CTAN011: Commercial and Industrial-Grade Products

Covered Products: All Cactus Technologies flash storage products

1. Introduction

There are major differences in the commercial and industrial market segments in the flash storage products industry; hence products targeting to these markets are different. This application note outlines the differences between the products for the two markets and explains why OEM customers should consider using industrial-grade flash storage products from Cactus Technologies for reliable mass storage needs.

2. Commercial and Industrial -grade Flash Storage Markets

Historically, electronic components and semiconductors are classified into three classes in terms of operating temperature and voltage tolerance.

Class	Temperature	Power Supply Tolerance
Commercial	0 - 70°C	Nominal ± 5%
Industrial	-40 - 85°C	Nominal ± 10%
Military	-55 - 125°C	Nominal ± 10%

Table 1: Temperature and voltage tolerance classification of electronic devices

The commercial grade flash storage market focuses primarily at consumer digital devices such as digital cameras, digital video recorders, cellphones and mobile media players. Most often they use commercial grade semiconductor devices, as devices in which they are used are not likely to be subjected to industrial temperature or voltage variations. The primary concerns for this market segment are price and capacity. Buyers are most likely to purchase the flash storage device with the highest storage capacity at the lowest average unit capacity cost. Product reliability, stability and performance are less concerning to many consumers.

The industrial grade flash storage market focuses primarily on OEM customers which build highly reliable systems that requires persistent storage, and magnetic disks were unsuitable due to environmental factors. These systems include network routers, industrial measurement and control systems, automotive and other high-reliability systems. Industrial and OEM customers are less sensitive to price, but they demand product reliability, stability and performance. The products must be stable and reliable over the designed operating environmental conditions. Also many applications require high performance to replace magnetic disk drives.

The demands for commercial and industrial markets are somewhat contradictory, and for many designers, using commercial grade flash storage products designed for consumer electronic devices in their high-reliability system designs proved difficult from design, implementation to maintenance phases of the product life cycle.

3. The Cactus Technologies Industrial-Grade Advantage

The Cactus Technologies industrial-grade flash storage products offers the following advantages for industrial and OEM customers:

1. Product stability.
2. Extended operating conditions.

3. Higher endurance and reliability.
4. Availability of additional features such as life-cycle management.
5. Longer product life cycle.
6. Detailed technical documentation and technical support.

3.1 Product Stability

Cactus Technologies keeps a stable BOM (Bill of Materials) for all Industrial-grade flash storage products, which means core components will not change after the product is officially released on the market. This includes core controller, flash IC and low-level firmware. A stable BOM and firmware ensures product stability in terms of specific device characteristics and minimum performance targets.

More importantly, the logical device geometry, storage capacity, and self-identification information are strictly maintained to the standard as published in the product manual and will not change after the product is officially released on the market. This ensures a consistent logical device interface between the host and flash storage device, thus avoiding the need for host designers to change specific parameters to adapt to different logical device characteristics due to unexpected changes between different product batches.

Designers can be sure that the Cactus Technologies flash storage devices currently shipping with production units are functionally identical to the Cactus Technologies flash storage devices they have verified during development.

If the BOM or logical device characteristics requires to be changed due to technical or other reasons, Cactus Technologies will notify affected customers through formal PCN (product change notification) document that explains the changes before they are implemented, so as to give sufficient time to customers to re-qualify the modified products.

3.2 Extended Operating Conditions

Cactus Technologies industrial-grade flash storage devices are designed and verified to operate under stressed environmental conditions:

- Shock
- Vibration
- Humidity
- Altitude
- Temperature

Cactus Technologies offers both commercial (0°c – 70°c) and industrial (-45°c – 90°c) temperature devices catering to different operating temperature range. The industrial-temperature models exceeded the accepted industrial-grade temperature standard as outlined in Section 1.

All operating environmental specifications and technical standards compliance are verified by reputable independent test laboratories. Copies of operating environmental test reports are available from Cactus Technologies sales representatives worldwide.

3.3 Higher Endurance and Data Reliability

SLC NAND flash memory has the following advantages over MLC NAND flash memory[1] often used in commercial flash storage devices:

- Faster access and erase performance.
- 10 times higher endurance in terms of program/erase cycles.
- Higher data reliability.
- Operation over both commercial and

1 For further information regarding to NAND flash technology and comparison between SLC vs. MLC NAND flash architectures, please refer to application note CTAN010.

industrial temperature range.

Cactus Technologies industrial-grade flash storage devices only use SLC NAND flash memory for commercial and industrial temperature models for higher performance and reliability.

Even with higher reliability and endurance of SLC NAND flash IC, it is necessary for NAND flash storage controllers to implement wear-leveling, error recovery and defect management algorithms to provide a lifespan comparable to magnetic disks.

The on-board intelligent controller of Cactus Technologies industrial-grade flash storage devices provides a sophisticated ECC error detection and correction algorithm to safeguard data. Furthermore, it employs a wear-leveling algorithm designed to operate safely and reliably under continuous read/write operations. This algorithm extends the typical SLC NAND flash program/erase cycles from 100,000 to around 300,000 cycles for SD cards (1,000,000 cycles for -800 series SD cards), and 2,000,000 cycles for other products. To further safeguard data, the intelligent controller also implements a real-time defect block remapping algorithm, completely transparent to the host, to minimize chances of a defect block developed over the lifetime of the flash storage device causing data loss due to unrecoverable ECC errors or program/erase failures.

3.4 Additional Features

Cactus Technologies offers extra features such as product batch number bar code labels for traceability, PIO-only transfer modes, customer-unique serial numbers and integrated life-cycle management on industrial-grade CF cards, PC Card ATA cards, SSDs and DOM units. Customers can also request special feature customizations and custom labeling.

3.5 Longer Product Life-cycle

Cactus Technologies will attempt to keep existing products in production as long as technically feasible to ensure customers can keep a stable BOM in their products.

If a product is declared EOL (end-of-life) due to technological obsolescence, Cactus Technologies will notify all affected customers via formal EOL notice; and our application engineers will assist customer in migrating their designs to current product lines.

3.6 Technical Documentation and Support

Cactus Technologies industrial-grade flash storage devices are fully documented with both verified technical specifications; and product manuals available on customer request, which covers technical specifications, device-host interfacing specifications and instructions on supported operating commands.

Cactus Technologies also provides technical support to customers in resolving issues around the use of our products.

4. Version History

Version	***Date***	***Change***
1.00	March 12, 2008	Initial Version
1.01	June 3, 2008	Minor edits