

Chapter 1

DE2-70 Package

The DE2-70 package contains all components needed to use the DE2-70 board in conjunction with a computer that runs the Microsoft Windows software.

1.1 Package Contents

Figure 1.1 shows a photograph of the DE2-70 package.



Figure 1.1. The DE2-70 package contents.

The DE2-70 package includes:

- The DE2-70 board
- USB Cable for FPGA programming and control
- DE2-70 System CD containing the DE2-70 documentation and supporting materials, including the User Manual, the Control Panel utility, reference designs and demonstrations, device datasheets, tutorials, and a set of laboratory exercises
- CD-ROMs containing Altera's Quartus[®] II Web Edition and the Nios[®] II Embedded Design Suit Evaluation Edition software.
- Bag of six rubber (silicon) covers for the DE2-70 board stands. The bag also contains some extender pins, which can be used to facilitate easier probing with testing equipment of the board's I/O expansion headers
- Clear plastic cover for the board
- 12V DC wall-mount power supply

1.2 The DE2-70 Board Assembly

To assemble the included stands for the DE2-70 board:

- Assemble a rubber (silicon) cover, as shown in Figure 1.2, for each of the six copper stands on the DE2-70 board
- The clear plastic cover provides extra protection, and is mounted over the top of the board by using additional stands and screws

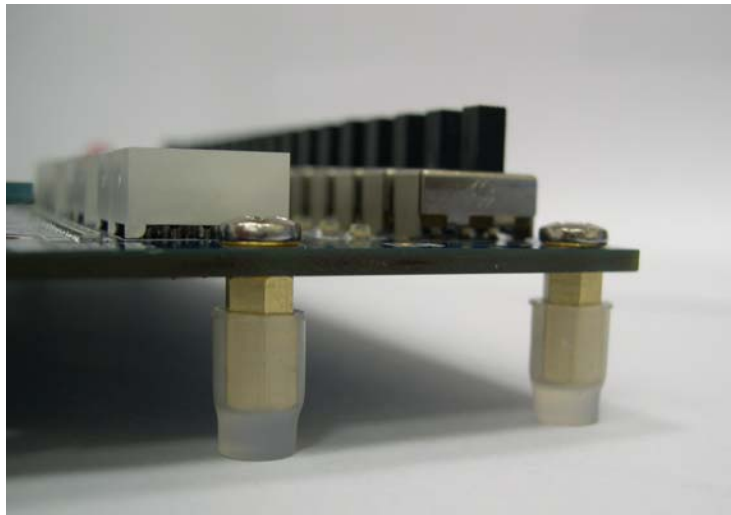


Figure 1.2. The feet for the DE2-70 board.

1.3 Getting Help

Here are the addresses where you can get help if you encounter problems:

- Altera Corporation
101 Innovation Drive
San Jose, California, 95134 USA
Email: university@altera.com
- Terasic Technologies
No. 356, Sec. 1, Fusing E. Rd.
Jhubei City, HsinChu County, Taiwan, 302
Email: support@terasic.com
Web: DE2-70.terasic.com

Chapter 2

Altera DE2-70 Board

This chapter presents the features and design characteristics of the DE2-70 board.

2.1 Layout and Components

A photograph of the DE2-70 board is shown in Figure 2.1. It depicts the layout of the board and indicates the location of the connectors and key components.

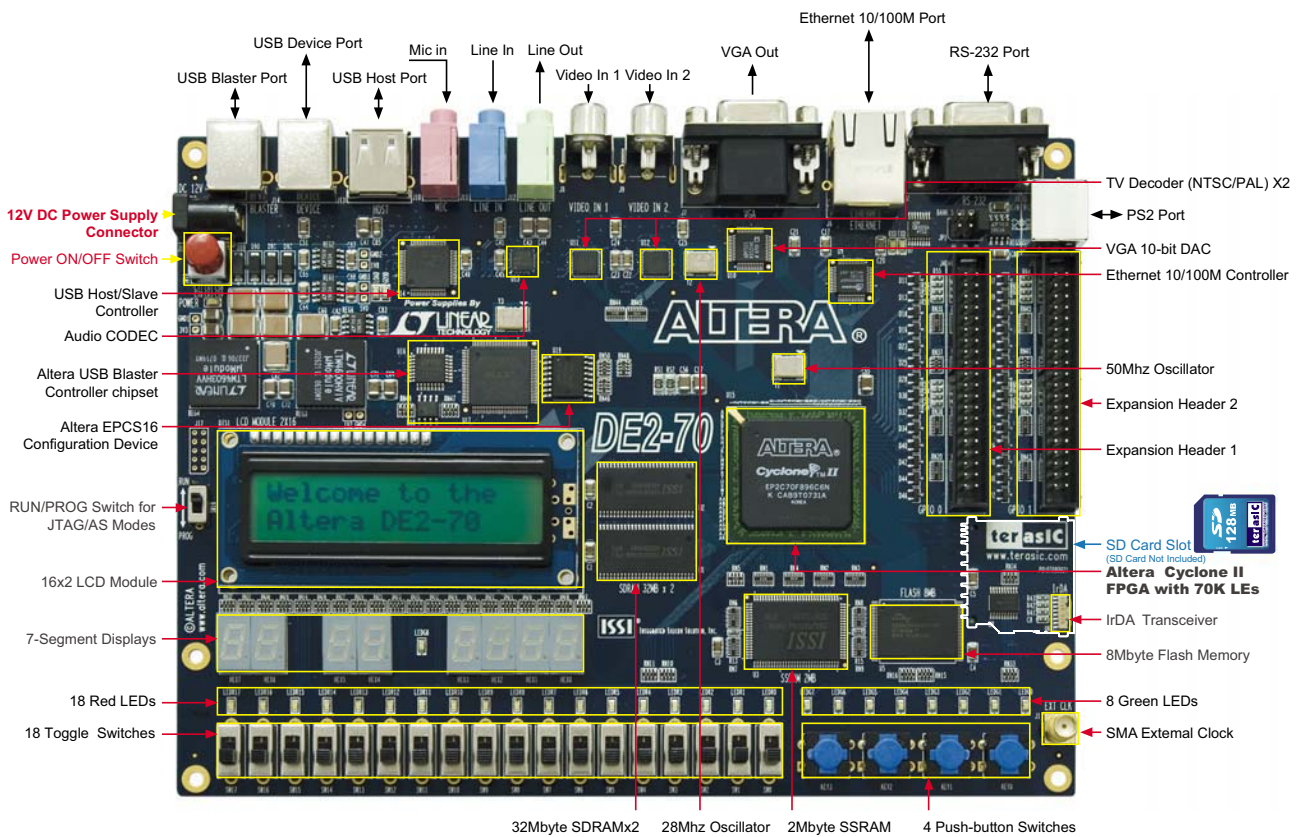


Figure 2.1. The DE2-70 board.

The DE2-70 board has many features that allow the user to implement a wide range of designed circuits, from simple circuits to various multimedia projects.

The following hardware is provided on the DE2-70 board:

- Altera Cyclone® II 2C70 FPGA device
- Altera Serial Configuration device - EPCS16
- USB Blaster (on board) for programming and user API control; both JTAG and Active Serial

(AS) programming modes are supported

- 2-Mbyte SSRAM
- Two 32-Mbyte SDRAM
- 8-Mbyte Flash memory
- SD Card socket
- 4 pushbutton switches
- 18 toggle switches
- 18 red user LEDs
- 9 green user LEDs
- 50-MHz oscillator and 28.63-MHz oscillator for clock sources
- 24-bit CD-quality audio CODEC with line-in, line-out, and microphone-in jacks
- VGA DAC (10-bit high-speed triple DACs) with VGA-out connector
- 2 TV Decoder (NTSC/PAL/SECAM) and TV-in connector
- 10/100 Ethernet Controller with a connector
- USB Host/Slave Controller with USB type A and type B connectors
- RS-232 transceiver and 9-pin connector
- PS/2 mouse/keyboard connector
- IrDA transceiver
- 1 SMA connector
- Two 40-pin Expansion Headers with diode protection

In addition to these hardware features, the DE2-70 board has software support for standard I/O interfaces and a control panel facility for accessing various components. Also, software is provided for a number of demonstrations that illustrate the advanced capabilities of the DE2-70 board.

In order to use the DE2-70 board, the user has to be familiar with the Quartus II software. The necessary knowledge can be acquired by reading the tutorials *Getting Started with Altera's DE2-70 Board* and *Quartus II Introduction* (which exists in three versions based on the design entry method used, namely Verilog, VHDL or schematic entry). These tutorials are provided in the directory *DE2_70_tutorials* on the **DE2-70 System CD-ROM** that accompanies the DE2-70 board and can also be found on Altera's DE2-70 web pages.

2.2 Block Diagram of the DE2-70 Board

Figure 2.2 gives the block diagram of the DE2-70 board. To provide maximum flexibility for the user, all connections are made through the Cyclone II FPGA device. Thus, the user can configure the FPGA to implement any system design.

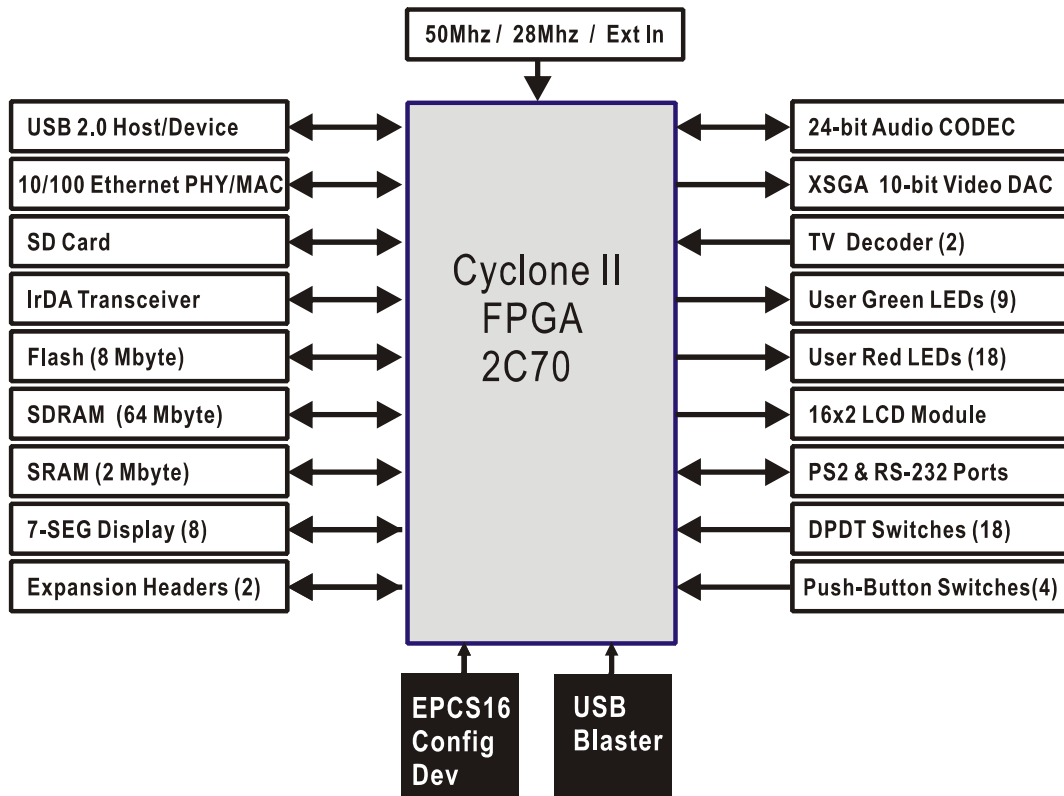


Figure 2.2. Block diagram of the DE2-70 board.

Following is more detailed information about the blocks in Figure 2.2:

Cyclone II 2C70 FPGA

- 68,416 LEs
- 250 M4K RAM blocks
- 1,152,000 total RAM bits
- 150 embedded multipliers
- 4 PLLs
- 622 user I/O pins
- FineLine BGA 896-pin package

Serial Configuration device and USB Blaster circuit

- Altera’s EPCS16 Serial Configuration device
- On-board USB Blaster for programming and user API control
- JTAG and AS programming modes are supported

SSRAM

- 2-Mbyte standard synchronous SRAM
- Organized as 512K x 36 bits
- Accessible as memory for the Nios II processor and by the DE2-70 Control Panel

SDRAM

- Two 32-Mbyte Single Data Rate Synchronous Dynamic RAM memory chips
- Organized as 4M x 16 bits x 4 banks
- Accessible as memory for the Nios II processor and by the DE2-70 Control Panel

Flash memory

- 8-Mbyte NOR Flash memory
- Support both byte and word mode access
- Accessible as memory for the Nios II processor and by the DE2-70 Control Panel

SD card socket

- Provides SPI and 1-bit SD mode for SD Card access
- Accessible as memory for the Nios II processor with the DE2-70 SD Card Driver

Pushbutton switches

- 4 pushbutton switches
- Debounced by a Schmitt trigger circuit
- Normally high; generates one active-low pulse when the switch is pressed

Toggle switches

- 18 toggle switches for user inputs
- A switch causes logic 0 when in the DOWN (closest to the edge of the DE2-70 board) position and logic 1 when in the UP position

Clock inputs

- 50-MHz oscillator
- 28.63-MHz oscillator
- SMA external clock input

Audio CODEC

- Wolfson WM8731 24-bit sigma-delta audio CODEC
- Line-level input, line-level output, and microphone input jacks
- Sampling frequency: 8 to 96 KHz
- Applications for MP3 players and recorders, PDAs, smart phones, voice recorders, etc.

VGA output

- Uses the ADV7123 240-MHz triple 10-bit high-speed video DAC
- With 15-pin high-density D-sub connector
- Supports up to 1600 x 1200 at 100-Hz refresh rate
- Can be used with the Cyclone II FPGA to implement a high-performance TV Encoder

NTSC/PAL/ SECAM TV decoder circuit

- Uses two ADV7180 Multi-format SDTV Video Decoders
- Supports worldwide NTSC/PAL/SECAM color demodulation
- One 10-bit ADC, 4X over-sampling for CVBS
- Supports Composite Video (CVBS) RCA jack input
- Supports digital output formats : 8-bit ITU-R BT.656 YCrCb 4:2:2 output + HS, VS, and FIELD
- Applications: DVD recorders, LCD TV, Set-top boxes, Digital TV, Portable video devices, and TV PIP (picture in picture) display.

10/100 Ethernet controller

- Integrated MAC and PHY with a general processor interface
- Supports 100Base-T and 10Base-T applications
- Supports full-duplex operation at 10 Mb/s and 100 Mb/s, with auto-MDIX
- Fully compliant with the IEEE 802.3u Specification
- Supports IP/TCP/UDP checksum generation and checking
- Supports back-pressure mode for half-duplex mode flow control

USB Host/Slave controller

- Complies fully with Universal Serial Bus Specification Rev. 2.0
- Supports data transfer at full-speed and low-speed
- Supports both USB host and device
- Two USB ports (one type A for a host and one type B for a device)
- Provides a high-speed parallel interface to most available processors; supports Nios II with a Terasic driver
- Supports Programmed I/O (PIO) and Direct Memory Access (DMA)

Serial ports

- One RS-232 port
- One PS/2 port
- DB-9 serial connector for the RS-232 port
- PS/2 connector for connecting a PS2 mouse or keyboard to the DE2-70 board

IrDA transceiver

- Contains a 115.2-kb/s infrared transceiver
- 32 mA LED drive current
- Integrated EMI shield
- IEC825-1 Class 1 eye safe
- Edge detection input

Two 40-pin expansion headers

- 72 Cyclone II I/O pins, as well as 8 power and ground lines, are brought out to two 40-pin expansion connectors
- 40-pin header is designed to accept a standard 40-pin ribbon cable used for IDE hard drives
- Diode and resistor protection is provided

2.3 Power-up the DE2-70 Board

The DE2-70 board comes with a preloaded configuration bit stream to demonstrate some features of the board. This bit stream also allows users to see quickly if the board is working properly. To power-up the board perform the following steps:

1. Connect the provided USB cable from the host computer to the USB Blaster connector on the DE2-70 board. For communication between the host and the DE2-70 board, it is necessary to install the Altera USB Blaster driver software. If this driver is not already installed on the host computer, it can be installed as explained in the tutorial *Getting Started with Altera's DE2-70 Board*. This tutorial is available in the directory *DE2_70_tutorials* on the **DE2-70 System CD-ROM**.
2. Connect the 12V adapter to the DE2-70 board
3. Connect a VGA monitor to the VGA port on the DE2-70 board
4. Connect your headset to the Line-out audio port on the DE2-70 board
5. Turn the RUN/PROG switch on the left edge of the DE2-70 board to RUN position; the PROG position is used only for the AS Mode programming
6. Turn the power on by pressing the ON/OFF switch on the DE2-70 board

At this point you should observe the following:

- All user LEDs are flashing
- All 7-segment displays are cycling through the numbers 0 to F
- The LCD display shows **Welcome to the Altera DE2-70**
- The VGA monitor displays the image shown in Figure 2.3.
- Set the toggle switch SW17 to the DOWN position; you should hear a 1-kHz sound
- Set the toggle switch SW17 to the UP position and connect the output of an audio player to the Line-in connector on the DE2-70 board; on your headset you should hear the music played from the audio player (MP3, PC, iPod, or the like)
- You can also connect a microphone to the Microphone-in connector on the DE2-70 board; your voice will be mixed with the music played from the audio player



Figure 2.3. The default VGA output pattern.