FUJIFILM

As of September, 2008

DATA STORAGE MEDIA

As Green IT becoming one of the biggest topic among the data center managers, tape storage is getting itself more and more acknowledged as "Green-Storage". FUJIFILM's high quality data storage tape does not only support the secure data center management but also contributes to customers' environmental challenges as a leader of tape storage industry.

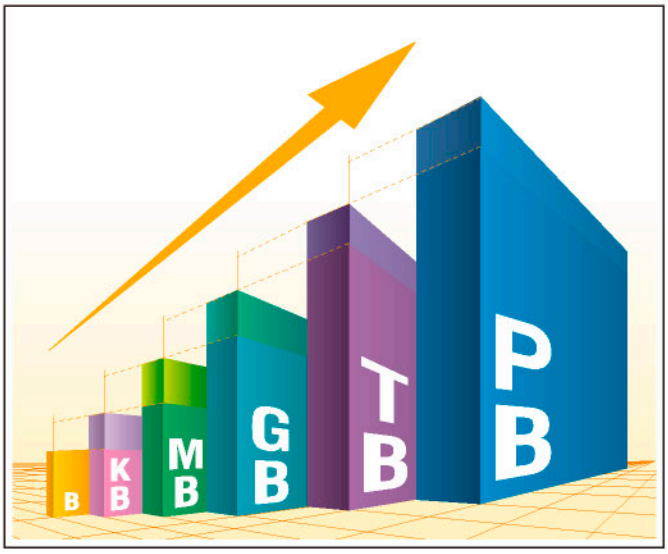


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Save Energy, *Save* Money,

The greatest challenge so ever is how to
without harming the environment
Tape storage - That is the key

The More Data to Store, the More Things to Think



Due to the rapid spread and penetration of information-society, establishment of infrastructure and improvement of data storage technology, nowadays, it is possible to handle massive capacity of data with ease. Under such circumstances, it has become much more important and critical issue of how to manage them especially among government, public sector and enterprises of any size. The trend of regulation over data management and availability rules such like SOX or HIPAA in the US best describes the challenges that companies are facing. The more regulative the rules become, the more data need to be stored. Companies are now suffering the expansion of data, which eventually brings the increase in their managing costs such as energy (power) cost and labor cost. Moreover, besides the governmental regulations over data management, companies must note the recent regulations aimed at recycling and anti-pollution measures. Thus, in order to survive through the flood of data connotes environmental issues, power efficiency definitely is the key in future data storage management.

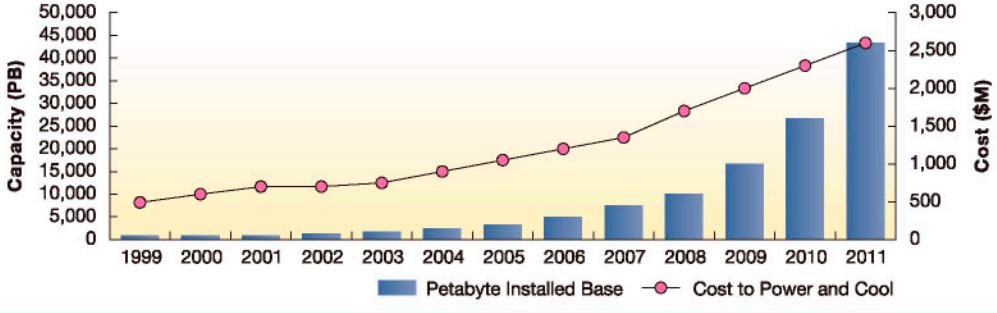
Cost and Energy Consumption is the Problem

Improving power efficiency is one of the greatest challenges facing today's data center managers, particularly in large data centers or in metropolitan areas where power demand is highest and resources are being pushed to the limit. For some, it is not just about escalating utility bills, but a more foreboding threat: running out of power capacity to support growth. New strategies to help store information more intelligently can deliver significant impact as it relates to improving power efficiency.

Historically, electrical power usage was not effectively managed as an expense in the data center. In fact, a report from the Green Grid says that many data center managers are unaware of their monthly energy bill expense.

According to IDC's research (2007), the cost to power and cool servers is showing a 10% CAGR from 2006 to 2011, and companies are looking for ways to reduce energy consumption wherever the can. Moreover, from the environmental point of view, impact of external storage can be measured in terms of the amount of carbon dioxide (CO_2) produced by the creation of electricity necessary to power and cool the hardware. IDC has estimated that in 2007, 19 billion kilowatt-hours were necessary to power and cool the world's external storage, resulting in nearly 30 billion pounds of carbon dioxide emissions.

Installed Petabytes of External Storage vs. the Cost to Power and Cool IT, 1999-2011



Save the Environment



manage the expanding capacity of data
and your budget at the same time.
for success FUJIFILM believes.

Tape Storage Saves the Data Center



In archiving and many backup applications, the greenest option by far is tape, which uses less power and produces a lower heat output. This not only eases the bite of the utility bill but also places less strain on cooling systems, extending the subsystem's service life. In contrast, the case can be made that using disk for archiving does more harm, since disks that spin constantly use much more power and generate much more heat. Although analysts and press reports have talked up tape's eventual demise for several years, the fact is that many enterprises cannot afford to operate without tape system. Even if an enterprise has the financial means to invest in a pure disk-based solution, keeping the storage servers up and running poses additional constraints. Data centers must consider the thermal heat issue and electricity costs when thinking about whether to opt out of tape storage.

Cutting cost is the name of the game for every IT organization. While the industry objectives might be different, the systems that make things happen aren't. Understanding your energy requirements from both a cooling and power perspective will be key to reducing your infrastructure bills, while keeping up with the ever-increasing demand for more. Appreciating the economy of energy in your tape infrastructure is part of that understanding. From the point of view of actual power draw, tape contributes to a more modest operating expense for enterprise of all sizes.

Source :
- Mark Ferelli, 5/2008 "Tape Empowers the Data Center"
- IDC, 6/2008 "The Real Costs to Power and Cool All the World's External Storage" (Doc #212714)
- IDC, 9/2007 "Power and Cooling in the Datacenter 2007"



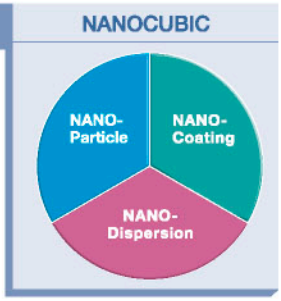
Following the philosophy of "green-storage," FUJIFILM puts corporate advertisement worldwide.

Save energy. Save money. Save the environment.

If you're still deciding on which way to go for data storage, here are some numbers to think about.
According to a recent study by The Clipper Group, the cost of using disks over a five year period can be up to 23 times more than tape. And energy costs for those same disks can run about 290 times higher than tape. Now factor in what that energy consumption will do to the planet...and your bottom line.
So what's the formula for success? Optimize your storage network and applications with FUJIFILM data storage tape – think what you could save.

NANOCUBIC Technology, the Epoch-making Technology

What Is NANOCUBIC Technology?



❶ NANO-Coating Technology See Fig.1 :

"Nano-order ultra thin magnetic layer for high resolution"

With the ATOMM technology, a submicron magnetic layer is coated onto a non-magnetic layer comparing with micron-order, single-layer MP tape. However, it is necessary to reduce the thickness of magnetic layers to a nano-order level in order to achieve high resolution for higher recording density than obtained by the ATOMM. Therefore, we further advanced the ATOMM technology, nano-coating technology. This new technology has made possible an ultra-thin magnetic layer, which is about a one-tenth of the thickness of magnetic layers under the ATOMM technology.

❷ NANO-Particle Technology See Fig.2 :

"Ultra-fine magnetic particles to reduce media noise"

Two types of nano-order ultra-fine magnetic particles have been developed, compared with submicron-order magnetic particles under the ATOMM technology, to reduce media noise. One is a newly developed ultra-fine metal particle. The size of particle is a few dozen nano-meters and about one half of that of ATOMM based particle. The other is a newly developed small tabular ferromagnetic hexagonal Barium-Ferrite particle, which is finer and smaller than ultra-fine metal particle.

❸ NANO-Dispersion Technology :

"Uniform particle dispersion technology featuring newly developed polymer compound"

The smaller is size of magnetic particles, the more difficult to disperse uniformly for reduction of media noise. As a solution, the nano-dispersion technology has been developed. This technology featuring newly developed polymer compound prevents flocculation of magnetic particles and makes it possible to align ultra-fine magnetic particle in order and to form a nano-order ultra thin magnetic layer. As a result, clear recording pattern can be realized in high density, which will be epoch making for increasing recording capacity and expanding future application.

Fig.1 NANOCUBIC Technology

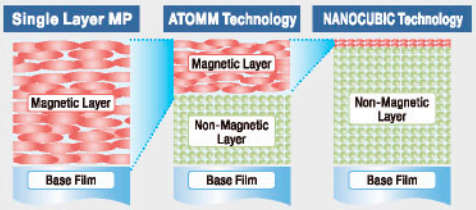
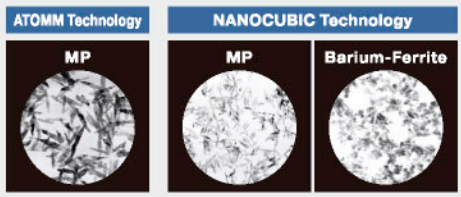


Fig.2 Photograph of Magnetic Particle

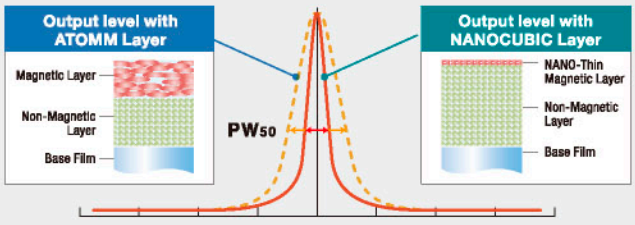


Features of Nano-Order Ultra Thin Magnetic Layer Achieved by NANOCUBIC Technology

❶ High Resolution See Fig.3

High resolution for high recording density Nano-thin layer coating technology has made it possible to recording data in digital form at high resolution. Flat output characteristics are achieved at higher frequencies than those used under the ATOMM technology. Additionally, the level of magnetic energy can be optically controlled, and the waveform distortion that might often occur with a high-sensitivity MR head at output saturation can be prevented.

Fig.3 High Resolution



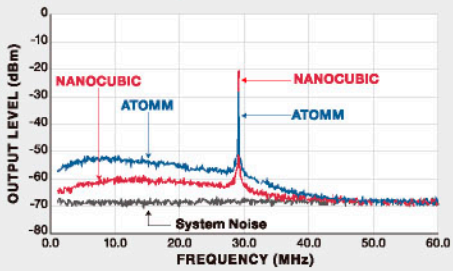
High Resolution – Increase in linear density is achieved by:

1. Shaping flux reversal of signal and narrowing pulse width at 50% threshold (PW50) of isolated pulse shape.
2. Flat frequency response by reducing low frequency output and increasing high frequency output. The above mentioned is accomplished by reducing the thickness of the magnetic layer. When MR elements in the head become saturated by output exceeding a certain level, distortion of wave or asymmetrical pulse occurs. To avoid this, the magnetic layer must be kept thin.

❷ High C/N Characteristic See Fig.4

Two magnetic materials were developed: ultra-fine metal particle and ultra-low noise Barium-Ferrite magnetic particle. Because these two materials can be aligned uniformly and densely, it is now possible to reduce media noise greatly.

Fig.4 Modulation Spectrum



High C/N – To improve C/N, it is very effective to reduce media noise as a level of system noise is low in systems with high sensitivity MR heads installed. For reducing media noise, it is essential to further decrease the size of the particles in media. Because particles must be aligned uniformly in magnetic layer to optimize performance out of particles in media, a higher level of dispersion technology is required as size of particles becomes smaller.

❸ Superior Storage Capability

As produced by a coating process using a high molecular binder, chemical stability of media is improved to a great deal and better stability is archived compared to media produced in evaporating process. In addition, this media can be stored for a longer period without performance deterioration.

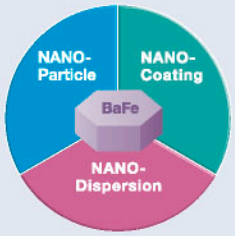
❹ Suitable for Mass Production

Nano-thin layer coated media enables stable mass production with existing coating machines. No need to use any type of vacuum evaporating facilities.

nanocubic

Barium-Ferrite (BaFe) Particle for Future Higher Capacity Storage Tape

NANOCUBIC + BaFe



Features of BaFe Particle

1 Higher Coercivity (= Stable Recording) See Fig.5

Because BaFe particle is oxidized in its original condition, it is known as naturally stable crystalline particle. This characteristic makes particle not to corrode or to change chemically overtime. On the other hand, the coercivity of conventional Metal particle is reduced when its size become smaller. The advantage of BaFe particle is that it enables to realize higher coercivity even with its small size.

2 Higher Signal to Noise Ratio (= Low Noise)

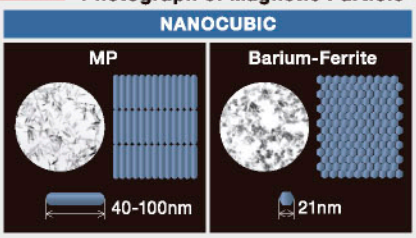
FUJIFILM researchers identified hexagon-shaped barrium-ferrite magnetic particles as having the smaller size, higher coercivity and low noise needed to produce the high signal-to-noise ratio required for high density recording media.

3 Higher Output

Even with high linear density, BaFe particle can maintain higher output compared to that of conventional Metal particle.

Enables to realize higher recording density

Fig.5 Photograph of Magnetic Particle

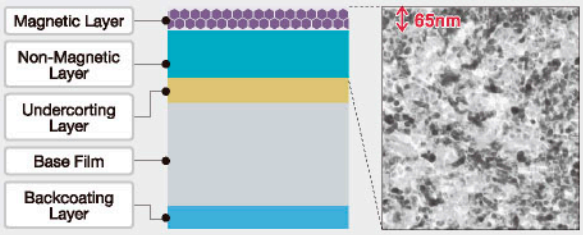


Incorporating BaFe Particles to FUJIFILM's NANOCUBIC Technology

1 Thin & Uniform See Fig.6

The unique FUJIFILM NANOCUBIC technology coats the BaFe particles in a very uniform manner with thickness variation of less than 10 percent across the length of the tape. Also its dispersion technology provides improvements that allowed the BaFe particles to be well isolated while creating a magnetic layer of only 65nm. The combination of small, uniformly dispersed particles and a uniformly coated thin layer result in higher SNR (signal-to-noise ratios) and resolution-critical for maximizing the capability of Giant Magneto-Resistive (GMR) heads, which represents tone of the advances in future generation recording technology.

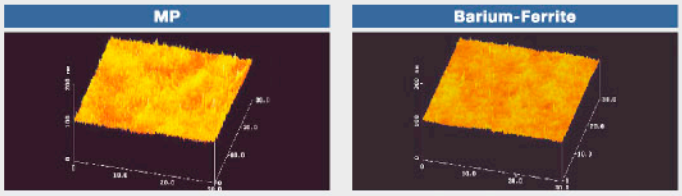
Fig.6



2 Smoother Tape Surface See Fig.7

In order to achieve accurate read/write, it is important to realize smooth tape surface. However, if it is excessively smooth, tape will stick on the head and leads to damage. For accurate read/write, it is important to maintain appropriate "uniform roughness."

Fig.7



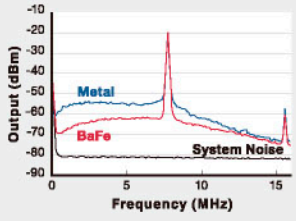
Tape surface using current Metal Particles <Ra:2.5nm>

Tape surface using Barium-Ferrite Particles <Ra:2.0nm>

3 Higher Signal to Noise Ratio See Fig.8

BaFe particle with 23.5dB of SNR, which is 9dB higher than conventional Metal particle tape, is more suitable for higher density recording.

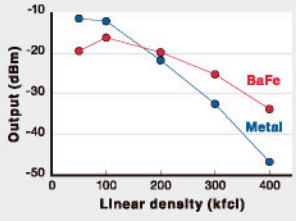
Fig.8



4 Higher Output See Fig.9

Output of BaFe particle tape is far better than that of Metal particle tape at over 200kfci.

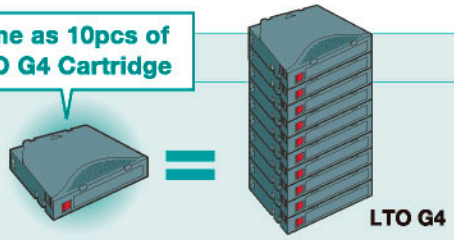
Fig.9



BaFe Accomplishment

IBM researchers succeeded in demonstrating to store **6.67**Gbpsi using the linear recording format (May, 2006).

The demonstration points to the possibility of creating **a single tape cartridge** capable of holding **8 Terabytes** in the future!!



Features of LTO Cartridge



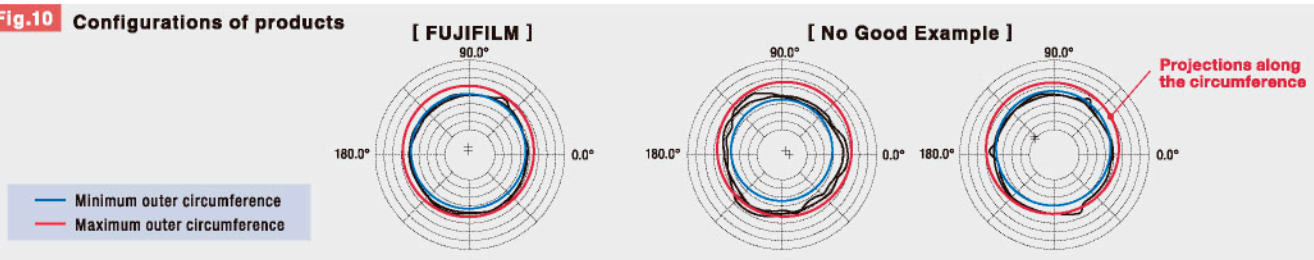
In order to realize high recording density, high dimensional precisions not only for tape but also of the mechanical elements are necessary. For the introduction of LTO G4, FUJIFILM newly designed mechanical parts including reel, release pad, etc. of high dimensional precision and morphological stability. Building upon the excellent characteristic features of the proceeding products up to LTO G3, FUJIFILM has brought out the potential of the tape to the maximum extent.

LTO G4 Cartridge

❶ Precision of Reel Core See Fig.10

Pure cylindrical-shape reel core realized stable reel rotation, which enables higher tape running stability. A reel core with poor circularity could disrupt the rotation cycle and give rise to instability of the tape running during the reel rotation.
The difference between the maximum and minimum outer circumferences or minute projections on the circumference could give rise to running instability owning not only to deformation on the tape surface but also to non-uniform rotation speed especially when the tape is close to the reel core.

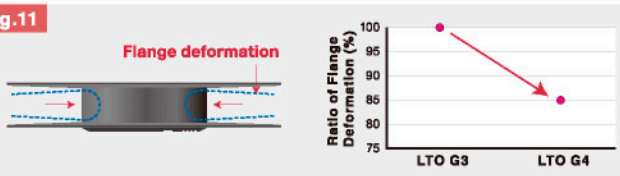
Fig.10 Configurations of products



❷ High Rigidity of Reel Core See Fig.11

Rigid reel core prevents flange deformation, which makes flange and running tape less likely to contact. This sufficient strength reduces the risk of edge-damage. If the strength were insufficient, not only the reel core but also the top and bottom reel flange would deform, thus exposing the running tape to the risk of abrasion of the edge.

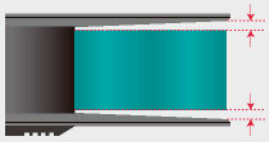
Fig.11



❸ Taper in Reel Flange See Fig.12

With an appropriate taper (=angle), running tape will be less likely to expose to flange, which reduces the risk of edge-damage. Without an appropriate taper (i.e. a flat surface), the tape edge may suffer abrasion leading to damage.

Fig.12



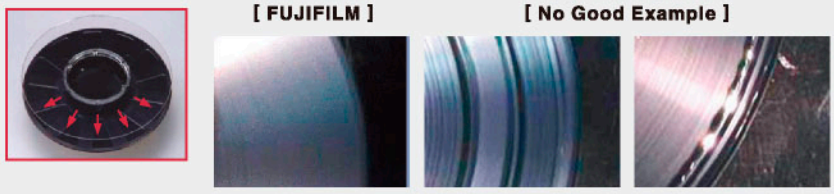
The inner surface of the reel flange is not strictly flat but is provided with an appropriate taper.

All LTO Cartridge

❶ Unique Flange for Air Controlling See Fig.13

FUJIFILM's unique flange keeps the best loading conditions even after running into drives. It reduces damages for edge. The reel has some grooves that control the air flow to make good shape of the tape winding. Smooth and good-shaped tape winding minimizes the risk of edge-damages.

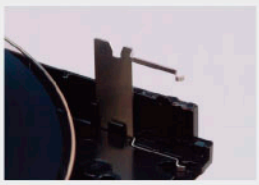
Fig.13



❷ Leader Pin Holder See Fig.14

FUJIFILM's patented unified leader-pin makes a leader pin position very accurate, which enables drive arm to catch the leader-pin certainly.

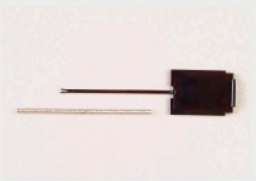
Fig.14



❸ Door-Spring See Fig.15

FUJIFILM's simple, patented and reliable door-spring proves high reliable load-unload capability, more than 25,000 times (about 20 years in five times load-unload per day) without degradation of spring force.

Fig.15



New Services for LTO

DC-Analyser

Tool for FUJIFILM Tape Health Check Service

Quick, inexpensive, offline LTO tape diagnostics anywhere using only cartridge memory and barcode information.

❶ Analyses LTO tape cartridges by reading only cartridge memory (CM) information, which has no risk of data leakage See Fig.16

The DC-Analyser reads mount history from the CM embedded in the LTO tape. It does not read the information recorded on the tape, thus avoiding risk of leaking confidential information.

❷ Offers quick and easy on-site tape diagnostics anywhere See Fig.17

Begin analysing tapes right away simply by connecting the DC-Analyser to a computer. After placing an LTO tape on the DC-Analyser, the data will be read in about 7 to 10 seconds.

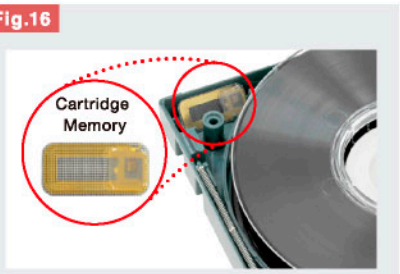
The DC-Analyser can read the barcode and CM simultaneously, allowing it to associate and save the CM information with the barcode information.

❸ Features precise, easy-to-understand tape diagnostic functions See Fig.18

The CM's mount history holds no more than four history entries, but the DC-Analyser's database can store up to 18 mount history entries for each LTO tape. This allows precise diagnostics by reviewing the tape's condition over the last 18 usages.

Based on FUJIFILM' s wealth of experience as a tape manufacturer, the DC-Analyser analyses data and diagnoses LTO tape cartridge. It presents the results to storage administrators in clear and understandable messages. By accumulating data on analyzed tapes, the DC-Analyser judges whether the tape or the drive is the source of error, and indicates the result with easy-to- understand messages.

Fig.16



❹ Various Analysis Functions See Fig.19

The software package has a function for listing tape diagnostic results in an Excel spreadsheet and a contextual search function to find specific tapes or drives.

Fig.17

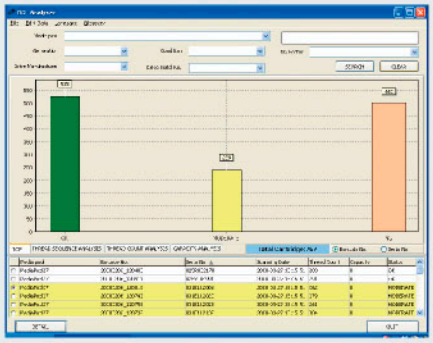


Fig.18

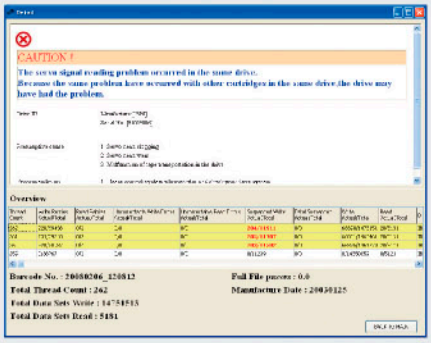
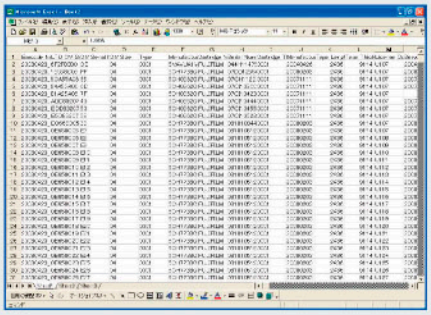


Fig.19





Parameter	Specifications
Overall dimensions	112mm × 252mm × 80mm (W × L × H)
Weight	310g
Operating conditions	Temperature: 5 – 45°C / Humidity: 5 – 95%
Operating system	Windows XP / Vista

Custom Barcode Labeling

Customized barcode labeling service realizes customers manage the continued rapid growth of data management.



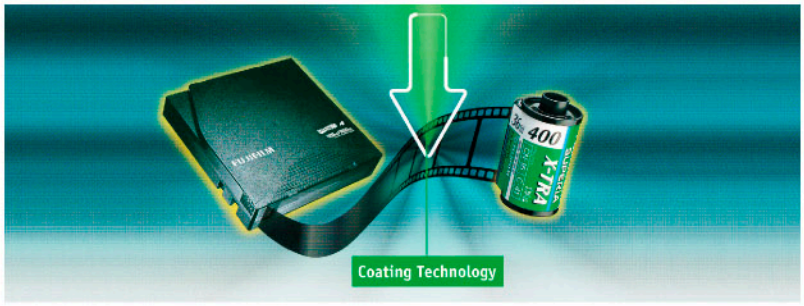
Example of Custom Barcode Labeling

Date	Code	Logo	Blank
2007.10.01 19H018L4	ABC0056 19H019L4	FUJIFILM 19H020L4	FUJIFILM 19H019L4

FUJIFILM's Continuous Efforts in Developing Epoch-Technology has been Leading the Industry

FUJIFILM as Technology Leader in Coating Technology

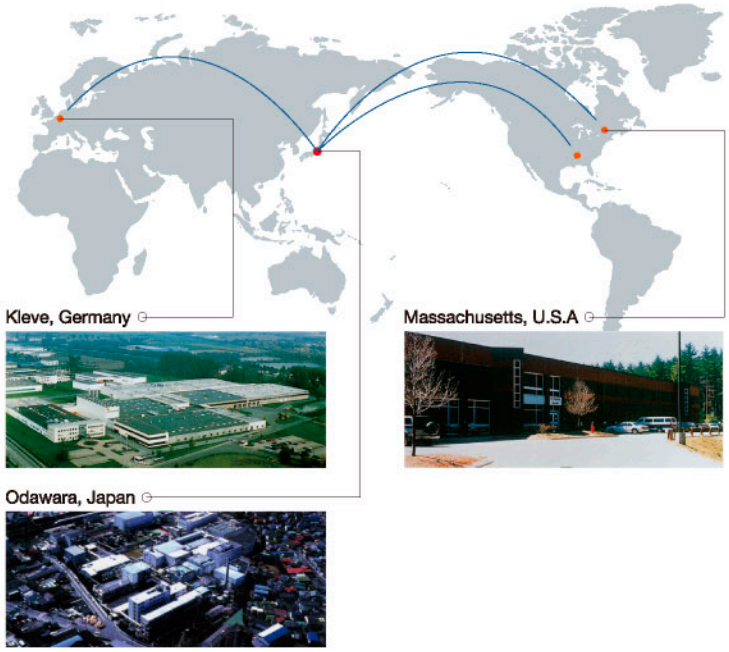
Coating is critical for both photographic film and magnetic tape.



- Photographic film is manufactured by simultaneously applying ten layers to a base film, and the technology developed to achieve this is applied to FUJIFILM's data storage media products, too.
- In 1989, FUJIFILM adapted its multi-layer coating technology developed for film to magnetic storage media, and dual-coating technology was born.
- This technology greatly improved video and audio tape performance, and was then adapted for computer data storage media to create a revolution in the industry with the birth of ATOMM, then to the NANOCUBIC Technology.

FUJIFILM Group has 227 Affiliated Companies around the World (as of April 2008)

As for Recording Media Products Division, FUJIFILM is a global manufacturing share leader in midrange products and supports customers at worldwide by global supply capability.



FUJIFILM Data Media History

1956 First successful domestically produced Computer "FUJIC"

1965 First domestically produced memory tape

1977 First domestically produced floppy disk

1992 World's first technical announcement of ATOMM technology

1995 High-capacity FD Zip™ 100Disk

Released DLTtape™ IV

1996 Released DDS 3

1999 Released DDS 4

2000 Released LTO Ultrium 1 data cartridge

2001 World's first technical announcement of NANOCUBIC

2002 Released Super DLTtape™ I

Released LTO Ultrium 2 data cartridge

2003 Released IBM TotalStorage® Enterprise Tape Drive 3592 data cartridge for IBM

2004 Released 3592 data cartridge

Released LTO Ultrium 3 data cartridge

Released DAT72 data cartridge

2005 Released Super DLTtape™ II

Released Sun StorageTek T10000 Tape Drive data cartridge for Sun Microsystems

2006 FUJIFILM Technology (BaFe) contributed IBM Demo of world first Multiple-Terabyte storage.

2007 Released DLTtape S4 data cartridge

Released LTO Ultrium 4 data cartridge

2008 Released DC-Analyser as LTO health check tool

For Further Reliable Data Storage, FUJIFILM's Data Storage Media will be the Answer

LTO

First Midrange Drive Format to offer Encryption with 1.6TB compressed capacity!

LTO Ultrium 4

nanocubic



LTO Ultrium 4

WORM is also available

WORM (Write Once Read Many) functionality provides a cost-effective means for storing data in non-rewriteable format to help address compliance requirements.



LTO Ultrium 4 WORM

Encrypted for Security

LTO Ultrium 4 systems store the Advanced Encryption Standard (AES) 256-bit encryption algorithms to keep data secure, which is the first time to midrange tape storage. With AES 256-bit encryption capability, Ultrium 4 format offers higher level of security during storage and transporting of sensitive information.

LTO Ultrium Series

ATOMM TECHNOLOGY



LTO Ultrium 3



LTO Ultrium 3 WORM



LTO Ultrium 2



LTO Ultrium 1



LTO Cleaning Cartridge

The universal cleaning cartridge is capable of being used in all generation 1/2/3/4 Ultrium format tape drives. Specific revisions of firmware may be required for proper operation.

• Linear Tape-Open, LTO, the LTO Logo, Ultrium and the Ultrium Logo are trademarks of HP, IBM and Quantum in the US and other countries.

Enterprise Tape

3592 Tape Cartridge

nanocubic



3592
Tape Cartridge (300GB)



3592 Economy
Tape Cartridge (60GB)



3592 Cleaning
Tape Cartridge

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WORM (Write Once Read Many) functionality provides a cost-effective means for storing data in non-rewriteable format to help address compliance requirements.



3592 WORM
Tape Cartridge (300GB)



3592 WORM Economy
Tape Cartridge (60GB)

DLT / SDLT

DLTtape®S4

ATOMM TECHNOLOGY





DLT S4

DLTtape® Series

ATOMM TECHNOLOGY



SDLT2



SDLT1



DLT4



SDLT1 Cleaning Cartridge



DLT Cleaning Cartridge

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