MultiMediaCards

MMCA Seminar

Technical Presentation

Taipei, Sept. 2003

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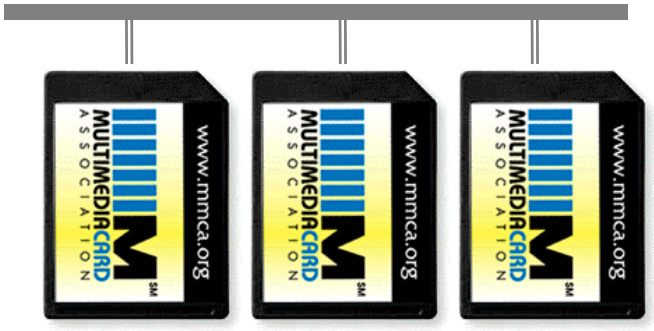
MultiMediaCard Architecture

System feature-1

- Multiple MultiMediaCard can be connected to one physical bus.
  30 pcs max.

- Variable clock frequency
  0 to 20MHz
  (up to 10 cards for max data rate)

- Transfer data size is changeable.
  1 byte to 2,048 bytes (for Read)



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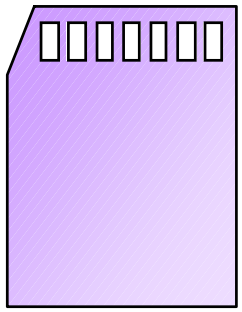
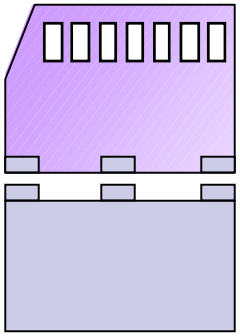
System feature-2

- System voltage range
  - High voltage MMC : 2.7-3.6v
  - Low voltage MMC : 1.65-1.95v, 2.7-3.6v

- Two form factors
  - Normal size : 24mm x 32mm x 1.4mm
  - Reduced size : 24mm x 18mm x 1.4mm



MMC



RS-MMC

RS-MMC adapter

System feature-3

Two operation mode

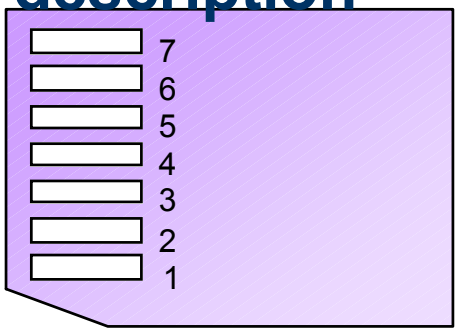
- **MMC mode (Primary)**
  3 pins serial bus

- **SPI mode (Secondary)**
  3 pins serial bus + Chip select pin

These 2 modes are independent in each.

After Card is powered on , card executes the initialization procedure and the mode is set with the level of #1 pin at the powered on. To change the mode another power cycle is required.

Pin description



MMC mode

Pin No	Name	Description
1	RSV	Reserved
2	CMD	Command/Response
3	VSS1	GND
4	VDD1	VCC
5	CLK	Clock
6	VSS2	GND
7	DAT	Data in/out

SPI mode

Name	Description
CS	Chip select
DI	Data in
VSS	GND
VDD	VCC
SCLK	Clock
VSS2	GND
DO	Data out

After power on card is set as MMC mode as default.

Comparison table of MMC and SPI mode

		MMC I/F	SPI I/F
Comparison of system specification	Interface	3 pins serial bus (CLK,CMD,DAT)	3 pins serial bus + CS (CLK,DI,DO & CS)
	Frequency	0-20 MHz	0-20 MHz
	Card Selection	Card is selected by MMC bus protocol. Host sends the relative card address to select the card which has the same one.	Card is selected by the CS signal.
	Access mode	Single block access, Multiple block access Stream access	Single block access Multi block access (from Ver.3.1)

Pin Arrangement	Pin No.	Name	Type	Description	Name	Type	Description
	1	RSV	NC	Reserved	CS	Input	Chip select
	2	CMD	I/O Push-pull/ Open-drain	Command/Response	DI	Input Push-pull	Data in
	3	VSS1	—	GND	VSS	—	GND
	4	VDD1	—	VCC	VDD	—	VCC
	5	CLK	Input	Clock	SCLK	Input	Clock
	6	VSS2	—	GND	VSS2	—	GND
	7	DAT	I/O Push-pull	Data in/out	DO	Output Push-pull	Data out

General function description

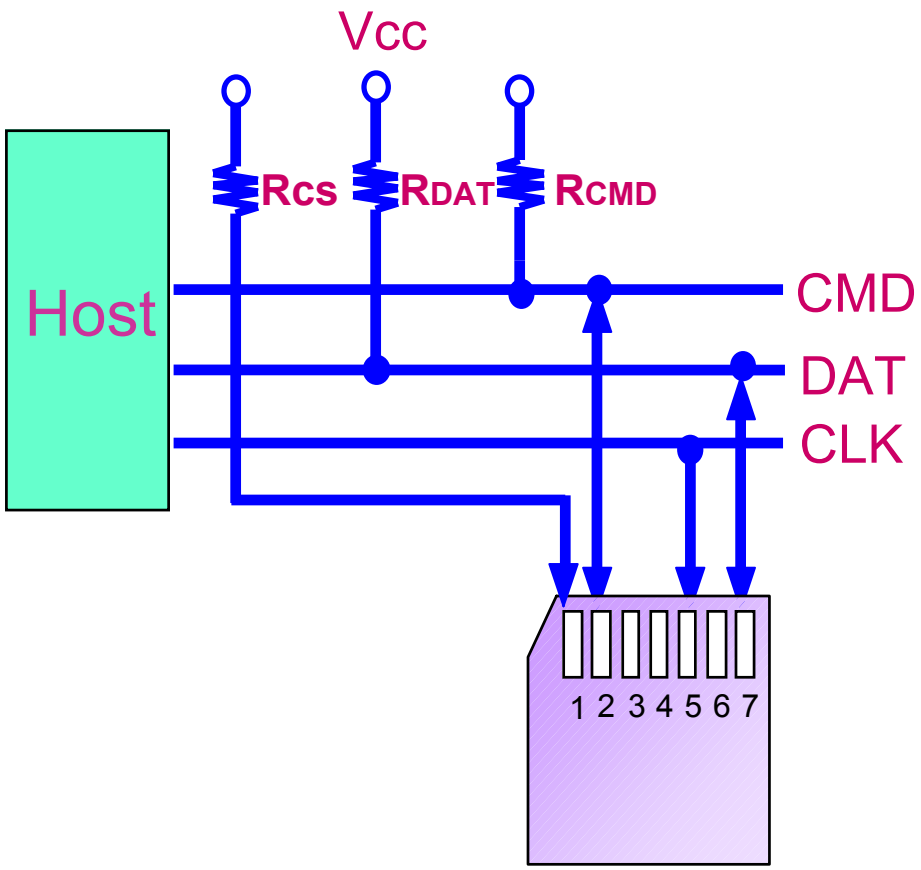
Card Identification mode

The host will be in card identification mode after reset and while it is looking for new cards on the bus. Card will be in this mode after reset until the SET_RCA command (CMD3) is received.

Data transfer mode

Card will enter data transfer mode once an RCA is assigned to them. The host will enter data transfer mode after identifying all the cards on the bus.

MMC (MultiMediaCard) mode



•Control CMD signal/DAT signal synchronized with CLK signal.

•CMD pin is the bi-directional pin. At first the command signal is input to the card through CMD line by host. Then respond data is output to the host through CMD line by card.

•DAT pin is the bi-directional pin. Read data is output to host through DAT line by card. Write data is input to the card through CMD line by host.

•There is no chip select pin.

•Single block access, Multiple block access and stream access are supported.

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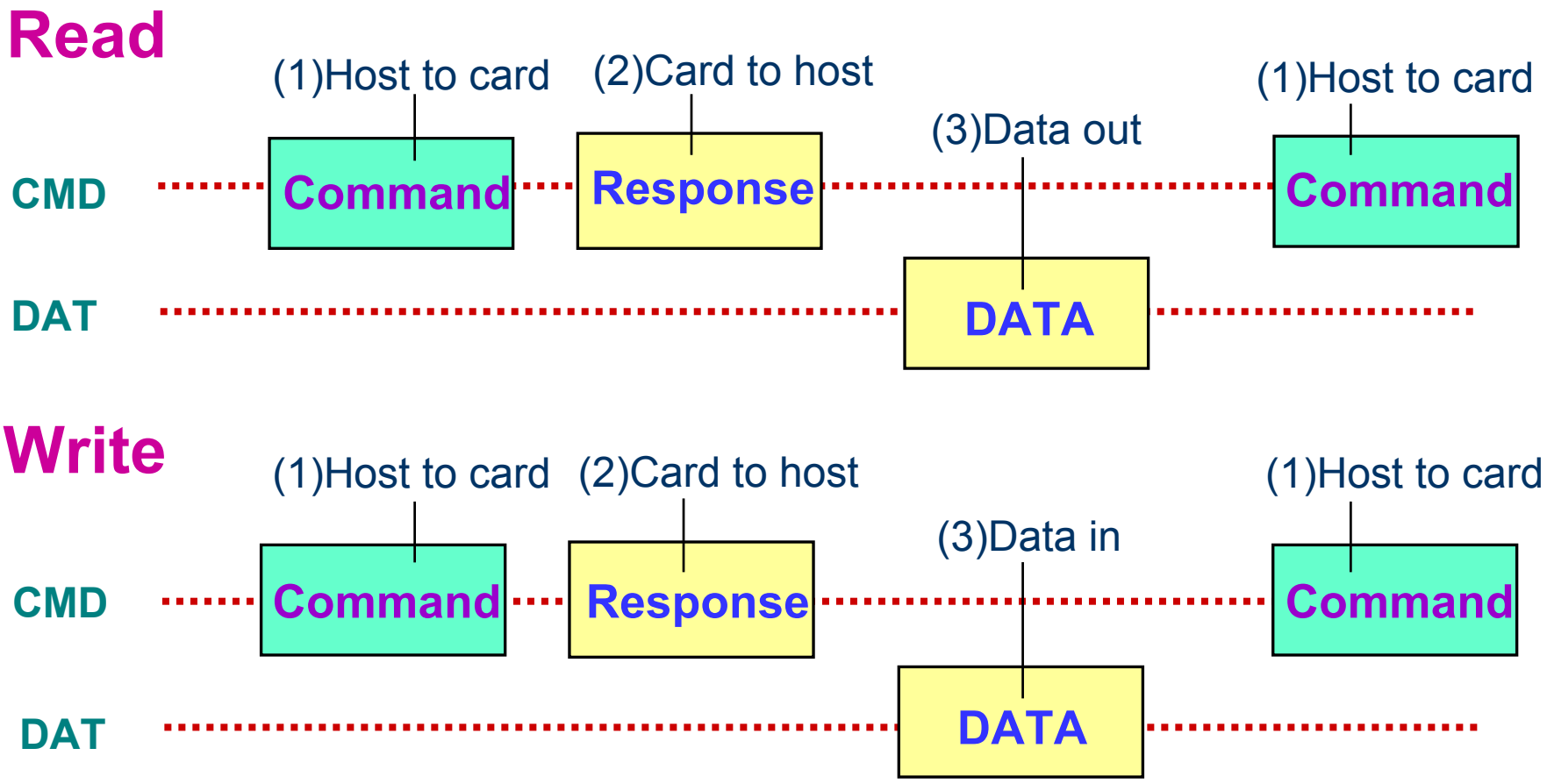
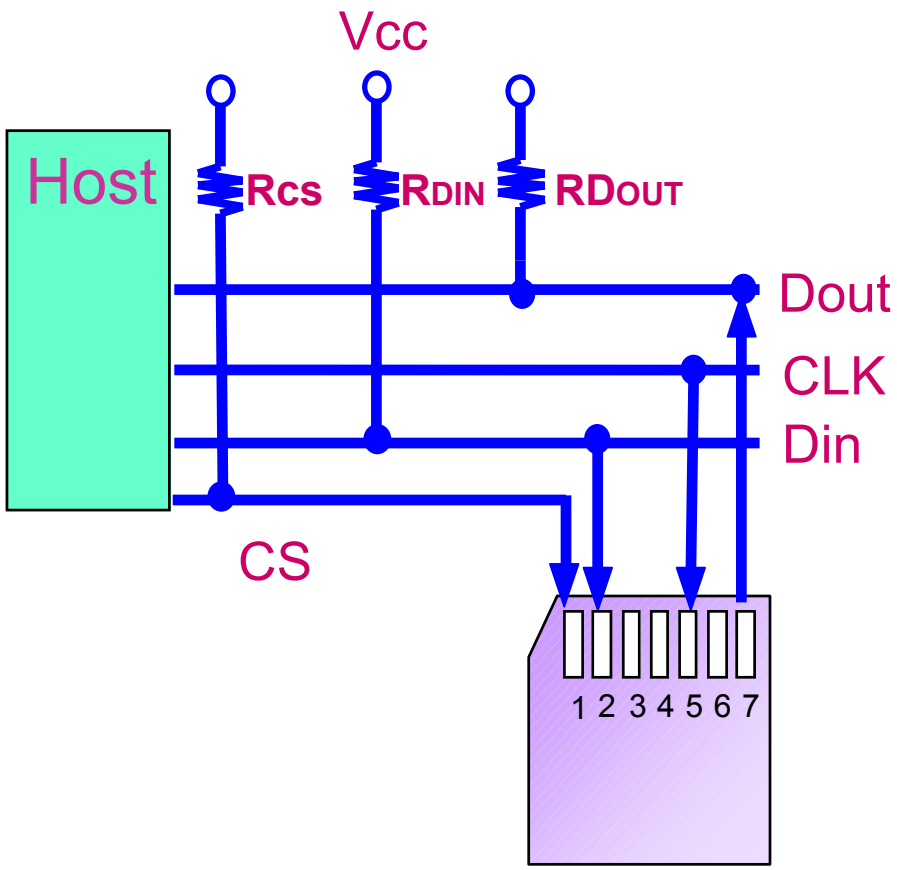
MMC mode data transfer

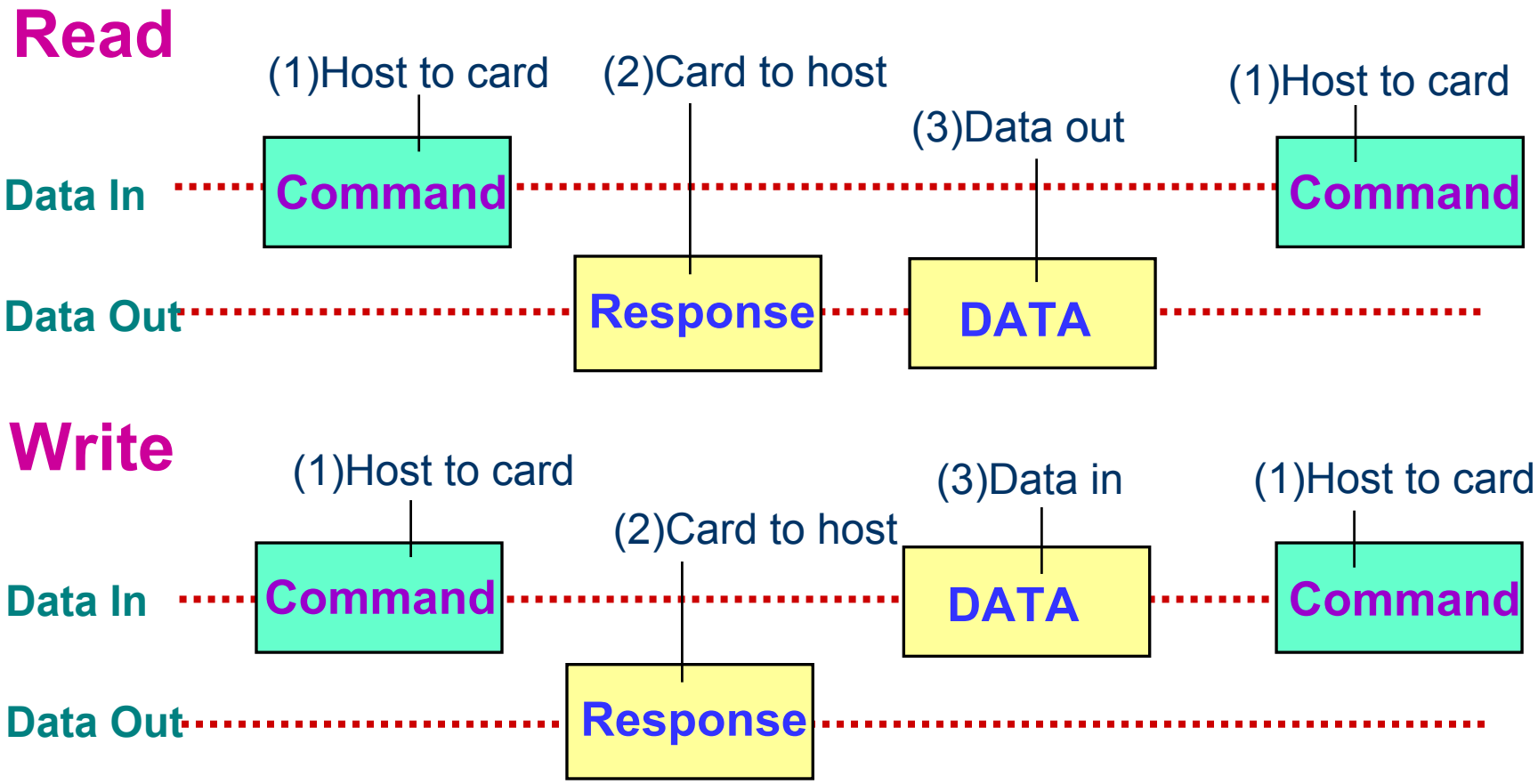


SPI mode



- Control CMD signal/DAT signal synchronized with CLK signal.
- Data is input to DI (data in) pin and output from DO (data out) pin.
- There is CS pin for chip select.
- Single block access and Multi block access is supported.

SPI mode data transfer



Access mode (for MMC mode)

Stream access command

Data read/write from the beginning to the end with only one command.

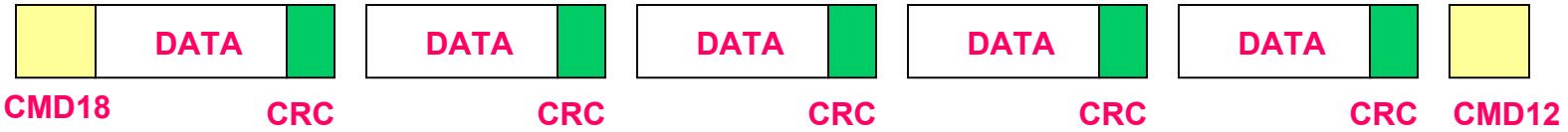
- Example of stream read

Multiple block access command

Data read/write of the multiple block with only one command. CRC* interruption is

occurred at the end of each block.

- Example of multiple block read



Single block access command

Data read/write of the single block with command.

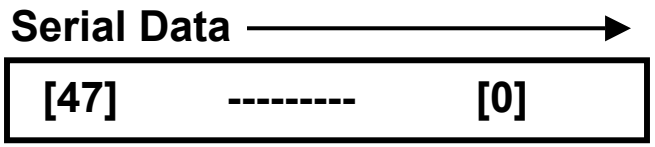
- Example of single block read

* CRC: Cyclic redundancy code

MultiMediaCard Command

Command format

Command consists of 48 bits (6 Bytes)



Bit position	47	46	[45:40]	[39:8]	[7:1]	0
Width (bits)	1	1	6	32	7	1
Value	0	1	X	X	X	1
Description	Start bit	transmission bit	command index	argument	CRC7	end bit

MMC mode command

CMD index	Argument	Command description
CMD0	GO_IDLE_STATE	Resets all cards to idle state
CMD1	CEND_OP_COND	Asks all cards in idle state to send their operation conditions register contents in the response on the CMD line
CMD2	ALL_SEND_CID	Ask all cards to send their CID numbers on the CMD line
CMD3	SET_RELATIVE_ADDR	Assigns relative address to the card
CMD4	SET_DSR	Programs the DSR of all cards
CMD7	SELECT/DESELECT_CARD	Command toggles a card between the stand-by and transfer states or between the programming and disconnect status. In both cases the card is selected by its own relative address and gets deselected by any other address.
CMD9	SEND_CSD	Addressed card sends its card-specific data (CSD) on the CMD line.
CMD10	SEND_CID	Addressed card sends its card identification (CID) on CMD line.
CMD11	READ_DAT_UNTIL_STOP	Reads data stream from the card, starting at the given address, until a STOP_TRANSMISSION follows.
CMD12	STOP_TRANSMISSION	Terminates a read/write stream/multiple block operation. When CMD12 is used to terminate a read transaction the card will respond with R1. When it is used to stop a write transaction the card will respond with R1b.
CMD13	SEND_STATUS	Addressed card sends its status register.
CMD15	GO_INAVTIVE_STATE	Sets the card to inactive state in order to protect the card stack against communication breakdowns.
CMD16	SET_BLOCKLEN	Sets the block length (in bytes) for all following block commands (read and write).
CMD17	READ_SINGLE_BLOCK	Reads a block of the size selected by the SET_BLOCKLEN command
CMD18	READ_MULTIPLE_BLOCK	Continuously transfers data blocks from card to host until interrupted by a stop command or the requested number of data block transmitted
CMD20	WRITE_DAT_UNTIL_STOP	Write data stream from the host, starting at the given address, until a STOP_TRANSMISSION follows.

MMC mode command

CMD index	Argument	Command description
CMD23	SET_BCLOC_COUNT	Define the number of blocks which are going to be transferred in the immediately succeeding multiple block read or write command
CMD24	WRITE_BLOCK	Write a block of the size selected by the SET_BLOCKLEN command
CMD25	WRITE_MULTIPLE_BLOCK	Continuously writes blocks of data until a STOP_TRANSMISSION follows or the requested number of block received
CMD26	PROGRAM_CID	Programming of the card identification register
CMD27	PROGRAM_CSD	Programming of the programmable bits of the CSD
CMD28	SET_WRITE_PROT	If the card has write protection features, this commands sets the write protection bit of the address group.
CMD29	CLR_WRITE_PROT	If the card has write protection features, this commands clears the write protection bit of the address group.
CMD30	SEND_WRITE_PROT	If the card provides write protection features, this command asks the card to send the status of the protection bits.
CMD35	ERASE_GROUP_START	Sets the address of the first erase group within a range to be selected for erase
CMD36	ERASE_GROUP_END	Sets the address of the last erase group within a continuous range to be selected or erase
CMD38	ERASE	Erase all previously selected write blocks
CMD39	FAST_IO	Used to write and read 8 bit (register) data fields. The command addresses a card and a register and provides the data for writing if the write flag is set.
CMD40	GO_IRQ_STATE	Sets the system unto interrupt mode
CMD42	LOCK_UNLOCK	Used to set/reset the password or lock/unlock the card.
CMD55	APP_CMD	Indicates to the card that the next command is an application specific command rather than a standard command
CMD56	GEN_CMD	Used either to transfer a data block to the card or to get a data block from the card for general purpose/application specific commands

SPI mode command

CMD index	Argument	Command description
CMD0	GO_IDLE_STATE	Resets the card
CMD1	CEND_OP_COND	Activates the card's initialization
CMD9	SEND_CSD	Asks the selected card to send its card specific data (CSD)
CMD10	SEND_CID	Asks the selected card to send its card identification (CID)
CMD12	STOP_TRANSMISSION	Stop transmission on multiple block read
CMD13	SEND_STATUS	Asks the selected card to send its status register
CMD16	SET_BLOCKLEN	Selects a block length for all following block commands
CMD17	READ_SINGLE_BLOCK	Read a block of the size selected by the SET_BLOCKLEN command
CMD18	READ_MULTIPLE_BLOCK	Continuously transfers data blocks from card to host until interrupted by a stop command or the requested number of data block transmitted
CMD23	SET_BLOCK_COUNT	Defines the number of blocks which are going to be transferred in the immediately exceeding multiple block r/w.
CMD24	WRITE_BLOCK	Write a lock of the size selected by the SET_BLOCKLEN command
CMD25	WRITE_MULTIPLE_BLOCK	Continuously writes blocks of data until a 'stop tran' token or the requested number of blocks received
CMD27	PROGRAM_CSD	Programming of the programmable bits of the CSD
CMD28	SET_WRITE_PROT	If the card has write protection features, this commands sets the write protection bit of the address group.
CMD29	CLR_WRITE_PROT	If the card has write protection features, this commands clears the write protection bit of the address group.
CMD30	SEND_WRITE_PROT	If the card provides write protection features, this command asks the card to send the status of the protection bits.
CMD35	TAG_ERASE_GROUP_START	Sets the address of the first erase group within a range to be selected for erase

SPI mode command

CMD index	Argument	Command description
CMD36	TAG_ERASE_GROUP_END	Sets the address of the last erase group within a continuous range to be selected or erase
CMD38	ERASE	Erase all previously selected write blocks
CMD42	LOCK_UNLOCK	Used to set/reset the password or lock/unlock the card.
CMD55	APP_CMD	Indicates to the card that the next command is an application specific command rather than a standard command
CMD56	GEN_CMD	Used either to transfer a data block to the card or to get a data block from the card for general purpose/application specific commands
CMD58	READ_OCR	Reads the OCR register of a card
CMD59	CRC_ON_OFF	Turns the CRC option on or off.

MultiMediaCard Initialization

MMC mode / SPI mode set

MMC Mode

1) Reset command:

(CMD0) Execute the soft reset. #1 pin must be high.

2) Operation voltage check:

(CMD1) Read OCR register and set the voltage range.

3) Card ID data read:

(CMD2) Get the Unique ID in the CID.

4) Card address set:

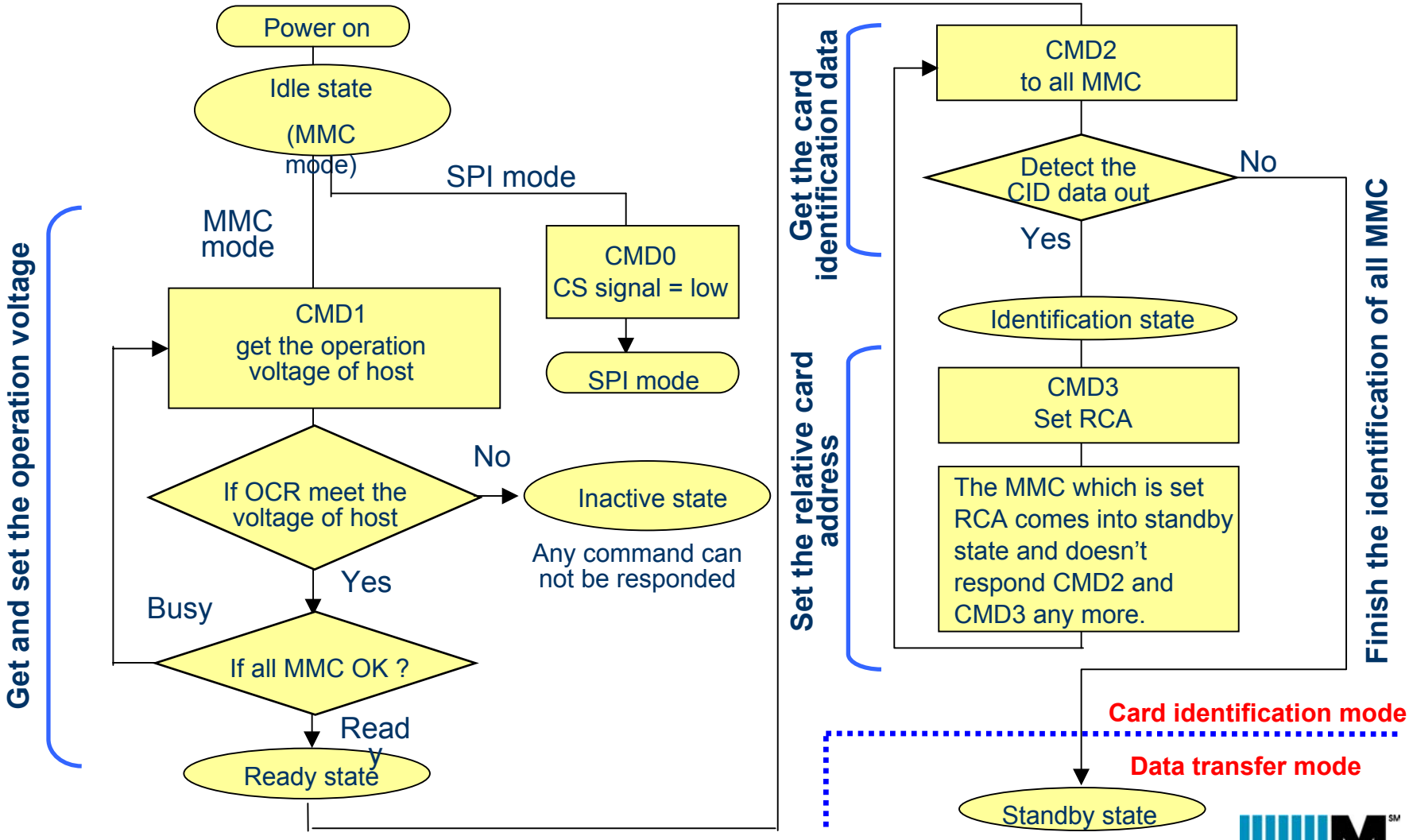
(CMD3) Set RCA for each cards.

SPI mode

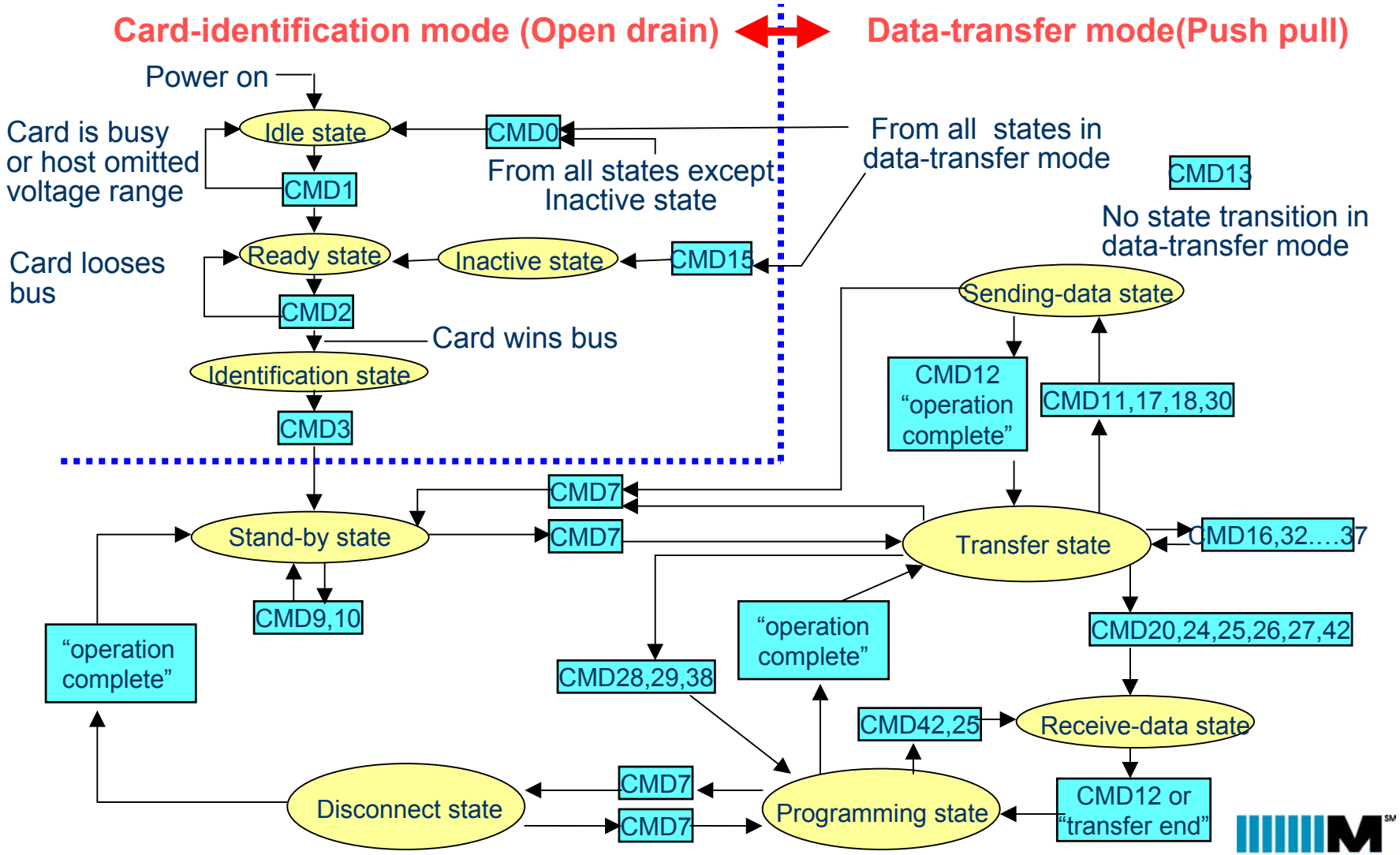
1) Reset command:

(CMD0) Execute the soft reset. #1 pin must be low.

Card identification Mode



State Diagram (Data Transfer Mode)



MultiMediaCard Register

OCR Register

Setting the operating voltage range

- Command: CMD1 (Check operating voltage range.)
- Register width : 32-bit
- Definition of operating voltage range: 1.65V to 3.6V

"1"data :operation voltage

"0"data :out of operation voltage

OCR Field

Example for 2.7v-3.6v

	OCR slice	Field	Value
MSB	D31	Card Power Up Status Bit (BUSY)	0
	D[30..24]	Reserved	0
	D23	3.5-3.6V	1
	D22	3.4-3.5V	1
	D21	3.3-3.4V	1
	D20	3.2-3.3V	1
	D19	3.1-3.2V	1
	D18	3.0-3.1V	1
	D17	2.9-3.0V	1
	D16	2.8-2.9V	1
	D15	2.7-2.8V	1
	D14	2.6-2.7V	0
	D13	2.5-2.6V	0
	D12	2.4-2.5V	0
	D11	2.3-2.4V	0
	D10	2.2-2.3V	0
	D9	2.1-2.2V	0
	D8	2.0-2.1V	0
LSB	D7	1.65-1.95v	0

Note : above is the definition of MMCA specification Ver.3.3

CID Register

- Command: CMD2 or CMD10 (Read CID)
- Register width： 128 bit
- Read only.
- Data is written by card manufacture.

CID Field

	Name	Field	Width	CID-slice
MSB	Manufacture ID *	MID	8	[127:120]
	OEM/Application ID	OID	16	[119:104]
	Product Name	PMN	48	[103:56]
	Product Revision	PRV	8	[55:48]
	Product Serial Number	PSN	32	[47:16]
	Manufacturing date	MDT	8	[15:8]
	CRC7	CRC	7	[7:1]
LSB	END_Bit	———	1	[0:0]

**Manufactured ID is registered by MMCA*

CSD Register

Provides information on how to access the card content

- **Command: CMD9 (Read CSD)**
- **Register width: 128-bit**
- **Read / Write (some bit)**

CSD Field

	Name	Field	Width	CID-slice	Type
MSB	CSD structure	CSD_STRUCTUR	2	[127:126]	Read only
	Spec version	SPEC_VERS	4	[125:122]	Read only
	Reserved	———	2	[121:120]	Read only
	Data read access-time-	TAAC	8	[119:112]	Read only
	Data read access-time-2 in CLK cycles	NSAC	8	[111:104]	Read only
	MAX data transfer rate	TRAN_SPEED	8	[103:96]	Read only
	Card command classes	CCC	12	[95:84]	Read only
	MAX. read data block	READ_BLK_LEN	4	[83:80]	Read only
	Partial blocks for read	READ_BLK_PARTI	1	[79:79]	Read only
	Write block	WRITE_BLK_MISALI	1	[78:78]	Read only
	Read block	READ_BLK_MISALIG	1	[77:77]	Read only
	DSR implemented	DSR_IMP	1	[76:76]	Read only
	Reserved	———	2	[75:74]	Read only
	Device size	C_SIZE	12	[73:62]	Read only
	Max. read current at Vcc	VCC_R_CURR_MIN	3	[61:59]	Read only
	Max. read current at Vcc max	VCC_R_CURR_MAX	3	[58:56]	Read only
	Max. write current at Vcc min	VCC_W_CURR_MIN	3	[55:53]	Read only
	Max. write current at Vcc max	VCC_W_CURR_MAX	3	[52:50]	Read only
	Device size multiplier	C_SIZE_MULT	3	[49:47]	Read only
	Erase sector size	SECTOR_SIZE	5	[46:42]	Read only
	Erase group size	ERASE_GRP_SIZ	5	[41:37]	Read only
	Write protect group size	WP_GRP_SI	5	[36:32]	Read only
	Write protect group	WP_GRP_ENABL	1	[31:31]	Read only
	Manufacture default	DEFAULT_E	2	[30:29]	Read only
	Write speed factor	R2W_FACTO	3	[28:26]	Read only
	MAX. write data block length	WRITE_BLK_LEN	4	[25:22]	Read only
	Partial blocks for write	WRITE_BLK_PARTI	1	[21:21]	Read only
	Reserved	———	5	[20:16]	Read only
	File format group	FILE_FORMAT_GR	1	[15:15]	Read/write
	Copy flag (OTP)	COPY	1	[14:14]	Read/write
	Permanent write	PERM_WRITE_PROTE	1	[13:13]	Read/write
	Temporary write	TMP_WRITE_PROTEC	1	[12:12]	Read/write/eras
	File format	FILE_FORMAT	2	[11:10]	Read/write
	ECC code	ECC	2	[9:8]	Read/write/eras
	CRC	CRC	7	[7:1]	Read/write/eras
LSB	Not used, always 1	———	0	[0:0]	Read only

RCA Register

Card relative address assigned by the host

- Command: CMD3 (Set RCA),
  CMD7 (Card is selected by its own RCA)
  ···MuMC mode only
- Register width： 16-bit
- The data is set by host.
  Card relative address can be defined freely
  Maximum number of address : 65,535 (0001 to FFFF (Hex))*

* 0000h is not used because of the reserved address.

MultiMediaCard Association Web site

[www.mmca.org]

Please visit to get more detail information.

Thank you so much !