

Read	(TAAC + NSAC)	100ms
Write	(TAAC + NSAC) * R2W_FACTOR	250 ms

The factors used in calculating the values in Table 1—TAAC, NSAC, and R2W_FACTOR—can be read directly from the CSD register of the MultiMediaCard and SD Card.

The TAAC factor's unit is time, and the NSAC factor has units of 100 clocks. You can convert TAAC units to clock cycles by multiplying by the frequency of the clock and calculate the time-outs in units of clock cycles if desired. Alternatively, given the frequency of the clock, you can convert the NSAC units to time and calculate the time-outs in units of time.

The R2W_FACTOR is a read-to-write factor and has no units. A design engineer can use the time-out values derived from the CSD register to make the design compatible with all MultiMediaCards and SD cards regardless of customer brand.

Interface

The MultiMediaCard and SD Card support multiple busses. Both cards support the 1-bit SPI bus that includes bus pins DATin, DATout, CLK, and CS. The SPI bus is generally found on Motorola and other major MCU manufacturer products.

The SD Card also supports a 4-bit and a 1-bit SD bi-directional bus mode. SD bus pins are CLK, CMD, and DAT in 1-bit mode and CLK, CMD, and DAT[0:3] in 4-bit mode.

The MultiMediaCard also supports the 1-bit bi-directional MMC bus mode that has CLK, CMD, and DAT bus pins. The CMD and DAT pins are bi-directional on the SD 1-bit, SD 4-bit, and MMC 1-bit.

The maximum burst rate achievable with the SD Card and MultiMediaCard depends on the clock speed and bus mode. The burst rate is the data transfer rate between the card's buffer and host.

Table 2. MultiMediaCard and SD Card Clock Speed and Burst Rate

Product	Maximum Clock Speed and Burst Rate	
MultiMediaCard	Clock Speed	Burst Rate
SPI Bus mode	20 MHz	2.5 MB/s
MMC 1-bit mode	20 MHz	2.5 MB/s
SD Card		
SPI Bus mode	25 MHz	3.125 MB/s
SD 1-bit mode	25 MHz	3.125 MB/s
SD 4-bit mode	25 MHz	12.5 MB/s

The write and read throughput rates of the SD Card and MultiMediaCard are slower than the burst rate because each card includes the busy time to write data from the card's buffers to its internal Flash RAM, and busy time to read data from the internal Flash RAM to the card's buffer. Since most designs use this write and read busy time to complete other processes, choosing a 1- or 4-bit bus mode can have a 4x speed effect on the time spent servicing the SD Card.

The example in Table 3 shows the difference between moving 512 bytes of data to and from a MultiMediaCard or SD Card internal buffer using different bus modes.