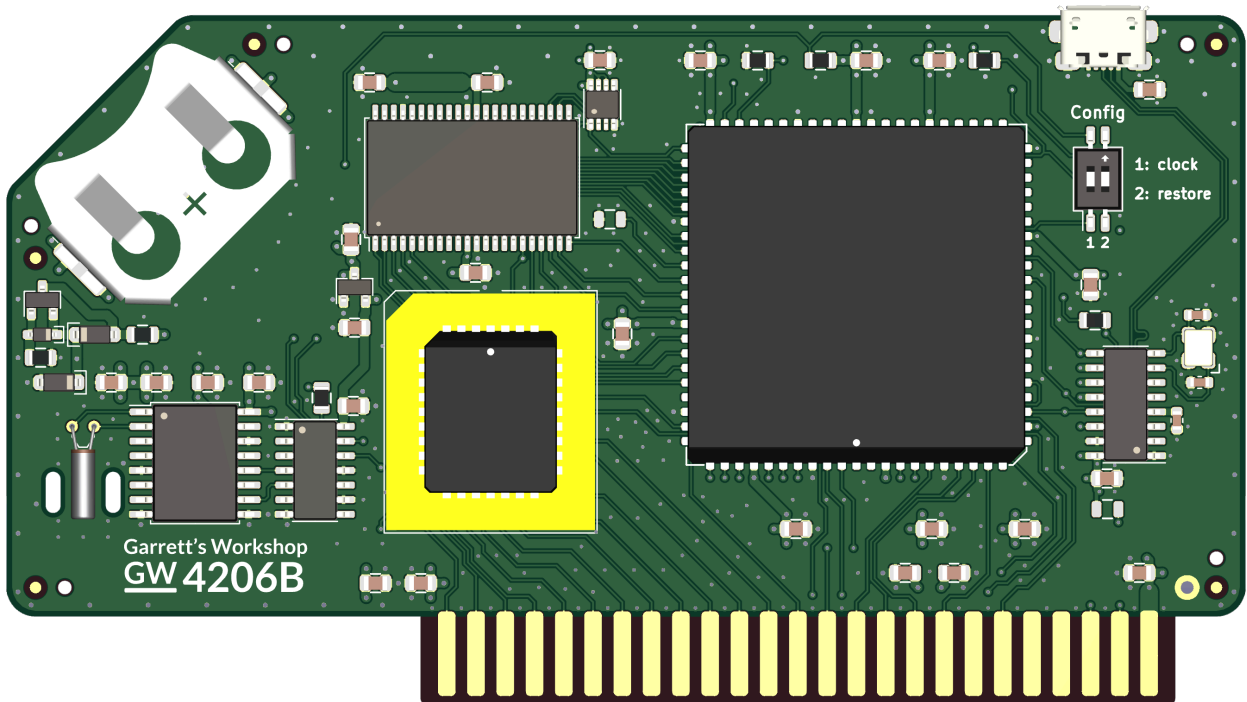


Garrett's Workshop

GW4206B "TimeDisk"

RAMFactor-compatible RAM Expansion and
NoSlotClock-compatible Clock for Apple II-series

User's Guide



Overview

TimeDisk (GW4206B) provides an Apple II-series machine with 1 MB of RAMFactor-type memory usable as a fast RAM disk or as RAM by supported applications. TimeDisk also provides a NoSlotClock-compatible real-time clock. A CR2032 coin cell battery is used power to the real-time clock and to retain the RAM contents during power-off.

Low-Power, SRAM-Based Design

Thanks to the use of low-power SRAM, TimeDisk uses a maximum of 0.4W at idle (80 mA @ 5V) and 0.6 watts in active use (120 mA @ 5V). To retain the RAM disk and clock, TimeDisk accepts a single CR2032 battery. Typical battery life for RAM disk and clock retention exceeds four years.

ProDOS Restore Partition

TimeDisk has a built-in restore function which can install a basic ProDOS system and NoSlotClock drivers from ROM into the onboard RAM disk. Using the real-time clock requires the CR2032 battery to be installed.

NoSlotClock-compatible Real-Time Clock

In addition to its RAM and disk features, TimeDisk has also includes a NoSlotClock-compatible real-time clock for ProDOS timekeeping. The ProDOS image contained in the restore partition contains the driver and utilities for the clock. Using the real-time clock requires the CR2032 battery to be installed.

USB Firmware Update Capability

TimeDisk includes USB firmware update capability. The firmware update utility requires a 64-bit Intel or ARM PC running Windows 10 or later. Supported systems also include Windows 10 or later running under Apple Boot Camp or Parallels Desktop on both Intel and ARM Macs.

Open-Source Design

TimeDisk's design is fully open-source. The schematics, board layouts, CPLD firmware, and utility software are all freely available for commercial and noncommercial use. To download the design files, visit the Garrett's Workshop GitHub page: <https://github.com/garrettsworkshop>

Installation

Hardware

Before installing TimeDisk, the configuration switch settings should be set (see the “Configuration Switch Settings” section in the manual) and, if desired, a CR2032 coin cell battery should be installed. TimeDisk must be installed into one of the Apple II’s peripheral card slots numbered 1 through 7. On machines with eight slots such as the Apple II and II+, using TimeDisk in slot 0 is not supported. Also ensure that TimeDisk is inserted in the correct orientation. Markings on the card indicate the side which is to face towards the rear of the Apple II. If you have another NoSlotClock peripheral installed in your Apple II, you must either set the TimeDisk’s switch labeled “1” to the DOWN position or disable/remove the other NoSlotClock device.

Software

The RAMFactor-type RAM provided by TimeDisk is automatically recognized by ProDOS as a RAM disk device. If a bootable copy of ProDOS is copied to the RAM disk (using the restore partition or otherwise), the card is bootable using a PR#n command. Select application such as AppleWorks can use RAMFactor RAM directly; refer to these programs’ documentation to determine compatibility.

The onboard NoSlotClock requires a driver for the clock to be recognized by ProDOS. The driver is included in the restore partition image.

RAM/Hardware Test

TimeDisk’s hardware can be tested by the host Apple II system. Executing the hardware test will erase the contents of your TimeDisk’s RAM. To test a TimeDisk card, enter the machine language monitor from BASIC using the “CALL -151” command. Depending on the slot into which your TimeDisk is installed, a different command must be entered in the monitor to begin the test. In the monitor, type “C”, followed by the slot number into which the TimeDisk is installed, followed by “AG”, then press the enter key. For example, if your TimeDisk card is installed in slot 7, type “C7OAG” and then press the enter key to begin the test. The RAM test will run indefinitely until it the computer is restarted or an error is detected.

Firmware Update

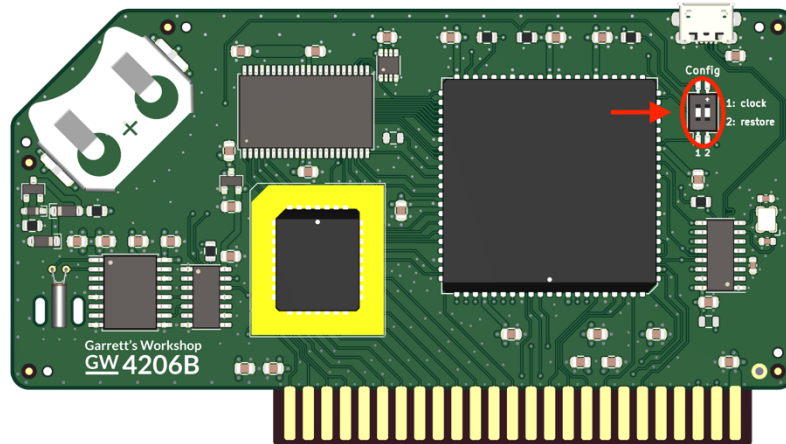
TimeDisk’s firmware should only be updated as necessary to fix bugs or resolve compatibility issues. The latest firmware is available from our website, <http://garrettsworkshop.com>.

To install the firmware update, make sure your Apple II is off and your Windows PC is on. Connect the TimeDisk card to your PC using a microUSB cable. Avoid using USB hubs or extenders and use only passive USB-C-to-A adapters. Install the TimeDisk card into your Apple II, then launch the update program and follow the instructions. If your PC does not have the correct drivers for the update adapter, the update program may request administrator permission to install them.

After a firmware update is applied, you must power-cycle your Apple II before using your TimeDisk card.

Configuration Switch Settings

TimeDisk has two configuration switches that can be used to independently enable or disable the NoSlotClock-compatible real-time clock and the ProDOS restore partition. These configuration switches are located near the top right of the TimeDisk board:



Enabling and disabling NoSlotClock

Using the NoSlotClock-compatible real-time clock requires a CR2032 battery to be installed. The onboard NoSlotClock can be enabled or disabled by configuration switch. To enable the NoSlotClock, set the switch labeled “1” to the UP position. If your Apple II system has more than one NoSlotClock peripheral installed, the TimeDisk’s clock must be disabled by setting the “1” switch to the DOWN position.

Using the ProDOS Restore Partition

Using the ProDOS restore partition requires a CR2032 battery to be installed. To boot from the ProDOS restore partition, turn off your Apple and set the switch labeled “2” to the UP position. After restarting your Apple, execute a PR#n command and follow the instructions to install the ProDOS disk image onto your TimeDisk. After installation, turn off your machine and set the “2” switch back to the DOWN position to disable the restore partition. With the restore partition disabled, the TimeDisk card’s RAM with the newly-restored ProDOS disk image will be visible as a ProDOS and SmartPort disk device and can be booted using a PR#n command.

Technical Specifications

Physical Dimensions

Parameter	Value
Height	59.817 mm \pm 0.2 mm
Width	107.569 mm \pm 0.2 mm
Thickness	< 12.7 mm
Weight	< 28 g

Electrical Specifications

Specifications are valid over temperature range of 0 °C – 85 °C and $V_{CC} = 4.5\text{ V} - 5.5\text{ V}$.

Parameter	Value	Conditions
V_{IHmin}	2.0 V	
V_{ILmax}	0.8 V	
V_{OHmin}	2.4 V	$I_{OH} = -4\text{ mA}$
V_{OLmax}	0.5 V	$I_{OL} = 4\text{ mA}$
Output Slew Rate	< 1.5 V/ns	
I_{Imax}	$\pm 20\ \mu\text{A}$	$V_{in} = 0\text{ V} - 5.5\text{ V}$
C_{IOmax}	50 pF	address bus A[15:0], R/W
	20 pF	all other Apple II bus signals
I_{CCmax}	120 mA	

Information for Developers: TimeDisk Signature

TimeDisk can be distinguished from other RamFactor-compatible RAM cards by the presence of the following signature bytes in the card's DEVSEL address space:

Location	Value
\$C0X4	\$47 (ASCII 'G', as in GW)
\$C0X5	\$06 (as in GW42 <u>06</u> B)
\$C0X6	\$42 (ASCII 'B', as in GW4206 <u>B</u>)

The firmware version is reported at address \$C0X7. \$10 corresponds to version 1.0. Subsequent versions will have higher numbers, e.g. \$11 for 1.1, \$1E for 1.14, \$5E for 5.14, etc.

To avoid activating softswitches present on non-RamFactor/Slinky cards, a potential TimeDisk card should be first identified as a RamFactor card by the presence of signature bytes in the IOSEL space before checking before checking \$C0X4-\$C0X6 in the DEVSEL space.