

Choosing SD cards for optimal duplicating efficiency

Selecting both target and master SD cards for your duplication operations involves many important factors, including price, storage capacity, and end use. An understanding of SD card read/write speeds, SD card labeling, and duplicator performance can help you make the right choice to optimize your duplication operations.

Virtual Console duplicators

Let's start with understanding the capabilities of the duplicators. Virtual Console (www.vconsole.com) makes 21 port (FCD-SD-21), 42 port (FCD-SD-42), 60 port (FCD-SD-60), and 120 port (FCD-SD-120-GEN2) duplicators.

Virtual Console duplicator speeds

The 21, 42, and 60 port duplicators provide write speeds up to 7 MB/s, while the 120 port duplicator can write at up to 23 MB/s.

In order to make the most efficient use of Virtual Console duplicators, you will want to ensure that your master card has a read speed of at least 7 or 23 (for the FCD-SD-120-GEN2) MB/s, and your target cards have at least write speeds of 7 or 23 MB/s.

SD Card read/write speeds

There are two industry-standard labeling regimes for SD cards: Class rating, and UHS rating. SD cards display at least the Class rating, and some cards will display both a Class rating and a UHS rating.

Class Rating

SD cards can carry a class rating of 2, 4, 6, or 10, which guarantee read/write performance of at least 2 MB/s, 4 MB/s, 6 MB/s, or 10 MB/s respectively.

As it happens, reading is typically a much simpler (and thus faster) operation than writing. For all practical purposes, the class rating is really a guarantee of write speed, and the read speed of a card may likely well exceed its class rating. Additionally, any particular card is likely to write at speeds somewhere between its listed Class rating and the next speed up.

For example, one Class 4 card we tested wrote at speeds exceeding 5 MB/s (but less than 6 MB/s), and read at speeds greater than 17 MB/s.

Recommended Class rating for 21, 42, and 60 port duplicators

For clients using Virtual Console (www.vconsole.com) duplicators which operate at up to 7 MB/s, Class 10 cards would, of course, be clearly fast enough to provide the most efficient duplication. However, keep in mind that some Class 6 may be less expensive than class 10 cards, and may also provide read/write speeds that permit the most efficient use of these duplicators.

How would you know if a Class 6 card could write that quickly? There is testing software available for free, and most laptops/desktops have the SD card hardware required for testing,

as well. A section on testing is included farther down in this article.

UHS rating

UHS stands for Ultra High Speed, and the technology was introduced to SD cards in 2010. Prior to the UHS upgrade, SD card read/write speeds were limited to 25 MB/s. UHS-I ratings denote a card with read/write speeds up to 104 MB/s, and UHS-II ratings denote read/write speeds up to 312 MB/s.

It is important to note that while these cards may be able to reach those speeds, performance may be limited by the host device. For example, UHS-II cards carry an additional set of pins. Hardware lacking these pins will not be able to take advantage of UHS-II speeds. Even UHS-I theoretical top speeds will be unavailable to SD card read/write hosts that connect via a USB 2.0 connection, as USB 2.0 tops out at 35 MB/s transfer rate.

In large part, the applications driving greater and greater speeds have been digital photography and HD video recording. While UHS-II can reach incredibly fast speeds, most devices are not equipped to move data that quickly. Indeed, in practice, at the moment, even the speediest cards on the market top out near the high end of UHS-I speeds.

Choosing cards for 120 card duplicators

Clearly, to take full advantage of the 23 MB/s second throughput of the Virtual Console (www.vconsole.com) FCD-SD-120-GEN2 120 slot SD card duplicator, you will want a master card that reads at least 23 MB/s and target card that writes at least 23 MB/s.

Here's where it gets a little tricky. Now, A Class 10 card is no guarantee of sufficient speed to utilize the full 23 MB/s 120 slot duplicator throughput, but just as importantly, neither is a UHS-I rating. UHS is a MAXIMUM rating, not a minimum rating.

For an illustration of the situation, take a look at SanDisk's current consumer offerings in UHS-I labeled cards. All of the cards are labeled Class 10, UHS-I. The Extreme Pro carries additional labeling offering up to 95 MB/s read and 90 MB/s write, the Extreme Plus promises 80 MB/s read and 60 MB/s write, the Extreme is labeled at 45 MB/s both read and write, and the Ultra offers up to 30 MB/s read and "write speed lower." Yet all the cards are appropriately labeled Class 10, UHS-I.

The need for speed?

There are trade-offs, of course, mostly in price-to-performance, that help determine which card is the right one for your duplication efforts.

How much does speed matter? Take a look at the chart below. Assume you are imaging the Raspbian Wheezy OS for the Raspberry Pi minicomputers. Coming in at 2,825,800KB (2762.5MB / 2.7GB), the time to duplicate the OS varies with read/write speed:

File size (K) 2825	target card	
	MB/s write speed	Minutes to duplicate
	4	11.77
	5	9.42
	6	7.85
	7	6.73
	8	5.89
	9	5.23
	10	4.71
	11	4.28
	12	3.92
	13	3.62
	14	3.36
	15	3.14
	16	2.94
	17	2.77
	18	2.62
	19	2.48
	20	2.35
	21	2.24
	22	2.14
	23	2.05

So, how can you know what a Class 10, UHS-I card really has for a write speed?

Labeling, and testing

Some manufacturers have taken to providing additional read/write speed guidance on the label of the card. As noted earlier, SanDisk's consumer cards carry this extra information. SanDisk also has a commercial Class 10 UHS-I card labeled at 30 MB/s read/write speed, with one important caveat: "depending upon host device." In our case, the host device has a top write speed of 23 MB/s, so the card won't write faster than the duplicator.

But what if the choice is between two cards at similar pricing that carry no more information than Class 10, UHS-I? If the goal is to get the most bang for the buck, testing is fairly straight forward.

Testing

Fortunately, simple testing software is free to obtain. The software h2testw_1.4 is the latest version of a testing tool that was developed in response to some SD card customers seeking to test actual card performance versus the performance promised by the card label. For a Windows platform, it is downloaded as a zip file, which, when unpacked, contains a simple .exe file that can be run without installation.

To be fair to manufacturers, it is important to acknowledge the likelihood of bottlenecks in the testing system. For example, a card reader moving data on a USB 2.0 connection won't write faster than 35 MB/s, since it is limited by the connection. On that system, SanDisk's top-end consumer card would not test as fast as its label. A USB 3.0 card reader, connected via USB 3.0 cable to a USB 2.0 port is still limited to USB 2.0, of course.

Fortunately for the purposes of benchmarking for Virtual Console speed, USB 2.0 is not a significant limitation, since it is faster than the write speed of the 120 card duplicator. Most relatively recent hardware should give an investigator fairly reliable results.

Card test results

We tested several cards:

Mfr	Size	Write	Read	Posted speed
Sandisk	16GB	25.0	30.0	45.0
Sony	16GB	11.4	27.1	40.0
Toshiba	8GB	11.1	27.1	30.0
PNY	16GB	19.0	30.7	35.0
Lexar	8GB	17.1	27.1	400x (58.0)
Sandisk	8GB	17.1	27.3	30.0

Test Tools:

External Sandisk USB 3.0 card reader to Windows 7
laptop via USB 2.0 port

Sandisk	16GB	16.0	17.3	45.0
Sony	16GB	10.7	16.7	40.0
Toshiba	8GB	10.9	16.9	30.0
PNY	16GB	12.8	17.1	35.0
Lexar	8GB	13.9	16.4	400x (58.0)
Sandisk	8GB	11.5	16.9	30.0

Test Tools:

Onboard Realtek USB 2.0 card reader Windows 7
laptop

There are a few interesting things to note from these results. First, the test tools matter. The same cards tested much slower on the Realtek USB 2.0 system than they did on the SanDisk USB 3.0 reader. So it may be that our test environment kept the cards from their full capacity.

However, it is clear that, even with the test environment limitations, the SanDisk card advertised at 45 MB/s well outpaced the Lexar advertised at 60 MB/s. In fact, the slower SanDisk card rated at 30 MB/s wrote as fast as the Lexar. And both the Sony and Toshiba cards tested similarly (not very well) on both systems.

Conclusion

SD card duplicators looking to make the most efficient use of their Virtual Console (www.vconsole.com) duplicators may want to perform independent testing on target cards used. Even accounting for some limitations in testing environments, it is clear that the speeds advertised by card manufacturers may not translate to speedier write times.