UM0300
User manual

Port expander STMPE2401 demonstration board

Introduction

This Document explains the functioning of the port expander demo board consists of the port expander IC STMPE2401 and controller ST72F63B microcontroller as I^2C master along with a PC GUI.

The objective of this demonstration board is to display to the user the features and capabilities of the port expander chip (STMPE2401) using a Windows-based host software application and one of several USB low-speed microcontrollers (ST72F63B) from ST acting as a control device.

The host software and the ST7 source code provide a user friendly environment to use demo board in following modes:

- Standalone mode
- PC GUI mode

In both modes, power to board can be provided from either USB bus itself or from external power.

In this demo board, the ST72F63B Microcontroller acts as the I^2C master and controls two STMPE2401 devices functioning as I^2C Slaves. The STMPE2401 devices are used to interface LCD, normal keypad, rotator controller, dedicated keys and 6 PWM outputs. All these interfaces are controlled by just using I^2C communication between master and slave devices.

all events like dedicated key press (four direction keys); keypad key press (4 x 4 keypad), Rotator direction, power mode etc. are captured and displayed in LCD screen and in the scan window of PC GUI. For visual display of the PWM output LEDs are provided on the board. The capability of rotator controller has been demonstrated by mechanically implementing the rotator configuration using switches.

For interfacing with the PC GUI, the application layer is built above the USB core library that makes all the hardware control of the USB interface transparent for the developers.

The PC GUI supports various power saving modes of port expander and wake up feature to get back to default operational mode.

In addition the board has the provision for an alternate I^2C path for external control.

Also the board has ICC connector to re-program the ST7 Microcontroller flash memory.

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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 2000 or Windows XP must be installed on the PC.

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:

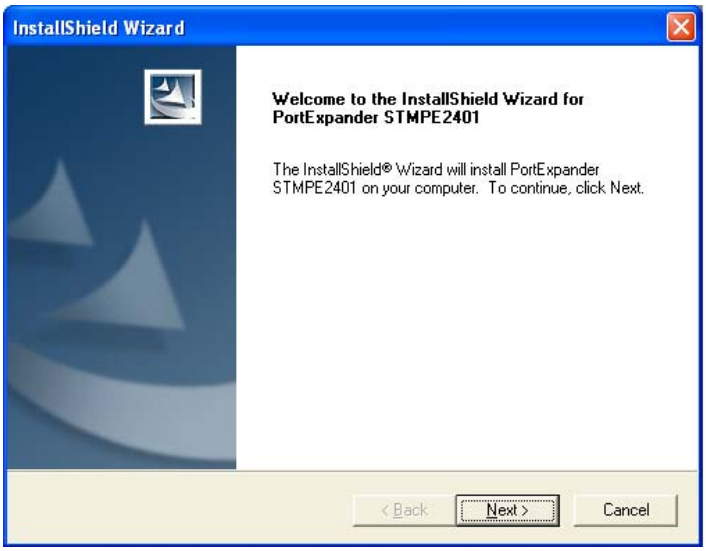
- Hardware content:
  - One demonstration board.
- Software content:
  - PC executable software (PE_2401_GUI) to be used along with demo board
- Documentation:
  - User manual

1.3 Software installation

To install the PC GUI software, follow the step as mentioned below:

- Step1: As soon as the user clicks the portexpander.exe Icon, the following window appears.

Figure 1. Installation window

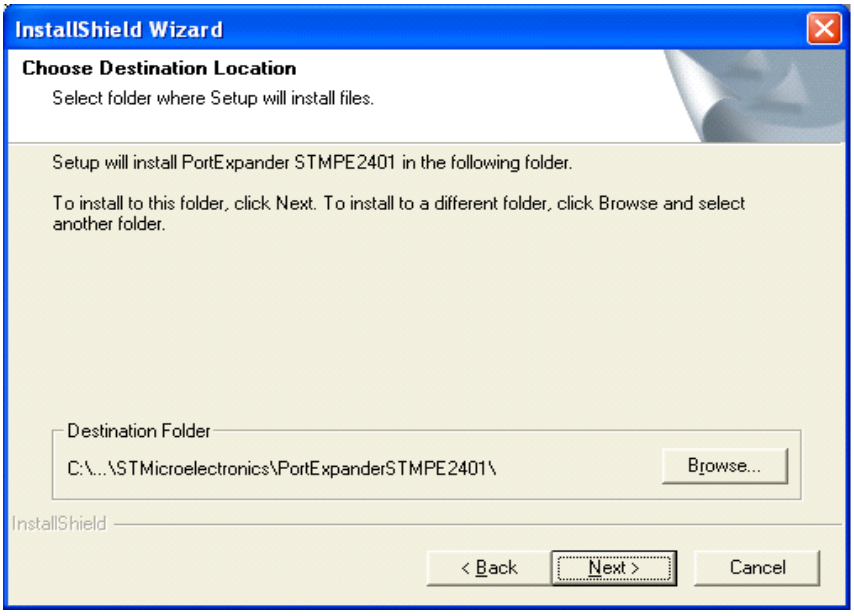


- Step 2: Read the license file and click the "Yes" button if you accept the license.

Figure 2. License window

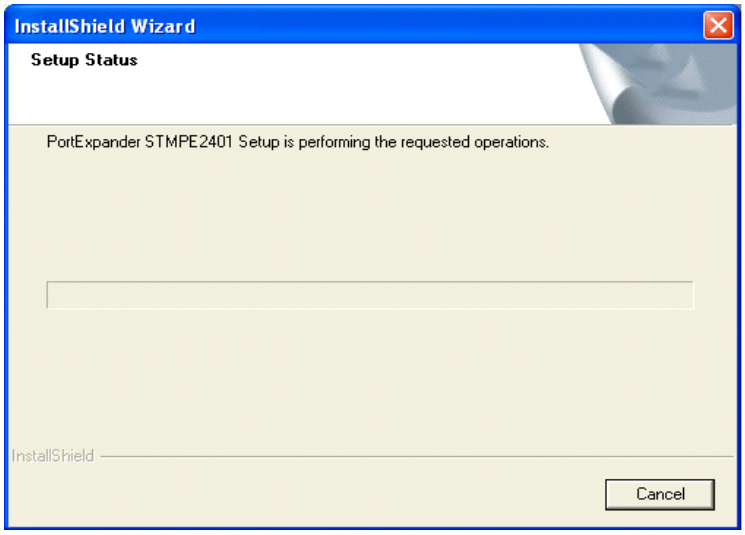
- Step 3: Please select the folder in which, you want to install the software. By default it will install the software in the following path- C:\Program Files\STMicroelectronics\PortExpanderSTMPE2401

Figure 3. Destination folder



- Step 4: After you select the folder and click the next button, it will start installing the software.

Figure 4. Installation ongoing



- Step 5:

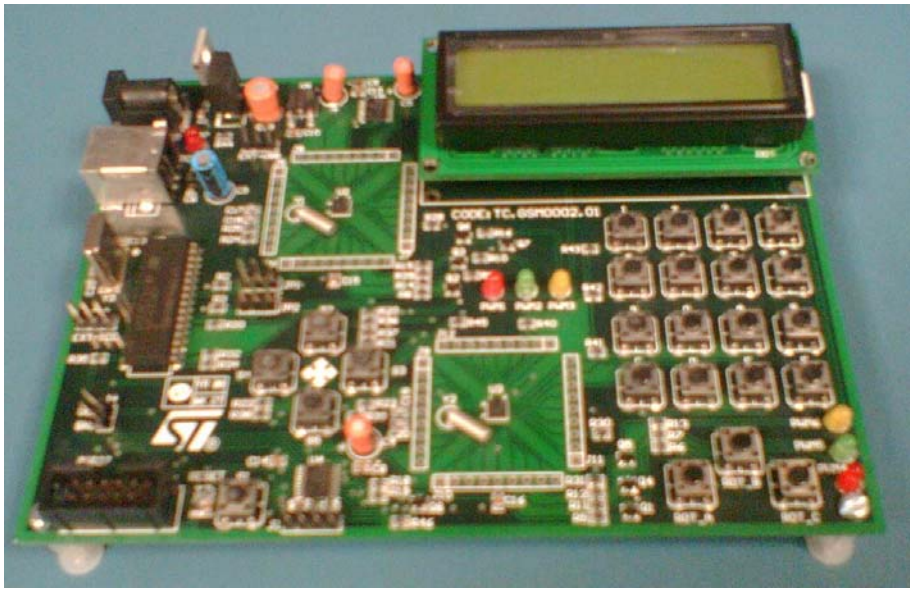
Figure 5. Installation complete

After you click the "Finish Button", you will find that the software is installed in the directory you selected or in the default directory. Also you will find the shortcut of this software also available in you START menu. This user manual is also available in the same directory.

1.4 Hardware installation

Figure 6 below shows the snapshot of the demonstration board.

Figure 6. Port expander demo board



1.4.1 Power supply

The demo board can directly be powered by the USB Connector (Bus powered).

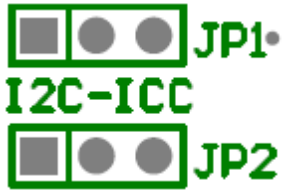
Or you can use an external power supply. The external power supply should be getting minimum supply of 7 V, 1 A and maximum power supply of 12 V, 1 A.

1.4.2 Jumper settings

There are four jumpers (JP1, JP2, JP3, and JP4) are available on the board. The correct connections of these connectors are necessary for the proper functioning of the demo board.

- JP1 and JP2: JP1 and JP2 are the connectors which are used to select between the I^2C lines and ICC lines (for programming the ST7 microcontroller) as shown in the *Figure 7* below.

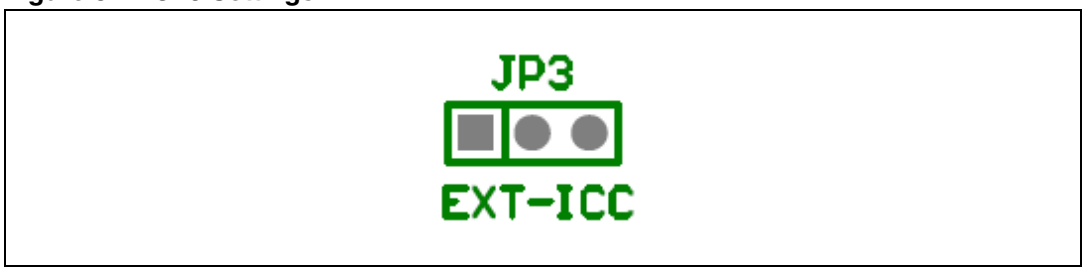
Figure 7. JP1 and JP2 Settings



These Jumpers allow the selection between ICC or I^2C data lines. While we do the programming the ST7 microcontroller, the jumpers must be connected on ICC side (right side) and when the board is used for demonstration, the jumpers must be connected on the I^2C side (left side).

- JP3: As shown in the *Figure 8* below, JP3 is used to select the clock source for the ST7 microcontroller.

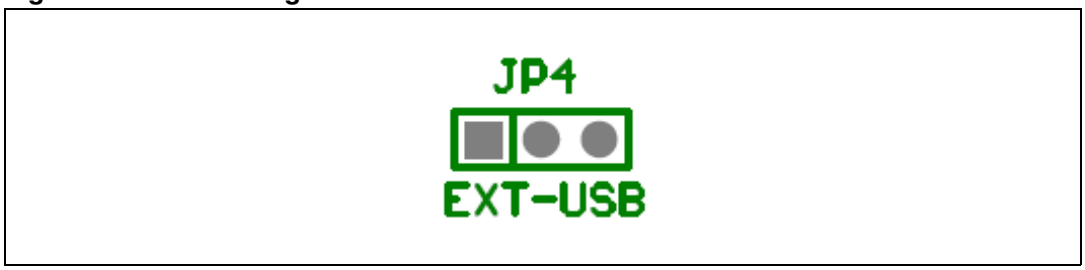
Figure 8. JP3 Settings



The default connection of this jumper is EXT side (Left Side) that is clock source external crystal resonator and when the board is used for demonstration. You need to connect to ICC side (Right Side) only if it is must to provide the ICC clock to the microcontroller during the re-programming microcontroller.

- JP4: As shown in the *Figure 9* below, JP4 is used for choosing power supply to be used for USB supply or the external board supply.

Figure 9. JP4 Settings



Connect the jumper to the Left side, whenever you want to use external power supply and to Right side (USB side), whenever you want to use USB supply. There is no restriction as such on using any of the power supply. You can use external power supply when you want to use the demo board in the stand-alone mode and USB power supply while you are using the PC GUI or in stand alone mode.

Even while providing the power to the demo from external source, you can use the PC GUI but for that you need to provide USB connectivity using USB connector.

2 Running the STMPE2401 port expander demo board

This Port Expander demo board consists of two main parts:

- PC GUI
- Demonstration board.

Again in Stand alone mode, the demonstration board can be used without PC GUI.

Before using the demo board in either standalone or PC GUI mode, we need to do following jumper settings-

- Connect JP1 and JP2 to the I^2C side (Left Side).
- Connect JP3 to the Left side to use external crystal oscillator
- Connect JP4 to the power supply you want to use.

2.1 Running in standalone mode

With in a few seconds after you plug in the power supply, a welcome message should come on LCD and this means that the demo has started correctly.

After that you will see a series of messages coming on the LCD screen. At the end, you will see a blank LCD screen and you will see all the LEDs blinking. These LEDs are the output of the 6 PWM outputs coming from 2 STMPE2401 devices. Now the system is ready to be used.

Again if you find that no message is coming on the LCD after giving the power supply. Remove the power supply and plugged in again and then observe. You should now see the message coming on the LCD. If this does not happen even after removing and plugged in the power supply several times, you need to contact technical support.

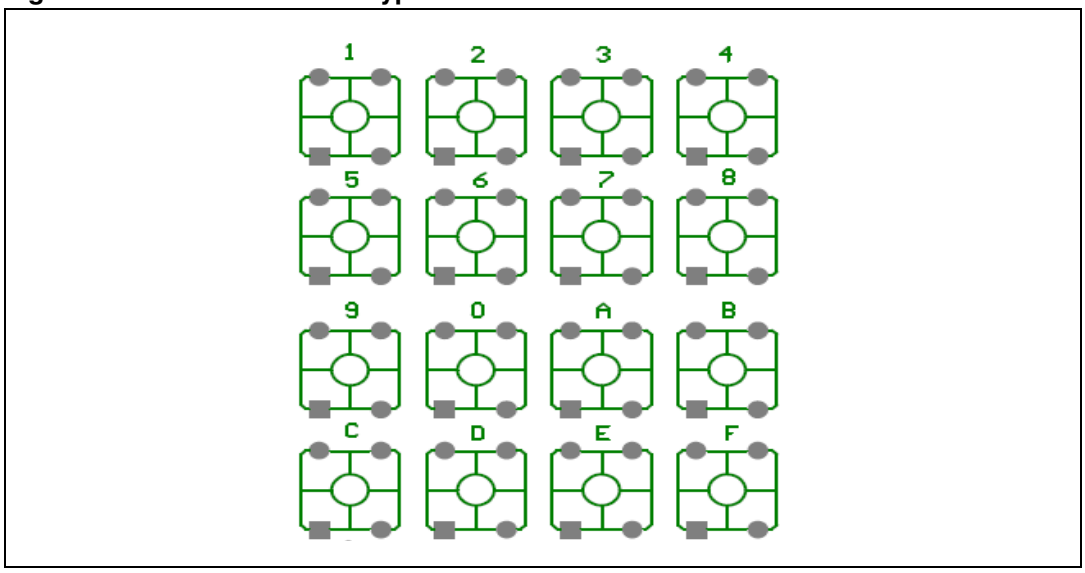
2.1.1 PWM Output demo

You can observe the PWM out on the CRO by connecting the probe at the corresponding LED output (there are 6 LED available in the demo board corresponding to each PWM). In stand-alone mode the PWM output are pre-programmed and can not be changed.

2.1.2 Keypad demo

As mentioned in the *Figure 10*, there is a 4 x 4 normal keypad available on the demo board. You can observe the key press event on the 16x2 LCD interface. You can observe at most 2 simultaneous key press events. For a case when you press more than 2 keys simultaneously only first 2 keys press will be detected. All key press events are displayed in LCD screen.

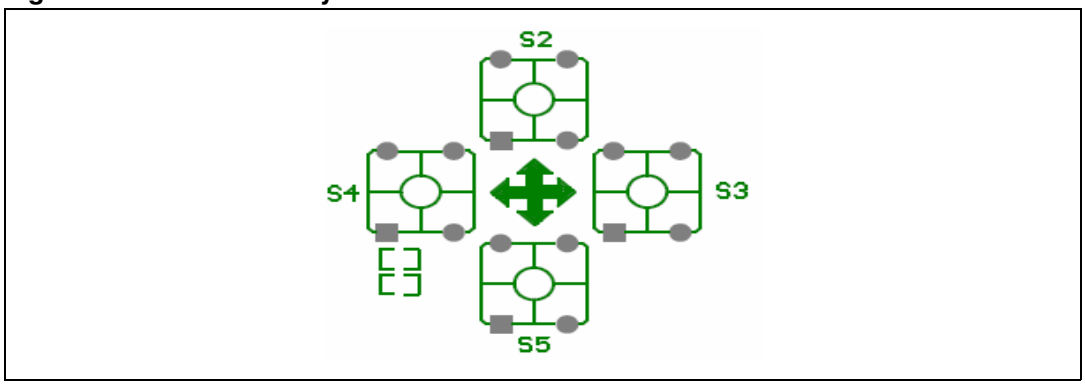
Figure 10. Embedded 4x4 keypad



2.1.3 Dedicated keypad demo

Similar to normal Key press, there are 4 dedicated keys available on the demo board as shown in *Figure 11*. In comparison to normal keypad where you can detect only 2 keys simultaneously, here you can observe 4 dedicated keys simultaneously. All dedicated key press events are displayed in LCD screen.

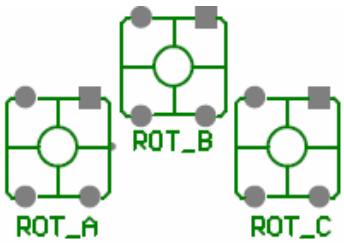
Figure 11. Dedicated keys



2.1.4 Rotator demo

The interface of Rotator is implemented in multiplexed manner with the keypad. That is either you will observe any key press event on the LCD or the Rotator event. The rotator is implemented using three switches as shown in *Figure 12*.

Figure 12. Rotator interface



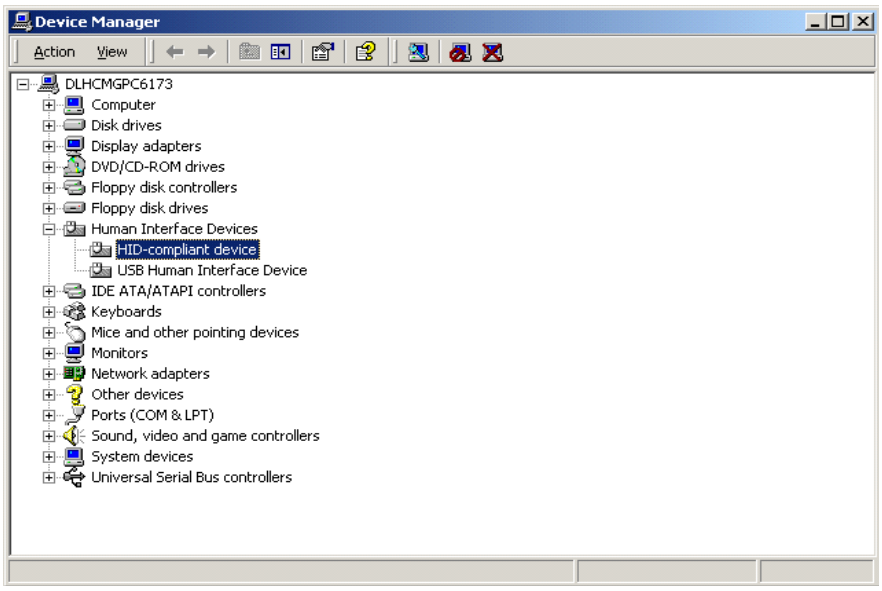
To use rotator, you have to press the 2 keys simultaneously and follow the instruction as mentioned in the datasheet. For the first 2 events you will not see any reaction but from then onwards you will the status on the LCD.

2.2 Running in PC GUI mode

In GUI mode, in addition to the functionalities mentioned in the above section, PC GUI is also available. For running the GUI, the demo board must first be connected to the PC with the USB cable and then provide the power supply to the demo.

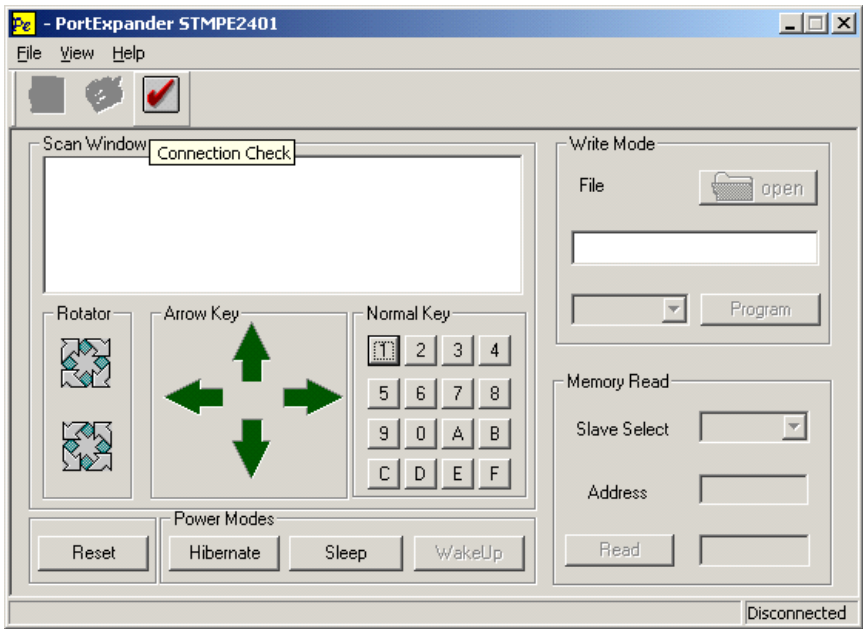
As a result, you should find the demo board enumerated as a HID device as shown *Figure 13*, and then board will be ready to use, if this message does not come contact the technical support.

Figure 13. Enumeration result



By starting the STMPE2401 PC GUI on the PC, you will see a graphical interface (*Figure 14*) for controlling the demonstration board. This PC software is used to issue various commands and to control data transfer between the PC and the ST7 peripheral.

Figure 14. STMPE2401 PC GUI

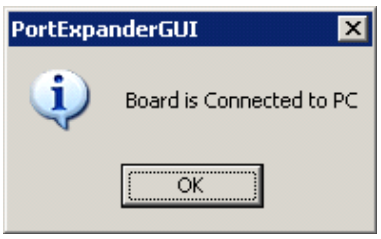


Again as you can see in the *Figure 14*, you can check whether the board is connected to the board or not by clicking the connection check button. If the board is not connected then you will see the following message.

Figure 15. Message for board not connect

And if board is connected then following message will appear.

Figure 16. Message for board connect



Once this is done, the PC GUI is properly connected to the demo board and ready to be used.

Now there are two modes operation in which GUI operates:

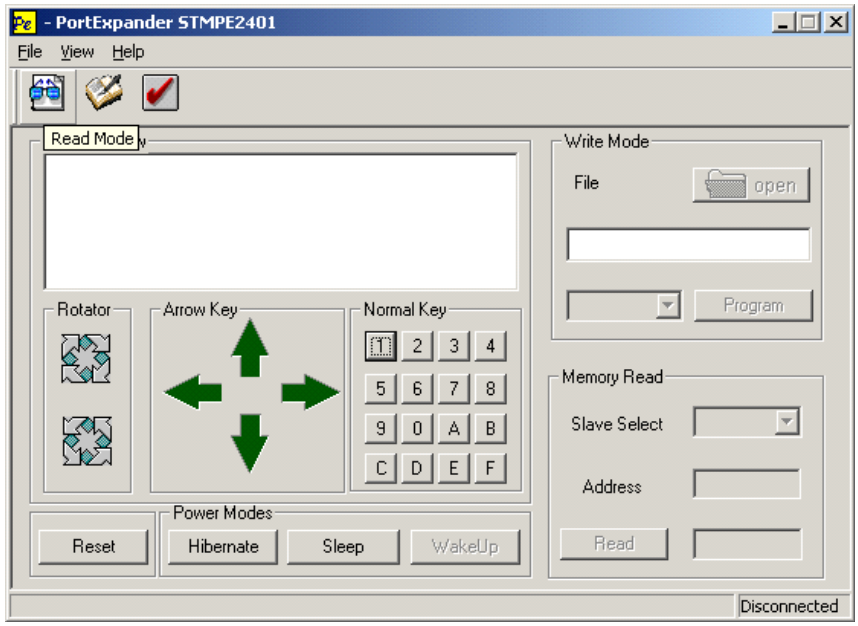
- Read/Scan mode
- Write/Program mode

In addition to these two modes, there are 2 power-down options available in the GUI to put STMPE2401 in power down modes. Again there is a RESET option available which can put the demo back in default settings.

2.2.1 Read/Scan mode

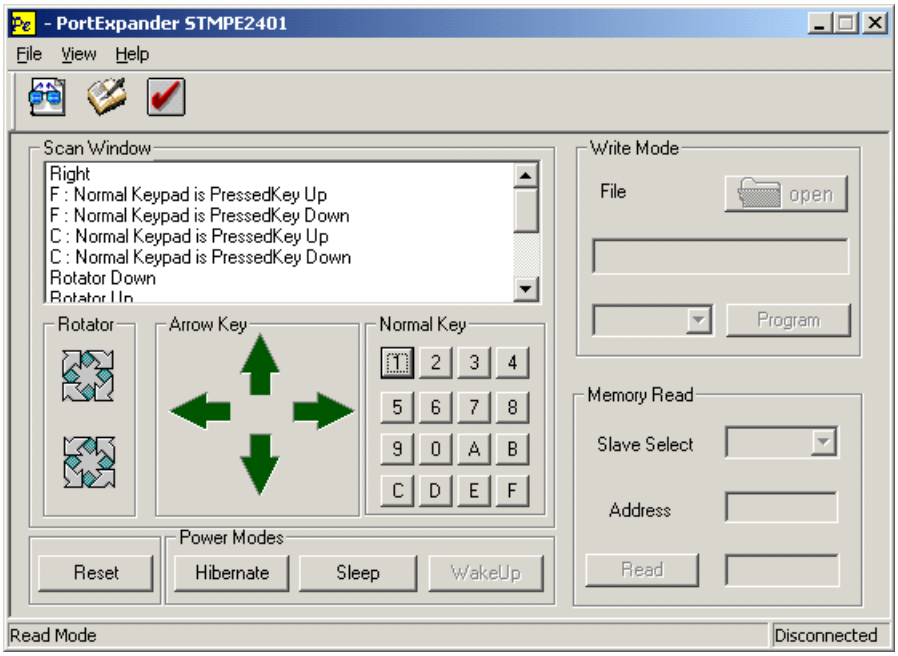
You can enter in to the Read/Scan mode by clicking the Read/Scan button as highlighted in the *Figure 17*.

Figure 17. Read/Scan mode



In Read/Scan mode, the key press, dedicated key press and rotator events are visible as blinking LEDs available on the GUI. These events are recorded in the scan window which allows observing past activity as shown in *Figure 18*.

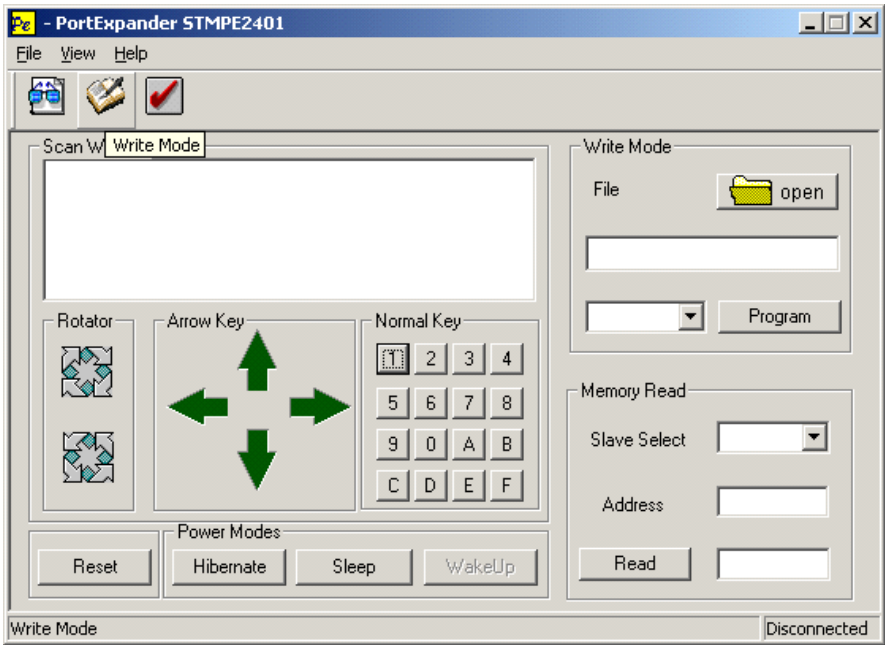
Figure 18. Events in scan window



2.2.2 Write/program mode

You can enter in to this mode by clicking Write/Program button as highlighted in *Figure 19*.

Figure 19. Write/program mode



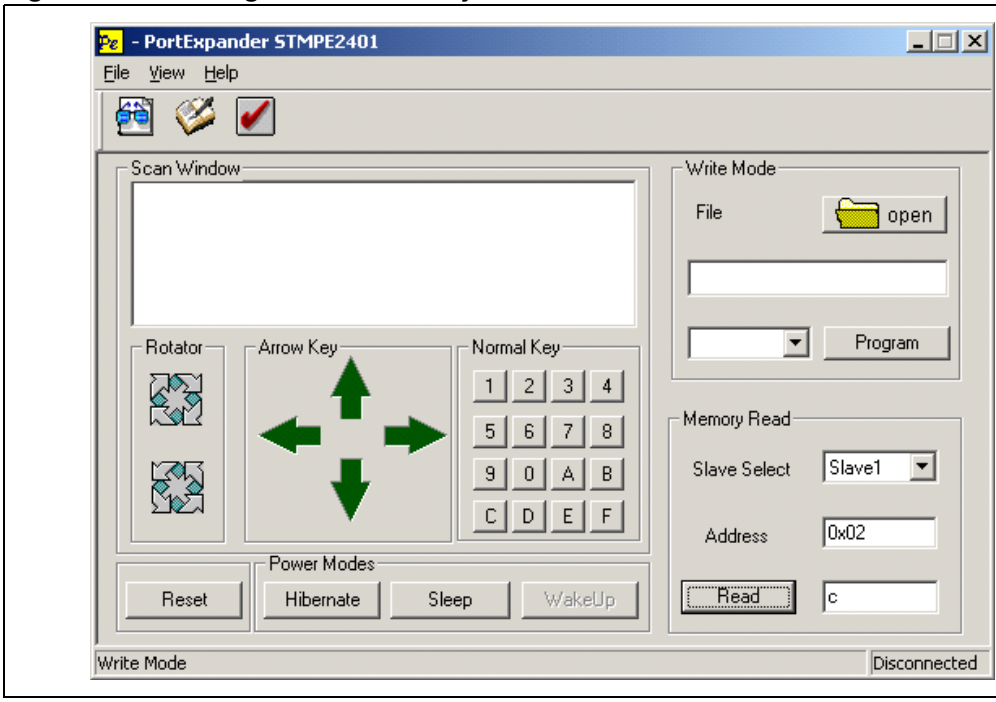
Once we click the Write/Program Button, The Write mode become active if previously scanning is being done that will be stopped.

The write mode provides the feature of the reading the internal memory of the either slaves or to program the any PWM output.

2.2.3 Reading internal memory of STMPE2401:

We can read the internal memory of particular STMPE2401 slave device by selecting that in "Memory Read" section from the pop menu as shown in the *Figure 20*. Then we can read the memory by writing the 8 bit address in the "Address" and then clicking "Read". The return data is in HEX format.

Figure 20. Reading internal memory of STMPE2401

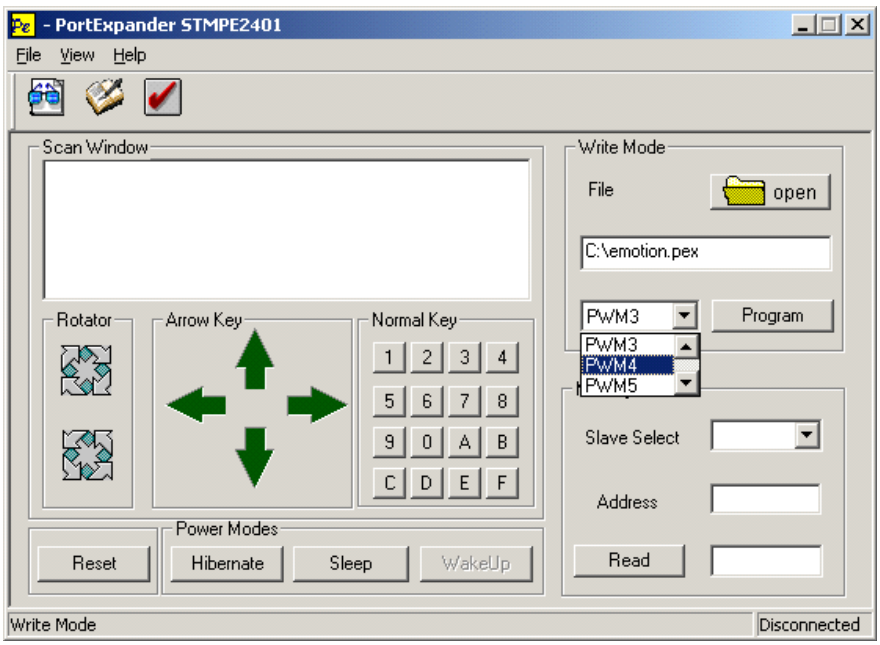


2.2.4 Programming PWM

Any of the 6 PWM outputs coming from 2 STMPE2401 slave devices can be programmed. In the "Write mode" section as shown in *Figure 21* select the PWM to be programmed from the pop up menu, and then load the correct PWM file (*.pex) by clicking the "Open" button.

Then click the "Program" button to program the particular PWM. If the PWM file is correctly programmed, the correct PWM signal can be observed on the CRO by connecting the CRO probe at the programmed LED output. Any error, (for example a PWM programmed with a faulty program) causes the particular PWM LED to stop blinking.

Figure 21. Programming STMPE2401 PWM



Again if you click the "RESET" button then demo will be put in the default settings and all the PWM will start running with the default program loaded in to their memory.

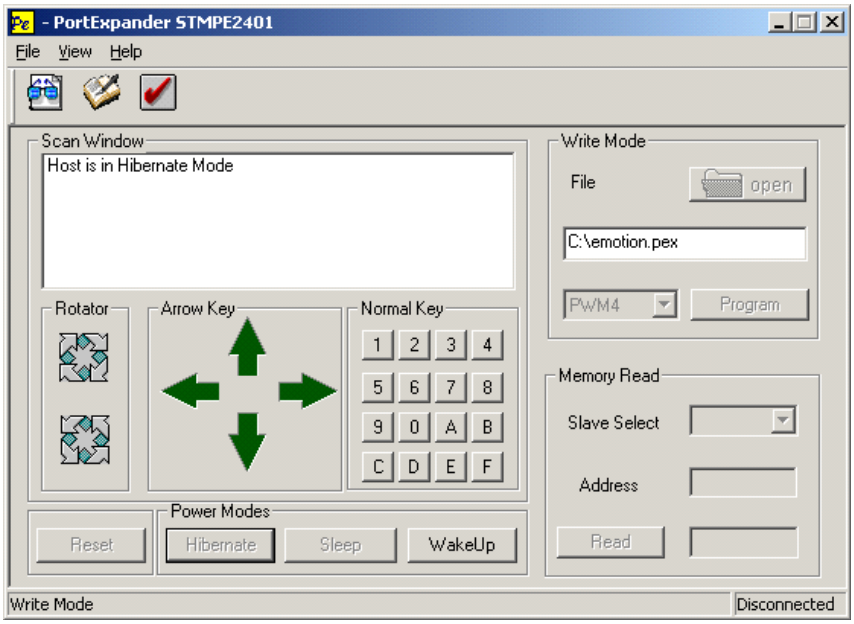
2.2.5 Power down mode

There are 2 power-down modes as mentioned below:

- Hibernate mode
- Sleep mode

The STMPE2401 slave devices can be put in to Hibernate mode or sleep mode by clicking corresponding button available on the GUI. For e.g. as shown in the *Figure 22*, if we click "Hibernate" button the device will be STMPE2401 device will be put in the hibernate mode.

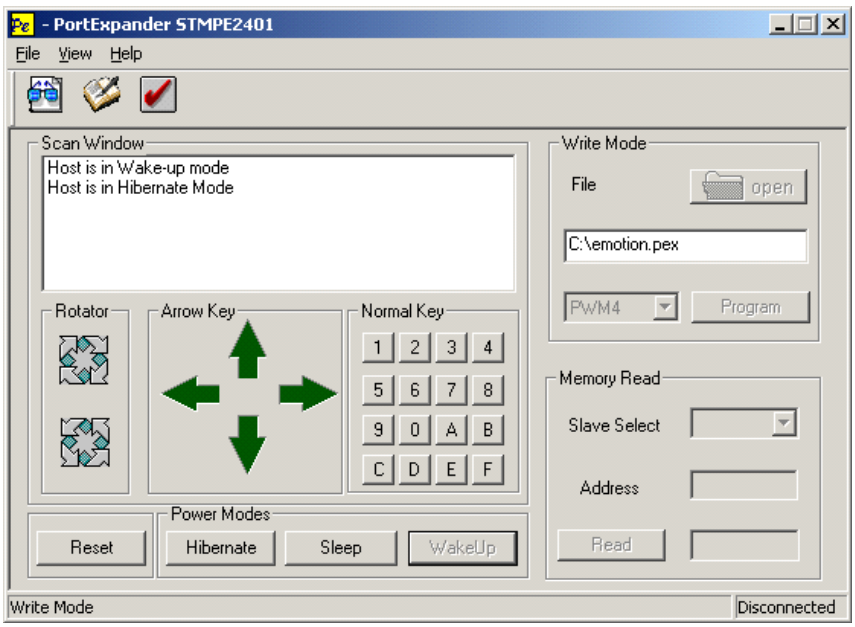
Figure 22. Entering in hibernate mode



A “sleep” mode is also available. A corresponding message appears on the LCD screen as well.

In Hibernate mode, as the clock to PWM is stopped, output LEDs stop blinking. While in sleep mode, PWM keeps running as these are controlled by the 32 KHz clock. In order to wake up the demo in low power mode, click the "Wake Up" button. A message in the Scan Window appears as soon as the demo comes out of the power down mode as shown in *Figure 23* .You can also wake up the demo from the sleep mode by clicking any normal key or dedicated key available on the demo board.

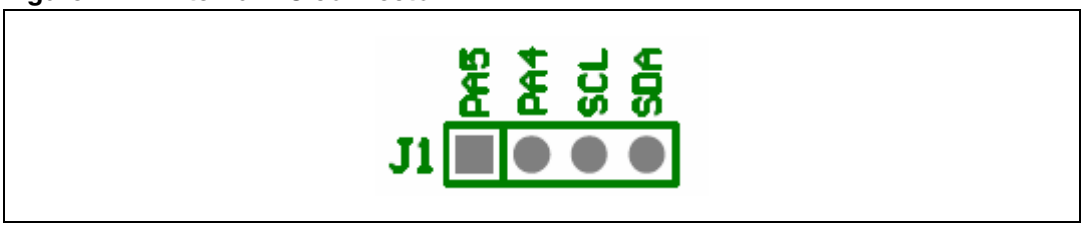
Figure 23. Wake-up from hibernate mode



3 Using the external I²C master:

We can also use an external I²C Master by using pins available on J1 connector as shown in the *Figure 24*, below:

Figure 24. External I²C connector



To control the STMPE2401 devices using the external masters, do the following steps:

1. Set the demo board to run mode as explained earlier.
2. Remove the I²C connections from jumper JP1 and JP2. This is required to avoid any conflict due to I²C operations done by the demo itself.
3. Connect the SCL and SDA lines available in jumper J1.
4. For controlling the Interrupt line, use PA4 for INT1 (Slave1 interrupt line) and use PA5 for INT2 (Slave 2 interrupt line),
5. After you have done the required operations, remove all the connections as mentioned in steps 2, 3 and 4. Now connect the make the I²C connections Jumper JP1 and JP2 again.
6. Reconnect the RESET button on the demo board to put demo back in action.

In this mode, PC GUI will not be available for the external user to use. Again you have to use the slave address as specified in the demo which is 0 x 84 for Slave1 and 0x86 for Slave2. Again this I²C lines are working at 5 V power supply so external I²C Master should use 5 V power supply.

Appendix A Application diagram

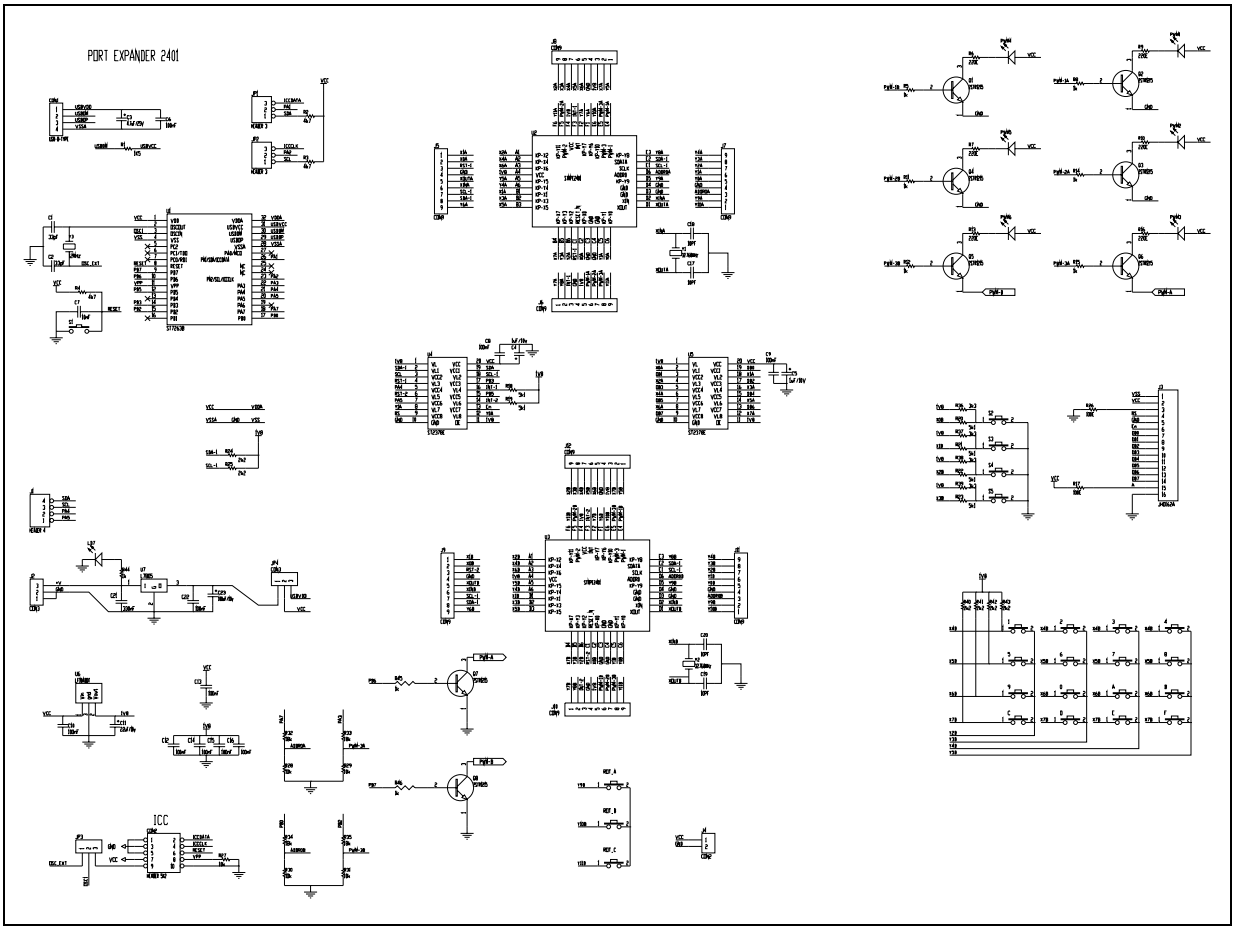


Table 1. Bill of materials

Index	Qty	Reference	Value / generic part number	Package	Manufacturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier's ordering code
1	2	C1, C2	33 pF	0805	Any			
2	13	C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C21, C22	100 nF	0805	Any			
3	4	C17, C18, C19, C20	10PF	0805	Any			
4	1	C23	100 µF/10	RB-5.5	Any			
5	1	C3	4.7 µF/25	RB-5.5	Any			
6	2	C4, C5	1µF/10	RB-5.5	Any			
7	1	CON1	USB-B-TYPE	USB-B	Any			
8	1	CON2	HEADER 5X2	IDC-10B	Any			
9	1	J1	HEADER 4	SIP4	Any			

Table 1. Bill of materials (continued)

Index	Qty	Reference	Value / generic part number	Package	Manufacturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier's ordering code
10	8	J5, J6, J7, J8, J9, J10, J11, J12	CON9	SIP9	Any			
11	1	J2	CON3	POWER	Any			
12	1	J3	JHD162A	LCD	Any			
13	1	J4	CON2	SIP2	Any			
14	4	JP1, JP2, JP3, JP4	CON3	SIP3	Any			
15	3	LD7, PWM1, PWM4	RED LED	LED-3 mm	Any			
16	2	PWM2, PWM5	GREEN LED	LED-3 mm	Any			
17	2	PWM3, PWM6	YELLOW LED	LED-3 mm	Any			
18	8	Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8	2STR1215	SOT-23	ST	2STR1215		
19	1	R1	1K5	0805	Any			
20	6	R6, R7, R9, R10, R13, R16	220E	0805	Any			
21	9	R5, R8, R11, R12, R14, R15, R44, R45, R46	1 k	0805	Any			
22		R17, R26	100E	0805	Any			
23	6	R18, R19, R20, R21, R22, R23	5k1	0805	Any			
24	6	R24, R25, R40, R41, R42, R43	2k2	0805	Any			
25	5	R27, R28, R29, R30, R31	10 k	0805	Any			
26	3	R2, R3, R4	4k7	0805	Any			
27	4	R32, R33, R34, R35	18 k	0805	Any			
28	4	R36, R37, R38, R39,	3k3	0805	Any			
29	1	U1	ST72F63BK4B1	SDIP-32	ST	ST72F63BK4B1		
30	2	U2, U3	STMPE2401	TFBGA36	ST	STMPE2401TBR		
31	2	U4, U5	ST2378ETTR	TSSOP20	ST	ST2378ETTR		
32	1	U6	LF18ABDT	DPAK	ST	LF18ABDT		
33	1	U7	L7805CV	TO-220	ST	L7805CV		
34	2	Y1, Y2	32.768 KHz	CRYS	Any			
35	1	Y3	12 MHz	XTAL-3	Any			
36	24	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F, ROT_A, ROT_B, ROT_C, S1, S2, S3, S4, S5	SWITCH	Push Button	Any			

4 Revision history

Table 2. Revision history

Date	Revision	Changes
19-Jan-2007	1	First issue
26-Mar-2007	2	*Table 1: Bill of materials* insertion