



Document LBA1-03

LBA Count for Disk Drives Standard

1.0 Purpose

The purpose of this standard is to define the required native LBA counts for a given capacity across all Disk manufacturers. This simplifies an aspect of Disk and reduces confusion and compatibility complication in the industry. It is a fact that for many years, each Disk supplier has different LBA count for a given reported Disk capacity. In addition, each system manufacturer requires different minimum LBA count for a given capacity resulting in LBA counts variations in the industry for each capacity point.

This variation is eliminated by this industry standard. This document shall be used to determine an industry standard LBA count for each reported capacity. It will also be used by all Disk suppliers and accepted by all system manufacturers. This implementation results in all Disks having the same LBA count for each reported capacity and system manufacturers will be rest assured with consistent LBA counts across manufacturers.

2.0 Scope

This document supersedes the LBA1-02 document which was intended for only IDE disk drives and applied only to 3.5 inch ATA drives 160GB and greater and 2.5 inch ATA drives 80GB and greater. Legacy capacities are not addressed by this standard to allow system manufacturers to continue to use established LBA counts. At that time, 3.5" 160GB have been shipping for a while so many system manufacturers have already defined their own LBA counts requirement. Most system manufacturers began to adopt the LBA1-02 implementation at or after 3.5" 320GB density point.

The scope of this document has been increased to include SATA/SAS Disk drive, SATA/SAS Large Data Sector (4k sector) drives and SAS disk drive whose sector is formatted with T10 PI (Protection Information), a.k.a. DIF (Data Integrity Format). This document defines the algorithm for determining the number of LBAs a disk drive shall have based on the reported capacity of the drive. The way in which a drive notifies the host of its LBA count is defined in standard documents referenced in section 3.0.

3.0 Reference Documents:

1. AT Attachment 8 – ATA/ATAPI Command Set (ATA8-ACS), Rev 4c or later (T13/1699-D)
2. SCSI Block Commands – 3 (SBC-3) (T10/1799-D)
3. SCSI Primary Commands – 3 (SPC-3) (T10/1416-D) (ANSI/INCITS 301-1997)
4. SCSI Primary Commands – 4 (SPC-4) (T10/1731-D)
5. Serial Attached SCSI (SAS) (T10/1562-D) (ANSI/INCITS 376-2003)
6. Serial Attached SCSI – 1.1 (SAS-1.1) (T10/1601-D) (ANSI/INCITS 376-2003)

4.0 Equipment

Not applicable

5.0 Test Samples

Not applicable

6.0 LBA counts and Reported Capacity

Basic LBA count = Reported Capacity / Sector Size

Basic Capacity = LBA count * Sector Size

IDEMA formula for LBA count and capacity provide 0.02% margin (see Table 1)

For SATA and SAS Disk Drive with 512bytes sector size:

The LBA1-03 algorithm is the same as LBA1-02. This formula is applicable for 2.5" SATA at 80GB or greater, 2.5" at 320GB or greater, 2.5" SAS at 73GB or greater, and 3.5" SAS at 450GB or greater.

LBA counts = (97,696,368) + (1,953,504 * (Reported Capacity in GBytes – 50.0))

Or

Reported Capacity (GB) = [(LBA counts – 97,696,368)/1,953,504] + 50.0

Examples:

To report 500GB capacity, the required LBA count is:

LBA count = 97696368 + (1953504 * (500 – 50.0)) = 976,773,168

If a drive has 585,397,500 LBA counts then the reported capacity is:

Reported Capacity = [(585,397,500 – 97,696,368)/1,953,504] + 50.0 = 300GB

For SATA and SAS Disk Drive with LDS (long data sector), sector size is 4096 bytes:

The formula is scaled by dividing the first two constants by eight. This results in consistent capacity margin over the basic capacity. The basic capacity is simply multiplying the sector size by the total number of LBA sector counts. The basic LBA count is basic capacity divided by as shown in Table 1.

LBA counts = (12,212,046) + (244,188 * (Reported Capacity in GBytes – 50.0))

Or

Reported Capacity (GB) = [(LBA counts – 12,212,046)/244,188] + 50.0

Examples:

To report a 500GB capacity (LDS format), the required LBA count is:

LBA count = 12,212,046 + (244,188 * (500 – 50.0)) = 122,096,646

If an LDS drive has 109,887,246 LBA counts then the reported capacity is:

Reported Capacity = [(109,887,246 – 12,212,046)/244,188] + 50.0 = 450GB

Table 1:

	<u>Reported Capacity (GB)</u>	<u>512 bytes sector</u>	<u>4096 bytes sector</u>
		LBA counts	LBA counts
IDEMA	450	879,097,968	109,887,246
Basic	450	878,906,250	109,863,281
Capacity Margin		0.02%	0.02%

Common LBA counts with Protection Information enabled HDDs formatted with T10 PI (Protection Information) have 8 bytes added to the end of each sector. However, the user usable sector size will remain at 512 bytes or 4096 bytes. The 8 bytes of PI will increase the overhead of the disk sector density similar to overhead of ECC bytes in a given sector. Unlike ECC bytes which vary by design, the T10 PI is a fixed 8 bytes to each sector. So, it will be (512+8) on 512 bytes sector and (4096+8) on 4096 bytes sector. Since these 8 bytes are not user usable sectors but are protocol overhead, the number of LBA count on a T10 PI formatted drives must be the same as their non-T10 PI counterparts for the same reported capacity. Therefore a reported capacity of 450GB will have identical user usable LBA sectors counts in either basic 512 bytes formatted drives or T10 PI formatted drives. HDDs that are not capable of supporting the common LBA count requirement shall be stated on the drive label.

Table 2 shows the illustration.

Table 2:

	<u>Reported Capacity (GB)</u>	<u>512 bytes sector no T10 PI Support</u>	<u>512 bytes sector T10 PI support</u>	<u>4096 bytes sector no T10 PI support</u>	<u>4096 bytes sector T10 PI Support</u>
		LBA counts	LBA counts	LBA counts	LBA counts
IDEMA	450	879,097,968	879,097,968	109,887,246	109,887,246
Basic	450	878,906,250	878,906,250	109,863,281	109,863,281
Capacity Margin		0.02%	0.02%	0.02%	0.02%