

SanDisk® QuickFlow™ Technology

The world's first SD™ and microSD UHS-I cards with transfer speeds of up to 200 MB/s* deliver more efficient workflows.

SanDisk® QuickFlow™ Technology is a workflow solution for professional photographers and content creators who want to maximize their shoot time. They can get back in the field faster with the latest SD and microSD™ UHS-I card¹ offload speeds from SanDisk. The faster speeds, and time savings they deliver, are achieved when SanDisk Extreme®, Extreme PLUS and Extreme PRO® UHS-I cards are paired with SanDisk® Professional PRO-READER SD and microSD.



Cards and readers sold separately.

Focus on UHS-I Camera Ecosystems

An estimated 100 million UHS-I card-compatible cameras are in use today, including DSLR and MIL cameras, action cams, and drones. MIL cameras, action cams and drones are expected to grow through 2030.² Canon, Nikon and Sony market UHS-I camera bundles directly to content creators who represent one of the fastest-growing small businesses: 50 million people around the world describe themselves as creators and two million make a living exclusively through their content.³ UHS-I camera systems are expected to remain the de facto choice of content creators as the step to UHS-II is steep; the cameras are more expensive as are the cards.

Relevance of High-Resolution Video

Video is widely considered the most effective and efficient means for conveying information, telling stories and building brands. Video shot in 4 or 5.3K can provide exceptional clarity and detail. But high-res video fills up cards quickly: a 64GB** SD or microSD card holds less than two hours of 4K video⁷ shot at 30 fps, for example,⁴ which reinforces the need for fast offload speeds.

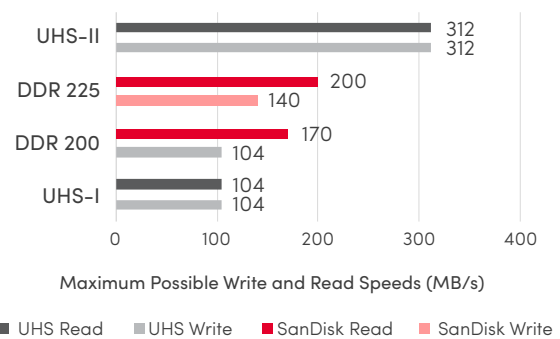


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The Foundation for Faster Speeds

SanDisk QuickFlow Technology has roots in Double Data Rate (DDR) technology. DDR runs electronic circuits at a high bandwidth and uses both edges of the clock to constrain their frequency. This forces data signals to operate with the same limiting frequency and thereby increases their transfer rate. Other industry applications of DDR include: Front-side bus (FSB) interfaces; PCI-X, predecessor to the emerging PCI Express standard; and, main memory, including DDR1 through DDR5.⁵ SanDisk launched its first DDR 200 solution in 2018, and its next generation DDR 225 in 2022.

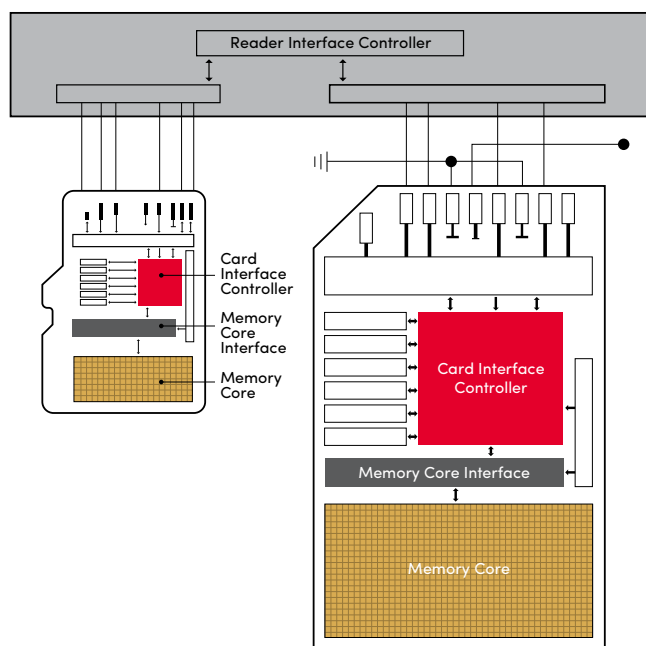
SanDisk Proprietary DDR Technology Positions in Standard Bus Interface Throughput Progress



* Speeds vary by capacity. For SanDisk Extreme PRO microSD and SD [64GB-1TB], and SanDisk Extreme PLUS microSD [64GB-1TB]: Up to 200MB/s read speeds, engineered with proprietary technology to reach speeds beyond UHS-I 104MB/s, require compatible devices capable of reaching such speeds. Write speeds lower. Based on internal testing; performance may be lower depending upon host device, interface, usage conditions and other factors. 1MB=1,000,000 bytes.
 1 64GB and higher SanDisk Extreme PRO microSD and SD UHS-I card and SanDisk Extreme Plus microSD UHS-I card
 2 Source: Western Digital internal data based on third party research.
 3 Yuan, Yuanling. "What Is the Creator Economy? Influencer Tools and Trends." SignalFire, 29 Nov. 2020, signalfire.com/blog/creator-economy/.
 4 Approximations; results and 4K UHD (3840x2160) support vary based on host device, file attributes and other factors.
 5 "Double Data Rate." Wikipedia, 2 Jan. 2022, en.wikipedia.org/wiki/Double_data_rate. Accessed 19 Apr. 2022.

IP for Faster Speeds and Greater Value

SanDisk's adaptation of DDR enables speeds greater than 104MB/s without use of additional strobes or pins (which add cost) on SD and microSD UHS-I cards. As described in US Patent 10129012, SanDisk has delivered innovation around the use of IO tuning and data sampling in firmware as a reliable replacement for physical hardware. Card speed increases are enabled by firmware that adjusts the clock to run at double data rates by sampling data on both the rising and falling edges of the clock. The original implementation –DDR200–did not change the clock frequency which remains at or below 208 MHz. The new implementation–DDR225 or SanDisk QuickFlow Technology–increases the clock frequency above 208 MHz to enable transfer speeds up to twice as fast as standard UHS-I cards. In-house designed and produced NAND with proprietary higher performance trims and interfaces also contribute to higher performance levels.



- Custom firmware with detection schemes and adjustments to clock, bus and card output timing
- Custom firmware sampling data on both rising and falling edges of the clock and increasing clock frequency.
- Faster memory core interfaces
- NAND memory with proprietary higher performance trims

Time and Money Savings

SanDisk QuickFlow Technology reduces 4K video transfer times by up to 53 percent.⁶ That means users will save 65 minutes⁶—more than an hour—when transferring 10 hours of 4K video⁷ shot at 60 fps, freeing them to shoot and create more.

Video Transfer Time Saved in Minutes:⁸
DDR 225 vs UHS-I and DDR 200

New

Hours of Video Read	UHS-I (104MB/s)		DDR 200 (170MB/s)	
	4K @ 30 fps	4K @ 60 fps	4K @ 30 fps	4K @ 60 fps
1	6.2	6.5	2.2	2.6
2	12.4	13.1	4.4	5.2
3	18.7	19.6	6.6	7.9
4	24.9	26.1	8.8	10.5
5	31.1	32.7	11.0	13.1
6	37.3	39.2	13.2	15.7
7	43.5	45.7	15.4	18.3
8	49.8	52.2	17.6	21.0
9	56.0	58.8	19.8	23.6
10	62.2	65.3	22.0	26.2

The technology reduces RAW photo transfer times by up to 47 percent which saves them 23 minutes after transferring 10,000 images.⁶ See appendix for additional detail.

Photo Transfer Time Saved in Minutes:⁸
DDR 225 vs UHS-I and DDR 200

New

Number of Photos Read	UHS-I (104MB/s)		DDR 200 (170MB/s)	
	6.7MB JPEG	23.7MB RAW	6.7MB JPEG	23.7MB RAW
1,000	0.6	2.3	0.1	0.3
2,000	1.3	4.5	0.1	0.5
3,000	1.9	6.8	0.2	0.8
4,000	2.5	9.1	0.3	1.0
5,000	3.2	11.4	0.4	1.3
6,000	3.8	13.6	0.4	1.6
7,000	4.4	15.9	0.5	1.8
8,000	5.0	18.2	0.6	2.0
9,000	5.7	20.4	0.6	2.3
10,000	6.3	22.7	0.7	2.5

In addition to saving time, SanDisk QuickFlow Technology enables a more efficient workflow at a significantly lower cost. Based on 256GB** SanDisk Extreme PRO UHS-I and UHS-II card pricing in June 2022, users would save approximately \$250 when purchasing a UHS-I card with PRO-READER SD and microSD instead of a UHS-II card. They would save even more—nearly \$350—when buying a UHS-I card with PRO-READER SD and microSD instead of a UHS-II card with PRO-READER Multi-card.

6 Based on internal testing with SanDisk Extreme PRO and Extreme PLUS microSD UHS-I cards [128GB] on SanDisk Professional PRO-READER SD and microSD card reader vs. SanDisk Ultra® microSD UHS-I card [128GB, up to 100MB/s read speed] on SanDisk MobileMate® microSD card reader (representing standard UHS-I speeds). Performance may be lower depending on host device, interface, usage conditions and other factors.

7 Compatible device required. 4K UHD (3840x2160) support may vary depending upon host device, file attributes, usage conditions and other factors. See www.sandisk.com/HD.

8 Based on internal testing with SanDisk Extreme PRO and Extreme PLUS microSD UHS-I cards [128GB] on SanDisk Professional PRO-READER SD and microSD card reader (representing DDR 225) vs. SanDisk Extreme PRO microSD UHS-I card [128GB] on SanDisk MobileMate microSD card reader (representing standard UHS-I speeds) and SanDisk Ultra microSD UHS-I card [128GB, up to 100MB/s read speed] on SanDisk MobileMate microSD card reader (representing standard UHS-I speeds). Performance may be lower depending on host device, interface, usage conditions and other factors.

Product Lines Involved

SanDisk QuickFlow Technology is enabled at 64GB capacities** and above in the Extreme PRO, Extreme PLUS and Extreme SD and microSD UHS-I card lines.

				
200MB/s 90MB/s	200MB/s 90MB/s	200MB/s 140MB/s	200MB/s 140MB/s	200MB/s 140MB/s
				
170MB/s 80MB/s	190MB/s 90MB/s	190MB/s 130MB/s	190MB/s 130MB/s	
				
170MB/s 80MB/s	180MB/s 90MB/s	180MB/s 130MB/s	180MB/s 130MB/s	
				
200MB/s 90MB/s	200MB/s 90MB/s	200MB/s 140MB/s	200MB/s 140MB/s	200MB/s 140MB/s
				
200MB/s 90MB/s	200MB/s 90MB/s	200MB/s 140MB/s	200MB/s 140MB/s	200MB/s 140MB/s
				
170MB/s 80MB/s	190MB/s 90MB/s	190MB/s 130MB/s	190MB/s 130MB/s	190MB/s 130MB/s

SanDisk Professional PRO-READER SD and microSD enables the stated speeds.⁹



The O.G. of Imaging Media

QuickFlow Technology is just one of countless innovations SanDisk has contributed to the Imaging space. SanDisk co-founder Dr. Eli Harari is credited with the development and commercialization of the compact, low-cost flash memory that helped make digital cameras possible, along with a vast range of products and entities including smartphones, tablets, computing and IoT devices, data centers, and more.¹⁰

SanDisk collaborated with Canon and Kodak in 1992 to standardize camera card slots and create the card ecosystem that remains intact today. Along with industry partners, SanDisk formed the CompactFlash Association and SD Association. Nearly every card format introduced includes SanDisk IP.¹¹

- **1994** Introduced the CompactFlash™ card
- **1997** Introduced the MultiMedia Card (MMC)
- **2000** Introduced the SD card with Panasonic and Toshiba
- **2002** Introduced the Memory Stick® PRO and half-size Duo card with Sony
- **2003** Introduced the miniSD card
- **2004** Introduced the Transflash (now microSD)
- **2013** Introduced the CFast™ 2.0 professional video cards
- **2016** Introduced the SD UHS-II card

In addition to bringing key media formats to market, SanDisk has launched most of the industry-first capacity options and performance levels, including the world's first 1TB** SD UHS-I card and world's fastest 1TB** microSD UHS-I card. SanDisk QuickFlow Technology builds on this legacy of innovation to deliver breakthrough performance and tangible consumer benefits.

⁹ 1MB/s = 1 million bytes per second. Engineered with proprietary technology to reach speeds beyond UHS-I 104MB/s, require compatible devices capable of reaching such speeds. Based on internal testing; performance may vary depending upon host device, usage conditions, drive capacity, and other factors.

¹⁰ "Western Digital Congratulates SanDisk Founder and Retired CEO Dr. Eli Harari on Induction into National Inventors Hall of Fame." Western Digital, 8 May 2017, www.western-digital.com/company/newsroom/press-releases/2017/2017-05-08-western-digital-congratulates-sandisk-founder-dr-eli-harari. Accessed 19 Apr. 2022.

¹¹ <https://www.flashmemorysummit.com/English/PDFs/FMS2020-Timeline.pdf>

** 1GB=1,000,000,000 bytes. 1TB=1,000,000,000,000 bytes. Actual user storage less.

Appendix

Video and Photo Transfer Times In Seconds: ⁸ DDR 225 vs. UHS-I vs. DDR 200	DDR 225	UHS-I		DDR 200	
	200MB/s	104MB/s	Change	170MB/s	Change
VIDEO					
Transfer 30 minutes of 4K UHD video shot at 30 fps in XX seconds (29.7 GB)	167	349	-49.1%	199	-15.8%
Transfer 30 minutes of 4K UHD video shot at 60 fps in XX seconds (31.5 GB)	175	370	-53.3%	215	-28.8%
Transfer one hour of 4K UHD video shot at 30 fps in XX seconds (59.8 GB)	330	703	-53.1%	462	-25.3%
Transfer one hour of 4K UHD video shot at 60 fps in XX seconds (63.0 GB)	348	740	-53.4%	505	-30.1%
PHOTO					
Transfer 1,000 standard resolution (JPEG) photos in XX seconds (6.7 MB)	48	86	-44.2%	52	-7.7%
Transfer 1,000 highest resolution (RAW) photos in XX seconds (23.6 MB)	152	288	-47.2%	167	-9.0%

Video and Photo Transfer Times In Minutes: ⁸ DDR 225 vs. UHS-I vs. DDR 200	DDR 225	UHS-I		DDR 200	
	200MB/s	104MB/s	Change	170MB/s	Change
VIDEO					
Transfer 30 minutes of 4K UHD video shot at 30 fps in XX minutes (29.7 GB)	2.78	5.82	-49.1%	3.32	-15.8%
Transfer 30 minutes of 4K UHD video shot at 60 fps in XX minutes (31.5 GB)	2.92	6.17	-53.3%	3.58	-28.8%
Transfer one hour of 4K UHD video shot at 30 fps in XX minutes (59.8 GB)	5.50	11.72	-53.1%	7.70	-25.3%
Transfer one hour of 4K UHD video shot at 60 fps in XX minutes (63.0 GB)	5.80	12.33	-53.4%	8.42	-30.1%
PHOTO					
Transfer 1,000 standard resolution (JPEG) photos in XX minutes (6.7 MB)	0.80	1.43	-44.2%	0.87	-7.7%
Transfer 1,000 highest resolution (RAW) photos in XX minutes (23.6 MB)	2.53	4.80	-47.2%	2.78	-9.0%



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