

Disable temporal dithering on Apple Macs

Temporal dithering is a technique graphics cards use to generate intermediate colors, by rapidly alternating a pixel between two adjacent color values. The effect is not perceptible to the human eye. For any compression algorithm, such as that used by PCoIP, this results in a significant overhead when dealing with the increased pixel color activity.

Enabling temporal dithering on a machine using PCoIP can result in high bandwidth usage and poor performance, even when the display is seemingly static. To resolve this, you must disable temporal dithering on the computer where the PCoIP host card is used.

Temporal dithering is enabled by default on Apple Macs, with no user-visible option to disable it.

To disable temporal dithering, you must install an appropriate macOS Kernel Extension ('kext'). The kext disables temporal dithering on the local graphics card by changing internal driver settings.

Contents

macOS/OS X and GPU compatibility.....	2
Warranty	2
How to install the disk image	2
Install AHKinject_SCN371 when there is no previous installation	3
Install AHKinject_SCN371 over a previous installation	5
Install AHKinject_SCN078.....	6
Restart the Mac after the AHKinject_SCN078 installation.....	7
How to install AHKinject_ECN491	8
What to do if temporal dithering is still not disabled.....	10
How to re-enable temporal dithering	10
Further information.....	10
Disclaimer	11

macOS/OS X and GPU compatibility

Use the kext files in [Table 1](#) to disable temporal dithering on AMD or NVIDIA GPUs. The kext files are contained within disk image (.dmg) files. Select the appropriate disk image from [Table 1](#) depending on the macOS/OS X version:

Disk image	Disk image MD5 Hash	GPU	Signed?	For macOS /OS X
AHKinject_SCN371.dmg	07d42a02cda9ad544146bde9ec7d9d41	AMD (ATI)	Yes	10.12 - 10.15
AHKinject_SCN078.dmg	52fee517ffaa632edd4b55c254ce9b0e	AMD (ATI)	Yes	10.9 - 10.11
AHKinject_ECN491.dmg	8091178e67c01fee6d80326be8073d47	AMD (ATI)/ NVIDIA	No ¹	10.9 (Mavericks) or earlier

Table 1: Disk image files

Version compatibility is as follows:

- See [Table 1: Disk image files](#) for which file is compatible with which OS;
- **AHKinject_ECN491** will load but cause a non-fatal error on Macs running OS X 10.9. It will not load on Macs running OS X 10.10 (Yosemite) or later;
- Temporal dithering will not be disabled if an incorrect kext is installed. For example, this situation may arise after installing the kext if the graphics card is later swapped for a different model.

Warranty

Amulet Hotkey provides these kext files 'as is'. Limited testing has been successfully conducted. No adverse effects have been observed through use, non-use or incorrect use of these kext files, including the subsequent use of a local monitor instead of a remote PCoIP monitor. See the full [Disclaimer](#) on page 11.

How to install the disk image

- To install **AHKinject_SCN371**, see [Install AHKinject_SCN371 when there is no previous installation](#), or see [Install AHKinject_SCN371 over a previous installation](#)
- To install the **AHKinject_SCN078**, see the sections [How to install AHKinject_SCN078](#) and [Restart the Mac after the AHKinject_SCN078 installation](#).
- To install the **AHKinject_ECN491**, see the section [Install AHKinject_ECN491](#).

¹ OS X 10.9 introduced code signature verification but still allows unsigned kexts to load. From OS X 10.10 (Yosemite) onwards, as a security precaution, only kexts with verified code signatures are permitted.

Install AHKinject_SCN371 when there is no previous installation

Note: You may require an administration password when entering commands in the terminal window.

1. Mount the disk image.
2. Open a Terminal window.
3. To copy the kext file from the disk image to the location from which it will run, enter the following command exactly as shown here:

Note: Type (DO NOT copy/paste) the command exactly as shown, including 'sudo', to make sure you have root privilege. To prevent errors, avoid using Tab to autocomplete file paths and do not use Finder.

```
sudo cp -r /Volumes/AHKinject_SCN371/ahkinject.kext /Library/Extensions
```

Note: For macOS Catalina, enter the additional command:

```
sudo kextload /Library/Extensions/ahkinject.kext
```

The System Extension Blocked window appears. (This may take up to five minutes with macOS 10.13 to 10.15).

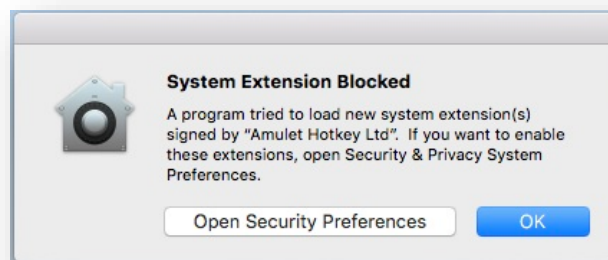


Figure 1: System Extension Blocked window

Note: If the System Extension Blocked window does not appear, type the following command:

```
sudo kextcache -u /
```

4. Click on the **Open Security Preferences** button.

The Security & Privacy window appears. At the bottom of the window, a message states that system software from Amulet Hotkey Ltd was blocked.

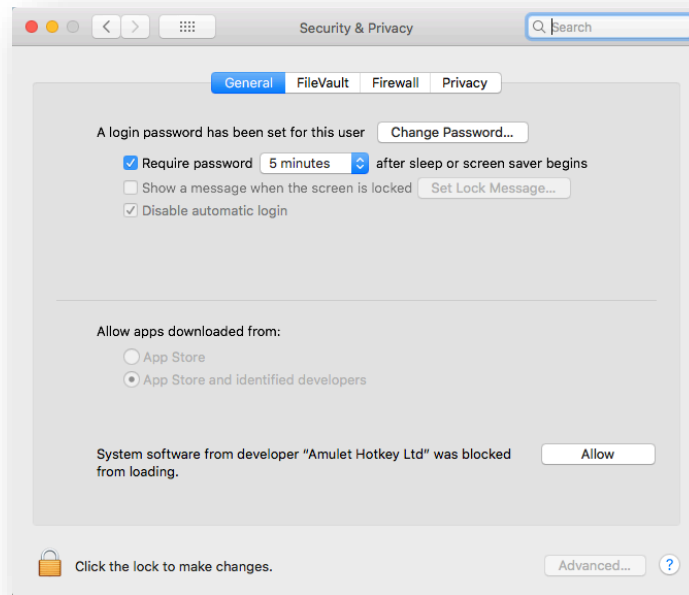


Figure 2: Security and Privacy window

5. Click on **Allow** and close the **Security and Privacy** dialog.

Temporal dithering is now disabled. There is no need to restart the system.

6. To confirm that the kext has loaded, type the following command and check that ahkinject is listed.

```
kextstat | grep -v apple
```

Note: If it is not listed, then see [What to do if temporal dithering is still not disabled.](#)

Install AHKinject_SCN371 over a previous installation

Note: You may require an administration password when entering commands in the terminal window.

1. Open a Terminal window and enter the following command:

```
sudo kextunload /Library/Extensions/ahkinject.kext
```

2. Enter the following command and check that ahkinject is no longer listed:

```
kextstat | grep -v apple
```

3. Remove the /Library/Extensions/ahkinject.kext folder and files.

*Note: You can use **Finder**, do it manually (you will need root permission), or use 'sudo'.*

4. Enter the following command:

```
sudo kextcache -u /
```

5. Restart the system and login.

6. Mount the kext's disk image.

7. Open a Terminal window and enter the following command:

Note: Type (DO NOT copy/paste) the command exactly as shown, including 'sudo', to make sure you have root privilege. To prevent errors, avoid using Tab to autocomplete file paths and do not use Finder.

```
sudo cp -r /Volumes/AHKinject_SCN371/ahkinject.kext /Library/Extensions
```

As the original kext was approved, there is no security warning at this point.

8. To confirm that the kext has loaded, type the following command and check that ahkinject is listed.

```
kextstat | grep -v apple
```

Note: If it is not listed, then see [What to do if temporal dithering is still not disabled](#).

Install AHKinject_SCN078

The developer of KextDrop has not yet updated the software for the change in third party kext locations in later versions of OS X. Install **AHKinject_SCN078** (for OS X versions 10.9 thru 10.11) through the command line using the commands that follow:

1. Mount the disk image.
2. Open a terminal window.
3. Copy the kext file from the disk image to the location from which it will run. Enter the following command exactly as shown here:

Note: Type (DO NOT copy/paste) the command exactly as shown, including 'sudo', to make sure you have root privilege. To prevent errors, avoid using Tab to autocomplete file paths and do not use Finder.

```
sudo cp -r /Volumes/AHKinject_SCN078/ahkinject.kext /Library/Extensions
```

4. Move to the directory that contains the kext file. Enter the command:

```
cd /Library/Extensions
```

5. Verify that the kext was copied. Enter the command:

```
ls | grep ahkinject
```

6. Examine the output and make sure the necessary files are there.

7. Change the permissions and ownership of all the files in the kext bundle. Enter the commands:

```
sudo chmod -R 755 ahkinject.kext  
sudo chown -R root:wheel ahkinject.kext
```

8. Force an update to the kext cache. Enter the command

```
sudo kextcache -u /
```

Restart the Mac after the AHKinject_SCN078 installation

Note: If you are running OS X High Sierra (10.13) or later, AHKinject.kext does not load on the first attempt due to the new User-Approved Kernel Extension Loading security mechanism.

1. Restart the Mac.

When you restart the Mac, a pop-up dialog box appears.

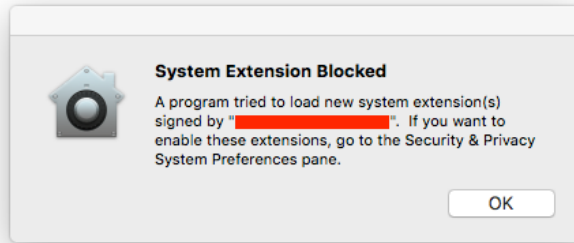


Figure 3: System Extension Blocked alert

2. Click **OK**.
3. Access the **Security & Privacy** menu in **System Preferences**.

The following window appears.

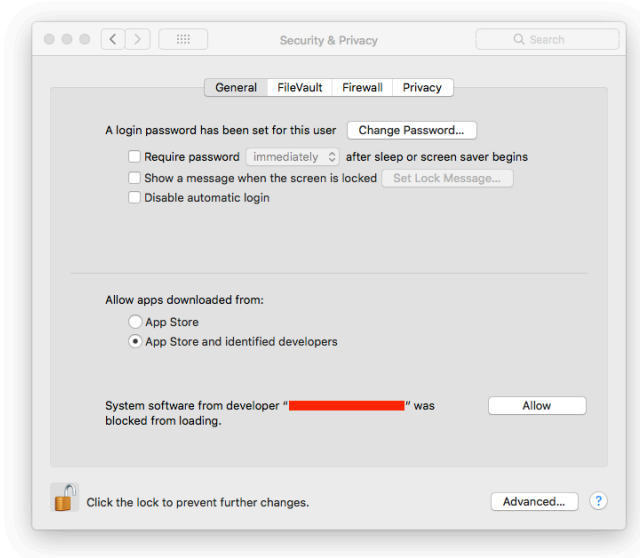


Figure 4: Security & Privacy window

4. Check the name of the developer is Amulet Hotkey Ltd or AHK and click on **Allow**.
5. Temporal dithering should now be disabled. If it is not, see the section, [What to do if temporal dithering is still not disabled](#) on page 10.

How to install AHKinject_ECN491

1. Download the disk image file **AHKinject_ECN491.dmg** from the Amulet Hotkey website to your Mac.
2. Mount the disk image file and accept the software licence.
3. After the image mounts, the Finder automatically opens the folder containing the image. See [Figure 3](#).

Note: *If it does not open, open it manually from the Mac desktop.*

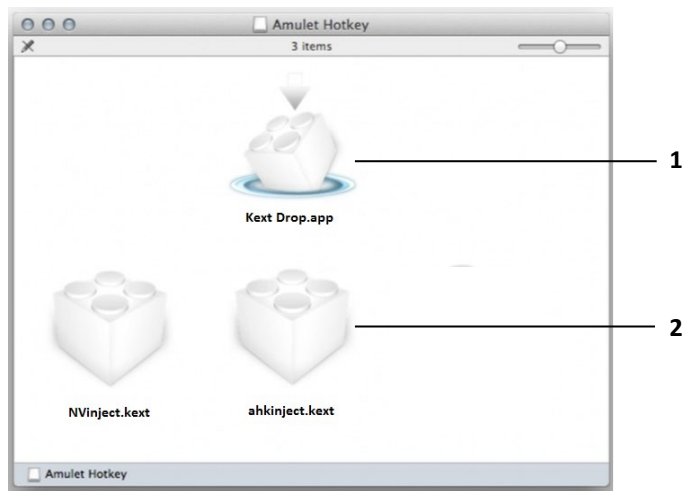


Figure 5: Kext Drop app and Kext files.

4. Double-click the **Kext Drop** app to launch it. See (1) in [Figure 3](#)

This utility installs kext files (2) in the correct location with the correct permissions.

5. Drag the correct kext file into the **Kext Drop** window. See (2) in [Figure 4](#).
 - for Macs with AMD graphics cards, select the **ahkinject** kext;
 - for Macs with NVIDIA graphics cards, select the **nvinject** kext.



Figure 6: Kext Drop window

The kext file to install displays in the Kext Drop window (see **1** in [Figure 5](#)).

6. Click the **Install** button (2) in the Kext Drop window (see [Figure 5](#)). You may be prompted for administrator credentials.

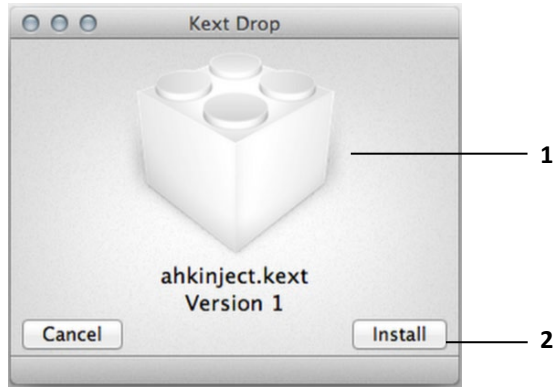


Figure 7: Kext Drop utility.

7. When the 'Installation Successful!' message appears, restart the Mac to complete the kext installation.

Temporal dithering should now be disabled. If it is not, see the section, [What to do if temporal dithering is still not disabled](#) on page 10.

What to do if temporal dithering is still not disabled

If, after you install the kext, this does not disable temporal dithering, make sure the kext is loaded.

1. Enter the following command in a Terminal window:

```
kextstat | grep -v apple
```

This command lists all non-Apple kexts loaded into the kernel.

*This list should include **ahkinject**. If none are listed, they have failed to load.*

2. Enter the following commands:

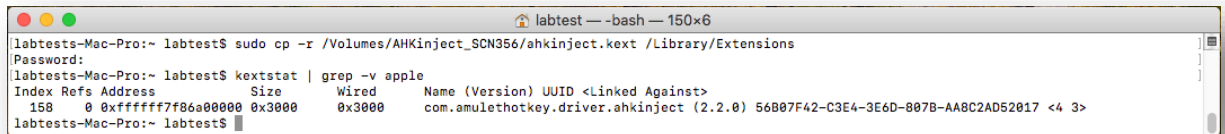
```
sudo kextcache -u /
```

```
sudo kextload /Library/Extensions/ahkinject.kext
```

3. Reboot the system.

4. To confirm that that the kext has loaded correctly, type the following command in the Terminal and check that ahkinject is listed.

```
kextstat | grep -v apple
```



```
labtests-Mac-Pro:~ labtest$ sudo cp -r /Volumes/AHKinject_SCN356/ahkinject.kext /Library/Extensions
Password:
labtests-Mac-Pro:~ labtest$ kextstat | grep -v apple
Index Refs Address          Size      Wired      Name (Version) UUID <Linked Against>
 158   0 0xffffffff7f86a00000 0x3000    0x3000    com.amulethotkey.driver.ahkinject (2.2.0) 56B07F42-C3E4-3E6D-807B-AA8C2AD52017 <4 3>
labtests-Mac-Pro:~ labtest$
```

Figure 8: List of non-Apple kexts in the Terminal

How to re-enable temporal dithering

To re-enable temporal dithering, you must uninstall the kext by running a command in Terminal. For example, to uninstall **ahkinject**, enter the command:

```
sudo kextunload ahkinject.kext
```

Further information

See the Technical Note TN2459 for full information

(<https://developer.apple.com/library/archive/technotes/tn2459/index.html>).

Disclaimer

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