Datasheet

DS001053

AS7057

Biosignal Converting Unit

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Content Guide

1 General Description

The AS7057 Biosignal Sensor Analog Frontend (AFE) is the next generation Vital Sign Sensor. 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 SpO_2 are also enabled by the two independent working photodiode inputs of the AS7057. The AS7057 is a size and performance optimized analog frontend to support space-limited applications such as in-ear vital sign monitoring.

The AS7057 provides three LED 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 AS7057 Biosignal Sensor Analog Frontend provides two ADC channels for simultaneous PPG measurements and an automatic photodiode offset control.

The AS7057'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 AS7057 suitable for height-constrained solutions like earbuds.

1.1 Key Benefits & Features

The benefits and features of the AS7057 Biosignal Converting Unit are listed below:

Figure 1:
Added Value of Using AS7057

Benefits	Features
Flexible LED/photodiode configuration.	Three LED drivers and three photodiode input pins.
Allows the 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.
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 frontend.
Long operating time.	Hardware sequencer to offload processor. Adjustable LED driver with current control.

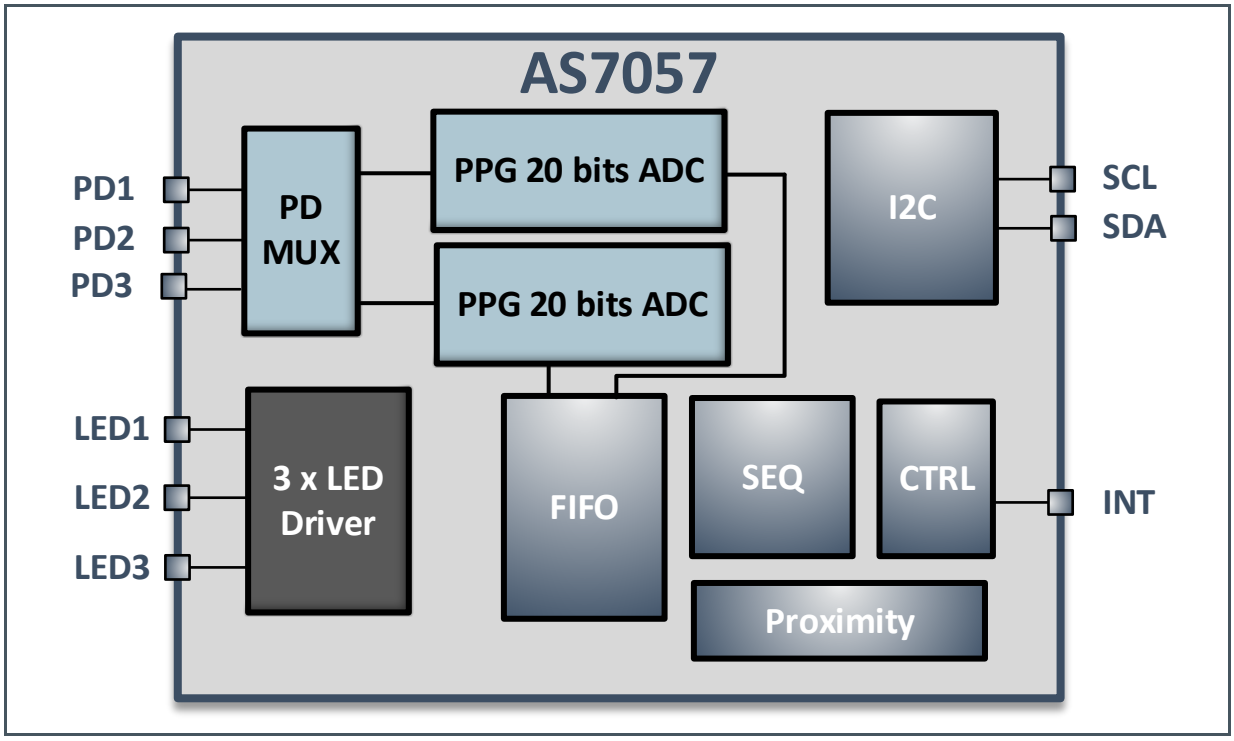
1.2 Applications

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

1.3 Block Diagram

The diagram below shows the functional blocks of this device:

Figure 2:
Functional Blocks of AS7057



2 Ordering Information

Ordering Code	Package	Marking	Delivery Form	Delivery Quantity
AS7057-BWLM	WLCSP	n.a.	Tape & Reel	500 pcs/reel
AS7057-BWLT	WLCSP	n.a.	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.

Figure 3
Absolute Maximum Ratings of AS7057

Symbol	Parameter	Min	Max	Unit	Comments
Electrical Parameters					
V_{DD}	Supply Voltage		1.98	V	
V_{IN}	Input Pin Voltage to Ground pins	-0.3	V_{DD+}0.3V max. 1.98 V	V	Internal diode to V_{DD}
V_{LED}	Voltage at Driver	-0.3	5.5	V	
$V_{GND-PGND}$	Analog to Power Ground Voltage Difference		±0.3	V	
I_{SCR}	Input Current (latch-up immunity)		±100	mA	Norm: JEDEC JESD78 Connect the specified capacitor on PDREF during latch-up test.
I_{LEDON}	Average LED ON Current		90	mA	DC current with all LEDs ON during all 8 time slots
Electrostatic Discharge					
ESD_{HBM}	Electrostatic Discharge HBM		±2.0	kV	JS-001-2017
Temperature Ranges and Storage Conditions					
T_{STRG}	Storage Temperature Range	-40	125	°C	JESD22-A103
T_{AMB}	Operating Free-air Temperature	-30	85	°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		Maximum floor life time unlimited @ 30°C/85% RH_{max}

(1) The reflow peak soldering temperature (body temperature) is specified according to IPC/JEDEC J-STD-020 “Moisture/Reflow Sensitivity Classification for Non-hermetic Solid State Surface Mount Devices.”

4 Electrical Characteristics

All limits are guaranteed at an ambient temperature of 25 °C. The parameters with Min and Max values are guaranteed with production tests or SQC (Statistical Quality Control) methods.

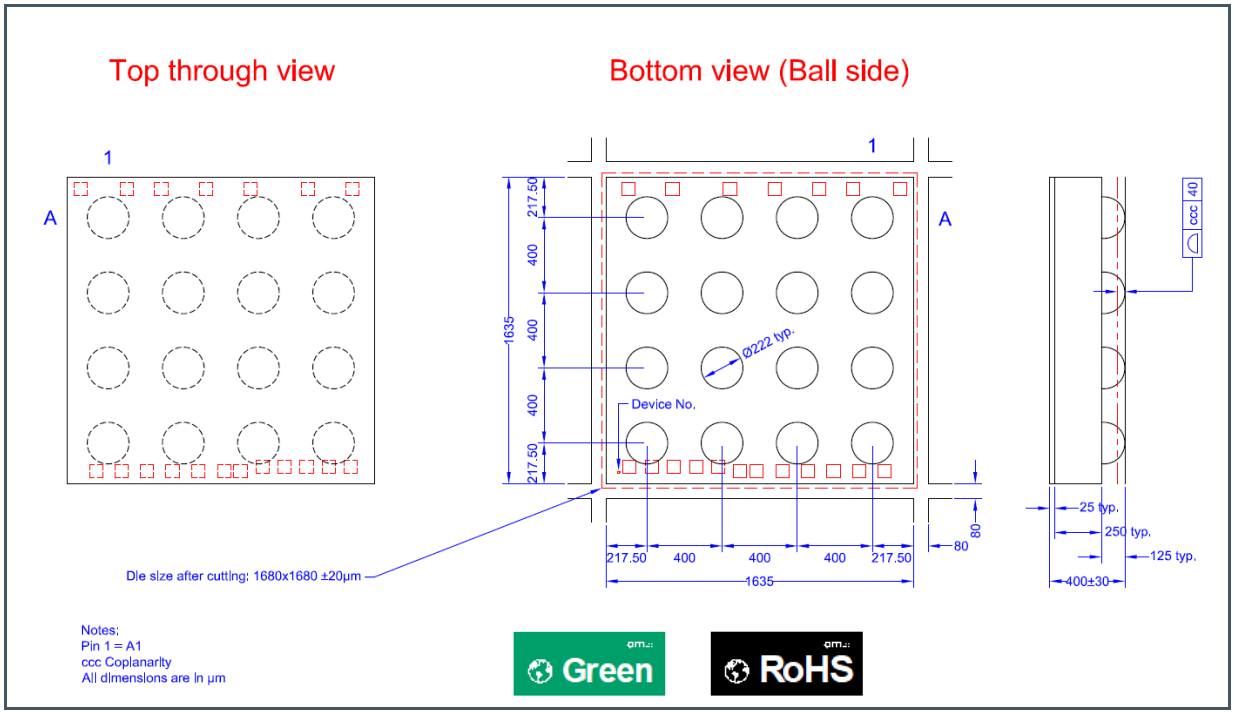
Figure 4:
Electrical Characteristics of AS7057

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DD}	Supply voltage		1.7	1.8	1.98	V
I_{VDD}	Supply current in power down mode			1.1		µA
	Supply current in idle mode			2.92		µA
	Supply current PPG ADC active	One subsample, one modulator @25 SpS; enabled Stand-by Mode		10	60	µA
$f_{Sampling}$	Sampling frequency		0.5	25	1000	Hz
Photodiode						
I_{OS}	DAC offset current full scale range	FSR 0		1		µA
		FSR 1		2		
		FSR 2		4		
		FSR 3		8		
		FSR 4		16		
		FSR 5		32		
		FSR 6		64		
		FSR 7		128		
C_{PD}	Total photodiode capacitance connected to PPG_ADC	0 V reserve voltage		60	300	pF
I_{PD}	Photo current input	(∑ signal range 1 µA-64 µA)	0		64	µA
LED Driver						
V_{LED}	LED pad voltage				5	V
LED Driver 1-3						
I_{LED}	Allowed operating LED output current			200.00		mA

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{Compl}	Compliance voltage				0.3	V

5 Package Drawings & Markings

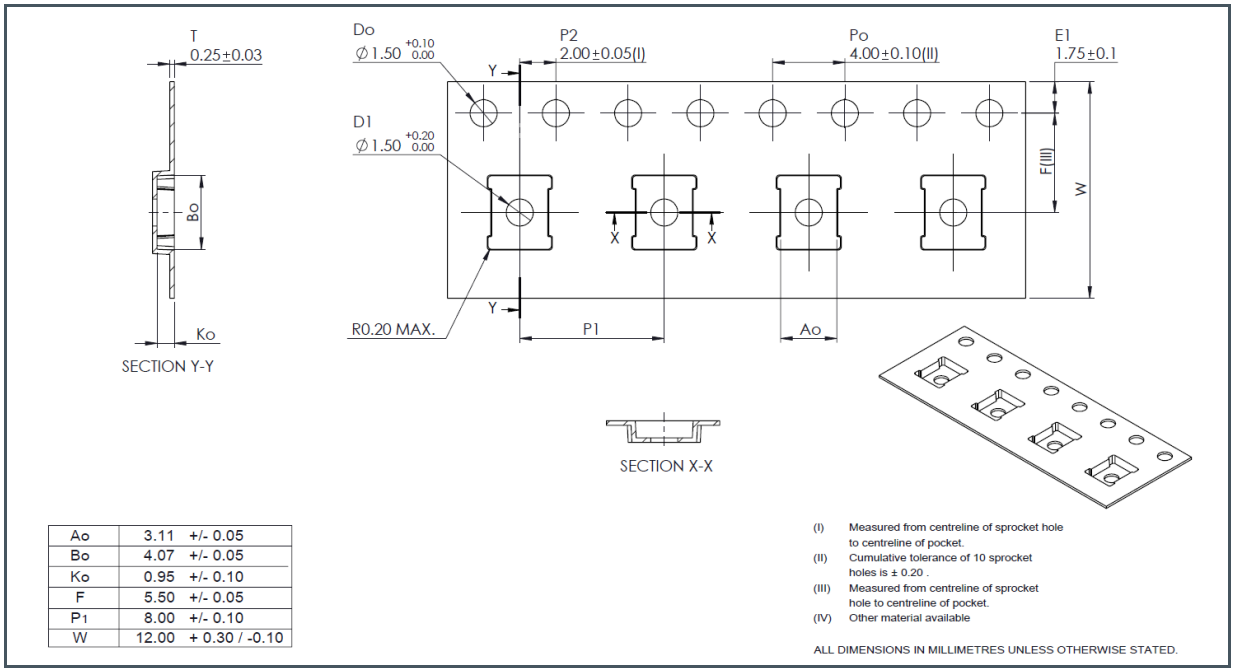
Figure 5:
WLCSP Package Outline Drawing



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

6 Tape & Reel Information

Figure 6:
Tape Dimensions



Ao	3.11 +/- 0.05
Bo	4.07 +/- 0.05
Ko	0.95 +/- 0.10
F	5.50 +/- 0.05
P1	8.00 +/- 0.10
W	12.00 + 0.30 / -0.10

(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

ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.

7 Soldering & Storage Information

Figure 7:
Solder Reflow Profile Graph

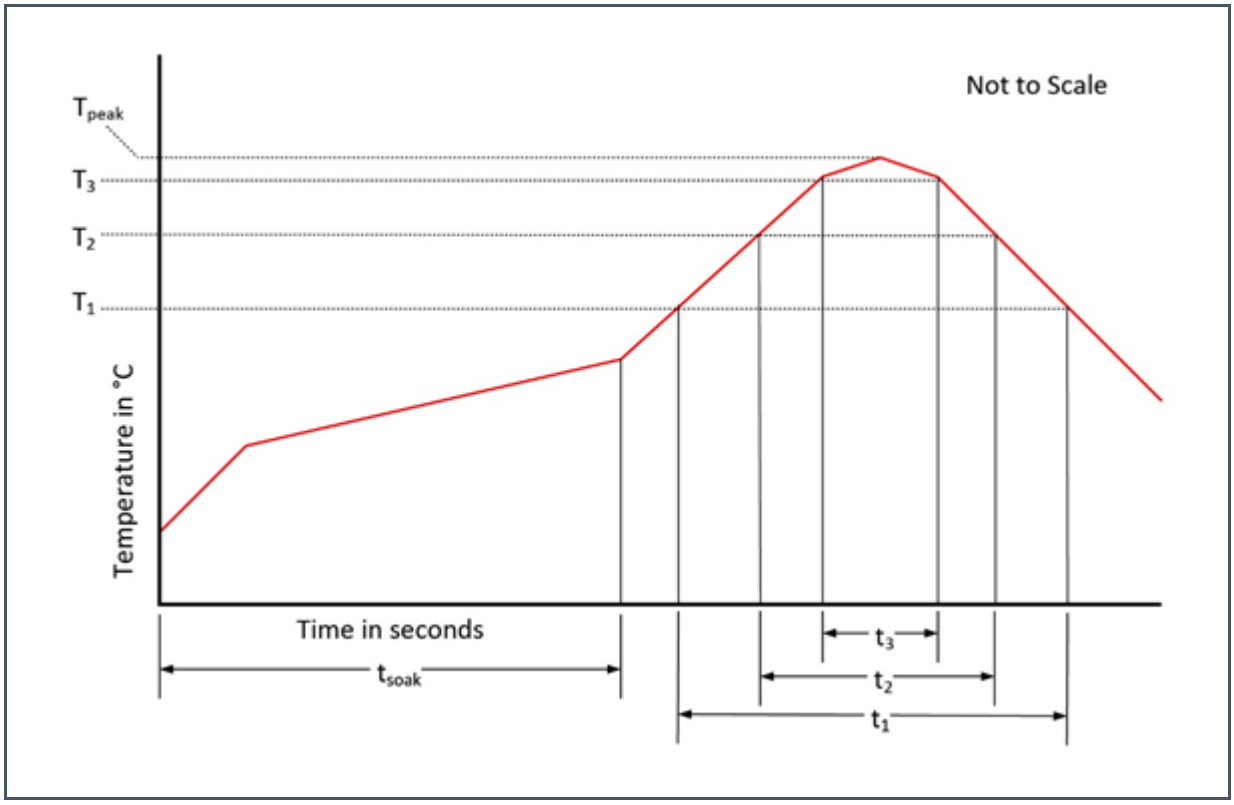


Figure 8:
Solder Reflow Profile

Parameter	Reference	Device
Average temperature gradient in preheating		2.5 °C/s
Soak time	t_{soak}	2 to 3 minutes
Time above 217 °C (T1)	t_1	Max 60 s
Time above 230 °C (T2)	t_2	Max 50 s
Time above T_{peak} – 10 °C (T3)	t_3	Max 10 s
Peak temperature in reflow	T_{peak}	260 °C
Temperature gradient in cooling		Max −5 °C/s

8 Revision Information

Changes from previous version to current revision v1-00	Page
This short datasheet is derived from v1-00 of full datasheet	all

- 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.