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# *Macronix Breaks the 128Mbit Barrier for Serial Flash in an Innovative and Simple Way*

## **Introduction**

Serial flash memory using the Serial Peripheral Interface (SPI) utilizes a 24-bit addressing scheme that limits the maximum density to 128Mbits. However, in order to add new features, more and more applications are requiring densities greater than 128Mb. For serial flash applications requiring more than 128Mb of storage, many systems engineers have been forced to search for alternative memory solutions. While other non-volatile memory solutions will work, they do not offer the well known advantages of serial flash--such as lower pin-count, smaller footprint, simplified board layout & design, reduced system noise/EMI, and reduced system cost. Hence, the ideal solution would be a serial flash device capable of breaking the 128Mb density barrier. As a leading manufacturer and supplier of serial flash memory, Macronix has solved this problem by providing an innovative and simple operation mode that extends the addressable range from 24 bits to 32 bits. The increased address range will accommodate future serial flash memories starting with 256Mb to densities as large as 32Gb. Macronix is currently offering serial flash densities up to 256Mb, but with 32-bit addressing, there is plenty of room for future density increases.

## **Potential Market Applications**

Potential market applications are mainly system applications related to the storage of large application image files, such as WiMAX, high-end data communication, set-top box, storage, high-end server, and high-end projector applications. Since high-density



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serial flash memory can provide high capacity storage yet remain low pin count, it is the ideal solution for system processor/controllers needing to store large program code images in non-volatile memory. In addition to code storage, a high density serial flash will have sufficient space for data storage as well. For example, user data and configuration files can be stored in the memory space not utilized by the code image. In other words, the market urge to adopt high-density serial flash memory is becoming stronger and stronger. Macronix is taking the lead to provide product solutions to satisfy this market demand. In the following, we will explain in detail how Macronix has enabled serial flash memory density to be increased from 128Mb to 256Mb and greater by using a very simple extension to the command set.

### **Simple Method for Address Accessing to 256Mb and Above- Define by a “Mode”**

As previously stated, current serial flash uses only 24-bits of address information when executing commands such as Read (03), Fast Read (0B), Page Program (02), and Erase Sector (20). There are up to 11 commands that require a 24-bit address for operation. Since there are already a large number of commands requiring an address, adding a new set of 32-bit address commands would double them. This would add complexity to the design of the silicon and increase its cost. A more efficient method would be to create a 24-bit or 32-bit mode that could be shared with all existing commands. Switching between modes could be done by adding two simple commands - one to select 32-bit mode and one to return to 24-bit mode. This is what Macronix is currently promoting. The 256Mbit serial flash can enable switching back and forth between addressing modes with just two newly added commands. (Please refer to the following figure.)

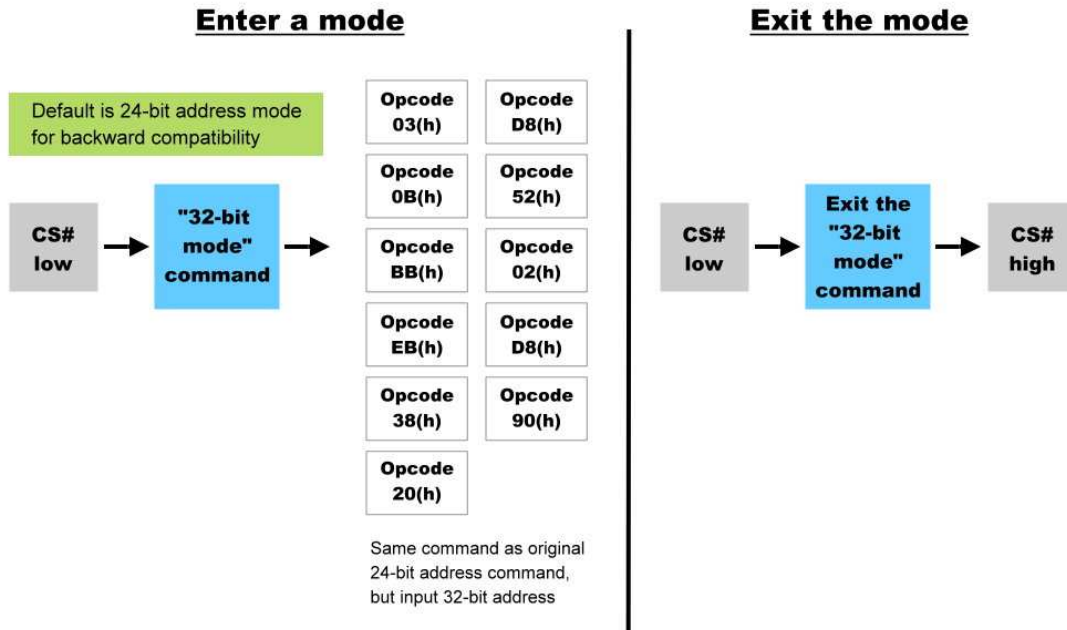


Figure 1. A Diagram to Explain the Operation

The actual method of operation is similar to the existing general command format where CS# is first driven low, followed by clocking in the 8-bit command for either entering (e.g. B7) or exiting (e.g. E9) the 32-bit addressing mode. Afterwards, one can use the standard commands in the normal fashion as long as one uses the appropriate number of address bits (24 or 32) for the selected addressing mode.

### 24-bit Address Operation—for Backwards Compatibility

Backwards compatibility to existing serial flash products was a very important design consideration when we added the 32-bit addressing mode. As such, the new 256Mb memory is always power-up in the 24-bit addressing mode. If random access through the entire 256Mb memory space is required, the user would need to activate the 32-bit addressing mode. But if the user only intends to dump the contents of the serial flash to DRAM, the device can remain in the 24-bit addressing mode. Given any 24-bit address in the lower portion of memory (first 128Mb), an internal 32-bit address counter will automatically increment from the starting address to the end of memory (256Mb) during any memory dumping. For example, in a FPGA (Field Programmable Gate Array), one can still download the entire contents of the 256Mb



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serial flash device to DRAM without entering the 32-bit addressing mode. The FPGA does not need to supply a 32-bit address. It only needs to know the size of the contiguous download. This allows the user to directly increase the density of the serial flash memory beyond 128Mb without the need to modify the main processor/controller, which makes it very convenient to system designers.

Moreover, existing software based on the 24-bit addressing scheme can be easily modified to accommodate the higher-density device— whether the application is to do a memory dumping of content stored in the area beyond 128Mb (using 24-bit addressing) or to perform random accesses through the entire 256Mb space (using 32-bit addressing).

## **Conclusion**

Macronix breaks through the existing 128Mb serial flash density barrier with a new 32-bit address mode that enables memory densities of 256Mb and higher (up to 32Gb). Hence, system designers can continue to use the Serial Peripheral Interface structure for their new high density applications and still benefit from the cost advantages of low pin count devices. Software engineers do not have to worry about rewriting their software but can continue to use their existing software and enhance it to take advantage of the additional memory space. Additionally, there is no longer a need for them to search for alternate memory solutions for their high density applications. For the industry, this represents a major milestone in the advancement of high-density serial flash and expands wide-ranging applications of serial flash memory..

### **About Macronix International Co., Ltd.**

Founded in 1989, Macronix International Co., Ltd. (TSE: 2337.TT) is a leading provider of innovative Non-Volatile Memory (NVM) solutions. Macronix is the largest worldwide manufacturer of ROM and Serial NOR Flash products, and also provides a wide range of Parallel NOR Flash products across various densities. These are used in embedded systems, consumer, computer, communications, networking and enterprise applications.

For more information, please visit the Company web site at [www.macronix.com](http://www.macronix.com).



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