Technology Paper

Fanless DVRs No Longer a Fantasy With Power Efficient Drives From Seagate

Fanless DVRs can help OEMs simplify manufacturing processes, meet the needs of a growing market and increase their bottom line.

By producing fanless DVRs, OEMs can:

- Reduce development and build costs with fewer components to source and manage
- Increase the reliability of their inventory by eliminating a component
- Minimize DVR power consumption to capitalize on potential "green" benefits
- Improve the customer experience by enhancing acoustics
- Increase production capacity for a highly marketable product with strong demand potential

Introduction

Advances in hard drive technology continue to change the way DVR and set-top-box manufacturers design and build home entertainment solutions. Now, the development of drives featuring remarkably low power consumption and heat generation make it feasible to produce DVRs without cooling fans. This constitutes a revolution in home electronics design and exposes exciting opportunities for DVR and set-top-box makers, and consumers.

As the world's largest hard drive manufacturer, Seagate Technology LLC provides industry-leading storage devices—alongside a comprehensive portfolio of services—to help original equipment manufacturers (OEMs) drive innovation and business growth. Based on the dramatic power efficiency and heat dissipation improvements achieved in the Seagate® Pipeline HD™ drive, production of fanless DVRs is now a viable option for OEMs looking to gain a competitive edge.

By embracing this new technology, OEMs can quickly ramp their capacity for building fanless DVRs to gain prime-mover advantage in a market with increasing growth potential. Further, OEMs can use fanless DVR to reduce their build costs through lower component counts and greater overall process efficiency.

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Enabling the Fanless DVR

Historically, DVRs have been designed to use high-speed hard drives that consume large quantities of power and generate a considerable amount of heat during operation. As a result, standard DVR design requires the use of a motorized cooling fan to aid natural convection and distribute heat away from critical device components.

But cooling fans can be noisy, especially when accelerated to offset the rising temperature inside the DVR box during intense usage periods. The transient noise from the fan can detract from the entertainment experience of the user. In addition, because fans are an essential component in the standard DVR model, the reliability of the entire device hinges on the life of a single part.

Consumer demand for quieter, more energy-efficient home entertainment devices is driving the development and production of systems with low power consumption. The emergence of the hybrid DVR design, which requires only intermittent use of the cooling fan, reflects this trend. But until now, power efficiency concerns made fanless DVRs impractical. The persistent technical challenge has been to create a drive that uses minimal power and produces less heat but is robust enough to withstand high ambient temperatures.

Low Power Density: The Key to Fanless DVR Operability

The fanless DVR design requires an increase in the amount of natural convection that occurs within the system. Because there is no fan to draw heat out of the DVR box, heat must be dissipated much more efficiently. Seagate has made this possible by creating a remarkably efficient hard drive that uses less power to complete tasks and produces up to 40 percent less heat than comparable drives during the same duty cycle. As illustrated in Table 1, the power density[1] of the 320-GB Seagate Pipeline HD drive is as low as 0.19 watts per square inch of drive surface.

	DVR Hard Drives				
	Seagate® DB35.3 Series™ 160-GB Drive	**Seagate® DB35.3 Series™ 320-GB Drive**	**Seagate® DB35.4 Series™ 250-GB Drive**	**Seagate® Pipeline HD™ 160-GB Drive**	**Seagate® Pipeline HD™ 320-GB Drive**
Power Consumption—3-Stream HD PVR (W)	6.0 to 6.5	7.5 to 8.5	5.0 to 5.5	3.9 to 4.5	4.5 to 4.7
Surface Area (in^2)	17	23	17	17	17
Power Dissipation (W/in^2)	0.35 to 0.38	0.33 to 0.37	0.35 to 0.38	0.23 to 0.26	0.19 to 0.24

Table 1: Power Density Comparison: Seagate® Pipeline™ HD vs. Comparable Drives

1 Power density is a measure of power per unit of volume. A hard drive with a low power density consumes less power per task and generates less heat during operation.

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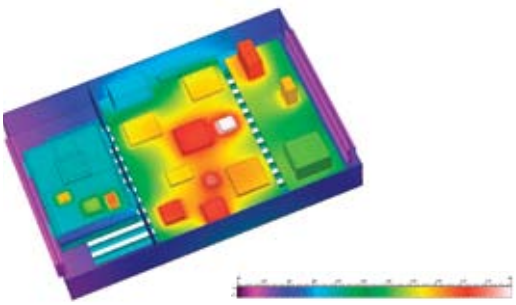
New Model, New Design

With significant improvements in drive engineering, the fanless DVR represents a breakthrough in consumer electronics. As such, it requires new thinking about the design of the DVR box and the configuration of the device components. Table 2 outlines design recommendations[2] for OEMs considering building fanless DVRs.

Design Recommendation	Description	Primary System Benefit
5900-RPM drive	Transition from use of 7200-RPM to 5900-RPM drives	Ensures lower operating temperature for increased reliability
Omni-surface ventilation	Air vents needed on all surfaces of DVR box	Maximizes natural convection
Compartmentalization (see Figure 1)	Increase segregation of components within the box	Prevents averaging of temperatures and channels convection vertically
Removal of isolator mounts (see Figure 1)	Allow direct contact between hard drive and chassis structure; isolate hard drive from other heat-producing components by a divider	Increases thermal conduction, pulling heat away from the hard drive

Table 2: Principal Design Recommendations for Building Fanless DVRs



- Hard drive isolated from other heat-producing components by divider wall
- Hard-mount design allows conduction cooling to the chassis structure, in addition to convection

Figure 1: Hard Drive Design Recommendations

Additional Design Considerations for OEMs

In addition to the recommendations contained in Table 2, OEMs interested in pursuing the production of fanless DVRs will also want to consider the following:

- **Duty cycle**—Because it relies on lower-speed, high-efficiency drive technology, the fanless DVR system design does not support the trend toward multi-room, high-definition service. Yet, it is still capable of meeting the needs of the large number of consumers who want a great single-room entertainment experience.
- **Total surface area**—While the size of today's standard DVRs is satisfactory to accommodate the fanless system design, current technology does not permit reducing the total surface area of the DVR box.
- **Bill of Materials**—OEMs should be aware that production of fanless DVRs will require changes to the bill of materials (BOM). But these changes will reflect the need for fewer components overall, which in turn means less material to source, purchase and inventory.

Green Living Favors Market Growth

Increasingly, consumers worldwide are demonstrating a firm commitment to adopting a more environmentally friendly, or "green" lifestyle. In the consumer electronics market, demand is on the rise for devices that use less power. Consumers want to actively promote energy conservation through their individual purchase decisions and reduce their annual household spending on electricity. Both of these trends favor the continuation of robust consumer demand for energy-efficient devices, including fanless DVRs.

DVR and set-top-box makers can take advantage of this opportunity to diversify their product offerings and reach new consumers—while expanding capacity to capture increasing future demand. The Seagate Pipeline HD drive, which features operational power consumption as low as 4.7 watts and storage capacity up to 1 terabyte, is well suited to the fanless DVR application, a fact confirmed by extensive testing.

2 Research and testing conducted by the Seagate Customer Experience Engineering (CEE) group.

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Aligning With the Seagate Roadmap

OEMs stand to benefit by aligning themselves with the Seagate brand and vision for power-efficient drives. This includes positioning the Seagate Pipeline HD drive as the industry standard component for fanless DVRs.

Seagate offers OEM partners the confidence of technology excellence, as evidenced by consistent leadership in power density—the primary driver for advances in hard drive efficiency. In terms of innovation, Seagate demonstrates a keen understanding of important customer concerns.

Finally, Seagate offers an unsurpassed commitment to quality, as well as direct assistance through the Seagate Customer Experience Engineering program, which provides OEM partners with access to technical consultation and validation for their designs.

Conclusion

Seagate has pioneered advances in hard drive engineering to create drives that are optimally efficient in terms of power consumption and heat generation. This breakthrough makes the development of fanless DVRs finally possible, providing OEMs with a unique market opportunity. In addition to enabling the production of energy-efficient devices, which consumers are demanding, Seagate provides OEMs with options for reducing their build costs while delivering a next-generation product to customers.

For More Information

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