

TK70 and TK50 CompacTape Cartridge Subsystems

High-capacity, Highly Reliable Tape Devices to Complement MicroVAX and Other Systems

digital



Industry-leadership, Compatible Subsystems That Meet Your Needs

The new TK70 and the recently enhanced TK50 continue to set the standard for capacity, data integrity, and reliability among microsystem tape drives. Both are excellent choices for backup, software distribution, data interchange, and archiving applications.

The TK70, with its 296-megabyte formatted capacity, can back up any of Digital's mini-Winchester disks (including the 280-megabyte RA70 disk) onto a single cartridge. The 95-megabyte capacity TK50 is an excellent match for moderate capacity disks. Yet both devices are very compact—either drive can be built into a MicroVAX or MicroPDP-11 system box. And despite its different recording density, the TK70 can read cartridges written on a TK50.

Both subsystems give you industry-leadership data integrity because they use a uniquely powerful error correction code (ECC), a cyclic redundancy check (CRC) for error detection, and a read-after-write procedure to verify that data has been correctly written.

Both devices are streaming tape devices. Their simplified mechanical design contributes to their high reliability. In addition, the TK70 has a highly intelligent controller that can automatically recover from most fault conditions, and its newly designed front panel communicates clearly with the user and helps ensure that even novice users will operate the TK70 correctly.

The TK70 and TK50 are complete subsystems that contain many of the features found on larger, more expensive subsystems. Now, with a choice of two family members, you can choose the capacity, performance, and price, that best fit your needs.

Highlights

- The maximum formatted capacity of 296 megabytes for the TK70 and 95 megabytes for the TK50, combined with streaming performance, makes these drives ideal for backing up high-capacity mini-Winchester disks or handling large application programs.
- Exceptional protection for your data: read-after-write, Cyclic Redundancy Check (CRC), and Error Correction Code (ECC) combine with precise control of tape speed and tension to maximize data integrity.
- Simplified mechanical and electrical design results in high reliability, low cost, and ease of use.
- Cost of ownership is low because both drives are truly maintenance-free products requiring no field adjustments and no preventive maintenance in normal use.
- Either drive is easy to install because it uses the same mounting and occupies the same 5.25-inch form factor as a mini-Winchester disk; it can be packaged in a system enclosure or, as in the case of a TK50, in a stand alone tabletop box.
- Compatible with Digital's Q-bus and UNIBUS (TK50 only) systems. Supported by Tape Mass Storage Control Protocol in Digital 16- and 32-bit operating systems. The cartridge is used as a software distribution device.
- Calibration tracks and automatic gain control ensure transportability of programs and data between subsystems. TK70 drives can read tapes written on both TK70 and TK50 drives. The TK50 drive can read tapes written on a TK50 drive only.
- Cache buffer (16 kilobytes in TK50 drives; 64 kilobytes in TK70 drives) enhances performance while maintaining data integrity.

Exceptional Data Integrity and Transportability

With its powerful microcode-based electronics, gentle tape handling, and self-adjusting design, the TK70 and TK50 safeguard your data and ensure its transportability to any like drive, for software distribution or data interchange. In addition, TK50-written media can be read on TK70 drives.

The Cyclic Redundancy Check automatically detects errors during writing and reading of data and causes them to be corrected "on the fly," without the need to reposition the tape. During "read" operations, the controller uses a powerful error correction code to correct data errors. As much as 25 percent of the data blocks in a cartridge could contain errors. In that unlikely event, the TK70 and TK50 would be able to correct them! In addition, the drives perform a read-after-write check to ensure that each bit is verified immediately after it has been recorded. This combination of CRC, ECC, and read-after-write features is a major advance among microsystem tape drives.

From a mechanical viewpoint, the CompacTape II cartridge encloses and protects the tape during storage and transportation. The drives protect it in use through gentle handling. A short, simple tape path, low tape tension, and exceptionally smooth operation contribute to this gentleness. The smoothness is possible because tape speed and tension are accurately controlled by a microprocessor-based servo system and the two reel motors.



The plastic leader (white in photo) allows automatic threading of tape through the drives' simple tape path. The recording surface touches only the head, thus minimizing mechanical wear and enhancing data integrity.

A tachometer mounted in a tape path roller guide provides accurate feedback directly to the microprocessor which then exerts precise control over the motors. The motors themselves minimize speed and torque variations and enhance the drives' uniform operation.

This uniformity, plus the drives' self-adjusting design, ensure that your data cartridge can be read on any like tape drive. The first time a Compact-Tape II cartridge is mounted in a TK70 subsystem, three reference bursts are automatically recorded at the beginning of the tape. Thereafter, whenever that cartridge is mounted in any TK70 drive, the head will automatically align itself to the reference bursts thus ensuring that it is in line to read the data tracks correctly. While

reading the reference bursts, the drive normalizes its signal amplification circuitry to further ensure correct reading of the tape.

A similar process occurs in TK50 drives. However, TK50 drives write two differently-positioned reference bursts. TK50 drives can recognize and read TK50 data only, while TK70 drives can recognize and read both TK70 and TK50 data. Neither drive can write the other's format.

This read compatibility means that the new drive can read archives of old cartridges and that TK50-mode cartridges can be used for software distribution to both TK50 and TK70-based systems.

Simplified Design and Built-in Intelligence for Reliability and No Preventive Maintenance

Simplicity is often a key to success and makes the TK70 a leader in reliability. When you are ready to use it, the drive will be ready to run.

In both the TK70 and the TK50, reliability is enhanced because they have fewer electronic and mechanical parts than are used in conventional designs. The parts that *are* used are more rugged. For example, the ferrite-and-ceramic head, and the ball-bearing, brushless dc motors are all designed for long life. The handle and interlocks are also reinforced to stand up to the rigors of heavy use. And many of the key functions of the drives are controlled by microcode, which is inherently very reliable.

In addition, the TK70 drive's intelligent controller automatically recovers from most fault conditions, and its newly designed front panel uses multiple, clearly-labeled lights and an audible signal to tell the user what the drive is doing and what operations are safe to perform. This helps ensure that even novice users will operate the TK70 drive correctly after minimal training. In the TK50 drives, several recent mechanical changes have further enhanced its reliability.

Another aid to trouble-free operation is the latching mechanism which accurately positions the cartridge so that the cartridge leader and drive leader will mesh properly for reliable automatic threading.

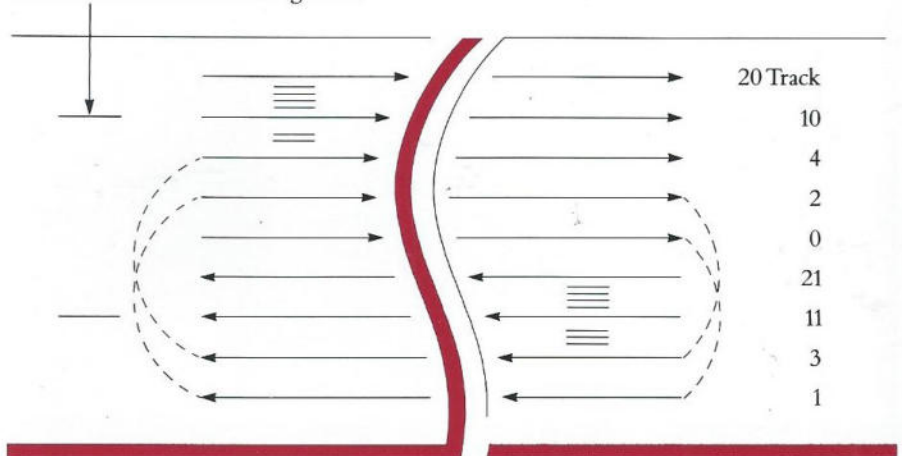
Finally, neither drive requires preventive maintenance—no adjustments or head cleaning in normal use.

It all adds up to trouble-free operation and low cost of ownership.

High Capacity and Good Performance in a Small Package

The CompacTape II cartridge is a Digital-designed, publicly available, compact cartridge with up to 296-megabytes of formatted capacity when written in TK70 format, or up to 95 megabytes in TK50 format—more than enough to back up any of Digital's mini-Winchester disks with no need for media changes.

Reference Bursts for Head Alignment



In serial serpentine fashion, the TK50 records data on 22 tracks and the TK70 drives record on 48 tracks. The head assembly contains two pair of read/write gaps and records one track in each direction before stepping to the next position. Tracks are numbered in the order recorded.

Although the cartridge measures approximately 10 centimeters square by 2.5 centimeters high (4 inches square by 1 inch high), it achieves its capacity by containing 182.9 meters of 1.3 centimeter wide (600 feet of 0.5 inch wide) tape on a single reel. The takeup reel is part of the drive. TK70 recording is on 48 tracks (22 tracks for the TK50) in serial serpentine fashion, allowing high capacity at low cost. You can write protect the tape by setting an easily visible slide switch on the front of the cartridge. The cartridge's compact size and rugged design make it easy to carry or ship, and its capacity allows it to transport large application programs, operating systems, or databases.

As streaming tape drives, the TK70 and TK50 drives are ideal for the applications listed above, which involve long continuous data transfers. If these drives are to be used for real-time data acquisition, journalling,

or other start/stop tasks, the application must be carefully designed. These applications require the drive to be ready to receive data at any time. However, certain latencies inherent in streaming drives cause them to be unavailable for short periods of time (from 4 seconds to 4 minutes). Key latencies are listed in the Specifications section. For further information, contact the Customer Support Center nearest you.

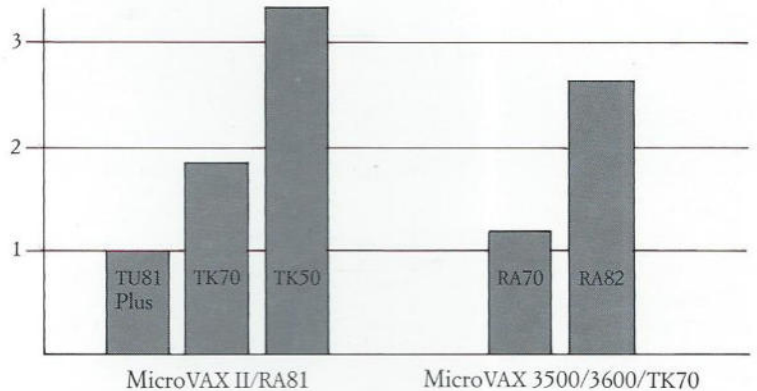
The subsystems are designed to run for relatively long periods, writing or reading blocks of data without stopping, and they include several features to help optimize operation:

- A speed of 75 inches per second gives a peak total transfer rate of 62.5 kilobytes per second, and a peak transfer rate for user data of 45 kilobytes per

second. The TK70 drive's 100 ips speed yields a peak transfer rate of 125 kilobytes per second and a peak transfer rate for user data of 90 kilobytes per second.

- Write-through cache buffers in the controllers enhance performance of slower host systems while avoiding risks to data integrity. (Other cache designs can lose data.) The write-through design does not allow data in memory to be erased until a copy of the data is safely on tape.
- The Tape Mass Storage Control Protocol allows the TK70 and TK50 controllers to queue commands and data from the host system.
- In order to enhance streaming performance with certain host system characteristics, blocks of zeroes may be written by the controller thereby allowing the drive to continue streaming and reducing the need to reposition. This will reduce cartridge capacity somewhat but will still be sufficient for single-cartridge backups under most conditions. Similarly, performance will vary, depending on the application and number of host system parameters. Consult your sales representative to estimate the performance and capacity to be expected with your software and system configuration.
- In both reading and writing operations, error correction takes place without stopping tape motion to do a reposition.

Time to Back Up a Full Disk (hours)



Typical backup performance using optimized backup parameters (Buffer = 5; Block Size = 16384; No CRC). Actual performance may vary, but these figures are a good guide to relative performance.

An Intelligent Controller for Enhanced Maintainability, Compatibility, and Performance

A TK70 and TK50 controllers consist of a single module that includes the microprocessor system with extensive diagnostics and microcode, a system bus interface, and the drive interface.

Built-in diagnostics monitor the drive and controller to assure the user that the system is performing properly, and to isolate problems should any arise. While the subsystem runs diagnostics, the CPU is free to perform other functions. On powerup, the controller comprehensively checks its own logic and data paths. At the same time, the drive tests itself, and will continue to do so during idling time. The testing takes about five seconds and is transparent to the user. Should a problem arise, an error condition

will be indicated on the front panel and more extensive diagnostics can be run to isolate the problem to either the drive or controller; these two components are the only field-replaceable units, which makes any necessary repair an easy swapping process.

The controller also implements the Tape Mass Storage Control Protocol, the software heart of the Digital Storage Architecture (DSA). By conforming to DSA, the TK70 and TK50 drives enjoy compatibility with a broad range of Digital's systems and storage devices. The DSA software drivers are or soon will be in all of Digital's 16-bit and 32-bit operating systems. The command set is virtually identical to



that used for our 9-track drives—the TU81 and the TA79. This means that writing programs to use the drives is a straightforward, familiar process.

The Digital Storage Architecture allows for independent evolution of storage devices, system hardware, and operating system software and greatly simplifies future product migration. Through this approach, we can bring

new technology to our users quickly, while we protect and enhance your investment in our current products.

Finally, as mentioned earlier, the controller enhances the TK70 and TK50 subsystem performance by allowing queuing of commands and data and error correction without repositioning.

A Wide Range of System and Software Support

Both tape subsystems can be supported by all of Digital's 16-bit and 32-bit operating systems and will be used as a software distribution device. With its Q-bus and UNIBUS (TK50

only) interfaces, they can also adapt to a wide range of system hardware to provide a convenient vehicle for software interchange.

Ease of Use

Because users hope computers will simplify their work, not complicate it, the TK70 and TK50 drives are designed to be easy to install, simple to operate, and maintenance free.

The subsystems can be packaged in several ways, to suit the needs of end users and OEMs. Either drive can be mounted in Digital's standard micro-system enclosures, occupying the same size slot as a 5.25-inch form factor Winchester disk or diskette drive and drawing power from the system power supply. If your system has no such spaces available, you can order the TK50 in a compact, stand alone tabletop box that includes its own power supply and connects to the system by a shielded cable. And for custom configurations, the TK50 drive is also available in a similar standalone box that is designed for rackmounting. OEMs who wish to design their own packaging will find the process easy and familiar because the drives' mounting and space requirements are very similar to those of our RX50 floppy disk drives.

Once the unit is installed, operation is straightforward. For the TK50, you insert a cartridge into the drive, press the button on the front panel, and the drive automatically threads the tape and advances to the beginning of tape

(BOT) marker. A light on the front panel indicates when the cartridge is locked in place and ready to be used, and a switch on the cartridge indicates whether the tape is write-protected. If a problem arises, the front panel light will flash rapidly to alert you.

The TK70 will automatically load the tape to the BOT mark, and the three lights on its front panel will clearly indicate: if the cartridge is write-protected, if the cartridge is loaded and ready for use, if the handle can be opened to remove the cartridge, or if an error condition exists. All other operations are initiated and controlled via the host system, and use familiar tape commands.

For Further Information

If you'd like to learn more about these products or other Digital products, call your nearest Digital Sales Office or contact your Digital Sales Representative.

Specifications

	TK70 Drives	TK50 Drives
Performance		
Read/write speed—streaming	100 in/s	75 in/s
Peak data transfer rate:		
Total	125 Kb/s	62.5 Kb/s
User data	90 Kb/s	45 Kb/s
Data Organization		
Number of tracks	48	22
Recording method	Serial, serpentine	Serial, serpentine
Recording density	10 Kbits/in	6667 bits/in
Variable record size	up to (64 Kb-1 byte)	up to (64 Kb-1 byte)
Capacity (max. formatted)	296 Mb	95 Mb
Recording medium:		
Type	magnetic tape	magnetic tape
Length	182.9 m (600 ft)	182.9 m (600 ft)
Width	1.3 cm (0.5 in)	1.3 cm (0.5 in)
Type of interface	Q-bus	Q-bus & UNIBUS
Operating Environment		
Temperature range	10-40°C (50-104°F)	10-40°C (50-104°F)
Relative humidity	20-80%	20-80%
Wet bulb (max.)	25°C (77°F)	25°C (77°F)
Altitude (max.)	3,655 m (12 K ft)	3,655 m (12 K ft)
Noise level (max.)	35 dBA	35 dBA
Power Requirements		
Drive (max. operating):		
@ +12 V dc	2.4 A	2.4 A
@ +5 V dc	1.4 A	1.4 A
Controller (max.)	5 V at 3.5 A	5 V at 3.0 A
Power consumption:		
Drive	38 W	35 W
Controller	17.5 W	15 W
Cooling (min.)	1.5 m ³ /min (5 ft ³ /min)	1.5 m ³ /min (5 ft ³ /min)

(continued)

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Specifications (continued)

	TK70 Drives	TK50 Drives
Physical Dimensions		
Without bezel:		
Height	8.2 cm (3.23 in)	8.2 cm (3.23 in)
Width	14.5 cm (5.70 in)	14.5 cm (5.70 in)
Depth	21.4 cm (8.44 in)	21.4 cm (8.44 in)
Bezel:		
Height	8.6 cm (3.38 in)	8.6 cm (3.38 in)
Width	14.9 cm (5.88 in)	14.9 cm (5.88 in)
Depth	0.9 cm (0.35 in)	0.9 cm (0.35 in)
Weight w/o cartridge	2.3 kg (5.0 lb)	2.3 kg (5.0 lb)
Cartridge dimensions:		
Height	10.4 cm (4.1 in)	10.4 cm (4.1 in)
Width	10.4 cm (4.1 in)	10.4 cm (4.1 in)
Thickness	2.5 cm (1.0 in)	2.5 cm (1.0 in)
Configuration Rules		
Drives per controller	1 max.	1 max.
Controller per cpu	4 max.	4 max.
Controller current (typical)	2.8 A	2.8 A
Controller mounting:		
Q-bus	Dual module	Dual module
UNIBUS	Not applicable	Quad module
Latencies to Consider In Start/Stop Applications		
Tape load & mount	60 s	60 s
Turnaround time at end of track	10 s	7 s
Reposition (start/stop) cycle	4 s	4 s
Re-synchronization of tape position*	2.3 min	3.5 min
Re-tries for error handling	0.01 s-4 min	0.01 s-4 min

*If an application causes start/stop activity beyond certain limits, the drive will rewind to the beginning of the track, re-calibrate its position, and re-position to the proper location for writing the next record. The TK50 limit is currently 500 start/stops per 8.6 megabytes. The TK70 limits are variable, but allow many more stop/stops; re-synchronization will be very rare on TK70 drives.