AU6438-JBS

USB2.0 Single-LUN Flash Card Reader Controller

Technical Reference Manual

Rev. 1.00

Jul. 2010

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Revision History

Date	Revision	Description
Sep 2009	0.90	Preliminary Release
Feb 2010	0.91	Update “1.1 Description and 1.2 Features”
Mar 2010	0.92	Update “Figure 4.1 AU6438 Block Diagram and 1.2 Features ”
Jul 2010	1.00	Modify “5. Electrical Characteristics"

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1. Introduction

1.1 Description

The AU6438 is designed to deliver outstanding performance for data transmission between USB and compatible flash card interface. It supports USB 2.0 high-speed transferring to various types of flash media cards such as SD, MMC and MS. Besides, the AU6438 supports several operating systems, including MS Windows, LINUX and Mac OS.
The design of 2-in-1 combo single slot makes the AU6438 more attractive and optimal. The AU6438 integrates a high performance 8051 CPU as well as a splendidly efficient DMA hardware engine and internal 5V to 3.3V/3.3V to 1.8V regulators. The AU6438 provides manufacturers not merely BOM cost saving with the minimal numbers of components needed on the PCB but also smaller circuit board with the 28-pin SSOP (150mil) package.
In addition to high-speed 8051 CPU embedded and DMA hardware engine integrated, the AU6438 is fully compliant with USB Device Class Definition for Mass Storage and Bulk-Transport V1.0.Combination with these features, the AU6438 provides a completely ultra high performance USB2.0 card reader solution in a single chip.

AU6438 maximizes performance with the latest and fastest flash card specification available from the industry. Based on the features of low pin count and high performance characteristic, AU6438 supports a wide range of flash card reader applications used to digital camera, MP3 players, cell phone, PDA, camcorder, GPS device and so on to store many types of data, such as digital map, digital photos and compressed music.

1.2 Features

■General
- Fully compatible with USB2.0 High Speed and backward compatible with USB1.1 specifications
- Supports multiple flash card interfaces, including SD/MMC/MS.
- Supports single LUN
- Supports both Windows and Mac OS
  -Default Mass Storage Class driver comes from Windows ME/2000/XP/Vista/Windows 7 and Mac OS
  -Windows 98 is supported by vendor driver from Alcor
- 28-pin SSOP lead-free/Halogen-free/RoHS compliant package is available.

■Compliance
- Complies with USB Device Class Definition for Mass Storage and Bulk-Transport V1.0
- Complies with Secure Digital Card (SD) specification up to ver. 3.0(SDXC)
- Complies with MultiMedia Card (MMC) specification up to ver. 4.2
- Complies with Memory Stick (MS) specification up to ver. 1.43
- Complies with Memory Stick PRO (MS_Pro) specification up to ver. 1.02
- Complies with Memory Stick PRO-HG (MS PRO-HG) specification up to ver. 1.01
- Complies with Memory Stick Interface Guideline for PC peripheral devices with Memory Stick Slot ver.1.16-00

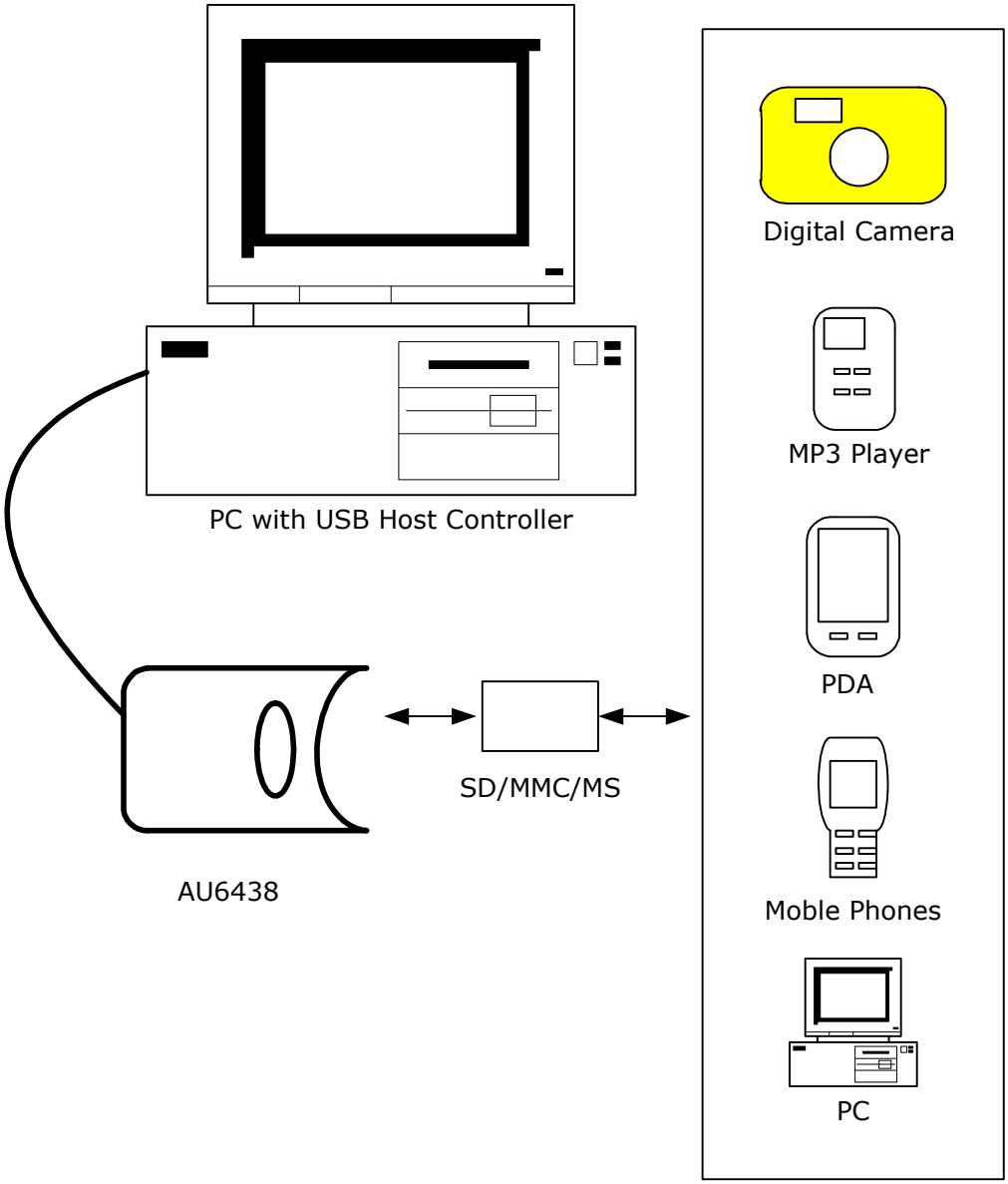
■Benefit

- 1K bytes of ping-pong FIFO buffs the data transmission between transmitter and receiver
- Integrated hardware DMA engine enhances overall performance of data transfers
- Supports power saving mode to reduce power consumption
- User-friendly Dynamic icon utility software can display icon message upon insertion/removal of compatible flash cards under Windows
- Optimizes performance via multiple sectors transfer
- Built-in 5V to 3.3V/3.3V to 1.8V regulator offers customers lower BOM cost
- Clock runs at 48MHz crystal

2. Application Block Diagram

Following application diagram demonstrates a typical card reader using the AU6438 chip. By connecting the card reader to a desktop or notebook PC through USB bus, the AU6438 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

AU6438 is available in 28-pin SSOP package. Below diagram shows signal name of each pin and table in the following page describes each pin in detail.

Figure 3.1 AU6438 Pin Assignment Diagram

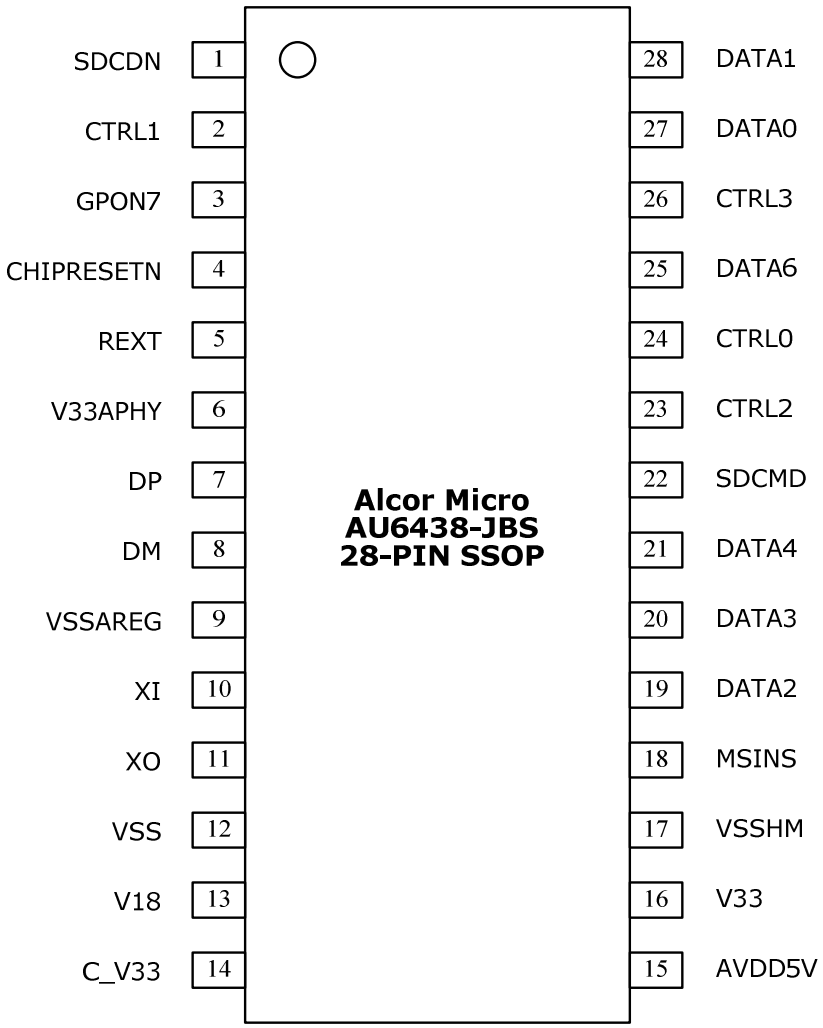


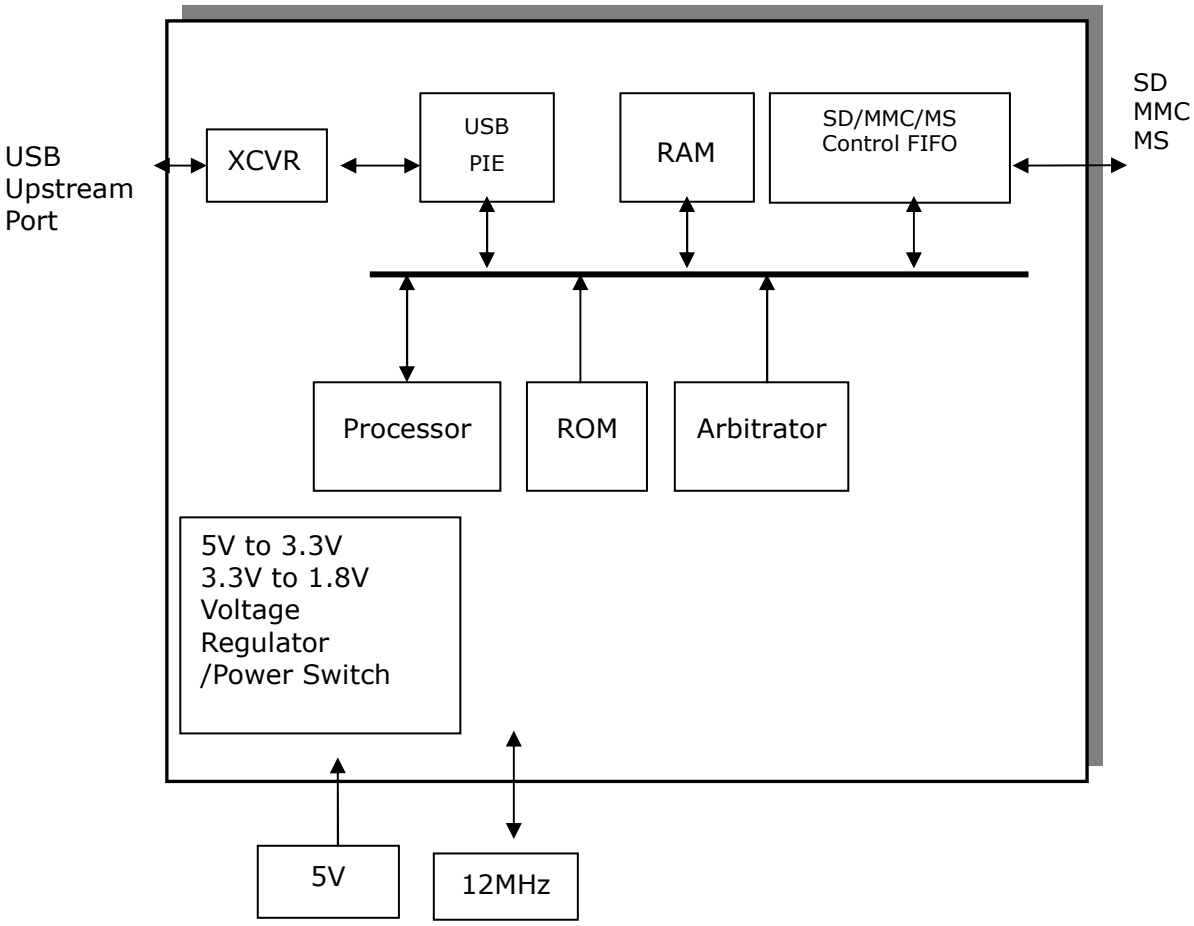
Table 3.1 AU6438 Pin Descriptions

Pin #	Pin Name	I/O	Description
1	SDCDN	IO	SDCDN
2	CTRL1	IO	SDWP/MSCLK
3	GPON7	O	Card access LED.
4	CHIPRESETN	I	Chip reset. Low active. Internal pull up.
5	REXT		680 Ω reference resistance
6	V33APHY		PHY 3.3V power pin
7	DP		USB DP
8	DM		USB DM
9	VSSAREG		
10	XI	I	Crystal input
11	XO	O	Crystal output
12	VSS		
13	V18		Regulator 1.8V output
14	C_V33		Card power 3.3V output
15	AVDD5V		Regulator 5V input
16	V33		Regulator 3.3V output
17	VSSHM		
18	MSINS	IO	MSINS
19	DATA2	IO	SDDATA2/MSDATA2
20	DATA3	IO	SDDATA3/MSDATA3
21	DATA4	IO	SDDATA4
22	SDCMD	IO	SDCMD
23	CTRL2	IO	SDDATA5/EEPCLK When I2C mode, internal has 45-75K pull up
24	CTRL0	IO	SDCLK/MSBS
25	DATA6	IO	SDDATA6
26	CTRL3	IO	SDDATA7/EEPDAT When I2C mode, internal has 45-75K pull up
27	DATA0	IO	SDDATA0/MSDATA0
28	DATA1	IO	SDDATA1/MSDATA1

4. System Architecture and Reference Design

4.1 AU6438 Block Diagram

Figure 4.1 AU6438 Block Diagram



5. Electrical Characteristics

5.1 Absolute Maximum Ratings

Table 5.1 Absolute Maximum Ratings

SYMBOL	PARAMETER	RATING	UNITS
VCC33	Power supply	-1 to 4V	V
V_{IN}	Input Signal Voltage	-1 to 4V	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
VCC33	Power Supply	3.0	3.3	3.6	V
V_{IN}	Input Signal Voltage	-0.3		VCC33 +0.3	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
I_{CC}	Operating supply current	Without Memory Card			24	mA

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_{D33P}	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_{D33P} 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

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		VD33P-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		440	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 Card Power Switch Output Capacity

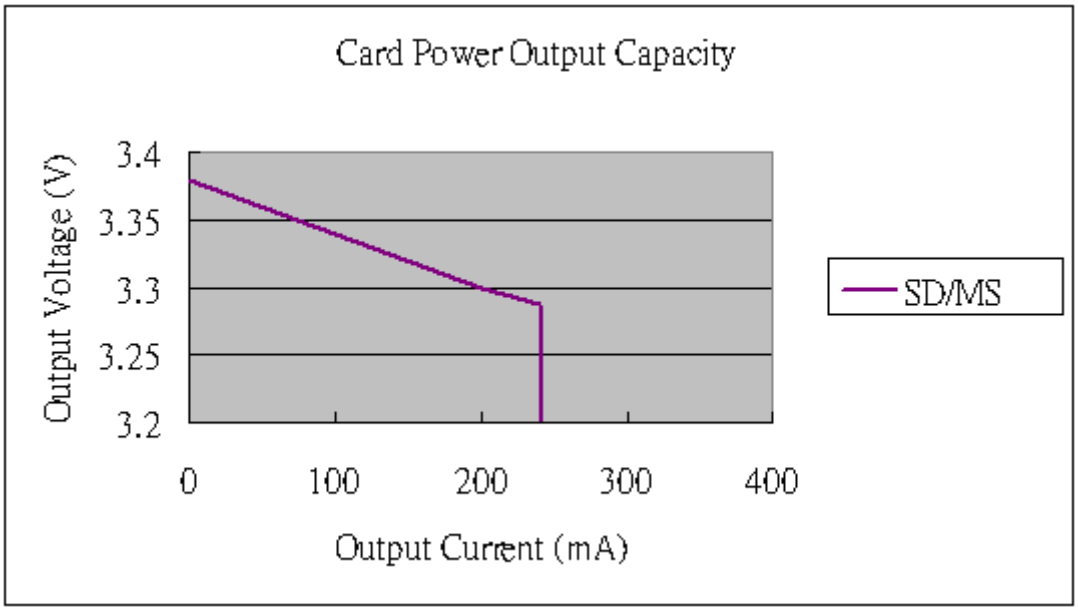
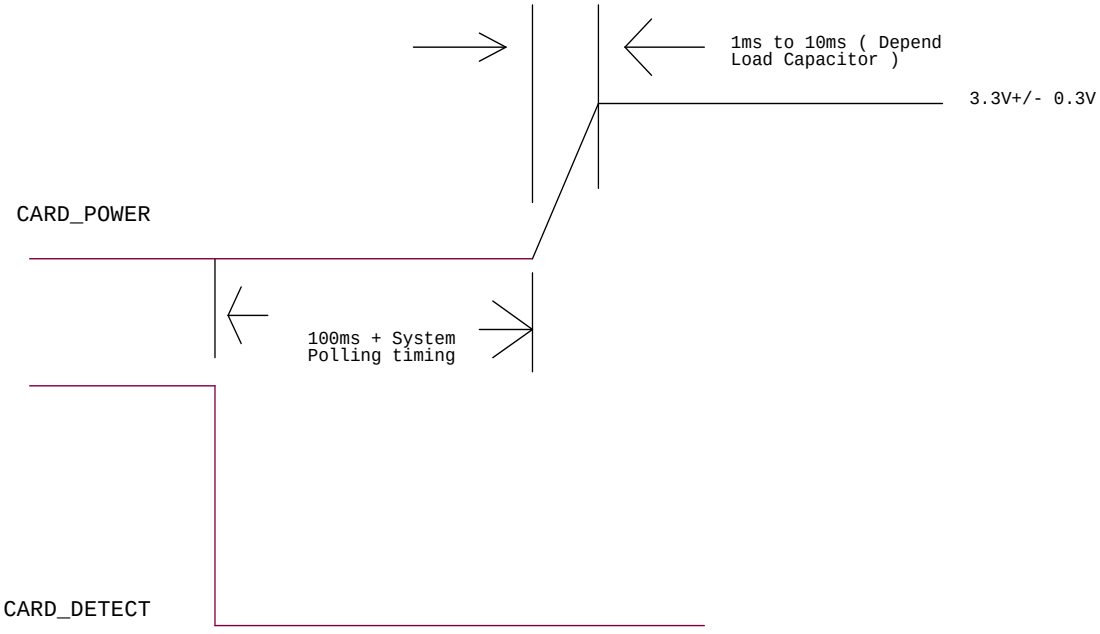
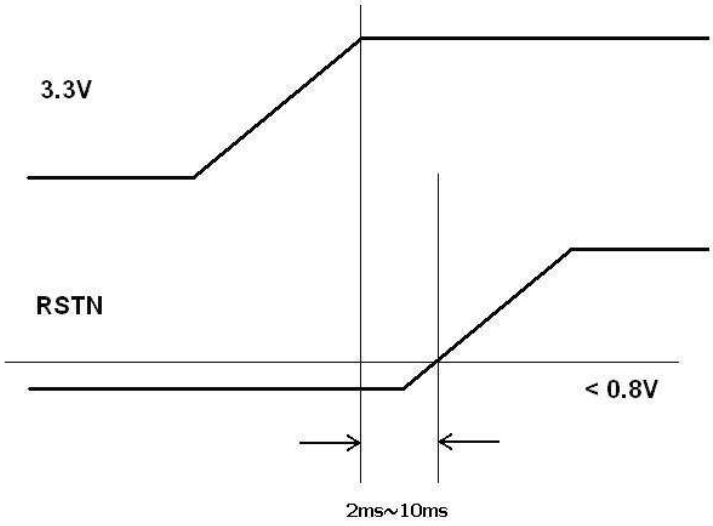


Figure 5.2 Card Detect Power-in Timing



5.7 Chip Reset Timing

Figure 5.3 Chip Reset Timing.

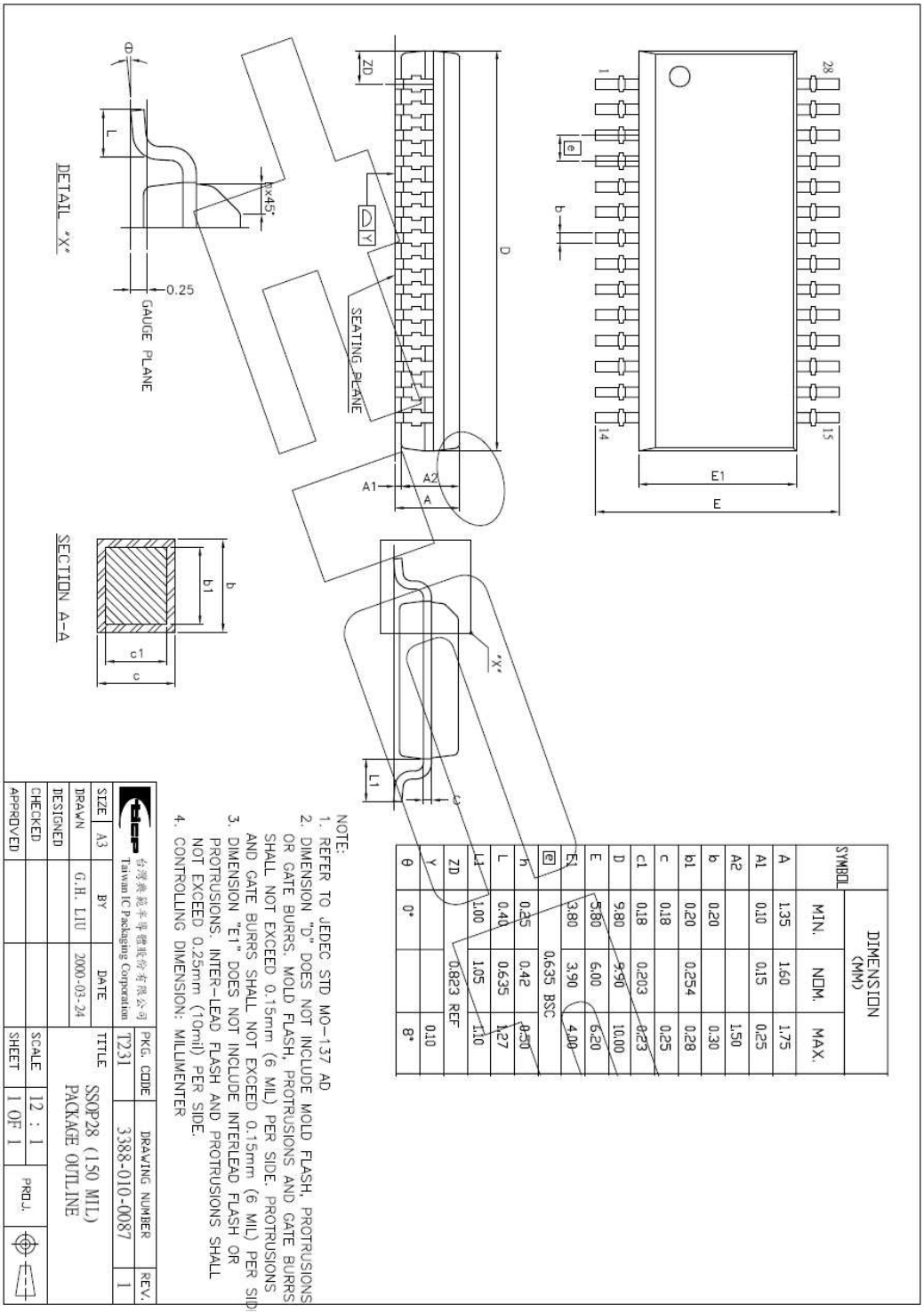


Chip reset should keep low (<0.8V) for 2ms ~ 10ms after:

1. 3.3V stable.
2. Clock stable

6. Mechanical Information

Figure 6.1 Mechanical Information Diagram



SYMBOL	DIMENSION (MM)		
	MIN.	NOM.	MAX.
A	1.35	1.60	1.75
A1	0.10	0.15	0.25
A2			1.50
b	0.20		0.30
b1	0.20	0.254	0.28
c	0.18		0.25
c1	0.18	0.203	0.23
D	9.80	9.90	10.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e		0.635 BSC	
h	0.25	0.42	0.50
L	0.40	0.635	1.27
L1	1.00	1.05	1.10
ZD		0.823 REF	
Y			0.10
θ	0°		8°

NOTE:
1. REFER TO JEDEC STD MO-137 AD
2. DIMENSION "D" DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS AND GATE BURRS SHALL NOT EXCEED 0.15mm (6 MIL) PER SIDE. PROTRUSIONS AND GATE BURRS SHALL NOT EXCEED 0.15mm (6 MIL) PER SIDE
3. DIMENSION "E1" DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSIONS. INTER-LEAD FLASH AND PROTRUSIONS SHALL NOT EXCEED 0.25mm (10mil) PER SIDE.
4. CONTROLLING DIMENSION: MILLIMENTER

台湾典範半導體股份有限公司 Taiwan IC Packaging Corporation			PKG. CODE	DRAWING NUMBER	REV.
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DESIGNED					
CHECKED			SCALE	12 : 1	
APPROVED			SHEET	1 OF 1	PROJ.

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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