A Deep Dive into Apple Keychain Decryption

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When it comes to the forensic investigation of Apple devices, a Keychain analysis is of particular importance. Not only does Keychain contain passwords from websites and applications, but it can also provide computer forensics with access to the same user's other Apple devices. Let's take a closer look.

Types of Keychains

Keychain or Keychain Services is the password management system in macOS and iOS. It stores account names, passwords, private keys, certificates, sensitive application data, payment data, and secure notes. These records are dynamically linked to users' particular login passwords so that, when they log on to a Mac device, all of their various accounts and passwords are made available to the operating system and select applications.

The Keychain storage is located in:

- *~/Library/Keychains/* (and subfolders)
- */Library/Keychains/*
- */Network/Library/Keychains*.

There are three types of Mac Keychains: **Login Keychain**, **System Keychain**, and **Local Items (iCloud) Keychain**. They can be decrypted in Passware Kit within the **Password Managers | MacOS Keychain** section.

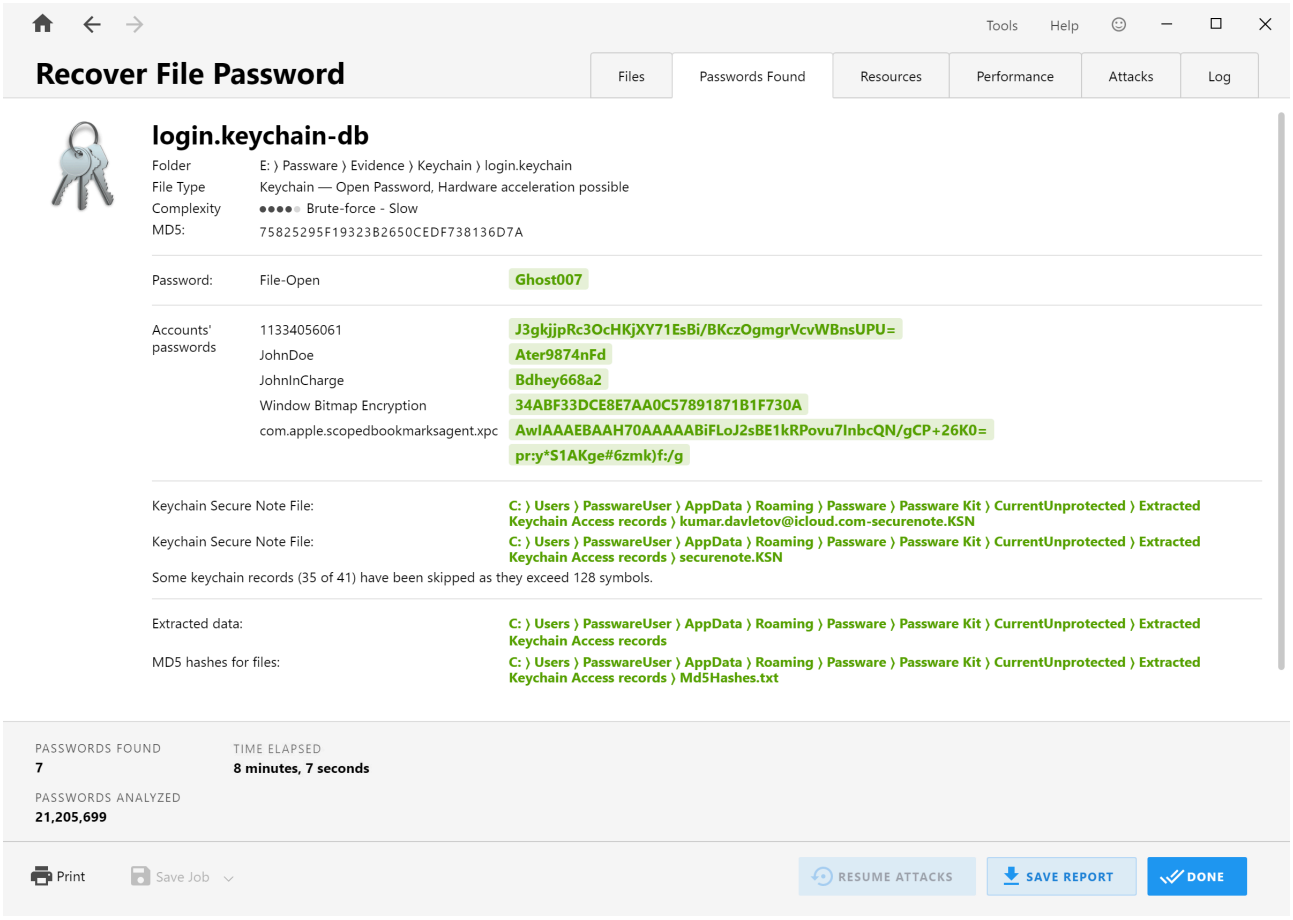
The Keychain files are viewed and edited through an application called Keychain Access. There is also a command-line equivalent to Keychain Access: */usr/bin/security*. While there is no Keychain Access utility for iOS, passwords are synchronized across all of the Apple devices tied to a given iCloud account provided that the user has enabled the iCloud Keychain option. When this option is enabled, synchronization of the data occurs partially, as some applications and services may set a special flag in a Keychain to prevent the transmission of the corresponding data to iCloud.

Login Keychain

The Login Keychain is the default Keychain file that stores most of the passwords, secure notes, and other data. The data is stored in a file named **login.keychain-db** (or **login.keychain** in macOS prior to 10.12 Sierra) located in */Users/<UserName>/Library/Keychains*.

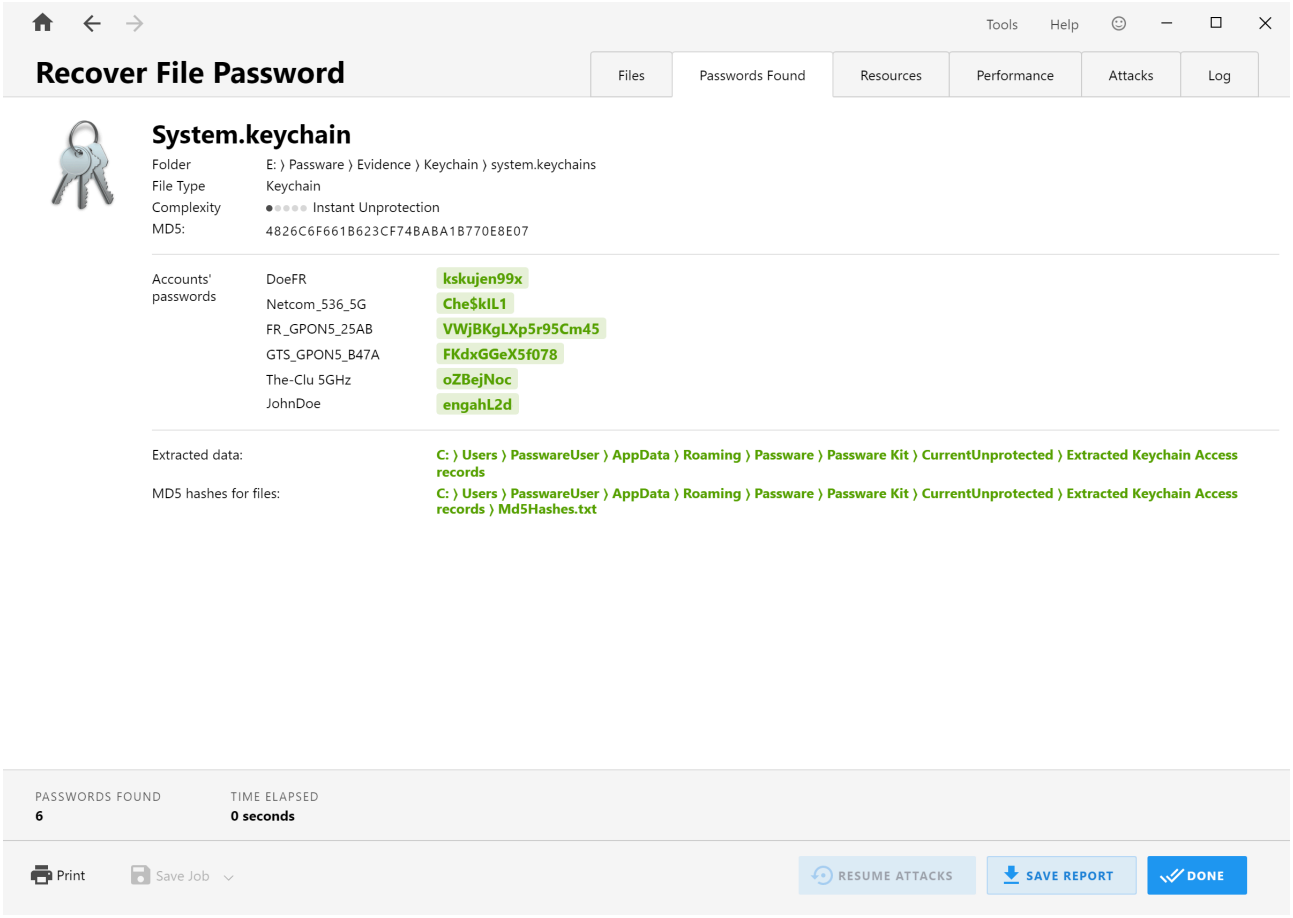
By default, the Login Keychain password is the same as the Mac user password.

The password recovery process for this Keychain is time-consuming, but it can be accelerated by using GPU, reaching speeds of up to 1,200,000 passwords per second on an AMD 6900 XT.



System Keychain

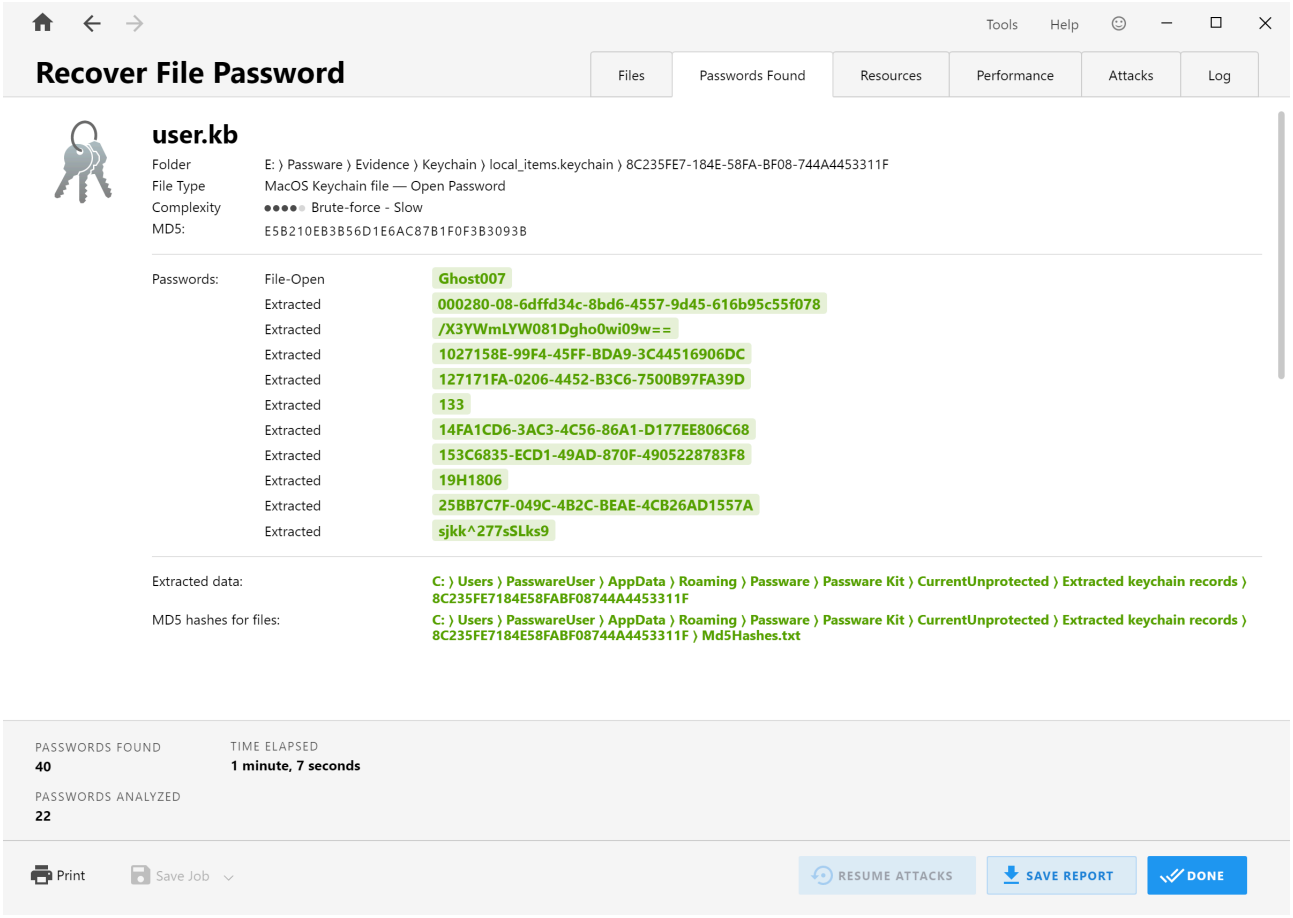
The System Keychain stores items that are accessed by the OS, such as Wi-Fi passwords, and shared among users. The file, which is usually located in */Library/Keychains/*, can be decrypted instantly if a “Master Key” file is available (usually located in */private/var/db/SystemKey*).



Local Items (iCloud) Keychain

The Local Items Keychain is used for keychain items that can be synced with iCloud Keychain. It contains encryption keys, applications data, webform entries, and some iOS data synced with iCloud. It presents two files: a keybag (**user.kb** file) and an SQLite database with encrypted records (**keychain-2.db**). If the iCloud synchronization is turned on, the **keychain-2.db** may contain passwords from other devices as well. Passware Kit recovers a password for the **user.kb** file and then decrypts the **keychain-2.db** database. By default, the user.kb password is the same as the macOS user password.

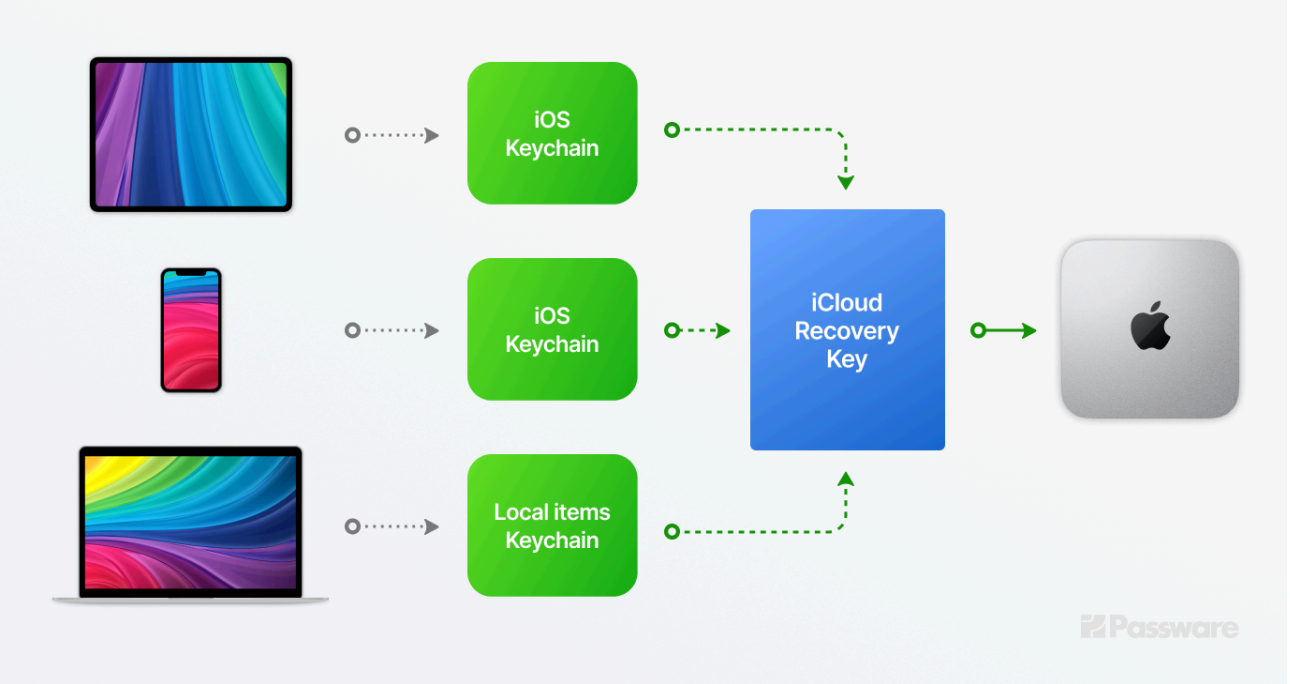
To recover the **user.kb** password on a Mac without a T2 chip, Passware Kit requires the 128-bit universally unique identifier number (UUID), which is the same as the name of the Keychain folder. Unfortunately, the password recovery for Local Items Keychain cannot be accelerated on GPU. After the successful recovery of a password, Passware Kit extracts all records that appear readable and saves the rest of the data in a file. Strings shorter than 128 symbols are considered passwords and saved to a **Passwords.txt** file, while ***json*** and ***bplist*** binary files are extracted as-is. Passware Kit also creates an **extracted-records.json** file with the complete extracted data.



Use Cases

It is extremely important to analyze as many Apple devices linked to the same iCloud account as possible. A decrypted Keychain from one device can gain entry into a device with stronger encryption, such as a Mac with a T2 chip. The following are some examples of cases in which Passware Kit facilitates the extraction of data from locked devices. Note that instant decryption is possible only if iCloud was selected as the backup option while the encryption was enabled.

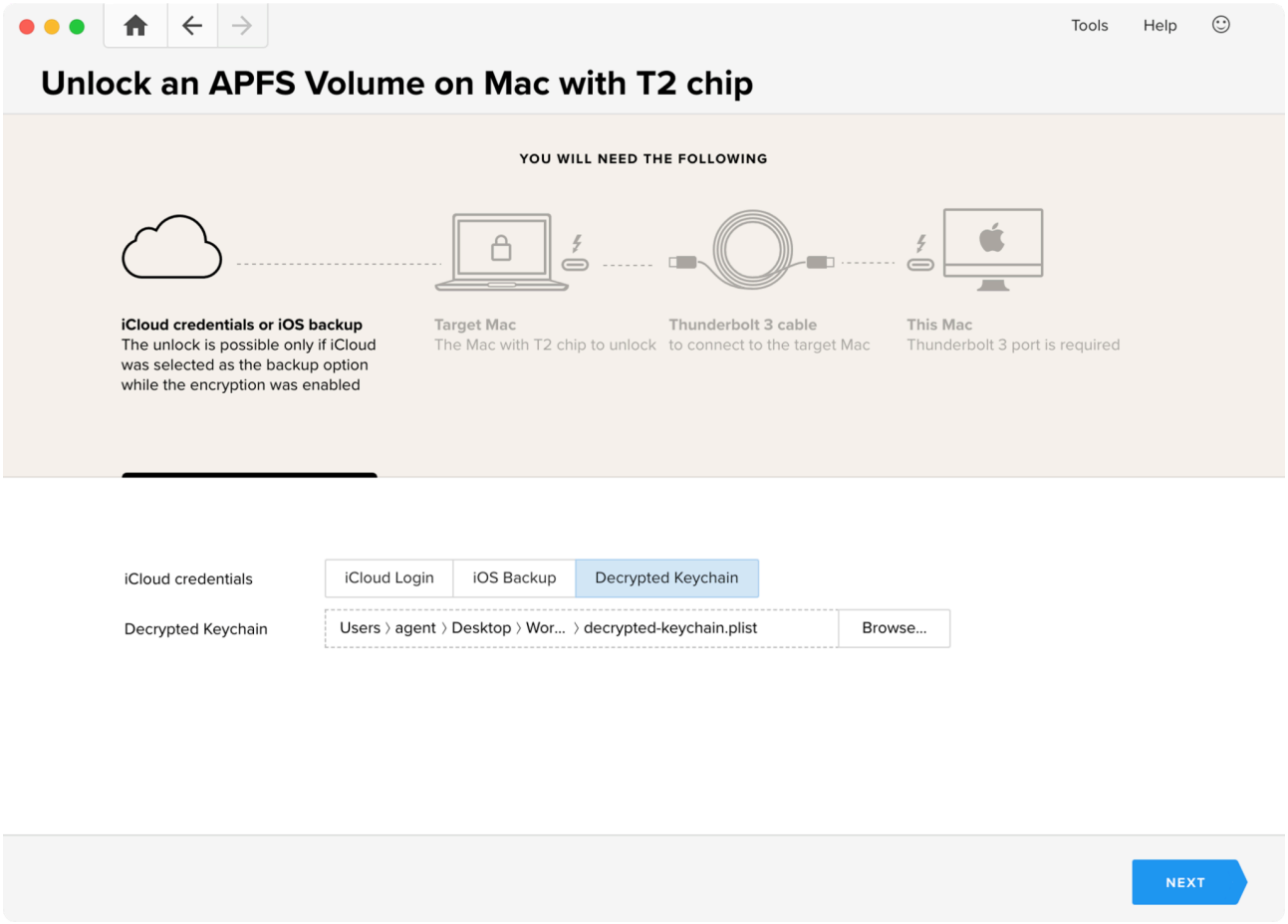
If there are no additional devices to extract the Keychain from, Passware offers a T2 Decryption Add-on to decrypt APFS disks from Mac computers protected with an Apple T2 security chip.

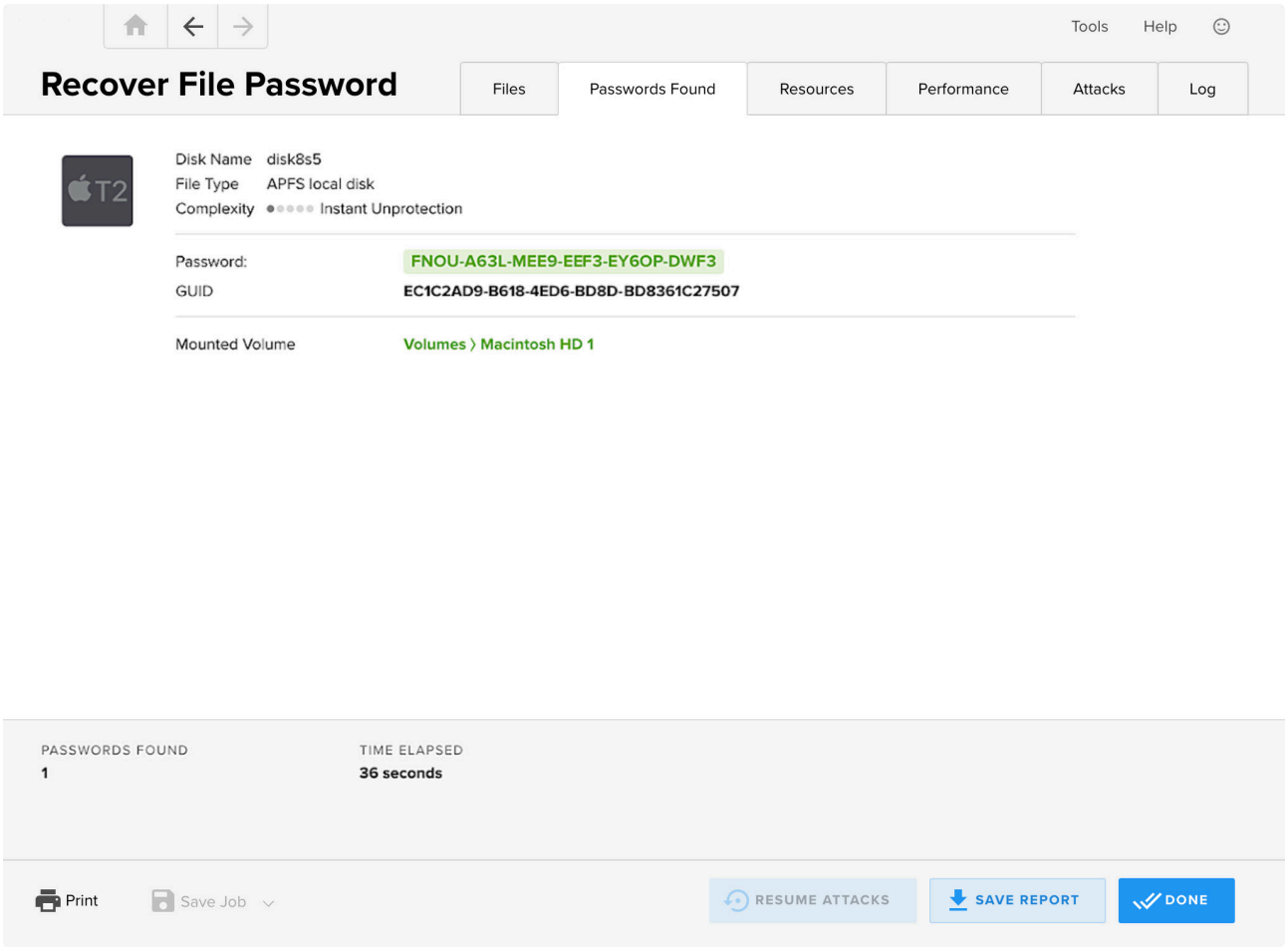


Case 1

A Macbook Air 2017 and a Mac Pro 2019 with a T2 chip of the same iCloud account

For the MacBook Air without a T2 chip, Passware Kit decrypts or recovers a password for an APFS disk using the **Full Disk Encryption | FileVault/APFS** option. Having gained access to the Keychain folder, Passware Kit recovers the Keychain password from a **user.kb** file by means of the **Password Managers | MacOS Keychain | Local Items Keychain** option and then extracts the data from the Local Items Keychain. The extracted data includes a **decrypted-keychain.plist** file that can serve to unlock an APFS disk on the Mac Pro with a T2 chip instantly with the **Full Disk Encryption | APFS/Mac T2** option.


Tools
Help
Unlock an APFS Volume on Mac with T2 chip
YOU WILL NEED THE FOLLOWING
iCloud credentials or iOS backup
The unlock is possible only if iCloud was selected as the backup option while the encryption was enabled
Target Mac
The Mac with T2 chip to unlock
Thunderbolt 3 cable
to connect to the target Mac
This Mac
Thunderbolt 3 port is required
iCloud credentials
iCloud Login
iOS Backup
Decrypted Keychain
Decrypted Keychain
Users 〉agent 〉Desktop 〉Wor... 〉decrypted-keychain.plist
Browse...
NEXT



Case 2

An iPhone 7 Plus disabled with time-lock and a Mac Mini 2018 with a T2 chip of the same iCloud account

Passware Kit Mobile recovers a passcode for the iPhone 7 and extracts the data from the device, including an iOS Keychain, saving a **decrypted-keychain.plist** file. With the **Full Disk Encryption | APFS/Mac T2** option, Passware Kit Forensic for Mac uses the decrypted keychain to unlock an APFS disk on the Mac Mini equipped with a T2 chip.

Case 3

An iPhone 13 and a decrypted APFS image of a Macbook Pro 2017 of the same iCloud account

Password recovery for a Login Keychain, unlike the recovery of a Local Items Keychain password, can be accelerated on GPU. Therefore, the first step is to recover a **login.keychain** file password from the APFS image using the **Password Managers | MacOS Keychain | Keychain** option. On an AMD 6900 XT, the speed is up to 1,200,000 passwords per second. By default, the password for the Login Keychain and Local Items Keychain is the same, so there is high chance that recovering the Login Keychain password also provides access to the Local Items (iCloud) Keychain database and, thus, to the records in the iPhone, such as mobile Safari passwords.

Case 4

An iPhone 6 and a Macbook Pro 2017 without a T2 chip of the same iCloud account

Passware Kit Mobile recovers the passcode for the iPhone 6 and extracts its data, including an iOS Keychain, saving a **decrypted-keychain.plist** file. Passware Kit Forensic uses the decrypted keychain to instantly decrypt the Macbook's APFS image with the **Full Disk Encryption | APFS / Mac T2** option. This approach avoids the need to perform a time-consuming brute-force password recovery process.

Summary

The table below summarizes the decryption and password recovery options for different types of Keychain.

Decryption and password recovery options

Type of Keychain	Location	Input files/folders	Decryption Recovery Options	GPU Acceleration
Login Keychain	/Users/<UserName>/ Library/Keychains	login.keychain	Brute-force - Slow	Yes
System Keychain	/Library/Keychains/ Master Key: /private/ var/db/SystemKey	System.keychain SystemKey	Instant Decryption	N/A
Local Items Keychain	~/Library/Keychains/ <UUID>	user.kb UUID	Brute-force - Slow	No

A comprehensive forensic investigation involves the analysis of multiple devices and artifacts. Starting from the least-secure devices (e.g., memory images, iTunes backups, and Macs without T2/M1 chip), Passware Kit extracts and decrypts a Keychain that can then be used to access data from other devices.

Learn more about Passware Kit Forensic capabilities and the best practices on the Passware Knowledge Base.
