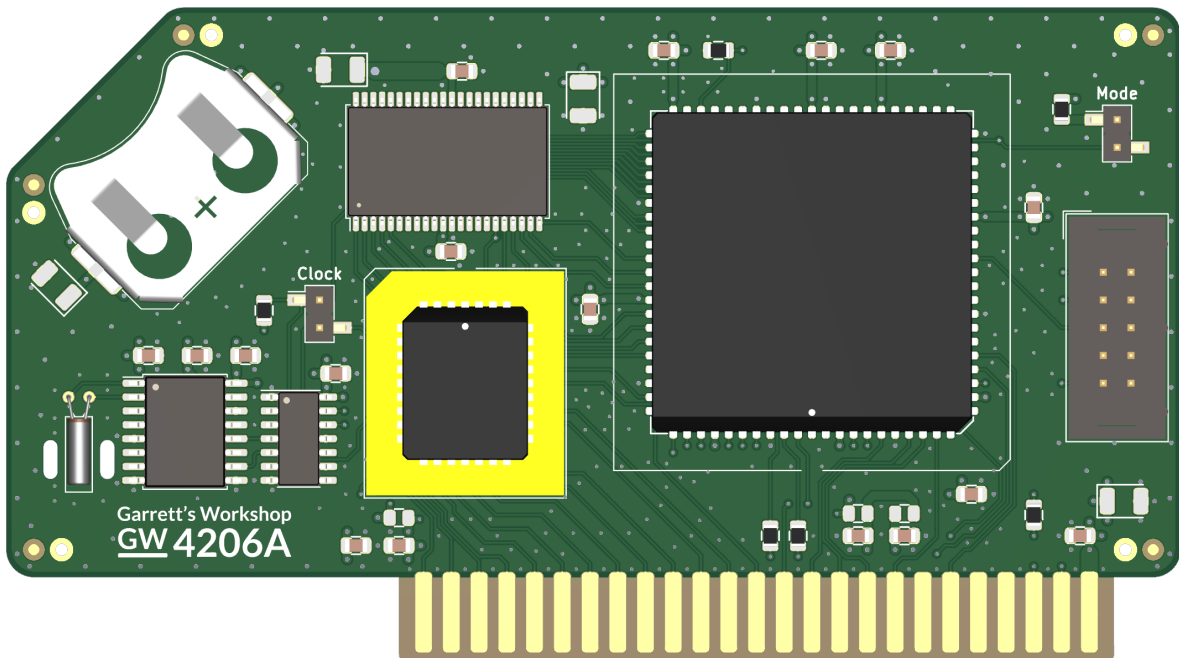


# Garrett's Workshop

## GW4206A "TimeDisk"

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

### User's Guide



## Overview

TimeDisk (GW4206A) 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 battery can be installed to 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.

### 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

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 installed in your Apple II, you must remove the TimeDisk's jumper labeled "Clock".

### Software

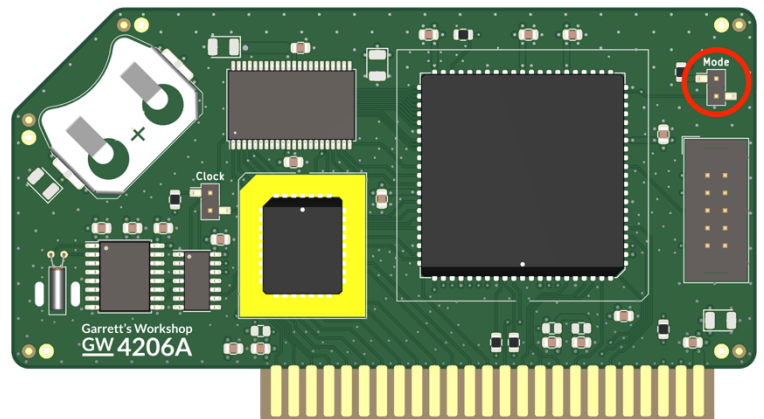
The RAMFactor-type RAM provided by TimeDisk is automatically recognized by ProDOS as a disk device. Select application such as AppleWorks can use RAMFactor RAM directly; refer to these programs' documentation to determine compatibility.

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

## Jumper Settings

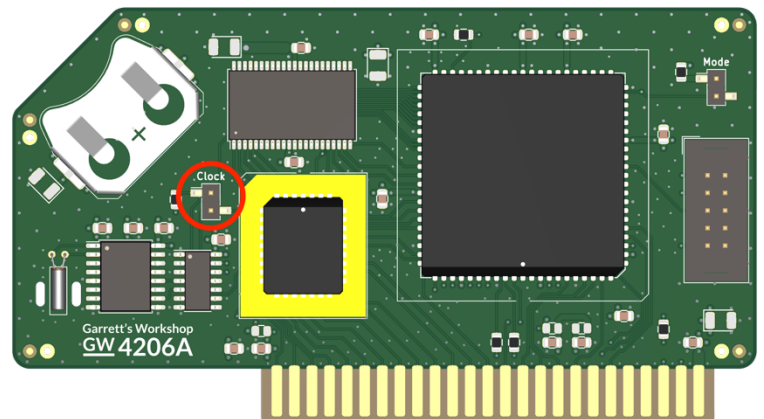
### ProDOS Restore Partition

To boot from the ProDOS restore partition, turn off your Apple and install the jumper labeled “Mode” in the top right corner of the TimeDisk board. After restarting your Apple, execute a PR#n command and follow the instructions to install the ProDOS restore image onto your TimeDisk. After installation, remove the “Mode” jumper and power cycle your machine to return TimeDisk to RAMFactor mode.



### Enabling and disabling NoSlotClock

The onboard NoSlotClock can be enabled or disabled by jumper. To enable the NoSlotClock, install the jumper labeled “Clock.” If your Apple II system has more than one NoSlotClock peripheral installed, the TimeDisk’s clock must be disabled and the jumper removed.



## 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 "C70AG" and then press the enter key to begin the test. The RAM test will run indefinitely until the computer is restarted or an error is detected.

## 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
$V_{IH_{min}}$	2.0 V	
$V_{IL_{max}}$	0.8 V	
$V_{OH_{min}}$	2.4 V	$I_{OH} = -4 \text{ mA}$
$V_{OL_{max}}$	0.5 V	$I_{OL} = 4 \text{ mA}$
Output Slew Rate	< 1.5 V/ns	
$I_{I_{max}}$	$\pm 20 \mu\text{A}$	$V_{in} = 0 \text{ V} - 5.5 \text{ V}$
$C_{IO_{max}}$	50 pF	address bus A[15:0], R/W
	20 pF	all other Apple II bus signals
$I_{CC_{max}}$	120 mA	