## SD Card Formatter

SD Association

SD Card Formatter is designed to optimize the performance of memory cards that conform to SDHC/SDXC standards, Cards formatted with SD Card Formatter maximize its performance and Speed Class capabilities and exhibit increased compatibility between different devices.

Note:
SD memory cards formatted using a utility bundled with your computer may not perform optimally. SD Association recommends formatting SD memory cards using SD Formatter available for downloading it from our website. (www.sdcard.org)

**Compatible Operating Systems**

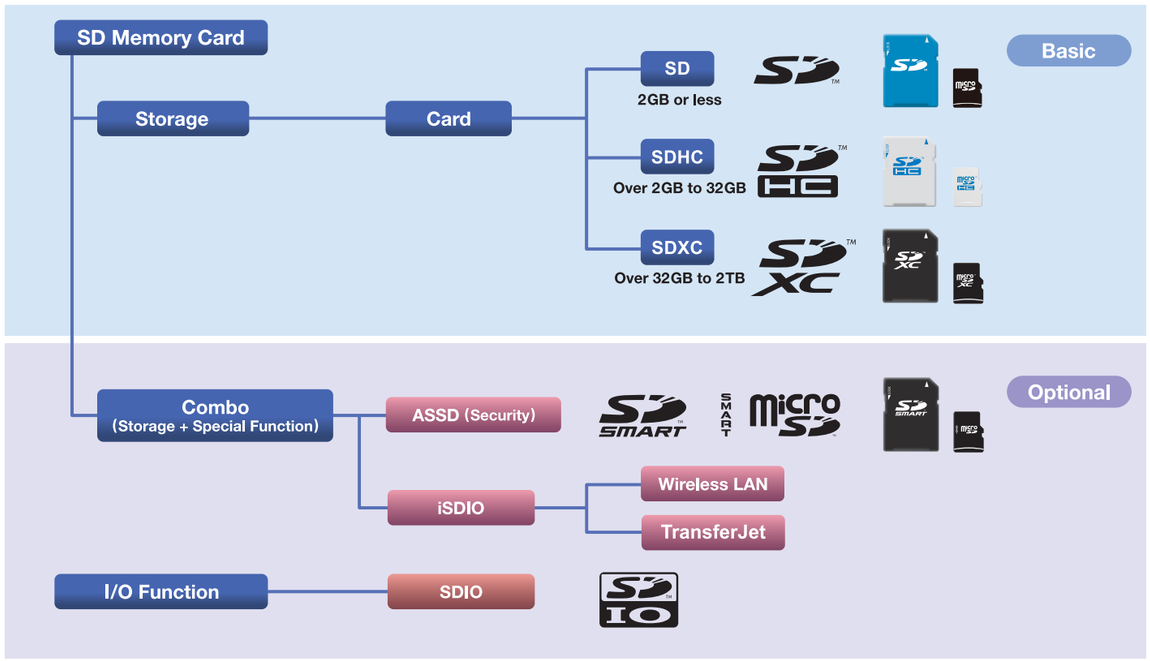
| | SDHC | SDXC |
|---|---|---|
| Windows | Windows® 8 • Windows® 7 • Windows Vista® • Windows® XP | Windows® 8 • Windows® 7 • Windows Vista® (SP1 or later)<br>Windows® XP (SP2 or later) Note: Requires updating the exFAT file system (KB955704). |
| Mac OS | Mac OS X (v10.8 Mountain Lion) • Mac OS X (v10.7 Lion)<br>Mac OS X (v10.6 Snow Leopard) • Mac OS X (v10.5 Leopard for Intel Mac) | Mac OS X (v10.8 Mountain Lion) • Mac OS X (v10.7 Lion)<br>Mac OS X (v10.6.5 Snow Leopard or later) |

## About the SD Association

Founded in January 2000 by Panasonic, SanDisk and Toshiba, The SDA Association is a group dedicated to establishing SD standards and facilitating their adoption and development. At its outset the Association represented just 14 member companies and has grown into a global alliance comprised of around 900 member companies. By developing and adopting SD standards, members enjoy better compatibility of member cards between devices, greatly enhancing consumer enjoyment and convenience.

## SD Family

As SD memory cards have grown in popularity, different standards have emerged. The basic standards are SD, SDHC and SDXC, all of which refer to removable cards standardized by capacity and file system. Also established as standards are Combo cards combining storage with special functions, such as ASSD which can be integrated with Smart Cards and iSDIO which has integrated wireless connectivity. SDIO uses the SD bus to realize I/O functionality.






Website: www.sdcard.org

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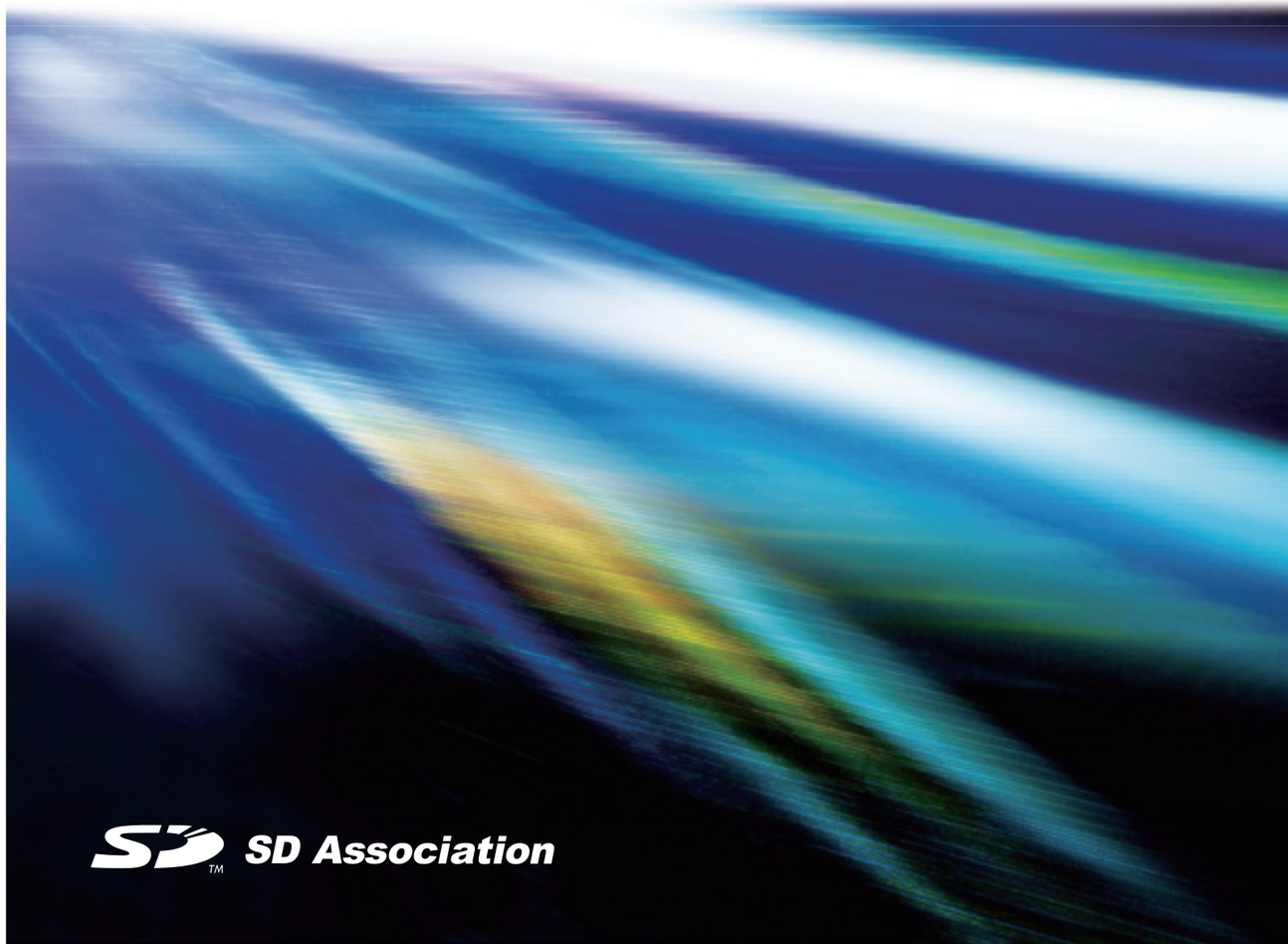
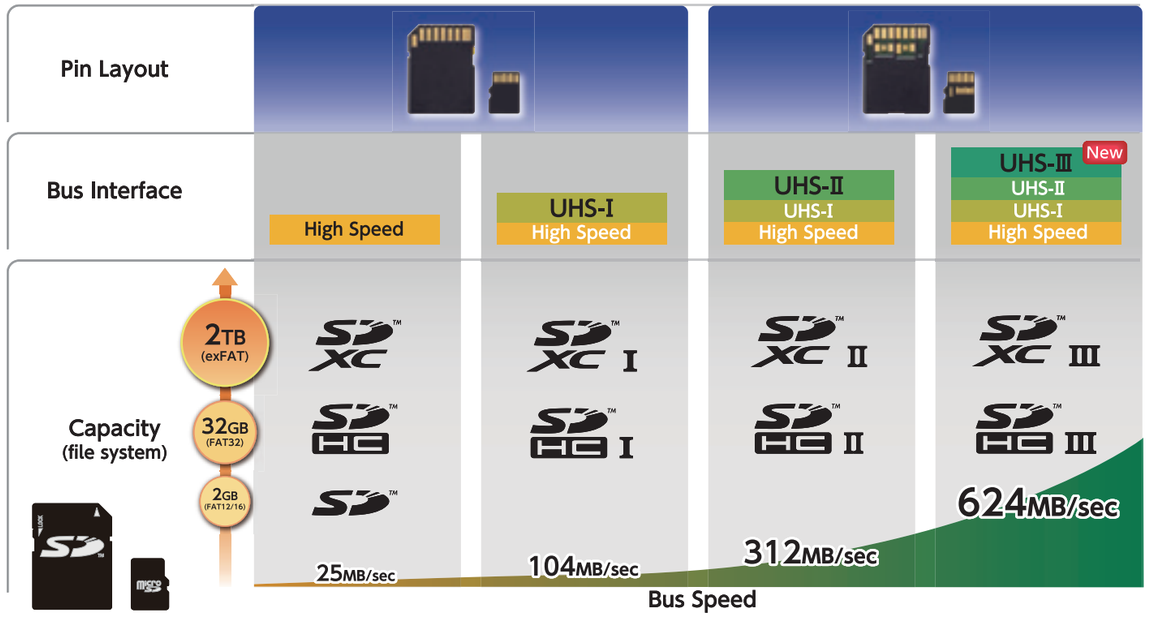
SD Standards —
Universal, High Performance Mobile Storage



SD Association

## SD Standard and Bus Interface

SD Standards define a variety of memory card capacities, bus interfaces and Speed Classes, giving manufactures a great deal of flexibility in developing new products to satisfy any need. The industry standard is used by a myriad of consumer electronics and portable devices, digital cameras, computers, tablet PCs and car navigation systems, to mention a few. Moreover, the cards feature outstanding interoperability and compatibility between devices, and are designed to support future applications. With the emergence of the SDXC and UHS standards, larger memory capacities and faster transfer rates are now possible. Highly versatile, portable and convenient, SD memory cards are leading the flash memory market, continually evolving to correspond to the changing digital landscape.




### SD Specification Evolution

| Release Year | 2000~2005 | 2006 | 2009 | 2010 | 2011 | 2013 | 2016 | 2017~ |
|---|---|---|---|---|---|---|---|---|
| Spec Version | Ver. 1.01 (2000)<br>Ver. 1.10 (2004) | Ver. 2.00 | Ver. 3.00 | Ver. 3.01 | Ver. 4.00 | Ver. 4.20 | Ver. 5.00<br>Ver. 5.10 | Ver. 6.00 |
| Capacity | SD (Ver.1.01 2000)<br>microSD (2005) | SDHC<br>microSDHC | SDXC<br>microSDXC | | | | | |
| File System | FAT12/16 (Ver. 1.01 2000) | FAT32 | exFAT | | | | | |
| Bus Speed | Default Speed DS (Ver. 1.01 2000)<br>High Speed HS (Ver. 1.10 2004) | | | UHS-I<br>SDHC I<br>SDXC I | UHS-II<br>SDHC II<br>SDXC II | | | UHS-III<br>SDHC III<br>SDXC III |
| Speed Class | | CLASS 2<br>CLASS 4<br>CLASS 6 | CLASS 10 | UHS Speed Class 1<br>U1 | | UHS Speed Class 3<br>U3 | Video Speed Class<br>V6 V10 V30<br>V60 V90<br>(Ver. 5.0) | |
| App Performance Class | | | | | | | A1 APP PERFORMANCE (Ver. 5.1) | A2 APP PERFORMANCE |
| Low Voltage Signaling | | | | | | | | LV LOW VOLTAGE |
| Combo Specifications (Storage + Special Function) | | SD SMART ASSD Advanced Secure SD | | | microSD SMART | iSDIO Wireless LAN SD | | |

## Application Performance Class New

With the expanded usage of SD memory cards for storing applications and application data, there is a growing need for a combination of Random and Sequential performance levels. This demand becomes even stronger with the introduction of Android's Adopted Storage Device capability. The Application Performance Class was introduced by SD 5.1 specification with the first App Performance Class1 (A1), to address these new application-intensive market demands followed by Class2 (A2). These new classes assure minimum random and sequential performance speeds to meet both run and store execution time requirements under given conditions, while still providing storage of pictures, videos, music, documents and other data.

**Application Performance Class Specification Table**

| Application Performance Class | Pictograph | Minimum Random Read | Minimum Random Write | Minimum Sustained Sequential Write |
|---|---|---|---|---|
| Class 1 (A1)* | A1 APP PERFORMANCE | 1500 IOPS | 500 IOPS | 10MBytes/sec |
| Class 2 (A2)** | A2 APP PERFORMANCE | 4000 IOPS | 2000 IOPS | 10MBytes/sec |

*The detailed preconditions and test are defined in SD 5.1 Part 1 Physical specification.
**The detailed preconditions and test are defined in SD 6.0 Part 1 Physical specification.

## Speed Classes

Speed Class indicates a memory card's minimum write speed. This distinction is especially needed when recording video, which requires a constant minimum write speed. Users can find out the speed of a card by the clearly indicated Speed Class, UHS Speed Class and Video Speed Class mark.


V6 V10 V30 V60 V90

The new Video Speed Class compatible cards will indicate the pictographs above

**SD Speed Class And Video Format**

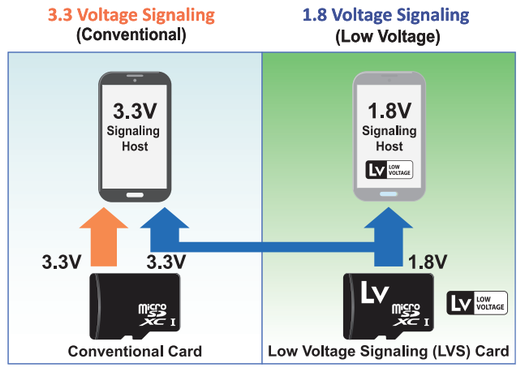
| Minimum Sequential Write Speed | Speed Class | UHS Speed Class | Video Speed Class |
|---|---|---|---|
| 90MB/sec | | | V90 |
| 60MB/sec | | | V60 |
| 30MB/sec | | U3 | V30 |
| 10MB/sec | C10 | U1 | V10 |
| 6MB/sec | C6 | | V6 |
| 4MB/sec | C4 | | |
| 2MB/sec | C2 | | |

Corresponding Video Format
The necessary speed varies by each recording/playback device condition even in the same format.

8K Video 7680 x 4320 pix
4K Video 3840 x 2160 pix
HD/ Full HD Video 1920 x 1080 pix
Standard Video 640x 480 pix

## Low Voltage Signaling New

This new feature lets product manufacturers take advantage of new SOC designs enabling smartphones to offer higher performance with less power consumption. While conventional SD memory cards have used 3.3V signaling interface, the new SD 6.0 specification introduces Low Voltage Signaling (LVS) with 1.8V signaling to let an LVS host device start in UHS-I mode directly, without 3.3V initialization process, after power up.
The LVS card is usable by both conventional hosts connected by 3.3V signaling and LVS hosts connected by 1.8V signaling. An LVS host cannot use conventional cards except when UHS-II mode is available.




## FAT File System

SDXC standard increased memory capacity more than 32GB to an extremely high capacity of 2TB, dramatically altering the digital-user experience. Moreover, adoption of the exFAT file system has enabled recording of HD videos and handling even larger files.

**Host Device and Card Compatibility**

| Host Device | SD Memory Card (2GB or less) | SDHC Memory Card (Over 2GB to 32GB) | SDXC Memory Card (Over 32GB to 2TB) |
|---|---|---|---|
| | FAT12/16 | FAT32 | exFAT |
| SD compatible | ✓ | N/A | N/A |
| SDHC compatible | ✓ | ✓ | N/A |
| SDXC compatible | ✓ | ✓ | ✓ |