



# AU6337

**USB2.0 SD/MMC/MS**

**Single/Dual LUN Card Reader controller**

Technical Reference Manual



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**<Memo>**



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# 1. Introduction

## 1.1 Description

AU6337 is an USB2.0 high-speed transmission controller, which is designed as a bridge between USB and SD/MS compatible flash card interface, such as SD, HS-SD, MMC, HS-MMC, RS-MMC, MMCmicro, MS, MS Pro and MS Duo...etc. AU6337 can read digital contents stored on memory card designed to cover a wide area of applications such as digital cameras, PDAs, MP3 players and smart phones...etc.

With the AU6337, users can transfer digital data between flash memory card and PC or other electronic devices.

AU6337 inherits the high-performance and cost-efficiency character from Alcor's products, included power switch integration, dynamic icon utility support, and DMA engine integration.

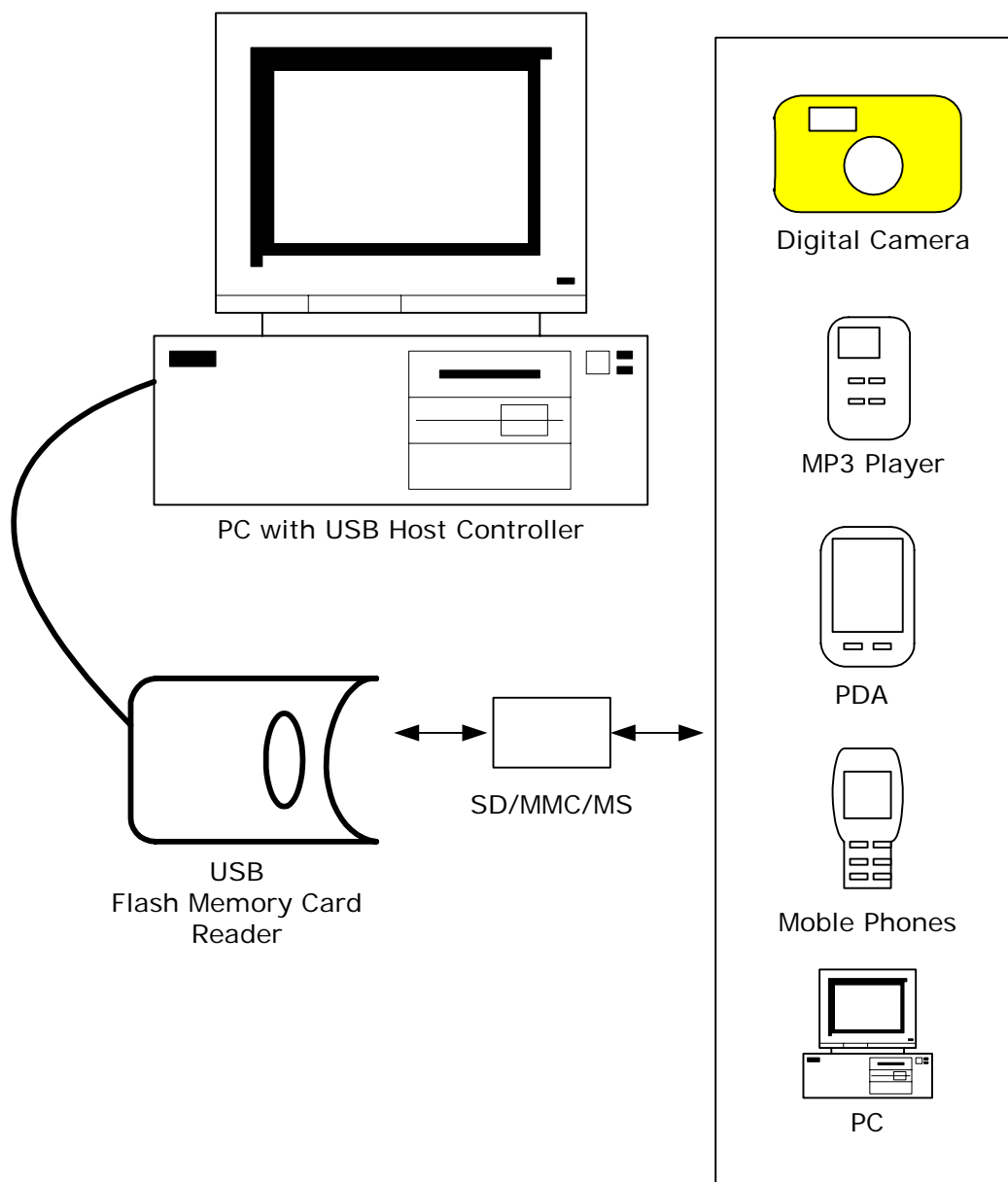
## 1.2 Features

- Support USB V2.0 specification and USB Device Class Definition for Mass Storage, Bulk-Transport V1.0
- Support SD/MMC/MS compatible flash card
- Support the latest flash card specification: SD2.0 (SDHC), MMC4.2 (8-bit), MSPro parallel mode (4-bit)
- Alcor 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 (Dual LUN)
- Support Dynamic Icon Utility
- Support LED for bus operating indication
- Power switch integrated to reduce production BOM cost
- 5→3.3 and 3.3→1.8V regulators built in
- 48-pin package for two slots (SD and MS)
- 28-pin package for single slot (SD or MS)

## 2. Application Block Diagram

The following application drawing demonstrates a typical card reader block diagram using AU6337. By connecting one card reader to a desktop or notebook PC through USB bus, the AU6337 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

There are three different form factor packages available to choose from. The following figure shows signal names for each pin and the table in the page after describes each pin in details.

**Figure 3.1 48 LQFP (GBL) Pin Assignment Diagram**

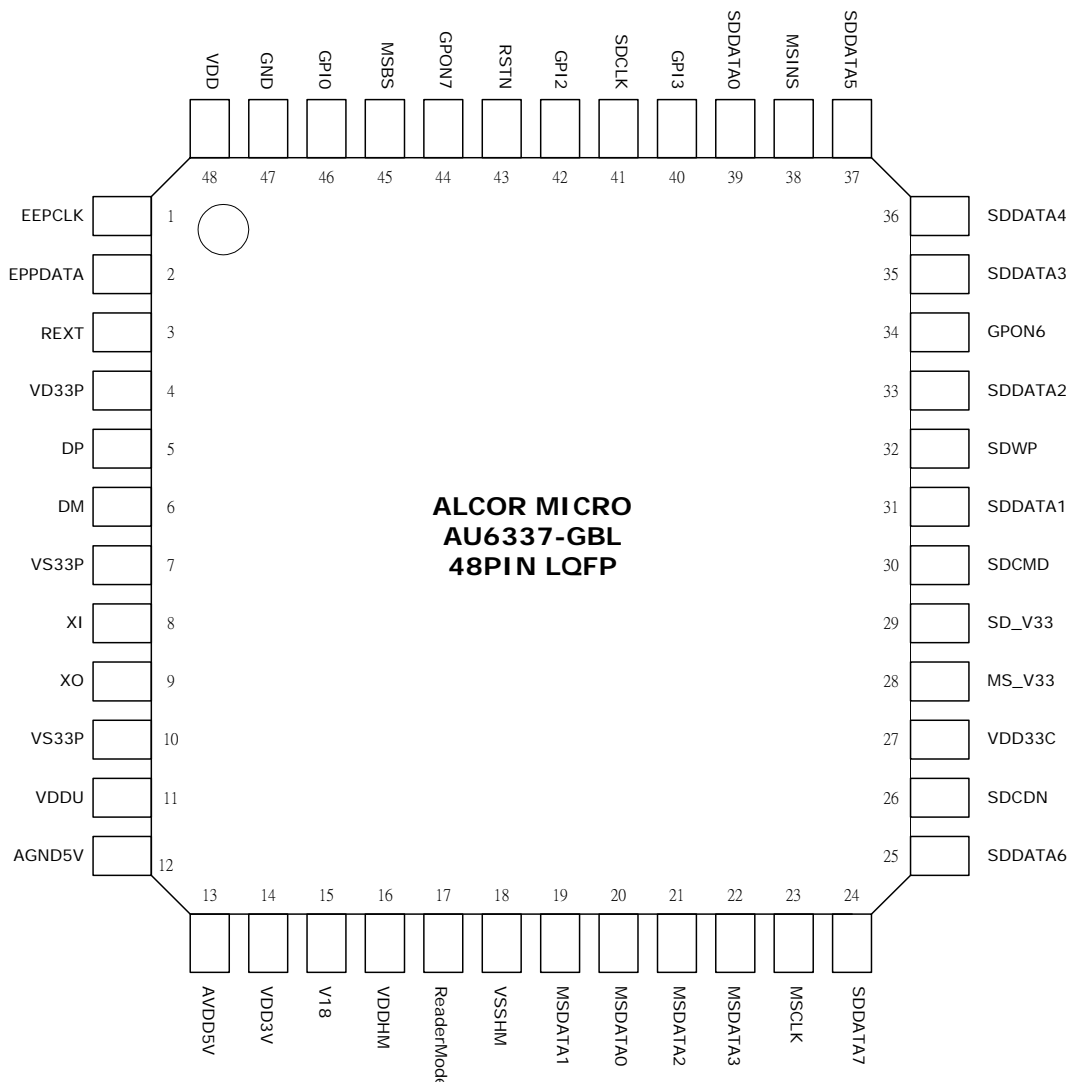




Table 3.1 48 LQFP (GBL) Pin Descriptions

Pin #	Pin Name	I/O	Description
1	EEPCLK	O	EEPROM serial clock.
2	EPPDATA	I/O	EEPROM for PID,VID customization.
3	REXT	I	External Resistor 330 to Ground
4	VD33P	I	Connected to 3.3V
5	DP	I/O	DP Signal for USB
6	DM	I/O	DM Signal for USB
7	VS33P	I	Connected to Ground
8	XI	I	12 MHz crystal input.
9	XO	O	12 MHz crystal output.
10	VS33P	I	Connected to Ground
11	VDDU	I	Connected to 1.8V
12	AGND5V	I	Ground
13	AVDD5V	I	5V input
14	VDD3V	O	Internal Regulator 3.3V output
15	V18	O	Internal Regulator 1.8V output
16	VDDHM	I	3.3V input for IO
17	ReaderMode	I	"0" for Normal, "1" for high-Z
18	VSSHM	I	Ground
19	MSDATA1	I/O	MS Data1. (suspend output mode and databus is zero)
20	MSDATA0	I/O	MS Data0. (suspend output mode and databus is zero)
21	MSDATA2	I/O	MS Data2. (suspend output mode and databus is zero)
22	MSDATA3	I/O	MS Data3. (suspend output mode and databus is zero)
23	MSCLK	O	MS serial protocol clock. (suspend IObus is zero)
24	SDDATA7	I/O	SD Data 7
25	SDDATA6	I/O	SD Data 6
26	SDCDN	I	SD Card Detect, Low Active
27	VDD33C	I	Card Power switch
28	MS_V33	O	MS card Power



Pin #	Pin Name	I/O	Description
29	SD_V33	O	SD card Power
30	SDCMD	I/O	SD Command
31	SDDATA1	I/O	SD Data 1
32	SDWP	I	SD Write Protect
33	SDDATA2	I/O	SD Data 2
34	GPON6	O	Card Access LED
35	SDDATA3	I/O	SD Data 3
36	SDDATA4	I/O	SD Data 4
37	SDDATA5	I/O	SD Data 5
38	MSINS	I	MS stick insertion/extraction detect.
39	SDDATA0	I/O	SD Data 0
40	GPI3	I	NC
41	SDCLK	O	SD Clock
42	GPI2	I	Current value. '0' for 100mA. '1' for 250mA. [Default]: '0'
43	RSTN	I	Reset (low active to reset the whole chip), must be pull up with RC.
44	GPON7	O	Power LED
45	MSBS	O	MS protocol bus state. (suspend IObus is zero)
46	GPI0	I	LUN mode select '1' for share 1LUN '0' for 2LUN
47	GND	I	Ground
48	VDD	I	1.8V input

The following figure shows signal names of each pin of the 80-pin package and the table in the page after describes each pin in details.

**Figure 3.2 28SSOP (GBS) Pin Assignment Diagram**

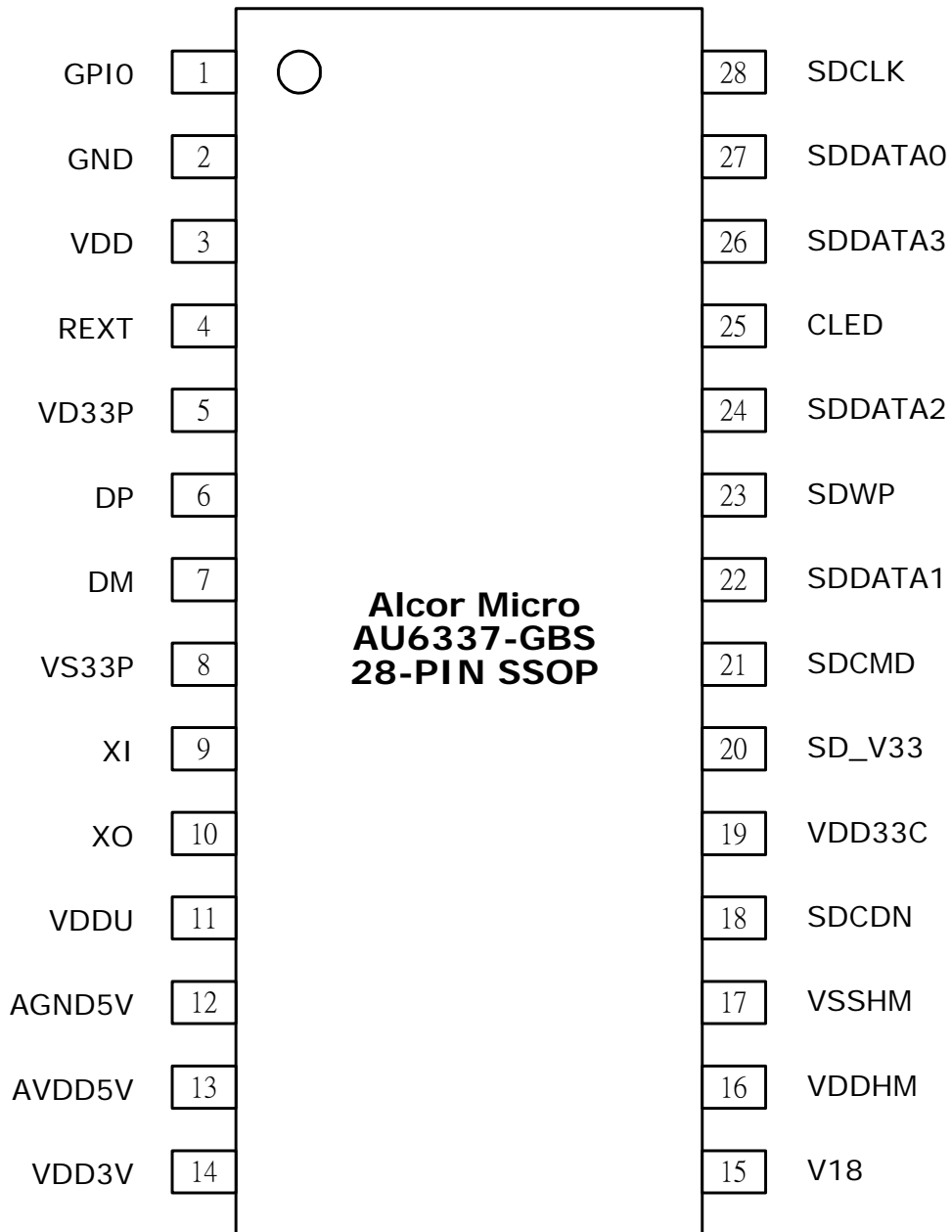




Table 3.2 28SSOP (GBS) Pin Descriptions

Pin #	Pin Name	I/O	Description
1	GPI0	I	Reserved. Always connect to 3.3V on PCB
2	GND	I	Core ground
3	VDD	I	Core 1.8V power input
4	REXT	I	External Resistor 330 to Ground
5	VD33P	I	UTMI 3.3V power input
6	DP	I/O	USB DP
7	DM	I/O	USB DM
8	VS33P	I	UTMI 3.3V ground
9	XI	I	12MHz crystal input
10	XO	O	12MHz crystal output
11	VDDU	I	UTMI 1.8V input
12	AGND5V	I	5 to 3.3 regulator ground
13	AVDD5V	I	5 to 3.3 regulator 5V input
14	VDD3V	O	5 to 3.3 regulator 3.3V output
15	V18	O	3.3 to 1.8 regulator 1.8V output
16	VDDHM	I	IO 3.3V power / 3.3 to 1.8 regulator 3.3V input
17	VSSHM	I	IO 3.3V ground
18	SDCDN	I	SD card detect
19	VDD33C	I	Card power switch 3.3V input
20	SD_V33	O	Card power switch output
21	SDCMD	I/O	SD command
22	SDDATA1	I/O	SD data 1
23	SDWP	I	SD write protect
24	SDDATA2	I/O	SD data 2
25	CLED	O	Card Access LED
26	SDDATA3	I/O	SD data 3
27	SDDATA0	I/O	SD data 0
28	SDCLK	O	SD clock

The following figure shows signal names of each pin of the 80-pin package and the table in the page after describes each pin in details.

**Figure 3.3 28SSOP (GCS) Pin Assignment Diagram**

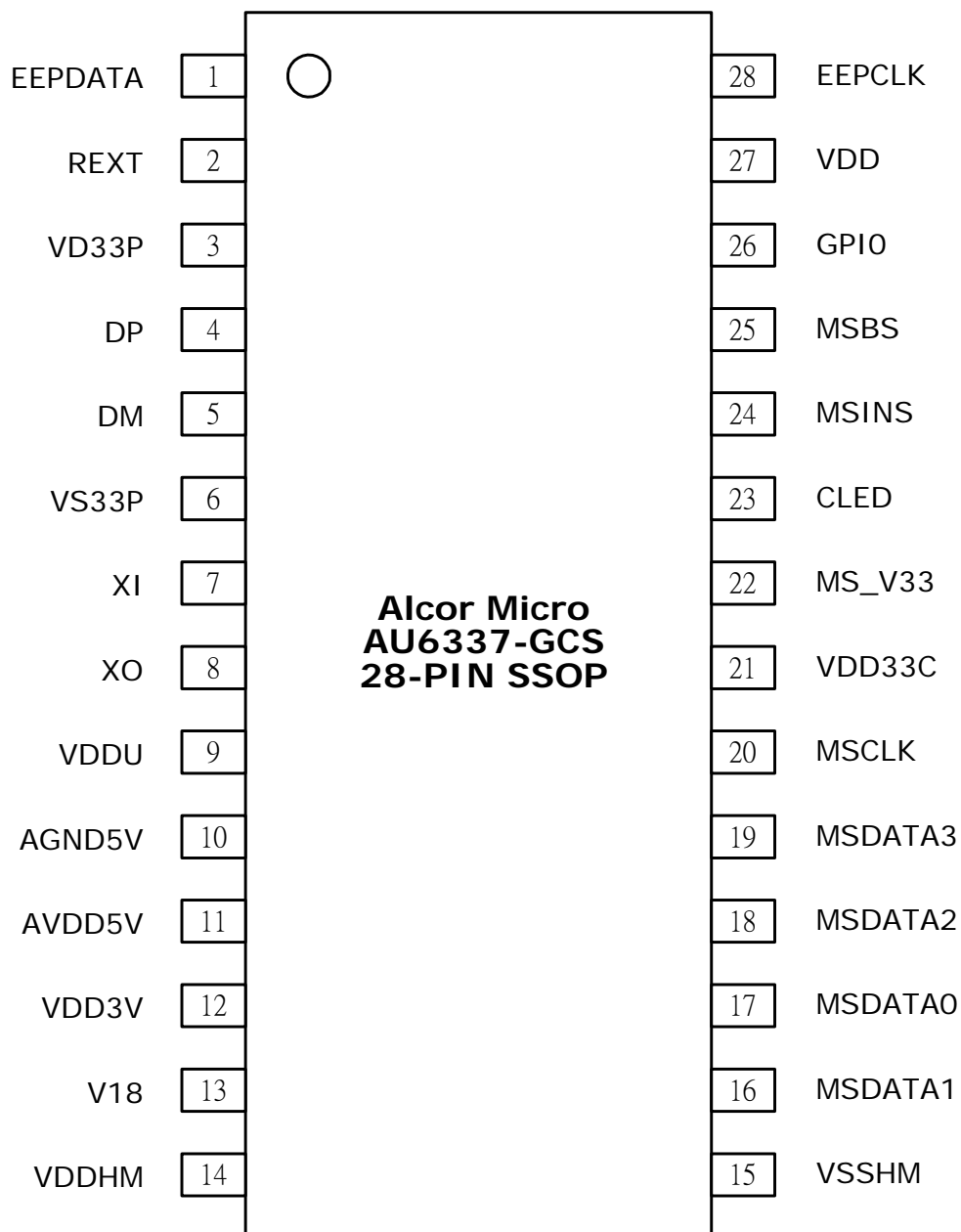




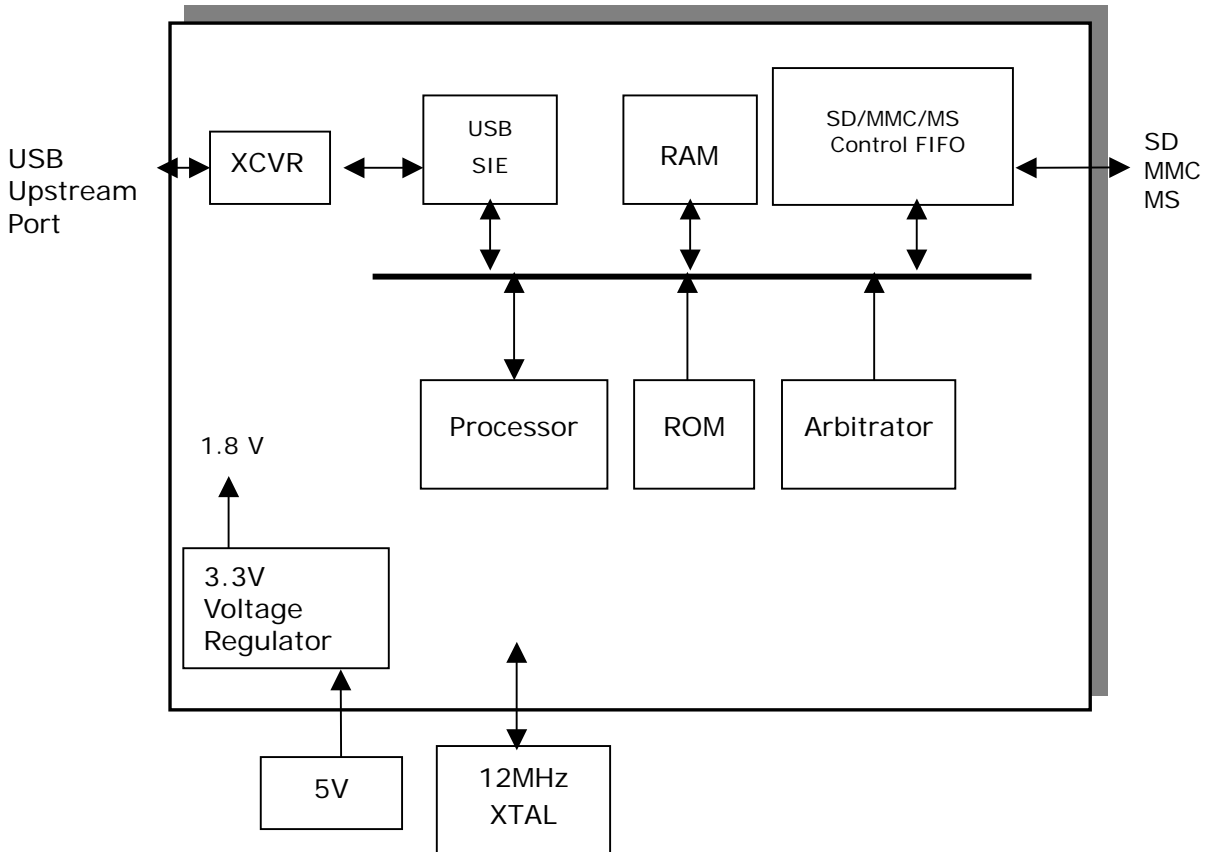
Table 3.3 28SSOP (GCS) Pin Descriptions

Pin #	Pin Name	I/O	Description
1	EEPDATA	I/O	EEPROM data
2	REXT	I	External Resistor 330 to Ground
3	VD33P	I	UTMI 3.3V power input
4	DP	I/O	USB DP
5	DM	I/O	USB DM
6	VS33P	I	UTMI 3.3V ground
7	XI	I	12MHz crystal input
8	XO	O	12MHz crystal output
9	VDDU	I	UTMI 1.8V input
10	AGND5V	I	5 to 3.3 regulator ground
11	AVDD5V	I	5 to 3.3 regulator 5V input
12	VDD3V	O	5 to 3.3 regulator 3.3V output
13	V18	O	3.3 to 1.8 regulator 1.8V output
14	VDDHM	I	IO 3.3V power / 3.3 to 1.8 regulator 3.3V input
15	VSSHM	I	IO 3.3V ground
16	MSDATA1	I/O	Memory Stick Data1
17	MSDATA0	I/O	Memory Stick Data0
18	MSDATA2	I/O	Memory Stick Data2
19	MSDATA3	I/O	Memory Stick Data3
20	MSCLK	O	Memory clock
21	VDD33C	I	Card power switch 3.3V input
22	MS_V33	O	Card power switch output
23	CLED	O	Card Access LED
24	MSINS	I	
25	MSBS	O	Memory Stick BS
26	GPI0	I	Reserved. Always connect to 3.3V on PCB
27	VDD	I	Core 1.8V power input
28	EEPCLK	O	EEPROM clock

# 4. System Architecture and Reference Design

## 4.1 AU6337 Block Diagram

Figure 4.1 AU6337 Block Diagram





## 5. Electrical Characteristics

### 5.1 Absolute Maximum Ratings

Table 5.1 Absolute Maximum Ratings

SYMBOL	PARAMETER	RATING	UNITS
$V_{DDHM}$ $V_{DD33C}$	Power Supply	-0.3 to $V_{DDH} + 0.3$	V
$V_{IN}$	Input Signal Voltage	-0.3 to 3.6	V
$V_{OUT}$	Output Signal Voltage	-0.3 to $V_{DDH} + 0.3$	V
$T_{STG}$	Storage Temperature	-40 to 150	°C

### 5.2 Recommended Operating Conditions

Table 5.2 Recommended Operating Conditions

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS
$A_{VDD5V}$	5V Power Supply	4.75	5.0	5.0	V
$V_{DDHM}$ $V_{DD33C}$	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	°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	
$V_{DDHM}$ $V_{DD33C}$	Power supply	3.3V I/O	3.0	3.3	3.6	V
$V_{il}$	Input low voltage	LVTTTL			0.8	V
$V_{ih}$	Input high voltage		2.0			V
$V_{ol}$	Output low voltage	$ I_{ol}  = 2\sim 16\text{mA}$			0.4	V
$V_{oh}$	Output high voltage	$ I_{oh}  = 2\sim 16\text{mA}$	2.4			V
$R_{pu}$	Input pull-up resistance	PU=high, PD=low	55	75	110	$K\Omega$
$R_{pd}$	Input pull-down resistance	PU=low, PD=high	40	75	150	$K\Omega$
$I_{in}$	Input leakage current	$V_{in} = V_{DDHM}$ or 0	-10	$\pm 1$	10	$\mu A$
$I_{oz}$	Tri-state output leakage current		-10	$\pm 1$	10	$\mu A$

## 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
$I_{CC(susp)}$	Suspend supply current	In suspend mode, current with $1.5k\Omega$ pull-up resistor on pin RPU disconnected			120	$\mu A$

**Table 5.6 Static characteristic : Digital pin**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Input levels						
V <sub>IL</sub>	Low-level input voltage				0.8	V
V <sub>IH</sub>	High-level input voltage		2.0			V
Output levels						
V <sub>OL</sub>	Low-level output voltage				0.2	V
V <sub>OH</sub>	High-level output voltage		VDDHM-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 <sub>HSDIFF</sub>	High speed differential input sensitivity	$ V_{I(DP)} - V_{I(DM)} $ measured at the connection as application circuit	300			mV
V <sub>HSCM</sub>	High speed data signaling common mode voltage range		-50		500	mV
V <sub>HSSQ</sub>	High speed squelch detection threshold	Squelch detected			100	mV
		No squelch detected	150			mV
V <sub>HSDSC</sub>	High speed disconnection detection threshold	Disconnection detected	625			mV
		Disconnection not detected			525	mV
Output Levels						
V <sub>HSOI</sub>	High speed idle level output voltage(differential)		-10		10	mV
V <sub>HSOL</sub>	High speed low level output voltage(differential)		-10		10	mV
V <sub>HSOH</sub>	High speed high level output voltage(differential)		-360		400	mV
V <sub>CHIRPJ</sub>	Chirp-J output voltage ( differential )		700		1100	mV
V <sub>CHIRPK</sub>	Chirp-K output voltage ( differential )		-900		-500	mV
Resistance						
R <sub>DRV</sub>	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/LS)						
Input Levels (differential receiver)						
$V_{DI}$	Differential input sensitivity	$ V_{I(DP)} - V_{I(DM)} $	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 $ V_{OH}-V_{OL} $ ;	4		20	ns
$t_{FF}$	Fall time	CL=50pF ; 90 to 10% of $ V_{OH}-V_{OL} $ ;	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
Low-Speed Mode						
$t_{LR}$	Rise time	CL=200pF-600pF ; 10 to 90% of $ V_{OH}-V_{OL} $ ;	75		300	ns



$t_{LF}$	Fall time	CL=200pF-600pF ; 90 to 10% of $ V_{OH}-V_{OL} $ ;	75		300	ns
$t_{LRMA}$	Differential rise/fall time matching ( $t_{LR} / t_{LF}$ )	Excluding the first transition from idle mode	80		125	%
$V_{CRS}$	Output signal crossover voltage	Excluding the first transition from idle mode	1.3		2.0	V
$V_{OH}$	High-level output voltage		2.8		3.6	V

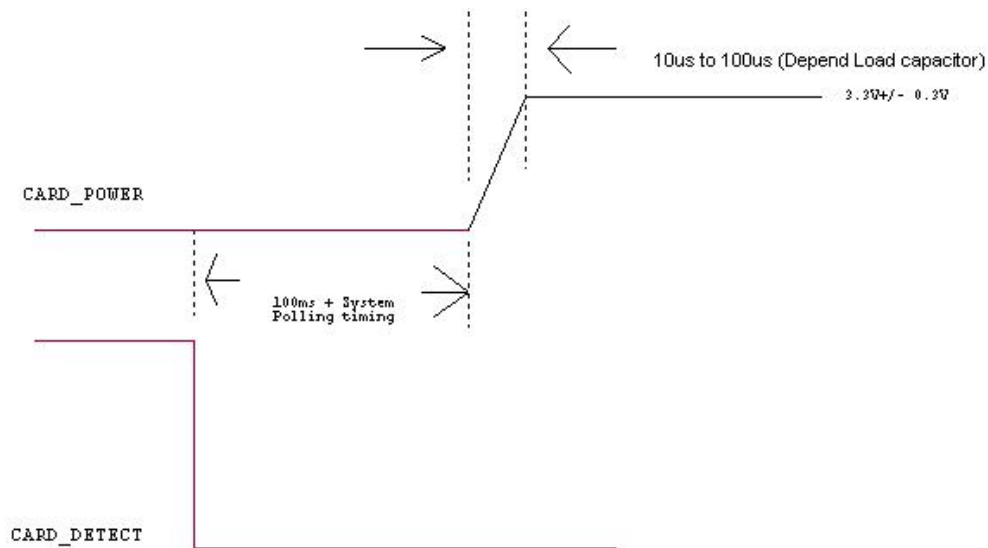
## 5.6 Power Switch Feature

AU6337 integrates a 5V to 1.8V voltage regulator and power switch to replace all MOS chips for flash card power supply.

### Card Power Output Current Range

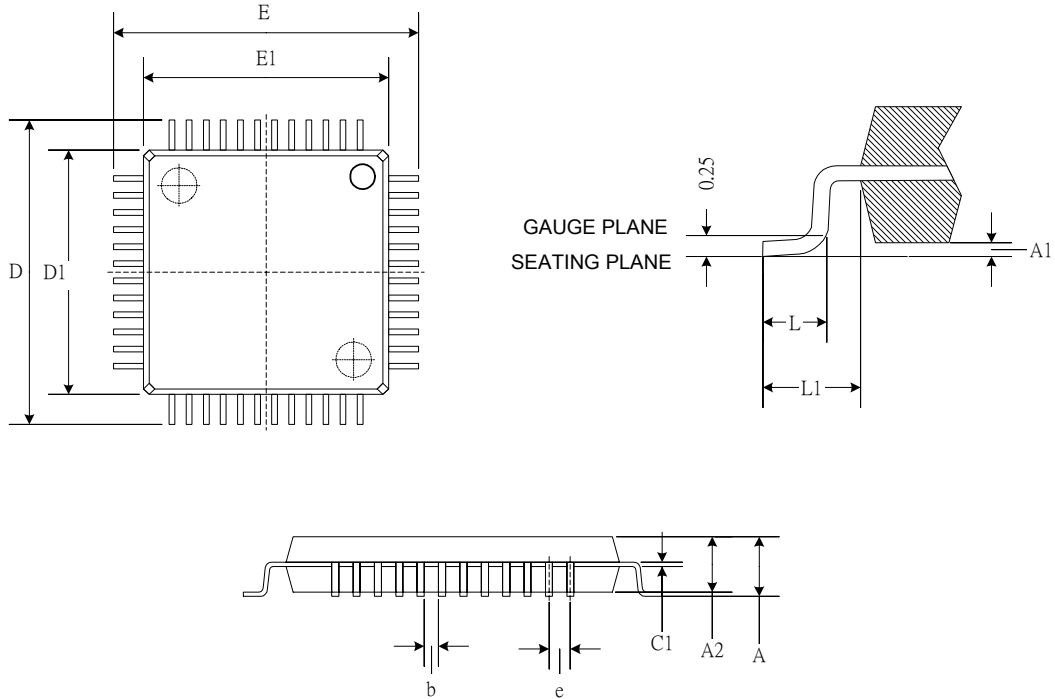
- For SD/MMC/MS
  - ◆ MAX: 200mA
- Card power output voltage range
  - ◆ MS/SD/MMC:  $3.3V \pm 0.3V$
- AU6337 will turn off all of Card Power in suspend mode

**Figure 5.1 Card Detect Power-on Timing**



# 6. Mechanical Information

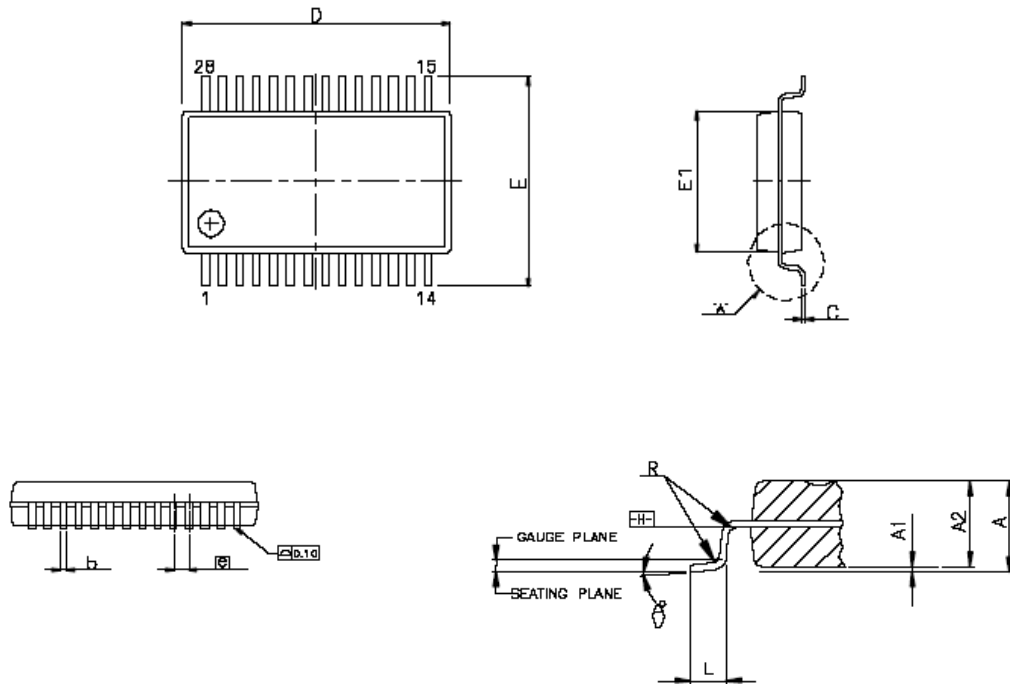
Figure 6.1 48 LQFP Mechanical Information Diagram



SYMBOLS	MIN.	MAX.
A	--	1.6
A1	0.05	0.15
A2	1.35	1.45
c1	0.09	0.16
D	9.00 BSC	
D1	7.00 BSC	
E	9.00 BSC	
E1	7.00 BSC	
e	0.5 BSC	
b	0.17	0.27
L	0.45	0.75
L1	1 REF	

1. JEDEC OUTLINE: MS-026 BBC
2. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PER SIDE. D1 AND E1 ARE MAXIMUM PLASTIC BODY SIZE DIMENSIONS INCLUDING MOLD MISMATCH.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED THE MAXIMUM b DIMENSION BY MORE THAN 0.08mm

Figure 6.2 28 SSOP Mechanical Information Diagram



DETAIL : A

SYMBOLS	MIN	NOM	MAX.
A	--	--	2.0
A1	0.05	-	-
A2	1.65	1.75	1.85
b	0.22	-	0.38
c	0.09	-	0.25
D	10.05	10.20	10.50
E	7.40	7.80	8.20
E1	5.00	5.30	5.60
e	0.65 BSC		
L	0.55	0.75	0.95
R	0.09	-	-
$\theta^\circ$	0°	4°	8°

UNIT: MM

1. JEDEC OUTLINE: MS-026 BBC
2. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PER SIDE. D1 AND E1 ARE MAXIMUM PLASTIC BODY SIZE DIMENSIONS INCLUDING MOLD MISMATCH.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED THE MAXIMUM b DIMENSION BY MORE THAN 0.08mm





## 7. Abbreviations

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

<b>SIE</b>	Serial Interface Engine
<b>SD</b>	Secure Digital
<b>MS</b>	Memory Stick
<b>MMC</b>	Multimedia Card
<b>UTMI</b>	USB Transceiver Macrocell Interface

## About Alcor Micro, Corp.

Alcor Micro, Corp. designs, develops and markets highly integrated and advanced peripheral semiconductor, and software driver solutions for the personal computer and consumer electronics markets worldwide. We specialize in USB solutions and focus on emerging technology such as USB and IEEE 1394. The company offers a range of semiconductors including controllers for USB hub, integrated keyboard/USB hub and USB Flash memory card reader...etc. Alcor Micro, Corp. is based in Taipei, Taiwan, with sales offices in Taipei, Japan, Korea and California. Alcor Micro is distinguished by its ability to provide innovative solutions for spec-driven products. Innovations like single chip solutions for traditional multiple chip products and on-board voltage regulators enable the company to provide cost-efficiency solutions for the computer peripheral device OEM customers worldwide.