Fusion ioMemory VSL® 3.2.11

Table of Contents

Fusion ioMemory Hardware Installation Guide for Fusion ioMemory VSL 3.2.11

Legal Notices

The information contained in this document is subject to change without notice.

ATTN: Legal
951 SanDisk Drive
Milpitas, CA 95035

(801) 424-5500

Part Number: 80-11-71092
Published: Monday, June 22, 2015

FCC CFR 47 Part 15 Class A device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Introduction

Overview

Congratulations on your purchase of a SanDisk solid-state storage device. This guide explains how to install your Fusion ioMemory device.

For information on installing software for your device, consult the *Fusion ioMemory VSL User Guide* for your operating system.

NOTE-

Throughout this manual, when you see a reference to an **Fusion ioMemory device**, you may substitute your particular device(s), such as Fusion ioMemory ioDrive2 devices, Fusion ioMemory ioScale devices, or Fusion ioMemory ioDrive Duo devices.

Software Compatibility

Compatible Software (Driver)

The Fusion ioMemory VSL software is more than just a hardware driver, it is the "secret sauce" that gives Fusion ioMemory devices their amazing performance. Each release of the Fusion ioMemory VSL software is compatible with certain Fusion ioMemory devices.

For a list of devices that are compatible with the version of the Fusion ioMemory VSL software that you are installing, consult the *Fusion ioMemory VSL Release Notes* for that version.

Compatible Operating Systems

The operating system requirements depends on the version of Fusion ioMemory VSL software that you are installing with this device.

For more information, consult the *Fusion ioMemory VSL Release Notes*.

Hardware Requirements

Before you install your Fusion ioMemory device(s) make sure your computer hardware meets these requirements.

PCIe Slot Requirements

The minimum slot requirements for your Fusion ioMemory device depends on the type of product.

ATTENTION!

Once you have installed the Fusion ioMemory VSL software, you can use the `fio-pci-check` utility on most operating systems to see if the PCIe slot meets the bandwidth requirements.

Fusion ioMemory ioDrive devices require at least:

- A PCI-Express (PCIe) Gen1 x4 slot, with at least 4 lanes that are electrically active.

- Clearance for a half-height, half-length PCI device.

Fusion ioMemory ioDrive2 devices, ioCache devices, and Fusion ioMemory ioFX devices require at least:

- A PCI-Express (PCIe) Gen2 x8 slot, with at least 4 lanes that are electrically active.

- Clearance for a half-height, half-length PCI device.

NOTE-

3.0TB Fusion ioMemory ioDrive2 devices require A minimum of a **full-height**, half-length slot.

Fusion ioMemory ioDrive Duo devices require at least:

- A PCIe Gen1 x8 slot or Gen2 x4 slot.

- A minimum of a **full-height**, half-length slot.

Fusion ioMemory ioDrive2 Duo devices require at least:

- A PCIe Gen2 x8 slot.

- A minimum of a **full-height**, half-length slot.

ioDrive Octal devices require at least:

- A PCIe Gen2 x16 slot

- Room for two **full-height**, full-length devices. The ioDrive Octal device is a full-height, full-length, double-wide device that resides in a Gen2, x16 PCIe slot. It is compliant to the PCI Express 2.0 base spec, and the 225W High Power specification.

NOTE-

For a list of servers that are compatible with ioDrive Octal devices, visit the *ioDrive Octal Compatibility Guide* Knowledge Base article at https://link.sandisk.com/commercialsupport .

3.2TB MLC ioScale devices:

- A PCIe Gen2 x8 slot, with at least 4 lanes that are electrically active..

- A minimum of a **full-height**, half-length slot.

All other ioScale devices supported with this release:

- A PCI-Express (PCIe) Gen2 x8 slot, with at least 4 lanes that are electrically active.

- Clearance for a half-height, half-length PCI device.

Adequate Power for Fusion ioMemory ioDrive2 Duo devices

Products with multiple Fusion ioMemory devices, such as the Fusion ioMemory ioDrive Duo device, require more power than products with a single Fusion ioMemory device.

SanDisk

Fusion ioMemory ioDrive Duo devices may benefit from improved performance when additional power is provided. Fusion ioMemory ioDrive2 Duo devices, require more power than the minimum 25W provided by PCIe Gen2 slots to properly function, and therefore **must** receive additional power. Without additional power, function will be limited.

You may increase power to the device by doing one of the following:

- **Power Cable**: Connect the device to an auxiliary power source via the external power connector and the external power cable. See Installing Power Cables on page 16 for more details.

    > **NOTE-**
    >
    > When a power cable is used, all of the power is drawn from the cable, and no power is drawn from the PCIe slot.

- **Enabling Full Slot Power Draw**: Some PCIe slots provide additional power (often up to 75W of power). If your slot is rated to provide at least 55W, then you may allow the device to draw full power from the PCIe slot by setting a VSL module parameter. For more information on enabling this override parameter, see the **Enabling PCIe Power Override** section in the *Fusion ioMemory VSL User Guide* for your operating system.

    > **NOTE-**
    >
    > This parameter overrides the setting that prevents device(s) from drawing more than 25W from the PCIe slot. The parameter is enabled per device (using device serial numbers). Once the setting is overridden, each device may draw up to the full 55W needed for peak performance.

    > **WARNING!**
    >
    > **WARNING**
    >
    > If the slot is not capable of providing the needed amount of power, then enabling full power draw from the PCIe slot may result in malfunction or even damage server hardware. You are responsible for any damage to equipment due to improper use of this override parameter and SanDisk expressly disclaims any liability for any damage arising from such improper use. Contact Customer Support if you have any questions or concerns about the override parameter use.

Before you enable this override parameter, ensure that each PCIe slot you will use is rated to provide enough power for all slots, devices, and server accessories. Consult the server documentation, BIOS interface, setup utility, and/or use `fio-pci-check` (if available) to determine the slot power limits.

> **ATTENTION!**
>
> **Confirm with Server Manufacturer**
>
> Contact the server manufacturer to confirm the power limits and capabilities of each slot, as well as the entire system.

> **ATTENTION!**
>
> Refer to the matrix to determine if your slot provides 75W. The `fio-status` and `fio-pci-check` utilities may incorrectly display a 75W slot as a 25W slot.

The following are important considerations:

- If you are installing more than one dual Fusion ioMemory device, and enabling the override parameter for each device, make sure the motherboard is rated to provide 55W power to each slot used.

  > **ATTENTION!**
  >
  > For example, some motherboards safely provide up to 75W to any one slot, but run into power constraints when multiple slots are used to provide that much power. Installing multiple devices in this situation may also result in server hardware damage. Consult with the manufacturer to determine the total PCIe slot power available.

- The override parameter, if enabled correctly, will persist in the system, and will enable full power draw on an enabled device even if the device is removed and then placed in a different slot within the same system. If the device is placed in a slot that is not rated to provide 55W of power, then you may damage your server hardware.

- This override parameter is a setting for the Fusion ioMemory VSL software per server, and is not stored in the device. When moved to a new server, the device will default to the 25W power limit until an external power cable is added or this override parameter is enabled for that device in the new server. Consult with the manufacturer to determine the total PCIe slot power available for the new server.

Adequate System Cooling

300 LFM: To maximize the longevity and performance of Fusion ioMemory devices, we recommend at least 300 Linear Feet per Minute (LFM) of airflow across the devices.

55°C Maximum: The ambient air temperature around the device should not exceed 55°C.

Device Thermal Monitoring: In order to protect against thermal damage, all Fusion ioMemory devices monitor the temperature of its onboard controller chip (This is reported by the `fio-status` command-line utility as `Internal temperature`). Newer devices, such as Fusion ioMemory ioDrive2 devices, also monitor the NAND boards to prevent overheating of the NAND flash components (reported by `fio-status`, using the `-fj` or `-fx` options, as `nand_thermal_deg_c`). If your device is throttled or shuts down due to thermal issues, the `fio-status` utility will print a warning and indicate whether the cause was the `FPGA Junction` (controller) or the `NAND Temperature`.

- In an attempt to contain temperatures within an optimal range, the Fusion ioMemory VSL software will start throttling write performance once the controller temperature or NAND board reaches a set temperature.

- If the controller or NAND board temperature continues to rise, the software will shut down the device once the maximum operating temperature is reached.

The throttling and shutdown temperature depends on the device. Some devices detect the NAND board temperature, while others do not.

Devices	Controller Throttle Temp.	Controller Shutdown Temp.	NAND Board Throttle Temp.	NAND Board Shutdown Temp.
Fusion ioMemory ioDrive2 devices, 600GB ioCache devices, First Generation Fusion ioMemory ioScale devices, 420GB Fusion ioMemory ioFX devices, and Fusion ioMemory ioDrive2 Duo devices	93°C	100°C	78°C*	83°C*
ioDrive Octal Devices	93°C	100°C	N/A	N/A
Fusion ioMemory ioDrive devices and Fusion ioMemory ioDrive Duo devices	78°C	85°C	N/A	N/A
Second Generation Fusion ioMemory ioScale devices, 825GB ioCache devices, and 1.6TB ioFX devices	78°C	85°C	78°C*	83°C*

* Some devices may report a `nand_thermal_deg_c` value of `0`. This means that the particular device is not set to throttle or shut down based on the NAND board temperature.

NOTE-

If your system logs indicate write-performance throttling due to high temperatures, consult your server's documentation for details on increasing airflow within your system (for example, by increasing the fans to **maximum** speed within the system via a BIOS setting).

ATTENTION!

High Performance/Power Mode

If your BIOS has a High Performance/Power Mode, enable it when using Fusion ioMemory devices. Also disable any power-saving modes. This improves performance in two ways:

1. Prevents operating systems and the BIOS from suspending PCIe devices (using ASPM), including Fusion ioMemory devices. Fusion ioMemory devices do not support ASPM.

2. Maintains higher fan speeds to prevent thermal throttling.

Sufficient System Memory (RAM)

The Fusion ioMemory VSL software requires enough RAM to accelerate your Fusion ioMemory device. The RAM requirements depend on how your operating system tracks I/O's (average written block sizes), the capacity of your Fusion ioMemory devices, and the version of the Fusion ioMemory VSL software.

For more information, including a chart on RAM required per GB of Fusion ioMemory device capacity, consult the *Fusion ioMemory VSL Release Notes* for the version of Fusion ioMemory VSL software that you will install with the device(s).

Firmware Requirements

The Fusion ioMemory device must have a certain level of firmware in order to work with particular versions of the Fusion ioMemory VSL software. Consult the *Upgrade Notes* section of the https://link.sandisk.com/commercialsupport for upgrade considerations.

WARNING!

Do not downgrade the Fusion ioMemory device to an earlier version of the firmware. Earlier versions of the firmware may not be compatible with the device, and downgrading the firmware will result in data loss. Contact Customer Support if you have issues with your upgrade.

In the Box

Your Fusion ioMemory device comes with these items:

- Fusion ioMemory device

- Quick Start Instructions

Additional Item(s)

Depending on your device, these additional items may be included (consult the installation instructions for item information):

- Half-height bracket, used on low-profile systems

- External Power Cable(s)

On the USB Key (if available) are the following items:

- Fusion-io Warranty

- Product Information document

Installing the Device

NOTE-

Please read the Hardware Requirements on page 5 if you have not done so.

WARNING!

Upgrade Previous Devices First

If you have Fusion ioMemory ioDrive devices configured for ioMemory VSL 2.x or earlier that you wish to use with Fusion ioMemory VSL software version 3.x, you must upgrade the firmware on the previously installed devices before installing new devices in the system. See the *Fusion ioMemory VSL Release Notes* for full Upgrade Notes.

WARNING!

Only Transport This Product in the SanDisk Provided Packaging or a Safe Shipping Configuration

We recommend saving the product box and electrostatic discharge (ESD) bag in case you need to store, transport, or return your device. The Fusion ioMemory device product box is the safest way to store or transport your Fusion ioMemory device. It is made of ESD-safe materials and protects the device from damage in shipping.

Do not transport the Fusion ioMemory device without replacing it in the SanDisk provided packaging, unless you have ensured that the alternative mode of transportation is safe and will not damage the Fusion ioMemory device. Specifically, transporting a Fusion ioMemory device once it has been installed into a server or workstation (as applicable) may damage the device or interfere with its proper installation and operation. Transportation configurations should be tested carefully prior to putting the Fusion ioMemory device at risk of damage. Damage to the Fusion ioMemory device caused when transported within a server or workstation, transported in inadequate packaging, or resulting from general physical mishandling will void the warranty for the product.

Installation Instructions

ATTENTION!

Electrostatic discharge (ESD) can damage electronic components. Be sure that you are properly grounded before beginning any hardware installation procedure.

ATTENTION!

Do Not Disassemble the Device

If you disassemble your Fusion ioMemory device, you will void the product warranty. Removing (and replacing) the bracket as instructed in this guide is **not** considered disassembly.

These installation instructions are for any SanDisk Fusion ioMemory device except the ioDrive Octal device. For ioDrive Octal devices, consult Installing ioDrive Octal Devices on page 20.

1. Locate the serial number label(s) on your device and record the number(s) for future reference.

NOTE-

The serial number label(s) will have a number and a barcode.

NOTE-

Visible in fio-status

Once the Fusion ioMemory VSL software is installed, the device's serial number(s) will be visible in the `fio-status` Fusion ioMemory VSL software utility.

---

2. Turn off the computer and disconnect the power cable.

3. Remove the computer's access panel. Locate an available PCIe slot compatible with the device. See Hardware Requirements on page 5 for PCIe slot requirements.

NOTE-

Consult your computer's documentation for details on removing the panel and identifying PCIe slots.

---

4. Remove the cover slot (if applicable).

5. **Optional Half-height Bracket**: If your product includes a half-height bracket (included with products that has one Fusion ioMemory device), and you are installing the device in a low-profile system, replace the full-height bracket before installing the device. Follow the installation instructions in Installing the Half-Height Bracket on page 14 and then return to this section.

6. **Power Cable**: If your device includes a power cable (included with some products), you may install it now.

ATTENTION!

Additional power (through the cable or through the PCIe slot) is required for newer products with multiple Fusion ioMemory devices.
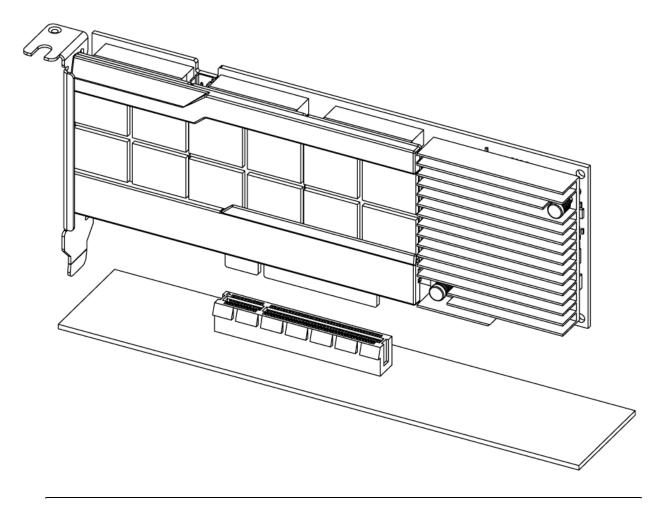

For best results, plug in the power cable. See Installing Power Cables on page 16 for instructions and to see if the power cable is required for your device. For more information on using the PCIe slot to provide additional power, see Adequate Power for Fusion ioMemory ioDrive2 Duo devices on page 6.

7. Grasp the Fusion ioMemory device by the top edge and seat it gently but firmly in the available PCIe slot, for example:

ATTENTION!

This illustration is an example of one type of Fusion ioMemory device, your specific device will install in the same manner.

ATTENTION!

Apply pressure only to the circuit board and/or bracket. Do **not** apply pressure to the heat sink or any other components that are attached to the circuit board (with the exception of the bracket).

---

8. Secure the Fusion ioMemory device's retaining bracket using a screw, lever, clasp, or other method (depending on how your hardware is configured, consult your computer's documentation).

9. Replace the computer's access panel.

10. Plug in the computer's power cable and turn on the computer.

11. Your operating system may detect the Fusion ioMemory device and ask if you want it to install a hardware driver for the device. In that case, click **Cancel**.

NOTE-

Device Packaging

Note: We recommend saving the product box in case you need to store or return your device. The Fusion ioMemory device product box is the safest way to store and transport your ioMemory device. It is made of ESD-safe materials, and protects the device from damage in shipping.

> To remove the Fusion ioMemory device, follow the above instructions in reverse. Be sure to place the device in an ESD-safe package.

You are now ready to install the driver and utilities software. See the *Fusion ioMemory VSL User Guide* based on your operating system.

Installing the Half-Height Bracket

For half-height installation (such as in low-profile systems), you need to replace the full-height retaining bracket with the included half-height bracket.

> **ATTENTION!**
>
> Electrostatic discharge (ESD) can damage electronic components. Be sure you are properly grounded before starting any hardware installation procedure.

1. Locate the half-height bracket in your Fusion ioMemory device package:
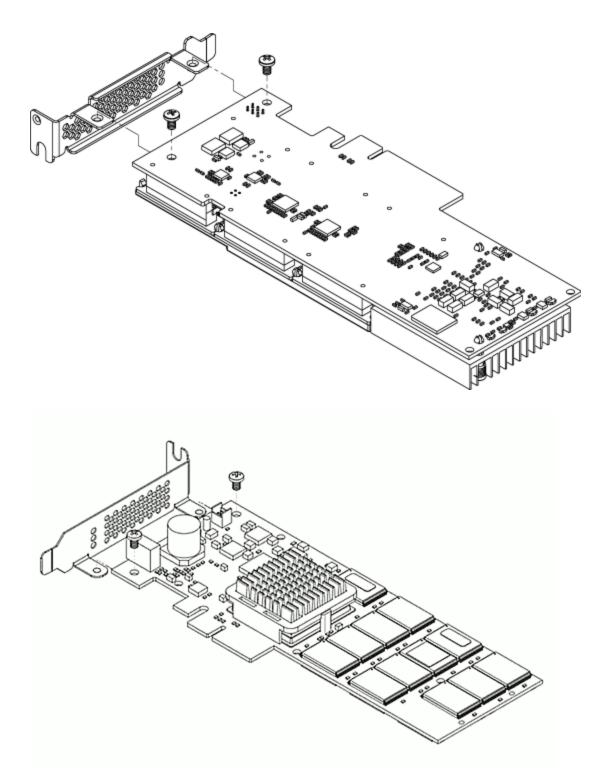
   > **ATTENTION!**
   >
   > Use care in removing the retaining screws. Do not twist or pull on the bracket until both screws are out as this can cause damage to the components.

2. To prevent damage to the Fusion ioMemory device, use only a Philips #1 tip screwdriver. Remove the two screws holding the full-height bracket to the Fusion ioMemory device

   > **ATTENTION!**
   >
   > Take note of the position of the screws and how the bracket screw holes were inserted in the device. You must insert the half-height bracket holes in the same manner.

3. Remove the bracket carefully from the device.

4. Align the LEDs on the Fusion ioMemory device with the holes in the half-height bracket. Insert the bracket screw holes in the same manner as the full height bracket was inserted. Refer to the example below that matches your device configuration.

5. Attach the half-height bracket using a Phillips #1 tip screwdriver to tighten the two screws.

ATTENTION!

Do not over-tighten! This can cause damage to the device.

6. Return to the installation instructions to complete the install.

Installing Power Cables

Some Fusion ioMemory devices are compliant with the PCIe 2.0 bus specification of 25W and do not require external power in compliant PCIe slots. Other devices require more than the 25W to function. If your device came with a power cable, you should consider using it.

Peak Performance

Regardless of whether the external power cable is optional or required for your Fusion ioMemory device, the cable will ensure that the dual device has all of the power it needs to maintain peak performance (if more power is required, especially under heavy write workloads).

As a best practice, install the external power cables to ensure your device will function properly. If you wish to not install the cable(s), see the illustrations below to see if additional power is optional for your device.

If additional power (beyond the standard 25W) is required, and using the power cable is not an option, you may be able to enable full power draw from the PCIe slot. See for more information.
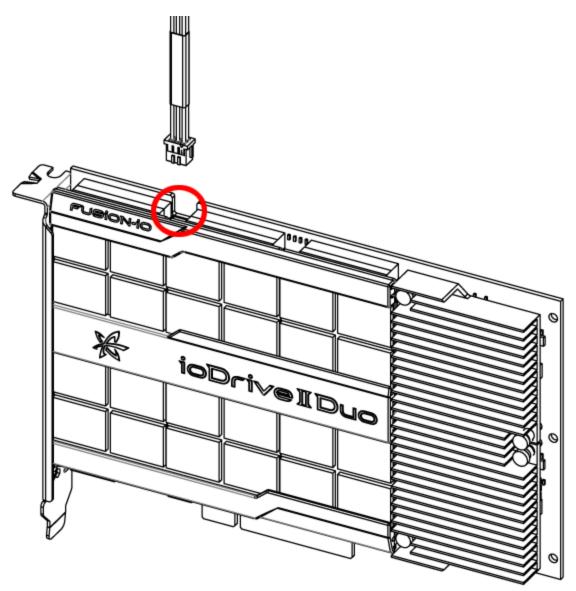
Installing the Cable

To use the external power cable, plug one end of the supplied cable into the product's power connection (circled below, refer to the example that matches your device configuration), and the other into the auxiliary power source.
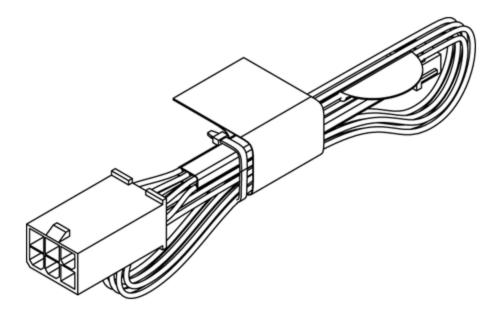
Fusion ioMemory ioDrive2 Duo devices

Additional power is **required** on these devices, either through the external power cable or through the PCIe slot. When the power cable is used, the device will draw 55 watts from the 12V rail over the external cable. Make sure your system has sufficient power for the installed devices.

Fusion ioMemory ioDrive2 Duo devices:

Plug the product end of the cable (shown above) into the device. Plug the other end of the cable (shown below) into an available power source cable. Consult your server documentation for available power options. Some servers may require alternative power sources and adapters to connect with the cable.
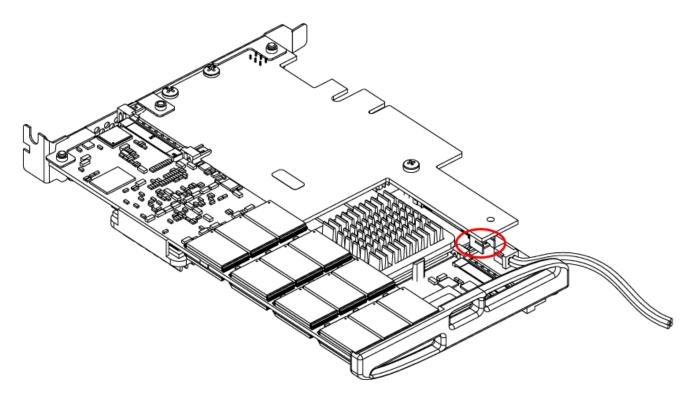

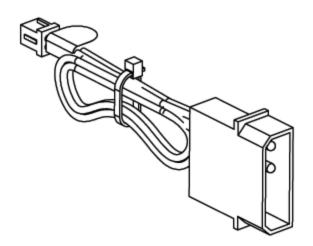Return to the installation instructions .

Previous ioDrive Devices

The external power cable is **optional** on the following devices (as is additional power through the PCIe slot). If the external power cable is used, the device can pull up to 36 watts from the 12V rail over the external cable. Make sure your system has sufficient power for the installed devices.

Fusion ioMemory ioDrive Duo devices:

Plug the product end of the cable (shown above) into the device. Plug the other end of the cable (shown below) into an available power source cable. Consult your server documentation for available power options. Some servers may require alternative power sources and adapters to connect with the cable.

Return to the installation instructions .

Installing ioDrive Octal Devices

NOTE-

For ioDrive Octal device hardware requirements, please see the ioDrive Octal Requirements in the PCIe Slot Requirements on page 5.

Installation Instructions

ATTENTION!

Electrostatic discharge (ESD) can damage electronic components. Be sure that you are properly grounded before beginning any hardware installation procedure.

1. Locate the serial number on your ioDrive Octal device and record it for future reference.
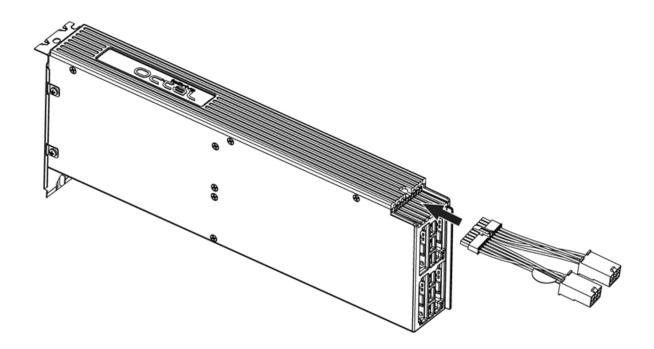
    NOTE-

    When installing a new Fusion ioMemory device along with existing devices, it is best to upgrade all of the devices to the latest available versions of the firmware and ioMemory VSL (driver). The latest versions are available at https://link.sandisk.com/commercialsupport .

    For information on upgrading the driver and firmware, see the *Fusion ioMemory VSL User Guide* for your operating system. For more information regarding firmware and ioMemory VSL versions and compatibility, contact support at support@fusionio.com .
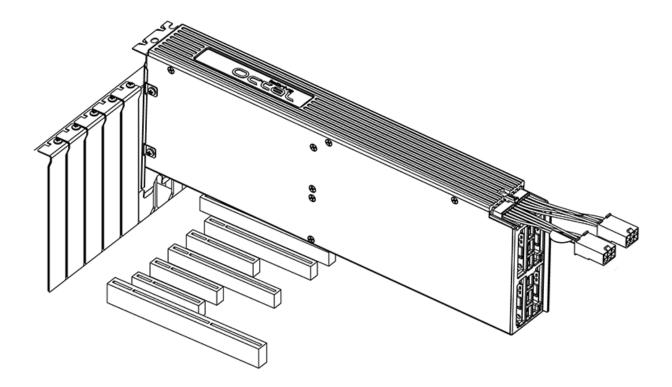
2. Attach the appropriate power cable to the ioDrive Octal device. Use the 2x cable with two 75W PCIe 6-pin connectors (shown below), or use the 1x cable with one 150W PCIe 8-pin connector.

    ATTENTION!

    These cables are PCIe Power Connectors, **not** EPS power cables.

3. Turn off the computer and disconnect its power cable.

4. Remove the computer's access panel. Locate an available x16 PCIe slot. (Consult your computer's documentation for details on removing the panel and identifying PCIe slots.)

5. Remove two cover slots (if applicable).

6. Grasp the ioDrive Octal device by the top edge and seat it gently but firmly in the available PCIe slot:

7. Secure the ioDrive Octal device's retaining bracket using screws or levers (depending on how your hardware is configured).

8. Connect the ioDrive Octal device's power connectors to the computer's internal power cables.

9. Replace the computer's access panel.

10. Plug in the power cable and turn on the computer.

11. Your operating system may detect the ioDrive Octal device and ask if you want it to install a hardware driver for the device. In that case, click **Cancel**.

ATTENTION!

Important - Removing the ioDrive Octal device
Many x16 PCIe slots include latches that hold the card steady. Before you remove the ioDrive Octal, be sure to reach under the device and release these latches. Failure to do so could cause damage to the latch or the motherboard.

You are now ready to install the driver and utilities software. See the *Fusion ioMemory VSL User Guide* based on your operating system.

WEEE Advisement Disposal and Acknowledgment

In 2002 the European Union introduced the Directive on Waste Electrical and Electronic Equipment (WEEE). The main aim of the Directive is to ensure that WEEE is collected and treated separately. WEEE may contain hazardous substances that should not end-up in the (human) environment and can have adverse effects on it if they do.

Furthermore, WEEE is a vast source of raw materials. With the ever rising worldwide demand for new equipment and the ever decreasing volume of natural raw materials, letting this potential source go to waste is unacceptable.

If equipment is collected separately, the equipment can be recycled and up to 85 to 90% of the equipment can be re-used as new material, saving the use of virgin raw materials and energy of producing these.

For above reasons, Fusion-io Inc expects end-users to dispose of the material in an environmentally friendly way. Electrical and Electronic Equipment is labeled with the following "crossed-out wheeled bin" symbol indicating that the equipment should be disposed of, by the end-user, separate from other types of waste.

The EU Directive and national legislation define various situations and financing options for doing so.

End-users should contact their sales representative/dealer/distributor and our company on disposal, collection and recycling options and terms and conditions in your country.

Determining Manufacture Date

You can determine the week and year the device was manufactured by locating the serial number label on your device and interpreting the first four numbers of the serial number.

Example Label:

The first two numbers on the label indicate the last two numbers of the calendar year, and the next two numbers indicate the week of that year.

In this example, the first four numbers are `1113`, this stands for the year 2011 (`11`) and the 13th week of the year 2011 (`13`).

Fusion Powered Support

We offer SanDisk Customer Services and Support by phone, e-mail and on the Web. For the most up-to-date contact information visit https://link.sandisk.com/commercialsupport .

E-Mail

Our support e-mail address is: support@fusionio.com

E-mail is the fastest way to get simple questions answered. Please give a detailed description of your problem with your complete contact information (name, phone number, email address, location address).

Warranty Support

Warranty Support is available via support@fusionio.com and https://link.sandisk.com/commercialsupport .

Telephone Support

ioFX Support

North America: (855) 322-5767

Enterprise Support

North America: (877) 816-5740

Country Numbers

For product support outside of North America, please use the number for the country/region closest to you. If that is not possible, please contact North America at (801) 424 5474.

Australia 1800 353 941 (02) 8278 1489	**Belgium** 02 700 74 86	**China** 40-08866109	**Denmark** 4331 4999	**Finland** 097 251 9979	**France** 01 57 32 48 90
Germany (069) 17 07 76 790	**Hong Kong** 3071 3587	**Italy** 02 23331509	**Japan** (03) 6743-9765	**Luxembourg** (224) 87 19 84	**Mexico** 01 882 816 5740
Netherlands 070 7703993	**Norway** 23 02 49 99	**Singapore** 6818 5692	**South Korea** 02 3483 6689	**Sweden** 08 593 663 99	**United Kingdom** (020) 3564 9935

Web

Go online to find tips, FAQs, and troubleshooting help, or download the latest user guides, software, and support packages at: https://link.sandisk.com/commercialsupport .