AU9560-GBS-GR

USB Smart Card Reader Controller

Technical Reference Manual

Rev. 1.01

June, 2012

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Revision History

Date	Revision	Description
April, 2012	1.00	Official Release
June, 2012	1.01	Update block diagram and features description

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1. Introduction

1.1 Description

AU9560 is a highly integrated single chip USB Smart Card reader controller. Highly integration enables the lowest BOM cost of smart card reader. The AU9560 supports multiple international standards including ISO7816 for IC card standard, PC/SC 2.0 for windows smart card standard, Microsoft WHQL, EMV for Europay MasterCard Visa standard and USB-IF CCID standard. The application of AU9560 can be generally applied to Smart Card read/write terminal device, such as ATM, POS terminal, Public telephone, E-Commerce, personal consumption on Internet, personal certification, prepay system, loyalty system…etc.

1.2 Features

Package

- 28 SSOP

Standard Compliance

- EMV 4.0 Level 1 specification certified
- PBOC2.0 Level 1 certified
- Supports USB 2.0 full speed, USB-IF certified
- Based on ISO7816 implementation
- Support PC Smart Card industry standard – PC/SC 2.0
- Support Microsoft Smart Card for Windows
- Meet Microsoft WHQL USB Smart Card Reader requirements
- Meet US Federal Information Processing Standards (FIPS) Publication 201 requirements on smart card reader interoperability

Features

- Support single slot
- Support T0, T1 protocol
- Support I2C memory card, SLE4418, SLE4428, SLE4432, SLE4442, SLE4436, SLE5536, SLE6636, AT88SC1608, AT45D041 card and AT45DB041 card via external EEPROM
- Support ISO7816 Class A, B and C (5V/3V/1.8V) card

- Implemented as an USB full speed device with bulk transfer endpoint, Mass Storage endpoint
- Built-in PLL for USB and Smart Card clocks requirement
- Support EEPROM for USB descriptors customization (PID/VID/ iManufacturer/ iProduct/Serial Number), Direct Web Page Link, and accessing memory card module.
- EEPROM programmable via USB interface
- Support software update for memory card module
- Support Direct Web Page Link via configuration in external EEPROM
- Support short APDU and extended APDU
- Compatible with Microsoft USB-CCID driver
- Support remote wake up through inserting card/removing card
- Support USB selective suspend
- Support Power Saving Mode (Using one pin to select between Normal/PWR Saving Mode)
- Support card power over current protection mechanism
- Built in resonator.
- Support USB LPM (Link Power Management) features.

2. Application Block Diagram

AU9560 is a highly integrated single chip, which is used as USB Smart Card reader or in an embedded USB device through the downstream port of an USB hub. Following is the application diagram of a typical card reader product with AU9560 by connecting the card reader to an ATM or E-Commerce. AU9560 can also be used in STB, embedded system, POS…etc.

Figure 2.1 Block Diagram

Smart Card Solutions

3. Pin Assignment

The AU9560 is packed in 28-SSOP-form factor. The following figure shows signal name for each pin and the table in the following page describes each pin in detail.

Figure 3.1 AU9560 Pin Assignment Diagram

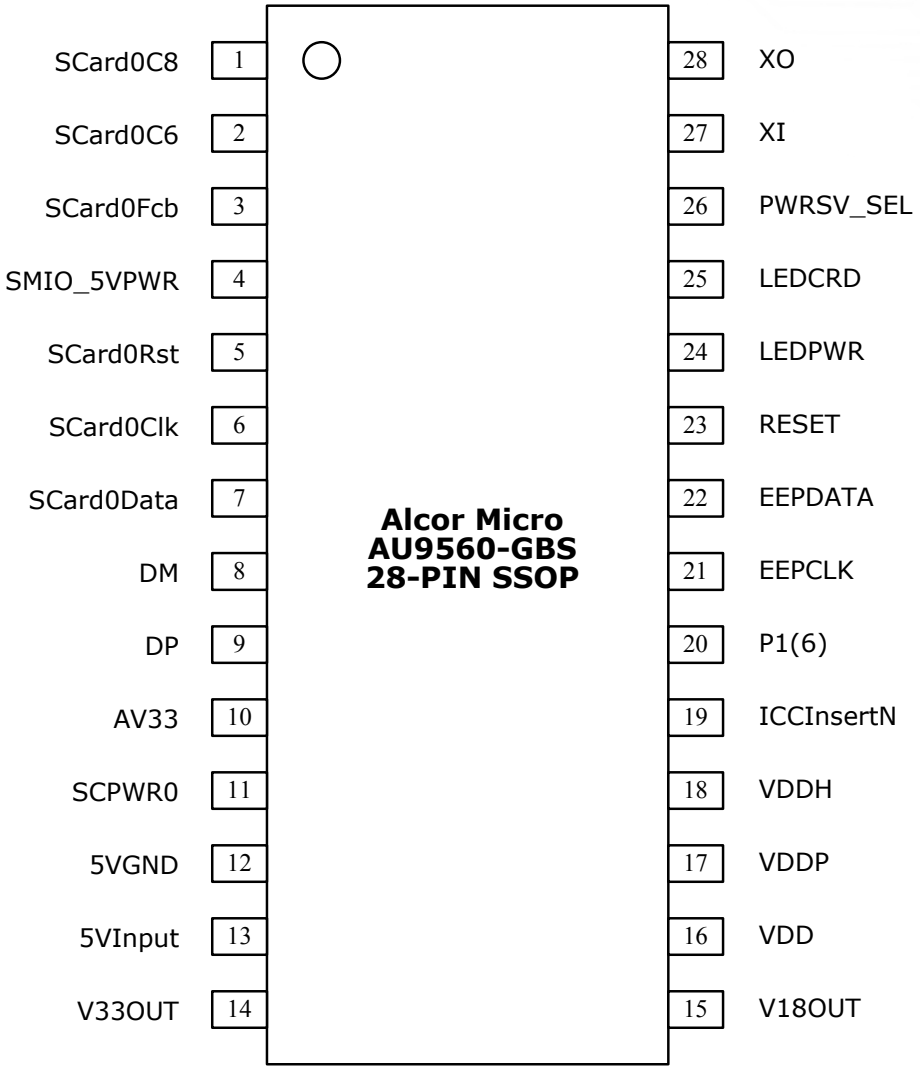


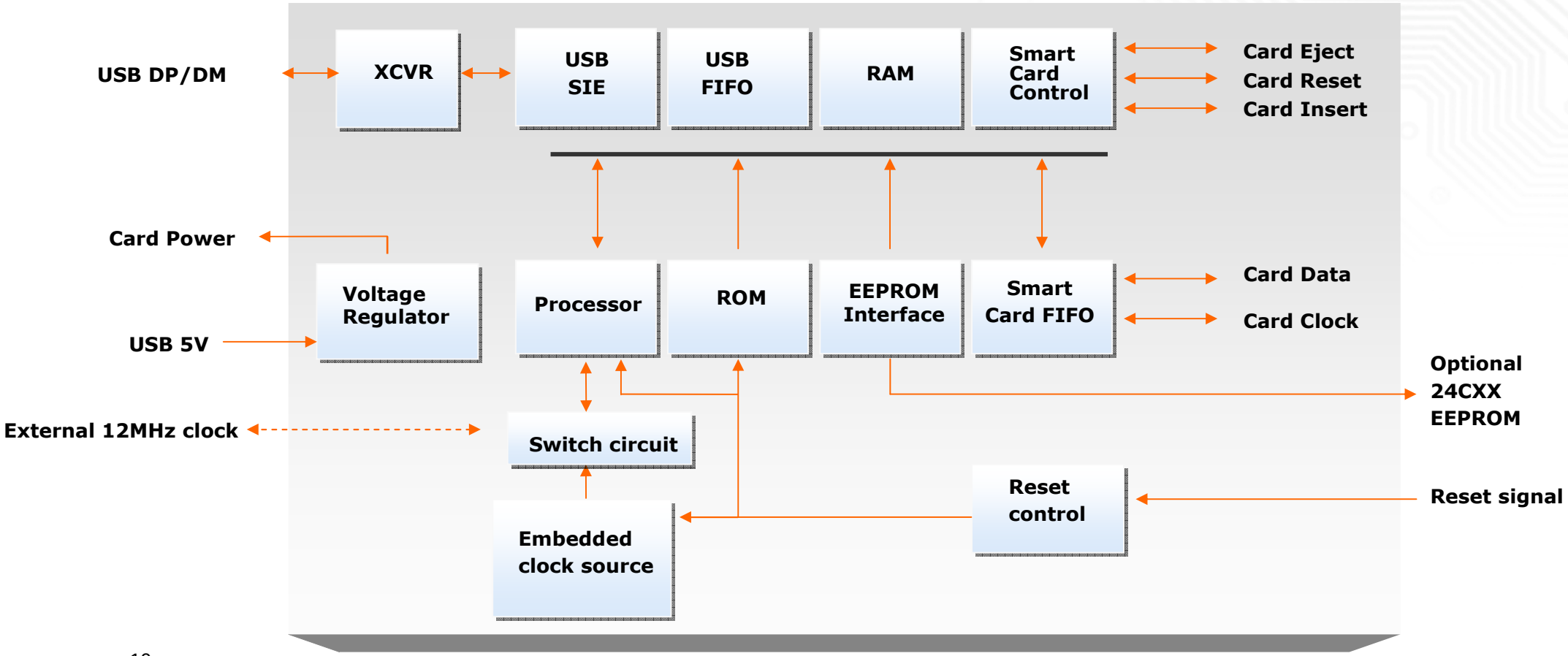
Table 3.1 AU9560 Pin Descriptions

Pin #	Pin Name	I/O	Description
1	SCard0C8	IO	Smart card GPIO_2
2	SCard0C6	IO	Smart card GPIO_1
3	SCard0Fcb	IO	Smart card GPIO_0
4	SMIO_5VPWR	PWR	Smart Card IO pad power
5	SCard0Rst	O	Smart card reset
6	SCard0Clk	O	Smart card clock
7	SCard0Data	IO	Smart card serial data
8	DM	IO	USB D-
9	DP	IO	USB D+
10	AV33	PWR	USB PHY power
11	SCPWR0	PWR	Smart card Power
12	5VGND	PWR	AGND5V
13	5VInput	PWR	5VInput
14	V33OUT	PWR	3.3V OUT
15	V18OUT	PWR	1.8V OUT
16	VDD	PWR	Core Power
17	VDDP	PWR	PLL Power
18	VDDH	PWR	Pad Power
19	ICCInsertN	I	Smart card insert detection (Low active) (internal pull high)
20	P1(6)	I	EEPROM Write Protect
21	EEPCLK	O	EEPROM Clock
22	EEPDATA	IO	EEPROM Data
23	RESET	I	Chip Reset
24	LEDPWR	O	Chip Power LED
25	LEDCRD	O	Card Slot LED
26	PWRSV_SEL	I	PWRSV_SEL (Default high) (High: Normal mode, Low: Power Saving Mode)
27	XI	I	NC, reserve for external 12MHz clock Input
28	XO	O	NC, reserve for external 12MHz clock output

4. System Architecture and Reference Design

4.1 AU9560 Block Diagram

Figure 4.1 AU9560 Block Diagram



5. Electrical Characteristics

5.1 Recommended Operating Conditions

Table 5.1 Recommended Operating Conditions

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS
V_{5IN}	5V Power Supply	4.75	5.0	5.25	V
V33	3.3V Power Supply	3.0	3.3	3.6	V
V_{IN}	Input Signal Voltage	V_{DDH} -0.3		V_{DDH} +0.3	V
V_{DDH}	Power Supply	3.0	3.3	3.6	V
V_{DD}	Digital Supply	1.62	1.8	1.98	V
T_{OPR}	Operating Temperature	0		85	^{O}C

5.2 General DC Characteristics

Table 5.2 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		pF
C_{OUT}	Output capacitance	Pad Limit		2.8		pF
C_{BID}	Bi-directional buffer capacitance	Pad Limit		2.8		pF
I_{CC}	Operating supply current	Without Memory Card			0.2	mA

5.3 DC Electrical Characteristics of 3.3V I/O Cells

Table 5.3 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	$\|I_{ol}\|$ =2~16mA			0.4	V
V_{oh}	Output high voltage	$\|I_{oh}\|$ =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

5.4 Power Consumption

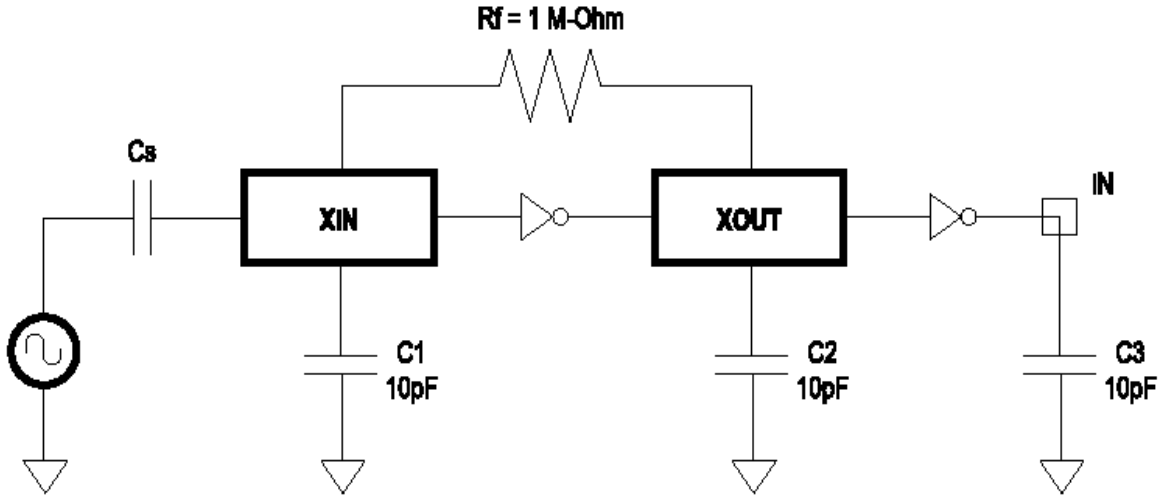
Table 5.4 Power Consumption

Status	Mode	Power Current	Note
With card present, before being suspended.	Normal Mode	33.4 mA	This value may vary with different card.
Without card present, before being suspended.	Normal Mode	26.14 mA	
After being suspended with smart card present	Normal Mode	380 μA	This value may vary with different card.
After being suspended without smart card present	Normal Mode	340 μA	
With card present, before being suspended.	Power Saving Mode	33.4 mA	This value may vary with different card.
Without card present	Power Saving Mode	240 μA	This value may vary with different card.
After being suspended with smart card present	Power Saving Mode	380 μA	

5.5 Crystal Oscillator Circuit Setup for Characterization

The following setup was used to measure the open loop voltage gain for crystal oscillator circuits. The feedback resistor serves to bias the circuit at its quiescent operating point and the AC coupling capacitor, Cs, is much larger than C1 and C2.
Figure 5.1 Crystal Oscillator Circuit Setup for Characterization

Figure 5.1 Crystal Oscillator Circuit Setup for Characterization



5.6 Behaviors of power saving mode

Table 5.5 Behavior Description

Power Saving Mode	Test item	Expected Behavior
Under power saving mode, when the card is removed, the USB connection of AU9560 will be disconnected from host. If the card is inserted, then AU9560 will be connected to the host.	**1.** Host is in normal mode. While there is no card inserted, plug AU9560 into host.	AU9560 will be in suspending mode. Host will not detect AU9560.
	2. Host is in normal mode. While there is card inserted, plug AU9560 into host.	AU9560 will be detected by the host and ready to operate smart card.
	3. Host is in normal mode. When AU9560 is connected to the host and there is card inserted in the slot, plug off the card and plug in it again.	When the card is removed, AU9560 will be forced into suspend mode. Host will detect that AU9560 is removed. When the card is inserted again, AU9560 will be detected by the host again.
	4. When AU9560 is not inserted into the host and host is in suspend mode, make sure there is no card inserted into AU9560 and plug AU9560 into the host.	Host will not detect AU9560. And host will not be woken up.
	5. When AU9560 is not inserted into the host and the host is in suspend mode. Plug AU9560 into the host with smart card inserted in advance.	Host will be woken up and detect AU9560. After the host is woken up, AU9560 is ready to operate card now.
	6. When AU9560 is inserted into the host, insert a smart card into AU9560. Then get host into suspend mode. After that, remove the smart card from AU9560. Then plug in the smart card again.	When user removes the card, it will not wake up the host from suspend mode. Then insert a card. It will wake up the host. After the host is woken up, AU9560 will be ready to operate the card.

	7. When there is no card inserted into AU9560 and the host is in suspend mode, plug AU9560 into the host. Then, insert a smart card into AU9560.	When AU9560 is plugged into the host without card inserted, the host will not be woken up. However, if user inserts a card now, the host will be woken up. This feature must work with host system that supports remote-wake up.

6. USB Selective Suspend Feature

The driver determines whether it should enter selective suspend state by the following requirements.

1. The card is in power off state or there is no card in the reader.

2. The reader is idle at least for a given time (30 seconds by default). It means during the period there is no command issuing to reader and there is no card inserting/removing event occurs.

When the driver detects both the two requirements above are met, it starts processing the following tasks,

1. Send standard USB command to the reader to enable remote wake function.

2. Start selective-suspend procedure to ask the system to suspend the reader.

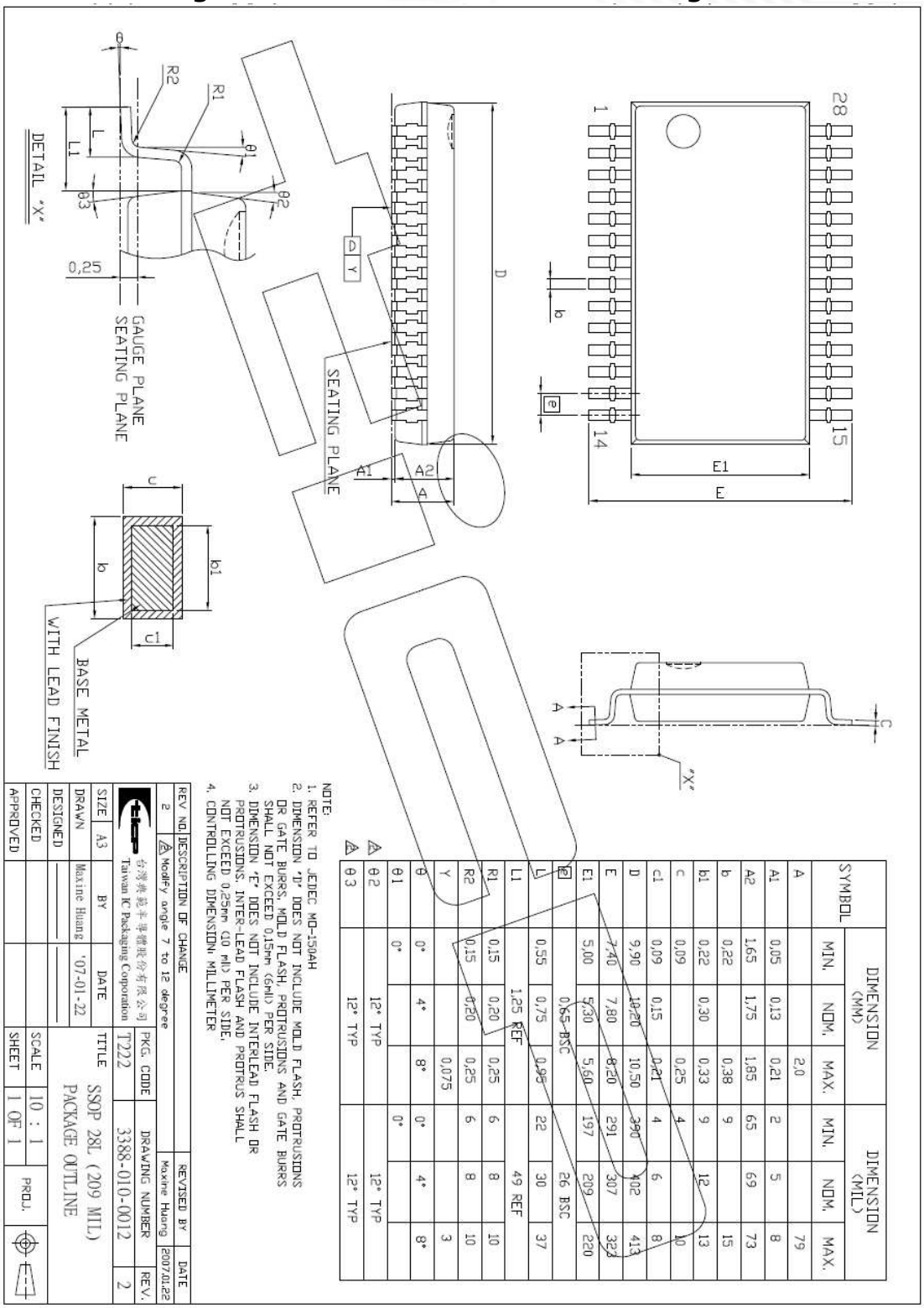
After entering the selective suspend state, the driver determines whether it should exit selective suspend state when one of the following conditions occurs,

1. There is any command which intend to communicate with the reader.

2. When card inserting/removing event occurs, the reader issues resume signal to the host. Then the system will inform the driver to exit selective suspend state.

7. Mechanical Information

Figure 7.1 Mechanical Information Diagram



SYMBOL	DIMENSION (MM) MIN.	NOM.	MAX.	DIMENSION (MIL) MIN.	NOM.	MAX.
A			2.0			79
A1	0.05	0.13	0.21	2	5	8
A2	1.65	1.75	1.85	65	69	73
b	0.22		0.38	9		15
b1	0.22	0.30	0.33	9	12	13
c	0.09		0.25	4		10
c1	0.09	0.15	0.21	4	6	8
D	9.90	10.20	10.50	390	402	413
E	7.40	7.80	8.20	291	307	323
E1	5.00	5.30	5.60	197	209	220
e		0.65 BSC			26 BSC	
L	0.55	0.75	0.95	22	30	37
L1		1.25 REF			49 REF	
R1	0.15	0.20	0.25	6	8	10
R2	0.15	0.20	0.25	6	8	10
Y			0.075			3
θ	0°	4°	8°	0°	4°	8°
θ1	0°			0°		
θ2	12° TYP			12° TYP		
θ3	12° TYP			12° TYP		

8. Abbreviations

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

WHQL	Windows Hardware Quality Labs
EMV	Europay MasterCard Visa
ATM	Automatic Teller Machine
BOM	Bill of Material
PC/SC	This is association name. (http://www.pcscworkgroup.com/)
VID	Vendor ID
PID	Product ID
PLL	Phase Lock Loop
GSM	Globe System for Mobile Communication
ESD	Electrostatic Sensitive Device

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.

9. Appendix: BatteryMark Test

Test Condition	With AU9560: Card Present	Without AU9560
BatteryMark Test Result: Condition Run	2:02	2:02
Version	BatteryMark 4.01	
Model Name	COMPAQ Presario CQ40	
CPU Name	Intel(R) Pentium(R) III or Pentium(R) III Xeon(TM)	
CPU Clock Speed	1900	
System BIOS Version	HPQOEM - 1	
Display Mode	1280 x 800 32 bits/pixel	
Display Refresh Rate (Hz)	60	