

Controlling a Compact Flash +™ Slot

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Introduction

The CompactFlash Specification was written to support very small, removable mass storage devices. The CompactFlash+ Specification added functionality to



support a wide variety of applications including Ethernet, fax-modem, USB, Bluetooth, 802.11b wireless LAN, digital phone cards and other digitally based systems. When designing an interface to support a Compact Flash+ (CF) socket, there are two primary areas

of concern. These are Power Control and Hot Plugging. The specifics of Power Control and Hot Plugging, the design concerns they entail, and viable handling options are discussed in this White Paper.

Power control

To assure compliance to Compact Flash or CompactFlash+ Specifications, a maximum current of 100mA must be available during both the Power On Reset (POR) and Identify Drive request sequences. This permits the host to execute specific commands to verify that power is sufficient to support the target device. The power verification information can be obtained by issuing a Card Information Structure (CIS) Read or an Identify Device command. The host then determines whether it can indeed run the device. If so, the maximum current a CF + device can draw is 500mA, or Power Level 1. Many CF devices, such as flash memory, are able to function using the 100mA supply. New CF+ host designs should include support for 500mA of current. Methods to optimize power utilization for the extension of battery life in portable devices are discussed below and in other documents.

To fully control a CF+ device, the host should manage the power supply to the socket. In cases where the CF+ device is neither expected to be removed nor battery powered, such as embedded storage on a processor board, this variable control feature is not necessary. Control of the power to the CF + slot can be as simple as adding a FET switch in series with a supply feed such as the MICREL MIC2026, or a controller chip such as the MAXim 1601 or 4370.

As a function of controlling the power to CF + devices, the host must verify that the device is ready to be powered down. Some devices, such as the Hitachi Microdrive®,

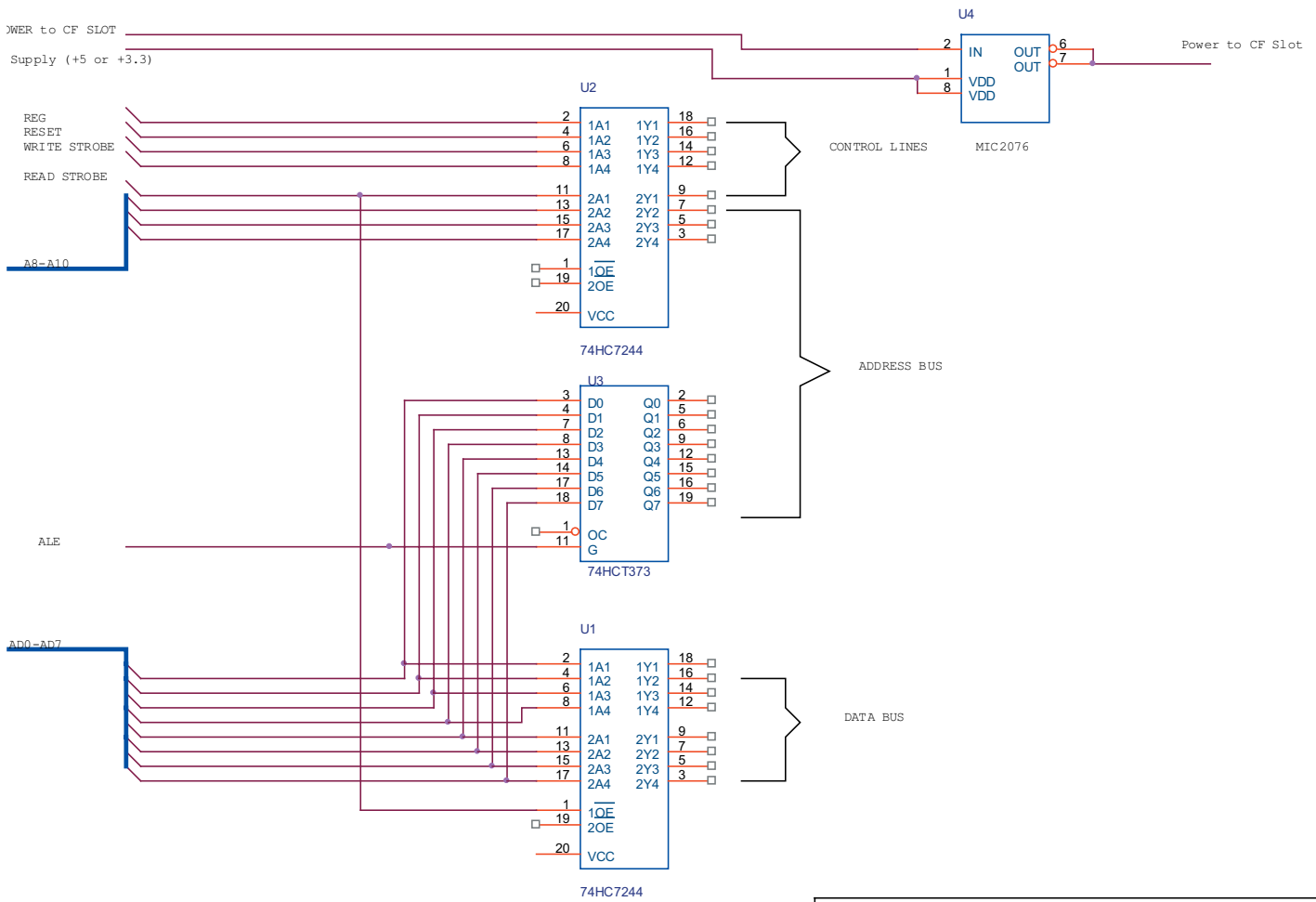
support Write Cache. When Write Cache is enabled and the heads are positioned over the media, the Microdrive will respond READY to a Write command. This may be interpreted by the host as a command complete, even if the Write data still resides in the drive cache and has not been written to the drive media. In this case, removing power from the device will result in data loss. It is therefore recommended that the host issue a STANDBY IMMEDIATE command and wait for the READY status to be returned from the device. The Microdrive will hold READY status until the cache is completely empty and the heads are securely parked off the disks. Once in this state, it is safe for the host to proceed in removing power from the drive.

Safe-guarding against Hot Plugging

The plugging of any CF + device into hot sockets should be avoided whenever possible. Even if the socket is designed to connect the power leads before signal, hot plugging should be discouraged. (The CD pins on the connector have been placed on opposite ends for this reason.) However, should the device be unintentionally exposed to a hot plug situation, the following precautionary measures should be supported.

The design concern with hot plugging stems from the need to isolate the address and data busses from transients caused by the CF + device. Isolation of the signal lines is especially critical during a Power On Reset (POR) operation, or when the pin capacitors are being charged. Drivers and receivers offer the best way to isolate these busses; (see Figure 1).

The address busses operate in one direction only. As a result, drivers are sufficient for their protection. However, data lines as well as some of the control lines need to be isolated from the host. Receivers work well for this purpose and should be preset in OUTPUT (or toward the CF device) before applying power to the socket. This will insure that the CF + device is fully isolated from the host processor and can only be connected to the data bus during the "read strobe." Many host busses have a time multiplexed bus design, and the address bus is usually isolated with a simple driver such as a 74244. On the other hand, the data bus lines are bi-directional as well as time multiplexed with the low order address bus. A 74373 or similar device can provide appropriate isolation.



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Figure 1: Hot Plug Tolerant CF Interface Schematic

When hot is really not

While the CF + socket is empty, the host will either periodically poll the CD lines, or its circuitry will detect the presence of a CF card. In either case, the host processor will receive an interrupt which will trigger the CF Enabling Process. This process begins by applying power through the control circuitry explained above.

The CF Enabling Process must wait a minimum of 300ms for the device to become ready to accept commands. This wait state usually consists of two phases. The first phase, from 0-100ms, is simply a wait state. During the second phase, from 100-300ms, Ready status should be checked; if not posted, the host should continue its wait. When the target device posts Ready, the host is free to proceed. However, if the target device does not post Ready within 300ms, the host should post a CF card error. If the drive becomes ready during the second phase, or between the 100 to 300ms time span, the host must read the status byte from the CF device.

Although much of this is handled by the driver software, the process is outlined here for embedded designs which may not be supported by a commercial operating system. In this example, the card has not really been hot plugged, although it appears so to the user.

The CF slot unplugged

The CD signal disappears upon removal of a CF card. When the host detects this condition, the host can remove power from the device and begin polling the CD signal for any change in its activity status.

Conclusion

CF technology offers small and lightweight digital applications new and expanded I/O functionality combined with data storage access solutions. The CompactFlash Association is an independent, non-profit organization and provides the CompactFlash and CF+ Specification at no charge through their web site. Now comprised of over 100 member companies, the Association was established in 1995. Hitachi participated from its founding, and is the only hard disk storage company on the CFA Board.

Additional suggested reading:

- 1) Hitachi Hard Drive Power Modes and Maximizing Battery Life, a White Paper by Dr. William Heybruck, available through www.hitachigst.com.
- 2) CF+ and CompactFlash Specification Revision 2.1, available through www.compactflash.org.

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