AU6376-GEL

USB2.0 Multi-LUN Flash Card Reader Controller

Technical Reference Manual

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Revision History

Date	Revision	Description
Dec 2007	1.01W	Modify “Table 5.8 Dynamic characteristic – remove Low speed Mode”

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Table of Contents

List of Figures

List of Tables

1. Introduction

1.1 Description

The AU6376 is a single chip integrated USB 2.0 multimedia card reader controller that enables PC/DVD/Printer to read/write various type of flash media cards. Flash media cards such as CF, SMC, XD, SD, MMC, Memory Stick are widely used in digital camera, cell phone, PDA and MP3 player to store digital photos and compressed music.
Performance of AU6376-GEL is maximized by implementing the latest and fastest card specification available form the industry.
Especially, AU6376-GEL is designed with the high performance characteristic in flash card I/O speed. Users can easy and fast transfer the digital content among the different flash card.

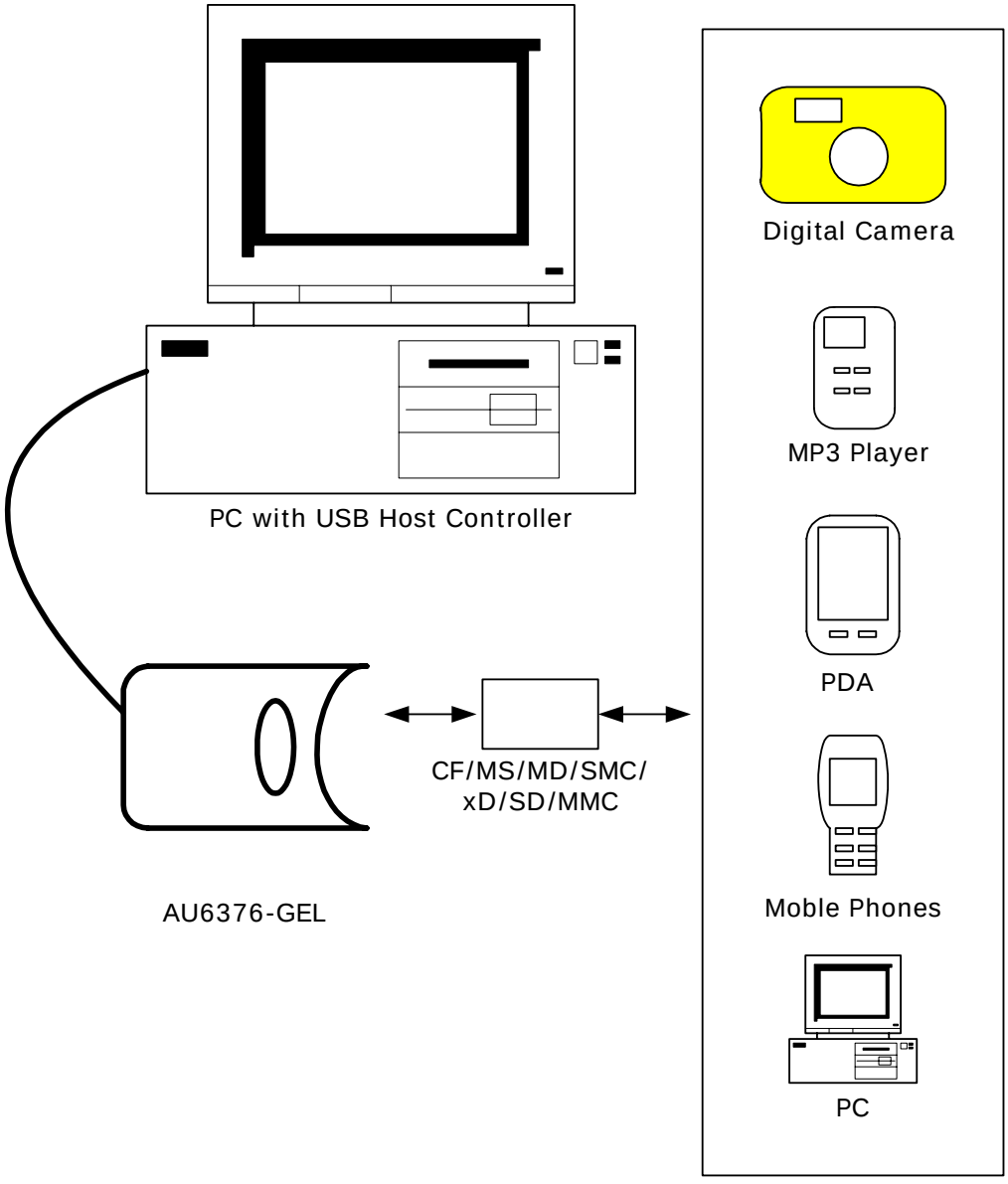
1.2 Features

- Support USB V2.0 specification and USB Device Class Definition for Mass Storage, Bulk-Transport V1.0
- Support CF/MD/SD/MMC/MS/MS_Pro/MS_Duo/xD/SMC compatible flash card
- Support SD1.1/SD2.0
- Support MMC4.1. MMC4.2.
- Support CF4.0 DMA mode.
- Compliant to xD 1.2 spec.
- Hardware DMA engine integrated for performance enhancement.
- Work with default driver from Windows ME/2000/XP/Vista and Mac OS X; Windows 98/2000(SP1/SP2) and Mac OS 9 are supported by vendor driver from Alcor.
- Ping-pong FIFO implementation for concurrent bus operation
- Support multiple sectors transfer optimize performance
- Support slot-to-slot read/write operation
- Support Dynamic Icon Utility
- Support LED for bus operating indication
- Power switch integrated to reduce production BOM cost
- 30MHz 8051 CPU
- Built in 3.3V to 1.8V regulator
- Runs at 12MHz crystal
- Available in 100-pin LQFP package

2. Application Block Diagram

Following application diagram demonstrates a typical card reader using the AU6376 chip. By connecting the card reader to a desktop or notebook PC through USB bus, the AU6376 becomes a bus-powered, high speed USB card reader, which can be used as a bridge for data transfer between Desktop PC and Notebook PC.

Figure 2.1 Block Diagram



3. Pin Assignment

AU6376-GEL is available in 100-pin LQFP package. Below diagram shows signal name of each pin and table in the following page describes each pin in detail.

Figure 3.1 AU6376-GEL Pin Assignment Diagram

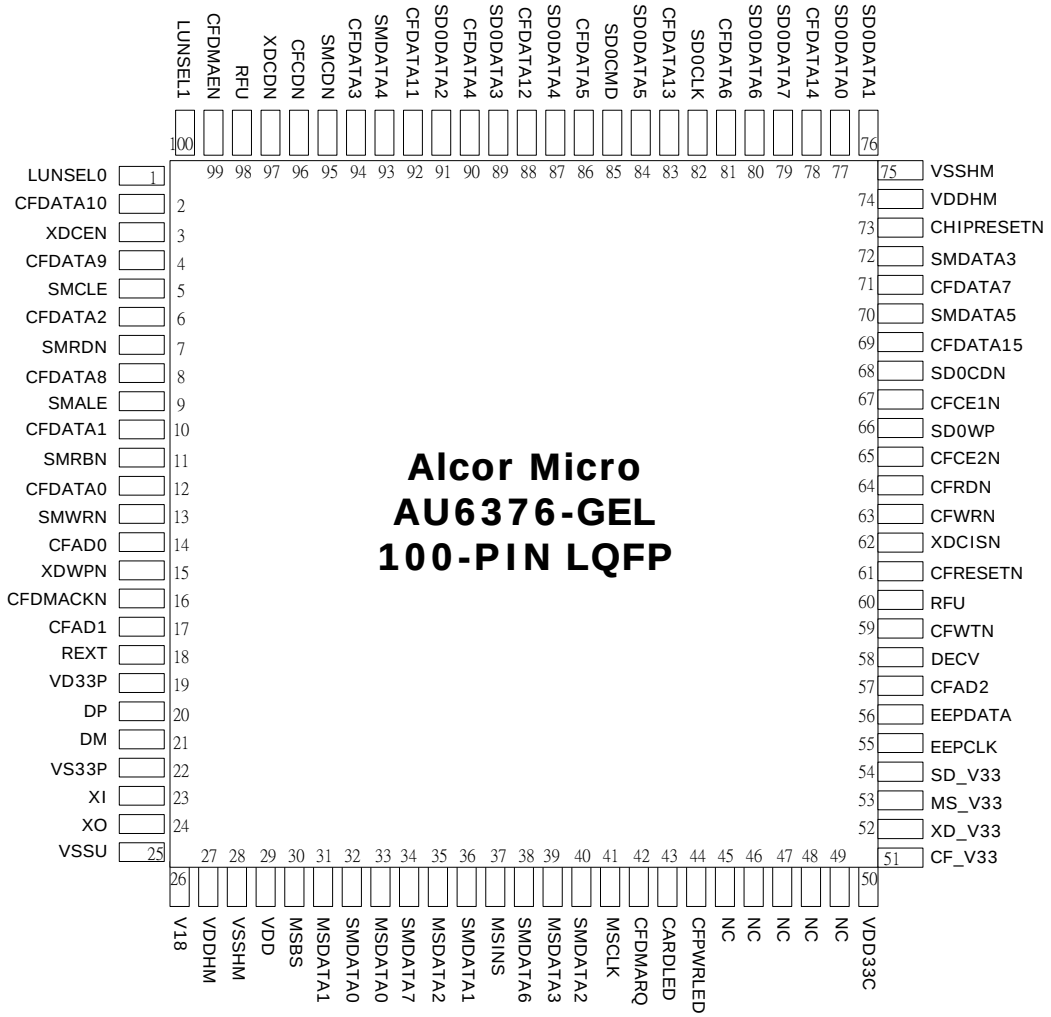


Table 3.1 AU6376-GEL Pin Descriptions

Pin #	Pin Name	I/O	Description
1	LUNSEL0	I	LUN mode select, (LUNSEL1, LUNSEL0)= (0,0): 4LUN (0,1): 1LUN (1,0): 2LUN (CF, others) (1,1): 2LUN (Others, Flash)
2	CFDATA10	IO	CF Data10
3	XDCEN	O	XD CEN
4	CFDATA9	IO	CF Data9
5	SMCLE	O	SMC CLE
6	CFDATA2	IO	CF Data2
7	SMRDN	O	SMC RDN
8	CFDATA8	IO	CF Data8
9	SMALE	O	SMC ALE
10	CFDATA1	IO	CF Data1
11	SMRBN	I	SMC RBN
12	CFDATA0	IO	CF Data0
13	SMWRN	O	SMC RBN
14	CFAD0	O	CF Address0
15	XDWPN	IO	XD WPN
16	CFDMACKN	O	CF DMA ACK. Low active.
17	CFAD1	O	CF Address1
18	REXT	IO	External Resistor 330 to Ground
19	VD33P	PWR	3.3V Power Source for UTMI
20	DP	IO	DP
21	DM	IO	DM
22	VS33P	GND	Ground Power
23	XI	I	12MHz Crystal Input
24	XO	O	12MHz Crystal Output
25	VSSU	GND	Ground
26	V18	O	1.8V Core Power
27	VDDHM	PWR	3.3V Power Source for IO pad

Pin #	Pin Name	I/O	Description
28	VSSHM	GND	3.3V ground for IO pad
29	VDD	PWR	Core Power 1.8V Input
30	MSBS	O	MS BS
31	MSDATA1	IO	MS Data1
32	SMDATA0	IO	xD/SMC Data0
33	MSDATA0	IO	MS Data0
34	SMDATA7	IO	xD/SMC Data7
35	MSDATA2	IO	MS Data2
36	SMDATA1	IO	xD/SMC Data1
37	MSINS	I	MS Card Detect (“0”:Detected; “1”:Undetected)
38	SMDATA6	IO	xD/SMC Data6
39	MSDATA3	IO	MS Data3
40	SMDATA2	IO	xD/SMC Data2
41	MSCLK	O	MS CLK
42	CFDMARQ	I	CF DMA request.
43	CARDLED	O	Card access LED.
44	CFPWRLED	O	CF power LED
45	NC		
46	NC		
47	NC		
48	NC		
49	NC		
50	VDD33C	PWR	3.3V power for PMOS
51	CF_V33	PWR	CF Power
52	XD_V33	PWR	XD Power
53	MS_V33	PWR	MS Power
54	SD_V33	PWR	SD Power
55	EEPCLK	O	EEPCLK
56	EEPDATA	IO	EEPDATA
57	CFAD2	O	CF Address2
58	DECV	I	USB current value.("1":250mA for WHQL; "0":100mA for normal mode)

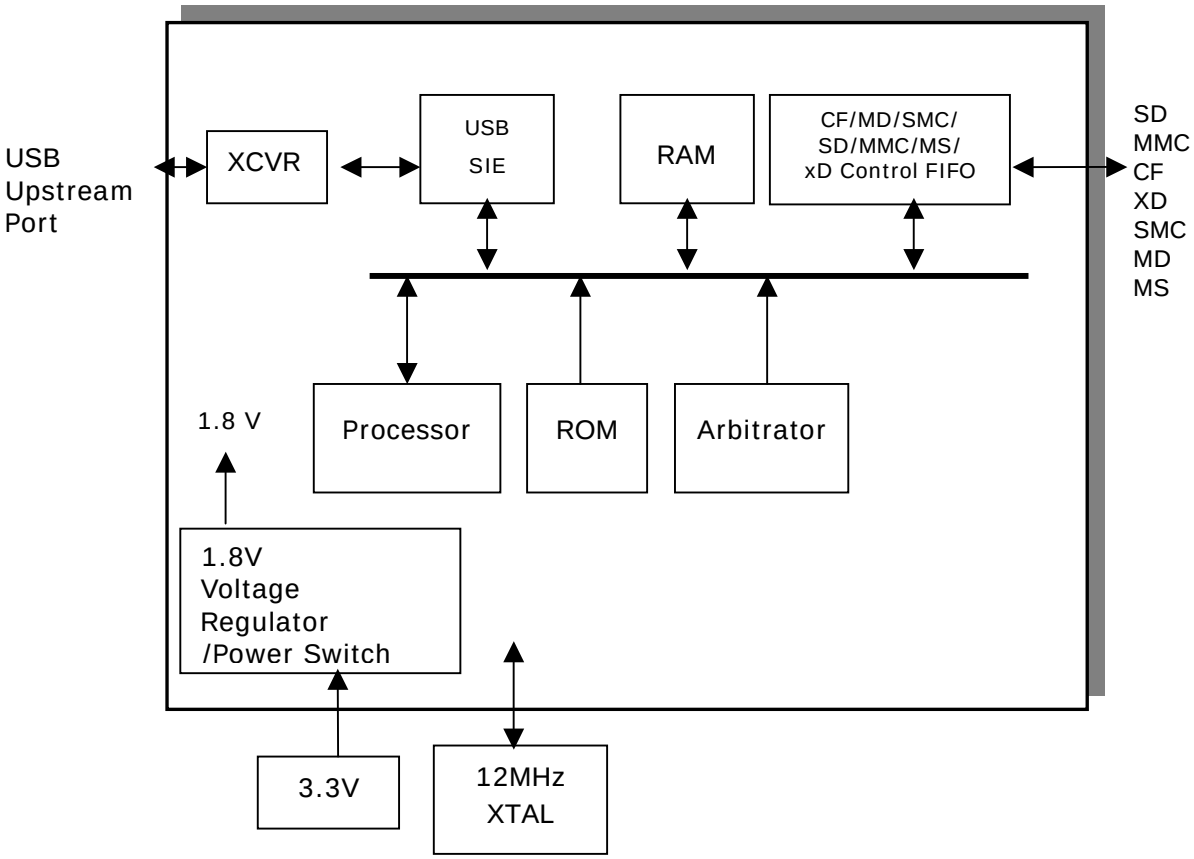
Pin #	Pin Name	I/O	Description
59	CFWTN	I	CF WTN
60	RFU	I	
61	CFRESETN	O	CF Reset
62	XDCISN	I	
63	CFWRN	O	CF WRN
64	CFRDN	O	CF RDN
65	CFCE2N	O	
66	SD0WP	I	SD0 Write Protect
67	CFCE1N	O	
68	SD0CDN	I	SD0 Card Detect (“0”:Detected; “1”:Undetected)
69	CFDATA15	IO	CF Data15
70	SMDATA5	IO	xD/SMC Data5
71	CFDATA7	IO	CF Data7
72	SMDATA3	IO	xD/SMC Data3
73	CHIPRESETN	I	Chip Reset
74	VDDHM	PWR	3.3V Power Source for IO pad
75	VSSHM	GND	3.3V ground for IO pad
76	SD0DATA1	IO	SD/MMC Data1
77	SD0DATA0	IO	SD/MMC Data0
78	CFDATA14	IO	CF Data14
79	SD0DATA7	IO	SD/MMC Data7
80	SD0DATA6	IO	SD/MMC Data6
81	CFDATA6	IO	CF Data6
82	SD0CLK	O	SD0 CLK
83	CFDATA13	IO	CF Data13
84	SD0DATA5	IO	SD/MMC Data5
85	SD0CMD	IO	SD0 CMD
86	CFDATA5	IO	CF Data5
87	SD0DATA4	IO	SD/MMC Data4
88	CFDATA12	IO	CF Data12
89	SD0DATA3	IO	SD/MMC Data3
90	CFDATA4	IO	CF Data4

Pin #	Pin Name	I/O	Description
91	SD0DATA2	IO	SD/MMC Data3
92	CFDATA11	IO	CF Data11
93	SMDATA4	IO	xD/SMC Data4
94	CFDATA3	IO	CF Data3
95	SMCDN	I	SMC Card Detect (“0”:Detected; “1”:Undetected)
96	CFCDN	I	CF Card Detect (“0”:Detected; “1”:Undetected)
97	XDCDN	I	XD Card Detect (“0”:Detected; “1”:Undetected)
98	RFU	I	NC
99	CFDMAEN	I	CF DMA mode enable '0' for disable. '1' for enable. [Default] '1'
100	LUNSEL1	I	LUN mode select, (LUNSEL1, LUNSEL0)= (0,0): 4LUN (0,1): 1LUN (1,0): 2LUN (CF, others) (1,1): 2LUN (Others, Flash)

4. System Architecture and Reference Design

4.1 AU6376 Block Diagram

Figure 4.1 AU6376 Block Diagram



5. Electrical Characteristics

5.1 Absolute Maximum Ratings

Table 5.1 Absolute Maximum Ratings

SYMBOL	PARAMETER	RATING	UNITS
V_{DDHM}	Power Supply	-0.3 to 3.6	V
V_{IN}	Input Signal Voltage	-0.3 to V_{DDH} +0.3	V
T_{STG}	Storage Temperature	-40 to 150	^{O}C

5.2 Recommended Operating Conditions

Table 5.2 Recommended Operating Conditions

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS
V_{DDH}	Power Supply	3.0	3.3	3.6	V
V_{DD} V_{18}	Digital Supply	1.62	1.8	1.98	V
V_{IN}	Input Signal Voltage	0	3.3	3.6	V
T_{OPR}	Operating Temperature	0		85	^{O}C

5.3 General DC Characteristics

Table 5.3 General DC Characteristics

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
I_{IN}	Input current	No pull-up or pull-down	-10	±1	10	μA
I_{OZ}	Tri-state leakage current		-10	±1	10	μA
C_{IN}	Input capacitance	Pad Limit		2.8		ρF
C_{OUT}	Output capacitance	Pad Limit		2.8		ρF
C_{BID}	Bi-directional buffer capacitance	Pad Limit		2.8		ρF

5.4 DC Electrical Characteristics of 3.3V I/O Cells

Table 5.4 DC Electrical Characteristics of 3.3V I/O Cells

SYMBOL	PARAMETER	CONDITIONS	Limits			UNIT
			MIN	TYP	MAX	
V_{DDH}	Power supply	3.3V I/O	3.0	3.3	3.6	V
V_{il}	Input low voltage	LVTTL			0.8	V
V_{ih}	Input high voltage		2.0			V
V_{ol}	Output low voltage	$\lvert I_{ol} \rvert$ =2~16mA			0.4	V
V_{oh}	Output high voltage	$\lvert I_{oh} \rvert$ =2~16mA	2.4			V
R_{pu}	Input pull-up resistance	PU=high, PD=low	55	75	110	KΩ
R_{pd}	Input pull-down resistance	PU=low, PD=high	40	75	150	KΩ
I_{in}	Input leakage current	V_{in}= V_{DDH} or 0	-10	±1	10	μA
I_{oz}	Tri-state output leakage current		-10	±1	10	μA

5.5 USB Transceiver Characteristics

Table 5.5 Electrical characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
VD33P	Analog supply Voltage		3.0	3.3	3.6	V
VDD V18	Digital supply Voltage		1.62	1.8	1.98	V
I_{CC}	Operating supply current	High speed operating at 480 MHz			55	mA

Table 5.6 Static characteristic：Digital pin

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Input levels						
V_{IL}	Low-level input voltage				0.8	V
V_{IH}	High-level input voltage		2.0			V
Output levels						
V_{OL}	Low-level output voltage				0.2	V
V_{OH}	High-level output voltage		VDDH-0.2			V

Table 5.7 Static characteristic：Analog I/O pins（DP/DM）

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
USB2.0 Transceiver（HS）						
Input Levels（differential receiver）						
V_{HSDIFF}	High speed differential input sensitivity	$\lvert V_{I(DP)}-V_{I(DM)} \rvert$ measured at the connection as application circuit	300			mV
V_{HSCM}	High speed data signaling common mode voltage range		-50		500	mV
V_{HSSQ}	High speed squelch detection threshold	Squelch detected			100	mV
		No squelch detected	150			mV
V_{HSDSC}	High speed disconnection detection threshold	Disconnection detected	625			mV
		Disconnection not detected			525	mV
Output Levels						
V_{HSOI}	High speed idle level output voltage(differential)		-10		10	mV
V_{HSOL}	High speed low level output voltage(differential)		-10		10	mV
V_{HSOH}	High speed high level output voltage(differential)		-360		400	mV
V_{CHIRPJ}	Chirp-J output voltage（differential）		700		1100	mV
V_{CHIRPK}	Chirp-K output voltage（differential）		-900		-500	mV
Resistance						
R_{DRV}	Driver output impedance	Equivalent resistance used as internal chip only	3	6	9	Ω

		Overall resistance including external resistor	40.5	45	49.5	
Termination						
V_{TERM}	Termination voltage for pull-up resistor on pin RPU		3.0		3.6	V
USB1.1 Transceiver（FS）						
Input Levels（differential receiver）						
V_{DI}	Differential input sensitivity	$\lvert V_{I(DP)}-V_{I(DM)} \rvert$	0.2			V
V_{CM}	Differential common mode voltage		0.8		2.5	V
Input Levels（single-ended receivers）						
V_{SE}	Single ended receiver threshold		0.8		2.0	V
Output levels						
V_{OL}	Low-level output voltage		0		0.3	V
V_{OH}	High-level output voltage		2.8		3.6	V

Table 5.8 Dynamic characteristic：Analog I/O pins（DP/DM）

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Driver Characteristics						
High-Speed Mode						
t_{HSR}	High-speed differential rise time		500			ps
t_{HSF}	High-speed differential fall time		500			ps
Full-Speed Mode						
t_{FR}	Rise time	CL=50pF；10 to 90% of $\lvert V_{OH}-V_{OL} \rvert$ ；	4		20	ns
t_{FF}	Fall time	CL=50pF；90 to 10% of $\lvert V_{OH}-V_{OL} \rvert$ ；	4		20	ns
t_{FRMA}	Differential rise/fall time matching（t_{FR} / t_{FF}）	Excluding the first transition from idle mode	90		110	%
V_{CRS}	Output signal crossover voltage	Excluding the first transition from idle mode	1.3		2.0	V

5.6 Power Switch Feature

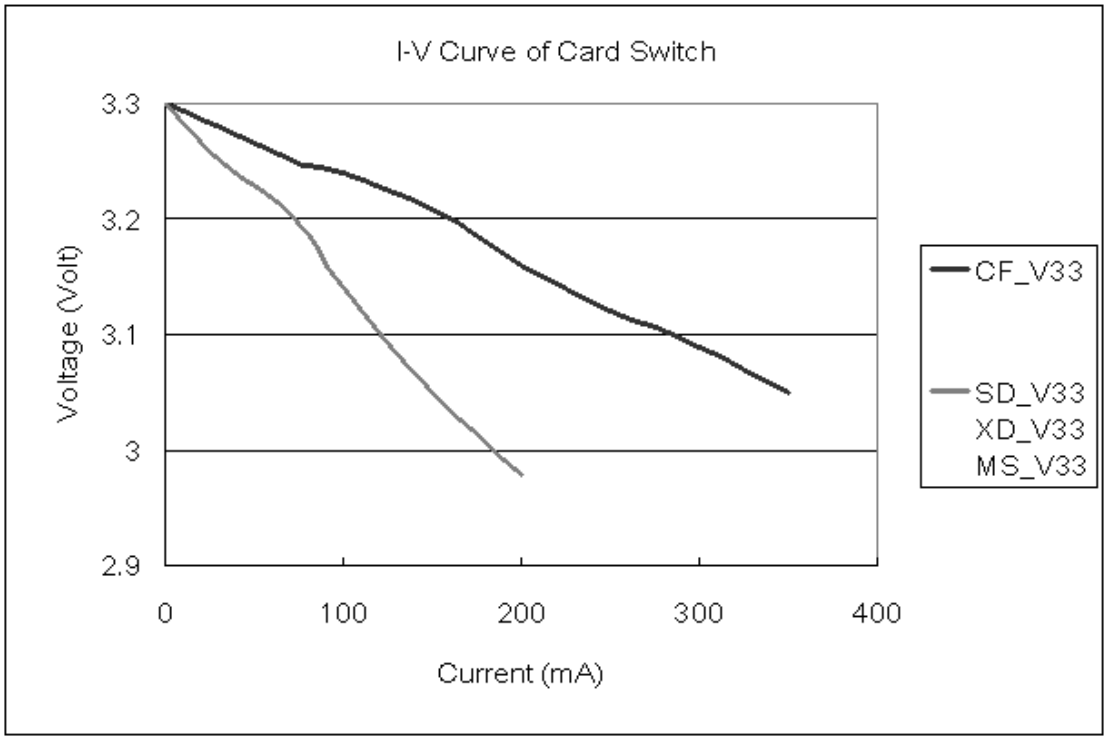


Figure 5.1 Built-in card power switch I-V curve

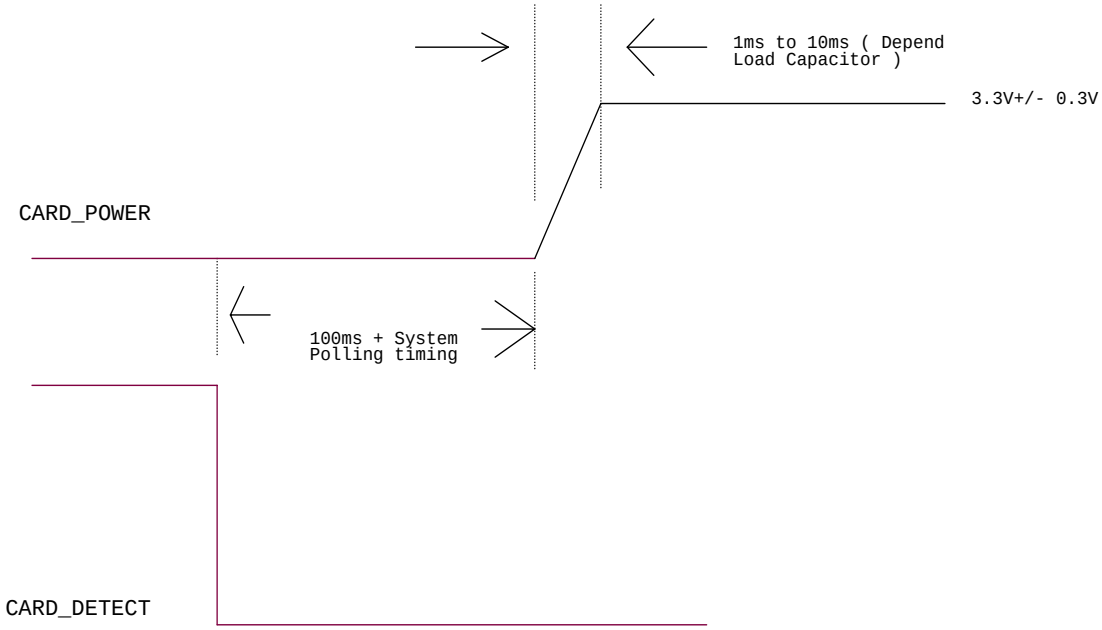
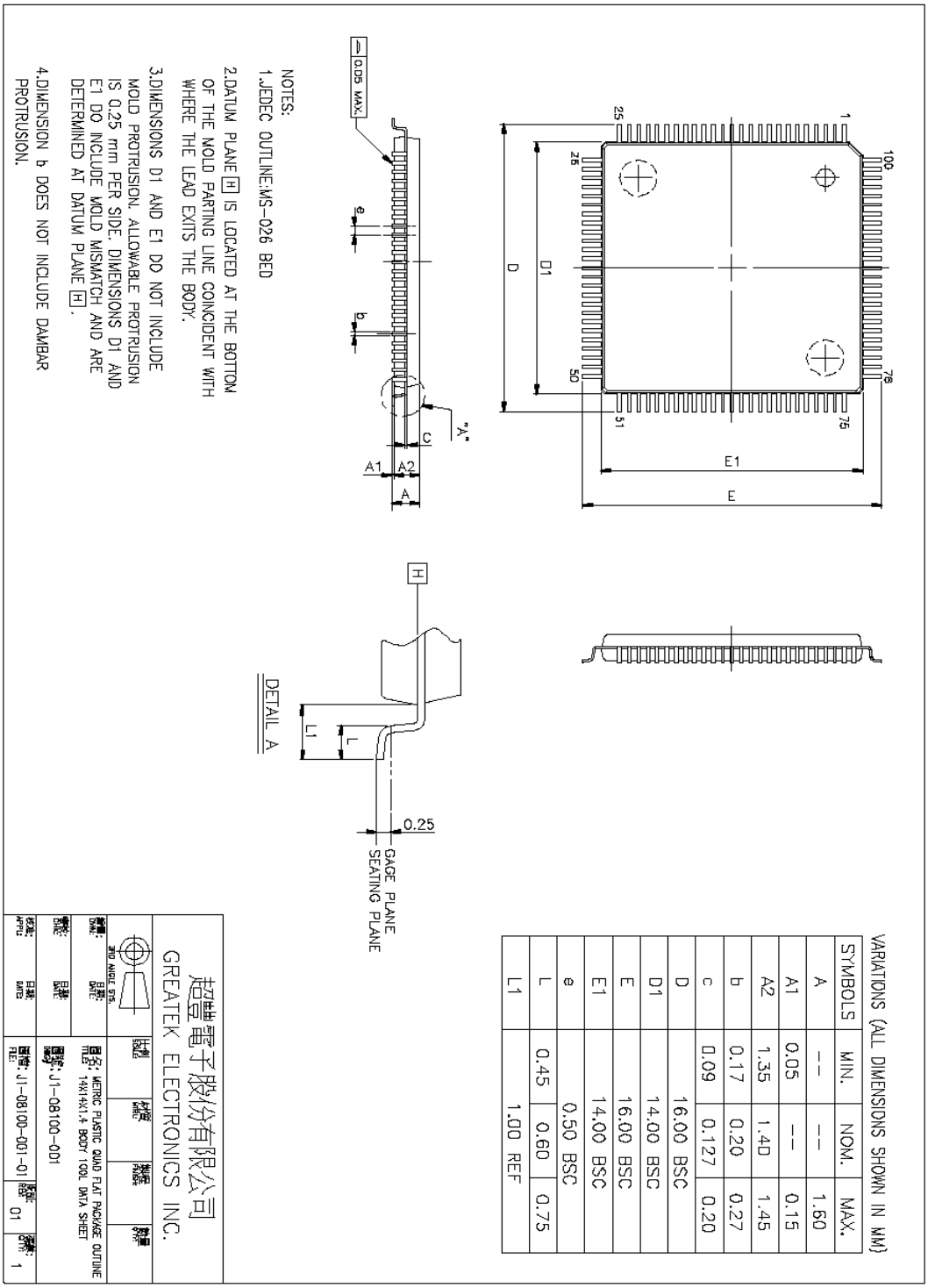


Figure 5.2 Card Detect Power-in Timing

6. Mechanical Information

Figure 6.1 Mechanical Information Diagram



7. Abbreviations

In this chapter some of the terms and abbreviations used throughout the technical reference manual are listed as follows.

SIE	Serial Interface Engine
CF	Compact Flash
MD	Micro Drive
SMC	SmartMedia Card
MS	Memory Stick
SD	Secure Digital
MMC	Multimedia Card
UTMI	USB Transceiver Macrocell Interface

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