EntréPad AES1610
Slide Sensor Data Sheet

Features and Benefits

- ✓ **TruePrint® and TrueMatch® Technology**
  - Best Ability To Acquire (ATA)
- ✓ **TrueNav® Cursor and Menu Navigation Technology**
  - Quickly scroll through menus, lists and documents
- ✓ **High Definition 128 x 8 Pixel Array**
  - 6.5mm x 0.40mm
  - 500 pixels per inch
- ✓ **Ultra Small Package**
  - 40 Ball Grid Array (BGA) eXtendaBall Packages
  - 12mm X 5mm X 1.96mm (thick)
  - 12mm X 5mm X 1.34mm (thin)
  - Perfect for notebooks, UMPCs, PC desktop peripherals, and small handheld devices
  - RoHS Compliant
- ✓ **Serial Flash Interface**
  - Secure matcher and template storage during pre-boot authentication (PBA)
- ✓ **USB Operating Voltage Range**
  - 3.0V to 3.6V single supply
- ✓ **0°C to +70°C Operating Temperature Range**
- ✓ **USB 2.0 Full Speed Interface**
  - Suspend and remote wakeup
  - Full support for C3 Selective Suspend mode
- ✓ **Multiple Frequency Operation with Crystal, Resonator, or with external clock input**
- ✓ **Ultra-Hard Wearing Surface Coating**
  - Scratch and impact resistant
  - > 10 Million rubs w/o degradation
- ✓ **IEC 61000-4-2 Level 4 ESD Immunity (+/- 15KV)**
- ✓ **Built-in low power Finger Detection w/ remote wakeup capability**
- ✓ **Multiple battery-friendly operating modes @ 3.3V**
  - Imaging @ 25 – 37 mA typical depending upon slide speed selection
  - Navigation / Graphical Cursor Control mode @ 10.5 mA typical.

1 Introducing the EntréPad AES1610 Slide Sensor

1.1 Operational Description

The AES1610 combines a USB2.0 full speed interface with compact size and low voltage low power operation. The USB interface features low-power suspend and remote wakeup capability. The AES1610 also includes a private Serial Flash SPI interface, providing simplified integration into PC pre-boot authentication while improving PC serviceability and customer privacy.

The AES1610 fingerprint sensor is a flexible subsurface fingerprint imaging device capable of performing many different functions at the touch of a finger. The primary functions of the sensor are to accurately detect and read an individuals fingerprint and finger motions under all conditions putting the power of touch to work for you. AuthenTec's TruePrint Technology and proprietary pattern-based matching algorithms deliver the industry's best Ability-To-Enroll (ATE) >>99%, False Acceptance Rate (FAR) <1:100,000, and lowest False Rejection Rate (FRR) < 1:500. The low FRR ensures that your customers will be able to easily authenticate themselves with the sensor without having to re-slide their finger due to unnecessary nuisance rejects while at the same time maintaining a high-level of security. The on-chip navigation timing and image optimization functions provide for high resolution motion calculation for all types of finger motions.

The TruePrint image pixel array of the AES1610 sensor is composed of 8 rows of 128 pixels (columns) at a pixel density of 500 pixels per inch. This highly advanced imaging system provides unparalleled accuracy and gives the AES1610 the outstanding biometric performance. The AES1610 features a full image frame buffer, further enhancing in-system performance. The slide speed of the device is selectable and ranges from 20cm/s to 50cm/s depending upon your requirements.

During an imaging event, the RF TruePrint Signal is conducted via the drive ring to the users' finger. The TruePrint Signal is then conducted through and modulated by the "live layer" of the finger where the true fingerprint originates. The imaging array measures the TruePrint signal, the strength of which corresponds to either a ridge or valley region. The sensing element of each pixel is an RF sense-amplifier, which picks up the TruePrint (high frequency AC) signal.

The AES1610 makes decision concerning the presence of a finger based on histograms created during imaging cycles. If the host places the sensor in suspend with the USB Remote Wakeup feature enabled, the AES1610 will automatically enter the continuous finger detect mode. The host can program all relevant registers of the sensor prior to placing it in suspend so that the sensor is setup to properly image or navigate when a finger is found. The host will program the sensor to ensure that the sensor will not consume more than 500uA while in suspend.

2 DC ELECTRICAL CHARACTERISTICS

2.1 Absolute Maximum Ratings

An absolute maximum rating is the maximum value guaranteed by the AuthenTec. The use of a product in violation of these ratings can result in significant loss of device reliability or cause damage to the sensor.

Symbol	Parameter	Min.	Max.	Units
V_{DD}	Supply Voltage	-0.5	4.3	V
V_I	Input Voltage	-0.5	V_{DD}+0.5	V
V_O	Output Voltage	-0.5	V_{DD}+0.5	V
I_{IK}	Input Clamp Current $V_I < V_{SS}$ of $V_I > V_{DD}$		±20	mA
I_{OK}	Output Clamp Current $V_O < V_{SS}$ of $V_O > V_{DD}$		±20	mA
T_{STG}	Storage Temperature	-65	150	°C
Latch-Up	Latch-Up Immunity	±100		mA
ESD_{PIN}	Pin-level ESD Immunity JESD22 Method A114-B	-2	+2	KV
$ESD_{PACKAGE}$	Package-level ESD Immunity IEC61000-4-2 Level 4 Air Discharge method using AuthenTec approved reference design	-15	+15	KV
T_{SOL}	Maximum Soldering Temperature (MSL=3)		+260	°C

Absolute Maximum Ratings

2.2 Recommended Operating Conditions

Symbol	Parameter	Min.	Typ	Max.	Units
V_{DD}	Power Supply Voltage	3.0	-	3.6	V
$V_{DDACp-p}$	Power Supply Ripple peak to peak	-50		+50	mV
V_I	Input Voltage	0		V_{DD}	V
V_O	Output Voltage	0		V_{DD}	V
V_{IH}	High Level Input Voltage	70% V_{DD}		V_{DD}	V
V_{IL}	Low Level Input Voltage	0		30% V_{DD}	V
t_t	Digital Input Transition (Rise and Fall) Time	3		10	nS
T_A	Ambient operating temperature	0		70*	°C

Recommended Operating Conditions

***Advisory**

The AES1610 remains fully operational at temperatures that are high enough to be uncomfortable for the user.

For reasons of safety and protection, AuthenTec reference designs include circuitry that serves to manage the junction temperature by controlling the supply current. If the hardware developer elects not to use the AuthenTec-provided control circuit design, it will then be essential that an equivalent design be developed and implemented.

2.3 DC Characteristics @ Recommended Operating Conditions

Unless otherwise specified, $V_I = V_{DD}$ or $V_{SS,}$ $T_{Ambient}$ = 25°C

Symbol	Parameter	Conditions	Min.	Typ	Max.	Units
V_{OH}	High Level Output Voltage	I_{OH}=2mA	Vdd-0.3			V
V_{OL}	Low Level Output Voltage	I_{OL}=2mA			0.3	V
I_{IL}	Low Level Input Current	V_I=V_{IL}(min.)			±1	μA
I_{IH}	High Level Input Current	V_I=V_{IH}(max.			±1	μA
I_{OZ}	High Impedance State Output Current				±20	μA
Power Supply Currents						
I_{DDQ}	Imaging mode @ 20cm/s	Vdd=3.3V		31		mA
I_{DDQ}	Imaging mode @ 30cm/s	Vdd=3.3V		37		mA
I_{DDQ}	Navigation	Vdd=3.3V		10.5		mA
I_{DDQ}	Suspend Mode C3-State Selective Suspend	Vdd=3.3V			400	uA
I_{DDQ}	Idle Mode	Vdd=3.3V		4.4		mA
I_{DDPeak}	Peak Imaging Current	Vdd=3.3V			89	mA

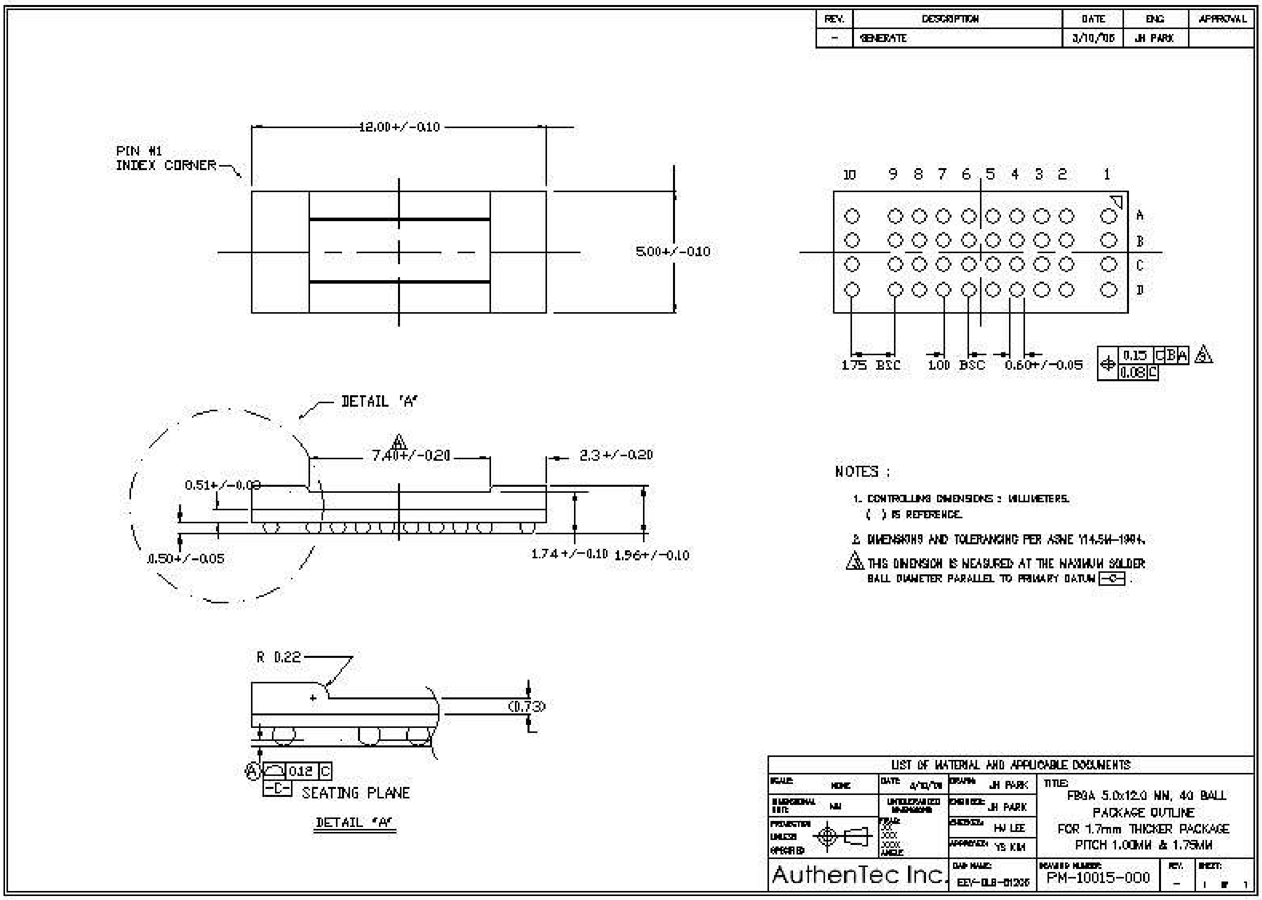
DC Characteristics

All I_{DDQ} Currents measured RMS using standard AuthenTec software and drivers. Use of other software or customized register settings may effect actual power consumption. Maximum slide speed limit is widely selectable. For specification purposes, 40 and 20 cm/sec were selected as typical options.
Substantial power savings in suspend can be yielded if the system can provide a 12MHz (or 6MHz) clock input to the sensor. Crystal/Resonator power can be up to 25% or more of the suspended current drain.

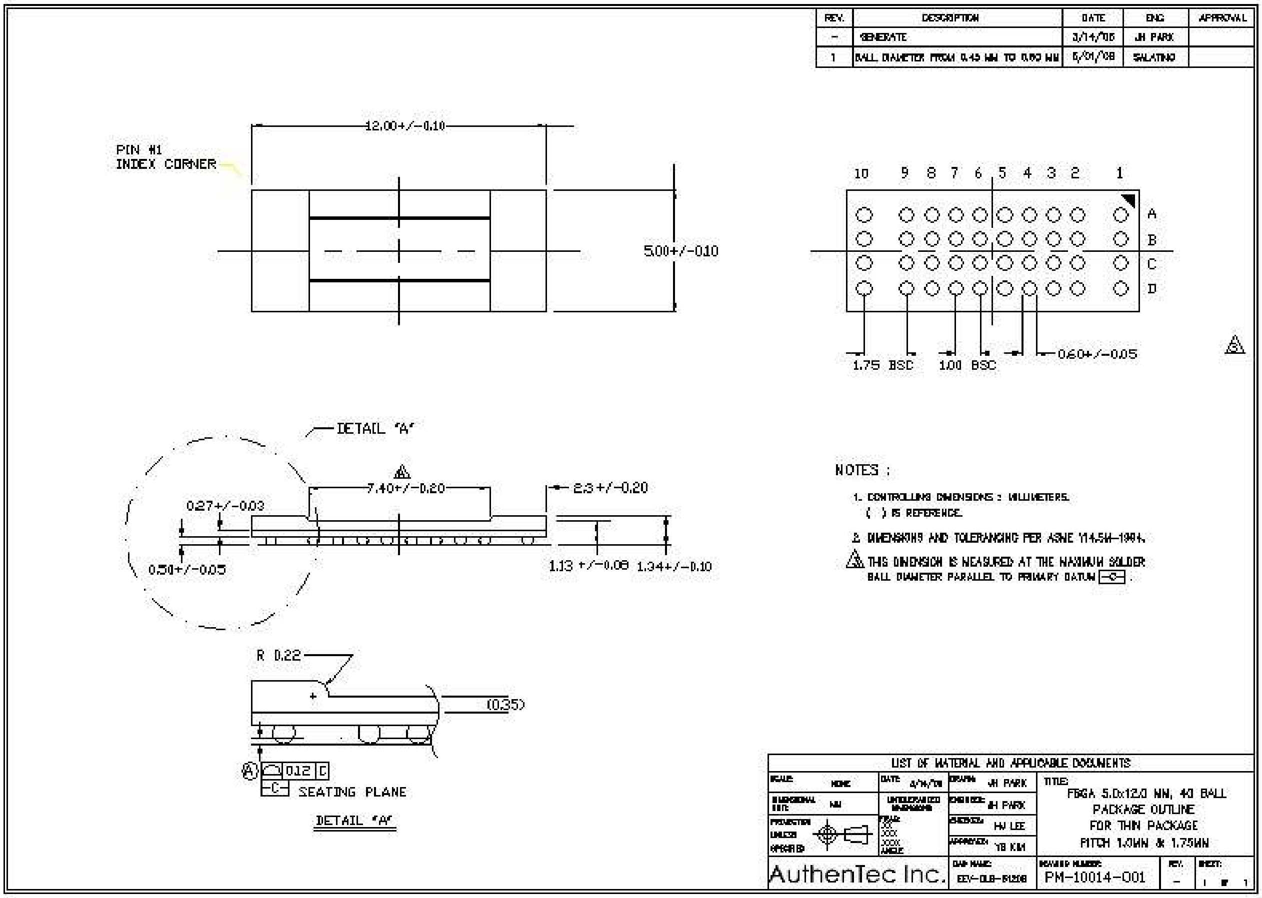
3 Packaging and Pinout Information

3.1 Sensor Packaging

The AES1610 sensor is housed in a plastic molded 40 Ball Grid Array package using lead-free solder balls. The eXtendaBall thick package (designator code “DF”) and the eXtendaBall thin package (designator code “FF”) are shown below.



40 BGA eXtendaBall Thick Package



40 BGA eXtendaBall Thin Package

3.2 Recommended PCB Footprint

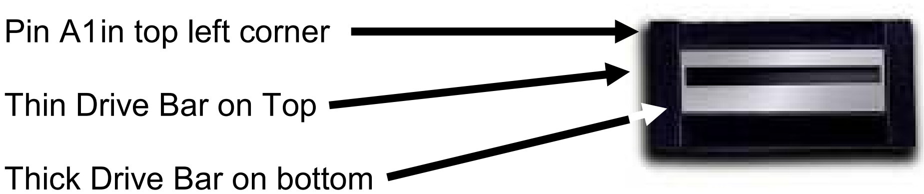
The PCB BGA pad sizes for the AES1610 which uses 0.60mm BGA balls, as shown on the package drawing, shall be 0.50 mm round pads with a 0.50 mm square solder mask and solder paste opening. The use of a >0.50 mm circular solder mask is authorized, but the square shape is preferred.

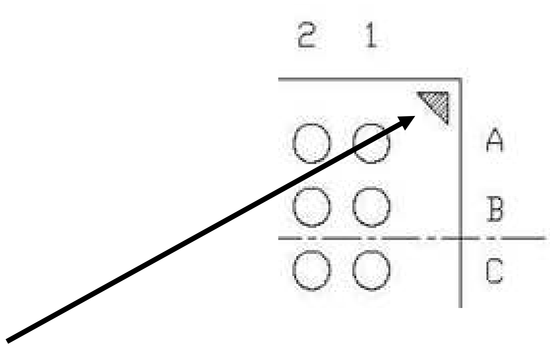
3.3 Topside Pin A1 Identification

The AES1610 package is fully symmetrical and thus there are no notches or other markings to signify pin A1 location when viewed from the top.

You can ensure that the sensor is mounted correctly by observing the asymmetrical drive bars visible on the sensor surface. This drive ring provides the TruePrint signal to the finger but also enables Pin A1 to be identified easily. This asymmetry is compatible with most vision-based inspection and pick & place equipment.

Pin A1 is located in the top left corner of the package when the thicker drive bar is located at the bottom of the sensor.



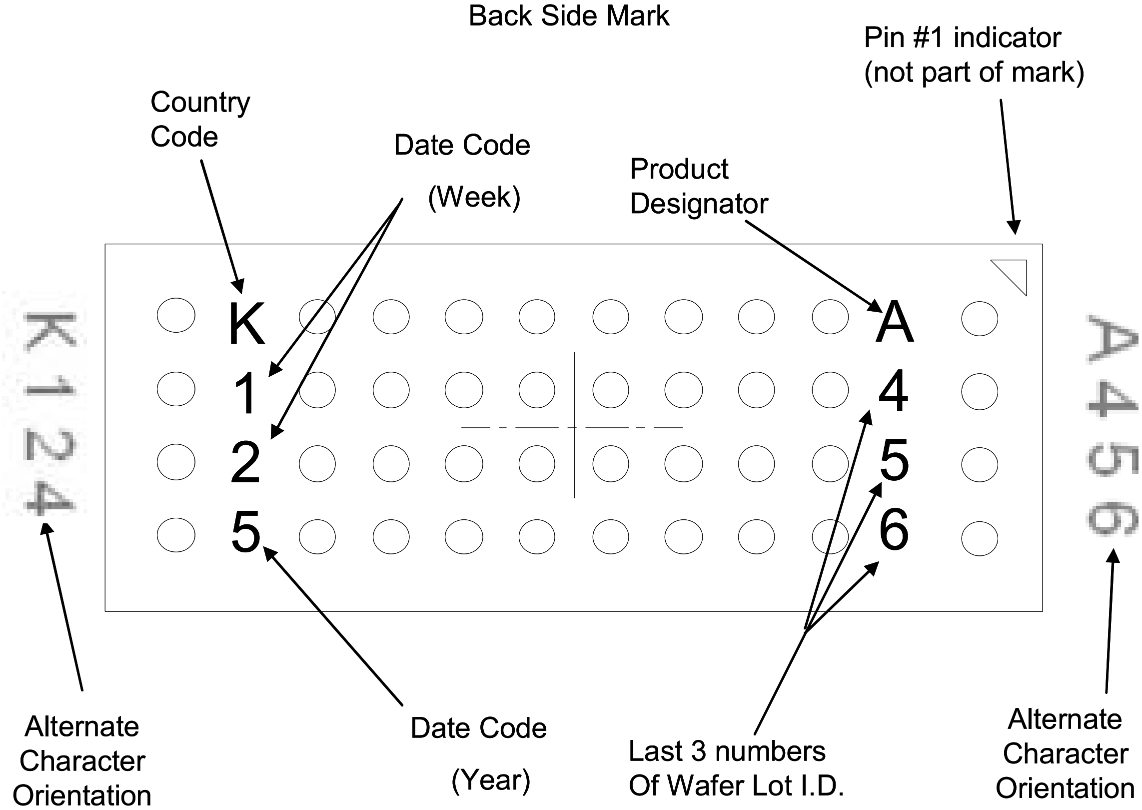


Backside Pin A1 is indicated by a single gold triangle in the corner of the package.

40 BGA eXtendaBall thick package mass: 0.20 grams
40 BGA eXtendaBall thin package mass: 0.10 grams

Labeling Diagram Document	Specification # PD-10005-004 Date: 05/09/2006
AuthenTec The Power of Touch	Package Type: 39 & 40 Exposed Die BGA
	Revision Extended Solder Ball, Bussless, Polyimide

Back Side Mark



Date Code Legend:
K = Country Code (U=USA, K=Korea, T=Taiwan, S= Singapore, C= China)
124 = Mold Week & Year (week 12, year 2005) (All 39/40BGAs are Pb-Free)
A = Product Designator
AA14565 = Wafer Lot I.D.

C: AES1510 Extended Solder Ball, Polyimide
D: AES1510 Extended Solder Ball

M: AES1610 Extended Solder Ball

Font Size: ~1 mm height
Ink Color: Laser Marking

3.4 Pin List by Interface

Pin assignments and pin function descriptions for the AES1610 sensor are shown below. The following pin list matches AuthenTec's certified reference designs.

Pin	Type	Digital Activity	Signal Name
A1	Input	Active	DRIVE_RING
A2	Power		VDDA
A3	Reserved		N/C
A4	Ground		VSS
A5	Passive	Static	PLL_FILTER
A6	Power		VDDA
A7	Input	Active	SF_MISO
A8	Output	Active	GPO2
A9	Output	Active	GPO1
A10	Ground		VSS
B1	Ground		VSS
B2	Input	Active	SYS_CLK
B3	Power		VDD
B4	Power		VDD
B5	Output	Active	VDDA_ON*
B6	Power		VDD
B7	I/O	Active	DPLUS
B8	I/O	Active	DMINUS
B9	Ground		VSS
B10	Output	Active	SF_MOSI
C1	Input	Static	VSSL
C2	Input	Static	SYSCLKSEL1
C3	Input	Static	SYSCLKSEL0
C4	Input	Static	VSSL
C5	Output	Active	GPO0
C6	Output	Active	SF_CS*
C7	Output	Active	ENUM
C8	Output	Active	SF_WP*
C9	Output	Active	SF_CLK
C10	Ground		VSS
D1	Output	Active	FDRV
D2	Power		VDDA
D3	Input	Active	RESET*
D4	Ground		VSS
D5	Input	Active	DRIVE_RING
D6	Passive		OVC_SENSE
D7	Power		OVC_VDDA
D8	Input	Static	VSSL
D9	Output	Active	OVC_DET
D10	Power		OVC_VDD

Pin List by Interface

3.5 Pin Type and Activity Definitions

Power:	VDD Power Supply Connections
Ground:	VSS Power Supply Connections
Passive:	Connections to passive components (ex: Filter caps, etc)
Input:	Active Inputs to the sensor
Output:	Active Outputs from the sensor
I/O:	Active I/O's from the sensor (state / configuration dependent)
Reserved:	Do Not Connect anything to these pins
Static:	DC or slowly changing voltages
Active:	Active Signals, Digital or Analog
VDDL:	Fixed Active High Logic Level
VSSL:	Fixed Active Low Logic Level
VDDA:	Pixel Array Power supply pin
VSSA:	Pixel Array Ground supply pin
N/C:	No Connection externally

3.6 Pin Descriptions (alphabetical listing)

Pin(s)	Signal Name	Function Description
B8	DMINUS	Negative half of differential USB signals
B7	DPLUS	Positive half of differential USB signals
A1	DRIVERING	Connection to the drive ring on the sensor
D5	DRIVERING	Connection to the drive ring on the sensor
C7	ENUM	Enumerates sensor to USB host by driving DPLS through a 1k resistor
D1	FDRV	TruePrint Signal Output used to drive TPRF signal though external circuitry to the finger drive bezel and on-sensor drive ring
C5	GPO0	General Purpose Output pins, used for debug or LED control
A9	GPO1	General Purpose Output pins, used for debug or LED control
A8	GPO2	General Purpose Output pins, used for debug or LED control
D9	OVC_DET	Over Current Detect Power Off output – Active low for power on. Refer to reference design schematics for detail.
D6	OVC_SENSE	Load side of current sense resistor input for over current control. Refer to reference design schematics for detail.
D10	OVC_VDD	Always-on power for Over Current protection circuit
D7	OVC_VDDA	Reference power supply rail for Over Current Protection circuit
A5	PLL_FILTER	Refer to USB Reference Design Schematic for appropriate filter components / connections
A3	Reserved	Reserved Pin – Do not connect
D3	RESET*	Sensor Reset Pin – Refer to Section 3.9
C9	SF_CLK	SPI clock pin to external serial flash ROM device
C6	SF_CS*	SPI chip select to external serial flash ROM device
B10	SF_MOSI	SPI data input to external serial flash ROM device
A7	SF_MISO	SPI data output from external serial flash ROM device
C8	SF_WP*	Write Protect input to external serial flash ROM device
B2	SYS_CLK	System Clock Input – Refer to Section 3.7
C3	SYSCLKSEL0	Selects between available clock frequencies or external clock. Refer to section 3.7
C2	SYSCLKSEL1	Selects between available clock frequencies or external clock. Refer to section 3.7
B3,B4,B6	VDD	Digital Power
A2,A6,D2	VDDA	Analog Power
B5	VDDA_ON*	Controls power to analog circuitry. Used as FET gate input on VDDA
A4,A10,B1, B9,C10,D4	VSS	Ground
C1,C4,D8	VSSL	Logic Low Input

AES1610 Active Pin Functional Description

3.7 Clock Select Control

AES1610 supports clock sources of either 6MHz or 12MHz. The AES1610 uses a single pin crystal/resonator oscillator circuit that can also be overdriven with an external clock source capable of driving >+/-5mA.

Clock frequency selection [including clocks driven into the SYS_CLK pin (Pin B2) is done via the SYSCLKSEL[1:0] input pins. The following table shows the SYSCLKSEL[1:0] pin configurations:

SYSCLKSEL[1:0] Pins C2:C3	Crystal/Resonator or Clock Frequency Ranges
00	6 MHz (nominal)
01	12 MHz (nominal)
10	Reserved
11	Reserved

SYSCLKSEL Decode

3.8 Low-Power Oscillator

The Low-Power Oscillator (LPO) is an internal oscillator circuit which produces a low frequency, low power clock signal for clocking sensor timers when suspended. This enables the sensor to turn off the higher frequency clock domains, the 12MHz oscillator, and the PLL. The LPO has a nominal frequency of 20KHz with a range from 10KHz to 40KHz. The AES1610 automatically determines the LPO frequency at power-up and continually while in suspend.

3.9 AES1610 Start-up

The RESET* pin is active low and has an internal pull-up resistor that is nominally 57K ohms with approximately 25% tolerance. This pin can generate a power-on reset for the sensor by adding a capacitor to ground. The capacitor must be selected so that the power on reset time constant is larger than the power supply ramp time plus the clock ramp time. Alternatively, though specifically not recommended, RESET* may be driven by the host directly, with the same requirement that it be held low during the power supply ramp time and the clock ramp time and only released after the allocated start-up time.

3.9.1 Crystal or Resonator Clocking

When a crystal or resonator is connected to the SYS_CLK pin, the clock start-up time is dependant upon the crystal or resonator. The load capacitance on SYS_CLK and the characteristics of the crystal or resonator will determine this start-up time. It is important to use the component values with similar crystal performance characteristics specified in the AuthenTec reference design. This is provided in documents which are part of the AuthenTec RDK.

AuthenTec's reference design, has an allocation for oscillator start-up time of 8.4ms. In this case, RESET* can be released a minimum of 8.4ms after Vdd reaches 3.0V.

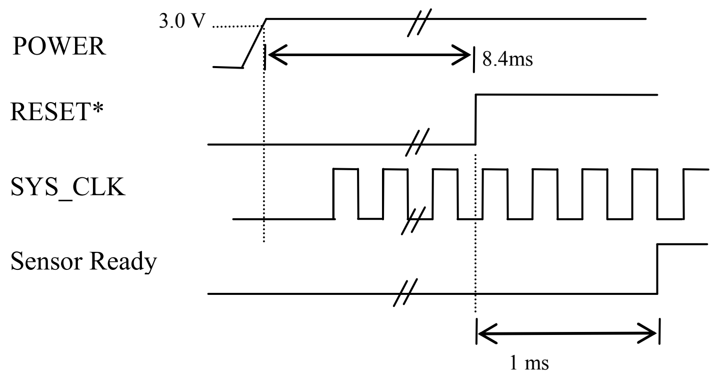


Figure 3-1 Start-Up with Crystal or Resonator

When using Power On Reset controlled by capacitor RC control, the sensor RESET_n input RC time constant must be calculated. It is very important to determine the minimum time that the RESET_n will be held active, as the clock must have completed its startup when RESET_n goes inactive. The RC time constant begins from the moment of power is turned on. However, the Power On Reset time must be larger than the power supply ramp time plus the clock startup time. This is to prevent slow power supply ramp times from affecting proper clock startup timing.

For example, assume the maximum power supply ramp time to minimum operating voltage is 400μs and the clock startup time to 1 Vpp is 8 milliseconds maximum. Using a 0.22μF capacitor, at minimum value from the 10% tolerance, with the minimum possible internal pullup resistor value, yields the following minimum timing for RESET_n going inactive.

$$T_{min} = R_{min} * C_{min} = 42.8K * \sim 0.198\mu F = \sim 8.4 \text{ milliseconds.}$$

This equation can be used since the RESET_n threshold value is 70%VDD, roughly equivalent to one time constant.

One millisecond after reset is released the sensor will be ready for transactions. During this time the internal Phase Lock Loop will lock on the oscillator frequency.

4 Interface Descriptions

4.1 Interfaces

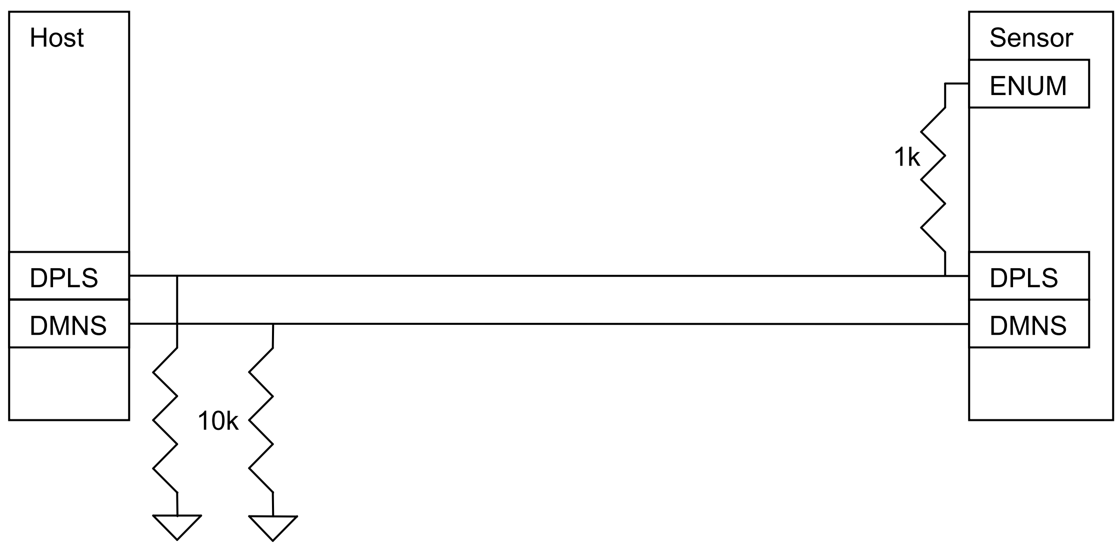
4.1.1 USB Interface

The USB interface of the AES1610 is USB2.0 Full Speed compliant. ESD recovery is employed that is designed to respond to loss of USB communication and latch-up events

The USB interface consists of the following pins:

SIO/ Pin	Name	Direction	Description
0 / B7	DPLS	I/O	Positive side of differential signaling
1 / B8	DMNS	I/O	Negative side of differential signalling
2 / C7	ENUM	O	Signals presence of sensor to USB host

SIO Pin Definitions USB Interface



USB Interface

The USB descriptors for AES1610 are provided in the tables below.

Field	Index	Value	Meaning
bLength	0	12h	Length of this descriptor = 18 bytes
bDescriptorType	1	01h	Descriptor Type = Device
bcdUSB(L)	2	10h	USB spec. version 1.10 (L)
bcdUSB(H)	3	01h	USB spec. version 1.10 (H)
bDeviceClass	4	FFh	Device class (FF is vendor specific)
bDeviceSubClass	5	FFh	Device sub-class (FF is vendor specific)
bDeviceProtocol	6	FFh	Device Protocol (FF is vendor specific)
bMaxPacketSize0	7	08h	Max Packet size for EP0 = 8 bytes
idVendor(L)	8	FFh	Vendor ID (L)
idVendor(H)	9	08h	Vendor ID (H)
idProduct(L)	10	00h	Product ID low byte
idProduct(H)	11	16h	Product ID high byte
bcdDevice(L)	12	Chip ID	Device ID (L)
bcdDevice(H)	13	Mask Rev	Device ID (H)
iManufacturer	14	00h	None
iProduct	15	01h	Product String – "Fingerprint Sensor"
iSerialNumber	16	00h	None
bNumConfigurations	17	01h	One configuration in this interface

Device Descriptor

Field	Index	Value	Meaning
bLength	0	09h	Length of this descriptor = 9 bytes
bDescriptorType	1	02h	Type = Configuration
wTotalLength(L)	2	20h	Total Length(L) including Interface and Endpoint descriptors
wTotalLength(H)	3	00h	
bNumInterfaces	4	01h	Number of interfaces in this configuration
bConfigurationValue	5	01h	Configuration value used by Set_Configuration to select this interface
iConfiguration	6	00h	00h = no string reference
bmAttributes	7	A0h	A0h, Attributes: bus-powered, remote wake-up supported
MaxPower	8	32h	Max current =100mA

Default Configuration Descriptor

Field	Index	Value	Meaning
bLength	0	09h	Length of the Interface descriptor = 9 bytes
bDescriptorType	1	04h	Descriptor type = interface
bInterfaceNumber	2	00h	Zero based index of this interface = 0
bAlternateSetting	3	00h	Alternate setting =0
bNumEndpoints	4	02h	Number of endpoints in this interface (not counting endpoint0)
bInterfaceClass	5	FFh	Interface Class = vendor specific
bInterfaceSubClass	6	FFh	Interface Sub Class = vendor specific
bInterfaceProtocol	7	FFh	Interface Protocol = vendor specific
iInterface	8	00h	Index to string descriptor = none

Default Interface 0, Alternate Setting 0 Descriptor

Field	Index	Value	Meaning
bLength	0	07h	Descriptor length = 7 bytes long
bDescriptorType	1	05h	ENDPOINT descriptor
bEndpointAddress	2	81h	In endpoint, endpoint #1
bmAttributes	3	02	xfr type = Bulk
wMaxPacketSize(L)	4	20h	Max Packet Size = 32 bytes
wMaxPacketSize(H)	5	00h	
bInterval	6	00h	Polling interval in milliseconds
Field		Value	Meaning
bLength	0	07h	Descriptor length = 7 bytes long
bDescriptorType	1	05h	ENDPOINT descriptor
bEndpointAddress	2	02h	Out endpoint, endpoint #2
bmAttributes	3	02h	xfr type = Bulk
wMaxPacketSize(L)	4	08h	Max Packet Size = 8 bytes
wMaxPacketSize(H)	5	00h	
bInterval	6	00h	Polling interval in milliseconds

Default Interface 0, Alternate Setting 0, Bulk Endpoint Descriptors

Field	Index	Value	Meaning
bLength	0	04h	String Index 0
bDescriptorType	1	03h	String descriptor type
wLANGID(0)(L)	2	09h	Language ID for English (L)
wLANGID(1)(H)	3	04h	Language ID for English (H)

String 0 Descriptor

Field	Index	Value	Meaning
bLength	0	26h	String Index 1
bDescriptorType	1	03h	String descriptor type
bString	2	4600h	“Fingerprint Sensor” – in UNICODE format “F”
	4	6900h	“i”, 00
	6	6E00h	“n”, 00
	8	6700h	“g”, 00
	10	6500h	“e”, 00
	12	7200h	“r”, 00
	14	7000h	“p”, 00
	16	7200h	“r”, 00
	18	6900h	“i”, 00
	20	6E00h	“n”, 00
	22	7400h	“t”, 00
	24	2000h	“ “, 00
	26	5300h	“S”, 00
	28	6500h	“e”, 00
	30	6E00h	“n”, 00
	32	7300h	“s”, 00
	34	6F00h	“o”, 00
	36	7200h	“r”, 00

String 1 Descriptor

4.1.2 Serial Flash Interface

The Serial Flash Interface on AES1610 provides a means of attaching a flash device to the sensor for access by the host through the sensor's USB interface. The ROM is intended to facilitate pre-boot authentication applications. The Serial Flash ROM Interface of the AES1610 follows standard 4-pin SPI protocol. There is a fifth pin commonly used as "Write Protect" on standard flash parts. This pin is typically used to protect the flash device from being written to. This is particularly useful when the host is issuing commands to determine what type of flash is connected to the AES1610, as one flash's READ_ID command may be another's ERASE command.

The AES1610 acts as a pass-through for communication from the host to the serial ROM device. For communication from the serial flash device to the host, the AES1610 is programmed to fetch a certain number of bytes from the flash and send those bytes to the host. The AES1610 utilizes its 512 byte frame buffer to create large transfers from the flash, to the host. The AES1610 can also be programmed to sign data from the flash device using the same authentication mechanisms available for signing image data.

AuthenTec maintains a list of certified suppliers of the serial flash which the AuthenTec software will work with. Consult AuthenTec applications, sales, or your local representative to get the latest information.

4.1.3 General Purpose Outputs

The AES1610 has three General Purpose Output pins, GPO[2:0]. The GPO[2} pin is defaulted to output the status of the internal USB_SUSPEND signal. The GPO[1] pin is defaulted to output the status of the internal USB_OE* signal. These defaults are provided as a means of sensor debug as well as useful status to the host if desired. GPO[0] has no default setting, therefore during sensor debug it will remain on its selected signal though a RESET* assertion. The host should take care to program GPO[0] to a valid selection prior to entering a low-power state.

The three GPO pins can be utilized by the system to provide either sensor status or drive LEDs.

5 Data Formats

5.1 Overview

The sensor communicates with the host via data packets. A data packet is considered a set of messages returned by the sensor in response to a command. The data packet includes an image data message, histogram message, authentication message, and a register message. Each message is preceded by a 1-byte message header for data synchronization. Note that since the pixel data formats use all 8-bits per byte, the header bytes are not unique in the data stream.

5.2 Image Data Message Format

The image data formats use all 8-bits per byte. The header for the frame is sent first, followed by each column vector sent as binary packed (1-byte), gray scale 2-bit per pixel (2-bytes), or gray scale 4-bit per pixel (4-bytes) image data message formats.

5.3 Histogram Message Format

When the histogram message is enabled, the histogram is returned once per image. The histogram message is preceded by a header byte. The header is followed by the counts for each of the bins representing possible pixel values. Bin 0 (the number of pixels whose value is 0) is sent first. This is followed by the counts for the remaining bins. The maximum value in any bin will be 128.

5.4 Authentication Message Format

The authentication word is sent after an image is complete. The authentication word message is preceded by a header byte. The authentication word is used to validate that the transaction is authentic (i.e. that the image data isn't merely being provided from some storage device containing a valid fingerprint image).

5.5 Registers Message Format

When a request to read registers is received, all of the register values are returned preceded by the address for that register. Unused or reserved register bits are always read as 0. Registers are written to by writing the register address followed by the data byte.

5.6 Flash ROM Data Format

When data is read from the flash, the AES1610 will prefix the data with a two-byte header.

6 Image Acquisition

The sensor array is composed of 128 x 8 pixels. The sensor communicates with the host processor via data packets. A data packet is a set of messages returned by the sensor in response to a command. The data packet includes an image data message, histogram message, authentication message, and a register message. Each message is preceded by a 1-byte message header for data synchronization.

7 Navigation

For accurate cursor placement, the AES1610 has implemented an on-chip navigation timing engine. By accurately timing a set of captured images, accurate dx/dy motions can be calculated over a broad range of finger motions. The dx/dy calculations are performed in software. When the sensor is in navigation mode, the sensor returns very small navigation data packets to the host for processing. The AES1610 supports menu scrolling, single and double taps, multi-finger speed dialing, and gaming quality navigation.

8 Power Management

Two methods exist for further reducing power consumption and extending battery life.

- Using the externally driven clock. Please refer to section 3.5.
- Reducing the swipe speed. Swipe speed is variable in software from 20cm/s – 30cm/s. Please refer to table 2.3.

9 Part Numbering Scheme

AES1610 – I – PP – CC – DDEE : 3.0 - 3.6V I/O

<u>I = Temperature Range</u>
C = Commercial temperature range = 0C to 70C

*Note: All package balls are lead-free.

<u>PP = Packaging Options</u>
DF = 40 BGA Thick (1.96mm) eXtendaBall package
FF = 40 BGA Thin (1.34mm) eXtendaBall package

<u>CC = Carrier Options</u>
CA = Plastic Carrier Trays with 245 sensors per tray
TR = Tape & Reel w/ 3000 sensors per reel (thick package) and 3500 sensors per reel (thin package)
SB = 10 unit sample pack (thick gold only)

<u>DD = Drive Ring Options:</u>
GO = Gold
NI = Nickel

<u>EE = Options</u>
00 = Silicon revision code in 1610 series*

* Contact AuthenTec Sales for current revision code.

Example: AES1610 with Thick eXtendaBall BGA package, Gold ring, shipped as tape reels:
AES1610-C-DF-TR-GO00

10 Hazardous Material Compliance

The AuthenTec AES1610 is manufactured to be in compliance with various world wide standards specifying the elimination of hazardous substances.

The silicon IC as well as the physical packaging and associated bezel are Lead (Pb) free and do not contain any of the hazardous substances currently being eliminated within the semiconductor industry.

The AES1610 is EU RoHS compliant.

11 Revision History

Version	Date	Person	Reason
1.0	12/20/05	Hicks	Preliminary Specification
1.1	02/10/06	Hicks	Modified section 3.8 to specify a range for load capacitance.
1.2	03/23/06	Hicks	Removed the thin package
1.3	04/12/06	Lee	Added PinA1, Text Updates, Formatting
1.4	05/22/06	Hicks	Added eXtendaBall packages and product mass, corrected the number of units/tray
1.5	06/05/06	Hicks	Updated the 40 BGA eXtendaBall drawing, added the backside laser part marking
1.6	07/10/06	Hicks	Added recommended PCB footprint, changed the navigation current consumption
1.7	02/09/07	Hicks	Corrected the “SB” carrier option, removed * from the OVC_DET signal, removed the standard package, modified the clock startup section

AuthenTec welcomes your suggestions. We try to make our publications useful, interesting, and informative, and we hope you will take the time to help us improve them. Please send any comments or suggestions by mail or e-mail.

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EntréPad AES1610 Slide Sensor Data Sheet

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