

Low-Cost Docking Stations for Mobile Devices

Low-Cost Docking Solution using the iCE40 Ultra-Low Density FPGA

Docking Stations

A docking station provides a simple way to “plug in” electronic devices such as laptops, media tablets, mobile internet devices and smartphones to common peripherals. Because a wide range of docking stations have different connectors, power signaling, and uses, docks are not standardized and therefore are often designed to work only with a specific device make and model.

A docking station can provide a desktop-like feel for mobile devices without sacrificing the mobile computing functionality of the device.

Types of Docking Stations

There are many different docking stations available in the market today. This document focuses on two types of docking stations used for mobile devices: media docking and keyboard docking.

Media docking is common due to the explosive growth of Apple products. Devices such as the iPad, iPhone and iPod have many versions of media docking stations. The primary purpose of a media docking station is to provide a better music and video experience along with ease of control. Docking stations also function as charging stations through a common interface port (see Figure 2).



Figure 1: Media docking station for smartphones.

The Need for Docking Stations

Though touch screens and motion detection sensors are popular, many applications still depend on basic interfaces such as keyboards and mice for optimal operation. A typical method of adding such peripherals to modern mobile devices is a dock (see Figure 2). One such interface is standard USB. It has the key advantage that a large library of device drivers is available, so a user’s application software needs only minimal modification to get these USB HID devices to function.



Figure 2: Smartphone and media tablet with keyboards.

The other type of docking is keyboard docking. Unlike laptop computers, tablets and smartphones aren’t usually equipped with the physical keyboard or mouse, and therefore need a docking station for keyboard expansion (see Figure 2). It usually connects through a USB port which is supported by most smartphone and tablet processors. Since it does not require high bandwidth, USB1.1 running at 12Mbps is sufficient to support this application.

USB Docking Solution

In general, the iCE40™ FPGA cannot support a USB interface directly because of electrical issues and the need to interface first to an USB PHY. However, the USB 1.1 physical interface can be emulated by using a pair of 3.3V, single-ended I/Os. In addition, USB 2.0 is required to be backward compatible with USB 1.1 devices. Thus, iCE40 FPGAs are able to emulate a USB 1.1 device and are compatible with a USB 2.0 host.

In addition to implementing required USB slave functions such as endpoints, the majority of the work for Lattice involves creating the proper HiD report, which is stored in the iCE40 device as ROM. The report structures tell the USB host software the capability of the USB devices and how to interface to them. Additionally, optional SHA-2 type challenge/response encryption can be implemented to authenticate genuine equipment.

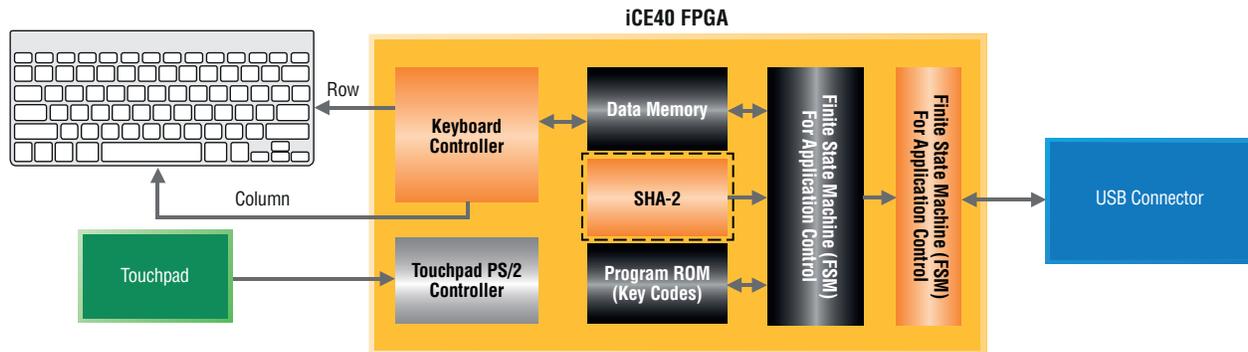


Figure 3: USB Docking Design using the iCE40 FPGA.

Media Docking Solution

A media docking station's purpose is to provide a station for better audio and video quality for the user. The Lattice media docking solution provides an easy way to connect all the audio and video sources from media devices (radio, smartphone, media tablet, etc.) to the external world. The video scaling portion of the design takes video input source from the media device and either downscales or upscales it and sends it to the external HDMI connector. Audio mixing takes in I²S audio source from the media and radio and plays one of them based on user input. Additionally, optional SHA-2 type challenge/response encryption can be implemented to authenticate genuine equipment.

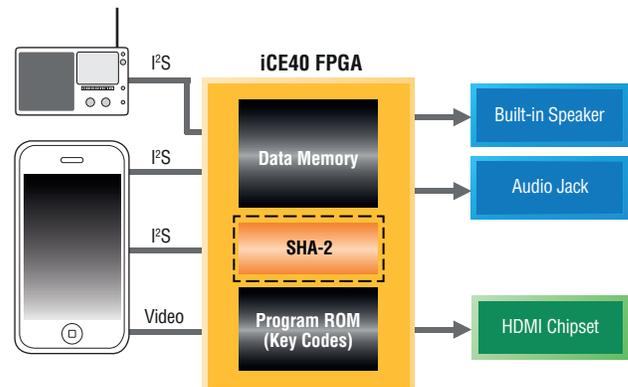


Figure 4: Media Docking Design using an iCE40 FPGA.

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