C64D PRELIMINARY PRODUCT DEFINITION November, 1987 Fred Bowen

Summary of Meeting conducted November 9, 1987 attended by:

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I. System Overview

This document contains preliminary specifications for the Commodore C64D personal computer. System requirements will be discussed in some detail, including hardware, software, and IC considerations.

The C64D is intended to be a member of the C64 personal computer family and by design will be 100% compatible with C64 software and peripherals.

The C64D shall feature a built-in 3.5" micro-floppy disk drive compatible with the Commodore 1581 fast serial disk drive, including fast and burst protocols, device number switches, and double sided, 800K-byte MFM formatted data capacity.

All features of the C64 shall be incorporated into the C64D, including the 6502-based 8-bit microprocessor, 64K byte RAM, standard 66 key keyboard, VIC-II video controller IC, SID audio controller IC, 44-pin expansion port, 24-pin user parallel port, standard cassette, CBM serial, audio/video, and dual control ports, and built-in BASIC 2.2 ROM operating system.

Software compatibility and extensibility shall be achieved utilizing a user and/or application software selectable mode switch. The functional differences between the C64 and C64D modes shall be limited to the Kernel ROM for the sole purpose of providing the fast/burst serial bus protocol.

The addition of new features or capabilities shall be minimized to achieve stringent cost, time, and manpower goals.

II. System Specifications

A. C64D board (C64C variant)

1. Processor. 8500 (6510 variant) 8-bit, 1.02MHz.

   Investigate bonding options to bring out P6 and P7, to be used for C64/C64D mode switch and FSDIR fast serial signal. Alternatively, investigate using 8502 processor currently used in C128/C128D computer systems which has P6 already available (would require changing to 48-pin package most likely. Perhaps other signals such as SYNC could be brought out if available). Cannot consider 65CF02 processor for many reasons, among them are compatibility (cycle times, opcodes), availability (does not exist yet), and non-existent support (analyzers, assembers, documentation, programmers & support personnel). Add reset button, as implemented on C128/C128D computer. Investigate problems with C64C product relating to expansion port dot clock signal and expansion RAM module.

2. Display. 8562/8565 VIC-II (NTSC/PAL) display controller.

   Investigate problems with current C64C product relating to poor luminance levels, and correct them.

3. Audio. 8580 SID sound controller. 9V required.

Investigate use of 6581, which requires 12V as does the FDD.

4. I/O. 6526 CIA. 1 MHz. Two required, implemented as in C64 with the exception of the SRQ line from CIA#1 required for fast serial interface. SRQ must be implemented as on C128/C128D systems such that it is directed to the user (parallel) port in C64 mode and to the fast serial interface in C64D mode. This is necessary for compatibility reasons and to prevent interference between the fast and slow serial bus drivers.

5. Memory. 64K byte DRAM, at least 32K byte ROM. 2114 (200ns) static RAM (color nibble memory).

Investigate combining C64 BASIC & Kernel (16K), C64D Kernel (8K), and character ROM (4K) into one ROM. Investigate combining static RAM with custom gate array (doubtful given time constraints, but otherwise possible).

6. Glue/PLA. Same as C64C, unless investigations indicate changes, such as adding static RAM or I/O ports.

B. FDD board (1581 variant)

1. Processor. 6502A 2MHz.

Requires separate reset button for FDD circuit, as implemented in C128D.

2. Controller. WD1772-00 as used in 1581. Must limit step rate to 6ms if Mitsumi "cheap" FFD used (otherwise 3ms is possible).

Investigate feasibility of combining controller with associated TTL, etc. in one 40-pin package. Gerard will negotiate this option as well as cost issues with Western Digital.

3. Memory. 8K bytes SRAM (4364 8Kx8). 32K bytes ROM. Can use existing 1581 ROM (or take this opportunity to correct minor bugs).

4. I/O. 8520A CIA 2MHz.

C. Mechanical.

1. Case. Integral unit, small foot print, not too deep (front to back). 3.5" Floppy drive on right side, requiring relocation of two control ports, power port, and power switch. Must add two reset buttons as implemented on C128D computer system.

Herb Mosteller and Y. Itoh (CJL) must prepare mock-ups urgently. Fred Bowen needs to review port locations, board size & configuration, etc. T.Tokuda is concerned about heat dissipation. Need design approval.

2. Keyboard. 66-key keyboard, standard C64 layout (with possible exception of function key group).

Investigate $5.00US membrane keyboard, Need sample from CJL. Need new switch for C64/C64D mode select, either a single pole or locking key switch (preferable) required.

3. Disk drive. 3.5" floppy, MFM, double-sided 800K formatted capacity.

Interface shall be analogous to fast serial implementation as used on C128D computer system. Requires modified SQR circuitry and a port 1 bit wide for FSDIR signal (discussed later under design considerations). Must include device number switches accessible to user, similar to those used on 1571/1581/1541-II disk systems. Requires 12V.

Investigate use of Mitsumi belt-driven FDD ($30US, available March '88). MTBF 5000 hours @ 20% duty. 6ms T/T step rate. Prototype samples available early December '87. QA must perform environmental testing. Need vendor FDD specification.

4. Power. Brick. Require A/C on PCB for 9VAC @ User port (adds approx. $2 cost to PCB and $2 cost to power supply). Power supply must be adequate for C64D and standard peripherals such as modem, mouse, and RAM expander.

III. Design Considerations.

The major implementation details are few in number. The greatest problem is where to find 2 programmable, bi-directional, 1-bit wide I/O ports:

One port is required for C64/C64D mode selection. This port must be able to be driven by software if the mode selection switch is in the "off" or "C64" position, allowing applications to select the appropriate mode.

The other port is required for the fast serial FSDIR signal, which is used to control the data direction of the fast serial interface and to isolate the fast serial drivers from the slow serial bus.

These lines should drive one TTL load on output, and have passive depletion mode pullup on input. External hardware may pull these lines down, but not up. Best option is to bond out processor P6 & P7 lines.

A decision must be made regarding the new features to be incorporated into the new C64D mode. At present only fast serial bus drivers are being considered, which may necessitate the removal of the cassette drivers from the C64D mode to make room (please note cassette data may still be loaded in C64 mode). No changes are planned for BASIC 2.2, since there is little room in the memory map (ROM and RAM). Enlarging the ROM to add, for example, BASIC 7.0 commands from the C128 without adding additional memory, an MMU, and a modified PLA (gate array) is virtually impossible. A investigation into available ROM memory is necessary.

The primary directive is compatibility with C64 software and peripherals, the integration of a fast serial, 3.5" floppy disk drive, and a preproduction release in March 1988. A functional prototype of the C64D computer system shall be presented by late December, 1987.

Fred Bowen