UM0401
User manual

User manual for eight bit port expander STMPE801 demonstration board

Introduction

This document explains the functioning of the demo board for the port expander Chip STMPE801 with a PC GUI for reading and writing to the eight GPIOs and controlling the I^2C interface.

The objective of this demonstration board is to display the capabilities of the 8-bit port expander (STMPE801) developed by STMicroelectronics using a Windows-based software application. The software application provides a user-friendly environment to test the port expander and verify its functionality.

The board is controlled by the GUI through the parallel port in the PC. The power to the board should come from an external 5 V constant DC power supply.

The PC based GUI acts as the I^2C host and controls the STMPE801 slave on the board. The eight GPIOs in the STMPE801 are accessible through headers and can be easily pulled high or low using jumpers. The GPIOs can be configured as outputs by writing to the appropriate registers using the GUI. All these interfaces are controlled by using I^2C communication between Host and Slave devices.

In addition, the hardware has a provision for controlling the STMPE801 through an external I^2C master.

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1 Getting started

1.1 System requirements

In order to use the port expander demonstration board with the Windows operating system, a recent version of Windows, such as Windows XP or Windows 2000 must be installed on the PC. The user must have administrative rights to install the executable and launch it.

The version of the Windows OS installed on your PC may be determined by clicking on the "System" icon in the Control Panel.

1.2 Package contents

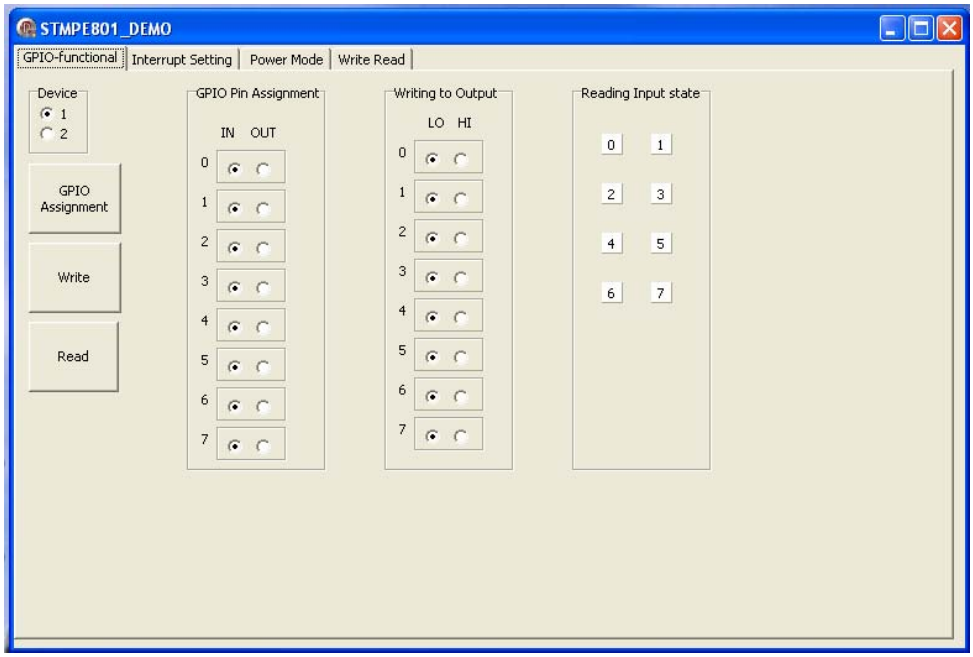
The port expander demo board includes the following items:

- Hardware content:
  - One demonstration board
  - One parallel port cable
- Software content:
  - PC executable software (STMPE801_GUI) to be used along with demo board
  - A DLL file to support the executable (io.dll) to be installed in the same directory as the executable file.
  - Source code (written in Borland Delphi)
- Documentation:
  - User manual
  - Schematic of the hardware

1.3 Software installation

The GUI is a simple executable that can be run even from a USB flash drive. The only requirement is that the user must have administrative rights on the system in order to open the accompanying DLL file. The GUI can be started by double-clicking on the file STMPE801_GUI.exe. When the exe file is opened, the GUI resembles *Figure 1* below:

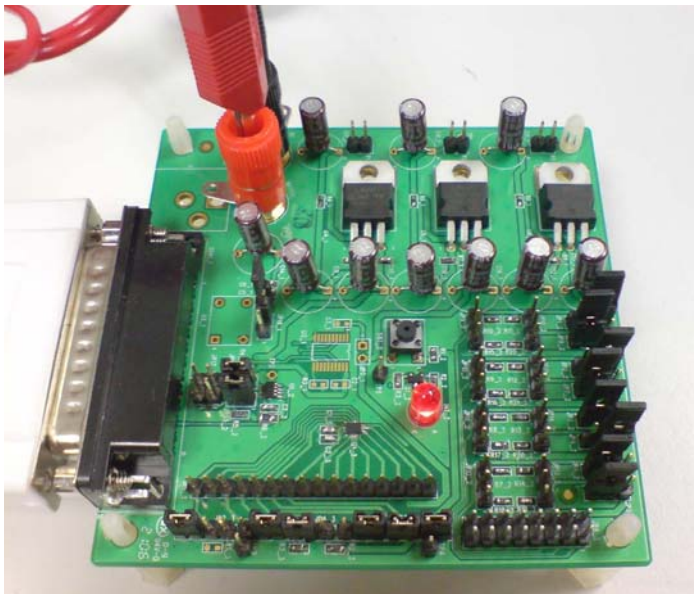
Figure 1. GUI start up screen



1.4 Hardware installation

Figure 2 below shows the snapshot of the demonstration board.

Figure 2. Port expander board



1.4.1 Power supply

The demo board should be powered from an external supply of 5 V, 1 A. (Connector X1 is for +5 V and Connector X2 is GND). This supply is regulated to get the required V_{CC}, V_{IO} and $V_{pull\text{-}up}$ voltages by adjusting the Resistor divider components.

Figure 3 below shows the Voltage regulation circuit used. For example, a V_{CC} of 1.8 V can be achieved by fixing the R6_1 resistor to 680 ohms and calculating R7_1 using the formula:

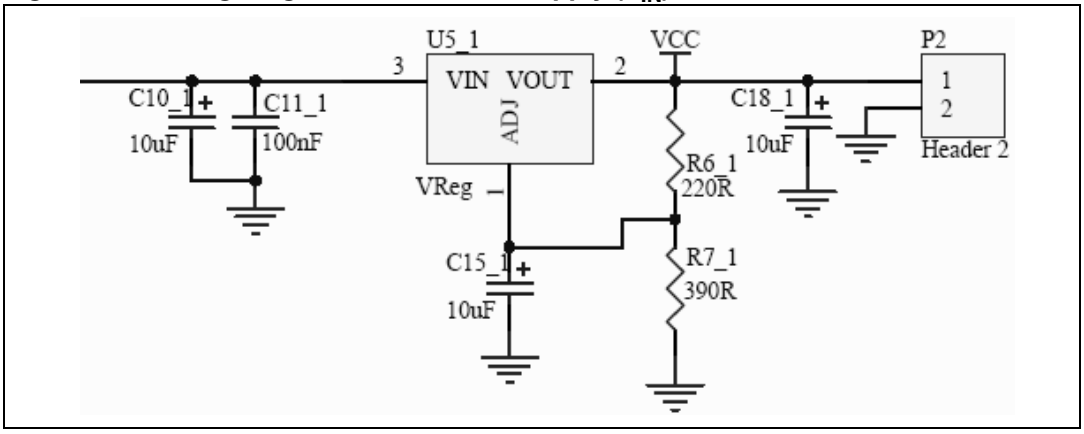
Equation 1

$$V_{OUT} = V_{REF}\left(\frac{1 + R_{7\_1}}{R_{6\_1}}\right) + I_{ADJ}R_{7\_1}$$

where, the V_{OUT} we need is 1.8 V, V_{REF} is 1.25 V and I_{ADJ} is 50 µA.

By default, the resistors are chosen to fix the voltages at V_{CC} = 1.8 V, V_{IO} = 3.3 V and $V_{pull\text{-}up}$ = 2.3 V in the demo board.

Figure 3. Voltage regulation from +5 V supply (V_{IN})

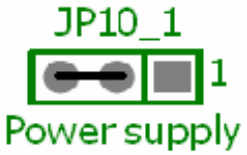


1.4.2 Jumper settings

There are several jumpers on the board that should be properly set to ensure proper functioning of the board.

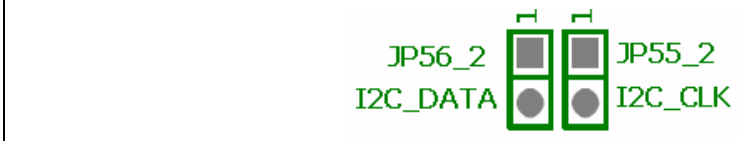
- JP10_1: as shown in *Figure 4* below, the JP10_1 jumper should be set to power the voltage Regulators with +5V from the X1 and X2 connectors. This is the main power connection for all the components on the board.

Figure 4. JP10_1 for Power supply



- JP55_2 and JP56_2: as shown in *Figure 5* below, these jumper settings are to select the I²C CLOCK and DATA source, either from the parallel port (DB-25 connector) or from an external I²C Master.

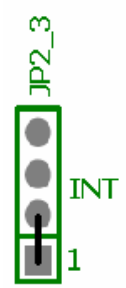
Figure 5. JP55_2 and JP56_2 for I²C_CLK and I²C_SDATA selection



These jumpers should be connected if STMPE801 is to be controlled by the GUI through the DB-25 connector. They can be left open if an external I²C Master is used. For using external I²C Master, refer to *Section 3*.

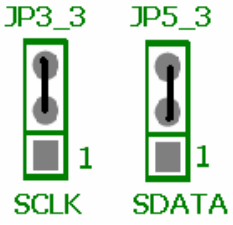
- JP2_3: as shown in *Figure 6* below, JP2_3 is used to connect the INT pin to the pull-up resistor and LED for easier monitoring of the generated interrupts. If this is not connected, an external pull-up resistor should be used to pull up the open drain INT output to VIO supply. The jumper should connect pins 1 and 2.

Figure 6. JP2_3 setting for STMPE801 INT pull-up



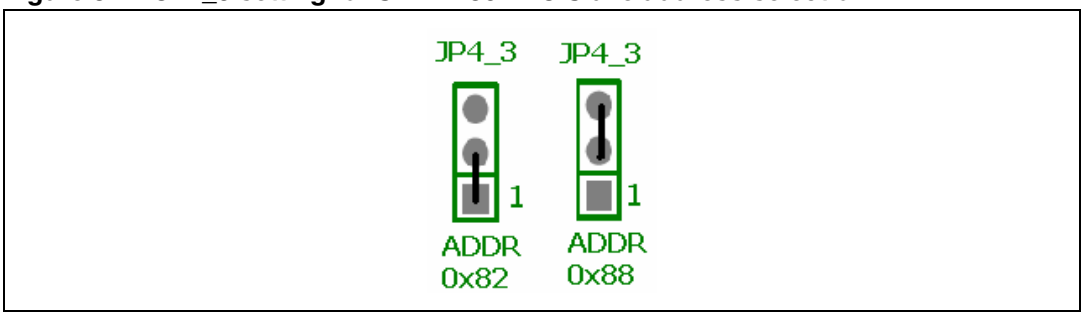
- JP3_3 and JP5_3: JP3_3 is used to connect the I²C_CLK from the I²C Master to the STMPE801 SCLK pin. And similarly JP5_3 is used to connect I²C_DATA from the I²C Master to the STMPE801 SDATA pin. *Figure 7* shows the jumper connection to be used on the board.

Figure 7. JP3_3 and JP5_3 setting for STMPE801 SCLK and SDAT



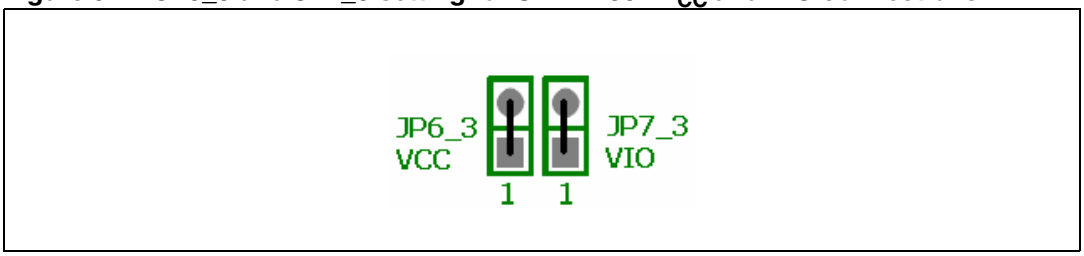
- JP4_3: JP4_3 is the jumper used to select the I^2C slave address as either 0x82 or 0x88. There are pull-down and pull-up resistors for the respective selection and these can be enabled by shorting the headers as shown in *Figure 8*.

Figure 8. JP4_3 setting for STMPE801 I^2C Slave address selection



- JP6_3 and JP7_3: These jumpers are provided to isolate the STMPE801 chip from the rest of the board for troubleshooting. They can also be used as test points to measure the respective supply operating current. To supply the chip with the V_{CC} and VIO, these jumpers should be shorted as shown in *Figure 9*.

Figure 9. JP6_3 and JP7_3 setting for STMPE801 V_{CC} and VIO connections



The board is ready to function after these jumper settings and the GPIOs can be accessed through the different headers provided. Refer to *Section 4* for the location of the various jumpers on the board.

2 Running the STMPE801 port expander GUI

This port expander demo board consists of two main parts:

- PC GUI
- Demonstration board

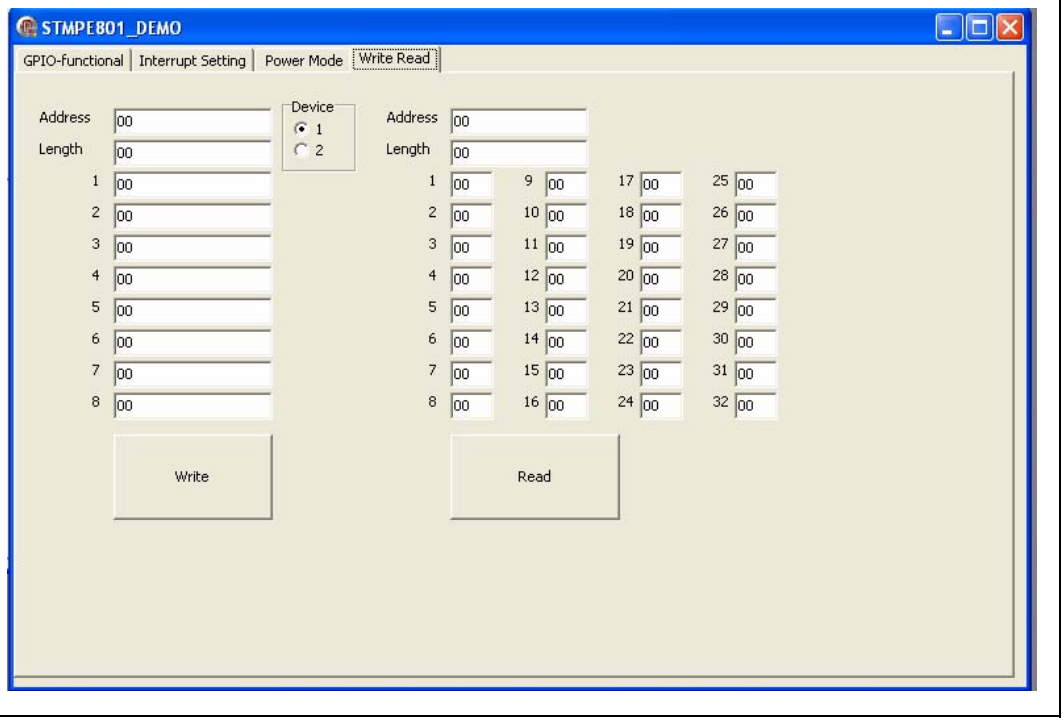
The various jumpers on the board should be configured correctly before running the GUI.

In order to run the GUI, the demo board must first be connected to the PC with the DB-25 parallel port cable and the power supply of +5 V should be provided.

The user should login as administrator before running the GUI (STMPE801_DEMO.exe). This file should be run from the same directory as the io.dll file.

When the GUI is successfully running, the startup screen resembles *Figure 10*. There are four tab options for testing the various device functionalities as explained in the following sections.

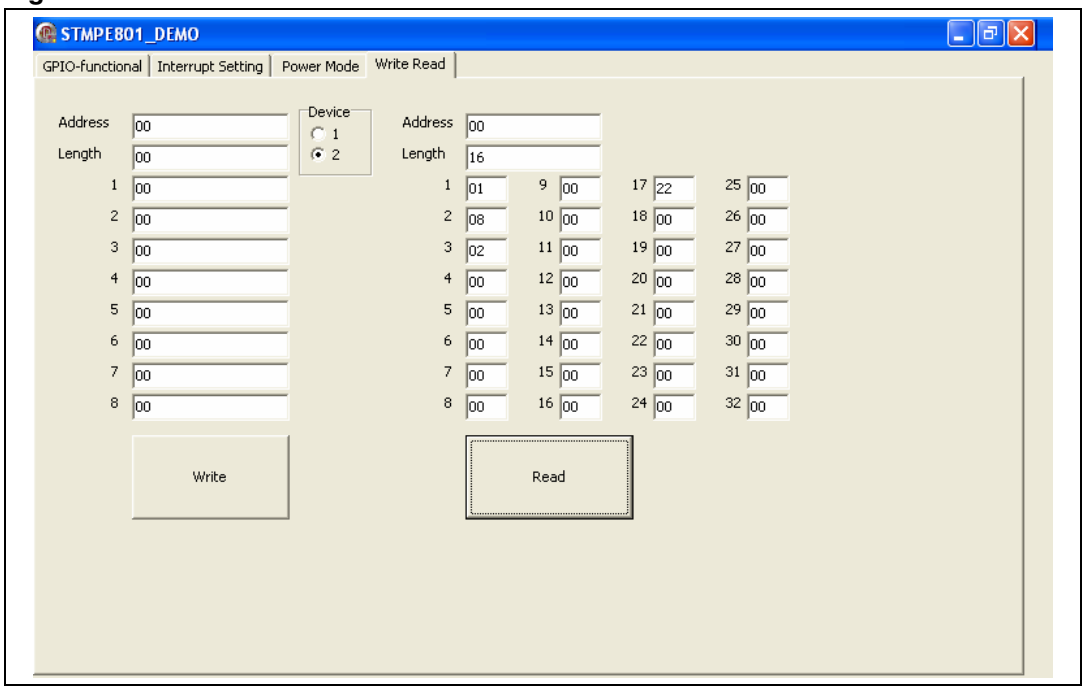
Figure 10. Screen shot of STMPE801 GUI startup screen



2.1 Running internal registers of STMPE801

The internal registers of the STMPE801 can be read or written to using the "Write Read" tab in the GUI. *Figure 11* shows a screen shot of this function. The radio button device 1 should be selected if the slave address is 0x82, and radio button device 2 should be selected if the slave address is 0x88. Making the wrong selection on the device radio buttons generates an error message as shown in *Figure 12*.

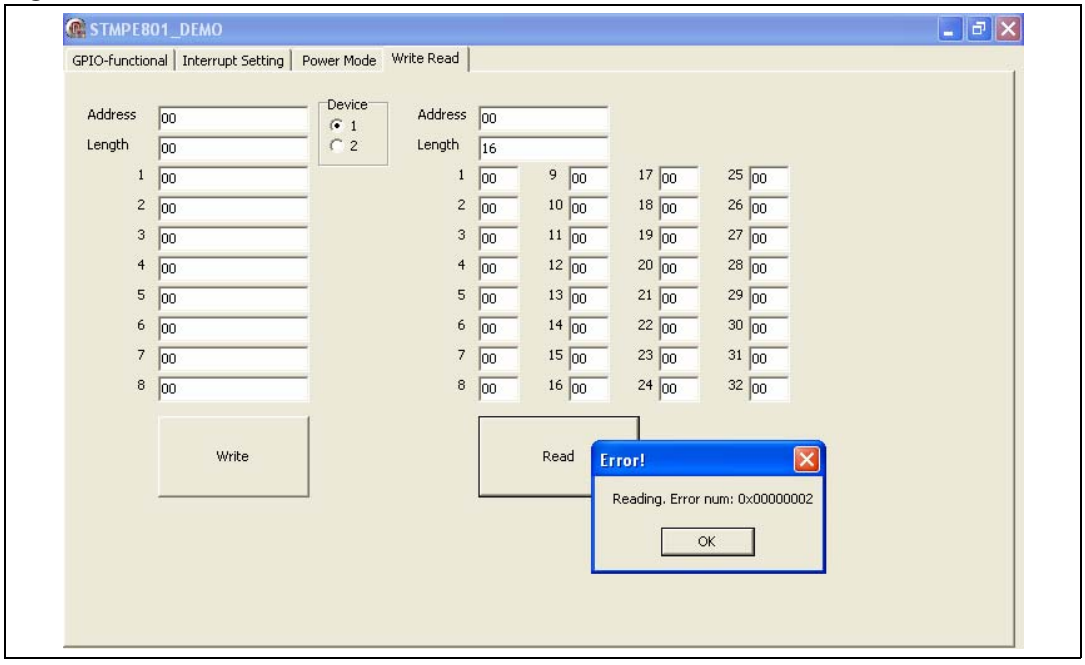
Figure 11. Screen shot of write/read tab in STMPE801 GUI



The register contents can be read by writing the 8-bit hex address into the "Address" field and the number of registers to be read in the "Length" field. Then click on the "Read" button. The contents displayed are in Hex and 8-bits wide. The same procedure can be followed for writing into the registers. The content to be written should be in bytes and only 8 bytes can be written with a single "Write" button click.

Note: The Length field should always be non-zero. A read or write with length zero causes the GUI to close.

Figure 12. Error screen when the incorrect I²C slave address is chosen



2.2 Programming GPIO

The eight GPIOs can be configured as input or output individually and independently of each other. The status of the GPIOs can be read and are displayed on the "GPIO-functional" tab of the GUI as shown in *Figure 13*.

As shown in *Figure 14*, GPIOs can be configured as outputs by selecting the corresponding radio button for IN or OUT assignment and clicking the "GPIO Assignment" button. The output state can be set to High or Low through the corresponding radio button and clicking on the "Write" button. The resulting state of the GPIOs can be read and displayed by clicking on the "Read" button.

Like the Read/Write to internal registers, the correct slave device should be chosen before the GPIO is configured. If the wrong slave device is chosen, errors appear indicating there is an error reading the GPMR or writing to GPDR registers depending on the function performed.

Figure 13. GPIO Input state screen shot

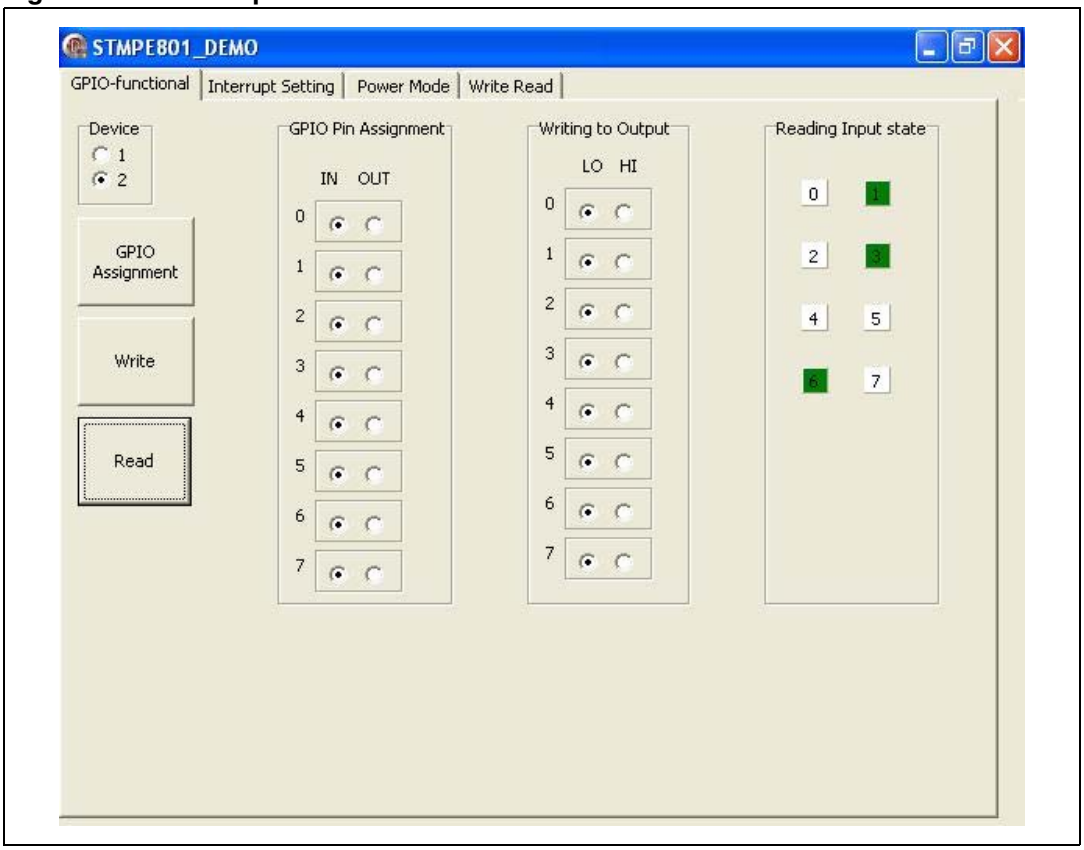
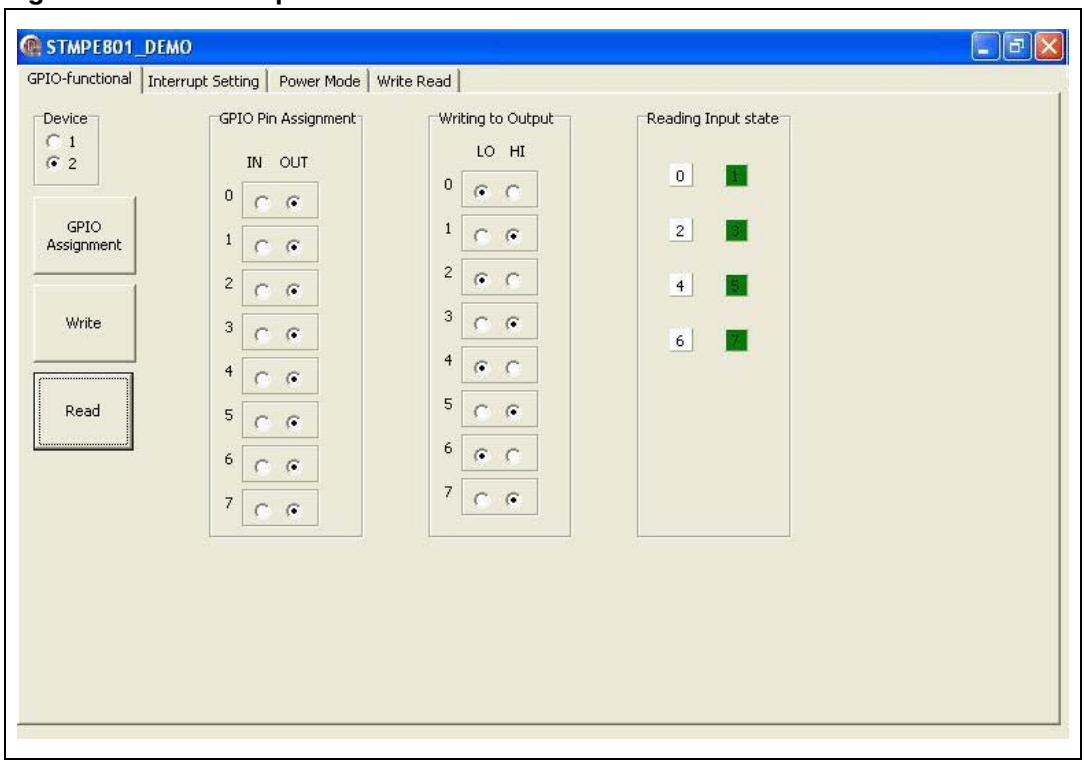


Figure 14. GPIO Output state screen shot



2.3 Power modes

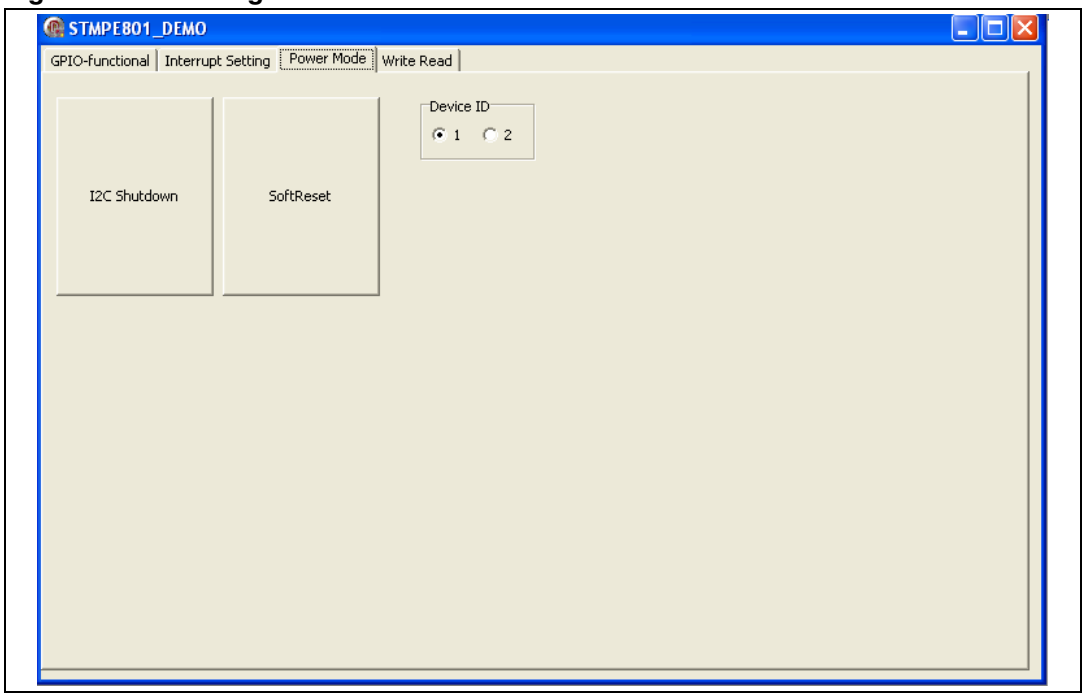
There are 2 functions that can be tested using this tab as shown in *Figure 15*.

- I^2C shutdown
- Soft reset

The STMPE801 slave devices can be put in Power down mode by clicking on the "I^2C Shutdown" button. This shuts down the device and displays a message to press the reset button to resume normal device operation.

Clicking the "Soft Reset" button performs the reset of the device. Like the other function tabs, the correct slave device should be chosen before clicking the buttons.

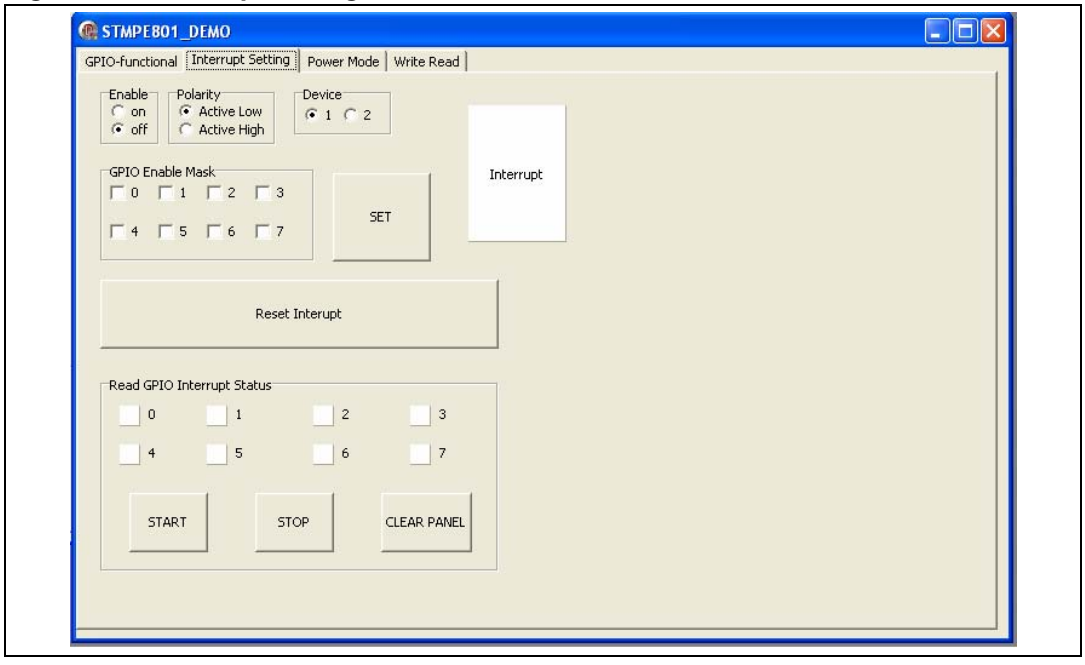
Figure 15. Entering in hibernate mode



2.4 Configuring interrupts

The GUI provides a convenient way to configure the GPIO interrupts in STMPE801 and monitor the change of state in the GPIOs that trigger interrupts, if so configured. *Figure 16* shows a screen shot of the Interrupt tab before the interrupts are configured and running. It allows configuring the interrupt polarity and the masking of each individual GPIO.

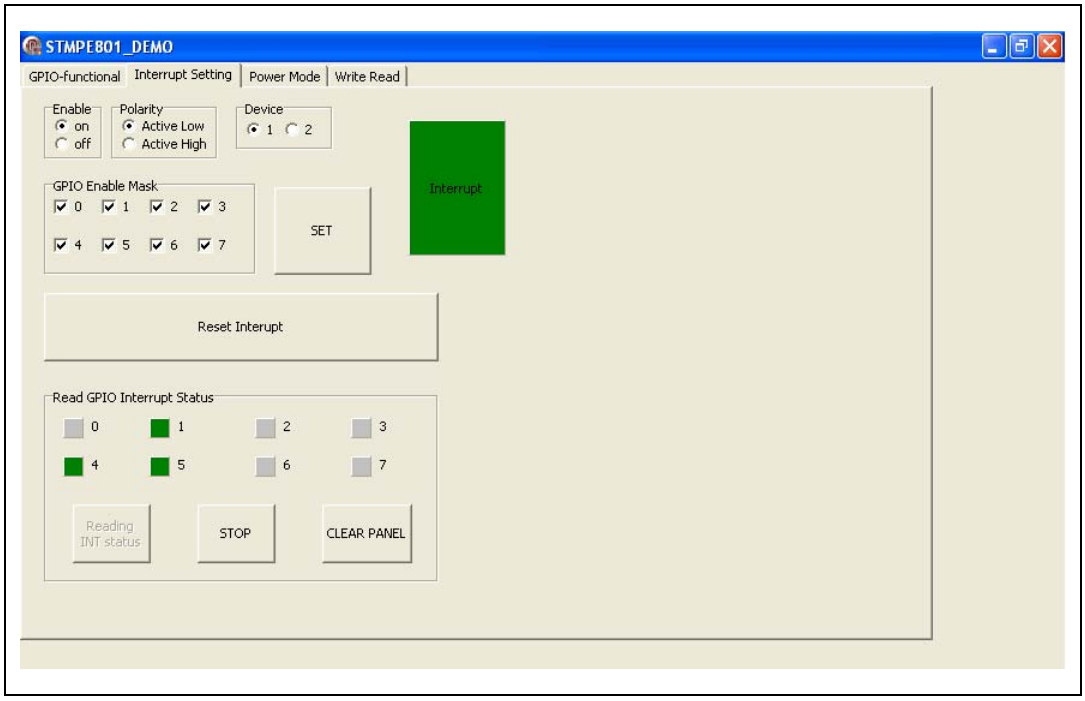
Figure 16. Interrupt setting tab screen shot



The appropriate slave device should be chosen before enabling the interrupt. The Interrupt settings are configured into the internal configuration registers as soon as the "SET" button is clicked. The Interrupt window turns green to indicate that the interrupt is enabled. In order to turn off all interrupt settings, click on the "Reset Interrupt" button . This is shown in *Figure 17*.

The ISR can be monitored using the "Read GPIO Interrupt Status" panel. Once the "START" button is clicked, the ISR is read at 100ms intervals and the results are displayed with corresponding green squares for GPIOS with state change. This monitoring can be stopped by clicking on the "STOP" button. All GPIOS are reset to default state by the "CLEAR PANEL" button. The clear panel does not work when the monitoring is running

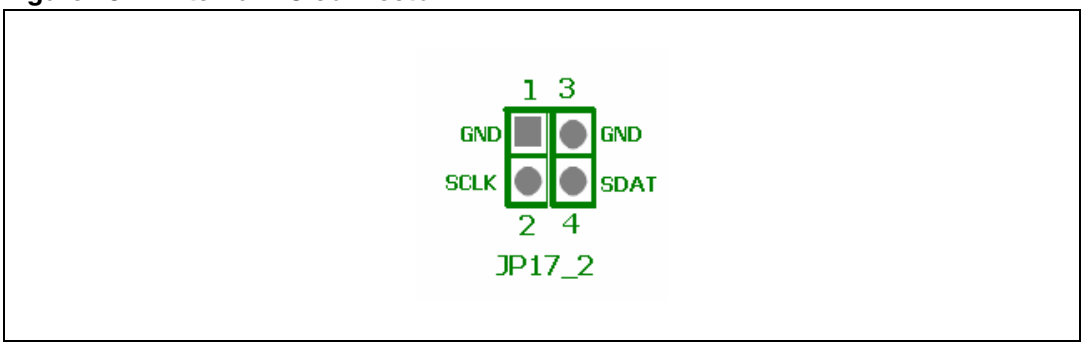
Figure 17. Interrupt enabled with indication of current interrupt status in the ISR - screen shot



3 Using the external I²C master

We can also use an external I²C Master to control the STMPE801 by using the pins available on the JP17_2 connector as shown in *Figure 18*.

Figure 18. External I²C connector



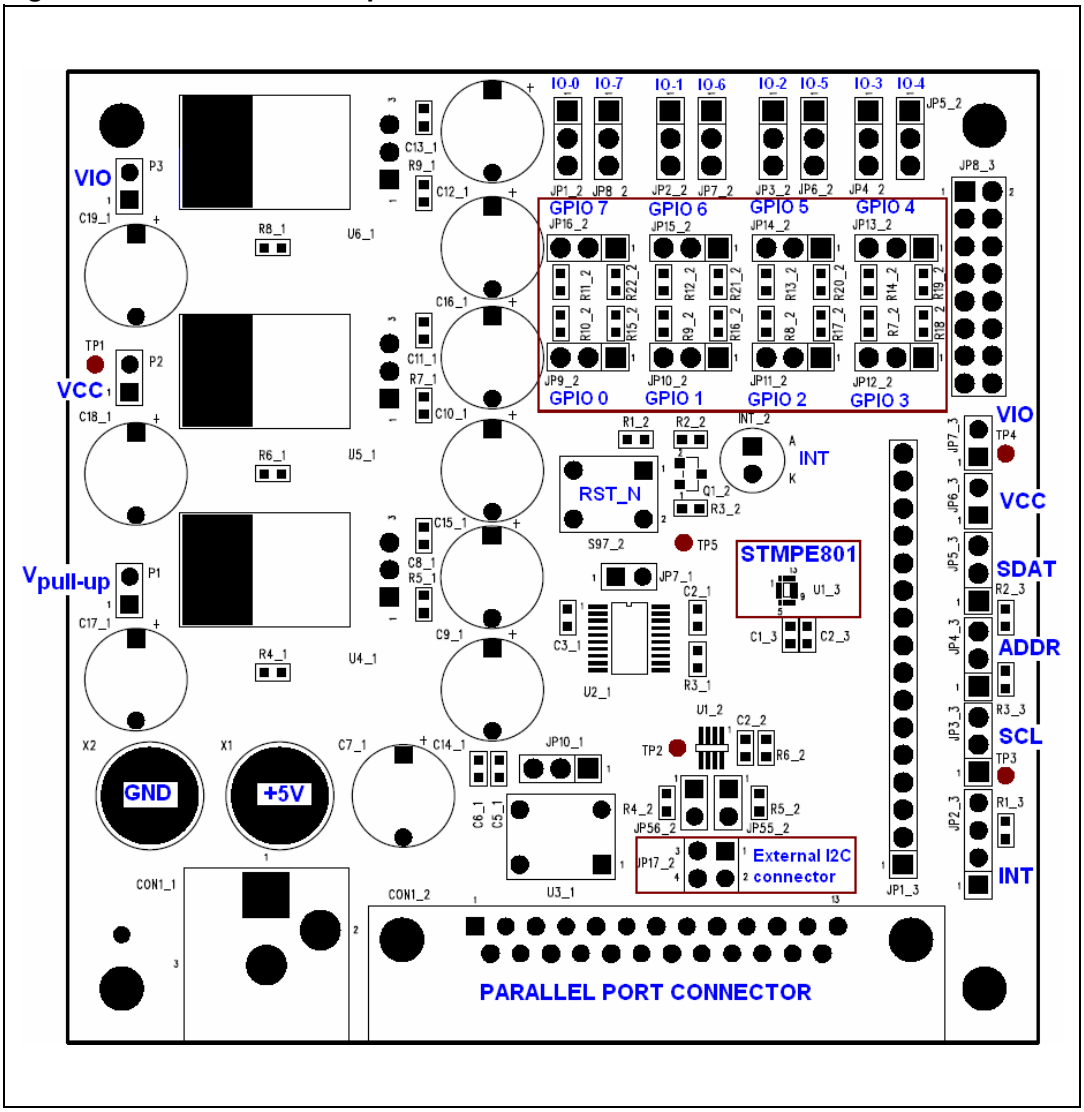
To control the STMPE801 devices using the external I²C master,

- The jumper settings on JP55_2 and JP56_2 should be removed. (Refer to *Figure 4*)
- The SCLK of the master should be connected to pin 2 of JP17_2 and the SDAT of master should be connected to pin 4 of JP17_2.
- Pins 2 and 4 already have pull-up resistors connected to pull up the open drain SCLK and SDAT pins. If these resistors are not required, the resistors R4_2 and R5_2 should be removed from the demo board.

In this mode, the PC GUI is not be available for the external I²C master.

4 Demo board footprint

Figure 19. Demo board footprint



5 Revision history

Table 1. Revision history

Date	Revision	Changes
05-Jun-2007	1	First issue

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