
UDO Compliant Write Once Media Technical Overview

**A technical overview of the operation of
UDO Compliant Write Once media**

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1 Compliant Write Once Media Product Overview

1.1 Market Requirements

Driven by industry regulations on data retention and corporate risk management objectives, organizations today are demanding secure archive solutions with a more complex range of service level requirements than in the past. Within a single archive environment, there are often a wide mix of retention periods and disposition specifications. Compliance with freedom of information legislation and concerns over legal liability are placing a new emphasis on the proper disposal of information. Many records must be retained on storage media that provides unquestioned authenticity, but also allows for the physical “shredding” or destruction of electronic files (documents) when they reach the end of their retention period. UDO Compliant Write Once media has been designed specifically to address these evolving requirements.

Compliant Write Once media has the same operational properties as traditional Write Once optical media with one important difference. Through the use of a specially designed “shred” operation, individual documents written to Compliant Write Once media can be completely destroyed. This carefully controlled and verified process provides an extremely high standard for data destruction, giving organizations complete confidence that shredded data is no longer physically present on the media. The development of Compliant Write Once UDO media was a direct response to evolving archive demands and represents a unique and powerful capability for professional archival storage environments.

1.2 UDO Media Type Overview

UDO Compliant Write Once media is part of a trio of UDO media options that also includes True Write Once and Rewritable formats. Each of the three media types has its own physical and operational properties making it well suited for different service levels within an overall archive strategy. Since UDO drives and Plasmon optical libraries support all media types, organizations can match the media format with the specific demands of each document class.

Rewritable UDO media is typically used in archive applications where the stability and longevity of optical media are important, but records change frequently and there is a need to delete and rewrite information. UDO Rewritable media is ideal for small office and departmental applications or in larger unstructured archives that are not subject to specific regulatory or corporate standards.

True Write Once media offers the highest level of physical record authenticity and is ideal for document classes with very long or indefinite record retention periods. Common uses of True Write Once media include medical, financial, industrial and cultural applications that require documents be retained for years or decades and must be held to a very high standard of legal admissibility.

Compliant Write Once media combines longevity and secure authenticity of Write Once UDO media with the ability to shred expired records for document classes that demand physical disposal. Designed specifically to assist organizations in meeting regulations on data retention and disposition while managing corporate risk, Compliant Write Once media can be used in a wide range of financial, administration and legal applications.



Figure 1 – Photograph of the three UDO media types

Refer to the UDO Media Overview datasheet for a more detailed description of the three UDO media types, their key benefits and typical applications.

2 Compliant Write Once Media Operational Overview

2.1 Physical Media Identification

UDO Write Once Media is available in two different formats: True Write Once and Compliant Write Once. Since both of these media formats offer similar Write Once media attributes, they are housed in the same blue Write Once antistatic media cartridge. While the cartridge color is the same, the Compliant Write Once media has a distinctive red text field printed on the shutter.

At an operational level, the UDO drive identifies the three UDO media types through the use of a SDI (Specific Disk Information) field registered on the media header during the manufacturing process. The SDI is present in a specific location on the media and cannot be altered or modified. In addition to containing a unique disk serial number, the name of the manufacturer and additional drive and media information, it also includes a code that identifies the media as Rewritable, True Write Once or Compliant Write Once. A UDO drive can read and write data on all three media types, but since the physical recording surfaces differ, the drive needs to know which media is loaded so a drive calibration can be performed for the appropriate media characteristics.

The SDI number is automatically read by the UDO drive when a piece of media is loaded, and if identified as Compliant Write Once media, the SDI authorizes the drive firmware to perform the shred operation used to destroy data sectors. The combination of a media based SDI and drive based firmware controls provides a highly secure architecture that ensures the proper and efficient operation of all three media types.

2.2 Media Sector Format

Compliant Write Once media uses the same 8KB sector size as the other two UDO media types. Each 8KB sector is divided into three primary fields: a VAP (Verify and Protect) field, the actual data field and a field containing ECC (Error Correction Code) information. Figure 2 provides a schematic diagram detailing the full structure of the 8KB sector.

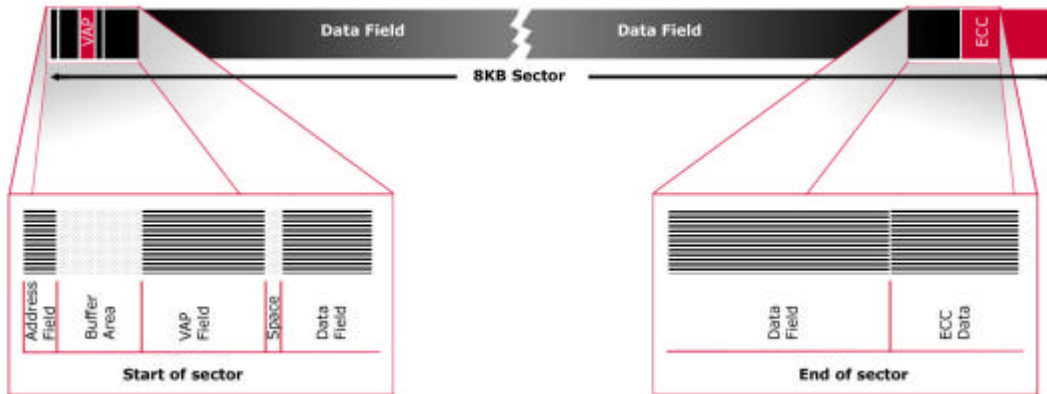


Figure 2 – Structure of 8KB Media Sector

The VAP field is created when data is written to media sectors on True Write Once and Compliant Write Once media. It is a standard identifier to verify that the sector in question is a Write Once sector. This field is present primarily for efficiency. The presence of the VAP field tells the application that there is no need to perform a “Blank Check” pass on the sector in question. The VAP field is very small, using less than one tenth of one percent of the 8KB sector.

The data field contains the actual file data written by the application or user and occupies about 90% of the total sector size. This is followed by the ECC field, which makes up the remaining 10% (approximately) of the sector. The ECC file contains coded parity information about the data in the sector that allows the drive to read the data field even if the media surface is dirty or has been damaged.

2.3 Data Shred Command Operation and Application Control

On Compliant Write Once media, the data field within a media sector can be destroyed by means of a unique data shred command executed through the SCSI interface. However, given the sensitive nature of data destruction, shred operations are normally only initiated at an application level where access and security can be closely managed.

When the shred command is executed against a specific sector or range of sectors, only the data field within each 8KB sector is destroyed. The VAP and ECC fields remain intact. These fields are left in place to allow the drive to quickly recognize the sector as shredded. If all fields within the sector were destroyed, the drive could confuse the sector(s) as unwritten or damaged causing unnecessary reallocation operations that would degrade performance.

Figure 3 illustrates the structure of an 8KB sector before and after a shred command has been executed.

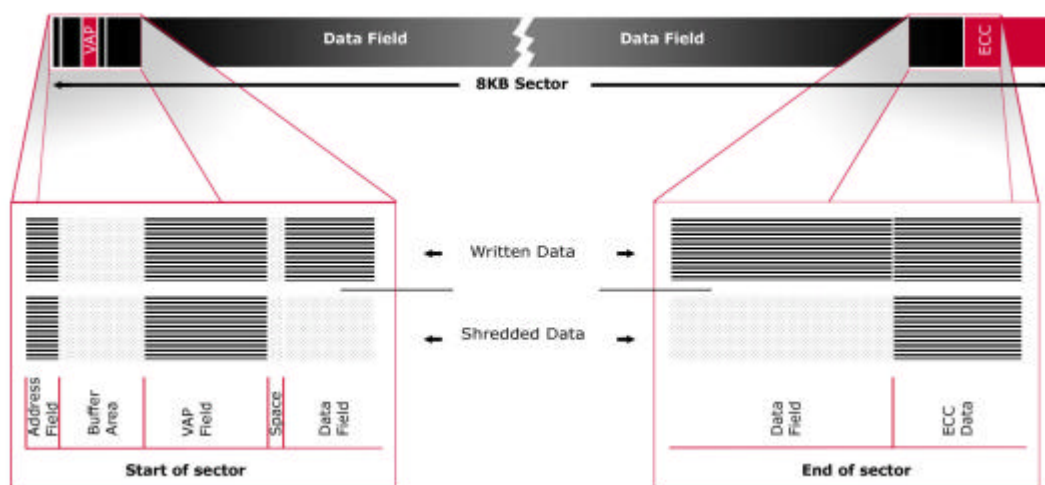


Figure 3 – Data Destruction on 8KB Media Sector

It is important to note that while the associated ECC information for a destroyed data field is left behind, it would be mathematically impossible to reconstruct the entire data field from the remaining coded information. The ECC parity data is only relevant if a portion of data field was damaged or obscured. ECC contains no actual data so its presence does not compromise the physical destruction of data field.

The ability to clearly and quickly identify shredded sectors is very important since it provides applications with a tool for secure audit trail management of the data destruction process. An application can track all shred operations and report precisely on which data was destroyed, when and by whom. Since the shredded sectors are easily identifiable, the application can even provide physical verification of destroyed documents.

2.4 Physical Destruction and Verification Process

UDO media employs a Phase Change recording process to read and write data on the three different media types. A high-density blue laser heats the recording surface changing the molecular structure between crystalline and amorphous states depending on the function being performed and the media type in question. With Rewritable media data, sectors can be erased and rewritten. True Write Once media only permits write and read operations since it is not possible for the laser, regardless of the temperature, to alter the data once it has been written. Like True Write Once media, Compliant Write Once media does not allow the deletion and rewriting of data, but has a special shred command to destroy data fields.

The shred command that operates on Compliant Write Once media uses a specific laser intensity that totally destroys the data files on targeted sectors. Data points written using Phase Change technology can exist in only one state at a time (amorphous or crystalline) so once destroyed the data cannot be retrieved. When shredded, the physical and chemical Phase Change process begins at the perimeter of the data points and re-crystallizes from the outside in. As a result, no residual traces of data are left behind even when factoring in track deviation and variance in laser intensity tolerances from one drive to another.

The destruction process on Compliant Write Once media is very different than the erase pass on a magnetic disk. Magnetic disk erase operations leave physical traces of recorded data that can be recovered using special procedures. To avoid data recovery on magnetic disks, a multi-pass erase and overwrite operation can be employed, rewriting a specific pattern as many as ten times over the same sector to ensure that data cannot be recovered. This multi-pass overwrite operation can be very time consuming if there are large numbers of documents to be destroyed and if this technique is not used, the documents may still be

present on the disk creating a potential liability risk for business or other organizational processes.

By contrast, UDO Compliant Write Once media uses a secure two-pass shred operation. The first pass is for the destruction of the data and the second pass is to verify that the operation was successfully completed. The physical nature of the Phase Change technology means that the destruction process on Compliant Write Once media is far more absolute than is possible with magnetic disk recording.

Refer to Section 5 of this document for oil immersion microscopic images of UDO Compliant Write Once media before and after a shred operation. These images visually demonstrate how effective the shred function is in totally destroying targeted sectors.

2.5 Shredding of Reallocated Sectors

Sector reallocation on UDO media uses a very similar technique as is employed with magnetic disks. If a defective media sector was identified during a write operation it would be automatically reallocated from the original sector to a secondary defect list. When a shred operation is executed against a sector with reallocation, both the original and reallocated sectors are shredded in order to ensure that all data related to the targeted sector is physically destroyed.

2.6 Verify and Scan Operations

Since Compliant Write Once media only allows data to be written once to any given sector, the media capacity from shredded sectors cannot be recaptured. Consequently, it is necessary for both the drive and higher level applications to easily distinguish shredded sectors from blank sectors when assessing sector availability and overall media capacity.

When a sector is shredded it retains a status that is clearly identifiable at an application level. If the application issues a standard "Verify for Written" SCSI operation against a shredded sector, the drive returns a "shredded" status to inform the host that the sector is not blank. If the application issues a "Verify for Blank" operation against a shredded sector, the drive returns a "Not Blank" status so that inappropriate write operations cannot be performed.

When trying to assess the available media capacity, a "Medium Scan" operation can be executed. This command identifies shredded sectors as "written", allowing the proper available media capacity to be determined.

3 Compliant Write Once Media Implementation Overview

3.1 Drive and Library Implementation

UDO drives are capable of supporting all three UDO media types, i.e. Rewritable, True Write Once and Compliant Write Once media. UDO drives installed in the field before the release of Compliant Write Once media require a straightforward firmware upgrade to enable the shred functionality. The data shred feature is supported in drive firmware versions U03 and later. Drives operating with firmware versions before U03 will not recognize the Compliant Write Once media, issuing an error message when the media is loaded. Drive firmware must be updated before Compliant Write Once media can be used.

Plasmon G-Series libraries support the full range of UDO media types without modification. A single library can contain a mix of Rewritable, True Write Once and Compliant Write Once media. This capability gives organizations the flexibility to match the business needs of their different data classes with the most appropriate media type.

3.2 Software Support

UDO drives and libraries are supported by more than 40 Independent Software Vendors (ISVs) that have integrated UDO technology into a wide range of data storage and document management applications. Plasmon worked closely with key ISVs to develop the concept of Compliant Write Once media and supplied both media and new drive firmware to the ISV community in advance of the official product release. The overall response to Compliant Write Once media from the ISV community has been extremely positive. The benefits of this media were recognized immediately by the software vendors, allowing them to extend the functionality of their applications to provide audit trails for the complete destruction of data when retention periods have expired.

At the time of formal product launch, many ISVs announced support for Compliant Write Once media with many more publishing schedules for product availability. Since the data shred operation was implemented using a third media type, it does not compromise the operation of the original Rewritable and True Write Once media and does not require that an ISV provide support. For this reason, it is important to confirm ISV support for applications planning to use UDO Compliant Write Once media within their archival storage strategy.

3.3 Roadmap Support for Future Generations

The UDO product development roadmap calls for read backward-compatibility with all future product generations. With the introduction of Compliant Write Once media, the backward compatibility requirement has been extended to include the shred functionality. This means that documents written on a first generation 30GB Compliant Write Once disk can be both read and destroyed in a second or third generation UDO drives.

This level of backward compatibility support is essential for any storage technology used in a long-term archive environment. Data retention periods mandated by industry regulation or corporate policy often require that data be maintained for years or decades before destruction is permitted. The unmatched media longevity of UDO makes it an obvious choice for the archival storage of these records, but the evolution of UDO technology cannot require that records be migrated each time a new generation product is released. As demonstrated by previous generations of backward compatible optical technology, organizations often choose not to migrate data, allowing it to reach end-of-life on the original media. Alternatively, they may decide to skip a generation, migrating data only after many years. Backward-compatibility for read and shred operations provides tremendous flexibility in managing records with long retention periods and delivers major cost savings in hardware and administration over the life of an archive.

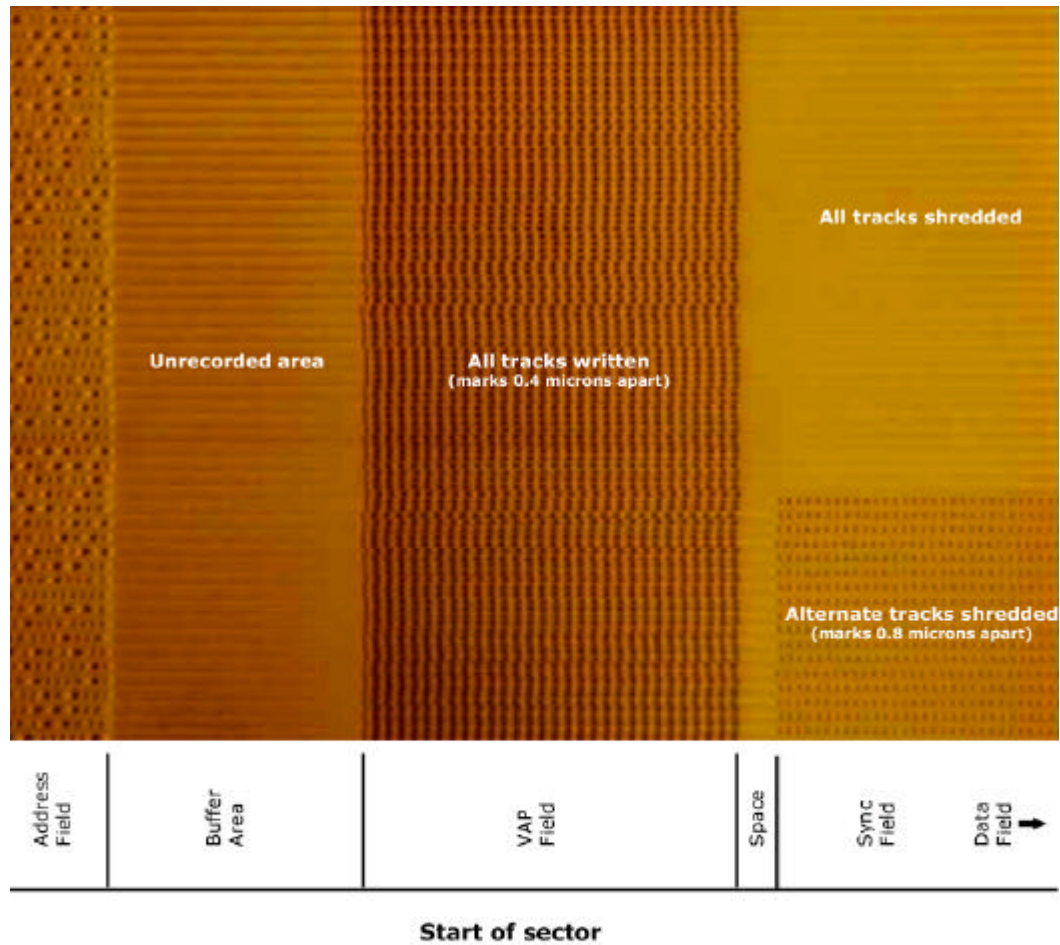
4 Compliant Write Once Media Summary

In the past, organizations focused very little on the disposition of aging data, but changes in technology, regulations and corporate risk management have dramatically altered the archive landscape. There is a growing imperative to better manage information assets in line with business priorities. Sometimes referred to as ILM (Information Lifecycle Management) or DLM (Data Lifecycle Management), the intelligent and articulate control of data is becoming essential to achieving fundamental business objectives.

The development of Compliant Write Once media was a very direct response to these evolving organizational and technical requirements. The functionality and physical attributes of the Compliant Write Once technology provides a unique combination of media longevity, record authenticity and assured data destruction that cannot be matched by magnetic disks or tapes. These technical capabilities make Compliant Write Once media a valuable tool in addressing industry regulations and corporate policies. As part of a trio of UDO media formats that also includes Rewritable and True Write Once, Compliant Write Once media provides organizations with the flexibility to match their business needs with the most appropriate archival storage technology.

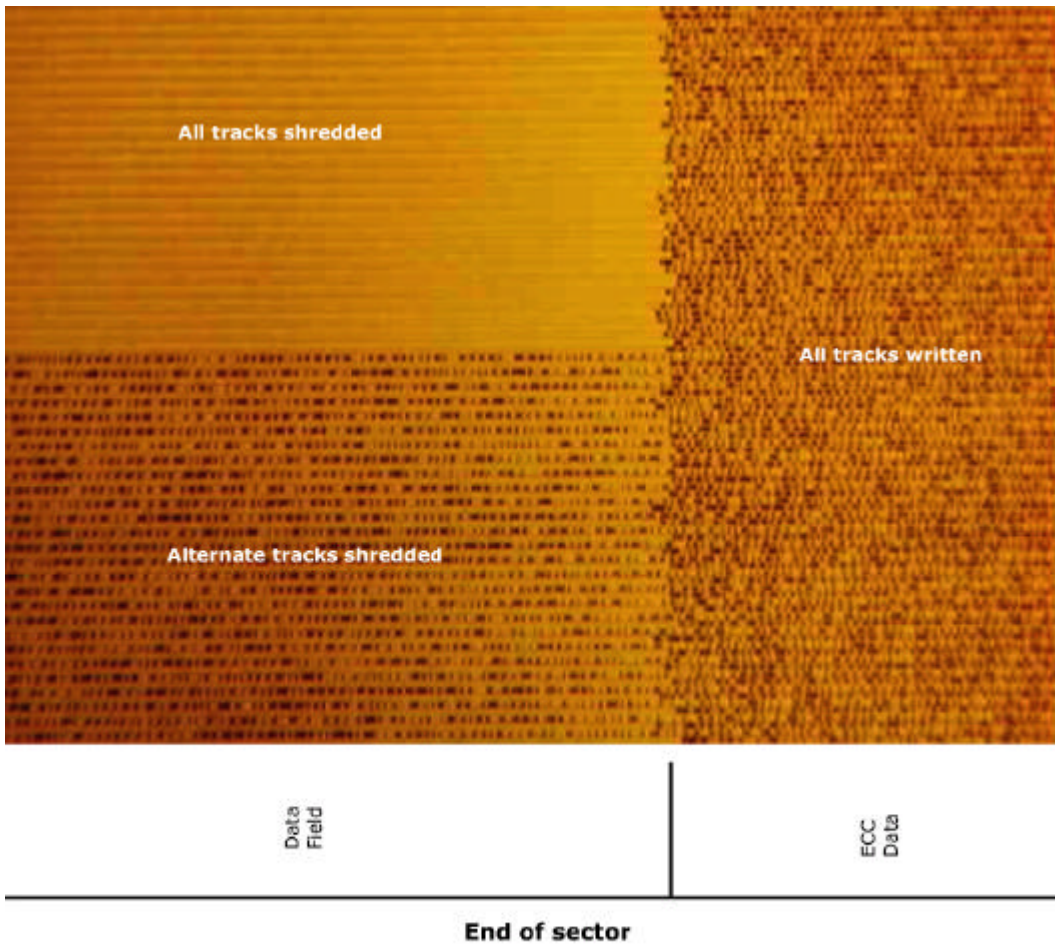
5 Microscopic Media Images

Figure 4 and Figure 5 are actual photographs of different sections on a UDO disk taken using an oil immersion microscope.



- Address Field:** contains unique information about the sector
- Buffer Area:** prevents overwriting of address field
- VAP Field (Verify And Protect):** protection mechanism to prevent overwriting data area
- Space:** provides processing time for the drive to check the VAP field prior to writing
- Sync Field:** intended to allow the drive to obtain byte synchronization for the following data field
- Data Field:** at the disposal of the user for recording information

Figure 4 – Start of 8KB Sector Microscopic Image



Data Field: at the disposal of the user for recording information
ECC (Error Correcting Code): ensures correctness of data and completeness of shred process

Figure 5 – End of 8KB Sector Microscopic Image