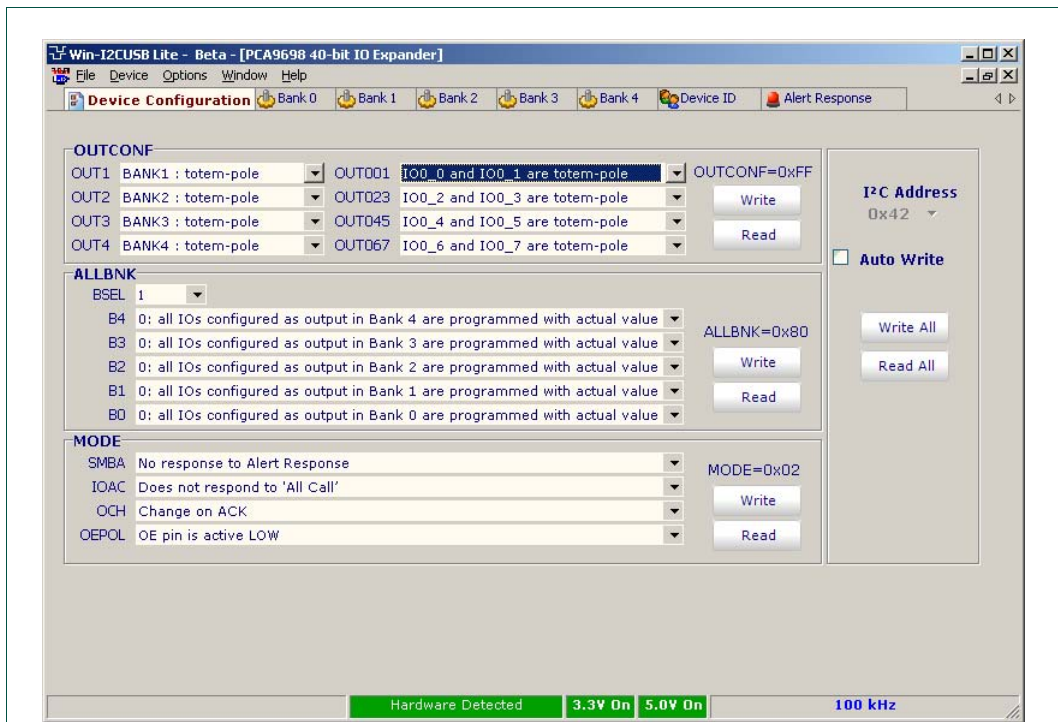


Fig 4. PCA9698 device configuration screen

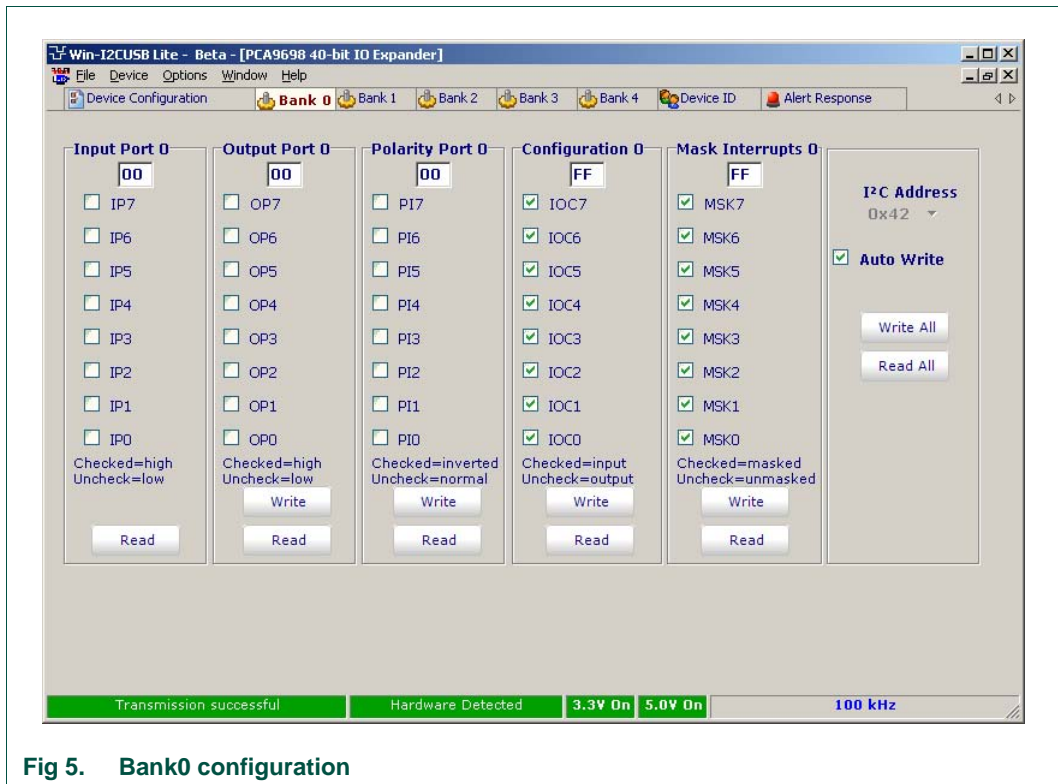


Fig 5. Bank0 configuration

## 8.2 GPIO input

### 8.2.1 Polling mode

In polling mode, the host controller must read the input port registers at predetermined intervals to check if an input has changed. Depending on the application, the interrupt mode described in [Section 8.2.2](#) may be a more efficient method of verifying changes of state on the input pins.

1. Select Bank0 and verify that the default values are displayed.
2. Since the PCA9698 has a small pull-up on the I/O, a read on the Input Port 0 register returns 0xFF.
3. Pull Port0.7 to a logic LOW.
4. Read the Input Port 0 register and verify that the Input Port 0 register reads 0x7F.

### 8.2.2 Interrupt mode

In interrupt mode the interrupt pin is toggled to signal the host controller when an input change of state has been detected. The interrupt mask register specifies which signal is allowed to generate an interrupt.

1. Select Bank1 and verify the default values are active.
2. Un-check the MSK7 and MSK6 bits in the Mask Interrupt 1 register.
3. With the aid of an external pull-down, pull Port1.6 and Port1.7 bits to a logic LOW.
4. Verify the INT light is illuminated on the board.
5. Toggle the MSK6 and MSK7 bits and verify the INT light goes off only when both bits are masked.
6. Read the Input Port 1 register and verify the contents is now 0x3F and the INT light is off.
7. Pull the IO1.7 signal HIGH and verify that the interrupt light is on.
8. Toggle the MSK6 bit and verify that the INT light remains on.
9. Read the Input Port 1 register and verify that the contents is 0xBF and the INT light is off.

## 9. Application specific: LED blinking and dimming with the PCA9530 and the PCA9698

### 9.1 Theory of operation

The PCA9698 has the capability to drive up to 40 LEDs (within certain power restrictions on the package, which can be overcome with the use of FETs). To enhance the application of the PCA9698, a PCA9530 can be used to drive the Output Enable ( $\overline{OE}$ ) pin to blink and dim the output of the LEDs. A pattern with intermediate complexity can be easily generated by combining the outputs of the PCA9530.

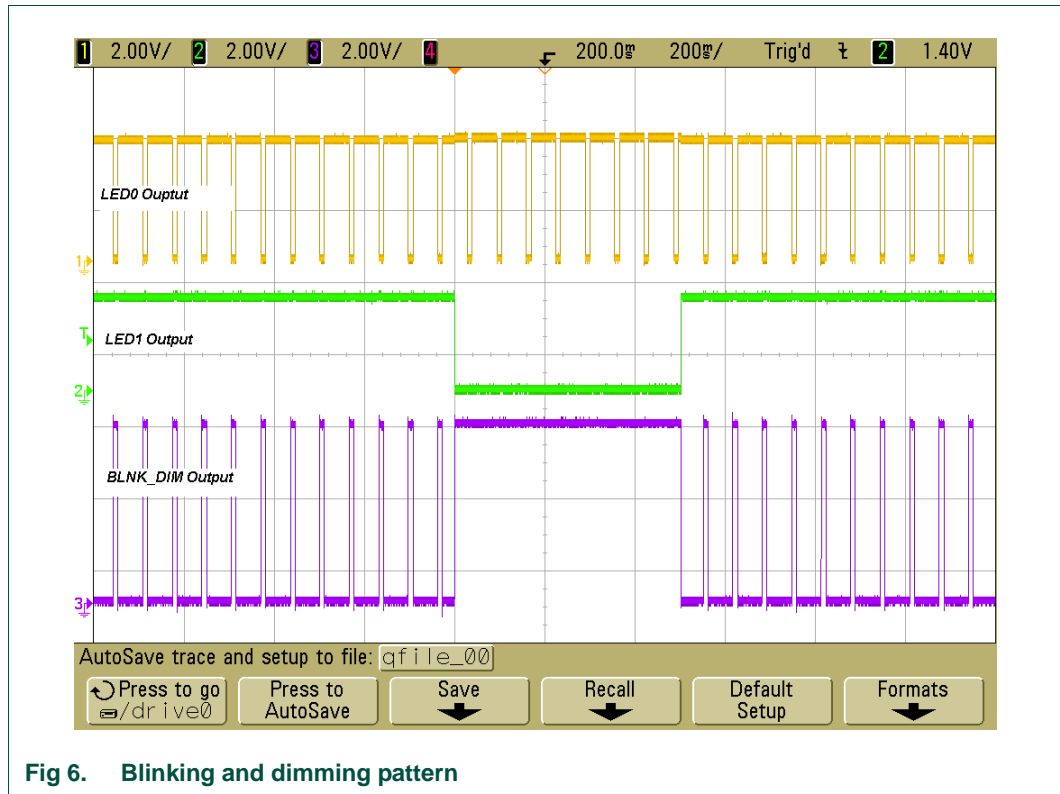
A 74LVC1G38GW NAND gate is used to demonstrate the  $\overline{OE}$  polarity inversion (active HIGH instead of default active LOW) of the PCA9698.

To drive LEDs, the GPIOs on the PCA9698 are configured to output mode. The LEDs are turned on and off by driving the outputs LOW and HIGH. To blink and dim the LEDs, the  $\overline{OE}$  pin is tied to the outputs of the PCA9530 through a NAND gate. When the  $\overline{OE}$  is driven HIGH, the outputs on the PCA9698 will be enabled. This will turn on the LEDs that are connected to outputs driven LOW. The truth table in [Table 2](#) illustrates the sequence.

**Table 2. LED control truth table**

LED0	LED1	$\overline{OE}$	GPIO output	LED
0	0	1	LOW	ON
0	1	1	LOW	ON
1	0	1	LOW	ON
1	1	0	LOW	OFF

Combining the blink and dimming, along with the individual on/off control of each LED allows the user to create eye-catching display patterns. The example outlined in [Section 9.2](#) will demonstrate how to obtain the waveform shown in [Figure 6](#).



**Fig 6. Blinking and dimming pattern**

## 9.2 Blinking/dimming with the PCA9530 demonstration steps

The following exercise demonstrates how this is achieved.

1. Move the OE\_Select jumper to the 3-4 position. The PCA9530 will now control the  $\overline{\text{OE}}$  pin.
2. Set-up the hardware and software as described in [Section 4 "Installation"](#).
3. Open the PCA9698 GUI.
4. In the 'Device Configuration' tab, select  $\overline{\text{OE}}$  enable HIGH.
5. Select the Bank0 tab.
6. Enable the output for bits 1-3. These bits control the RGB LED on the board.
7. The RGB LED should be off.
8. Go to the 'Device' selection tab and select the 'LED blinkers and Dimmers' to select the PCA9530. The configuration screen will appear. See [Figure 7](#).
9. Select the 'Auto-write' option.
10. Slide the selection tab on LED0 to the ON position.
11. Verify the RBG LED is ON, displaying white.
12. Move the LED0 slider to PWM0.
13. Move the LED0 Period slider to 0.033 seconds and the LED0 Duty Cycle to 14.45 %.
14. Observe the pattern displayed on by the RGB LED.
15. Move the LED1 Period slider to 0.296 seconds and the LED1 Duty Cycle to 12.11 %.
16. Move the LED1 slider to PWM1.
17. Observe the pattern being output on the RGB LED.
18. Observe LED 8 and LED 9, which individual blink/dim patterns generated by the LED0 and LED1 outputs on the PCA9530.
19. To change the color displayed by the RGB LED, go back to the PCA9698 Bank0.
20. Turn off the green LED by selecting bit 2 HIGH.
21. Verify that the blink color is now mauve.
22. Turn off the red LED by selecting bit 1 HIGH.
23. Verify the blink color is now blue.
24. Slide the Period and Duty Cycle bars for the LED1 and LED0 and observe how the blink and dim patterns vary.

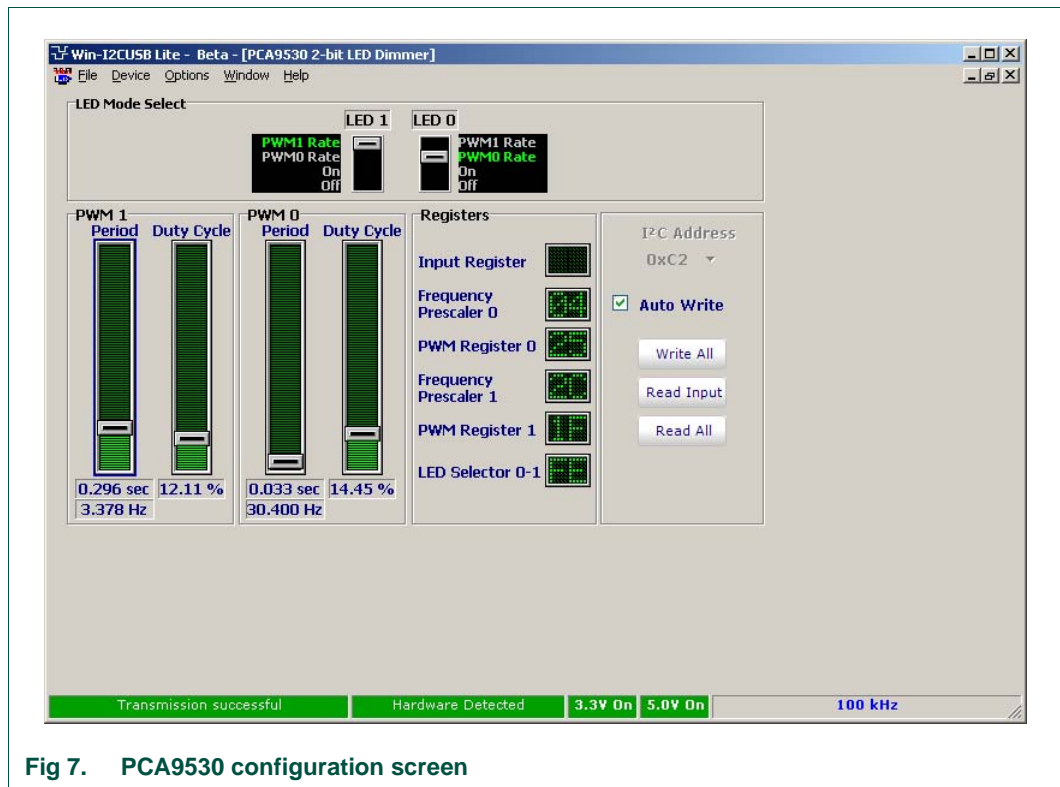


Fig 7. PCA9530 configuration screen

## 10. Abbreviations

Table 3. Abbreviations

Acronym	Description
FET	Field-Effect Transistor
Fm+	Fast-mode Plus
GPIO	General Purpose Input/Output
GUI	Graphical User Interface
I/O	Input/Output
I <sup>2</sup> C-bus	Inter Integrated Circuit bus
IC	Integrated Circuit
LED	Light-Emitting Diode
PC	Personal Computer
RAM	Random Access Memory
RGB	Red/Green/Blue
SMBus	System Management Bus
USB	Universal Serial Bus

## 11. References

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- [1] **PCA9698 data sheet** — NXP Semiconductors
- [2] **PCA9530 data sheet** — NXP Semiconductors
- [3] **74LVC1G38 data sheet** — NXP Semiconductors
- [4] **I<sup>2</sup>C 2005-1 User Manual** — NXP Semiconductors

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