THE DATASHEET OF

AS7050-BWLM_REV.C

Datasheet

DS000XXX

AS7050

Analog Frontend for Vital Sign Monitoring

v3-00 • 2022-Mar-17

Content Guide

1 General Description

The AS7050 Biosignal Sensor Analog Frontend is the next generation Vital Sign Sensor. It enables the user to detect biosignals such as photoplethysmogram (PPG), electrocardiogram (ECG) and galvanic skin resistance (GSR). 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. ECG is the reference for any measurement of the biopotential generated by the heart.

Compared to the previous ams-OSRAM biosignal sensor generation, AS7050 is a biosignal converting unit. The AS7050 provides up to 8 LED driver outputs, samples up to 6 photodiode inputs and supports external electrodes. This enables the highest flexibility for several LED and photodiode arrangements in different applications. Furthermore, the AS7050 Biosignal Sensor Analog Frontend provides 2 ADC channels for simultaneous PPG and ECG measurements and an automatic photodiode offset control.

The embedded ECG analog front-end satisfies IEC 60601-2-47 requirements.

The AS7050's low-power design and small form factor are particularly well suited to application in fitness bands, smartwatches, sports watches, smart patches and earbuds. In these cases, board space is limited, and users look for extended, multi-day intervals between battery recharges. Thin package dimension makes the AS7050 suitable for height constrained solution likes earbuds

1.1 Key Benefits & Features

The benefits and features of AS7050, Analog Frontend for Vital Sign Monitoring are listed below:

Figure 1:
Added Value of Using AS7050

Benefits	Features
High flexible LED/photodiode configuration.	Up to 8 LED drivers and 6 photodiode input pins.
Allows smallest application size e.g. narrow HRM measurement band.	Small Wafer-Level-Chip-Scale-Package (WLCSP).
Electrocardiogram ECG with dry electrodes.	Embedded low noise analog front-end for ECG signals acquisition.
Enables blood pressure measurements.	Synchronized PPG and ECG acquisition.
Excellent HRM measurement quality.	Low noise analog front-end for PPG acquisition
Additional information for end user.	Analog electrical front-end (e.g. for temperature sensing using a NTC or galvanic skin resistivity (GSR)).
Long operating time.	Hardware sequencer to offload processor. Adjustable LED driver with current control.
Ready for blood oxygen measurement	2 PPG channels useable in simultaneous mode available
Acquiring several bio signals in parallel	ECG and PPG channels separated and simultaneous useable

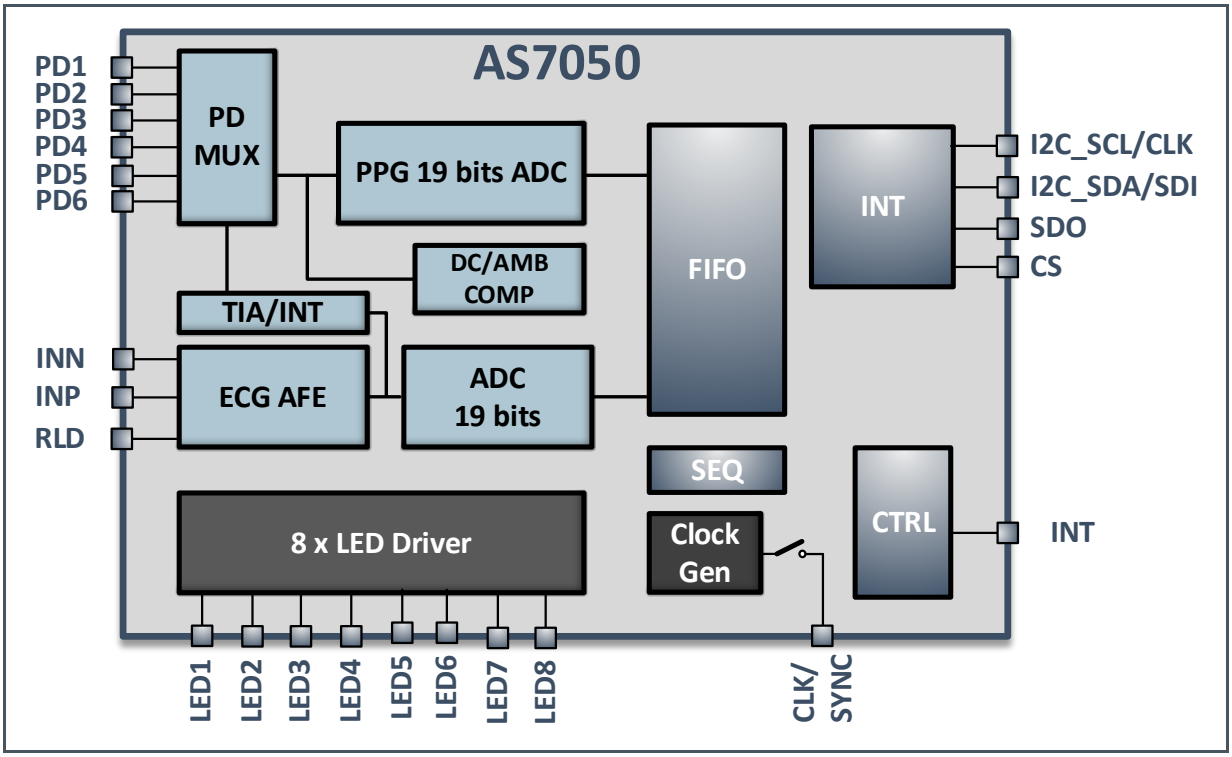
1.2 Applications

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

1.3 Block Diagram

The functional blocks of this device are shown below:

Figure 2 :
Functional Blocks of AS7050



2 Ordering Information

Ordering Code	Package	Marking	Delivery Form	Delivery Quantity
AS7050-BWLM	WLCSP	n.a.	Tape & Reel	500 pcs/reel
AS7050-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 AS7050

Symbol	Parameter	Min	Max	Unit	Comments
Electrical Parameters					
V_{DD}	Digital Supply Voltage		1.98	V	
V_{DDA}	Analog Supply Voltage		1.98	V	
V_{DDIO}	IO Supply Voltage		6	V	
$V_{GNDA-PGND}$	Analog to Power Ground Voltage Difference		±0.3	V	
$V_{GNDA-GND}$	Analog to Digital Ground Voltage Difference		±0.3	V	
I_{SCR}	Input Current (latch-up immunity)		±100	mA	Norm: JEDEC JESD78 Connect specified capacitor on SIGREF and V_LDO during latch-up test.
I_{LEDON}	Average LED ON Current		35	mA	DC current with all LEDs ON during all 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	
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. The parameters with Min and Max values are guaranteed with production tests or SQC (Statistical Quality Control) methods.

Figure 4:
Electrical Characteristics of AS7050

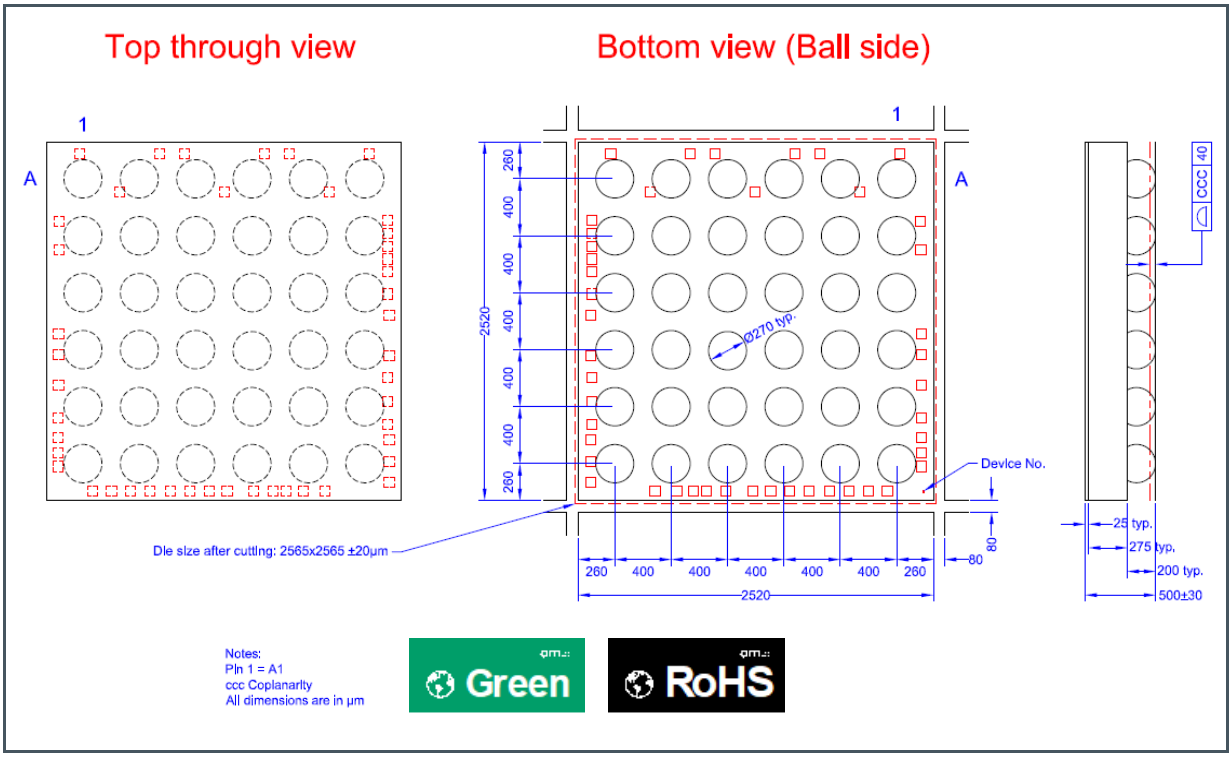
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DD}	Supply voltage		1.7	1.8	1.98	V
V_{DDA}	Analog positive supply voltage		1.7	1.8	1.98	V
V_{DDIO}			V_{DD}	3.3	6	V
f_{EXTCLK}	External clock frequency		2		4	MHz
$f_{Sampling,ECG}$	Sampling frequency				8	kHz
$f_{Sampling,PPG}$	Sampling frequency				1	kHz
Photodiode						
I_{OS}	DAC offset current full scale range				128	µA
C_{PD}	Total photodiode capacitance connected	0 V reserve voltage		60	300	pF
I_{PD}	Photo current input	RTIA (TIA gain) values 9.375 kΩ-1.2 MΩ; (∑ signal range 1 µA-64 µA)	0		64	µA
ECG						
V_{IN_SIG}	Input signal ECG	Max ECG input signal according to IEC 60601-2-47, chapter 201.12.4.4.101	-10		10	mV

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{IN\_DC\_OFF}$	Input DC offset	Max ECG DC Offset voltage according to IEC60601-2-47, chapter 201.12.4.4.101	-300		300	mV
$V_{Noise, p-v}$	Input-related peak to valley noise	Measured at the output of ECG amplifier in the frequency range of f_{IN} according to IEC 60601-2-47, chapter 201.12.4.4.106			50	µV
R_{IN}	Input Impedance	According to IEC 60601-2-47, chapter 201.12.4.4.102		100		MΩ
ECG-MODE DSM Interface						
ECG_CR	ECG conversion rate	19-bit resolution		8		kSps
ECG_P_TOTAL	Power consumption			5		mA
ECG_RES	ECG Resolution		19			bits
ECG_ENOB	ENOB			17		bits
V_{ECGADC_REFP}	Positive reference voltage			1.6		V
LED Driver						
V_{LED}	LED pad voltage				5	V
LED Driver 1-6						
I_{LED}	Allowed operating LED output current				300	mA
V_{Compl_1}	Compliance voltage				0.85	V
LED Driver 7-8						
I_{LED}	Allowed operating LED output current				50	mA
V_{Compl_1}	Compliance voltage				0.3	V

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Reference Block						
V_{ECG_VCM}	Reference voltage	at T=27 °C		0.8		V
V_{REF_ADC}	Reference voltage	Trimmed reference voltage, at T=27 °C		1.6		V
V_{PPG_VCM}	Reference voltage	at T=27 °C		0.8		V
TSEN_OUT	Temperature sensor output voltage	At room temperature		636		mV
TSEN_TK	Temperature sensor temperature coefficient of the output voltage	-40 °C to 105 °C		-2.03		mV/°C
Analog Front End						
V_{OUT_DAC}	Output voltage DAC			1.6		V
V_{OUT_AFE}	Output voltage range AFE		0.3		1.4	V
R_{RANGE}	Bias resistor trimming range	Across process and voltage corners, 25 °C		500		kΩ
C_{GPIO}	Load capacitance GPIO1/2				50	pF
LDO						
V_{LDO}		HV power supply	2.3		5.5	V
V_{LDO1V8}	Output voltage	Output voltage in operating mode		1.8		V
C_{LDO}	Output capacitance	External blocking capacitance		1		µF

5 Package Drawings & Markings

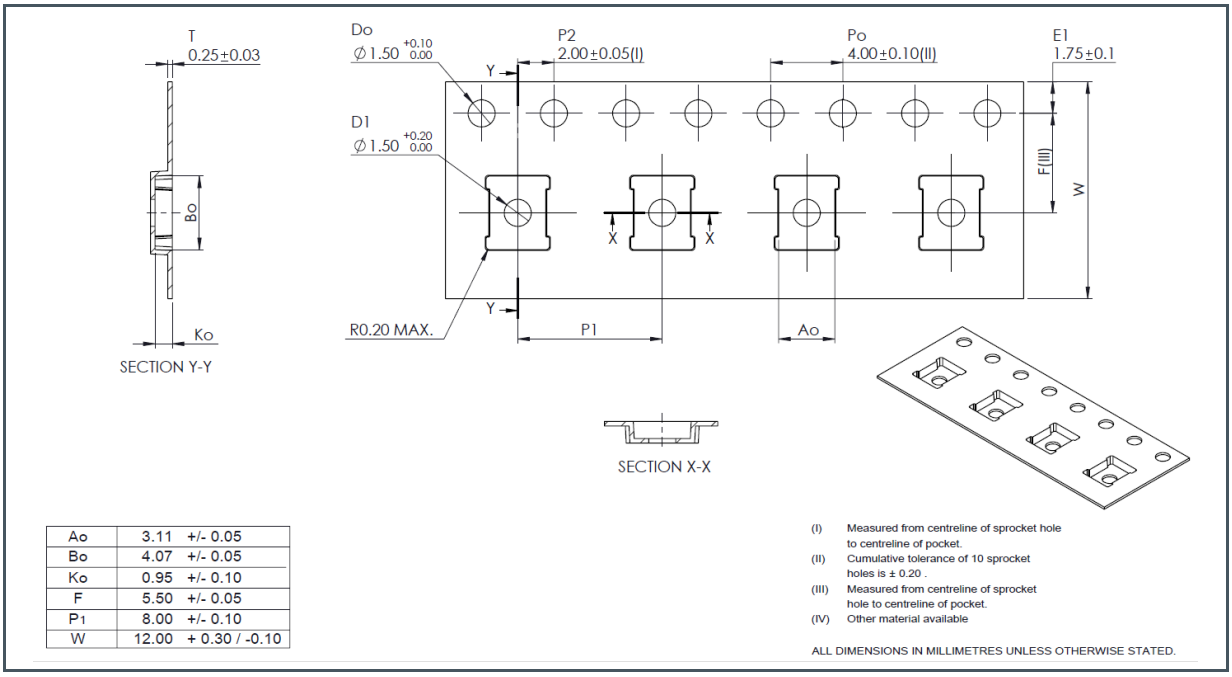
Figure 5:
Package Outline Drawing



(2) All dimensions are in micrometers. Angles in degrees.
(3) Dimensioning and tolerancing conform to ASME Y14.5M-1994.
(4) This package contains no lead (Pb).
(5) 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

7 Soldering & Storage Information

Figure 7:
Solder Reflow Profile Graph

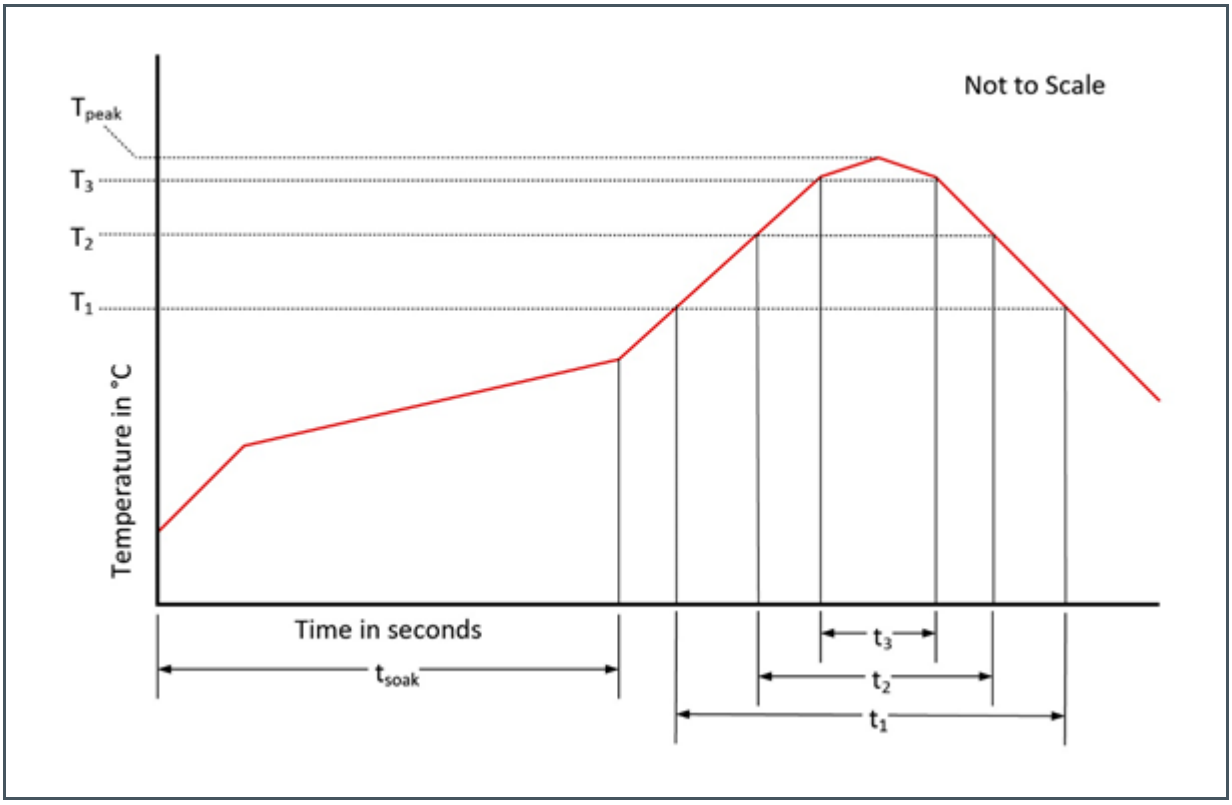


Figure 8:
Solder Reflow Profile

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

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
Preliminary Datasheet	Pre-Production	Information in this datasheet is based on products in the design, validation or qualification phase of development. The performance and parameters shown in this document are preliminary without any warranty and are subject to change without notice
Datasheet	Production	Information in this datasheet is based on products in ramp-up to full production or full production which conform to specifications in accordance with the terms of ams AG standard warranty as given in the General Terms of Trade
Datasheet (discontinued)	Discontinued	Information in this datasheet is based on products which conform to specifications in accordance with the terms of ams AG standard warranty as given in the General Terms of Trade, but these products have been superseded and should not be used for new designs

Changes from previous version to current revision v3-00	Page

- 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.

9 Legal Information

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