XENSIV™ PAS CO2 1.5

Description

Infineon has leveraged its knowledge in sensors and MEMS technologies to develop a disruptive gas sensor for CO_2 sensing. The XENSIV™ PAS CO2 is a real CO_2 sensor combining NDIR technology with Infineon's high SNR MEMS microphones, allowing for state-of-the-art accuracy in an exceptionally small form factor.

The sensor is based on the photoacoustic spectroscopy (PAS) principle, where CO_2 molecules within the sensor cavity absorb infrared light, generating small pressure changes that are detected by an acoustic detector. CO_2 concentration is then delivered in the form of a direct ppm readout thanks to the integrated microcontroller. Highly accurate CO_2 readings are guaranteed.

Features

- **Operating range:** 0 ppm to 32000 ppm
- **Accuracy:** ± 50 ppm ± 5% of reading between 400 ppm and 3000 ppm
- **Lifetime:** 10 years for indoor mission profile
- **Interface:** I2C, UART, and PWM
- **Package dimension:** 13.8 x 14 x 7.5 mm^3

Potential applications

High accuracy, compact size, and SMD capability make the XENSIV™ PAS CO2 sensor ideal for indoor air quality monitoring solutions in the market with numerous potential applications.

- **HVAC (Heating, Ventilation, Air Conditioning)**
- **Home appliances**
- **Smart home IoT devices**
- **Agriculture/ Greenhouses**
- **In-cabin air quality monitoring unit**

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1 Block diagram

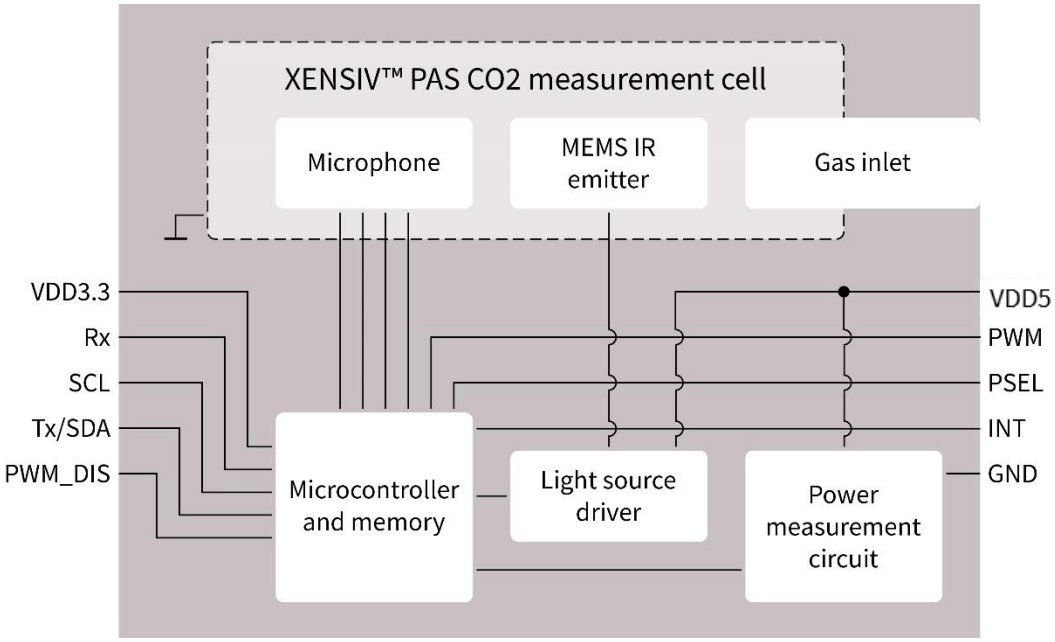

Figure 1 Block diagram of XENSIV™ PAS CO2

2 Pin-out diagram

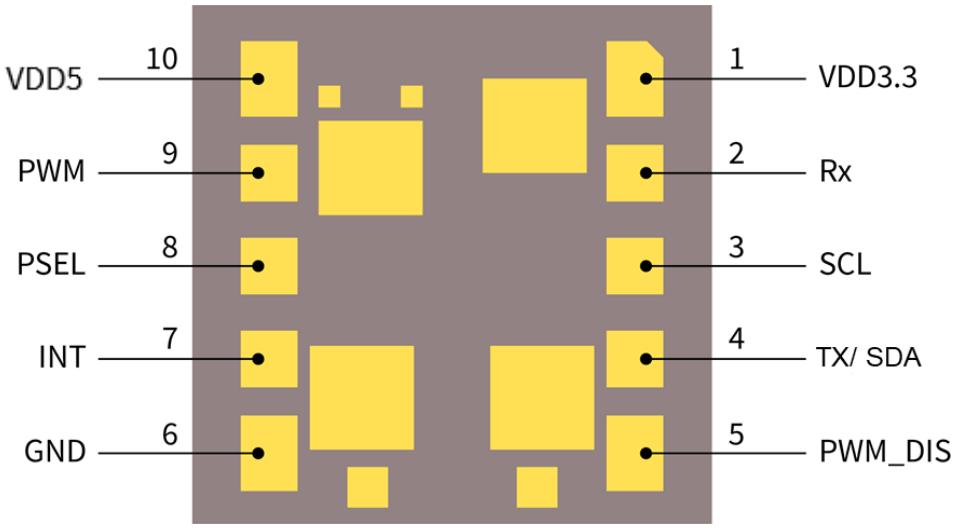

Figure 2 Pin-out diagram (Bottom view)

Table 1

PIN	Symbol	Type	Description
1	VDD3.3	Power supply (3.3V)	3.3V digital power supply
2	Rx	Input/ Output	UART receiver pin (3.3V domain)
3	SCL	Input/ Output	I2C clock pin (3.3V domain)
4	TX/ SDA	Output	UART transmitter pin (3.3V domain) / I2C data pin (3.3V domain)
5	PWM_DIS	Input	PWM disable input pin (3.3V domain)
6	GND	Ground	Ground
7	INT	Output	Interrupt output pin (3.3V domain)
8	PSEL	Input	Communication interface select input pin (3.3V domain)
9	PWM	Output	PWM output pin (3.3V domain)
10	VDD5	Power supply (5V)	5V power supply for the IR emitter

3 Characteristics and parameters

3.1 Specification

3.1.1 Operating range

The following operating conditions must not be exceeded to ensure proper operation of the sensor. All parameters specified in the following sections refer to these operating conditions unless otherwise specified.

Table 2 Operating range

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
CO_2 measurement range[1]	C_{CO2}	0		32000	ppm	Functional measurement range
Ambient temperature[1]	T_{amb}	0		50	°C	
Relative humidity[1]	rH	0		85	%	Non-condensing
Pressure[1]	p	750	1013	1150	hPa	
Supply voltage[1]	VDD3.3	3	3.3	3.6	V	
	VDD5	4.45	5	5. 5	V	
Lifetime[1]	T_{life}		10		Year	Depends on mission profile

3.1.2 Storage conditions

Storage condition refers to Dry pack: Packed, evacuated, desiccant[2], Humidity Indicator Card (HIC) sealed moisture barrier bag.

Table 3 Storage condition

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Storage temperature[1]	$T_{storage}$	5		40	°C	<90% r.H.[3]
Storage time[1]	$t_{storage}$			3	Year	
Storage temperature during transport[1]	$T_{storage\_transport}$	-20		60	°C	
Storage time during transport[1]	$t_{storage\_transport}$		10		Day	

[1] Not subject to production test. This parameter is verified by design/ characterization.

[2] Number of desiccant units to be calculated according to JEDEC Standard 033.

[3] Condensation and bedewing shall be avoided.

3.1.3 Timing characteristics

Table 4 Timing characteristics

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Sampling time[1]	$T_{sampling}$		60	4095	s	
Time to sensor ready[1]	T_{sensor_rdy}			1	s	
Time to early notification[1,2]	T_{early_noti}		2		s	The only application for the continuous mode of operation
I2C Clock frequency[1]	f_{I2C}		100 400		kHz	
PWM frequency[1]	f_{pwm}		80		Hz	
UART baud rate[1]	f_{baud}		9.6		kbps	

Typical measurement timing sequence for I2C and UART is presented in figure 4.

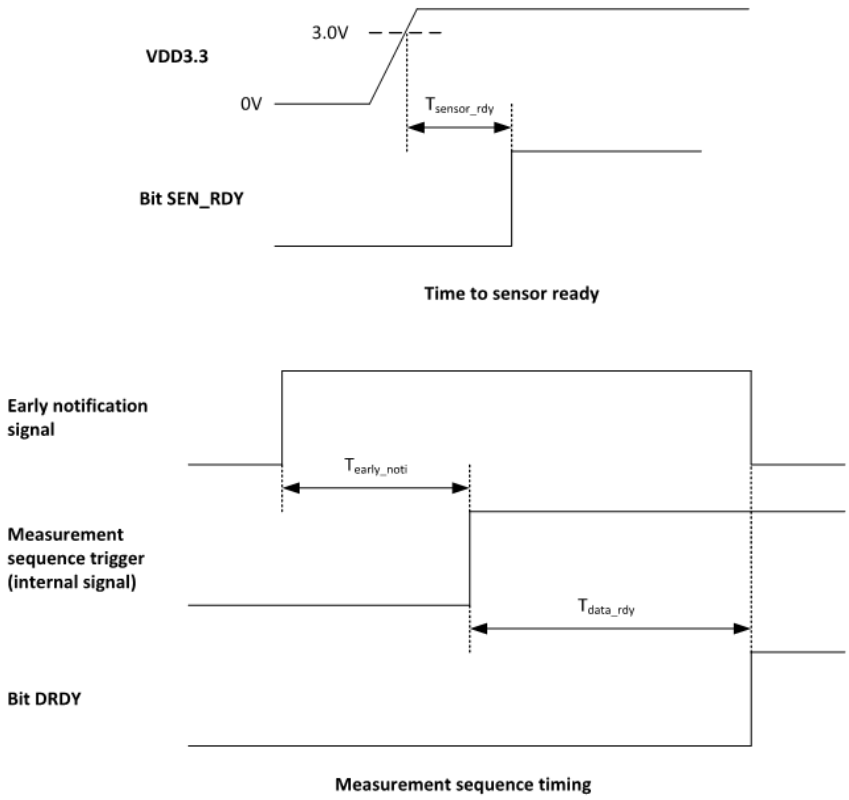

Figure 3 Illustration of the timing characteristic parameters

[1] Not subject to production test. This parameter is verified by design/ characterization.

[2] Relevant for continuous mode of operation.

3.1.4 Absolute maximum ratings

Table 5 Absolute Maximum Ratings

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
MSL Level	MSL		3			
Maximum ambient temperature	T_{amb_max}	-10		60	°C	
Maximum relative humidity	rH_{max}	0		95	%	
5V Supply voltage	V_{VDD5}	4.45		5.5	V	
3.3V Supply voltage	$V_{VDD3.3}$	3.0		3.6	V	
Reflow temperature	T_r			245	°C	JEDEC J-STD-020E
ESD Human Body Model	V_{ESD_HBM}	-2		2	kV	HBM (JS001)
ESD Charge Discharge Model	V_{ESD_CDM}			500	V	CDM (JS002)

Note: Stresses above the values listed as "Absolute Maximum Ratings" may cause permanent damage to the devices. Exposure to absolute maximum rating conditions for extended period of time may affect device reliability.

3.1.5 The current rating and power consumption

All parameters specified in table 5 refer to the following operating conditions unless otherwise specified: VDD3.3 = 3.3V, VDD5 = 5V, T_{amb} = 25°C, % rH = 30 %, p = 1013 hPa.

Table 6 Current rating

Parameter	Symbol	Pin	Values			Unit	Note or Test Condition
			Min.	Typ.	Max.		
Peak current[1]	$I_{peak\ 5}$	VDD5		265	290	mA	
Peak current[1]	$I_{peak\ 3.3}$	VDD3.3		10		mA	
Average current[1]	$I_{avg\ 5}$	VDD5		1		mA	At 1 meas/ min.
Average current[1]	$I_{avg\ 3.3}$	VDD3.3		10		mA	At 1 meas/ min.
Average power[1]	P_{avg}			30		mW	At 1 meas/ min.

Power consumption can be optimized further. For more details please refer to our application note section at the product web page.

[1] Not subject to production test. This parameter is verified by design/ characterization.

3.1.6 CO2 Transfer Function

All parameters specified in the following sections refer to the operating conditions unless otherwise specified:

VDD3.3 = 3.3V, VDD5 = 5V, T_{amb} = 25°C, % r.H. = 30 %, p = 1013 hPa and $t_{sampling}$ = 1 meas/ min.

Table 7 CO_2 Transfer Function

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Accuracy[1]	Acc	-50 ppm - 5 % of reading		+50 ppm +5% of reading	ppm	C_{CO2}: 400 - 3000 ppm
Response time[2]	T_{63}		55		s	
Repeatability[2, 3]	R			10	ppm	
Pressure stability[2]	p_{error}		0		%/hPa	With pressure compensation feature
Acoustic stability[2]	SPL_{error}	3	6	15	ppm	Up to 94 dB for Pink noise from 100 Hz to 10 kHz.

[1] Accuracy verified using certified calibration gas mixtures and high-precision reference sensors. Uncertainty in calibration gas mixtures of ±2% needs to be considered. Temporary deviations in accuracy caused by assembly or other harsh environmental influences can be corrected using Forced Calibration Scheme (FCS) or Automatic Baseline Offset Correction (ABOC).

[2] Not subject to product test. This parameter is verified by design/ characterization.

[3] Stepwise Reaction IIR filter is enabled.

4 Revision history

Table 8 DS version tracking

Reference	Description	Date
1.0	Creation	20.02.2024
1.1	Halogen-free and RoHS symbol and storage time added/updated	06.03.2024

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