AS7056

Datasheet

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AS7056 Biosignal converting unit

1 General description

The AS7056 Biosignal Sensor Analog Frontend (AFE) is the next generation Vital Sign Sensor in the ams OSRAM product family. It enables the user to detect biosignals such as photoplethysmogram (PPG) and pulse transit time (PTT), as well as proximity. PPG is the most used HRM method. It measures the pulse rate - by sampling light modulated by the blood vessels, which expand and contract as blood pulses through them. Apart from HRM/HRV, optical blood pressure and SpO2 are also enabled by the two independent working photodiode inputs of the AS7056. The AS7056 is a size and performances optimized Analog Frontend to support space-limited applications such as in-ear vital sign monitoring as well as ring applications.

The AS7056 provides two LEDs and one VCSEL driver outputs, samples up to three photodiode inputs, and supports proximity detection integrated into one of the PPG signal channels. This enables high flexibility for several LED and photodiode arrangements in different applications. Furthermore, the AS7056 Biosignal Sensor Analog Frontend provides two ADC channels for simultaneous PPG measurements and an automatic photodiode offset control.

The AS7056's low-power design and small form factor are particularly well-suited for application in earbuds, fitness bands, smartwatches, sports watches, and smart patches. In these cases, board space is limited, and users look for extended, multi-day intervals between battery recharges. A thin package dimension makes the AS7056 suitable for height-constrained solutions like earbuds.

1.1 Key benefits & features

The benefits and features of AS7056, Biosignal converting unit are listed below:

Table 1: Added value of using AS7056

Benefits	Features
Flexible LED/photodiode configuration.	2 LED + 1 VCSEL driver and 3 photodiode input pins.
Allows smallest application size, e.g. in-ear vital sign monitoring	Small Wafer-Level-Chip-Scale-Package (WLCSP).
Enables optical blood pressure measurements.	Two synchronized PPG acquisition channels.

Benefits	Features
Enables proximity detection for additional energy savings	Two independent, programmable sequence blocks inside the PPG signal acquisition.
Good HRM measurement quality.	Low noise analog optical front-end.
Long operating time.	Hardware sequencer to offload processor. Adjustable LED driver with current control.

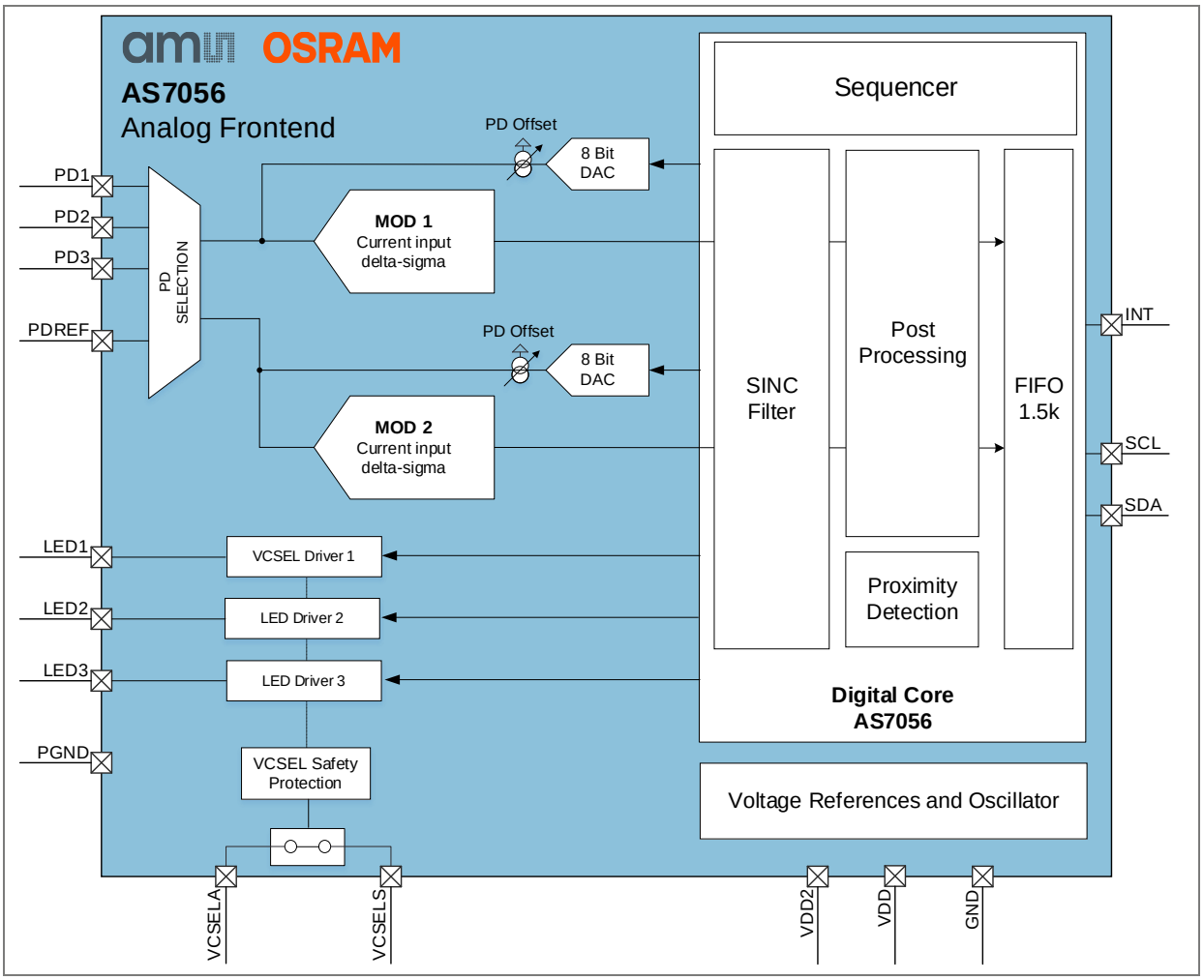
1.2 Applications

- Earbuds
- Hearables
- Optical sensor platform
- Fitness band
- Smart watch
- Smart patches
- Smart rings
- Heart rate monitor
- Cuff-less optical blood pressure measurements

1.3 Block diagram

The functional blocks of this device are shown below:

Figure 1: Functional blocks of AS7056



2 Ordering information

Ordering code	Description	Package	Delivery form	Delivery quantity
Q65114A1331	AS7056 without ams OSRAM algorithm support	WLCSP	Tape & Reel	500 pcs/reel
Q65114A1333	AS7056 without ams OSRAM algorithm support	WLCSP	Tape & Reel	10000 pcs/reel
Q65114A2980	AS7056A with ams OSRAM algorithm support	WLCSP	Tape & Reel	500 pcs/reel
Q65114A2984	AS7056A with ams OSRAM algorithm support	WLCSP	Tape & Reel	10000 pcs/reel

3 Absolute maximum ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated under “Operating Conditions” is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 2: Absolute maximum ratings of AS7056

Symbol	Parameter	Min	Max	Unit	Comments
Electrical Parameters					
V_{VDD_MAX}	Positive supply voltage	-0.3	1.98	V	VDD to VSS
V_{VDD2_MAX}	Analog supply voltage	-0.3	1.98	V	VDD2 to VSS
V_{VCSELS_MAX}	VCSELS supply voltage	-0.3	5.5	V	VCSELS to AGND
V_{VCSELA_MAX}	VCSELA pin voltage	-0.3	5.5	V	VCSELA to AGND
$V_{VCSELA-VCSELS}$	Voltage difference between pins VCSELA and VCSELS	-0.3	0.3	V	Internal diode to V_{VCSELS}
V_{LED_MAX}	LED pin voltage	-0.3	5.5	V	Applicable to pins LED1, LED2 and LED3
$V_{IN\_MAX\_MAX}$	Maximum analog and digital input voltage	-0.3	V_{VDD}+0.3 V max. 1.98 V	V	Applicable to pins PD1, PD2, PD3, SDA and SCL. Internal ESDD protection diode to VDD pin present on analog and digital input pins.
$V_{GND-PGND}$	Power to analog ground voltage difference	-0.3	0.3	V	
$I_{LED\_AVER\_}$	Average LED ON current		35	mA	DC current with all LEDs ON during all 8 time slots
I_{SCR}	Input current (latch-up immunity)	± 100		mA	JEDEC JESD78E
Electrostatic Discharge					
ESD_{HBM}	Electrostatic discharge HBM	± 2		kV	JS-001-2017
ESD_{CDM}	Electrostatic discharge CDM	± 500		V	JS-001-2017
Temperature Ranges and Storage Conditions					
T_{AMB}	Operating ambient temperature	-30	85	°C	
T_{STRG}	Storage temperature range	-40	125	°C	
T_{BODY}	Package body temperature		260	°C	IPC/JEDEC J-STD-020 (1)
RH_{NC}	Relative humidity (non-condensing)	5	85	%	
MSL	Moisture sensitivity level	1			According to JEDEC J-STD-020E Represents a max. floor life time of unlimited

Symbol	Parameter	Min	Max	Unit	Comments
$t_{STRG\ DOF}$	Storage time for DOF/Die or wafers on foil		3	months	Refers to indicated date of packing

(1) The reflow peak soldering temperature (body temperature) is specified according to IPC/JEDEC J-STD-020 “Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices.” The lead finish for Pb-free leaded packages is “Matte Tin” (100 % Sn)

4 Electrical characteristics

All limits are guaranteed. The parameters with Min and Max values are guaranteed with production tests or SQC (Statistical Quality Control) methods.

Conditions: T_A = 25 °C, V_{VDD} = 1.8 V; V_{VDD2} = 1.8 V

Table 3: Electrical characteristics of AS7056

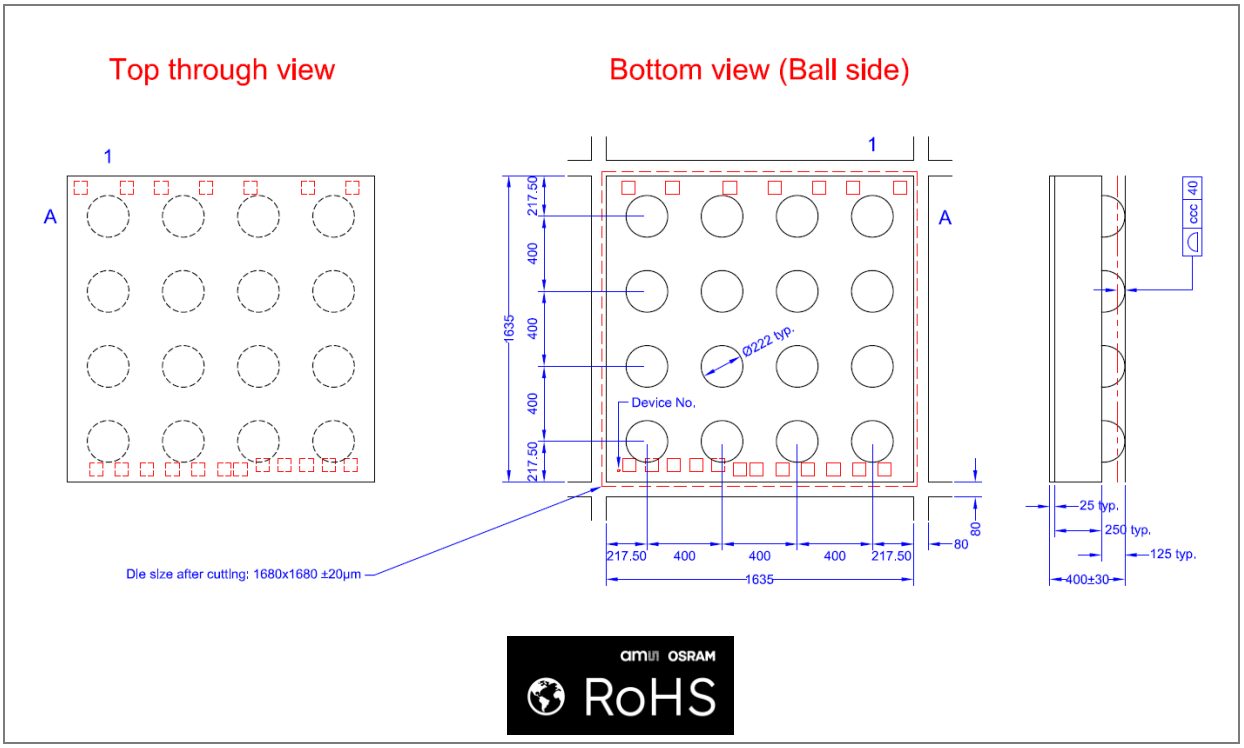
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{VDD}	Supply voltage VDD pin		1.70	1.80	1.98	V
V_{VDD2}	Supply voltage VDD2 pin		1.70	1.80	1.98	V
V_{VCSELS}	VCSELS supply voltage	Voltage must not be below V_{AVDD}	1.75		5.50	V
Photodiode Inputs						
C_{PD}	Total photodiode capacitance connected to MOD1 or MOD2	0 V reverse voltage			300	pF
I_{PD}	Photocurrent input				64	µA
MOD1 & MOD2 (PPG Channels)						
I_{PD}	Photodiode input current range	Configurable ADC input full scale current range via register **MODx_SEQx_IREF** with 1µA step size	1		64	µA
MOD_{RES}	ADC resolutions of MOD1 and MOD2			20		bit
f_{MOD_SAMPL}	Typical Modulator sampling frequency		0.5	25	1000	Hz

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
C_{PD}	Total photodiode capacitance connected to PPG_ADC	0 V reserve voltage		60	300	pF
MOD_{DAC_OFF}	DAC ambient light cancellation offset current full-scale range for MOD1 or MOD2	**MODx_IOS_FS** = 0		1		µA
		MODx_IOS_FS = 1		2		
		MODx_IOS_FS = 2		4		
		MODx_IOS_FS = 3		8		
		MODx_IOS_FS = 4		16		
		MODx_IOS_FS = 5		32		
		MODx_IOS_FS = 6		64		
		MODx_IOS_FS = 7		128		
LED / VCSEL Driver						
LED_{RES23}	LED driver resolution	Applicable to LED2 and LED3 driver		7		Bit
LED_{RES1}	LED driver resolution	Applicable to VCSEL LED1 driver		6		Bit
I_{RANGE1}	LED1 current range			20		mA
V_{COMP_LED1}	LED1 driver compliance voltage	I_{LED}=20mA			0.3	V
$I_{RANGE23}$	LED2 and LED3 current range			200		mA
V_{COMP_LED23}	LED1 and LED2 driver compliance voltage	I_{LED}=200mA			0.4	V
Digital Input SCL and SDA						
V_{IH}	Input high	Switching threshold while rising edge of the input signal is introduced	0.54		1.26	V
V_{IL}	Input low	Switching threshold while falling edge of the input signal is introduced	0.54		1.26	V
Digital Output SDA						
V_{OH}	Output high	Pin's source load current is 6 mA condition: E2=E4="1" (full available driver strength)			V_{VDD}-0.4	V
V_{OL}	Output low	Pin's sink load current is 6 mA condition: E2=E4="1" (full available driver strength)			0.4	V

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Digital Output INT						
V_{OH}	Output high	Pin's source load current is 2 mA condition: E2=E4="1" (full available driver strength)			V_{VDD}-0.4	V
V_{OL}	Output low	Pin's sink load current is 2 mA condition: E2=E4="1" (full available driver strength)			0.4	V

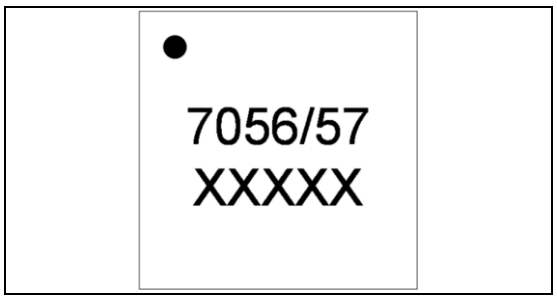
5 Package drawings & markings

Figure 2: WLCSP package outline drawing



(1) All dimensions are in millimeters. Angles in degrees.
(2) Dimensioning and tolerancing conform to ASME Y14.5M-1994.
(3) This package contains no lead (Pb).
(4) This drawing is subject to change without notice.

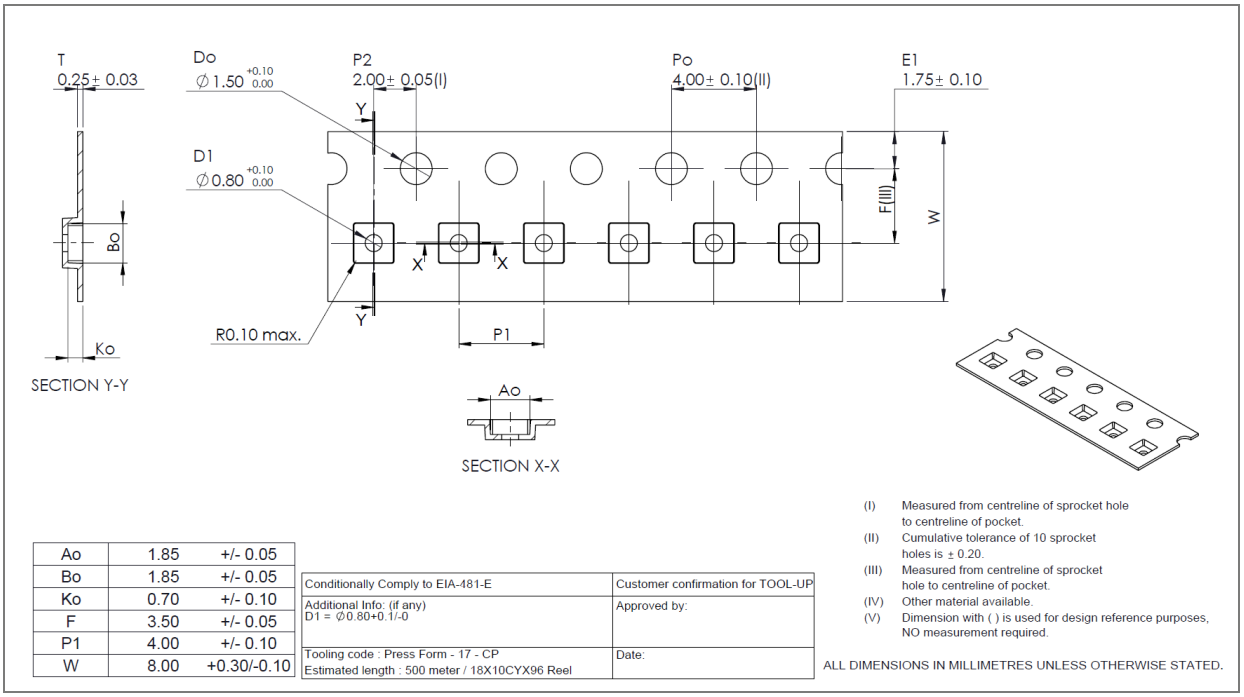
Figure 3: AS7056/57 package marking/code



xxxxx Tracecode

6 Tape & reel information

Figure 4: AS7056 tape dimensions



Ao	1.85	+/- 0.05
Bo	1.85	+/- 0.05
Ko	0.70	+/- 0.10
F	3.50	+/- 0.05
P1	4.00	+/- 0.10
W	8.00	+0.30/-0.10

Conditionally Comply to EIA-481-E	Customer confirmation for TOOL-UP
Additional Info: (if any) D1 = ∅0.80+0.1/-0	Approved by:
Tooling code : Press Form - 17 - CP Estimated length : 500 meter / 18X10CYX96 Reel	Date:

(I) Measured from centreline of sprocket hole to centreline of pocket.
(II) Cumulative tolerance of 10 sprocket holes is ± 0.20.
(III) Measured from centreline of sprocket hole to centreline of pocket.
(IV) Other material available.
(V) Dimension with ( ) is used for design reference purposes, NO measurement required.

ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.

7 Revision information

Document status	Product status	Definition
Product Preview	Pre-development	Information in this datasheet is based on product ideas in the planning phase of development. All specifications are design goals without any warranty and are subject to change without notice
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Changes from previous released version to current revision v5-00	Page
Updated Figure 1	5

- Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.
- Correction of typographical errors is not explicitly mentioned.

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