



Datasheet

DS001052

AS7056

Biosignal Converting Unit

v1-00 • 2022-May-10

Content Guide

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1 General Description

The AS7056 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 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.

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 the AS7056 Biosignal Converting Unit are listed below:

Figure 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. |
| 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. |

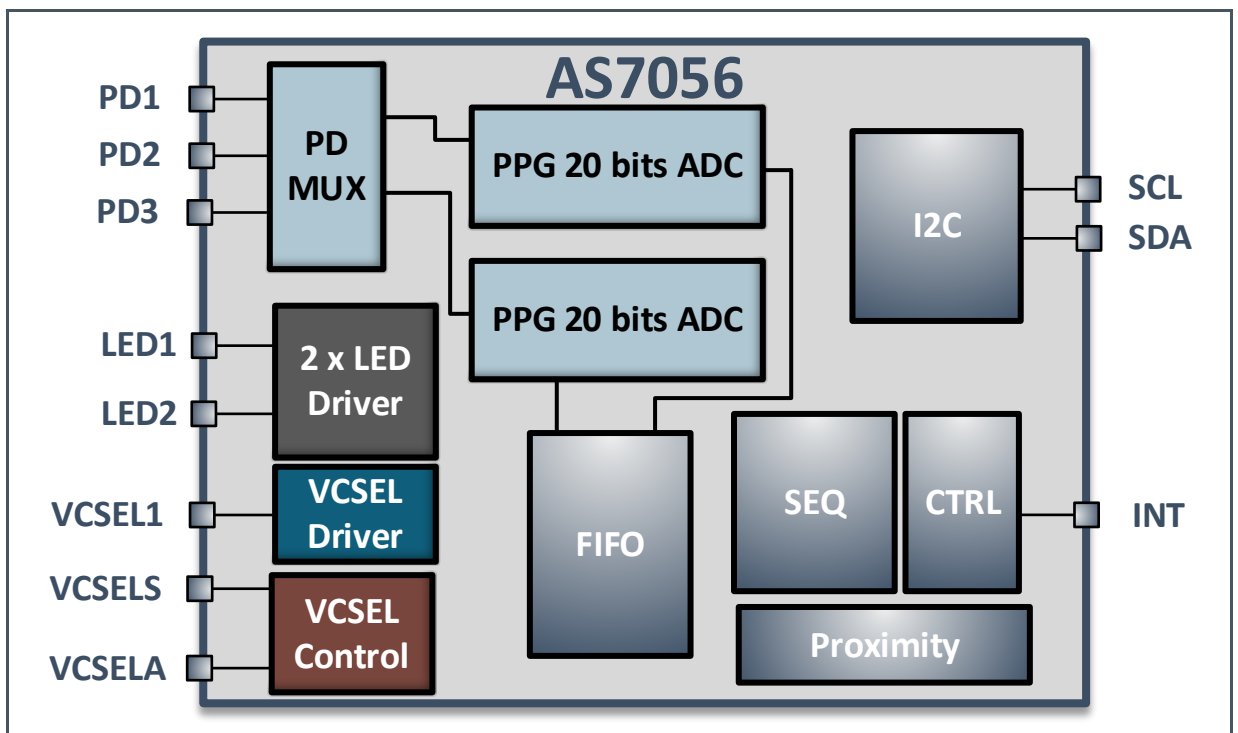
1.2 Applications

- Earbuds
- Hearables
- Optical sensor platform
- Fitness band
- Smart watch
- Smart patches
- 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 AS7056



2 Ordering Information

| Ordering Code | Package | Marking | Delivery Form | Delivery Quantity |
|---------------|---------|---------|---------------|-------------------|
| AS7056-BWLM | WLCSP | n.a. | Tape & Reel | 500 pcs/reel |
| AS7056-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 AS7056

| 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 | $V_{DD}+0.3$ max. 1.98 | V | Internal diode to V_{DD} |
| V_{LED} | Voltage at Driver Pins | -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 | | 35 | 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 minimum (Min) and maximum (Max) values are guaranteed with production tests or SQC (Statistical Quality Control) methods.

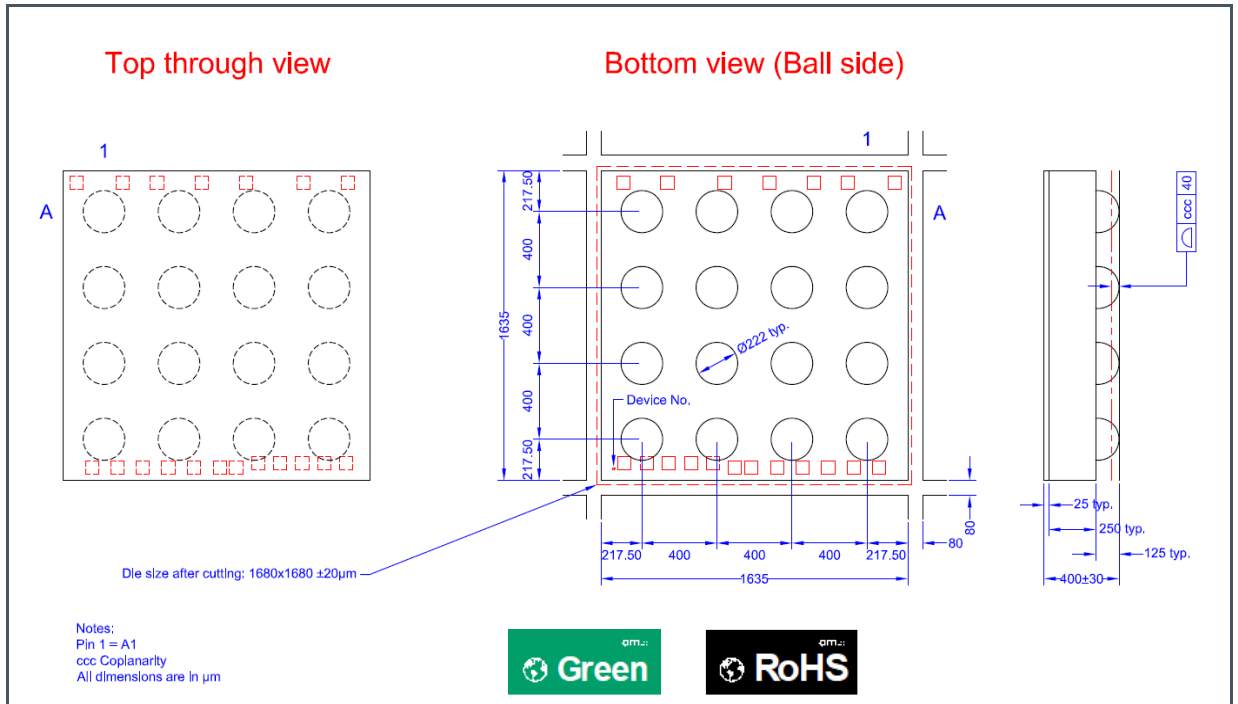
Figure 4:
Electrical Characteristics of AS7056

| 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 | (\sum signal range 1 μA -64 μA) | 0 | | 64 | μA |
| LED Driver | | | | | | |
| V_{LED} | LED pad voltage | | | | 5 | V |

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------------------|--------------------------------------|------------|-----|--------|-----|------|
| LED Driver 2-3 | | | | | | |
| I_{LED} | Allowed operating LED output current | | | 200.00 | | mA |
| V_{Compl} | Compliance voltage | | | | 0.3 | V |
| VCSEL Driver | | | | | | |
| I_{VCSEL} | Allowed operating LED output current | | | 20.00 | | mA |
| V_{Compl} | Compliance voltage | | | | 0.3 | V |

5 Package Drawings & Markings

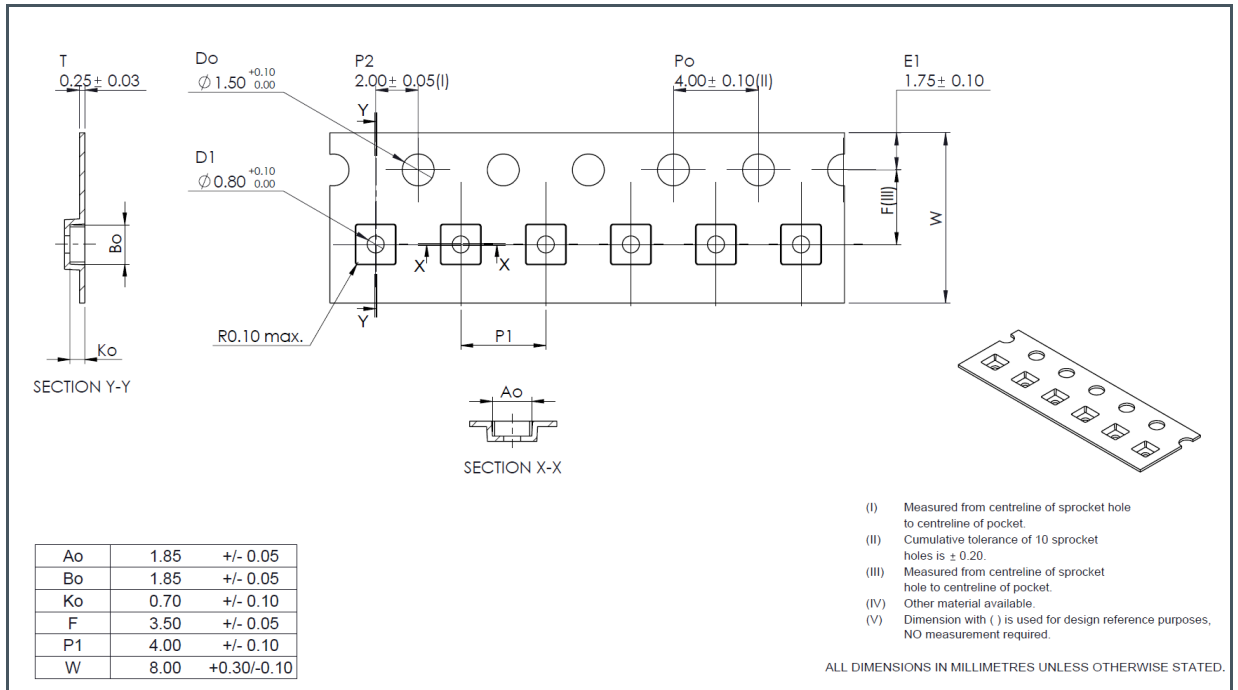
Figure 5:
WLCSP Package Outline Drawing



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

6 Tape & Reel Information

Figure 6:
Tape Dimensions



7 Soldering & Storage Information

Figure 7:
Solder Reflow Profile Graph

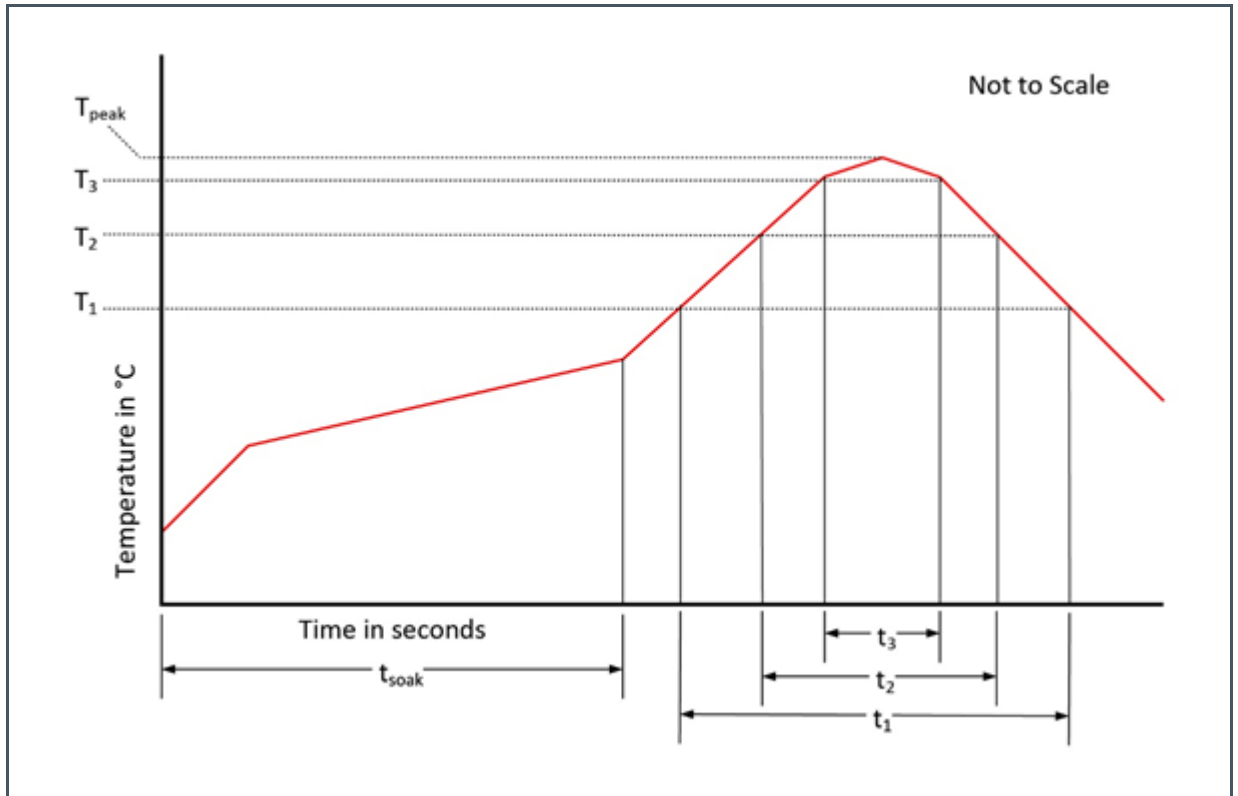


Figure 8:
Solder Reflow Profile

| 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 | |
| | |
| | |

- 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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