Memory Card Specs and Compatibility

Introduction

First, much of the information gathered here is from the SanDisk manufacturer. I provide a recommendation at the end for an example camera which will help with your selection of a memory card. You can click on some of the figures below to get an enlarged view when connected to the Internet.

Memory Card Type Summary

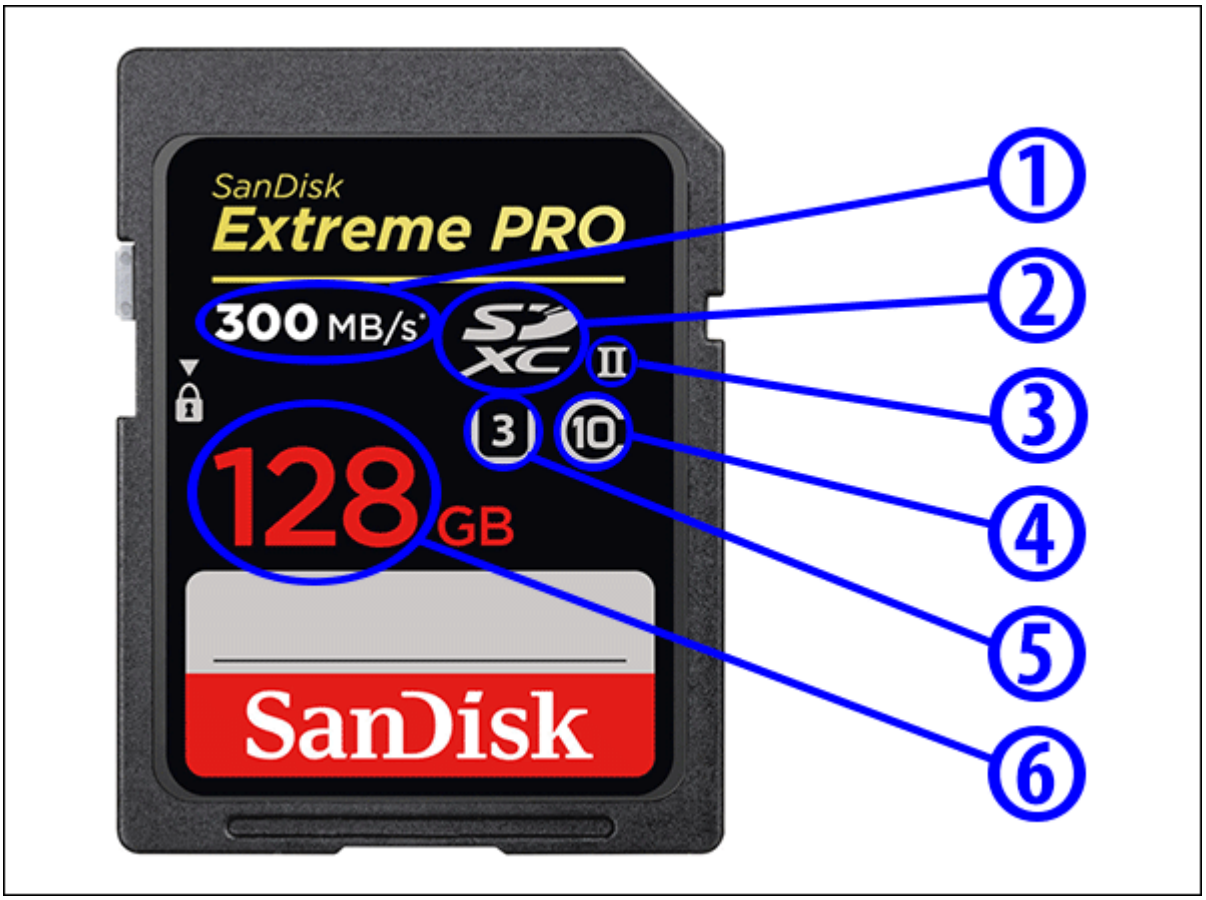
#	Memory Card Name	Abbreviation	Dimensions (WxLxH)
1	Secure Digital [1]	SD	24.0 x 32.0 x 2.1mm
2	Secure Digital High Capacity	SDHC	24.0 x 32.0 x 2.1mm
3	Secure Digital Extended Capacity	SDXC	24.0 x 32.0 x 2.1mm
4	MicroSD / MicroSDHC / MicroSDXC	MicroSD / MicroSDHC / MicroSDXC	11.0 x 15.0 x 1.0mm
5	Memory Stick, Memory Stick PRO [1]	MS	50.0 x 21.5 x 2.8mm
6	Memory Stick Duo / PRO Duo / PRO-HG Duo	MSD / MSPD / MSPDX	20.0 x 31.0 x 1.6mm
7	CompactFlash Type I	CF-I	42.8 x 36.4 x 3.3mm
8	CompactFlash Type II [1]	CF-II	42.8 x 36.4 x 5.0mm
9	CFast	CFast	42.8 x 36.4 x 3.6mm
10	XQD	XQD	38.5 x 29.6 x 3.8mm

[1] Discontinued / Uncommon

Memory Card Speed Class

Minimum Sequential Write Speed	Speed Class	UHS Speed Class	Video Speed Class
2 MB/sec	Class 2 (C2)		
4 MB/sec	Class 4 (C4)		
6 MB/sec	Class 6 (C6)		V6 Class 6 (V6)
10 MB/sec	Class 10 (C10)	U1 Class 1 (U1)	V10 Class 10 (V10)
30 MB/sec		U3 Class 3 (U3)	V30 Class 30 (V30)
60 MB/sec			V60 Class 60 (V60)
90 MB/sec			V90 Class 90 (V90)

Card Markings



1. **Maximum Read Speed** – This is the maximum sequential read speed the memory card is capable of in Mega Bytes per second (MB/sec). Please note that write speeds are rarely ever published on memory cards and you will need to find that information in memory card manual or listed specifications. In this case, the maximum read speed of the SD card is 300 MB/sec.
2. **Type of SD Memory Card** – You should also be able to locate the proprietary SD card logos on memory card labels that indicate whether the card is of SD, SDHC or SDXC type. In this particular case, it is an SDXC memory card.
3. **UHS Bus Speed** – UHS bus speed is also often published directly on memory card labels. If it is a UHS-I card, you will just see roman numeral one (I), whereas if it is a UHS-II card, you will see roman numeral two (II), as in the case of the above card.
4. **SD Speed Class** – This number indicates what SD Speed Class card it is, per table above. As in the above case, all modern SD cards should be rated at 10 minimum, which guarantees minimum sequential write speed of 10 MB/sec.
5. **UHS Speed Class** – Aside from UHS bus speed, you will also typically find a UHS speed class label. In this particular example, I can see that the card is rated at minimum 30 MB/sec write speed, thanks to this U3 label.
6. **Memory Card Capacity** – The capacity of the memory card is typically displayed in large numbers. As can be seen here, this memory card has a total capacity of 128 GB.

SD/SDHC/SDXC Specifications and Compatibility

What SD (or microSD) cards are compatible with my host device? How do I choose the best card for my host device?

There are three main types in the SD memory card family. **SD**, **SD High Capacity** (SDHC™), and **SD Extended Capacity** (SDXC™). This article details the different specifications of all three types of SD memory cards and the speed class ratings and compatibilities that are different with each type.

SD capacities range from **128MB to 2GB**

Default Format: **FAT16**

SD cards will work in all host devices that support SD, SDHC, or SDXC

SD High Capacity (SDHC™) card is an SD™ memory card based on the SDA 2.0 specification.

SDHC capacities range from **4GB to 32GB**

Default Format: **FAT32**

Because SDHC works differently than standard SD cards, this new format is **NOT** backwards compatible with host devices that only take SD (128MB - 2GB) cards. Most readers and host devices built after 2008 should be SDHC compatible.

To ensure compatibility, look for the SDHC logo on cards and host devices (cameras, camcorders, etc.)

SD Extended Capacity (SDXC™) card is an SD™ memory card based on the SDA 3.0 specification.

SDXC capacities range from **64GB to 2TB**

Default Format: **exFAT**

Because SDXC uses a different file system called exFAT and it works differently than standard SD cards, this new format is NOT backwards compatible with host devices that only take SD (128MB to 2GB) or host devices that only take SDHC (4GB to 32GB). Most host devices built after 2010 should be SDXC compatible.

To ensure compatibility, look for the SDXC logo on cards and host devices (cameras, camcorders, etc.).

NOTE: Internal card readers on laptops from 2008 and prior may NOT support SDXC cards. SDXC cards will work in SDHC compatible readers (not SD readers) if the computer OS supports exFAT. For more information on exFat see: Operating Systems that support the exFAT File System

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Ultra-High Speed, Phase I (UHS-I) bus design for SDHC and SDXC cards was added in SD spec 3.0. This is a design enhancement to increase the performance of SDHC/SDXC cards.

UHS-I specification defines two bus architecture options for up to 50MB/s (UHS-50) and 104MB/s (UHS-104) data transfer rates. These are theoretical maximum limits and actual maximum performance for a specific card is defined on it label or in advertising.

UHS is an enhancement to the original SD interface specifications. Host devices will obtain the UHS maximum speed when both the card and host device support UHS. Otherwise, the host device and card will use the slower SD maximum speed obtainable.

There is no compatibility problem using a UHS card with a non-UHS device.

Ultra-High-Speed Phase II (UHS-II) bus design for SDHC and SDXC was added in SD spec 4.0. This is an additional design enhancement with connector interface modifications to increase performance.

UHS-II specification defines bus architecture for options of 156MB/s and 312MB/s. Manufacturers implemented the 312MB/s option in memory cards. These are theoretical maximum limits and actual maximum performance for a specific card is defined on the label or in advertising.

Host devices will obtain the maximum UHS-II speed when both the card and the host device support UHS-II. Otherwise, the host device and card will use the highest compatible UHS-I or SD bus speed.

There is no compatibility problem using a USH-II card in a UHS-I or non-UHS device.

Speed Class & UHS Speed Class Rating

Speed class ratings define a minimum guaranteed speed of SDHC/SDXC cards. Speed class rating is important for HD video mode or camcorders, where the device is actually saving a steady stream of data. The resolution and format of the video determines the amount of steady stream data. You should consult your camera user manual for minimum speed class requirements for HD video modes.

Speed Class (SD Bus)

Class	Minimum Speed
2	2MB/s
4	4MB/s
6	6MB/s
8	8MB/s
10	10MB/s

UHS Speed Class (UHS Bus)

UHS Class	Minimum Speed
1	10MB/s
3	30MB/s

Compatibility Summary

The chart below shows the host device and the memory cards supported.

Host device (ex. cameras, video recorders, phones, readers, etc.)	**Memory cards supported**

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SDXC cards and host devices
- SDXC memory cards can ONLY be used with SDXC host devices.
- SDXC memory cards will NOT work with SD / SDHC host devices.

Additional info on SDXC cards and host devices
- SDXC host devices can use and support SD, SDHC and SDXC memory cards.
- SDHC host devices can use and support both SD and SDHC memory cards.
- SDHC memory cards can be used with SDHC and SDXC host devices.

Difference between Speed Class, UHS Speed Class, Speed Ratings (performance) and Video Speed Class for SD/SDHC/SDXC cards

What is the difference between Speed Class and Speed Ratings for SD™/SDHC™ cards?

The **speed rating** measures maximum transfer speed for reading and writing images to and from a memory card, expressed as megabytes per second. However, video doesn't need as big a data pipe because the video format is a smaller "fixed stream" that uses only a portion of the data pipe.

Unlike card write speeds that measure *maximum* performance, **class ratings** measure the *minimum* sustained speed required for recording an even rate of video onto the card. The class rating number corresponds to the transfer rate measured in megabytes per second. Class 2 cards are designed for a minimum sustained transfer rate of 2 megabytes per second (MB/s)[1], while Class 10 cards are designed for a minimum sustained transfer rate of 10MB/s[2].

What does this difference mean for me?

Rated Speed (e.g. 15MB/s, 30MB/s, etc.) is maximum speed of the card and also what you would expect to approximately see in typical usage of writing or reading files on the card. This measurement is pertinent to still photography, especially for taking pictures with high resolution and/or saving in RAW format where the files created are very large. The faster the card, the faster it can save the file and be ready to take another picture. You can really notice speed differences with high-megapixel DSLR cameras when using multi-shot burst mode.

Still digital images shot on high-megapixel cameras should utilize fast data throughput (a large data pipe), higher speed cards for improved performance. Higher speed cards can also improve how fast you can transfer the files to and from the card and your computer.

Speed Class is a minimum speed based on a worst-case scenario test. The Speed Class is important for video mode or camcorders, where the device is actually saving a steady stream of data. The resolution and format of the video determines the amount of steady stream data. This translates to a minimum speed you need to guarantee that the video captured on the cards is recorded at an even, sustained rate with no dropped frames (which would result in lost data and choppy playback).

Compared to high-megapixel photography, video doesn't need as big a data pipe because the video format is a smaller "fixed stream" that uses only a portion of the data pipe. But you do need a minimum guaranteed speed for the SDHC card that satisfies the requirement of the data stream. Your camera's specifications should state the minimum SDHC Class Rating required.

Using a card without the proper class rating on a more advanced camera, such as a high-definition (HD) camcorder or Digital Single Lens Reflex (DSLR) camera with HD video record settings is likely to result in an error message indicating that video can only be recorded at a lower definition setting.

The current SDHC specification defines Class 2, 4, 6, 8 and 10 as follows:

Class	Minimum Speed
2	2MB/s
4	4MB/s
6	6MB/s
8	8MB/s
10	10MB/s

UHS Speed Class was introduced in 2009 by the SD Association and is designed for SDHC and SDXC memory cards. UHS utilizes a new data bus that will not work in non-UHS host devices. If you use a UHS memory card in a non-UHS host, it will default to the standard data bus and use the "Speed Class" rating instead of the "UHS Speed Class" rating. UHS memory cards have a full higher potential of recording real time broadcasts, capturing large-size HD videos and extremely high quality professional HD.

UHS Class	Minimum Speed
1	10MB/s

3	30MB/s

Video Speed Class or "V Class", was created by the SD Association to identify cards that can handle higher video resolutions and recording features. This speed class guarantees minimum sustained performance for recording video.

The other speed classes are either not optimized or are unable to accommodate the recording of multiple video streams, 360 capture, virtual reality content or 8K and higher resolution video.

V Class	Minimum Sustained Speed
V6	6MB/s
V10	10MB/s
V30	30MB/s
V60	60MB/s
V90	90MB/s

[1] *1 megabyte (MB) = 1 million bytes*
[2] *Based on SanDisk internal testing; performance may vary depending upon host device.*

Recommendations

I have a Sony RX100 Mark 6 and the memory card for this camera has the following requirements if you want to record the highest quality videos which is XAVCS 4K at 30P 100M (100 Mega Bits per second).

Looking at the table below, you'll want to get a UHS-I with a rating of at least U1 (10MB/s minimum speed). U3 would be the best, and it's just a few dollars more. The reason is because anything slower is not enough for 4K videos or taking a few pictures in burst mode.

Class	Speed	Our opinion
Class 4	4MB/s	Too slow for most modern cameras. Skip it.
Class 6	6MB/s	A little bit better but unless you take 3 pictures a year, skip it.
Class 10	10MB/s	Good enough for most cameras with 20+ megapixels and Full HD video.
U1 (UHS)	10MB/s	Good enough for most cameras with 20+ megapixels and Full HD video
U3 (UHS)	30MB/s	Perfect for fast burst cameras, Full HD at 60fps and 4K video

Here's a few cards shown below.


64GB
300
MB/s
Lexar
PROFESSIONAL
2000x
SanDisk
Extreme PRO
95 MB/s
32 GB
SanDisk
Transcend
R95·W60MB/s
LOCK
64GB