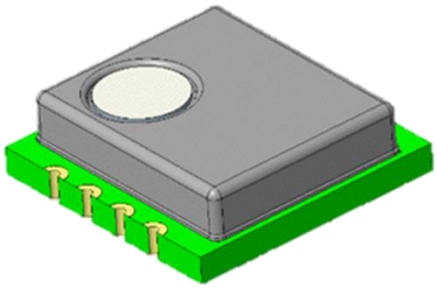
Thermal Runaway Sensor

Description

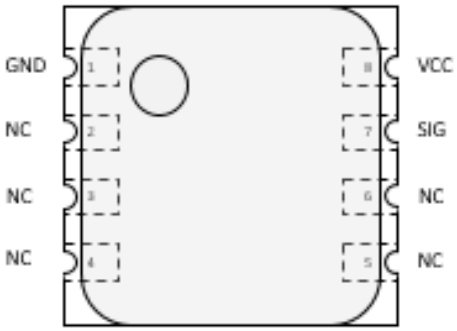
The AX221100 is a fully calibrated Hydrogen detection sensor designed for applications where battery thermal runaway events are a concern. The output of the sensor is a ratio metric analog output with a detection range of 0 to 16% H2 gas concentration.



Features

- -40 to 95°C operation
- Automotive Qualified (production design)
- 16-bit analog output
- SMT package

1. Pin Description



Pin Configuration (Top View)

Pin	Name	Description
1	GND	Ground
2	NC	Internal Programming Pin, do not connect
3	NC	Internal Diagnostic Pin, do not connect
4	NC	Normal Operation – High(Should be left floating internally pulled-up), Calibrate – Low

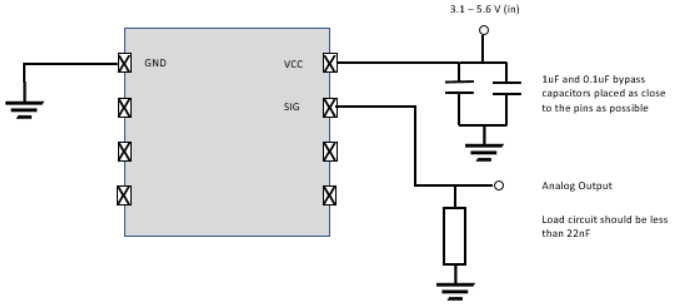
5	NC	Internal Communication, do not connect
6	NC	Internal Communication, do not connect
7	SIG	Analog signal output
8	VCC	Supply Voltage

2. Operating Conditions

Parameter	Min	Typ	Max	Unit
Operating Temperature Range	-40		95	°C
Humidity	0		95	%
Vibration[1]		2.0		G_{RMS}

1. Tested against Passenger/Trunk Compartment Sprung Masses

3. Typical Connection



4. Electrical Characteristics

Parameter	Name	Min	Typ	Max	Unit
Operating Supply Voltage	Vcc	3.1	3.3	5.6	Vdc
Supply Current (Peak)[1]	I_{peak}		46	48.44	mA
Supply Current (Average)[2]	I_{avg}		9		mA
Signal Output (Source Current)	I_{sig}			20	mA
Capacitance Load Signal Output	C_{Load}			22	nF
Signal Output (Ratio Metric)	V_{Sig}	10%		90%	Vcc

1. Peak current does not include $I_{sig.}$ (See section 7 for current profile)
2. Average current is calculated based on the percentage of time between peak and idle current

5. ESD Ratings

Parameter	Name	Value	Unit
ESD Capability, Human Body Model (Note 1)	ESD_{HBM}	2000	V
ESD Capability, Machine Model (Note 1)	ESD_{MM}	200	V

1. ESD Human Body Model tested per EIA/JESD22−A114
   ESD Machine Model tested per EIA/JESD22−A115
   Latch up Current Rating tested per JEDEC standard: JESD78

6. Sensor Parameters and Output Characteristics

Parameter	Name	Test Condition	Min	Typ	Max	Unit
Signal Output Resolution[1]		3.3Vcc		40		uVdc
Sensing Resolution				5		ppm
Sensing Output Range	H2[R]	H2 Concentration	0		160,000	ppm
H2 Accuracy[2]	H2[acc]	0 to 80,000ppm	-8,000		+8,000	ppm
H2 Accuracy[2]	H2[acc]	80,000ppm to 160,000ppm	-8,000		+8,000	ppm
H2 Response Time[3]	H2[Tr]	Ideal System		1	3	Sec.

1. Signal output resolution is calculated to be 16bit DAC resolution between 10% and 90% of Vcc
2. Under all Environmental Conditions (see section 2)
3. [Tr] is calculated at 63.2% of final value when subjected to a step change in environment.
   Note: [Tr] does not indicate detection time. First detection of a Thermal Runaway event is related to sample rate [Sr].

Transfer Function

This sensor is fully calibrated. The analog output follows a linear transfer function based on Hydrogen concentration and supply voltage:

$$Vcc\ x\ (a\ x\ H + b) = \text{Vout}$$

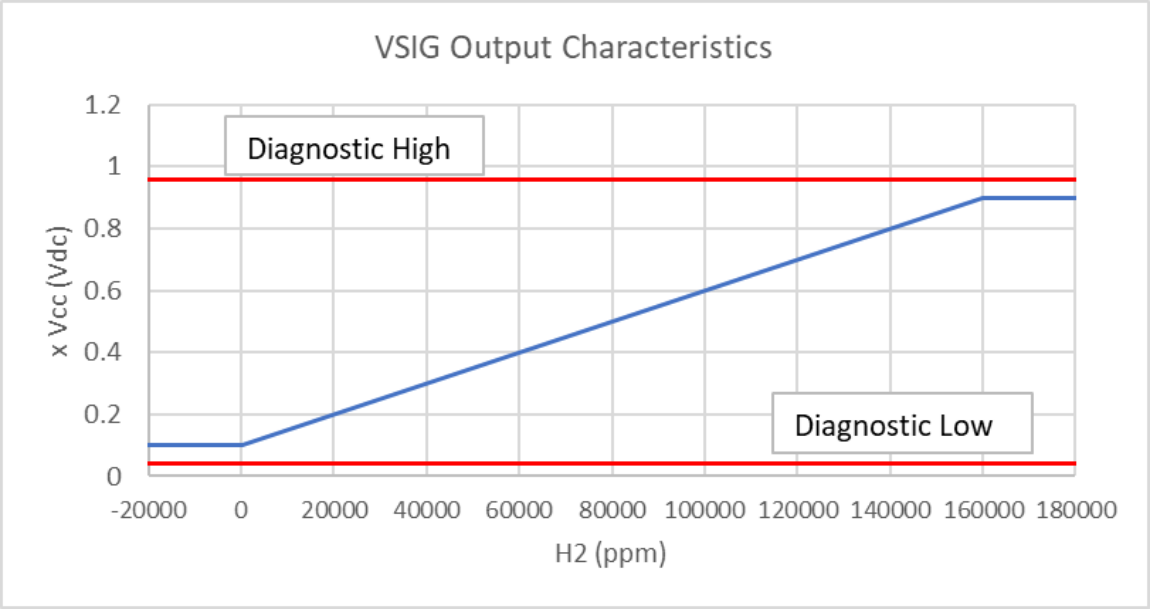
	Gas Concentration %			Gas Concentration %PPM		Output Voltage Range@3.3Vcc		
	Symbol	Value	Unit	Value	Unit	Symbol	Value	Unit
Min	H_in,1	0	%	0	ppm	V_out,1	0.33	V
Max	H_in,2	16	%	160,000	ppm	V_out,2	2.97	V

H = Hydrogen Concentration in % or PPM

Slope and Offset (PPM)		
Symbol	**Value**	**Unit**
a	0.000005	1/PPM
b	0.1	-

Slope and Offset (%)		
Symbol	**Value**	**Unit**
a	0.05	1/%
b	0.1	V

Shown as percent of Vcc vs PPM of Hydrogen



7. Operation and Timing

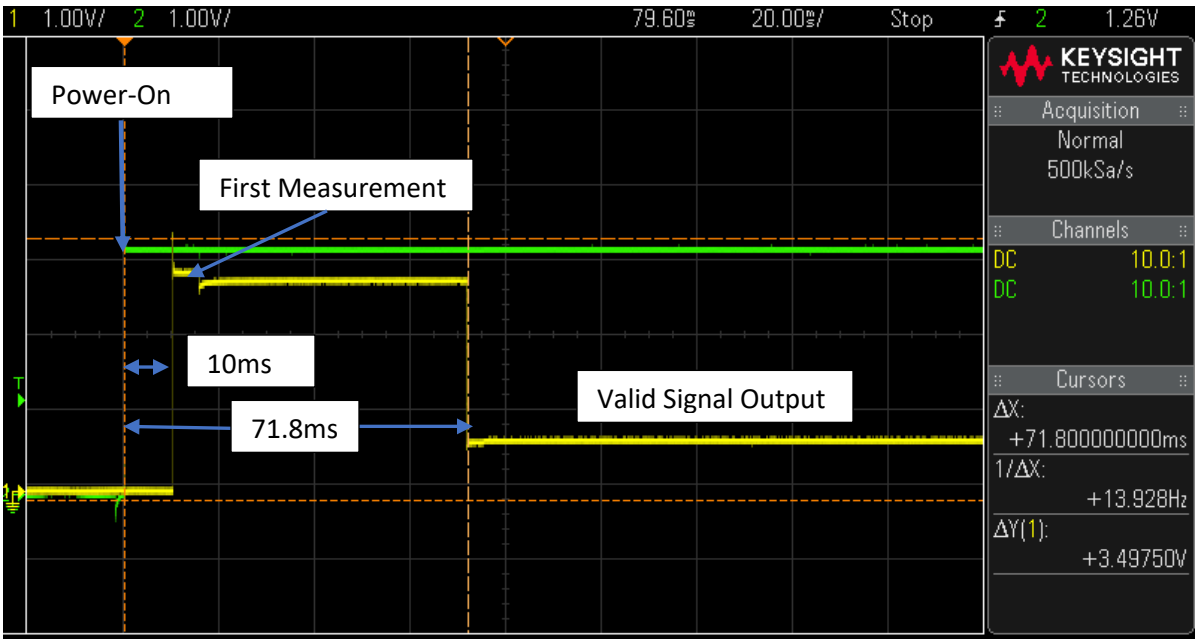
Parameter	Name	Test Condition	Min	Typ	Max	Unit
Start-up Time[1]	T[s]		60	70	80	ms
Sampling Rate	T[r]			0.5		s
Measurement Time	T[m]		55	60	65	ms

1. Default shown in typ. value, Min and Max show configurable limits. Sample Rate is defined as the “commanded” message rate.

   Increasing sample rate will increase average current consumption.

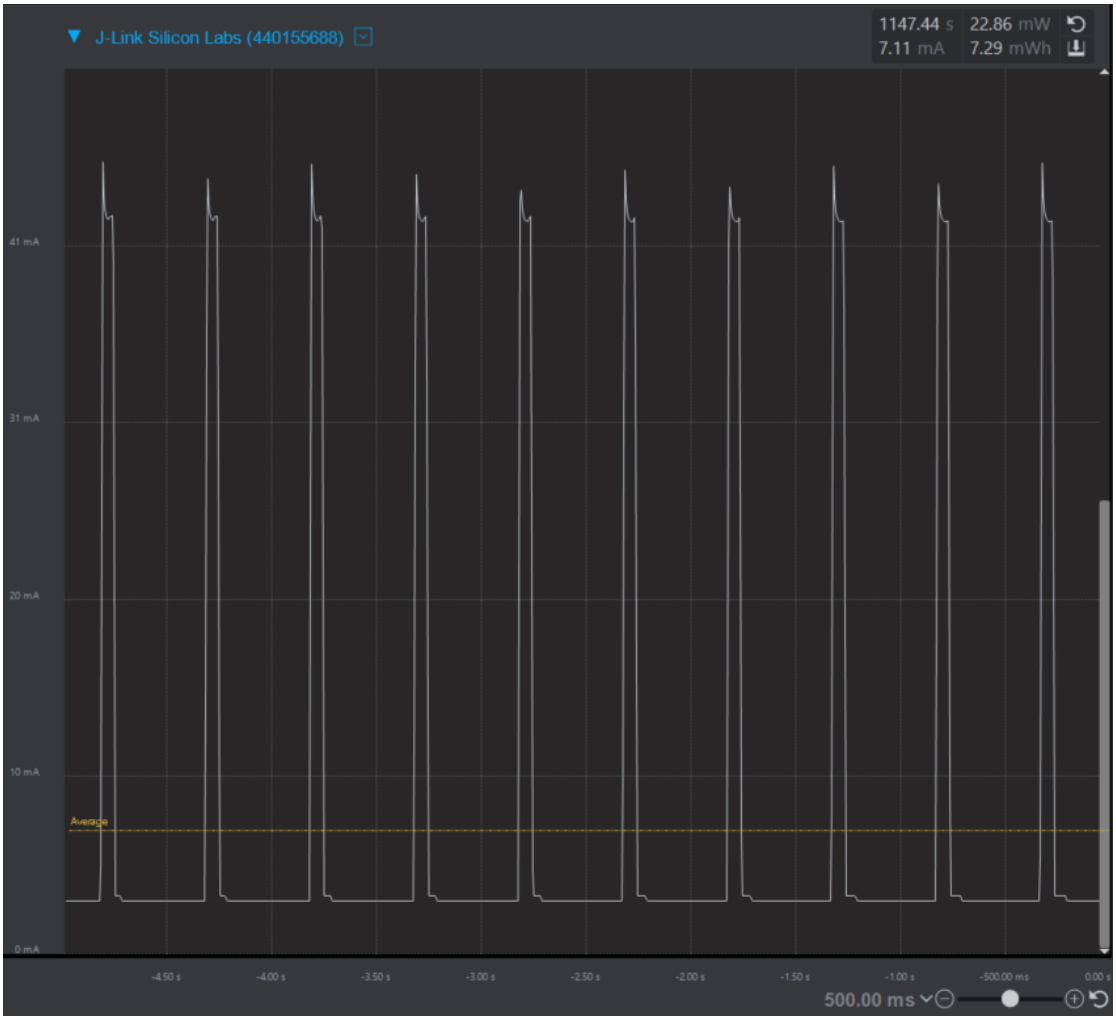
During power up the Output Signal pin is high-Z until the first conversion is completed. The First conversion occurs at 10ms after power-up and will be invalid until the first commanded measurement is made at approximately 72ms. Once a commanded measurement is made the output will go to the proper voltage level.

Typical Power-up Profile



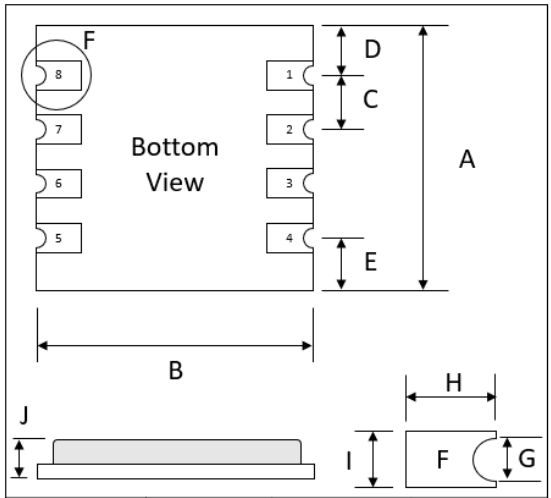
Sample Rate is the duty cycle of commanded measurements. At the specified sample rate, the sensor will be commanded to make a measurement. The measurements take the specified measurement time to complete. During the measurements, maximum power will be consumed. When the sensor is not making measurements, the signal output is held at its last value and the part goes into an idle mode consuming minimum power.

Current Profile (Default Mode)



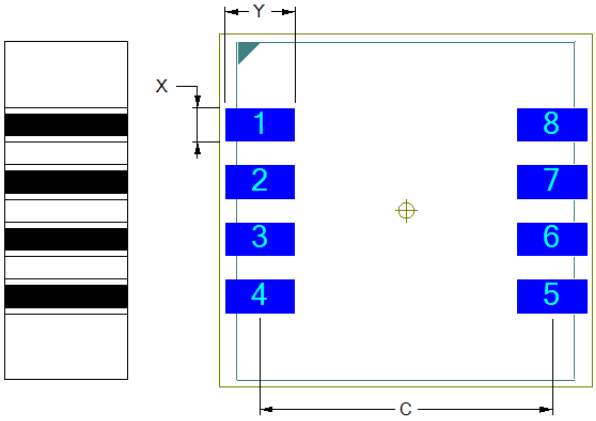
8. Mechanical

Component Footprint



Symbol	Min. (mm)	Typ. (mm)	Max. (mm)
A		15	
B		15	
C		2.54	
D		3.69	
E		3.69	
F			
G		0.66	
H		2.54	
I		1.53	
J			5.0

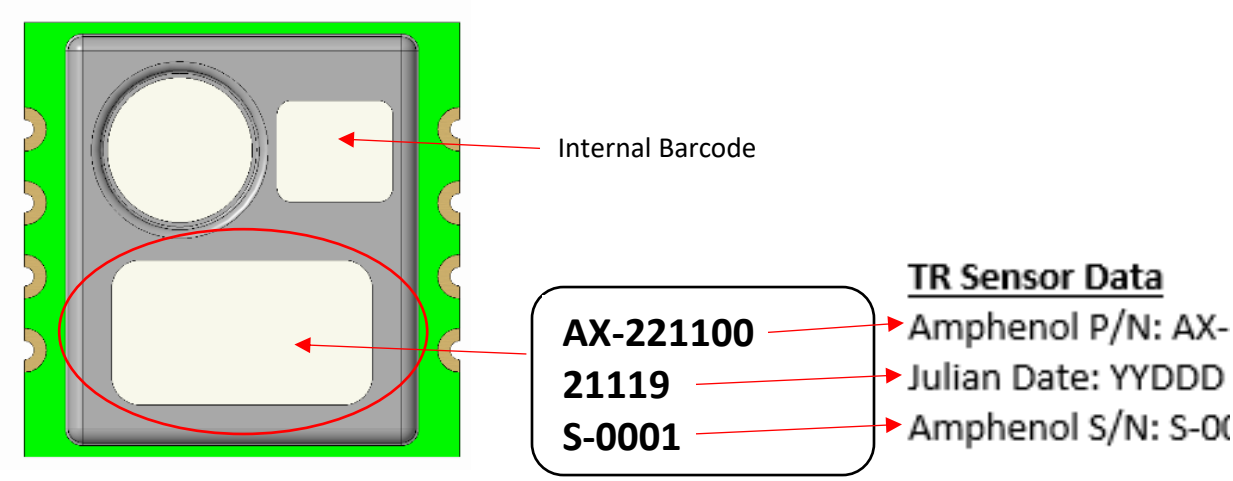
Recommended Land Pattern



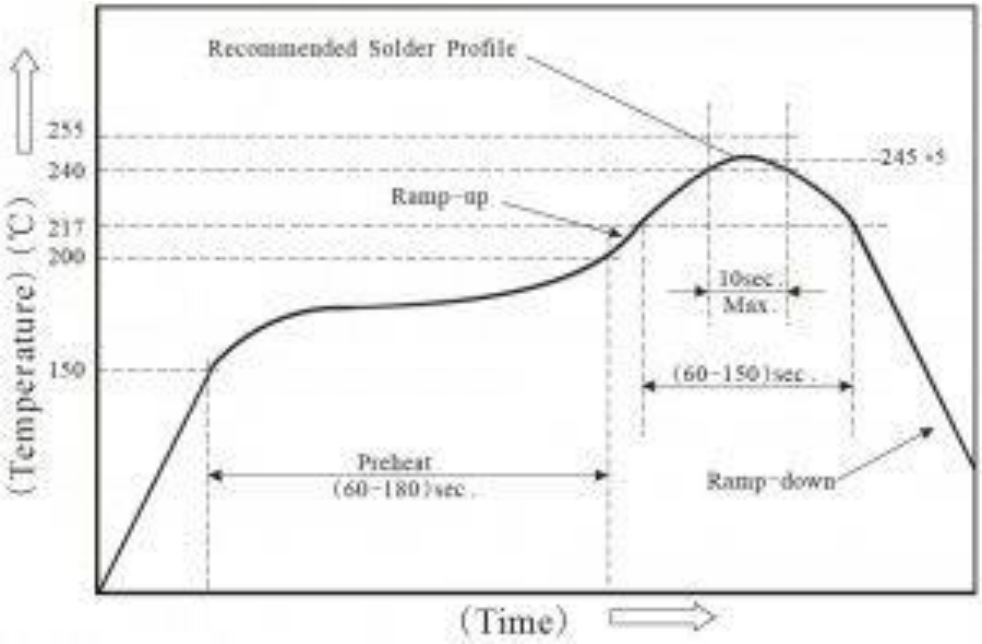
Dimensions

Land Space C	13.00
Land X	1.50
Land Y	3.10
Silkscreen R1	9.25
Silkscreen R2	15.20
Courtyard V1	16.60
Courtyard V2	15.70

9. Marking



10. Reflow Profile



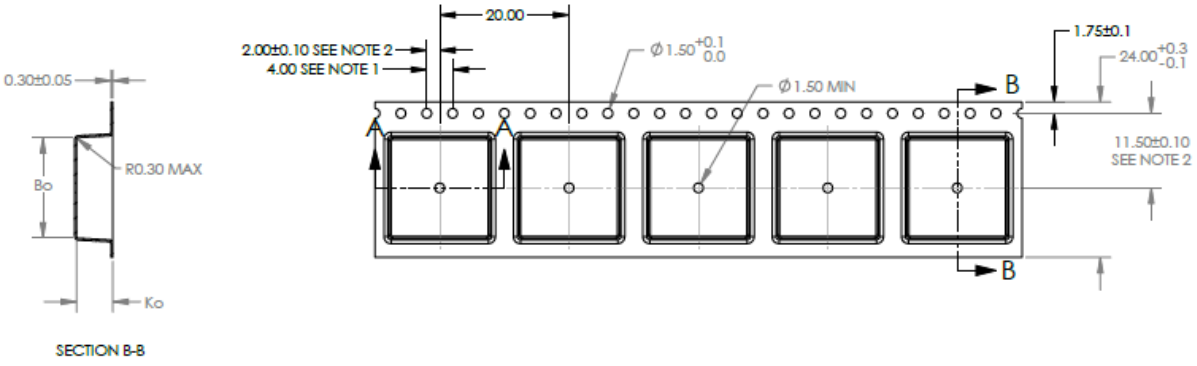
11. Packaging

Tape and Reel Details

13” Standard Reel Size
24mm Reel width
500pcs/reel

Pocket Tape Dimensions

Part Size* (mm)	A =	15.00	B =	15.00	K =	5.00
Pocket Size* (mm)	Ao =	15.50	Bo =	15.50	Ko =	5.60
Carrier Tape Material	0.30mm Static Dissipative Tri-laminate Polystyrene - Black					
Tape Width - W (mm)	24					
Pocket Pitch - P (mm)	20	* Dimensions listed are nominal				



	DIM	±
Ao	15.50	0.10
Bo	15.50	0.10
Ko	5.60	0.10

NOTES:
1. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.2
2. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE.
3. Ao AND Bo ARE MEASURED ON A PLANE AT A DISTANCE "R" ABOVE THE BOTTOM OF THE POCKET.

12. Revision History

Revision	Description	Date
00	Initial Writing	08/30/2021
01	Remove Block Diagram	02/24/2022
02	Updated Pin Descriptions	02/26/2022
03		