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## Keyboard Scanning with MAX II CPLDs

### Introduction

With high levels of flexibility, performance, and programmability, the MAX II family of instant-on, non-volatile CPLDs is useful in many applications such as the keyboard scanner, de-bounce circuit, ASCII decoder, and RS-232 transmitter. This technical brief illustrates how to use MAX II CPLDs in a keyboard scanner application that uses the Galaxy MAX II Starter Kit.

### Design Details for MAX II CPLDs

The keyboard scanning design uses the internal 8-Kbit user flash memory (UFM) of the MAX II CPLD to store the startup-screen message as well as the key matrix-to-ASCII lookup table (LUT). The main clock for the keyboard scanning function comes from the internal ~4-MHz oscillator in the MAX II CPLD, and an external 16-MHz oscillator produces the baud clock for the UART IP core.

The design uses a total of 27 I/Os in the MAX II CPLD. These I/Os are used for the active-low hardware reset signal, the 16-MHz external oscillator signal, three DIP switches for the UART baud rate selection, a UART transmit data line, 18 row and column lines to scan the keyboard, and three outputs to drive the SHIFT, ALT, and CTRL LEDs.



To download this design, refer to Altera's [keyboard scanner design for MAX II CPLDs](#).

### Implementing the Design

The following steps are required to set up the hardware interface for the Galaxy MAX II Starter Kit with the keyboard PCB.

1. Plug a 9-pin serial cable into the PC.
2. Connect the MAX II Starter Kit to the Keyboard PCB as described in "[Ribbon Cable Insertion](#)" on page 2.
3. Configure the DIP switch and jumper settings on the MAX II Starter Kit as described in "[DIP Switch and Jumper Settings](#)" on page 3.
4. Connect the 9-pin serial cable to the MAX II Starter Kit.
5. Connect the wall power supply to the MAX II Starter Kit and plug it in.
6. Launch the Hyper Terminal application in Windows by navigating to Start → All Programs → Accessories → Communications → Hyper Terminal.
7. When Hyper Terminal starts, enter a name for the new connection, such as "MAX II Starter Kit." Choose an icon and click OK.
8. On the next screen, in the "Connect using" menu, select the COM port corresponding to the 9-pin serial cable connected in Step 1. Click OK.
9. For the port settings, choose 38,400 bits per second, 8 data bits, no parity, 1 stop bit, and no flow control. Click OK.
10. Press the reset button on the MAX II Starter Kit. The following will appear on the terminal screen:

Keyboard Scanning Demo  
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11. At this point, any key pressed on the keyboard will be displayed in the Hyper Terminal window. Note the following:
  - Some keys on the keyboard do not produce a visible character, such as the ESC key and the END key.
  - For this demonstration, each key press produces only one ASCII character. The HOME key produces a carriage return and the ENTER key produces a line feed (the ENTER key on a conventional keyboard typically produces both characters at once).
  - Pressing any key longer than ½ second will result in that key being repeated.
  - The SHIFT key is operational and will modify all alpha keys on the keyboard.
  - The SHIFT, ALT, and CTL keys will illuminate the corresponding LED on the MAX II Starter Kit PCB.
12. Once the demonstration is complete, close the Hyper Terminal application. You can save the MAX II Starter Kit terminal session settings for later reference, if desired.

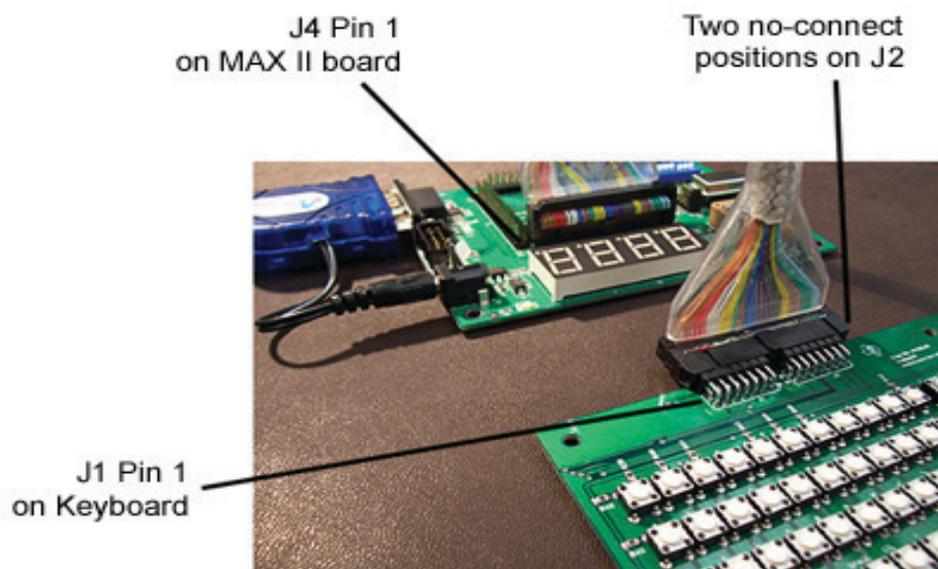
### Ribbon Cable Insertion

The keyboard reference design uses a 34-wire floppy disk ribbon cable, which allows the MAX II Starter Kit PCB to connect to the keyboard PCB as shown in [Figure 1](#).

1. Insert the ribbon cable to J4 on the MAX II Starter Kit PCB.
2. Connect the Pin 1 of the ribbon cable (marked by an arrow on the cable's connector, nearest to the brown-colored wires) to Pin 1 of J4 (the pin nearest the JTAG connector) on the MAX II Starter Kit PCB.
3. Similarly, at the opposite end of the cable, connect Pin 1 of the cable to J1 Pin 1 of the Keyboard PCB.

 Note that the last two positions of the cable's connector do not connect to the keyboard PCB (see [Figure 1](#)).

*Figure 1. Ribbon Cable Insertion for PCB-to-PCB Connectivity*

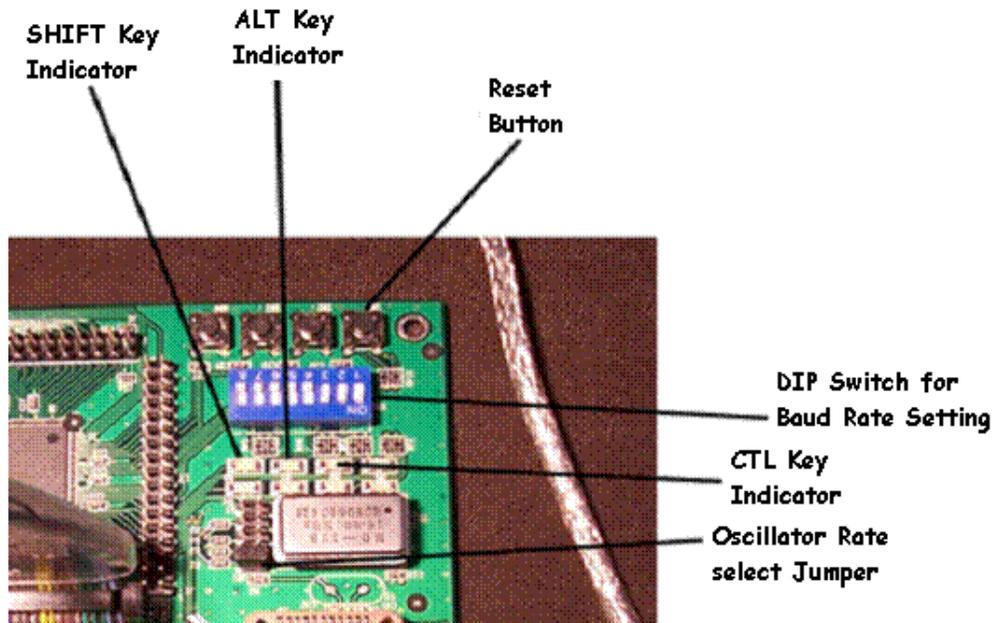


## DIP Switch and Jumper Settings

Figure 2 shows the various DIP switch and jumper settings:

- The 8-position DIP switch on the MAX II Starter Kit PCB sets the baud rate for the UART.
- Because the baud rate for this demo is 38,400 bps, SW1–3 are set to ON and SW4–8 are set to OFF.
- The shunt for the oscillator rate select jumper is placed in the position nearest to the empty PLCC socket.

Figure 2. DIP Switch, Oscillator Rate Select Jumper, and LED Indicators



## LED Operation

The three LEDs on the MAX II Starter Kit are operational for this demonstration. As shown in Figure 2, the first LED indicates when the SHIFT key is depressed, the second LED indicates when the ALT key is depressed, and the third LED indicates when the CTL key is depressed.

## Conclusion

This technical brief provides and illustrates the necessary steps to implement the keyboard scanner application with a MAX II CPLD. With their internal flash memory and oscillators, MAX II CPLDs are the ideal programmable logic devices to implement applications such as the keyboard scanner reference design.

## Further Information

- Keyboard scanner reference design for the MAX II CPLD:  
[www.altera.com/literature/tb/kbd\\_uart.qar](http://www.altera.com/literature/tb/kbd_uart.qar)
- MAX II Starter Kit:  
[www.altera.com/products/devices/cpld/max2/design/mx2-design.html#kit](http://www.altera.com/products/devices/cpld/max2/design/mx2-design.html#kit)  
or  
[www.gfec.com.tw/pro\\_flypage.php?language\\_page=english&class1\\_serial=1&class2\\_serial=&class3\\_serial=&p\\_serial=11](http://www.gfec.com.tw/pro_flypage.php?language_page=english&class1_serial=1&class2_serial=&class3_serial=&p_serial=11)
- Texas Instruments' keyboard PCB schematic:  
<http://focus.ti.com/lit/ml/sllr041/sllr041.pdf>
- Texas Instruments' TUSB2136-TPS2149 Product Development Kit:  
<http://focus.ti.com/docs/toolsw/folders/print/tusb2136tps2149pdk.html>
- Floppy drive ribbon cables are available as surplus or from Digi-Key:  
<http://search.digikey.com/scripts/DkSearch/dksus.dll?Detail&name=AK3620-.75-ND>



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[www.altera.com](http://www.altera.com)

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