

1. GENERAL DESCRIPTION

P2ROM MMC stands for P2ROM MultiMediaCard in which an Oki Original Product P2ROM is embedded. P2ROM (Production Programmed ROM) utilizes Oki unique memory cell, which is an exclusive Oki technology. Unlike MASKROM, no mask charges apply; Unlike OTP and Flash memory, no additional programming cost is required.

■ Features

- Compliant with MMCA standard (Version 3.1)
- Card name/capacity
16MB P2ROM MMC: MR57T01601K
- Operating voltage: 2.7V~3.6V
- Outside dimension: 32(D)×24(W)×1.4(H)mm

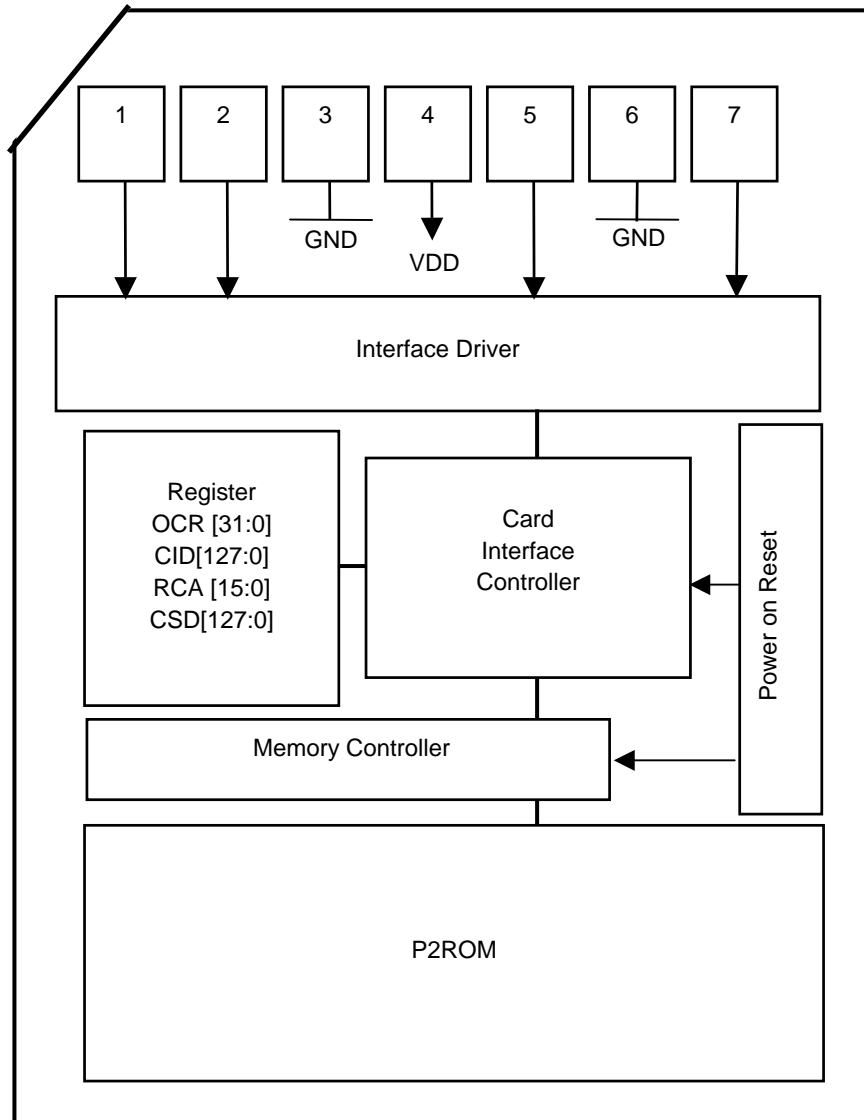
■ Notice

This product is different from Secure MMC.

■ Applications

P2ROM MMC is applied to devices embedded with MultiMediaCard Slot, e.g. Mobile phone, Electronic dictionary, Game machine, etc.

2. BLOCK DIAGRAM



3. PIN DESCRIPTIONS

Pin No	MMC Mode			SPI Mode		
	Symbol	Type	Function	Symbol	Type	Function
1	RSV	NC	Reserved	CS	Input	Chip select (50K Pull-up)
2	CMD	Input/ Output	Command/Response (Output: 8mA)	DI	Input	Data in
3	VSS	S	Supply voltage ground	VSS	S	Supply voltage ground
4	VDD	S	Supply voltage	VDD	S	Supply voltage
5	CLK	Input	Clock	SCLK	Input	Clock
6	VSS	S	Supply voltage ground	VSS	S	Supply voltage ground
7	DAT	Input/ Output	Data (Output: 8mA)	DO	Output	Data out (Output: 8mA)

Note: No. 6 pin is used to supply V_{pp} when writing data into P2ROM. It should be connected to GND for general use.

4. COMMAND

4.1 Command Format (MMC Mode/SPI Mode)

Bit position	47	46	[45:40]	[39:08]	[07:01]	00
Bit width	1	1	6	32	7	1
Value	"0"	"1"	X	x	x	"1"
Description	Start bit	Transmission bit	Command index	Argument	CRC7	End bit

4.2 Command Class (MMC Mode)

		0	1	2	3	4	7	9	10	11	12	13	15	16	17	18	20	23
Class 0	Basic	+	+	+	+	+	+	+	+		+	+	+					
Class 1	Stream read									+								
Class 2	Block read													+	+	+		+

4.3 Command Class (SPI Mode)

		0	1	9	10	12	13	16	17	18	23	58	59
Class 0	Basic	+	+	+	+		+					+	+
Class 1	Non support												
Class 2	Block read					+		+	+	+	+		

4.4 Command -1/3

CMD	Abbreviation	Command Description	MMC mode			SPI mode	
			Type	Argument	Resp	Argument	Resp
0	GO_IDLE_STATE	Resets all cards to Idle state. When CS signal is set in Low state, the card transits to SPI mode after receiving this command.	bc	[31:00] stuff bits	-	None	R1
1	SEND_OP_COND	Asks the card to send an R3 response including OCR data. The operation voltage span of the card can be got according to OCR data. Moreover, the highest-order 1 bit of OCR is used to check whether the internal processing of the card is finished or not (Ready /Busy polling).	bcr	[31:00] OCR without busy	R3	None	R1
2	ALL_SEND_CID	Asks the cards in Ready state to send their CID numbers. The numbers are sent to CMD signal when the card is in MMC mode. When every 1 bit is transferred, the CMD signal state is compared with the state within the card. If different, data transmission stops, and the card returns to Ready state. If matched, the card recognizes itself selected and transits to Identification state.	bcr	[31:00] stuff bits	R2	-	-
3	SET_RELATIVE_ADDR	Assigns Relative Card Address (RCA) to the card in Identification state. When RCA is assigned, the card transits to Stand-by state, and does not respond to following CMD2 & CMD3.	ac	[31:16] RCA [15:00] stuff bits	R1	-	-

4.4 Command-2/3

CMD	Abbreviation	Command Description	MMC mode			SPI mode	
			Type	Argument	Resp	Argument	Resp
4	NOP (SET_DSR)	This command is for setting DSR (Drive State Register). But this card does not support DSR.	bc	[31:16] DSR [15:00] stuff bits	-	-	-
7	SELECT/ DESELECT_CARD	Selects a card and toggles it between the Stand-by and Transfer states. When given an assigned RCA, the card transits from Stand-by state to Transfer state, and responds to the following read and other commands. When given an unassigned RCA, the card transits to Stand-by state. When RCA=0000h, the card transits to Stand-by state unconditionally.	ac	[31:16] RCA [15:00] stuff bits	R1	-	-
9	SEND_CSD	Asks the card to send its CSD data.	ac	[31:16] RCA [15:00] stuff bits	R2	None	R1
10	SEND_CID	Asks the card to send its CID data.	ac	[31:16] RCA [15:00] stuff bits	R2	None	R1
11	READ_DAT_UNTIL_STOP	Asks the card to transfer P2ROM data from the given address, until interrupted by CMD12.	adtc	[31:00] data address	R1	-	-

4.4 Command-3/3

CMD	Abbreviation	Command Description	MMC mode			SPI mode	
			Type	Argument	Resp	Argument	Resp
12	STOP_TRANSMISSION	Forces the card to stop processing of CMD11 and CMD18.	ac	[31:00] stuff bits	R1	None	R1
13	SEND_STATUS	Asks the card to send the information of its status register.	ac	[31:16] RCA [15:00] stuff bits	R1	None	R2
15	GO_INACTIVE_STATE	Sets the card to inactive state.	ac	[31:16] RCA [15:00] stuff bits	-	-	-
16	SET_BLOCKLEN	Sets the block length for following CMD17& CMD18.	ac	[31:00] block length	R1	[31:00] block length	R1
17	READ_SINGLE_BLOCK	Asks the card to transfer a data block from the address assigned by argument. (The block length is set by CMD16).	adtc	[31:00] data address	R1	[31:00] data address	R1
18	READ_MULTIPLE_BLOCK	Asks the card to transfer data blocks continuously from the address assigned by argument until interrupted by CMD12. (The block length is set by CMD16)	adtc	[31:00] data address	R1	[31:00] data address	R1
23	SET_BLOCK_COUNT	Sets number of blocks to be transferred for immediately following CMD18.	ac	[31:16] set to 0 [15:00] number of block	R1	[31:16] set to 0 [15:00] number of block	R1
58	READ_OCR	Asks the card to transfer OCR data.	-	-	-	None	R3
59	CRC_ON_OFF	Makes CRC option to be ON /OFF. The default in SPI mode is CRC OFF. [CRC option bit = 1] means CRC ON; [CRC option bit = 0] means CRC OFF.	-	-	-	[31:01] stuff bits [00:00] CRC option	R1

5. RESPONSES (MMC MODE)

5.1 R1 response

Object commands

CMD3: SET_RELATIVE_ADDR

CMD11: READ_DAT_UNTIL_STOP

CMD12: STOP_TRANSMISSION

CMD13: SEND_STATUS

CMD16: SET_BLOCKLEN

CMD17: READ_SINGLE_BLOCK

CMD18: READ_MULTIPLE_BLOCK

CMD23: SET_BLOCK_COUNT

Bit position	47	46	[45:40]	[39:08]	[07:01]	0
Bit width	1	1	6	32	7	1
Value	"0"	"0"	X	x	x	"1"
Description	Start bit	Transmission bit	Command index	Card status	CRC7	End bit

5.2 R2 response

Object commands

CMD2: ALL_SEND_CID

CMD9: SEND_CSD

CMD10: SEND_CID

Bit position	135	134	[133:128]	[127:1]	0
Bit width	1	1	6	127	1
Value	"0"	"0"	"111111"	x	"1"
Description	Start bit	Transmission bit	Reserved	CID or CSD register Internal CRC	End bit

5.3 R3 response

Object commands

CMD1: SEND_OP_COND

Bit position	47	46	[45:40]	[39:08]	[07:01]	0
Bit width	1	1	6	32	7	1
Value	"0"	"0"	"111111"	x	"1111111"	"1"
Description	Start bit	Transmission bit	Reserved	OCR register	Reserve	End bit

5.4 Card Status (MMC Mode)

Bit	Identifier	type	Value	Description	CC
31	out_of_range	ER	"0"= no error "1"= error	The command's argument was out of the allowed range for this card.	C
30	address_error	ERX	"0"= no error "1"= error	A misaligned address which did not match the block length was used in the command.	C
29	block_len_error	ER	"0"= no error "1"= error	The transferred block length is not allowed for this card, or the number of transferred bytes does not match the block length.	C
[28:24]	-	-	x	Don't care.	-
23	com_CRC_error	ER	"0"= no error "1"= error	The CRC check in the immediately previous command failed.	B
22	illegal_command	ER	"0"= no error "1"= error	Command is not legal for the card state.	B
[21:13]	-	-	x	Don't care.	-
[12:09]	current_state	SX	"0000"= idle "0001"= ready "0010"= ident "0011"= stby "0100"= tran "0101"= data Others: reserve	Current state of the card.	B
[08:00]	-	-	x	Don't care.	-

5.5 Card status field / command – cross reference (MMC Mode)

CMD	Response Format 1 Status bit #					
	31	30	29	23	22	12:9
3				x	x	x
7				x	x	x
11	x	x		x	x	x
12				x	x	x
13	x	x		x	x	x
16			X	x	x	x
17	x	x		x	x	x
18	x	x		x	x	x
23				x	x	x

5.6 Card State Transition Table (MMC Mode)

	current state						
	idle	ready	ident	stby	tran	data	ina
command	changes to						
class independent							
CRC error	-	-	-	-	-	-	-
command not supported	-	-	-	-	-	-	-
class 0							
CMD0	idle	idle	idle	idle	idle	idle	-
CMD1, card VDD range compatible	ready	-	-	-	-	-	-
CMD1, card is busy	idle	-	-	-	-	-	-
CMD1, card VDD range not compatible	ina	-	-	-	-	-	-
CMD2, card wins bus	-	ident	-	-	-	-	-
CMD2, card loses bus	-	ready	-	-	-	-	-
CMD3	-	-	stby	-	-	-	-
CMD4	-	-	-	stby	-	-	-
CMD7, card is addressed	-	-	-	tran	-	-	-
CMD7, card is not addressed	-	-	-	-	stby	stby	-
CMD9	-	-	-	stby	-	-	-
CMD10	-	-	-	stby	-	-	-
CMD12	-	-	-	-	-	tran	-
CMD13	-	-	-	stby	tran	data	-
CMD15	-	-	-	ina	ina	ina	-
class 1							
CMD11	-	-	-	-	data	-	-
class 2							
CMD16	-	-	-	-	tran	-	-
CMD17	-	-	-	-	data	-	-
CMD18	-	-	-	-	data	-	-
CMD23	-	-	-	-	tran	-	-

6. RESPONSES (SPI MODE)

6.1 R1 response

Object commands

CMD0: GO_IDLE_STATE

CMD1: SEND_OP_COND

CMD9: SEND_CSD

CMD10: SEND_CID

CMD12: STOP_TRANSMISSION

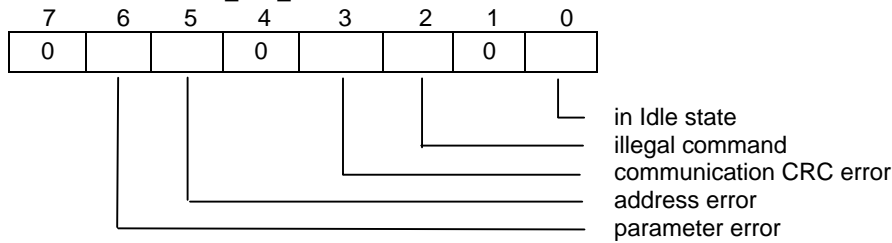
CMD16: SET_BLOCKLEN

CMD17: READ_SINGLE_BLOCK

CMD18: READ_MULTIPLE_BLOCK

CMD23: SET_BLOCK_COUNT

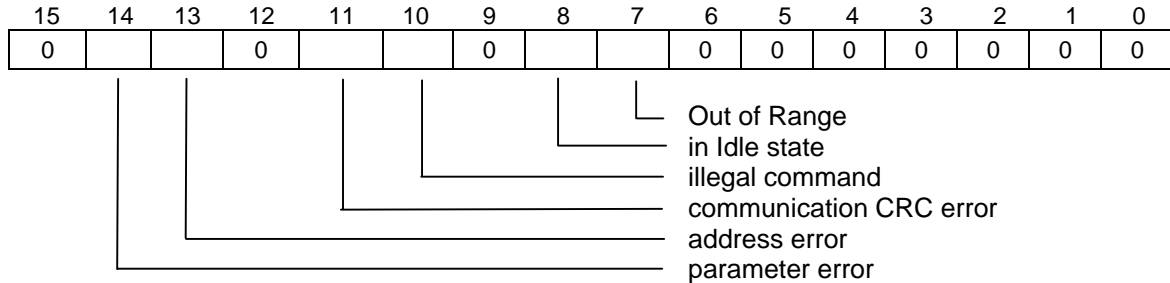
CMD59: CRC_ON_OFF



6.2 R2 response

Object commands

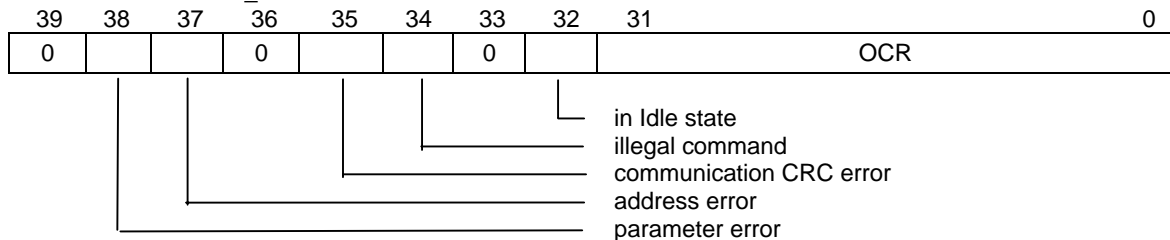
CMD13: SEND_STATUS



6.3 R3 response

Object commands

CMD58: READ_OCR



6.4 Data Tokens (SPI Mode)

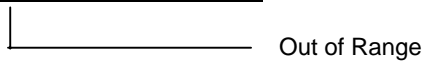
Data tokens are 4 to (N+3) bytes long (Where N is the data block length set by SET_BLOCK_LENGTH Command) and have the following format:

Token Type	Transaction Type	Bit Position							
		7	6	5	4	3	2	1	0
Start Block	Single Block Read	1	1	1	1	1	1	1	0
Start Block	Multiple Block Read	1	1	1	1	1	1	1	0

6.5 Data Error Token

If a read operation fails or the given data is not accepted, following Data Error Token is sent:

7	6	5	4	3	2	1	0
0	0	0	0		0	0	0



Data Response

Token Type (1byte)	Data (512Bytes)	CRC (2bytes)
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6.6 Card Status (SPI Mode)

Bit	Identifier	type	Value	Description	CC
15	-	-	0	"0" always	-
14	parameter error	ERX	"0"= no error "1"= error	An error occurred in command's parameters.	C
13	address error	ERX	"0"= no error "1"= error	A misaligned address which did not match the block length was used in the command.	C
12	-	-	x	Don't care.	-
11	com crc error	ER	"0"= no error "1"= error	The CRC check in the immediately previous command failed.	C
10	illegal command	ER	"0"= no error "1"= error	Command is not legal for the card state.	C
	-	-	x	Don't care.	-
08	idle state	SR	"0"= card is ready "1"= card is in idle state		A
07	out_of_range	ER	"0"= no error "1"= error	The command's argument was out of the allowed range for this card.	C
[06:00]	-	-	x	Don't care.	-

7. REGISTERS

7.1 OCR register (Operation conditions register)

OCR-slice	Field	Value	Remarks
31	Status after power up	0 or 1	
[31:24]	reserved	0	
23	3.5 – 3.6V	1	
22	3.4 – 3.5V	1	
21	3.3 – 3.4V	1	
20	3.2 – 3.3V	1	
19	3.1 – 3.2V	1	
18	3.0 – 3.1V	1	
17	2.9 – 3.0V	1	
16	2.8 – 2.9V	1	
15	2.7 – 2.8V	1	
14	2.6 – 2.7V	0	
13	2.5 – 2.6V	0	
12	2.4 – 2.5V	0	
11	2.3 – 2.4V	0	
10	2.2 – 2.3V	0	
09	2.1 – 2.2V	0	
08	2.0 – 2.1V	0	
07	1.9 – 2.0V	0	
06	1.8 – 1.9V	0	
05	1.7 – 1.8V	0	
04	1.65 – 1.70V	0	
03	1.60 – 1.65V	0	
02	1.55 – 1.60V	0	
01	1.50 – 1.55V	0	
00	1.45 – 1.50V	0	

7.2 CID register (Card identification register)

This register uses the data written in P2ROM's particular field.

CID-slice	Name	Field	Bit Width	Value	OKI original
[127:120]	Manufacture ID	MID	8	0x41	OKI ID Assigned by MMCA
[119:104]	OEM/Application ID	OID	16	0x0000	OKI Device Name
[103:56]	Product name	PNM	48	P2 016	Product Name
[55:48]	Product revision	PRV	8	0x10	Rev. of Product (version 1.0)
[47:16]	Product serial number	PSN	32	0x00000001	Product serial number Default=1, settable
[15:8]	Manufacturing data	MDT	8	Month of receiving Code file	Date OKI recieved Code file from customer or Programmed
[7:1]	7-bit CRC checksum	CRC7	7	CRC	check sum
[0:0]	-	-	1	1	" 1" always

7.3 CSD register (Card-Specific Data register)

This register uses the data written in P2ROM's particular field.

CSD-slice	Name	Filed	Bit width	Value		Type	Remarks
				Bin.	Hex.		
[127:126]	CSD Structure	CSD_STRUCTURE	2	10	0x2	R	Version 3.1
[125:122]	spec version	SEPC_VERS	4	0011	0x3	R	Version 3.1
[121:120]	reserved		2	X	X	R	Don't care
[119:112]	data read access time1	TAAC	8	00001000	0x08	R	1ns
[111:104]	data read access time2	NSAC	8	00000001	0x01	R	100cycles
[103:96]	max data transfer rate	TRAN_SPEED	8	00101010	0x2A	R	20Mb/s
[95:84]	card command class	CCC	12	000000000111	0x007	R	Support Class0,1,2
[83:80]	max read data block length	READ_BL_LEN	4	1001	0x9	R	512bytes
79	partial blocks for read allowed	READ_BL_PARTIAL	1	1	0x1	R	
78	reserved		1	X	X	R	Don't care
77	read block misalignment	READ_BLK_MISALIGN	1	0	0x0	R	Crossing block is not allowed
76	DSR implemented	DSR_IMP	1	0	0x0	R	DSR: Non support
[75:74]	reserved		2	X	X	R	Don't care
[73:62]	device size	C_SIZE	12	111111111110	0xFFE	R	
[61:59]	min. read current	VDD_R_CURR_MIN	3	000	0x0	R	0.5mA
[58:56]	max. read current	VDD_R_CURR_MAX	3	100	0x4	R	35mA
[55:50]	reserved		6	X	X	R	Don't care
[49:47]	device size multiplier	C_SIZE_MULT	3	001	0x1	R	
[46:31]	reserved		16	X	X	R	Don't care
[30:29]	manufacture default ECC	DEFAULT_ECC	2	00	0x0	R	ECC: Non support
[28:26]	reserved		3	X	X	R	Don't care
[25:22]	Max. write data block length	WRITE_BL_LEN	4	1001	0x9	R	
[21:16]	reserved		6	X	X	R	Don't care
15	file format group	FILE_FORMAT_GRP	1	0	0x0	R	
14	Copy flag (OTP)	COPY	1	0	0x0	R	Default=0, settable
13	permanent write protection	PERM_WRITE_PROTECT	1	1	0x1	R	
12	temporary write protection	TMP_WRITE_PROTECT	1	1	0x1	R	
[11:10]	file format	FILE_FORMAT	2	00	0x0	R	Default=0, settable
[9:8]	ECC code	ECC	2	00	0x0	R	ECC: Non support
[7:1]	CRC	CRC	7	CRC	CRC	R	
0	reserved		1	1	0x1	R	

*1 Card Capacity

Name	Card Capacity	C_SIZE_MULT	C_SIZE	MULT	BLOCKNR	BLOCK_LEN
MR57T01601K	16MB	1	4094	8	32760	512

Cross reference of CSD fields vs command class

CSD Field	Command Classes		
	0	1	2
CSD_STRUCTURE	+	+	+
SEPC_VERS	+	+	+
TAAC		+	+
NSAC		+	+
TRAN_SPEED		+	+
CCC	+	+	+
READ_BL_LEN			+
READ_BL_PARTIAL			+
READ_BLK_MISALIGN			+
DSR_IMP	+	+	+
C_SIZE		+	+
VDD_R_CURR_MIN		+	+
VDD_R_CURR_MAX		+	+
DEFAULT_ECC		+	+
FILE_FORMAT_GRP....			
COPY	+	+	+
PERM_WRITE_PROTECT	+	+	+
TMP_WRITE_PROTECT	+	+	+
FILE_FORMAT			
ECC		+	+
CRC	+	+	+

8. ELECTRICAL CHARACTERISTICS

8.1 General

Parameter	Symbol	Min	Max	Unit	Remarks
Peak voltage on all line		-0.3	4.6	V	Absolute maximum rating
Input Leakage Current		-10	10	uA	
Input Leakage Current for CS signal			200	uA	
Output Leakage Current		-10	10	uA	

8.2 Recommended operating conditions

Parameter	Symbol	Min	Max	Unit	Remarks
Power supply voltage	VDD	2.7	3.6	V	
Operating frequency (Identification Mode)	FOD		400	KHz	
Operating frequency (Data Transfer Mode)	Fpp		20	MHz	
Operating temperature	Ta	-10	85	°C	
Storage temperature	Tstg	-40	85	°C	Absolute maximum rating

8.3 Open-Drain Bus Signal Level

Parameter	Symbol	Min	Max	Unit	Condition
Output LOW voltage	VOL		0.3	V	IOL=2mA

8.4 Push-Pull bus signal level

Parameter	Symbol	Min	Max	Unit	Condition
Output HIGH voltage	VOH	VDD-0.2		V	IOH=-100uA @VDD min
Output LOW voltage	VOL		0.125*VDD	V	IOL=100uA @VDD min
Input HIGH voltage	VIH	0.625*VDD	VDD+0.3	V	
Input LOW voltage	VIL	VSS-0.3	0.25*VDD	V	

8.5 Bus Signal Line Load

Parameter	Symbol	Min	TYP	Max	Unit	Condition
Pull-up resistance for CS	Rcs		50		K Ω	
Bus signal line capacitance	CL			250	pF	Fpp<= 5MHz 30 cards
Bus signal line capacitance	CL			100	pF	Fpp<= 20MHz 10 cards
Signal card capacitance	C_CARD			17	pF	

8.6 Supply Current

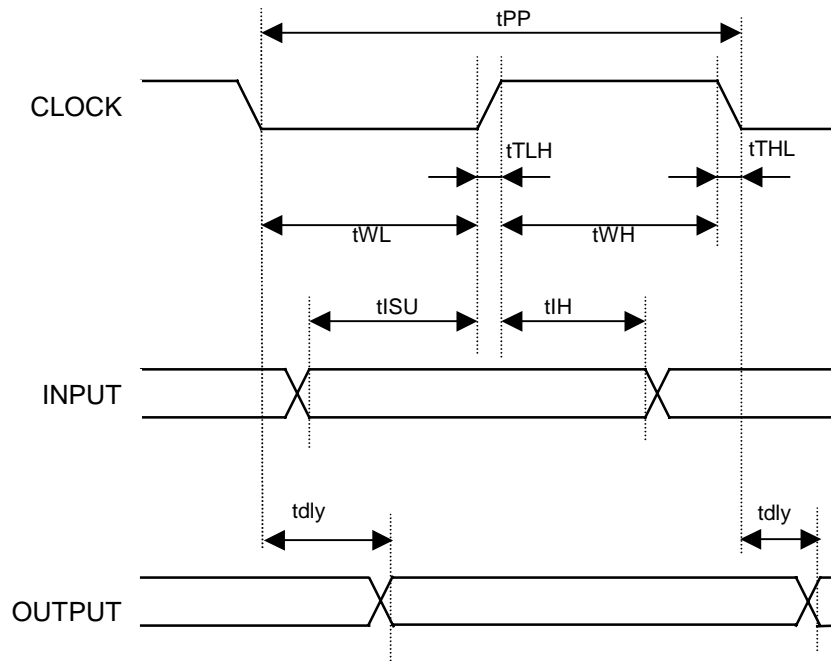
Parameter	Symbol	Min	Max	Unit	Condition
Supply Current	IDD		30	mA	VDD=2.7~3.6V, Ta=-10~85°C at 20MHz
Supply Current	IDDS		200	μ A	VDD=2.7~3.6V, CS=VDD, VIH=VDD, VIL=Vss, Ta=-10~85°C at 0MHz (standby)

8.7 AC Characteristics

($V_{DD}=2.7\sim 3.6V, T_a = -10\sim +85^{\circ}C$)

Parameter	Symbol	Min	Max	Unit	Remarks
Clock frequency (Identification Mode)	FOD	0	400	KHz	
Clock frequency (Data Transfer Mode)	Fpp		20	MHz	CL<=100pF (10cards)
Clock Low time	tWL	10		ns	
Clock High time	tWH	10		ns	
Clock rise time	tTLH		10	ns	
Clock fall time	tTHL		10	ns	
Clock frequency (Data Transfer Mode)	Fpp		5	MHz	CL<=250pF (30cards)
Clock Low time	tWL	50		ns	
Clock High time	tWH	50		ns	
Clock rise time	tTLH		50	ns	
Clock fall time	tTHL		50	ns	
Input set-up time	tISU	3		ns	
Input hold time	tIH	3		ns	
Output set-up time	tdly	0	15	ns	

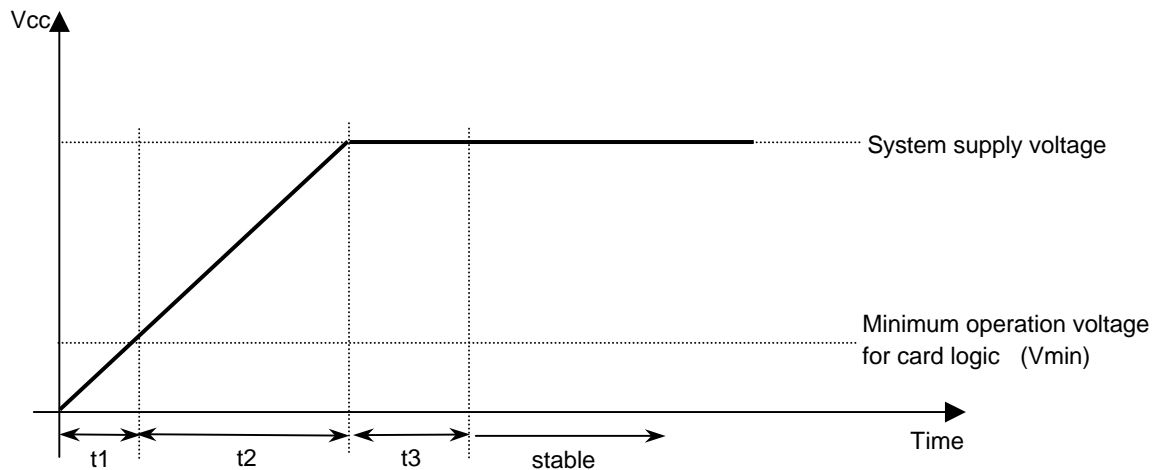
Note: Design values are shown above. The values are to be decided after evaluation.



9. POWER UP

Power up sequence is shown below.

Circuit for detecting power-supply voltage is embedded in this MMC. When the voltage is below a certain value, power-on reset is generated in order to prevent operation error. As long as enough voltage is reached, the internal initialization is done automatically.



Parameter	Symbol	Min	Max	Unit	Remarks
Min VCC for logic	Vmin		1.5	V	
Power up time-1	t1				Clock-supply is not allowed
Power up time-2	t1+t2		1	ms	
Initialize time	t2+t3	37		clock	

10. SHORTCUT PROTECTION

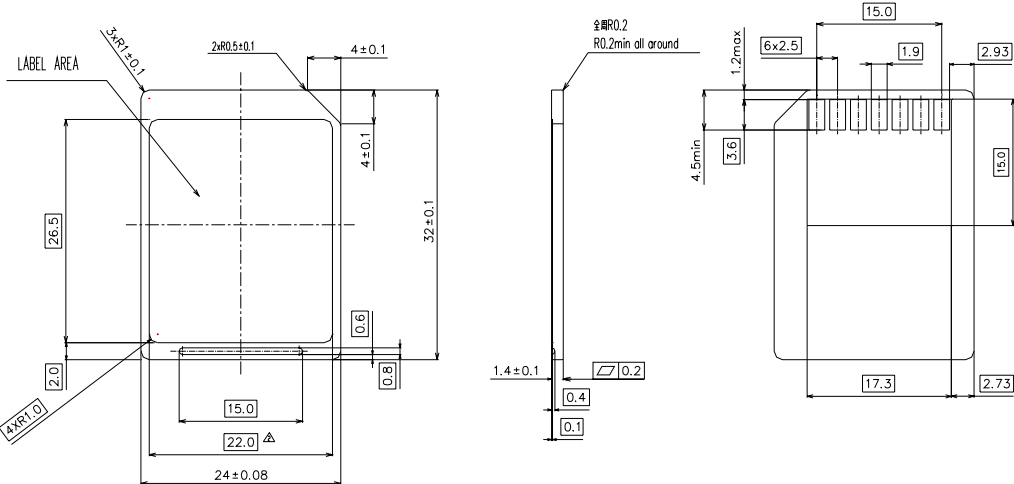
Cards shall be inserted/removed into/from the bus without damage. If one of the supply pins (V_{DD} or V_{SS}) is not connected properly, then the current is drawn through a command line or a data line. In such case, the card cannot work normally.

The device connector for P2ROM MMC insertion should be connected as following steps, for the length of contact pins is different (length of V_{SS} , V_{DD} > length of other signals).

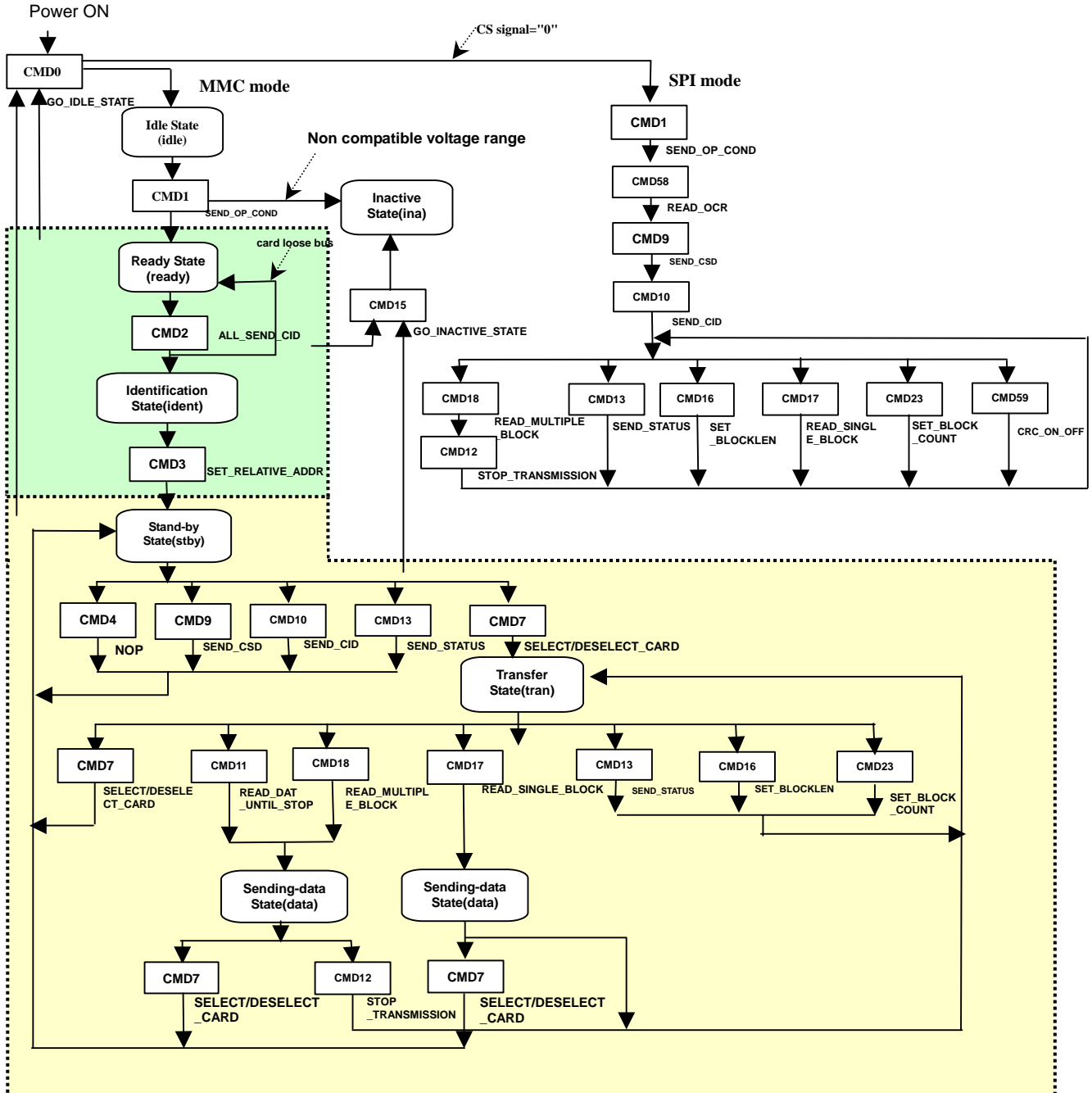
Step-1: V_{SS} (pin 3), V_{DD} (pin 4) connection

Step-2: Other signals (pin 1~2, 5~7) connection

11. CARD DIMENSION DIAGRAM



12. STATE TRANSITION DIAGRAM



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