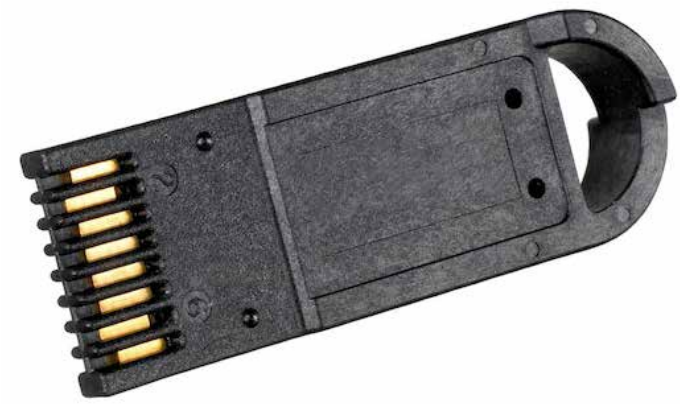
WHITE PAPER

ON

IMPROVING THE PHYSICAL RUGGEDNESS OF SD CARDS FOR USE IN HARSH ENVIRONMENT APPLICATIONS



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IN THE RIGHT SHAPE: INCREASING THE RUGGEDNESS OF SECURE DIGITAL MEMORY DEVICES

One of the most important qualities expected of memory storage and data transfer devices in the military, aerospace and industrial sectors is consistent, reliable operation.

So, when designing these products for use in harsh environments, it is useful to ensure they meet certain government or industry standards.

This is also true for general consumer products, where standardising the design and operation of a device can have a number of advantages for manufacturers and consumers alike.

For example, Secure Digital (SD) cards were developed as an improved standard for memory storage and data transfer for light, portable consumer items such as digital cameras, video cameras and mobile phones, replacing the old Multimedia Card (MMC).

The SD format was established by SanDisk, Matsushita and Toshiba in 2000 – with the smaller microSD cards following in 2004 – and today many electronic devices are built with a slot to accommodate such a card.

In addition, many retailers stock SD cards, making them easy and inexpensive to replace.

Given the ubiquity of the format, it is little surprise that the military, industrial and aerospace markets would look to adopt this commercial solution. Equally, it is unsurprising that manufacturers of SD memory cards should respond by releasing specialised versions which are more robust than standard consumer products.

OPERATIONAL CHANGES WITHIN THE STANDARD SHAPE

Standard SD cards are rated for operation for temperatures from -25°C to +85°C. This lower end of the range does not meet the operational requirements of products designed for, say, military markets, so some SD cards have been developed which are rated from -40°C.

In addition, most consumer SD cards use Multi-Level Cell (MLC) NAND flash, which has four states per cell and allows for a larger memory capacity for a given die size. This lowers the cost per byte, but does so at the cost of lower write speeds and a lower number of program/erase cycles.

The alternative is to use Single Level Cell (SLC) NAND flash, which has only two states per cell and is much more robust in write-intensive applications. So, manufacturers focused on military, aerospace and industrial applications often offer SD memory with SLC NAND flash to those markets.

Another offer to those markets from SD card manufacturers is fixed/controlled Bills of Materials (BOMs). The main components of an SD card's electronics are the NAND flash memory, the SD controller integrated circuit, and the firmware run by the controller.

In consumer SD cards, any three of these could change from lot to lot, resulting in differing capacity and performance levels.

By offering a fixed BOM, manufacturers pledge that any change to one of these controlled items would require a product change notification.

DEPARTING FROM THE STANDARD SD SHAPE

All of these enhancements can be accomplished while keeping the SD card in the same size and shape.

However, they only improve the ruggedness of the device in relation to operational temperature, longevity of read-write use and consistency of performance, not its physical sturdiness.

Since the design of the card has been driven by less demanding uses than those required by military, industrial and aerospace applications, there is a limit to what can be done while still conforming to that standard.

In consequence, achieving the physically robust level needed by these more demanding applications requires a departure from the standard form of the SD card.

This has, as might be expected, both advantages and disadvantages for the resulting product.

ADVANTAGES OF ALTERING THE SHAPE FORMAT

One great advantage is that a proprietary form factor limits the devices that can fit in that socket. This is counter to the advantage of consumer SD slots, which can be fitted by MMC cards, SD cards, the higher capacity SDHC cards, extended capacity SDXC cards and more. But allowing such a range of models produced by scores of manufacturers can increase the likelihood of compatibility issues.

For example, some older devices designed to work with standard SD cards might be unable to communicate with the a newer SDHC or SCXC card. In addition, some operating systems are not licensed to use the exFAT file system utilised by SDXC cards. While alternative file systems are available, many devices using SDXC cards expect to read the exFAT system on cards larger than 32GB. A card with an unrecognised file system may be treated as damaged or blank and automatically reformatted, leading to a loss of data.

Removing the possibility of using any SD format card in the socket removes the requirement to test great numbers of different cards to determine their compatibility.

It also increases security, as it now becomes much more difficult for someone to use an unauthorised device, which could introduce malware or otherwise affect or access the host.

This is especially the case where the availability of the proprietary memory devices is controlled and cannot be purchased by the general public.

In addition, if the proprietary memory device is lost, the data cannot be easily accessed by whoever finds it by plugging it into a consumer computer. Just as that proprietary device is the only memory storage item to fit the slot of the host device, so the memory device cannot be plugged into any standard slot, adding an extra level of protection to the on-board data.

Controlling the availability of the proprietary version also provides an additional revenue source for the host system's manufacturer. While standard SD cards are easily obtainable from a number of retail sources, the manufacturer of the host system can be the sole source for the approved memory device. Depending on the volume of devices required, this can be a significant income source for the manufacturer.

DRAWBACKS OF THIS APPROACH

Nonetheless, there are disadvantages to consider, not least of which is that a more robust design is more costly to produce, particularly in comparison with a standard, mass-produced SD card.

Standard SD cards are, of course, much easier to replace, too. If a proprietary device is lost, and a suitable replacement is not kept on hand, users will have to contact the manufacturer for a new device, which will likely take a little longer than a trip to the nearest retailer.

Sometimes, there is a need to transfer data from a proprietary device to a PC or other device that has only standard connectors. In this case, an adapter must be used to interface with one of the PC's standard ports.

CONCLUSION

It can be seen, then, that while standard SD cards are well suited to their intended consumer use, adaptations are often required for military, industrial and aerospace applications where they may be exposed to temperature extremes, physical and electric shock, vibrations, dirt, moisture and general rough use.

These applications therefore require a more durable solution, which may involve changing the shape and size of a standard SD card to significantly improve the device's rugged qualities.

As the trusted name in rugged memory integration for 30 years, Nexus has the experience and expertise to help manufacturers of embedded electronics make the right choice in industrial memory solutions. As the exclusive partner of Datakey ruggedised memory products in the UK, Ireland, Scandinavia, Germany, Switzerland and Austria, we can advise OEMs on the best way to integrate Datakey products into embedded systems.

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