Miniature Card Technology Brief

What is Miniature Card?

Miniature Card is a new small form factor memory card that supports many different markets and applications. These markets include Audio Recording, Digital Photography, Cellular Phone, Handheld PCs and other small portable electronic devices. Miniature Card's high performance, small size (38 mm x 33 mm x 3.5 mm), low cost, and simple interface are ideal for memory expansion and data storage.

Miniature Card provides a very high-performance memory bus capable of handling applications that require high-speed flash disk drives, eXecute In Place (XIP) memory, DRAM expansion, or ROM applications. Miniature Card also supports a special identification scheme that allows memory technology on the card to be identified along with its timing requirements. This method of identification provides true plug-n-play functionality.

Some typical uses for Miniature Card are:

- High-speed solid-state disk drive (Flash)
- Data transfer mechanism to the PC (Flash)
- Operating system and applications storage/execution (Flash and ROM)
- Expansion of system memory (DRAM)
- Simple system code updates (Flash and ROM)

The Miniature Card specification also supports multiple memory technologies on the same card (e.g., a card with both Flash and ROM).

Miniature Card Features

The following table lists some of the major features of Miniature Card.

Feature	Benefit
Flexible Host Design	• Supports Flash, ROM, and DRAM memory devices
60 connection memory-only bus interface	• Easy system integration • Low cost implementation • Low cost cards
Small Form Factor (38 mm x 33 mm x 3.5 mm)	• Minimized system area consumed by card • More card sockets per system
16-bit non-multiplexed data bus	• High-performance data transfers
Addresses up to 32 Mwords (64 Mbytes)	• High-capacity data storage
Consumer-friendly form-factor	• Easy to insert and remove • Easy to upgrade memory • Easy to add applications
Voltage level keying for single and multiple voltage hosts and cards	• Allows OEMs to design systems supporting only one voltage level or multiple voltage levels • Allows multiple voltage cards (5V and 3.3V) to plug into 5V only and 3.3V only hosts • Prevents a 5V card from being plugged into a 3.3V system (and vice versa)
Single Power Supply	• No program voltage supply required on the host
V_{CCR} (Refresh Voltage)	• Allows self-refresh DRAMs to retain data contents while V_{CC} is off • Longer system battery life
Burst Mode Support	• High performance using bursting memory cards
Hot and Cold Insertion/Removal	• Cards can be inserted and removed without turning off system power • If system does not support hot insertion, safety measures are outlined to handle accidental hot insertion and removal.
Elastomeric Connector	• Low cost • Rugged and reliable • Removable and replaceable • Minimum of 5000 insertion / removal cycles
ESD Protection	• Protection against ESD is designed into the Miniature Card housing.
Write Protection	• User-selectable write protect switch • Protects important data from accidental deletion

Miniature Card Specification Summary

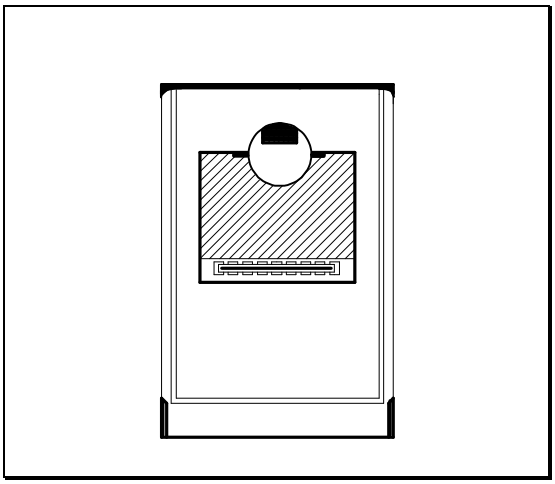
The following table summarizes the Miniature Card specification.

Interface Type	Memory (CE and RAS/CAS)
Memory Types	Flash, ROM, OTPROM, EEPROM, DRAM, SRAM*
Miniature Card Identification	AIS stored in memory device or serial EEPROM
Data Access	Random access
Data Bus	16 bits
Addressing	32 Mwords (64 Mbytes)
Supply Voltage	Operation at 5.0 V, 3.3 V, or x.x V
Hardware Keys	Voltage Keys (5.0/3.3/x.x), and DRAM Key
Hot Swapping	Optional card insertion and removal detection

* The Miniature Card Specification does not preclude support for SRAM.
However, no special provisions for battery voltage detection are provided.

A Detailed Look at Some of Miniature Card's Features

PC Card Compatibility
The Miniature Card interface is a subset of the PC Card standard interface. Data can be easily transferred from the Miniature Card back to a PC using a Type II PC Card adapter.

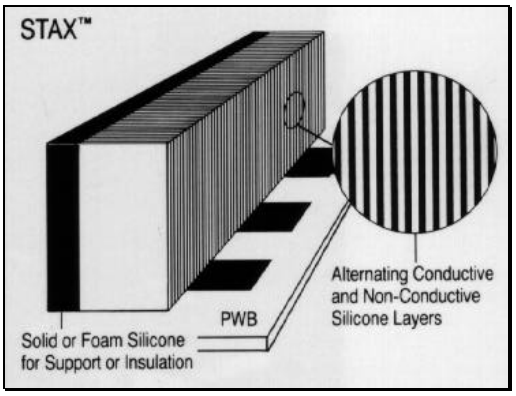


Conceptual Drawing of Type II PC Card Adapter

Memory Interface
The Miniature Card interface is designed to support two types of memory cards: standard and DRAM. Standard memory cards consist of Flash, ROM, EEPROM, etc. These devices use OE and WE signals to read and write data from/to the card. The card enable (CEL and CEH) signals select the card for reading/writing.

DRAM memory cards use the same OE and WE signals for reading/writing, but use the RAS signal for selecting the card. Host sockets can be designed to operate with both types of cards. DRAM Miniature Cards can be "keyed" so they only fit into sockets designed to support the DRAM signals (see Hardware Keys section).

Elastomeric Connector
The elastomeric connector consists of alternating layers of conductive and non-conductive silicone. It is a rugged, low resistance, consumer-friendly connector, ideal for consumer applications.



*STAX is a trademark of Elastomeric Technologies Inc.

Attribute Information Structure (AIS)
The AIS provides the host system a means of identification for the Miniature Card. The AIS describes the characteristics and capabilities of the card. The AIS includes information about the memory type(s), speed, size and configuration. This information can also be used by the host to optimize accesses to the Miniature Card.

The AIS information is divided into five unique data sections:
1) Identification data: This includes manufacturing information about the card (manufacturer's name, card name, etc.).
2) Compatibility data: This specifies basic information about the card (memory size, access times, memory type, power requirements, etc.).
3) Burst Data: This data specifies information about burst devices (burst length, burst access, etc.)
4) DRAM Data: This data specifies information related to DRAM devices (row addresses, column addresses, refresh rate, etc.).
5) Reserved Data: This data area is reserved for future use.

Flash and ROM Miniature Cards store the AIS in the memory device at fixed addresses. DRAM Miniature Cards store the AIS in a separate serial EEPROM. The host reads the information out of the EEPROM using the I^2C serial interface signals.

Multiple Voltage Support
Miniature Cards can be designed to operate from one or more of the these voltage sources: 5.0 volts, 3.3 volts, and a future x.x volts. In addition, interface signals are included to allow the host to detect the proper Miniature Card "power-up" voltage (if the host supports more than one voltage), as well as physical voltage keys to prevent a card from being placed in a host that doesn't support the card's voltage.

Hot Insertion and Removal

Inserting and removing cards without turning off system power is an important feature that is supported by the Miniature Card Specification.

Hot Insertion

The Card Insertion contact, located in the front of the Miniature Card, can be used by the host system as an early detection mechanism. This signal is grounded on the card so the host can detect this signal before the interface signals make contact with the host. The state of this signal can be used to control power to the socket (or even shut down the system power in the event the host cannot handle hot card insertions).

Hot Removal

The host can implement a "switch" at the rear of the Miniature Card socket for an additional detection mechanism. On card insertion, this switch would activate last (after all interface signals make connection). When the user removes the card, the switch would open first (before the card's interface signals were broken), allowing time for the system to prepare for a card removal event.

Hardware Keys

The Miniature Card specification defines two types of hardware keys: Voltage key and DRAM key. The keys have been designed to prevent damage to the cards. The keying mechanism prevents cards from plugging into an incompatible system. If the user can easily insert the card into the socket, he/she knows that it is a capable socket and will not cause any damage to the card or system.

Voltage Keys

The Voltage keys determine the operating voltage of the Miniature Cards. The voltage keys are located at the front of the card and can be configured so the card is keyed for a single voltage or multiple voltages. Single and multiple voltages for both the Miniature Card and Miniature Card socket are allowed in the Miniature Card specification.

DRAM Key

The DRAM key consists of a special tab located at the front of the DRAM Miniature Card. This tab matches up with a corresponding slot in host socket. This special key is needed because DRAM sockets require additional DRAM signals and read the AIS using the serial interface, which Flash and ROM cards may not support. Sockets can be designed to either support all cards or to exclude DRAM cards.

The Miniature Card Interface

Interface signals: Connect through the elastomeric connector

Signal	Name	Direction
A[24:0]	Address Bus	Input
D[15:0]	Data Bus	Input/Output
OE#	Output Enable	Input
WE#	Write Enable	Input
CEL#	Card Enable Low Byte	Input
CEH#	Card Enable High Byte	Input
RAS#	Row Address Strobe	Input
CASL#	Column Address Strobe Low Byte	Input
CASH#	Column Address Strobe High Byte	Input
RESET#	Reset	Input
BUSY#	Busy	Output
VS1#, VS2#	Voltage Sense	Output
V_{CCR}	Voltage Refresh	Input
CD#	Card Detect	Output
BS8#	Bus Size 8	Input
SDA	Serial Data and Address	Input/Output
SCL	Serial Clock	Input
RFU (x3)	Reserved for Future Use	-

Power and card insertion signals: Connect through the front of the Miniature Card

GND	Ground	-
V_{CC}	V_{CC} Power	-
CINS#	Card Insertion	Output

Note: All Miniature Card signals are at CMOS levels

Address Bus: The address bus consists of 25 signals that can address up to 32 Mwords (64 Mbytes) of data.

Data Bus: The data bus consists of 16 non-multiplexed signals to transfer data to/from the Miniature Card's memory.

Control Signals: The control signals provide a simple memory interface to the card. OE and WE are used to read and write data, and CEL/CEH are used to enable the card. For DRAM cards, RAS and CAS signals are provided in place of CEL/CEH.

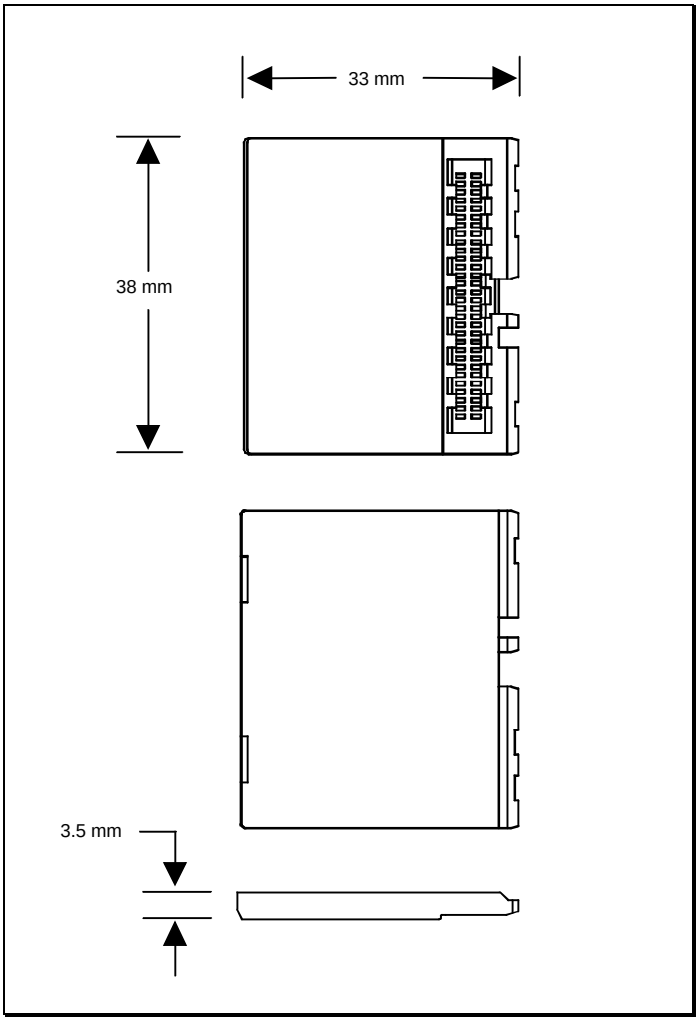
Power Control: For DRAM cards, V_{CCR} supplies a low current (refresh) voltage to keep the DRAM memory refreshed after V_{CC} has been removed.

Voltage Detect: Two signals are provided to allow the host to determine the power-up voltage for the Miniature Card. VS1# and VS2# can be sensed by a multiple-voltage hosts to determine the card's power requirements. (These signals are similar to those found in PC Cards.)

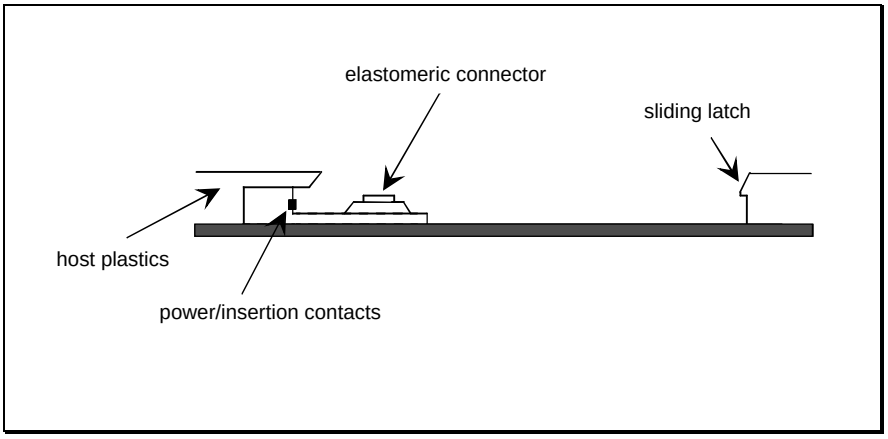
Card Detection: CINS# provides an early card insertion detection mechanism. CD# provides a card interface signal detection mechanism.

Serial Interface: SDA and SCL are provided for interfacing with the serial EEPROM on DRAM cards. These two signals form an I^2C interface for reading the DRAM card's identification information (AIS).

The Physical Look of Miniature Card



Miniature Card Dimensions



Host Socket Cross Section

Miniature Card Implementers Forum

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The Miniature Card Implementers Forum is a program designed to promote the Miniature Card Specification technology and its benefits of lower system costs, improved interoperability and greater capabilities to the users of electronic devices.

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